Lexicon of Geologic Names Of the United States For 1936-1960

Part 1, A-F

GEOLOGICAL SURVEY BULLETIN 1200

Lexicon of Geologic Names Of the United States For 1936-1960

By GRACE C. KEROHER *and others*

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A compilation of the geologic names of the United States, its possessions, the Trust Territory of the Pacific Islands, and the Panama Canal Zone

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Major stratigraphic and time divisions in use by the U.S. Geological Survey

Era	System or Period	Series or Epoch	Estimated ages of time boundaries in millions of years Holmes [1] Kulp [2]
Cenozoic	Quaternary	Recent	
		Pleistocene	—1—1
	Tertiary	Pliocene	—11—13
		Miocene	—25—25
		Oligocene	—40—36
		Eocene	—60—58
		Paleocene	—70—63
Mesozoic	Cretaceous [3]	Upper (Late) Lower (Early)	—135—135
	Jurassic	Upper (Late) Middle (Middle) Lower (Early)	—180—181
	Triassic	Upper (Late) Middle (Middle) Lower (Early)	—225—230
Paleozoic [3]	Permian [3]	Upper (Late) Lower (Early)	—270—280
	Carboniferous Systems: Pennsylvanian [3]	Upper (Late) Middle (Middle) Lower (Early)	
	Carboniferous Systems: Mississippian [3]	Upper (Late) Lower (Early)	—350—345
	Devonian	Upper (Late) Middle (Middle) Lower (Early)	—400—405
	Silurian [3]	Upper (Late) Middle (Middle) Lower (Early)	—440—425
	Ordovician [3]	Upper (Late) Middle (Middle) Lower (Early)	—500—500
	Cambrian [3]	Upper (Late) Middle (Middle) Lower (Early)	—600—600?
Precambrian [3]		Informal subdivisions such as upper, middle, and lower, or upper and lower, or younger and older may be used locally.	—3, 000+

Terms designating time are in parentheses. Informal time terms early, middle, and late may be used for the eras, and for periods where there is no formal subdivision into Early, Middle, and Late, and for epochs. Informal rock terms lower, middle, and upper may be used where there is no formal subdivision of a system or of a series.

[1] Age values given are the Holmes time scale (Holmes, A , 1960, A revised geological time scale: Edinburgh Geol. Soc., Trans. v. 17, pt. 3, p. 204).

[2] Ages given are the Kulp time scale (Kulp, J. Laurence, 1961, Geologic time scale: Science, v. 133, no. 3459, p. 1111).

[3] Includes provincial series accepted for use in U.S. Geological Survey reports.

LEXICON OF GEOLOGIC NAMES OF THE UNITED STATES FOR 1936–1960

By GRACE C. KEROHER and OTHERS

INTRODUCTION

PREVIOUS COMPILATIONS OF GEOLOGIC NAMES

The U.S. Geological Survey has published six compilations treating the names of geologic formations and stratigraphic classification and nomenclature. The Survey publishes lexicons of geologic names at regular intervals as a means of keeping the geologic profession informed as to changes and current status of geologic names within the United States and its possessions.

The first compilation, "North American Geologic Formation Names," Bulletin 191, by F. B. Weeks, was published in 1902. This bulletin contains: (1) an alphabetical listing of 1,500 North American sedimentary formation names and 100 names applied to igneous rocks, together with their geologic age, geographic occurrence, and pertinent references, (2) a list of sedimentary formations arranged alphabetically by geographic provinces under the geologic periods to which they had been assigned, and (3) an index list of formation names.

The next compilation, "The Geologic Time Classification of the United States Geological Survey Compared with Other Classifications, Accompanied by the Original Definitions of Era, Period, and Epoch Terms," Bulletin 769 by M. Grace Wilmarth, was published in 1925 and is still invaluable for its quotations from original definitions and descriptions of standard and other stratigraphic and time divisions from widely scattered and sometimes unavailable sources.

In 1931, the Survey published the third compilation, "Names and Definitions of the Geological Units of California," Bulletin 826, by M. Grace Wilmarth. This work was actually an extract from a larger, more exhaustuve compilation on which Wilmarth was working; it was published to test the reactions of geologists to the material and the format of the forthcoming lexicon and at the same time to make available a useful reference for geologists who worked exclusively in California.

The first exhaustive compilation, M. Grace Wilmarth's "Lexicon of Geologic Names of the United States (including Alaska)," also called

the Wilmarth Lexicon, was published in 1938 as Bulletin 896; it met a long-standing and continuing need and was reprinted in 1951 and again in 1957. The Wilmarth Lexicon contains 13,090 names. Of this number, 9,128 are stratigraphic units in the United States and its possessions.

After the publication of the Wilmarth Lexicon, the Survey planned to continue the compilation of geologic names as new names or revisions of old names appeared in the literature. This work was interrupted by World War II, but in 1952 a sustained effort was begun to review the pertinent geologic publications for preparation of a new lexicon. After the review had been brought up to date (through calendar year 1955), Bulletin 1056–A, "Geologic Names of North America Introduced in 1936–1955," by Druid Wilson, W. J. Sando, R. W. Kopf, and others, was published in 1957. A brief form of presentation made it possible to publish quickly some of the essential data concerning new names that had been published since 1935, the cutoff date of the Wilmarth Lexicon. Bulletin 1056–A listed about 5,000 new names introduced for use in North America, the Pacific Island possessions of the United States, and the Trust Territory of the Pacific Islands, as well as a few pre-1936 names not included in the Wilmarth Lexicon.

In the nonalphabetical "Index to the Geologic Names of North America," Bulletin 1056–B, by Druid Wilson, Grace C. Keroher, and Blanche E. Hansen, published in 1959, geologic names of North America, Greenland, the West Indies, the Pacific Island possessions of the United States, and the Trust Territory of the Pacific Islands, that were published before 1956 are arranged to form an index to both the Wilmarth Lexicon (1938) and the "Geologic Names of North America Introduced in 1936–1955" (1957). Grouping the geologic names by the age of the unit and by the politico-geographic divisions containing the type locality of the unit provided a valuable key to the literature not available elsewhere.

PRESENT LEXICON

Those who have collaborated in and contributed to the preparation of the present lexicon are Barbara Bedette, Jean L. Eggleton, Blanche E. Hansen, Rudolph W. Kopf, Carolyn Mann, William G. Melton, Jr., Helen L. Nace, Kay Dennison Palmer, William J. Sando, Jack E. Smedley, Sandra Whalen Stock, Carol S. Swift, Martha S. Toulmin, and Druid Wilson.

The geographic area covered includes the United States, its possessions, the Panama Canal Zone, and the Trust Territory of the Pacific Islands presently administered by the United States. This geographic area is much smaller than that for the Wilmarth Lexicon, which, in addition to U.S. geologic units, included the names and ages (but not the definitions) of geologic units of Canada, Mexico, the West Indies,

and Central America. This smaller geographic area was selected primarily because the International Lexicon, compiled under sponsorship of the Stratigraphic Commission of the International Geological Congress, now treats the geologic nomenclature of the other countries.

The stratigraphic papers summarized and used in preparing this lexicon were published between January 1, 1936, and December 31, 1960. In order to clarify the history of some of the older names, however, several pre-1936 reports not summarized in the Wilmarth Lexicon were also included. In all, approximately 200,000 papers were evaluated in selecting the material to be summarized.

This lexicon contains 14,634 names, including cross references. Of this number, 9,128 names appeared previously in the Wilmarth Lexicon and 5,506 are post-1935 names or pre-1936 names not included in the Wilmarth Lexicon.

Names of subsurface units are included if they have been defined or distinguished as a part of formal stratigraphy.

Names listed in the Wilmarth Lexicon but omitted from the present lexicon include (1) all paleontologic and descriptive terms, (2) all names of economic units, such as miner's terms, trade names, and subsurface oil and gas sands, (3) names of moraines and other units of which physiography is an essential part of the definition, and (4) names of orogenies.

Research on the names from the Wilmarth Lexicon reveals that 3,589 of them have not been used since 1935, the cutoff date of that lexicon. These names are listed in the present lexicon, and the ages of the geologic units, the geographic areas, original references, and type localities or statements of derivation of the names are given verbatim as they appeared in the Wilmarth Lexicon.

The superscript (1) after a name in the present lexicon denotes entries taken from the Wilmarth Lexicon. Many pre-1936 names are still being used in the same way in which they are defined in the Wilmarth Lexicon. Other names are still being used as defined in the Wilmarth Lexicon but in addition have slightly modified usages that involve changes in rank and (or) lithology; the changes are noted in the present lexicon. For still another group of pre-1936 names, the usage given in the Wilmarth Lexicon has been replaced by a new usage, which is given in the present lexicon.

Thus, the superscript (1) indicates that additional annotated material can be found in the Wilmarth Lexicon; it also can be useful in tracing the history of the nomenclature of a particular formation. For example, the entry for the Ste. Genevieve Limestone is:

Ste. Genevieve Limestone
Ste. Genevieve Limestone (in Blue River Group)
Ste. Genveieve Limestone (in Meramec Group) [1]

The superscript (1) shows that the accepted name of the formation as of 1935 was the "Ste. Genevieve Limestone in the Meramec

Group." Since then the formation has been called "Ste. Genevieve Limestone in Blue River Group" in another area. Finally, the name in boldface indicates that the Survey now considers it a formation. The absence of the superscript, of course, means that the name has been introduced since 1935.

The term "original reference" refers to the original reference as cited in the Wilmarth Lexicon. As a general rule, these references were not rechecked.

In the interest of brevity, a semitelegraphic style of writing has been used in the summary material. Because this material has usually been gleaned from many pages of the report cited, not all pages from which the factual material was obtained are listed; only the page or pages containing the essential part of the data or the inclusive pages of the paper cited are given.

Various transliterations of many of the names of units described from the Trust Territory of the Pacific Islands have appeared in English, in the Romaji of Japanese publications, and in English translations of the Japanese. The published and unpublished recommendations of the U.S. Board on Geographic Names on the native geographic names from which the geologic names are derived have been followed, but there were no decisions on some names of obscure origin. Cross references are given if the recommended forms and published sources differ and if the transliterations are inconsistent.

The stratigraphic code proposed by the American Commission on Stratigraphic Nomenclature (1961, Am. Assoc. Petroleum Geologists Bull., v. 45, no. 5, p. 645–665) was adopted by the U.S. Geological Survey on June 6, 1961. Article 10 of this code recommends that the initial letters of all words used in forming the names of formal rock-stratigraphic units be capitalized. All the geologic names listed in this lexicon, however, were published before the 1961 code, and the bulk of the present lexicon had been compiled before the code became effective. Therefore, the Commission's recommendation on capitalization is followed in the entry listings but not in the summaries. Undoubtedly there will be differences of opinion about the capitalization (or noncapitalization) used for some of the names listed in this lexicon. Quotation marks are used around names if the author cited used them.

Geologic names currently adopted for use by the U.S. Geological Survey are printed in boldface type, as in the Wilmarth Lexicon. These names have been used in Survey reports, and they constitute a part of the official geologic nomenclature of the Survey. The Survey has had occasion to consider for acceptance or rejection considerably less than half of the names that have been applied to geologic units in the United States.

The rank, lithology, and (or) age designations of some units for which the Survey has approved names are shown as they are currently

(1964) carried in the files of the Survey, even if the reports for which such designations were adopted either were still in preparation or were published after 1960. These changes will be documented in future lexicons.

Ages of all the units are given in terms of the standard major divisions of geologic time, as used by the U.S. Geological Survey (p. iv). For the sake of consistency, the designation "early" or "late," if used by an author with the age of rock units, is changed to "lower" or "upper." The age given for a unit whose name is printed in boldface type is the age presently (1964) assigned by the U.S. Geological Survey. The age given for a unit not printed in boldface is the age given by the author of the report being cited.

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The cooperation and assistance of George V. Cohee, the late Roger G. Miller, Walter S. West, Rudolph W. Kopf, and Verda M. Dougherty, all of the staff of the Geologic Names Committee, is gratefully acknowledged. Information and suggestions generously furnished by many geologists with State universities and State geological surveys are greatly appreciated. Many helpful suggestions were given by U.S. Geological Survey colleagues. Special thanks are due Blanche E. Hansen for her accuracy and consistency in the compilation, Helen L. Nace for her invaluable assistance during the final stages of the preparation of the manuscript and, Dimitra J. Kalivas for her able help during the proofreading.

SYMBOLS

Names printed in boldface type have been adopted for use by the U.S. Geological Survey.

Names preceded by a dagger (†) have either been abandoned by their authors or rejected for use by the U.S. Geological Survey.

Names followed by the superscript ([1]) are listed in the Wilmarth Lexicon (U.S. Geol. Survey Bull. 896).

Names in roman type without a dagger have not been considered by the Committee on Geologic Names of the U.S. Geological Survey for use in Survey reports.

Aarde Shale[1] Member (of Howard Limestone)

Pennsylvanian (Virgil Series): Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 94, 96.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 57 (fig. 22), 63, 70 (fig. 25). Bluish- to yellowish-gray clayey and sandy shale containing a persistent coal bed (Nodaway), ranging from about 1 inch to 2 feet in thickness, and a persistent black fissile shale in many outcrops. Thickness ranges from about 2 to 15 feet. Underlies Church limestone member; overlies Bachelor Creek limestone member.

M. R. Mudge, C. P. Walters, and R. E. Skoog, 1959, U.S. Geol. Survey Bull. 1060–D, p. 193, 252–253, pl. 7. In Nemaha County, Kans., member is basal unit of Howard limestone. Consists of silty slightly calcareous dark-gray to tan shale. Average thickness 4½ feet. Base of Nodaway coal designated as base of Aarde. Underlies Church limestone member.

Named for Aarde farm, sec. 4, T. 26 S., R. 11 E., Greenwood County.

Aaron Slate[1]

Precambrian or Paleozoic: Central northern North Carolina and central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 15, 19–27, map.

J. L. Calver, 1960, Virginia Div. Mineral Resources Bull. 75, p. 17. In Pittsylvania and Halifax Counties, overlies Hyco quartz porphyry. Varies from nearly pure greenstone to fairly pure argillaceous sandstone and slate; in some areas decidedly conglomeratic. Paleozoic or Precambrian.

Well exposed at many places along Aaron's Creek, Person and Granville Counties, N.C.

Abbott Formation (in McCormick Group)

Middle Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 28 (fig. 4), 30–31, 44 (table 1), pl. 1. geol. sections. Proposed for strata from top of Pounds sandstone member of Caseyville formation to top of Bernadotte sandstone member of western Illinois. Overlaps Caseyville formation, and throughout most of central, northern, and western Illinois is basal formation of Pennsylvanian. Overlapped by Spoon formation (new) of Kewanee group (new). Consists of strata that were included in lower part of sequence formerly called Tradewater group. Characterized by dominance of sandstone, sandy shale, and siltstone; coals rarely more than 24 inches thick and have much less continuity than higher coals. Maximum thickness 300 to 350 feet in southern Illinois; thins westward and northward. Members: southern Illinois—(ascending) Reynoldsburg coal, Grindstaff sandstone, Willis

coal, Finnie sandstone (new), Delwood coal, and Murray Bluff sandstone; western Illinois—(ascending) Babylon sandstone, Manley coal, Tarter coal, Pope Creek coal, and Bernadotte sandstone. Report presents new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type locality: Along Illinois Central Railroad, secs. 5–7, T. 11 S., R. 5 E., Pope County. Named for Abbott Station.

Abbyville Gabbro[1]

Precambrian: Central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 37–38, map.

Occurs in vicinity of Abbyville, Mecklenburg County.

Abercrombie Formation[1]

Middle Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Correlation chart of recommended revision of stratigraphic units pertaining to Great Basin shows Abercrombie formation below Young Peak dolomite and above Busby quartzite.

Underlies and named for Abercrombie Peak, on ridge south of Dry Canyon, in Gold Hill district.

Aberdeen Sandstone (in Pottsville Formation)[1]

Aberdeen Sandstone (in Tradewater Formation or Group)

Pennsylvanian: Western Kentucky, southern Illinois, and southern Indiana.

Original reference: A. F. Crider, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 1, p. 173–175.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 33. Noted as occurring in Illinois and Indiana.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart (column 26). Shown on correlation chart as sandstone in Tradewater formation. Underlies Mannington coal; overlies Ice House coal.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 14 (fig. 2). Shown on correlation chart as sandstone in Tradewater group. Below Rock Island coal and above Pope Creek coal.

Named for Aberdeen, Butler County, Ky., where it stands out in prominent cliffs along Green River. Typically exposed at Aberdeen Ferry.

Aberdeen Sandstone Member (of Blackhawk Formation)[1]

Upper Cretaceous: East-central Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 184, pl. 3. Stratigraphically extended to include overlying coal-bearing rocks and associated offshore bar deposits. Consists of basal white-capped sandstone with maximum thickness of 88 feet and an overlying series of shale, sandstone, and coal with a maximum thickness of about 100 feet

at Kenilworth. Includes the Castlegate "A" or Aberdeen coal. Underlies Kenilworth member (new); overlies Spring Canyon member (new).

Exposed near Aberdeen mine, northeast of Kenilworth, Castlegate quadrangle, Carbon County.

Abilene Conglomerate[1]

Tertiary: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 786, 789, 797.

C. C. Williams and S. W. Lohman, 1949, Kansas Geol. Survey Bull. 79, p. 60. Locally conglomeratic bed occurs at base of McPherson formation. Material in conglomerate is similar to materials composing so-called Abilene conglomerate, a good exposure of which is near NW cor. sec. 30, T. 18 S., R. 2 E., just east of mapped area. Believed that, at various outcrops, beds called Abilene conglomerate may represent different ages; hence, term Abilene may not have much stratigraphic significance. Conglomerate at base of McPherson in this area [McPherson County, most of Harvey County, and parts of Sedgwick, Marion, and Reno Counties] may be equivalent to some exposures of the Abilene conglomerate in Dickinson County.

Named for Abilene, Dickinson County.

Abilene Formation[1]

Permian: Central and central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 95–96.

Occurs around Abilene and perhaps southward beneath Callahan Divide.

Abilene Limestone[1]

Age not stated: Kansas.

Original reference: E. C. Parker, 1925, Am. Assoc. Petroleum Geologists Bull., v. 9, no. 6, p. 982.

Type section: Abilene, Dickinson County.

Abingdon Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), 62, pl. 1. Assigned member status in Spoon formation (new). Occurs above Isabel sandstone member and below Browning sandstone member. Very thin; represented by coaly streak in type section of Spoon. Coal named by Culver (1925, Illinois Geol. Survey Min. Inv. 29). Report presents new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Center sec. 6, T. 9 N., R. 2 E.

Abingdon cyclothem (in Carbondale Group)

Abingdon cyclothem (in Spoon Formation)

Pennsylvanian: Western Illinois and eastern Iowa.

J. M. Weller and H. R. Wanless *in* J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1586 (fig. 1), 1589. Commonly embryonic and thin; characterized only by a dark streak or coal horizon separating underclay and gray shale; in most areas, identi-

fied and correlated solely on basis of its stratigraphic position. In area of Knox and Fulton Counties, Ill., includes basal sandstone, underclay, and a few inches of coal, and gray shale bearing a thin unpersistent layer of brownish- to purplish-gray fine-grained limestone. Neither a basal sandstone nor a marine limestone is characteristically present, and most distinctive member of cyclothem in Iowa is thin red platy almost fissile shale directly above coal horizon. In western Illinois and Iowa, persistently present between Greenbush cyclothem below and Liverpool cyclothem above. Formerly tentatively termed Lower Liverpool.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 83–85, geol. sections 6, 23, 25, 28–32, 34, 36, 37, 40, 42. Includes Isabel sandstone. Also includes a channel sandstone, called Browning by Searight (1929). It is possible Browning may be channel facies of Isabel sandstone. However, in this report Browning is included in Liverpool cyclothem. Cyclothem also present in western Indiana and western Kentucky, where it probably includes lowest beds of Carbondale formation as used in Kentucky.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. Included in Spoon formation, Kewanee group (both new). Occurs above Greenbush cyclothem and below Tonica cyclothem (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Well exposed in tributaries of Brush Creek, especially near the center of sec. 6, T. 9 N., R. 2 E., 4 miles east of Abingdon, Knox County, Ill.

Abiquiu Tuff

Abiquiu Tuff Member (of Santa Fe Formation)

Miocene: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103; 1938, Jour. Geology, v. 46, no. 7, p. 937 (fig. 4), 944–952, 958. Consists of stream-laid tuff and volcanic conglomerate, with a few small interbedded lava flows; maximum thickness more than 1,000 feet. Underlies Santa Fe formation; overlies El Rito formation (new). Miocene.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 467 (fig. 3), 469–472, pl. 1. Name Abiquiu(?) formation assigned to lower part of late Tertiary beds of Galisteo-Tonque area. Beds are chiefly non-tuffaceous. Believed to be southward extension of water-laid volcanic debris named Abiquiu tuff by Smith (1938). Abiquiu(?) is as much as 1,500 feet thick. Occurs above Cienequilla limburgite and below Santa Fe formation.

A. J. Budding, C. W. Pitrat, and C. T. Smith, 1960, New Mexico Geol. Soc. Guidebook 11th Ann. Field Conf., p. 83, 84. Rank reduced to member status in Santa Fe formation. Unconformably overlies El Rito formation. Thickness at least 1,350 feet on west slope of Sierra Negra. Area of report is southeastern part of Chama basin.

Named for outcrops in Abiquiu quadrangle.

Abo Sandstone,[1] Redbeds,[1] or Formation

Lower Permian (Wolfcamp and Leonard): New Mexico.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 389.

G. F. Loughlin and A. H. Koschmann, 1942, U.S. Geol. Survey Prof. Paper 200, p. 20–22, pl. 2. In Magdalena district, Abo sandstone uncon-

formably overlies Madera limestone of Magdalena group. Unconformable below Datil(?) formation. Maximum thickness about 175 feet.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 674–676. In some previous reports, Abo sandstone was considered to be approximately equivalent to Wolfcamp series, and supposed unconformity at its base was thought same as that at base of Wolfcamp. This correlation now seems to be incorrect. Herein suggested that Abo is mostly or wholly post-Wolfcamp and that equivalent of Wolfcamp series lies in upper part of Magdalena group as at present defined and mapped. Basal formation of Manzano group.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1654–1657. Lee (1909) gave name Abo sandstone to succession of dark-red coarse-grained sandstones, in part conglomerate, exposed in Abo Canyon at south end of Manzano Mountains. He gave maximum thickness of 800 feet. Lee stated that Abo was underlain unconformably by Magdalena limestone (Pennsylvanian), but his definition of upper boundary is not clear. Abo was termed basal member of Manzano group, which contained (ascending) Abo sandstone, Yeso formation, and San Andres limestone. Several thin fossiliferous limestones that Lee described as lying near base of Abo are now known to belong to underlying Pennsylvanian. Lee's conclusion that shale in Abo is subordinate in amount to sandstone and conglomerate is in error. Lee did not designate type section. In type section herein designated and described, Abo consists of about 60 percent red shale and about 40 percent sandstone, arkose, and conglomerate. This ratio holds approximately true for most exposures in central New Mexico. It is incorrect to refer to formation as Abo sandstone. Thickness 915 feet at type section. Overlies unnamed basal Permian limestone; underlies Yeso (redefined).

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. In Sandoval and Rio Arriba Counties, Abo formation underlies and intertongues with Meseta Blanca sandstone member (new) of Yeso formation.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. In Lucero uplift, Valencia, Socorro, and Bernalillo Counties, Abo formation overlies and intertongues with Red Tanks member (new) of Madera limestone and underlies and intertongues with Meseta Blanca sandstone member of Yeso formation.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. Consists of dark-red shale, dark-red sandstone and arkose, conglomerate, and lime-pellet conglomerate. Thickness ranges from 300 feet in Joyita Hills to 910 feet in type section. Overlies Bursum formation (new). Age of formation is in question. Fossil plants indicate at least upper part should be correlated with strata of Leonard and not Wolfcamp age.

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1155. In Los Pinos Mountains, Abo formation disconformably overlies Aqua Torres formation (new). Thickness exceeds 500 feet.

R. L. Bates and others, 1947, New Mexico Bur. Mines Mineral Resources Bull. 26, p. 26–28. As described by Needham and Bates, Abo in Abo Canyon, consists of 914 feet of continental red beds that overlie a thin "unnamed basal Permian limestone." Fieldwork for present report shows that this limestone is at top of Bursum formation. Uppermost unit of type Abo of Needham and Bates is a 6-foot white massive sandstone. Further work

in Gran Quivira quadrangle has shown presence, just above this sandstone, of a thin limestone that is identical with lowest unit of Yeso as redefined by Needham and Bates. It has been pointed out by C. B. Read (personal commun.) that basal Yeso limestone cannot be found in Yeso sections in northern part of state—in Glorieta Mesa and Zuni Mountains, for example—and consequently cannot serve as universally recognizable base of Yeso. Read states that a 100- to 300-foot section of sandstones and shales, heretofore considered uppermost Abo, can be recognized and mapped regionally. Read and his workers have mapped Abo-Yeso contact some distance below basal Yeso limestone of Needham and Bates. Applied to Abo type section, this revision lowers Abo-Yeso contact 104 feet, to top of interval 32 of Needham and Bates section. Wood and Northrop (1946) have named this 104-foot section Meseta Blanca sandstone member of Yeso.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93 (columnar section), 101. Discussion of Sacramento Mountain escarpment. Abo formation was deposited over entire escarpment area. In basinal area east of Tularosa, Abo is about 1,100 feet thick and composed principally of dark-reddish-brown mudstone and arkose. Here it grades into underlying latest early Wolfcampian marine strata. Thins rapidly toward positive block in southeast and is about 400 feet thick in High Rolls area. Here it is composed of basal quartzite conglomerate cobbles and an overlying thicker sequence of dark-reddish-brown mudstones and arkose. Farther south, it is 200 to 550 feet thick and splits into an uppermost and a basal series of red beds and a middle sequence composed principally of thin-bedded limestone, dolomitic limestone, and nonred shales. Middle sequence thickens southward to Hueco Mountains, changes from brackish to marine facies, and forms most of Wolfcampian part of Hueco limestone. Upper tongue of Abo red beds (entire Abo of Darton, 1928, U.S. Geol. Survey Bull. 794) can be traced nearly to Texas border, and forms Deer Mountains red shale of Hueco limestone. Throughout area, overlies angular unconformity cut on folded and faulted pre-Permian strata. Columnar section shows Abo penetrated by Pendejo tongue (new) of Hueco formation.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5. p. 17. Mentioned as containing Powwow conglomerate member at base.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 6, 7 (fig. 2), 10, pl. 1. In Socorro County, Abo formation conformably underlies Los Vallos member of Yeso formation.

G. O. Bachman and P. T. Haves, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 689–700. Discussion of Sand Canyon area, Otero County, N. Mex. Abo sandstone is divided into lower and upper tongues by interfingering with Hueco limestone. Lower tongue is herein named Danley Ranch and upper tongue Lee Ranch. About 15 miles north of area, Hueco wedges out between upper and lower parts of Abo. Rocks that previous workers have identified as Abo formation south of Culp Canyon are interpreted as distinct unit and herein named Otero Mesa member of Yeso formation. Contact with underlying Pennsylvanian rocks (Magdalena group) unconformable throughout area. Locally relief before deposition of Abo was so great that Danley Ranch tongue is absent because of nondeposition. Lee Ranch tongue is apparently early Leonard. Lower Permian.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 58–71. In northern Sacramento Mountains, Abo formation overlies

Labrocita formation (new) and underlies Yeso formation; locally overlies Holder formation. Thickness as much as 1,400 feet. Basal formation of Manzano group. Wolfcampian and Leonardian.

U.S. Geological Survey has abandoned term Manzano Group.

Type section (Needham and Bates): From base of formation in sec. 32, T. 3 N., R. 5 E., Valencia County, just north of U.S. Highway 60, through sec. 33, into sec. 2, T. 2 N., R. 5 E., to upper limit of formation at top of hill just east of road to Abo Ruins in sec. 25, T. 3 N., R. 5 E., Torrance County. Base of section lies about 1 mile northwest of village of Scholle; top lies about 2 miles west-northwest of village of Abo. Named for Abo Canyon at south end of Manzano Range, Valencia and Torrance Counties.

Abrams Mica Schist[1]

Pre-Silurian: Northern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 225–245.

Seymour Mack, 1958, U.S. Geol. Survey Water Supply Paper 1462, p. 16–18, pl. 1. Thick series of metasedimentary rocks, dominantly quartz-mica schist, which is overlain unconformably by Salmon hornblende schist. Hinds (1932) introduced term Siskiyou terrane to include Abrams and Salmon schists. Exact stratigraphic position of rocks composing Siskiyou terrane is not known. Abrams and Salmon are oldest formations in area of this report [Scott Valley]. In northern and western parts of area, they are overlain unconformably by several thousand feet of greenstone and greenstone schist possibly correlative with Devonian(?) Copley greenstone of southern Klamath Mountains. In southern part of mountains surrounding Scott Valley, Chanchelulla(?) formation of probable Silurian age lies unconformably on Abrams and Salmon schists. Present evidence indicates only that Abrams and Salmon schists can be adjudged with certainty to be of pre-Silurian age. Assignment to Precambrian or lower Paleozoic would be extremely tenuous.

W. P. Irwin, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B315–B316; 1960, California Div. Mines Bull. 179, p. 19–20. Geologic mapping in Weaverville quadrangle indicates that (1) structure of metamorphic rocks in that quadrangle is synclinorial and Abrams mica schist overlies Salmon hornblende schist, (2) Abrams is probably younger, rather than older, than Salmon, and (3) marble lenses are of stratigraphic significance in that they are chiefly in lower part of Abrams.

Named for Abrams post office, in upper Coffee Creek region, Trinity County.

Abrigo Limestone[1] **or Formation**

Middle and Upper Cambrian: Southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 9, 16–20, pl. 5. In Cochise County, described as limestone, limestone mottled with shale, shale, sandstone, edgewise conglomerate, and a little quartzite. Thickness varies but is 770 feet at type locality. Underlies Upper Devonian Martin limestone; overlies Bolsa quartzite.

Named for exposures in Abrigo Canyon, 3 miles southwest of Bisbee.

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Absalona Formation

Precambrian(?): Rhode Island.

G. M. Richmond *in* G. M. Richmond and W. B. Allen, 1951, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 4, p. 10, 11–12, pl. 1. Predominantly porphyroblastic biotite gneiss; includes, locally, lenses of quartz-biotite schist at its base and mappable units of biotite gneiss and amphibolite in its upper part; small quartzite lenses occur throughout. Thickness 650 to 4,700 feet. Underlies Woonasquatucket formation (new); overlies Nipsachuck gneiss (new).

Named for exposures on southwest slope of Absalona Hill along U.S. Route 44, Georgiaville quadrangle.

Absaroka sequence

Mississippian (Chesterian) to Pennsylvanian (Des Moinesian): Central and Western United States.

L. L. Sloss, W. C. Krumbein, and E. C. Dapples *in* C. R. Longwell, chm., 1949, Geol. Soc. America Mem. 39, p. 110–111, 112 (table 2), 121. "Operational unit" for use in interregional facies analysis. Term derived from Absaroka Mountain Range in northwestern Wyoming and southern Montana. Outcrops along eastern flank of range at western border of Bighorn basin expose base of sequence at contact between Madison limestone and Amsden formation. Top of sequence not defined, but no regionally significant discontinuity is recognized short of base of Upper Jurassic Morrison formation.

Absher Limestone (in Carbondale Group)

Pennsylvanian (Des Moines): Southern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 17 (fig. 3), 23 [1943]. Comparatively thin and somewhat impure bed. Overlies Harrisburg (No. 5) coal; in vicinity of Harrisburg, generally separated from coal by as much as 20 feet of shale (bed 6 of complete cyclothem). Included in St. David cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 54 (table 3). Replaced by St. David limestone member of Carbondale formation (redefined). Report presents new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Named from village in southeastern Williamson County.

†Accabee Gravels[1] or Phos-gravels[1]

Pleistocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published 1908 *in* South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20, 21.

Named for exposures in pit at Corn Hill, near Accabee Flats, west of Charleston.

Accord Shale

Upper Silurian (Murderian): Southeastern New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Suggested for unfossiliferous calcareous shale underlying Rosendale waterlime. Thickness at type section 18 feet.

Type section: Abandoned railroad cut, southern edge of Accord, Rosendale quadrangle.

Acebedo Formation

Acebedo Member (of Lodo Formation)

Eocene, middle: Southern California.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 46 (footnote), 50–51. Name Acebedo formation applied by Leo Herrera (1951, unpub. thesis) to siltstones underlying Avenal sandstone in Tent Hills area. Consists, at least locally, of a basal conglomerate containing a coarse orbitoidal sandstone and a siltstone sequence. Rests unconformably on Cretaceous. May represent a coarser clastic phase of Lodo formation deposition, about equivalent, at least in upper part, in age and stratigraphic position to Arroyo Hondo member of Lodo farther north at Cantua Creek. Falls within Ulatisian stage. Footnote, page 46, refers to unit as member of Lodo formation.

Well exposed in Tent Hills region, south of Reef Ridge area, about 18 miles southwest of Avenal, Kern County.

†Ackerman Formation (in Wilcox Group)[1]

Eocene, lower: Northeastern Mississippi, southwestern Alabama, southeastern Missouri, and western Tennessee.

Original reference: E. N. Lowe, 1913, Mississippi Geol. Survey Bull. 10, p. 23–35.

J. M. Weller and H. S. McQueen, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 159. Geographically extended into Scott County, Mo., where it underlies Holly Springs formation and overlies Porters Creek formation.

F. F. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 30 (fig. 6), 33, 37–43. Restricted to exclude Midway-Wilcox "transitional beds" or "basal clays" of Lowe. As thus restricted, underlies Holly Springs formation and overlies Fearn Springs formation (new) and includes not only clays and lignites as exposed in type section but a persistent basal sand member.

G. I. Whitlatch and Benjamin Gildersleeve, 1946, Econ. Geology, v. 41, no. 8, p. 843 (fig. 2), 844–845. Geographically extended into western Tennessee where it underlies Holly Springs formation and overlies Porters Creek clay.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3-195, p. 17–18. In 1943, during work on Mississippi geologic map, it was found that type Holly Springs of northern Mississippi, formerly included in the Wilcox and correlated with Tuscahoma sand of Alabama, is nonmarine equivalent of Tallahatta formation to south. Name Holly Springs was abandoned in favor of Tallahatta for all of Mississippi. Removal of beds designated as Holly Springs from Wilcox group left Ackerman formation as only unit formerly recognized by U.S. Geological Survey in the Wilcox of Mississippi. Although usually correlated with Nanafalia formation of Alabama, Ackerman at its type locality in Mississippi was found to correlate with beds well up in Tuscahoma sand of Alabama. It was decided, rather than attempt to redefine Ackerman, to adopt Wilcox formation for all beds of Wilcox age in Mississippi. [Hence, Ackerman formation is abandoned.]

J. S. Attaya, 1951, Mississippi Geol. Survey Bull. 71, p. 10–19. Ackerman formation in its outcrop in Lafayette County is entirely nonmarine. On basis of data obtained from shallow exploratory holes and surface exposures, Ackerman is herein divided into four units (numbered 1 to 4 in ascending order), the composite of which forms a cyclothem. Third unit of Ackerman has probably been confused with Holly Springs formation. Herein proposed that name Holly Springs be dropped from literature. Overlies Fearn Springs formation; underlies Meridian formation.

James Turner, 1952, Mississippi Geol. Survey Bull. 76, p. 10–14. Described in Yalobusha County, Miss., as composed of sand, clay, shale, lignite, quartzite, and iron concretions. Basal sand not present at surface. Thickness 68 to 140 feet. Underlies Meridian formation.

T. W. Lusk, 1956, Mississippi Geol. Survey Bull. 80, p. 25–43, pl. 1. Entire Ackerman is present in Benton County. Thickness varies from featheredge on east to about 100 to 150 feet on west. Overlies Fearn Springs formation; underlies Meridian formation. Wilcox.

Typically exhibited in cut 1 mile east of town of Ackerman, Choctaw County, northeastern Mississippi.

Acme Dolomite Member (of Blaine Formation)[1]

Permian: Northwestern Texas and west-central Oklahoma.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 948 (fig. 1), 951.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 686 (table 1). Geographically extended into Oklahoma where it is shown as underlying shales below Shimer member and overlying shales above Cedartop member.

Named Acme from type exposure in Hardeman County, Tex.

Acton Granite

Late Paleozoic(?): Eastern Massachusetts.

W. R. Hansen, 1956, U.S. Survey Bull. 1038, p. 48–50, pl. 1. Fine-grained moderately foliated light-gray to light-olive-gray granite. Composed chiefly of quartz, orthoclase, microcline, and oligoclase. Occurs in small individual plutons, chiefly as intruded sheets or sill-like bodies, and as crosscutting dikes and irregular masses that range in thickness from a few inches to several hundred feet and in length from a few yards to more than a mile. All observed exposures lie within boundaries of Nashoba formation (new).

Named for town of Acton where it is well exposed. Also exposed in Boxborough, Bolton, Harvard, Hudson, and Stow.

Acworth Gneiss[1]

Precambrian: Northwestern Georgia.

Original reference: C. W. Hayes, 1901, Am. Inst. Mining Engineers Trans., v. 30, p. 408.

Named for development around Acworth, Cobb County.

Ada Formation[1]

Pennsylvanian (Virgil Series): South-central Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2. p. 128–132, pls. 3, 27, map.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 99–103. Formation in Seminole County consists of variegated pastel shales, sandstones, and siltstones, and limestones and limestone conglomerates. Includes Snomac limestone member (new). Thickness 150 to 250 feet; thickens and thins in no regular manner. Overlies Vamoosa formation; underlies Vanoss formation. Fieldwork across Okfuskee, Seminole, and Pontotoc Counties coupled with data taken from Morgan's map shows that Ada formation truncates in succession Pawhuska, Vamoosa, Hilltop, Belle City, Nellie Bly, Coffeyville, and Seminole formations.

Named for development within and to west of town of Ada, Pontotoc County.

Ada Limestone

Upper Ordovician: Central Oklahoma, western Illinois, and Missouri.

W. H. Shideler, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 367–368. The "Fernvale," extending from Glen Park, Mo., and Valmeyer, Ill., to south side of Arbuckles in Oklahoma, is massive, uniformly crystalline limestone with varied fauna of ostracods and trilobites; this limestone differs from the typical Fernvale. Name Ada is proposed for the crystalline limestone.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 524. Templeton and Willman (1953, unpub.) reported that name Ada was preempted and proposed name Cape limestone for the Missouri "Fernvale."

Well exposed at Lawrence quarry, 7 miles southwest of Ada, Pontotoc County, Okla.

Ada Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia, eastern Tennessee(?), and southwestern Virginia.

Original reference: D. B. Reger. 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 421.

C. L. Cooper, 1941, Illinois Geol. Survey Rept. Inv. 77, p. 12. Mentioned in discussion of Chester ostracodes of Illinois. Overlies Reynolds limestone member; underlies Talcott shale member.

Type locality: On north side of East River, in public road between Ada and Stony Gap, and less than one-fourth mile west of Ada, Mercer County, W. Va.

Adamana shales[1]

Lower Triassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 335.

Exposed near railroad station of Adamana, Apache County.

Adamant Granite

Devonian: Central Vermont.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Mottled gray fine- to medium-grained granite, occurring as thick sills, thinner subsidiary sills, and sill-like dikes. Maximum thickness of individual sills several hundred feet. Enclosed in Waits River formation, except for one thin sill in Moretown formation.

Typically exposed at surface and in quarries within a mile north and northwest of village of Adamant in southwestern Calais Township, Montpelier quadrangle.

Ada Mayes facies[1]

See **Mayes Formation.**

Adams Branch Limestone Member (of Graford Formation)[1]

Adams Branch Formation (in Graford Group)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 391.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Graford group (redefined). Expanded below to include shale and sandstone section about 50 feet thick above Wiles limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 64–65. Middle member of Graford formation. Overlies Brownwood shale member; underlies Cedarton shale member. Commonly light-gray wavy-bedded slabby limestone. A few miles northeast of Brownwood, member grades laterally into shale, calcareous sandstone, and, in some places, a coquina of brachiopod, mollusk, and crinoid fragments. Thickness about 15 feet, just west of Brownwood; thickens downdip to about 40 feet in wells; 50 to 60 feet in McCulloch County, south of Colorado River.

Type locality: Adams Branch, Brown County, close to town of Brownwood.

Adaville Formation[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

R. H. Peterson, D. J. Gauger, and R. R. Lankford, 1953, Utah Geol. and Mineralog. Survey Bull. 47, p. 16 (fig. 4), 17–18. Consists of about 4,000 feet of yellow, gray, and black carbonaceous clays with irregularly bedded brown and yellow sandstones and numerous coal beds. Includes Lazeart member at base. Overlies Hilliard formation.

Well exposed at Adaville mine, 2 miles south of Hodges Pass Tunnel, on Oregon Short Line.

Addington Formation[1]

Permian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 8–9.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Rejected by Oklahoma Geological Survey. Name preoccupied.

Exposed in Jefferson County.

Addington Sandstone Member (of Wise Formation)[1]

Pennsylvanian: Southwestern Virginia.

Original reference: J. B. Eby, 1923, Virginia Geol. Survey Bull. 24.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 72, 77 (table 5). In Wise formation about 180 feet above base, between Addington and Clintwood coals.

Named for Addington Station, 1½ miles south of Glamorgan, Wise County.

Addison Formation[1]

Middle Ordovician: Northwestern Vermont.

Original reference: E. J. Foyles, 1929, Vermont State Geologist 16th Rept., p. 275–279.

In central part of Ferrisburg Township, northwestern part of Addison County.

Addy Quartzite[1]

Lower Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 61, map.

H. E. Culver, 1939, Washington State Coll. Monthly Bull., v. 22, no. 7, pt. 1, p. 19. Mentioned as overlying Huckleberry greenstone (new).

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 9, pls. 1, 2. Restricted to exclude underlying greenstone and conglomerate. These units, now named Huckleberry greenstone and Huckleberry conglomerate, were included in Addy by Weaver (1920). Thickness at least 3,000 feet; may be as much as 5,000 feet. In most of area, Addy lies on greenstone, but in south, locally overlaps greenstone and lies on schistose conglomerate. Overlain by what are presumably extensions of Old Dominion limestone.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Unconformably overlies Huckleberry group. Probably Cambrian.

U.S. Geological Survey currently considers Addy Quartzite to be Lower Cambrian in age.

Near Addy, Stevens County.

Adel Mountain Volcanics

Upper Cretaceous: Northwestern Montana.

J. B. Lyons, 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 449 (fig. 2), 455, 459–460, pl. 1. Trachybasalt and basalt agglomerates, coglomerates, and flows, with numerous intrusives, analcime and augite trachybasalts in upper measures. Contains plant fossils in upper conglomerates. Entire succession strongy zeolitized. Unconformably underlies Great Falls lake sands (new); unconformably overlies Two Medicine formation. Thickness 3,200 feet. In area of Lewis overthrust, Precambrian Spokane shale is thrust over Adel Mountain volcanics.

J. D. Barksdale, 1951, Am. Jour. Sci., v. 249, no. 6, p. 439–442. Mentioned in discussion of Cretaceous glassy welded tuffs of Lewis and Clark County, Mont.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 40. Adel Mountain volcanics are younger than Elkhorn Mountains volcanics (new) in southern Elkhorn Mountains.

Area of reports includes about 900 square miles of northern end of Big Belt Range and adjacent plains. Adel Mountain volcanics occupy approximately 330 square miles of northern Big Belts. Adel Mountain is in mapped area.

Aden Basalt Flow

Quaternary: Southwestern New Mexico.

F. E. Kottlowski, 1960, New Mexico Bur. Mines Mineral Resources Geol. Map 14. Named on map legend. Unit mapped in southwestern part of Las Cruces quadrangle.

Adirondack (Anorthosyte) Anorthosite[1]

Precambrian: Eastern New York.

Original reference: C. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, no. 1, p. 82.

W. J. Miller, 1943, Am. Geophys. Union Trans., v. 24, pt. 1, p. 257–264. Discussion of emplacement of Adirondack anorthosite. Terms Adirondack anorthosite body (or massif) and Adirondack syenite-granite series also used in text.

Anorthosite mass constitutes all high central peaks of true Adirondack Mountains.

Adirondack Gneiss[1]

Precambrian: Northeastern New York.

Original reference: C. H. Hitchcock, 1879, Macfarlane's Geol. Ry. Guide, p. 56.

David Gallagher, 1937, New York State Mus. Bull. 311, p. 15–16. Suggests that best term for the rock as a whole is granite.

In Adirondack region.

Adirondack-Border Series

Upper Cambrian: Northern New York.

R. R. Wheeler, 1946, Harvard Univ. Summ. of Theses, 1942, p. 143, 145. Term used for Upper Cambrian deposits which represent an on-lap and off-lap cycle of deposition. Comprises (descending) Whitehall formation, Little Falls dolomite, Theresa passage beds, and Potsdam sandstone. Physically and faunally distinct from overlying Beekmantown rocks.

Adirondack-Border region.

Adler Sedimentary Series (in Yavapai Group)

See **Alder Group** (in Yavapai Series).

Admiral Formation (in Wichita Group)[1]

Admiral Group

Lower Permian (Wolfcamp Series): West-central Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 192–195, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 93, 94–96. Rank raised to group. Restricted; redefined to include beds above Coleman Junction and below Jim Ned shale members (new) of Belle Plains formation. Comprises Fisk formation (new), above, and redefined Hords Creek formation.

R. C. Moore, 1947, *in* A. K. Miller and Walter Youngquist, Kansas Univ. Paleont. Contr. 2, Mollusca, art. 1, p. 1 (footnote). Mentioned as formation including two new members: Overall limestone and underlying Wildcat Creek shale.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Shown on composite columnar section as comprising (ascending) Lost

Creek shale, Hords Creek limestone, Wildcat Creek shale, and Overall limestone. Underlies Belle Plains formation; overlies Putnam formation.

Named for village of Admiral, Callahan County.

Admiralty Drift[1] **or Clay**

Pleistocene (pre-Wisconsin): Western Washington and British Columbia, Canada.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 13–18, 38–39, pl. 1. Described in Snohomish County as firm finely bedded gray, green, and blue silt and clay with carbonized wood and a few dirty sand and gravel beds. Exposed thickness about 200 feet. In some areas underlies Pilchuck clay member (new) of Vashon drift, and in some areas Esperance sand member (new) of Vashon. In plateau blocks of the county, clay is overlain by several hundred feet of water-laid deposits.

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 14–15, 26, pl. 1. Drift described in Kitsap County where it consists principally of massive blue clay and silt; deformed in most places. Contains till, volcanic ash, peat, or lignite, sand, and some gravel. Top of formation commonly near or below sea level. Thickness as much as 400 feet. Underlies lower member of Orting gravel.

Principal exposures in bluffs along shores of Admiralty Inlet.

Admiralty glacial epoch[1]

Pleistocene (pre-Wisconsin): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

Admire Group[1]

Admire Formation

Admire Shale (in Wabaunsee Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and central Oklahoma.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 53.

G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 8–9. Rank raised to group; age designated as Permian. Subdivided into (ascending) Towle shale, Aspinwall limestone, Hawxby shale, Falls City limestone, West Branch shale, Five Point limestone, and Hamlin shale. Underlies Council Grove group; overlies Wabaunsee group (Pennsylvanian).

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Group mapped in Oklahoma. Not subdivided.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Redefined. Subdivided into three formations (ascending): Onaga shale (new), Falls City limestone, and Janesville shale (new). Overlies Wood Siding formation of Wabaunsee group.

C. C. Branson, 1956, Oklahoma Geology Notes, v. 16, no. 11, p. 123, 124–125. Stratigraphic unit from top of Brownville limestone to base of Foraker limestone is indivisible in Lincoln, Payne, and Pawnee Counties. Corresponds to entire Admire group of Kansas and can be referred to as Admire formation.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 73–77. Group, as currently defined, is basal Permian (Wolfcampian) unit of midcontinent area and includes beds overlying Brownville limestone and underlying

Americus limestone. In Nebraska and Kansas, group is subdivided into seven limestone and shale units; Indian Cave channel sandstone occurs locally at base. Taylor (1953), Vosburg (1954), and Fisher (1956) in unpublished theses made tentative correlations with some Kansas units. In Pawnee County, exposures of group are poor, and no attempt at subdivision has been made. Branson (1956) proposed that, where subdivision of group is not possible, name Admire formation be applied to sedimentary sequence separating Brownville and Americus limestones. Formation in Pawnee County forms broad valley, averaging 3 miles in width, that trends north-south across county. Thickness 140 feet, representing abrupt increase in thickness southward from Osage County.

Probably named for Admire, Lyon County, Kans.

Adobe Formation (in Veredas Group)

Pennsylvanian (Missouri Series): New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 61–62. Name introduced for all rocks in northern part of Oscura Mountains between top of Coane formation (new) and base of Council Springs limestone (new). At type locality, composed of noncherty to highly cherty gray limestone, gray shale, and arkosic sandstones. In most areas of central New Mexico, basal part of formation is fossiliferous highly arkosic sandstone to granule conglomerate. Thickness ranges from about 47 feet at type locality to more than 200 feet in area of Ladron Mountains and Cadronito Hills.

Type locality: Northeast slope of Oscura Mountains (SE¼ sec. 36, T. 5 S., R. 5 E.) in Socorro County. Geographic term Adobe is derived from Adobe village, about 3 miles northeast of north end of Oscura Mountains.

Aeolian Buttes Glacial Stage

Aeolian Buttes Till

Pleistocene: East-central California.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1289, pl. 1. At least four ice advances occurred in Pleistocene; earliest stage, here named Aeolian Buttes, was followed by the Sherwin, Tahoe, and Tioga previously named by Blackwelder. Till may be equivalent in age to McGee stage, but Aeolian Buttes can be dated with respect to local volcanic and glacial succession and McGee at its type locality 25 miles southeast cannot; therefore new name is proposed. Rhyolitic ash and pumice, now Bishop welded tuff, were erupted in interval between Aeolian Buttes and Sherwin stages. Aeolian Buttes till rests on an abraded surface of quartz monzonite.

W. C. Putnam, 1960, California Univ. Pubs. Geol. Sci., v. 34, no. 5, p. 235. Sherwin till is pre- rather than post-Bishop tuff. Name Aeolian Buttes till should be considered invalid as representing an earlier Pleistocene, pre-Sherwin glacial till. If name is retained at all, it should be regarded as having significance only in Mono Basin as probable equivalent of more widely recognized Sherwin glacial stage.

Till crops out on crest of Aeolian Buttes, a low craggy ridge between U.S. Highway 395 and Mono Craters; till also exposed in Mono Craters tunnel.

Aetna[1]

Permian: Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 353.

Named from Aetna, Barber County, Kans.

Afono Trachyte

Pleistocene(?): Samoa Island (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub, 340, p. 108, 129–130. Trachyte plug and associated trachyte dike. Pioa rhyolite, Matafao, Papatele, Afono, and Vatia trachytes were erupted contemporaneously or nearly so.

H. T. Stearns, 1944, Geol. Soc. American Bull., v. 55, no. 11, p. 1285–1286 (table 1), 1305. Afono trachyte plug associated with Pago volcanics (new). Pliocene and early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 150. Pleistocene(?).

Forms 200-meter cliff on east side of Afono Bay.

Afton Beds

Middle Devonian: Northeastern Michigan.

[G. M. Ehlers], 1938, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 8th Ann. Field Excursion, [fig. 2] after p. 8. Shown on columnar section as underlying Marvin Quarry bed (new) and overlying Black Killians bed [Killians limestone].

W. A. Kelly, 1940, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion, [p. 1, figs. 3, 4, 6, and 7], maps 1 and 2. Shown on columnar section as limestone beds. Thickness about 29 feet. Upper half of section at Afton cannot be definitely correlated with section near Lake Huron, and provisional names Afton beds, Marvin beds, and Beebe beds are used in place of Alpena, Norway Point, Potter Farm, Partridge Point, and Squaw Bay, employment of which would imply stricter correlation than is justified.

Present in Black Lake-Afton area.

Afton Limestone Member (of Wellington Formation)

Permian: Southeastern Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 4, 10–11. Claystones, green and red shales and clays at top of formation. Claystones at the top of the member carry copper carbonate flakes and nodules. Underlies typical Harper red beds; overlies Slate Creek limestone member (new).

Type locality: Afton Township 28 S., R. 3 W., Sedgwick County.

Aftonian Interglaciation

Aftonian Age, Stage

Aftonian stage of deglaciation[1]

Pleistocene: Iowa, Illinois, Kansas, and Nebraska.

Original reference: T. C. Chamberlain, 1895, Jour. Geology, v. 3, no. 3, p. 272–277.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99. Discussion of Pleistocene of Kansas. Aftonian age (stage), second time unit in Pleistocene, is an interglacial interval. Follows Nebraskan age (stage) and precedes Kansan age (stage).

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 128–130. Aftonian stage represented in this area—Beardstown, Glasford, Havana, and Vermont quadrangles—by brown leached gravel, of early Aftonian or possibly Nebraskan age, and noncalcareous silt with wood, probably of early or middle Aftonian age.

Name amended to Aftonian Interglaciation to comply with Stratigraphic Code adopted 1961.

Name derived from exposures between Afton and Thayer, southwestern Iowa.

Agamenticus Complex[1]

Devonian(?) or Mississippian(?): Southwestern Maine.

Original reference: Alfred Wandke, 1922, Am. Jour. Sci., 5th ser., v. 4, p. 149, 152–154.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 104. Age given as Mississippian(?).

Occurs on slopes of Mount Agamenticus, York County.

Agamok Sediments

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1615. Name applied to beds that have not been correlated successfully with any of the other 19 units of Knife Lake series described in this report. It seems these sediments were among earlier ones to form. They could antedate Knife Lake series if it were not for fact that some pebbles of Saganaga granite are found in conglomerate layers which are interstratified with slates and graywackes in NE¼ sec. 30, T. 65 N., R. 5 W. Sediments form a synclinorium which strikes about S. 60° E. between Ogishkemuncie and Gabimichigami Lakes.

Report covers belt in eastern Vermilion district more or less parallel to international boundary.

Agate Bay Group[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 143–146, pl. 14.

Exposed on Agate Bay, northeast of Duluth, St. Louis County.

Agathla Sandstone[1]

Lower Triassic: Northeastern Arizona and southeastern Utah.

Original references: D. Hager, 1924, Min. and Oil Bull., v. 10, no. 2, p. 137; no. 4, p. 383–384, 423, 437.

Near Agathla Peak, northern part of Navajo County, northeastern Arizona.

Agathla Shale[1]

Lower Triassic: Northeastern Arizona and southeastern Utah.

Original references: D. Hager, 1924, Min. and Oil Bull., v. 10, no. 2, p. 137; no. 4, p. 383–384, 423, 437.

Near Agathla Peak, northern part of Navajo County, northeastern Arizona.

Agattu Beds

Cretaceous or Tertiary: Southwestern Alaska.

R. P. Sharp, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1197; 1946, Jour. Geology, v. 54, no. 3, p. 193–199. Name applied to well-bedded sedimentary strata occurring on Agattu Island. Consist chiefly of amorphous silica and fine detritus derived from a volcanic terrain. Beds are gently tilted, faulted, and possibly folded. Thickness at least 2,000 feet. Deposits may be as old as Cretaceous but are more probably Tertiary.

Exposed on Agattu, Aleutian Islands.

†Agawa Iron-Formation Member (of Knife Lake Slate)[1]

Precambrian (Knife Lake Series): Northeastern Minnesota, and western Ontario, Canada.

Original reference: J. M. Clements, 1903, U.S. Geol. Survey Mon. 45.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1616; F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1035–1036. Suggests that term Agawa formation be dropped. In area of this report [Knife Lake region to northwestern Minnesota], Knife Lake series consists of 10 to 20 recognizable members. Agawa iron formation as described by Clements (1903) may not exist as a formation at all. It does not occur at a definite horizon in the series, and except on Lake Agawa it is never more than a very few feet thick. Some of Agawa formation of older surveys is really a replacement.

Named for exposures on shores of Agawa Lake, Ontario, 1½ miles north of international boundary.

Agawan Gypsum Bed (in Marlow Formation)

Permian: Southwestern Oklahoma.

C. C. Branson, 1954, Shale Shaker, v. 4, no. 6, p. 7. A thin white gypsum bed in the Marlow.

Occurs only in Grady and Stephens Counties.

Agency Shale Member (of Pierre Shale)

Agency Shale zone (in Sully Member of Pierre Formation)

Upper Cretaceous: North-central South Dakota.

W. L. Russell, 1930, South Dakota Geol. and Nat. History Survey Rept. Inv. 7, p. 5. Hard fissile very light gray shale defined as basal member of Pierre shale. Exposed thickness about 120 feet.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 8, 18, 19, 22–23, pls. 2, 3. Rank reduced to zone in Sully member (new) of Pierre formation.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 10), 2341, 2343. Abandoned. Agency-Oacoma zone redefined and included in DeGrey member (new) of the Pierre shale.

Named from Cheyenne River Agency where it is well exposed. Unit extends up Missouri River to within a few miles of mouth of Moreau River, down the Missouri below mouth of Cheyenne River, and some distance up Cheyenne River.

Agua Sandstone Member (of Santos Shale)[1]

Agua Sandstone Member (of Temblor Formation)

Miocene, lower: California.

Original reference: L. M. Clark and A. Clark, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 1, p. 137.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 8, pl. 1. Described in Bitterwater Creek area, where it is treated as basal member of Temblor formation. Consists of gray to buff fine- to medium-grained friable sandstone with abundant fragments of pectens. Thickness as much as 48 feet. Unconformably overlies Point of Rocks sandstone; overlapped by upper Santos shale.

Traceable from vicinity of Carneros Creek to mouth of Cedar Canyon, several miles northwest, Temblor Range, Kern County.

Agua Caliente Gabbro

Precambrian (Keweenawan?): Northern New Mexico.

Evan Just, 1937, New Mexico Bur. Mines Mineral Resources Bull. 13, p. 11, 25. Gabbroic rocks; not schistose. Suggests that they may be intrusive and of Keweenawan age.

Exposed on one of southern tributaries of Agua Caliente Creek, Picuris area.

Aguada Formation or **Limestone**

Miocene, lower: Puerto Rico.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85, 2 sheets. Proposed for transitional beds, approximately 75 meters thick, between underlying Río Guatemala group (new) and overlying Aymamón limestone (new). Consists essentially of interbedded hard pure limestone and softer chalky to marly limestone; from 1 to 10 meters of basal gravel, sand, and shale present where unit rests directly on Cretaceous rocks.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 33–34, pl. 2. In San Juan metropolitan district, consists predominantly of noncarbonate rocks; hence termed formation to allow for lithologic variation. Estimated thickness 325 feet; 62½ feet exposed in quarry near Bayamón hospital. There is some question whether formational name Aguada is correctly applied to these beds. From lithologic standpoint, they resemble noncarbonate clastic subdivisions of late Oligocene Río Guatemala group which, according to Zapp and others (1948), does not occur in San Juan area. Because no paleontologic study was made of middle Tertiary section of San Juan area in preparation of this report, formational assignment cannot be examined in light of age criteria.

W. H. Monroe, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B356, B358 (fig. 164.2). Oligocene and Miocene sequence in north-central Puerto Rico is (ascending) San Sebastian formation, Lares limestone, Cibao formation, Aguada limestone, and Aymamón limestone. Aguada, about 90 meters thick, consists of somewhat earthy limestone interbedded with chalk and marl.

Named from prominent exposures in vicinity of town of Aguada, near west coast of Island.

Aguadilla Limestone (in Arecibo Formation)

Miocene, lower: Puerto Rico.

C. J. Maury, 1919, Am. Jour. Sci., v. 48, no. 285, p. 214 (chart). Shown on correlation chart as subdivision of Arecibo formation above Lares limestone and below Quebradillas limestone. Upper Oligocene.

C. J. Maury, 1919, Science, v. 70, no. 1825, p. 609. Lower Miocene.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 315. Not distinguished in field and of doubtful stratigraphic value. Lower Miocene.

Aguadulce Formation

Pleistocene(?): Panama.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 258.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 322. Poorly defined name for surficial deposits. Pleistocene(?).

Occurs in Aguadulce Plain, Coclé Province.

Agua Fria[1] Formation (in Amador Group)

Middle or Upper Jurassic: East-central California.

Original reference: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283, 284. In Merced River section Agua Fria is uppermost formation in Amador group. Thickness 3,500 feet. Overlies Penon Blanco volcanics. Age of Amador group believed to be upper Middle to lower Upper Jurassic.

Occurs on Merced River and southward into Indian Gulch quadrangle.

Aguagua [Formation in Tapaliza Group or Member of Tapaliza Formation]

Aquaqua formation

Miocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 131–132, 134 (chart). Correlation chart shows Aquaqua formation above Arusa formation and below Tuira formation. Upper Oligocene and lower Miocene.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart), 241. Tapaliza can be divided into an upper or Miocene part and a lower or Oligocene part. These are known respectively as the Aguagua and the Arusa.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5 Amérique Latine, fasc. 2a, p. 322. Aguagua formation is undefined name for early Miocene fine-grained deposits. Age based on foraminifera.

In Darien area.

Aguanga Tonalite

Cretaceous: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 9 (table), pl. 1. Named on map legend in list of Cretaceous plutonics. Occurs below Lake Mountain tonalite and above San Marcos gabbro.

1956, California Dept. Public Works, Div. Water Resources Bull. 57, v. 1, pl. 13B; v. 2, p. B–21 (table B–1), B–34. Mapped in Santa Margarita

River watershed. Described as a biotite-rich quartz diorite. In plutonic sequence, occurs below Bonsall tonalite and above San Marcos gabbro.

Well exposed on north and south sides of Aguanga Valley and north of Lancaster Valley, Riverside County.

Aguas Buenas Limestone Member (of Fajardo Formation)

Aguas Buenas Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: D. R. Semmes, 1919, New York Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, v. 1, p. 64.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper(?) Cretaceous; however, text and other table headings do not qualify Upper Cretaceous.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 143. Assigned to member status in Fajardo formation. Contains rudistids and crinoid remains. Lies at base of formation and unconformably overlies nonstratified rocks of volcanic complex.

Named for occurrences near town of Aguas Buenas, San Juan district.

Agua Verde Shale Member (of Fayette Formation)

Eocene: Southern Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 269–270. Proposed for marine shales overlying Sanchez sandstone tongue. Shales are 150 feet thick, mostly gray green, and bentonitic but contain some red nonmarine beds in upper part. Underlies Villa Nueva sandstone member. In southern Zapata County, the shales appear to be overlapped by the Frio, or may, in part, grade into nonmarine shales that resemble Frio. Area in which Agua Verde shale crops out is limited, and beds are poorly exposed because of heavy overburden.

Named from Agua Verde ranchhouse on north line of Escobares quadrangle [Zapata County].

Agua Zarca Sandstone Member (of Chinle Formation)

Agua Zarca Sandstone Member (of Moenkopi Formation)

Upper Triassic: Northwestern New Mexico.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Consists of conglomeratic sandstone with occasional siltstone and silty shale. Underlies Salitral shale tongue (new); overlies Glorieta sandstone member of San Andres formation. From latitude of San Miguel Canyon, unit thins rapidly; in Mesa Poleo it is thin but recognizable.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Guidebook 2d Field Conf., p. 17. Age given as Lower Triassic. Type locality indicated.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 91, 92. Interpreted as basal sand member of Moenkopi. Thickness ranges from less than 70 feet to 150 feet across San Juan basin; Salitral member thickens westward in main body of Moenkopi at expense of underlying Agua Zarca.

Type locality: Agua Zarca Creek, Rio Arriba County.

Aguigan (Aguijan) Limestone

Pliocene or Pleistocene: Mariana Islands (Aguigan).

Risaburo Tayama and Yasushi Ota, 1940, Geomorphology, geology, and coral reefs of Aguijan Island: Tropical Industry Inst., Palau, South Sea Islands Bull. 6 [English translation in library of U.S. Geol. Survey, p. 16–17, 19 (chart)]; Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 55, table 4 [English translation in library of U.S. Geol. Survey, p. 66]. Gray well-bedded limestone. Unconformably underlies Mariana limestone. Pliocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 14–16. Age given as Pleistocene.

Occupies base of sea cliff on southern coast of island.

Aguila Sandstone

Upper Cretaceous: Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 19–20, pls. 2, 3. Massive light-brown medium-grained graywacke with closely spaced concretionary ledges and local thin conglomerate at top. Thickness at type locality 2,035 feet. Rests with apparent conformity upon Johnson Peak formation (new); at most places conformably underlies Serpiente sandstone (new); along south limb of Stoker Canyon syncline, where perhaps as much as 8,000 feet of Upper Cretaceous strata have been removed by erosion, Aguila is unconformably overlain by middle Eocene Avenal sandstone; locally underlies lower Eocene(?) beds.

Type locality: Stoker Canyon syncline, Orchard Peak area, Tent Hills quadrangle, Kern County. Named for Aguila Canyon on north limb of Stoker Canyon syncline.

Aguja Formation[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 271, 505, 506.

C. G. Moon, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 153, 170–173, pl. 1. Described in Agua Fria quadrangle. Consists primarily of sandstone and shale. Standstone yellowish gray, gray, and brown, fine grained; shales light to dark gray or almost black and blackish red; lignite and lignitic shales. Thickness, partial section, 101 feet. Underlies Terlingua beds; contact gradational. Wherever Aguja is overlain by Tertiary rocks, contact is distinctly marked by an unconformity which is angular in some localities and apparently disconformable in others.

Type locality: Sierra Aguja (Needle Peak), in the flat in front of Santa Helena fault scarp, 6 miles south of Terlingua, Brewster County.

Aguja sandstone

Precambrian (Protozoic): Northern Arizona.

C. R. Keyes, 1939, Pan-Am. Geologist, v. 71, no. 1, p. 69. Substitute title for the Protozoic Chiquito sandstone of the Grand Canyon.

Named for "The Needle," or Aguja, hillock at mouth of Little Colorado River, near entrance to Grand Canyon.

Ahearn Member (of Chadron Formation)

Oligocene, lower: Southwestern South Dakota.

John Clark, 1954, Carnegie Mus. Annals, v. 33, art. 11, p. 197. Designated as basal member of formation. Underlies Crazy Johnson member (new). Author previously described unit as "Lower Member" of Chadron.

Type locality: At standard section of Chadron formation in Big Badlands on south fork of Indian Creek, Pennington County, from sec. 34, T. 3 S., R. 12 E. to sec. 10, T. 4 S., R. 12 E. Name is that of a ranch formerly at mouth of south fork of Indian Creek.

Ahern Quartzite

See **Ahorn Quartzite.**

Ahlosa Member (of Caney Shale)

See Ahloso Member (of Caney Shale).

Ahloso Member (of Caney Shale)

Mississippian (Meramecian): South-central Oklahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 60–62, 70 (table 2). Name Ahlosa introduced for basal unit of Caney shale; commonly referred to as "Mayes" or "Ada Mayes." Consists of dark-gray fine-grained coarsely laminated to nearly massive calcareous shale. Thickness 25 to 190 feet. Underlies Delaware Creek member (new); overlies Welden limestone.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 5, 7, 21. Name emended to Ahloso. Type section designated. Thickness 49.2 feet.

Type section: Beds 10 to 18, measured section D, sec. 14, T. 2 S., R. 7 E., Johnston County. Name derived from village at junction of Highways 99 and 3, in sec. 14, T. 3 N., R. 6 E., about 3 miles southeast of Ada, Pontotoc County.

Ahorn Quartzite

Precambrian (Belt Series): Northwestern Montana.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 211, 213 (table 1), 217–218. Composed of two sharply demarcated units, a lower pink quartzite about 1,700 feet thick and an upper green and red argillite 400 feet thick. Because upper part of formation has been greatly eroded, thickness varies considerably within relatively short distances. Unconformably underlies Flathead formation; overlies Hoadley formation (new). Miller Peak argillite, Cayuse formation (new), Hoadley formation, and Ahorn quartzite are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931) in Sapphire and Garnet Ranges.

Present in Saypo and Silvertip quadrangles. Named from Ahorn Creek in southeastern corner of Silvertip quadrangle where headward part of creek is incised in these rocks.

Ahtell Diorite[1]

Carboniferous: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 38, map.

Composes hills drained by west tributaries of Ahtell Creek.

Aibonito Conglomerate[1]

Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

†Aiken Beds[1]

Upper Cretaceous and Pliocene(?): Western South Carolina.

Original reference: E. Sloan, 1904, South Carolina Geol. Survey, ser. 4, Bull. 1, p. 72.

Exposed at Aiken, Aiken County.

Aimeliik Formation

Aimiriiki Agglomerate

See Aimiliiki Agglomerate or Conglomerate.

Aimiliiki (Aimiriiki) Agglomerate or Formation

Eocene, upper: Caroline Islands (Babelthuap).

Risaburo Tayama and Misaburo Shimakura, 1937, On the coal of Babelthuap Island, Palau group. Geol Soc. Japan Jour., v. 44, no. 6, p. 526 [English translation in library of U.S. Geol. Survey, p. 1]. Aimiliiki listed in stratigraphic succession on Babelthuap. Below lignite-bearing beds and above Galdog beds.

Risaburo Tayama, 1939, Brief report on the geology and ore resources of Babelthuap Island (Palau Island proper): Tropical Industry Inst., Palau South Sea Islands Bull. 3 [English translation in library of U.S. Geol. Survey, p. 8–9]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 65, table 4 [English translation in library of U.S. Geol. Survey, p. 77]. Older than Almongui agglomerate and younger than Ngardok beds. Agglomeratelike tuff; contains fragments of amygdaloidal andesite, shale, and limestone in lower part.

S. Hanzawa *in* J. Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 16. Conformably and locally unconformably underlain by Ngardok (Galdog) formation and probably unconformably overlain by Ngaremlengui (Almonogui) agglomerate. Upper Eocene.

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 40–45, pls. 4, 8, 9. Aimeliik formation consists of andesitic basaltic volcanic breccias, tuff breccias, and tuff. Divided into older Ngarsul member and younger Ngardok member. Thickness may be more than 2,000 feet. Overlies Babelthuap formation; underlies Ngeremlengui formation. Eocene.

Type locality: Aimelik, Babelthuap Island.

Ainoni Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 76. Nepheline basalt flow about 100 feet thick, and associated cinder cone. Eruption probably occurred simultaneously with that of Maunawili volcanics. Distribution noted.

Named for Ainoni Spring, which issues from east margin of flow. Flow is 0.75 mile long and 0.5 mile wide; lies on northeast side of Koolau Range about 8 miles northwest of Makapuu Head.

Ainsworth Formation[1]

Upper Cretaceous: Southwestern South Dakota and northwestern Nebraska.

Original reference: F. Ward, 1922, South Dakota Geol. and Nat. History Survey Bull. 11.

First described in southeastern part of Pennington County and southwestern part of Jackson County, S. Dak.

Airai Clay or Formation

Airai Lignite Bearing Beds

Miocene and Pliocene: Caroline Islands (Babelthuap).

Risaburo Tayama, 1939, Brief report on the geology and ore resources of Babelthuap (Palau Island proper): Tropical Industry Inst., Palau, South Sea Island Bull. 3 [English translation in library of U.S. Geol. Survey, p. 6–7, 17]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull. v. 11, p. 66, table 4 [English translation in library of U.S. Geol. Survey, p. 78–79]. Referred to as lignite-bearing beds containing carbonaceous clay, sand and gravel, and brown lignite. Thickness on Palau proper, less than 40 meters. Resembles Talofofo peat-bearing beds on Guam. Older than Palau limestone; younger than Alumongui agglomerate. Pliocene.

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 39 (table 5), 52–55, pls. 4, 8, 9. Airai clay or formation probably has maximum thickness of 150 feet, but beds rest on irregular base. Assigned to Miocene and Pliocene, but exact age not certain. Probably equivalent to lower beds of Palau limestone at some localities, although not lowermost beds of Palau.

Named for deposits north of Goikul, in Airai municipality.

Air Point Granite[1]

Precambrian: Southwestern Virginia.

Original reference: A. I. Jonas, 1933, Geol. Soc. America Bull., v. 44, p. 29–30.

Edward Steidtmann, 1945, Virginia Geol. Survey Bull. 64, p. 26, 27–28. Mentioned in discussion of commercial granites in Virginia.

Named for Air Point on Bent Mountain, Roanoke County.

Aitkin Formation[1]

Precambrian (upper Huronian): Central Minnesota.

Original reference: C. Zapffe, 1930, Lake Superior Min. Inst. Proc., v. 28, p. 101–106.

Underlies large area in northern and eastern parts of Aitkin County and extends into Crow Wing and Cass Counties.

Ajax Dolomite

Ajax Limestone[1]

Upper Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 9, 11 (fig. 3). Limestone described in East Tintic Mountains. Subdivided into

three members: lower, 90 to 100 feet thick, chiefly medium- to coarse-grained medium- to dark-blue-gray faintly mottled dolomite which encloses pods and short lenses of black and brown chert; Emerald dolomite member, about 30 feet; upper, averaging about 450 feet, chiefly dolomite with thin-bedded argillaceous dolomite at top. Conformably overlies Opex formation; conformably underlies Opohonga limestone.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 25–26, 28 (fig. 4). Limestone described in Stansbury Mountains where it is 750 to 900 feet thick. Overlies Dunderberg shale and underlies Garden City formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 57, pls. 1, 17. Described in Sheeprock Mountains where it is entirely dolomite. Thickness in West Lookout Hills 1,012 feet. Includes Emerald member, 150 feet thick, near middle. Underlies House limestone; overlies Opex formation.

Named for Ajax mine, one-fourth mile east of Mammoth, Tintic district.

†Ajax Quartzite[1]

Middle Cambrian: Southeastern Arizona.

Original reference: J. A. Church, 1903, Am. Inst. Mining Engineers Trans., v. 33, p. 3–37.

In Tombstone district.

Ajibik Quartzite[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 540.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1436 (table 1), 1461. Palmer gneiss, previously considered pre-Huronian, consists of metamorphic Mesnard quartzite, Koma dolomite, Wewe slate, and Ajibik quartzite. Table 1 shows middle Huronian sequence in Marquette area (ascending): Ajibik quartzite, Siamo slate, and Negaunee iron-formation.

W. T. Stuart, E. A. Brown, and E. C. Rhodehamel, 1954, Michigan Dept. Conserv., Geol. Survey Div. Tech. Rept. 3, p. 11 (table 3). Thickness 700 to 900 feet in Marquette district. Underlies Siamo slate. Overlies Wewe slate; unconformity. Middle Huronian.

Typical exposures on Ajibik Hills northeast of Palmer.

Ajo Volcanics

Tertiary, middle(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 43–45, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 39–40. Biotite and hornblende andesite tuffs and breccias, passing upward into flows. Unconformably underlies Sneed andesite (new); interfingers with underlying Locomotive fanglomerate (new). Thickness 3,500 to 5,000 feet.

Ajo quadrangle, Pima County. Caps Ajo Peaks; makes up hills west and southwest of Ajo Peaks and extends for about 3 miles in low range of hills southeastward from peaks.

†Akins Shale Member[1] (of Winslow Formation)

Pennsylvanian: Central eastern Oklahoma.

Original reference: J. A. Taff, 1905, U.S. Geol. Survey Geol. Atlas, Folio 122.

Named for Akins, Sequoyah County.

Akron Dolomite[1]

Upper Silurian: Western New York and Ontario, Canada.

Original reference: A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 544, 550.

Winifred Goldring, 1946, New York State Mus. Bull. 332, p. 129. Dolomitic phase of Cobleskill limestone in Erie County.

D. W. Fisher, 1959, New York State Mus. Sci. Services Geol. Map and Chart Ser. 1. Shown on correlation chart above Williamsville waterlime of Bertie group.

Named for exposures in village of Akron, Erie County, N.Y.

†Alabama White Limestone[1]

Tertiary: Alabama.

Original reference: T. L. Casey, 1902, Philadelphia Acad. Nat. Sci. Proc., v. 53, p. 513.

Exposed on Tombigbee River near St. Stephens and on Alabama River near Claiborne, Monroe County.

Alabaster Gypsum Member (of Blaine Formation)

Permian: Oklahoma.

Sherwood Buckstaff, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 434–435. A fifth gypsum bed, called by field men the "alabaster" or "rock-crusher" gypsum, and lying between the Shimer and Medicine Lodge members of the Blaine as defined by Evans (1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 409–412), is present in Blaine County. Probably not present in area discussed by Evans, but should be considered in any complete revision of Blaine nomenclature.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1468. Name applied to gypsum bed in Blaine formation; occurs above Medicine Lodge member and below Shimer gypsum member. Thickness 3 feet.

Occurs northwest of El Reno in Canadian County.

Alachua Formation[1]

Pliocene: Northern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 127–130, 157, 320.

H. E. Wood, 2d, and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 13, pl. 1. Hemphillian.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 189–208. As described in Citrus and Levy Counties, Alachua includes terrestrial deposits of diverse lithology, but is composed largely of clays, fine sands, and a basal rubble of phosphate rock, silicified wood, clay beds, and silicified Suwannee and Ocala limestone residuum. Sediments rest on bedrock of limestone ranging in age from middle Eocene to Oligocene, except in Citrus County where they interfinger with, and, in part, lie upon

Hawthorn formation. Unconformably overlain by fine to medium quartz sand containing no phosphate and believed to be early Pleistocene in age. Undetermined phosphate clay mineral forms matrix for much of fine sand and phosphate rubble, and Alachua formation is characterized by presence of this mineral and by fairly numerous specimens of vertebrate remains contained in sinks and depressions. These vertebrates range in age from lower Miocene into Pleistocene, and sediments of formation may have accumulated not only throughout Miocene epoch but also during period extending into Pleistocene. No stratigraphic relationships were determined during identification of vertebrate fossils, and presence of Pliocene and Pleistocene fossils may represent contamination by entrapment of these animals during epochs following Miocene, Maximum thickness about 66 feet.

H. S. Puri and R. O. Vernon, 1956, (abs.) Jour. Paleontology, v. 30, no. 4, p. 1000. Facies in Hawthorn facies of Alum Bluff stage.

K. B. Ketner and L. J. McGreevy, 1960, U.S. Geol. Survey Bull. 1074–C, p. 59–62. Lower Miocene strata commonly included in Alachua formation of Sellards (1914, Florida Geol. Survey 6th Ann. Rept.) are included in Tampa limestone. Simpson (1930, Am. Mus. Nat. History Bull., v. 59), who considered type locality of Alachua to be in vicinity of Williston, reviewed evidence to determine age of formation. He studied vertebrate fossils, which were collected from clay of Alachua on Mixson farm and from largely unknown stratigraphic positions in several hard-rock phosphate mines north of area. He concluded that Alachua is late Miocene or early Pliocene in age. Cooke (1945, Florida Geol. Survey Bull. 29), on basis of same fauna, designated age as middle Pliocene. Authors of present report believe that term Alachua should be used only in its original sense; that is, for clay deposits which Simpson designated to be of late Miocene or early Pliocene age, typified by those on Mixson farm.

Named for its many exposures in Alachua County.

Aladdin Sandstone

Middle Ordovician: Eastern Wyoming and western South Dakota.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 45 (chart), 46–47. Quartzose-type sandstone which is occasionally calcareous. Commonly 25 to 30 feet thick. Conformably underlies Ice Box shale (new); conformably overlies Deadwood formation.

Type section: Bear Lodge Mountains, Crook County, Wyo., in sec. 14, T. 52 N., R. 63 W. Formation crops out on southern flank of Sheep Mountain, where it is exposed by faulting. Name taken from town of Aladdin, Wyo.

Alajuela Formation

See **Alhajuela Sandstone Member** (of Caimito formation).

Alameda Formation[1]

Pleistocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, **Folio 193.**

D. H. Radbruch, 1957, U.S. Geol. Survey Misc. Inv. Map I–239. Overlain by Temescal formation, Merritt sand, or Bay mud. Maximum known thickness 1,050 feet (south of Oakland West quadrangle).

Named for fact that it is well developed at Alameda, San Francisco region.

Alamito shale[1].

Pennsylvanian: New Mexico.

Original reference: C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 22. Keyes proposed to divide Pennsylvanian into two (or possibly three) series which he called Ladronesian below and Manzanan above. He listed term Alamito under Ladronesian. He did not give source or definition of any of his terms. Terms introduced by Keyes are not considered established and are not used in present report.

Alamo Formation

Pliocene, lower: Northern California.

A. S. Huey, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 335. Incidental mention.

Carlton Condit, 1938, Carnegie Inst. Washington Pub. 476, p. 224, 228. Underlies Orinda formation; overlies Neroly formation. Southwest side of Mount Diablo.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1957. Underlies newly defined Green Valley formation (previously referred to as Orinda).

B. L. Clark *in* C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. Abandoned; formation renamed Diablo.

G. D. Louderback, 1951, California Div. Mines Bull. 154, p. 76. Mentioned as 1,000 feet of marine beds deposited above Neroly beds during lower Pliocene.

Occurs in Tesla quadrangle located about 40 miles southeast of Berkeley.

Alamogordo Member (of Lake Valley Formation)

Mississippian (Osage): Southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1941, (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73, 74 (strat.. column); 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 12, p. 2114–2116, 2118–2119 (figs. 5, 6), 2125–2133. Defined as basal member of Lake Valley formation. Consists normally of four distinct facies: siltstone at base, overlain by hard cherty limestone, overlain by soft blue-gray marl, and capped with gray thin-bedded crinoidal limestone. Member is complicated by large crinoidal bioherms; bioherm facies consists of rounded dome-shaped masses of black relatively unfossiliferous almost featureless limestone. Thickness 130 feet. Underlies Arcente member (new); unconformably overlies Caballero formation (new).

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 13, 26, 27 (fig. 13). As originally defined Alamogordo included beds here designated as Andrecito, Nunn, and Tierra Blanca. Alamogordo is here restricted to massive black very cherty poorly fossiliferous cliff-forming limestone beds above thin-bedded Andrecito member and below blue-gray crinoidal marls of Nunn member. Thickness averages from 30 to 50 feet and is fairly constant. Alamogordo (restricted) makes conspicuous scarp along front of Sacramento Mountains.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 74 (fig. 9), 83, 84 (fig. 10). Geographically extended to Caballo Mountain area where it is shown as overlying Percha shale.

Type area: Deadman Canyon, sec. 3, T. 17 S., R. 10 E., near Alamogordo, Otero County.

Alamosa Formation[1]

Pliocene, upper, or Pleistocene, lower: Central southern Colorado.

Original references: C. E. Siebenthal, 1910, Science, new ser., v. 31, p. 745; U.S. Geol. Survey Water-Supply Paper 240, p. 40.

W. J. Powell, 1958, U.S. Geol. Survey Water-Supply Paper 1379, p. 20–24. Underlies large part of San Luis Valley but is well exposed only in southern part, where Rio Grande and its tributaries have cut into upper part of formation. Thickness 41½ feet at Hansen Bluff on east bank of Rio Grande southeast of Alamosa. Recent deposits overlie Alamosa, but similarity of materials make it difficult to determine contact between the two; in this report, Recent materials are included in Alamosa except in some well logs. Most reliable data on formation comes from well logs.

Named for Alamosa, Conejos County, near center of San Luis Valley.

Alapah Limestone (in Lisburne Group)

Upper Mississippian: Northern Alaska.

A. L. Bowsher and J. T. Dutro, Jr., 1957, U.S. Geol. Prof. Paper 303–A, p. 4, 6, 25–34, figs. 2–4, pl. 2. Forms upper part of Lisburne group. Comprises nine unnamed members at type locality (ascending): shaly limestone, 85 feet thick; dark limestone, 175 feet; platy limestone, 187 feet; banded limestone, 210 feet; black chert-shale, 38 feet; light-gray limestone, 46 feet; fine-grained limestone, 80 feet; chert-nodule member, 80 feet; and upper limestone, 70 feet. Total thicknss 970 feet. Disconformably overlies Wachsmuth limestone (new).

Type locality: On northern part of Mount Wachsmuth, Shainin Lake area, central Brooks Range. Named from Alapah Creek, which flows into south end of Shainin Lake.

Alapah Mountain Glaciation

Pleistocene (late Wisconsin): Northern Alaska.

R. L. Detterman, A. L. Bowsher, and J. T. Dutro, Jr., 1958, Arctic, v. 11, no. 1, p. 45, 54–57, 60 (table 1), figs. 2, 3. Six glacial advances recognized in northern Brooks Range and on Arctic Slope. Alapah Mountain preceded by Echooka and Itkillik glaciations and succeeded by Fan Mountain glaciation (new). Deposits largely remnants of unsorted drift composed of limestone, sandstone, and shale fragments derived from nearby cirques. Morainal areas contain kettle lakes, and consequent drainage has undergone little or no modification.

Morainal remnants found in pass between Anaktuvuk River and Ernie Creek 16 miles south of Shainin Lake, these deposits having been formed at snouts of glaciers originating on slopes of Alapah Mountain, Arctic slope of Brooks Range.

Alaska Bench Limestone[1] (in Big Snowy Group)

Alaska Bench Limestone Member (of Amsden Formation)

Mississippian or Pennsylvanian: Central Montana.

Original reference: O. W. Freeman, 1922, Eng. and Min. Jour.-Press, v. 113, no. 19, p. 826–827.

P. A. Mundt, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1925–1929. Limestone is light to dark brown and gray, with dull purplish red mottlings. Where exposed, commonly weathers to shades of pink, red, and gray; weathered Alaska Bench limestone superficially resembles unweathered carbonate rocks of Amsden formation. Many workers have assigned both limestone and overlying dolomite to Amsden, and this is common usage among Montana geologists. Thickness along

Durfee Creek, Fergus County, 201 feet. Underlies Amsden formation; overlies and is gradational with Tyler formation.

H. D. Hadley and P. J. Lewis, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 142, 143. Overlies Cameron Creek formation and underlies Devils Pocket formation (both new).

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 332 (fig. 2), 334 (fig. 3), 338–339, 347. Included in Big Snowy group. Alaska Bench limestone, as used in this report, includes not only massive limestone sequence recognized by Freeman but also similar and closely related overlying beds of limestone and dolomite that are missing from type area but that are exposed on south flank of Big Snowy Mountains. Freeman gave no specific measured section for formation but implied that Beacon Hill, sec. 6, T. 12 N., R. 20 E., should be type locality. On Alaska Bench and throughout most of Fergus County, all overlying strata and much of Alaska Bench limestone itself have been removed by erosion; only known complete surface sections are in vicinity of Stonehouse Ranch on south slope of Big Snowy Mountains and at Durfee Creek. Overlies Cameron Creek formation; underlies Devils Pocket formation.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1963. Reallocated to member status in Amsden formation (restricted). Underlies unnamed dolomite member; overlies Cameron Creek member of Tyler formation.

Well exposed on top of Alaska Bench, east of the Snowies. Forms series of hogbacks and sloping benches around Big Snowy Mountains.

Alaskan Glaciation

Recent: Alaska.

T. N. V. Karlstrom, 1957, Sci., v. 125, no. 3237, p. 74. Named on correlation chart of Alaskan glacial sequences. Younger than Naptowne glaciation.

T. N. V. Karlstrom, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B331 (fig. 153.1). Table shows Alaskan glaciation as Recent. Includes Tustumena and Tunnel advances.

Report discusses Cook Inlet area.

Albanian series[1]

Permian: North-central Texas.

Original references: C. R. Keyes, Pan-Am. Geologist, 1933 v. 57, p. 350, 351; 1933, v. 59, p. 144, 146.

Albany Clay[1]

Pleistocene: Eastern New York and western Vermont.

Original reference: E. Emmons, 1846, New York Nat. History, Agric., v. 1, p. 202–204.

G. H. Chadwick, 1944, New York Mus. Bull. 336, p. 196 (fig. 72). Varved clays in part of Cats Kill delta in Lake Albany.

Well developed at Albany, N.Y.

Albany Conglomerate[1]

Lower Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 107–110.

In Orleans County.

†Albany Formation[1]

Permian: Northern Texas and southwestern Oklahoma.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lxvii.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677. Incidental mention in discussion of Wolfcamp series equivalents.

Well developed in vicinity of Albany, Shackelford County, Tex.

Albany Granite[1]

Upper Devonian or Upper Carboniferous: Northern New Hampshire.

Original references: C. H. Hitchcock, 1874, Geology of New Hampshire, pt. 1, p. 508–545; 1877, pt. 2, p. 143.

In northern part of Carroll County.

Albany Porphyritic Nordmarkite[1]

Devonian(?): New Hampshire.

Original reference: L. Kingsley, 1931, Am. Jour. Sci., 5th, v. 22, p. 143.

Albany Porphyritic Quartz Syenite (in White Mountain Plutonic-Volcanic Series)

Albany Quartz Syenite[1]

Mississippian(?): New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, Summer Mag. No., p. 73.

Alonzo Quinn, 1941, Geology of the Winnipesaukee quadrangle, New Hampshire: New Hampshire State Plan. and Devel. Comm., p. 14, geol. map. Albany porphyritic quartz syenite mapped in Winnipesaukee quadrangle. Included in White Mountain magma series. Probably Carboniferous.

Alonzo Quinn, 1953, Geology of the Wolfeboro quadrangle, New Hampshire: New Hampshire State Plan. and Devel. Comm., p. 13, geol. map. Mapped in northwestern part of Wolfeboro quadrangle. Intrudes Moat volcanics. Mississippian.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in the White Mountain plutonic-volcanic series of Mississippian(?) age.

Town of Albany is in Carroll County.

Albany and Boston Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 25–27, 80, 81, 85, chart.

Named for occurrence in Albany and Boston mine, Houghton County.

†Albany and Boston Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 53–57, 61, 81, 84, 85, chart.

Named for occurrence in Albany and Boston mine, Houghton County.

Albee Formation[1]

Ordovician: Northwestern New Hampshire and eastern Vermont.

Original reference: M. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

M. P. Billings, 1937, Geol Soc. America Bull., v. 48, no. 4, p. 472–475, pl. 1. Four belts of Albee formation cross area [Littleton-Moosilauke], one near Gardner Mountain (Littleton quadrangle), second near Towns Mountain (Littleton quadrangle), third near village of Littleton, and fourth near villages of Lisbon and Bath. Thickness about 4,000 feet. Base not exposed in area. Not everywhere possible to establish precise boundary between Albee and overlying Ammonoosuc volcanics. Probably Upper Devonian.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. In Grafton County, includes Piermont member (new). Thickness about 5,000 feet. Ordovician.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 17. Geographically extended into Orange County, Vt. Two narrow tongues of formation extend on either side of Orfordville formation just south of village of Bradford.

D. J. Melton, 1960, New England Intercollegiate Geol. Assoc. Guidebook 52d Ann. Mtg., p. 25. Stratigraphic nomenclature developed by Billings and his coworkers in New Hampshire is, in general, valid in Speck Mountain quadrangle, Maine, but is used here only in an informal sense. Oldest formation is Albee considered to be of Ordovician age.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pl. 3. Shown on correlation chart as Middle Ordovician.

Type locality: That part of Gardner Mountain which lies between Hunt Mountain (just southwest of Littleton quadrangle) and Albee Hill in Littleton quadrangle, New Hampshire.

Alberhill Clay[1]

Eocene: Southern California.

Original reference: P. H. Dudley, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 223.

P. H. Dudley, 1936, Geol. Soc. America Bull., v. 47, no. 3, p. 361. Clays include marine, lacustrine, and residual facies. Shown on table as underlying San Jacinto sediments and overlying late Jurassic(?) Cajalco quartz monzonite.

Occurs in area between towns of Riverside, San Jacinto, Corona, and Elsinore.

Albertan System

Middle Cambrian: Western North America.

A. W. Grabau, 1921, A text book of geology, pt. 2, Historical geology; New York, D. C. Heath & Co., p. 243 (footnote). Author states he proposed name Albertan for Middle Cambrian of Pacific Province in his "Geology of the Non-Metallic Mineral Deposits other than Silicates," v. 2, chapter 21, 1920. [Apparently this was never published.]

A. W. Grabau, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 24. Restricted to western North America where Cambrian (old Middle Cambrian) has its greatest development.

Albin shale[1]

Upper Cambrian: Northeastern Iowa.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 319, 326.

Named for fine exposures at Albin, Allamakee County.

Albion Formation or Shale

Mississippian (Meramecian): Southeastern Oklahoma.

B. H. Harlton, 1947, Tulsa Geol. Soc. Guidebook Field Trip, May 8, 9, and 10, p. 41. Basal section of Stanley is well exposed on east side of Black Knob Ridge in T. 1 S., R. 12 E., and along outer periphery of Potato Hills, especially in T. 2 N., R. 19 E. Gray to dark-gray fossiliferous siliceous shale bed, about 20 feet thick, is present near base. T. A. Hendricks contemplates using name Albion for this shale.

R. M. Becker, chm., 1954, Ardmore Geol. Soc. [Guidebook] Field Trip, October 1954, chart facing p. 1. Shown on chart as underlying Ten Mile Creek formation.

Albion Glacial Stage

Pleistocene (Wisconsin): North-central Colorado.

R. L. Ives, 1953, Geog. Review, v. 43, no. 2, p. 237–243, 249 (table). Time covered by deposition of Albion moraines. Younger than Pretty Meadow glacial stage (new).

Area: Silver Lake Valley at head of North Boulder Creek in Boulder County.

Albion Gravel[1]

Pleistocene: Central northern Iowa.

Original reference: S. W. Beyer, 1897, Iowa Geol. Survey, v. 7, p. 210, 231.

Albion, Marshall County.

Albion Group

Albion Sandstone[1]

Albion Series

Lower Silurian: Western New York and Ontario, Canada.

Original reference: E. O. Ulrich, 1913, Int. Geol. Cong. 12th, Canada, p. 26, 27, 30, 36, 39.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 15–26. Term Albion group, Medinan series, used in this report [Clyde and Sodus Bay quadrangles] in preference to Alexandria group. Term used to include Whirlpool sandstone, Manitoulin sandstones and shales, Cabot Head shale, and Grimsby sandstones and shales. Grimsby sandstone is oldest rock cropping out in area of report. There may be an equivalent age relationship between Albion group and Alexandria group. Overlies Richmond group.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Term Albion group used to include (ascending) Whirlpool sandstone, Manitoulin shale, Cabot Head shale (restricted), Grimsby sandstone, and Thorold sandstone. Occurs below Clinton group. Term Albion series used for lower part of Silurian below Niagaran series.

R. E. Griswold, 1951, New York Water Power and Control Comm. Bull. GW–29, p. 10–12. Only upper beds of Albion sandstone are exposed in Wayne County. These consist mainly of thick red layers of sandstone interbedded with a few layers of red sandy shale; pebbly layer present

locally. Thickness about 119 feet. Underlies Clinton formation of Niagara group.

J. J. Galloway, J. B. Patton, and T. G. Perry, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Term Albion series used on generalized stratigraphic column of Silurian rocks exposed in Jefferson and Switzerland Counties. Includes Medina group.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1983, 1984. Silurian of type section along Niagara Gorge is divided into three groups (ascending): Medinan, Clintonian, and Niagaran. Recommended that term Albion be suppressed.

Named for village of Albion, Orleans County, N.Y.

Albion Monzonite

Cretaceous(?): Eastern Colorado.

R. L. Ives, 1950, Sci. Monthly, v. 71, no. 2, p. 114. Albion monzonite of Colorado Front Range is substantially similar to Little Cottonwood monzonite in Little Cottonwood Canyon, Utah.

R. L. Ives, 1953, Geog. Rev., v. 43, p. 232 (fig. 3). Albion monzonite mapped in Silver Lake Valley.

Silver Lake Valley is at head of North Boulder Creek, Boulder County.

Albion Schist Member (of Westboro Quartzite)[1]

Precambrian(?): Eastern Rhode Island.

Original reference: B. K. Emerson and J. K. Perry, 1907, U.S. Geol. Survey Bull. 311, p. 8, 10–13, map.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Quad. Map [GQ–1]. Lens of schist 4,500 feet long and 400 feet thick lying within Westboro quartzite. Includes conglomerate beds that contain boulders as much as 10 feet in diameter.

Extends northwestward from village of Albion that it underlies.

Albion Range Group[1]

Precambrian(?): South-central Idaho.

Original reference: A. L. Anderson, 1934, Jour. Geology, v. 42, no. 4, p. 377–379.

C. P. Ross and J. D. Forrester, 1947, Geologic map of the State of Idaho (1:500,000): U.S. Geol. Survey. Age given as Precambrian(?).

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 3–4. Postulated Precambrian(?) beds in Cassia County were first named Harrison series by Anderson (1931) and later changed to Albion group by Anderson (1934). Consists mainly of quartzite, with some schist and marble. Thickness more than 9,000 feet. Anderson suggests correlation between his Albion Range group and Hyndman and East Fork formations on basis of lithologic similarity. Not correlated with Belt series.

Type locality not stated, but Albion Range is in Cassia County.

Albirupean Black Marl[1]

Upper Cretaceous: Maryland.

Original reference: P. R. Uhler, 1901, Maryland Acad. Sci. Trans., new ser., v. 1, p. 185–201.

†Albirupean Formation[1]

Upper Cretaceous: Eastern Maryland and Virginia.

Original reference: P. R. Uhler, 1888, Am. Phil. Soc. Proc., v. 25, p. 42, map.

Excellent sections on the Severn River, Md.

Alboroto Rhyolite (in Potosi Volcanic Group)

Alboroto Quartz Latite[1] or Group

Tertiary, middle or upper: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 36.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 93 (table 18), 132–143, pl. 1. Referred to as rhyolite. Described in detail in San Juan district. Lies between Sheep Mountain quartz latite (below) and Huerto quartz latite (above). Lower part chiefly tridymite rhyolite, 0 to 500 feet thick, which consists of widespread thin flows and associated tuff beds. Found chiefly near borders of mountains. Includes Campbell Mountain rhyolite, Willow Creek rhyolite, and probably Outlet Tunnel quartz latite [all included in Alboroto group] of Creede district. Upper part biotite-hornblende latitic rhyolite, 0 to 3,000 feet, makes up most of formation; includes Equity and Phoenix Park quartz latites [included in Alboroto group] in Creede district.

U.S. Geological Survey currently designates the age of the Alboroto Rhyolite or Group as middle or upper Tertiary on the basis of age change of Potosi Volcanics.

First described in Platoro-Summitville district.

Albright Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northeastern West Virginia and western Maryland.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Preston County, p. 140.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 120. Bloomfield limestone member of the Conemaugh was named by Stout (1918) in Muskingum County, Ohio. According to Waagé (1950, Maryland Dept. Geology, Mines and Water Resources Bull. 9), Hennen and Reger (1914) named an equivalent limestone in Preston County, W. Va., the Albright. Thus, Albright has precedence over Bloomfield. Recommended that term Albright replace term Bloomfield if and when positive correlation is determined.

Occurs at Albright, Preston County, W. Va.

Albuquerquan series[1]

Precambrian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geological formations of New Mexico, p. 4.

Exposed in the Tijeras Canyon, east of Albuquerque.

Albuquerque Marl[1]

Tertiary, upper: Central northern New Mexico.

Original reference: C. L. Herrick, 1898, Am. Geologist, v. 22, p. 26–43.

Kirk Bryan and F. T. McCann, 1937, Jour. Geology, v. 45, no. 8, p. 806. Mentioned in discussion of Santa Fe formation. Herrick recognized dis-

similarities between valley fill at Albuquerque and Santa Fe marls of Hayden (1869) and Cope (1874, U.S. Geol. and Geog. Survey W. 100th Mer. (Wheeler report), p. 115–130), but his attention was largely directed to caliche on the upland surface, which he regarded as lake deposit. His term Albuquerque marl applies strictly to the caliche.

Named for occurrence in Albuquerque region.

Albuquerque series[1]

See Rio Grande series.

Alcalde Shale (in Panoche Formation or Group)

Upper Cretaceous: Central western California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2), 991. Panoche group (or formation) is subdivided into 10 units. Alcalde shale is seventh in sequence (ascending). Underlies Joaquin Ridge sandstone (new); overlies Los Gatos sandstone. Assigned to Cachenian stage (new). Name credited to J. Q. Anderson.

Occurs in Alcalde Hills, Coalinga-Ortigalito area, San Joaquin Valley.

Alcova Limestone Member (of Chugwater Formation)[1]

Alcova Dolomite (in Chugwater Group)

Triassic: Central Wyoming.

Original reference: W. T. Lee, 1927, U.S. Geol. Survey Prof. Paper 149, p. 14.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 135. In Wind River basin, referred to as Alcova dolomite in Chugwater group. Overlies Red Peak formation; underlies Crow Mountain formation.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 17. Underlies Popo Agie member; overlies Red Peak member. Crow Mountain member not present in area of this report [central Wyoming]. Thickness ranges from wedge-edge to 15 feet.

T. C. Woodward, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 230, 231. In Deadman Butte area, Alcova member overlies Red Peak member and underlies Crow Mountain sandstone member (restricted usage). Thickness 6 to 10 feet.

G. N. Pipiringos, 1957, Wyoming Geol. Survey Bull. 47, p. 2, 9 (table 1), 13–15, pl. 5. Described in Laramie basin where it consists of about 11 feet of limestone, separated into beds 1 to 4 feet thick, colored gray black, purple to green brown, green gray and gray white; upper and lower parts sandy. Overlies main body of Chugwater; under lies Jelm formation (restricted). Contains mollusks of probable Early Triassic; may be Middle Triassic, but unlikely to be of Late Triassic age.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, p. 12. In this report [paleotectonic map of Triassic], Alcova member is assigned to interval C, which is approximately correlative with Upper Triassic series and with Karnian, Norian, and Rhaetian of Europe.

Named for occurrence near Alcova, Natrona County.

Alcyone Trachyte[1]

Teritary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 27, map.

Named for Alcyone mine.

Alden Limestone[1]

Mississippian: North-central Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52, 92, 99.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, 150. Also called Gilmore City limestone.

Named for exposures in south bank of Iowa River, just below wagon bridge at town of Alden, Hardin County.

Alden Limestone[1] (in Arbuckle Group)

Ordovician: Southern Oklahoma.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56. Included in Arbuckle group. Shown in list of formations for Arbuckle and Wichita Mountains section as underlying West Spring Creek formation and overlying Cool Creek limestone.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1313. Name Kindblade formation substituted for preoccupied name Alden.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Abandoned by Oklahoma Geological Survey.

Alder Group

Alder Formation

Alder Sedimentary Series (in Yavapai Group)

Precambrian (Yavapai Series): Central Arizona.

E. D. Wilson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 112; 1939, Geol. Soc. America Bull. v., 50, no. 7, p. 1118 (table 1), 1121–1123. Yavapai group is subdivided into Yaeger greenstone, Red Rock rhyolite, and Adler [Alder] sedimentary series (all new). Series consists of locally metamorphosed shale, grit, quartzite, and conglomerate; intensely folded and faulted. Exposed thickness unknown; appears to exceed 5,000 feet. All observed contacts with Yaeger greenstone (probably oldest in group) and Red Rock rhyolite are faults; hence relative age not definitely known, but character of rhyolite pebbles in its conglomerate suggests that Alder is younger than Red Rock.

Gordon Gastil, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1225; 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (tables 1 and 2), 1499–1500, pl. 1. Referred to as formation. Divided into three unnamed members (ascending): interbedded slate, wacke, quartzite, and conglomerate, thickness unknown, probably 4,000 feet or more; quartzite, 300 to 1,000 feet; slate, wacke, and conglomerate as much as 580 feet. In Diamond Butte quadrangle (this paper), conformably underlies Flying W formation (new); in fault contact with pre-Alder(?) rocks. Upper contact of formation, as here defined, is base of lowest cobble volcanic or volcanic strata. Wilson's Alder series includes up to 1,000 feet of cobble conglomerate. This portion of Alder series may be equivalent to part of Flying W formation. Correlation chart shows Wilson's Alder series stratigraphically above Yaeger greenstone and below Red Rock rhyolite.

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C. A. Anderson and C. S. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 9, 20–32, pl. 1. Wilson's Alder series modified to Alder group. Rocks divided into six formations, which fall into two classes: those of probable known stratigraphic succession and those of unknown stratigraphic succession. Former comprises three volcanic sequences (ascending): Indian Hills, Spud Mountain, and Iron King (all new); latter divided into Green Gulch volcanics, Chaparral volcanics, and Texas Gulch formation (all new). Thickness not known; appears to be 20,000 feet or more, and may be as much as 30,000. Separated from Ash Creek group (new) by Shylock fault; hence relative ages not certain.

Named for typical occurrence in vicinity of Alder Creek in central segment of Mazatzal Range, Jerome area. Crops out extensively in Mazatzal Mountains, eastern Tonto basin, Black Hills, and to small extent in Del Rio area.

Alder Creek Basalt

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 46–47. Contains conspicuous phenocrysts of augite. Has blocky to scoriaceous crust. Thickness 100 to 150 feet. Covers Butte Creek basalt (new).

Issued from fissure near top of precipitous north wall of Alder Creek Canyon and cascaded 1,700 feet to canyon floor, Macdoel quadrangle.

Alderson Limestone (in Greenbrier Limestone)[1]

Mississippian (Chesterian): Eastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 449, 462, 699.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Shown on correlation chart in Greenbrier series. Chesterian.

Type locality: On road toward Wolf Creek one-third mile south of Alderson, Monroe County, W. Va.

Alderton Formation or **Interglaciation**

Pleistocene: Northwestern Washington.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 389–391. Consists of alluvial and lacustrine sediments, peat, volcanic ash, and mudflows from Mount Rainier. Alluvial sediments, composed chiefly of andesite fragments, range from sand to pebble and cobble gravel. Lacustrine sediments are mostly silt and fine to medium sand. Volcanic ash occurs both as distinct layers and disseminated throughout formation. Mudflows, which occur at several horizons, range from less than 10 feet to several tens of feet in thickness and are lenticular in cross section. Exposed thickness at type section 52 feet; probable total thickness more than 130 feet. Considered to have been deposited during a nonglacial interval that followed Orting glaciation and preceded Stuck glaciation. Separated from overlying Stuck drift (new) by erosional unconformity.

Typically exposed in west wall of Puyallup-Duwamish Valley in gullies under transmission line of Bonneville Power Administration in center sec. 1, T. 19 N., R. 4 E., about half a mile southwest of Alderton, Pierce County.

†Aldrich Limestone[1]

Middle or Upper Cambrian: Central Alabama.

Original reference: H. McCalley, 1897, Alabama Geol. Survey Rept. on Coosa Valley, p. 41–42.

Near Aldrich, Shelby County.

Aldrich Station Formation (in Wassuk Group)

Miocene, upper, and Pliocene, lower: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 23–29, 63–64, figs. 2, 3, 4. Consists of six major lithologic units (ascending): sandstone, shale, conglomerate, and breccia—thickness 150 feet; siliceous shale—thickness 400 feet; sandstone and conglomerate—thickness 750 feet; siliceous shale—thickness 350 feet; diatomaceous shale—thickness 1,600 feet; and silt, sandstone, and pebble conglomerate—thickness 800 feet. Aggregate thickness 4,050 feet. Underlies Coal Valley formation with local unconformity; overlies older rocks with unconformity.

Type area named for Aldrich Station, an old stagecoach station which is now represented by a stone foundation on county road at north base of Aldrich Hill; this site lies near middle of formation. Crops out prominently near base of Wassuk Range 5 miles southeast of Morgan's ranch, where lower part forms conspicuous white knolls against base of the range, Hawthorne quadrangle.

Aldwell Formation

Eocene, middle to upper: Northwestern Washington.

R. D. Brown, Jr., H. D. Gower, and P. D. Snavely, Jr., 1960, U.S. Geol. Survey Oil and Gas Inv. Map OM–203. Named for a sequence of well-indurated greenish-gray to medium-olive-gray marine siltstone that overlies and interfingers with Crescent formation in south limb of Clallam syncline. At type locality, lentil of pillow lava and flow breccia about 350 feet thick occurs 1,000 feet above base of formation; similar lentils or tongues of lava present in formation in other parts of area. Thickness about 2,950 feet at type locality; less than 100 feet near western boundary of mapped area. Underlies and interfingers with Lyre formation. Foraminifera, together with stratigraphic position, establish age of formation as middle to early late Eocene.

Type section: Exposures along Lake Aldwell on Elwha River from point 700 feet south of NE cor. sec. 28, T. 30 N., R. 7 W., to point 1,600 feet east, 1,200 feet south of NW cor. sec. 22, T. 30 N., R. 7 W.

Alegria Formation

Oligocene (Refugian): Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 30–31, pls. 1, 2. Defined as marine facies of continental Sespe formation in Gaviota and Point Conception quadrangles. Consists of about 1,200 feet of sandstone and minor amount of siltstone lying conformably above Gaviota formation and disconformably below Vaqueros formation. Varies in lithology and thickness along strike. From Agua Caliente Canyon grades laterally eastward into nonmarine Sespe; red clays appear progressively lower until at Capitan Canyon they occur throughout section, which apparently is all nonmarine.

Type locality: Ridge east of Canada de Santa Anita, Santa Barbara County. Formation is developed only on south flank of Santa Ynez

Range between a point 4 miles north of Point Conception and Capitan Canyon.

Aleman Cherty Member (of Montoya Dolomite)

Aleman Formation (in Montoya Group)

Upper Ordovician: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 57, 60–62, figs. 2, 3; F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 25–26. Consists of alternating beds of chert and dolomite. Chert occurs as irregular bands 1 to 3 inches thick alternating with 1- to 6-inch bands of dolomite. Chert weathers white, brown, and black, and the dolomite light gray to medium gray. Thickness varies; about 200 feet in Organ Mountains. Thins to an edge northward owing to pre-Percha, pre-Lake Valley, and pre-Magdalena erosion. Underlies Cutter formation (new); overlies Upham dolomite (new).

U.S. Geological Survey currently classifies the Aleman as a member of Montoya Dolomite on basis of study now in progress.

Type locality: In Cable Canyon opposite Sierrite mine in NW¼ sec. 10, T. 16 S., R. 4 W. (Sierra County). Name taken from station along Santa Fe Railroad to east of the mountains in the Jornada del Muerto.

Aleuts Member (of Kialagvik Formation)

Lower Jurassic: Southwestern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1), 205–206. Lower 650 feet consists of dark-gray to black shale grading upward into gray shaly sandstone; upper 450 feet consists of interbedded sandstone, shale, and conglomerate, increasing in coarseness upward with several beds of conglomerate in upper 200 feet. Underlies Kolosh member (new); overlies Bidarka formation (new).

Occurs in vicinity of Wide Bay, south of Katmai National Monument, Alaska Peninsula.

Alexandria Syenite[1]

Precambrian: Northeastern New York.

Original reference: H. P. Cushing and others, 1910, New York State Mus. Bull. 145, p. 10, 39, map.

Named for Alexandria Township, west and north of Redwood.

Alexandrian Series[1]

Alexandrian Group

Lower Silurian: Mississippi Valley.

Original reference: T. E. Savage, 1908, Illinois Geol. Survey Bull. 8, p. 110.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Alexandrian group comprises (ascending) Girardeau limestone (Orchard Creek shale), Edgewood limestone, and Brassfield limestone. In Albion series.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1984. Discussion of stratigraphy of Medinan group in New York and Ontario. Recommended that terms Albion, Alexandrian, Anticostian, Cataract, and Power Glen be suppressed and discontinued in type area of "Early" Silurian.

U.S. Geological Survey uses term Alexandrian as provincial series comprising Lower Silurian in Missouri, Illinois, and Michigan.

Named for Alexander County, Ill.

Alferitz Formation

Miocene, middle (Luisian): Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Whitish to yellowish siltstone containing orange concretionary layers and occasional thin poorly sorted sands. Maximum thickness 700 feet. Unconformably underlies McLure shale; overlies Escudo sandstone (new).

Occurs in Devils Den oil field district in northwestern Kern County adjacent to Kings County line, about 40 miles from Paso Robles and about 60 miles northwest of Bakersfield.

Alfred Shale[1]

Upper Devonian: Western New York.

Original reference: E. R. Eller, 1935, Carnegie Mus. Annals, v. 24, no. 164, art. 8, p. 263–264.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Listed on correlation chart. Stratigraphically above Dunkirk shale and below Rushford sandstone.

Occurs at Alfred Station, Allegany County.

Alger Formation[1]

Silurian (Niagaran): East-central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Bull. 7, p. 27, 61.

Wilber Stout, 1941, Ohio Geol. Survey Bull. 42, p. 34–35. Subdivided in southwestern Ohio into three members (ascending): Osgood, Laurel, and Massie. Average thickness about 55 feet.

Named for Alger, a station on railroad between Panola and Irvine, about 1 mile east of Estill-Madison County line, Kentucky.

Algomah Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144.

Named for occurrence at Algomah mine, Ontonagon County.

Algomah Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence at Algomah mine, Ontonagon County.

Algoman granite or gneiss[1]

Precambrian: Lake Superior district.

[Original reference]: A. C. Lawson, 1914, *in* Internat. Geol. Cong., 12th, Canada, 1913, Comptes rendus, p. 349–370.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1038–1041, 1070 (table 4). Terms Algoman intrusives, Algoman granite, and Algoman time used in discussion of Precambrian stratigraphy in

Minnesota. As shown on table of possible correlations, Algoman granite is younger than Knife Lake group and older than Animikie group.

Name derived from Algoma, a district in western Ontario, Canada.

Alhajuela Sandstone Member (of Caimito Formation)

Alajuela Formation or Member (of Caimito Formation)

Miocene, lower: Panamá.

Charles Schuchert, 1935, Historical geology of the Antillean-Caribbean region: New York, John Wiley and Sons, p. 586. Alajuela formation consists principally of sandstones which become more calcareous below and have a barnacle limestone at their base. In part, marine equivalent of Caimito formation. Lower Miocene.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart). Correlation chart shows Alajuela as uppermost member of Caimito formation. Lower Miocene.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 235–236, 246 (fig. 2). Uppermost member of Caimito formation in Madden basin. Present only in type area. Consists of massive fine- to coarse-grained tuffaceous sandstone. Thickness 275 feet. Late early Miocene or possibly early middle Miocene. The Alhajuela is the Gatún(?) formation of Reeves and Ross (1930, U.S. Geol. Survey Bull. 821) and member 1 of sandstone formation of Kellogg (1931, Final report on field investigations of the Madden Dam and Reservoir site at Alhajuela, Panama Canal Zone, Panama Canal Rept.).

Type region: Small area at and near Madden Dam in central part of Madden Basin, including site of former village of Alhajuela.

Alhambra Formation

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 49, 50–53, pls. 2B, 4A. Proposed for a sequence of brown silty shale, coarse silty sandstone and thinly laminated light-gray to white brittle shale which unconformably underlies San Ramon formation and overlies Escobar sandstone (new) in both limbs of Pacheco syncline. Thickness about 834 feet. In area of type section, comprises (ascending) Castro shale, Roop sandstone, and Pereira shale members (all new). Alhambra was mapped as Tejon in Concord quadrangle of San Francisco folio.

Type section: West limb of Pacheco syncline in Santa Fe cuts east of east portal of Muir Tunnel near Martinez, Contra Costa County.

Aliamanu Basalt (in Honolulu Volcanic Series)

Pleistocene: Oahu Island, Hawaii (subsurface).

H. T. Stearns, 1940, Hawaii Div. Hydrography Bull. 5, p. 55; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 76–77. Melilite nepheline basalt. Overlain by 47 feet of Salt Lake tuff; underlain by 17 feet of alluvium which rests on Koolau basalt. Occurs between 62 and 93 feet in well.

Named for Aliamanu Crater within which it occurs. Penetrated only in one well, hence extent not known.

Aliamanu Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, 77. Water-laid gray to black or grayish-brown tuff containing numerous olivine crystals and some augite and magnetite, and also rounded gravel and sand; partly deposited by mud flow. Distribution noted.

Named from Aliamanu Crater, from which it is believed to have been erupted. Exposed intermittently over area of about 3 square miles east of Pearl Harbor, southwest of Koolau Range about 17 miles west of Makapuu Head.

Ali Baba Member (of Moenkopi Formation)

Lower Triassic: Southwestern Colorado and southeastern Utah.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1840–1841, 1842–1843, 1845–1846. Consists mainly of red-brown to purplish ledge-forming beds of conglomeratic arkosic sandstone separated by interbedded red- and chocolate-brown silty shale and thin layers of fine- and coarse-grained sandstone. Exhibits marked facies change from northeast to southwest near Uncompahgre Plateau, to northeast, ledge-forming beds of sandstone are highly arkosic, heavily conglomeratic, and constitute dominant part of member. To southwest, sandstones become progressively finer grained, better sorted, and less abundant. Southwest of Moab Valley becomes lithologically indistinguishable from overlying Sewemup member (new). Thickness 0 to 290 feet. Over most of salt anticline region, Ali Baba unconformably overlies Tenderfoot member (new), and locally in Sinbad Valley, Paradox Valley, and around Fisher Valley unconformity is sharply angular. In Sinbad Valley, rests locally on Paradox member of Hermosa formation. In Paradox Valley, rests in places on Cutler formation. In Fisher Valley, rests locally on the Cutler and on Paradox member. Cut out toward Uncompahgre Plateau in vicinity of Gateway, Colo., by angular unconformity at base of Chinle. In Sinbad Valley, thins locally by internal angular uncomformities and is overlapped by Sewemup and Pariott (new) members toward axis of salt anticline.

Type section: East side Sinbad Valley, sec. 15, T. 49 N., R. 19 W., Mesa County, Colo. Named for Ali Baba Ridge in Sinbad Valley, hogback underlain by conglomeratic sandstone of member.

Alibates Dolomite Lentil (of Quartermaster Formation)[1]

Permian: Northern Texas.

Original reference: C. N. Gould, 1907, U.S. Geol. Survey Water-Supply Paper 191, p. 17–20.

L. E. Lincoln, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 259–264. Described as persistent dolomite occurring in upper portion of Rustler formation.

Named for Alibates Creek, Potter County.

Alkali Formation[1]

Recent: Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Alkali Lake and Alvord Basin, Lake County.

Alkali Creek[1] (red stratum in Wind River Formation)

Eocene, lower: Wyoming.

Original reference: W. Granger, 1910, Am. Mus. Nat. History Bull., v. 28, p. 244.

Along Alkali Creek near Lost Cabin, northeast corner of Fremont County, Wyo.

Allah Quartzite

Paleozoic: North-central Utah.

B. F. Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 271, pl. 1. A 50-foot bed of fine-grained quartzite with prominent bedding planes. Easily traceable across entire district.

Occurs in West Tintic Mining District [Juab County], approximately 21 miles southwest of Eureka, Utah. Named for Allah mine.

Allamakee dolomite[1]

Upper Cambrian: Northeastern Iowa.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 319–326.

Probably named for exposures in Allamakee County.

Allamoore Limestone or Formation

Precambrian: Western Texas.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 144 (fig. 1), 145, 148–149. Proposed for lower part of Millican formation of Richardson. Limestone is characteristically thin bedded, of blue, gray, or brown color, with nearly all beds seamed at regular intervals by thin bands of chert. Associated with limestone are masses of volcanic rocks; these include diabasic flows, in part amygdaloidal, in part massive, and various pyroclastic rocks, such as breccias and fine-grained, well-bedded tuffs. Volcanics are interbedded with limestone in thin to thick members. Allamoore is exposed only in strongly folded belt north of overthrust mass of Carrizo Mountain schist. Over wide areas its beds stand nearly vertical, so that its thickness is perhaps to be measured in thousands of feet. Underlies Hazel sandstone; overlies Carrizo Mountain schist.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 1. Thickness given as 3,000 feet.

Type area: Van Horn region. Name derived from village of Allamoore, 11 miles west of Van Horn on the Texas and Pacific Railway and U.S. Highway 80. This name is spelled two ways, Allamoore for the post office, Allamore for the railroad station. Post office spelling is one adopted.

Allan Hollow Shale Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 138–140, 143 (fig. 2), 145 (fig. 3). Dark-gray marine shale with interbedded thin sandstone at base and top. Thickness 780 feet. This occurrence of marine shale represents parts of section by faulting. Only complete surface section found on northwest flank between crest of [Coalville] anticline in sec. 6, T. 2 N., R. 6 E., and Grass Creek Valley 3½ miles north-northwest. Formation, where it occupies northwest flank, partly covered by unconformable overlap of Knight formation and cut by several normal faults. Overlies Coalville member (new).

Named for typical exposures in Allan Hollow immediately northeast of Coalville, Summit County. Allan Hollow is a strike valley between northwest dip slope of Coalville member and overlying cliff of Oyster Ridge sandstone.

Allegany Drift[1]

Pleistocene: Pennsylvania.

Original reference: R. M. Deeley, 1913, Geol. Mag. London, new ser., Dec. 5, v. 10, table opposite p. 14.

Probably refers to drift west of Allegheny River in northwestern Pennsylvania.

Allegany Park parvafacies[1]

Devonian or Carboniferous: Southwestern New York.

Original reference: K. E. Caster, 1934, Bulls. Am. Pal., v. 21, no. 71, p. 28.

Named for development in New York State Park of this name, south of Salamanca, N.Y.

Allegheny Formation[1] or Group

Allegheny Series

Middle Pennsylvanian: Western Pennsylvania, eastern Kentucky, western Maryland, eastern Ohio, western Virginia, and western West Virginia.

Original reference: H. D. Rogers, 1840, Pennsylvania Geol. Survey 4th Ann. Rept., p. 150.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 28–55, pls. Group described in Brookville quadrangle. Includes all rock between top of Upper Freeport coal and base of clay under Brookville coal. Contains seven coal beds or horizons (descending): Upper Freeport, Lower Freeport, Upper Kittanning, Middle Kittanning, Lower Kittanning, Clarion, and Brookville. Divided into three formations: Freeport, extending from top of Upper Freeport coal to top of Upper Kittanning coal; Kittanning, extending from top of Upper Kittanning coal to base of clay under Lower Kittanning coal: Clarion, extending from base of Kittanning formation to bottom of clay under Brookville coal. Thickness about 325 feet. Underlies Conemaugh group; overlies Pottsville series.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 665–666, 683, chart 6 (columns 8, 9, 10, 11, 12, 23). Boundary between Pottsville and Allegheny strata has been fixed only by correlations between anthracite and bituminous coal districts, and there are uncertainties in this correlation. Generally, base of Allegheny beds has been drawn at base of Brookville coal. The Allegheny beds, which are designated as a series on present chart, are treated as extending downward to base of Homewood sandstone (slightly below Brookville coal) and upward to top of Freeport coal, which has long been recognized as Allegheny-Conemaugh boundary. Some students believe Allegheny should be defined as extending up from base of Lower Kittanning coal, which corresponds to Buck Mountain coal, just above type Pottsville. In eastern Kentucky, Allegheny is treated as a formation and shown as overlying Breathitt formation.

G. H. Ashley, 1945, Jour. Geology, v. 53, no. 6, p. 374–389. Base of Brookville coal (or top of underlying Homewood sandstone) long accepted Pittsburgh-Pottsville (Upper-Lower Pennsylvanian) boundary in Appa-

lachian bituminous coal fields. But increasingly, for last 45 years, detailed studies have shown that boundary has been drawn at many horizons, some over 500 feet apart in same section, owing to different correlations. Reasons for these diverse correlations cited. It is proposed to shift boundary to base of Lower Kittanning-No. 5 Block coal, believed to correlate with Buck Mountain bed, whose base forms boundary at type Pottsville locality, at Pottsville, Pa. If above proposal is accepted, it is further proposed that, until thoroughly established, the Allegheny group, down to base of Lower Kittanning coal, be called "Allegheny group, restricted," and that all Pottsville series, including all strata up to base of Lower Kittanning coal, be called "Pottsville series, extended."

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 46–77, pls. Group described in Smicksburg quadrangle, where it is 340 to 370 feet thick. Overlies Pottsville series, base taken at base of clay underlying Brookville coal. Underlies Conemaugh group. Studies by Ashley showed that Lower Kittanning coal is, regionally, most persistent coal in lower Allegheny group. Ashley (unpub. manuscript) proposed reclassification of Pennsylvanian system into Pottsville and Pittsburgh series. Pittsburgh series contained (ascending) Allegheny, Conemaugh, and Monongahela groups. Allegheny group contained (ascending) Kittanning member (with base at base of Lower Kittanning clay) and Freeport member. Clarion member placed in Kanawha group of Pottsville series. Until Ashley's proposal is accepted, Brookville coal considered base of Allegheny group.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40–57, pl. 1. Series described on cyclothemic basis. Nine cyclothems named. [For sequence see Brookville cyclothem.] In this report, Allegheny includes Homewood, lowest member of Brookville cyclothem. Area of report, Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 14–24. Considered series in this report. Strata included in Ohio extend from base of Brookville (No. 4) coal to top of Upper Freeport (No. 7) coal. In Morgan County, outcropping strata range from Middle Kittanning (No. 6) coal to top of series, or about top third of Allegheny strata present in Ohio. Total thickness in Morgan County 111 feet including covered interval of 23 feet. Cyclothemic classification not used in this report, but units are referred to as members.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 46–92. Series described on cyclothemic basis in report on Athens County. Thirteen cyclothems named. [For sequence see Brookville cyclothem.] Lower limit of series placed between base of Homewood sandstone and top of Tionesta coal, and top boundary between top of Uffington shale and base of Lower Mahoning shale and sandstone. This transfers Homewood sandstone and Brookville underclay from Pottsville to Allegheny series and Uffington shale from Conemaugh to Allegheny series.

E. G. Williams and R. P. Nickelsen, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 36–50. Allegheny series described in parts of Clearfield and Centre Counties. Boundary between Pottsville and Allegheny series placed at base of clay beneath Brookville coal, following Graeber and Foose (1942). Comprises (ascending) Clarion, Kittanning, and Freeport formations.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 68–71. Stratigraphic classification of parts of Pottsville-Allegheny rocks in western Pennsylvania still a matter of controversy. There is general agreement that Allegheny-Conemaugh boundary, drawn at top of Upper Freeport coal, is significant and useful one. However Pottsville-Allegheny boundary, drawn at base of so-called Brookville coal or clay, has not been generally satisfactory. Brookville coal not adequately defined in type area, and coal designated Brookville by later geologists is probably Mercer (Ashley, 1945). Investigations by Renick (1924, Jour. Geology, v. 32, no. 1), Ashley (1945), and Williams and Nickelsen (1958) showed that, throughout many areas of western Pennsylvania, either Mercer or Clarion coals have been mapped as Brookville, and there is some doubt that true Brookville was ever mapped. In present report, Lower Clarion clay is used as boundary between Allegheny and Pottsville groups. Use of this boundary requires the least modification of existing terminology. In southern counties of state, where marine fossils are not associated with lower Allegheny and Pottsville coals, correlation with type areas has not yet been established. Group in western Pennsylvania averages 280 feet thick. Consists of six mappable coals or coal zones separated by variable and locally cyclic sequences of shale, siltstone, sandstone, limestone, and clay. Group has been arbitrarily subdivided into three formations (ascending), Clarion, Kittanning, and Freeport, at horizon of certain economically important clay or coal horizons.

Named for exposures in valley of Allegheny River, western Pennsylvania.

†Allegheny Group[1]

Mississippian: Pennsylvania.

Original reference: A. Sherwood, 1878, Pennsylvania Geol. Survey Rept. G, p. 11–42.

Corresponds approximately to Pocono formation, and name is also preoccupied.

†Allegheny River coal series[1]

Mississippian and Pennsylvanian: Pennsylvania and northern West Virginia.

Original reference: J. P. Lesley, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. XXIII.

Allegrippis Sandstone Member (of Chemung Formation)[1]

Upper Devonian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 99–100.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Allegrippus conglomerate underlying Middle Chemung (Wellsburg sandstone) and overlying Lower Chemung (Cayuta sandstone and shale).

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Member of Chemung formation. Generally, greenish-gray sandstone weathering white but locally coarse conglomerate; commonly has layers or pockets of conglomeratic sandstone. Thickness about 77 feet near Saxton. Occurs about 1,400 feet above Piney Ridge sandstone member. Occurs below Saxton conglomerate member.

Forms Allegrippus [Allegrippis] Ridge, Huntingdon County.

Allen Complex

Tertiary: Western Texas.

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Quad. Map 22. Name given to an intrusive complex composed of rhyolite porphyries, vitrophyres, perlite, glassy breccias, and some sedimentary breccias.

Most rock types of complex crop out in belt of intrusions that trends west-southwest—east-northeast of old Allen place, Pinto Canyon area, Presidio County.

†Allen Limestone Member[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 238, p. 20.

Named for Allen, Lyon County.

Allenby Coal Member (of Carbondale Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), pl. 1. Proposed for coal formerly called Bankston so that name may be restricted to Bankston Fork limestone. Stratigraphically above Bankston Fork limestone member and below Galum limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: In roadside east of railroad crossing in NE¼NW¼ sec. 24, T. 9 S., R. 4 E., Williamson County. Name derived from village of Allenby in Saline County, about one-half mile southwest of type outcrop.

Allen Ridge Formation (in Mesaverde Group)

[Upper Cretaceous]: Southeastern Wyoming.

J. R. Bergstrom, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 114 (generalized composite strat. section). Comprises (ascending) about 550 feet of ripple-marked sandstones alternating with thicker carbonaceous shales and coaly beds; more than 550 feet of light-brown sandstones, generally 5 to 20 feet thick, separated by very poorly consolidated sandy shales and shaly sandstones which contain a few carbonaceous units; and 80 feet primarily of gray to gray-blue soft noncalcareous shale. Total thickness of formation 1,200 feet. Underlies Pine Ridge sandstone; overlies Steele formation.

Composite section from sec. 9, T. 22 N., R. 79 W., and sec. 18, T. 23 N., R. 79 W.

Allens Creek facies (of Edwardsville Formation)[1]

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 249.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Listed as a facies in Edwardsville formation. Includes (ascending) Mount Ebel sandstone, Weed Patch, and Cutright sandstone members.

Occurs in Lawrence, Monroe, and Morgan Counties.

Allens Falls Fanglomerate

Precambrian: Northwestern New York.

P. D. Krynine, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1333–1334. Fluvial arkosic fanglomerate referred to as "basal breccia"

filling ancient sinkholes in Grenville marble and covered unconformably by Potsdam quartzite.

Vicinity of Allens Falls and Canton, St. Lawrence County.

Allensville Conglomerate Member[1] (of Logan Formation)

Mississippian: Central and southern Ohio.

Original references: J. E. Hyde, 1912, History of Fairfield County, p. 211; 1915, Jour. Geology, v. 23, p. 656, 657, 764, 771, 775–778.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173. Included in Pretty Run sandstone facies of Logan formation.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 27, 67, 68. Moderately fine-grained to coarse conglomeratic sandstones interbedded with bluish-gray, argillaceous shale. Thickness commonly 15 to 25 feet. Underlies Vinton member; overlies Byer member.

Named for exposures at Allensville, Vinton County.

Allentown Dolomite

Allentown Limestone[1] or Formation.

Upper Cambrian: Eastern Pennsylvania and western New Jersey.

Original reference: E. T. Wherry, 1909, Science, new ser., v. 30, p. 416.

B. L. Miller, D. M. McCoy, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 229–241. Formation represented in Northampton County by broad band of magnesian limestones that extends from New Jersey west-southwestward to Lehigh County and underlies major portions of Easton and Bethlehem; also forms floor of larger part of Saucon Valley and occurs in extreme southeastern corner of county in vicinity of Coffeetown and Frya Run. Estimated thickness 1,500 to 1,600 feet; no exposure of entire thickness known in region. Overlies Tomstown with apparent conformity; underlies Beekmantown strata.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1355–1368. Discussion of subdivision and dating of Cambrian of eastern Pennsylvania. Trempealeauian Late Cambrian age of highest limestones in Lehigh and Durham Valleys established, and formation name, Allentown, applied. Dresbachian Late Cambrian age of next underlying limestones established, and formation name Limesport proposed for them. Restricted Allentown 400 to 500 feet thick. In Lehigh Valley, underlies Beekmantown dolomite. Allentown pinches out and is absent in Buckingham Valley.

Bradford Willard, 1958, Pennsylvania Acad. Sci. Proc., v. 32, p. 178–179, 182. Correlation of magnesian limestone of Ordovician age in Lehigh Valley with Beekmantown questioned. Proposes to reinstate Wherry's Coplay formation for Lower and Middle Ordovician beds between Upper Cambrian Allentown and Middle Ordovician Jacksonburg formations.

Named for exposures along Lehigh and Jordan Creeks in vicinity of Allentown, Pa.

Allen Valley Shale (in Indianola Group)

Upper Cretaceous: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 127–128, 133 (fig. 17). Body of marine shale, 600 to 800 feet thick, underlying Funk Valley formation (new) and overlying Sanpete formation (new).

Consists largely of evenly bedded gray marine shale interbedded with thin layers of yellowish bentonite, siltstone, very fine grained sandstone, and gray limestone. No individual bed more than 1 foot thick. Thickness at type locality 620 feet.

Type locality: Base of Wasatch Plateau in Allen Valley about 3 miles southwest of Manti. Top and base are well exposed in Salina Canyon, about 5 miles east of Salina.

Allison Member (of Menefee Formation)

Allison Member or Barren Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1925, U.S. Geol. Survey Bull. 767.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156, 2157. Nomenclature of Mesaverde in San Juan basin, revised. Allison reallocated to member status in Menefee formation. Overlies Cleary coal member (new).

Well exposed near village of Allison, McKinley County.

Alloa Rhyolite[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 126.

Exposed on both sides of elliptical mound on Shanks Farm, just northeast of United Presbyterian Church, Caledonia Township.

Allouez Conglomerate (in Portage Lake Lava Series)

Allouez Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 53–57, 60, chart.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

Named for occurrence in Allouez mine, Houghton County.

Alloway Clay[1]

Miocene, upper: Southwestern New Jersey.

Original reference: H. B. Kummel and G. M. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 142.

William Lodding, 1956, Rutgers Univ. Bur. Mineral Research Bull. 7, p. 19, 65, 78, pl. 2. Alloway clay (Kirkwood) mentioned in discussion of raw materials for lightweight aggregate production in New Jersey.

Near Woodstown and Ewan Mills. Continues from near Swans Mill, south of Mullica Hill, Gloucester County, to point 2 miles south of Alloway, Salem County.

Allsboro Sandstone (in Chester Group)[1]

Mississippian: Northwestern Alabama and northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Allsboro sandstone of Morse (1928) included in Tanyard Branch member of Pride Mountain formation (both new).

Named for small village in Alabama near Mississippi line.

Alma Glacial Substage

Pleistocene (Wisconsin): Central Colorado.

Q. D. Singewald, 1950, U.S. Geol. Survey Bull. 955–D, p. 120, pl. 9 [1951]. Times of maximum ice advance and of two principal ice stands during retreat are called Fairplay, Briscoe, and Alma substages, respectively, of Wisconsin stage of glaciation. Alma substage represents time covered by deposition of Alma moraine.

Area, northwestern Park County.

†Alma Limestone (in Council Grove Group)[1]

Permian: Northeastern Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 44–45.

Named for Alma, Wabaunsee County.

†Almagre Beds[1]

Eocene, lower: Northwestern New Mexico.

Original reference: Walter Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 205–207.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Wasatch formation as described in this report [eastern side of San Juan Basin, N. Mex.] contains lower faunal division of the Wasatch as recognized by Granger (1914), the Almagre beds.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 6, p. 368, 369, 370–374. In type region of San Jose formation (new) are two distinguishable clay facies corresponding to Granger's (1914) Almagre and Largo beds. "Almagre" facies occurs in lower part of formation throughout type region, except northward of Arroyo Blanco where it is sandstone facies. Forms lower part of formation.

Named for Almagre watershed. Simpson measured section near where continental divide crosses pass between head of the Largo and southwest branch of "Almagre" Arroyo, mostly in NE¼ sec. 8, T. 23 N., R. 1 W., Rio Arriba County.

Almenan Sub-Age

Pleistocene: Midcontinent region.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 359 (fig. 1), 363. Provincial term used to designate third and youngest time-stratigraphic and time unit of post-Sangamonian time. Includes time from Bradyan to present.

Name derived from vicinity of Almena, Norton County, Kans., which is type area of Almena terrace of Prairie Dog Creek Valley.

Almond Formation (in Mesaverde Group)[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Consists of white and brown soft sand-

stone, gray sandy shale, coal, and carbonaceous shale. Overlies Ericson sandstone and underlies Lewis shale.

Rock Springs uplift, Sweetwater County.

Almongui (Almonogui, Arumonogui) Agglomerate

Eocene(?): Caroline Islands (Babelthuap)

Risaburo Tayama, 1939, Brief report on the geology and ore resources of Babelthuap Island (Palau Island proper): Tropical Industry Inst., Palau, South Sea Islands Bull. 3 [English translation in library of U.S. Geol. Survey, p. 7–8, 17]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 65, table 4 [English translation in library of U.S. Geol. Survey, p. 78]. Composed chiefly of augite-andesite, with occasional layers of tuff. Bedding horizontal or dips less than 10°. Not in contact with Airai lignite-bearing bed, but considered older than those beds.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 17. Consists mostly of augite- and pyroxene-andesite with occasional interbedded tuff. Dip of formation is commonly less than 10°. Distinguished from Babelthuap and Aimelik [Aimiliiki] agglomerates by not being propylitized and by having no limestone lenses and metallic ore deposits. Although direct contact with Aimelik formation not found, latter is supposed to be unconformable below this formation. Eocene(?).

Covers more than half of Babelthuap Island. Along western coast of Almongui edge of formation forms hogback.

Almont Sandstone (in Tongue River Member of Fort Union Formation)

Paleocene: Southwestern North Dakota.

R. V. Hennen, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 12, p. 1573 (fig. 1), 1580. In a measured section, Almont lies approximately 35 feet above base of Tongue River member.

Section was measured along south margin of T. 138 N., Rs. 86 and 87 W. Sandstone forms high cliffs just above drainage, 1 mile south of Almont Railway Station [Morton County].

Almy Formation

Almy Conglomerate

Almy Formation (in Wasatch Group)[1]

Eocene, lower: Southwestern Wyoming.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 14, pl. 1. Formation included in Wasatch group. Tentatively considered Paleocene (Dragonian-Torrejonian).

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1). 842–844, pl. 1. Conglomerate, in north-central Wasatch Mountains, includes (ascending) Pulpit conglomerate and Saw Mill conglomerate divisions (both new). Thickness about 3,200 feet. Overlies Henefer formation (new); underlies Fowkes(?) formation. Paleocene; included in Wasatch group, which is here given as middle Paleocene(?) to lower Eocene (Wasatchian?).

A. J. Eardley, 1952, Utah Geol. Soc. Guidebook 8, p. 54–55. In Wasatch hinterland, Almy conglomerate probably rests unconformably on Wanship

formation (new). Best exposed in cliffs at mouth of Echo Canyon and up canyon for about 5 miles to where it is covered unconformably by Knight conglomerate. In vicinity of Henefer in core of Henefer anticline, Almy is thousands of feet thick. Some beds were originally thought to underlie Almy unconformably and were named Henefer formation. They are now thought to make up lower part of the Almy. Locally underlies Fowkes formation.

B. E. Lofgren, 1955, Utah Geol. Soc. Guidebook 10, p. 75. Coarse red cliff-making conglomerate near headwaters of South Fork 8 miles above Huntsville has been mapped as Almy conglomerate by Eardley (1944), thus correlating it with Almy formation (Veatch, 1907) in southwestern Wyoming. Since Eardley's original mapping, he and students have remapped area and now regard Saw Mill conglomerate as Knight conglomerate.

J. I. Tracey, Jr., and S. S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 126–130. Veatch (1907) subdivided Wasatch group in Evanston area into Almy formation—basal unit of reddish-yellow sandy clays containing prominent conglomeratic beds in places; Fowkes formation—sequence of rhyolitic ash beds containing limestone lenses; and Knight formation—reddish-yellow sands and clays similar to Almy but separated from it and Fowkes by pronounced angular unconformity. Veatch noted that in places Almy seemed more closely related to underlying Evanston than to overlying Knight. In Kemmerer and Sage quadrangles, much of areas Veatch mapped as Almy are underlain by rocks more properly assigned to Evanston formation. Also, rhyolitic ash beds that Veatch defined as Fowkes formation, although apparently accordant with dipping beds of Almy at type locality, are, in fact considerably younger than nearby beds of Knight formation that Veatch interpreted as overlying the Fowkes. Fresh-water gastropods from type locality of Fowkes and from lithologically similar beds near Sage which Veatch called Fowkes are late Eocene or, possibly, earliest Oligocene. Massive light-gray conglomeratic cliffs northeast of Sage, called Almy by Veatch, are a part of this late Eocene unit. No vertebrate fossils have been collected from type locality of Almy. Knight and Almy formations were distinguished by Veatch partly on basis that lower peripheral conglomeratic beds of Wasatch are apparently more involved in structural deformation of basin than higher beds near center of basin. Lower, conglomeratic Almy of Veatch's type section may be as old as latest Paleocene despite absence of supporting evidence, whereas beds underlying Green River formation near Fossil Butte in center of basin are of early Eocene (Lysite) age. At present, use of names Almy and Knight seems inadvisable without explicit statements as to their meaning. Future mapping may clarify subdivisions of Wasatch in Fossil basin and perhaps relate them to subdivisions in Bridger basin.

A. J. Eardley, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 167. With recognition that Fowkes does not occupy a layered position between Knight and Almy, relation of Knight and Almy becomes a problem. In those localities where Veatch shows Knight resting directly on Almy, present writer [Eardley] has found it impossible to detect any real break. Apparently Almy is simply a basal unit of Knight and of no real stratigraphic significance. No means

has been found of recognizing Almy outside of its type locality just north of Evanston.

U.S. Geological Survey currently designates the age of the Almy as earliest Eocene in Fossil basin (type area) on the basis of a study now in progress.

Named for Almy, a few miles north of Evanston, Uinta County, Wyo.

Alnwick Lake Beds[1]

Miocene, upper, or Pliocene: Eastern Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

Occurs in valley of Oil Creek about Alnwick, Pikes Peak region.

Alofau Volcanics

Pliocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1286 (table 1), 1289–1290, pl. 1. Include all thin-bedded, chiefly olivine-bearing aa and pahoehoe basalts and dikes, breccias, firefountain deposits, and trachyte forming Alofau Volcano. About 962 feet thick.

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 151–152. Appear to overlap Olomoana volcanics and to be overlapped by Pago volcanic series. Pliocene(?); no fossils; age designation on basis of weathering and erosion.

Named for village of Alofau in center of volcano. Cover about 1½ square miles on east side of Fagaitua Bay at east end of island.

Alpena Limestone[1] (in Traverse Group)

Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 175.

A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 526. Restricted to exclude "black Alpena" zone which is separated below as Killians limestone (new). Dock Street clay of Grabau (1902) is considered local clay facies of upper Alpena horizon. Underlies Norway Point formation (new). Included in Traverse group.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Overlies Newton Creek limestone (new).

G. A. Cooper and A. S. Warthin, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 879; G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, p. 1743–1744, chart 4. Further restricted. Lower 15 feet, which contains a Genshaw fauna, placed in that formation. Next division, which consists of 25 feet of yellowish to brown crystalline limestone, to which the name Alpena is restricted, consists of 79 feet of light-gray to white limestone. Above Alpena (restricted) occur 8 feet of blue clay shale, Dock Street clay of Grabau (1902), a lens confined to east side of Alpena, and classified with Alpena limestone. Overlying Dock Street and Alpena is Four Mile Dam limestone.

G. V. Cohee, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 28. Michigan Geological Survey considers Newton Creek limestone a member of Alpena limestone.

Named for exposures at Alpena, Mich.

Alpine Formation (in Lake Bonneville Group)

Pleistocene: West-central Utah.

K. C. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 21. Oldest of Lake Bonneville deposits. Gilbert (1890, U.S. Geol. Survey Mon. 1) used term Intermediate to refer to Lake stage represented by these deposits. Consists of a high proportion of fine-textured sediment, mostly silt. Sorting excellent and bedding distinct. Underlies Bonneville formation (new). Name credited to H. J. Bissell (unpub. thesis).

C. B. Hunt, H. D. Varnes, and H. E. Thomas, 1953, U.S. Geol. Survey Prof. Paper 257–A, p. 17–20, pl. 1. Formation thickens southward from about 50 feet in vicinity of Lehi to about 100 feet near Provo. Underlies glacial outwash and in some places Provo formation; overlaps onto pre-Lake Bonneville alluvial fans.

Named for town of Alpine in northern Utah Valley.

Alpine Quartz Diorite[1]

Upper Jurassic or Lower Cretaceous: Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 115–141, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 486, table 4. Plutonic sequence in southern San Diego County comprises (ascending) Viejas gabbro-diorite, Alpine quartz diorite, Harbison quartz diorite, Descanso granodiorite, and La Posta quartz diorite. Late Mesozoic.

Typical occurrence in general vicinity of Alpine, southern Peninsular Range.

Alpreston Quartzite[1]

Middle Cambrian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 435, map.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 3. Mentioned in summary of work on Cambrian system in and near western Montana. Alpreston quartzite (Flathead quartzites) is oldest Cambrian in Elkhorn region. Succeeded by Starmount limestones.

Forms crest of hill west of Elkhorn, Jefferson County.

Alsate Shale[1]

Lower Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066, 1069–1070.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 6, 13 (table 1), 19–20, 106–107, 110, 117. Black shale that forms distinct break between blue-gray-weathering Marathon limestone and tan-weathering limestones and sandstones of Fort Pena formation. In Alsate Creek exposure in Marathon anticlinorium, conglomerate underlies black shale and was included in Alsate by King. Conglomerate is merely a lens; it can be traced into limestone at top of Marathon and should not included in Alsate. Thickness about 100 feet in Alsate Creek and in exposures on ridge east of road to Roberts ranch; thins to 85 feet 3 miles to southwest. Thinner in Dagger Flat anticlinorium and commonly occupies covered interval. Here is greenish-weathering black shale. Granular limestone layers containing *Oncograptus*, which King (1937,

U.S. Geol. Survey Prof. Paper 187) described as part of formation, belong to overlying Fort Pena formation.

Named for Alsate Creek, which joins Pena Colorada Creek from west at Fort Pena, Colo. Well exposed in cut on creek 2½ miles west southwest of Fort Pena, near road to Roberts ranch, Brewster County.

Alsen Limestone[1] (in Helderberg Group)

Lower Devonian: Eastern New York.

Original reference: A. W. Grabau, 1919, Geol. Soc. America Bull., v. 30, p. 468–470.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 184–190. Overlies Becraft and underlies Port Ewen, but Port Ewen is missing at Alsen (locality from which Alsen was named). Underlies Oriskany where Port Ewen is missing. Thickness 25 feet in quarry at Alsen. Has been considered basal part of Port Ewen.

Named for section at Alsen, Greene County, where it is well shown in the hills.

Alsobrook Member (of Pride Mountain Formation)

Alsobrook Formation (in Chester Group)[1]

Upper Mississippian: Northwestern Alabama and northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

W. C. Morse, 1936, Mississippi Geol. Survey Bull. 32, p. 11, 16, 21. Constitutes lowest formation in Chester series. Shown as comprising Cripple Deer sandstone or shale member above, Hargett sandstone or shale member, and unnamed limestone. Underlies Allsboro sandstone.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Basal member of Pride Mountain formation (new) in Colbert County, Ala., and Tishomingo County, Miss. Morse described sequence as consisting of limestone 1 to 10 feet thick, containing brachiopod *Productus inflatus* McChesney, and overlying green shale 70 to 80 feet thick, containing a sandstone bed of variable thickness in upper part. He named the sandstone Cripple Deer sandstone member of his Alsobrook. Name Alsobrook is herein reduced to member status and redefined to include only basal limestone and that part of shale below Morse's Cripple Deer sandstone. Thickness about 50 feet in type area; thins eastward to 3 feet or less in vicinity of Spring Valley in Colbert County. Underlies Tanyard Branch member (new); overlies Tuscumbia limestone. Upper Mississippian.

Named for Alsobrook Homestead and Alsobrook Bridge, located about 3 miles north of Allsboro, Ala., in sec. 10, T. 4 S., R. 15 W.

Alta Formation[1]

Permian: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10–25.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 673, 674, pl. 2 (column 2). Composed largely of clastics. Underlies Cibolo formation; overlies Cieneguita formation.

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. Oldest formation exposed in Pinto Canyon, Presidio County. Dark-gray thin-bedded mudstone forms about 80 percent of the 610 feet exposed in measured section. Underlies Pinto Canyon formation (new).

Named for Sierra Alta Hill, on side of Sierra Alta Creek, Presidio County.

Alta Formation

Alta Andesite or Andesite Series

Oligocene(?): Western Nevada.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 33, 52–54, pl. 1. Referred to as Alta andesite series. Breccias predominate in lower part of series; toward top are lavas and lesser amounts of breccia. Thickness about 3,600 feet. Contains Sutro tuff member. Overlies Hartford Hill rhyolite. Miocene. Series was previously named Forman andesites [volcanics].

D. I. Axelrod, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1935. Oligocene age indicated on basis of flora in Sutro tuff member.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 51–52. Formation consisting mainly of tuff-breccia, flow breccia, and lava flows. Contains sedimentary Sutro tuff member (present only in Comstock lode district), which ranges in texture from shale to conglomerate and forms discontinuous lenses at different stratigraphic horizons. Probably interfingers with overlying Kate Peak formation in some places, but rock types are not sufficiently distinctive to be absolutely sure of this relation; intruded by Davidson granodiorite. Oligocene(?).

Occurs in Silver City district, on eastern slope of Virginia Range, 12 miles north of Carson City. Named for exposures near Alta mine shaft [on Comstock lode].

†Alta Granodiorite[1]

Upper Cretaceous or Tertiary, lower: Utah.

Original reference: F. F. Hintze, 1913, New York Acad. Sci. Annals, v. 23, p. 85–143.

Crops out just east of Alta, in central Wasatch Mountains, Salt Lake County.

†Alta Shale[1]

Lower and Middle Cambrian: Central northern Utah.

Original reference: F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 104.

Named for its prominence at little town of Alta.

Alta Loma Sand

Pleistocene: Texas (subsurface).

N. A. Rose, 1943, Progress report on the ground-water resources of the Texas City area, Texas: Texas Board of Water Engineers, p. 3–5. Consists of massive sand bed ranging from about 100 to 350 feet in thickness. Composed principally of fine- to coarse-grained sand but contains lenses of clay and sandy clay. Sand dips southeastward at rate of 15 to 20 feet per mile. Underlies Beaumont clay; overlies Lissie sand.

Named for town of Alta Loma, Galveston County. Sand is well developed in all wells that have been drilled in this locality for city of Galveston water supply.

†Altamaha Formation[1] or Grit[1]

Miocene, lower: Southeastern Georgia, Alabama, and northern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 81–82, 157, 320.

Named for exposures in bluffs of Altamaha River, especially between Rocky Hammock and Doctortown, Wayne County, Ga.

Altamira Shale Member (of Monterey Formation)[1]

Miocene, middle and upper: Southern California.

Original reference: W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 131.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 16–33, 39–40, pls. 3, 4, 6–7, 10–B, 28. Basal member of Monterey in Palos Verdes Hills area. Includes thick bentonitic tuff, Portuguese tuff bed, and a thin pumice tuff, Miraleste tuff bed. Thickness about 1,000 feet in type region; about 600 feet on north slope of hills owing to overlap on schist basement. Underlies Valmonte diatomite member. Division between middle and upper Miocene is between middle and upper parts of Altamira.

Type region: On south slope of hills along and adjoining Altamira Canyon, Palos Verdes Hills, Los Angeles County.

Altamont Limestone[1] (in Marmaton Group)

Altamont Limestone Member (of Oologah Limestone)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southern Iowa, southwestern Missouri, and northeastern Oklahoma.

Original reference: G. I. Adams, 1896, Kansas Univ. Geol. Survey, v. 1, p. 22.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 29. Subdivided into two formations, Tina below and Worland. Occurrences in Iowa noted.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 325–334. Further subdivided to include a middle member, Lake Neosho shale. Type exposure designated; thickness at type exposure about 19 feet.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 7–8; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 96. Comprises (ascending) Amoret limestone (name Amoret limestone substituted for Tina limestone), Lake Neosho shale, and Worland limestone members. Overlies Bandera formation; underlies Nowata formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as upper member of Oologah limestone in Rogers, Nowata, and Craig Counties.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30–31, fig. 5. Comprises (descending) Worland limestone, Lake Neosho shale, and Amoret limestone members. Unit not previously recognized as formation in Iowa, but as result of studies made in Madison County it now appears valid formation for this area. Underlies Nowata shale; overlies Bandera shale. Maximum thickness about 13 feet. Marmaton group.

Type locality: Near center of west line of sec. 5, T. 33 S., R. 19 E., about 3.5 miles west of Altamont, Labette County, Kans. No exposures in vicinity of Altamont show whole Altamont formation.

Alto coal group (in Pottsville Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1880, Pennsylvania 2d Geol. Survey Rept. R.

In Alton Basin, Lafayette Township, McKean County.

Alto Formation[1]

Middle Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th ser., v. 49, p. 168–178.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 16–19. Strata intervening between Grand Tower limestone (or Dutch Creek sandstone where that is absent) and Mountain Glen shale (or Springville shale where that is absent) have been referred by Savage (1920) to Misenheimer shale and Lingle and Alto limestones. Restudy of area suggests that recognition of these three formations may be neither stratigraphically logical nor practically feasible. Might be advisable to apply to them the name St. Laurent formation which is used for Devonian beds overlying Grand Tower limestone in southeastern Missouri.

A. S. Warthin, Jr., and G. A. Cooper, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 10, p. 1524–1525. At its type locality, contains at its top about 11 feet of hard brown irregularly bedded finely granular dolomitic sandy limestone with much brown chert. Below this is about 70 feet of dark-brown to dark-gray irregularly laminated silty to sandy shale, with a few 1-foot layers of sandstone and sandy limestone. Some of shales are dark enough to be confused with Mountain Glen black shale above, if it were not for intervening cherty limestone. Formation has been variously correlated with rocks of Hamilton age, but is here considered as entirely post-Hamilton. Subsurface data. Middle Devonian.

Named for exposure along a creek in NE¼ sec. 34, in Alto Township, Union County.

Altona Dolomite Member (of Blaine Gypsum)[1]

Permiam: Central Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 48.

Named for Altona, western part of Kingfisher County.

Altonian Substage

Pleistocene (Wisconsinan): Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 2 (fig. 1), 5–6. Wisconsinan stage of Lake Michigan lobe is subdivided into (ascending) Altonian, Farmdalian, Woodfordian, Twocreekan, and Valderan substages. Radiocarbon dates suggest an age of 50,000 to 70,000 radiocarbon years B. P. as beginning of Altonian. Altonian is judged to include half or more of total duration of Wisconsinan age. Includes Roxana silt and Winnebago drift (both new).

Named for city of Alton, in southwestern Illinois, located on bluff of Mississippi River valley below mouth of Illinois River.

Altoona Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth and W. H. H. Piatt, 1894, Kansas Univ. Quart., v. 2, p. 115–117.

Named for Altoona, Wilson County.

Altuda Formation

Altuda Shaly Member (of Capitan Limestone)[1]

Permian (Guadalupe): Western Texas.

Original reference: P. B. King, 1927, Am. Jour. Sci., 5th ser., v. 14, p. 217.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 655. Rank raised to formation.

Named for exposures in vicinity of Altuda section house [Brewster County].

†Altuda Granite[1]

Age(?): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, Sci. ser. No. 11, p. 70.

Covers an area of somewhat more than 1 square mile, 4 miles north of Mount Ord, southwest of Altuda, Brewster County.

Alturas Formation[1]

Pliocene, middle or upper: Northeastern California.

Original reference: Erling Dorf, 1933, Carnegie Inst. Washington Pub. 412, p. 6, 23.

D. I. Axelrod, 1944, Carnegie Inst. Washington Pub. 553, p. 264, 276 (table 25). Relatively horizontal strata; includes coarse, brownish tuffaceous sandstones and pebbly conglomerates, as well as lenses of white to gray tuffaceous shales and clays. Total thickness only a few hundred feet. Rests disconformably upon channeled and eroded surface of Upper Cedarville formation; overlain regularly by Warner basalt. Pliocene.

Flora collections made in vicinity of Rattlesnake Butte, about 4 miles east of Alturas, Modoc County.

Altyn Limestone[1] (in Ravalli Group)

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta and southeastern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 321.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1881–1884. Consists of dolomites, limestones, limy argillites, sandstones, and minor mud breccias, which form lower calcareo-magnesian division in Belt sediments in Glacier Park facies. Sediments show considerable variety in color, texture, and bedding; they contain mud cracks, ripple marks, and many beds of flat-pebble and edgewise conglomerates. Upper limit is base of Appekunny formation with which there is some intergradation; lower limit concealed beneath Lewis thrust. Thickness 2,180 to 2,480 feet. Includes (ascending) Waterton (Canada only), Hell Roaring (new), and Carthew (new) members. This definition includes Altyn of Willis (1902) and Daly's Waterton formation because no significant break exists between them.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112. Included in Ravalli group. Underlies Appekunny argillite.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 18–21, pls. 1, 2. Not exposed in Flathead region, and base has nowhere been recognized. Does not appear to be exposed in any other part of Montana. Commonly regarded as part of Ravalli group—a convenient procedure which is herein

adopted provisionally. No evidence exists as to stratigraphic relations of the Altyn of Glacier National Park to basal components of Ravalli group in other parts of Montana or to underlying Prichard formation. Fenton's members discussed, but formation not subdivided in present report. Limestone forms Range extending about as far south as lat 48°20′ N. and northward past Canadian border. Here it immediately overlies Lewis overthrust, and much of it has been cut out by that fault. Also exposed in outlying blocks such as those in Divide and Chief Mountains and on either side of Waterton Lake.

Type locality: In cliffs of Appekunny Mountain, due north of Altyn, in Swift Current Valley, Glacier National Park. Entire section exposed only in Waterton Lakes Park, where it is complicated by faults and folds.

Alum Phyllite

Precambrian: Southwestern Virginia.

R. V. Dietrich, 1959, Virginia Polytech. Inst. Bull., Eng. Expt. Sta. Ser. 134, p. 75–84, pl. 1. Chiefly sericitic slate-phyllite. Main mass appears to lie conformably within Lynchburg gneiss (Lynchburg as used here may not be correlative of type locality Lynchburg). The Alum grades both upward and downward, through a few feet, into Lynchburg gneiss, except locally along its northern contact where it appears to grade into Little River gneiss (new).

Named for Alum Ridge district. Underlies a nearly 2-mile-wide belt that extends from near northwestern corner of Floyd County northeastward to Route 8.

Alum Bluff Group[1]

Alum Bluff Stage

Miocene, lower and middle: Florida, southern Georgia and southeastern Alabama.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 112–113, 122–123, 157, 158, 320.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table 1), 18 (fig. 2), 21–27, fig. 3 facing p. 18. Stage embraces all sediments of post-Tampa and pre-Choctawhatchee age, the middle Miocene of most authors, in Florida panhandle and their equivalents in Central and Western Gulf states. In Florida panhandle, includes Chipola, Shoal River, Oak Grove, and Hawthorn facies.

C. W. Cooke, 1954, Florida Geol. Survey Bull. 29, p. 18 (table), 136–144. Formations now included in group are (descending) Shoal River, Chipola, and Hawthorn (east of Apalachicola River). Oak Grove sand included in Shoal River formation. Group consists predominantly of micaceous sand, sandy clay, fuller's earth, and limestone. Conformably overlies Tampa limestone, or, where Tampa is absent, Ocala limestone or Suwannee limestone forms the bedrock. Unconformably underlies Duplin marl or Pliocene or Pleistocene deposits.

Named for exposures at Alum Bluff on east side of Apalachicola River, Liberty County, Fla.

†Alum Bluff series[1]

Miocene, middle and upper: Northwestern Florida.

Original reference: D. W. Langdon, 1891, Georgia Geol. Survey 1st Rept. Prog., p. 91–97.

Alum Cave[1] Limestone Member (of Petersburg Formation)

Pennsylvanian: Western and southwestern Indiana.

Original reference: W. N. Logan, 1929, Indiana Dept. Conserv. 11th Ann. Rept., p. 30–34.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1. Allocated to member status in Petersburg formation. In Jasonville quadrangle, Clay, Greene, and Sullivan Counties, consists of gray impure hard limestone. Normally separated into two beds by 1 to 6 inches of calcareous shale; lower 1 or 2 inches of lower bed is shaly and fossiliferous. Thickness 4 to 6 feet. Underlies Dugger formation (new); overlies a black shale unit which overlies Coal V.

Derivation of name not stated.

Alumonogui Agglomerate

See Arumonogui (Almongui) Agglomerate.

Alum Rock Rhyolite

Post-Cretaceous: Northwestern California.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 47–48, pls. 1, 3. Pale-colored aphanitic rock; strongly jointed; more or less silicified. Fresh surfaces range in color from nearly white to brownish red or purple. Intruded into Cretaceous Oakland conglomerate and Berryessa formation (new). Known only to be post-Cretaceous, but by analogy with Leona rhyolite of the Oakland, it is more likely post-Orinda and possibly Quaternary.

Area: San Jose-Mount Hamilton area in Coast Ranges about 50 miles southeast of San Francisco. Mapped area is on west slope of Diablo Range. Rhyolite is intrusive body about 1,000 feet wide and 400 feet long which crops out in lower Alum Rock Canyon.

Alverson Andesite Lava

Miocene: Southeastern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22. Dark-brown basic andesite. About 400 feet thick in Alverson Canyon and about 700 feet thick at east end of Coyote Mountains where it is associated with tuff and breccia. Overlies Split Mountain conglomerate and older basement rocks in western foothills of Coyote Wells Valley, in Coyote Mountains, and in Fish Creek Mountains; in some areas underlies the Fish Creek gypsum (new) and (or) Imperial formation.

Type locality: Alverson Canyon, Imperial Valley region.

Alverson Canyon Formation

Miocene(?): Southeastern California.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1781–1782. Nonmarine unassorted sediments and associated basic igneous flows and tuffaceous sediments unconformably overlying all older rocks. Unfossiliferous. Thickness as much as 700 feet. Overlies Split Mountain formation (new); underlies Imperial formation.

L. A. Tarbet, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 260, 261 (fig. 40). Because Alverson Canyon formation rests directly on basement complex, it may be equivalent in age to Split Mountain formation. However, Split Mountain probably predates volcanic activity

prevalent in Alverson Canyon formation because no volcanic debris was observed in Split Mountain.

Imperial Valley area.

Alvord Formation[1]

Miocene, lower: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed on east side of Alvord Valley, southern part of Harney County.

Alvord Creek Formation

Alvord Creek Beds[1]

Pliocene: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington Univ. Pubs. in Geology, v. 3, no. 1, p. 7–130.

D. I. Axelrod, 1944, Carnegie Inst. Washington Pub. 553, p. 225. Alvord Creek beds described by Fuller are here designated Alvord Creek formation. Lower Pliocene.

Howel Williams and R. R. Compton, 1953, U.S. Geol. Survey Bull. 995–B, p. 24–25. In mapped area (Steens and Pueblo Mountains), formation is restricted to narrow belt along foot of High Steens scarp bordering Pike and Little Alvord Creeks. Consists predominantly of well-stratified flat-lying white and pastel-tinted tuff, tuffaceous clay, and silt, with occasional interbeds of chert, opaline shale, and conglomerate; near mouth of Pike Creek includes a rhyolite flow. Thickness 500 feet; base not exposed. Unconformably underlies Pike Creek volcanic series; unconformably overlies pre-Tertiary rocks.

Probably named for occurrences near base of Steens Mountain scarp between Cottonwood Creek and Little Alvord Creek, Harney County.

Alvord Peak Basalt

Miocene: Southern California.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 18–21, pls. 1, 2. Nonporphyritic basalt flow sequence. Thickness 300 to 400 feet at Alvord Peak. Conformably overlies Clews fanglomerate (new); northwestward, overlaps Clews as fanglomerate wedges out, and rests on plutonic rocks and granodiorite porphyry dikes of basement complex. Underlies Spanish Canyon formation (new) or Barstow formation where Spanish Canyon is missing. Assigned to middle Miocene or older on basis of middle Miocene vertebrate fossils in lower part of overlying Barstow.

Named for Alvord Peak, Alvord Mountain quadrangle, San Bernardino County.

Amador Group

Middle and Upper Jurassic: East-central California.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 89–90. Amador group substituted for preoccupied name Tuolumne. Consists of clastic sediments and volcanics which are strongly folded and frequently faulted. Thickness less than 5,000 to more than 15,000 feet. Underlies Mariposa [slates].

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 282–284, 303, 306 (fig. 2), 307 (fig. 3). On Cosumnes and Calaveras Rivers, divisible into two formations: Cosumnes below and Logtown Ridge agglomerates (both new). Thickness on Cosumnes River immediately west of Mother Lode Highway 7,100 feet; thicker to west and acutely folded. On Merced River, divisible into five formations: lower volcanics (thickness unknown, and base not exposed), pillow basalts (1,200 feet), Hunter Valley cherts (950 feet), Penon Blanco volcanics (about 9,000 feet), and Agua Fria (3,500 feet). Complete correlation of sections not established, but Logtown Ridge and Penon Blanco are correlated and pillow basalts and Hunter Valley cherts are equivalent to part of Cosumnes formation. Batholithic intrusions of granodiorite and diorite common, as are plugs, sills, and dikes of basic and ultrabasic rocks. Younger than Calaveras and older than Mariposa. Nearly everywhere Amador grades upward into Mariposa; north of Middle Fork of American River, Mariposa overlaps Amador. Occurs as long narrow belts, either flanking western Calaveras or rising as overturned anticlines from beneath Mariposa; overturning is commonly toward west, axial planes of folds dipping eastward at angles of 60° to 70°. Exact age of Amador not known but believed to be from upper Middle to lower Upper Jurassic. Type sections designated. On various geologic folios, group of rocks here called Amador has been mapped as Calaveras, Mariposa, "diabase and porphyrite," amphibolite schist, and quartz amphibolite.

G. R. Heyl and J. H. Eric, 1948, California Div. Mines Bull. 144, pt. 1, p. 51–53, pl. 7. Series of schists and greenstone in Newton mine area (near Jackson, Amador County), tentatively correlated with Jurassic Amador group described by Taliaferro (1942), subdivided into four formations (descending): Mountain Spring volcanics, Dufrene slate, Newton Mine volcanics, and Sunnybrook volcanics. Section described exposed in western part of area from Mariposa slate eastward along Mountain Spring Creek to Newton mine. In general rocks dip steeply eastward; in some places beds are vertical; graded bedding suggests that rocks lie on western, overturned limb of major anticline and become progressively older toward east. Approximate thickness of section 2,057 feet.

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 10–11, pls. 1, 2. Described in Angels Camp and Sonora quadrangles, Calaveras and Tuolumne Counties, where it includes Cosumnes and Logtown Ridge formations. Middle or Upper Jurassic.

Type section for northern end of group is on Cosumnes River, Eldorado and Amador Counties; for southern end, on Merced River. Named for exposures along Cosumnes River, Amador County.

Amalia Formation

Tertiary, middle or upper: Northern New Mexico and southern Colorado.

P. F. McKinlay, [1955], New Mexico Bur. Mines Mineral Resources Bull. 42, p. 16–18, pl. 1. Includes interbedded arkosic sedimentary rocks, basalt flows, and rhyolite tuffs. Beds and flows are often lenticular and irregular. Thick flows of olivine basalt occur near base. These are overlain by beds of siltstone, tuff, and pumice, 50 to 200 feet thick. A 50- to 150-foot layer of welded tuff lies above the siltstones. This unit is silicified and forms conspicuous outcrops for more than 7 miles along strike. Welded tuff is overlain by 200 to 600 feet of semiconsolidated sandstones and conglomerates. The total exposed thickness approximately 2,000 feet.

Upper beds of formation grade into, or are overlain by, thick Tertiary gravels. South and east of Costilla, Amalia overlain unconformably by Quaternary-Tertiary basalt flows. Amalia lies above andesite and andesite tuffs. South of Rito de los Cedros, appears to overlap onto Precambrian granite and metamorphic rocks.

Named for Amalia [N. Mex.] post office which lies on west side of Costilla Valley, 5 miles southeast of town of Costilla. Unit is best exposed east of the Rio Costilla, 4 or 5 miles south of Costilla, N. Mex., and on north side of canyon formed by Rito de los Cedros.

Amana Beds

Devonian: East-central Iowa.

S. W. Stockey, 1933, (abs.) Pan-Am. Geologist, v. 60, no. 1, p. 78. Incidental usage.

M. A. Stainbrook, 1945, Geol. Soc. America Mem. 14, p. 7–8. Described as a thick body of shales overlying Cedar Valley limestone. Encountered in wells.

Apparently occur at surface only between Middle and High Amana communities in Iowa County.

Amargo Formation

Jurassic: Southern California.

H. S. Gale, 1946, California Jour. Mines and Geology, v. 42, no. 4, p. 358. Group of altered volcanic rocks and minor intrusive bodies. Evidently unmelted remnants of rocks that were intruded by quartz monzonite, apparently portions that floated on the upper surface of the granitoid batholithic magma during its intrusion.

Occurs in low hills beginning less than 1 mile southeast of the Baker and Western mines. Lies on both sides of paved road that connects the mines with the settlement, formerly called Amargo, but now called Boron [Mohave Desert region, Kern County].

Amargosa chaos

Post-Miocene(?): Southeastern California.

L. F. Noble, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1936; 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 963–978, pl. 3. Name applied to rocks of overthrust plate of Amargosa thrust. These rocks are broken into innumerable blocks and slices, which are thrust over one another to form an extremely complex mosaic. Chaos is divided into Virgin Spring, Calico, and Jubilee facies, each characterized by certain kinds of rock. The thrust and chaos are folded into several plunging anticlines of northwesterly trend, along whose crests earlier Precambrian rocks below the thrust are exposed. Unconformably underlies Funeral fanglomerate.

Virgin Spring area, in Black Mountains east of Death Valley. Features similar to Amargosa thrust and chaos occur throughout an area of at least 8,000 square miles that borders and includes Death Valley trough.

Amargosan series[1]

Early Tertiary: California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78.

Best exposed in Amargosa Desert and in Furnace Canyon near Death Valley.

Amarillo sandstone[1]

Jurassic(?): Northeastern New Mexico.

Original reference: C. R. Keyes, 1905, Am. Jour. Sci., 4th, v. 20, p. 424.

Derivation of name not given.

Amasa Formation (in Baraga Group)

Precambrian (Animikie Series): Northwestern Michigan.

Stephen Royce, 1936, Lake Superior Min. Inst. Proc. 29th Ann. Mtg., p. 78, 81, 86, 97. One of the iron-bearing formations of Lake Superior region. Separated by conglomerate from overlying Upper Huronian slates; associated with contemporaneous volcanics, called Hemlock greenstone, at its base.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36–37. Included in Baraga group (new); Animikie series. Lies stratigraphically between Hemlock formation and Michigamme slate. Occupies same stratigraphic position as Fence River formation (new), but direct equivalence not yet proved. Contains wide variety of rocks—pyritic slate, ferruginous slate and quartzite, chert, and cherty hemotitic iron-formation. Aggregate thickness about 1,500 feet.

Occurs in Iron County on western Menominee Range.

Amawalk Granite

Upper Ordovician(?): Southeastern New York.

T. W. Fluhr, 1948, Rocks and Minerals Mag., v. 23, no. 8, p. 699. Shown on map legend as underlying Croton Falls diorite and overlying Thomaston granite.

Vicinity of New York City.

Amazonia Limestone Member (of Lawrence Shale)

Amazonia Limestone Bed (in Lawrence Shale)[1]

Pennsylvanian (Virgil Series): Northwestern Missouri and eastern Kansas.

Original reference: H. Hinds and F. C. Greene, 1915, Missouri Bur. Geology and Mines, v. 13, 2d ser., p. 31, 170, 179.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 158–159. Amazonia limestone member occurs about 24 feet below top of Lawrence shale at Amazonia, at Heumader quarry, 1½ miles northwest of St. Joseph, Mo., and near Wathena, Kans. Thickness 9 feet at type locality; 13 feet near St. Joseph and Wathena; thins southward.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 68 (fig. 24), 72. Typically light-gray dense hard limestone occurring about 25 or 30 feet below top of Lawrence shale. Separated from underlying Ireland sandstone member by unnamed shale and sandstone interval. Thickness ranges from featheredge to about 13 feet. In southern outcrop area, it averages about 1.5 feet.

Type locality: Amazonia, Andrew County, Mo.

Amboy stoneware clay[1] (in Raritan Formation)

Cretaceous: Northeastern New Jersey.

Original reference: Heinrich Ries, H. B. Kümmel, and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 168–172.

H. C. Barksdale and others, 1943, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec.

Rept. 8], p. 66, 67. Varies in color from light gray through darker grays to nearly black with considerable amount of carbonaceous material. Thickness 0 to 30 feet. Where present, forms impermeable layer between Old Bridge sand member (new) of Raritan and Magothy formation.

Named for occurrence at South Amboy, Middlesex County.

Amchitka Formation

Tertiary or older: Alaska.

H. A. Powers, R. R. Coats, and W. H. Nelson, 1960, U.S. Geol. Survey Bull. 1028–P, p. 533–536, pl. 69. Water-laid beds of volcanic breccia and some thin-bedded fine-grained tuff, all interbedded with pillow flows of lava. Andesitic to latitic in composition. Tilted, jointed, and slightly metamorphosed in many areas. Thickness several thousand feet. Overlain with angular unconformity by tuff and conglomerate of Banjo Point formation (new) and lava and conglomerate of Chitka Point formation (new). Oldest recognized rocks on island. Geologic age unknown but must be at least as old as early Tertiary inasmuch as overlying Banjo Point rocks are of early middle Tertiary age.

Type section: Exposed along south coast from South Bight westward to long 179°18′ E., Amchitka Island (Aleutian Islands). Makes up northern part of western third, and most of eastern fourth of island; small isolated exposures at and west of Cyril Cove.

Amelia-Goochland Quartz Monzonite Gneiss[1]

Precambrian: Central Virginia.

Original reference: A. A. Pegau, 1932, Virginia Geol. Survey Bull. 33, p. 15, 20–22, pl. 1.

Occurs in Amelia, Goochland, Powhatan, and southern Louisa Counties.

American Falls Lake Beds[1]

Pleistocene, upper: Southeastern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30 (table), 69–72, pl. 6. Report discusses ground-water resources of Snake River Plain. American Falls lake beds are younger than Cedar Butte basalt and older than Madson basalt. Consist of a sedimentary member and a basalt member. Thickness about 150 feet.

Type locality: Bluffs along Snake River from American Falls Dam, Power County, to narrows, a distance of about 5 miles.

American Flat Basalt

Quaternary: Western Nevada.

V. P. Gianella, 1936, Nevada Univ. Bull. 30, no. 9, Geology and Mining Ser. no. 28, p. 33, 76–77, pl. 1. Flow of dark-gray to almost black-olivine basalt about 25 feet thick. Underlies alluvium. Stratigraphically above Knickerbocker andesite (new).

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 59–60. Replaced by McClellan Peak olivine basalt. Name American Flat preoccupied.

Occurs in Silver City district in Virginia Range, 12 miles north of Carson City. Largest body of basalt is in extreme southeastern part of American Flat.

American Flat Latite[1]

Miocene: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1907, U.S. Geol. Survey Geol. Atlas, Folio 153.

F. D. Spencer and M. I. Erwin, 1953, U.S. Geol. Survey Circ. 258, p. 8 (fig. 1). Chart shows American Flat latite in sequence above Silverton volcanic series and below Potosi volcanic series.

Occurs in vicinity of Ouray.

American Fork Formation[1]

Lower(?) Cretaceous: Central southern Montana.

Original reference: E. Douglass, 1909, Carnegie Mus. Annals, v. 5, p. 269–288.

Occurs near American Fork of Musselshell River, Sweetgrass County.

American Lakes Glacial Substage

American Lakes Till

Pleistocene (Wisconsin): Central Colorado.

D. F. Eschman, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1380. Time of latest of four glacial advances in area. Minor advance resulting in deposition of formless deposits of fresh drift. Followed Silver Creek advance (new).

D. F. Eschman, 1955, Jour. Geology, v. 63, p. 201 (fig. 2), 206–207, pl. 2. Deposits of substage mapped as American Lakes till. Pebbles in till are fresh, and no weathered profile evident. Surface of drift area sparsely strewn with large boulders of rock types present in cirque head wall. Deposits are more recent than those of Silver Creek substage but not so recent as some deposits not definitely connected with a glacial advance and referred to as post-American Lakes in age.

Named for American Lakes, at head of Middle Fork Michigan River, North Park. Two rock steps immediately below lakes are covered with deposits of substage. Deposits also present in hanging valley below Lake Agnes and near head of Silver Creek.

American Nettie Quartzite[1]

Upper Cretaceous: Southwestern Colorado.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

Probably named for a mine.

American Ravine Andesite Porphyry

Miocene(?): Western Nevada.

V. P. Gianella, 1936, Mining and Metallurgy, v. 15, no. 331, p. 299 (table 1). Incidental usage.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 33, 44–45, 50–52, pl. 1. Light-gray felsitic hornblende andesite about 500 feet thick. Underlies Hartford Hill rhyolite; overlies fanglomerate, monzonite, or metamorphic rocks. Eocene.

F. C. Calkins, 1944, Outline of the geology of the Comstock lode district, Nevada: U.S. Geol. Survey, p. 16–17; F. C. Calkins and T. P. Thayer, 1945, Geologic map of the Comstock lode district (1:24,000): U.S. Geol. Survey. Intrusive into Hartford Hill rhyolite and probably into Alta andesite. Miocene(?).

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 52, pl. 3. Distinguished only in Comstock lode district.

Occurs on eastern side of Virginia Range, near Virginia City.

†Americus Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Named for Americus, Lyon County.

Americus Limestone Member (of Foraker Limestone)[1]

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: M. Z. Kirk, 1896, Kansas Univ. Geol. Survey, v. 1, p. 80.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 43 (fig. 17), 49, 51 (fig. 19). Basal member of Foraker limestone. Underlies Hughes Creek shale member; overlies Oaks shale member of Hamlin shale. Commonly two limestone beds separated by shale. Thickness ranges from 6 to 22 feet. Wolfcampian.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 53–56. Described in Wabaunsee County, Kans. Limestone formerly called Houchen Creek south of Pottawatomie County does not correlate with type section in Nebraska, but coalesces with Americus limestone member in Wabaunsee County. This limestone has distinctive type of algae in lower part of Americus that can be traced north into Pottawatomie and Jackson Counties. Americus formerly consisted of one or two beds of limestone 12 or more inches thick in lower part, 4 to 8 feet of gray fossiliferous shale in middle part, and bed of gray limestone 18 or more inches thick in upper part. In this report, upper contact of Americus is restricted to top of lower one or two beds of limestone. This places upper bed of limestone, which is absent in some places, and beds of shale in Hughes Creek shale member. Lower part of Americus is redefined to include algal bed heretofore referred to as Houchen Creek limestone in Chase County (Moore, Jewett, and O'Connor, 1951, Kansas Geol. Survey, v. 11, pt. 1) and in Lyon County (O'Connor, 1953, Kansas Geol. Survey, v. 12, pt. 1). In southern part of Wabaunsee County, Americus now consists of three beds of limestone separated by two beds of shale, but northward lower shale bed pinches out and lower bed of limestone coalesces with, and becomes part of, middle bed of limestone in northern part of county. Shale that lies above algal limestone was called Oaks shale member in Chase County (Moore, Jewett, and O'Connor, 1951) and in Lyon County (O'Connor, 1953). In Wabaunsee County, this is lower shale bed of Americus. Underlies Hughes Creek shale member; overlies Hamlin shale member of Janesville shale.

Named for exposures near Americus, Lyon County, Kans.

Ames cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 134–140. Embraces interval between Harlem cyclothem, below, and Gaysport cyclothem (new) above. Thickness about 17 feet. Includes

(ascending) Ames shale and (or) sandstone, Ames underclay, Ames coal, and Ames limestone members. In area of this report, Conemaugh series is discussed on a cyclothemic basis; 15 cyclothems are named. [For sequence, see Mahoning cyclothem.]

Type section: About center of Ames Township, Athens County (locality 8984, map 16).

Ames Limestone Member (of Conemaugh Formation)[1]

Ames Limestone (in Conemaugh Group)

Upper Pennsylvanian: Eastern Ohio, eastern Kentucky, southwestern Maryland, southwestern Pennsylvania, and northern West Virginia.

Original reference: E. B. Andrews, 1873, Ohio Geol. Survey, v. 1, p. 235, 271, 296.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 43, pl. 9. Correlation chart shows occurrence in eastern Kentucky.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 31–32. Described in eastern Ohio as a dark bluish- to greenish-gray limestone. Thickness varies from a few inches to a maximum of about 15 feet. Lies below Gaysport limestone in some areas. In this report, the Conemaugh is treated as a series.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 71–72, table 1. Top member of Harlem cyclothem.

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Occurs 172 feet above Nadine limestone (new) and 126 feet above Carnahan Run shale (new) in Armstrong County, Pa.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 54–55. Described in Morgan County as member in Conemaugh series. Thickness 10 inches to 3½ feet. Occurs about middle of series and about 140 to 160 feet below Pittsburgh (No. 8) coal. Above Harlem coal and Harlem shale member; separated from Gaysport limestone member by unnamed shale and sandstone members.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94, 138–140. In this report [Athens County], Conemaugh is described on a cyclothemic basis. Ames limestone, Ames coal, Ames underclay, and Ames shale and (or) sandstone are classified as members of Ames cyclothem (new). Ames limestone is about 200 feet above Upper Freeport (No. 7) coal and 180 feet above Pittsburgh (No. 8) coal.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69, 71, 77. Referred to as Ames limestone in Conemaugh group.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Conemaugh formation as mapped includes Mahoning sandstone near base, Ames limestone in middle of sections, and Brush Creek limestone in lower part of section.

Named for exposures near Amesville, Ames Township, Athens County, Ohio.

Ames Monzodiorite[1]

Mississippian(?): Central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1895, 1901–1902, pl. 1. Listed in chronology of White Mountain Magma series as older than Endicott diorite (new) and younger than Gilmanton monzodiorite (new). Described as gray medium-grained monzodiorite composed primarily of feldspar and hornblende, with some biotite.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 73. Included in a discussion of White Mountain plutonic-volcanic series of Mississippian(?) age.

On shore of Lake Winnipesaukee, northwest of Ames Station, in Belknap Mountains.

Ames Red Bed (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia and western Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 6.

Occurs at Morgantown, W. Va., and at Latrobe, Pa.

Ames Shale (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 289.

Probably named for occurrence in limestone identified as Ames limestone.

Ames shale and (or) standstone

See Ames cyclothem.

Ames Knob Formation[1]

Silurian: Central southern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 4.

W. T. Forsyth, 1953, Report of the State Geologist 1951–1952, p. 45. Incidental mention in discussion of Ellsworth schist in Blue Hill. Contains Niagaran fossils.

Named for exposures on shore of Southern Harbor, northwest of Ames Knob, which lies one-half mile west of village of North Haven, Knox County.

Amherst Schist[1]

Pre-Triassic: Central Massachusetts, northern Connecticut, and southwestern New Hampshire.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 218, 219, 222, 224–225.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. In Mount Toby quadrangle, Amherst is quartz-muscovite-biotite schist that locally has been so silicified and pegmatized as to change it into a massive gneissic granitelike rock. Extensive area north of Amherst that was mapped earlier by Emerson as Williamsburg granodiorite and interpreted by him as an intrusive igneous body is altered Amherst schist. Pre-Triassic.

Exposed in Mount Warner and across Amherst, Mass.

Amherstburg Formation (in Detroit River Group)

Amherstburg Dolomite Member (of Detroit River Dolomite)[1]

Middle Devonian: Western Ontario, Canada, southeastern Michigan, and northern Ohio.

Original reference: W. H. Sherzer and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 542.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 41–42. Referred to Detroit River group in Ohio where it is basal unit of group and underlies Lucas formation.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1466. In revised classification of Detroit River group, Amherstburg dolomite is noted as overlying Sylvania sandstone and underlying Lucas dolomite.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 2 (fig. 2), 7–14. Redefined to include Sylvania sandstone, where present, as basal sandstone member of formation. Includes Filer sandstone lentil (new). Except for Sylvania and Filer sandstones, Amherstburg is limestone or dolomite. The only evaporites within the formation are occasional nodules of anhydrite observed in cores from wells drilled in the basin. Beds assigned to Amherstburg in central part of basin agree with fauna, stratigraphic position, and lithologic character of Amherstburg at its type locality. Noncherty limestone or dolomite beneath evaporites and above the Bois Blanc formation on north flank of Michigan basin, and heretofore described by the writer [Landes, 1945] as upper part of the Bois Blanc, is now considered to be Amherstburg. Basal formation of Detroit River group. Underlies Lucas formation. Overlies Bois Blanc formation.

Named for fact that it forms bottom of eastern channel of Detroit River opposite Amherstburg, Ontario.

Amicalola Gneiss

Precambrian: North-central Georgia.

A. S. Furcon and K. H. Teague, 1945, Georgia Geol. Survey Bull. 51, p. 31–34, pl. 3. Term Amicalola gneiss is used to define that part of Precambrian basal complex [of this area] which contains much altered sedimentary rocks and which is characterized by deposits of massive kyanite. Locally replaces term Carolina gneiss. On north, underlies beds of Oglethorpe formation (new); on south and east, terminated by Dawsonville shear zone; western boundary marked by Marble Hill overthrust.

Mapped in parts of Cherokee, Pickens, Gilmer, and Dawson Counties. Lies between Tate and Dawsonville so that a line connecting these towns divides area into about equal parts.

Amity limestone (deposit)

Age not stated: Eastern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 11. Mentioned in report on limestone deposits in Willamette Valley. One and possibly two limestone lenses that strike north and dip a few degrees west. Only a few feet thick. Lower contact covered. Limestone is interbedded with fine-grained white fossiliferous tuff which is in turn overlain by light-colored tuffaceous sandstone. Fossils indicate marine origin.

Occurs 3 miles south of Amity, Polk County, in foothills of Eola Hills about 1 mile east of Pacific Highway (U.S. 99W) in NE¼ sec. 9, T. 6 S., R. 4 W., W. M., at elevation of about 225 feet.

Amity Member (of Cattaraugus Formation)

Amity Shale[1]

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original reference: G. H. Chadwick, 1925, Geol. Soc. America Bull., v. 36, p. 457–464.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1744, chart 4. Upper Devonian. In column occurs above Panama conglomerate and below Salamanca. Geographically extended to southwestern New York.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33. Member of Cattaraugus formation in southwestern New York where it overlies Panama conglomerate member and underlies Saegerstown member. Derivation of name given.

Name derived from Amity Township, located in Erie County, Pa.

Ammonoosuc Volcanics[1]

Middle Ordovician: Northwestern New Hampshire, north-central Massachusetts, and Vermont.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map. Geographically extended into Massachusetts, where it underlies Clough formation.

M. P. Billings, 1956, The geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 7 (fig. 3), 17–19, 94–98, geol. map. Ammonoosuc volcanics present in four zones, chiefly in western part of state. Belt that extends northeast from Woodsville includes type locality. Second belt northeast of Monroe correlated with Ammonoosuc volcanics because of its lithology and stratigraphic position above Albee formation. Third belt, extending northeast from 3 miles east of Haverhill, correlated because of its lithology and repetition of entire stratigraphic sequence from Albee to Littleton. Fourth belt extending whole length of the state, correlated because of its lithology and repetition of startigraphic sequence, from Ammonoosuc formation through Littleton. In area southwest of Littleton, where both top and bottom of formation are present. Ammonoosuc volcanics are about 2,000 feet thick, but extensive folding makes precise determination difficult. In belt that extends north from Massachusetts to Maine, formation is thinner because only top is exposed above Oliverian plutonic series. Four miles southwest of Randolph thickness is about 5,000 feet. Summary of arguments for and against correlations with other units. Assigned to Upper Ordovician(?) on geologic map, but formation may be Middle Ordovician.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 15 (fig. 4), 17–19. Described in southeast corner of St. Johnsbury quadrangle, Vermont and New Hampshire. Overlies Albee formation. Older than Waits River formation. Middle or Upper Ordovician.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 544–545, 551, 554, pl. 1. Discussion of stratigraphic and geotectonic relationships in northern Vermont and southern Quebec. Ammonoosuc volcanics assigned to Middle Ordovician.

Type locality: In district bounded on north by Slate Ledge School and Partridge Lake and on south by Youngs Pond (Ogontz Lake) and Tinkerville, N.H. Locality name taken from old Ammonoosuc mining

district, northwest of Ammonoosuc River between Woodsville and Littleton.

Amnicon Formation (in Oronto Group)[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 50, 54.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474–1479. Thwaites assumed that Eileen sandstone (in Oronto group) lay below Amnicon sandstone on basis of distribution of outcrops and strike and dip. Eileen at type locality is not in contact with any other formation of Oronto series but is separated by unexposed interval of almost 1½ miles from Amnicon formation. Therefore relation of Eileen and Amnicon is not definitely known at type locality, and sequence postulated by Thwaites is only one of several possible explanations of relation of these two sandstones. Lithological and heavy-mineral evidence suggest that Eileen sandstone belongs above the Amnicon and includes beds on Middle River and Fish Creek sections that Thwaites classes as lower Orienta (in Bayfield group). The Eileen, which resembles Bayfield group of sandstones, is probably basal Orienta, and Amnicon arkose is upper Freda. Thickness of Amnicon as given by Thwaites—5,000 feet—included in his estimate of thickness of Freda. Hence, Oronto group revised to exclude Eileen and Amnicon sandstones.

Exposed on Fish Creek, near Ashland, and on Middle and St. Louis Rivers in Douglas County.

Amoeba Lake Graywackes, Slates, and Tuff

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1603–1605. Differs only slightly from "well-banded Knife Lake" slates and graywackes (unit 5 of series) in that they contain more graywacke and considerable tuffaceous material. Gradational bedding common; interstratified lenses of conglomerate. Highly folded. Thickest sediments, 4,000 to 5,000 feet, occur in segment of Knife Lake snyclinorium whose axis passes through Amoeba Lake. Overlie massive arkosites; underlie Kekekabic Lake tuffs, agglomerates, and slates (new). In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Amoeba Lake graywackes as unit 9 occurring above pink andesite conglomerates and agglomerates and below Ensign Lake green slates, tuffs, and graywackes (new).

Sediments named after Amoeba Lake where they are best exposed. Report covers a belt in eastern Vermilion district more or less parallel to international boundary.

Amole Arkose or Group

Lower Cretaceous and (or) Upper Cretaceous: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 713, 716–720, pl. 1. Series of gray to pink coarse-grained arkose, interbedded with shales and a few limestone beds; characterized by rapid and repeated changes in rock type; interbedded shales are usually silvery gray. Few of the limestone units are more than 2 feet thick, and most of them are very thin bedded and range in color from blue gray to black. Unconformably underlies Cat Mountain rhyolite (new); conformably

overlies Recreation redbeds (new) into which it grades through a zone about 75 feet thick. Thickness of formation about 2,275 feet [measured near the Ranger Station]. Similarity in some limestone beds suggests repetition in the section, but this could not be proved. Top of Cretaceous is apparently not exposed in range but is cut off either by erosion, as in measured section, or by overthrust sheet.

W. B. Fergusson, 1959, Arizona Geol. Soc. Guidebook 2, p. 44 (fig. 4), 46–47. In southern parts of Tucson Mountains, Kinnison (1958, unpub. thesis) estimated that clastic sediments similar to Amole arkose are more than 5,000 feet thick. At least part of this section was mapped by Brown (1939) with his volcanic unit. Kinnison divided southern section into four formations and suggested that term Amole be elevated to group status. Base of group rests on Permian limestone with a limestone conglomerate. Because there is an angular unconformity within Amole group, Kinnison suggests that group may include two sequences of lithologically similar clastic rocks separated by andesite-pebble conglomerate and the Recreation red beds.

J. E. Kinnison, 1959, Arizona Geol. Soc. Guidebook 2, p. 48 (fig. 5A), 49, 50, 51 (fig. 5B), 54, 55, 149 (fig. 28). Group includes Recreation red beds of Brown (1939) and, possibly andesitic volcanic rocks (Kinnison, 1958) whose exact stratigraphic positions are unknown. Age of group probably Lower and Upper Cretaceous, and some strata may be as young as early Tertiary. Group underlies Tucson Mountain chaos.

D. L. Bryant and J. E. Kinnison, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1235. Paleontological evidence suggests that Amole arkose and underlying Recreation redbeds are most probably Lower Cretaceous and are not wholly Upper Cretaceous as previously designated.

Area: Tucson Mountains, southeastern Arizona. Amole arkose crops out chiefly on western side of southern part of range and extends north to Amole Peak, where it is cut off by granitoid intrusives. Northeastern part of belt extends across and around eastern side of peak.

Amole Granite

[Upper Cretaceous and (or) Tertiary] (Laramide): Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 721–722. Granite occupies western side of exposed part of a stock west of Amole Peak. Occurs in three different topographic positions which govern its appearance on weathered outcrops. On fresh surfaces, rock is pink speckled with black. On weathered surfaces, it is light tan to drab. Along its southern margin, granite is clearly intrusive into Cretaceous sedimentary rocks. It is not in contact with Tertiary volcanic rocks, but metamorphosed Cretaceous adinoles and hornfels occur in conglomerate at base of Tertiary volcanic rocks on cliff south of Safford Peak. This seems to indicate that granite is Laramide in age.

Area: Tucson Mountains, southeastern Arizona. City of Tucson is located at east base of central part of range.

Amole Latite

[Upper Cretaceous and (or) Tertiary] (Laramide): Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 725–726, pl. 1. An intrusive on top of Amole Peak. Occurs in series of roughly east-west fingers extending eastward from [Amole] quartz

monzonite. Latite is intrusive as sills into Cretaceous sedimentary rocks. It shows extreme variety. Commonest is dense felsitic rock with inconspicuous phenocrysts of quartz and feldspar and abundant xenoliths of arkose and other Cretaceous sedimentary rocks. Elsewhere, rock is coarsely felsitic and so full of fine-grained inclusions that it closely resembles invaded arkoses. No gradational contacts with [Amole] quartz monzonite have been found.

Area: Tucson Mountains, southeastern Arizona. City of Tucson is located at east base of central part of range.

Amole Quartz Monzonite

[Upper Cretaceous and (or) Tertiary] (Laramide): Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 723–725. Belt of gray quartz monzonite about 1 mile wide and 4 miles long. Occurs to west and northwest of Amole Peak and circles northeasterly part of Amole granite (new). Best exposure is in steep arroyo heading about 1,000 feet west of Amole Peak and extending northward.

Area: Tucson Mountains, southeastern Arizona. City of Tucson is located at base of central part of range.

Amoret Limestone Member (of Altamont Formation)

Pennsylvanian (Des Moines Series): Western Missouri, south-central Iowa, eastern Kansas, and northeastern Oklahoma.

J. G. Grohskopf and Earl McCracken, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 10, p. 17. Mentioned as basal member of Altamont formation. Underlies Lake Neosho shale member. Name credited to L. M. Cline and F. C. Greene.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 7–8. Name Amoret suggested as substitute for Tina, which is abandoned because type Tina proved not to be Altamont. Type locality designated.

L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 18–21. At type locality, consists of three gray limestone beds and a thin greenish-gray shale bed; thickness about 5 feet. Varies in thickness and lithology in short distances. Overlies Bandera shale. Reference is made to an underclay as part of Amoret cyclothem. Occurrence in Madison County, Iowa, noted.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 15, 16 (fig. 2). Occurs in Oklahoma where it is shown as a limestone [bed] within Altamont member of Oologah formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31, fig. 5. Represented in Madison County by thin layer of fresh-water limestone nodules in matrix or red underclay that is continuous with Neosho Lake shale member above. Amoret is not present farther south in Iowa. Maximum thickness exposed in Madison County 10 inches.

Type locality: Two miles south of Amoret, Bates County, Mo., in sec. 33, T. 40 N., R. 33 W.

Amos Wash Member (of Supai Formation)

[Permian]: Central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 86–88. Shown on stratigraphic section as overlying Naco formation and underlying Big "A" sand facies of Supai. Name credited to S. S. Winters.

Type locality and derivation of name not stated. Winters (1951, Plateau, v. 24, no. 1) described, but did not name, members of the Supai along Amos Wash, 15 miles west of White River, Fort Apache Reservation.

Amsden Formation[1]

Amsden Formation (in Montchauve Group)

Mississippian and Pennsylvanian: Wyoming and Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

H. W. Scott, 1935, Jour. Geology, v. 43, no. 8, pt. 2, p. 1017 (table 3), 1020–1023. In its type locality, consists of those beds that occur between top of Madison limestone and base of Tensleep formation. Originally considered Pennsylvanian in age; Branson and Greger (1918, Geol. Soc. America Bull., v. 29, no. 2) have shown Amsden of Wind River Mountains to be Mississippian. In south-central Montana, Amsden rests upon erosional surface developed on Madison limestone. In area between Three Forks and Townsend, Amsden is separated from Madison by series of fossiliferous sandstones, shales, and limestones that attain thickness as great as 1,200 feet in central Montana. Group of strata between Amsden and Madison in central Montana has been designated Big Snowy group (new). In central Montana, Amsden underlies Ellis formation (Upper Jurassic). Section measured on southeast corner of Quadrant Mountain (type section of Quadrant) shows Amsden formation (beds 1–7) 109 feet thick; underlies Quadrant formation (beds 8–21); overlies Madison limestone.

C. C. Branson, 1937, Jour. Paleontology, v. 11, no. 8, p. 650–660. Restricted at base to exclude unit herein named Sacajawea formation. At measured section on Bull Lake Creek, Wyo., Lower Amsden consists of 21 feet of unfossiliferous laminated limestone possibly of Chester age; Upper Amsden consists of 80 feet of sandstone overlain by 96 feet of limestone, sandstone, and shale. Underlies Tensleep sandstone.

C. C. Branson, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1201, 1223. Discussion of Pennsylvanian of central Wyoming. Tensleep sandstone of Darton is only locally recognizable as lithologic unit and is not a true stratigraphic unit. No boundary can be drawn to separate it from Amsden formation, and fauna of upper part of Amsden is indistiguishable from that of Tensleep sandstone. Name Tensleep is herein retained as name of a formation which includes entire Pennsylvanian sequence in central Wyoming; that is, Tensleep sandstone of Darton, upper part of Amsden, and some unnamed beds above Tensleep. Measured sections show that the Tensleep overlies Sacajawea formation, or Sacajawea(?), or unnamed beds of Chester(?) age.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 132. Discussion of Wind River Mountains area. Tensleep as herein defined includes upper part of Amsden of Darton and name Amsden is dropped.

M. L. Thompson and H. W. Scott, 1941, Jour. Paleontology, v. 15, no. 4, p. 350. Scott's (1935) section on Quadrant Mountain revised. Beds 3–21 are Pennsylvanian and are included in Quadrant formation; beds 1–2 are Mississippian and are referred to Sacajawea(?) formation. Name Amsden deleted from section.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 18–19, 21 (fig. 5). Amsden, in Three Forks area, overlies Madison formation and underlies Quadrant formation. Lower part, which is probably equivalent to Sacajawea, contains an upper Mississippian fauna comparable to that of Brazer limestone; beds in upper 100 feet contain fossils generally considered Pennsylvanian.

E. S. Perry and L. L. Sloss, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1293–1295. Branson (1937, 1939) and Thompson and Scott (1941) recognized that the Amsden, as defined by Darton, included strata of both Pennsylvanian and Mississippian age. They placed all Pennsylvanian strata in the Tensleep (Quadrant) and established Sacajawea formation to include lower beds bearing a Ste. Genevieve fauna. Between redefined Tensleep and Sacajawea are unnamed strata bearing a Chester fauna. These latter beds may be traced throughout central Montana and much of Williston basin, overlapping truncated edges of Big Snowy strata and transgressing peninsula area devoid of both Big Snowy and Sacajawea sediments along Montana-Wyoming border. Name Amsden should be retained for these strata in Montana and Williston basin; if name Amsden is not retained, then new term must be coined for these strata.

H. W. Scott, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1195. *Millerella* zone occurs about middle of formation.

P. T. Walton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1296, 1301–1302. Amsden, in Judith basin area, consists of two members: lower sequence of red and pink shales and mudstone, red coarse poorly sorted ferruginous sandstones, and locally thin beds of grayish-green and buff fine-grained limestone; upper sequence of marine fossiliferous limestone contining interbedded red, maroon, and purple shale. In places, where pre-Ellis erosin has not cut too deep, a thin sequence of yellow, pink, and purple clay shale lies above the marine limestone section. Overlies erosional surface truncating Heath and Otter shales; underlies Ellis formation. Mississippian and Pennsylvanian (Morrow).

J. D. Vine and W. J. Hail, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 108. Where exposed along northern flank of Little Belt Mountains, the Amsden ranges in thickness from about 500 feet to more than 900 and rests with apparent conformity on Otter formation. Unconformably underlies Ellis group which in this area commonly consists only of Swift formation.

L. R. Laudon and J. L. Severson, 1953, Jour. Paleontology, v. 27, no. 4, 512 (fig. 2d). Discussion of crinoid fauna from Mississippian Lodgepole formation. Columnar section shows Amsden formation overlying Mission Canyon formation. Pennsylvanian.

W. F. Scott and P. C. Wilson, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1554. Sacajawea formation restricted vertically to include only red-bed sequence at base of Amsden and extended laterally throughout area where red beds are recognizable. Term Amsden should be retained for limestones and dolomites between Sacajawea (restricted) and typical sandstone of Tensleep or its equivalents.

C. A. Burk, 1954, Jour. Paleontology, v. 28, no. 1, p. 1–16. Review of fossils identified from Amsden formation indicates a Pennsylvanian rather than Mississippian age for the Amsden in Wyoming.

J. D. Love, 1954, Tentative diagrammatic correlation of Tensleep, Amsden, Casper, and Hartville formations in Wyoming: Wyoming Geol. Assoc.

Guidebook 9th Ann. Field Conf. Chart shows that Darwin sandstone member of Amsden overlies type Sacajawea formation at Bull Lake.

A. B. Shaw and W. G. Bell, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 3, p. 333–337. Discussion of age of Amsden formation at Cherry Creek, Wind River Mountains. Six new collections of fossils from lower part of Amsden place Mississippian-Pennsylvanian boundary more than 48 feet and less than 63 feet above Madison limestone. Lower faunas are Chesteran in age, and upper faunas are tentatively dated Atokan. Name Sacajawea formation is rejected for Mississippian beds at Cherry Creek. Presence of two sandstones in Amsden, both of which have been called "Darwin sandstone" is inferred. Amsden at Cherry Creek contains beds that are specifically excluded farther north in Wind River Mountains. Thus, there is dual usage of name Amsden. Solution of problem lies in type area of formation. If typical Amsden contains both Mississippian and Pennsylvanian faunas, Cherry Creek section is also typical Amsden, and Love's (1954) restricted Amsden should be renamed. Conversely, if type Amsden lacks Sacajawea fauna, restricted Amsden is proper, and Cherry Creek section should be renamed.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 49, pl. 6. Formation, in Crazy Creek area, Johnson County, Wyo., overlies Madison limestone and underlies Tensleep sandstone. Thickness about 250 feet. Corals in lower part of formation range from late Mississippian to early Pennsylvanian.

P. A. Mundt, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1918–1919, 1928–1929. In central Montana, so-called "Amsden" formation consists of three lithologic divisions: an upper dolomite unit, a middle brownish limestone unit, and a lower sequence of red shale and sandstone beds. Dolomite unit is lithologically, stratigraphically, and paleontologically equivalent to carbonate part of Amsden at its type locality in Wyoming. Amsden dolomite overlaps toward the south the underlying brown limestone and red shale beds and also formations of Big Snowy group. Unconformably(?) underlying Amsden dolomite of Atokan age is brown ostracodal limestone unit which is probably of Chester age but may be all or in part early Pennsylvanian. This brown limestone was named Alaska Bench formation by Freeman (1922), and his terminology is recommended herein. Thickness 33 feet along Durfee Creek, Fergus County; top of section eroded.

V. L. Freeman, E. T. Ruppel, and M. R. Klepper, 1958, U.S. Geol. Survey Bull. 1042–N, p. 498–499, 550, pl. 42. In Townsend Valley, Broadwater and Jefferson Counties, Mont., Amsden formation, which is probably separated from Mission Canyon limestone by erosional unconformity, includes rocks of both Mississippian and Pennsylvanian age. Consists of red calcareous siltstone with medial unit of gray carbonate rock and grades into Quadrant formation. Thickness 259 feet in Limestone Hills.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 344–346. Big Snowy group revised to include (ascending) Kibby sandstone, Otter, Heath, Cameron Creek, and Devils Pocket formations. Various parts of Big Snowy group (revised) have been correlated with Amsden formation of northern Wyoming and southern Montana. The two sequences represent same general interval of geologic time, from end of Madison to beginning of Tensleep. They occupy distinct basins separated by a divide, toward which Amsden rocks thin and vanish from

the south and Big Snowy rocks thin and vanish from the north. Scott (1935) used Amsden formation in central Montana for rocks (Cameron Creek formation and Alaska Bench limestone) lying above Heath formation. Very few dependable correlative ties have been found between Big Snowy rocks of central Montana and Amsden rocks less than 50 miles away in southern Montana. Mundt (1956) shifted name Amsden from rocks to which it was assigned by Scott and applied it to entirely different rocks of Atokan age. In present report, it is preferred to give these rocks separate formational names and discontinue term Amsden in central Montana.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1962–1963. This paper concurs with Scott and Wilson's (1953) proposals of applying name Sacajawea to persistent predominantly red shale unit (including Darwin sand) formerly referred to as "lower Amsden." Term Amsden then is restricted to the overlying predominantly cherty carbonate sequence. Term Amsden (restricted) is used in central Montana area to refer to carbonate sequence underlain by Tyler formation, or older rocks where Tyler is absent. Unit is overlain either by Tensleep sandstone, Minnelusa formation of Williston basin, or strata of Ellis group. Maximum thickness 400 feet (south end of Judith basin). Divisible into two units: lower, predominantly Alaska Bench limestone member, and unnamed upper part referred to as dolomite member. Pennsylvanian (Morrowan-Atokan). Name Amsden (restricted) could possibly be extended into Williston basin region.

T. W. Todd, 1959, Dissert. Abs., v. 20, no. 6, p. 2230–2231. Sacajawea formation, Amsden formation, and Tensleep sandstone are products of marine transgressive-regressive cycle that took place on Wyoming cratonic shelf during Pennsylvanian period as one phase in development of eastern Cordilleran geosyncline. Name Montchauve group is suggested for these formations.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of stratigraphy of Pennsylvanian in northern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Suggested that Quadrant and Casper formational names be abandoned and Tensleep-Amsden-Sacajawea terminology extended to include strata formerly referred to by these names and that term Sacajawea be accepted as formational name applicable to red clastic sequence between Madison limestone, or equivalent, and Amsden carbonates.

Named for Amsden Branch of Tongue River, west of Dayton, Sheridan County, Wyo.

Amsterdam Limestone (in Black River Group)[1]

Amsterdam Limestone (in Trenton Group)

Middle Ordovician: Eastern New York and western Vermont.

Original reference: R. Ruedemann, 1910, New York State Mus. Bull. 138, p. 72.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 259–260, pl. 2. Included in lower part of Trenton group and discussed under formations of Rockland age. At Manny Corners, underlies Larrabee member (new) of Glens Falls formation and overlies Lowville formation. Dark-gray medium-textured limestone. Thickness about 11 feet. At Crown Point, 16 feet of Amsterdam beds overlie 27 feet of Chaumont and underlie 16 feet of Isle la Motte. Typical section given.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. Evidence presented to substantiate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs region. Previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam sandstone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation (new), Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland? Hull, Sherman Fall representatives), and Canajoharie shale. Amsterdam is 3 feet thick in area instead of 50 feet as previously indicated. Where Lowville is absent, the Amsterdam overlies Gailor dolomite.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 15). Shown on correlation chart as underlying Isle la Motte limestone in western Vermont and Lake Champlain area.

Typical section in quarry one-half mile east of Manny Corners, 3 miles east-northeast of Amsterdam, Montgomery County, N.Y.

Anacacho Limestone[1]

Anacacho Limestone (in Taylor Group)

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 240.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 46–47. Foraminifera described. Anacacho limestone listed in Taylor group.

Named for Anacacho Mountains, Kinney County, which are capped by the formation.

Anadarche Conglomerate (in Hoxbar Formation)[1]

See Anadarche Member (of Hoxbar Formation).

Anadarche Limestone (in Hoxbar Formation)[1]

See Anadarche Member (of Hoxbar Formation).

Anadarche Member (of Hoxbar Formation)[1]

Anadarche Member, Beds, or Limestone (in Hoxbar Group)

Pennsylvanian (Missouri Series): Southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15–16.

C. W. Tomlinson, 1929, Oklahoma Geol. Survey Bull. 46, p. 43–44. Described as Anadarche member of Hoxbar formation. Includes Anadarche conglomerate and Anadarche limestone of Tomlinson (1928). Consists of dense hard bluish-gray limestone as much as 20 feet thick at top and limestone conglomerate as much as 10 feet thick at base. Thickness 100 to 200 feet. Lies 500 to 800 feet above Crinerville member and 400 to 600 feet below Daube limestone member. Type locality designated.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 697, chart 6 (column 37). Correlation chart shows Anadarche limestone in Hoxbar group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa,

Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 42–43. Anadarche referred to as Anadarche beds or member of Hoxbar group. Thickness 100 to 200 feet. Lies 400 to 500 feet above Crinerville beds or member and some 400 feet below Daube limestone member. Includes basal sandstone or conglomerate, medium shale, and capping limestone.

Type locality: On Anadarche Creek one-eighth mile south of NW cor. sec. 35, T. 5 S., R. 2 E. [Carter County].

Anahuac Formation

Anahuac Stage

Oligocene, upper, or Miocene, lower: Subsurface in Louisiana and Texas.

J. B. Eby, 1943, Oil Weekly, v. 111, no. 4, p. 22–23. Wedge of dark-greenish shale. Ranges in thickness from about 1,600 feet in southeast corner of [Jackson] county to featheredge in northwest section of county.

A. C. Ellisor, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1355–1368. Includes *Discorbis*, *Heterostegina*, and *Marginulina* zones. Lies between basal sands of Fleming above and subsurface Frio below. Type well and locality designated.

A. D. Warren, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 223 (fig. 1), 225–227. In southwestern Louisiana, sediments of Anahuac stage are almost identical to type section in Texas. Stage consists, for most part, of shales with some sand in west and central parts of south Louisiana and of limestone and calcareous clastics in eastern part of State. Younger than Frio stage. Either upper Oligocene or lower Miocene; age is controversial. In reference well for stage, Anahuac sequence is about 3,500 feet thick.

H. C. Goheen, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 91–103. Formation in southern Louisiana subdivided to include Erath member (new). Upper Oligocene or lower Miocene.

Type locality: Anahuac oil field, 5 miles east of town of Anahuac, Chambers County, Tex. Type well: Humble Oil and Refining Co. Middleton No. 1. Formation present in well from 5,890 to 6,984 feet. Reference well: Humble Oil and Refining Co. E. E. Wild No. 1, Jefferson Davis Parish, La.

Anakeesta Formation (in Great Smoky Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 959–960. Consists mainly of dark-gray or black silty argillaceous rocks, variously metamorphosed. Interbedded are thick beds of lighter gray coarser feldspathic sandstone. Many of the lighter beds form single layers in the darker rocks, but some form units of considerable thickness that are classed as tongues of Thunderhead sandstone. Overlies and intertongues extensively with the Thunderhead; individual tongues do not exceed 2,000 feet in thickness but range through a stratigraphic interval of nearly 5,000 feet. East of Thunderhead Mountain where there is no intertonguing, the Anakeesta forms unbroken unit about 4,500 feet thick, underlain by Thunderhead sandstone and overlain by a similar but unnamed sandstone.

Named for Anakeesta Ridge, a high spur between Mount Le Conte and Newfound Gap, Sevier County. Typically exposed along U.S. Highway

441 from base of the ridge up to the gap. Occurs well back in Great Smoky Mountains where it crops out in narrow steep-sided ridges and craggy pinnacles. A synclinal belt extends westward from Mount Sequoyah to meridian of Gatlinburg, most of belt being north of State-Line divide. Farther west, formation appears in homoclinal sequence in head drainages of the prongs of Little River.

Anaktuvuk Group[1]

Lower Cretaceous: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 245.

P. S. Smith, 1913, U.S. Geol. Survey Bull. 536, p. 55 (table), 82–84. Discussion of Noatak-Kobuk region. Anaktuvuk group consists of sandstones with subordinate shales and conglomerates. Estimated thickness 2,000 feet. Probably contemporaneous with Koyukuk group. Probably Lower Cretaceous.

Named for Anaktuvuk River on which it occurs.

Anaktuvuk River Glaciation

Pleistocene (pre-Wisconsin): Central northern Alaska.

R. L. Detterman, 1953, *in* T. L. Pewe and others, U.S. Geol. Survey Circ. 289, p. 11, 13 (table 1). Four Quaternary glacial advances recognized in Sagavanirktok-Anaktuvuk district. Anaktuvuk, the oldest, succeeded by Sagavanirktok glaciation (new). Evidence for glaciation consists of quartzitic conglomerate boulders on hills 500 to 600 feet above Anaktuvuk River and drift preserved as low subdued tundra-covered morainal hills that occupy area of 100 square miles along the river.

Renamed Anaktuvuk River Glaciation in order to retain name Anaktuvuk for group.

In Sagavanirktok-Anaktuvuk region.

Analomink Red Shale[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1206.

Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 5, p. 588. Local unit of 100 feet of red beds at its type locality. White (1881) mistook it for his much younger New Milford red shale, from which it is separated by beds probably equal to lower Chemung and upper Portage. Valuable only for recognizing base of Delaware River formation.

Type locality: Analomink, Monroe County.

Anamosa Dolomite[1]

Silurian (Niagaran?): Central eastern Iowa.

Original reference: S. Calvin, 1895, Iowa State Univ. Bull. Lab. Nat. History, v. 3, no. 3, p. 186, 189.

Named for Anamosa, Jones County.

Anarchist Series[1]

Late Paleozoic: Southern British Columbia, Canada, and north-central Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 10, 11, 12.

A. C. Waters and Konrad Krauskopf, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1358–1364, pl. 1. Heterogeneous group of greenstones, phyllites, quartzites, chlorite schists, crystalline limestone, and partially metamorphosed conglomerates. Subdivided into three units termed Lower, Middle, and Upper Anarchist series. Total thickness unknown; sections over 5,000 feet thick, apparently without duplication, include only a part of 1 of the 3 divisions. Older than Colville batholith. Shown on map legend as unconformably underlying Triassic limestone.

Daly mapped Anarchist series around Anarchist Mountain, British Columbia.

Anastasia Formation[1]

Pleistocene: Florida.

Original reference: E. H. Sellards, 1912, Florida Geol. Survey 4th Ann. Rept., p. 18.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 65–67. Formation as herein defined includes coquina, sand, sandy limestone and shelly marl of pre-Pamlico Pleistocene age that lies along both Florida east and west coasts. This excludes surficial sand of Pamlico age. Upper part of formation is contemporaneous with Miami oolite, upper part of Key Largo limestone, and Coffee Mill Hammock marl member of Fort Thompson formation, all of which might be considered as facies of Anastasia. Formation is wedge shaped, thin toward the interior and thick toward coast, where it may be as much as 60 feet thick. On west coast is a thin irregular deposit extending from Marco Island as far north as Tampa Bay; greatest thickness probably not more than 10 feet. Merges with upper marine members of Fort Thompson in Caloosahatchee River valley.

Typically exposed on Anastasia Island; also in cut made by Florida East Coast Railway on Tomora Creek, near Ormon, and along coast at Rockledge.

Anaverde Beds

Miocene: Southern California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on geologic map legend as nonmarine sediments. No text.

This may or may not be same unit later defined as Anaverde Formation.

Anaverde Formation

Pliocene, lower to middle: Southern California.

R. E. Wallace, 1946, (abs.) Am. Geophys. Union Trans., v. 27, no. 4, p. 552. Mentioned as part of sediments occurring in trough of San Andreas rift between Palmdale and Elizabeth Lake.

R. E. Wallace, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 785, 790–792. Consists of pink to reddish conglomerate and arkose (at base), white to buff conglomerate and arkose, and about 1,000 feet gypsiferous shale at top. Thickness about 2,000 feet. Unconformably underlies Quaternary deposits; rests with depositional contact on granite. Derivation of name given. Name credited to C. L. Gazin (unpub. ms.).

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Further described and noted as occurring only north of San Andreas fault.

This may or may not be same unit as Anaverde Beds (Jenkins, 1938).

Named from Anaverde Valley [Palmdale quadrangle].

Anawalt Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 245.

Exposed at southwest edge of town of Anawalt, McDowell County.

Ancell Group

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 11. Shown on columnar section as comprising (ascending) Kingdom, Daysville, Loughridge, and Harmony Hill formations. Underlies Platteville group; overlies Prairie du Chien group. Includes Glenwood subgroup.

Occurs in Dixon-Oregon area.

Ancha Formation (in Santa Fe Group)

Pliocene, upper, or Pleistocene: North-central New Mexico.

E. H. Baltz, Jr., and others, 1952, New Mexico Geol. Soc. Guidebook 3d Field Conf., p. 12, 15, 16, 17. Consists of poorly consolidated sandstone, siltstone, and conglomerate. Thickness 0 to 200 feet. Unconformably overlies Galisteo sandstone. Considered eastward extension of Puye gravel.

Brewster Baldwin and F. E. Kottlowski, 1955, New Mexico Bur. Mines Mineral Resources Scenic Trips to the Geologic Past, no. 1, p. 8, 21, 24, geol. map. Formation rests on westward-sloping surface that cuts across tilted Tesuque formation. Mapped near Canada Ancha west of city of Santa Fe.

Brewster Baldwin, 1957, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 115–121. Included in upper unit of Santa Fe group. Puye gravel, Ancha formation, and Tuerto gravel all rest with angular unconformity on deformed beds of Tesuque formation. These units of gravel are 500, 300, and 150 feet in maximum thickness respectively. Distinction between Tesuque and Ancha formations in Santa Fe area is based largely on westward dip and somewhat better consolidation of the former. In Buckman area, Ancha appears to intertongue with Puye gravel and with river gravel that has been assigned by some workers to the ancestral Rio Grande.

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines Mineral Resources Bull. 48, p. 5 (table 1), 28–29. In Cerrillos area, underlies Cuerbio basalt. Thickness 0 to 350 feet. Early Pleistocene(?).

Ming-Shan Sun and Brewster Baldwin, 1958, New Mexico Bur. Mines Mineral Resources Bull. 54, p. 7 (table 1), 18, 22–23, pl. 1. Discussion of Cienga area, Santa Fe County. Formation forms blanket of silt, sand, and gravel that is now being eroded from Cienguilla limburgite and earlier rock units in area. Thickness commonly less than 100 feet. On west side of area, covered by and interbedded with flows of olivine-

bearing basalt; locally gravel rests on top of flows. Basalt tuff present about 20 feet below lowest flow, and, though tuff mapped separately in Santa Fe area, it is not distinguished from Ancha formation in area of this report. Formation and basalt flows tentatively dated as early Pleistocene, but they might be Pliocene in age.

Named in vicinity of Santa Fe. Derivation of name not stated. Canada Ancha is shown on topographic map of Agua Fria quadrangle, west of Santa Fe.

Anchor Limestone Member (of Monte Cristo Limestone)[1]

Anchor Member (of Monte Cristo Dolomite)

Lower Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 17.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 880, 881, 883 (fig. 2). Geographically extended into Nopah Range, Inyo County, Calif., where it consists essentially of limestone with minor amounts of shale and chert. Thickness 622 feet. Underlies Bullion limestone member; overlies Dawn limestone member.

Charles Deiss, 1952, U.S. Geol. Survey Bull. 973–C, p. 115–116, pl. 13. Described in Sloan district, Nevada, where it is 65 to 75 feet thick and consists of thin-bedded (2 to 18 inches) buff and pale-gray dolomite with nodules of gray and tan chert in irregular layers. Overlies Dawn member; underlies Bullion member.

D. F. Hewett, 1956. U.S. Geol. Survey Prof. Paper 275, p. 42. Described in Ivanpah quadrangle (California-Nevada) where it commonly consists of several thick layers of light-bluish-gray limestone that contains layers of chert nodules. Overlies Dawn limestone member; underlies Bullion dolomite member.

Named for exposures in region of Anchor mine, Goodsprings quadrangle, Nevada.

Anchor Silt

Pleistocene, lower: Southern California.

P. U. Rodda, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2478–2481, 2489–2490. Consists largely of massive buff-colored fine sands and silts with thin irregular beds of cobble gravel. Maximum thickness 60 feet; base not exposed. In disconformable contact with overlying Medill sand (new).

Area is near hilltop on Overland Avenue, about 1,000 feet south of National Boulevard, and 1 mile southwest of Castle Heights area, in Cheviot Hills, Los Angeles. Named for exposures on Anchor Avenue.

Anchor Mine Tongue (of Mancos Shale)[1]

Upper Cretaceous: Eastern Utah.

Original reference: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 36–38.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 180 (fig. 2), 190. Figure 2 shows Anchor Mine tongue of Mancos intertonguing with Segó member of Price River formation. Erdmann reported series of coal-bearing rocks in Anchor Mine tongue and named most conspicuous

unit Anchor Mine coal. In present study, coal-bearing bed in Anchor Mine tongue was not noted. These beds lie above upper sandstone tongue of Sego member. Proposed herein to use Erdmann's name Anchor Mine coal for the main coal bed in Sego member of Price River.

Exposed at Anchor mines, Book Cliffs coal field.

Ancon Hill Rhyolite or Dacite

Miocene: Panama.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 25. Dense porphyritic much-jointed hard light-gray material. Pre-Pliocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 323. Rock is dacite. Miocene.

Forms rocks at Ancon Hill, located between towns of Panama and Balboa.

Anderdon Limestone Member (of Lucas Formation)

Anderdon Limestone Member (of Detroit River Dolomite)[1]

Middle Devonian: Western Ontario, Canada, southeastern Michigan, and northwestern Ohio.

Original reference: W. H. Sherzer and A. W. Grabau, 1908, Science, new ser., v. 27, p. 408.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1466. Considered an uppermost formation in Detroit River group. Overlies Lucas dolomite. Middle Devonian.

G. M. Ehlers, E. C. Stumm, and R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northwestern Ohio, p. 5, 8 (fig. 2), 11, 12. Geographically extended into Ohio where it is shown as underlying Dundee limestone. Thickness about 24 feet. Type locality stated.

U.S. Geological Survey classifies the Anderdon as member of Lucas Formation.

Named for exposure in Anderdon (Brunner, Mond Canada, Ltd.) quarry about 1¼ miles north of Amherstburg, Ontario.

Anderson Clay[1] (in Conemaugh Formation)

Pennsylvanian: Ohio.

[Original reference]: Wilber Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 452–456.

D. L. Norling. 1958, Ohio Geol. Survey Bull. 56, p. 40. Member of Conemaugh series. In Morgan County, Anderson clay is developed subjacent to Anderson coal in some exposures. Beds range in thickness from 2 inches to maximum of 1½ feet and consist of gray to tan, subplastic to plastic clays and clay shales.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 121. Anderson underclay member of Anderson cyclothem. Average thickness 2⅔ feet in Athens County. Normally lies directly below Anderson coal, although the coal may be reduced to paper thinness. In northern Appalachian region, the clay is known as (Lower) Bakerstown or Thomas clay. Overlies Bloomfield limestone member. Conemaugh series.

Takes its name from overlying Anderson coal.

Anderson cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 16. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 66–68, table 1, geol. map. Includes (ascending) Anderson shale, 15 feet; Bloomfield limestone (absent in Perry County); Anderson coal; and Portersville shale and limestone, 3 to 8 feet. Occurs below Barton cyclothem and above Wilgus cyclothem. In area of this report Conemaugh series is described on cyclothemic basis; seven cyclothems are named. [For sequence see Mahoning cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 118–123. In Athens County, includes (ascending) Bakerstown shale and (or) sandstone, Bloomfield limestone, Anderson underclay, Anderson coal, and Portersville shale and limestone. In this report [Athens County], Conemaugh series is described on cyclothemic basis; fifteen cyclothems are named. [For sequence see Mahoning cyclothem.]

Exposed in Perry County.

Anderson Phyllite[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 622, 641.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consists of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

In Medicine Bow Mountains. Named for old Anderson mining prospect on Libby Creek, near contact of this formation with Nash marble series.

Anderson Sandstone

Anderson Sandstone (in Pottsville Group)[1]

Pennsylvanian: Eastern Tennessee.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 33.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 18). Shown on correlation chart as overlying Scott formation and including strata from Pilot Knob sandstone up to top of Pennsylvanian.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], p. 1. Name Anderson formation discontinued. In new classification presented, sediments formerly described as Anderson are redefined and included in Cross Mountain and Vowell Mountain groups (both new).

J. K. Englund, 1957, U.S. Geol. Survey Coal Inv. Map C–39. Youngest Pennsylvanian in mapped area [Scott and Campbell Counties, Tenn.]. Overlies Scott shale. [Pottsville group not used in this report.]

U.S. Geological Survey has discontinued use of Pottsville Group in Tennessee.

Named because of its frequent occurrences in Anderson County.

Andorno Formation

Upper Triassic: North-central Nevada.

R. R. Compton, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1388, pl. 1. Phyllite interbedded with persistent thin beds of quartzite, dolomitic quartzite, dolomite, and limestone. Thickness 7,000 to 8,000 feet. Overlies Singas formation (new) with contact gradational; underlies Mullinix formation (new) with contact gradational.

Type area: On high ridges that separate drainage of Andorno, Buffalo, Stone House, and Wash O'Neill Creeks, Santa Rosa Ranges, Winnemucca region.

Andover Granite[1]

Carboniferous: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 39–40. Term Gospel Hill gneiss proposed for mass of granitic rocks that Emerson (1917) mapped as variant of Andover granite but that is considered in this report [Hudson and Maynard quadrangles] as granitized product of Nashoba (new) and Marlboro formations.

Occupies large area around Andover.

Andrada Formation

Permian: Southeastern Arizona.

E. D. Wilson, 1951, Arizona Bur. Mines Bull. 158, Geol. Ser. 19, p. 50. Listed in stratigraphic sequence in Empire Mountains. Consists of shale, marl, limestone, and gypsum, 300 to 1,500 feet thick. Underlies Snyder Hill formation; overlies Naco limestone. Permian.

R. E. Thurmond, W. E. Heinrichs, Jr., and E. D. Spaulding, 1954, Mining Eng., v. 6, no. 2, p. 198 (fig. 1). Shown on generalized columnar section of Mineral Hill area as Andrada (Manzano) formation. Thickness about 400 feet. Underlies Snyder Hill formation; overlies Naco limestone. Permian.

D. L. Bryant, 1955, Dissert. Abs., v. 15, no. 7, p. 1224. Defined to include rocks between Horquilla (Pennsylvanian) and Scherrer (Permian) formations in western part of area where distinctive characters of Earp, Colina, and Epitaph formations are lost.

First described in Empire mining district, Empire Mountains, southeast of Tucson. Derivation of name not given.

Andrecito Member (of Lake Valley Formation)

Mississippian (Osage): Southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11 (fig. 4), 12–13, passim. Proposed for basal member of Lake Valley formation (redefined). At type section, consists of approximately 35 feet of thin-bedded gray fossiliferous limestone grading upward into thin-bedded dark-gray somewhat cherty limestone. Varies in thickness and lithology throughout area of exposure; thickens northward from type section to over 75 feet in Rich Rim and thins again toward north end of range; maximum thickness approximately 270 feet in Cooks Mountains. At type section, underlies Alamogordo member and unconformably overlies Caballero formation; overlies various units of the

Devonian in areas where Caballero is missing—either Contadero formation or Box member of Percha shale.

Type section: Along south wall of Andrecito Canyon in San Andres Mountains in NW¼ sec. 8, T. 18 S., R. 4 E.

†Andrew shale (in Douglas Formation)[1]

Pennsylvanian: Northwestern Missouri, southwestern Iowa, and eastern Kansas.

Original reference: C. R. Keyes, 1899, Am. Geologist, v. 23, p. 306.

Named for Andrew County, Mo.

Andrew Bay Volcanics

Tertiary: Southwestern Alaska.

R. R. Coats, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 5, p. 77, 78, pl. 6. Thick accumulation of breccia, tuff-breccia, and lava flows; these rocks are products of an ancient volcano, herein called Andrew Bay Volcano. Maximum thickness about 1,000 feet; original thickness much greater. Considered younger than newly defined Zeto Point basalt porphyry (Mesozoic?): oldest volcanic rocks of "Mount Adagak" are banked against a sea cliff cut in Andrew Bay volcanics.

Andrew Bay volcanics make up ridge rising steeply from water's edge on east shore of Andrew Bay, northern Adak Island.

Andrews Schist[1]

Andrews Formation

Lower Cambrian: Western North Carolina, north-central Georgia, and eastern Tennessee.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 7, p. 377. Suggested stratigraphic sequence (descending): Murphy marble, Andrews schist, Nottely quartzite. Calcareous and ferruginous Andrews schist may be transitional beds between the quartzite and the marble.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Included in Talladega series considered to be Precambrian.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 53–54, pl. 1, geol. map. Redefined as formation. Metasedimentary sequence, 1,400 to 1,800 feet thick, that lies between Murphy marble [below] and Nottely quartzite. Base of sequence is a calcareous schist which corresponds to Keith's Andrews schist in Nantahala quadrangle but were mapped by Keith as part of Valleytown formation. Although formation contains rocks which were mapped by Keith (1907) and LaForge and Phalen (1913, Folio 187) as parts of other formations, its stratigraphic limits are same as those specified by Keith for Andrews schist.

Named for exposures in vicinity of Andrews, Cherokee County, N.C.

Androscoggin Formation

Androscoggin Gneiss and Schist

Androscoggin Series

Ordovician(?): Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed as Androscoggin gneiss and schist. Underlies Bates limestone (new); overlies Precambrian orthogneisses. Cambro-Ordovician(?).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. Seven formations in Lewiston area (ascending): Danville injection gneiss (new), Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate-gneiss (new), Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite biotite schist. Middle Silurian.

L. W. Fisher, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 81. Five mappable units have been established in area formerly mapped as Precambrian in southwestern Maine. Sequence (ascending): Danville-Pejepscot (new) series, Taylor Brook injection gneiss (new), Androscoggin series, including Bates limestone and Deer Rips lime silicate gneiss, and Thorncrag-Sabbatus series.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 117–124, pl. 1, table 1 (facing p. 112). Formation includes four phases: highly injected biotite-garnet gneiss, lime-silicate gneiss, marble, and quartz-biotite schist. Thickness about 3,500 feet. Underlies Sabattus formation; overlies Taylor Brook formation. Quartz-biotite facies traced into Vassalboro formation between Litchfield and South Litchfield. Ordovician(?). Type locality designated.

Type locality: At City Rapids between Lewiston and Auburn [Androscoggin County].

Aneth Formation

Upper Devonian: Subsurface in Utah, Arizona, Colorado, and New Mexico.

R. L. Knight and J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 56, 57, 58; J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 61–63. Dark dolomite interval interbedded with varying amounts of gray, brown, and black shale, gray siltstone, and lighter dolomites. Thickness 170 feet in type well; occurs between depths of 8,161 and 8,331 feet. Thins gradually in all directions from a center just southwest of type well. Underlies McCracken sandstone (new); unconformity inferred. Overlies Ophir formation, contact unconformable.

Type section: Described from well core Shell Oil Company Bluff Unit No. 1 located in sec. 32, T. 39 S., R. 22 E., near the town of Blanding, Utah.

Angaur (older and younger) Limestone

Pleistocene or early Holocene: Caroline Islands (Angaur).

Risaburo Tayama, 1951, Tohoku Univ. Inst. Geology and Paleontology Short Papers no. 3, p. 102 (geol. map), 103, 105; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 67, table 4 [English translation in library of U.S. Geol. Survey, p. 80]. Consists of two units referred to as Older Angaur and Younger Angaur limestone. Older limestone constitutes major part of Angaur terraces referred to as C_1 and C_2; white and porous, composed mainly of *Halimeda* limestone with some coral limestone. Younger limestone constitues lowest terrace C_3 and is exposed at altitude of 5 feet in limited areas along shore; hard limestone principally of *Halimeda* and corals. Younger than Palau limestone. Pleistocene and Recent.

Angaur Island, Palau group.

†Angelina series[1]

Tertiary: Eastern Texas.

Original reference: R. T. Hill, 1902, Franklin Inst. Jour., v. 154, no. 2, p. 153–154.

Probably named for Angelina County or Angelina River.

Angell Member (of Ballard Formation)

Pleistocene (Nebraskan): Southwestern Kansas.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 57–58. Name applied to sand, gravel, and cobble member at base of Ballard formation. Thickness about 7 feet. Underlies Missler member; overlies Rexroad formation.

Type section: Sanders gravel pit, SE¼NW¼ sec. 7, T. 32 S., R. 28 W., Meade County. Name derived from old Angell Schoolhouse which was located in SE cor. NE¼ sec. 31, T. 32 S., R. 29 W.

Angel Lake Glacial Stage[1]

Pleistocene: Northeastern Nevada.

Original reference: E. Blackwelder, 1931, Geol. Soc. America Bull., v. 42, p. 918.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243A, table 2 facing p. 24. Mentioned in discussion of Wisconsin glaciation.

Well displayed at Angel Lake, southwest of Wells, Elko County.

Angola Shale Member (of West Falls Formation)

Angola Shale[1]

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 24, chart.

Wallace de Witt, Jr., and G. W. Colton, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–30. Conformably underlies Pipe Creek member of Hanover shale. Gradational contact with underlying Rhinestreet shale. About 235 feet thick in Silver Creek quadrangle. Composed largely of medium- to light-gray even- to lumpy-bedded shale and blocky- to irregular-bedded mudstone. Interbedded are small amounts of fissile grayish-black and dark-brown shale; a few medium-light-gray muddy siltstones; some thin beds of medium-gray argillaceous limestone; many calcareous nodules and concretions.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Chart OC–55. Reallocated to member status in West Falls formation (new). Overlies Rhinestreet member; in some areas, intertongues with Gardeau shale member; in some areas, overlies Nunda sandstone member; locally underlies Pipe Creek member of Hanover shale.

Named for Angola, Erie County, where it is exposed along Big Sister Creek.

Animas Formation[1]

Upper Cretaceous and Paleocene: Southwestern Colorado and northwestern New Mexico.

Original references: C. W. Cross, 1896, U.S. Geol. Survey Mon. 27, p. 217–219; J. H. Gardner, 1917, U.S. Geol. Survey Prof. Paper 101, p. 185–186.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Described on eastern side of San Juan Basin, N. Mex. Estimated thick-

ness, 3,000 feet near New Mexico-Colorado line. Thins southward to about 1,200 feet in northwestern part of T. 25 N., R. 1 E. Divisible into lower part consisting chiefly of sandstone and conglomerate and an upper part consisting chiefly of soft sandstone and clay. Toward south, formation includes larger percentages of clays and sandy clays and grades laterally into lithologic unit consisting chiefly of softer beds which has been traced to south into sequence that has been mapped as undivided Puerco and Torrejon formations (Dane, 1936, U.S. Geol. Survey Bull. 860–C) in vicinity of Cuba. This lateral transition takes place gradually over distance of many miles, but some arbitrary division of nomenclature is necessary. Name Animas is extended only southward to Canyoncito de las Lleguas in T. 25 N., R. 1 E. Conformably overlies Fruitland formation in northern and northwestern part of basin; underlies Wasatch formation. Separation on lithologic grounds of the part of the Animas that is Cretaceous and the part that is Paleocene has not yet been made.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map OM–149. Described in La Plata and Montezuma Counties, Colo. Above Kirtland shale a sequence of purple and olive-drab rocks containing much volcanic debris was named, "Animas River beds" by Cross and Animas formation by Gardner (1917). Reeside (1924) divided sequence into McDermott formation and Animas formation. Reeside's typical section of the McDermott is herein subdivided as follows: lowest 95 feet of pebble-bearing sandstone and sandy shale is part of Kirtland shale, the overlying 127 feet of purplish beds is McDermott member, and top 106 feet is included in upper member (unnamed) of Animas. The two members are gradational, and aside from contrast in color, show no consistent lithologic distinction. The dominantly purple McDermott strata are best exposed on Animas River, where they intertongue with overlying greenish-gray olive-drab, and tan Animas strata. Northeastward from Animas River, the McDermott thins by intertonguing with upper member so that in area of Florida-Los Pinos divide the purple sediments are replaced by greenish beds. Where maroon and purple sequence is present in Colorado the formation consists of basal McDermott member and an upper member; elsewhere in Colorado the formation is not subdivided. Above Animas formation is sequence of tuffaceous shale and lenticular sandstone mapped by Reeside as Torrejon formation but herein called Nacimiento formation.

Typical exposures on Animas River below Durango, Colo.

†Animas interglacial epoch[1]

Pleistocene: Southwestern Colorado.

Original reference: W. W. Atwood and K. F. Mather, 1912, Jour. Geology, v. 20, p. 392–409.

Animas Valley Basalt

Pleistocene, upper, or Recent: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 77–78, table 1, pl. 1. Dark-gray to dull-black fine-grained vesicular olivine basalt. Thickness estimated to be about 60 feet, undoubtedly not uniform. Part of flow covered by valley sediments.

Exposures confined to floor of western side of Animas Valley, along southeastern side of Peloncillo Mountains, Hidalgo County.

Animikie Group[1]

Animikie Series[1]

Precambrian: Ontario, Canada, and northern Michigan, northeastern Minnesota, and northern Wisconsin.

Original reference: T. S. Hunt, 1873, Am. Inst. Mining Engrs. Trans., v. 1, p. 331–395.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1041–1051. Retained as group name in Minnesota because outcrops are well correlated with original Animikie locality and not well correlated with type locality of Huronian. Includes (ascending) Pokegama quartzite, Biwabik iron formation series, and Virginia slate. Unconformable above Algoman batholithic intrusives; unconformable below Keweenawan group.

D. A. White, 1954, Minnesota Geol. Survey Bull. 38, p. 3 (table 1), 4. In Gunflint district, the three units of Animikie group corresponding to Pokegama, Biwabik, and Virginia formations of Mesabi district are called, respectively, Kakabeka, Gunflint, and Rove formations.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 33–35. Reinstated and given series rank in application to Michigan strata. Term Huronian, used in area for nearly 60 years, is not used here because of uncertainty of correlation with type Huronian of Canada; strata previously correlated with Huronian are now referred to Animikie on basis of accepted correlations with strata of Mesabi district of Minnesota, which have been traced into type Animikie of Thunder Bay area of Canada. Series divided into four groups (ascending): Chocolay, Menominee, Baraga, and Paint River. Series rests unconformably on eroded surface of lower Precambrian (post-Dickinson) granitic rocks; Animikie strata were deformed, metamorphosed, and intruded by dikes, stocks, and sills of gabbroic to granitic composition in a pre-Keweenawan orogenic interval.

F. F. Grout, R. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 20–29. In Cook County, group consists of Pokegama quartzite, Gunflint iron formation, and Rove formation. These units are correlated with Pokegama quartzite, Biwabik iron formation, and Virginia formation of Mesabi Range. Lies between Knife Lake group below, and Keweenawan group above.

Named for occurrence along Thunder Bay, north shore of Lake Superior, Ontario, Canada. Animikie is Indian same for Thunder Bay.

Anita Shale

Eocene, middle: Southwestern California.

F. R. Kelley, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 1, p. 3, 4, 5, 6–7. Thick unit of Eocene shales with subordinate beds of sandstone and some limestone nodules. At one or more horizons, includes red foraminiferal shale. Disconformably underlies Matilija sandstone; disconformably overlies Upper Cretaceous sandstone. Thickness about 600 feet.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 26, pls. 1, 2, 5, 6. Consists of about 1,000 feet of clay shale lying above Jalama formation (new). Relationship to the Jalama appears to be conformable, but in northerly exposures [Santa Ynez Range] the Anita rests unconformably on Jalama or older formations.

Type locality: On south side of Santa Anita Canyon 1 mile west of Big Bend [Santa Barbara County].

Ankareh Shale,[1] Formation, or Redbeds

Lower and Upper Triassic: Northeastern Utah. southeastern Idaho, and southwestern Wyoming.

Original reference: J. M. Boutwell, 1907, Jour. Geology, v. 15, p. 439–458.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 474, 476, 477 (fig. 2). Name Ankareh shale restricted to those red beds between Thaynes limestone and unconformity below Higham grit in northeastern Utah. Name Red Wash formation proposed for red beds at eastern end of Uinta Mountains that are equivalent to Woodside, Thaynes, and Ankareh (restricted).

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1260 (fig. 2), 1266 (fig. 5), 1270, strat. sections. In western Uinta and central Wasatch Ranges, overlies Thaynes limestone and unconformably underlies Gartra member of Stanaker formation (both new). Thickness 862 to 1,400 feet. Summary of stratigraphic nomenclature in area.

Bernhard Kummel, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., fig. 1 facing p. 48. In central Wasatch Mountains and western Uinta Mountains, subdivided into (ascending) Mahogany (new), Gartra grit. and Stanaker members.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 18), 178 (fig. 21), 179–180. As now used, name Ankareh is applied to different parts of post-Thaynes sequence in middle Rocky Mountains. In western Wyoming, applied to all strata between Thaynes formation and Nugget sandstone. In Utah, applied only to beds from Thaynes to Gartra grit. In Idaho, name Ankareh was abandoned by Mansfield (1927) although Gartra grit is probably equivalent to Higham grit and Higham grit is present in Ankareh in Wyoming. It is here proposed that Ankareh formation, as originally defined by Boutwell to include all strata between Thaynes and Nugget formations, be applied in northern Utah and western Wyoming and all formations that have been proposed for parts of this sequence be reduced to member rank. In eastern Uinta Mountains, Colorado Plateau nomenclature is used following Kinney and Rominger (1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 82). Wood shale is considered westward tongue of Ankareh formation as used in Wyoming. Stanaker formation and Gartra grit (Thomas and Krueger, 1946) are reduced to member status in Ankareh. Unit referred to Ankareh by Thomas and Krueger (1946) and Williams (1945) must be renamed. Name Mahogany member is here proposed for unit between top of Thaynes and base of Gartra member. Name Lanes tongue of Ankareh proposed for Sheep Creek section in Idaho. Main areas of outcrop and units present in each discussed briefly.

W. W. Rubey, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–109. Ankareh redbeds mapped in Bedford quadrangle, Wyoming.

U.S. Geological Survey currently designates the age of Ankareh as Lower and Upper Triassic on the basis of a study now in progress.

Named for Ankareh Ridge, Park City district, Utah.

Anna Shale Bed (in Pawnee Limestone Member of Oologah Formation)

Anna Shale Member (of Pawnee Limestone)

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 316–317, pl. 1. Lowermost member of Pawnee limestone. Includes a thin dark slabby limestone (at base) and a black platy and locally fissile shale. Thickness 3 to 11 feet. Underlies Myrick Station member; overlies Labette shale.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6–7, fig. 1. Geographically extended into Missouri and reallocated to Pawnee formation. Unit now termed Anna shale had been included in Labette formation.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 15, 16 (fig. 2). Occurs in Oklahoma where it is shown as a shale [bed] at base of Pawnee member of Oologah formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 32, fig. 5. Geographically extended into southwestern Iowa. As exposed in Madison County, upper bed is olive shale that weathers buff and contains fossil fragments; below this is dark-gray platy shale with light-gray fucoidal markings; lower shales are dark gray to black, hard, and slaty with thin gray lime concretions and bands in the upper part and are soft and clayey in lower part. Thickness 2.2 feet. Lowermost member of formation. Underlies Myrick Station limestone member; overlies Labette shale.

Type locality: North of center sec. 7, T. 27 S., R. 24 E., in Bourbon County, Kans., on Kansas Highway 7.

Annabelle Shale (in Monongahela Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 250.

At Annabelle, Marion County.

Annelly Gypsum Member (of Wellington Formation)

Permian: Southeastern Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5, 12. Consists of gypsum interbedded with lesser amounts of drab clays; both selenite and alabaster varieties of gypsum are present. Three prominent beds of gypsum commonly present, but locally, only two are present; in some places additional thin gypsum beds are interbedded with the clays. Thickness about 13 feet; at type locality, three beds of gypsum are exposed, each about 3 feet thick. Underlies Chisholm Creek shale member (new); overlies Geuda Springs shale member (new).

Type locality: High cliff on west branch of Whitewater River one-fourth mile south of Annelly, sec. 15, T. 24 S., R. 2 E., Harvey County.

Annie Creek Flows, Pumice Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 87–89, pl. 5 (fig. 2). Annie Creek flows (pumice flows) were products of glowing avalanches that swept down Munson Valley from Mount Mazama

into Annie Creek. Glowing avalanches of pumice and scoria were part of final activity of Mount Mazama and followed what is termed main pumice fall.

Annie Creek flows southward from Crater Lake.

Annona Chalk[1]

Annona Chalk (in Taylor Group)

Upper Cretaceous: Northeastern Texas, southwestern Arkansas, Louisiana, and southeastern Oklahoma.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 308.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 133–146. Annona chalk, which in eastern Red River County is estimated to be 300 or 400 feet thick, is time equivalent of combined lower part of Taylor marl, Wolf City sand member, and Pecan Gap member of Lamar, Delta, and Fannin Counties. Phosphatic bed that forms base of Annona chalk north of White Rock, in Red River County, has been traced westward and found to be continuous with phosphatic bed at base of Taylor marl just above Gober tongue of Austin chalk in Lamar County. In southwestern Arkansas, Annona chalk and underlying Ozan formation are together the approximate time equivalent of Annona chalk in Red River County, Tex.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 43–45. Annona chalk included in Taylor group. Pecan Gap chalk has been considered to be tongue of Annona chalk, with lower marl [east of Taylor group] and Wolfe City sand being lateral equivalents of lower part of Annona chalk (interpretation accepted here). Foraminifera described.

F. F. Mellen, 1958, Mississippi Geol. Survey Bull. 85, p. 29–40. Name Annona first projected into Mississippi into a part of Selma chalk by Shreveport Geological Society. In stratigraphic cross sections, projection was from Desha basin on north side of Monroe-Sharkey uplift and also within salt basin province south of Monroe-Sharkey uplift. Nomenclature and usage are set out in Gulf Cretaceous correlation chart (Shreveport Geol. Soc., 1945, v. 2, p. 480–481). In present study, it was assumed that stratigraphic studies and correlations of Annona section by Shreveport stratigraphers were essentially correct. It was upon this premise, that name Annona chalk was adopted to apply to a portion of lower part of Demopolis chalk. A 2-foot bed in upper part of Annona chalk as used herein has been traced over an area of all or part of more than 40 counties in Mississippi. This bed is herein named Coonewah, for outcrops in Coonewah Creek valley. Most data subsurface.

Named for outcrops about 2 miles northwest of Annona, Red River County, Tex.

Annsville Phyllite

Cambro-Ordovician: Eastern New York.

K. E. Lowe, 1947, Geol. Rev., v. 7, no. 1, p. 10. Near Tomkins Cove, both Wappinger limestone and associated Annsville phyllite (Hudson River series) trend southwest representing continuation of Cambro-Ordovician belt of sediments in Sprouts Brook (Peekskill) across Hudson River to northeast.

S. Schaffel, 1958, New York Geol. Assoc. Guidebook 30th Ann. Mtg., p. 2. Commonly dark bluish gray but may be black. Thickness uncertain because extent of isoclinal folding is not known. Conformably overlies Wappinger limestone. Youngest rock unit of Paleozoic age preserved in Peekskill Valley.

Probably named for occurrence in vicinity of village of Annsville, near Peekskill, Westchester County.

Annville Limestone[1]

Annville Formation (in St. Paul Group)

Middle Ordovician: Eastern Pennsylvania.

Original reference: B. L. Miller, 1925, Pennsylvania Geol. Survey, 4th ser., Bull. M–7, p. 124, 125, 133.

Carlyle Gray, April 1951, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 136, p. 12–15. Composed of two members: lower, thick-bedded high-calcium limestone; and upper, thin-bedded impure limestone. Total thickness more than 250 feet at western boundary of Berks County. Overlies Beekmantown limestone; underlies Jacksonburg formation. Formerly considered to be of Stones River age, but now correlated with "cement limestone" member of Jacksonburg. This correlation implies that Annville is in part Trenton and possibly in part Black River in age. Name Annville has been used as trade name.

C. E. Prouty, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1471. Annville limestone, heretofore a commercial term for cement limestone in Lebanon and adjacent counties, is defined and given formational status. Overlying "Leesport" will be renamed.

Carlyle Gray, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 140, p. 1, 3. Predominantly thick-bedded to massive crystalline high-calcium limestone. In eastern part of area, beds are blue, with some light-gray colors and pinkish gray. Light-gray and pinkish-gray colors dominant in west. Normal stratigraphic thickness about 240 feet; thins east of Myerstown to 20 feet at Womelsdorf. Underlies Myerstown limestone (new). Directly overlies Beekmantown group.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2720. Overlies Ontelaunee formation (new).

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 6–12. Though Miller (1925) used name in formational sense (Annville limestone), it was apparently proposed as trade name. Overlies Beekmantown group throughout most of its extent, but, in Harrisburg area, overlies rocks similar to middle member of "Stones River." Underlies Myerstown limestone in all observed sections. Type section designated.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in St. Paul group.

Type section: Quarry at old Palmyra plant of H. E. Millard Limestone Company about 1½ miles northwest of Palmyra. Named for town of Annville, Lebanon County.

Anón Andesite-Diorite

Eocene, postearly middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 113–115, geol. map. At type locality, shows needlelike phenocrysts

of hornblende and square phenocrysts of plagioclase feldspar. Intrudes lower middle Eocene rocks of Jacaguas group. Postearly middle Eocene and probably premiddle Oligocene.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 85. Commonly light to medium gray in color with phenocrysts of plagioclase feldspar. Andesitic rather than dioritic in texture. Intrudes rocks of Guayabal group (new). Footnote states that Guayabal group is currently called Jacaguas.

Type locality: On Camino Anón at kilometer post K9HO and below in bed of Río Inabon. Name derived from Hacienda Anón, 1.65 kilometers northeast of Cerro Santo Domingo. Occurs in series of stocks extending from Barrio Guayabal in northwestern part of Río Descalabrado quadrangle to Barrio San Patricio in northwestern Ponce quadrangle.

Anson Formation

[Silurian]: West-central Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Brown-mottled grits and arenaceous phyllites. Brown spots caused by oxidation of siderite. Position and formational status of Anson still in doubt. Correlates on basis of similar lithology with Vassalboro formation which is Clinton [Silurian] in age.

In Anson quadrangle.

Ansonia Granite

Pre-Triassic(?): Southwestern Connecticut.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 18–19, pl. 1. Light-gray biotite-muscovite granite gneiss. Cuts Hartland formation and Prospect gneiss.

Named for town of Ansonia, Naugatuck quadrangle.

Antelope Rhyolite[1]

Tertiary(?): Northwestern Arizona.

Original reference: C. Lausen, 1931, Arizona Bur. Mines Bull. 131, map.

Oatman district, Mohave County.

Antelope Shale

Upper Cretaceous: North-central California.

N. L. Taliaferro, 1954, *in* Northern California Geol. Soc. Spring Field Trip, [p. 6, 7], correlation chart, structure sections A, B, and C. Shown on correlation chart and structure sections as underlying Venado sandstone and overlying Salt Creek conglomerate (new). Beds vertical to overturned. Thickness 4,200 to 5,200 feet.

Klaus Kupper, 1956, Cushman Foundation Foram. Research Contr., v. 7, pt. 2, no. 152, p. 40–47. Description of Upper Cretaceous pelagic Foraminifera from "Antelope shale" of Taliaferro (1954). Kirby (1943, California Div. Mines Bull. 118) referred to these strata as Horsetown formation of Shasta group. J. Lawton (unpub. thesis) has proposed term Fiske Creek formation for "Antelope shale" which is junior homonym of Antelope formation (Miocene) of Kern County, described by Noble (1940 Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3).

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2287. If it is desirable that Shasta series be restricted to Early Cretaceous, base of conglomerate below so-called Antelope shale of

Taliaferro appears to be good choice for its upper limit and is so considered in this report.

Occurs in Rumsey Hills-Capay Valley-Wilbur Springs area on west side of Sacramento Valley.

Antelope Shale Member (of Monterey Formation)

Miocene, upper: Central California.

E. B. Noble, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 7, p. 1332 (fig. 1). Initially used as local name for a productive oil zone in Kern County.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1611 (fig. 2), 1617, 1621 (fig. 4), 1627 (fig. 8). At surface, consists of siliceous well-bedded light-brown shale containing minor lenses of sandstone and limestone. Thickness about 2,400 feet. Unconformably underlies Santa Margarita formation; conformably overlies McDonald shale member of Monterey formation.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, road log, strat. profile, chart, map. Underlies Chico Martinez chert member (new) and overlies McDonald shale member in Chico Martinez Creek area. Thickness about 2,750 feet. McDonald shale, Antelope shale, and Chico Martinez chert members are equivalent to McLure shale member of Monterey.

Type locality not stated. Area under study was Crocker Flat landslide in central Temblor Range.

Antelope Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 385, 386.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 70. Variable sandstone, friable to hard, pure to clayey, with conglomerate and some clay. Underlies Indian Creek bed; overlies Comanche Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, Ricker, is in common use today, and that name has been restricted to base of Drake's Ricker bed.

Named for Antelope Creek, San Saba County.

Antelope Flats Member (of Wellington Formation)

Permian: North-central Oklahoma.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1928. Uppermost member of formation. Thickness 195 feet. Overlies Billings member (new).

Type locality and derivation of name not stated.

Antelope Valley Limestone (in Pogonip Group)

Lower and Middle Ordovician: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 28–29. Name applied to uppermost formation in

Pogonip group. Dominantly thick-bedded or massive medium-gray or light-bluish-gray fine-grained limestone. Very little chert present. Cliff-forming units not uncommon. Locally contains thinner bedded zones, as at base of formation on Martins Ridge, where there is about 150 feet of rather thinly bedded argillaceous limestone. Here, formation not separable from underlying Ninemile formation (new) on basis of change from thinner bedded to thicker bedded limestone, but color change in thin-bedded rocks is distinctive. Thinner bedded limestones present near top of formation both in Antelope Valley and at Eureka. In this part of section, limestone tends to be flaggy or platy with tan argillaceous partings and mottlings, although limestone still retains medium-gray to light-bluish-gray color in bulk of unit. Thickness about 400 feet near Eureka; about 1,100 feet at Martins Ridge. In type area, underlies Copenhagen formation (new); in Eureka district proper, underlies Eureka quartzite.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). In Toquima Range, overlies Stoneberger shale (new); underlies Caesar Canyon formation or Diana formation (both new).

U.S. Geological Survey currently designates the age of the Antelope Valley Limestone as Lower and Middle Ordovician on the basis of studies now in progress.

Named for occurrence in Antelope Valley region. Well exposed on Martins Ridge, linear northward-trending ridge that separates Copenhagen Canyon from Antelope Valley and is about 25 miles southwest of Eureka.

Antero Formation

Oligocene: Central Colorado.

J. H. Johnson, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 77; J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7), 63–67, 170–171, pl. 1. Lacustrine sediments with some associated delta and flood plain deposits and beds of volcanic ash and agglomerate. Beds contain layers and reefs of algal limestones. Thickness about 2,010 feet. Underlies Wagontongue formation (new); overlies Balfour formation (new).

Area: South and west of Hartsel in Tps. 12–15 S., Rs. 75–76 W.; occupies several long, narrow, and partly connected basins in the Precambrian north-northeast of Hartsel, in Tps. 10–11 S., Rs. 74–75 W., Park County.

Antes Shale (in Trenton Group)

Middle Ordovician (Mohawkian): Central Pennsylvania.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3 (fig. 2); no. 2, p. 114. Comprises about 400 feet of dark, brownish-weathering shale lying between Coburn limestone and silty and arenaceous Reedsville shale. *Dicranograptus nicholsoni* (Hall) abundant near top of formation; *Tiarthrus eatoni* Hall common in underlying shales. Antes has been included in Reedsville in reports and maps of region.

Exposed along Antes Creek above Antes Gap, Clinton County.

Antes Gap Shale

See Antes Shale.

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Anthony cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann Field Conf., p. 18. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 21–22, table 1, geol. map. Includes (ascending) Anthony shale and (or) sandstone, 7 feet thick; Sciotoville clay, 4 feet; and Anthony coal. Occurs below Huckleberry cyclothem and above Harrison formation. In area of this report, Pottsville series is described on a cyclothemic basis; 10 cyclothems are named (ascending): Anthony, Huckleberry, Quakertown, Bear Run, Vandusen, Lower Mercer, Flint Ridge, Middle Mercer, Bedford, and Tionesta.

Well exposed in Monday Creek Township along Little Monday Creek valley, in Temperance Hollow, and in headwater region of Turkey Run, Perry County.

Anthony Sandstone (in Hennessey Formation)

Permian: Western Oklahoma.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). Shown on a projected cross section of upper Permian.

Anthony Shale or Sandstone

Pennsylvanian (Pottsville Series): Eastern Ohio.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 70–80. Defined as shale which occupies interval extending upward from Anthony coal to base of Quakertown clay. Locally contains an iron ore above Anthony coal. Shale horizon has rather limited extent. Average thickness about 22 feet. Underlies Massillon shale; overlies Sciotoville clay.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 21–22. Anthony shale and (or) sandstone included in Anthony cyclothem.

Generally present on outcrop through Scioto, Jackson, Vinton, Hocking, Perry, Licking, and Muskingum Counties. Present in parts of Wayne, Summit, Trumbull, and Mahoning Counties.

Anthony Lake granodiorite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 205–206, 235. Potash-poor granodiortie. Contemporaneous with Bald Mountain tonalite (new).

Occurs near Anthony Lake, Elkhorn Mountains [Grant County]. Granodiorite commences in zone approximately 2½ miles inward from contacts of Bald Mountain batholith and covers area of about 36 square miles.

Antietam Sandstone,[1] **Quartzite,** or **Schist** (in Chilhowee Group)

Antietam Formation

Lower Cambrian: Maryland, southeastern Pennsylvania, Virginia, and West Virginia.

Original reference: A. Keith, 1893, as reported by G. H. Williams and W. B. Clark, *in* Maryland, its resources, industries, and institutions, chap. 3, p. 68.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties [Rept. 12], p. 41–42. Antietam quartzite described in Carroll and Frederick Counties. Occurs in foothills east side of Catoctin Mountain west of Frederick Valley, and in series of linear hills in eastern part of valley. In foothills of Catoctin Mountain, crops out in narrow belt about one-fourth mile wide which extends from Point of Rocks at Potomac River to Little Tuscarora Creek northwest of Frederick, where it is cut out by Triassic border fault. Quartzite throughout this belt is underlain by Harpers phyllite and overlain by Tomstown dolomite, in normal sequence. On east side of Frederick Valley, Antietam forms discontinuous line of low wooded hills from New Midway, where quartzite is overlapped by Triassic sedimentary rocks, southwestward to Potomac River. Quartzite here is unconformably overlain by Frederick limestone. Total thickness in belt west of Frederick Valley estimated about 300 feet. Lower Cambrian.

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 115–124. Referred to as sandstone or quartzite in West Virginia. Only outcrop is in Jefferson County where its length is about 14 miles and its width ¾ mile. Underlies Tomstown dolomite. Oldest fossiliferous formation in state. Estimated thickness 500 to 600 feet.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 15 (fig. 5), 20–24, pl. 1. Described in Elkton area, Virginia, where it is assigned to Chilhowee group. Uniform thickness of about 800 feet. Divided into two members of about equal thickness. Lower member composed of white vitreous quartzite and contains worm tubes, or *Scolithus*. Forms prominent ledges up to 100 feet thick; between ledges are thinner bedded sandstone or quartzite, but greater part is formed by relatively less resistant buff or brown sandstone. Overlies Harpers formation; underlies Tomstown dolomite.

R. W. Chapman, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 193–194, 200–201. Described in Safe Harbor area, Pennsylvania, as Antietam schist. Grades upward into Vintage dolomite through zone roughly 10 feet thick.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 39. Referred to as Antietam sandstone. Occurs only in eastern Washington County in foothills of South Mountain and Elk Ridge.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 51–52, pl. 1. In Sugarloaf Mountain area, Antietam quarzite conformably overlies Harpers phyllite and underlies Frederick limestone. Crops out in two southeast-trending belts, 1 to 2 miles wide, along western part of area. Western belt is tight anticline which forms ridge above surrounding Frederick limestone. Eastern belt, which is discontinuous, is separated from western belt by limestone valley.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Antietam formation.

Named for exposures near Antietam Creek, north of Potomac River, Washington County, Md.

Antioch Sandstone[1]

Permian: Central southern Oklahoma.

Original reference: D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1465, 1466.

Garvin County.

Antler Peak Limestone

Upper Pennsylvanian and Lower Permian: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad Map [GQ–10]. Name given to limestone beds whose principal exposures underlie Antler Peak and crop out in a belt trending diagonally across the range. Limestones are medium to thick bedded for most part and form prominent outcrops. Thickness at type section 625 feet; east of Copper Basin probably more than 800 feet. Unconformably underlies Edna Mountain formation (new); overlies Battle formation (new).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2824 (fig. 5), 2843, 2853, (fig. 11). Late Pennsylvanian to early Permian on basis of diversified fauna including fusulinids.

Type section: Antler Peak.

Antlers Sand[1] (in Trinity Group)

Lower Cretaceous (Comanche Series): Southeastern Oklahoma and northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 303.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2333 (fig. 2), 2335. Correlation chart of Trinity group shows Antlers sand, undifferentiated, in outcrop in southeastern Oklahoma. Antlers is referred to as having Paluxy-like lithology. Paluxy is not included in Trinity as defined in this study. Term Paluxy is restricted to sandstones and shales which are time-stratigraphic equivalent of, and are laterally continuous with, part of Walnut, which is lowest formation of Fredericksburg group.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 26, pl. 1. Forgotson (1957) has shown that type Paluxy is Fredericksburg. So-called Paluxy of McCurtain County is either upper part of Antlers sand or may be assignable to Rusk sand.

Named for Antlers, Pushmataha County, Okla.

†Antoine Dolomite[1]

Precambrian (lower Huronian): Northwestern Michigan.

Original references: C. R. Van Hise, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 16, 17; 1899, U.S. Geol. Survey Mon. 36, p. XXV, XXVI.

Menominee district.

Antonio slate[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 5.

Well displayed at north end of Manzano Mountains. Derivation of name not given.

Antonito limestone[1]

Pennsylvanian(?): Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 5.

Exposed at southern extremity of Sandia Range. Derivation of name not given.

Antrim Shale[1]

Upper Devonian and Lower Mississippian: Michigan.

Original reference: A. C. Lane, 1901, Michigan Miner, v. 3, no. 1, p. 9.

A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 525. Overlies Squaw Bay limestone (new) of Traverse group.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 460. In Afton-Onaway area, overlies Beebe School formation (new) of Traverse group.

G. V. Cohee, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Consists of dark-gray to black hard thin-bedded brittle carbonaceous shale interbedded with some gray shale in lower part; contains some brown argillaceous limestone and dolomite. In eastern Michigan, thickens northward from 130 feet in Washtenaw County to 500 feet in Montmorency County; in western Michigan, underlies Bedford shale; in western Michigan, grades laterally into Ellsworth shale. Upper Devonian and Lower Mississippian.

Named for Antrim County in which shales are exposed.

Anvil Ferruginous Chert Member (of Ironwood Iron-Formation)[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501, 505.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Overlies Pence member; underlies Pabst member of Tyler formation. Thicknesses (taken from drill holes) 22½ and 53 feet.

Named for Anvil mine east of Bessemer, Gogebic County, Mich.

Anvil Points Member (of Green River Formation)

Eocene: Northwestern Colorado.

J. R. Donnell, 1953, Rocky Mountain Assoc. Geologists Guidebook Field Conf. May 14–16, chart facing p. 17. Consists of low-grade marlstone, thin-bedded shales, and sandstones alternating with gray and brown shales. Algal bed in lower part. Thickness about 1,500 feet. Underlies Parachute Creek member; overlies Wasatch formation.

Exposed between Rifle and De Beque Canyon.

Anvil Rock Sandstone Member (of Lisman Formation)

Anvil Rock Sandstone Member (of Carbondale Formation)

Anvil Rock Sandstone Member (of McLeansboro Formation)[1]

Pennsylvanian: Western Kentucky and southeastern Illinois.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 45, plate showing section of Lower Coal Measures.

E. J. Harvey, 1956, U.S. Geol. Survey Water-Supply Paper 1356, p. 64, 65–68. Reallocated to Lisman formation. In Henderson [Kentucky] area, underlies Madisonville limestone member; overlies No. 12 coal. In some localities, forms base of formation where No. 12 coal and Providence limestone member have been eroded.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 48 (table 1), 54 (table 3). Member of Carbondale formation. In sequence listed, overlies Conant limestone member (new) and underlies Bankston Fork limestone member.

Named from bluff known as Anvil Rock [southwest of Henshaw near Ohio River] in Union County, Ky.

Anvil Spring Formation

Lower Permian: Southeastern California.

B. K. Johnson, 1957, California Univ., Pubs. Geol. Sci., v. 30, no. 5, p. 382–384, figs. 1, 3. Proposed to include carbonate rocks of Permian age in Manly Peak quadrangle and adjacent Wingate Wash quadrangle to east. Consists of light-gray to white limestones alternating with dark-gray limestones in beds a few feet thick; cherty beds and nodules in middle of section; shales and argillaceous limestones near top: fossiliferous. In Manly Peak quadrangle, has exposed thickness of about 3,600 feet and is divisible into two parts: lower, exposed at Striped Butte, is more than 2,200 feet; upper part, near western edge of area, about 1,400 feet. C. Wrucke, who is credited with name, measured thickness of 4,100 feet in Warm Spring Canyon where he subdivided formation into five members. Base not exposed in Manly Peak quadrangle. In fault contact with Precambrian east of quadrangle. Near Warm Spring, the Permian passes under Tertiary volcanic rocks; unconformably underlies Triassic andesite flows at east edge of quadrangle.

Named from Anvil Spring in Butte Valley, Manly Peak quadrangle, southern Panamint Range, Inyo County.

Anzar phase (of Santa Lucia Series)[1]

Paleozoic(?): Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 471, map.

San Benito County.

Apache Flow or Tongue (of Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 112, 133, 134, 143 (fig. 20). East of type locality, Clayton basalt consists of many long tongues. For purposes of this report, these tongues have been named, from south to north, Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that gave rise to these basalts are unknown.

Forms basalt rim on north side of Apache Canyon, eastern Union County.

Apache Formation

Miocene, upper: Southern California.

T. W. Dibblee, Jr., *in* Chester Stock, 1948, Southern California Acad. Sci. Bull., v. 46, pt. 2, p. 84. Buff-red sand, pebbly sand, and gypsiferous clays. Continental. Equivalent to Santa Margarita formation to west.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2999. Preoccupied name Apache replaced by Quatal formation.

Occurs in Apache Canyon, Ventura County, sec. 2, T. 8 N., R. 23 W., Mount Pinos quadrangle.

Apache Group[1]

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 13.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, p. 29–34. At and near Roosevelt Dam, comprises (ascending) Scanlan conglomerate, Pioneer shale, Barnes conglomerate, Dripping Springs quartzite, Mescal limestone, unnamed basalt, and Roosevelt member (new). Underlies Troy quartzite.

N. P. Peterson, 1938, Arizona Bur. Mines Bull. 144, Geol. Ser. 11, p. 8–9. In Mammoth mining area, Pinal County, Apache series (group) unconformably overlies Oracle granite (new).

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1113–1164. Group unconformably overlaps Yavapai group, Mazatzal quartzite, and granite in eastern Tonto basin area and the granite at southeastern end of Mazatzal Range. Does not appear farther northwest in central Arizona areas. Apache strata are younger Precambrian and are separated by unconformity from older Precambrian rocks. Discussion of Mazatzal revolution.

J. R. Cooper, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 31, 32 (fig. 13). In Johnson Camp area, Cochise County, comprises (ascending) Scanlan conglomerate, Pioneer shale, Barnes conglomerate, and Dripping Spring quartzite. Overlies Pinal schist, angular unconformity; underlies Bolsa quartzite, angular discordance not apparent in outcrops but regional relations indicate discordance of more than 2° in some parts of mountains.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. In Globe quadrangle, group comprises (ascending) Scanlon conglomerate, Pioneer formation, Barnes conglomerate, and unnamed basalt. Underlies Troy quartzite; overlies Pinal schist. Late Precambrian.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. In Haunted Canyon quadrangle, comprises (ascending) Scanlan conglomerate, 6 inches to 12 feet thick; Pioneer formation, 300 to 450 feet; Barnes conglomerate, 6 inches to 30 feet; Dripping Spring quartzite, 350 to 500 feet; Mescal limestone, 250 feet; unnamed basalt, remnants of which may reach about 120 feet. Unconformably overlies Ruin conglomerate; disconformably underlies Troy quartzite. Upper Precambrian.

Named for exposures on west face of Apache Mountains.

Apache Limestone[1]

Permian: Western Texas.

Original reference: K. H. Crandall, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 929, 939–940.

In Apache Mountains, southeastern Culberson County.

†Apache Sandstone[1]

Upper Cambrian: Arizona.

Original reference: D. Hager, 1924, Mining and Oil Bull., v. 10, p. 137.

Grand Canyon.

Apache Sandstone[1]

Upper Cretaceous: Eastern Colorado.

Original reference: C. S. Lavington, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 4, p. 399.

J. M. Mitchell, John Greene, and D. B. Gould, 1956, *in* Rocky Mountain Assoc. Geologists Guidebook to the geology of the Raton Basin, Colorado, p. 131. Listed in catalog of stratigraphic names as Apache Creek sandstone member of Pierre shale.

In Walsenburg district.

Apache Creek Sandstone Member (of Pierre Shale)

Upper Cretaceous: Eastern Colorado.

See Apache Sandstone, Upper Cretaceous.

†Apalachicola Group[1]

Miocene, lower and middle: Northern Florida and southern Georgia.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 67–69, table opposite p. 50.

Named for exposures along Apalachicola River in western Florida.

Apex Formation

Permian (Wolfcamp): Southern Nevada.

J. E. Welsh, 1960, Dissert. Abs., v. 20, no. 8, p. 3263. Limestones, sandstones, and siltstones which occur in basin facies northwest of structural lineament here designated Las Vegas hinge line. Contains fusulinids of early, middle, and late Wolfcampian.

Type locality and derivation of name not stated. Report discusses biostratigraphy of Pennsylvanian and Permian systems in southern Nevada.

Apex Till

Pleistocene: Southwestern Montana.

W. B. Hall, 1960, Billings Geol. Soc. [Guidebook] 11th Ann. Field Conf., p. 197–199. Till deposited during Marble Point stage (new). Thickness more than 100 feet in places. Average elevation of till 9,000 feet. Near Apex Point, till rests on steeply dipping Cretaceous volcanic shales and bentonites. In some areas, rests on welded tuffs of Pliocene(?) age. Episode represented by Marble Point and Apex tills is probably either early Wisconsin in age or slightly older.

Named for exposures at Apex Point, secs. 27 and 34, T. 9 S., R. 3 E., Gallatin County. Summits appear, but are unnamed, on U.S. Geological Survey Sphinx Mountain quadrangle topographic map. Summit labeled "Apex Point," 2 miles to south, and appearing on Hebgen Dam quadrangle, seems to be an error.

Apishapa Shale (in Colorado Group)[1]

Apishapa Shale Member (of Niobrara Formation)

Upper Cretaceous: Eastern Colorado.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 567.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (col. 48). Shown on correlation chart as member of Niobrara formation. Overlies Timpas limestone member.

K. M. Waage, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 375 (fig. 1). Thickness 400 feet in Denver-Golden area. Overlies Timpas limestone; underlies Pierre shale.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basins, Colorado, p. 53. Believed

that names Fort Hays and Smoky Hill have priority over terms Timpas and Apishapa; if used, would help standardize Niobrara terminology in west-central Colorado.

Named for Apishapa River.

Apison Shale[1] Member (of Rome Formation)

Lower Cambrian: Eastern Tennessee, northwestern Georgia, and western North Carolina.

Original reference: C. W. Hayes, 1894, U.S. Geol. Survey Geol. Atlas, Folio 2; Folio 4.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1, pl. 12; pt. 2, p. 44. Variegated shale. Mapped as a basal member of Rome. Underlies an unnamed sandstone-bearing member of Rome.

Named for exposures at Apison, James [now Hamilton] County, Tenn.

Aplington Formation

Lower Mississippian: Northern Iowa.

M. A. Stainbrook, 1950, Jour. Paleontology, v. 24, no. 3, p. 365–385. Dominantly dolomite with subordinate amount of shale and limestone at base. Thickness 25 to 30 feet. Beds formerly included in Sheffield shale. Underlies Chapin limestone; overlies Sheffield shale.

Type section: About one-half mile directly north of Aplington, Butler County, on west side of road. Formation crops out in narrow belt extending from south line of Cerro Gordo County to southwest corner of Butler County.

Apodaca Formation (in Green Canyon Group)

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 32, 34, 36. Name applied to top formation of Green Canyon group. Consists of dense gray limestone with masses and lenses of chert, nodular limestone, calcareous shales, black to dark-gray calcareous siltstones, and greenish- to bluish-gray shales. Thickness increases from about 55 feet at type locality to over 150 feet in southern part of state where formation consists of essentially pure limestone. Underlies Hot Springs formation (new); overlies the Arrey formation (new).

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73 (fig. 8), 74. Underlies Fra Cristobal formation. Name replaces preoccupied Hot Springs formation.

Type section: Eight-tenths of a mile east of Derry, sec. 32, T. 17 S., R. 4 W., Sierra County. Named for Apodaca Creek, a west tributary of Rio Grande.

†Appalachian Group,[1] Series,[1] or System[1]

Paleozoic: Pennsylvania.

Original reference: H. D. Rogers, 1836. Pennsylvania Geol. Survey 1st Ann. Rept., p. 12–22.

†Appanoose Beds or Group

Pennsylvanian (Des Moines Series): South-central Iowa.

Original reference: H. F. Bain, 1896, Iowa Geol. Survey, v. 5, p. 378–394.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 31). Shown on Pennsylvanian correlation chart as a group

comprising strata from unconformity below Mulky coal to base of Pleasanton [shale].

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2027–2028. Apparently abandoned in favor of Marmaton group. Appanoose includes some upper Cherokee strata and corresponds to Henrietta group as treated by Cline (1939) and redefined by McQueen (1943).

Named for development in Appanoose County.

Appekunny Argillite[1] } (in Ravalli Group)
Appekunny Formation }

Precambrian (Belt Series): Northwestern Montana, and southeastern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 322.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1885–1887. Redefined to exclude Rising Wolf member which is placed in Grinnell formation. As redefined, formation includes following members (ascending): Singleshot, Appistoki, and Scenic Point (new). Consists of argillite interbedded with quartzite, conglomerate, and minor beds of argillaceous limestone; prevailingly green, greenish-gray to brownish, with some dull-red, white, and purplish beds; thin-bedded, with fine laminae; massive only in quartz conglomerates and quartzites; grades into adjacent formation. Thickness in east 2,500 to 5,300 feet; in west as much as 10,000 feet. Underlies Grinnell formation; overlies Altyn formation.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112. Appekunny argillite included in Ravalli group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 21–27, pls. 1, 2. Middle formation of Ravalli group. Overlies Altyn limestone; underlies Grinnell argillite. Thickness 2,000 to 5,000 feet. Formation as whole consists of dark fine-grained sedimentary rock sufficiently uniform in character so that Willis gave it name of argillite. Lithologic variations exist in both Appekunny and overlying Grinnell to give support to the Fentons (1937) referring to units rather than argillites. The Fentons' members are discussed, but formation is not subdivided in present report. Tentatively concludes that rocks mapped during present investigation as belonging to Appekunny argillite correspond essentially to Appistoki member of the Fentons. On this basis, most of the Fentons' Scenic Point member may have been mapped with Grinnell, and their Singleshot member probably is not exposed in areas mapped for this report.

Excellent exposures occur on northeast spur of Appekunny Mountain, Glacier National Park, Mont. Forms irregular band in northeastern part of park just west of exposures of Altyn limestone that are associated with Lewis overthrust. Another band extends from Canadian border southeastward in western part of park until it joins band in northeastern part of park. Also exposed near Waterton Lake.

Appistoki Member (of Appekunny Argillite[1] or Formation)

Precambrian (Belt Series): Northwestern Montana and southern Alberta, Canada.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1886. Gray, green, olive-brown, and rusty-gray argillites in thin minor, but thick major, beds interbedded with thickly stratified greenish, white, or pink quartzites. Member intergrades with other members, yet preserves fairly well-marked limits. Thickness in Lewis Range 2,000 to 2,200 feet. Underlies Scenic Point member (new); overlies Singleshot member. Type locality designated.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 21–27. Rocks mapped in present investigation as belonging to Appekunny argillite may correspond essentially to Appistoki member of Fenton and Fenton (1937).

Type locality: Appistoki Peak, near Two Medicine Lake, Glacier National Park, Mont.

Applegate Group

Applegate Series

Upper Triassic(?): Southwestern Oregon and northwestern California.

F. W. Libbey and others, 1942, Oregon Dept. Geology and Mineral Industries Bull. 17, p. 21. Mentioned as Applegate series. Names credited to F. G. Wells and P. E. Hotz.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 3–4. Assemblage of metamorphosed volcanic rocks with lens-shaped interbeds of quartzite, conglomerate, and marble. Thickness unknown but is probably to be measured in miles, although its apparent thickness may be exaggerated by faulting and closefolding. Underlies Upper Jurassic Galice formation with angular unconformity; no rocks that are known to be older than Applegate group are exposed in Kerby quadrangle, hence basement on which Applegate group accumulated is unknown. Derivation of name given.

F. G. Wells and F. W. Cater, Jr., 1950, California Dir. Mines Bull. 134, pt. 1, chap. 2, p. 81. Geographically extended into California.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Mapped in Medford quadrangle, Oregon-California. Upper Triassic(?).

Named after drainage basin of Applegate River [Kerby quadrangle, Oregon] where group is prevailing country rock.

Appleton Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51–52.

Probably named for Appleton, Pope County, Ark.

†Appomattox Formation[1]

Pliocene(?) and Pleistocene: Atlantic Coastal Plain, Virginia to Alabama.

Original reference: W. J. McGee, 1888, Am. Jour. Sci., 3d, v. 35, p. 125, 328–330.

Typically exposed on and near Appomattox River from its mouth to some miles west of Petersburg, Dinwiddie County, Va.

Apulia Member (of Tully Formation)

Apulia Shale[1] or Limestone[1]

Devonian: New York.

Original reference: T. A. Conrad, 1841, New York Geol. Survey 5th Ann. Rept., p. 31.

G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, p. 790–808. Member of Tully formation. Overlies Tinkers Falls member (new); overlies West Brook member (new). Type section designated.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1787, chart 4. Middle Devonian.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 29–33. Tully type section consists of following members: Tinkers Falls, Apulia, and West Brook. In Tully clastic facies, Apulia is represented by Laurens member.

Type section: In ravine adjacent to June's quarry, 1½ miles southwest of Apulia Station, Tully Township.

Aquaqua Formation

See Aguagua [Formation in Tapaliza Group or Member of Tapaliza Formation].

Aquashicola Formation[1]

Silurian: Northeastern Pennsylvania.

Original reference: B. L. Miller, 1911, Pennsylvania Topog. and Geol. Survey Rept. 4, p. 51.

Named for occurrence in valley of Aquashicola Creek.

Aqua Torres Formation

Permian: Southwestern New Mexico.

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1. p. 1154–1155, 1171, pls. 1, 7. Consists of a thin basal conglomerate, a sequence of arkoses, red sandstones, red shales, nodular limestones, and at top gray massive limestone. Thickness about 80 feet. Underlies Abo formation; overlies Pennsylvanian rocks of Virgil age.

R. L. Bates, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 6, p. 1043, 1044. Suggested as being synonymous with Bursum formation and Red Tanks member of Madera limestone.

Exposed in the Arroyo Aqua Torres in southeast portion of mountains and also along Highway 60 east of the thrust faults.

Aquetuck lithofacies (of Leeds facies of Schoharie Formation)

[Devonian]: Eastern New York.

J. H. Johnsen, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Lower part of Leeds facies, upper part termed Saugerties lithofacies; composed of calcareous mudstone and calcareous siltstone with minor argillaceous limestone and calcareous sandy mudstone. Carries many chert nodules in upper mid-Hudson Valley; chert diminishes rapidly southward. Lower beds intertongue with upper Carlisle Center beds in parts of mid-Hudson Valley.

Type area not stated. Town of Aquetuck is in Albany County.

Aquia Formation[1] **or Greensand** (in Pamunkey Group)

Eocene, lower: Eastern Virginia, Delaware, and Maryland.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene volume, p. 58.

R. R. Bennett and G. G. Collins, 1952, Washington Acad. Sci. Jour., v. 42, no. 4, p. 114–116. Overlies Brightseat formation (new).

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 22–23. In Prince Georges County, Md., name Aquia greensand is applied to Eocene deposits that intervene between Paleocene Brightseat formation and Nanjemoy formation. Term is equivalent to Aquia formation of Clark and Martin (1901). More specific term greensand is preferred to formation in this region because glauconite is dominant mineral and occurs throughout formation. Estimated thickness 100 feet. Aquia rests unconformably on Brightseat formation or overlaps on older formations.

A. R. Loeblich, Jr., and Helen Tappan, 1957, U.S. Natl. Mus. Bull. 215, p. 177 (fig. 28). Shown on correlation chart as Paleocene.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 24, 25–26, pl. 2. Described in York-James Peninsula, Va., where it is exposed at surface near Richmond. Maximum thickness about 125 feet. No unconformity with underlying Mattaponi formation (new) in subsurface. Underlies Nanjemoy formation.

Type locality: Aquia Creek, Stafford County, Va.

†Aquia Creek Series[1]

Lower Cretaceous: Northeastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 326.

Typically developed within vicinity of Aquia Creek, Stafford County.

†Aquia Creek Stage[1]

Eocene: Eastern Virginia and Maryland.

Original reference: W. B. Clark, 1895, Johns Hopkins Univ. Circ., v. 15, no. 121, p. 3.

Named for Aquia Creek, Va.

†Aquidneck Series or Shales[1]

Carboniferous: Southeastern Rhode Island and southeastern Massachusetts.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 348–364, pl. 31, map.

Forms almost whole of Aquidneck Island, near Newport, Newport County, R.I.

Aquinnah Conglomerate[1]

Pleistocene: Southeastern Massachusetts.

Original reference: J. B. Woodworth and E. Wigglesworth, 1934, Harvard Coll. Mus. Comp. Zool. Mem., v. 52, p. 160.

R. F. Flint, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 543. Discussion of beginning of Pleistocene in eastern United States. Inland along Coastal Plain, not only in South Atlantic States but occurring discontinuously from Cape Cod district to lower Mississippi River, are

extensive areas of highly quartzose gravel and sand (and along Gulf Coast, silt and clay). These sediments, on Atlantic Coast at least, indicate selective weathering and deposition by streams. They have not been studied as a whole, but throughout long distances they appear to have same general character. They are known under various regional or local names, such as Citronelle formation, Bryn Mawr gravel, Beacon Hill gravel, Manetto gravel, and Aquinnah conglomerate.

Known to occur only at Gay Head Cliffs fold on Marthas Vineyard. Aquinnah is Indian name for Gay Head.

Arago Group[1] **or Formation**

Arago Series

Eocene: Southwestern Oregon.

Original reference: J. S. Diller, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 458–462, 475.

W. H. Twenhofel, 1943, Oregon Dept. Geology and Mineral Industries Bull. 24, p. 3. Referred to as Arago series. Comprises Coaledo formation (above) and Pulaski formation. Unconformably underlies Miocene Empire formation; unconformably overlies Cretaceous Myrtle formation.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 589–590, chart 11. Formation originally named and described by Diller was later divided into lower, or Pulaski formation, and upper, or Coaledo formation, for purpose of distinguishing coal-bearing beds from noncoal-bearing beds. Arago formation used in original sense of Diller is 8,400 feet thick and consists of alternating members of brownish-gray sandy clay shales, medium- and coarse-grained sandstones, shaly sandstones, and occasional layers of conglomerate.

C. E. Weaver, 1945, Washington [State] Univ. Pubs. in Geology, v. 6, no. 2, p. 31–46, pls. 2, 3, 4, 5, 10. Redescribed in Coos Bay area as formation. Divided into three unnamed members. Total thickness 8,370 feet; base not exposed. Consists of shale and sandstone. Underlies Bassendorf formation.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 16. Prong of Arago group extends southward into southwestern corner of Kerby quadrangle, where it is exposed for 5 miles along east side of canyon of Illinois River. Beds in this area are referred to as Arago formation because here they cannot be identified with subdivisions of group. Formation is assemblage of lenticular bodies of sandstone and conglomerate in nearly equal amounts with thin interbeds of shale. Characterized by poor sorting, crossbedding, and abrupt lateral and vertical variations. Maximum thickness 500 feet, on ridge south of Indigo Creek; thins rapidly toward east, wedging out completely in less than one-half mile; thins southward to about 250 feet near mouth of Silver Creek. Overlaps Dothan formation.

Well exposed at Cape Arago, Coos Bay quadrangle.

Arakabesan Member (of Ngeremlengui Formation)

Eocene, upper, or Oligocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers 1956, Military geology of Palau Islands, Caroline Islands: U.S. Corps of Engineers, Far East, p. 48–49, pl. 8. Volcanic breccia, volcanic conglomerate, and tuff, with related dikes,

sills, and flows. Maximum thickness 4,000 feet or more in Ngardmau area; about 3,000 feet on Arakabesan Island; on north end of Arekalong Peninsula may be as much as 2,000 feet. Uppermost member of formation; overlies Medorm member (new).

Type section: On Arakabesan Island. Extends as broken strip along west coast of Babelthuap Island from village of Ngardmau on Ngardmau Bay south-southwest nearly to village of Medorm. Present on north end of Arekalong Peninsula and on the two islands just north. Composes Malakal Island.

Arapaho Glacial Stage

Pleistocene (middle Wisconsin): North-central Colorado.

R. L. Ives, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 75; 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1059–1060. Covers interval between River and Monarch glacial stages (both new).

Area: Monarch Valley, in Grand County.

Arapahoe Formation[1]

Arapahoe Conglomerate Member (of Laramie Formation)

Upper Cretaceous: Eastern Colorado.

Original reference: G. H. Eldridge, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 97.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1309–1312, 1320. Dawson arkose merges northward into Arapahoe and Denver formations along foothills of Front Range. Dawson and Arapahoe along this belt overlie, with erosional irregularity, Laramie formation.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 65–86. Discussion of Cretaceous-Tertiary boundary in Denver basin, Colorado. Stratigraphic and paleontologic evidence shows that Laramie formation, Arapahoe formation, and Cretaceous parts of Denver formation and Dawson arkose comprise a unit correlative with Lance formation and its equivalents. Proposed that Laramie be redefined to include all Upper Cretaceous sequence between top of Fox Hills and base of Paleocene and that term Arapahoe as Arapahoe conglomerate member of Laramie be retained for conglomerate immediately overlying present Laramie formation.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 107–112. Discussion of post-Laramie stratigraphic correlations in Denver basin. Proposed that (1) Laramie-Arapahoe contact remain as originally defined by Emmons, Cross, and Eldridge (1896, U.S. Geol. Survey Mon. 27); and (2) Arapahoe-Denver contact be placed at widespread erosional disconformity at base of lowest, thickest, and most prominent basalt-andesite pebble conglomerate bed in Denver area, instead of at first appearance of andesitic debris as proposed by Emmons, Cross, and Eldridge (1896). Arapahoe and Denver formations can be mapped throughout Denver basin, and these names should replace term "lower Dawson" of Dane and Pierce (1936).

Named for development in Arapahoe County.

Arapien Shale

Upper Jurassic: Central Utah.

S. L. Schoff, 1938, Ohio State Univ. Abs. Doctors' Dissert. 25, p. 377–378. Consists of drab calcareous, shale with red patches and intercalated

limestone, gypsum, and salt. Highly folded; thickness uncertain, probably between 4,000 and 11,000 feet. Underlies Indianola group (new).

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 123–125. Subdivided into Twist Gulch member above and Twelvemile Canyon member (both new). Underlies Morrison(?) formation. Type area designated.

C. T. Hardy, 1952, Utah Geol. and Mineralog. Survey Bull. 43, p. 1, 11–13, 14–22. Restricted to include only Twelvemile Canyon member. As restricted, thickness 3,000 feet.

Type area: Arapien Valley, which lies parallel to base of Wasatch Plateau about 6 miles southeast of Gunnison. Formation is typically, if not completely exposed, on west side of valley.

Arbuckle Limestone[1] or **Group**[1]

Upper Cambrian and Lower Ordovician: Southern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55–56. Rank raised to group. Subdivided into (ascending) Fort Sill limestone, Royer marble (dolomite), Signal Mountain limestone, Chapman Ranch dolomite, McKenzie Hill limestone (new), Wolf Creek dolomite (new), Cool Creek limestone, Alden limestone (new), and West Spring Creek formation. Thickness about 9,000 feet. Underlies Simpson group; overlies Timbered Hills group (new).

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1311–1321; 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 16 (table 1), 20–23. Divided into nine formations, four of which are Upper Cambrian and five Lower Ordovician. Upper Cambrian formations (ascending): Fort Sill, Royer dolomite, Signal Mountain, and Butterly dolomite (substituted for Chapman Ranch as name for the upper dolomite, and Chapman Ranch placed as basal member of McKenzie Hill formation). Lower Ordovician formations (ascending): McKenzie Hill, Strange dolomite (replaces preoccupied Wolf Creek formation), Cool Creek, Kindblade (replaces preoccupied Alden), and West Spring Creek.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 19. Restricted to exclude four Cambrian formations which are included in newly defined Blue Creek Canyon group. This classification credited to E. A. Frederickson (unpub. thesis).

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in eight formations. This subdivision follows Decker (1939) with exception that Strange formation is omitted.

Named for Arbuckle Mountains, of which it composes major part of central mass.

Arcadia Clays (in Claiborne Group)[1]

Eocene, middle: Louisiana, Arkansas, Mississippi, and Texas.

Original reference: O. Lerch, 1893, Louisiana Geol. Survey, pt. 2, p. 85.

Named for Arcadia, Bienville County, La.

†Arcadia Marl[1]

Pliocene, lower: Southern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 131–132, 157, 320.

Named for exposures near Arcadia, De Soto County, on Mare Branch, a tributary of Peace River, about 6 miles north of Arcadia.

Arcadia Member (of Trempealeau Formation)

Upper Cambrian (Croixan): Eastern Minnesota and western Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 44, p. 147. Consists of 3-foot basal bed of edgewise conglomerate, flat pebbles of buff siltstone in a greensand matrix, that grades upward into lenticular strata of varied lithology, dominantly dolomitic siltstone. Thickness about 20 feet. Underlies St. Lawrence member; unconformably overlies Bad Axe member, Franconia sandstone.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 174–175. In basinward exposures, strata of Lodi member of St. Lawrence vertically succeed Black Earth dolomite member. Elsewhere Lodi occurs beneath Black Earth member as well as above it. At Arcadia, these strata beneath the dolomite are regarded by Raasch (1952) as type Arcadia member of Trempealeau. Except for content of *Osceolia* fauna, on which basis they were designated Arcadia member, these beds do not differ from strata above the dolomite.

Type locality: In roadcut and small quarry on State Highway 93, 1 mile east of Arcadia, Trempealeau County, Wis. Continuously extensive north of Black River valley in Wisconsin and Minnesota.

Arcadian Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 78, 131, 132, 133, pl. 10.

Named for occurrence at Arcadian mine, Houghton County.

Arcadian Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence at Arcadian mine, Houghton County.

Arcadia Park Formation[1] (in Eagle Ford Group)

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 425.

W. L. Moreman, 1942, Jour. Paleontology, v. 16, no. 2, p. 192–220. Discussion of paleontology of Eagle Ford group which comprises (ascending) Tarrant, Britton, and Arcadia Park formations.

W. L. Turner, 1951, Field and Laboratory, v. 19, no. 2, p. 51–65. Discussion of geology of Eagle Ford quadrangle, which contains type locality of Eagle Ford formation as well as Moreman's (*in* Adkins, 1932 [1933]) Arcadia Park formation. Moreman's classification of rocks exposed in Eagle Ford quadrangle not applicable for purposes of this study. Eagle Ford formation subdivided into three unnamed lithologic units.

Type locality: Arcadia Park Station, 7 miles west of Dallas, Dallas County.

Arcente Member (of Lake Valley Formation)

Mississippian (Osage): Southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1941, (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73–75; 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 12, p. 2116, 2120 (fig. 7). Consists of thin evenly bedded gray relatively unfossiliferous shaly siltstone. Basal part over 50 percent shale; upper part slightly thicker bedded and less shaly. Thickness about 230 feet. Underlies Dona Ana member (new); overlies Alamogordo member (new).

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11 (fig. 4), 15. Overlies Tierra Blanca member (new). Thickness 230 feet in Sacramento Mountains; generally less than 25 feet in San Andres Mountains. Not present in Mimbres Range, Cooks Mountains, and Silver City area.

Type area: Deadman Canyon, sec. 3, T. 17 S., R. 10 E., near Alamogordo. Named for Arcente Canyon which traverses northern end of main anticlinal structure in which Lake Valley beds are exposed.

Arch Marble or Formation (in Evington Group)

Lower Paleozoic(?): South-central Virginia.

W. R. Brown, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1547. Named in sequence of units mapped in James River synclinorium. Younger than Joshua schist (new) and older than Pelier schist (new).

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 93. Fine-grained blue-gray micaceous marble, locally arenaceous. Thickness about 400 feet. Included in Evington group (new). Type locality designated.

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 16–17. Archer Creek formation (new) includes Arch marble and Joshua schist of Brown (1951, 1953).

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2). Age shown on columnar section as Lower Paleozoic(?).

Type locality: Vicinity of The Arch on Norfolk and Western Railroad, 1 mile east of Six Mile Station, Campbell County.

†Archer Beds[1]

Pliocene, lower: Northeastern Florida.

Original reference: W. B. Scott, 1894, Geol. Soc. America Bull., v. 5, p. 594–595.

Named for exposures at Archer, Alachua County.

Archer Creek Formation (in Evington Group)

Paleozoic(?): South-central Virginia.

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 15 (table 1), 16–17. Green to blue-gray siliceous graphitic schist member, as much as 500 feet thick, forms lower part of formation; bluish fine- to medium-grained marble member, as much as 400 feet thick, lies in upper part of formation and is interbedded with graphitic schist member. Marble commonly forms valleys. Includes Joshua schist and Arch marble of Brown (1951, 1953). Underlies Mount Athos formation; overlies Candler formation.

Named for exposures along Archer Creek about 1½ miles above its confluence with James River. Exposed extensively along James River valley

to southwest of Allen Creek, in neighborhood of Jack Mountain and Chestnut Mountain, and southeast of Evington [Campbell County].

Arch Point Basalt

Quaternary: Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 2, p. 13, pl. 2; 1955, U.S. Geol. Survey Bull. 1028–A, p. 8–9, pl. 3. One of three extensive lava-flow units filling old canyons and gullies carved in Belkofski tuff (new) and intrusive diorite stocks. Consists of thick lava beds that crop out south of known exposures of Black Point basalt (new). Overlain by Dushkin basalt (new). Sources of flows not exposed.

Well exposed on Arch Point south of Dushkin Lagoon, vicinity of Pavlof Volcano, Alaska Peninsula.

Arch Rock Granite

[Cretaceous]: Eastern California.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2123 (fig. 1). Shown on map in paper dealing with potassium-argon dating of igneous rocks. Age shown on map legend as 95.3 millions of years. Oldest rock dated; older than Gateway granodiorite. [Calkins (1930, U.S. Geol. Survey Prof. Paper 160) referred to biotite granite of Arch Rock. Compiler was unable to locate reference to Arch Rock granite.]

Occurs in Yosemite National Park.

Archuleta shale[1]

Upper Cretaceous: Northwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 260; 1915, Conspectus of geologic formations of New Mexico, p. 2, 5.

In San Juan region. Derivation of name not stated.

Archusa Marl Member (of Cook Mountain Formation)

Archusa Marl Member (of Wautubbee Formation)

Eocene: Eastern Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull, 48, p. 49–52. Defined as basal member of Wautubbee formation in eastern Mississippi. Interbedded marls and limestones. Thickness 45 to 60 feet; 48 feet at type locality; neither contact exposed. Underlies Potterchitto member (new), and where exposed contact is conformable and gradational; overlies Kosciusko formation, and where exposed contact is disconformable and sharply defined.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Assigned to Cook Mountain formation. Underlies Potterchitto sand member; overlies Sparta sand. Mississippi Geological Survey uses Wautubbee formation instead of Cook Mountain formation.

Type locality: Bluff beneath south end of bridge across Chickasawhay River on U.S. Highway 45, 2 miles south of Quitman, Clarke County. Named for Archusa Springs, a health resort.

Arcola Limestone Member (of Mooreville Chalk)

Arcola Limestone Member (of Selma Chalk)

Upper Cretaceous: Southeastern Alabama and northeastern Mississippi.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1655–1657. Defined as member of Selma chalk. Thin but persistent unit, consisting of layers of pure hard limestone, interbedded with chalk. Lies about 300 feet above base of Selma. Thickness about 29 feet.

R. H. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey; W. H. Monroe and D. H. Eargle, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 50. Reallocated to member status in Mooreville chalk. Unconformably underlies Demopolis chalk.

Type exposure: In bluff at old Arcola Landing on Warrior River, NE¼ sec. 4, T. 18 N., R. 3 E., Hale County, about 5 miles northeast of Demopolis, Ala. Unit has been traced from Bullock County westward through Alabama and northward through Mississippi nearly to Mooreville in Lee County.

Arcturus Limestone[1] or **Formation**

Permian: Eastern Nevada and western Utah.

Original references: A. C. Lawson, 1906, California Univ. Pub. Bull., Dept. Geology, v. 4, no. 4, p. 294; A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 26–28.

E. N. Pennebaker, 1932, Mining and Metallurgy, v. 13, no. 304, p. 164. Overlies Rib Hill formation (new). Most of Rib Hill was formerly included in Ely limestone.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2174–2178. Name Arcturus geographically extended into Confusion Range, Utah, where it replaces terms "Supai?," "Supai equivalents," and Supai sandstone. Consists of poorly indurated yellowish-gray calcareous sandstone with thin ledge-forming interbeds of dark-gray to tan limestone and dolomite. Total thickness uncertain; minimum thickness 2,700 feet, measured southeast of Indian Pass. Conformably overlies Ely limestone; underlies Kaibab limestone of Park City group. Fossils and stratigraphic position suggest formation is early to middle Permian. Pennebaker (1932), in report on Robinson (Ely) mining district, separated a predominantly sandstone unit of Permian age, which he named Rib Hill formation, from beds previously mapped at Rib Hill as Ely limestone by Spencer (1917). Spencer's description of Ely contains no reference to sandstone, yet Rib Hill area, which is underlain by sandstone, was mapped as Ely limestone. Present writers [Hose and Repenning] believe that in vicinity of Rib Hill, where exposures are poor, inclusion of this predominant sandstone sequence in the Ely by Spencer was inadvertent and that it should have been included in Arcturus formation.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 103–106. Arcturus limestone was defined by Lawson (1960) as a shaly limestone sequence stratigraphically underlying "Ruth Limestone" and overlying Ely limestone, in Robinson (Ruth) mining district. Lawson's failure to understand structural complexities within general Ruth area resulted in the naming of "Ruth" and "Ely" limestones, which later were proved equivalent by Spencer (1917). Lawson's original description of Arcturus limestone does not make clear to which unit he was referring, but there is little doubt that Lawson's Arcturus limestone did include those beds later referred to as "Rib Hill" by Pennebaker (1932). Additional work is necessary before formation can

be further defined and its regional relationship fully understood. At present time, name Arcturus should be applied to those light-colored platy limestones and thin interbedded silts lying stratigraphically above Riepetown sandstone (name proposed to replace Rib Hill) and below Kaibab formation or Loray formation (new). Outcrops of Arcturus distributed over area of about 4,800 square miles.

W. B. Douglass, Jr., 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 182, 183. In southern Butte Mountains, White Pine County, Nev., Arcturus conformably overlies Carbon Ridge formation. Thickness variable due to angular unconformity at top of unit. Only 264 feet present on west side of range; estimated 2,500 to 3,000 feet present on eastern flank of mountains. Underlies Kaibab(?) formation.

Named for exposures on Arcturus mining claim, NW¼SW¼NE¼ sec. 15, T. 16 N., R. 62 E, White Pine County, Nev.

Arden Granite

Age not stated: Northern Delaware.

R. F. Ward, 1959, Geol. Soc. America Bull., v. 70, no. 11, p. 1427–1429, 1438–1439, pl. 1. Potassium feldspar-bearing rock, which, in some places, has composition of true granite. Bordered on three sides by banded gneiss of Wilmington complex (new), and on east covered by Quaternary and Recent sediments.

Underlies approximately 4 square miles in vicinity of Arden, Newcastle County.

Ardian Series or Epoch

Lower Pennsylvanian: North America.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 284, 286–292. Analysis of physical characters and paleontological features of Pennsylvanian rocks in North America leads to conclusion that stratigraphic cleavage at two positions within system has paramount significance. Three series recognized: Ardian-Lower Pennsylvanian, Oklan-Middle Pennsylvanian, and Kawvian-Upper Pennsylvanian. Ardian series includes Springeran and Morrowan rocks which are classed as stages. Thickness of sediments about 5,000 feet in type area where both Springeran and Morrowan stages are present. *Millerella* is only genus of fusulinids in Ardian, and Ardian may be designated as zone of *Millerella*. Rocks of Ardian age probably widespread in Appalachian region; seemingly most rocks referred to lower Pottsville are of Ardian age. Time equivalent is Ardian epoch.

Type sequence: Ardmore basin south of Arbuckle Mountains, southern Oklahoma. Name derived from first syllable of Ardmore.

Ardmore Bentonite Bed (in Pierre Formation)

Upper Cretaceous: Southwestern South Dakota.

R. C. Spivey, 1940, South Dakota Geol. Survey Rept. Inv. 36, p. 3, 23–34. Bentonite bed about 4 feet thick. Occurs near base of Pierre formation. Commercially important.

Named for exposures near Ardmore, Fall River County.

Ardmore cyclothem

See Ardmore Formation (in Cherokee Group)

Ardmore Formation (in Cherokee Group)

†Ardmore Limestone Member (of Cherokee Shale)[1]

Pennsylvanian (Des Moines Series): Northwestern and north-central Missouri, southern Iowa, and southeastern Kansas.

Original reference: C. H. Gordon, 1893, Missouri Geol. Survey Sheet Rept. 2, (v. 9), p. 20.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group is divided into 15 cyclic formational units. Admore 13th in sequence (ascending); occurs above Croweburg and below Bevier. Average thickness 5 feet. [For complete sequence see Cherokee group.]

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 53–54. Redefined to include all of limestones (and intervening shale members) between coal [lower Ardmore] and top of Ardmore of previous definitions. Missouri and Kansas Surveys have traced Ardmore toward southwest and showed it to be equivalent to Rich Hill limestone of southeastern Kansas and to Verdigris limestone of northeastern Oklahoma. Has been traced northwestward from Iowa-Missouri line for 135 miles into Iowa. Throughout this distance is best developed limestone in Cherokee group.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 83–89. Formation in Cherokee group. In Missouri overlies Tebo formation (new); underlies Bevier formation. Thickness as much as 17 feet.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 45. Cyclothem redefined to include Croweburg cyclothem of Abernathy (1937).

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 72–74. Verdigris limestone (Smith, *in* Woodruff and Cooper, 1928) comprises bed or beds called Ardmore by Gordon (1893) in Missouri. Term Verdigris has had wider usage than Ardmore and for that reason was adopted at Nevada Conference (Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12) for limestone in Verdigris formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 34, fig. 5. Ardmore limestone, Cherokee group, is exceptionally widespread unit that maintains approximately same characteristics over wide area reaching from Oklahoma to Iowa. Consists of two thin gray limestones separated by thinly laminated dark-gray shale. Ardmore limestone of Iowa is Verdigris limestone of Kansas, Missouri, and Oklahoma, and may be equivalent of lower Oak Grove of Illinois.

Named for Ardmore, Macon County, Mo.

Arecibo Formation[1]

Tertiary: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 10–17.

C. J. Maury, 1919, Am. Jour. Sci., v. 48, no. 285, p. 214 (chart). As shown on correlation chart, comprises (ascending) Lares, Aguadilla, and Quebradillas limestones. Upper Oligocene and lower and middle Miocene.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 316. Name not now in use.

Named for exposures in region about Arecibo.

Arendtsville Fanglomerate Lentil (in Gettysburg Shale)[1]

Upper Triassic: South-central Pennsylvania.

Original reference: G. W. Stose, 1929, U.S. Geol. Survey Geol. Atlas, Folio 225.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. C–67, p. 115, 117. In type area in Adams County, the Gettysburg is predominantly a red shale and sandstone with interbedded hard gray to white sandstones in the Heidlersburg member and a coarse fanglomerate called Arendtsville fanglomerate lentil at top.

Forms large hills southwest and west of Arendtsville, Adams County, for which it is named.

Argenta limestone[1]

Pennsylvanian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 37.

Derivation of name not stated.

Argentine Limestone[1] Member (of Wyandotte Formation)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, western Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf., correlation chart.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 106 (fig. 20), 109–110. Mostly very fine grained light-bluish-gray limestone that weathers creamy white, grayish white, or light buff. Bedding thin and uneven; many layers distinctly nodular. Normally, thickest subdivision of Wyandotte formation. Average thickness 20 feet; 30 feet thick at Kansas City. Overlies Quindaro shale member; underlies Island Creek shale member, or, where this shale is absent, underlies Farley limestone member. Disappears south of Lane [Kansas] but is persistent northeastward in Missouri; identified in Iowa and southeastern Nebraska.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25, fig. 5. Argentine member in Madison County is 18-foot sequence of two or three massive limestones separated by dark-gray to buff calcareous shales. Fossiliferous throughout with *Osagia* and brachiopods. Thickness 12 feet in Union County. Overlies Quindaro shale member; underlies Island Creek shale member.

Type exposure: In quarry south of 26th and Metropolitan Ave., Kansas City, Kans. Named for Argentine Railway Station.

†Arickaree Shale[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 52.

Named for Arikaree River, Cheyenne County.

Arido sandstone[1]

Jurassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 65, no. 4, p. 303, 306.

Named for Arido Creek, in northern part of Navajo Reservation.

Arikaree Sandstone,[1] Formation, or Group

Miocene: Western Nebraska, northeastern Colorado, southeastern Montana, southern South Dakota, and southeastern Wyoming.

Original reference: N. H. Darton, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 732, 735, 742, 743–748.

J. B. Hatcher, 1902, Am. Philos. Soc. Proc., v. 41, no. 169, p. 116–119. Redefined and used in group sense to include Monroe Creek above and Gering sandstones. Underlies Loup Fork group; overlies White River group.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, no. 210, p. 443–444. Suggests continued use of term Arikaree as group name. Redefined to include only Gering sandstone, Monroe Creek, and Harrison formations (the latter as defined by Hatcher 1902). Underlies Marsland formation (new).

A. L. Lugn, 1938, Am. Jour. Sci., 4th ser., v. 36, no. 213, p. 227 (table). Group includes Gering, Monroe Creek, and Harrison formations. Overlies White River group; underlies Hemingford group (new). Thickness 700 to 800 feet.

Billings Geol. Soc. [Guidebook] 2d Ann. Field Conf., 1951, p. 8 (correlation chart). Geographically extended into southeastern Montana.

Edward Bradley, 1956, U.S. Geol. Survey Water-Supply Paper 1368, p. 18–19, pl. 1. Arikaree group (formation in Niobrara County, Wyo.), as described in this report, includes all sediments of Miocene age. The sediments have been divided into Arikaree and Hemingford groups, but in this report these units are not differentiated and are mapped as Arikaree group. Underlies Ogallala formation.

A. F. Agnew, 1957, Geology of the White River quadrangle (1:62,500): South Dakota Geol. Survey. Formation consists of reddish-brown cross-bedded quartzose channel sandstone that is overlain by gray and pinkish unconsolidated tuffaceous quartzose sands. Top of Arikaree arbitrarily drawn at base of lowest pink fine-grained limestone bed. Thickness as much as 82 feet. Overlies Brule formation; underlies Mellette formation (new).

S. G. Collins, 1959, Geology of the Martin quadrangle (1:62,500): South Dakota Geol. Survey. Formation represented by Monroe Creek and Harrison members. Disconformably underlies Valentine formation.

W. D. Sevon, 1959, Geology of the Okreek quadrangle (1:62,500): South Dakota Geol. Survey. Thickness as much as 238 feet including Mellette facies. Underlies Valentine formation of Ogallala group; overlies White River group.

S. G. Collins, 1960, Geology of the Patricia quadrangle (1:62,500): South Dakota Geol. Survey. Group comprises (ascending) Sharps, Monroe Creek, and Harrison formations. Underlies Ogallala group, which here comprises (ascending) Valentine and Ash Hollow formations.

Name Arikaree is applied to formation because Arikaree Indians were at one time identified with area in which it is most largely developed. Well developed in face of Pine Ridge in Sioux County, Nebr., and Converse County, Wyo.

Arikareean Age

Miocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 11, pl. 1. Provincial time term based on the Arikaree group of western Nebraska, Agate being the most typical locality, with the limits as redefined by Schultz (1938) but including Rosebud beds. Includes time between Whitneyan (Oligocene) and Hemingfordian (Miocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

†Arizona Slates,[1] Arizonian Slate[1]

†Arizonan[1]

Precambrian: Southeastern Arizona.

Original reference: W. P. Blake, 1883, Eng. Mining Jour., v. 35, p. 254.

Exposed along sides of Queen Creek valley, west of town of Pinal, Gila County.

Arkadelphia Marl

Arkadelphia Marl (in Navarro Group)[1]

Upper Cretaceous: Southwestern Arkansas, northwestern Louisiana, and northeastern Texas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 53–56, 188.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Arkadelphia marl shown on correlation chart of outcropping formations in southwestern Arkansas. Occurs above Nacatoch sand. Navarro group not used in this area.

C. A. Renfroe, 1949, Arkansas Geol. Survey Bull. 14, fig. 2 (facing p. 8). Arkadelphia formation shown on generalized columnar section of eastern Arkansas. Consists of light-gray calcareous shale, sparingly glauconitic; medium-gray finely micaceous fissile shale near base. Thickness 50 to 150 feet. Overlies Nacatoch formation; underlies Clayton "calcareous" Midway. Navarro group.

Typical outcrops are 2 to 3 miles northwest of Fulton, Hampstead County, Ark., and at numerous localities 5 to 7 miles north and northwest of Hope. It is possible that basal few feet of formation crops out, though not typically, at Arkadelphia.

†Arkansan series[1]

Pennsylvanian: Western Arkansas and eastern Oklahoma.

Original reference: C. R. Keyes, 1901, Iowa Acad. Sci. Proc., v. 8, p. 119–132.

Named for valley of Arkansas River, Ark. and Okla.

†Arkansas Marls[1]

Miocene, upper, and Pliocene: Central southern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept., p. 75–91.

Occupy entire valley of Arkansas River.

Arkansas Novaculite[1]

Devonian and Mississippian: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 39–40.

W. H. Hass, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 12, p. 2526–2541. Definition and description based on section at Caddo Gap, Montgomery County, Ark. Lower division: nearly white thick-bedded novaculite; some interbedded greenish-gray and dark-gray shale near base; thickness 466 feet; Lower or Middle Devonian. Middle division: dark-gray and greenish-gray shale; many dark-gray beds of novaculite; thickness 347 feet; Upper Devonian and Mississippian. Upper division: nearly white granular thick-bedded novaculite; thickness 127 feet; Mississippian. Underlies Stanley shale; overlies Missouri Mountain slate (Silurian).

L. S. Griswold (1892, Arkansas Geol. Survey Ann. Rept. 1890, v. 3) described trade name Arkansas stone and (or) novaculite in an economic report on whetstones and novaculites of Arkansas.

Named for quarries in Arkansas. Principal formation in Ouachita Mountains.

†Arkansas Sandstone[1]

Pennsylvanian and Permian: Central southern Colorado.

Original reference: F. M. Endlich, 1874, U.S. Geol. and Geog. Survey Terr. 10th Ann. Rept., p. 312.

Named for proximity to Arkansas River.

Arkill Limestone (in Saavedra Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8, 11, 15. Slabby grayish-brown and buff arenaceous limestone. Fossiliferous. Thickness about 2 feet. Overlain by a soft white, in some places buff, sandstone. A buff sandstone separates the Arkill from underlying Barata limestone (new).

Type locality of Lowell formation is in southwestern flank of Bisbee anticline, southeast of Bisbee and east of Naco; standard section of Lowell is in Ninety One Hills.

Arkose Ridge Formation

Cretaceous: South-central Alaska.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 10–12. Assemblage of arkose, conglomerate, and shale more than 2,000 feet thick. Arkose is fine grained and conglomeratic in places, but conglomeratic feature nowhere predominates. Rocks are dark brown to gray and contain all essential constituents of granite. On north side of Arkose Ridge, formation believed to rest with sedimentary contact on granite of Talkeetna batholith; on south side of ridge, formation in fault contact with Chickaloon and Matanuska formations. Older than Chickaloon formation and possibly, at least in part, older than Matanuska formation. Upper Cretaceous(?).

U.S. Geological Survey currently designates the age of the Arkose Ridge as Cretaceous on the basis of a study now in progress.

Typically exposed on Arkose Ridge, northwest of Wishbone Hill. In belt extending along northern border of Matanuska Valley west of Chickaloon River.

Arkwright Group

Upper Devonian: Western New York.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 31; 1955, New York State Mus. Sci. Service Circ. 42, p. 9–19. Succession of black and gray shales with some thin siltstone layers. Thickness 1,450 feet. Comprises Canadaway (lower) and Chadakoin formations; thus includes all rocks from base of Dunkirk shale to top of Ellicott shale. Underlies Conewango group; overlies Seneca group.

Name derived from Arkwright Township, Chautauqua County.

Arline Formation

Middle Ordovician (Mohawkian): Eastern Tennessee, northern Georgia, and southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 41–43, chart 1 (facing p. 130). Mostly cobbly weathering impure limestone containing considerable quantities of fine clastic material. Weathers to yellow-brown soil containing numerous silicified fossils. Thickness about 400 feet. Underlies Red Knobs formation (new); overlies Lenoir formation. Thin remnant underlies Effna calcarenites and reefs at Porterfield quarry, Virginia. Includes Fetzer tongue (new), which is recognized in Virginia, Tennessee, and Georgia. Interfingers with silty calcareous beds of Athens formation in southeastern Tennessee and with Rich Valley formation (new) at Marion, Va., and vicinity. Fingers of Arline appear in Tellico formation in belt along west front of Great Smoky Mountains. Occurs in area for which Porterfield stage is named. Name attributed to B. N. Cooper and G. A. Cooper.

Exposed almost in its entirety on both sides of valley of small stream tributary to Gallagher Creek, 2 miles southwest of railroad switch at Arline on Concord (TVA 138-SW) and Louisville (TVA 138-SE) quadrangles, Tennessee.

Arlington Formation[1]

Mississippian: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 14). Underlies Shoofly formation (Pennsylvanian?); overlies Devonian Taylorsville formation.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Water-laid tuff and slate and minor andesitic metabreccia and metaconglomerate. Mapped with Permian marine sedimentary and metasedimentary rocks.

Named for Arlington Heights, Plumas County.

Arlington Gravel Member (of Vashon Drift)

Pleistocene: Northwestern Washington.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 26, 27, pl. 1. An outwash deposit of sand and gravel forming a thin veneer

over a terrace cut mainly in the earlier Stillaguamish sand member (new). Underlies Marysville sand member (new).

Area: Snohomish County; contains Tps. 26-32 N. of the Willamette base line.

†Arlington Lake Beds[1] or Formation

Tertiary, late, and Pleistocene: North-central Oregon.

Original reference: E. T. Hodge, 1930, Monthly Weather Rev., v. 58, p. 405–441.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 869. Abandoned in favor of Shutler formation. Name Arlington preoccupied.

Town of Arlington is near Shutler, Gilliam County.

Armendaris Group

Pennsylvanian (Des Moines Series): New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 41–49. Proposed for all rocks between top of Derry series below and base of Bolander group above. Entirely of marine origin and composed largely of gray to light-gray cherty limestone, with a few thin shale and sandstone beds scattered throughout. Subdivided into three formations (ascending): Elephant Butte, Whiskey Canyon limestone, and Garcia.

Type locality: In north end of Mud Springs Mountains in west end of Whiskey Canyon, in and on either side of westernmost box canyon in southwest part of sec. 1, T. 13 S., R. 5 W., Sierra County. Name is derived from large Armendaris Grant to east and northeast of Hot Springs.

Armendaris limestone[1]

Ordovician: New Mexico.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 259, 260.

Derivation of name not stated.

Armenia Limestone Lentil (of Oswayo Formation)[1]

Devonian or Carboniferous: Central northern Pennsylvania.

Original reference: H. S. Williams and E. M. Kindle, 1905, U.S. Geol. Survey Bull. 244.

Armenia Mountain section, Bradford County.

Armes Gap Sandstone (in Graves Gap Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19 pls. 2, 3, 4. Thickness near Armes Gap about 10 feet; 20 to 40 feet in Camp, Austin, Petros, and Fork Mountain quadrangles; from this area thins northward; 20 to 70 feet in a northwest-southeast belt through Lake City, Duncan Flats, Block, Norman and Huntsville quadrangles. Separated from underlying Indian Bluff group (new) by a shale interval as much as 300 feet thick that includes Jordan and Norman Pond coals; separated from overlying Roach Creek sandstone (new) by a shale interval as much as 130 feet thick that includes Pioneer coal.

Named from exposures in Armes Gap, north of Petros, Morgan County.

Armstrong Member (of Cuyahoga Formation)[1]

Armstrong Sandstone Member (of Cuyahoga Formation)

Mississippian: North-central Ohio.

Original reference: G. E. Conrey, 1920, Ohio Geol. Survey, 4th ser., Bull. 24, p. 54.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 49, 50–51. Described as Armstrong sandstone member of River Styx conglomerate facies and Killbuck shale facies of Cuyahoga formation. In River Styx facies, Armstrong includes Rittman conglomerate submember.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Overlies Rittman which is here raised to member status; underlies Wooster member (new) used in place of Black Hand which is here restricted. Lower Mississippian.

Named for exposures near village of Armstrong, Wayne County.

Armuchee Chert[1]

Lower and Middle Devonian: Northwestern Georgia.

Original reference: C. W. Hayes, 1902, U.S. Geol. Survey Geol. Atlas, Folio 78, p. 3.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Underlies Frog Mountain sandstone.

Named for exposures around Armuchee, Floyd County.

Armuelles Formation

Pleistocene: Panamá and Costa Rica.

R. A. Terry, 1941, Geog. Rev., v. 31, no. 3, p. 381 (fig. 5), 382. Conglomerate that passes upward into sandstones and shales. Overlies Charco Azul formation. Thickness more than 4,000 feet. Pleistocene.

A. A. Olsson, 1942, Bulls. Am. Paleontology, v. 27, no. 106, p. 160–161 (8–9); 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 248–249. Beds consist principally of gray well-bedded foraminiferal shales and soft sandstones. Fossils described.

Typically exposed near Puerto Armuelles, Burica Peninsula. Extends into Costa Rica.

Arnheim Shale,[1] **Limestone,**[1] **or Formation** (in Richmond Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, west-central Kentucky, and Tennessee.

Original reference: A. F. Foerste, 1905, Science, new ser., v. 22, p. 150.

C. V. Theis, 1936, U.S. Geol. Survey Water-Supply Paper 677, p. 31 (table), 74. Unconformably underlies Fernvale formation and overlies Leipers limestone in south-central Tennessee.

Wilber Stout, K. V. Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 33, p. 113. Formation in Ohio. Subdivided into Sunset member below and Oregonia member above. Underlies Waynesville formation; overlies McMillan formation. Richmond group.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 11. In proposed changes of nomenclature for Ordovician system of central Tennessee, the Ohio name Arnheim is retained. In case its correlation with strata in Tennessee is seriously questioned, a local name should be applied. Richmond group.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 201–207. Described as dark-blue to blue-gray thin-bedded to massive argillaceous rubbly limestone in Tennessee. Thickness varies from 10 to 20 feet.

Overlies Leipers formation unconformably with single known exception of exposure at Clinton where it overlies Hermitage formation. Underlies Sequatchie formation in western exposures; in southeasternmost exposures is overlain by Fernvale limestone. Locally Chattanooga shale rests on Arnheim.

A. C. McFarlan and W. H. White, 1952, Kentucky Geol. Survey Bull. 10, p. 12. Oregonia member at base of formation in Kentucky.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Arnheim formation in Maysville group shown on generalized stratigraphic column of Ordovician and Silurian rocks exposed in Jefferson and Switzerland Counties. Thickness 70 to 80 feet. Overlies Mount Auburn formation; underlies Waynesville formation of Richmond group. Cincinnatian.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. If reference section of the Cincinnatian, in Cincinnati region, be considered to include all strata between Point Pleasant (Cynthiana) beds and the Brassfield and their lateral equivalents, it is possible to recognize eight formational units in the sequence. These are (ascending) Eden, Fairview, McMillan, Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations. The Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn define the Richmond stage of the Cincinnatian.

Named for Arnheim, Brown County, Ohio.

Arnold Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Arnold mine, Keweenaw County.

Arnold Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Arnold mine, Keweenaw County.

Arnold Limestone (in Deese Group)

Arnold Member (of Deese Formation)[1]

Pennsylvanian (Des Moines Series): South-central Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as a limestone in Deese group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma—a symposium, v. 2. Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 32, 33. Occurs some 3,000 feet above base of Deese group (in maximum section). Includes a very fossiliferous thin-bedded limestone, more or less earthy and lumpy and interbedded with calcareous shale; with maximum aggregate thickness about 100 feet. Rocky Point conglomerate is about 1,400 feet above Arnold. Devils Kitchen conglomerate is 1,800 feet below Arnold.

Named for Arnold's Reef on Arnold Farm in sec. 33, T. 3 S., R. 1 E., north of Ardmore.

Arnoldsburg cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 178–181. Embraces interval between Benwood cyclothem (new) below and Lower Union cyclothem (new) above. Includes (ascending) Fulton shale and sandstone, Arnoldsburg redbed, Arnoldsburg limestone, Arnoldsburg underclay, Arnoldsburg coal, and Arnoldsburg roof shale members. In its normal position between Benwood coal bed and Arnoldsburg sandstone, average thickness of cyclothem in Athens County is a little over 16 feet. Individual members do not regularly appear in section, and their thickness frequently exceeds average thickness of entire cyclothem. Where Benwood cyclothem is absent, base of Arnoldsburg is considered to lie above roof shale of Sewickley coal bed; where base of cyclothem is drawn at this position, its average thickness is 71 feet. Under these circumstances, Sewickley sandstone, Tyler redbed, and Benwood limestone members are placed in Arnoldsburg cyclothem. In area of this report, Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Well developed in Athens County.

Arnoldsburg Limestone Member (of Monongahela Formation)

Arnoldsburg Limestone (in Monongahela Formation)[1]

Upper Pennsylvanian: Northern West Virginia and eastern Ohio.

Original reference: W. Stout, 1929, West Virginia Acad. Sci. Proc., v. 3, p. 140, 143.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 10). Shown on correlation chart as formation in Monongahela series. Underlies Uniontown limestone; overlies Benwood limestone.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 37. In Jefferson County, Ohio, Arnoldsburg consists of several layers of gray to buff limestone interbedded with buff calcareous clay shale. Average thickness about 13 feet, more than half of which is calcareous shale. Limestone is overlain by about 30 feet of gray arenaceous shale. Overlies Fulton green shale.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 81. Arnoldsburg limestone and shale member of Monongahela series described in Morgan County. Occurs between Fulton green shale member and Arnoldsburg coal member, although Fulton is not recognized definitely in Morgan County. Thickness 25 to 35 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 181. In this report [Athens Couty]. Monongahela series is described on a cyclothemic basis. Arnoldsburg limestone member is included in Arnoldsburg cyclothem (new). Thickness 13½ feet.

Named for its close association with the Arnoldsburg sandstone which occurs near Arnoldsburg, Calhoun County, W. Va.

Arnoldsburg redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 180. Member of Arnoldsburg cyclothem in report on Athens County. Recognized only if Benwood cyclothem is intact. Average thickness 13 feet. Where Arnoldsburg cyclothem is considered to be at base of

Sewickley sandstone, the lateral equivalents of this unit are lost in Tyler redbed and Benwood limestone sections.

Named for Arnoldsburg cyclothem.

Arnoldsburg roof shale member

See Arnoldsburg cyclothem.

Arnoldsburg Sandstone Member (of Monongahela Formation)

Arnoldsburg Sandstone (in Monongahela Formation)[1]

Upper Pennsylvanian: Western West Virginia, eastern Ohio, and southwestern Pennsylvania.

Original reference: R. V. Hennen, 1911, West Virginia Geol. Survey Rept. Wirt, Roane, and Calhoun Counties, p. 57, 202, 505.

W. O. Hickok and F. T. Moyer, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 123, 124 (fig. 29). Geographically extended into Fayette County, Pa., where it is described as medium-grained soft gray-brown sandstone occurring in thin to medium beds. Average thickness about 10 feet. Underlies Uniontown limestone; overlies Benwood limestone.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 37. Overlies Arnoldsburg limestone in Jefferson County, Ohio, and northwestern part of West Virginia.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 82. Arnoldsburg sandstone and shale member of Monongahela series described in Morgan County. Occupies stratigraphic position between overlying Uniontown limestone and underlying Arnoldsburg coal and (or) Arnoldsburg limestone. Consists of erratic development of sandstones and sandy shales ranging in thickness from 4 to 22 feet and averaging about 12 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158, 181. In this report [Athens County], Monongahela series is described on cyclothemic basis. Arnoldsburg shale and sandstone member is included in Lower Uniontown cyclothem (new). Arnoldsburg sandstone is represented as an olive-gray silty shale about 8 feet thick. Where Lower Uniontown coal is absent, Arnoldsburg sandstone is basal member of cyclothem. Underlies Ritchie redbed member (new).

Named for Arnoldsburg, Calhoun County, W. Va.

Arnoldsburg underclay member

See Arnoldsburg cyclothem.

Aromas Red Sands

Pleistocene, middle(?): West-central California.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 43–45, pls. 1, 2, 3. Dark-brown to red friable quartzose sandstone. Thickness 600 to 800 feet; 180 feet at type section. Underlie terrace gravels and alluvium; unconformably overlie all older formations with which they are in contact, successively overlapping upon Santa Lucia granite, San Lorenzo, Vaqueros, volcanics, and Pliocene rocks [Purisima formation].

Type section: In railroad cut 1 mile west of town of Aromas [Monterey County].

Aroostook Limestone[1]

Silurian: Northeastern Maine and western New Brunswick, Canada.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 44–45.

C. O. Nylander, 1940, Geological formations of the St. John River valley, northern Maine and New Brunswick: Caribou, Maine, p. 11–12 [privately printed]. Noted as occurring in western New Brunswick.

R. L. Miller, 1947, Maine Geol. Survey Bull. 4, p. 7, 10, pl. 2. Composed of three lithologic members: lower slate, middle ribbon limestone, and upper argillaceous limestone. Apparent thickness 18,000 feet; this may be excessive because structure of region is very complex. Underlies sequence of shale and slate (Ashland limestone and shale of former reports); overlies sandstone and conglomerate formation (Sheridan sandstone of former reports).

Occurs in eastern part of Aroostook County, Maine. The Aroostook River cuts the limestone from Wade Township to its junction with St. John River.

Aroostook Falls Diabase[1]

Age(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 115, 175–177.

Named for occurrence at Aroostook Falls, Aroostook County.

Arp Member (of Queen City Formation)

Arp Sand (in Reklaw Formation)

Eocene (Claiborne): Northeastern Texas and Louisiana.

B. W. Blanpied and R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 128 (correlation chart). Shown on correlation chart as Arp sand in Reklaw formation.

H. B. Stenzel, 1953, Texas Univ. Pub. 5305, p. 10 (fig. 3), 83–85. Described as member at base of Queen City formation. Consists of sands, silts, and thinly bedded, silty, carbonaceous shales. Thickness ranges from 48 to 75 feet. Underlies Omen sandstone member; overlies Marquez shale member, Reklaw formation. Type locality designated. Name credited to C. L. Moody.

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2520–2521. Member overlies Reklaw formation at alternate type locality of Queen City.

Type locality: Vicinity of Homer Lacey country store on road from Bell Church to Griffin, Henrys Chapel quadrangle. Named from town of Arp in southeastern Smith County, Tex., 6 miles north of mapped area.

Arpin Conglomerate and Quartzite[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 366.

Exposed immediately south of Arpin, Wood County.

Arrastre Complex

Arrastre Quartzite[1]

Middle Paleozoic(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 351, 353–365, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 471–472. Because Arrastre quartzite is closely involved with much granitic material, it

might be better to call combination Arrastre complex. Younger than Cambrian, probably about Middle Paleozoic.

Named for Arrastre Creek, San Bernardino County.

Arrey Formation (in Green Canyon Group)

Pennsylvanian (Derry Series): New Mexico and western Texas.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 32–33, 35–36. Name used for the basal formation of the Derry series. At type locality, formation is composed of dense massive limestones, highly nodular limestones with irregular interbedded highly calcareous shales and very irregular masses and lenses of chert; northward from type locality, formation is more highly clastic, but southward it is essentially pure limestone. Thickness ranges from 32 feet at type locality to more than 300 feet in Hueco Mountains of western Texas. Underlies Apodaca formation (new).

Type locality: On west-facing slope of hill about three-fourths mile east of Derry, Sierra County, N. Mex. Name derived from village of Arrey on the west side of Rio Grande on Highway 85 about 4½ miles northwest of Derry.

Arriban series[1]

[Tertiary]: New Mexico.

Original references: C. R. Keyes, 1906, Science, new ser., v. 23, p. 921; 1906, Am. Jour. Sci., 4th, v. 21, p. 298–300.

Derivation of name not stated.

Arrow Creek Member (of Colorado Shale)

Lower Cretaceous: Central Montana.

J. B. Reeside, Jr., and W. A. Cobban, 1960, U.S. Geol. Survey Prof. Paper 355, p. 8, 14 (fig. 8), 38, 39, 40, 41, 42, 43, 44. Consists of bentonite, tuff, and porcelanite. Thickness 40 feet in type area. Underlies Mowry member. In Teigen area, the bentonite is 2½ feet thick and is about 50 feet below Mowry member. Thickens northwestward, and top of member gradually approaches base of Mowry.

Type section: North side of Arrow Creek in sec. 23, T. 18 N., R. 10 E., Judith Basin County. Forms conspicuous white outcrop for 35 miles between Belt Butte and Stanford.

Arrowhead Limestone Member (of Monte Cristo Limestone)[1]

Upper Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9, 18.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 23). Age shown on correlation chart as Mississippian (Meramecian).

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42. Commonly alternating layers of fine limestone several inches thick, and thin shale. Thickness about 10 feet. Overlies Bullion dolomite member; underlies Yellowpine member.

Named for Arrowhead prospect, sec. 9, T. 24 S., R. 58 E., Goodsprings quadrangle, Clark County, Nev.

†Arrowmink Arkosic Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: F. Bascom, 1904, Am. Jour. Sci., 4th, v. 17, p. 143.

In Philadelphia region.

Arroyo Formation (in Clear Fork Group)[1]

Lower Permian (Leonard Series): Central Texas.

Original reference: J. W. Beede and V. V. Waite, 1918, Texas Univ. Bull. 1816, p. 45–46.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42. Basal formation of Clear Fork group. Underlies Vale formation; overlies Lueders limestone. Thickness about 250 feet.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on stratigraphic table as comprising (ascending) Rainey, Lytle, and Standpipe limestone members. Underlies Vale formation; overlies Lake Kemp formation.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Shown on composite columnar section of Permian rocks in Colorado River valley as overlying Lueders limestone.

Occurs on and near Los Arroyo 2¼ miles west of Ballinger, Runnels County.

Arroyo Hondo Formation

Eocene: West-central California.

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 13 (table 1), 27–32. Name applied to strata that have been referred by various writers to Martinez, Meganos, and Tejon stages. Formation includes Cantua sandstone (at base), Ragged Valley shale (new), and an upper white sandstone member (unnamed) 100 to 300 feet thick. Unconformably underlies Domengine formation; uncomformably overlies Moreno formation.

Type section: Along the Arroyo Hondo, north of Coalinga [Fresno County].

Arroyo Hondo Shale Member (of Lodo Formation)

Eocene: West-central California.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 257. Upper member of Lodo formation (new). Overlies Cantua sandstone member.

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1725 (fig. 1), 1726 (fig. 2), 1735, 1738. Type section designated. Name credited to E. R. Atwill (unpub. paper read before 9th annual meeting of Pacific section of American Association of Petroleum Geologists). Atwill described Arroyo Hondo as a shale formation, with a white arkosic sandstone member at top, lying between Cantua sandstone and restricted Domengine. White found Arroyo Hondo shale genetically a part of Lodo formation, relegated its rank to a member, and excluded from it the white sandstone unit. Vokes (1939) used preoccupied term Arroyo Hondo to include most of Lodo formation and an unnamed sandstone unit between Lodo and Domengine. Vokes also proposed term Ragged Valley shale member to include most of Lodo shale, Cerros shale member, and Arroyo Hondo shale member, all of which were named and defined previous to his designation. Underlies Yokut sandstone (new).

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map. OM–128. In Tumey and Panoche Hills area, Fresno County, member consists of 1,040 feet of gray claystone and minor amounts of interbedded siltstone and sandstone. Overlies Cantua sandstone member; where Cantua is not present, it is impossible to distinguish between Cerros and Arroyo Hondo members. Underlies Yokut sandstone.

Type locality: Arroyo Hondo Creek in S½ sec. 14, T. 17 S., R. 13 E. [Fresno County].

Arroyo Penasco Formation

Upper Mississippian: Northern New Mexico.

A. K. Armstrong, 1955, New Mexico Bur. Mines Mineral Resources Circ. 39, p. 3, 6–9. Proposed for the 20 to 150 feet of gray dense fine-grained to oolitic massive- to medium-bedded limestone occurring in Pinos and Penasco Canyons in Nacimiento Mountains. A fossiliferous chert zone some 15 to 20 feet thick occurs at top of formation. Unconformably underlies Pennsylvanian Log Springs formation (new); in some areas, unconformable below Sandia formation; uncomformably overlies Precambrian gneiss.

J. P. Fitzsimmons, A. K. Armstrong, and Mackenzie Gordon, Jr., 1956, Am. Asso. Petroleum Geologists Bull., v. 40, no. 8, p. 1935–1944. Underlies Sandia formation. Fauna described.

Type locality: SW¼SE¼ sec. 5, T. 16 N., R. 1 E., Cuba quadrangle. Named for arroyo 1 mile southeast of type section. Also exposed in San Pedro, Jemez, Sandia, and Sangre de Cristo Mountains.

Arroyo Seco Gravel[1]

Pleistocene: Northern California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Incidental usage on map legend.

A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 33, 49–55, pl. 1. A pediment gravel. Thickness as much as 19 feet. Underlies Victor formation (new); overlies gravel deposits of uncertain age; in some areas overlies Mehrten formation (new) and in others Laguna formation (new). [This is cited by Wilmarth as "in press."]

Named for Arroyo Seco land grant [along west front of Sierra Nevada] where formation is extensively preserved.

Artemisia Gravel[1]

Pleistocene: Great Lakes region, Ontario, Canada, and Michigan.

Original reference: W. E. Logan, 1863, Canada Geol. Survey Repts. 1843–1863, p. 887, 908–909.

Named for Artemisia Township, Ontario.

Arthur Limestone (in Carbondale Formation)

Pennsylvanian: Southwestern Indiana.

J. A. Culbertson, 1932. The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 5–6. Thin very fossiliferous limestone lying about 10 feet above Petersburg coal.

Occurs between Oakland City and Arthur, Pike County.

Artillery Formation

Eocene, lower(?): West-central Arizona.

S. G. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 14 (table 2), 16–22, pls. 1, 2. Consists of conglomerate, arkose, sandstone, shale, limestone, a little clay, some tuff, and a widespread basalt member. About 2,500 feet thick. Rests with angular unconformity upon rocks of Precambrian complex and Paleozoic(?) sediments. In some areas, unconformably underlies Miocene(?) volcanics; in other places, overlain by Chapin Wash formation, Cobwebb basalt, or Sandtrap conglomerate (all new); on east side of Bill Williams River, overlain by extensive gravel blanket, and in Santa Maria district by Quaternary(?) basalt. In central spur of Artillery Mountains, has been overthrust by Precambrian complex and Paleozoic(?) rocks. Silicified palm roots were collected from some of the limestone beds. Tentatively assigned to lower Eocene (p. 21). Plates 1 and 2 (geol. maps) show age as early Eocene(?).

Named for Artillery Mountains (Mohave County). Formation occupies broad tracts within mapped area and extends far beyond its borders, particularly northward along Big Sandy River and westward into Rawhide Mountains.

Artist Drive Formation

Oligocene and Miocene(?): Eastern California.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 955–956. Comprises 1,000 feet or more of impure well-stratified ash beds that contain remains of fresh-water fish, conformably overlain by alternating basaltic and latitic flows, tuffs, and breccias that are more or less altered. Interlain with volcanics are basin deposits that range from fanglomerate to playa clay and algal limestone. Unconformably underlies Furnace Creek formation. Name credited to T. P. Thayer.

Typically exposed in west face of Black Mountains near Artist Drive in Death Valley.

Arumonogui (Almongui) Agglomerate

See Almongui Agglomerate.

Arundel Formation[1] **or Clay** (in Potomac Group)

Upper Cretaceous: Eastern Maryland.

Original reference: W. B. Clark 1897, Maryland Geol. Survey, v. 1, p. 156, 190.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 5–6. More specific name Arundel clay is preferred because formation consists almost entirely of clay. Unconformably underlies Patapsco formation; unconformably overlies Patuxent formation.

Gerald Meyer, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 95, pl. 3. Gives thickness as much as 200 feet. Clay dips southeast at an average rate of about 45 to 50 feet per mile.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2169 (fig. 1), 2177. Lower Cretaceous. This assignment is made on basis of both floral and faunal evidence. Detailed discussion of problem.

Named for Anne Arundel County.

Arusa Formation

See Aruza Formation.

Aruza Formation (in Tapaliza Group)

Aruza Member (of Tapaliza Formation)

Oligocene: Panamá.

Karl Sapper, 1937, Mittelamerika Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 132–133, 134 (correlation chart). Arusa formation shown on correlation chart below Aquaqua formation and above Clarita formation (both new). Upper Oligocene.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart), 241. Tapaliza can be divided into an upper or Miocene part and a lower or Oligocene part, known respectively as the Aguagua and the Arusa.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 36, 44. Referred to as Aruza formation.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 324. Indicates correct spelling is Aruza.

Dareen area.

Arvada Formation

Pleistocene: Northeastern Wyoming.

L. B. Leopold and J. P. Miller, 1954, U.S. Geol. Survey Water-Supply Paper 1261, p. 8–10, 18, 31. Consists of highly weathered gravel or gravelly sand, generally stained red but containing many cobbles stained with a yellow or yellow-brown limonite. Disconformably underlies Ucross formation (new). Thickness up to 5 feet.

Type locality: At west abutment of highway bridge across Powder River on Highway 16, 3 miles north of Arvada, Wyo.

Arvison Formation

Lower Jurassic: Northern California.

A. F. Sanborn, [1953] Stanford Univ. Abs. Dissert., v. 27, p. 436–437. Fossiliferous strata conformably underlying Potem formation and unconformably overlying Modin formation.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 11–14, pl. 1. Proposed for series of dominantly pyroclastic beds with minor andesitic flows, which are intermediate between Modin and Potem formations and which do not appear to be continuous with Bagley andesite of Diller. Bagley andesite, as traced from its type area into Big Bend region, overlies and is interfingered with basal beds of Potem formation. Because basal strata of Potem appear to lie between Bagley andesite and Arvison pyroclastic accumulations, new name is proposed for the lower beds. Thickness 5,090 feet in type area. Overlies Kosk member (new) of Modin formation.

Type area: Extends from point on Kosk Creek about 1¾ miles south of Arvison Flat to point about 1 mile north of Arvison Flat at contact with underlying Triassic beds, Big Bend quadrangle, Shasta County.

Arvonia Slate[1]

Upper Ordovician: Central Virginia.

Original reference: T. L. Watson and S. L. Powell, 1911, Am. Jour. Sci., 4th ser., v. 31, p. 36–43.

G. W. Stose and A. J. Stose, 1948, Am. Jour. Sci., v. 246, no. 7, p. 393–412. In central Virginia is not restricted to belt of commercial slate but includes a porphyroblastic facies of slate, called knotted slate. Underlies Bremo quartzite (new); overlies Peters Creek formation. Suggested that age may be Silurian or younger.

Exposed at Arvonia.

Asan Limestone

Aquitanian: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 52, table 4 [English translation in library of U.S. Geol. Survey, p. 62]. Hard red or white limestone that unconformably overlies Fena beds. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 18–19. Paleontologically same as Tagpochau limestone on Saipan. Aquitanian.

Type locality: Asan, Guam.

Asbury Clay[1]

Miocene, upper: Eastern New Jersey.

Original reference: H. B. Kummel and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 145.

Named for development just west of Asbury Park, Monmouth County.

Ashawa till[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203.

Ashawan[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 45, p. 150–151.

Ashbed Amygdaloid (in Portage Lake Lava Series)

Ashbed Amygdaloid (in Ashbed Group)[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 56, 58, 102, 116, 129, chart.

H. R. Cornwall, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–34. Included in Portage Lake lava series.

In old Ashbed mine, Keweenaw County.

Ashbed Flow[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

In old Ashbed mine, Keweenaw County.

†Ashbed Group[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 172–173, 178, 186, pls. 17, 18.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Name Portage Lake lava series (new) proposed to include Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports; these subdivisions are quite arbitrary and depend on continuity of individual flows or conglomerate beds for validity. They are not useful for purpose of this report.

Occurs in old Ashbed mine, Keweenaw County.

Ashby Stage

Middle Ordovician (Mohawkian): North America.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 8, chart 1 (facing p. 130). Mohawkian series divided into five stages (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness. In Hogskin Valley, Elray and Lincolnshire formations comprise Ashby stage. Kay (1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8) places formations of this stage in his Chazyan, but this does not seem justified on paleontological grounds. Name credited to G. A. Cooper and B. N. Cooper.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 93, 94, 95. Virginia sequence consists of Blackford (new), Ashby, Porterfield, and Wilderness stages. Place of Marmor stage is in dispute. Blackford and Ashby stages believed to be Chazyan, but not to constitute whole of that series. They are in a provincial series that is approximately the St. Paul group (Neuman, 1951).

Named from road intersection on Hogskin Creek, in northeast quarter of center subquadrangle of Maynardville (30′) quadrangle, Tennessee.

Ash Creek Group

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 9–10, pl. 1. Eastern of two major subdivisions of Yavapai series. Separated from western subdivision, the Alder group, by Shylock fault. Rocks consist of basaltic, andesitic, rhyolitic, and dacitic flows and pyroclastic rocks and thick sequence of tuffaceous sedimentary rocks containing interbeds of jasper-magnetite and chert. Divided into seven formations. Gaddes basalt (new) is oldest, and is overlain by Buzzard rhyolite (new). Shea basalt, dacite of Burnt Canyon, and Brindle Pup andesite (new), lenticular units about the same age, separate Buzzard rhyolite from younger Deception rhyolite. Grapevine Gulch formation (new) is younger than Deception rhyolite. Group perhaps 20,000 feet thick, not including base or top. Sum of maximum thickness of each formation is 23,500 feet, but because some volcanic formations are lenticular, a lower figure is more accurate estimate for group as a whole.

Named from Ash Creek, which cuts through a representative section south of Mingus Mountain, Jerome area, Yavapai County.

Ash Creek Series

Precambrian: New Mexico.

C. H. Hewitt, 1959, New Mexico Bur. Mines Mineral Resources Bull. 60, p. 12–13, 33, 53–57, 104–105, pls. 1, 12. Contains seven metasedimentary rock types grouped into four mappable units (not in stratigraphic sequence): sericite phyllite and andalusite-sericite schist; cordierite

hornfels; spotted andalusite hornfels, biotite hornfels, and diopside quartzite; serpentine-carbonate rocks. Maximum exposed thickness approximately 5,800 feet. Younger than Bullard Peak series (new). Occurs as complex xenoliths or roof pendants in Burro Mountains granite.

Named for Ash Creek Canyon, Big Burro Mountains area. Underlies about 1½ square miles in secs. 9, 16, 17, 21, and 22, T. 18 S., R. 18 W., Grant County.

Asher Formation[1]

Permian: Central and southern Oklahoma.

Original reference: G. D. Morgan, 1924, Oklahoma Bur. Geology Bull. 2, p. 141–142, pls. 3, 27, map.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1519 (fig. 1). Shown on graphic section of "Wanette" time division of Permian sediments. Included in Pontotoc terrane. Gradational equivalent of Stratford shale.

Named for development at and west of Asher, Pottawatomie County.

Asherville Alluvium

Pleistocene(?): Southeastern Missouri.

Willard Farrar and Lyle McManamy, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 6, p. 38–41. Composed of reddish, angular sand grains, with a small amount of red to light-brown clay. Thickness varies from 18 to 80 feet. Overlies Powell(?) and Ripley formations and also loess.

Found in vicinity of Asherville in sec. 15, T. 26 N., R. 8 E., Puxico quadrangle [Stoddard County].

Ash Hollow Formation (in Ogallala Group)

Ash Hollow Member (of Ogallala Formation)

Ash Hollow Series or Formation

Pliocene: Western Nebraska, western Kansas, South Dakota, and southeastern Wyoming.

Henry Engelmann, 1876, *in* Appendix 1 *of* Report of explorations across the Great Basin of the territory of Utah for a direct wagon route from Camp Floyd to Genoa, in Carson Valley, in 1859, by Capt. James H. Simpson, Engineer Dept., U.S. Army: Washington, U.S. Govt. Printing Office, p. 260–262, 283. Near junction of North and South Forks of Platte River, first rocky strata were observed. They continue along South Fork, cropping out at intervals at one or the other side of river, and were found most developed in Ash Hollow where they attain thickness of over 250 feet. This series is composed of an alternation of loose, finely sandy, and of harder rocky strata, the latter consisting of fine or coarse drift-sand, generally cemented by carbonate of lime, forming more or less calcareous sandstones, and gritty, very impure limestones. Probably Pliocene-Tertiary. Fossilized seeds present in rocks near forks of Platte River. From Ash Hollow westward, strata gradually assume different appearance, and instead of being calcareo-arenaceous they become more purely arenaceous and, finally, argillo-arenaceous. This formation is older than Ash Hollow series. Term Ash Hollow formation used on page 283.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 223–224, 227. Name Ash Hollow formation applied to "mortar beds" of Ogallala group.

Thickness 100 to 250 feet. Underlies Sidney gravel formation; overlies Valentine formation.

A. L. Lugn, 1939, Am. Jour. Sci., v. 237, no. 6, p. 435–436; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1260–1261. At type locality, where they overlie about 55 feet of Brule formation, beds belonging to Ash Hollow formation consist of layers of gravel, sand, silt, and fine sandy clay, with some beds of volcanic ash, all more or less indurated into hard caliche beds at regular intervals. Thickness 250 to 275 feet. Term Ash Hollow is not a new or even recent name as was supposed by Lugn (1938). Term Ash Hollow formation was applied to exactly same beds in Ash Hollow Canyon by Engelmann (1876).

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 139–145. Subdivided to include (ascending) Wray channel, Minnechaduza, and Feldt Ranch beds (all new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 18 (fig. 8), 19 (fig. 9), 20. Geographically extended into Kansas where it is considered member of Ogallala formation. Underlies Kimball member; overlies Valentine member.

A. L. Lugn and B. W. Brown, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1384. Geographically extended into southeastern Wyoming.

J. S. Carey and others, 1952, Kansas Geol. Survey Bull. 96, pt. 1, p. 9–13, 27. In Norton County, Kans., includes (ascending) Calvert ash bed and Reager ash bed (both new).

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 253–255. In northwestern Kansas, includes (ascending) Rawlins (new), Fort Wallace (new), Dellvale (new), Reager, and Reamsville (new) volcanic ash beds.

R. E. Stevenson, 1959, Geology of the Dallas quadrangle (1:62,500) : South Dakota Geol. Survey. Geographically extended into Dallas quadrangle, South Dakota. Bulk of formation consists of interbedded buff to greenish-tan fine-grained arkosic sand and ledge-forming vuggy calcareous arkosic sandstone; beds of greenish-tan fine-grained clayey and silty arkosic sand locally present; some of strata are ashy, and some contain white dense limestone concretions. Maximum thickness 110 feet. Includes Bijou facies. Underlies Herrick formation.

Type section: Exposures in Ash Hollow Canyon southeast of Lewellen, Garden County, Nebr.

Ashishik Basalt

Tertiary and Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 3, p. 25, 27, 38, pl. 3. Consists of a sequence of massive basalt flows with minor interbedded tuff-breccia and tuff; individual flows range in thickness from 20 to 60 feet. Thickness 500 feet measured on cliff west of New Jersey Creek, but base not exposed. Underlies Crater Creek basalt (new).

F. M. Byers, 1959, U.S. Geol. Survey Bull. 1028–L, p. 309–311, pl. 41. As redefined in this report, includes most of bulk of Okmok Volcano and comprises Ashishik basalt, tuff breccia, and tuff, that part of Crater Creek basalt on outer flanks of Okmok Volcano, Idak basalt, excepting the mass of Mount Idak, and basalt flows of Hill 1200 (Byers and others,

1947). Ashishik basalt is subdivided into three lithologic units: mafic phenocryst basalt, palagonitized pyroclastic rocks, and aphyric (non-porphyritic) feldspathic basalt. Separated from younger Crater Creek basalt by erosional surface. Separated from Crater Creek by fault on north wall of Okmok Caldera. Latest Tertiary and Quaternary.

Named for exposures in east-facing cliff, 2 to 3 miles south of Ashishik Point at northernmost part of Umnak Island.

Ashland Formation

Silurian: Northeastern Maine.

W. H. Twenhofel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1978–1979; 1941, Jour. Paleontology, v. 15, no. 2, p. 170–172, 173–174. Defined to include Ashland limestone, Ashland shale, and Graptolite shale of Williams (1900). Field relations and fossils suggest that Graptolite shale and Ashland shale are parts of one stratigraphic unit, that strata designated Ashland limestone are lenses of limestone in this shale, and that Sheridan sandstone succeeds Ashland shale. Thus interpreted, section becomes (descending) Sheridan formation, Ashland formation, Aroostook formation.

W. S. White, P. E. Cloud, Jr., and Josiah Bridge, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1939–1940. Stratigraphic sequence given (descending): Ashland formation, Aroostook formation, Sheridan sandstones.

Named for exposures in Ashland village, Aroostook County.

Ashland Limestone[1]

Silurian: Northeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 51, 52, 54.

W. H. Twenhofel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1978–1979; 1941, Jour. Paleontology, v. 15, no. 2, p. 170–172, 173–174. Included in Ashland formation (new).

Named for exposures in Ashland village (in a ledge opposite Ashland Hotel), Aroostook County.

Ashland Limestone

Ashland limestone facies (of Callaway Formation)

Middle Devonian: Northeastern Missouri.

E. B. Branson, 1941, Kansas Geol. Soc. Guidebook 15th Ann. Field Conf., p. 81, 83, 85. Compact, fossiliferous limestone. Maximum thickness about 15 feet. In type area, uncomformably underlies Callaway limestone; unconformably overlies Jefferson City dolomite. Crops out in sec. 1, T. 47 N, R. 12 W.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 37–39. Term Ashland is preoccuped. Unit is herein referred to as Ashland limestone facies to denote *Rensselandia*-bearing beds of Callaway formation. Type locality redesignated due to typographical error in original description.

Type locality: NE¼SW¼ sec. 1, T. 46 N., R. 12 W., Boone County, about 0.3 mile north of Sycamore School, along an old abandoned roadway, 9 miles north-northwest of Jefferson City. Type locality covers only about 10 acres. Name derived from village of Ashland.

Ashland Limestone[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 24.

Named for town of Ashland.

Ashland Mica Schist[1]

Ashland Series

Precambrian: Eastern Alabama.

Original reference: E. A. Smith and H. McCalley, 1904, Alabama Geol. Survey Bull. 9, p. 8.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1379. Considered as part of the Carolina gneiss or series.

F. R. Hunter, 1944, Alabama Geol. Survey Bull. 54, p. 13, 14. Referred to as Ashland series. Described as containing a variety of metasedimentary rocks that have been severely folded and faulted. Bordered on west by Hillabee chlorite schist and on the east by Pinckneyville granite (known to be younger than Ashland). Area of report covers Coosa County.

Named for exposure around Ashland, Clay County.

Ashland Shale[1]

Silurian: Northeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 45, 49–51.

W. H. Twenhofel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1978-1979; 1941, Jour. Paleontology, v. 15, no. 2, p. 170–172, 173–174. Included in Ashland formation (new).

In Ashland village, along road opposite the hotel, and southward toward Masardis, Aroostock County.

†Ashley Marl[1]

†Ashley River Beds or Marl[1]

†Ashley-Cooper Beds or Marl[1]

Eocene, upper: Southern South Carolina.

Original reference: M. Tuomey, 1848, Agric. Survey South Carolina 1st Rept., p. 162–169, 190, 211.

Named for exposures along Ashley River, Dorchester County.

Ashley Hill Limestone[1]

Cambrian: Eastern New York.

Original reference: T. N. Dale, 1893, U.S. Geol. Survey 13th Ann. Rept., pt. 2, p. 312.

J. C. Craddock, 1957, Geol. Soc. America Bull., v. 68, no. 6, p. 694–695. Ashley Hill conglomerate mentioned under section headed Schodack shale and limestone. Rock sequence crops out on west ridge of Ashley Hill. Sequence begins with dark-gray quartzite and is succeeded by sequence of limestone, shale, and limestone conglomerate which is not known elsewhere in Kinderhook quadrangle. A crystalline limestone pebble in Ashley Hill conglomerate contains *Botsfordia caelata*. On basis of lithologic, stratigraphic, and fossil evidence, conglomerate and un-

derlying limestone and shale are correlated with Schodack shale and limestone. Underlying quartzite is probably equivalent to Diamond Rock quartzite (Ruedemann, 1930, New York Mus. Bull. 285).

Occurs at Ashley Hill, in northeast corner of Chatham Township, Columbia County, about 1 mile north of Rayville or Rider's Mills Station on Lebanon Springs Railroad, and 2 miles south of Brainard, in Nassau.

Ash Mountain Complex

Paleozoic(?)-Mesozoic(?): Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 6–7, pl. 1. Four rock types are mapped together as Ash Mountain complex. Major type is dark-gray fine-grained rock of quartz diorite composition which is intruded by a fine-grained lighter gray rock also of quartz diorite composition. The two fine-grained types are dissimilar to the plutonic types in mapped area and are possibly altered metamorphic rocks. Smaller amounts of quartz diorite, resembling material of Giant Forest pluton, and Cactus Point pluton, are present within the complex.

Named for exposures in vicinity of Ash Mountain Park headquarters, Sequoia National Park.

Ashnola Gabbro[1]

Carboniferous(?): Southwestern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Lies 2 miles east of Ashnola River, British Columbia and Washington.

Ashokan Formation (in Hamilton Group)

Ashokan Beds[1]

Ashokan Shales and Flags

Middle Devonian: Eastern New York.

Original reference: A. W. Grabau, 1917, Geol. Soc. America Bull., v. 28, p. 954.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 267–273. Referred to as Ashokan shale and flags.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 15, pl. 2. Described as a formation consisting of tough laminated arkosic flagstones containing interbedded shales which weather red or brown. Sandstones are generally coarse grained and range from thin beds to flags thick enough to be quarried. Maximum thickness in Albany County nearly 350 feet. Outcrop area small. Overlies Mount Marion formation; underlies Kiskatom formation.

Named for exposures in Ashokan district, west of Kingston.

Ashtabula Till

Pleistocene (Wisconsin): Northern Ohio and northwestern Pennsylvania.

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey Bull., 4th ser., G–32, p. 10 (fig. 3), 13 (fig. 4), 45, pl. 1. Gray to bluish-gray, moderately pebbly silt till deposited during Ashtabula advance near close of Cary time. Younger than Hiram till (new). Name credited to G. W. White (in press).

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 10–11. Thickness generally more than 25 feet and probably exceeds 50 feet in many places; at type section 19½ feet. Surface material in many areas. Overlies bedrock, Hiram till, or, in places where Hiram is absent, an earlier, coarser till. Youngest glacial deposit in Ohio. Type section designated.

Type section: Roadcut at top of bluff on east side of valley of Ashtabula River at Plymouth-Sheffield Township line, 1 mile south of northwest corner of Sheffield Township and 3 miles east of southeast corner of Ashtabula corporation line, Ashtabula County, Ohio.

†Ashton Schists[1]

Precambrian: Northeastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 106, 107.

Occurs at Ashton, Providence County.

†Aspalaga Clay or Marl[1]

†Aspalaga phase (of Chattahoochee Formation or Waldo Formation)[1]

Miocene, lower: Florida and southern Georgia.

Original reference: L. C. Johnson, 1892, Geol. Soc. America Bull., v. 3. p. 128–132.

Probably named for exposures at Aspalaga, Liberty County, Fla.

Aspen Shale[1]

Aspen Shale Member (of Mancos Shale)

Lower Cretaceous: Southwestern Wyoming, eastern Idaho, northwestern Montana, and northeastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 97 (table 1), 100 (table 2), 101–102. Member of Mancos shale in Uinta Basin, Utah. Overlies a lower unnamed shale member; underlies a middle unnamed shale member. Thickness 15 to 95 feet.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 839–840. Mapped in north-central Wasatch Mountains where it is about 250 feet thick. Underlies Frontier formation; overlies Kelvin(?) formation.

L. S. Gardner, 1944, U.S. Geol. Survey Bull. 944–A, p. 6, pl. 1. Mapped in Irvine quadrangle, Idaho. Thickness 2,015 feet. Underlies Frontier formation; overlies Bear River formation.

W. A. Cobban and J. B. Reeside, Jr., 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1893. Age designated as Lower Cretaceous on basis of ammonite fauna.

Teng-Chien Yen, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 760–761. Bear River formation in type area underlies Aspen shale. On basis of fauna, Bear River strata are assigned to Upper Cretaceous (Cenomanian).

A. La Rocque and C. D. Edwards, 1954, Geol. Soc. America Bull., v. 65, no. 4, p. 315–326. Cretaceous Bear River and Aspen section in Willow Creek, 6 miles southeast of junction of Hoback and Snake Rivers, Teton County, Wyo., described in detail including position and nature of its faunas. Bear River is 539 feet thick, and Aspen 1,307 feet. On lithologic and

paleontologic grounds, Bear River-Aspen contact is placed lower than in earlier reports. Aspen section contains 63 feet of porcellanite, which suggests prolonged volcanic activity in region. Conflicting age assignments for Bear River and Aspen discussed. Suggested that this conflict may be due to complex intertonguing between the two formations.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 356 (table 1), 367, 368, pl. 1. Mapped in Lima region, Montana. Overlies Kootenai formation. Upper(?) Cretaceous.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 98. In this report [Uinta River-Brush Creek area, Duchesne and Uintah Counties, Utah], term Mowry is used in preference to Aspen for lower dark-gray fissile shale member of Mancos.

J. B. Reeside, Jr., and W. A. Cobban, 1960, U.S. Geol. Survey Prof. Paper 355, p. 7–11. Short summary of Aspen shale included in report on Mowry shale and contemporary formations in United States and Canada. Note on type area.

Named for former station at Aspen, on now abandoned alinement of Union Pacific Railroad. Old Aspen was at center of sec. 29, T. 14 S., R. 118 W., Uinta County, Wyo., about 20 miles northeast of southwest corner of the State.

As Perdido Beds

See Asuberudido Beds.

Aspermont Dolomite[1]

Aspermont Member (of Dog Creek Formation)

Permian: North-central Texas and southwestern Oklahoma.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, sec. opposite p. 96.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 686, 687. Middle member of Dog Creek formation. Shown on chart as underlying unnamed shales and gypsums below Childress member and overlying shales above Guthrie member. Noted as occurring in Harmon County, Okla.

Probably named for Aspermont, Stonewall County, Tex.

Asphalto Lake Bed[1]

Pliocene: Southern California.

Original reference: J. G. Cooper, 1894, California Acad. Sci. Proc., 2d ser., v. 4, p. 168.

Probably named for exposures at or near Asphalto, a village near McKittrick, Kern County.

Asphalt Ridge Sandstone (in Mesaverde Group)

Upper Cretaceous: Northeastern Utah.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 99 (table 2). 110–111, pl. 1. Defined as lower of two basal marine sandstones of Mesaverde group in Vernal (Utah) region. Usually a single massive yellow to white soft sandstone bed bounded on top by a thin tongue of Mancos shale and on bottom by main body of Mancos shale. Upper boundary transitional; in some places it is impossible to draw a sharp line between Asphalt Ridge and overlying Rim Rock sandstone (new). Thickness about 100 feet.

Typically exposed in Asphalt Ridge. Traced, with interruptions, from north end of Asphalt Ridge to the Rim Rock at Green River, where it feathers out into main body of Mancos shale.

Asphaltum Sandstone[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 10.

G. W. Chase, 1954, Oklahoma Geol. Survey Mineral Rept. 26, p. 1–2, 4–5. Discussion of occurrence of radioactive material in sandstone lenses of southwestern Oklahoma. These sandstone lenses are associated with a crossbedded bituminous gray sandstone shown on Geologic Map of Oklahoma (Miser, 1954). Age of sandstone is given by Miser as probably equal to that of base of Garber sandstone of northern Oklahoma. Crossbedded bituminous sandstone was mapped in Cotton County and part of Tillman County as upper part of Auger conglomerate in upper part of Wichita formation by Munn (1914). Auger conglomerate extends from Cotton County into Jefferson County where it was mapped by Bunn (1930) as Ryan-Asphaltum sandstone. Crossbedded bituminous gray sandstone occurs in upper part of Asphaltum sandstone. Ryan sandstone is almost entirely crossbedded dark-gray sandstone.

Exposed in vicinity of Asphaltum, Jefferson County.

Aspinwall Limestone Member (of Onaga Shale)

Aspinwall Limestone Member (of Chicago Mound Formation)

Aspinwall Limestone or Shale (in Admire Shale)[1]

Permian: Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 9, 17, 29.

G. E. Condra, 1935, Nebraska Geol. Survey Paper 9, p. 9. Permian. Underlies Hawxby shale formation; overlies Towle shale formation.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 99. Noted as persisting into northern Oklahoma. Lowermost limestone of Admire group.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 37. Basal member of Chicago Mound formation (new); underlies Hawxby shale member. Thickness 1 to 3 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Reallocated to member status in Onaga shale (new). Underlies Hawxby shale member; overlies Towle shale member.

Type locality: Aspinwall [now abandoned], Nemaha County, Nebr.

Assabet Quartz-Diorite

Upper Paleozoic(?): Eastern Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 46, pl. 1. Medium grained, medium to dark gray, and slightly to moderately foliated. Composed chiefly, and in order of abundance, of andesine, hornblende, quartz, and biotite.

Type locality: Exposures on Hill 272 in northeast corner of Maynard. The main tongue-shaped mass of rock extends from Maynard north-

eastward into Concord quadrangle. Named for exposures near Assabet River in town of Maynard.

Assumption Coal Member (of Spoon Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), pl. 1. Assigned member status in Spoon formation (new). Present in lower part of formation. Coal named by Cady (1935, Illinois Geol. Survey Bull. 62). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Mine, NE¼NW¼ sec. 2, T. 12 N., R. 1 E., Christian County.

Astoria Formation

Astoria Shale[1]

Miocene, middle: Northwestern Oregon and southwestern Washington.

Original reference: E. D. Cope, 1880, Am. Nat., v. 14, p. 457–458; 1880, Am. Phil. Soc. Proc., v. 19, p. 62.

H. V. Howe, 1926, Pan-Am. Geologist, v. 45, no. 4, p. 295–306. In city of Astoria [type locality], formation consists of a lower sandstone member, probably more than 150 feet thick, overlain by a succession of sandy shales, about 1,000 feet thick, and these in turn by a second sandstone member.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 173, 175–187; C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 184, chart. Formation consists of sandy clay shales with brown sandstone in upper part, in Grays Harbor area; becomes progressively more sandy toward the lower Columbia River and prevailingly massive brown medium-grained sandstone in northwest Oregon. Basaltic flows are intercalated in southwest Washington and increase in importance until, east of Portland, the formation is composed almost entirely of basalt. Thickness varies from 1,500 to as much as 12,000 feet. In some areas underlies Montesano formation; unconformably overlies Twin Rivers formation.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 42. In Clatsop and Tillamook Counties, Oreg., the Astoria reported as overlying beds of Blakeley age.

W. R. Rau, 1948, Jour. Paleontology, v. 22, no. 6, p. 774–782. Foraminiferal fauna indicates an age of lower to middle Miocene; some evidence indicates upper lower Miocene (upper Saucesian).

Well exposed in the city of Astoria, Oreg., on south side of Columbia River near its mouth. Formation has been folded into a syncline whose axis trends northwest through city of Astoria.

†Astoria Group[1]

Miocene: Northwestern Oregon and southwestern Washington.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 223–227.

Named from Astoria, Clatsop County, Oreg.

†Astoria Sandstone[1]

Miocene: Northwestern Oregon and southwestern Washington.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 223–227.

Named from Astoria, Clatsop County, Oreg.

Asuberudido (As Perdido) Beds

Eocene(?): Mariana Islands (Saipan).

Risaburo Tayama, 1952. Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 47–48, table 4 [English translation in library of U.S. Geol. Survey, p. 57]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 19. Oldest fossiliferous beds on island. Upper member consists of (ascending) tuff, conglomerate, agglomerate, shale, limy tuff; lower member is thick, false-bedded sandy tuff cut by small faults. Underlie andesite.

Typical outcrop at Asuberudido (also spelled Asuberudedo).

Asuncion Group or Formation

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 11, p. 2095. Upper Cretaceous sediments (Asuncion group) rest on lower Upper Cretaceous (Jack Creek formation) with angular unconformity up to 70°, and overlap all older rocks. Asuncion group is thickest and most widespread of all divisions in Santa Lucia Range.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 132–134, pt. 2 [preprint 1941]. Name Asuncion group is used to include all of Upper Cretaceous beds in central Coast Ranges above Pacheco group (new). Asuncion group consists of over 10,000 feet of coarse conglomerates, sandstones, and shales, which, in Santa Lucia Range, unconforably overlie Pacheco sediments and overlap onto all older rocks, Shasta, Knoxville, and Franciscan, and basement complex. In Santa Lucia Range, group is subdivided into Cantinas sandstones, Godfrey shales, and Piedras Altas formation (all new). On west side of San Joaquin Valley, group is divided into Panoche (restricted), Moreno, and Garzas formations. Majority of beds previously mapped in this region [central Coast Ranges] as "Chico" belong to Asuncion group. The two groups are separated by Santa Lucian orogeny.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 484–512. In this report, which discusses Cretaceous of Santa Lucia Range, both terms, Asuncion group and formation, are used. Asuncion group is separated from older Pacheco group by Santa Lucian orogeny. Asuncion formation unconformably overlies Jack Creek formation of Pacheco group. Ordinarily in fault contact with Lower Cretaceous Marmolejo formation (new), though in some areas there is angular discordance. Type section stated. Anderson's Upper Cretaceous Paskenta and Horsetown groups are considered faunal stages.

F. M. Anderson, 1958, Geol. Soc. America Mem. 71, p. 30–71. Discussion of subdivisions of Pacific Coast Upper Cretaceous. Taliaferro's terms Asuncion and Pacheco groups are used. All strata definitely referable to Senonian are included in Lower Asuncion group, and strata of probable Maestrichtian age are included in Upper Asuncion group.

Type section: In Asuncion Grant, in southeast part of Adelaida quadrangle where there are good exposures of all phases along Santa Rita Creek, Templeton-Cayuocos Road, and road past Asuncion School.

Asuncion Limestone

Pleistocene: Mariana Islands (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Named on correlation chart. Correlated with Chatcha [Chacha] limestone of Saipan, Peleliu limestone of Palau, and Fais limestone of West Caroline. [Appears to be same as Sonson limestone (Tayama, 1952).]

Asylum terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg., p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703 (fig. 8), 1707, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Asylum is applied to a terrace deposit younger than Uvalde and older than Capitol (new). Thickness near Austin about 15 feet. Name Asylum was applied to a terrace by Hill and Vaughan (1898, U.S. Geol. Survey 18th Ann. Rept).

Named for occurrence at Austin State Hospital, Austin, Travis County. Present along Colorado River.

Atalaya Limestone

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 47, 48 (table 4). Incidental mention. [May be synonymous with Las Marias limestone.]

Occurs in Atalaya Mountains, Lares district.

Atarque Member (of Mesaverde Formation)

Upper Cretaceous: Northwestern New Mexico.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 11, 35, 60, pl. 12. Nonmarine deposit composed of sandstones, shales, carbonaceous shales, and thin seams of coal. Thickness about 127 feet. Lowest Mesaverde in area. Underlies Horsehead tongue (new) of Mancos shale.

Occurs near village of Atarque, Valencia County, and also in Zuni Indian Reservation, McKinley County.

†Atascadero Formation[1]

Upper Cretaceous: Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio. 101.

Named for exposures along Atascadero Creek, San Luis Obispo County.

Atascosa Formation

Cenozoic(?): Southern Arizona.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. RME–2009, p. 7, pl. 1. Consists of coarse conglomerates and some thin interbedded lava in upper section. Becomes increasingly tuffaceous toward base. Tuffs well bedded; one unit up to 500 feet thick. Thickness about 800 feet. Conformably overlies Montana Peak formation (new).

Named because of its prominent outcrops in Atascosa Range, Ruby quadrangle.

Atchinson Formation

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a) 18–20, 61, 63. In most places, basal unit of this formation is black breccia composed of angular blocks of augite andesite lava; about 500 feet thick and grades irregularly into unbroken flow-rock in Atchinson Mountain; locally at base are found a little white limestone and red sandstone gravel. Upper unit is a red to red-brown monolithic breccia. Thickness ranges from a fraction of a foot to about 500 feet. Overlies Rencher and Grass Valley formations (both new).

Mapped in northern half of Pine Valley Mountains, Washington and Iron Counties. Named for exposures on Atchinson Mountain.

Atchison Formation

Pleistocene: Northeastern Kansas and southern Nebraska.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 12 (fig. 5), 15. Sand and silt, well sorted; sand and gravel at base; commonly thinly laminated in upper part. Comprises pro-Kansas outwash of early Kansas age. Not recognized beyond limits of Kansas glaciation. Maximum thickness in Atchison County, 80 feet; commonly 40 feet. Underlies Kansas glacial till; overlies Nebraska till.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 51, 62 (fig. 2), 70–74, pl. 1. Extended into Nebraska where it overlies Red Cloud formation. Type locality designated.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, p. 55 (fig. 1). In revised classification, Atchison is basal member of unnamed formation in upper part of Meade group.

Type locality: Exposures in creek bank in SE¼SW¼ sec. 2, T. 6 S., R. 20 E., Atchison County, Kans.

†Atchison shale[1]

Pennsylvanian: Northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

Original reference: C. R. Keyes, 1899, Am. Geologist, v. 23, p. 309.

Named for Atchison County, Mo.

Athelstane Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Athens Group[1]

Pennsylvanian: Appalachian Basin.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 178.

Named for Athens County, Ohio.

Athens Marble[1]

Silurian: Central western Illinois.

Original reference: A. H. Worthen, 1866, geology: Illinois Geol. Survey, v. 1, p. 1933; 1882, Econ. Geology, v. 1, p. 102–103. Menard County.

Athens Shale or **Limestone**

Athens Shale (in Blount Group)[1]

Middle Ordovician: Eastern Tennessee, northern Alabama, western North Carolina, and western Virginia.

Original reference: C. W. Hayes, 1894, U.S. Geol. Survey Geol. Atlas, Folio 4, p. 2.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 159–170. Formation has three distinct facies in Virginia; gray to black shale, sandstone, and limestone. Thickness varies from a few feet on western margins to perhaps 5,000 to 10,000 feet in large area in southern Washington County, Va., and northern Sullivan County, Tenn. In all areas in Virginia where Holston limestone and Athens are both present, Athens is underlain by Whitesburg limestone; locally overlies Lenoir limestone; in Rich Valley underlies Ottosee limestone; in Shenandoah, Rockingham, Montgomery, and Pulaski Counties, underlies Chambersburg limestone; in some areas, underlies Lowville-Moccasin formation. In Blount group. Chazyan series.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226. Described in Montevallo and Columbiana quadrangles, Alabama, where it is 12 to 350 feet thick. Unconformable above Lenoir limestone and below Little Oak limestone.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 1–145. Discussion of graptolites of Athens shale. Shale occurs in narrow long strip for about 700 miles in Appalachian Valley from central Alabama, across northwestern Georgia, eastern Tennessee, and western part of Virginia. Athens graptolite fauna is repeated in Normanskill shale of New York. Normanskill-Athens fauna extends northeastward across New England, eastern Quebec, New Brunswick, and Newfoundland, a total distance of 2,300 miles. If westward extent is considered, including Womble shale of Arkansas and Stringtown shale and lower Viola limestone of Oklahoma, there is total extent of Athens fauna for 2,800 miles in North America.

John Rodgers, 1952, Geology of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map. Commonly yellow-weathering blue calcareous shale or shaly limestone. Thickness 400 feet. Underlies Holston limestone; overlies Lenoir limestone. Hayes (1895, Folio 20) and Keith (1896, Folio 25) recognized that Athens they mapped is lateral equivalent of what they mapped as Chickamauga limestone, which corresponds to Lenoir limestone of Athens area. Keith mapped typical Athens as grading laterally along strike into less argillaceous limestone in Oostanaula Valley less than 10 miles northeast of Athens. Unfortunately, evidence of this lateral gradation of Athens shale into Lenoir limestone has since been overlooked by most geologists, and Athens has been mistakenly placed above the Holston instead of below. Only lowest beds of Lenoir in Sweetwater Valley are equivalent to Lenoir at Athens and farther southeast, the rest being equivalent to Athens shale. Middle Ordovician.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 72–80, pls. Name Athens shale was proposed by Hayes and first used by him in Kingston folio for Upper Ordovician shale, here assigned to Reedsville shale, in belt next northwest of Whiteoak Mountain fault. In Cleveland folio (1895), which includes type locality, Hayes used name Athens

for the shale here in question, between a thin "Chickamauga" limestone (Lenoir of Rodgers, 1953 [1952]) and the "Tellico sandstone" (Holston marble of Rodgers, 1953 [1952]). For present map, the thin underlying limestone is included at base of Athens. Athens in belt between Knoxville and Rocky Valley faults and Chestuee and Dumplin Valley faults consists partly of shaly nodular limestone like that in contiguous Lenoir limestone and partly of blue yellow-weathering very calcareous shale similar to that in Ottosee shale. The two grade into each other, and the formation is perhaps more generally shaly limestone than true shale. No black or noncalcareous shale and no sandstone are present. Thickness 800 to 1,100 feet. At Athens, the "shale" is exposed along southwest side of Oostanaula Creek southwest of Etowah road, but better section is exposed along Athens branch of Louisville and Nashville Railroad and along stream just north. Decker (1952) called railroad locality the type locality of Athens. Lenoir limestone and Athens shale grade into each other in vague belt near Monroe-McMinn County line. This gradation was observed and mapped by Keith (1896, Loudon folio), and it is difficult to understand how Keith's field observations could have been so long overlooked while attempt was made to fit Athens shale into the column above Holston formation instead of below. In western Sevier County, some sandstone layers in Sevier shale contain hematite and grade into red-weathering calcareous sandstone like that in Holston formation. In Blount County, detailed work by Neuman has shown that such sandstone layers occur at intervals through several thousand feet of shale. In this area, Keith (1895, Knox folio; 1896, Loudon folio) mapped some of these sandstone layers; a lower group he mapped as Tellico sandstone separating Athens shale below from Sevier shale above, and a thick persistent layer above the middle he mapped as a sandstone lentil in Sevier shale. Correlation of these layers is in dispute. Lower group of layers constitutes type Tellico sandstone as mapped by Keith on Tellico River, Monroe County (1896, Loudon folio). To the compiler [Rodgers], thick middle layer is representative in this belt [southeast of Chestuee and Dumplin Valley faults and of Saltville fault northeast of Morristown] of sheet of red sandstone and lime-sandstone forming Holston formation, and it is mapped as such from western edge of Sevier County through Blount and Monroe Counties. Shale below it is called Athens, and shale above it Ottosee. By this correlation, the lower group of layers, typical Tellico of Keith, occurs within Athens and becomes Tellico sandstone member of Athens; the higher and more lenticular layers correspond to limestone and sandstone lenses and layers in the typical Ottosee shale. Neuman disagrees with this correlation; he believes the whole shale sequence here called Sevier is younger than Holston formation in what is herein termed the standard belt. [See Holston limestone.]

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145, 148, 149, 154. Discussion of Middle Ordovician of Tellico-Sevier belt, eastern Tennessee. Classification used does not agree with that used by Rodgers (1953). Blockhouse shale (new) was included in lower part of Athens by Rodgers. Tellico formation, as defined in present report, includes upper part of Athens. Believed that Rodgers' introduction of terms Ottosee shale and Holston formation and continued use of Athens shale give these terms time-stratigraphic rather than rock-unit status.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 43–45. Proposed that name Athens be restricted to type region where formation proves to be a facies of Arline formation (new). At type section, Athens rests on thin tongue of "Chickamauga" limestone, identified in this belt as Lenoir, overlain by thin bed of impure limestone, Fetzer tongue (new) of Arline formation. Athens shale of Georgia is thinned representative of Paperville formation (new). Athens shale of Alabama is papery black shale herein named Columbiana formation. Athens shale of Virginia has been renamed, in Bristol area and Catawba Valley, Paperville formation. Graptolite shales in Saltville thrust block are herein named Rich Valley formation. Ash-weathering black limestones of Virginia, called Athens by Butts, were regarded as facies of Edinburg formation for which Campbell's (1905) name "Liberty Hall" was revived by Cooper and Cooper (1946).

Named for exposures at Athens, McMinn County, Tenn.

Athensville Coal Member (of Modesto Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), pl. 1. Name introduced for coal formerly called Upper Scottville. Stratigraphically above Rock Branch coal member (new) and below Scottville limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE¼NW¼SW¼ sec. 16, T. 12 N., R. 9 W., Macoupin County. Name derived from village of Athensville, Greene County, about 4½ miles to southwest of type locality.

Atherton Clay[1]

Mississippian: Southern Indiana and northwestern Kentucky.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908 and 1909, p. 76, 83, 84.

Derivation of name not stated.

Atherton Formation

Pleistocene: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19–20, 21, pl. 1. Formation, as defined by W. J. Wayne (in preparation), includes a number of interrelated unnamed facies, all of which are a part of, or are closely associated with, sands and gravels that were deposited along melt-water streams during glacial ages. Only two of the major facies of formation are present in Huron area, and only one of these is exposed at surface. Windblown sand facies is exposed on valley slopes along East Fork of White River; thickness probably does not exceed 20 feet. Outwash sand and gravel facies present in valley of White River to a depth of 60 feet or more below present river level; exact distribution unknown as deposits are covered by alluvial sands of Martinsville formation (new). Sand and gravel facies probably intertongues with lower part of Prospect formation (new). Part is Wisconsin but part may be Illinoian or older.

Type locality and derivation of name not stated.

Athertonville facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 148–154. Consists of limestone in upper half; lower strata generally siltstone and silty, gritty shales. Thickness 175 to 200 feet. Includes near base, Rolling Fork limestone (above) and Ginseng siltstone members (both new) of Brodhead formation. Merges with Pilot Knob facies (new) on west and with Liberty facies (new) on east. Underlies Floyds Knob formation; overlies New Providence formation, Keith Knob and Junction City facies (both new).

Named for village of Athertonville, on U.S. Highway 68, northwestern La Rue County. Entire Brodhead formation is exposed along secondary road which ascends valley side of Rolling Fork of Salt River, one-fourth mile north of village.

Athol Shale[1]

Middle Devonian: Western New York.

Original reference: A. W. Grabau, 1930, Science Quart. Nat. Univ. Peking, China, v. 1, no. 4, p. 322–326.

Exposed on the Lake shore (Eighteen-mile Creek region) at Athol Springs and Bay View, Erie County.

Atkinson Formation

Upper Cretaceous: Subsurface in Georgia, Alabama, and Florida.

P. L. Applin and E. R. Applin, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 26. Comprises subsurface deposits of early Upper Cretaceous sequence occurring between base of beds of Austin age and top of Lower Cretaceous. On basis of differences in lithology, formation is divided into three unnamed members.

Name derived from Atkinson County, Ga., where Sun Oil Co. drilled Doster-Ladson Well 1 (lot 71, Land District 7).

Atlantic Amygdaloid (in Ashbed Group)[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Atlantic mine, Houghton County.

Atlantic Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Atlantic mine, Houghton County.

†Atlantic Group[1]

Tertiary: Atlantic Coastal Plain.

Original reference: O. Meyer, 1888, Am. Geologist, v. 2, p. 88–89, 93–94.

Comprises the Atlantic States proper from New Jersey to Florida.

Atlantic Muck

Pleistocene and Recent: Panamá.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 23. Heterogeneous mixture of alluvially deposited silts,

clays, and carbonaceous material within which are beds of marine origin containing Pleistocene and early Recent forms of mollusks and corals.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 324. Informal name. Marine deposits contain numerous species of mollusks, nearly all of which are Recent.

Present on Atlantic side of Panama Canal.

Atlas Formation[1]

Quaternary: Southern California.

Original reference: A. C. Lawson, 1906, California Univ. Pub., Dept. Geology Bull., v. 4, p. 431–462.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 673. Quaternary. Older than Tank volcanics.

Derivation of name not stated.

Atoka Formation[1]

Atoka Series

Atoka(n) Stage

Middle Pennsylvanian: Eastern Oklahoma, western and southwestern Arkansas, eastern New Mexico, and central and western Texas.

Original reference: J. A. Taff and G. I. Adams, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 273.

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 504–507; C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 24–35, pl. 1. Formation, in Muskogee-Porum district, subdivided into 12 units, 6 sandstone members each overlain by an unnamed shale unit. Sandstone members (ascending): Coody (Coata), Pope Chapel, Georges Fork, Dirty Creek, Webbers Falls, and Blackjack School. Thickness about 600 feet. Overlies Bloyd formation of Morrow group; underlies Hartshorne sandstone. Basal formation of Des Moines group. Atoka, Hartshorne, McAlester, and Savanna formations and a part of Boggy shale are directly traceable into Winslow formation as heretofore mapped in Muskogee quadrangle.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 858, 859. Overlies Barnett Hill formation (new). Unit here termed Barnett Hill was locally assigned by Taff to Atoka formation but in other areas was included in Wapanucka.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 156. Discussion of main divisions of Pennsylvanian system. Pronounced unconformities are reported within thick type Atoka section; hence it is thought to represent considerable length of time and complex geologic history. If Atoka division is not given rank of series, it might be given rank of group; if time-rock term stage is to be used for Paleozoic rock divisions as it is in Europe and as it has been introduced for Mesozoic and Cenozoic rocks of United States, this division could appropriately be called Atoka stage.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 185–186. Raised to series rank and defined to include all beds from top of Wapanucka limestone, Morrow series, to base of Hartshorne sandstone, Des Moines series. As thus defined, includes

Marble Falls, Smithwick, and overlying *Fusulinella* (restricted)-bearing beds of central and north Texas, Derry series of New Mexico and west Texas, and equivalent beds in other areas as equivalence is established.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66, p. 17 (table 1), 50–52, measured section. Detailed discussion of Morrow series in northeastern Oklahoma. All sections measured in Morrow series were carried at least to base of Atoka sandstone and, where possible, to top of hills, so as to include a portion of Atoka formation. Locally thin-bedded, generally medium- to coarse-grained crossbedded sandstone rests on upper part of Bloyd shale in all areas except northward from Yonkers, where Bloyd was removed by pre-Atoka erosion, and Atoka is in contact with Hale formation. Top of Atoka not present in area. These post-Morrow beds in Adair and most of Cherokee Counties were called Winslow (Taff, 1905, U.S. Geol. Survey Geol. Atlas, Folio 122; 1906, U.S. Geol. Survey Geol. Atlas, Folio 132) and, in Wagoner and Mayes Counties, have been referred to Cherokee. Croneis (1930, Arkansas Geol. Survey Bull. 3) first used term Atoka for beds called Winslow in Arkansas, and Wilson (1937) recognized Atoka, Hartshorne, McAlester, and Savanna formations in Muskogee area, replacing general term Winslow. Des Moines series.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 292. Rocks of Oklan series (new) are divisible into two stages, Atokan (or Derryan) and Desmoinesian.

T. A. Hendricks and Bryan Parks, 1950, U.S. Geol. Survey Prof. Paper 221–E, p. 69 (table), 70–73, pl. 11. Discussion of Fort Smith district, Arkansas. Atoka formation, oldest bedded rock exposed in area, crops out in five parts of district; largest area of outcrop is in southern part of district. Consists chiefly of alternating beds of sandstone and shale, the shale being more abundant, and locally contains discontinuous streaks of coal and coaly shale. Thickness about 6,900 feet south of Backbone Mountain; about 3,300 feet near Mansfield. Underlies Hartshorne sandstone, minor unconformity. Atoka formation of Fort Smith district is identical with Atoka formation in Oklahoma.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1935–1953. Formation, in Arkansas, subdivided to include Greenland sandstone member (new) at base. Overlies Bloyd shale of Morrow group. Exact position of boundary between Morrow group and Atoka locally difficult to determine on purely physical stratigraphic basis in Washington County.

J. A. Reinemund and Walter Danilchik, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–192. Formation described in Waldron quadrangle, Scott County, Ark. Composite section of measured outcrops of Atoka across Waldron syncline shows that about 11,800 feet of strata assigned to formation crop out between top of formation, 4 miles north of Waldron and Ross Creek fault, 3½ miles south of Waldron. Rocks underlying those exposed in Waldron syncline crop out in Brushy Mountain anticline where they have combined stratigraphic thickness of about 7,200 feet. Total thickness in northern part of Waldron quadrangle, north of Ross Creek fault, appears to be at least 19,000 feet. In southern part of quadrangle, stratigraphic thickness in Black Fork syncline is estimated at about 18,500 feet, but highest and lowest strata are not present.

Overlies Johns Valley shale; underlies Hartshorne sandstone. (Stratigraphic equivalence of Hartshorne in Waldron quadrangle with Hartshorne in Fort Smith district and eastern Oklahoma is in doubt). Atoka formation is included in Atoka series.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 82–86, pls. Discussion of south and west flanks of Ozark uplift, northeastern Oklahoma. Atoka formation is widespread from Arkansas line westward to Arkansas River southeast of Muskogee. Thins northward from maximum of 600 feet southeast of Muskogee to 0 near Adair where it is truncated and overlapped by younger units. Northward thinning is by convergence, loss of lower member by progressive northward overlap and unconformity above. Webbers Falls member believed to be most extensive. Lies with unconformity upon Bloyd, Hale, and Fayetteville formations. Truncated by erosion and overlapped northward by shales, clays, and sandstones of Hartshorne-McAlester sequence. Assigned to Atoka series of Middle Pennsylvanian age.

J. G. Blythe, 1959, Oklahoma Geol. Survey Circ. 47, p. 5–74. Discussion of Atoka formation on north side of McAlester basin. Formation passes northward into a platform facies, thins, and is overlapped by Desmoinesian rocks. Facies changes and thinning of section north of Arkansas River made it unwise to attempt perfect identification of the rapidly thinning shelf-facies section with member as described in Muskogee-Porum area. Webbers Falls sandstone provided persistent marker unit and made it possible to identify Blackjack School member. Georges Fork and Dirty Creek members could not be identified north of Arkansas River and were mapped as one unit. Likewise Coody and Pope Chapel were mapped as one unit. Thickness 37 to 508 feet.

O. B. Shelburne, 1960, Oklahoma Geol. Survey Bull. 88, p. 17 (fig. 2), 41–44, 63, 64, pl. 1. Formation is 6,800 feet thick in Boktukola syncline; an unknown thickness has been removed by erosion. Basal part of formation is Morrowan. Contains sandstone mold faunas similar to Honess' (1924, [Oklahoma] Bur. Geology Circ. 3) "Morrow fauna" and spiculite cherts which may be partially equivalent to Chickachoc chert. Middle and upper parts of formation of Boktukola syncline are equivalent to Atoka formation of frontal Ouachitas. Harris Creek syncline is fan fold which exposes Atoka formation rather than anticline of Stanley shale as shown on Geologic map of Oklahoma. Overlies Johns Valley formation in Boktukola and Harris synclines. Morrowan-Atokan.

Named for Atoka, Atoka County, Okla., which is situated on outcrop of formation.

Atolia Quartz Monzonite[1]

Cretaceous(?): Southern California.

Original reference: C. D. Hulin, 1925, California State Mining Bur. Bull. 95, p. 33–42, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 509–510, table 4. Mentioned in discussion of crystalline rocks of southern California. Listed on table as Late Mesozoic.

U.S. Geological Survey currently designates the age of the Atolia as Cretaceous(?) on the basis of a study now in progress.

Named for exposures at and around Atolia, San Bernardino County.

Atrasado Member (of Madera Limestone)

Pennsylvanian: West-central New Mexico.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Thin- to thick-bedded gray to dark-gray limestone, gray and red shale, and red to light-reddish-brown and gray conglomeratic sandstone. Thickness 550 to 800 feet. Underlies Red Tanks member (new); conformably overlies Gray Mesa member (new).

Occupies tops of Gray Mesa and Monte de Belen; exposed in other parts of Lucero Uplift, Valencia and Socorro Counties.

Atrypa limestone[1]

Upper Devonian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78.

Name derived from Atrypa Peak, in Eureka district.

Attalla Chert Conglomerate Member (of Chickamauga Limestone)[1]

Attalla Formation

Middle Ordovician: North-central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 45, 53, 55. Referred to as Attalla formation. Butts applied name Attalla to a coarse conglomerate, 20 to 40 feet thick, at base of Chickamauga limestone in Birmingham Valley. Conglomerate is patchy in occurrence. This conglomerate, together with red and green shales at base of the Chickamauga which the writer [Cooper] includes in name Attalla, is suggestive of Blackford lithology of Tennessee and Virginia but obviously deposited at a different time than Blackford. Except for Butts' use of name Chickamauga in Alabama, term has passed into disuse.

Named for exposures at Attalla, Etowah County.

Attica Shale[1] (in Naples Group)

Upper Devonian: Western New York.

Original references: G. H. Chadwick, 1919, Geol. Soc. America Bull., v. 30, p. 157; 1923, Geol. Soc. America Bull., v. 34, p. 69.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 63, no. 12, pt. 1, chart 4. Shown on correlation chart as overlying Cashaqua shale and underlying Grimes sandstone or Angola shale. Included in Naples group.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 10–11, 19. Name Attica shale, formerly applied to Naples strata above Cashaqua formation in Lake Erie region, is herein abandoned, and term Rhinestreet black shale is applied westward to Lake Erie.

Probably named for exposure at Attica, Wyoming County.

Attleboro Sandstone[1]

Carboniferous: Southeastern Massachusetts and Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 144, 151–152.

Named for exposures in town of North Attleboro, Bristol County, Mass.; also exposed in vicinity of Deantown, in Attleboro Township.

Attwood Series[1]

Carboniferous(?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 10.

Mapped at and around Attwood Mountain, British Columbia.

Atwater Member (of Crooked Creek Formation)

Pleistocene (Kansan and Yarmouthian): Southwestern Kansas.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 58. Named and described as consisting of sandy silt, silt, silty clay, and clay which contains Pearlette ash lentil, when present; massive caliche generally present at top of member. Thickness about 50 feet. Overlies Stump Arroyo sand and gravel member; underlies Kingsdown formation.

Type section: In N½ sec. 21, T. 33 S., R. 28 W., on east side of Crooked Creek, Meade County. Name derived from old Atwater post office.

Atwater Creek Shale[1]

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann, 1921, New York State Mus. Bull. 227, 228, p. 124–126, 130.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 286, pl. 4. Arenaceous transitional facies between black Deer River shale and sandy Lorraine shale of northwestern New York. Thickness at type locality about 70 feet.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 286, chart 2 (column 19). Placed in Utica shale (restricted).

Type area: Atwater Creek, west of Martinsburg, Lewis County.

Aubrey Group[1]

Pennsylvanian and Permian: Northern Arizona, southeastern Nevada, and southern Utah.

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Meridian, v. 3, p. 176–185, 197.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Group includes (ascending) Supai formation, Hermit shale, Coconino sandstone, Toroweap formation, and Kaibab limestone. Overlies Redwall limestone; underlies Moenkopi formation.

Named for exposures at Aubrey Cliff, which faces Aubrey Valley, in northern Arizona and stretches southeast nearly to Camp Apache.

†Aubrey Limestone[1]

Permian: Northern Arizona, southeastern Nevada, and southern Utah.

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Meridian, v. 3, p. 171–187, figs. 81, 82.

Named for exposures at Aubrey Cliff, which faces Aubrey Valley, in northern Arizona and stretches southeast nearly to Camp Apache.

†Aubrey Sandstones[1]

Permian: Northern Arizona, southeastern Nevada, and southern Utah.

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Meridian, v. 3, p. 171–187, figs. 81, 82.

Named for exposures at Aubrey Cliff, which faces Aubrey Valley, in northern Arizona and stretches southeast nearly to Camp Apache.

Aubreyan series[1]

Carbonic: Northern Arizona.

[Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 336.]

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart), 223. Includes (ascending) Chiquito sandstones, Huethawali limestone, Havasupai sandstones, Wompats limestone, and Kanab limestones (new). Unconformably overlies Tusayan series (new). Of Carbonic age.

In Grand Canyon region.

Auburn Chert[1]

Middle Ordovician (Trentonian): East-central Missouri.

Original reference: R. R. Rowley, 1908, Missouri Bur. Geology and Mines, 2d ser., v. 8, p. 14, 16.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 262–263, chart 2 (column 51). Placed in lowest Trentonian to conform to placement of Spechts Ferry shale with which it is correlated.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 27, pt. 1, p. 117. Has been suggested that Auburn chert be included in Plattin group; brachiopods are not in accord with this suggestion. Here suggested that formation may be chertified Decorah of Missouri-Barnhart formation (new) rather than Plattin and correlation should be with Guttenberg member of Decorah.

Forms surface stone of Auburn, Lincoln County.

Auburn Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northeastern Missouri, southeastern Nebraska, and northern Oklahoma.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 30.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 18. Geographically extended into Iowa and Missouri.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 56 (fig. 21), 60, 70 (fig. 25). Somewhat complex and variable unit composed chiefly of shale containing minor amounts of sandstone and limestone, part of which is chalky. Contains two or more local coal beds. Near Kansas River, contains lenses of crossbedded limestone and conglomerate and coquinoid masses of molluscan and algal remains as much as several feet thick; locally contains dark shale-bearing ostracodes and pelecypods. Thickness in Kansas ranges from about 20 to 70 feet. Underlies Reading limestone; overlies Wakarusa limestone.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Wabaunsee group redefined. Auburn shale overlies Wakarusa limestone member of Bern limestone (new); underlies Reading limestone member of Emporia limestone.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 54–55. Term is applied to sandstone-shale sequence between Wakarusa and Reading limestones. Auburn is continuous from southeastern Nebraska across

Kansas into northern Oklahoma, where it has been traced into southern Lincoln County. South of Lincoln County, limiting limestones pinch out, and Auburn cannot be distinguished from adjacent shales. Thickness 65 to 70 feet in Pawnee County. Overlies Wakarusa limestone; underlies Reading limestone member of Emporia limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Bull. 15, p. 13, fig. 5. Upper part of greenish-gray clayey shale; in center shale is deep red to maroon, silty, and micaceous; this middle part commonly contains leaf prints and carbonaceous films; lower part is silty, dark gray to black, and locally carbonaceous. Thickness about 35 feet. Underlies Reading limestone; overlies Wakarusa limestone. Wabaunsee group.

Type locality: Not designated but undoubtedly in vicinity of Auburn, Shawnee County, Kans. Good exposures along Wakarusa Creek near NE cor. sec. 26, T. 13 S., R. 14 E., southwest of Auburn.

Auger Conglomerate Lentil (in Wichita Formation)[1]

Permian: Southwestern Oklahoma.

Original reference: M. J. Munn, 1914, U.S. Geol. Survey Bull. 547, p. 23–26.

G. W. Chase, 1954, Oklahoma Geol. Survey Mineral Rept. 26, p. 1, 2, 3–4. Discussion of radioactive material in sandstone lenses of southwestern Oklahoma. These sandstones are associated with a crossbedded bituminous gray sandstone shown on Geologic Map of Oklahoma (Miser, 1954). Age of sandstone is given by Miser as probably equal to that of base of Garber sandstone of northern Oklahoma. The crossbedded bituminous sandstone was mapped in Cotton County and parts of Tillman County as upper part of Auger conglomerate in upper part of Wichita formation by Munn (1914). Auger conglomerate extends from Cotton County into Jefferson County where it was mapped by Bunn (1930, Oklahoma Geol. Survey Bull. 40PP) as Ryan-Asphaltum sandstone.

Named for old Fort Auger and Auger Creek, Tillman County.

Au Gres Limestone

See Point aux Gres Limestone.

†Augusta limestone,[1] group,[1] or stage[1]

Mississippian: Iowa, Illinois, and Missouri.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 59–71.

Named for Augusta, Des Moines County, Iowa.

Augusta Mountain Formation

Middle Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Limestone and dolomite with some intercalated shale. At type locality subdivided into three unnamed members. Total thickness about 2,500 feet. Conformably underlies Cane Spring formation (new); conformably overlies Favret formation (new).

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Overlies Panther Canyon formation (new).

Type locality: Augusta Mountain.

Augustinillo Formation (in Jacaguas Group)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 94–103, geol. map. Consists of 17,000 feet of marine sediments. Includes Collores member (new) to east and Monserrate member (new) to west. Interfingers with Naranjo formation (new). May interfinger with Río Culebrinas formation to west.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Cong., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83, 84–85. Text states that Augustinillo is in Guayabal group. Footnote states that the Guayabal is currently called Jacaguas group.

Typically exposed in area to east and west of Cerro Augustinillo. Crops out in Ponce, Jayuya, and Adjuntas quadrangles.

Aunuu Tuff

Aunuu Island Tuff

Recent: Samoa Islands (Aunuu).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 113, pl. B (geol. map). Mapped as Aunuu Island tuff. Referred to in text as Aunuu cone and crater.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1), pl. 1 (geol. map). Aunuu tuff about 200 feet thick.

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 153. Referred to Aunuu Island formations. A tuff cone, consisting of palagonitic tuff containing fragments of reef limestone. Recent.

Occurs on Aunuu Island.

Aurela Ridge Group or Granulites

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 231–274, geol. map. Essentially granulites; associated with minor amphibolites, mylonitic plutonic rocks, and plutonic intrusives. Separated from Cucamonga Canyon group (new) by Cucamonga Canyon thrust. Alf (1948, Geol. Soc. America Bull., v. 59, no. 11) referred to these rocks as "pyroxene dioritic gneiss," but term is misleading and is therefore discarded.

Named for exposures on Aurela Ridge in Cucamonga quadrangle, San Bernardino County. Occurs in an east-northeast-trending belt with a maximum width of about three-fourths of a mile.

Aurora Siltstone Member (of Orangeville Shale)

Aurora Sandstone Member (of Orangeville Shale)[1]

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 123, 209, 211.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 44–45. Listed as a submember of Orangeville shale member of Tinkers Creek facies of Cuyahoga formation.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 42. Composed predominantly of siltstone. At type locality, lies upon about 12 feet of grayish-black and very dark gray shale of the Orangeville which includes Sunbury member. Maximum thickness about 6 feet.

Named for exposures on Aurora Creek in northwest part of Portage County.

†Ausable Granite[1]

Precambrian: Northeastern New York.

Original reference: J. F. Kemp, 1894, New York State Mus. 47th Ann. Rept.

Quarried near Keeseville, Essex County.

Ausable Sandstone[1]

Upper Cambrian: Eastern New York.

Original reference: H. I. Alling, 1919, New York State Mus. Bull. 207, 208, p. 113–145.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329. Name was briefly mentioned by Alling (1919), and never since used, for basal Potsdam underlying the white Potsdam or "Keeseville" sandstone. Probably not valid unit.

Austell Granite

Precambrian(?): Northwestern Georgia.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 41–42. Described as an augen gneiss.

Exposed in an elongate area extending from Austell, Cobb County, southwestward across Douglas County, into eastern Carroll County.

Austin Chalk[1]

Austin Group

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 583, 585.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 133–146. Consists of interbedded layers of hard chalk, softer chalk, and chalky marl; some of marly layers are strongly argillaceous as in upper part that Adkins (1932 [1933]) called Burditt marl. Estimated thickness at type locality 420 feet. Relation of faunal zones in upper part of Austin chalk to top of chalk indicates presence of unconformity of regional extent separating the Austin and beds of Austin age from overlying Taylor marl and beds of Taylor age. Time value of this unconformity varies from place to place along strike.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 34–39. Austin group comprises Ector tongue, Bonham clay, Blossom sand, Brownstown marl, Gober tongue, Austin chalk, and Burditt marl. Below Taylor group and above Eagle Ford group. Foraminifera described.

Type area: Travis County. Named for Austin.

†Austin Marble[1]

Lower Cretaceous (Comanche Series): Southeastern Texas.

Original reference: R. T. Hill, 1889, Texas Geol. Survey Bull. 4, p. xxii.

Named for occurrence at Austin.

Austin Glen Member (of Normanskill Formation)

Middle Ordovician: Eastern New York.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 327, p. 28. Incidental mention in discussion of Cambrian and Ordovician fossils.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 331, p. 93 (fig. 35), 102, 107–108, 115–116, geol. map [1946]. Grit and shale with lenses of mud pebbles and arkosic conglomerate. Thickness varies; more than 500 feet. Overlies Mount Merino member; underlies Rysedorph conglomerate. Derivation of name given.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 14). Shown on correlation chart as Mohawkian (Trentonian).

Named for Austin Glen in Catskill Valley near village of Catskill [Catskill quadrangle]. Exposed in creek bed where it forms a north-south striking anticline, giving an outcrop of 355 feet length across the strike.

Austinville Dolomite Member (of Shady Dolomite)

Lower Cambrian: Southwestern Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 41, 42, 51–52. Defined as middle member of Shady dolomite. Thick-bedded coarsely crystalline nearly white light-gray to cream-colored dolomite. Thickness about 1,000 feet. Underlies Ivanhoe limestone member; overlies Patterson limestone member.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 115. Name Austinville not used because dolomite exposed at Austinville is regarded as Ledger dolomite and not part of Shady dolomite.

Named for town of Austinville, Wythe County.

Au Train Formation

Lower and Middle Ordovician: Northern Michigan.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Survey Div. Pub. 51, p. 6 (fig. 1), 115–120, pls. 2, 4. Dominantly medium- to fine-grained dolomitic sandstone. Comprises two unnamed members. Lower member, approximately 100 feet thick, characterized by abundant glauconite which occurs as disseminated grains in dolomitic sand and concentrated in thin dark-green beds. Thin beds of glauconite more abundant near base of section at 3- to 12-foot intervals. Bedding in glauconitic member thin and undulatory; color buff to brownish gray, except for more glauconitic areas where color is speckled green or solid dark green. Some of more dolomitic beds blue to bluish gray. Much of weathered surface a definite brown. In upper member, glauconite completely absent and thin sandstone lenses numerous. Sandstone beds, more than 10 feet thick, also present. Sandstone characteristically medium to fine grained and contains few thin lenses of blue to greenish shale. Maximum thickness of formation, indicated in core samples, slightly more than 300 feet but only lower 125 feet exposed at type locality. Overlies Miners Castle member (new), Munising formation with unconformity. Ham-

blin, following Grabau (1906), proposes that Au Train formation be used for these rocks, which had been included under Hermansville limestone.

U.S. Geological Survey currently designates the age of the Au Train as Lower and Middle Ordovician on the basis of a study now in progress.

Type locality: Au Train Falls, in Alger County, where rocks are best exposed and sections are thickest.

Auts Canyon Formation (in Sheeprock Group)

Precambrian: West-central Utah.

DeVerle Harris, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 1, p. 6, 8–15, pl. 1. Succession of phyllites, phyllitic quartzites, quartzites, feldspathic quartzites, and graywacke conglomerate semischists that comprises allochthon of Sheeprock thrust. Total measured thickness 5,559 feet. Underlies Ekker formation (new).

Measured in Aut's Canyon, Dutch Peak area, Sheeprock Range, Tooele County.

Aux Sable Limestone[1]

Upper Ordovician: Northeastern Illinois

Original reference: J. R. C. Evans, 1926, Chicago Univ., Abs. Theses, Sci. serv., v. 2, p. 199–200.

Type locality not stated.

Aux Vases Sandstone[1]

Aux Vases Formation

Aux Vases Sandstone (in New Design Group)

Upper Mississippian (Chester Series): Eastern Missouri, southwestern Illinois, and southern Indiana.

Original reference: C. R. Keyes, 1892, Geol. Soc. America Bull., v. 3, p. 295.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 134; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 823–824. Basal formation of newly defined New Design group. Commonly a brownish massive fine-grained crossbedded sandstone. In Missouri more or less variegated shaly beds occur in both upper and lower parts of formation and middle massive sandstone is more yellowish; in Perry County, is coarser grained and locally resembles St. Peter formation. Basal conglomerate present in many places in both Illinois and Missouri. Thickness varies because of deposition upon uneven surfaces of Ste. Genevieve and St. Louis limestone and because it suffered erosion before deposition of Renault limestone. In Monroe County, Ill., overlapped by Renault; elsewhere attains thickness of 80 to 100 feet.

C. A. Malott, 1946, Jour. Geology, v. 54, p. 322–326. Geographically extended into southern Indiana where it underlies Paoli limestone and overlies Ste. Genevieve limestone.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations in southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 11–12. Aux Vases typically rests on Bryantsville breccia. Varies from thin shaly beds only a few inches thick to a hard cross-laminated

calcareous sandstone 1 to 8 feet thick. At many places, welded directly with base of Paoli limestone without sign of break between the two. Extends throughout outcrop area of base of Chester, except locally; about 6 miles northwest of Greencastle, Putnam County, Pennsylvanian Mansfield sandstone cuts below it at Mississippian-Pennsylvanian contact.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 23, pl. 1. Because Indiana exposures contain variety of rock types and mixtures of rock types, Indiana Geological Survey uses term Aux Vases formation. Term New Design group not used in Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 49–50. Term Aux Vases rejected in Indiana. Unit formerly called Aux Vases is included in Paoli limestone as herein redefined.

Named for exposures on Aux Vases River, Ste. Genevieve County, Mo.

Auxvasse Creek Sandstone Member (of Callaway Limestone)[1]

Devonian: East-central Missouri.

Original reference: F. B. Conselman, [1935], Missouri Acad. Sci. Proc., v. 1, p. 105, 108–113, 119.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 3, p. 144. Discussion of stratigraphy of Independence shale of Iowa. Stratigraphically, Independence corresponds to 15-foot bed of sandstone which crops out about 10 miles south of Hannibal, Mo. At this locality, Callaway limestone has typical Cedar Valley fossils and limestone below the Cooper is in every way similar to Davenport member of Wapsipinicon. This sandstone appears to be the same one previously designated as Auxvasse Creek sandstone member of Callaway. It seems to be a continuation of the sandstone below Cedar Valley to north in southeast Iowa and of Independence shale farther north.

Occurs in Auxvasse Creek quadrangle, Callaway County.

Ava Shale (in Pottsville Formation)[1]

Ava Shale (in Tradewater Group)

Pennsylvanian: Southwestern Illinois.

Original reference: T. B. Root, 1928, Illinois Geol. Survey Rept. Inv. 16, p. 9, 10, pls. 1, 2.

H. R. Wanless and Raymond Sevier, 1956, Illinois Geol. Survey Circ. 217, pl. 1 (column 5). Shown in Tradewater group. Lies below Makanda formation and above Boskydell sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 28, 54, 55, 56. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois. Term Tradewater group discontinued; hence terms Ava, Makanda, and Boskydell are discontinued.

Avant Limestone Member (of Iola Limestone)

Avant Limestone Member (of Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 31, 37.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40, 43. Reallocated. Comprises upper member of Iola formation. Underlies Lane-Vilas shale; overlies Muncie Creek shale member, Iola formation. Equivalent to Raytown in Kansas.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 82–83, pl. 11. Described as limestone, sandy limestone, calcareous shale, and clay shale. Locally interfingers with underlying Muncie Creek shale member. Underlies Wann formation. Type locality designated.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 32–33. Member of Iola. Avant is 55 feet thick at type locality. Only upper part of this thick phase extends across Tulsa County. There are sandy limestone beds in sec. 4, T. 20 N., R. 10 E., that occupy same stratigraphic position as basal bed of Avant at Avant and they extend across Tulsa County. The two sets of calcareous beds are called colloquially upper and lower Avant and are thought to mark limits of Avant member, which contains more shale than limestone at south side of western Tulsa County. In Creek County, a prominent escarpment that extends from north line to south side of sec. 20, T. 14 N., R. 9 E., is capped by sandy limestone that represents Avant limestone member, but upper limit of member cannot be determined. This limestone grades into basal part of massive sandstone, Tiger Creek sandstone of Fath (1925), that caps the escarpment southward.

Type locality: In T. 23 N. [Rs. 12 and 13 E.]. Named for Avant, Osage County.

Avawatz Formation

Pliocene, lower: Southern California.

P. C. Henshaw, 1939, Carnegie Inst. Washington Pub. 514, p. 5–7, 8, 16 [preprint]. Proposed to include Tertiary series of sedimentary rocks which lie immediately to south and west of eastern end of Avawatz Mountains. Roughly divided into four members: a coarse conglomerate (fanglomerate); green and brown clays (lake beds); resistant breccia (atmoclastic breccia); and arkosic sands and tuffs (fluviatile deposits). Overlies basement complex of metamorphic and plutonic rocks; unconformably underlies a coarse conglomerate believed to be Quaternary in age. Thickness over 1,000 feet, possibly several thousands of feet.

Area is in Avawatz Mountains quadrangle. A fossil locality lies on southeasternmost flank of Avawatz Mountains, 10 miles by road northwesterly from town of Silver Lake on Tonopah and Tidewater Railroad.

Avenal Sandstone[1]

Eocene: Southern California.

Original reference: F. W. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 164–168.

J. A. Cushman and S. S. Siegfus, 1942, San Diego Soc. Nat. History Trans., v. 9, no. 34, p. 390. Listed as underlying Canos siltstone member of Kreyenhagen shale at Garza Creek, Kings County.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 46, 50–51. In Tent Hills area, overlies Acebedo formation (new).

Exposed at Tar Springs and at Sulphur Springs on Zapato Chino Creek, Diablo Range.

Averill Granite[1]

Age(?): Northeastern Vermont.

Original reference: R. A. Schroeder, 1921, Vermont State Geol. Rept. 1919–1920, p. 39–42.

B. K. Goodwin, 1959, Dissert. Abs., v. 20, no. 5, p. 1740. Granitic rocks occupy about two-thirds of Island Pond area. Three major granitic bodies are present: Averill granite, Nulhegan quartz monzonite (new), and Echo Pond granitic complex (new).

Underlies and surrounds Big Averill Lake and all but a small part of Little Averill Lake, Essex County.

Avery Shale[1]

Middle Devonian: Western New York.

Original reference: A. W. Grabau, 1930, Sci. Quart. Nat. Univ. Peking, China, v. 1, no. 4, p. 323–326.

On Eighteen-Mile Creek. Derivation of name not stated.

Avila Member (of Serpiente Sandstone)

Upper Cretaceous: Southern California.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 21–24, pls. 1, 2. Large tongue of concretionary sandstone, 2,710 feet thick; lies between upper and lower portions of Torcido member. To north, member extends outside mapped area for an undetermined distance; at its southern end, it tapers and pinches out about one-half mile south of Avila Canyon.

Named for occurrence in vicinity of Avila Canyon, Orchard Peak area, Kern County.

Avilton Conglomerate[1]

Upper Devonian: Western Maryland.

Original reference: C. K. Swartz and others, 1913, Maryland Geol. Survey Middle and Upper Devonian volume, p. 352, 383–385.

Named Avilton because of its occurrence in immediate vicinity of post office of that name on Pea Ridge.

Avis Limestone (in Hinton Formation[1] or Group)

Avis Limestone Member (of Pennington Formation)

Mississippian (Mauch Chunk Series): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 347.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 174, 175, pl. 15. Avis limestone member near top of Pennington formation in Burkes Garden quadrangle. Consists of 15 to 40 feet of bluish-gray shaly limestone. Underlies Falls Mills sandstone member.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98, 99). In Virginia, limestone in Pennington formation. Elsewhere considered in Hinton group. Locally, in West Virginia, overlies Payne Branch sandstone.

Type locality: Vicinity of Avis and Hinton, Summers County, W. Va.

Avis Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 345.

Type locality: High up sides of mountains in vicinity of Hinton and Avis, Summers County. Also observed in Mercer County.

Avis Sandstone Member (of Graham Formation)

Avis Sandstone Formation (in Thrifty Group)

Avis Sandstone Member (of Thrifty Formation)[1]

Upper Pennsylvanian: North-central Texas.

Original reference: P. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Thrifty group (redefined).

D. A. Myers, 1960, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., [Guidebook] Ann. Field Trip, p. 49 (fig. 2), 50, 56. Reallocated to member status in Graham formation. A channel-fill deposit. Overlies Wayland shale member; underlies Ivan limestone member.

Named for town of Avis, Jack County. Typically developed in Jack, Young, and Stephens Counties.

Avis Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 346–352.

Type locality: Region around Avis, Hinton, and Bellepoint, Summers County. Also in Mercer County.

Avoca Limestone Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, northwestern Missouri, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 44, 45, 47.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 155; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. Avoca limestone member of Lecompton formation; overlies King Hill shale member; underlies Tecumseh formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16 p. 23. In Nebraska, underlies Kenosha shale member of Tecumseh formation. Thickness 1 to 4 feet or more in Iowa, Nebraska, and northwestern Missouri; becomes cryptozoon-bearing limestone and thicker in southern Kansas and Oklahoma. Type locality stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Consists of two thin fossiliferous dark- to bluish-gray limestones separated by dark-gray fossiliferous shale. Thickness about 2 feet in western Mills County; not differentiated in northeastern Adair County.

Overlies King Hill shale member; underlies Kenosha shale member of Tecumseh shale.

Type locality: On south branch Weeping Water Creek, 3 miles east of Avoca, Otoe County, Nebr.

Avon Shale and Limestone (in Pottsville Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

Derivation of name not stated, but probably named for Avon, Fulton County.

†Avondale Limestone[1]

Precambrian: Southeastern Pennsylvania.

Original reference: P. Frazer, 1883, Pennsylvania 2d Geol. Survey Rept. C_4, p. 307, 321, 322.

Avondale, Kennett Square, and other places in Chester County.

†Avondale Series[1]

[Precambrian]: Pennsylvania.

Original reference: A. C. Hawkins, 1924, Am. Jour. Sci., 5th, v. 7, p. 355–364.

Vicinity of Avondale, Chester County, Pa.

Avon Park Limestone

Avon Park Limestone (in Claiborne Group)

Eocene, middle: Florida (subsurface and surface).

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1678 (table 1), 1680, 1686–1688. Name used for upper part of late middle Eocene which, in well samples, shows distinct faunal and lithologic characteristics. Mainly cream-colored highly microfossiliferous chalky limestone throughout its known extent. Thickness varies; 50 feet or less in northeast Florida where only basal part is present; 450 to 650 feet in southern part of peninsula. Underlies Ocala limestone; in region of Tallahassee overlies Tallahassee limestone (new), elsewhere overlies Lake City limestone (new). Tentatively correlated with Yegua formation (Claiborne). Avon Park limestone, Tallahassee limestone (with its equivalent nonfossiliferous facies), and Lake City limestone represent Claiborne group in peninsular Florida, and where all three units are present they appear to make, in most places, a conformable sequence.

D. B. Ericson, 1945, Science, new ser., v. 102, no. 2644, p. 234. Suggests abandoning name in favor of Gulf Hammock formation because outcrops have been discovered in Levy and Citrus Counties.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Used on correlation chart as name of surface formation.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 95–111, pl. 1. Surface exposures described. As used in this report, Avon Park is a series of pasty to fragmental marine carbonate beds containing a distinct fauna and considerable amounts of peat, lignite, and plant remains. Unconformably underlies Inglis member (new) of Moodys Branch formation; unconformably overlies Lake City limestone. Name Gulf Hammock abandoned. Claiborne group.

Type well: At Avon Park Bombing Range, Polk County, Fla., sec. 31, T. 32 S., R. 30 E. Samples from well are indexed at No. W–668 in files of Florida Geological Survey. Surface outcrops in Citrus and Levy Counties.

Axemann Limestone (in Beekmantown Group)[1]

Lower Ordovician: Central Pennsylvania.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 552, 653, 660, 674, pl. 27.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 23. Fossiliferous pure Upper Canadian limestone, 158 feet thick, at Bellefonte, Pa. Here it rests on about 500 feet of dolomite [Nittany] containing unquestionable Cotter fossils; succeeded by Bellefonte dolomite which extends upward, with thickness of 2,140 feet, to boundary between Canadian and Ordovician systems. Suggests term Nittany be abandoned.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1555, 1556 (fig. 19). Medium-bedded bluish limestone. Thickness 500 feet. Underlies Bellefonte dolomite; overlies Nittany dolomite, Beekmantown group.

Crops out 1 mile east of Axemann, Centre County.

Axes Creek phase (of Cherry Creek Series)

Precambrian: Southwestern Montana.

E. S. Perry, 1948, Montana Bur. Mines and Geology Mem. 27, p. 2, pl. 2B. Name suggested for zones of marble in Cherry Creek series. On Axes Creek at least six marble members are present, and some are 400 to 800 feet or more thick. Amount of marble in series decreases eastward, and members cannot be correlated readily between Dillon and Ennis.

Well exposed on Axes Creek in Beaverhead County.

Axtell Formation

Pliocene or Pleistocene: Central Utah.

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 38, geol. map. Youngest bedrock in area. Conglomerate containing pebbles, cobbles, and boulders of all other bedrock formations including lava. At type locality, conglomerate is 50 to 75 feet thick and dips northward about 21° in an angular unconformity over west-dipping Green River limestone. Probably late Tertiary.

W. N. Gilliland, 1949, Ohio State Univ. Abs. Doctors' Dissert. 57, p. 71, 72. Overlies Bald Knoll formation (new) with angular discordance.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 7, p. 11 (table 1), 50–52, pl. 2. In some areas in Gunnison quadrangle, overlies Bald Knoll formation with angular unconformity, and in some areas overlies unnamed pyroclastics and associated sediments with angular discordance. Spieker tentatively assigned Axtell to late Pliocene or early Pleistocene because it is obviously younger than all bedrock in region. Mapped as Pliocene.

Type locality: Stretch about 2 miles east of Axtell on eastern margin of Sevier Valley between abandoned plant of Great Western Salt Company and Willow Creek.

Aycross Formation

Eocene, middle: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 10, 11 (fig. 2), 66–73, pl. 17. Proposed for middle Eocene sequence lying unconformably upon all older rocks from Precambrian to lower Eocene and which is unconformably overlain by strata of upper Eocene age. Consists of variegated clays, acidic andesite tuffs, conglomerates, and bentonite beds.

Changes in physical appearance rapidly in short distances. Thickness at type locality about 1,000 feet; in some areas less than 100 feet. In type area, formation was deposited on a surface of high relief cut in folded and faulted rocks. In places there is angular discordance of 90° with underlying strata, whereas in adjacent localities only a few miles distant there is only slight erosional unconformity. Shown on columnar section as unconformably underlying Tepee Trail formation (new) and unconformably overlying Wind River formation.

R. L. Hay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1880, 1892–1896. West and south of Anchor post office, Masursky (1952, Wyoming Geol. Assoc. Guidebook 7th Ann. Field Conf., map) mapped beds equivalent to Pitchfork formation (new) as Aycross. He showed Aycross strata extending as far south as Owl Creek Range, where, on axis of range, they pinch out between limestone of Paleozoic age and Tepee Trail formation. It is believed that use of Aycross for these beds is misleading, as beds considered Aycross in Bighorn basin may never have been continuous with beds of Aycross south of Owl Creek Range, in Wind River basin. As used here, Pitchfork formation includes beds in Bighorn basin named Aycross by Masursky.

Type area: North side of North Mesa in secs. 7, 8, 17, and 18, T. 7 N., R. 5 W., Fremont County, about 1 mile southeast of A Cross Ranch. Named derived from A Cross Ranch on East Fork River at Duncan.

Ayer Granite[1] **or Granodiorite**

Late Paleozoic(?): Eastern Massachusetts, northeastern Connecticut, and southeastern New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 86, 223–228.

R. H. Jahns, 1942, Am. Geophys. Union Trans., v. 23, pt. 2, p. 341–342. Referred to as Ayer granodiorite in Lowell area, Massachusetts.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250.000): U.S. Geol. Survey. Mapped as Ayer granodiorite. Upper Devonian(?).

M. P. Billings, J. B. Thompson, Jr., and John Rodgers, 1952, Geol. Soc. America Guidebook for field trips in New England, p. 45. Listed with units included in New Hampshire magma series.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 47–48, pl. 1. Described in Hudson and Maynard quadrangles, Massachusetts, as Ayer granite. Light to medium gray, moderately coarse grained. Consists of two mappable facies, a porphyritic and nonporphyritic. Late Paleozoic(?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 68. Discussed with units included in Hillsboro plutonic series (new) which may belong to New Hampshire magma series.

Type area extends from Hampstead, N.H., to point between Harvard and Bolton, Mass., and is 6 miles across at its widest part, between Harvard and East Groton, Mass.

Ayers Cliff Formation

Ayers Cliff Member (of Waits River Formation)

Middle Ordovician (Trentonian or younger): Northern Vermont, and Quebec, Canada.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 15, 22–24, pl. 1. Belt of impure limestones, calcareous sandstones, and minor slates. Thick-

ness about 4,500 feet. Unconformably underlies Barton River formation; overlies Northfield slates. Newly defined terms Ayers Cliff, Barton River, and Westmore formations make terms Waits River formation (Currier and Jahns, 1941), and Tomifobia formation (Clark, 1934) inadequate.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 16. Name Ayers Cliff retained as member of Waits River formation although Ayers Cliff does not crop out in area of this report [Lyndonville quadrangle].

Type section: In series of roadcuts beginning one-half mile west of village of Ayers Cliff at south end of Lake Massawippi in Canada. Good exposures occur at Coventry Falls in the Black River, on Stony Hill, 2 miles northwest of Irasburg, and on shore of Lake Memphremagog. Formation is traceable from vicinity of Round Hill [Irasburg quadrangle] northward into Canada.

Ayers Landing Member (of Caloosahatchee Marl)

Pleistocene: Southern Florida.

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 192 (table 1). Table shows Ayers Landing as uppermost member of Caloosahatchee. Overlies Bee Branch limestone member (new); underlies Okaldakoochee marl member (new) of Fort Thompson formation.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136 (fig. 4), 144. Shell bed that conformably overlies Bee Branch member in many localities between La Belle and Fort Denaud. At many localities, unit is very arenaceous, and calcium carbonate content is mainly in form of mollusk shells. Thick beds are generally only slightly consolidated. Sands are usually tan to yellow brown, and fossils nearly white. At some localities, unit is better consolidated, much more calcareous, concretionary, and fine grained. Both facies are massive and generally without stratification. Thickness 2½ to 8½ feet; unit is discontinuous, being absent or greatly thinned over the arches.

H. S. Puri and R. O. Vernon, 1959. Florida Geol. Survey Spec. Pub. 5, p. 192, 193, 194. Thickness 3.1 feet at type locality, herein stated. Here, overlies Bee Branch member and underlies Fort Thompson formation(?). Includes shell bed, marine limestone, and *Panope* faunizone. Entire upper section of Caloosahatchee, which is called Ayers Landing marl by DuBar (1958), was included in Fort Thompson formation by Parker and Cooke (1944, Florida Geol. Survey Bull. 27) and Parker and others (1955, U.S. Geol. Survey Water-Supply Paper 1255) and considered to be Pleistocene in age.

Type locality: DuBar's section A35. (SW¼NW¼ sec. 1) T. 43 S., R. 28 E., Hendry County. Section measured on right bank of Caloosahatchee River about 90 yards upstream from Turtle Creek, in vicinity of Ayers Landing.

Ayiyak Member (of Seabee Formation)

Upper Cretaceous: Northern Alaska.

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 253–254, figs. 4, 5. Greenish-gray somewhat tuffaceous siltstone and silt shale. Sandstone, although a subordinate lithologic constituent, forms important part. Sandstones are light tan to light chocolate brown, slightly tuffaceous, hard, and clean and weather to light buff. Member becomes progressively more shaly toward base, and limestone lenses and beds occurr in this shaly part.

Locally, "salt-and-pepper" sandstone near base. Thickness at type locality 360 feet. Underlies nonmarine beds of Tuluvak tongue of Prince Creek formation; overlies dark clay shale typical of Seabee formation and is mappable unit in southernmost exposures of the marine formation. Cannot be differentiated from rest of formation north of Umiat-Maybe Creek area.

Type locality: Along east fork of Tuluga River, lat 68°50′ N., and between long 151°28′ W. and 151°35′ W. Named from Ayiyak River along which it is exposed.

Aylesworth Limestone Member (of Pottsville Formation)[1]

Pennsylvanian: Northwestern Illinois.

Original reference: T. E. Savage, 1930, Illinois Acad. Sci. Trans., v. 22, p. 498.

McDonough County. Derivation of name not stated.

Aylor Member (of Big Saline Formation)

Lower Pennsylvanian: Central Texas.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143, 144; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196, 197; 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 64–66. Consists of light-gray crystalline limestone and oolite. In vicinity of Colorado River, oolite increases in thickness to form a lentil 5 miles long and 10 to 100 feet thick. Underlies Lemons Bluff member; overlies Gibbons member.

Type section: On Aylor Bluff in McAnnelly's Bend of Colorado River [San Saba County].

Aylor Bluff member

See Aylor Member.

Aymamón Limestone

Miocene, lower: Puerto Rico.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85, sheets 1, 2. Includes uppermost Tertiary of northern coastal belt. Consists almost entirely of very dense conchoidally fracturing limestone of white, light-gray, buff, and rose colors; unit is quite uniform in lithology over its entire outcrop and throughout its entire thickness. In Aymamón Mountains, shows sharply defined uniform bedding, the beds averaging between 1 and 2 meters in thickness. Top of limestone is erosion surface developed since end of Tertiary deposition; hence thickness varies with irregularities of that surface. Greatest thickness is in area west of Isabela, where beds capping outer sea cliffs are estimated to be 325 to 350 meters above base of limestone. Overlies Aguada limestone (new). Includes units formerly termed Quebradillas limestone and Los Puertos limestone.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 34–35, pl. 2. Described in San Juan metropolitan area where it conformably overlies Aguada formation. Thickness may be over 2,000 feet at latitude of coast.

W. H. Monroe, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B356, B358 (fig. 1642). Oligocene and Miocene sequence in north-central Puerto Rico is (ascending) San Sebastián formation. Lares limestone, Cibao formation, Aguada limestone, and Aymamón limestone. Aymamón con-

sists of more than 200 meters of very pure limestone, generally stratified to massive but locally consisting of breccia.

Named from Aymamón Mountains, an area of rugged limestone hills, west of Río Guajataca and about midway between towns of San Sebastián and Quebradillas.

Azotea Tongue (of Seven Rivers Formation)

Azotea Tongue (of Carlsbad Limestone)[1]

Permian: Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7, p. 847 (fig. 5), 868.

A. M. Morgan, 1938, New Mexico State Engineer 12th-13th Bienn. Repts., p. 172. Underlies Three Twins member of Chalk Bluff formation; overlies Seven Rivers gypsiferous member of Chalk Bluff formation.

U.S. Geological Survey has abandoned term Carlsbad and currently classifies the Azotea as a tongue of Seven Rivers Formation.

Caps western Azotea Mesa, Pecos Valley.

Aztec Sandstone[1]

Jurassic(?): Southeastern Nevada.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9, 35.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 929 (table 1), 931. Shown on table of formations of Muddy Mountain area, Nevada, as underlying Upper Cretaceous Willow Tank formation (new) with angular unconformity and overlying Chinle formation. Thickness about 2,500 feet.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34 (fig. 4), 35. In Frenchman Mountain area, Nevada, underlies Thumb formation (new) with angular unconformity. In Muddy Mountains, underlies Willow Tank formation and overlies Chinle formation.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 48, pl. 1. Described as a red sandstone made up of lenses of sand mostly 10 to 25 feet thick; these lenses are made up of laminae, ½ to 2 inches thick, that have parallel strike and dip within the lenses. Thickness 2,100 feet at northern edge of Goodsprings quadrangle; 800 feet thick in Ivanpah quadrangle where it overlies Chinle formation. In Ivanpah quadrangle, overlain by 50 feet of limestone and dolomite beds mapped with Aztec.

Name derived from Aztec Tank [Goodsprings quadrangle], a natural depression in the sandstone several hundred feet east of Contact mine.

Aztecan series[1]

Cretaceous: Colorado, New Mexico, and Arizona.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico, p. 2, 5.

San Juan region.

Azuero Formation[1]

Cretaceous(?): Azuero Peninsula, Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 237.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 324. Poorly defined name for basement altered volcanic rocks. Late Jurassic or Early Cretaceous age suggested.

On west side of Azuero Peninsula.

Babcock Hill Member (of Onondaga Formation)

Middle Devonian: East-central New York.

R. E. Stevenson, 1949, New York State Sci. Service Rept. Inv. 3, p. 7, 8. Named and described as thin- to medium-bedded gray fine-grained fossiliferous limestone with abundant nodular and irregularly bedded cream-colored to black chert. Thickness 36 to 50 feet. Underlies unnamed member; overlies Springfield Center member (new).

Occurs in area of Herkimer-Otsego County line.

Babeldoab Agglomerate

See Babelthuap Agglomerate.

Babelthuap (Babeldoab) Agglomerate

Eocene: Caroline Islands (Babelthuap).

Risaburo Tayama, 1935, Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 18, p. 13, 18–20, 40–41 [English translation in library of U. S. Geol. Survey, p. 21–24, 46–48]. Massive unstratified agglomerate. Lower part is dark-green or blackish augite andesite; upper part black pyroxene andesite with light-colored hornblende andesite agglomerate at top. Conformably, and locally disconformably, underlies Ngardok (Galdog) formation.

U.S. Army Corp of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corp of Engineers Far East, p. 38–40, pls. 4, 8, 9. Thickness probably 2,000 feet but may exceed 5,000 feet; data uncertain because of lack of continuous section and recognizable beds for correlation; numerous fractures and faults and dips varied. Base not exposed; grades upward into Aimeliik formation. Believed to be Eocene; diagnostic fossils not found.

Exposed on Babelthuap, Korror, Ngarebobasang (Arakabesan), and Makarakar.

Baby Capulin Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, pt. 2. p. 132, 144, pls. 1b, 13. Medium dark-gray porphyritic vesicular basalt. Usually has scattered, large olivine phenocrysts. This flow was last volcanic event of northwestern Union County. Baby Capulin basalt lies within levees of Twin Mountain (new) or Purvine Hills basalt (new).

Derived from vent of Baby Capulin, a small cinder cone that lies about midway between Capulin Mountain and Folsom village, in sec. 36, T. 30 N., R. 28 E.

Babylon cyclothem (in Abbott Formation)

Babylon cyclothem (in Tradewater Group)[1]

Pennsylvanian: West-central Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 189, 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 65, 201, 202, 203. Cyclothem occurs near base of Tradewater group and in sequence underlies Tartar cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2). Included in Abbott formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Named from exposures along Spoon River one-half mile north of Babylon, in NE¼NE¼ sec. 14, T. 7 N., R. 1 E., Fulton County.

Babylon Sandstone Member (of Abbott Formation)

Babylon Sandstone (in Tradewater Group)

Pennsylvanian: West-central Illinois.

Original reference (cyclothem): H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 189, 192.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 37, 78. Babylon sandstone is normally basal Pennsylvanian member in western Illinois. Sandstone is medium grained, well sorted, and free from feldspar, mica, and argillaceous matter. Occurs below Babylon coal.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 65, 201, 202, 203. Babylon sandstone, present in practically all parts of area where cyclothem occurs, has maximum exposed thickness of 25 feet. Cyclothem occurs near base of Tradewater group and in sequence underlies Tartar cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1). Included in Abbott Formation (new). Occurs at base of formation below Manley coal member (new). Provisionally correlated with Grindstaff sandstone member in southern Illinois; pending further study both names are retained. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Along Spoon River one-half mile north of Babylon, in NE¼NE¼ sec. 14, T. 7 N., R. 1 E., Fulton County.

Baca Formation

Eocene(?): Central New Mexico.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas. Inv. Prelim. Map. 61. Coarse conglomerate, red and white sandstone, and red clay. Thickness of conglomerate ranges from 80 to 140 feet. Total thickness of formation in Baca Canyon 694 feet. Unconformably overlies all Cretaceous formations in area; underlies Datil formation. Eocene(?).

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 23–26, pl. 1. Age designated as Upper Cretaceous(?) to Eocene(?) on plate 1. Baca Canyon section measured by Wilpolt and others here cited as type section. Thickness in Puertecito quadrangle ranges from a fraction of a foot to as much as 700 feet.

Type section: In Baca Canyon from which unit is named, in secs. 4, 5, 8, 9, T. 1 N., R. 4 W., north Bear Mountain, Socorro County.

Bachelor Formation

Lower Mississippian: East-central and southwestern Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 94–98. Proposed for a basal Mississippian sandstone that cuts across time zones ranging in age from oldest Mississippian to as late as early Osagean.

With exception of Siphonodella zone at base, lithology is varied although it consists dominantly of pale buff quartz sandstone of medium grain size, moderately well to poorly sorted. Over most of extent, including Siphonodella zone, thickness of unit is to be measured in inches rather than feet. In Callaway County, average thickness is perhaps less than 2 feet; in east-central Callaway and western Montgomery Counties, thicknesses of as much as 8 to 10 feet may be found. Unconformable above underlying strata; subjacent beds range from Jefferson City Ordovician to late Massie Creek (new); conformable with overlying strata—Burlington or Chouteau.

Type locality: Exposure in SE¼NW¼SW¼ sec. 9, T. 48 N., R. 8 W., Callaway County. Named for exposures to east, west, and south of Bachelor.

Bachelor Creek Limestone[1] Member (of Howard Limestone)

Pennsylvanian (Virgil Series): Southern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 21, 94, 96.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 57 (fig. 22), 63. Basal member of Howard limestone. Underlies Aarde shale member; overlies Severy shale. Locally two beds separated by shale. Thickness as much as 8 feet.

Type locality: Bachelor Creek, sec. 33, T. 25 S., R. 11 E., about 5 miles east of Eureka, Greenwood County, Kans.

Backbone Limestone[1]

Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 169–178.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 127, 128; 1940, Illinois Geol. Survey Rept. Inv. 71, p. 23–24. Known only in Union and Jackson Counties. Estimated thickness 230 feet. Thins and disappears southward or, in that direction, has been so completely weathered that it cannot be identified. Believed to overlie Grassy Knob chert. May have been included in Clear Creek in many places.

Well exposed near southern end of Devil's Backbone Ridge, a short distance north of Grand Tower, Jackson County.

Backwater Creek Shale Member (of Fort Scott Formation)

See Blackwater Creek Shale Member (of Fort Scott Formation).

Bacon Limestone Member (of Ferry Lake Formation)

Lower Cretaceous (Glen Rose): Eastern Texas (subsurface).

W. V. Jones, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 6, p. 839–845. Name given to a lenticular limestone developed at the base of the Ferry Lake. Thickness varies from 18 to 28 feet; extends from 7,287 to 7,312 feet in discovery wells.

Type well; Tide Water Associated Oil Co. and Seaboard Oil Co. A. J. Bacon No. 1, New Hope field, Franklin County. Alternate type locality (designated because of poor core from type well): Suite of cores from Tide Water Associated Oil Co. and Seaboard Oil Co. F. M. Anderson No. 1, in the C. F. McKenzie (Abstract 307) Survey, Franklin County.

Bacon Bend Member (of Sevier Formation)

Middle Ordovician: Eastern Tennessee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 160, 162–164, pl. 27. Unit at top of formation in which gray calcareous shale and sandstone have submarine slump structures; also contains even-bedded beds of gray and red calcareous mudrock. Thickness 40 to 165 feet. Underlies Bays formation; overlies main body of Sevier formation.

Name taken from meander neck of same name on Little Tennessee River (Vonore quadrangle), Monroe County. Type section about 1 mile northeast of southeast end of prominent bluffs that overlook river.

Bacon Ridge Sandstone

Upper Cretaceous: Northwestern Wyoming.

J. D. Love and others, 1948, Wyoming Geol. Survey Bull. 40, p. 2–3, 4–5, 21–24, 32–34. Name applied to thick sequence of marine sandstone; overlies about 2,000 feet of shale that in turn overlies Frontier formation as defined in central Wyoming. Measured sections show thicknesses of 318, 714, and 925 feet.

Well exposed along both sides of Bacon Ridge, in T. 41 N., R. 111 W., Teton County.

Bad Axe Member (of Franconia Sandstone)[1]

Upper Cambrian: Southeastern Minnesota and western Wisconsin.

Original reference: A. C. Trowbridge and others, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 81, 92, 134, 140, 159, 431, 446, figs. 1, 2.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1239; C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 40–41, measured section. In Minnesota, underlies Nicollet Creek member (new) of St. Lawrence formation.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 141, 147. Underlies Arcadia member (new) of Trempealeau formation.

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 864–865. Franconia member names used by Twenhofel, Raasch, and Thwaites (1935, Geol. Soc. America Bull., v. 46, no. 11) are geographic names applied to faunal zones. New member names are proposed to designate rock types because distribution of faunal zones in formation is largely independent of natural rock units. Bad Axe member is *Dikelocephalus postrectus* zone. This fauna is present in Reno member.

Named for Bad Axe River, near Franconia, Chisago County, Minn.

Baden Sandstone[1]

Pennsylvanian: Central eastern Missouri.

Original reference: H. A. Wheeler, 1895, St. Louis Acad. Sci. Trans., v. 7, p. 125.

Named for exposures at Baden, St. Louis County.

Bader Limestone (in Council Grove Group)

Bader Formation (in Council Grove Group)[1]

Permian: Northeastern Kansas and southeastern Nebraska.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 4, 7.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 61–62. Contains (ascending) Eiss limestone, Hooser shale, and Middleburg limestone, units that were named by Condra as members of the Garrison formation. Type exposure noted.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Underlies Easly Creek shale; overlies Stearns shales. Wolfcamp series.

Type exposure is near Bader, Chase County, Kans.

Badger Shale

Lower Cretaceous(?): Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 9–12, pls. 1, 2. Dark-green silty clay shale with gray buff-weathering calcareous nodules: some very fine-grained arkosic graywackes with abundant fragments of carbonized wood on bedding planes; contains two tuffaceous graywackes. Thickness 3,620 feet at type locality; 3,710 feet in Annette quadrangle southwest of Orchard Peak. Underlies Risco formation (new); at type locality, contact is conformable; in Annette quadrangle, thrust contact. Lower contact is everywhere a fault, generally, a thrust surface along which serpentine has been squeezed. This unit has been designated as Shasta by previous workers.

Type locality: Badger Ridge, 1½ miles west of Cottonwood Pass, Orchard Peak area, Tent Hills quadrangle, northwestern Kern County.

Badger Butte Quartz-Biotite Norite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 193–195, 235. A medium-grained dark-gray rock with a crude parallelism of plagioclase. Intruded by, and nearly surrounded by, Bald Mountain tonalite (new).

Exposed in area near Badger Butte, in Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Badito Formation[1]

Pennsylvanian and Permian(?): Central southern Colorado.

Original reference: R. C. Hills, 1900, U.S. Geol. Survey Geol. Atlas, Folio 68.

R. B. Johnson, 1958, U.S. Geol. Survey Bull. 1042–0, p. 559–560. On flanks of Greenhorn anticline, consists of from 200 to 382 feet of rocks lithologically similar to Sangre de Cristo formation and rests on Precambrian rocks. Locally underlies Ocate sandstone. Pennsylvanian and Permian(?).

Probably named for Badito Peak or town of Badito, just west of Walsenburg quadrangle and in Huerfano quadrangle.

Badito Quartzite Member (of Hopewell Series)

Precambrian (Proterozoic): North-central New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13, (table 1), 21, pl. 2. Consists of bluish-gray quartzite, unquestionably of sedimentary origin. At mouth of Picuris Canyon, it has been converted to quartz-muscovite schist.

Occurs in Picuris area along north side of Rio Pueblo gorge and in a long strip extending from mouth of Picuris Canyon across south and east spurs of Picuris Peak, Taos and Rio Arriba Counties.

Bad River Dolomite[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: C. R. Van Hise, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 338.

N. K. Huber, 1959, Econ. Geology, 1959, no. 1, p. 85 (table 1). Included in Animikie series. Overlies Sunday quartzite; underlies Palms quartzite with uncomformity.

Named for occurence at Bad River, in Penokee Gap section, Wisconsin.

†Bad River Gabbro[1]

Precambrian (Keweenawan): Northwestern Wisconsin and northern Michigan.

Original references: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 115, 134, 135; 1883, U.S. Geol. Survey Mon. 5, p. 40–41, 144, 155, 377, 435.

Largely developed in Bad River region, Ashland County, Wis., and exposed on Bad River, Iron County, Wis.

†Bad River Sandstone[1]

Precambrian (Keweenawan): Northwestern Wisconsin.

Original reference: E. T. Sweet, 1876, Wisconsin Acad. Sci., Arts., and Letters Trans., v. 3, p. 40–55.

Largely represented on Bad River, Ashland County.

Badwater Greenstone (in Baraga Group)

Precambrian (Animikie Series): Northern Michigan and northeastern Wisconsin.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 37. Uppermost formation in group. Lies stratigraphically above Michigamme slate; relationship is based on top directions established by graded bedding in Michigamme and ellipsoidal structures in the greenstone; this relationship is important in that it establishes not only the position of the greenstone but of sequence of rocks [Paint River group] that overlies it in Florence district of Wisconsin and Iron River-Crystal Falls district of Michigan. Maximum thickness attained is several miles; beds now exposed are about vertical. Map patterns reveal mound-like piles in which thicknesses of several miles diminish to the vanishing point within as little as 15 miles along the strike.

Named for extensive exposures in secs. 1, 2, and 11, T. 40 N., R. 31 W., in vicinity of Badwater Lake, Dickinson County, Mich.

Baga Shale and Limestone (in Joserita Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12. Dark-gray and greenish impure limestone in places lens shaped and grading laterally into white shale. Thickness 7 feet.

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Bagley Andesite[1]

Lower(?) Jurassic: Northern California.

Original reference: J. S. Diller, 1960, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 14, pl. 1. As traced from its type area into Big Bend region, overlies and is interfingered with basal beds of Potem formation. Term Arvison formation is proposed for series of dominantly phyroclastic beds, which are intermediate between Modin and Potem formations and which do not appear to be continuous with Bagley. Estimated thickness of Bagley in Big Bend area, 700 feet. Since Bagley andesite appears to be volcanic facies of Potem formation, its age and correlation in this area are considered to be same as that of the Potem—Lower and Middle Jurassic.

Named for Bagley Mountain in northeast corner of Redding quadrangle.

Bagnell glaciation

Bagnell till[1]

Pleistocene (pre-Nebraskan): Missouri.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203, 208, 217.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 68. no. 2, p. 129. Referred to as glaciation.

Bailey Limestone[1]

Bailey Limestone (in Helderbergian Group)

Lower Devonian: Eastern Missouri and southwestern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 110.

J. M. Weller *in* J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 7, 11; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 21–22; 1944, Illinois Geol. Survey Bull. 68, p. 89, 94. Described in Illinois where it is included in Helderbergian group. Thin-bedded very earthy and siliceous formation that contains much chert; limestone is medium gray, dense or slightly shaly and commonly occurs in beds less than 4 inches thick. Thickness more than 200 feet and may be as much as 350 feet. Contact with underlying Bainbridge not observed; may be transitional. Underlies Grassy Knob chert; contact transitional.

Carey Croneis, 1944, Illinois Geol. Survey Bull. 68, p. 103 (chart), 105–111. Described in southeastern Missouri where neotype area is designated.

Continuous exposures of entire formation not available. In Perry County, three more or less characteristic divisions showing gradational contacts are recognized: lower, thin- to medium-bedded gray and buff limestones, with interbedded shales and cherts—125 feet, middle, medium- to thick-bedded blue and buff limestones, with large flint concretions—75 feet; upper, very thin-bedded limestones and interbedded cherts—100 feet. Greatest thickness probably occurs in Perry County, either in region between Wittenberg and Neelys Landing, or in neotype area near Red Rock Landing. If partially covered exposure at Red Rock Landing is actually a continuous section, beds have thickness of more than 300 feet, and possibly nearly 400 feet. Thins both north and south from Red Rock Landing and at westernmost exposure in Ste. Genevieve County is at least 200 feet. No undoubted contacts with subjacent or superjacent formations have been clearly observed, although contact with underlying Bainbridge can be located near village of Lithium Springs. Youngest part of underlying Bainbridge apparently considerably older than youngest America Silurian beds, and oldest Bailey is presumably younger than oldest known Devonian. Presumably unconformable with overlying Little Saline formation in Ste. Genevieve County; contact with overlying Clear Creek should also be disconformable because variations in thickness of Bailey suggest post-Bailey pre-Clear Creek erosion.

J. M. Weller and others, 1952, Illinois Geol. Survey Bull. 76, p. 56. Bailey limestone is very cherty and siliceous, light to dark brownish gray, and very fine grained. A more cherty upper part has been described from outcrops in Union County and called Grassy Knob chert, but subsurface studies in Illinois fail to separate this from rest of formation, and it is believed that the greater part of chert in the outcrops is due only to local leaching of limestone and concentration of silica in post-Devonian times. Helderbergian group.

J. E. Lamar, 1959, Illinois Geol. Survey Rept. Inv. 211, p. 18. Exact thickness not known. Maximum observed thickness 130 feet, but total thickness may be between 300 and 400 feet. Basal beds of formation are greenish or gray shale that grades down into shale of upper part of underlying Bainbridge group.

Neotype area: Outcrops in river bluffs at and north of Red Rock Landing, Perry County, Mo. Here beds crop out in fault block tilted toward river and are exposed southeastward along fault zone in a narrow discontinuous band almost to Brazeau Creek in NW¼ sec. 11, T. 34 N., R. 13 E. Ulrich (1904) gave name Bailey to strata considered to be identical with or equivalent to rocks comprising Meek and Worthen's (1866, Illinois Geol. Survey, v. 2) "Lower Helderberg group" exposed in bluffs of Mississippi River at and above Red Rock Landing, Mo. Name was derived from settlement of Bailey's Landing, which was apparently at or near present site of Grand Eddy. Boat landing has been abandoned owing to changes in river channel, and outcrops mentioned by Meek and Worthen have been buried under alluvium. Inasmuch as no Devonian rocks are exposed at Grand Eddy neotype area is herein designated.

Bailey Spring Limestone[1]

Upper Mississippian and Lower Pennsylvanian: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 21.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). On correlation chart of recommended revision

of stratigraphic units pertaining to Great Basin, Bailey Spring limestone is shown equivalent to Ely limestone; Ely is recommended term. Pennsylvanian. Pioche district, as used in this report, extends north to Dutch John Mountain, approximately 40 miles north of Pioche.

Present in large areas southeast of Bailey Spring, on western side of Bristol Range, Pioche district, Lincoln County.

Baileyville Member (of Stonehenge Limestone)

Lower Ordovician (Canadian): Central Pennsylvania.

A. C. Donaldson, 1960, Dissert, Abs., v. 20, no. 9, p. 3693. Characterized by algal and aphanitic limestones. Overlies Graysville member (new); underlies Logan Branch member (new).

Type locality and derivation of name not stated.

Bainbridge Limestone[1]

Bainbridge Formation

Bainbridge Group

Middle Silurian: Eastern Missouri and southwestern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 110.

J. R. Ball, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 4, p. 595–601. Described at designated type section as Bainbridge formation. Includes some red, strongly mottled, argillaceous limestones; some poorly bedded, greenish-gray earthy limestones; and a unit of finely laminated dark brown shale in which *Cyrtograptus ulrichi* Ruedemann is conspicuous fossil. Thickness more than 100 feet, but base is below water level and a railroad bridge is against foot of bluff.

J. M. Weller, 1940, *in* J. M. Weller and G. E. Ekblaw, Illinois Geol. Survey Rept. Inv. 70, p. 10–11; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 21. In Illinois, Bainbridge limestone overlies Sexton Creek limestone; contact with underlying Bailey limestone not observed. Thickness about 40 feet south of Thebes.

J. R. Ball, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 7–11. Includes Osgood member below and Laurel member above.

Carey Croneis, 1944, Illinois Geol. Survey Bull. 68, p. 110. In Missouri, underlies Bailey limestone though no undoubted contacts have been observed. Youngest part of Bainbridge is apparently considerably older than youngest American Silurian.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 12–18. Redefined as group. Consists of Niagaran strata of belt east and south of Ozarks. Characterized by two lithologically well-differentiated formations, St. Clair below, and Moccasin Springs (new) above. Formations extend considerably beyond area under consideration; at their geographic limits both formations interfinger with other Niagaran formations. Group is distinguished by its red, pink, and purplish colors, predominance of limestone, absence of chert, and comparative persistence of lithologic types over wide areas. Underlies tapering wedge of Thorn group (new). [Report deals with Niagaran reefs in Illinois and their relation to oil accumulation; much data relative to thickness and distribution of units are based on subsurface studies.]

A. J. Boucot, 1958, Jour. Paleontology, v. 32, no. 5, p. 1029–1030. Bainbridge limestone considered to be of lower Ludlow or highest Wenlock, that is, early Late or latest Middle Silurian, because of occurrence of Ludlovian and highest Wenlock eospiriferids of the *Eospirifer nobilis* type.

Type section: In head of small box canyon in SE¼SE¼NW¼ sec. 24, T. 32 N., R. 14 E., along Bainbridge Creek, near Moccasin Springs, Cape Girardeau County, Mo.

†Bainbridge Marl[1]

Eocene, upper: Southwestern Georgia.

Original reference: A. F. Foerste, 1894, Am. Jour. Sci., 3d, v. 48, p. 41–54.

Named for exposures at Bainbridge, Decatur County.

Bainbridge residual beds[1]

Oligocene and Miocene: Southwestern Georgia.

Original reference: W. H. Dall and J. Stanley Brown, 1894, Geol. Soc. America Bull., v. 5, p. 170.

Named, apparently, for exposures at or in vicinity of Bainbridge, Decatur County.

Baird Shale[1] or Formation

Mississippian: Northern California.

Original reference: H. W. Fairbanks, 1894, Am. Geologist, v. 14, p. 28.

C. A. Lamey, 1948, California Div. Mines Bull. 129, pt. K, p. 141 [1946]. Listed in Shasta County as Baird formation consisting of tuff, sandstone, and shale. Underlies Permian(?) McCloud limestone.

I. E. Klein, W. P. Irwin, and B. A. Ogle, 1960, Sacramento Geol. Soc. Ann. Field Trip, June 3–5, geol. map. Map explanation shows Baird formation as Pennsylvanian.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Baird formation, according to Diller (1906, U.S. Geol. Survey Geol. Atlas, Folio 138), consists of lower 500 feet of white and purple tuff and tuffaceous slaty sedimentary rocks, and an upper 200 feet of tuffaceous and siliceous slate. Near McCloud River bridge, the Baird is present on both sides of river and is said to be disconformably beneath McCloud limestone. Although well-documented fossiliferous beds of the Baird have a Mississippian fauna, presence of *Staffella?* in beds a few feet below Baird-McCloud contact at this locality indicates that here topmost beds of the Baird formation are at least Pennsylvanian and may be Permian in age.

Prominantly exposed on west side of [McCloud] River just above Baird Post Office [Shasta County].

†Baker Limestone[1]

Lower Silurian: Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

Named for Baker, Davidson County.

Baker Member (of Ladd Formation)

See **Baker Canyon Conglomerate Member** (of Ladd Formation).

Baker Canyon Conglomerate Member (of Ladd Formation)

Baker Member (of Ladd Formation)

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named Baker member of Ladd formation. Gray to brownish massive- to thick-bedded boulder conglomerate below, grading up into thick bedded to shaly arkosic soft brown sandstone above; sandstones at top highly fossiliferous. Thickness about 200 feet. Underlies Holz member of Ladd formation (both new); overlies Trabuco formation.

W. P. Popenoe, 1941, Jour. Geology, v. 49, no. 7, p. 740. Referred to as Baker conglomerate member of Ladd formation.

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 170–171. Renamed Baker Canyon member of Ladd formation. Name Baker preoccupied. Derivation of name given.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map 154. Shown on map legend as Baker Canyon conglomerate member of Ladd formation.

Named for its development in Baker Canyon, north of Silverado Canyon, Santa Ana Mountains.

Baker Lake Porphyry

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 83, pl. 1. Quartz monzonite porphyry, coarser and darker gray than typical Eshe porphyry. Block jointing has broken rock units into slabs from a few inches to a few feet in diameter. Talus obscures contacts with surrounding sediments.

Exposed in northwestern part of South Park in secs. 17, 19, 20, 28, 29, and 30, T. 7 S., R. 75 W., and secs. 24 and 25, T. 7 S., R. 76 W., Park County. Outcrop is 4 miles long and averages one-half mile wide. Central part of outcrop has been eroded to a depression which now holds Baker Lake.

Baker Pond Gneiss (in Oliverian Magma Series)

Upper Devonian(?): West-central New Hampshire.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. Fine-grained gray gneiss, locally containing microcline phenocrysts. Largely quartz monzonite with some granodiorite. Border phase is dark-greenish-gray quartz diorite gneiss. Included in Oliverian magma series whose age is younger than Lower Devonian and is probably Upper Devonian.

Mapped in the area around Upper Baker Pond, which is located on the border of the Mount Cube and Rumney quadrangles.

Bakerstown Clay[1]

Pennsylvanian (Conemaugh Series): Western West Virginia.

[Original reference]: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Kanawha County, p. 177.

J. B. McCue and others, 1948, West Virginia Geol. Survey [Repts.], v. 18, p. 14. Bakerstown underclay, 3 to 10 feet thick, commonly occurs below Bakerstown coal which is generally 160 to 190 feet above base of Conemaugh series.

Occurrences noted in Barbour, Braxton, Kanawha, Lewis, Roane, and Upshur Counties.

Bakerstown Sandstone (in Conemaugh Formation)[1]

Bakerstown shale and sandstone member

Pennsylvanian: Southwestern Pennsylvania and eastern Ohio.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. xlx (preface), 305–308.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 120. Geographically extended into Athens County, Ohio, where it is called Bakerstown shale and (or) sandstone member of Anderson cyclothem in Conemaugh series. Lesley applied name in Pennsylvania to sandstone underlying Bakerstown (Anthony) coal and overlying Lower Barren Measure (Conemaugh) red shales, which rest on Pine Creek (Wilgus?) coal. Heretofore member has been unnamed in Ohio or called Anderson as by Flint (1951, Ohio Geol. Survey, 4th ser., Bull. 48). In Athens County, Bakerstown member has maximum and minimum thickness of 32 and 3 feet, respectively, with average thickness of 13 feet. Where underlying Cambridge and Wilgus members [of Wilgus cyclothem] are absent or indistinct and replaced by sandy and shaly beds, it is difficult to separate Bakerstown member from Buffalo member and undifferentiated Buffalo-Bakerstown shale and sandstone members attain considerable combined thickness. Stratigraphically below Bloomfield limestone member [of Anderson cyclothem]. Bloomfield member is well developed only in Muskingum County.

Name first used in Allegheny County, Pa.

Bakersville Gabbro[1]

Precambrian(?): Western North Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 5.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 25; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Dense, hard unmetamorphosed rock, nearly black when fresh but becoming reddish brown on weathering. Composed chiefly of plagioclase, hornblende, and pyroxene in crystals of medium size with small amounts of magnetite, epidote, and garnet as accessory minerals. Texture usually massive and granular, but locally becomes aplite. Exact age still in doubt. Some recent workers believe Bakersville may have been emplaced between late Ordovician or early Silurian and the Triassic.

U.S. Geological Survey currently designates the age of the Bakersville as Precambrian(?) on the basis of a study now in progress.

Named for Bakersville, Mitchell County.

Bakken Formation

Upper Devonian(?) and Lower Mississippian: Subsurface in North Dakota and Montana, and Manitoba and Saskatchewan, Canada.

J. W. Nordquist, 1953, Billings Geol. Soc. Guidebook 4th Ann. Field Conf., p. 72–74, figs. 4, 5. Consists of two black fissile shales separated by light-gray to gray-brown fine-grained calcareous sandstone interbedded with minor amounts of gray-brown cryptocrystalline limestone. Thickness 105 feet in type well. Occurs between depths of 9,615 and 9,720 feet. Overlies Three Forks formation; underlies Lodgepole formation.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2328. Overlies Three Forks formation in standard subsurface section of Three Forks. Devonian(?) and Lower Mississippian.

U.S. Geological Survey currently designates age of the Bakken as Upper Devonian(?) and Lower Mississippian on basis of study now in progress.

Type well: Amerada Petroleum Corporation-H. O. Bakken No. 1 deep test, center SW¼NW¼ sec. 12, T. 157 N., R. 95 W., Williams County, N. Dak.

Bakoven Shale[1] (in Hamilton Group)

Middle Devonian: Eastern New York.

Original reference: G. H. Chadwick, 1933, Am. Jour. Sci., 5th, v. 16, p. 480, 483.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Beds hitherto classified as "Marcellus" shale (Bakoven of Chadwick) immediately underlie Stony Hollow member (new) of Marcellus and are now proved to be equivalent of Union Springs member of Marcellus.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. Represents easternmost known facies of Union Springs shale.

Winifred Goldring and G. A. Cooper, 1943, New York State Mus. Bull. 332, p. 240–249. In Coxsackie quadrangle, forms narrow belt for full length of area. In upper part, it is entirely included in Hamilton escarpment which rises abruptly above Onondaga Flats. Further south, in part, it forms east face of Hamilton Hills and, in part, underlies a hilly valley occupied in extreme south by Hollister Lake and a branch of the Catskill. Thickness for this area between 180 and 200 feet. Not in contact with Onondaga in this quadrangle. Stony Hollow member (new) of Marcellus overlies Bakoven shale. Bakoven shale of Chadwick now represents gray shale facies of Union Springs member of Marcellus.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 11 (fig. 3), 15. Bakoven, formerly termed "Marcellus shale," is basal formation of Hamilton group in Albany County. Typically black pyritiferous fissile shale. Thickness about 200 feet. Underlies Mount Marion formation; overlies Onondaga limestone. Middle Devonian.

Type section (partial): Where Catskill-Palenville Road crosses Kaaters Kill. Bakoven is local Dutch name of valley produced by the shale.

Balaklala Rhyolite[1]

Middle Devonian: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. R. Kinkel, Jr., and J. P. Albers, 1951, California Div. Mines Spec. Rept. 14, p. 4. Name restored as formal stratigraphic unit because new evidence indicates formation is composed principally of extrusive rhyolite and pyroclastics and not intrusive alaskite porphyry as considered by Graton (1910) who abandoned the name.

A. R. Kinkel, Jr., W. E. Hall, and J. P. Albers, 1956, U.S. Geol. Survey Prof. Paper 285, p. 1, 17–32, pl. 1. Composed of soda-rich rhyolitic flows and pyroclastic material. Subdivided into three units: lower non-

porphyritic rhyolite, middle medium-phenocryst rhyolite, and upper coarse-phenocryst rhyolite. Probably 3,500 feet thick in central part of district, but forms volcanic pile that thins on edges. Conformably overlies, and in some areas interfingers with, Copley greenstone; underlies Kennett formation.

I. E. Klein, 1960, Sacramento Geol. Soc. [Guidebook] Field Trip June 3, 4, and 5, p. 11. Intruded by Mule Mountain granite (new).

Named for fact it forms hills about Balaklala mine, Redding quadrangle. Rhyolite crops out in a belt 16 miles long and 5 miles wide that strikes N. 15° E. from south half of Whiskeytown quadrangle to southwest quarter of Behemotosh quadrangle.

Balanos Beds

See **Bolanos Pyroclastic Member** (of Umatac Formation).

Bald Crater Basalt Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 33. Name applied to basalt flow on Bald Crater. [See Timber Crater Basalt Flow.]

Bald Crater is north and west of Crater Lake.

†Bald Eagle Conglomerate,[1] Formation, or Sandstone

Bald Eagle Member (of Juniata Formation)

Upper Ordovician: Central Pennsylvania.

Original reference: A. W. Grabau, 1909, Jour. Geology, v. 17, p. 235.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1165–1198. Term Oswego apparently misapplied in Pennsylvania. For beds commonly referred to by that name, term Bald Eagle (Grabau, 1909) is revived and treated as basal member of Juniata. This new application of term restricts Martinsburg at top. Grades upward into red Juniata. Where Juniata is absent, underlies Tuscarora sandstone; overlies Martinsburg formation, in some areas the Fairview member. Thickness varies from 10 feet to as much as 124 feet.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., p. 4–5, diagram. At its type section, Bald Eagle formation is about 650 feet thick and consists of poorly winnowed unfossiliferous graywacke-type sandstones, virtually without pebbles except for shale-chips of intraformational type. Formation includes a middle strong ridge-making sandstone member, underlain by weaker shale and sandstone member. Eastward toward Lewistown, ridge-making member of Bald Eagle sandstone becomes conglomeratic, with pebbles of vein quartz, quartz-veined quartzites, cherts and jaspers, and rarely of quartz-veined metaargillites. This conglomerate is here named Lost Run conglomerate. Overlies Reedsville shale and at eastern limit Martinsburg shale; underlies unnamed sandstone member of Juniata.

F. M. Swartz, 1955, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. Bald Eagle sandstone, in type area, subdivided into Centennial School sandstone and shale member below and Spring Mount sandstone member (both new). Underlies East Waterford red sandstone member (new) of Juniata; overlies Reedsville shale.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook for Field Trips, Pittsburgh Mtg., p. 7, pl. 1. Formation comprises typically dark-gray, greenish, well-cemented, poorly sorted graywacke and orthoquartzite. Basal part commonly conglomeratic. Thickness 30 feet at Susquehanna Gap; nearly 1,000 feet in central Pennsylvania. Underlies Juniata formation. Contact with underlying Reedsville transitional; contact arbitrarily placed at youngest occurrence of *Orthorhynchula*.

Named for Bald Eagle Mountain at Tyrone, Blair County.

Bald Hill Agglomerate Member (of Tuscan Formation)

[Pliocene]: Northern California.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. Tuscan formation is subdivided into five members. Bald Hill agglomerate is second in sequence (ascending). Underlies Seven-Mile tuff and sand member; overlies Supan tuff and sand member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

Bald Hill Granite Gneiss[1]

Precambrian: Southeastern New York.

Original reference: C. E. Gordon, 1911, New York State Mus. Bull. 148, p. 11, 14–16, 20–21, 32, 34, 40.

Composes Bald Hill, Poughkeepsie region.

Bald Hill Limestone (in Tradewater Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 263.

Exposed in railroad cut east of Stonefort as a discontinuous layer a few inches thick but is more typically developed at Bald Hill, about 2 miles southeast of Stonefort, Saline County, on north side of Big Four Railroad.

Bald Hill Sandstone (in Tradewater Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 258, 263.

Occurs along crest of hill north of Stonefort, that is, Stonefort Hill, and is exposed on low knoll upon which Mitchellville, Saline County, is located.

Bald Hill Shale (in Henshaw Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 118.

Named for Bald Hill, just east of Dixon.

Bald Hills Formation

Upper Cretaceous: Northern California.

M. A. Murphy and P. U. Rodda, 1960, Jour. Paleontology, v. 34, no. 5, p. 835–858. Conglomerate, sandstone, and mudstone. Thickness 1,870 feet at type locality. Conformably overlies Ono formation; conformably underlies unnamed Upper Cretaceous mudstone unit. Molluscan fauna described.

Type section: In Bald Hills along Crow Creek in secs. 25, 26, and 31, T. 30 N., R. 7 W., Mount Diablo base and meridian, Shasta County.

Baldhills Member (of Isom Formation)

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 99. Porphyry of latitic composition, glassy to lithoidal in texture, black to dark red brown in color, with strong platy parting and blocky fracture. Exhibits some features of ignimbrites of very highly welded type, but has some internal structural features indicative of viscous flow. Lower member of formation; underlies Hole-in-the-Wall member (new). Discussion of ignimbrites of area.

Named for occurrence in Baldhills ridge (Three Peaks quadrangle) which trends northward from type locality of Isom formation, Iron Springs district.

Bald Knob Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1915, West Virginia Geol. Survey Rept. Boone County, p. 497.

Named for Bald Knob post office, Boone County.

Bald Knoll Formation

Eocene, upper, or Oligocene, lower: Central Utah.

W. N. Gilliland, 1949, Ohio State Univ. Abs. Doctors' Dissert. 57, p. 71; 1951, Nebraska Univ. Studies, new ser., no. 9, p. 11 (table 1), 43–47, pl. 2. Succession of light-green, light-tan, gray, and white clays with interbedded siltstone, sandstone, and minor amounts of soft limestone of the same colors. Thickness at type locality about 600 feet; elsewhere may be as much as 800 to 1,000 feet. Underlies Axtell formation with angular discordance; overlies Crazy Hollow formation.

D. P. McGookey, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 5, p. 605, 606–608. Gray Gulch formation as designated by Spieker (1949) includes strata equivalent to Bald Knoll formation of Gilliland (1951), part of Bullion Canyon volcanics of Callaghan (1939), and a previously unnamed interval that was mapped as Gray Gulch(?) formation by Lautenschlager (1952, unpub. thesis). Proposed herein that term "Gray Gulch" be abandoned and term "Bald Knoll formation" be used for lower part of interval formerly assigned to Gray Gulch. Thickness about 1,049 feet on Lost Creek. Underlies Dipping Vat formation (new); overlies Crazy Hollow formation. Eocene.

Type locality: At mouth of Bald Knoll Canyon in southwest corner of Gunnison quadrangle.

Bald Mountain Dacite[1]

Tertiary: Central southern Colorado.

Original reference: W. Cross, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 295.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, the volcanics, in order of decreasing age, consist of Rosita fragmental andesite, Bunker massive andesite, Fairview diorite in dikes cutting earlier andesite. Bald Mountain dacite flows, rhyolite in dikes,

eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Named for Bald Mountain, Custer County.

Bald Mountain Formation

Precambrian: Northeastern Utah.

D. J. Jones, 1955, Utah Geol. Mineralog. Survey Bull. 51, p. 13, 14, fig. 2. Series of buff-colored thin-bedded quartzites and metamorphosed conglomerate. Many thin layers of brown and green shale in between layers of quartzite. Thickness about 1,250 feet.

Named from Bald Mountain, Uinta Mountains, where formation is well exposed.

Bald Mountain Gneiss[1]

Precambrian: Northeastern Oregon.

Original references: W. D. Smith and E. L. Packard, 1919, Oregon Univ. Bull., v. 16, no. 7, p. 105; 1919, Jour. Geology, v. 27, p. 105.

Bald Mountain Lake Beds Member (of Esmeralda Formation)[1]

Miocene, upper, and Pliocene, lower: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Composes upper part of Bald Mountain within 400 feet of its top. Manhattan district.

Bald Mountain Limestone[1]

Lower Ordovician: Eastern New York and western Vermont.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, p. 367.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Shown on correlation chart for Vermont. In Taconic sequence, Bald Mountain limestone occurs above Deepkill shale and below Normanskill formation. Taconic sequence occupies a range that extends southward from Brandon, Vt., into Massachusetts and Connecticut.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76. Only lower part of Bald Mountain is Canadian; upper part is of Black River and Trenton ages.

Named for occurrence on Bald Mountain, Washington County, N.Y.

Bald Mountain Tonalite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 197–204, 235. Medium-grained fairly uniform pale-blue-gray tonalite with some dark minerals. Intrudes Permian sedimentary and volcanic sequence and Triassic ultramafic-gabbroic series. Intruded by Mount Ruth leucogranodiorite and Red Mountain leucogranodiorite (both new). Surrounds Badger Butte quartz-biotite norite (new). Grades into Anthony Lake granodiorite (new) near center of batholith; this transition zone is intruded by Elk Peak quartz monzonite (new).

Characteristically exposed on Mount Ireland (Bald Mountain), in Elkhorn Mountains [Grant County]. Major rock component of Bald Mountain batholith.

Bald Peak Basalt[1] (in Berkeley Group)

Bald Peak Formation (in Contra Costa Group)

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 2, map.

D. E. Savage, B. A. Ogle, and R. S. Creely, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1511. Bald Peak formation included in sequence of formations (in west-central Contra Costa County) for which a new group name is proposed [name not given]. Sequence (ascending): Orinda, Moraga, Siesta, Bald Peak, and unnamed formation.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 143. Noted as Bald Peak lavas, which are chiefly flows of basalt and andesite. Interbedded with and overlies Siesta formation.

C. R. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 15. Included in Contra Costa group (new).

Forms large part of Bald Knob, east of Berkeley, Contra Costa County.

Bald Rock Conglomerate Member (of Lee Formation)[1]

Pennsylvanian: Southwestern Virginia.

Original reference: J. B. Eby, 1923, Virginia Geol. Survey Bull. 24, p. 65.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 14. Middle of three conglomerates in the type Lee—the Bee Rock at top and an unnamed zone at base.

Named for Bald Rock, about 4 miles west of Dungannon, Wise County.

Bald Rock Granite

Late Jurassic(?): Northern California.

Anna Hietanen, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 583, 584. Named in a petrographic discussion of rocks of the area.

Report on the Merrimac area, Plumas National Forest, Butte and Plumas Counties.

Baldwin Formation

Mississippian (Chester Series): Southwestern Illinois.

J. M. Weller, 1939, *in* Stuart Weller and J. M. Weller, Illinois Geol. Survey Rept. Inv. 59, p. 10 (fig. 2), 12, 13; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 837. Proposed for strata formerly known as upper Okaw or Plum Creek beds. Consists of more or less sandy beds at bottom and top separated by shale and dark-gray somewhat cherty limestone; these three parts are equivalent to Tar Springs, Vienna, and Waltersburg formations of southern Illinois, but the sandstones are erratically developed and it is impractical to map them separately. Thickness 60 to 75 feet. Conformably underlies Menard limestone; locally overlies Okaw limestone unconformably and rests on different members of it in different places.

Name derived from town on east side of Kaskaskia River in Randolph County. Outcrops extended from near Baldwin to Fort George and thence along Mississippi bluff to mouth of Marys River.

Baldwin Gneiss

Precambrian(?): Southern California.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5, 6–7, pl. 1. Chiefly fine-grained gneiss and schist and augen gneiss. Includes two

ages of pre-Mississippian granitic intrusives. Thickness about 2,000 feet. Gneiss is in reverse fault contact with Chicopee formation (new) east of Baldwin Lake and with Furnace limestone to south. West of Doble mine, gneiss is in fault contact with Chicopee formation and overthrust by Saragossa quartzite. Intruded by Cactus quartzite. Gneisses and associated granitic intrusions were included in Saragossa quartzite by Vaughan (1922).

Type locality: East of Baldwin Lake, San Bernardino Mountains, San Bernardino County.

Baldwin Sandstone Member (of Mesaverde Formation)

Upper Cretaceous: Central Colorado.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. Name proposed for strata, near village of Baldwin, identified earlier (W. T. Lee, 1912) as Bowie member. Contains several coal beds locally. Underlies Rollins sandstone member.

Village of Baldwin located in Anthracite-Crested Butte coal district, Gunnison County.

Baldwin Corner Formation

Lower Ordovician: East-central New York.

John Rodgers *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., 1952, Geol. Soc. America Guidebook for Field Trips in New England, p. 35 (table 2), 53 (road log). Gray or yellow earthy fine-grained dolomite with persistent limestone layers near middle and at base. Thickness 120 feet. Underlies Great Meadows formation (new); overlies Whitehall formation. Formerly included in Whitehall formation. Refers to R. H. Flower (unpub. ms.).

Occurs in Fort Ann quadrangle.

Baldwinsville Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central eastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1934, Illinois Geol. Survey Bull. 61, p. 129–138.

Derivation unknown.

Baldy Hill Formation (in Dockum Group)

Triassic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, pt. 2, p. 31, 35–38, pls. 1a, 1b, 2. Consists of silty mudstone, with beds of ledge-forming sandy mudstone and very fine-grained sandstone in type section where it is 115 feet thick. A 13-foot interval of claystone present near bottom of section. Formation characterized by purple color, which mottles orange, gray red, light to medium gray, and light olive. Nodules of red and yellow chalcedony and some silicified wood present below top of unit. Several sandstone beds present at base of formation where it underlies Travesser formation (new) 1 or 2 miles east and northeast of type section.

Type section: Measured 2,000 feet north of Baldy Hill at sec. 36, T. 32 N., R. 32 E., Union County. Exposed in an area of about 8 square miles on the former Baker Ranch, just north of junction of New Mexico Highways 325 and 370. Named from Baldy Hill.

Baldy Mountain Member (of Davis Creek Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Named as lower member of formation. Underlies Buck Island member (new); overlies Round Mountain member of Little Valley formation (both new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Balfour Formation

Oligocene, lower: Central Colorado.

J. H. Johnson, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 77. Consists of brown clays and sandy shales with interbedded flows and trachyte and fragmental volcanic material. Underlies Antero formation (new); overlies Denver formation.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7), 61–63, pl. 1. Sequence of stream-channel, flood-plain, alluvial-fan, deltaic, and true lake sediments. Thickness 0 to 200 feet. Relation to Denver formation nowhere exposed; may prove to be merely topmost part of the Denver.

Area: Best exposed north of Balfour in T. 13 S., R. 75 W. Scattered outcrops occur within area extending from R. 74 to R. 76 W., and from T. 14 to T. 12 S., Park County.

Ballard Formation (in Meade Group)

Pleistocene (Nebraskan and Aftonian): Southwestern Kansas.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 56. Name proposed to include deposits between Rexroad formation below and Crooked Creek formation above in southwestern Kansas. Thickness about 20 feet. Includes Angell member (new) at base and Missler member. Separated by erosional unconformities from both underlying and overlying formations.

Type locality: On Big Springs Ranch in secs. 7 and 17, T. 32 S., R. 28 W., Meade County. Named from Louise Ballard Ranch which is shown on Meade County Platt book as saving included the present Big Springs Ranch.

Ballard Harmon Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 244.

Quarried on southwest side of Tug Fork, just below mouth of Ballard Harmon Branch, McDowell County.

†Ballast Point silex bed[1] (in Tampa Limestone)

Miocene, lower: Central Florida.

Original reference not stated.

Named for exposures at Ballast Point, Tampa, Hillsborough County.

Ballena Gravel[1]

Eocene: Southwestern California.

Original reference: W. J. Miller, 1935, Geol. Soc. America Bull., v. 46, no. 10, p. 1556–1561.

Type locality: Southwest of Ballena, San Diego County.

Ballou Clay (in Allegheny Formation)[1]

Pennsylvanian: Ohio.

Original reference not stated.

In Muskingum County.

Balmville Limestone Member (of Wappinger Limestone)[1]

Middle Ordovician: Southeastern New York.

Original reference: F. Holzwasser, 1926, New York State Mus. Bull. 270, p. 38–41, 43.

E-an Zen, 1960, (abs.) Geol. Soc. American Bull., v. 71, no. 12, pt. 2, p. 2009. Discussion of time and space relationships of Taconic rocks in western Vermont and eastern New York. Within southern Taconic area, Normanskill and higher rocks are autochthonous; they rest in normal succession on Whipple-correlative Balmville limestone member of Wappinger limestone.

Crops out north of Balmville, Orange County.

Balsora Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 24.

Occurs along Boone Creek. Named for outcrop in valley of a small stream 1 mile west of Balsora, Wise County.

Baltic Amygdaloid[1] (in Bohemian Range Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 135, 136.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 678 (fig. 1). Name used on geologic section of Michigan copper district.

Named for occurrence in Baltic mine, Houghton County.

Baltic Conglomerate[1] (in Bohemian Range Group)

Precambrian: Northern Michigan.

Original reference: A. C. Lane, 1906, Mines and Minerals, v. 27, p. 204–206.

Named for occurrence in Baltic mine, Houghton County.

Baltic Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

H. R. Cornwall, 1951, Geol. Soc. America Bull., v. 62, no. 2, p. 194. Ophitic basalt of the Baltic flow overlies No. 3 conglomerate in Michigan copper district.

Michigan copper district on Keweenaw Peninsula in Houghton and Keweenaw Counties.

Baltic Sandstone[1] (in Bohemian Range Group)

Precambrian: Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 495, 499.

Probably named for its occurrence near Baltic mine or at or near town of Baltic, Houghton County.

Baltic West Amygdaloid[1] (in Bohemian Range Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named because it is usually the first amygdaloid west of Baltic lode.

Baltic West Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Baltic mine, Houghton County.

Baltimore Gabbro or Gabbro Complex

Paleozoic (post-Lower Ordovician): Eastern Maryland.

Ernst Cloos and H. G. Hershey, 1936, Natl. Acad. Sci. Proc., v. 22, no. 1, p. 71, 78. Baltimore gabbro is intrusive into Glenarm series.

Ernst Cloos and others, 1936, Maryland Geol. Survey, v. 13, p. 33 (table 1), 217–236, pl. 1, 41. Post-Lower Ordovician. Gabbro occurs in peneplained area and occupies a structural basin in the Glenarm series and Baltimore gneiss.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 979–1015. Discussed as Baltimore gabbro complex. Intrudes Wissahickon and Peters Creek and is cut by quartzose intrusives including Relay diorite, Port Deposit granodiorite gneiss, and Ellicott City granite. The Relay occurs persistently along southeast margin of gabbro.

Complex comprises an area of about 50 square miles in Piedmont of Baltimore City and County and Howard County.

Baltimore Gneiss[1]

Precambrian: Northern Maryland, southeastern Pennsylvania, and central northern Virginia.

Original reference: G. H. Williams and N. H. Darton, 1892, U.S. Geol. Survey map of Baltimore to accompany "Guide to Baltimore" prepared for Baltimore meeting Am. Inst. Mining Engrs. Feb. 1892, p. 88, 139.

Ernst Cloos and others, 1936, Maryland Geol. Survey, v. 13, p. 33 (table 1), 217, pl. 1. Baltimore gabbro occurs in peneplained area and occupies a structural basin in Glenarm series and Baltimore gneiss.

Chi-shang Ch'ih, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 924. Northwest of Philadelphia, the Wissahickon is cut off by Cream Valley fault which brings it into contact with Baltimore gneiss.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 980. Unconformable below Glenarm series, lowest unit of which is Setters quartzite.

R. H. Jahns and W. R. Griffitts, 1953, U.S. Geol. Survey Prof. Paper 248–C, pt. 4, p. 172. Geographically extended into Anna River area,

Virginia, where it forms a well-defined belt on east side of area; west of gneiss is Wissahickon schist.

Named for outcrops in city of Baltimore, Md., along banks of Jones Falls and Gwynns Falls.

†Baltimorean Formation[1]

Lower Cretaceous: Eastern Maryland.

Original reference: P. R. Uhler, 1888, Am. Philos. Soc. Proc., v. 25, p. 48.

Well developed in city of Baltimore.

Banbury Formation or **Basalt** (in Idaho Group)

Banbury Volcanics[1]

Pliocene, middle: Southern Idaho.

Original references: H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932); 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 31 (table), 50–51, pl. 5. Volcanics crop out fairly continuously as a series of even-bedded massive basalt flows more than 300 feet thick. Stratigraphic section shows Banbury volcanics above Raft lake beds and below Hagerman lake beds.

U.S. Geological Survey currently classifies the Banbury Basalt as a formation in Idaho Group on basis of study now in progress.

Named for exposures near Banbury Hot Springs, sec. 33, T. 8 S., R. 14 E., Twin Falls County.

Bandelier Tuff

Bandelier Rhyolite Tuff

Pleistocene: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Named as sixth in a list of seven Quaternary formations in area. Older than Santa Clara basalt (new); locally overlies Puye gravel (new).

V. C. Kelley and Caswell Cooper, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14). Pleistocene.

Occurs in Abiquiu quadrangle, Rio Arriba County.

Bandera Shale[1] (in Marmaton Group)

Bandera Shale Member (of Oologah Limestone)

Bandera Shale (in Henrietta Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Iowa, and northeastern Oklahoma.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 32.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 292, 321–325, pl. 1. Subdivided to include Bandera Quarry sandstone member (new). Overlies Laberdie limestone member (new) of Pawnee limestone; underlies Tina limestone member of Altamont limestone. Thickness commonly 50 feet. Included in Marmaton group. Note on type exposure.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v .25, no. 1, p. 26–27 (fig. 2). Columnar section shows Bandera shale in Henrietta group.

L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 15–17. Geographically extended into Missouri. Underlies Altamont formation, in some areas Amoret limestone member. [Amoret replaces Tina.] Overlies Pawnee formation, Coal City member.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 28. Term Oologah is extended to Kansas-Oklahoma line to include (ascending) Pawnee limestone, Bandera shale, and Altamont limestone as members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31, fig. 5. In southwestern Iowa, formation comprises rocks between Altamont formation above and Pawnee formation below. Not subdivided, and where Amoret member of Altamont is missing it is not possible to differentiate the formations. Bandera is well exposed below the Amoret and above Coal City limestones in ravine in NW¼ sec. 26, T. 75 N., R. 26 W., Madison County. Here it consists of 10 feet of red and green mottled clay and shale at top followed by 15 feet of green micaceous crossbedded sandstone and siltstone below. Marmaton group.

Named from Bandera Station in sec. 29, T. 25 S., R. 23 E., Bourbon County, Kans.

Bandera Quarry Sandstone Member (of Bandera Shale)

Pennsylvanian (Des Moines Series): Southeastern Kansas and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 292. Name applied to sandstone lenses in the Bandera shale.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 196. Gray and brown sandstone, generally thin bedded, locally "flagstones;" lenticular. Thickness as much as 30 feet; average 15 feet.

J. M. Jewett, 1945, Kansas Geol. Survey Bull. 58, p. 35, 37, 38, pl. 3. Sandstone is commonly well bedded and is fine and micaceous; locally the sandstone occupies entire Bandera section; where present, it is generally separated by shale ranging in thickness from a few feet to 20 or more feet.

C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, p. 132 (fig. 2), 136–137. Geographically extended into Nowata and Craig Counties, Okla., where it occurs near top of Bandera shale, about 10 feet below base of the Altamont. A channel filling; most exposures show even bedding that is continuous for many miles. Locally contains thin shale members. Thickness of sandstone group is 11 feet.

Nearly all local occurrence is in flagstone quarries in vicinity of center of north line of SW¼ sec. 29, T. 25 S., R. 23 E., Bourbon County, Kans.

Bangor Beds (in Martinsburg Shale)[1]

Upper Ordovician: Southeastern Pennsylvania.

Original references: C. H. Behre, Jr., 1926, Jour. Geology, v. 34, p. 485–487; 1927, Pennsylvania Geol. Survey, 4th ser., Bull. M–9, p. 33, 104–107, maps.

Quarried at Bangor, Northampton County.

Bangor Limestone[1]

Upper Mississippian: Alabama, northwestern Georgia, and central and eastern Tennessee.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 155–157, map.

W. B. Jones, 1928, Alabama Geol. Survey Circ. 8, p. 13–15. Includes Burgess oolite and Rockwood oolite.

W. B. Jones, 1939, Econ. Geology, v. 34, no. 5, p. 575–578. Includes Spout Spring oolite (new) near base. Overlies Hartselle sandstone.

G. W. Stose, 1952, Washington Acad Sci. Jour., v. 42, no. 8, p. 214, 242 (fig. 1). In Murphree Valley anticline, Alabama, Bangor is fossiliferous cliff-making limestone about 600 feet thick. Underlies Pennington shale; overlies Tuscumbia limestone.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 57–64. In Madison County, composed of about 350 to 420 feet of crystalline and oolitic limestone, dolomite, and shale. Overlies Hartselle sandstone; underlies Pennington formation; where Hartselle is missing, unconformably overlies Gasper formation.

Named for development at Bangor, Blount County, Ala.

Banjo Point Formation

Oligocene to Miocene: Alaska.

H. A. Powers, R. R. Coats, and W. H. Nelson, 1960, U.S. Geol. Survey Bull. 1028–P, p. 536–539, pl. 69. Bedded marine sandstone, conglomerate, tuffaceous shale, and some lapilli tuff of basaltic composition. Everywhere, top of formation is the present erosion surface. Could be as little as 400 feet thick; no marker beds could be traced through the many fault blocks to permit reconstruction of complete section, but partial section (considered type section) is about 138 feet thick, base not exposed. Unconformably overlies Amchitka formation (new). West of Banjo Point is in fault contact with Chitka Point formation (new). On basis of meager fauna, age range is considered Oligocene to Miocene.

Type section: Exposed on north coast at Banjo Point, Amchitka Island (Aleutian Islands). Occupies entire width of island westward from Makarius Bay to about 5 miles west of Banjo Point, and also several square miles of Saint Makarius Point; present on north coast west of Kirilof Point.

Bankston cyclothem

See Bankston Fork cyclothem.

Bankston Fork cyclothem (in Carbondale Formation)

Bankston Fork cyclothem (in McLeansboro Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). In list of upper Pennsylvanian cyclothems, Bankston Fork occurs below Sparland cyclothem and above Jamestown cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. On correlation chart, Bankston cyclothem is shown as including (ascending) Anvil Rock sandstone, Bankston Fork limestone, and Bankston coal. Underlies Cutler cyclothem (new); overlies Jamestown cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 54 (table 3). In Carbondale formation.

Type locality not given; however, type locality of Bankston Fork limestone is in Saline County.

Bankston Fork Limestone Member (of Carbondale Formation)

Bankston Fork Limestone (in McLeansboro Formation)[1]

Bankston Fork Limestone (in McLeansboro Group)

Pennsylvanian: Southern Illinois and western Kentucky.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 257, 261, 262.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Included in Bankston cyclothem, McLeansboro group. On correlation chart, shown below Bankston coal and above Anvil Rock sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 48 (table 1), pl. 1. Reallocated to member status in Carbondale formation (redefined). Name Allenby coal member proposed for coal formerly called Bankston so that name may be restricted to Bankston Fork limestone. Stratigraphically above Anvil Rock sandstone member. Correlation chart shows Bankston Fork in western Kentucky. Type locality stated; location given by Cady (1926) incorrect. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NW¼ sec. 19, T. 19 S., R. 5 E., Saline County, Ill.

Banner Limestone

Pennsylvanian(?) or Permian(?): Northeastern Nevada.

A. E. Granger and others, 1957, Nevada Bur. Mines Bull. 54, p. 116, pl. 14. Thick-bedded grayish-blue limestone, altered to silicates in wide zone adjoining quartz monzonite contact; conglomerate at base grading into quartzite. Estimated thickness 500 to 1,100 feet. Unconformably overlies Rio Tinto formation (new); underlies Nelson amphibolite (new). Fauna suggests age assignment of probably Pennsylvanian or Permian(?). Mapped in Carboniferous(?).

Map shows Banner Hill in Elko County.

Bannock Volcanic Formation[1]

Precambrian or Lower Cambrian: Southeastern Idaho.

Original reference: A. L. Anderson, 1928, Idaho Bur. Mines and Geology Pamph. 38, p. 3.

J. C. Ludlum, 1942, Jour. Geology, v. 50, no. 1, p. 88–89. Stratigraphically restricted to exclude upper sediments which are renamed Pocatello formation. Redefined as a series of lavas, tuffs, and volcanic breccias. Minimum thickness 400 feet. Precambrian.

Named for its occurrence in Bannock Range, Bannock County.

Baraboo Quartzite[1]

Precambrian: Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 504–519, 539, 542.

N. A. Riley, 1947, Jour. Geology, v. 55, no. 6, p. 453–475. Discussion of structural petrology of Baraboo quartzite. Thickness more than 4,000

feet. Underlies Seeley slate; overlies rhyolite, tuff, and granite. Algonkian.

Type locality and derivation of name not stated. Crops out in Baraboo area, Sauk and Columbia Counties.

Baraboo series[1]

Precambrian: Central southern Wisconsin.

Original reference: S. Weidman, 1904, Wisconsin Geol. and Nat. History Survey Bull. 13, Econ. ser. no. 8, p. 4, 22, 161, 162, 169–171.

In Baraboo region, Sauk County.

Baraga Group

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 27, 30 (table 1), 35–36. As defined, comprises most of strata referred to as Upper Huronian of previous reports, namely, Goodrich quartzite (basal formation), and Michigamme slate, the lower part of which in Marquette district includes Bijiki iron-formation member, Clarksburg volcanics member, and Greenwood iron-formation. In Iron and Dickinson Counties, six formations are represented: Goodrich quartzite (lowermost unit), Hemlock formation, Fence River formation, and its probable correlative, Amasa formation, Michigamme slate, and Badwater greenstone (new). In the sequence, Baraga is younger than Menominee group and older than Paint River group (new).

Named for Baraga County in which rocks of group are widely exposed.

Baranos Beds

See Bolanos Beds, Andesite, or Formation.

Barata Limestone (in Saavedra Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11. Streaked calcareous sandstone near the top and fossiliferous limestone below. Thickness 2 feet. Separated from overlying Arkill (new) by 12 feet of buff sandstone.

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Bar B Formation (in Magdalena Group)

Pennsylvanian: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 93–94, 253–254, figs. 2, 11. Consists dominantly of thin-bedded limestone and shale in alternating thin intervals. Cherty and noncherty limestone present. Chert commonly mottled and weathered tan or yellowish brown. Uppermost beds intercalated with reddish-brown siltstone, limestone conglomerate, and calcareous sandstone through interval of about 50 feet. Comprises upper third of group and is 339 feet thick at type section. Underlies Abo formation with transitional contact; conformably overlies Nakaye formation (new). Whereas 80 percent of Nakaye formation is limestone and remainder shale, ratio is nearly reversed in the Bar B formation.

Type section: In Caballo Mountains on South Ridge, sec. 10, T. 15 S., R. 4 W., Sierra County. Name taken from Bar B Draw east of Blue Mountain where, near head of draw formation is widely exposed.

Barbacoas Formation

Oligocene(?): Panamá.

R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 183–187, 206, 209. Loosely cemented white earthy rock composed of firm fine particles, apparently siliceous, but water sorted, and showing distinct lines of lamination, in alternating degrees of fineness and coarseness. Grades down into mass of brownish rock called San Pablo phase of Barbacoas. Term Panamá formation used to include analogous deposits of Barbacoas, San Pablo, and Miraflores.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 325. An informal name for tuff at a now submerged locality in Canal Zone. Oligocene(?).

At Barbacoas, Canal Zone.

Barberian series

Mesozoic (Early Cretacic): Southwestern Kansas and New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 105 (chart), p. 147-149; no. 3, p. 201. Name applied to early Cretacic rocks of Kansas. Includes Kiowa and Garrett shales. Term also extended into New Mexico.

Named for Barber County, Kans.

Barboursville Silts

Pleistocene (Illinoian): Western West Virginia.

D. P. Stewart, 1952, West Virginia Acad. Sci. Proc., v. 23, p. 113–115. Name applied to silts in vicinity of Barboursville. Thickness about 85 feet. Silts believed to have been deposited during slack water stage when waters of Cincinnati River and its tributaries were backed up behind Illinoian ice.

Barboursville is on Mud River in Cabell County. Silts extend from river southward to valley walls.

†Barclay Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 175.

Probably named for Barclay, Osage County.

Bardons Peak Grabbro (in Duluth Gabbro Complex)

Precambrian (middle Keweenawan): Northeastern Minnesota.

R. B. Taylor, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 1, p. 42, 46 (table 1), 56. Name applied to a coarse-grained melagabbro in the Duluth gabbro complex. Unit is approximately 200 feet thick, dips irregularly about 35° to northeast, and can be traced for about 1½ miles.

Exposed along Canadian National Railroad, northwest of Duluth, in St. Louis County.

Bar Harbor Series[1]

Bar Harbor detrital facies (of Frenchman Bay Series)

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1047–1052, 1060, map.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Considered facies of Frenchmans Bay series (new). Interfingers with, and is of same age as, Cranberry Island volcanic facies. Silurian.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172–173. Detrital facies consists of thin-bedded or shaly-looking submetamorphosed quartzose silts. Developed extensively in northern and northeastern parts of Mount Desert Island.

C. A. Chapman and P. S. Wingard, 1958, Geol. Soc. America Bull,. v. 69, no. 9, p. 1194. Correlation table shows Bar Harbor series Lower or Middle Devonian.

Named for Bar Harbor Landing, Mount Desert Island, Hancock County.

Baring Migmatites

[Paleocene or older]: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Were thrust over Stillaguamish rocks, producing intense cataclasis and truncation of earlier structures in autochthon and allochthon.

In central part of Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

†Barker Formation[1]

Middle and Upper Cambrian: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 3. Mentioned in discussion of history of work on Cambrian system in and near western Montana.

Well exposed near Barker and in broad valley of Pilgrim Creek and cliffs to north, Fort Benton region.

Barker Porphyry[1]

Post-Cretaceous: Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

F. C. Armstrong, 1957, Econ. Geology, v. 52, no. 3, p. 221. Mentioned in report of Montana as a source area of uranium. Locally Flathead quartzite has been intruded by post-Cretaceous Wolf and Barker porphyries.

Forms Big Baldy Mountain to south of Barker, Little Belt Mountains.

Barker Quartzite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 401.

Probably named for Barker Hill, 4 miles east of north from Castleton, Rutland County.

Barker Syenite[1]

Age(?): Montana.

Original reference: L. V. Pirsson, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 465–468.

Forms intrusive mass north of Barker, Cascade County.

Barker Dome Tongue (of Cliff House Sandstone)

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144, sheet 1. Most extensive tongue of basal Cliff House sandstone in Menefee formation in Barker Dome-Fruitland area is here named Barker Dome tongue. Southwestern wedge-edge of this tongue trends N. 45° W., as determined by exposures in Mancos Canyon and at Barker Dome. From this depositional edge, tongue extends approximately 2½ miles northeastward before it coalesces with main body of Cliff House sandstone. Contacts are sharp.

Crops out on Barker Dome, Southern Ute Dome, and in upper drainage of Barker Creek, San Juan County, N. Mex.; also in walls of Mancos Canyon, Colo.

Barkerian series[1]

Cambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Barkley quartzites[1]

Lower Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Barlow Cove Formation

Permian and Triassic(?): Southeastern Alaska.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Largely chlorite-epidote-albite schist with minor amounts of augite-bearing volcanic flow breccia, andesite, quartz-pebble graywacke conglomerate, laminated massive homogeneous graywacke, and black slate. Well-defined member of chlorite-epidote-albite schist, slate, graywacke, and quartz-pebble conglomerate, approximately 300 to 800 feet thick extends from Barlow Cove to Lone Mountain and delineates Lone Mountain fold. Total thickness approximately 6,500 feet. In contact with Retreat group (new) along bedding fault. Underlies Symonds formation (new).

U.S. Geological Survey currently designates the age of the Barlow Cove Formation as Permian and Triassic(?) on basis of study now in progress.

Type locality: Along eastern shore of Barlow Cove, Juneau (B–3) quadrangle. Extends from south boundary of the quadrangle northward to Barlow Point and Hump Island.

Barlow Pass Volcanics

Eocene: Northwestern Washington.

J. A. Vance, 1957, Dissert, Abs., v. 17, no. 9, p. 1985. About 4,000 feet of gently folded andesitic and basaltic and subordinately acidic flows, with prominent arkosic interbeds.

Occurs in Sauk River area in northern Cascades.

Barlow Ranch Beds

Pleistocene, lower: Southern California.

J. E. Eaton, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 2, p. 124. Statement is made that Arnold tentatively correlated Barlow Ranch beds with upper San Pedro series or Palos Verdes formation of typical locality.

J. E. Eaton, 1943, California Div. Mines Bull. 118, pt. 2, p. 204, 205 (fig. 86) [preprint 1941]. Shown as underlying Hall Canyon and overlying San Pedro marine beds.

Occurs in Los Angeles and Ventura Basins.

Barnard Gneiss[1]

Cambrian or Ordovician: Southeastern and east-central Vermont.

Original reference: C. H. Richardson, 1924, Vermont State Geologist Rept. 1923–1924, p. 91–92.

P. H. Osberg, 1952, Vermont Geol. Bull. 5, p. 116. Lower and Middle Ordovician.

Well exposed in Barnard Township, Windsor County.

Barnegat Limestone[1]

Lower Cambrian to Middle Ordovician: Southeastern New York.

Original reference: W. W. Mather, 1838, New York Geol. Survey 2d Rept., p. 168–169.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329, 343. Rejected because of lack of usage.

Extends from Barnegat up Wappingers' Creek, by Pleasant Valley and Pine Plains into Columbia County, and on south it passes from Milton to Newburg; on the west down the great valley through New Jersey into Pennsylvania.

Barnes Conglomerate Member (of Dripping Spring Quartzite)

Barnes Conglomerate (in Apache Group)[1]

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Composed of smooth, ellipsoidal pebbles in matrix of coarse arkosic sand firmly cemented by silica in Globe quadrangle. Thickness 6 inches to 50 feet; commonly 10 to 20 feet. Overlies Pioneer formation; underlies Dripping Spring quartzite.

U.S. Geological Survey currently classifies the Barnes Conglomerate as a member of Dripping Springs Quartzite on the basis of a study now in progress.

Forms conspicuous strata girdle about Barnes Peak, Globe district.

Barneston Limestone (in Chase Group)

Barneston Formation (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, ser. 2, p. 41.

R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12 (fig. 4), 69 (fig. 45). Includes Oketo shale member (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44–45. Includes (ascending) Florence limestone, Oketo shale, and Fort Riley limestone members. Thickness 80 to 90 feet. Underlies Holmesville shale member of Doyle shale; overlies Blue Springs shale member of Matfield shale. Wolfcamp series.

Type locality: In bluffs west and southwest of Barneston, Gage County, Nebr.

Barnett Shale[1] or Formation

Mississippian: Central Texas.

Original references: F. B. Plummer and R. C. Moore, 1921 [1922], Texas Univ. Bull. 2132, p. 24–31; R. C. Moore and F. B. Plummer, 1922, Jour. Geology, v. 30, no. 1, p. 25 (chart), 26–28.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 52–59. Sellards (1932 [1933], Texas Univ. Bull. 3232) designated unit Barnett formation, and present report [Ellenburger group of central Texas] follows this emendation. Although Barnett strata are largely shale in east and north and contain fauna similar to that of Moorefield formation and Ruddell shale of Arkansas, strata of Barnett age in southwestern part of Llano region grade laterally into detrital limestone containing fossils of strong Keokuk affinities and lesser affinities with younger strata. Only section described by Plummer and Moore (1921) was presumably above type section of Chappel limestone and about 2.2 airline miles southwest along Simpson Creek fault zone from type locality. This is locality 205–T–24 from which Plummer and Scott (1937, Texas Univ. Bull. 3707) collected goniatities, and it shows best section of the Barnett in vicinity of type locality. Formation ranges in thickness and character from 40 to 50 feet of mostly shale in vicinity of type locality to featheredge on one hand, and on the other hand to thickness of about 140 feet of mostly crinoidal limesands in Bear Spring area in Mason County. Formation was considered to be probably Pennsylvanian at time of its description but is now commonly accepted as Mississippian. Lower limit of age is fixed as Keokuk but upper limit might be as high as Ste. Genevieve. Present authors consider it unlikely that any part of Barnett is as young as Chester as it is their opinion that it is actually entirely pre-St. Louis if not pre-Spergen.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 32–46. Formation occurs as narrow band of outcrop between Marble Falls and Ellenburger along almost entire area of Ellenburger outcrop. It is thin and entirely absent in places around Brady and absent along most of Ellenburger border south of Colorado River in Marble Falls, Spicewood, and northeast Kimble County districts. Thickness 5 to 90 feet. In some areas, underlies Sloan formation of Marble Falls group; overlies Chappel limestone which is herein subdivided into [ascending] Kings Creek marl, Ives conglomerate, Espey Creek limestone, and Whites Crossing coquina members.

W. H. Hass, 1953, U.S. Geol. Survey Prof. Paper 243–F, p. 69–94. Formation, in Llano region, contains two conodont faunal zones. Upper zone is restricted to that part of formation which in this report is regarded as being definitely of Meramec age and possibly also partly of Chester age; lower zone is regarded as being Osage (Keokuk) age. For most part, base of Barnett is easily recognized, though it is now known that, at many localities, a thin sequence of Mississippian and Devonian beds is present between the Barnett and Ellenburger groups. Opinions differ as to where base of Barnett should be drawn in southwest quadrant of region, as beds occur there which some stratigraphers place in Chappel lime-

stone but which others place in Barnett formation (Cloud and Barnes, 1948; Plummer, 1950).

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 808, 810, pl. 2. Plummer's (1950) Whites Crossing coquina member of Chappel formation is an echinodermal limestone facies in lower part of Barnett formation. In some areas, Chappel limestone is missing, and the Barnett overlies Houy formation (new).

Named from Barnett Springs, about 5 miles east of San Saba, near which is typical exposure of the shale.

Barnett Hill Formation

Bendian (Morrow Series): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 858, 859, 902–912. Proposed for uppermost formation of series in area; unit formerly considered unnamed upper member of Wapanucka here restricted to exclude the Barnett Hill. Consists of calcareous, fossiliferous sandstones and shales; siliceous shale near base; changes laterally within short distances; typically an overlapping deposit. Thickness varies; at first type section 415 feet; at second type section 760 feet. Underlies Atoka formation; north of Arbuckles and in frontal Ouachitas overlies Wapanucka (restricted); in southern Ouachitas overlies Round Prairie formation (new). Morrow series is here included above Pushmataha series in upper part of the Bendian period.

R. B. Laudon, 1958, Oklahoma Geol. Survey Circ. 46, p. 20. Harlton suggested separation of Barnett Hill formation containing an unquestionable Morrow fauna from the Atoka. Barnett Hill has been included in the Wapanucka but lithologically is almost inseparable from the overlying Atoka, and for this reason its status as a separate formation is open to criticism. Subsequent workers have not separated the Barnett Hill from the Atoka.

Type locality: Barnett Hill, 1 mile north of Clarita, sec. 2, T. 1 S., R. 8 E., Coal County. Second type locality: Goose Creek in secs. 19 and 20, T. 1 N., R. 8 E.

Barnhart Formation

Ordovician: Eastern Missouri.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1 p. 116. Name proposed for the "Decorah" of Missouri which overlies Plattin group and underlies Kimmswick formation. Consists of about 20 feet of greenish shale with interbedded thin limestones, all abundantly fossiliferous.

Type section: At Koch Valley School on U.S. Highway 61–67, 2 miles south of Barnhart, Kimmswick (15′) quadrangle, Jefferson County.

Barnsdall Formation (in Ochelata Group)

Pennsylvanian (Missouri Series): North-central Oklahoma.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119, 120, 121. Consists of sandstone and limestone. At Kansas-Oklahoma line, consists of Birch Creek limestone at base and two unnamed shale members that are separated by inconspicuous unnamed sandy limestone less than 2 feet thick. Southward this unnamed sandy limestone grades into sandstone continuous with Okesa sandstone member. Farther south, the Okesa is much thicker at the expense of the two shale members, and includes, as its basal bed, limy sandstone that is equivalent to Birch Creek limestone.

Upper shale member contains Wildhorse dolomite bed only a few feet below the top of formation. Unconformably overlies Wann formation; conformably underlies Tallant formation (new). Thickness about 100 feet.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 38–41, pls. Extends from Kansas-Oklahoma line southward through western Washington County, eastern Osage County, western Tulsa County, and western Okfuskee County to Canadian River. Thicknesses: 100 feet at Kansas-Oklahoma line, T. 29 N., R. 12 E.; 110 feet in T. 23 N.; 45 feet in T. 22 N.; 190 feet in T. 19 N., R. 9 E., western Tulsa County. Irregular in thickness in Creek County, ranging upward from about 140 feet in T. 18 N. to 200 feet in north part of T. 17 N., and thence downward to about 100 feet in south part of T. 14 N. Includes Okesa sandstone member. Rests unconformably upon Wann formation across Creek County, truncates Iola formation in southern Creek County, and rests unconformably upon Chanute formation. In Creek County, conformable with Tallant formation above but is overlain unconformably by lower Virgil rocks across most of Okfuskee County to south.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 18–20. Wildhorse dolomite member, which occurs near top of formation in Osage County, is not found south of Arkansas River.

Type locality: Area between Barnsdall and Wolco, T. 24 N., R. 11 E., Osage County. Name is from town of Barnsdall, formerly Bigheart. This is same town from which Bigheart sandstone was named (White and others, 1922). Type locality of Bigheart is in hills west of the town, and name of town has been changed to Barnsdall. Town now called Bigheart is in sec. 3, T. 27 N., R. 10 E., Osage County, and is on the outcrop of neither Barnsdall formation or Bigheart sandstone.

†Barnstable Series[1]

Pleistocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 503–593.

Named for occurrence at Barnstable, Barnstable County.

Barnwell Sand[1] or Formation[1] (in Jackson Group)

Eocene, upper: Southwestern South Carolina and eastern Georgia.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 17

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 61–67. In this report, Cooke and Shearer's (1918, U.S. Geol. Survey Prof. Paper 120) usage is adopted, except that part of the so-called Congaree clay is restored to the McBean formation. Further subdivided in Georgia to include Sandersville limestone member in upper part. Thickness estimated as less than 200 feet in eastern Georgia and a little more than 200 feet in Twiggs County, where Twiggs member accounts for nearly half the thickness. Unconformably overlies McBean formation and overlaps beyond it across Tuscaloosa formation to crystalline rocks of Piedmont; toward southwest end of outcrop area, merges laterally into Ocala limestone; at most places, the Flint River formation or Hawthorn formation overlaps beyond seaward edge of Barnwell and lies unconformably on it.

P. E. LaMoreaux, 1946, Georgia Geol. Survey Bull. 50, pt. 1, p. 3 (fig. 1), 9–22. In east-central Georgia divided into three members: basal Twiggs clay member, Irwinton sand member (new), and unnamed thin upper member of coarse red sand with flat rounded beach pebbles. East of Ogeechee River, formation is undifferentiated. This study indicates that no part of the so-called Congaree clay or Twiggs clay is of Claiborne age, and that base of Barnwell in this area is base of Twiggs clay member which rests unconformably on the Tuscaloosa except where channel sands are present.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20, 26–27. Discussed in South Carolina where it is undifferentiated and is only true representative of the Jackson among outcropping formations. Large part of deposits formerly mapped as Barnwell have proved to be Congaree. Name Barnwell formation was applied to leached residues of sandy limestone, and no type locality was ever designated. It now appears that actually the railroad cut at Barnwell was made in a part of Miocene Hawthorn formation, although many geologists must have regarded it as typical Barnwell. Residues of limestone of Jackson age certainly are present elsewhere in Barnwell County beneath Hawthorn cover, and there is no reason why name Barnwell cannot be applied to unleached Jackson beds farther downdip even though type area falls entirely within area of solution.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321–322, 327–329, 343 (fig. 15). Basal part of Barnwell, extending from central Georgia to Savannah River, is termed Twiggs clay member. Conformably above the Twiggs is Irwinton sand member, which is overlain by much localized unit, the Sandersville member. In a few areas near overlap of Barnwell on Precambrian crystalline rocks, the Upper Sand member (LaMoreaux, 1946) is designated as part of the Barnwell. In present investigation, stratigraphically higher beds of argillaceous red sand making up typical uppermost Barnwell were found to crop out above the Irwinton and Upper Sand members in Glascock and Jefferson Counties. As much as 7 to 15 feet of massive brilliant- to dark-red fine-grained argillaceous unconsolidated quartz sand occurs in these two counties. To southwest, in Crawford County, 40 feet of these uppermost Barnwell sands occur at Rich Hill, and south of town of Roberta. At this locality, these sands lie with conformity on Twiggs clay, the Irwinton and Upper Sand members being absent. North of Fort Valley, Peach County, summits of highest hills are capped by dark-red argillaceous quartz sand unlike the Irwinton and Upper Sand members. The uppermost sands are herein designated Roberta sand member.

Type area: Barnwell County, S.C.

Barrack Mountain Granite Gneiss[1]

Precambrian(?): Northwestern Connecticut.

Original reference: W. M. Agar, 1929, Am. Jour. Sci., 5th, v. 17, p. 204, 211.

Rock forms Barrack Mountain, 1 mile south of Falls Village, Litchfield County.

Barranquitas Shaly Limestones[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 29.

J. D. Weaver, *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 316–317, Upper Cretaceous.

Crop out in northwest-southwest belt of unknown extent, in vicinity of Barranquitas in central Puerto Rico and form crest of island in that area.

Barranquitas-Cayey Series

Lower Cretaceous: Puerto Rico.

E. T. Hodge, 1920, New York Acad. Sci., Scientific Survey of Porto Rico and the Virgin Islands, v. 1, pt. 2, p. 132–137. Chiefly shales and shaly limestones with numerous limestone lenses and an occasional bed of tuff and conglomerates. Thickness 2,000 to 3,000 feet. Lower part grades into Rio de la Plata series; upper part forms sharp contact with Sierra de Cayey series.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 37, 38, 39. Lower Cretaceous.

Named from two villages situated on rocks in northeast corner and in eastern margin of Coamo-Guayama district.

Barre Granite[1]

Devonian: East-central Vermont.

Original reference: C. H. Richardson, 1902, Vermont State Geologist 3d Rept., p. 61–98.

V. R. Murthy, 1957, Vermont Geol. Survey Bull. 10, p. 70–73. Barre granite is an elongated, oval-shaped body that crops out in northwestern and west-central parts of East Barre quadrangle. Outcrop is confined to Westmore formation except at eastern margin, near East Barre village, where it extends a short distance in Waits River formation.

Occurs mostly in Barre Township, Washington County, with small area in Williamstown Township, Orange County.

Barre Group

Silurian: Eastern Vermont.

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 276, 278–282, 286 (fig. 4). Proposed that section regarded as Waits River formation by Currier and Jahns (1941) be elevated to status of group—to be called Barre group. Includes (ascending) Barton River, Westmore, and Waits River (redefined) formations. In its stratigraphic limits, group is identical with old Waits River formation. Overlies Northfield slate.

Type locality and derivation of name not given. Report includes Barre-East Barre area.

Barree Limestone[1]

Silurian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 132–133.

Outcrop belt crosses Little Juniata River at Barree forge, and it is quarried for flux at Barree furnace, Huntingdon County.

Barree Shales[1]

Silurian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 133.

Exposed along river bank below Barree furnace, Huntingdon County.

Barrelian series[1]

Cambrian: California.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 56, p. 76.

Barrel Spring Formation[1]

Barrel Spring Formation (in Eureka Group)

Middle Ordovician: East-central California.

Original reference: F. B. Phleger, 1933, Southern California Acad. Sci. Bull., v. 32, pt. 1, p. 1–6.

R. L. Langenheim, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2086 (fig. 2), 2087 (fig. 3), 2091–2092. Described in Mazourka Canyon area, Independence quadrangle. Thickness about 100 feet at Mexican Gulch to 150 feet at Lead Canyon Trail. Consists of sandstone, shale, and limestone. Divided into four unnamed members. Overlies Mazourka formation; underlies unnamed unit referred to as undifferentiated upper part of Eureka group.

H. R. Pestana, 1960, Jour. Paleontology, v. 34, no. 5, p. 109–112. Underlies Johnson Spring formation (new), which is name proposed for undifferentiated upper part of Eureka group of Langenheim and others (1956).

Well exposed in Barrel Spring Canyon and in each of next four canyons to the north, Inyo Range.

Barrett Shale[1]

Lower Cretaceous: Northeastern Wyoming and western South Dakota.

Original reference: W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 593, fig. 122, map.

Mapped at and around Barrett, Crook County, Wyo.

Barrigada Limestone

Miocene, upper, and Pliocene: Mariana Islands (Guam).

H. T. Stearns, 1940 (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1948. Includes quantities of reef talus; now forms northern plateaus of island.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 59, table 4 [English translation in library of U.S. Geol. Survey, p. 69]. Older than Merizo limestone.

U.S. Geological Survey currently designates age of Barrigada Limestone as upper Miocene and Pliocene on basis of study now in progress.

Forms northern plateau of island.

Barrington Clays[1]

Pleistocene (Wisconsin Stage): Rhode Island.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 987–988, chart opposite 988, pl. 62.

Present in town of Barrington, Bristol County.

Barron Quartzite[1]

Precambrian (Keweenawan): Northwestern Wisconsin.

Original reference: N. H. Winchell, 1895, Am. Geologist, v. 16, p. 150–162.

E. F. Bean, 1959, Geologic map of Wisconsin (1:1,000,000): Wisconsin Geol. Nat. History Survey. Varies from soft sandstone to hard vitreous

quartzite. Maximum known thickness 600 feet. Average thickness probably not more than 200 feet. Exact correlation not known; probably Upper Keweenawan.

Present in eastern part of Barron County.

Barrow Trail Member (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska.

C. L. Whittington, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 246, 249, 250–251, fig. 5. More than one-half the member at type locality is fine- to very fine-grained light-gray to olive-gray thick-bedded sandstone, in part bentonitic to tuffaceous. Interbedded with sandstone are clay shale, siltstone, bentonite, and tuff. Marine fossils found at five horizons from 40 feet to 525 feet above base. A minor nonmarine tongue of Prince Creek formation represented in this type section by a 2-foot coal bed about 170 feet above base. Thickness 575 feet in vicinity of Umiat, at least 700 feet and possibly as much as 900 feet at Schrader Bluff. Underlies Sentinel Hill member; overlies Rogers Creek member (new.) Rogers Creek and Barrow Trail members defined to include rocks overlying Tuluvak tongue of Prince Creek formation that were formerly included in Tuluga member.

Type locality: Bluffs along north side of Colville River, 3 to 5 miles northeast of Umiat Mountain. Named from Barrow Trail, and old tractor trail which, in the area from 13 to 28 miles west of Umiat Mountain, follows cuesta formed by sandstones of this member.

Barryville Member[1] (of Shohola Formation)

Barryville parvafacies (in Shohola facies group)

Upper Devonian: Southeastern New York and northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4 p. 571, 586–587.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7). Shown as a parvafacies.

Well displayed on New York side of Delaware River in vicinity of Barryville, Sullivan County, N.Y.

Barstovian Age

Miocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term based on Barstow formation, San Bernardino County, Calif., and specifically on fossiliferous tuff member in Barstow syncline and its fauna. Covers interval between Hemingfordian (Miocene) and Clarendonian (Pliocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Barstow Formation[1]

Miocene, middle and upper: Southern California.

Original reference: O. H. Hershey, 1902, Am. Geologist, v. 29, p. 369–370.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 26–35, pls. 1, 2. Described in Alvord Mountain quadrangle, where it consists of three members: lower that consists of 500 to 600 feet of interbedded sandstone and pebble conglomerate overlain by 200 to 300 feet of tuff,

tuffaceous sandstone, siltstone, and volcanic pebble conglomerate; tuffaceous middle member about 25 feet thick that comprises two or three, rarely more, friable white granular tuff beds and intervening clastic beds; upper member, as much as 500 feet thick, of sandstone, siltstone, and conglomerate. Maximum thickness about 1,500 feet. Conformably overlies Spanish Canyon formation (new) and rests unconformably on older formations. Upper contact conformable and gradational with overlying granitic fanglomerate in downfaulted block of fanglomerate at NW cor. sec. 30, T. 12 N., R. 4 E. Main contact around north side of Alvord Mountain is slight angular unconformity, in which upper part of Barstow and lower part of granitic fanglomerate are missing. Middle and late Miocene on basis of vertebrate fossils.

Type section: Near Barstow, San Bernardino County.

Bartholomew Siltstone Member (of Orangeville Shale)

Mississippian: Northwestern Pennsylvania.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1347, 1351, 1364; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 18 (fig. 9), 42–43. Name proposed for gray or brownish-gray siltstone at or near base of Orangeville shale. Characterized by many short curved or curly markings which generally have a random distribution; in unweathered state, markings are darker than rest of siltstone. Thickness less than 1 foot. Occurs 8 feet above base of Orangeville at type locality; overlies Shellhammer Hollow formation (new) in some other areas. Lower Mississippian.

Type locality: Bartholomew Quarry section 1 mile northwest of Littles Corner on a small run, Hayfield Township, Crawford County. Also occurs in Erie and Venango Counties.

Bartlett Barren Member (of Crevasse Canyon Formation)

Bartlett Barren Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1925, U.S. Geol. Survey Bull. 767.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2153 (fig. 3), 2156, 2157. In revised nomenclature of Mesaverde group, San Juan basin, New Mexico, Bartlett barren member is reallocated to Crevasse Canyon formation. Overlies Dalton sandstone member; underlies Gibson coal member.

Named for exposures near old Bartlett mine shaft, McKinley County.

Bartlett Island Schist

Bartlett Island Series[1]

Precambrian or Cambrian: Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1038–1041, 1060.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Age no greater than Cambrian. Older than Frenchmans Bay series.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172, 176. Referred to as Bartlett's Island schist. Was incorrectly renamed Ellsworth schist.

Named for development on Bartlett Island located off west coast of Mount Desert Island, Hancock County.

Bartolo conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 658. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of Puente Hills, Los Angeles County.

Crops out in a nameless canyon in northern section of the hills, due east of Bartolo Station on Union Pacific Railroad.

Barton Clay (in Conemaugh Formation)[1]

Barton clay shale member

Pennsylvanian (Conemaugh Series): Central eastern Ohio.

Original reference: R. E. Lamborn, 1930, Ohio Geol. Survey Bull. 35, p. 137–138.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 68, 70. Barton clay shale included in Barton cyclothem although not present in area of report, Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 46–47, fig. 7. In Morgan County, Barton clay shale member (of Conemaugh series) includes the 6 to 11 feet of section between Ewing limestone member below and Barton coal member above.

First described in Jefferson County. Named for association with Barton coal.

Barton cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 16. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 68–71, table 1, geol. map. Includes (ascending) Cow Run shale and (or) sandstone, 30 feet; Ewing limestone, 3 to 8 feet; and Barton clay shale and Barton coal (absent in Perry County). Occurs below Harlem cyclothem and above Anderson cyclothem. In area of this report, Conemaugh series is described on a cyclothemic basis; seven cyclothems are named. [For sequence see Mahoning cyclothem.]

Exposed in Perry County.

Barton Gneiss[1]

Precambrian: Northeastern New York.

Original reference: J. F. Kemp, 1898, Am. Inst. Mining Engineers Trans., v. 27, p. 178, map and cross sections.

Occurs near Port Henry, Essex County.

Barton Group (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1877, Pennsylvania 2d Geol. Survey Rept. K_2, p. 67.

Barton Limestone (in Conemaugh Formation[1] or Group)

Pennsylvanian: Western Maryland and southwestern Pennsylvania.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 96–97. In Fayette County, Barton limestone occurs 8 feet below Barton coal, which is separated from overlying Morgantown sandstone by 12 feet of black shale. Limestone is 3 feet thick, dark gray, knobby, and impure. Directly overlies Birmingham red shale.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips, Pittsburgh Mtg., p. 69 (fig. 4). Barton limestone shown on generalized columnar section for Pennsylvanian of western Pennsylvania. Above upper Grafton sandstone and below Barton (Elk Lick) coal. Conemaugh series.

First described in Allegany and Garrett Counties, Md.

Barton Red Shale (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 65.

In Potomac basin.

Barton Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

Allegany and Garrett Counties.

Barton Canyon Member (of Windfall Formation)

Cambrian: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 161. Name applied to marker bed near base of formation. Consists of 25 to 35 feet of homogeneous medium- to light-gray aphanitic or finely clastic limestone in beds 2 to 3 feet thick.

Named from exposures in Barton Canyon of Cherry Creek Range, Ely quadrangle.

†Barton Creek Limestone[1]

Lower Cretaceous (Comanche Series); Central Texas.

Original reference: R. T. Hill and R. A. F. Penrose, Jr., 1889, Am. Jour. Sci., 3d, v. 38, p. 470.

Exposed on Barton Creek near Austin above the ford, also in high bluffs of the Colorado at and opposite Johnson's quarry; also in west bluff of Mount Bonnel, Travis County.

Barton Creek Limestone (in Millsap Lake Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1929, Texas Bur. Econ. Geology, geol. map of Palo Pinto County.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] May 11–12, p. 70. Listed in summary of nomenclature of Morrow, Bend, and Strawn series, Fort Worth basin area. Millsap group, Strawn series. Lies lower in section than Santo limestone and above Buck Creek sandstone. Name not now in use.

Barton Creek, Palo Pinto County.

Barton River Formation (in Barre Group)

Barton River Member (of Waits River Formation).

Silurian or Devonian: Northeastern Vermont.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 15, 25–32. Lower part of formation consists of mostly slates and phyllites intercalated with limestones and calcareous schists. Calcareous rocks are more abundant toward top; phyllites most common at top. Thickness difficult to determine because of overturning, about 8,800 feet. Underlies Westmore formation (new); unconformably overlies Ayers Cliff formation. No recognizable fossils found; assigned to Silurian because of stratigraphic position.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 12, 16–19, pl. 1. Rank reduced to member of Waits River formation; age given as Lower(?) to Middle(?) Devonian. Base not exposed in area of this report [Lyndonville quadrangle].

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 277, 279. Formation included in Barre group (new). Waits River formation restricted in this report. Formation crops out in belt about 1½ miles wide in northwestern corner of East Barre quadrangle, where it is in contact with Northfield slate and has total outcrop width of about 6½ miles. Average dip of beds of unit is taken at 45°, and, assuming that repetition of beds due to minor isoclinal folds is compensated by tectonic thinning, approximate thickness of formation is about 21,700 feet. Doll (1951) considered Barton River formation equivalent to middle part of present Barre group, but in view of the fact that it lies immediately above Northfield slate in Barre area, present writer [Murthy] considers this equivalent to lower part of Barre group. Age controversial.

Type locality: In Newport City in low cut along main highway to Derby and on south flank of Shattuck Hill, Memphremagog quadrangle. Named from good exposures on higher slopes of Barton River valley. Continuous from southern border of Memphremagog quadrangle, northeastward into Canada.

Basco Formation

Ordovician: Northeastern Nevada.

D. W. Lovejoy, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 545–551, 559, pl. 1. Consists of four members: basal calcareous siltstone that includes a sandstone bed and lenses of altered peridotite; lower chert; shale; upper chert. Thickness about 1,750 feet. Calcareous siltstone contains Lower Ordovician graptolites and shale contains Middle Ordovician graptolites. Underlies Silurian siltstone.

Type locality: Valley slopes north and south of Basco Creek, Elko County. Crops out in thrust slice southwest of Lone Mountain. Belt of outcrop trends northwest and is about one-half mile wide and 2½ miles long.

Bascom Formation (in Stockbridge Group)

Bascom Formation (in Beekmantown Group)

Ordovician: West-central Vermont and northwestern Massachusetts.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 539, 540, 542–545. In addition to limestone, formation contains dolomite, sandstone, quartzite, limestone breccia, and sandy calcareous shales. Variation in lithology very distinctive. Four zones recognized. Generalized section for Hinesburg synclinorium is (ascending) white marble or limestone with thin sandy or argillaceous stripes; buff dolomite and thin-bedded dolomitic quartzites; "curdled" limestone, some bedded dolomite; and thin-

bedded slaty quartzites and sandstones. Thickness approximately 375 feet. Underlies Bridport dolomite (new) conformably; overlies Cutting dolomite (new) conformably. Underlies Crown Point limestone east of meridian of Cornwall, west-central Vermont. Corresponds to Division D of the "Calciferous" (Brainerd and Seely, 1890, Am. Mus. Nat. History Bull., v. 3). Strata in west-central Vermont designated as lower Chazy (Brainerd, 1891, Geol. Soc. America Bull., v. 2, p. 299) actually appear to be uppermost Bascom beds of Beekmantown group (Beekmantownian).

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 27–28. In Castleton area, formation is included in Valley sequence. Overlies Columbian marble member of Boardman formation (new). Estimated thickness about 500 feet.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Included in Stockbridge group in Cheshire quadrangle, Massachusetts. Overlies Shelburne marble; underlies Berkshire schist, unconformity. Bascom may include beds that are equivalent in time to rocks of Chazyan age in Vermont.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Bascom underlies the Chipman herein reduced to formation rank to include Burchards, Weybridge, Beldens, and Bridport members. Age of Chipman designated Lower Ordovician, Beekmantown age. [See Chipman formation, this reference.]

Named for "Bascom's Ledge" in eastern Shoreham Township, Addison County, Vt.

Baseline Sandstone

Upper Cretaceous: Southeastern Nevada.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 929 (table 1), 932–933, pl. 5. Friable sandstone, gray, reddish, and variegated. Contains many lenticular beds of conglomerate, some very coarse, especially in upper part. Change in textural character, together with the average higher coloration in upper part of section, is basis for dividing formation into two members. Maximum thickness of lower member about 2,000 feet; of upper member about 1,500 feet. Upper member restricted to a belt west of the Baseline fault; this member with part of lower member as well, eroded from eastern (upthrown) fault block. Overall thickness more than 3,000 feet. Underlies Overton fanglomerate with angular unconformity; overlies Willow Tank formation (new). Previously a part of Overton fanglomerate.

Exposed along Baseline Wash in Muddy Mountains, Clark County.

Basey Formation

Middle Jurassic: Northeastern Oregon.

W. R. Richardson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Weberg, Warm Springs, and Basey (new) formations are lateral equivalents of Snowshoe formation.

Type locality and derivation of name not stated. Report discusses Izee area, Grant County.

Bashi Formation (in Wilcox Group)[1]

Bashi Marl Member (of Hatchetigbee Formation or Wilcox Formation)

Eocene, lower: Southern Alabama, Georgia, and southeastern Mississippi.

Original reference: A. Heilprin, 1882, Philadelphia Acad. Nat. Sci. Proc. 1881, p. 158–159.

V. M. Foster, 1940, Mississippi Geol. Survey Bull. 41, p. 53–61. Formation as described by Smith and Johnson (1887, U.S. Geol. Survey Bull. 43) is marked by 2 feet of lignitic and lignite clay at base overlain by 35 to 40 feet of yellowish crossbedded sand which grades upward into 25 feet or more of gray lignitic sandy clays and associated beds of lignite; top of formation is marked by 15 to 30 feet of glauconitic marl; passes up without apparent break into overlaying lignitic sands and clays of Hatchetigbee formation. Essentially same section, with exception of the basal lignite, is present in Mississippi, extending from southeastern corner of Lauderdale County to Meridian, near center of the County. In this area, typical Bashi marl is overlain by bed of sandy clay and silt which reaches thickness of 30 feet in some areas, and grades upward into lignitic sand and silt. This unit is here placed in Bashi formation although it has been considered to be basal Hatchetigbee by some earlier workers. Overlies Holly Springs formation.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 9. Formation is here considered to be restricted to fossiliferous marine greensand marl, 6 to 20 feet thick in central and western Alabama, and to equivalent sand, clay, and fossiliferous marl beds, 40 feet thick or more, in eastern Alabama. Overlies Tuscahoma formation which includes about 70 feet of strata formerly included in the Bashi; underlies Hatchetigbee formation. Formation extends across state.

F. S. MacNeil, 1944, Southeastern Geol. Soc. [Guidebook] 2d Field Trip, p. 27–28; 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 22. Proposed that Bashi marl be allocated to member status in Hatchetigbee formation. Thickness 2 to 25 feet; in some places splits into two or three distinct beds and there thickness is greater.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Mapped as marl member of Wilcox formation.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart. 29. Correlation chart of outcropping Tertiary formations of Eastern Gulf region shows Bashi marl member of Hatchetigbee extending into Georgia.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 182–188, pls. 1, 5. Basal member of Hatchetigbee formation. Thickness about 40 feet in Kemper County. Overlies Tuscahoma sand.

Named for exposures on Bashi Creek, Clarke County, Ala., especially at Wood's Bluff, Tombigbee River, just below mouth of Bashi Creek.

†Bashi Marl[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1887, U.S. Geol. Survey Bull. 43, p. 39, 43–46, 69.

Named for exposures on Bashi Creek, Clarke County.

Basic City Shale Member (of Tallahatta Formation)

†Basic Claystone (in Claiborne Group)[1]

Basic Claystone Member (of Tallahatta Formation)

Eocene, middle: Southeastern and north-central Mississippi.

Original reference: E. N. Lowe, 1919, Mississippi Geol. Survey Bull. 14, p. 74–75.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 15–24, fig. 1, pl. 2, profile C. Basic claystone member is stratigraphic and lithologic equivalent of type section of Tallahatta formation in Alabama. Term Basic is used here because it was found necessary to set up another member in Mississippi. Typical Tallahatta buhrstone section, herein called Basic claystone member, is well developed throughout eastern Mississippi, but, in central and western parts of its outcrop, the typical facies is largely replaced by sand section herein named Neshoba member. Thickness in eastern Mississippi 50 to 115 feet; 10 to 90 feet in central part of outcrop; 5 to 30 feet through southern and central Montgomery County. Overlies Meridian sand. At type locality, overlain by Winona greensand. In this report, base of Claiborne is placed at base of Basic member.

G. F. Brown and R. W. Adams, 1943, Mississippi Geol. Survey Bull. 55, p. 43–44, 55–56, pl. 1. Term Basic [pronounced like classic] was used by Lowe (1919) as member of Tallahatta formation for lightweight material, typically exposed in cuts on Gulf, Mobile, and Ohio Railroad in vicinity of Basic Station, Clarke County, which he described as claystone or diatomaceous earth. Other workers have indicated that indurated deposits at Basic are contemporary with Tallahatta shales and interfinger with them in northern Mississippi. As strike of member is followed northwest from Basic, beds become more fissile and laminated, although locally thin lenses retain structural characteristics of claystone or siltstone, by which terms they have long been designated. Although much of the member consists of sand in northern Mississippi, the identifying characteristic over larger areas is lightweight shale. It seems advisable to retain term "Basic" for this member and, to prevent confusion from mispronunciation, to designate it Basic City shale member. In area of this report [Grenada, Montgomery, and Yalobusha Counties], Basic City conformably overlies Meridian sand member of Tallahatta and underlies Winona sand member of Lisbon formation. Thickness irregular due to nature of lower contact; 78 feet on Gunby Hill, Montgomery County.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas. Inv. Prelim. Chart 29. Correlation chart shows Basic City shale member underlies Neshoba sand member and overlies Meridian sand member; interfingers with Holly Springs sand member; in some areas underlies Winona formation.

Type locality: Deep cut on railroad just north of Basic City, a railroad station in northwestern Clarke County.

Basin Rhyolite [in Basin Ridge Group]

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 100–101. Yellowish buff to gray and characteristically aphanitic except for a few widely scattered phenocrysts of biotite and feldspar. Maximum thickness measured 300 feet. Relationship with underlying rocks not definite, but near southern end of Basin Ridge, rhyolite thought to lie either directly on Pierre shale or very nearly so.

Caps central part of Basin Ridge and occupies center of Basin Ridge syncline. Known in outcrops extending from about middle of east line of

sec. 20, T. 9 S., R. 76 W., to northern boundary of sec. 27, T. 10 S., R. 76 W., South Park, Park County. Average width of outcrop is 2 miles.

Basin Shale[1]

Upper Cretaceous: Northern Wyoming.

Original reference: F. F. Hintze, 1915, Wyoming State Geol. Bull. 10, on Basin and Greybull oil and gas fields, Bighorn County, Wyo., p. 17, 24–29.

Basin and Greybull oil fields, Bighorn County.

Basin Creek Member (of Katalla Formation)

Oligocene: Southeastern Alaska.

D. J. Miller, D. L. Rossman, and C. A. Hickcox, 1945, Preliminary report on petroleum possibilities in the Katalla area, Alaska: U.S. Geol. Survey, p. 7 (table), 9–10; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Alternating beds of very fine grained massive gray sandstone and gray sandy shale. Beds range in thickness from 1 to 50 feet and average about 10 feet for sandstone and 25 feet for shale. Some sandstone beds are glauconitic. Shale contains many round calcareous concretions from 1 to 6 inches in diameter at least 40 percent of which contain fossil crabs. Thickness 550 to 1,000 feet; average about 700 feet. Underlies Burls Creek shale member; overlies Split Creek sandstone member. Name first used as member of Burls Creek formation in unpublished manuscript by oil-company geologists.

Named for Basin Creek, Katalla area, where member is well exposed.

Basin Ridge Group

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 95–101, pl. 1. Thick series of volcanic rocks, flow breccias, tuffs, and rhyolites. The various flows thin toward the south. Thick red and white tuff-breccia and variolitic andesite breccia are the most persistent lenses. Agglomerate, which thickens southward with thinning of flows, is well exposed toward southern end of Basin Ridge. Volcanics consist of lower variolitic andesite member and upper red and white member. Near Basin Ridge gap, lower member comprises augitic variolitic andesite breccia, augitic andesite variolite, variolitic tuff, and hornblendic andesite flow variolite —thickness, 1,000 to 1,150 feet; upper member consists of gray porphyry flow, red breccia, agglomerate, red and white tuff-breccia, and hornblende andesite—thickness, 640 to 715 feet. [Uppermost in group is Basin rhyolite (new).] Mapped on plate 1 as Denver Basin group.

Underlies northern two-thirds of Basin Ridge, extending from a point about 2 miles southwest of Como, into sec. 10, T. 11 S., R. 76 W., South Park, Park County. Two outliers, structurally and lithologically similar to Basin Ridge volcanics, form hills approximating in area 1 square mile each, in sec. 7, T. 9 S., R. 76 W.; sec. 12, T. 9 S., R. 77 W.; and secs. 29 and 32, T. 8 S., R. 76 W.

Bas Obispo Formation[1]

Oligocene(?): Panamá.

Original reference: D. F. MacDonald, 1913, Geol. Soc. America Bull., v. 24, p. 708.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 21–32, 51 (fig. 4), pl. 1. Bas Obispo formation and Las Cascadas agglomerate are

entirely volcanic. They are interpreted to represent pyroclastic rocks that accumulated at periphery of a volcanic pile. Bas Obispo is thought to grade into Bohio formation. Thickness unknown. Volcanic rocks now included in Bas Obispo formation and Las Cascadas agglomerate were named Obispo formation or Obispo breccia by Howe (1907). Emendation to Bas Obispo formation and splitting off of younger part as Las Cascadas agglomerate were proposed by MacDonald. Doubtfully referred to Oligocene because of inferred relations to Bohio formation.

Type region: Northern part of Gaillard Cut, where it is oldest formation exposed.

Bass Limestone (in Unkar Group)[1]

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (table), 110. In Grand Canyon series. Rapid alternation of layers of limestone and shale, bedding surfaces of which are often notably sun cracked. Thickness 300 feet. Overlies Newberry formation (new); underlies Hakatai shale.

R. P. Sharp, 1940, Geol. Soc. America Bull., v. 51, no. 8, p. 1242. In Hotauta Canyon, overlies Hotauta conglomerate.

J. H. Maxson, 1942, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1963, 1964. Thickness 250 feet in Bright Angel quadrangle. Underlies Hakatai shale; overlies fractured Archean basement.

Named for Bass Canyon, Grand Canyon region, where typically exposed

Bassendorf Shale[1]

See **Bastendorff Shale,** correct spelling.

Bassick Agglomerate[1]

Tertiary: Central southern Colorado.

Original reference: W. Cross, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 307.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, volcanics, in order of decreasing age, consist of Rosita fragmental andesite, Bunker massive andesite, Fairview diorite in dikes cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Composes Bassick Hill and greater part of Mount Tyndall, Custer County.

†Bassimenan Lake Granite[1]

Precambrian (Laurentian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4.

Well exposed on islands and along south shores of Bassimenan Lake.

Bass Islands Dolomite[1]

Bass Islands Group

Upper Silurian: Southeastern Michigan and northern Ohio, and western Ontario, Canada.

Original reference: A. C. Lane, C. S. Prosser, W. H. Sherzer, and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 554.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 38–40, chart facing p. 46. Rank raised to group in Ohio. Includes (ascending) Greenfield, Tymochtee, Put-in-Bay, and Raisin River formations. Thickness 400 to 700 feet; average about 570 feet. Unconformable above Niagara group and below Oriskany formation.

K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 26, 32, 33, 35 (table 1), 71, 110. In proposed classification for Mackinac Straits region, term Bass Island is used as group. Includes St. Ignace formation (new). Bass Island overlies Salina formation everywhere beneath surface in Southern Peninsula. In different parts of this area, variously overlain by Garden Island(?) formation, Bois Blanc, Sylvania, and Detroit River rocks. Silurian (Cayugan). Discussion of use of term Bass Islands vs. Bass Island. Original use of term was Bass Islands. [U.S. Geological Survey retains original spelling Bass Islands.]

Named for group of islands in western Lake Erie.

Bass Mountain Diabase[1]

Bass Mountain Basalt

Mississippian: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

N. E. A. Hinds, 1940, 6th Pacific Sci. Cong. Proc. for 1939, p. 283–284. Referred to as Bass Mountain basalt. Exposed in two principal areas. Along Middle Salt Creek, volcanics rest unconformably on Copley metaandesite and Kennett formation and are interbedded with and overlain by Bragdon strata. On Bass Mountain, it appears eruptions took place contemporaneously with deposition of Bragdon sediments.

Named for fact it forms southern slope of Bass Mountain, Redding quadrangle.

†Basswood Granite[1]

Precambrian (Laurentian): Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept.

Occupies all the Minnesota shores of Basswood Lake except southwest shore of Arm 1, Vermilion district.

Bastard Limestone[1]

[Lower Devonian]: New York and Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 97–98.

Bastendorff Shale[1]

Eocene and Oligocene: Southwestern Oregon.

Original reference (Bassendorf): H. G. Schenck, 1927, California Univ. Pub. Dept. Geol. Sci. Bull., v. 16, no. 12, p. 454, 457, 459.

J. E. Allen and E. M. Baldwin, 1944, Oregon Dept. Geology and Mineral Industries Bull. 27, p. 27–29, pl. 3. Bastendorf [Bastendorff] shale at beach section consists of 1,845 feet of shale and 60 feet of sandstone plus covered thickness of 1,000 feet which to south along creek appears to be shale, giving total of 2,905 feet. Overlies Coaledo formation of Arago

group; underlies Tunnel Point sandstone. Uppermost Eocene and possibly lower Oligocene in part.

Typical exposure at Bastendorff (Bassendorf) Beach, in sec. 3, T. 26 S., R. 14 W., Coos Bay district.

Bastimentos Shale

Miocene, middle: Panamá.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 52, 77. Massive, poorly bedded soft gray clay shale at base of Gatun formation. Interfingers with Minitimi limestone. Overlies Conch Point shale, which it resembles closely. On Columbus Island, surface structure is gently rounded dome on which early Miocene Conch Point shale crops out at crest, over an area about 1 mile in diameter, surrounded by middle Miocene Bastimentos shale. Seismograph survey indicated structure is cut by fault striking N. 24° E.

Occurs on Isla Colón (Columbus Island) and Isla Bastimentos (Provision Island).

Bastrop Park terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941, Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg., p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703–1704, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Bastrop Park is proposed for a terrace deposit of siliceous gravel with elevation of 525 feet at Bastrop State Park. Younger than Gay Hill (new); older than Uvalde from which it is differentiated by lack of calcareous material. Thickness as much as 20 feet.

Present at Bastrop State Park, about 1½ miles east of Bastrop, Fayette County. Part of the park and National Youth Administration camp are located on this deposit.

Batamote Andesite

Pliocene(?): Central southern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 48–49, pl. 1. Comprises three principal varieties of basaltic andesite flows: dense dark-gray rock that weathers reddish brown with small rare crystals of hornblende and feldspar; platy dark-gray brown-weathering, generally more or less vesicular, finely porphyritic rock; and the most widespread variety, medium-gray, generally massive though locally platy, aphanitic olivine andesite, which forms bulk of Black, Batamote, and Childs Mountains. Some flows may be true basalts. At Black Mountain, basaltic andesite consists of dark flow breccias and massive flows that range in thickness from about 20 to 60 feet and average about 30 feet. Full thickness 1,348 feet. Unconformably overlies Childs augite latite (new) in Batamote and Childs Mountains and the Cardigan gneiss and conglomerate elsewhere.

James Gilluly, 1946, U.S. Geol. Survey Prof. Paper 209, p. 9, 45–46, pls. 3, 21 [1947]. Scoriaceous red basalt and andesite breccia form what is probably the throat of a volcano (Batamote Peak) and cinder cones (Childs Mountain).

Named from Batamote Mountains, the bulk of which are made up of the andesite. Most widespread of the bedrock formations in Ajo quadrangle.

Bat Cave Limestone or Formation (in El Paso Group)

Lower Ordovician: Southwestern New Mexico.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2201 (table). On table only. Thickness from fraction of a foot to over 1,000 feet. Underlies Cable Canyon sandstone (new); overlies Sierrite limestone (new).

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 45–52, 53, fig. 4. At type section, formation composed of a lower light-colored slope-forming unit and an upper somewhat darker and banded cliff-forming unit. Lower unit contains many biostromes and bioherms distributed irregularly in thin- to medium-bedded limestone. Biostromes and bioherms predominantly stromatolitic and surrounded and interspersed with much detrital limestone. Stromatolitic rock is light to medium gray and weathers very light gray. Upper unit consists of medium- to thick-bedded alternating dark- and medium-gray limestone, dolomitic limestone, and some dolomite. Most beds are very fine grained. Chert occasionally present in beds or intervals as nodules and bands. Chert weathered light brown to dark brown. A few beds in upper unit are biostromal. Solution caverns commonly exposed in cliffs of upper unit, and large masses of collapse breccia present. Thickness ranges irregularly from 216 feet at Molinas Canyon to 305 feet at Mud Springs Mountains. Unconformably underlies Cable Canyon sandstone; conformably overlies Sierrite limestone. Type location and areal distribution indicated.

Type locality; North side of Cable Canyon, Caballo Mountains. Formation named from Bat Cave whose opening is prominent landscape mark on sheer cliff in upper part of unit, a few hundred yards northwest of type section.

Bates Limestone

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Metamorphosed limestone. Thickness of individual beds varies from a fraction of a foot to several feet. Cut by granitic, aplitic, and basic dikes. Older than Thorncrag limy gneiss of Tacoma series (both new); younger than Androscoggin gneiss and schist (new). Cambro-Ordovician(?).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. Middle Silurian.

L. W. Fisher, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 81. Included in Androscoggin series.

Type locality: City quarry located in low hill known locally as "West Rose Hill", in southern part of city of Lewiston, Androscoggin County.

Bates Hole Formation[1]

Eocene: Wyoming.

Original reference: F. B. Weeks, 1902, U.S. Geol. Survey Bull. 191.

In valley of Bates Creek, Natrona County.

†Batesville Ash Bed[1]

Upper Ordovician (Richmond) : Northeastern Arkansas.

Original reference: J. F. Williams, 1891, Arkansas Geol. Survey Ann. Rept 1890, v. 2, p. 373–375.

Named for Batesville, Independence County.

Batesville Sandstone[1]

Batesville Formation

Upper Mississippian: Northern Arkansas, southern Missouri, and northeastern Oklahoma.

Original reference: J. C. Branner and F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xiii, 26, 49–53.

R. A. Brant, 1941, *in* Tulsa Geol. Soc. [Guidebook] Field Trip, Oct. 18, strat. sections. In Tulsa-Choteau-Grand River area, underlies Grand River formation (new) and overlies Hindsville formation.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 266–267. Geographically extended into southern Missouri where it underlies Fayetteville formation; in some areas conformably overlies Hindsville limestone and in other areas unconformably overlies Keokuk limestone.

Named for Batesville, Independence County, Ark.

Bath Sandstone Submember (of Pony Spring Siltstone Member[1] of Maroon Formation)

Permian: Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, p. 973, 990, 995, 1000.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleontology Contr., v. 6, no. 4, p. 59–70. Mentioned in discussion of some Paleozoic plants from central Colorado and their stratigraphic significance. Bath submember has yielded *Walchia* sp. *Walchia* has been found in Pennsylvanian strata as well as Permian and is, therefore, not a strict time marker, but rather a reflection of environment.

Forms prominent ridge that separates Platte and Arkansas drainage for several miles northwest of summit of Trout Creek Pass, where there is the abandoned town of Bath, Park and Chaffee Counties.

Battell Member (of Monastery Formation)

Lower Cambrian: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 43, 44. Black graphitic quartz-muscovite schist with large porphyroblasts of albite. A few lenses of white to gray dolomitic marble occur at base. Beds of porphyroblastic albite-quartz-chlorite-muscovite schist are also associated with this unit. Thickness varies from a featheredge to a maximum of 80 feet. Underlies undivided part of Monastery formation (new); overlies Tyson member (new) of Monastery formation.

Named from exposures in Hancock Branch on southeast slope of Battell Mountain in Rochester area. No other good exposure.

Battery Formation[1]

Pleistocene: Northwesetrn California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1–2, p. 136, map.

William Back, 1957, U.S. Geol. Survey Water-Supply Paper 1254, p. 17 (table), 24–31, pl. 5, Battery formation, as used in this report [Smith River plain, Del Norte County], includes related continental deposits consisting of contemporaneous stream gravels and elongate sand ridges. These ridges may not be of aqueous origin, but they are composed of reworked marine sediments and therefore are related to Battery formation. Thickness as much as 66 feet; 28 feet at Pebble Beach. Where Pliocene sediments [St. George formation] remain, the Battery overlies them with slight unconformity; in rest of area, overlies Dothan rocks of Jurassic age with angular unconformity; underlies terrace deposits.

Named for exposures at Battery Point southwest of Crescent City, Del Norte County.

Battery Rock cyclothem (in Caseyville Formation)

Battery Rock cyclothem (in Caseyville Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Caseyville group includes (ascending) Lusk, Battery Rock, and Pounds cyclothems.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 5, 9, pl. 1. Includes (ascending) Battery Rock (Lick Creek) sandstone or conglomerate, Sellers limestone, Battery Rock coal, and Drury shale, Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 54 (table 3), pl. 1. In Caseyville formation (redefined) above Lusk cyclothem and below Pounds cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Sec. 26, T. 11 S., R. 2 E., Hardin County.

Battery Rock Sandstone Member (of Caseyville Formation)

Battery Rock Conglomerate

Battery Rock Formation (in Caseyville Group)

Lower Pennsylvanian: Southern Illinois and northern Kentucky.

D. D. Owen, 1856, Kentucky Geol. Survey Rept. 1854 and 1855, p. 49. Incidental mention as Battery Rock conglomerate.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36, 37–38. Formation has maximum thickness of more than 200 feet and consists of two nearly equal parts: Battery Rock sandstone below and Drury shale member above. The sandstone is medium to coarse grained, crossbedded, and massive; it ranges from less than 50 to more than 100 feet in thickness. Transition from sandstone to Drury shale member is locally abrupt, but elsewhere thin-bedded and shaly sandstone beds make determination of sharp boundary impossible; thin beds of massive sandstone also are locally present above Battery Rock member so that, where exposures are discontinuous, its upper limit is difficult to determine. Underlies Pounds formation (new); probably unconformable but actual contact rarely exposed. Unconformably overlies Lusk formation (new) except in parts of northwestern Union County where it overlaps Chester strata. Relations to Lick Creek sandstone at Cedar Bluff not entirely clear, and use of this name for widespread sandstone at base of Battery Rock is questionable.

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H. R. Wanless, 1944, Geol. Soc. America Mem. 13, p. 136. Lick Creek sandstone now considered to be Battery Rock.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 30, 44 (table 1), 61, pl. 1. Termed sandstone member of Caseyville formation (redefined). In southeastern Illinois, occurs above Lusk shale member and below Sellers limestone member; in southwestern Illinois, occurs above Wayside sandstone member and below Drury shale member. Thickness 98 feet in type section of Caseyville. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: Along Ohio River bluff, sec. 26, T. 11 S., R. 10 E., Shawneetown quadrangle, Hardin County, Ill.

Battie Quartzite[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 3.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in area of Rockland quadrangle, Knox County, is (ascending) Islesboro formation containing Coombs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, a siliceous limestone member above the quartzite, and Rockport limestone member at top.

Named for development on Mount Battie, a small mountain on mainland north of Camden, Knox County, in Rockland quadrangle.

Battiest Chert Member (of Tenmile Creek Formation)

Mississippian (Meramecian): Southeastern Oklahoma.

O. B. Shelburne, Jr., 1959, Dissert. Abs., v. 20, no. 3, p. 998; 1960, Oklahoma Geol. Survey Bull. 88, p. 16, 17 (fig. 2), 18–19, pl. 1. Proposed for chert member in middle part of formation. Battiest chert member was named Smithville chert lentil by Miser and Honess (1927); this name was little used and was abandoned by Oklahoma Geological Survey in 1957. Where best exposed, west of Battiest, member is 15 feet thick and consists of 3-inch beds of dark cherty siliceous shale interbedded with black siliceous shale; one 6-inch bed of black chert is cut by veins of milky quartz. Near Beachton (in type area of Honess' and Miser's Smithville chert) member consists of 15 feet of blue-black chert and siliceous shale which is poorly exposed in series of tight folds trending east-west.

Well exposed along half-section- and section-line roads near village of Battiest in secs. 7 and 8, T. 2 S., R. 23 E., McCurtain County. Area is Boktukola syncline.

Battle Formation or Conglomerate

Middle Pennsylvanian: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]. Reddish-brown to dark-red conglomerate, with interbedded sandstone, shale, and thin limestone beds. Lower beds conglomerates; middle beds interbedded conglomerate, sandstone, and shaly sandstone; upper beds interbedded pebble conglomerate, sandstone, shale, calcareous shale, and limestone. Shale and limy beds

metamorphosed to hornfels, and conglomerates and sandstones to quartzite near intrusive bodies; generally bleached white or light gray. Thickness at type locality 700 feet. Rests unconformably on three older formations of lower plate sequence. Lower Pennsylvanian.

H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle. Nevada: U.S. Geol. Survey Quad. Map [GQ–15]. Underlies Antler Peak limestone conformably in Battle Mountain.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2824 (fig. 5), 2825 (fig. 6), 2841–2842. Highway limestone in Osgood and Edna Mountains is facies of Battle formation.

Type section: In Cow Canyon, a tributary of Galena Canyon, southeast flank of Antler Peak, Antler Peak quadrangle.

Battle Ax Basalts

Pliocene and Pleistocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 706, 709 (fig. 2), 713 (fig. 3). Tentatively correlated with Minto lavas on basis of petrographic similarity and comparative amount of dissection of flows.

Source of basalts is near Battle Ax Mountain, northeast of Detroit, Marion County. Basalts form prominent cliffs for about 4 miles along north wall of Breitenbush River valley.

Battleground Schist[1]

Ordovician to Mississippian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith and D. B. Sterrett, 1931, U.S. Geol. Survey Atlas, Folio 222.

W. R. Griffitts and J. C. Olson, 1953, U.S. Geol. Survey Prof. Paper 248–D, p. 204, 206. Mentioned in discussion of mica deposits in Shelby-Hickory district, North Carolina.

W. C. Overstreet and Henry Bell, 3d, 1960, South Carolina Div. Geology Geol. Notes, v. 4, no. 4, p. 27–30, fig. 1. Battleground schist described in Kings Mountain belt, Laurens County, S.C. Precambrian(?) or Paleozoic (?).

U.S. Geological Survey currently designates the age of the Battleground Schist as Ordovician to Mississippian on basis of study now in progress.

Named for exposures on Kings Mountain Battleground, York County, S.C.

Battle Mountain Formation

Pennsylvanian (Des Moines): Northwestern Colorado.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleontology Contr., v. 6, no. 4 p. 60, 68. Mentioned in discussion of Paleozoic plants from central Colorado. Name credited to K. G. Brill (unpub. thesis) who considered formation to be Lower Pennsylvanian (Des Moines) on basis of invertebrates.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1376 (fig. 1), 1378 (fig. 2), 1379–1385. Proposed for sequence of lower Pennsylvanian rocks which lies unconformably on Mississippian and older rocks and which is disconformably overlain by State Bridge formation. Composed chiefly of grits and sandstones with thick beds of shale and conglomerate; occasional beds of limestone and dolomite which range from a few inches to 30 feet in thickness. About 4,300 feet thick in north part of area; more than 7,900 feet farther south; nearly

1,600 feet are porphyry sills of Cenozoic age. In early reports, sequence of sediments here assigned to Battle Mountain was divided into six formations on basis of lithology or color; these were (ascending) Weber formation, Robinson limestone, White Quail limestone, Maroon formation, Jacque Mountain limestone, and Wyoming formation. As here defined Battle Mountain includes (ascending) Belden shale (new), Robinson limestone, and Jacque Mountain limestone members. Report covers Gore area, Eagle and Summit Counties.

Type section: North side Turkey Creek; section begins on top of Hill 11610 (Minturn quadrangle) west of Dagett Pass (Shrine Pass Road) about 6 miles east of Red Cliff, Eagle County. Name derived from Battle Mountain 3½ miles northeast of Red Cliff.

Battle Spring Formation

Eocene, lower and middle: Southwestern Wyoming.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 101 (chart), 103. Very coarse grained to pebbly arkosic sandstone with small amounts of bright-green claystone that contains abundant large angular grains of clear quartz. Sandstone crossbedded. Inferred thickness about 3,300 feet but probably is greater. Unconformably overlies Fort Union formation; partly underlies and intertongues with Morrow Creek member of Green River formation. Intertongues to the south with Red Desert (new), Niland (new), and Cathedral Bluffs tongues of Wasatch formation; and with Luman (new) and Tipton tongues of Green River formation.

Typical exposures southwest of Battle Spring Flat and southeast of Lost Creek Butte, Sweetwater County. Underlies most of eastern part of Great Divide Basin. Base of formation exposed on north slope of Flattop Buttes and at a point about 10 miles west of Rawlins in NW pt. T. 21 N., R. 89 W.

Bauers Tuff Member (of Quichapa Formation)

Oligocene: Southwestern Utah and eastern Nevada.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90, 91–94. An ignimbrite that differs from younger Leach Canyon tuff member by (1) lower content of pyrogenic mineral grains, (2) absence of foreign rock fragments, and (3) higher induration. In about 95 percent of its outcrop, consists of three intergrading but sharply contrasted phases: basal vitrophyre, about 10 feet thick; middle lithoidal phase characterized by a conspicuous compaction foliation, 150 to 200 feet thick; and an upper nonfoliated lithoidal phase, 10 to 40 feet thick. At type locality, overlies Swett tuff member and underlies Harmony Hills tuff member (both new); elsewhere lava flows or other volcanic rocks of local origin and extent are present at contacts. Zircon age of Leach Canyon tuff member is 28 million years; this suggest that Quichapa formation is Oligocene. Discussion of ignimbrites of area.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 138 (fig. 3). Geographically extended into eastern Nevada.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 37. Described in Washington County where it is as much as 200 feet thick. Overlies Leach Canyon tuff member; underlies Little Creek breccia member (new).

Type locality: Bauers Knoll, Cedar City Northwest quadrangle, Iron Springs district, Utah.

Baum Limestone Member (of Paluxy Sand)

Baum Lentil or Limestone (in Trinity Formation)

Lower Cretaceous: Southern Oklahoma.

Ardmore Geological Society, 1938, Ardmore Geol. Soc. [Guidebook] Field trip to the Lower Pennsylvanian of the Berwyn and Baum areas, Apr. 23, p. 7 (stop 3). Name Baum lentil proposed for marly limestone in basal Trinity. Type locality stated.

C. W. Tomlinson, 1952, *in* Ardmore Geol. Soc. [Guidebook] Field Trip, p. 3, 4. Mentioned in road log as Baum limestone at base of Trinity.

J. R. Wayland, 1954, Am. Assoc. Petroleum Geologist Bull., v. 38, no. 11, p. 2400–2406. Formally proposed. Consists of four intergrading lithofacies: (1) basal red clay, which disappears eastward, (2) limestone conglomerate, which is best developed at northern margin of outcrop near Arbuckle Mountains, (3) massive fine-grained limestone, which is the thickest and most widely distributed of the units, and (4) arkosic limestone and calcareous arkose, present only in eastern outcrop area near Ravia. Because of irregular distribution, each of these units locally is at base of the Baum. Thickness ranges from 13 feet on Turkey Creek, where top and base are exposed, to maximum of 73 feet on Washita River where base is not exposed and top is eroded. In vicinity of type locality, the Baum rests on steeply dipping Pennsylvanian rocks; it disappears westward, apparently by interfingering with Paluxy sand; in easternmost outcrop rests on Precambrian granite and pre-Pennsylvanian highly folded rocks; in Ardmore basin, rests on steeply dipping Pennsylvanian shales and sandstones, northern extent is marked here by steep escarpment at top of Sycamore limestone (Mississippian).

Type locality: Hill in NE¼SE¼ sec. 36, T. 3 S., R. 3 E., 1.2 miles east of Baum, Carter County. Three of the lithofacies are exposed here.

Bautista Beds[1]

Pleistocene: Southern California.

Original reference: C. Frick, 1921, California Univ. Pub., Dept. Geol. Bull., v. 12, p. 283–288.

Occur in Bautista Badlands or Bautista Creek area, San Jacinto quadrangle.

Baxter Shale[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

J. D. Love, J. L. Weitz, and R. R. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in southwestern Wyoming. According to map legend, occurs above Frontier formation and below Blair formation.

R. J. Weimer, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 1, p. 8, 9. Discussion of Upper Cretaceous stratigraphy, Rocky Mountain area. Baxter (Mancos) shale consists of 3,000 to 4,000 feet of marine shale between Mesaverde group and Frontier formation.

Exposed in Baxter Basin. Named for exposures in vicinity of Baxter, Sweetwater County.

Baxter Hollow Granite

Age not stated: South-central Wisconsin.

R. M. Gates, 1942, Am. Mineralogist, v. 27, no. 10, p. 699–711. The "normal" granite is red to light pink and very fine grained and contains few dark minerals. Only some of the pegmatoid veins approach coarseness of a normal granite. Other rock types associated with the granite and which generally grade into one another are biotite hybrid, pegmatite hybrid, porphyroblastic hybrid, arkose, sheared rock, and cleavelandite dike rock. Intrusive into Baraboo quartzite.

Granite found only at Baxter Hollow of Baraboo district [Sauk County].

Bayard Formation[1]

Lower Pennsylvanian: Northeastern West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Exposed all around Bayard, Grant County, W. Va.

Bayard paleosol complex

Oligocene, upper, to Miocene: Northwestern Nebraska.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 46, fig. 10. Proposed for paleosol soil capping top of Whitney member of Brule formation and extending into Gering formation.

Occurs in Castle Rock section near Bayard, Morrill County.

Bay de Noc Limestone

Bay de Noc Member (of Stonington Beds)[1]

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Michigan Univ. Mus. Geol. Contr., v. 2, no. 8, p. 113–150.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Shown on correlation chart as Bay de Noc limestone underlying Ogontz limestone and overlying Bills Creek shale.

Well exposed along east shore of Little Bay de Noc, from 1½ miles north of Stratton's farm northward, and also south to Stonington post office, Delta County.

Bayfield Gravel[1]

Pliocene(?): Southwestern Colorado and northwestern New Mexico.

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

V. C. Kelley, 1949, New Mexico Univ. Pubs. in Geology 4, fig. 2. Geographically extended into San Juan County, N. Mex. Name appears only on chart.

Named for occurrence on several hills a few miles north of Bayfield, La Plata County, Colo.

Bayfield Group[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 25.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1480–1483. Group subdivided by Thwaites into (ascending) Orienta, Devils Island, and Chequamegon sandstones. Overlies Oronto group.

Jacobsville sandstone in Michigan believed to be eastern equivalent of Bayfield group.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 137–150. Discussion of Cambrian-Keweenawan boundary. Suggested that Bayfield sediments are continental deposits of Middle and quite possibly also of Early Cambrian age laid down in structural basins at or after close of the Algonkian. Term Chequamegon dropped; unit is Port Wing brownstone member (new) or Orienta formation repeated by faulting. In this report, term Bayfield embraces the following: Red Clastics, Fond du Lac, or Hinckley in Minnesota and in Michigan the Jacobsville sandstone.

Named for occurrences in Bayfield County.

Bayhorse Dolomite[1]

Cambrian(?): Southern central Idaho.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 11 (correlation chart), 12-14. Commonly massive thick-bedded dolomite, in part oolitic. Thickness about 1,000 feet. Overlies Garden Creek phyllite; underlies Ramshorn slate. Cambrian(?).

Named for town and creek in Custer County. Best exposed near town.

Bayloran series[1]

[Permian]: North-central Texas.

Original reference: C. R. Keyes, Pan-Am. Geologist, 1932, v. 57, p. 337, 350–355.

Named for Baylor County.

Bay Mud Formation

Quaternary, late: Western California.

P. D. Trask and J. W. Ralston, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1081, 1082. Silty clay containing grains of wind-blown sand; upper part includes thin layers of fine- to medium-grained sand alternating with silty clay. Thickness ranges from a few inches to as much as 150 feet. Overlies Merritt sand; youngest formation in area.

D. H. Radbruch, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–239. Overlies Temescal formation, Merritt sand, or Alameda formation.

Crops out on east side of San Francisco Bay near Francisco-Oakland Bay Bridge.

Bayne Formation } (in Puget Group)
Bayne Series[1] }

Eocene: Western Washington.

Original reference: G. W. Evans, 1912, Washington Geol. Survey Bull. 3, p. 42–49.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology 4, p. 55, 56, 60. Lowest formation of group in Green River area. Consists of alternating strata of massive sandstone, shaly sandstone, sandy shale, carbonaceous shale, and coal beds of varying degrees of purity. Thickness in Green River Canyon about 3,000 feet; base not exposed. Underlies Franklin formation; eastward from Green River Canyon, formation passes unconformably beneath Pleistocene lavas and tuffs. Formations

in Green River Canyon are involved in anticlinal and synclinal folds whose axes trend northeast.

Named for town of Bayne, King County.

Bayou Calamus Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 159–161. Term applied to fossiliferous marine lentil about 32 feet thick in Verda member; stratigraphically and lithologically similar to Saddle Bayou lentil described by Fisk (1938) in Grant Parish; may be equivalent of Saddle Bayou, but the two units are separated by many miles of territory in which no similar beds occur.

Typical exposure occurs in erosion gully 75 yards east of road in SW¼ NW¼ sec. 24, T. 12 N., R. 4 E., Caldwell Parish. Named for exposure in ravines at head of Bayou Calamus.

Bayou Chicot Limestone[1]

Upper Cretaceous(?): Southwestern Louisiana.

Original reference: G. D. Harris and A. C. Veatch, 1899, Louisiana Geol. Survey, pt. 5, Rept. for 1899, p. 61.

Outcrops about 8 miles southwest of Bayou Chicot post office, Evangeline County.

Bayou Lenann Member (of Pendleton Formation)

Eocene, lower: Northwestern Louisiana and northeastern Texas.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 184 (fig. 4), 186. Consists of glauconitic fossiliferous marine sand that grades upward into lignitic silt. Thickness approximately 90 feet. Underlies Slaughter Creek member (new); overlies beds of Marthaville age.

Typically exposed on Bayou Lenann, sec. 12, T. 6 N., R. 13 W., Sabine Parish, La. Traced from vicinity of Geneva, Tex., to Hagewood, Natchitoches Parish, La.

Bayou Manard Member (of Moorefield Formation)

Mississippian (Chesterian): Northeastern Oklahoma.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 51–54, pls. 1–5. At type locality, composed of black argillaceous limestones and interbedded black calcareous shales; limestones vary from lithographic to medium crystalline; strata are commonly jointed in proximity to major faulting, forming large rectangular blocks; lithology fairly constant eastward to vicinity of Stilwell where it intergrades with medium-crystalline limestone of overlying Lindsey Bridge member (new). Northward along Grand River in Mayes and Wagoner Counties, consists of lower sequence of blue-gray dense fine-grained to lithographic limestone with thin beds and nodules of black chert succeeded by upper thin to platy weathering limestone. Maximum thickness 65 feet. Lies unconformably upon Tahlequah member and, in different areas, upon other older Mississippian rocks, Keokuk chert, Reeds Spring formation, and Chattanooga black shale.

Type locality: Southeast of Muskogee and Fort Gibson in SE¼ sec. 19, T. 15 N., R. 20 E., southwest of bridge over Bayou Manard, Muskogee County. Named for exposures along Bayou Manard.

Bay Point Formation

Pleistocene: Southern California.

L. G. Hertlein and U. S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 63 (fig. 4), 71–72. A deposit of crossbedded sands and silt. Thickness generally 5 to 10 feet, but maximum thickness may be 20 feet or more. Overlies Sweitzer formation.

Named from its exposures along west shore of Bay Point in Mission Bay, San Diego County.

Bayport Limestone[1] (in Grand Rapids Group)

Mississippian: Michigan.

Original reference: A. C. Lane, 1899, U.S. Geol. Survey Water-Supply Paper 30, p. 81.

G. H. Pringle, 1937, Michigan Dept. of Conserv., Geol. Survey Div. Prog. Rept. 3, p. 14. At Point au Gres, 6 feet of Bayport limestone occur along lake shore on west side of point. This is limestone named Pointe aux Gres by Douglass.

G. M. Ehlers and W. E. Humphrey, 1944, Michigan Univ. Contr. Mus. Paleontology, v. 6, no. 6, p. 114–117. Description of fauna from Point au Gres limestone at Grand Rapids. History of nomenclature reviewed, and reference made to work of Lane (1893, 1895, 1899, 1900, 1909). Concluded that Point au Gres, instead of "Grand Rapids" or "Bayport," should be used for limestone under discussion. Usage is based on definition of Point au Gres by Douglass (1841 [1839]). Continued reference to limestone as "Bayport" would be unfortunate because this name and "Grand Rapids" were used only in casual manner by Lane.

Named for outcrops at Bayport, Huron County, where it is quarried.

Bays Formation

Bays Sandstone[1] or Limestone[1]

Middle Ordovician: Northeastern Tennessee and southwestern Virginia.

[Original reference]: Bailey Willis, 1893, U.S. Geol. Survey 13th Ann. Rept., pt. 2, pls. 60, 61.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1178. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Measured sections compared with revised classification of Tazewell County, Va., (Cooper and Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6). "Mosheim," "Ottosee," and "Bays" should be discontinued as definite formational names. Moccasin is equivalent to "Bays" formation in its type area along Bays Mountain. It is equal to Bays as mapped in Knoxville folio (Keith, 1895), but not equivalent to "Bays" of other folios in area, where it is mapped for younger Juniata formation. As Bays has been often misused and is not as widely used as the Moccasin, it would best be discontinued.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 68, 78, fig. 4. Includes much siltstone and shale and some limestone as well as sandstone; hence, here called Bays formation. Overlies Ottosee shale.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (chart), 164–165, 166 (table 3), pl. 28. Formation described in Tellico-Sevier belt, eastern Tennessee, where it is characterized by red calcareous mudrock and siltstone. Thickness 400 feet at northeastern end of exposures; about

1,000 feet at southwest. Overlies Bacon Bend member (new) of Sevier formation; underlies Chattanooga shale. Term Bays sandstone was first used by Willis (1893), who gave its thickness for several sections but did not describe the rocks. Term was subsequently used in Estilville (Campbell, 1894). Knoxville (Keith, 1895), Morristown (Keith, 1896), and Greenville (Keith, 1905) folios; the latter two contain the type locality of the formation. In latter two folios, the name was applied erroneously in Clinch Mountain belt to a unit of Upper Ordovician rocks now known as Juniata formation. Outcrops of Bays formation in present report are in same structural belt as type area of formation. Middle Ordovician.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. May GQ–76. Formation described in Shooks Gap quadrangle, Tennessee, where it is about 700 feet thick. Overlies Ottosee shale; underlies Martinsburg shale. Bays is correlative, at least in large part and possibly exactly, with Moccasin formation of northwestern part of Ridge and Valley province.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 45, 97. Overlies Wassum formation (new).

Named for exposures in Bays Mountains of Hawkins and Greene Counties, Tenn.

Bay State Dolomite Member (of Nevada Formation)

Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 45–46, pl. 2. Proposed for massive-bedded and dark-colored dolomites overlying Woodpecker limestone member (new) in vicinity of Eureka. Thickness 600 to 850 feet. Slight thickening to the north and west. Basal unit of member is a light-gray dolomite sand, that locally contains fragments of boulders of dolomite and siltstone, which forms a sharp contact with underlying Woodpecker limestone member. Contact with overlying Devils Gate limestone is gradational.

Type locality: Section above the mine in Mining Canyon. Well exposed in vicinity of Bay State mine on Newark Mountain.

Bayview Granodiorite[1]

Probably Jurassic or Cretaceous: Northern Idaho.

Original reference: J. L. Gillson, 1927, Jour. Geology, v. 35, no. 1.

Named for exposures around Bayview, Kootenai County.

Bay View Avenue lenses[1]

Upper Cretaceous: Southeastern New Jersey.

Original reference: J. K. Prather, 1905, Am. Geologist, v. 36, p. 171, 172.

Bay View Avenue Sand[1]

Upper Cretaceous: Southeastern New Jersey.

Original reference: J. K. Prather, 1905, Am. Geologist, v. 36, p. 171, 172, 175.

Extends from Bay View Avenue Station near Atlantic Highlands some 800 feet in direction of Hiltons.

†Bazoo Porphyry[1]

Eocene: Colorado.

Original reference not given.

Named from its occurrence in Bazoo claim, Leadville district.

Beach Mountain Paramphibolite[1]

Precambrian: New York.

Original reference: H. L. Alling, 1927, Geol. Soc. America Bull., v. 38, p. 798–799.

In eastern Adirondacks.

Beacon Flat Formation

Permian (Wolfcampian-Leonardian): Northeastern Nevada.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 10, p. 1695 (fig. 1), 1697–1699. Proposed for a three-member unit 2,800 feet thick. The 550-foot lower member of gray silty calcarenites and chert beds contains Wolfcampian-Leonardian boundary; alluvium covers undescribed middle member; cherty fossiliferous, gray calcarenites make up the 1,150-foot-thick upper member. Conformably overlies Buckskin Mountain formation (new); conformably underlies Carlin Canyon formation (new).

Type section: Lower member, on north side Humboldt River at Carlin Canyon, in SE¼SE¼NW¼ sec. 15, and NE¼NE¼SW¼ sec. 15, T. 33 N., R. 53 E.; upper member, SW¼SE¼ sec. 14 and NW¼ sec. 23, T. 33 N., R. 53 E., Elko County. Poorly exposed on a broad almost featureless plateau, Beacon Flat, north and east of low hills formed by Buckskin Mountain formation.

Beacon Hill Gravel[1]

Pliocene(?): New Jersey.

Original reference: R. D. Salisbury, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 47–57, 67–72.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 4 (fig. 2), 61–62. Continental; consists of quartz gravel with some chert and sandstone. Thickness 0 to 20 feet. Overlies Cohansey sand. Youngest Tertiary formation in New Jersey. Considered Pliocene, but difficult to differentiate from supposed Pleistocene material [Bridgeton, Pensauken, and Cape May].

Well developed and exposed on summit of Beacon Hill, 3 miles south of Matawan, Monmouth County.

Beacon Peak Dolomite Member (of Nevada Formation)

Lower Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 42, pl. 2. Composed of beds of dense, sometimes porcellaneous, light-olive-gray to slightly brownish creamy-gray dolomite that weather to a pale gray to white and has a faint blue tinge. Some is clastic in origin. Individual beds probably average a foot in thickness. A number of thin brown-weathering sandstone interbeds in upper half of member. Thickness 470 to 940 feet, the larger thickness being to the north. Unconformably overlies Lone Mountain dolomite and is rather sharply gradational with overlying Oxyoke Canyon sandstone member (new).

Type locality: Well exposed on lower west slope of Beacon Peak in Oxyoke Canyon, vicinity of Eureka.

Bead Lake Formation (in Newport Group)

Precambrian: Northeastern Washington and western Idaho.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 10–11, pl. 1. Fine-grained argillaceous and quartzitic sandstones with quantities of light-colored argillite and light-colored arenaceous argillite. Thickness about 12,500 feet. Injected by Marshall diorite (new).

Underlies No Name argillite (new), contact gradational; base of formation not exposed.

Crops out in Bead Lake district, Pend Oreille County, Wash.

Beadle Green Granite[1]

Age(?): Northeastern Vermont.

Original reference: C. H. Richardson and C. K. Cabeen, 1923, Vermont State Geologist Rept. 1921–1922.

Occurs on Crompton Hill in southwest corner of Randolph Township, Randolph quadrangle, Orange County.

Bead Mountain Limestone Member (of Belle Plains Formation)[1]

Bead Mountain Formation (in Belle Plains Group)

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 426.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Belle Plains herein redefined and given group status. Includes Beaverburk member. Overlies Valera shale and anhydrite; underlies Grape Creek formation of Clyde group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorodo River valley as uppermost member of Belle Plains formation. Overlies Valera shale member; underlies Grape Creek limestone member of Clyde formation; boundary somewhat arbitrarily defined.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 274, pls. 11, 12. Member forms prominent escarpment in Brazos River drainage area. Consists of alternating beds of limestone and shale; limestone beds range in thickness from 1 to about 15 feet, and shale beds range in thickness from less than 1 foot to 65 feet. Overlies Valera shale member; underlies unnamed shale member at base of Clyde formation.

Named for Bead Mountain, Coleman County.

Bealville Fanglomerate

Oligocene: Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 36-37, pls. 1, 2, 3. Defined as the unsorted boulder-gravel facies of both overlying Walker and Bena formations. At type section, formation consists of granitic fanglomerate that dips southward and attains a thickness of over 7,000 feet. West of type section, grades laterally into both Walker and Bena (new) formations.

Type section: Exposed along highway southward from Ilmon, Breckenridge Mountain quadrangle, Kern County.

Bean Canyon Formation[1]

Bean Canyon Series[1]

Paleozoic(?): Southern California.

Original reference: E. C. Simpson, 1934, California Jour. Mines and Geology, v. 30, no. 4, p. 371–401, map.

U.S. Geological Survey currently designates the age of the Bean Canyon Formation as Paleozoic(?) on basis of study now in progress.

Named for exposure in Bean Canyon in northwest corner of Elizabeth Lake quadrangle, Los Angeles and Kern Counties.

Bear Formation

Paleocene: Central Montana.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, p. 15 (chart), 17–20, pls. 1, 2. Name applied to unit, 500 to 600 feet thick, that occurs above Hell Creek formation and below the Fort Union (No. 1 or Lebo). Consists of alternating pale crossbedded sandstones and shales. Contains turtle bones but no dinosaurs or mammals. All beds are tilted, but no evidence of angular unconformity. Change from Hell Creek to Bear is more abrupt than from Bear to Fort Union No. 1, the latter being transitional through a thickness of 15 to 20 feet, boundary here being taken arbitrarily at a local shell lens. Discussion of Cretaceous-Tertiary transition.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, pl. 1. Shown on correlation chart below Lebo formation and above Hell Creek formation. Fort Union series, Puercan.

Typically developed around Bear Butte, Sweetgrass and Wheatland Counties.

Bear Branch Limestone Member (of Olive Hill Formation)[1]

Bear Branch facies (of Ross Limestone Member of Ross Formation)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 738.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 282 (fig. 3), 283, 297–299. In this report [Pre-Chattanooga stratigraphy of central Tennessee], Dunbar's (1919, Tennessee Div. Geology Bull. 21) classification of Lower Devonian is modified. Bear Branch limestone is interpreted as a restricted facies equivalent to upper part of Ross limestone member of Ross formation herein defined to include all beds overlying Decatur limestone and underlying Flat Gap or Harriman formations. Facies is unconformably overlain by Flat Gap limestone or by Hardin sandstone member of Chattanooga shale. Includes interbeds referred to as Decaturville chert zone. Thickness at Olivehill approximately 45 feet.

Named for exposure on Bear Branch, about 2 miles southeast of Olive Hill [Olivehill], Hardin County.

Bear Canyon Sandstone Member (of Kreyenhagen Formation)

Eocene, upper: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 211 (fig. 5), pl. 3. Proposed for persistent sandstone occurring about one-third of distance above base of Kreyenhagen on southwest side of Butts Ranch syncline. Thickness 100 to 300 feet. Overlies an unnamed unit, 300 to 1,000 feet thick, of foraminiferal clay-shales and platy shales, with some interbedded sandstone and limestone, and a thin glauconitic sandstone at base. Unit is faunally equivalent to Canoas siltstone member in Coalinga district. Underlies an unnamed upper member 500 to 1,500 feet thick consisting of siliceous and calcareous foraminiferal platy shales and some limestone.

Type locality: Bear Canyon, 1 mile north of Big Oak Flat, San Benito County.

Bear Creek Shale (in Clinton Formation)[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 53–54, 154, 155. Chadwick used term Bear Creek to designate dark pelecypod-bearing shales which were supposed to underlie the Furnaceville in town of Wolcott. However, no such shale exists beneath the Furnaceville, but there is a shale above the ore which contains the fauna. Bear Creek is herein redefined to apply to pelecypod-bearing shales and argillaceous limestones on Bear Creek, in eastern part of town of Wolcott. As redefined, is argillaceous facies of Reynales limestone. At type locality, is a dark-gray thin-bedded silty slightly calcareous shale with argillaceous limestone layers; both shales and limestones pyritic. Lower 7 feet are about half shale and half argillaceous limestone; next 6 feet are mostly shale. Top of formation is marked by an 8-inch limestone layer which in turn is overlain by 3 inches of hematitic limestone. Underlies lower Sodus shale.

Type locality: Town of Wolcott, Wayne County. Exposed on small tributary of Black Creek which is known locally as Bear Creek; tributary enters Black Creek a little north of where southwest road from Fair Haven crosses Black Creek.

Bear Gulch Limestone Member or Lentil (in Tyler Formation)

Bear Gulch Tongue (in Cameron Creek Member of Tyler Formation)

Mississippian: Central Montana.

G. H. Norton, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 58, 59 (fig. 5), 60 (fig. 6), 62. Limestone lentil or member in the Tyler formation. Overlain by Amsden sandstone.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1953, 1954. Bear Gulch referred to as tongue in Cameron Creek member.

Named for exposures in Bear Gulch, sec. 35, T. 14 N., R. 21 E., Fergus County.

Bear Island Granodiorite

Age uncertain: District of Columbia and eastern Maryland.

Ernst Cloos *in* Ernst Cloos and C. W. Cooke, 1953, Geologic map of Montgomery County and District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Light discordant granodiorite, mostly unfoliated and massive. Contains plagioclase, quartz, potash feldspar, muscovite, biotite, and, as accessories, topaz, rutile, zircon, and garnet. Composition variable. Alteration common.

Mapped in District of Columbia and northward to vicinity of Bethesda, Md. Named for occurrence near Bear Island on the Potomac.

Bear Mountain Basalt

Pliocene: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 260–261. Light-gray loose-textured uniform-grained rock in which clear yellow olivine grains are conspicuous in network of colorless plagioclase crystals. Covered by Warner basalt on northern and eastern sides.

Occurs on Bear Mountain in Modoc Lava-Bed quadrangle.

Bear Mountain Granite[1]

Precambrian(?): Central northern Colorado.

Original reference: H. B. Patton, 1909, Colorado Geol. Survey 1st Rept., p. 128, map.

Forms summit of Bear Mountain, Summit County.

Bear Mountain Granite

[Precambrian]: Central Texas.

R. E. McAdams, 1936, Am. Mineralogist, v. 21, p. 129, 133, 134, 135. Bear Mountain granite believed to be younger than Wolf Mountain (new) and Lone Grove granites.

Present near Fredericksburg, Llano County.

Bearpaw Shale (in Montana Group)[1]

Upper Cretaceous: Northern, eastern, and southern Montana and central Wyoming, and Alberta, Canada.

Original references: J. B. Hatcher and T. W. Stanton, 1903, Science, new ser., v. 18, p. 211–212; 1905, U.S. Geol. Survey Bull. 257.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 6–65, pl. 6. Described in Crazy Woman Creek area, Johnson County, Wyo., where it overlies Parkman sandstone and underlies Lance formation. Consists mainly of dark-greenish-gray shale with light-gray siltstone laminae. Upper Cretaceous.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 116 (fig. 7), 117–118. On northwest flank of Sweetgrass arch, northwestern Montana, present only in area north of Dupuyer Creek. Consists largely of dark-gray marine shale that contains ferruginous concretions, bentonite, and thin layers of sandstone. Thickness 225 to 400 feet. Overlies Two Medicine formation. Upper part of Bearpaw passes westward and southwestward into shallow-water sandy unit that is treated herein as a separate unit and designated as Bearpaw-Horsethief transition.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows that Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

W. P. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 59, pls. In Buffalo-Lake De Smet area, northeastern Wyoming, consists of thin sequence of marine shale that is conformable with both underlying Parkman sandstone and overlying Lance formation. Thickness about 200 feet.

Named for exposures around north, east, and south borders of Bearpaw Mountains, Mont.

Bear Pond Limestone Member (of Seboomook Formation)

Lower Devonian: West-central Maine.

A. J. Boucot, Charles Harper, and Keith Rhea, 1959, Maine Geol. Survey Spec. Geol. Studies Ser. 1, p. 7, 8, map. Blue gray on fresh surfaces and gray on weathered surfaces; contains subrounded to subangular granite pebbles up to 2 inches across; fragments of brachiopods, corals, and crinoid stems; angular black calcite crystals or fragments up to coarse sand size; brown and white mica flakes; some pyrite and other iron-sulfide crystals. Observed only at one outcrop where it is 10 feet

stratigraphically above a slate exposure; neither top nor bottom of unit exposed. Thickness about 10 feet.

Exposed in NW cor. T. 3, R. 5, in area west of Beck Pond and Bear Pond, Spencer quadrangle, Somerset County.

Bear Pond Schist[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. N. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs above Catamount schist and below Beech Mountain amphibolite.

Type locality: Bear Pond, Ticonderoga Township, Essex County.

Bear River Formation[1]

Lower Cretaceous: Southern Wyoming, southeastern Idaho, and northeastern Utah.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico, 3d Ann. Rept. Hayden Survey, p. 91, 92.

D. A. Andrews and C. B. Hunt, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 70. Mapped in Utah. Lower Cretaceous.

J. D. Vine and G. W. Moore, 1952, U.S. Geol. Survey Circ. 212, p. 3, 4, 5. In Bonneville County, Idaho, underlies Wayan formation and overlies Tygee sandstone of Gannett group. Thickness 152 feet. Lower Cretaceous.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 958. Age mentioned as Lower Cretaceous.

Teng-Chien Yen, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 757–764. In type area, overlain by Aspen shale and underlain by Beckwith formation. Aspen shale has been considered Lower Cretaceous on basis of ammonite fauna. If this age determination is considered conclusive, then Bear River beds should be assigned to Lower Cretaceous. However, on basis of fauna, Bear River strata are here assigned to level near base of Upper Cretaceous (Cenomanian).

A. La Rocque and C. D. Edwards, 1954, Geol. Soc. America Bull., v. 65, no. 4, p. 315–326. Cretaceous Bear River and Aspen section in Willow Creek, 6 miles southeast of junction of Hoback and Snake Rivers, Teton County, Wyo., described in detail including position and nature of its faunas. Bear River is 539 feet thick, and Aspen 1,307 feet. On lithologic and paleontologic grounds, Bear River-Aspen contact is placed lower than in earlier reports. Conflicting age assignments for Bear River and Aspen discussed. Suggested that this conflict may be due to complex intertonguing between the two formations.

J. D. Vine, 1959, U.S. Geol. Survey Bull. 1055–I, p. 259 (table), 262–263. In Bonneville County Idaho, unconformably underlies Wayan formation and conformably overlies Tygee sandstone of Gannett group. Thickness 300 to 500 feet. Lower two-thirds of formation consists of dark-gray ferruginous carbonaceous shale and siltstone interbedded with thin beds of dark-brown sandstone. Upper third consists of prominent ledge of medium-grained gray to brown quartzite or sandstone 75 feet thick. Overlain by black shale, thin beds of fine-grained brown sandstone, coaly shale, and black fossiliferous granular limestone. Upper and lower contacts of formation, as described herein follow usage of

L. S. Gardner (oral commun. 1952). Bear River formation, as used herein, includes strata included in Tygee formation by Kirkham (1924). Lower Cretaceous.

First mentioned in vicinity of Bear River City, Wyo.

Bear River Formation

Bear River Series[1]

Miocene, upper: Northern California.

Original reference: W. Stalder, 1915, California State Mining Bur. Bull. 69, p. 447–449.

G. C. Gester, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 205. Referred to as Bear River formation in Eel River basin. Consists of marine shale with hard calcareous members. Thickness 1,000 feet. Underlies Wildcat series; overlies Franciscan.

Occurs in Humboldt County.

Bear Run cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 4. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 24–28, table 1, geol. map. Includes (ascending) Massillon shale and (or) sandstone, 20 feet thick; Bear Run clay, 3 feet; and Bear Run coal. Occurs above Quakertown cyclothem and below Vandusen cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Exposed in Perry County.

Bear Run Member (of Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Southern Ohio.

Original reference: H. Morningstar, 1922, Ohio Geol. Survey Bull. 25, p. 13, 25–28, 299–300.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull, 39, p. 86–89. Sandstone and shale member varies from about 20 to 60 feet; average 30 feet; proportions of sandstone and shale vary locally. Horizon is defined by Bear Run coal and clay beds beneath and Vandusen clay and coal above.

Type locality and derivation of name not given.

Bear Spring Formation

Middle Devonian: Central Texas.

V. E. Barnes, P. E. Cloud, Jr., and L. E. Warren, 1947, Geol. Soc. America Bull., v. 58, no. 2, p. 136–138. Name applied to fossiliferous and in part cherty limestones of lower Middle Devonian age that occur in an ancient collapse structure. Rocks are fine to coarse grained; color varies—white to cream colored, yellowish or greenish brown to buff, bronze, olive brown, ivory, or nutria; over lower part of collapsed area, considerable dull-white to speckled-gray porcelaneous to semiporcelaneous chert occurs in float. At type locality, a patch of rocks, 240 feet long in northeast-southwest direction and 140 to 160 feet wide, has collapsed into limestones of Lower Ordovician Gorman formation and is in part overlapped by rocks of Mississippian age.

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Type locality: Near head of east fork of a draw that enters south side of valley of Honey Creek about 280 feet upstream from rock cabin on Roy Zesch Ranch, Mason County.

Bear Springs Basalt

Tertiary, upper: Southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 48–49, pl. 1. Flows of purple fine-grained porphyritic iddingsite-bearing rock, at times scoriaceous. Thickness about 150 feet. Unconformable contacts with Razorback formation below and Santa Fe(?) formation above.

W. E, Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 34–36, pl. 1. In Dwyer quadrangle, composed of flows, breccias, agglomerates, conglomerates, and, rarely, chocolate-colored sandy tuffs. Groundmass is gray to black.

Elston (1957) cites Jicha (1954) as designating type locality in sec. 25, T. 18 S., R. 9 W., Lake Valley quadrangle. Named from outcrop at intersection of secs. 17, 18, 19, and 20, T. 20 S., R. 8 W., about one-half mile distant from Bear Springs Canyon (Jicha, 1954, p. 48). [However, pl. 1 does not show unit mapped at this locality.]

Beartooth Quartzite[1]

Upper(?) Cretaceous: Southwestern New Mexico.

Original reference: S. Paige, 1916, U.S. Geol. Survey Geol. Atlas, Folio 199.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 285, pl. 1. In Santa Rita area, is 50 to 120 feet thick and consists of light-colored massive conglomerate, vitreous quartzite, and sandstone with a few shaly layers. Underlies Colorado formation; unconformably overlies Syrena (upper Magdelena) or Abo.

C. H. Hewitt, 1959, New Mexico Bur. Mines Mineral Resources Bull. 60, p. 78–80. Described in northern Big Burro Mountains-Redrock area, where, in vicinity of Slate Creek and Fox Tail Creek, it forms cliffs 100 to 125 feet high. Lies unconformably on Precambrian granite (Burro Mountain granite). In many areas, Colorado shale crops out in valleys or saddles between Beartooth quartzite and overlying lavas.

Named for Beartooth Creek, near Fort Bayard, Silver City region.

Beartooth Butte Formation[1]

Lower Devonian: Northwestern Wyoming and Montana.

Original reference: E. Dorf, 1934, Jour. Geology, v. 42, p. 723–737.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1746, chart 4. Placed in Oriskany lower Onondaga position opposite that portion of Nevada limestone, only other known Lower Devonian of the West. Lower, and Lower or Middle Devonian.

Named for occurrence on Beartooth Butte, in SW cor. T. 58 N., R. 105 W., Park County, 3 miles south of Montana line, just northwest of Beartooth Lake, and in Crandall quadrangle (of Absaroka folio).

Bearwallow Conglomerate (in Pottsville Group)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Named for Bearwallow Ridge, west of Dry Fork, McDowell County, W. Va.

Bear Wallow facies[1] (of Edwardsville Formation)

Lower Mississippian: Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 288–293.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, p. 1. Facies nomenclature discussed. Correlation chart lists Bear Wallow facies of Edwardsville formation.

Name derived from Bear Wallow, a prominent upland, 3 miles northeast of Nashville, Brown County.

Bearwallow Schist

Age not stated: Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, TVA Div. Geology Bull. 4, p. 13–14. Essentially mica, garnet, and kyanite schist. Kyanite only makes small part of schist. Division of the Buck Ridge schist (new).

Outcrops on west side of gap at head of Bear Creek and also one-half mile southwest of Ledger Schoolhouse, Spruce Pine quadrangle.

Beattie Limestone (in Council Grove Group)

Beattie Formation (in Council Grove Group)[1]

Permian: Northeastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1, p. 13.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46–47. Beattie limestone includes (ascending) Cottonwood limestone, Florena shale, and Morrill limestone members. Thickness 15 to 25 feet. Underlies Stearns shale; overlies Eskridge shale. Wolfcamp series.

Type locality: Beattie, Marshall County, Kans.

Beattyville Shale (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original references: A. M. Miller, 1917, Table of geological formations of Kentucky: Lexington, Ky., Univ. Book Store, p. 2; 1919, Kentucky Dept. Geology and Forestry, ser. 5, Bull. 2, p. 10 (table), 147 (table).

A. C. McFarlan, 1954, Kentucky Geol. Survey Spec. Pub. 4, p. 11–14. In Natural Bridge State Park, area consists of succession of shales and thin sandstones up to 30 feet thick. Underlies Rock Castle conglomerate; overlies Mississippian Mammoth Cave limestone. Locally absent.

Apparently named for Beattyville, Lee County.

Beaufort Formation

Paleocene: Eastern North Carolina (subsurface).

P. M. Brown, 1959, North Carolina Div. Mineral Resources Bull. 73, p. 8 (table 4), 12–13, 29–30, 37–38, 45, 51–52, 64, 71. Variable composition, ranging from green glauconite sands containing about 90 percent glauconite to gray argillaceous sands containing about 5 percent glauconite; indurated shell-limestone intercalations common; euhedral pyrite common accessory; fossiliferous. Type well penetrated 65 feet of Paleocene strata between depths of 150 and 215 feet. Well logs show formation underlies Castle Hayne limestone or Yorktown formation, or locally, an unnamed middle(?) Miocene unit; overlies Upper Cretaceous Peedee formation. Midway age.

Type locality: Well 215 feet deep, drilled in 1952 for Nelson Motel at Chicowinity, Beaufort County. Recognized in wells in Martin, Bertie, Hertford, Gates, and Chowan Counties.

Beaumont Clay[1]

Beaumont Formation

Pleistocene: Eastern Texas and southwestern Louisiana.

Original reference: W. Kennedy, 1903, U.S. Geol. Survey Bull. 212, p. 20, 27, pls. 1, 2.

W. A. Price, 1939, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1875. Lake Charles and Ingleside formations (both new) replace Beaumont formation.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1708–1709. Quaternary deposits of Texas Coastal Plain between Brazos River and Rio Grande are divided into (ascending) Willis, Gay Hill, Bastrou Park, Uvalde, Asylum, Capitol, Beaumont (Sixth Street), Live Oak Bar (approximately of Beaumont age), First Street, Riverview, and Sand Beach terrace deposits.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1830–1831. In southwestern Louisiana, Beaumont formation is divided into Oberlin (Lower Beaumont) and Eunice (upper Beaumont).

Named for Beaumont, Jefferson County, Tex.

Beauvais Sandstone[1]

Middle Devonian: Eastern Missouri.

Original reference: C. L. Dake, 1918, Missouri Bur. Geology and Mines, v. 15, 2d ser., p. 88, 174–175.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 123–124. Predominantly white sand. Thickness as much as 50 feet. Overlies Grand Tower limestone; underlies St. Laurent.

Type exposures along Little Saline Creek, in Beauvais Township, Ste. Genevieve County.

Beaver division[1] (of Leon Series)

Upper Cambrian or Lower Ordovician: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. 259–306, pl. 3.

Named for Beaver Creek, Burnet County.

Beaver Gypsum[1]

Permian: Western Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 359, 363.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Rejected by Oklahoma Geological Survey. Name preoccupied.

Named for occurrence near Beaver City and in Beaver County.

†Beaver Limestone[1]

Lower Cambrian: Eastern Tennessee.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

Named for Beaver Ridge, north of Knoxville, Knox County.

†Beaver Sandstone (in Pottsville Group)[1]

Pennsylvanian: Eastern Kentucky.

Original reference: I. B. Browning and P. G. Russell, 1919, Kentucky Geol. Survey, 4th ser., v. 5, pt. 2, p. 11–18.

Exposed in Magoffin County.

Beaver Basin Formation

Pleistocene: Southeastern Utah.

G. M. Richmond, 1956, Dissert. Abs., v. 16, no. 6, p. 1128. Consists of two members that comprise 10 lithofacies, including till, rock glaciers, and various alluvial, colluvial, and eolian deposits. Tills form two sets of upper canyon end moraines. Weakly developed Pack Creek soil is formed on lower member where it is overlain by upper member. Moderately developed Castle Creek soil is formed on upper member and on deposits of the lower member not overlain by the upper member. Older than Gold Basin formation (new); younger than Placer Creek formation (new).

Located in La Sal Mountains area.

Beaver Bay Complex (in Keweenawan Group)

†Beaver Bay Diabase[1]

†Beaver Bay Group[1]

Precambrian: Northeastern Minnesota.

Original reference (Beaver Bay Group): R. D. Irving, 1883, U.S. Geol. Survey, 3d Ann. Rept., p. 143–146, pl. 14.

F. F. Grout and G. M. Schwartz, 1939, Minnesota Geol. Survey Bull. 28, p. 12, 13, 32–33. Beaver Bay complex is an expansion of phrase Beaver Bay group as used by Irving and Beaver Bay diabase as used by Winchell (1899, Minnesota Geol. and Nat. History Survey Final Rept., v. 4). Diabases and related basic rocks of complex form largest exposures in southern Lake County; they form bluffs and ridges up to 300 feet high. Intrusives that follow the structure, dipping toward Lake Superior, form northward-facing escarpments and more gentle back slopes, but transgressive and dikelike masses may form bluffs facing in other directions. Beaver Bay diabase is sill-like with minor irregularities and several petrographic facies. In table of formations, Beaver Bay complex is listed above Keweenaw Point volcanics (new); ages of both are middle Keweenawan.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3). Beaver Bay complex included in middle part of Keweenawan group.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior Geology, Apr. 21–22, p. 1. Complex comprises three gabbroic intrusions: Beaver River gabbro, Beaver Bay ferrogabbro, and Black Bay gabbro (all new). Gabbros intrude North Shore Volcanic group (new) which is considered middle Keweenawan.

Exposed on Beaver Bay.

Beaver Bay Ferrogabbro (in Beaver Bay Complex)

Precambrian: Northeastern Minnesota.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior Geology, Apr. 21–22, p. 1. Second intrusion of the complex. Younger than Beaver River gabbro (new). Surrounded and intruded by Black Bay gabbro (new).

In southeastern Lake County.

Beaver Bend Limestone[1]

Beaver Bend Limestone (in West Baden Group)

Beaver Bend Limestone Member (of Renault Formation)

Mississippian (Chester Series): Southwestern Indiana and central northern Kentucky.

Original reference: C. A. Malott, 1919, Indiana Univ. Studies, v. 6. no. 40, p. 7–20.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig. 1), 269, 270 (fig. 3), 271, 273. In Meade, Hardin, and Breckinridge Counties, Ky., Beaver Bend limestone is considered member of Renault formation. Overlies Mooretown sandstone member; underlies Sample sandstone. Unit has been placed in Gasper oolite and referred to as Renault limestone, but always undifferentiated. Thickness 14½ feet at Ohio River and as far south as Webster and Lodiburg, both in Breckinridge County; 38 feet in western part of Big Clifty quadrangle.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 825; J. M. Weller and others, 1948, Geol. Soc. America Bull. v. 59, no. 2, chart 4 (column 76). Considered member of Renault formation in Indiana.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7, 13. Renault formation of standard Chester column has triple expression in southern Indiana (ascending): Paoli limestone, Mooretown sandstone, and Beaver Bend limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves a name in its own right. Thicker sections of Beaver Bend are downdip away from eastern outcrop margin; in places along higher margin, unit is quite thin and locally absent. In western Putnam County, cut out and overlapped by Pennsylvanian Mansfield sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 24, pl. 1. Beaver Bend limestone in Indiana is light gray, oolitic, crystalline, and thick bedded to massive. Thickness 1 to 20 feet. Overlies Mooretown sandstone: underlies Sample sandstone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 46–47, pl. 1. Included in West Baden group (redefined). Brown-gray thick-bedded finely crystalline fossiliferous limestone 8 to 27 feet thick. Overlies Bethel formation; underlies Sample formation.

Named for exposures at conspicuous bend in Beaver Creek, just east of Huron, Lawrence County, Ind.

Beaverburk Limestone (in Wichita Group)[1]

Beaverburk Member (of Bead Mountain Formation)

Permian (Leonard Series): North-central Texas.

Original reference: J. A. Udden and D. M. Phillips, 1912, Texas Univ. Bull. 246, p. 31–36, 42–43.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as a member of Bead Mountain formation.

Named for exposures in basin of Beaver Creek and around Burk, Wichita County.

†Beaver Creek Chalky Member (of Niobrara Formation)[1]

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

Abandoned by U.S. Geological Survey as corollary of action transferring Sage Breaks member to Carlile shale; this left Beaver Creek as only representative of Niobrara formation. Consequently, formation name only is used in the area.

Named for exposures along Beaver Creek, in T. 46 N., R. 64 W., Weston County, Wyo.

Beaver Creek Member (of New Providence Formation)

Beaver Creek sand[1]

Lower Mississippian: South-central Kentucky.

Original reference: D. C. MacLachlan, 1928, Michigan Acad. Sci. Arts, and Letters, Papers, v. 8, p. 298, 302.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77. Beaver Creek member of New Providence formation in area of Forbush facies.

Occurs in Pulaski, Russell, and Wayne Counties.

Beaver Dam Black Shale Member (of Needmore Shale)

Middle Devonian: Central Pennsylvania.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 141, 153. Name proposed for thick black shale near middle of Needmore shale. Unit also listed in table 20 as part of Selinsgrove limestone which overlies Needmore shale. Contains few scattered calcareous concretions; none near base. Thin sandstone partings in lower part. Thickness 78 feet.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2867. Redefined as Beaverdam Run member of Newton Hamilton formation (new).

Type locality: In large cuts on the Pennsylvania Railroad east of Newton Hamilton, Mifflin County. Named from brook at type locality.

Beaverdam Sand

Pleistocene (Aftonian): Southeastern Maryland (subsurface and surface)

W. C. Rasmussen and T. H. Slaughter, 1955, Maryland Dept. Geology, Mines and Water Resources Bull. 16, p. 113, 115 (table 17), 116. Composed of unconsolidated white to buff medium-grained quartz sand, with small quantities of coarse and fine sand, pebbles and granules, and a minor admixture of white silt. Thickness as much as 72 feet. In some places, underlies Walston silt (new); in others the Pamlico formation.

Reference locality: Test hole, Wi-Cf 63, 2 miles east of Salisbury, Wicomico County. Crops out in banks and roadcuts surrounding Schumaker Pond. Named for Beaverdam Creek, each branch of Wicomico River, because of its prominent occurrence in and beneath drainage basin of that stream.

Beaverdam Creek Augen Gneiss

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 32-34, pl. 1. Dark-gray rock banded by red-brown biotite, with coarse gray microcline metacrysts, which are deformed into augen, and blue quartz

grains. Derived when granitic solutions related to Striped Rock granite injected Saddle gneiss (new).

Named from occurrence on Beaverdam Creek southeast of Independence, Grayson County. Wide distribution in belt that extends from Baxter Ferry on New River southwestward to Penitentiary Ford on same river.

Beaverdam Run Member (of Newton Hamilton Formation)

Upper Devonian: Central Pennsylvania.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2860 (fig. 2), 2867. At type section, consists of 18 to 20 feet of dark-gray to black thinly laminated to fissile and papery shale, weathering greenish gray; pyritiferous nodules of black chert occur at several levels; at base is 6-inch unit of dark-gray very argillaceous and carbonaceous fine- to coarse-grained calcareous sandstone representing reworked Ridgeley and resting with sharp contact on that formation. Underlies Hares Valley limestone and shale member (new). This member was named Beaver Dam black shale member of Needmore by Willard and others (1939). Willard's original definition as the black shale in the middle part of the section is here discarded and member redefined.

Type section: In railroad cut northeast of Newton Hamilton, Mount Union quadrangle, corresponding with type section of formation. Named from Beaverdam Run which empties into Juniata River, 1½ miles northeast of Newton Hamilton.

Beaver Divide Conglomerate Member (of White River Formation)

Beaver Divide Conglomerate Member (of Chadron Formation)

Oligocene, lower: Southwestern Wyoming.

R. L. Nace, 1939, Wyoming Geol. Survey Bull. 27, p. 11 (table), 32–34, pl. 1. Proposed for basal conglomerate of Chadron. Gray to nearly black cross-bedded boulder and pebble conglomerate in matrix of coarse tuffaceous calcareous sandstone. Thickness varies; as much as 68 feet. Disconformable above Continental Peak formation (new).

F. B. Van Houten, 1950, U.S. Geol. Survey Oil and Gas Inv. Map OM–113. In this report, unit is referred to as Beaver Divide conglomerate member of White River formation.

F. B. Van Houten, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–140. Member of White River formation. Conformably overlies Sand Draw sandstone lentil (new) in Long Creek-Beaver Divide area, Fremont County. Maximum thickness about 80 feet. Grades upward into typical Wind River rocks by introduction of more sandy and silty matrix and reduction in number of conglomerate lenses.

Named for occurrence in Beaver Divide area. Well exposed on east side North Oregon Butte, west-central part sec. 2, T. 26 N., R. 101 W., Sweetwater County.

Beaverhead Formation

Beaverhead Conglomerate

Upper Cretaceous, Paleocene, and Eocene: Southwestern Montana and east-central Idaho.

A. J. Eardley, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1552. Cited as conglomerate of Upper Cretaceous or Paleocene age.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 235–243. Beaverhead formation proposed for sequence of conglomerate,

sandstone, siltstone, and limestone that crops out over area of at least 400 square miles in Beaverhead County, Mont., and extends across Montana-Idaho boundary. Divided into four mappable units at type section. Top and bottom members dominantly conglomerate; intermediate member consists of two mappable units: a lower thick massive limestone, locally concretionary, and an upper sequence of interbedded siltstone, sandstone, arkose, limestone, and subordinate conglomerate. Approximately 9,700 feet thick at incomplete section where neither top nor base is exposed. Rests unconformably upon rocks as young as Colorado group and as old as early Paleozoic, and it probably rests unconformably upon rocks as young as Montana group and as old as Precambrian. Unconformably overlies Kootenai, Dinwoody, Thaynes, Phosphoria, Quadrant, and Madison. At McKnight Canyon section, base of section is marked by high-angle normal faults which have dropped the Beaverhead against Triassic Thaynes formation and Mississippian Madison. Contact between Beaverhead and Pennsylvanian Quadrant obscured by talus. At top of section, a plate of Madison limestone has been thrust over Beaverhead formation. Unconformably overlain by fluviatile or lacustrine beds of Eocene or Oligocene age. Age designated as probably late Cretaceous to early Eocene.

Type locality: Near mouth of McKnight Canyon, 6 miles west of Dell, Beaverhead County, Mont.

Beaverhead Granite

Eocene: Southwestern Montana and east-central Idaho.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 370–372, pl. 1. Moderately coarse-grained granite ranging from light gray to pink and light green. Cut by coarse quartz veins and small aplite dikes of same composition as main body but of much finer texture. More than 6 miles long and 2 miles wide in outcrop. Underlies Medicine Lodge volcanics (new).

Crops out in Beaverhead Range along Idaho-Montana state line. Described from occurrences in Beaverhead County, Mont.

Beaver Lake Alluvium

Quaternary: Southwestern Utah.

P. J. Barosh, 1960, Utah Geol. and Mineralog. Survey Bull. 68, p. 28–29. Most extensive alluvium formation in area. Consists mainly of silt, sand, and gravels with only small amount of pebbles and larger clasts.

Present in Beaver Lake Mountains, Beaver County.

Beaver Lake Dolomite

Upper Ordovician(?)-Silurian: West-central Utah.

P. J. Barosh, 1960, Utah Geol. and Mineralog. Survey Bull. 68, p. 14, 20–22, 49. Chiefly dark- to medium-gray mottled or laminated dolomite, which weathers a lighter gray; contains few beds of edgewise conglomerate; fossiliferous. Base not exposed; thickest measurable section is 200 feet on northwest side of Lime Mountain; estimated minimum exposed thickness 400 feet. Conformable below Lime Mountain dolomite (new); stratigraphically above but not in contact with Burrows(?) limestone. Metamorphosed rocks on west flank of Lime Mountain are considered altered equivalent of the Beaver Lake.

Crops out in northern part of Beaver Lake Mountains area around northern base of Lime Mountain and ridges to northwest of it, Beaver County.

Beaver Mountain Group[1]

Mesozoic or Tertiary: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 7, 8.

Exposed in section running from Champion Station eastward into Beaver Mountain, British Columbia.

Beaver River Formation (in Pottsville Group)[1]

Pennsylvanian: Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia(?).

Original reference: J. P. Lesley and I. C. White, 1876, Pennsylvania 2d Geol. Survey map of Beaver County.

Typical section is along Big Beaver River and Connoquenessing Creek in Beaver County, Pa.

Beaver River Gabbro (in Beaver Bay Complex)

Precambrian: Northeastern Minnesota.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior Geology, Apr. 21–22, p. 1. Oldest intrusion of complex. Followed by Beaver Bay ferrogabbro intrusion (new). Intrudes North Shore volcanic group (new).

In southeastern Lake County.

Beavertown Marl (in Brassfield Limestone)[1]

Silurian: Southwestern Ohio.

Original reference: A. F. Foerste, 1885, Denison Univ. Sci. Lab. Bull. 1, p. 65.

Located at various localities in vicinity of Dayton and near Beavertown, southeast of city and southeast of Soldiers Home, west of city.

Bechler Conglomerate,[1] Redbeds, Shale, or Formation (in Gannett Group)

Lower Cretaceous: Southeastern Idaho and western Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98–G, p. 76, 82.

L. S. Gardner, 1944, U.S. Geol. Survey Bull. 944–A, p. 7. In Irwin quadrangle, referred to as Bechler shale, 35 feet thick. Underlies Draney limestone; overlies Peterson limestone.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 43, pl. 1. In Ammon quadrangle, Idaho, predominantly sandstone with scattered beds of conglomerate. Unit involved in folds and faults; full thickness not exposed; 1,000 feet of formation may be present. Overlies Peterson limestone; unconformably underlies Wayan formation. Early Cretaceous.

C. A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 65 (table 1), 67 (fig. 2), 68. Referred to as Bechler formation in Gannett Hills area, Wyoming, where it is about 1,000 feet thick and consists of sandstones, siltstones, conglomerates, a few thin coarsely crystalline limestones, shales, and mudstones. Overlies Peterson limestone; underlies Draney limestone.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 56, pl. 21. In Jackson Hole area, Bechler "conglomerate" member of Gannett group is a 100- to 150-foot interval of weak beds consisting almost entirely of light-blue, purplish, or reddish-gray shale.

Overlies Peterson limestone member and underlies Draney limestone member.

W. L. Stokes, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 80, 81 (fig. 1). In western Wyoming, normally underlies Draney limestone and overlies Peterson limestone; where in contact with Ephraim conglomerate, separation of the two is difficult.

Named for Bechler Creek which enters Stump Creek from north about one-fourth mile north of mouth of Boulder Creek, T. 6 S., R. 45 E., Boise meridian, Bannock County, Idaho.

Becket Granite Gneiss[1]

Precambrian: Western Massachusetts, western Connecticut, and southwestern Vermont.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 18, 31–38, pl. 34.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 4. Informaly called gneissic granite and trondhjemite in report on Danbury quadrangle.

Named for occurrence at Becket, Mass.

Beckett Limestone (in Plattin Group)

Middle Ordovician: Southwestern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2049–2052. Named as the second of four formations in the group. Fucoidal fine-textured calcite limestone having layers of intraformational calcarenite and carbonate pebble conglomerate; nodular chert common in upper part. Thickness at type section 117 feet. Overlies Bloomsdale formation (new); in southern areas, disconformably overlain by Hager formation (new); north of western St. Louis County, overlain by Macy formation (new); in Franklin, Montgomery, and Callaway Counties, succeeding beds are Devonian and Mississippian.

Type section: Below roadcuts along Missouri Highway 25, in NW¼ sec. 27, T. 38 N., R. 8 E., Ste. Genevieve County. Name derived from Beckett Hills.

Beckler Quartz Diorite

[Paleocene or older]: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Probably an offshoot from the Mount Stuart batholith. Intruded Tonga formation (new). Produced late-kinematic contact minerals up to warm-mesozonal grade.

Between central and eastern part of Skyhomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Beck Pond Limestone

Lower Devonian: West-central Maine.

A. J. Boucot, Charles Harper, and Keith Rhea, 1959, Maine Geol. Survey Spec. Geol. Studies, Ser. 1, p. 9–19, 24, map. Subdivided into five members (ascending): member 1, predominantly coarse gray-green quartzose limestone containing one or two stromatoporoid biostromes with some of the sandy layers well crossbedded; member 2, chiefly stromatoporoid biostromes interlayered with minor amounts of gray-green quartz-rich limestone containing some coral and stromatoporoid fragments; member 3, similar to member 1 and has also distinct bedding and crossbedding;

member 4, light-colored granite-boulder conglomerate containing boulders but to 15 feet across; member 5, coarse-grained gray-green calcareous quartz conglomerate similar to member 4 but containing more fossils, which are concentrated in certain layers. Thickness about 750 feet. In some areas, unconformably overlain by slate of Seboomook formation. Overlies pre-Silurian granitic basement complex; contact not exposed. A body of diabase intrudes both the Beck Pond and the granite.

W. A. Oliver, Jr., 1960, U.S. Geol. Survey Bull. 1111–A, p. 1–22, pls. Rugose corals described. Corals comparable to Beck Pond species are found in Coeymans limestone in New York and in Keyser limestone of Late Silurian and Early Devonian(?) age in Maryland and West Virginia.

Type area: On south part of low hill in NW cor. T. 3, R. 5, in area west of Beck Pond and Bear Pond, Spencer quadrangle, Somerset County.

Becks Limestone

Upper Devonian: Northern Utah.

N. C. Williams, 1940, Compass, v. 20, no. 2, p. 76 (fig. 1), 77. Becks limestone overlies Swan Peak(?) formation and is in turn overlain by Madison-Brazer limestones of Mississippian age.

J. E. Brooks, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 55. In areas of Becks Spur and City Creek Canyon, Edvalson (1947, unpub. thesis) described section of Upper Devonian rocks to which he applied name Becks formation. Underlies the Madison and rests on quartzose sandstones and quartzites which were provisionally referred to Swan Peak quartzite. Granger and Sharp (1952) applied name City Creek to these same rocks. Granger (1953, p. 2) abandoned name City Creek and applied name Pinyon Peak.

Granger (1953, U.S. Geol. Survey Circ. 296) did not use term City Creek. It is inferred that he abandoned the term in favor of Pinyon Peak.

Probably named for Becks Spur, Wasatch Mountains, Salt Lake County. Also recognized in City Creek Canyon.

Beck Spring Dolomite

Precambrian (Pahrump Series): Southern California.

D. F. Hewett, 1940, Washington Acad. Sci. Jour., v. 30, no. 6, p. 240; 1956, U.S. Geol. Survey Prof. Paper 275, p. 26, 28, pl. 1. Consists largely of beds of light-bluish-gray dolomite, 2 to 4 feet thick, separated by layers of shaly material; contains numerous beds of oolite several feet thick. No clearly identifiable fossils present, but layers of roundish concretions about one-half inch in diameter may be of algal origin. Thickness about 1,000 feet. Conformably underlies Kingston Peak formation (new); conformably overlies Crystal Spring formation (new).

L. A. Wright, 1952, California Div. Mines Spec. Rept. 20, p. 7 (fig. 3), 12, 13. Described in Superior talc area, Death Valley region. This is most westerly known occurrence of unit. Composed mostly of light-brown fine-grained dolomite containing subordinate olive-gray to light-brown quartzite and shale; dolomite beds are commonly 2 to 10 feet thick and locally contain thin siliceous layers parallel with bedding; quartzite and shale layers range in thickness from a few inches to as much as 20 feet and are most abundant in upper 200 feet of formation. Thickness about 1,300 feet. Overlies Crystal Spring formation; underlies Kingston Peak formation.

Crops out in belt 6 miles long on north slope of Kingston Range, Ivanpah quadrangle. Name derived from Beck Spring on north slope of range.

Beckwith Formation[1]

Jurassic and Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

D. A. Andrews and C. B. Hunt, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 70. Shown on map legend of northeastern Utah. Jurassic and Cretaceous.

W. L. Stokes, 1955, Wyoming Geol. Soc. Guidebook 10th Ann. Field Conf., p. 80. Originally included beds now constituting Preuss, Stump, and present Gannett group. Remainder of Beckwith has been treated differently. Some workers have retained name Beckwith for restricted part, others have attempted to distinguish members of Gannett within it, and still others have treated it as undifferentiated Gannett. This situation has led to general abandonment of term Beckwith, but problem of just which members, if any, of the Gannett can be recognized in areas where Beckwith has long been used is not settled.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in southwestern Wyoming.

Named for development on Beckwith Ranch, just east of Beckwith Station on Oregon Short Line, Lincoln County, Wyo.

Becraft Limestone[1] **or Sandstone** (in Helderberg Group)

Becraft Limestone Member (of Helderberg Limestone)

Lower Devonian: Eastern New York, western Maryland, New Jersey, Pennsylvania, Virginia, and northern West Virginia.

Original reference: J. Hall, 1893, New York State Geol. 12th Ann. Rept., p. 9-13.

Winifred Goldring, 1931, New York State Mus. Handb. 10, p. 190, 370, 377. Underlies Alsen limestone (new).

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 62–65. At Becraft Mountain, opposite Catskill, N.Y., New Scotland beds are overlain by Becraft limestone, 45 feet thick and consisting of light-gray crystalline in part crinoidal beds. Above Becraft are 25 feet of Alsen limestone. Becraft continues southward to Kingston, where it is 35 feet thick, and into New Jersey, where it is 15 to 20 feet thick. Alsen beds disappear southward and are displaced by Port Ewen beds. In Pennsylvania, Becraft and Port Ewen occur as units to which these names can be applied only in eastern part of Monroe County. Mandata shale and Licking Creek limestone of central and south-central Pennsylvania are partially of these ages.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 279–286. Referred to as member of Helderberg in Virginia and West Virginia. In Virginia, the Becraft is generally bounded by New Scotland limestone but, in places perhaps, by Tonoloway limestone where rest of Helderberg is absent. Bounded above by either Oriskany sandstone or Onondaga formation, as the sequence varies from place to place. Thickness about 50 feet to about 100 feet.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 126. Swartz (1929) named Rocky Gap sandstone from Rocky Gap, Bland County. Butts

(1940) used name Becraft for this sandstone throughout southwestern Virginia; this use should be abandoned, and term Rocky Gap continued.

H. P. Woodward, 1948, West Virginia Geol. Survey, v. 15, p. 95–97. In most previous reports dealing with Helderberg group in the Virginias, a so-called Becraft limestone has been recognized and described. It is now believed, on evidence presented by F. M. Swartz, that the horizon so identified lies at a higher level than the true Becraft in New York. According to this interpretation, whatever representation the true Becraft has in West Virginia must come below cherty beds of Port Ewen (previously called, in part "Shriver" chert) and above cherty beds of New Scotland. This interval is occupied by soft gray calcareous shale that contains late New Scotland fauna with sparse forms of probable Becraft affinity.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 83–84. In Maryland, Becraft member of Helderberg is an arenaceous limestone interbedded with black chert. Present only in Washington County where it is 85 feet thick. In Cumberland and Keyser sections, member is missing, but it continues into Virginia where it was described by Butts (1940). Overlies New Scotland member.

Named from Becraft Mountain, Columbia County, N.Y.

Bedford Augen Gneiss[1]

Age(?): Southeastern New York.

Original reference: C. R. Fettke, 1914, New York Acad. Sci. Annals, v. 23, p. 239.

Southeast and south of Bedford village, Westchester County.

Bedford Clay (in Pottsville Formation)[1]

Bedford clay member

Pennsylvanian: Eastern Ohio.

[Original reference]: Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 93.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 36, table 1. Member of Bedford cyclothem in report on Perry County. Average thickness 3 feet. Lies below Bedford coal and above Bedford shale and sandstone member. Pottsville series.

Bedford cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 7. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 36–39, table 1. geol. map. Includes (ascending) Bedford shale and (or) sandstone, 17 feet thick; Bedford clay, 3 feet thick; coal; and upper Mercer flint and limestone, 2 feet thick. Occurs below Tionesta cyclothem and above Middle Mercer cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Exposed in southeastern Perry County.

†Bedford Limestone[1]

Mississippian: Indiana.

Original reference: C. E. Siebenthal and T. C. Hopkins, 1897, Indiana Dept. Geol. and Nat. Res. 21st Ann. Rept., p. 291.

Named for Bedford, Lawrence County, where it is extensively quarried.

Bedford shale and (or) sandstone member

See Bedford cyclothem.

Bedford Shale[1] or Formation

Devonian and Mississippian(?): Eastern Ohio, northeastern Kentucky, and southwestern Pennsylvania.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 21.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Bedford shale has been traced across Ohio and into Pennsylvania where it lies below the Berea and above Cussewago sandstone. In Pennsylvania, name Cussewago was first applied to this shale by White (1881, Pennsylvania 2d Geol. Survey Rept. Q_4), and later name Hayfield was substituted by Chadwick (1925, Geol. Soc. America Bull., v. 36, no. 3). The Hayfield has been found to be Bedford in present investigation. Name Bedford has priority; hence term Hayfield is invalid.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1354–1357; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Paper 259, p. 13, 21–25. At type locality, composed of about 85 feet of light-gray silty shale, many platy siltstones, and some hard discordal limy nodules. A wedge of red shale, which is 25 feet thick in Independence Township and thins to featheredge on Cuyahoga-Lake County line, present in upper part of formation north of type locality. In eastern half of Cuyahoga County, contains two members: Sagamore siltstone and Euclid siltstone. Thins eastward from type locality to about 45 feet in western Trumbull County. Overlies Cleveland shale member of Ohio shale; contact gradational. Upper contact irregular in area between Cuyahoga County and Trumbull County, because Berea sandstone fills deep channels into, and in some places through, the Bedford. Traced into vicinity of Meadville, Crawford County, Pa. East of Grand River, underlain by Cussewago sandstone and overlain by siltstone facies of Berea. In vicinity of Meadville, Bedford shale and overlying siltstones of Berea sandstone grade laterally into Shellhammer Hollow formation (new) and lose identity as individual formations.

U.S. Geological Survey currently designates age of Bedford as Devonian and Mississippian(?) on basis of study now in progress.

Type locality: On Tinkers Creek, near Bedford, Bedford Township, Cuyahoga County, Ohio.

Bedford Canyon Formation

Triassic(?) and Jurassic: Southern California.

E. S. Larsen, 1948, Geol. Soc. America Mem. 29, p. 18–22, pl. 1. Name proposed for group of mildly metamorphosed slates and argillites with some quartzites and a few thin lenses of limestone. Thickness unknown because base is not exposed and top is a surface of erosion; probably 20,000 feet exposed in Santa Ana Mountains. Unconformably underlies Santiago Peak volcanics (new). Smith (1898) used term Santa Ana for a limestone in these slates in western part of Santa Ana Mountains.

Merrill (1914) called the slates the Santa Ana metamorphic strata. Since Santa Ana has been used for Tertiary strata in California, name Bedford Canyon is used here.

Rene Engel, 1959, California Div. Mines Bull. 146, p. 17. Santa Ana formation includes Bedford Canyon formation and Santiago Peak volcanics of Larsen (1948).

U.S. Geological Survey currently designates age of Bedford Canyon Formation as Triassic(?) and Jurassic on the basis of a study now in progress.

Named for Bedford Canyon, Orange County, where formation is well exposed. Formation lies west of main batholith (of southern California) and underlies much of Santa Ana Mountains. Regional strike of formation is about N. 30° W., approximately parallel to Santa Ana Mountains and the coast. Regional dip is to east; averages about 50° in Santa Ana Mountains and a little steeper to the east.

Bedias Sandstone Member[1] (of Wellborn Formation)

Eocene, upper: Southeastern Texas.

Original reference: B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 26–28, table opposite p. 17.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2627, 2628. Incidental mention in discussion of Wellborn sandstone which is here considered a formation, undivided.

Named for exposures at Bedias, Grimes County.

Beebe Beds

Middle Devonian: Northeastern Michigan.

W. A. Kelly, 1940, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion [p. 1]. Upper half of section at Afton cannot be definitely correlated with section near Lake Huron, and provisional names, Afton beds, Marvin beds, and Beebe beds, are used in place of Alpena, Norway Point, Potter Farm, Partridge Point, and Squaw Bay, employment of which would imply stricter correlation than is justified.

Present in Black Lake-Afton area.

Beebe Limestone[1]

Beebe Limestone (in West Castleton Formation)

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 402.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Massive but discontinuous unit in West Castleton formation (new).

Named for exposures near Beebe Pond, in Hubbardton, Rutland County.

Beebe Limestone[1]

Upper Devonian: Central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 202.

In Ithaca region.

Beebe School Formation (in Traverse Group)

Middle Devonian: Northern Michigan.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 448 (fig. 1), 449, 450 (fig. 2), 456 (fig. 3), 459 (fig. 5), 460–461. Name applied to limestone and shale beds which overlie Gravel Point formation and underlie Antrim shale. Subdivided into four unnamed members (ascending): massive biostrome composed of unoriented coralla, fragmentary remains of crinoids, Bryozoa, and Brachiopoda; thin-bedded light-gray brown-weathering cherty limestone with some very fossiliferous layers; yellow-weathering calcareous shale interbedded with thin highly fossiliferous limestone layers; prevailingly thin-bedded dark-gray, weathering to light-gray and buff, fine- to medium-textured limestone interbedded with shaly limestone and shale. Thickness 70 feet.

Exposed in front and back slopes of a series of low cuestas which trend in northwest direction from Beebe School which is in sec. 14, T. 34 N., R. 2 W., Cheboygan County.

Bee Branch Limestone Member (of Caloosahatchee Marl)

Pleistocene: Southern Florida.

J. R. DuBar, 1957, Illinois Acad Sci. Trans., v. 57, p. 192 (table 1). Table shows Bee Branch limestone as middle member of Caloosahatchee underlies Ayers Landing member (new); overlies Fort Denaud member (new).

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136 (fig. 4), 143-144. Relatively hard solution-riddled marine limestone or marl unit. Consists of two principal facies, one of which, represented at type locality, is a massive hard calcareous ledge-forming bed; the other is softer, less consolidated, more arenaceous, and more distinctly concretionary. Thickness a few inches to about 5 feet; average about 2½ feet. Conformably overlies Fort Denaud member; conformably underlies Ayers Landing member. Where erosion has been extensive, overying beds may belong to either Fort Thompson or Pamlico formation, and contact is unconformable.

J. R. DuBar, 1958, Florida Geol. Survey Bull. 40, p. 58–61. Report does not use either Fort Denaud member or Ayers Landing marl member; underlying and overlying units referred to as lower Caloosahatchee beds and upper Caloosahatchee shell bed.

Type locality: Along Caloosahatchee River in Hendry County near its confluence with tributary called Bee Branch.

Beech Granite[1]

Beech Granite Gneiss

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 3.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 19; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Beech granite gneiss consists of Beech granite as mapped by Keith. Three varieties of granite are present: one is a coarse-grained, usually porphyritic rock, another is medium to fine grained, and the third is a coarse red variety. Unit has been greatly changed by metamorphism. Precambrian(?).

Named for Beech Mountain, Cranberry quadrangle, Watauga (now Avery) County, N.C.

Beech Member (of Valcour Formation)

Middle Ordovician (Chazyan): Northwestern Vermont, and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 825 (fig. 4), 826 (fig. 5), 833, 836–838. Upper member of formation. Overlies Hero member (new) from which it differs both lithologically and faunally, being essentially the *Rostricellula plena* zone. Well exposed beds at Rockwell Bay include principal lithic variants. Basal 35 feet is fossiliferous calcarenite somewhat dolomitized and enclosing two reef lenticles. Succeeding 41 feet has medium-bedded calcarenites, irregularly dolomitized, succeeded by shaly calcargillite with massive zoaria of *Anolotichia* sp. and *Stromatotrypa* sp. Upper 51 feet is gray medium- to coarse-grained calcarenite having cross-stratified beds, with *Rosticellula, Mimella,* and ramose trepostomes. Top contact not exposed here but where it is exposed on northern tip of Valcour Island, brown-weathering dolomite is succeeded by "Lowville" calcilutite. Thickness near Rutland Station, South Hero, 86 feet.

Type section: Along Beech Bay, South Hero, Vt.

Beechatuda Tongue (of Cliff House Sandstone)

Upper Cretaceous: Northwestern New Mexico.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144, sheet 1. Described as tongue of Cliff House sandstone in Menefee formation. Southeastward rise of about 90 feet in stratigraphic position of base of Cliff House sandstone is involved. Contacts are sharp.

Exposed in Beechatuda Draw in northwestern part of secs. 5 and 6, T. 30 N., R. 15 W., San Juan County, and can be traced approximately 2½ miles along the outcrop.

Beech Creek Limestone Member (of Golconda Formation)

Beech Creek Limestone[1] (in Stephensport Group)

Beech Creek Limestone Member (of Paint Creek Formation)

Upper Mississippian (Chester Series): Southwestern Indiana and central northern Kentucky.

Original reference: C. A. Malott, 1919, Indiana Univ. Studies, v. 6, no. 40, p. 7–20.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 828; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Considered member of Paint Creek formation in Indiana.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7, 14–17, 73. Paint Creek of standard Chester column has triple expression in southern Indiana (ascending): Reelsville limestone, Elwren sandstone, and Beech Creek limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves a name in its own right. At designated type section, Beech Creek limestone is 24½ feet thick. Persistent through area of outcrop except where it is truncated and overlapped by Pennsylvanian Mansfield.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 18, 20. Beech Creek (lower Golconda) underlies Fraileys (middle Golconda) shale (new).

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 25, 72–78, pl. 1. Thickness 8 to 33 feet in Indiana. Gray fine- to coarse-grained crystalline limestone weathering to rough cubical blocks; large crinoid stems common. Underlies Cypress sandstone; locally transition contact separates the two. Overlies Elwren sandstone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 41–42, pl. 1. Lowermost formation in Stephensport group (redefined). Thickness 12 to 18 feet. Underlies Big Clifty formation; overlies Elwren formation of West Baden group.

U.S. Geological Survey currently classifies the Beech Creek as a member of Golconda Formation in Kentucky, on basis of study now in progress.

Type section: At Ray's Cave, NE¼NW¼ sec. 13, T. 7 N., R. 4 W., one-fourth mile north of State Road 54 at Ridgeport, and 3½ miles southwest of Solsberry, Greene County, Ind. Named for exposures along Beech Creek.

Beech Creek Shale (in Chester Group)[1]

Mississippian: Southwestern Indiana.

Original reference: W. N. Logan, 1926, Indiana Dept. Conserv., Div. Geol. Pub. 55.

Beecher Dolomite Member (of Bluebell Formation)

Upper Ordovician and Silurian: Central Utah.

Paul Billingsley *in* J. M. Boutwell, 1933, 16th Internat. Geol. Cong. [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Name appears on stratigraphic column of Tintic district. Overlies Eagle member (new); underlies Dora member (new).

T. S. Lovering and others, 1949, Econ. Geology Mon. 1, p. 7 (table 1). Upper 60 feet light-gray lithographic dolomite; overlies well-bedded fine-grained blue-gray dolomite; 26-foot bed strongly mottled blue-gray dolomite 62 feet above base. Thickness 212 feet.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 141. Suggested that strata which comprise Beecher dolomite of older reports be referred to Laketown dolomite in Boulter Mountains quadrangle.

Type locality and derivation of name not stated.

Beecher Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 33, figs. 3, 9. Dolomite, pure, nonshaly, noncherty; thick bedded. Thickness about 3½ feet. Shown on columnar section as underlying Eagle Point member (new) and overlying St. James member (new).

Occurs in Dixon-Oregon area.

Beecher Island Shale Member (of Pierre Shale)[1]

Upper Cretaceous (Gulf Series): Northeastern Colorado and northwestern Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull. 32, no. 7.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 22. Gray shale; irregular concretionary limestone near top; limonite concretions throughout; thin beds of bentonite and limestone concretions in lower part. Thickness 100 feet. Uppermost member of Pierre shale; overlies

an unnamed shale member, 500 to 600 feet thick, that in turn overlies Salt Grass shale member.

Named for exposures at Beecher Island, Yuma County, Colo.

Beech Mountain Amphibolite[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. N. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs above Bear Pond schist.

Named for occurrence on Beech Mountain, southeast of Graphite, Warren County.

Beech River Shaly Limestone Member (of Brownsport Formation)[1]

Beech River Formation (in Brownsport Group)

Middle Silurian: Western and central Tennessee.

Original reference: W. F. Pate and R. S. Bassler, 1908, U.S. Natl. Mus. Proc., v. 34, p. 410–432.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as basal formation of Brownsport group.

T. W. Amsden, 1949, Yale Univ. Peabody Mus. Nat. History Bull. 5, p. 25. In area of this report [western Tennessee], there does not seem to be any valid basis for subdividing the Brownsport into three members or formations. Here proposed that terms "Beech River," "Bob," and "Lobelville" be abandoned.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 257–262, figs. 77, 78, 80, 81, 82. Beech River formation included in Brownsport group. Argillaceous formation consisting of interbedded shaly limestone and calcareous shale that begins with widespread basal limestone that ranges from 1 to 12 feet in thickness. Thickness of formation as much as 60 feet. Overlies Dixon formation with apparent conformity; underlies Bob limestone into which it seems to grade by progressive replacement of one by the other or by interbedding of the two facies; locally contact is sharp. Where Bob limestone has been removed by erosion, Beech River is overlain by Decatur limestone, a Devonian formation, or the Chattanooga shale; where the Bob may be locally absent due probably to nondeposition, the Beech River is overlain by Lobelville formation, and in such cases the two cannot be separated lithologically.

Named for Beech River, Decatur County.

Beechwood Limestone Member (of Sellersburg Limestone)[1]

Beechwood Formation (in Hamilton Group)

Middle Devonian: Central northern Kentucky and southern Indiana.

Original reference: C. Butts, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 2, p. 118, 120.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1057, 1064–1065, 1067. Rank raised to formation at top of Hamilton group. Overlies Silver Creek formation in Clark County, Deputy formation (new) in Jennings County, and Jeffersonville formation in Bartholomew County. Difficult to distinguish from Swanville formation (new) on lithology alone, and unit termed Swanville has been regarded as a continuous bed of Beechwood; however, the two have not been found in the same section

at any place. Close relationship of Silver Creek and Beechwood implied by their treatment as member of Sellersburg does not exist; their fossils represent separate time divisions in standard Hamilton scale. The two are separated by an erosional disconformity.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 42, pl. 1. Beechwood is not necessarily younger than all other Hamilton beds of southeastern Indiana. It is present nearly everywhere the Silver Creek is identifiable, but its thickness varies within small areas, and at places it is absent. At such places, Silver Creek lithology extends to top of Hamilton section; absence of Beechwood does not decrease thickness of Hamilton; this fact suggests that the same time of deposition is represented, where Beechwood is not found, by beds that have Silver Creek lithology. Indiana Geological Survey used term Beechwood for a member at top of Hamilton sequence.

Named for Beechwood Station, Jefferson County, Ky. Exposed in stream a few rods north of Shelbyville turnpike, one-half mile south of Beechwood.

Beehive Formation[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 7.

Typical occurrence on Beehive Mountain, north of Lost Creek, British Columbia.

Beehive Rhyolite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 740–741. Described as massive porphyritic biotite rhyolite. Makes up two intersecting dikes which form a small but prominent spire called Beehive Peak. Believed to represent a volcanic neck. Spire rises above a mass of biotite rhyolite believed to have come from the volcanic neck.

Exposed in and around Beehive Peak, Tucson Mountains, Pima County.

Beehive Mesa Alluvium

Pleistocene or Recent: Southern California.

B. F. Howell, Jr., 1954, California Div. Mines Bull. 170, map sheet 10. Shown on stratigraphic column as bedded dark fan remnants as much as 100 feet thick. May be same age as Kagel or Lopez alluvium.

Occurs in Little Tujunga area, Los Angeles County.

Beekmantown Group,[1] Limestone,[1] Shale, or Dolomite

Lower Ordovician: New York, western Maryland, Pennsylvania, Tennessee, Vermont, and Virginia.

Original reference: J. M. Clark and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

John Rodgers, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 98. There were three major pre-Chazy invasions of Champlain area during early Paleozoic, instead of two as commonly suggested. The first corresponds to Potsdam-Little Falls sequence in Mohawk Valley; the third gave the type "Beekmantown" (including Fort Cassin strata). Middle invasion, newly recognized, correlates with the Chepultepec and Gasconade forma-

tions. These facts indicate that name "Beekmantown" should be redefined or perhaps abandoned altogether.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1573–1588. Name Beekmantown was originally proposed for entire Calciferous (Brainerd and Seely, 1890, Am. Mus. Nat. History Bull., v. 3), but since it became evident that Calciferous spanned break between Cambrian and Ordovician (or Ozarkian and Canadian of Ulrich), term has been restricted to Ordovician (Canadian part of sequence). There has been no general agreement as to position of this break in Champlain sequence. Ulrich and Cushing (1911, New York State Mus. Bull. 140) considered break to lie between middle of Division A [of Calciferous] and base of Division C [of Calciferous] in section at Ticonderoga where upper part of Division B [of Calciferous] is lacking. They considered that the missing beds were part of the overlying formation, whereas actually they form a unit with the underlying, but in any case they excluded the Whitehall beds (new) at Ticonderoga from the Beekmantown. However, Whitehall is now correlated with beds considered basal Ordovician (although Ulrich holds they are upper Ozarkian), and hence, if term Beekmantown is to be used for Ordovician Calciferous, in its use in Champlain Valley it should be extended to cover Whitehall formation.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 23. Term should either be abandoned entirely or restricted to beds between Upper Cambrian Potsdam and Theresa sandstones and base of Chazyan in vicinity of Beekmantown. As term is used in this paper [Ozarkian and Canadian brachiopods], it refers solely to Middle Cambrian lithological and faunal facies on west side of Champlain basin and to north at Beauharnois near southwestern angle of Province of Quebec. The fauna, characterized by species of *Lecanospira*, is of northern origin and widely distributed in both Cordilleran and Appalachian troughs and in Missouri, Oklahoma, and Texas.

B. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 241–249. Formation described in Northampton County where it constitutes surface indurated rocks in broad band from 1½ to 4 miles in width extending continuously across the county between Lehigh and Delaware Rivers. An isolated fault block area of Allentown, Beekmantown, and Jacksonburg in vicinity of Portland extends from Delaware River in gradually narrowing band to Johnsonville. The band of Beekmantown limestones is bounded on south by older and underlying Allentown strata and on north by younger and overlying Jacksonburg limestones. Estimated thickness 1,000 to 1,200 feet, perhaps less in vicinity of Delaware River.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 102–119. In Virginia, Beekmantown group (formation) is overlain by limestones of Chazyan age (Murfreesboro, Lenoir, and Mosheim) and underlain by Chepultepec limestone. Three distinct facies present: dolomite in area southwest of Lexington and in northwestern belts from Lee County to Highland County; dolomite and limestone southwest of Frederick County; and dominantly limestone in Frederick and Clarke Counties.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 53–66. Term Beekmantownian series used to include the following formations in Minnesota: Kasota sandstone, Blue Earth siltstone, Oneota

dolomite, Root Valley sandstone, and Shakopee dolomite. Formations carry fauna distinctly older than usual formations of Ordovician or those commonly referred to as Canadian. Shakopee dolomite underlies St. Peter sandstone of Chazyan series. Term Ozarkian has been applied to these Minnesota formations.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2036. Upper Cambrian (Hoyt) fossils have been found in upper part of Division B of "Calciferous" formation. Previous workers have considered these beds Tribes Hill (Beekmantown) in age. Tribes Hill and *Lecanospira* faunas were found above crossbedded base of Division C. Thus, Hoyt fauna overlies Little Falls dolomite in Champlain and Mohawk Valleys instead of underlying it as previously designated. Since a recognized late Upper Cambrian fauna underlies standstone at base of Division C and an accepted Lower Ordovician fauna overlies it, base of the Beekmantown must be moved up to base of Division C. Thus Cambrian-Ordovician boundary should be placed at base of Division C.

R. R. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence Valleys. Revisions involve definitions and succession of previously accepted Cambro-Ordovician formations (Upper Cambrian Potsdam, Theresa, Hoyt, and Little Falls and Lower Ordovician Whitehall, Tribes Hill, and Beekmantown). Lower "typical" Theresa is physically and faunally differentiated from "Upper Theresa" (now Heuvelton member of Tribes Hill formation); Hoyt fauna occurs in lower half of emended Whitehall formation above Little Falls dolomite; a new, upper (Skeene) member of Whitehall formation represents late Cambrian offlap; two marine cycles, represented by Tribes Hill formation (containing Norton-Heuvelton, Fort Ann-Bucks Bridge, Benson-Ogdensburg members) and Cassin formation, constitute Beekmantown series. Each revised unit is tied in with Division A through E of original "Calciferous" formation.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54 no. 1, p. 862–865. In Tazewell County, Va., Cliffield formation (new) disconformably overlies Beekmantown dolomite.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 27-33. Formation described in Burkes Garden quadrangle where its maximum thickness is about 1,000 feet. Equivalents of the Nittany and Bellefonte are present, but Stonehenge or its equivalent, the Chepultepec, does not appear to be present. Overlies Copper Ridge formation; underlies Blackford member of Cliffield formation.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 522 (fig. 3), 524 (table), 539–548. Mappable units of Beekmantown group of west-central Vermont correspond with few exceptions to "Divisions B, C, D, and E" of Brainerd and Seely (1890, Am. Mus. Nat. History Bull. 3). They are here called (ascending) Shelburne marble, Cutting dolomite (new), Bascom formation (new), and Bridport dolomite (new), respectively. Overlies Upper Cambrian Clarendon Springs dolomite; underlies Chazyan Crown Point limestone.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Group, in Hollidaysburg-Huntingdon quadrangles, Pennsylvania, comprises (ascending) Mines dolomite, Larke dolomite, Nittany dolomite, Axemann

limestone, and Bellefonte limestone. Overlies Gatesburg formation; underlies Carlim limestone.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 71, 72. In Shenandoah Valley, New Market limestone (new) overlies Beekmantown group.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1402 (fig. 2). Term Beekmantownian series used on table of classification of sections along Allegheny synclinorium. Followed by Chazyan series.

C. R. Fettke, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1460 (fig. 2). Term Beekmantownian used on correlation chart of Middle and Lower Ordovician and Cambrian formations around northern rim of Appalachian basin. It is interval between Upper Cambrian Croixian and Middle Ordovician Chazyan.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1550–1563. Discussion of outcrop areas of Lower Ordovician Beekmantown sediments in New York, Pennsylvania, and Maryland. Tribes Hill limestone of Tribes Hill region, Mohawk Valley, represents thin featheredge of Beekmantown deposits lapping from south onto margin of old Adirondack Peninsula. In Taconic plate, Beekmantown sediments of overthrust mass or allochthone consist of Schagticoke shale and all but topmost part of Deepkill shale. In central Pennsylvania, Beekmantown group consists of (ascending) Stonehenge limestone, Nittany dolomite, Axemann limestone, and Bellefonte dolomite.

C. E. Prouty, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1598 (fig. 1). Discussion of Trenton and sub-Trenton stratigraphy of northwest belts of Virginia and Tennessee. Generalized section shows Beekmantown group comprises (ascending) Chepultepec, Longview, Kingsport, and Mascot dolomites. [These formations included in Knox group by some authors.] Occurs above Upper Cambrian Copper Ridge dolomite and below Blackford formation of Cliffield group (Chazyan).

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 35–37. Described as Beekmantown dolomite in Elkton, Va., area. Overlies Conococheague limestone; underlies unit of thin limestones of Middle Ordovician age.

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 278. Group underlies St. Paul group (new), which name replaces Stones River group of Maryland and adjacent states. Thickness about 2,500 feet near Pinesburg Station, Washington County, Md.

Carlyle Gray, 1951, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 136, p. 7–12. Described in Berks County. Thickness 1,000 to 2,000 feet. Subdivided into lower limestone member, middle interbedded member, middle dolomite member, upper limestone member, and an uppermost member of massive dolomites and interbedded limestone and dolomite. Underlies Annville limestone. Beekmantown fossils were reported in Coplay formation by Miller (1911, Pennsylvania Geol. Survey, 3d ser, Rept. 4). Thereafter term Beekmantown gradually replaced term Coplay for rocks between Allentown and Jacksonburg formations.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 70–107. Beekmantown group (limestone or dolomite) described in West Virginia. As used herein, term refers to body of calcareous Lower Ordovician rocks above Stonehenge-Chepultepec limestone, which formation has been withdrawn from Beekmantown and treated separately. Be-

lieved that representatives of Nittany and Bellefonte dolomites occur in Beekmantown, but precise identification is withheld until further correlations and field evidence have been reviewed and studied. Underlies Chazyan group.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 73. Advocates discontinuation of name Beekmantown unless it is relegated to Middle Cambrian (Roubidoux), the only known Canadian rocks outcropping in vicinity of Beekmantown, N.Y.

W. J. Sando, 1956, Geol. Soc. America Bull., v. 67, no. 7, p. 935-936; 1957, Geol. Soc. America Mem. 68, 161 p, pls. Beekmantown group of Maryland comprises (ascending) Stonehenge limestone, Rockdale Run formation (new), and Pinesburg Station dolomite (new). Aggregate thickness about 3,600 feet. Term Beekmantown as used herein applies to beds between Conococheague formation below and St. Paul (Stones River) group above. This usage, however, does not necessarily imply exact equivalence with type section. Reference section designated.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2710–2722. Group, in Berks County, comprises (ascending) Stonehenge, Rickenbach (new), Epler (new), and Ontelaunee (new) formations. Thickness about 2,305 feet. Underlies Jacksonburg limestone. Lower boundary drawn at base of exposures above concealed interval. Hence Cambrian-Ordovician boundary cannot be placed in area of this report because of poor exposure.

F. M. Swartz and R. B. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 1–14. In Franklin County, Beekmantown dolomite is 2,300 feet thick, including at base Stonehenge limestone member, 500 feet thick. Underlies Social Island limestone member (new) of Row Park limestone of St. Paul group.

Bradford Willard, 1958, Pennsylvania Acad. Sci. Proc., v. 32, p. 177–182. Beekmantown has for some years been used to include Ordovician part of dolomitic limestones in Lehigh and Delaware Valleys. Name is not appropriate because of lack of correlation with type Beekmantown and because of presence of post-Beekmantown fossils. Wherry's (1909) Coplay limestone is reinstated for Lower and lower Middle Ordovician beds between Upper Cambrian Allentown and Middle Ordovician Jacksonburg formations.

C. W. Welby, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 22–23. Group, in central Champlain Valley comprises (ascending) Whitehall formation, Cutting formation, Cassin limestone, and Bridport dolostone. Overlies Ticonderoga formation (new); underlies Day Point formation of Chazy group.

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 5. Stose and Jonas (1927) mapped argillaceous limestone between Susquehanna and Lehigh Rivers that have same stratigraphic position as Jacksonburg, below Martinsburg and above Beekmantown. They assigned name Leesport formation to these rocks. Name Leesport as defined and mapped should not be considered a valid formation and should be redefined or renamed. Interval between Beekmantown group and Martinsburg formation, embodying essentially the Leesport in east-central Pennsylvania and in a restricted sense, the Jacksonburg of eastern Pennsylvania and western New Jersey is herein divided into (ascending) Annville, Myerstown, and Hershey limestone.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 735 (fig. 4). In west-central Vermont, group comprises (ascending) Shelburne formation, Cutting dolomite, Bascom formation, and Chipman formation. Overlies Clarendon Springs dolomite; underlies Middlebury limestone.

Reference section (Sando): Begins at top of Beekmantown group exposed in Potomac River bluff about 1,000 feet west of intersection with southwest face of Pinesburg Station quarry and continues westward along abandoned Chesapeake and Ohio Canal for 1 mile, Washington County, Md. Named for exposures at Beekmantown, Clinton County, N.Y.

Beekmantownian[1] Series

Lower Ordovician: North America.

Original reference: A. W. Grabau, 1909, Jour. Geology, v. 17, p. 209–252.

See **Beekmantown Group, Limestone, Shale,** or **Dolomite.**

Beeman Formation (in Magdalena Group)

Pennsylvanian (Missourian): Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Consists of shale, argillaceous limestone, and conglomerate. Bioherms at base locally. Thickness as much as 500 feet. Underlies newly named Holder formation and overlies newly named Gobbler formation.

In Sacramento Mountains, Otero County.

Bee Rock Sandstone Member (of Lee Formation)

Bee Rock[1] Conglomerate or Sandstone Member (of Lee Formation)

Lower Pennsylvanian: Southwestern Virginia.

Original reference: J. J. Stevenson, 1881, Am. Philos. Soc. Proc., v. 19, p. 96.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 88; 1946, Geol. Soc. America Mem. 13, p. 136. Topmost conglomeratic sandstone of Lee formation.

Exposed at Bee Rock in Big Stone Gap, Wise County.

Bee Spring Sandstone[1] Member (of Caseyville Formation)

Pennsylvanian (Pottsville): Western central Kentucky.

Original reference: C. J. Norwood, 1876, Kentucky Geol. Survey, v. 1, new ser., pt. 6, p. 16, 42, 52–55.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 77. Massive slightly conglomerate sandstone. Top member of Caseyville formation. Equivalent to Makanda sandstone.

Named from Bee Spring Edmonson County.

Bee Tree Shale (in Breathitt Formation)

Pennsylvanian: Southeastern Kentucky.

A. F. Crider, 1916, Kentucky Geol. Survey [Rept.], 4th ser., pt. 1, p. 138, 142; H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 88, 136. Name applied to bed of shales 45 or more feet thick that overlies a 25- to 30-foot shale interval above Elkhorn coal and below Amburgy coal.

Exposed on Bee Tree branch of Smoot Creek, Letcher County.

Begg Formation

Upper Triassic: Northeastern Oregon.

W. R. Dickinson, 1960, Dissert, Abs., v. 20, no. 11, p. 4367. Upper Triassic sequence includes Begg, Brisbois, and Rail Cabin formations. Thickness of sequence, which is overlain by Lower Jurassic Graylock formation (new), is nearly 15,000 feet.

Type locality and derivation of name not stated. Report discusses Izee area, Grant County.

Beidell Quartz Latite

Beidell Latite-Andesite[1]

Miocene(?): Southwestern Colorado.

Original reference: Whitman Cross and E. S. Larsen, 1935, U.S. Geol. Survey Bull, 843, p. 63–64, pl. 1.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 83–86, pl. 1. Flow and clastic beds redescribed as quartz latite. Underlies Conejos quartz latite in most places; on its northern borders, it irregularly underlies Tracy Creek quartz latite.

Receives its name from old mining camp of Beidell, around which it is best developed, Del Norte quadrangle, Saguache County. Also present in adjacent Saguache quadrangle.

Beil Limestone Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and eastern Kansas.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 48.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23–24; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 66. Consists of two limestones separated by shale. Thickness 3 to 6 feet in Nebraska and 4 to 12 feet in Kansas. Underlies King Hill shale member; overlies Queen Hill shale member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Consists of two limestones separated by shale. Upper limestone light gray, dense, massive, with abundant *Osagia*. Shale is buff and calcareous, grading into limestones above and below, and carries profusion of coral *Campophyllum torquim*. Lower limestone fossiliferous and argillaceous. Thickness 3 to 6 feet. Underlies King Hill shale member; overlies Queen Hill shale member.

Type locality: Missouri River bluff near mouth of Kenosha Valley, 2 miles south and 1 mile east of Rock Bluff, Cass County, Nebr. Name derived from Beil Farm. Occurs from southwestern Iowa to Oklahoma.

Beirdneau Sandstone Member (of Jefferson Formation)

Upper Devonian: Northern Utah.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1139, 1140. Composed wholly of buff-weathering sandstones. Thickness 820 to 920 feet. Overlies Hyrum dolomite member (new); gradational contact. Unconformably underlies Madison formation.

Named for continuous exposure about base of Beirdneau Peak, Logan quadrangle.

Belcher Member (of Bluestone Formation)

Mississippian (Chester Series): Southeastern West Virginia and southwestern Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 184–185, pl. 15. Beds classified by Reger (1926) as Lower Belcher shale, Lower Belcher sandstone, Upper Belcher shale, and Upper Belcher sandstone, are grouped into single member and named Belcher member of Bluestone formation. Thickness 80 to 100 feet. Underlies Bratton member; overlies Mud Fork member (new).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98). Shown on correlation chart as Belcher beds in Bluestone formation or group.

Type locality: Along Bluefield-Princeton Road across Big Ridge, near Belcher School, Mercer County, W. Va. Well exposed along Road 656 about 1½ miles north of Bailey, Tazewell County, Va.

Belcher Sandstone (in Bluestone Formation)[1]

Belcher Shale (in Bluestone Formation)[1]

Mississippian (Chester Series): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 318–320.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 184. Beds classified by Reger (1926) as Lower Belcher shale, Lower Belcher sandstone, Upper Belcher shale, and Upper Belcher sandstone are herein grouped together and defined as Belcher member of Bluestone formation.

Units are exposed just north of Belcher School, Mercer County, W. Va.

Belchertown Tonalite[1]

Carboniferous(?): Central Massachusetts and northern Connecticut.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 243–248, pl. 34.

M. E. Willard, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–85. Described in Williamsburg quadrangle, Massachusetts, as typically light-gray equigranular medium- to coarse-grained tonalite Contains orbicular and lenticular concentrations of hornblende. Angular to subrounded xenoliths of quartzite, quartz-mica schist, phyllite, and amphibolite present. Foliation present throughout. Cut by small aplitic dikes of similar composition. Intrudes Brimfield schist at type locality. Carboniferous(?).

Named for occurrence at Belchertown, Mass.

Belden Granodiorite

[Jurassic]: Northern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 6. Discussed in report dealing with potassium-argon age determinations. Age given as 135.7 million years. Pluton from which collections were made is intrusive into slates of Carboniferous age and into metavolcanic rocks of possible Jurassic age.

Present near town of Belden on Feather River Highway, Plumas County.

Belden Shale or Formation

Belden Shale Member (of Battle Mountain Formation)

Pennsylvanian: Northwestern Colorado.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1376 (fig. 1), 1383–1384, 1385–1387. Proposed as member of Battle Mountain formation to replace name Weber shale in area. Composed of 100 to 200 feet of black and dark-gray carbonaceous shale and argillaceous limestone with thin beds of dark-colored sandstone; thin seams of impure coal present locally. Thickness at type locality about 125 feet. Underlies Robinson limestone member; unconformably overlies Leadville limestone.

K. G. Brill, Jr., 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 624–627. Rank raised to formation. Replaces Weber shale as applied to basal Pennsylvanian in Colorado, and is Des Moines in age. Base is clearly defined erosional contact with the pre-Pennsylvanian; underlies Maroon formation.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 192–193. Described in Pando area. Following usage of Brill (1944), term Belden shale is applied to dark Pennsylvanian shales and limestones unconformably overlying Leadville dolomite—the beds formerly called Weber(?) shale. Thickness 25 to 200 feet. Underlies Minturn formation (new). Grades upward into overlying Minturn formation.

R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 552 (fig. 3), 556, 557, 559–561. Described in Crested Butte quadrangle, Gunnison County, where it is 451 to 555 feet thick, and underlies Gothic formation (new).

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 16–17. Discussed in Garfield quadrangle, Chaffee and Gunnison Counties. Maximum thickness about 1,110 feet. At most places, three units can be distinguished: lower, 200 to 500 feet, chiefly dark shale or argillite; middle, 400 to 700 feet, limestone and shale in which either one or the other may predominate; upper, about 200 feet, contains more quartzite than underlying beds. Grades into overlying Minturn; contact arbitrarily placed where quartzite and micaceous shales of Minturn exceed limestone and shale of Belden. Overlies Leadville; locally overlies Manitou. In Monarch and Tomichi districts, Crawford (1913) used term Garfield formation for lower 2,600 feet of Pennsylvanian section. In present usage, Belden shale corresponds to lower 1,110 feet of Crawford's Garfield formation.

Type section: North side of Rock Creek Valley along U.S. Highway 24 (1938) 0.2 mile north of Gilman, Eagle County. Name derived from station of Belden on Denver and Rio Grande Western Railroad.

Beldens Formation

Beldens Member (of Chipman Formation)

Lower Ordovician: West-central Vermont, and southern Quebec, Canada.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 550–552. Bright, orange-buff-weathering dolomite in beds 1 or 2 feet thick interbedded with snow-white marbly limestone. Near base, rock is duller buff or gray and less dolomitic, marble beds are less abundant, and mottled blue-gray limestones are the interbeds. Includes Weybridge member (new). Maximum thickness 600 to 700 feet. Underlies Mid-

dlebury limestone (new); overlies Crown Point limestone. Inasmuch as Day Point beds thin or pinch out, north of west-central Vermont, and inasmuch as the Valcour undergoes considerable change in lithology and obliteration of fossils eastward from Lake Champlain, Crown Point limestone is only term used along Lake Champlain appropriate in eastern area. Terms Beldens formation, Weybridge member of Beldens, and Middlebury limestone are here applied to beds probably mainly equivalent to the Valcour. Middle Ordovician (Chazyan).

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1172. In Highgate Springs sequence, the Beldens, about 500 feet thick, underlies Carman quartzite (new). Oldest exposed formation. Chazy.

Marshall Kay and W. M. Cary, 1947, Science, v. 105, no. 2736, p. 601. Included in Chipman group (new). Overlies Burchards limestone (new).

Marshall Kay, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1476. Beldens calcite marble of Middlebury synclinorium, west-central Vermont, has been classed as upper Chazyan because it succeeds *Maclurites*-bearing beds, recently called Burchards, long thought to be middle Chazy Crown Point. The Beldens in Middlebury synclinorium underlies Middlebury slaty argillicalcilutite; in Highgate Springs sequence to northwest, the Beldens is separated by succeeding Carman quartzite from Youngman slate in Vermont, and near St. Dominique, Quebec, the Beldens and Carman underlie calcarenites like those in the Day Point. The Beldens is interpreted as a calcitic facies of Bridport dolomite and of the upper Canadian series; the two facies are continuous in outcrop in Cornwall and Shoreham, and each has interbeds of the dominant lithology of the other; Weybridge quartz-silty facies of Beldens in Middlebury synclinorium has such genera as *Goniotelus* and *Syntrophia* in Orwell, Cornwall, and Weybridge, supporting late Canadian classification. Bridport is uppermost part of Beekmantown.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 65–96. Described in detail in Highgate Springs slice that extends from north of St. Dominique, Bagot County, Quebec, to northwestern Chittenden County, Vt., a distance of about 90 miles. Best sections of Beldens are (1) in lowland northwest of escarpment west of St. Dominque, one-half mile north of highway; (2) in hill south of Highway 104, one-half mile east of Swanton, Vt.; (3) west of road to Tuller School, one-half mile northeast of St. Albans Bay village, Vermont; and (4) on Mill River south of St. Albans Bay. The sections near St. Albans expose contact with younger Carman quartzite. Most striking feature about Beldens in Highgate slice is that it is persistent throughout belt of exposure, yet in no place has underlying Burchards been definitely recognized, yet the Beldens commonly lies directly beneath Lower Cambrian rocks of Rosenberg slice, as well displayed in Fonda quarry. Canadian. Ordovician classification discussed.

W. M. Cady and E-an Zen. 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Rank reduced to member status in the Chipman, herein reduced to rank of formation. Lower Ordovician (Beekmantown). [See Chipman formation, this reference.]

Named for exposures southeast of Beldens and west of highway north from Middlebury, Addison County, Vt.

Belfast Bed[1]

Upper Ordovician(?): Southwestern Ohio.

Original reference: A. F. Foerste, 1896, Cincinnati Soc. Nat. History Jour. v. 18, p. 161, 189, 190.

Named for Belfast, Highland County.

†Belfast Beds[1]

Mississippian: Southeastern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 43, 47, 214.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 812. Name Belfast has been proposed for Salem formation in Iowa. [Van Tuyl's proposal referred to representatives of Spergen limestone.]

Named for exposures near town of Belfast, Lee County.

Belgium Member[1] (of Lake Church Formation)

Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. Rept. 9th Ann. Field Conf., p. 260, 262, 263.

Probably named for town in Ozaukee County.

Belknap Flows, Tuff

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 56, 62, pl. 10. Discussion of volcanoes of Three Sisters region. Name Belknap is applied to flow that issued from Belknap Crater.

Belknap Crater is south of Mount Washington and west of Little Belknap Crater.

Belknap Limestone Member (of Thrifty Formation)

Belknap Limestone Member (of Harpersville Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31, 39.

U.S. Geological Survey currently classifies the Belknap as a member of the Thrifty Formation. Term Harpersville is abandoned.

Named for old Fort Belknap, Young County. Typical exposures are in vicinity of Newcastle.

Belknap Syenite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1903–1904, pl. 1. Typically coarse-grained aggregate of feldspar and hornblende without visible quartz. Fracture of rock rough and hackly. Intrudes older schists of the area. Angular blocks occur as inclusions in Sawyer quartz syenite. Contact with Albany syenite shows latter chilled against the Belknap. Assigned to White Mountain magma series.

Type locality: Elliptical body occurring on Belknap and Gunstock Mountains in the Belknap Range.

Belkofski Tuff

Tertiary, upper: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, p. 12, pl. 2; 1955, U.S. Geol. Survey Bull. 1028–A, p. 6–7, pl. 3. Thick series of well-bedded tuff composed largely of fine to coarse lithic tuff, ranging in color from green to purple to gray. Beds have been intensely silicified and sericitized in vicinity of diorite stocks that intrude them. Beds are gently undulating with average dips of 5° to 10°. Plant fossils, principally silicified and carbonized trunks of trees and impressions of conifer needles, present in lower part of formation beds 1 to 5 centimeters thick of silicified and carbonized plant remains present. Thickness more than 3,000 feet. Unit cut by stocks of quartz diorite, by basaltic plugs and necks, by thick sills of andesite, and by smaller sills and dikes of basalt and andesite. Conformably overlies nonfossiliferous beds of green arkose; lava flow units —Black Point basalt, Arch Point basalt, and Dushkin basalt (all new) —fill canyons and gullies carved in tuff and intrusive diorite stocks; probably comparable in age to Cathedral Valley agglomerate (new). Evidence indicates a post-Eocene, pre-Pleistocene age; tentatively assigned to late Tertiary.

Beds crop out principally around Belkofski Bay and on Belkofski Point, vicinity of Pavlof Volcano, Alaska Peninsula.

Bell Shale[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 191, 210.

G. M. Ehlers and R. E. Radabaugh, 1937, Michigan Acad. Sci., Arts, and Letters, Sec. Geology and Mineralogy [Guidebook] 7th Ann. Field Excursion [p. 8–9]; 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v. 23, p. 442. Base of Traverse group. Overlies Rogers City limestone (new).

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 578–580. Underlies Rockport Quarry formation and overlies Rogers City limestone in Thunder Bay area. Thickness 11 feet. Data on Grabau's locality.

Type locality not mentioned by Grabau, but he probably named formation from claypits (now abandoned) near former settlement of Bell. Workings still visible along country road in SE¼ sec. 11, T. 33 N. R. 8 E., Presque Isle County. Bell was situated on False Presque Isle Harbor in sec. 13, T. 33 N., R. 8 E. Bell post office was in SE cor. NE¼ sec. 34, same township.

Bella Shale[1]

Bella Shale Member (of Percha Shale)

Upper Devonian or Lower Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engineers Bi-Monthly Bull. 19, p. 7-21.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Assigned to Linnian series.

M. A. Stainbrook, 1947, Jour. Paleontology, v. 21, no. 4, p. 298. Considered upper member of Percha shale. Upper part of Percha also

termed Box member by Stevenson (1944). There is little doubt that the Bella and Box were proposed for identical divisions of Percha, and there is little reason to replace earlier name. Percha of early Mississippian age.

Named for Bella mine, near Lake Valley, Sierra County.

Bellaire Sandstone (in Conemaugh Formation)[1]

Bellaire sandstone and shale member

Pennsylvanian: Eastern Ohio.

Original reference: D. D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 20, 22.

D. L. Norling, 1958, Ohio. Geol. Survey Bull. 56, p. 62–63. Bellaire sandstone well represented in Morgan County [this report]. Occurs between Upper and Lower Little Pittsburgh coals when those thin beds are present. In absence of nonpersistent coaly streaks, Bellaire comprises interval between Lower Pittsburgh and Upper Pittsburgh limestone. Thickness of Bellaire member 10 to 20 feet. Strata consist of tan to buff fine- to medium-grained thin platy bedded sandstone which varies in amount of included sandy shales. Conemaugh series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 156. Condit (1912) named a sandstone closely underlying the Pittsburgh coal Bellaire for city of Bellaire, Ohio. He stated in same description that it [Bellaire] "is also prominent in Pennsylvania where it has been called Lower Pittsburgh sandstone." Stout (in Brownocker and Dean, 1929, Ohio Geol, Survey Bull. 34) placed the Bellaire in Upper Little Pittsburgh cyclothem rather than in its correct position as correlative of Lower Pittsburgh sandstone, that is, as basal member of Pittsburgh. cyclothem. Unless it can be demonstrated that Lower Pittsburgh sandstone is absent in type area of Bellaire sandstone, then Stout's correlation of Bellaire sandstone is in error as indicated by Condit's original definition.

Named for Bellaire, Belmont County.

Bell Canyon Formation (in Delaware Mountain Group)

Permian (Guadalupe Series): Western Texas and southern New Mexico.

P. B. King, 1940, *in* R. K. DeFord and E. R. Lloyd, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 4 (fig. 2), 8. Shown on correlation chart as uppermost formation in group. Occurs above Cherry Canyon formation (new).

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 581–586, pl. 2. Consists of sandstones and interbedded limestones. Thickness about 700 feet. Includes (ascending) Hegler limestone, Pinery limestone, Rader limestone. and Lamar limestone members. Conformably underlies anhydrites and limestones of Castile formation; overlies Cherry Canyon formation. Grades northwestward into Capitan limestone.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 53–59, pl. 3 [1949]. In southern part of Guadalupe Mountains, the Bell Canyon is 670 to 1,040 feet thick and consists of sandstone with some thin dark-gray limestone beds. In northern Guadalupe Mountains, grades into Capitan limestone; here it is 1,500 to 2,000 feet thick. Hegler, Pinery, and

Rader members are closely spaced in lower fourth of formation, and are separated by several hundred feet of sandstone from Lamar member; about half way between Rader and Lamar member is an unnamed "flaggy limestone bed."

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 15, 53. Includes McCombs limestone member (new) between Lamar limestone member above and Rader limestone member below.

Named for Bell Canyon, a gorge that drains eastward from Rader Ridge to old route of U.S. Highway 62, where it joins Lamar Canyon, Culberson County, Tex. Crops out in broad belt between crest of Delaware Mountains and Gypsum Plain on the east; lower part extends into Guadalupe Mountains, or into reef zone at margin of Delaware basin.

Belle City Limestone[1]

Pennsylvanian (Missouri Series): Central Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2, p. 123–125, pls. 3, 27, map.

W. F. Tanner, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 2047 (fig. 2), 2048 (fig. 3). Underlies Hilltop formation (new); overlies Nellie Bly formation or Francis formation.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 78–84, pls. 1, 2. In Seminole County, consists of upper and lower limestones separated by a dark shale. Maximum thickness 36 feet, thins northward. In central part of county, lies conformably between Nellie Bly and Hilltop formations; in southern part, the Vamoosa locally rests unconformably on the Belle City, which in turn is conformable with underlying Nellie Bly; between Belle City and Vamoosa are isolated outliers of red or blue shale which probably belong to Hilltop. In Pontotoc County, to the south, the Belle City is truncated by Ada formation. Type locality stated.

Type locality: Village of Belle City, SW¼ sec. 35, T. 8 N., R. 7 E., Seminole County.

Bellefonte Dolomite (in Beekmantown Group)[1]

Lower Ordovician: Central Pennsylvania and northern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 552, 553, 652–660, pl. 27.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 20–22, pls. 1, 3. Present locally in Draper Mountain area, Virginia. Maximum thickness less than 50 feet. Conformably overlies Draper dolomite member (new) of Nittany formation; unconformably underlies Mosheim limestone of Stones River group. Canadian. [Term Beekmantown not used in this report.]

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Bellefonte dolomite includes all dolomite above Axemann limestone and below Carlim limestone in Hollidaysburg-Huntingdon quadrangles. Thickness about 1,000 feet south of Roaring Spring; about 1,250 feet east of Williamsburg. Beekmantown group.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 72, 74–76. Term Bellefonte tentatively applied to upper member of Beekmantown.

Application of term Bellefonte here does not necessarily imply precise correlation with Bellefonte of central Pennsylvania. Term Beekmantown used as both formation and group.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Uppermost formation in Beekmantown group.

Named for exposures at Bellefonte, Centre County, Pa.

Belle Fourche Shale

Belle Fourche Shale Member (of Cody Shale or Colorado Shale)

Belle Fourche Shale Member (of Graneros Shale)[1]

Upper Cretaceous: Wyoming, Montana, North Dakota, and South Dakota.

Original reference: A. J. Collier, 1920, U.S. Geol. Survey Press Bull. 9065.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Shown on correlation chart as Belle Fourche shale; occurs above Mowry shale and below Greenhorn limestone.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 8, 9–10. Belle Fourche shale member is uppermost part of Graneros. Estimated thickness 580 feet. Includes Orman Lake limestone (new) near middle. Overlies Mowry shale member; underlies Greenhorn formation.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2197. Formations in Black Hills that are equivalent in Colorado shale are Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Belle Fourche shale of northern Black Hills consists of 565 feet of dark bluish shale, with many beds of bentonite and ferruginous concretions. In central Montana, it is represented by 240 to more than 315 feet of similar beds in middle of Colorado shale. Westward these beds become increasingly sandier and much thinner, and on west flank of Sweetgrass arch as little as 13 feet of sandy shale is of Belle Fourche age.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 12 (fig. 3), 17–21, pls. 1, 2. Basal member of Cody shale in Hardin district, Montana and Wyoming. Underlies Greenhorn member; overlies Mowry shale. Thickness about 482 feet. Includes Soap Creek bentonite bed in upper half. Rocks of this interval have, in part, been designated Frontier formation in publications dealing with this district (Thom and others, 1953; Richards and Rogers, 1951; Knechtel and Patterson, 1952).

U.S. Geological Survey currently classifies the Belle Fourche as a member of the Colorado Shale in Montana on the basis of a study now in progress.

Named for exposure along Belle Fourche River in vicinity of Wind Creek, Crook County, Wyo.

Belle Plains Formation (in Wichita Group)[1]

Belle Plains Group

Permian: Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 192–198, charts.

M. G. Cheney, 1904, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 93. Rank raised to group and expanded below to include Elm Creek limestone and Jim Ned shale (new), which strata had been included in the Admiral herein given group status and stratigraphically restricted above. As redefined, the Belle Plains includes (ascending) Jim Ned Shale, Elm Creek limestone, Jagger Bend limestone, Valera shale and anhydrite, and Bead Mountain limestone. Underlies Clyde group.

R. C. Moore, 1948, *in* M. G. Cheney, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets 3, 4. Formation further subdivided to include Voss shale member between Jagger Bend limestone member above and the Elm Creek limestone member below.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 80, sheet 2. Described in Colorado River valley as a formation. Consists mainly of gray limestone beds, 1 to 5 feet thick, separated by shale or marl in beds of comparable thickness. Near Colorado River is 400 feet thick. Includes (ascending) Jim Ned shale, Elm Creek limestone, Voss shale, Jagger Bend limestone, Valera shale, and Bead Mountain limestone members. Overlies Admiral formation; underlies Grape Creek member of Clyde formation; boundary somewhat arbitrarily defined.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 272–274, pls. 11, 12. Formation described in Brazos River area where it is 525 to 640 feet thick. Consists of six members as listed by Moore (1949). Overlies Admiral formation; underlies Clyde formation.

Named for town of Belle Plains, Callahan County.

Bellepoint Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 298, 365.

Type locality: In vicinity of Bellepoint, Summers County, and well exposed on Keeney Mountain road east of Hinton.

Bellepoint Member (of Columbus Limestone)[1]

Middle Devonian: Central Ohio.

Original reference. C. K. Swartz, 1907, Johns Hopkins Univ. Circ. 7, p. 62.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 276 (fig. 1). Shown on generalized section of Franklin and Delaware Counties as underlying Ebersole chert member or Marblehead member where the Eversole is absent; overlies Bass Island.

Named for Bellepoint, Delaware County.

Bellepoint Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties. p. 297–298, 360–368.

Type locality: In bluffs of New and Greenbrier Rivers near Bellepoint, Summers County; also seen in Mercer County.

Bellepoint Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297–298, 362–371.

Type locality: In road which ascends Wolf Creek Mountain just southeast of Bellepoint; also observed in Giles and Tazewell Counties, Va.

Belleville Formation[1]

Pleistocene: Central northern Kansas.

Original reference: M. E. Wing, 1930, Kansas Geol. Survey Bull. 15, p. 12, 19.

V. C. Fishel, 1948, Kansas Geol. Survey Bull. 73, p. 89–95. Does not agree with Lugn's (1934) proposal to abandon name in favor of Grand Island formation. Name Belleville is retained in this report to designate stream-deposited sand and gravel in Republican that occurs in and near channel of ancestral Republican River and below loess. Overlies Greenhorn limestone. Pleistocene.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Used by Wing (1930) for beds which are now, at least in part, Sanborn formation.

Probably named for occurrence near Belleville, Republic County, Kans.

Bellevue Limestone Member (of McMillan Formation)[1]

Bellevue Formation (in Maysville Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and central northern Kentucky.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 82.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on chart of Ordovician rocks exposed in Jefferson and Switzerland Counties as Bellevue formation. Blue to dark-gray irregularly bedded rubbly highly argillaceous limestone; contains clay partings and fossils. Thickness 25 to 35 feet. Underlies Corryville formation; overlies Fairmount formation.

Named for old Bellevue House, a landmark, now disappeared, at bend in Clifton Avenue, Cincinnati, Ohio.

Bell Hill Dolomite

Middle Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI-330, p. 105; M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 23–25, pl. 1. Made up of two members: lower eight-ninths is dark-gray coarse-grained clastic dolomite; upper one-ninth is light-gray fine-grained dolomite. In northern part of Spor Mountain, a 28-foot-thick dolomite bed with distinctive contorted, convoluted appearance occurs approximately 40 feet from top of unit. Thickness 395 to 430 feet. Overlies Floride dolomite and underlies Harrisite dolomite (both new).

Type section: On steep mountainside one-half mile north of Floride mine, NE¼ sec. 3, T. 13 S., R. 12 W., Juab County. Named for Bell Hill mine on southern end of Spor Mountain.

Bellingham Beds[1]

Eocene: Northwestern Washington.

Original reference: L. G. Hertlein and C. H. Crickmay, 1925, Am. Philos. Soc. Proc., v. 64, no. 2, p. 225–226.

Bellingham Bay region.

Bellingham Conglomerate[1]

Pennsylvanian: Southeastern Massachusetts and northeastern Rhode Island.

Original reference: G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zool. Bull., v. 49, geol. ser., v. 8, no. 4, p. 99.

G. M. Richmond, 1951, *in* G. M. Richmond and W. B. Allen, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 5, p. 15–16, pl. 1. Described in two small structural basins in Georgiaville quadrangle, Rhode Island. Unconformably overlies Absalona and Woonasquatucket formations (both new) and Blackstone series. Age considered Carboniferous and probably Pennsylvanian.

Outcrop area extends from near North Bellingham, Mass., southward into Rhode Island.

Bellisle Mountain Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 121, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined. Bellisle Mountain is fourth in known sequence; younger than Mud Hill and older than Robinson Mountain. Consists of single flow 15 to 20 feet thick and with well-developed platy structure.

Bellisle Mountain is small volcanic peak 10 miles west of Union County on Johnson Mesa in northeastern Colfax County.

Bell Mountain Quartz Diorite

Late Paleozoic or Mesozoic: Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 504. Cuts Paleozoic metasediments and is intruded by Victorville quartz monzonite.

Occurs in several parts of Victorville area, San Bernardino County.

†Bell Mountain Sandstone Member (of Miguel Formation)[1]

Upper Cretaceous: Southwestern New Mexico.

Original reference: D. E. Winchester, 1920, U.S. Geol. Survey Bull. 716-A.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187. Abandoned because unit that was so named is merely an upfaulted duplication of Gallego sandstone member of Gallup sandstone.

Well exposed near foot of Bell Mountain, T. 3 N., R. 9 W., Socorro County.

Bellows Falls Granite Gneiss[1]

Post-Ordovician: Southeastern Vermont and southwestern New Hampshire.

Original reference: E. Hitchcock, 1823, Am. Jour. Sci., 1st, v. 6, p. 11–12, map dated 1822.

Extends from village of Bellows Falls, Vt., south into Westminster and east across Connecticut River into Walpole, N.H.

†Bellowspipe Formation[1]

Ordovician: Northwestern Massachusetts.

Original reference: T. N. Dale, 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 559, 562.

On Mount Greylock, Berkshire County.

Bellowspipe Limestone[1]

Ordovician: Northwestern Massachusetts.

Original reference: T. N. Dale, 1891, Am. Geologist, v. 8, p. 1–7.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Most previous authors have drawn upper contact of Berkshire schist below Bellowspipe limestone but validity of this limestone as a formation is questionable. Within Cheshire quadrangle [this report], Bellowspipe limestone grades into rocks, both above and below, that are clearly Berkshire schist. Furthermore its eastern and western areas of outcrops differ lithologically and are at different stratigraphic horizons, so they cannot be traced into each other.

Named for occurrence at the "Bellows Pipe," in notch between Ragged Mountain and Greylock.

†Bellowspipe Quartzite[1]

Ordovician: Southwestern Massachusetts.

Original reference: T. N. Dale, 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 559, pl. 71.

In Monument Mountain, in southwest part of Berkshire County.

Bell Ranch Formation (in San Rafael Group)

Upper Jurassic: Northeastern New Mexico.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2006, fig. 2. Alternating sequence of light-gray sandstone and brownish-red siltstone beds. The alternating, parallel beds are 2 to 10 feet thick, in sharp contrast to massive Entrada sandstone below and poorly bedded Morrison formation above. Small nodules of gypsum present in uppermost bed of siltstone in northeastern part of area, and in vicinity of Colorado line, thin beds of gypsum found within beds of siltstone. Thickness 66 feet at type locality; ranges from 0 to about 65 feet in the area. Formerly called Wanakah formation in this area.

Type section: At Carpenter's Point, 18 miles southeast of Bell Ranch headquarters and 13 miles northwest of Tucumcari. Named from Bell Ranch and proposed that name be used in Tucumcari-Sabinoso area and in northeastern New Mexico.

Bells Landing Marl Member (of Tuscahoma Sand)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1883, Alabama Geol. Survey Prog. Rept. for 1881–82, p. 256, 321.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 65, pl. 3. Described in Choctaw County where it lies about 25 feet above the Greggs Landing marl member and about 120 feet below Bashi marl member of Hatchetigbee formation.

Named for exposures at Bells Landing, on Alabama River, in Monroe County.

†Bells Landing Series[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 46–51.

Named for exposures at Bells Landing, on Alabama River, in Monroe County.

Bellton coal group (in Greene and Washington Formations)[1]

Permian: Northern West Virginia and southwestern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 32, 34.

Named for Bellton, Marshall County, W. Va.

Bell Top Formation

Miocene: Southwestern New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 145, 148 (chart). Consists of pumice, soft pinkish rhyolite tuffs, vitrophyre flows and dikes, banded rhyolite flows and domes interbedded with light-colored pumiceous and tuffaceous sand and sandstone, and a few lenses of stream gravel. Thickness more than 800 feet. Underlies Uvas basalt (new); overlies unnamed rhyolite.

Exposed in Las Cruces region of Rio Grande Valley.

Bellvale Flags[1]

Bellvale Sandstone[1]

Bellvale Sandstone Member (of Marcellus Formation)

Middle Devonian: Southeastern New York and northern New Jersey.

Original reference: N. H. Darton, 1894, Geol. Soc. America Bull., v. 5, p. 367, 373.

Bradford Willard, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 196, p. 271, 272. In proposed stratigraphic nomenclature for Green Pond Mountain area, New Jersey, Bellvale sandstone is considered member of Marcellus formation. Overlies Cornwall shale member of Onondaga formation; passes gradually upward into continental Skunnemunk conglomerate.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1794, chart 4. Bellvale sandstone shown on correlation chart below Skunnemunk conglomerate and separated from underlying Cornwall shale by a unit termed Bakoven(?)

Name derived from Bellvale Mountain, Orange County, N.Y.

Bell Valley Andesite (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad Map 21. Name proposed for a thick sequence of dark-gray olivine andesite flows. Maximum exposed thickness 610 feet on Chipsa Mountain. Youngest volcanic formation in area.

R. K. DeFord and others, 1958, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., Guidebook Apr. 10, 11, 12, p. 31 (fig. 14). Gen-

eralized columnar section shows Bell Valley andesite above Means trachyte.

Type section: North side of Chipsa Mountain, Wylie Mountains area, Jeff Davis County. Name derived from Bell Valley on north side of Chipsa Mountain.

Bellwood Dolomite

Silurian (Niagaran): Northeastern Illinois.

T. E. Savage *in* C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 536, chart 3. Proposed for beds formerly called Waukesha dolomite in northeastern Illinois. Underlies Racine dolomite; overlies Joliet dolomite (restricted).

H. B. Willman, 1943, Illinois Geol. Survey Rept. Inv. 90, p. 29. Term Bellwood as used by Savage (1942) includes strata herein considered Waukesha and Racine.

Well exposed in vicinity of Bellwood, Cook County.

Belmont facies[1] (of Locust Point Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 143–145.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Correlation chart lists Belmont facies of Locust Point formation.

Name derived from village of Belmont situated on State Highway 46, 1 mile east of Monroe-Brown County line, SW¼SW¼ sec. 6, T. 8 N., R. 2 E.

Belmont Fanglomerate

Pliocene(?): Northeastern Nevada.

T. E. Eakin, 1960, Nevada Dept. Conserv. Nat. Resources Rept. 1, p. 26. Chiefly unbedded gravel and fanglomerate. Unconformable above Lake Newark formation (new); unconformable below alluvium. Name credited to F. L. Humphrey (in press).

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 46, pl. 1. Formal proposal of name. Composed of unsorted and generally massive limestone, sand and pebbles, chert pebbles, and locally quartzite and granitic debris. Drill hole near Monte Cristo penetrated 1,200 feet of gravel without encountering bedrock. Upper formational contact arbitrarily placed because no clearly defined boundary between fanglomerate and recent alluvium and reworked gravels was recognized. Overlies Lake Newark formation (new) or bedded gravels which possibly correlate with Lampson formation (new).

Name derived from Belmont Canyon, White Pine mining district, White Pine County.

Belmont Porphyry[1]

Tertiary, upper(?): Central western Montana.

Original reference: J. Barrell, 1907, U.S. Geol. Survey Prof. Paper 57.

Mapped on and around Mount Belmont, 1 mile west of Marysville, Lewis and Clark County.

Beloit Dolomite[1]

Middle Ordovician: Eastern Wisconsin and northeastern Illinois.

Original reference: F. W. Sardeson, 1896, Am. Geologist, v. 18, p. 356–368.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 113. Listed among upper Mississippi Valley formations not in general use.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 262–264. In eastern part of zinc-lead mining district and farther east, strata of Platteville, Decorah, and Galena age are dolomite, and gross lithology of the three formations is somewhat similar. This eastern area is the type for Sardeson's (1896) Beloit formation. However, since term Beloit has been virtually forgotten and terms Platteville and Decorah have been used consistently since 1906, they are retained in this report.

Named for exposures at Beloit, Wis.

Belridge Diatomite

Miocene, upper: Southern California.

S. S. Siegfus, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 25. Name applied to diatomite facies that has not been clearly differentiated from typical Reef Ridge shale lithology into which it grades laterally.

Umberto Young, 1943, California Div. Mines Bull. 118, pt. 3, p. 523–524. Consists largely of both massive and bedded white punky diatomaceous shale which weathers to a yellowish gray and is interbedded with thin lenses of white quartz sand; also occasional interbeds of dark-grayish brown siltstone and some sandstone and conglomerate reefs. Thickness about 1,200 feet. Unconformably underlies Etchegoin formation; overlies McLure shale.

Occurs in Midway-Sunset area in San Joaquin Valley.

Belt Series[1]

Precambrian: Montana, Idaho, and Washington, and British Columbia, Canada.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110, p. 15–20.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1873–1970. Belt series, within its northern basin, is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Of these facies, following are herein defined: Meagher, Blackfoot Canyon, Glacier Park, Galton, Purcell, and Coeur d'Alene. Comprises (ascending) Ravalli, Piegan (new), and Missoula groups. Following formations described: Altyn, Appekunny, Grinnell, Siyeh, Spokane, and Miller Peak.

Charles Deiss, 1943, Geol. Soc. American Bull., v. 54, no. 2 ,p. 211–218. In Saypo quadrangle, Montana, only upper Belt rocks are exposed. Series divided into (ascending) Miller Peak argillite, Cayuse formation (new), Hoadley formation (new), and Ahorn quartzite (new). Formations are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931).

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1096–1099. In Borah Peak quadrangle, Idaho, Belt series subdivided into (ascending) Lemhi and Swauger quartzites (both new).

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 8–19, pl. 1. Thickness 40,000 feet in Libby quadrangle, Montana. Comprises five formations (ascending): Prichard, Ravalli, Wallace, Striped Peak, and Libby (new). Prichard, Wallace, and Striped Peak correlated with formations of same name in Coeur d'Alene district; the Ravalli correlated with Burke formation, Revett quartzite, and St. Regis formation of that district.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111–113. Proposed to include lower part of Belt series in Ravalli group with exception of Prichard formation and Neihart quartzite, the middle part in the Piegan group, and upper part in Missoula group. Name North Boulder group proposed for hitherto unnamed components of Belt series in isolated exposures near Jefferson River, southeast of Butte. Relations between North Boulder group and units farther north are not clear. The North Boulder may be equivalent in age to some part of Missoula group or to part of that group and part of Piegan group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 16–57, pls. 1, 2. Discussion of Belt series in Glacier National Park and Flathead region, Montana. Terms Ravalli, Piegan, and Missoula groups are used but their limits are redefined. Table compares present terminology with that used by Fenton and Fenton (1937).

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Belt series, in Bonner quadrangle, Montana, comprises (ascending) Piegan group with Newland limestone, and Missoula group consisting of (ascending) Miller Peak argillite, Bonner quartzite (new), McNamara argillite, Garnet Range quartzite, and Pilcher quartzite (new).

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 551–569, pl. 28. St. Regis-Superior area, Mineral County, Mont., is underlain by about 50,000 feet of metasedimentary rocks of Belt series. Lower part of Belt series is divided into (ascending) Prichard, Burke, Revett, St. Regis, and Wallace formations; upper part, or Missoula group, is divided into (ascending) Spruce, Lupine, Sloway, and Bourchard formations (all new), and an unnamed feldspathic quartzite.

Name derived from extensive development in Big Belt and Little Belt Mountains of central Montana.

Belton Sand (in Chanute Formation)

Pennsylvanian (Missouri Series): Northwestern Missouri.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, p. 20–25, pl. 1. Consists of main lens, elongated in general northeast-southwest direction and three smaller disconnected lenses, at about same horizon, which have slightly different alignment. Total area about 8 square miles. Stratigraphically replaces Westerville limestone of Kansas City group and all or parts of shale above and below this horizon in area where it is present. Varies from 0 to 34 feet in thickness and occurs at depth of 59 to 152 feet below surface in wells.

Present under all or parts of secs. 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 19, 20, and 30, T. 46 N., R. 33 W., Cass County. Derivation of name not stated but town of Belton lies in this area.

Belva Shale[1]

Pennsylvanian: Western Arkansas.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Belva, Scott County.

†Belvidere Shale[1] (in Dakota Group)

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: R. T. Hill, 1859, Am. Jour. Sci., 3d, v. 50, p. 208–234.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.; Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21-23]. Underlies Ellsworth formation (new); overlies Cheyenne sandstone. Comprises (ascending) Kiowa shale, Marquette sandstone, and Mentor sandstone member. Dakota group.

R. C. Moore and K. K. Landés, 1937, Geologic map of Kansas (1:500,000): Kansas Geol. Survey. Mapped with Dakota group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 154. Kiowa shale as herein defined probably contains stratigraphic units formely called "Greenleaf sandstone," "Mentor beds," and others, and is in part equivalent to "Belvidere formation," "Medicine bed," "Elk River beds," and others.

Named for Belvidere, Kiowa County.

Belvidere Mountain Amphibolite[1] (in Camels Hump Group)

Cambrian: Northwestern Vermont.

Original reference: S. B. Keith and G. W. Bain, 1932, Econ. Geology, v. 27, no. 2, p. 173–174.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. Very coarse-grained amphibolite with large blades of dark-green hornblende, porphyroblasts of dark-red almandite garnet, and segregations of epidote. Assigned to Camels Hump group as upper formation. Maximum thickness about 1,000 feet. Underlies Ottauquechee formation; overlies undivided Camels Hump group. Type locality cited.

Named for exposures on Belvidere Mountain [in Jay Peak quadrangle], 3½ miles north-northwest of The Knob.

Bena Gravels

Miocene, lower and middle: Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 38–40, pls. 1, 2, 3. Series of terrestrial gravels of lower and middle Miocene age conformably overlying Walker formation and Ilmon basalt (new) and unconformably underlying Kern River gravels in lower Caliente Canyon. In Cottonwood Canyon (outside mapped area), Bena gravels overlie Freeman-Jewett shale and grade laterally into marine Olcese sandstone and Round Mountain silt. Considered continental facies of lower and middle Miocene marine formations of eastern San Joaquin Valley. Thickness at type locality about 2,500 feet.

Type locality: Hills 3 miles southeast of Bena, Breckenridge Mountain quadrangle, Kern County. Also well exposed from Bena northwestward into Cottonwood Canyon.

Benbolt Limestone or Formation

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 833–836, 868–871. In Tazewell County, strata embraced by Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Benbolt is applied to unit which includes second zone of coarse-grained limestone (zone 10), *Opikina* beds (zone 11), *Chasmatopora* beds (zone 12), and zone of crossbedded limestone (zone 13). Zones 10 and 11 are designated Shannondale limestone member; zones 12 and 13 Burkes Garden limestone member. Maximum thickness 325 feet. Overlies Cliffield formation (new); underlies Gratton limestone (new). Benbolt is probably the same as Butts' Lenoir of certain areas, and, in western Tazewell County and in Burkes Garden, comprises part of Butts' Ottosee.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 138 (fig. 12), 139–140, 141 (fig. 13). In Russell County, overlies Rockdell limestone (new) and underlies Wardell formation.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists, v. 30, no. 7, p. 1160–1165. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Detailed sections measured along seven belts were compared with revised classification of Tazewell County, Va. The Blackford, Five Oaks, Lincolnshire, Thompson Valley (new), upper Peery, Benbolt, Wardell, Bowen, Witten, and Moccasin formations extend into Tennessee. Benbolt is well developed in St. Paul belt from Narrows, Va., southwest to and beyond Heiskell, Tenn. At Heiskell, Ulrich (1911) assigned name Heiskell, though without definition, to beds which there presumably contain Benbolt and Wardell formations. In absence of Gratton calcilutite, Benbolt and Wardell formations are essentially inseparable lithologically. Where contact between Benbolt and Wardell cannot be accurately drawn, the two should be combined under Sevier formation as defined in this report.

Type section: About 1⅛ miles south of Benbolt, west of Tazewell County Farm. Named after historic homestead in east environs of Tazewell, Va.

Benbrook Limestone Member (of Goodland Formation)

Lower Cretaceous (Comanche Series): Northeastern Texas.

B. F. Perkins, 1957, Dissert. Abs., v. 17, no. 6, p. 1310; 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 17 (fig. 7), 18 (fig. 8), 19, 20–21. Proposed for upper section of thick limestones and marly limestones of Goodland formation. At type locality, consists of 70 feet of thick limestone and marly limestone units alternating with thinner marls. Overlies Marys Creek member (new); underlies Kiamichi formation.

Type locality: Along Marys Creek on Rowan Ranch, 2.7 miles northwest of town of Benbrook, Tarrant County.

†Bend Formation[1]

Lower and Middle Jurassic: Northern California.

Original reference: J. S. Diller, 1895, U.S. Geol. Survey Geol. Atlas, Folio 15.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 976. Abandoned in favor of Potem formation.

Crops out along western arm of Great Bend of Pit River, Gold Belt region.

Bend Group[1]

†Bend (Bendian) Series[1]

Lower and Middle Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lxv.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Group as mapped includes Marble Falls limestone and Smithwick shale.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). 82–83. Marble Falls and Smithwick deposits as seen at outcrop form natural unit structurally that has been referred to as Bend series or Bend group. When studied regionally, including areas where covered by later sediments, these beds are divisible into three lesser groups. In this report, these groups are termed Marble Falls, Big Saline (new), and Smithwick. Big Saline and Smithwick are groups in Lampasas series (new), and Marble Falls is group in Morrow series. Term group has broad meaning and wide application without regard to series boundaries; hence continued use, when needed, of term Bend group does not appear inconsistent with usage of these lesser group names proposed here.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 185–186. Report proposes that term Atoka formation be elevated to Atoka series and defined to include all beds from top of Morrow series to base of Des Moines series. This would include the Marble Falls and Smithwick. Term Atoka is preferred to redefinition of Lampasas series or of older term Bend group or series.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., Spring Mtg. and Field Symposium May 11, 12, p. 70. Bend series, as presently recognized, includes Smithwick formation and Marble Falls, exclusive of that part of Marble Falls which may be of Morrowan age.

R. C. Moore, 1958, Introduction to historical geology: New York, McGraw-Hill Book Co., p. 244 (fig. 10, 11). Diagrammatic section shows the Bendian occupying interval between Morrowan below and Desmoinesian above.

R. C. Moore, ed., 1960, Treatise on invertebrate paleontology, pt. 1, Mollusca 1: Lawrence, Kans., Univ. Kansas Press, p. xxi. List of divisions of geologic column shows Bendian stage in lower part of Oklan series, Middle Pennsylvanian.

Named for exposures at McAnnelly's Bend of Colorado River, San Saba County.

Ben Day Porphyry

Tertiary, lower: Southwestern Texas.

R. L. Ives, 1941, Am. Jour. Sci., v. 239, no. 5, p. 344, 347. Dense grayish porphyry with light-colored glassy-appearing phenocrysts, some of which iridesce like labradorite. Arrangement of phenocrysts in some of the darker porphyries is very regular.

Occurs as sheets, dikes, and necks in Mitre Peak area, which lies across Brewster-Jeff Davis County line, roughly 12 miles northwest of Alpine.

Bendian Period

Post-Chester-pre-Des Moines: Midcontinent.

Original reference (Bend Series): E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lxv.

B. H. Harlton, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 8, p. 1018–1049. On basis of paleontological and diastrophic evidence, term Bendian is proposed for new period to include that part of section between Chester group of Mississippian age and Des Moines series of Pennsylvanian age. Bendian period in midcontinent is divided into Lower, Middle, and Upper Bendian. In Ardmore basin, Lower Bendian is represented by basal Springer formation, Middle Bendian by middle and upper Springer formation, and Upper Bendian by lower and middle Dornick Hills formation. These formations are correlated with Hot Springs sandstone, Stanley shale, Jackfork sandstone, and Johns Valley shale, the Bendian representatives in Ouachita Mountains. Carboniferous stratigraphy of Ouachita Mountains is made up of Mississippian part of Arkansas novaculite, Bendian Hot Springs sandstone, Stanley shale, Jackfork sandstone, Johns Valley shale, and Pennsylvanian Atoka formation.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 852–914. Bendian period subdivided into two series, Pushmataha (new) below and Morrow above.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 130–139. Discussion of age classification of upper Pushmataha series in Ouachita Mountains. [Term Bendian period not used in this paper.]

Benevides Formation

Cretaceous (Comanche Series): Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981; 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. Lower part dark-gray shales; overlain by yellow-brown skeletal calcarenite that forms prominent cap rock. Thickness 125 to 150 feet. Overlies Finlay limestone; underlies Loma Plata limestone (new).

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 23. Described in Van Horn Mountains where it is 160 feet thick. Concordantly overlies Finlay limestone and underlies Loma Plata limestone.

Type section: One and one-half miles southwest of Cleveland triangulation station, Pinto Canyon area, Presidio County. Named from Benevides Ranch.

Benezette Limestone Member (of Pocono Formation)[1]

Mississippian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1885, Pennsylvania 2d Geol. Survey Rept. R_2, p. 104–105.

Crops out 1 mile west of village of Benezette, Elk County.

Ben Hur Limestone

Middle Ordovician: Southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Buff-weathering shaly limestone with a few interbeds of purer crystalline limestone. Thickness 127 to 153 feet. Underlies Hardy Creek limestone; overlies Woodway limestone (new). Same as lower unnamed member of Moccasin limestone on U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 56–58. 117, pl. 1. Further described and type section given. Thickness at type locality 125 feet. Discussion of correlation problems and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Type section: Along railroad cut of Louisville and Nashville Railroad 1,000 feet west of railroad station at Ben Hur, Lee County.

Benito Sandstone (in Panoche Group)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Green micaceous sandstone 1,100 feet thick. Overlies Redil shale (new); underlies Ciervo shale (new). Name credited to D. W. Sutton (1960, unpub. thesis).

Type locality: Papanatas Canyon, Fresno County. Name derived from Benito Hill, near center south line sec. 32, T. 14 S., R. 11 E.

Benner Group or Formation

Benner Limestone (in Black River Group)

Benner Limestone (in Hunter Group)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Name applied to limestone in Black River group. Includes Stover and Snyder members. Thickness 189 feet in type section.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 15–19. Subdivided into Snyder member (lower) and Stover member (upper). Overlies Hostler member of Hatter formation. Underlies Valley View member of Curtin limestone in northwestern outcrops as at Bellefonte; disconformably underlies Nealmont limestone from Union Furnace southeastward as it thins by loss of upper beds. Derivation of name, distribution, and more exact location of type section stated.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. [1402], 1409. Assigned to Hunter group and Hunterian subseries (Bolarian series). Comprises lower and greater part of group.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 97, 102. Rank raised to a group; term replaces Hunter group for application to upper Bolarian series.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Benner formation.

Type section: In Pennsylvania Railroad cut at Union Furnace, Huntingdon County. Named for Benner Township, Centre County, where recognized in section near Bellefonte. Present throughout central Pennsylvania southeastward to western belts of Cumberland Valley.

Bennerian Stage

Middle Ordovician (Bolarian): Virginia and West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 100. Name applied to later of two stages of Bolarian epoch in discussion of Middle Ordovician formations of eastern and southern West Virginia and western Virginia.

[Name probably derived from Brenner Township, Centre County, Pa., for which Benner limestone (and group) is named.]

Bennett Formation

Pliocene, lower: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Bennett Shale[1] Member (of Red Eagle Limestone)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88, 185.

R. C. Moore, 1935, Rock formations of Kansas in Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 8. Rank reduced to member status in Red Eagle formation. Overlies Glenrock limestone member; underlies Howe limestone member.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. As currently defined, consists of shale and, locally, some impure limestone; shale is characteristically dark gray to black in lower part and light gray in upper part; brachiopods abundant locally in black shale; grades into limestone southward from Elk County, Kans. Thickness 2½ to 15 feet. Underlies Howe limestone member; overlies Glenrock limestone member. Wolfcamp series.

Type locality: Along Little Nemaha and its branches south of Bennett, Lancaster County, Nebr.

Bennett Bridge Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 87–89, 131, 141, 149, 154.

Exposed along upper Sandy Creek and at Bennett Bridge, below Salmon Falls, Oswego County.

Bennettsville facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 149–163.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 75; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128,

pl. 1. Facies nomenclature discussed. Bennettsville is one of eight facies of Carwood formation.

Name derived from village of Bennettsville, 3¼ miles southeast of Carwood, east-center sec. 14, T. 1 S., R. 6 E., Clark County.

Bennington Limestone[1]

Lower Cretaceous: Southeastern and central southern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79. L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart above Bokchito formation and below Woodbine sand.

Named for Bennington, Bryan County.

Bennington Quartzite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: C. D. Walcott, 1896, U.S. Geol. Survey Bull. 134, p. 33.

In Bennington County.

Bens Creek Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 204.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 77. Massive sandstone in Kanawha group between Eagle above and Bens Creek coals.

Named for Bens Creek, Mingo County.

Benson Dolomite Member (of Tribes Hill Formation)

Lower Ordovician: East-central New York.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Named as member of Tribes Hill.

R. R. Wheeler, 1942, Am. Jour. Sci., v. 240. no. 7, p. 518, 522. Top unit in Tribes Hill in Champlain and Hudson Valleys. Overlies Fort Ann limestone member; disconformably underlies Cassin formation. Represents divisions C 4 and D 1 of Brainerd and Seely's "Calciferous." [See 1890 and 1891 references under Beekmantown group.]

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 74. Name preoccupied; unit is middle Canadian in age, not Tribes Hill (lower Canadian). Subdivisions of Tribes Hill in Champlain Valley are poorly defined and can not be used in Mohawk Valley.

Occurs in Champlain and Hudson Valleys.

Benson facies (of Cow Bayou Member of Logansport Formation)

Paleocene (Midway): Northwestern Louisiana.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 112–114. Named as lower facies of member. Consists of wedge(?) of chocolate-brown lignitic clays with interbedded gray silts; carries marine and brackish water microfauna and macrofauna. Transitional into underlying Lula facies.

Type locality: Exposures in roadcut on north side of State Highway 745, one-half to three-fifths mile west of Benson, in SW¼NE¼ sec. 9, T. 10 N., R. 13 W., De Soto Parish.

Benson Limestone[1]

Mississippian: Utah.

Original reference: F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 109, 113.

Named for occurrence in Reade [Reed] and Benson Ridge, just above old mine workings of same name, in Salt Lake County.

†Benson Limestone[1] (in Lexington Group)

Benson Limestone (in Lexington Limestone)

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 380, 389, 429, 430.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41, 42; 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 13–14. Considered uppermost formation in Lexington group.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1635–1636. Occurs at top of lower Lexington limestone; overlies Jessamine limestone; underlies Brannon limestone in middle Lexington. Thickness 40 to 75 feet. South from central Bluegrass area includes Perryville facies (until recently regarded as post-Woodburn in age and referred to as Perryville formation).

Named for Benson, Franklin County.

Bent Beds (in Bluestone Formation or Group)

See Bent Mountain Member (of Bluestone Formation).

Bent Limestone (in Bluestone Formation)[1]

Bent Sandstone (in Bluestone Formation)[1]

Bent Shale (in Bluestone Formation)[1]

Mississippian (Chester Series): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 293, 316.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 186. Reger's (1926) subdivisions of the Bluestone, Lower Bent shale, Bent limestone, Upper Bent shale, and Bent sandstone are herein defined as Bent Mountain member of Bluestone formation. Reger's Lower Bent shale and Bent limestone are the same as his Upper Bent shale; a double thickness of Upper Bent shale, produced by close folding, is exposed along Road 656 about 1½ miles north of Bailey; here, Reger apparently mistook the repeated Upper Bent shale for his Lower Bent shale and Bent limestone; the Bent sandstone of Reger, which overlies the Upper Bent shale on Bent Mountain, W. Va., is not present in area of this report [Burkes Garden quadrangle].

Type locality: Bent Mountain, Mercer County, W. Va., 1.2 miles southeast of Pride.

Bentley Formation

Bentley Member

Pleistocene: Central and southwestern Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 157–160. The series of Pleistocene deposits in Grant and La Salle Parishes is divided into four members, their names corresponding to the four

distinct depositional terrace surfaces: Williana (oldest), Bentley, Montgomery, and Prairie. Bentley member consists of sequence which grades from coarse basal materials to silty clays in upper part of section; differs from Williana sediments in that they are thinner, and show greater variation in central and upper parts of sequence. Average thickness less than 60 feet. Unconformably overlies Miocene Catahoula formation; along eastern valley wall of Nantaches Lake is in unconformable contact with Jackson Eocene.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 177–180, pl. 1. Rank raised to formation. Described in Rapides and Avoyelles Parishes where along walls of Red River Valley it has an average thickness of 80 to 100 feet; locally overlies undifferentiated Fleming formation.

Well exposed along State Highway 19 between Bentley and Colfax, Grant Parish, and between Trout and White Sulphur Springs, La Salle Parish, and on U.S. Highway 71 between Grant-Rapides Parish line and Bayou Rigolette.

Bent Mountain Member (of Bluestone Formation)

Mississippian (Chester Series): Southeastern West Virginia and southwestern Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 186, pl. 15. Bent Mountain member, as herein defined and used, consists of four of Reger's (1926) subdivisions of the Bluestone, Lower Bent shale, Bent limestone, Upper Bent shale, and Bent sandstone. In Burkes Garden quadrangle, member consists of only lower 60 feet of member as developed at type locality; most of the 60-foot section is red and green shale and mudrock. Overlies Hunt member (new). Reger's Lower Bent shale and Bent limestone are same as his Upper Bent shale. Double thickness of Upper Bent shale, produced by close folding, is exposed along Road 656 about 1½ miles north of Bailey; here, Reger, apparently mistook the repeated Upper Bent shale for his Lower Bent shale and Bent limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98). Shown on correlation chart as Bent Mountain beds (or Bent beds) in Bluestone formation or group.

Type locality (Reger, 1926): On Bent Mountain, Mercer County, W. Va., 1.2 miles southeast of Pride.

Benton Sand[1]

Tertiary: Southeastern Missouri.

Original reference: C. F. Marbut, 1902, Missouri Univ. Studies, v. 1, no. 3, p. 18, 23, 32.

Named for exposures at Benton Ridge, Scott County.

Benton Shale[1] or **Formation** (in Colorado Group)

Benton Group

Lower and Upper Cretaceous: Southeastern Montana, eastern Colorado, northwestern Iowa, southern Minnesota, northeastern New Mexico, South Dakota, and eastern Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 421.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 14. Name Benton, given by Meek and Hayden to include section now classed as Carlile, Greenhorn, and Graneros, is no longer in use except at places

where the Greenhorn is poorly developed or absent. This condition does not obtain in Nebraska, and name Benton is dropped.

B. C. Petsch, 1946, South Dakota Geol. Survey Rept. Inv. 53, p. 17 (fig. 5), 43–47. Discussion of geology of Missouri Valley in South Dakota. Text refers to Benton group as comprising Graneros shale, Greenhorn limestone, and Carlile shale. Group is exposed along Missouri River from St. Helena in Cedar County, Nebr., to Ponca State Park in Nebraska. Exposures are also present in Iowa along bluffs of Big Sioux River from Akron to Sioux City and along tributaries to the Bix Sioux in Union County, S. Dak. Table of formations (fig. 5) shows Benton formation, in Colorado group, comprises Graneros, Greenhorn, and Carlile as members.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 51–52, measured secs., pl. 1. In South Park, Colo., the Benton of Colorado group, consists mainly of black shale; some sandstone, limestone, and bentonite beds present. Thickness 410 to 460 feet. Conformably overlies Dakota formation, underlies Niobrara formation, probable unconformity.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1001. Benton formation listed in geologic succession in central Minnesota.

K. M. Waagé, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 373 (fig. 1). Benton shale shown on generalized stratigraphic section of rocks exposed in Denver-Golden area. Thickness 480 feet. Overlies Dakota sandstone; underlies Timpas limestone.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwestern part of Mora County, N. Mex., formation represented by equivalents of Graneros shale, Greenhorn limestone, and Carlile shale. Thickness 395 feet. Overlies Dakota sandstone; contact with Niobrara formation not observed in area.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 15, 28, 34, 37, 39, 46. In northern Front Range, Colo., overlies South Platte formation (new) of Dakota group.

A. B. Shaw, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basin, Colorado, p. 49 (fig. 1), 50. Name Benton has been used for many years in North Park, Colo., and is still useful in group sense to include all rocks from Thermopolis shale through Frontier sandstone, that is, from top of Dakota sandstone of Cloverly group to base of Niobrara formation. This definition does not coincide with Benton shale as used in northern Front Range for interval from top of South Platte formation of Dakota group to base of Timpas limestone member of Niobrara formation.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks Basin, Colorado, p. 52–53, pl. 1. Formation, in Red Dirt Creek area, Grand County, Colo., consists of 418 feet of black to dark-gray fissile shale containing bentonite seams. Contains Codell sandstone member. Graneros, Greenhorn, and Carlile members not recognized in this area. Conformably overlies Dakota formation; underlies Niobrara formation.

T. A. Steven, 1960, U.S. Geol. Survey Bull. 1082–F, p. 336 (table 1), 346–348, pl. 12. Discussion of Northgate district, Colorado. Benton shale of Early and Late Cretaceous age consists of 665 feet of dark-gray thin-bedded shale with interbedded bentonite layers. Overlies Dakota group with contact gradational; underlies Niobrara formation.

Named for Fort Benton, on Missouri River, about 40 miles below Great Falls, Mont.

Benwood cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 176–178, 179 (map 23). Embraces interval between Sewickley cyclothem (new) below and Arnoldsburg cyclothem (new) above. Where complete, displays normal suite of members (ascending): Sewickley shale and sandstone, Tyler redbed, Benwood limestone, Benwood underclay and coal, and Benwood roof shale. Average thickness 65 feet. Cyclothem is seldom found intact; commonly upper limit cannot be determined owing to absence of members above Benwood limestone and below Arnoldsburg redbed. In area of this report, Monongahela series is described on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Bern, Canaan, Lodi, Rome, and Alexander Townships of Athens County.

Benwood Limestone Member (of Monongahela Formation)

Benwood Limestone and Shale (in Monongahela Group)

Benwood limestone and shale member

Pennsylvanian: Northern West Virginia, western Maryland, eastern Ohio, and western Pennsylvania.

Original reference: M. R. Campbell, 1903, U.S. Geol. Survey Geol. Atlas, Folio 94, p. 10.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 121–123, 124 (fig. 29). In Fayette County, Benwood limestone is divided into several parts by intervening sandstones, shales, and a coal and black shale horizon. Coal is present in only a few sections, but the black shale is persistent and is used to divide Benwood into an upper and lower part. Lower Benwood overlies Upper Sewickley coal and underlies Benwood coal; Upper Benwood underlies Arnoldsburg sandstone. Included in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 76–80, geol. map. Ohio Geological Survey recognizes the Benwood member (Monongahela series) as that section of limestones and shales between Upper Sewickley sandstone and Fulton green shale member. Basal boundary indefinite in many areas as the limestone occurs just above Meigs Creek coal when Upper Sewickley sandstone is absent; upper boundary uncertain because of inconspicuous development or absence of Fulton green shale. Benwood consists of thick sequences of limestones in many areas and of alternations of limestone and calcareous shales in other localities; some exposures consist almost entirely of calcareous shales. Thickness in Morgan County 25 to 35 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 177–178. Limestone member of Benwood cyclothem (new) in report on Athens County. Name is used for fresh-water limestone above Sewickley sandstone and below Fulton green shale. In Athens County, unit lacks division of upper and lower units as in Pennsylvania. A highly variable unit a few inches to 38 feet thick. Occurs as nodules or ledges

and is interbedded with calcareous clay shale of redbed type (Tyler redbed member).

Named from town of Benwood, Marshall County, W. Va.

Benwood roof shale member

Benwood underclay member

See Benwood cyclothem.

Berdoo Granite

Precambrian: Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 473, 491. Name applied to granite occurring in Chuckwalla complex.

Named for its occurrence in Berdoo Canyon, Little San Bernardino Mountains, Riverside County.

Berea Sandstone[1] **or Formation**

Devonian or Mississippian: Ohio, northeastern Kentucky, southern Michigan, western Pennsylvania, and northern West Virginia.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 21, 29.

Wallace de Witt, Jr., and D. F. Demarest, 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1357; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1955, U.S. Geol. Survey Prof. Paper 259, p. 28–40, pls. Three phases of Berea sandstone recognized. First and oldest is massive medium-grained sandstone which fills channels that were scoured into and at some places through Bedford shale. Similar appearance of Cussewago sandstone and coarse aggregates of grains found in channel sandstone phases of Berea has led some geologists to conclude that the Cussewago was part of the Berea. Second or fluviatile phase of Berea sandstone lies above channel phase in sheet 20 to 35 feet thick with thickest part in western Cuyahoga County, Ohio; feathers out in area of valley of Grand River in western Ashtabula County. Third is marine siltstone phase about 5 to 20 feet thick with thinnest part in western Cuyahoga County; thickens to east. Lenses of silty gray shale and very thin ripple-marked siltstone in many sections of the Berea have been cited by some geologists as evidence that the Berea is a tripartite formation composed of two sandstone members separated by a shale member. Irregular occurrence of lenses of silty shale in the Berea does not support this hypothesis. Siltstone facies thins eastward from 15 feet at Wick, Ohio, to 7 feet at Bartholomew quarry section near Littles Corner, Pa. In this section, the siltstone facies of Berea was identified as Corry sandstone by White (1881). Much of resulting confusion of correlations came from this identification. At Bartholomew quarry, the 7 feet of Berea is underlain by 22 feet of Bedford shale. The Berea thins rapidly across Hayfield Township and grades laterally into Shellhammer Hollow formation (new) in vicinity of Meadville. Throughout northern Ohio and northwestern Pennsylvania, upper contact of Berea sandstone is sharp, although it is overlain conformably by Orangeville shale. In northern Ohio, pyritic cap rock of the Berea grades upward in a distance of 2 inches into basal part of Sunbury member of Orangeville. In northwestern Pennsylvania, where pyritic cap rock is absent, Sunbury member of Orangeville is conformable on siltstone facies of Berea sandstone.

U.S. Geological Survey currently designates the age of the Berea as Devonian or Mississippian on the basis of a study now in progress.

Named for Berea, Cuyahoga County, Ohio.

Berenda limestone[1]

Paleozoic (Devonic): New Mexico and Arizona.

Original reference: C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Table shows Berenda included in Devonic of Arizona. Assigned to Linnian series. Older than Escacado limestone (new); younger than Bella shale.

Probably named for Berenda Valley, N. Mex.

Bergen Shale Member (of Lykins Formation)

Permian; North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31, 33, 35, fig. 7. Thin-bedded red arenaceous shales and mudstones containing numerous small irregular spots and streaks of bluish green. Thickness at type section 62 feet; at Ralston Creek 35 feet. Underlies Glennon limestone member (new); overlies Falcon limestone member (new).

Type locality: In roadcut on Highway 74 just west of business district of town of Morrison and in west fork of Glennon Canyon, Golden-Morrison area. Named from Bergen irrigation ditch, which cuts through Lyons sandstone in Turkey Creek, sec. 12, T. 5 S., R. 70 W., Morrison quadrangle.

Berger Formation (in Wilcox Group)

Eocene: Central Arkansas.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 4), 38–46, plates. Proposed to include all terrestrial rocks between unconformity at top of marine sediments of Midway group and unconformity at base of Saline formation (new). Comprises section of gray and greenish-gray silty clay and argillaceous sand and some interbedded lignite and sideritic layers; where formation abuts nepheline syenite masses, it includes many bauxite deposits of Arkansas region and associated kaolinitic fragmental underclay. Contains three distinct facies: deposits of bauxite, bauxitic clay, and kaolinitic clay; deposits of lignite, lignitic clay, and gray silty clay that overlies bauxite deposits in many open-pit mines; deposits of gray "salt and pepper" or grayish-green sand that occupy channels in lignitic beds in overburden sections at several bauxite pits, that underlie lignite beds locally in several of the drilled areas, and that form major part of formation downslope from bauxite area. Thickness 0 to 347 feet; surface outcrops reach maximum of 25 feet; drill-hole data show greater thicknesses. Rests upon eroded surface of Wills Point formation; along lower slopes of nepheline syenite hills, generally overlaps Wills Point and rests on residual clay or on rocks of Paleozoic age; in larger subsurface valleys where Wells Point has been removed, Berger rests upon the Kincaid or upon basement rocks.

Type section: South side of Chicago, Rock Island, and Pacific Railroad tracks on east side of viaduct and road crossing tracks at Brittain siding, Pulaski County, in SE¼SW¼ sec. 5, T. 1 S., R. 12 W., three-fourths mile southwest of Berger. Exposed in a narrow discontinuous band of out-

crop as much as 1½ miles wide. Outcrop area extends northeastward from Hurricane Creek in Saline County to northeast end of Fourche Mountain in Pulaski County. West of Hurricane Creek, wedges out beneath Saline formation. At east end of outcrop area, truncated by Quaternary sediments of Arkansas River flood plain.

Bergman Group[1]

Lower and Upper Cretaceous: Northwestern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 246.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 245). Age shown on correlation chart as Lower Cretaceous in both Koyukuk Valley and Kobuk Valley areas.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Mostly marine. Age given on chart as Albian and Cenomanian.

U.S. Geological Survey currently designates the age of the Bergman Group as Lower and Upper Cretaceous on the basis of a study now in progress.

Named for Bergman trading post on Koyukuk River in Koyukuk-Kobuk region.

Berino Member (of Magdalena Formation)

Pennsylvanian (Strawn): Western Texas.

L. A. Nelson, 1937, Colorado Univ. Studies, v. 25, no. 1, p. 89. In Franklin Mountains, Texas, formation is divided into (ascending) La Tuna, Berino, and Bishops Cap members (all new).

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 167, 168–169. Predominantly limestone; fossiliferous. Thickness about 555 feet. Derivation of name given.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. On basis of fusilinid studies, seems inadvisable to apply Nelson's terms to Pennsylvanian rocks of central New Mexico.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 25. Berino is Strawn in age, but might include some Bend in lower parts.

Named from Berino, Dona Ana County, N. Mex., on Santa Fe Railroad about 4 miles north of Texas-New Mexico boundary.

Berkeley Group[1]

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 375, map.

Group includes Bald Peak Basalt, Moraga Formation, and Siesta Formation.

Named for occurrence east of Berkeley, Alameda County.

†Berkshire Limestone[1]

Lower Cambrian to Lower Ordovician: Western Connecticut, Massachusetts, and Vermont.

Original reference: E. Hitchcock, 1833, Rept. on Geol., Min., Bot., and Zool. of Massachusetts, p. 297–305.

Berkshire Schist[1]

Berkshire Formation

Middle Ordovician: Western Massachusetts, western Connecticut, eastern New York, and southwestern Vermont.

Original reference: T. N. Dale, 1891, Am. Geologist, v. 8, p. 1–7.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1089–1090. Abandoned in eastern part of Taconic Range, Vt. Mettawee and Schodack formations are extended to this area to replace the Berkshire.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 38–40. Locally abandoned in Castleton quadrangle, Vermont, where name is replaced by Hortonville slate and phyllites of Mendon series. Remainder of Berkshire south of Castleton River mapped as Nassau formation.

E. N. Cameron, 1951, Connecticut Geol. Nat. History Bull. 76, p. 8–9. Included in Mount Prospect complex (new). Formation is complex series of mica gneisses, feldspathic quartz mica schists, and micaceous quartzites.

R. M. Gates, 1952, *in* R. M. Gates and W. C. Bradley, Connecticut Geol. Nat. History Survey Misc. Ser. 5, p. 7, 8. Formation abandoned in New Preston quadrangle, Connecticut. Replaced by Waramaug formation (new) because these rocks differ from Berkshire of past and present definitions.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Berkshire of this report [Cheshire quadrangle, Massachusetts] includes some rocks mapped as Berkshire, Hoosac, and Greylock by Pumpelly, Wolff, and Dale (1894, U.S. Geol. Survey Mon. 23) and as Hoosac, Normanskill, and Rowe by Prindle and Knopf (1932). Consists of lower schistose marble, schistose quartzite, and graphic schist; black muscovite-quartz-albite-schist; and schistose marble. Transgresses older formations from west to east and from north to south. Most authors have drawn upper contact below Bellowspipe limestone, but validity of this limestone as a formation is questionable. In this report, color was used as primary distinction between Berkshire and overlying Greylock schist. Overlies Bascom formation. Middle Ordovician.

Named for occurrence in Berkshire County, Mass.

Berkshire County Series[1]

Precambrian: Western Massachusetts.

Original reference: W. O. Crosby, 1876, Rept. on geol. map of Massachusetts, p. 40.

Berkshire County.

Berlin Clay[1]

Pleistocene, upper: Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

Underlies parts of eastern Berlin Township.

†Berlin Gneiss[1]

Post-Lower Devonian: Northern New Hampshire.

Original reference: C. H. Hitchcock, 1873, Rept. Geol. Survey New Hampshire 1872, p. 7.

R. W. Chapman, 1935, Am. Jour. Sci., 5th ser., v. 30, no. 179, p. [404], 405–406. Described as a trondhjemite composed of quartz, oligoclase, biotite, and muscovite. Assigned to New Hampshire magma series.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1075–1077. Named abandoned in Percy quadrangle; unit assigned to Oliverian magma series.

Named for Berlin Township in village of Berlin, Coos County.

Berlin Group (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

In Allegheny County.

†Berlin Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: F. and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 223, 286, 292.

At Forwardstown, Somerset County.

Berlin Rhyolite Gneiss[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 520.

Crops out at Berlin, Green Lake County.

Berlin Volcanics

Oligocene: Northwestern Oregon.

I. S. Allison and W. M. Felts, 1956, Geology of Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Tentative name Berlin volcanics used by Felts (1936, unpub. thesis) is abandoned in favor of Mehama volcanics.

Bermeja Complex

Upper Cretaceous or older: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 323–324, pl. 1. Serpentinite, silicified porphyritic volcanics, and fine-grained silicified sediments or volcanics, with minor spilite, amphibolitized spilite, and amphibolite. Diorite plug intrudes complex. Oldest rocks in area; exposed only in some anticlinical cores. Unconformably overlain by a sequence of shallow-water sediments and extrusive and pyroclastic volcanics, Cretaceous to Eocene in age; in most parts of area lava flows, the Río Loco formation, is at base of sequence. Where Río Loco is absent, underlies Mayagüez group (new). Age unknown. Age determinations in basal Mayagüez rocks resting unconformably on serpentinite show that Bermeja complex is older than Santonian-Campanian and possibly older than Cenomanian.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm., and Princeton Univ. Dept. Geology, p. 20, 21. Mattson restricts word complex to basement rocks. He applied term Bermeja complex to these rocks which include amphibolites, serpentinites, and metamorphosed cherts. In present report, term deformed sequence is applied to the folded, faulted, intruded, but unmetamorphosed rocks that rest unconformably on Bermeja complex. Bermeja complex crops out only in southwestern Puerto Rico. Here it is overlain unconformably by Río Loco formation, oldest unit of deformed sequence. In Barranquitas quadrangle in south-central Puerto Rico, the Río Loco underlies a

formation containing fossils of Cenomanian-Turonian age. Bermeja complex must be Cenomanian or older in age.

Complex is exposed in greatest variety in Sierra Bermeja.

Bern Limestone (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276–2277. Defined to include persistent escarpment-forming limestone and associated strata which occur between Auburn shale above and Scranton shale below. Thickness ranges from about 7 feet to 35 feet; average 20 feet. Comprises (ascending) Burlingame limestone, Soldiers Creek shale, and Wakarusa limestone members.

Type section: In roadcut in SE¼SE¼ sec. 7, T. 1 S., R. 13 E., about one-half mile north and 1 mile west of Bern, Nemaha County. Name derived from town of Bern in northern part of county.

Bernadotte cyclothem[1]

Pennsylvanian: Central western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

Derivation of name not stated.

Bernadotte Sandstone Member (of Abbott Formation)

Bernadotte Sandstone (in Pottsville Formation)[1]

Bernadotte Sandstone (in Tradewater Group)

Pennsylvanian: Northern Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 70–72, 203. In original description, Savage correlated this bed with massive sandstone that terminates outcrop of No. 1 coal and Seville limestone at type outcrop of Seville cyclothem. At south end of this cyclothem, sandstone thickens to abont 16 feet and rests directly on a coal. Savage believed this was No. 1 coal and considered Seville limestone cut out by sandstone. Outcrops now available show that No. 1 coal and Seville limestone thin out as they rise above sandstone and that coal that underlies sandstone in Pope Creek is Tarter coal. Bernadotte is older than No. 1 coal rather than younger. Occurs at base of Seville cyclothem. Type outcrop given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 45 (table 1), 63. pl. 1. Allocated to member status in Abbott formation (new). Above Pope Creek coal member (new). Thickness about 16 inches. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type outcrop: Road and ravine just southwest of Bernadotte. SW¼ sec. 19, T. 5 N., R. 2 E., Vermont quadrangle, Fulton County.

Bernal Formation

Permian: Central northern New Mexico.

V. C. Kelley, 1949, New Mexico Univ. Pubs. in Geology 2, fig. 2. Name appears on composite stratigraphic chart of formations in Socorro and Santa Fe Counties.

J. E. Allen and S. M. Jones, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1320. Red quartz sandstone and shale 354 feet thick. Overlies upper Permian San Andres limestone. Triassic(?).

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. As defined herein, consists of brownish-red siltstone and fine-grained sandstone; in southern part of area, a single bed of gray to brown medium-grained sandstone about 1 foot thick is interbedded with the reddish-brown rocks. Average thickness 100 feet; 126 feet about 1 mile east of Ocate. Overlies Glorietta sandstone member of San Andres formation; disconformably underlies Santa Rosa sandstone. Has been considered a part of San Andres. Appears to be correlative with parts of Chalk Bluff formation of southeastern New Mexico and possibly Whitehorse sandstone of Oklahoma. Permian.

[Replaced by Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4).]

Type sequence: Near villages of Bernal and Chapelle, San Miguel County.

†Bernalillan series[1]

Permian: New Mexico.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 42.

Bernalillo shale[1]

Permian: Central northern New Mexico.

Original reference: C. R. Keyes, 1903, Ores and Metals, v. 12, p. 48.

In Sandia Mountains. Derivation of name not given.

Bernardston Formation[1]

Silurian and Devonian(?): Central and western Massachusetts, southwestern New Hampshire, and southeastern Vermont.

Original reference: J. D. Dana, 1873, Am. Jour. Sci., 3d ser., v. 6, p. 339–352.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, p. 1747, chart 4. Age of limestone shown as Lower or Middle Devonian.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ 90. Further described in Bernardston quadrangle, Massachusetts. Most common rock type is glossy sericitic minutely stratified light-gray phyllite locally merging into dark-gray and black slate. At the base is fine-grained dark-gray phyllite with thin quartz interbeds. Includes lenses of aphanitic laminated light-gray metatuff, well-foliated fine-grained amphibolite, massive greenish-gray diabase, light-gray fine-grained rhyolite, and white and yellow-brown quartz and quartz conglomerate. Latter are important horizon marker. Fossiliferous coarsely crystalline limestone at one locality. Thickness several thousand feet. Conformably overlies Leyden argillite. Silurian(?) or Devonian(?).

A. J. Boucot and others, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 855–870. Lower part of Bernardston formation in Massachusetts contains fossils of probable Silurian age. On lithologic basis, it is possible that lower part of Bernardston, including conglomerates, quartzites, and calcareous quartzite, is lateral equivalent of Clough formation and that limestone associated with Bernardston is lateral equivalent of Fitch formation.

Named for occurrence at Bernardston, Franklin County, Mass.

†Bernardston Limestone[1]

Lower and Middle Devonian: Western and central Massachusetts and New Hampshire.

Original reference: J. D. Dana, 1877, Am. Jour. Sci., 3d v. 14, p. 379–387.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart in Massachusetts and New Hampshire. Age given as Lower or Middle Devonian.

First described near Bernardston, Mass.

Berne Member[1] (of Cuyahoga Formation)

Berne Member (of Logan Formation)

Lower Mississippian: South-central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 660, 667, 669, 674–682.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 1), 55–56. Berne conglomerate member included in Pretty Run sandstone facies (new) of Logan formation. Underlies Byer sandstone member; overlies adjoining Granville and Killbuck facies of Cuyahoga formation. Thickness a few inches to 16 feet; commonly 1 to 3 feet. Age given as Lower Mississippian.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 98–101. Report refers to unit as Berne member, or pebble bed, of Cuyahoga formation. Overlies Black Hand member in Granville and Hocking Valley provinces. In a 1910 manuscript, Hyde referred to Berne as Hanover pebble bed.

Named for exposures in Berne Township, Fairfield County.

Berne Member (of Marcellus Shale)[1]

Middle Devonian: Eastern New York.

Original reference: G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544, 548.

Winifred Goldring, 1946, New York State Mus. Bull. 332, p. 238, 249. Cooper proposed name Berne member for shale interval between Onondaga limestone and Otsego member, an interval considered equivalent of Union Springs, Cherry Valley, and Chittenango members of Marcellus. Recent work has shown presence of Cherry Valley or Cherry Valley equivalent in the Helderbergs and southward. Cooper (p. 249) restricts Berne to the Chittenango sandy equivalent about 100 to 150 feet thick. As thus restricted, the Berne extends from its type locality around northeast end of Catskills at least as far south as Mt. Marion and Haliha Hill north of Kingston.

Type section: In hill south of Berne, Berne-Durham quadrangle, Albany County.

†Berners Formation[1]

Paleozoic(?), Triassic, and Jurassic: Southeastern Alaska.

Original reference: A. Knopf, 1911, U.S. Geol. Survey Bull. 446, p. 14–19, map.

Well exposed along west shore of Berners Bay and along Lynn Canal from Point St. Mary to mouth of Independence Creek; also on east shore of Berners Bay.

†Berry Formation

Eocene to Miocene, lower: West-central California.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as underlying Vaqueros formation (restricted) and overlying The Rocks sandstone (new). Thickness about 1,000 feet.

R. R. Thorup, 1943, California Div. Mines Bull. 118, pt. 3, p. 464 (fig. 190), 465. Usually white poorly sorted, poorly bedded, feldspathic, considerably crossbedded conglomeratic sandstone; red beds in upper part; probably of continental origin. Upper part of formation appears to grade into Vaqueros formation; contact of the two is placed at lowest occurrence of finer grained sandstone. Oligocene. Derivation of name given.

M. N. Bramlette and S. N. Daviess, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 24. Age may be Eocene to lower Miocene and may vary in different areas.

Type locality: SE¼ sec. 26, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County. Named for typical exposures near Berry Ranch.

Berryessa Formation

Cretaceous: Central California.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 31, 33–35, pl. 1. Introduced to designate sandstone, siltstone, and shale between Lower Cretaceous Oakland conglomerate and Tertiary Monterey formation. In western limb of Tularcitos syncline, thickness about 1,000 feet at Berryessa Creek; 1,600 feet at Alum Rock Canyon; 2,000 feet near Hendricks Ranch; may be thicker south of there, but base has not been mapped accurately, and top is clearly faulted; no complete section exposed in eastern limb of syncline. About 1 mile south of Alum Rock Canyon, Monterey formation overlaps Berryessa completely. Formation consists of rocks called Chico by Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193) and included in Knoxville by Templeton (1913, Geol. Soc. America Bull., v. 24, p. 96). Intruded by Alum Rock rhyolite (new). Name Berryessa does not imply that its exact age and stratigraphic position are known, but rather is an attempt to avoid the confusion associated with name Chico.

Type locality: On Berryessa Creek, San Jose-Mount Hamilton area, in central Coast Ranges, about 50 miles southeast of San Francisco; both top and base are exposed at type locality. Crops out on both sides of Tularcitos syncline; one band extends along Calaveras fault from vicinity of Calaveras Reservoir to Halls Valley a short distance east of San Felipe Valley; other band extends from Scott Creek across Alum Rock Canyon, then is faulted out for a distance of 3 miles and reappears west of Masters Hill and extends southeast to Panochita Hill, faulted segments reach edge of mapped area southeast of San Felipe Valley.

Bertha Limestone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 393.

Named for association with Bertha sandstone and Upper Bertha shale, but not exposed at type locality of Bertha shale. Observed, however, at other localities in Summers County, in Monroe and Mercer Counties, and also in Tazewell and Giles Counties, Va.

Bertha Sandstone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Mercer, Monroe, and Summers Counties, p. 299, 391.

Type locality: Along mountain road which ascends from Bertha toward Low Gap School, Summers County. Also exposed in Monroe County and in Tazewell County, Va.

Bertha Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 392–394.

Occurs in Mercer, Monroe, and Summers Counties.

Berthelet Member[1] (of Milwaukee Formation)

Middle Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. 9th Ann. Field Conf., p. 262, 265.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above the Thiensville and below the Lindwurm. Middle Devonian.

Type locality: Milwaukee Cement quarry, Milwaukee County. Probably named for village of Berthelet.

Bertie Limestone (in Salina Group)

Bertie Formation

Bertie Group

Bertie Limestone Member (of Salina Formation)[1]

Upper Silurian: Western and east-central New York, and Ontario, Canada.

Original reference: E. J. Chapman, 1864, A popular and practical exposition of the minerals of Canada, p. 190.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Bertie waterlime listed as top formation in Salina group. Occurs above Camillus shale. Cayugan series.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 5–14, fig. 1. Bertie formation, in east-central New York, comprises (ascending) Fiddlers Green dolomite member, unnamed member, and Williamsville dolomite member. Overlies Camillus shale and merges eastward into Brayman shale (redefined). Underlies Cobleskill.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Formation, in central New York, consists of three members (ascending) Fiddlers Green, Forge Hollow (new), and Williamsville. Fiddlers Green dolomite continues westward into Falkirk member of Bertie. Overlies Salina formation; underlies Cobleskill, Cayugan series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Rank raised to group. Includes rocks between base of Oatka and top of Williamsville. In western New York, comprises (ascending) Oatka shale, Falkirk dolomite, Scajaquada shale, and Williamsville waterlime. In central New York comprises (ascending) Fiddlers Green dolomite, Forge Hollow shale, and Oxbow dolomite (new). In Canastotan and Murderian stages (both new).

Named for exposures at Bertie (and in Bertie Township), Ontario, about 6 miles west of Buffalo, N.Y.

Bertram Dolomite[1]

Silurian (Niagaran): Eastern Iowa.

Original reference: W. H. Norton, 1895, Iowa Geol. Survey, v. 4, p. 135–138.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Bertram dolomite above Gower dolomite.

Named for Bertram, Linn County.

Berwick Formation (in Merrimack Group)

Berwick Gneiss[1]

Probably Ordovician and Silurian: Southwestern Maine and southeastern New Hampshire.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 453 (fig. 2), 456–459, 475–476, pl. 1. Termed a formation. Consists of black, gray, and green phyllite, quartz-mica schist, quartzite, actinolite-quartz granulite, actinolite granulite, biotite-actinolite schist and actinolite amphibolite in the biotite metamorphic zone. Similar rocks in garnet zone. Well-bedded and lacking in gneissic structure. Maximum thickness in Mount Pawtuckaway quadrangle, New Hampshire, 7,000 feet. Silurian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Includes Gove member which was reallocated from Littleton formation. Included in Merrimack group in New Hampshire. Probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 41–43. Age tentatively considered Silurian.

Named for development at Berwick, York County, Maine.

Berwick Quartz Diorite[1]

Devonian(?): Southwestern Maine.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 153.

About 2 miles east of Berwick, York County.

Berwyn Conglomerate[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. T. Richards and R. A. Birk, 1925, Am. Assoc. Petroleum Geologists Bull., v. 9, no. 6, p. 983, 987-988.

Named for occurrence south of town of Berwyn, Carter County.

†Berwyn Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 219, 221.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180–181. Name abandoned. Replaced by Butternut shale member (new).

Derivation of name not stated, but probably is village in Tully quadrangle.

Bessemer Clay

Pennsylvanian (Pottsville): Northeastern West Virginia.

W. A. Tallon, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 17. Hammond clay grades downward into horizon here named Bessemer clay.

Type locality and derivation of name not given. Hammond clay occurs in vicinity of Hammond, Marion County.

Bessemer Granite[1]

Ordovician to Mississippian: Southern North Carolina and northwestern South Carolina.

Original reference: A. Keith and D. B. Sterrett, 1917, U.S. Geol. Survey Bull. 660-D, p. 129.

W. R. Griffitts and J. C. Olson, 1953, U.S. Geol. Survey Prof. 248–D, p. 204. Incidental mention in discussion of Shelby-Hickory district, North Carolina.

H. W. Jaffe and others, 1959, U.S. Geol. Survey Bull. 1097-B, p. 116. Lead-alpha age 491 millions of years.

U.S. Geological Survey currently designates the age of the Bessemer Granite as Ordovician to Mississippian on the basis of a study now in progress.

Named for fact that one of the minor bodies of granite underlies Bessemer City, Gaston County, N.C.

Bessemer Sandstone or Quartzite

Precambrian (Proterozoic): Northwestern Michigan.

W. A. Seaman *in* A. K. Snelgrove, W. A. Seaman, and V. L. Ayres, 1944, Michigan Dept. Conserv. Geol. Survey Div. Prog. Rept. 10, p. 16. Bessemer sandstone or quartzite and overlying lava flows which are cut by felsite and then by olivine diabase dikes, belong to lower part of Sibley series.

Occurs in Houghton, Ontonagon, and Gogebic Counties.

Bessie Member (of Quartermaster Formation)[1]

Permian: Western Oklahoma.

Original reference: H. L. Griley, 1933, Pan-Am. Geologist, v. 59, no. 3, p. 234.

Bethany Falls Limestone Member (of Swope Formation)

Bethany Falls Limestone (in Kansas City Group)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: G. C. Broadhead, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 320.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Uppermost member of Swope limestone (or formation). Overlies Hushpuckney shale member; underlies Galesburg formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 40. Thickness about 22 feet in south-central Iowa; 12 feet, Sarpy County, Nebr.; about 20 feet at Kansas City, Mo.; 12 to 27 feet in eastern Kansas, average 18 feet; pinches out near Oklahoma line.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Uppermost member of Swope. Composed of thick limestone

beds containing thin shale partings which are usually quite calcareous and fossiliferous. Uppermost beds generally algal and occasionally oolitic but have fine-grained texture in basal sections. Average thickness about 16 feet. Overlies Hushpuckney shale member; underlies Galesburg shale.

Named for exposures at falls of Big Creek, near Bethany, Harrison County, Mo.

†Betheden Formation

Paleocene or Eocene: East-central Mississippi.

F. F. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 26–28. Includes all residual material at top of Midway and below Midway-Wilcox unconformity; includes deposits of bauxite, kaolin, bauxitix and kaolinitic clays and the overlying lignite. Thickness approximately 25 feet. Gradationally overlies Porters Creek formation; unconformably underlies Fearn Springs formation, or the Ackerman formation where Fearn Springs is absent.

F. S. MacNeil, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1070. Fearn Springs and Betheden appear to be intraformational. Recommended that name Betheden be abandoned and that Fearn Springs include both units.

Type locality: At Livingston Spring, 50 yards south of highway at Betheden, SW¼SE¼ sec. 23, T. 16 N., R. 13 E., Winston County.

Bethel Granite[1]

Devonian: Southeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for Bethel, which is in northwest part of Windsor County.

Bethel Group[1]

Upper Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1927, Vermont State Geologist 15th Rept., p. 127–158.

Probably named for Bethel, Windsor County.

Bethel Pyroxene Diorite[1]

Age(?): Eastern New York.

Original reference: R. Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, pl. 1.

Dutchess County.

Bethel Sandstone[1]

Bethel Formation (in West Baden Group)

Bethel Sandstone (in New Design Group)

Upper Mississippian (Chester Series): Western Kentucky, northwestern Alabama, southeastern Illinois, southern Indiana, and northeastern Mississippi.

Original reference: C. Butts, 1917, Mississippian series in western Kentucky: Kentucky Geol. Survey, p. 63.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 826–827. Assigned to New Design group (new). In standard Mississippian section, underlies Paint Creek formation and

overlies Renault formation. Sandstone is brownish moderately fine grained, in part massive and crossbedded and in part more thinly and evenly bedded; locally conglomeratic at base. Not more than 10 feet thick in Union County, Ill.; in southwestern part of county and in southeastern Perry County, Mo., cannot be recognized sufficiently to separate Renault and Paint Creek formations. Thickness in southern Johnson County, Ill., 12 feet; thickens to east to 50 feet in Ohio River bluff below Golconda; on both sides of river near Shetlerville at least 100 feet thick. Thins southward in Kentucky and not recognized beyond Elkton, Todd County.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 3. In this report [southwestern Indiana], Bethel formation is used in place of Mooretown sandstone. Stratigraphic position is below Beaver Bend limestone and above Paoli limestone.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. In northwestern Alabama, beds described by Butts (1926, Alabama Geol. Survey Spec. Rept. 14) as Bethel sandstone are included in Tanyard Branch member of Pride Mountain formation (both new).

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 47, pl. 1. Lowermost formation in West Baden group (redefined). Thickness 16 to 35 feet. Underlies Beaver Bend limestone; overlies Paoli limestone of Blue River group (new).

Named for exposures in vicinity of Bethel School, 3½ miles west of Marion, Crittenden County, Ky.

Bethel Schist[1]

Upper Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1924, Vermont State Geologist 14th Rept., p. 82–83.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 42 (table 2), 43 (table 3), 50-51. In Rutland area, "Bethel" formation resembles Pinney Hollow formation. There is possibility that the "Bethel," as mapped to the east, actually represents structural repetition of the Pinney Hollow. There is a question as to proper subdivision of unit mapped as "Bethel." About 6,000 feet of rock is exposed with no horizons detected. The ill-defined term "Bethel" is herein applied to the entire unit; however, it may include the Stowe and parts of Moretown formations in an unknown structural relationship. The "Bethel" overlies Ottauquechee formation. Cambro-Ordovician.

First described in Bethel Township.

Bethlehem Gneiss[1] (of New Hampshire Plutonic Series)

Upper Devonian(?): New Hampshire.

Original reference: C. H. Hitchcock, 1872, Rept. Geol. Survey New Hampshire, 1871.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 504–506, 536–538. Unit should be called gneiss, not granodiorite gneiss, because it ranges in composition from granite to quartz diorite.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Belongs to New Hampshire plutonic series of Upper Devonian(?) age.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 55, 57. Summary discussion. Type locality for unit as currently defined.

Type locality: Exposures on Green Mountain, 2 miles southwest of Landaff, Moosilauke quadrangle. Named for town of Bethlehem, Grafton County.

Bethpage Gravel[1]

Miocene: Southeastern New York.

Original reference: C. P. Berkey and J. F. Sanborn, 1923, Am. Soc. Civil Engrs. Trans., v. 86, no. 1509, p. 75, pl. 3.

J. H. Sanford, 1938, New York State Water Power and Control Comm. Bull. GW–7, p. 11, 12, 18. Crosby's use of term Bethpage gravels mentioned in discussion of geologic history of Long Island.

First described in pits in central part of Long Island.

†Bettles Group[1] or Series[1]

Silurian: Northern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 475.

Excellent exposures on lower part of Bettles River, where mountains which these rocks compose rise 2,000 feet or more above river. Principal capping rock over 2,000 square miles of upper waters of Chandlar and Koyukuk Rivers.

Beulah Limestone[1]

Mississippian: Eastern Colorado.

Original reference: A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte, 1930, Kansas Geol. Soc. Guidebook 4th Ann. Field Conf., p. 84, 86, 88, 90, 94.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39; 1951, World Oil, v. 133 (Oct.), p. 89–91. Upper finely sandy and finely oolitic limestone beds of sequence previously called Madison in vicinity of Beulah are considered as formation and here named Beulah limestone. Name Beulah was used by Brainerd, Baldwin, and Keyte (1930) to refer to beds now known as Williams Canyon limestone. Original authors abandoned name before it came into common use. Name Beulah is only one suitable for the limestone in this locality and is therefore used. Predominantly pink- to red-stained, white to buff, finely oolitic limestone; concentrations of reddish-yellow dense chert and pyrite present in uppermost layers, and traces of red sandy chert. Thickness at type section 53 feet. Overlies Hardscrabble limestone (new); underlies arkosic beds of Fountain formation; both contacts unconformable. Meramec(?).

Type section: In NW¼ sec. 4, T. 23 S., R. 68 W., Pueblo County. Restricted to isolated exposure on South Hardscrabble Creek in Custer County and to the almost continuous upper ledge in cliffs north and west of Beulah, Pueblo County.

†Beulah Shale[1] or Clays[1]

Upper Jurassic: Northeastern Wyoming and South Dakota.

Original reference: W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 593, fig. 122, map.

In Hay Creek coal field; also 3 or 4 miles north of Beulah, in Red Water Valley, Crook County, Wyo.

Beulah Church Sand Lentil (in Slaughter Creek Member of Pendleton Formation)

Eocene, lower: Northwestern Louisiana.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 184 (fig. 4), 187. Consists of 2 to 4 feet of glauconitic, sparingly fossiliferous sand about 30 feet below top of member.

Well developed at type locality of Slaughter Creek member on Slaughter Creek, Sabine Parish.

Beverly Syenite[1]

Late(?) Paleozoic: Northeastern Massachusetts.

Original references: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.; B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, map; C. H. Clapp, 1921, U.S. Geol. Survey Bull. 704, p. 85–89.

U.S. Geological Survey currently designates the age of the Beverly Syenite as Late(?) Paleozoic on the basis of a study now in progress.

Named for occurrence at Beverly, Essex County.

Bevier cyclothem

See Bevier Formation (in Cabaniss Group).

Bevier Formation (in Cabaniss Group)

Bevier Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Western Missouri, southeastern Kansas, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 19, 23; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group divided into 15 cyclic formational units. The Bevier, fourteenth in sequence (ascending), overlies the Ardmore and underlies the Mulky. Average thickness 9 feet. [For complete sequence see Cherokee group.]

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 89–90, 94. Formation comprises Bevier coal with underlying gray clay and overlying black slate. Thickness in Callaway County about 6 feet; 3 feet in Macon County. Overlies Ardmore formation; underlies Lagonda formation. Cherokee group.

W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Generalized section of strata exposed in Carroll and Livingston Counties shows Bevier formation above Wheeler formation (new) and below Lagonda formation. Cabaniss group.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic column as Bevier formation in Cabaniss group. Overlies Verdigris formation; underlies Lagonda formation.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as Bevier coal cycle in Senora formation in Oklahoma. Overlies Verdigris coal cycle and underlies Lagonda coal cycle. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 78–80. Formation consists of two members: Bevier coal and its underclay. Thickness 8 inches to 8 feet. Overlies Verdigris formation; underlies Lagonda formation. Cabaniss subgroup of Cherokee group. Note on derivation of name.

Name Bevier was originally applied by McGee (1888, St. Louis Acad. Sci. Trans., v. 5) to coal mined at Bevier, Macon County, Mo.

†Bexar[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 114.

Probably named for Bexar County.

Bexar Shale Member (of Pearsall Formation)

Cretaceous (Comanche Series); Subsurface in eastern and southern Texas and northern Louisiana.

J. M. Forgotson, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 91 (chart); 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2333 (fig. 2), 2337 (fig. 3), 2346–2350. Proposed for upper of three members of Pearsall formation; includes interval between either base of Rodessa formation, Hensell sand, or Glen Rose undifferentiated, and top Cow Creek or James limestone member. In type well, occupies interval from 3,320 to 3,340 feet and consists essentially of black calcareous shale and thin dense finely crystalline limestone beds. Bexar is a sedimentary wedge that thickens into basin with greatest thickening southward from Llano uplift. Depositional edge of Bexar on flanks of Llano uplift is missing owing to an unconformity at base of Hensell sand so that, on outcrop, Hensell sand rests directly on Cow Creek limestone member.

Type well: Ralph E. Fair, Jack Woodward, Inc., and F. B. Lafevre's Pauline Lyro Well 1 in the J. M. Bustillo Survey 29, Bexar County, Tex.

Bibb Dolomite[1]

Upper Cambrian: Northern central Alabama.

Original reference: E. O. Ulrich, 1915, U.S. Nat. Mus. Bull. 92, v. 1, p. vii; v. 2, pl. 2.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart as Upper Cambrian. Occurs above Ketona dolomite and below Copper Ridge dolomite.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 23. Listed with formations of Cambrian or Ordovician age.

Named for exposures at Bibb Furnace, about 2 miles west of Brierfield, Bibb County.

Bickett Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 430.

Type locality: On northwest angle of Bickett Knob, Monroe County. Also observed in Mercer and Summers Counties, W. Va., and in Giles County, Va.

Bickford Granite[1] (of New Hampshire Plutonic Series)

Upper Devonian(?): North-central New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, p. 69–78.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Mapped with same symbol as Concord granite under name of "binary granite." Belongs to New Hampshire plutonic series of Upper Devonian(?) age.

Typically exposed on Bickford Mountain, Franconia quadrangle.

Bicknell Sandstone[1]

Upper Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map 1–175. Shown on paleotectonic map as underlying Hinchman sandstone and unconformably overlying unnamed volcanic rocks that overlie Mormon sandstone.

Named for Bicknell's ravine, Mount Jura, near Taylorsville, Plumas County.

†Bicknell Tuff[1]

Upper Jurassic: Northern California.

Original reference: A. Hyatt, 1892, Geol. Soc. America Bull., v. 3, p. 407. Taylorsville region.

Bidahochi Formation[1]

Pliocene: Northeastern Arizona and northwestern New Mexico.

Original reference: A. B. Reagan, 1924, Pan-Am. Geologist, v. 41, p. 357 (map), 366.

C. A. Repenning and J. H. Irwin, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1821–1826. Comprises three unnamed members: lower, 214 feet thick, banded gray, brown, and pink flat-bedded mudstone and argillaceous fine-grained sandstone and a few beds of white rhyolitic ash; middle volcanic member, 5 to 100 feet thick; upper, 274 feet thick, predominantly white to very pale brown crossbedded, poorly cemented medium- to fine-grained argillaceous sandstone and a few beds of white rhyolitie ash. Thickness of formation at reference section herein designated 488 feet; volcanic member not present as mappable unit. Overlies Wingate sandstone, angular unconformity. Pliocene.

E. M. Shoemaker, F. S. Hensley, Jr., and R. W. Hallogen, 1957, U.S. Atomic Energy Comm. TEI Rept. 690, p. 389–398. Formation divided into six members for mapping purposes. Four lower members constitute conformable sequence of claystone and siltstone or very fine grained sandstone that corresponds approximately to "lower member" of Repenning and Irwin (1954). Fifth member, informally referred to as White Cone member includes beds designated as "volcanic member" as well as beds included in "upper member" by Repenning and Irwin. Sixth member is mostly cross-stratified sandstone with minor interbedded claystone.

Type locality not stated; Reagan mapped formation 15 to 20 miles to north and east of settlement of Bidahochi, near Twin Buttes, Ariz. Reference section: Pueblo Colorado Wash 15 miles east of Bidahochi.

Bidarka Formation

Lower Jurassic: Southwestern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1), 205. Comprises 1,000 feet of massive to thin-bedded tuffaceous sandstone and interbedded calcareous shale and limestone in lower part and 1,300 feet of dark-gray-black shale with occasional thin beds of light-colored, coarse-grained, well-indurated sandstone in upper part. Underlies Kialagvik formation and overlies Kamishak formation.

In Cold Bay district.

Biddeford Granite[1]

Post-Carboniferous(?): Southwestern Maine.

Original references: C. H. Hitchcock, 1861, Maine Bd. Agr. 6th Ann. Rept., p. 193; F. J. Katz, 1917, U.S. Geol. Survey Prof. Paper 108, p. 177.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 476. Incidental mention in report on stratigraphy and structure of Mount Pawtuckaway quadrangle, New Hampshire.

Occurs in Biddeford, Kennebunkport, Kennebunk, and Dayton Townships, York County.

Biddie Knob Formation

[Lower Cambrian]: West-central Vermont.

E-an Zen, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1829–1830. Revised stratigraphic sequence proposed for north end of slate belt, Taconic Range. Consists of three major units: basal purple and green chloritoid slate (Biddie Knob formation); an intermediate Bull formation; and a black slate formation (the Hooker). Fossils in Bull and Hooker formations indicate that bulk of section is early Cambrian.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1. Underlies Mettawee member of Bull formation.

Type locality and derivation of name not stated.

Bidwell Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45 (table), 65, pl. 1. Proposed for previously unnamed coal. Forms lowermost member of Spoon formation (new) in southeastern part of state. Underlies New Burnside coal member (new). Thickness about 6 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼SE¼SW¼ sec. 5, T. 11 S., R. 4 E., Johnson County. Named for exposures about three-fourths mile northeast of Bidwell School.

Bienevides Formation

See Benevides Formation.

Big A Sandstone Member (of Supai Formation)

Big A standstone facies (of Supai Formation)

Permian: Central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 84–91. Winters (unpub. thesis) recognized four members of Supai in Fort Apache area: Corduroy (new), Fort Apache, Big "A," and Amos Wash (new). In area of present report [Fossil Creek], Supai comprises (ascending) Packard Ranch (new), Oak Creek (new), Big A sand facies, and Corduroy sand facies.

First described near Fort Apache, Ariz.

Big Baldy Granite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec, Rept. 53, p. 14, pl. 1. Medium grained, contains small amounts of dark mineral. Sparsely porphyritic

with potash feldspar phenocrysts. May be in part correlative with Cactus Point granite (new).

Named for Big Baldy, highest point on prominent ridge in northwest part of area, Sequoia National Park. Exposed over an area of about 4 square miles and bounded on east and west by metamorphic rocks.

Big Basin Formation

Big Basin Sandstone (in Cimarron Group)[1]

Permian: Central southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 46–48.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1760–1761 (fig. 1), 1764–1765 (fig. 3), 1813–1814. Overlying Day Creek dolomite are 65 feet of Permian red beds which Cragin named Hackberry shales and Big Basin sandstone. Name Hackberry being preoccupied, it has been dropped but Big Basin has been retained. Because these strata can be considered one formation of sand beds interstratified with beds of silty and sandy shale, they are herein considered to be one formation and all beds between Day Creek dolomite and top of Permian red beds of Kansas (here covered by Cretaceous) are termed Big Basin formation. Should further work establish correlation of lower shaly part of formation with Doxey shale member of Oklahoma Quartermaster formation, name Big Basin would be restricted to the sand beds alone, the possible equivalent of Elk City sandstone member of Quartermaster. At present, interrelations of type Quartermaster with Day Creek dolomite and so-called Cloud Chief member of Whitehorse have not been definitely established. Writer [Norton] believes that Evans (1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4) was not justified in attempting to drop Kansas nomenclature. Lowermost 25 feet is silty shale, and lower 7 feet of this shaly member is gray-green at some localities. Upper and more prominent part of formation consists of 40 feet of sandstones and sandy shales, both locally lithified to varying extent. Kiger division of Cimarron series.

Named for Big Basin, a depression in Clark County, Kans.

Big Bend facies[1]

Big Bend magnafacies[1]

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original reference: K. E. Caster, 1934, Bull. Am. Paleontology, v. 21, no. 71.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 46. Complete succession of magnafacies as outlined by Caster for southern New York and northwestern Pennsylvania is not represented in Genesee group. At Cayuga, except for Genesco shale, group is presumably within the Big Bend magnafacies, for it is lithologically like Ithaca beds which Caster (1934) placed in that magnafacies. If facies are to be given names and more or less specific boundaries, Starkey tongue of the Sherburne, penetrating the shales to the west, might be treated as a tongue of the Big Bend magnafacies, though its extension away from main mass of magnafacies is far more limited than that of the black shales. With so many variations in ideal sequence of magnafacies and

parvafacies, it is inadvisable to extend terms into western and central New York.

Named for exposures along Allegheny River from Kinzua through Big Bend, Warren County, Pa., and on to Warren, Pa.

Big Bend Gravel[1]

Pleistocene: Northwestern Pennsylvania.

Original references: E. H. Williams, Jr., 1917, Pennsylvania glaciation, First phase; 1917, Am. Philos. Soc. Proc., v. 59, p. 68–75.

Named for Big Bend, Warren County.

Big Blue Group[1]

Big Blue Series[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 5.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677–1678. In Oklahoma and Kansas, Leonard series extends from the horizon near top of Herington limestone up to top of Dog Creek shale—that is, to base of Whitehorse group. Therefore, formations of Big Blue and Cimarron series of Kansas and Nebraska should be reclassified according to assignments in Wolfcamp, Leonard, and Guadalupe series.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 40. Term Wolfcamp supplants term Big Blue, which has heretofore been used as name of lowermost series in Permian in northern midcontinent area. Big Blue series included some higher beds which are now assigned to the Leonard series. Boundary between Wolfcamp and Leonard in Kansas is drawn at top of Nolans formation.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 24, 30–31. Nebraska Geological Survey continues use of Big Blue series. As here considered, includes section between top of Herington limestone and the unconformity at horizon of Brownwille limestone; includes redefined Chase group, Council Grove group, and Admire group.

Named for Big Blue River, which, in northern Kansas, cuts deeply into these rocks.

Big Blue Serpentinous Member (of Temblor Formation)[1]

Miocene, middle: Southern California.

Original reference: R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603.

Named for exposures in Big Blue Hills.

Big Branch Formation[1] (in Dornick Hills Group)

Pennsylvanian (Desmoinesian): Southern Oklahoma.

Original reference: F. W. Floyd and D. C. Nufer, 1935, Tulsa Geol. Soc. Digest, 1934, p. 10–11.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1. Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 140–142. Description of type locality as taken from personal communication by Nufer: 800 feet of section, lower part gray shale with one thin sand bed near middle, upper 400 feet mainly shale with sandstones, chert conglomerate, and several limestones

near top of section; placed in geologic column as that unit from top of Pumpkin Creek limestone down to top of Lester limestone; fauna is Des Moines in age and has no Morrow characteristics, and should be removed from the Dornick Hills. This definition is modified by raising base of Big Branch formation from top of Lester limestone to top of Frensley limestone member of Lake Murray formation. Underlies Deese formation.

C. W. Tomlinson and William McBee, Jr., 1959 *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 30. Maximum thickness about 450 feet. Includes Pumpkin Creek limestone member at top. Overlies Frensley limestone; underlies unnamed unit at base of Deese group. Desmoinesian.

Type locality: Exposures along Big Branch of Washita River in NW¼ sec. 11, T. 3 S., R. 2 E., Carter County.

Big Branch Gneiss

Precambrian: Central Texas.

V. E. Barnes, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 53 (geol. map). Shown on geological map of Cut Off Gap area.

V. E. Barnes, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 56–57 [1945]. Predominantly medium- to dark-gray, medium- to fine-grained quartz diorite composition. Intrudes Valley Spring gneiss and Packsaddle schist. Granites of area and their pegmatites and aplites intrude Big Branch gneiss. Derivation of name given.

Frederick Romberg and V. E. Barnes, 1949, Geophysics, v. 14, no. 2, p. 152–153, fig. 1. Coal Creek serpentine mass is bordered along south and for half of its distance along north by Big Branch gneiss. On map legend Big Branch gneiss is placed above Red Mountain gneiss and below Coal Creek serpentine.

V. E. Barnes, [1952?], Geologic map of the Blowout quadrangle, Blanco, Gillespie, and Llano Counties, Texas (1:31,680): Texas Univ. Bur. Econ. Geology. Most abundant Precambrian rock in quadrangle. Intruded Packsaddle schist and Valley Spring gneiss. Age relation of Red Mountain gneiss and Big Branch gneiss not known. They may be nearly same age and derived from common source. Age relation to Coal Creek serpentine also in question.

Occurs in northeastern Gillespie and northwestern Blanco Counties. Name derived from Big Branch of Coal Creek.

Big Buffalo Series[1]

Lower Ordovician: Northern Arkansas.

E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

Named for exposures on Buffalo River (formerly called Buffalo Fork of White River), in Newton County.

Big Butt Quartzite

Precambrian (Ocoee Series): Western North Carolina and eastern Tennessee.

G. W. Stose and A. J. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233. Big Butt quartzite caps Bald Mountains and

also occurs in Murphy syncline where it is overlain by Valleytown formation.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 272–273, 284–285. Thick-bedded white granular quartzite and interbedded argillite and fine-grained greenish arkose. On Big Butt, formation consists of two beds of massive quartzite, each about 30 feet thick, separated by approximately 100 feet of arkose and argillite. Northeast of the Big Butt, the quartzite caps Rich Mountain and in vicinity of Nolichucky River forms Jump Hill and caps Stony Point; at these places, the quartzite is enclosed in main syncline of Ocoee series and overlies Nantahala slate. One mile southeast of Murphy, Big Butt quartzite makes prominent ridge which is cut through by Hiwassee River; in exposures on north side of river, quartzite is 200 feet thick and consists of two layers of massive thick-bedded white quartzite with thinner beds of dark-banded white and blue, irregularly bedded quartzite in middle. In northern part of Ellijay quadrangle, quartzite is apparently 500 to 600 feet thick but thins southwestward and is not known south of Ellijay. In Murphy syncline, Keith, (1907, U.S. Geol. Survey Geol. Atlas, Folio 143) and La Forge and Phalen (1913, U.S. Geol. Survey Geol. Atlas, Folio 187) mapped a white quartzite—the Tusquitee—which overlies Nantahala slate and underlies Brasstown schist and Valleytown formation. At most places, Keith mapped the quartzite in two parallel lenticular bands with anticlines of Nantahala slate between. These white quartzite are herein correlated with Big Butt quartzite, and intervening slaty beds are regarded not as Nantahala slate but as part of the Big Butt quartzite equivalent to the fine-grained arkosic quartzite and argillite that separate the two quartzite beds of the Big Butt on Bald Mountain. Keith (1905, U.S. Geol. Survey Geol. Atlas, Folio 118) termed the quartzite Nebo and the softer beds Murray shale, which are names that properly should be applied only to Lower Cambrian formations; hence, new name for the youngest formation of Ocoee series in Bald Mountains is proposed.

Named from the Big Butt, northeast culmination of Bald Mountains on Tennessee-North Carolina line.

Bigby Limestone[1]

Bigby facies (of Bigby-Cannon Limestone)

Middle Ordovician: Central Tennessee.

Original reference: C. W. Hayes and E. O. Ulrich, 1903, U.S. Geol. Survey Geol. Atlas, Folio 95, p. 2.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 80, 107–121. Bigby limestone grade laterally into Cannon limestone; the two are contemporary facies of unit here termed Bigby-Cannon limestone which overlies Hermitage formation and underlies Catheys formation. All included in Nashville group.

Named for exposures on Big Bigby Creek, Maury County.

Big Clifty Sandstone[1] **Member** (of Golconda Formation)

Big Clifty Formation (in Stephensport Group)

Upper Mississippian: Western Kentucky and southern Indiana.

Original reference: C. J. Norwood, 1876, Kentucky Geol. Survey, new ser., v. 1, pt. 6, p. 10, 13, 15, 16, 51, 73, 369.

D. H. Swann and Elwood Atherton, 1948, Jour. Geology. v. 56, no. 4, p. 277–278. Sandstone lenses occur sporadically in lower part of Golconda (Indian Springs) shale as far west as Marion County, Ill. Eastward these coalesce into a continuous sandstone unit which has its maximum thickness in a belt extending through eastern Gibson County, Ind., and Daviess County, Ky. There are places where the sandstone is more than 100 feet thick and lies on an unconformable surface which cuts into and even through Beech Creek limestone. This is most continuous and most prominent sandstone in lower and middle Chester of Indiana and Kentucky outcrop belt. Name "Big Clifty" was applied to this sandstone by Norwood (1876). Name has been little used since sandstone has generally been considered equivalent to Cypress sandstone, previously named in Illinois. Northeast of line extending from Shawneetown, Ill., through Dixon and Greenville, Ky., Big Clifty is separated from true Cypress by sheet of Beech Creek (Barlow) limestone; southwest of this line along outcrop belt through Christian and Caldwell Counties, Ky., Big Clifty may lie directly on true Cypress.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 18. Name Haney limestone is proposed for the "Golconda" as recognized east of Todd County, Ky., and north into Indiana. Abandoned name Big Clifty returns to use for sandstone that underlies the Haney and caps the Dripping Springs escarpment from Todd County eastward and northward to Ohio River. Because Big Clifty is represented by little or no sandstone in westernmost Kentucky outcrop and subsurface, in Illinois outcrop, and most of Illinois subsurface, name is unsuitable to these areas, and name Fraileys shale is proposed for interval between Haney and Beech Creek limestone wherever sandstone is insignificant or lacking.

D. J. McGregor, T. G. Perry and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 2. Name Big Clifty formation is used here instead of Cypress as it now appears practically certain that name Cypress has been incorrectly used in Indiana. Formation consists of medium-bedded fine-grained sandstone with gray shale locally at base. Thickness 25 to 40 feet. Underlies Golconda formation; overlies Beech Creek limestone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 40–41, pl. 1. Included in Stephensport group (redefined). Includes shale unit formerly considered to be lower part of Golconda formation. Thickness 42 to 56 feet. Underlies Golconda limestone; overlies Beech Creek limestone.

U. S. Geological Survey currently classifies the Big Clifty Sandstone as a member of Golconda Formation on the basis of a study now in progress.

Named for exposures on Big Clifty Creek, Grayson County, Ky.

Big Cottonwood Formation

Big Cottonwood Quartzite Series[1]

Big Cottonwood Series

Precambrian: Central northern Utah.

Original reference: S. F. Emmons, 1895, U.S. Geol. Survey 16th Ann, Rept., pt. 2, p. 362.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table). Table of summary of formations in Logan quadrangle, Utah, lists Precambrian Big Cottonwood Canyon series below Cambrian Brigham quartzite.

M. D. Crittenden, Jr., 1950, Utah Geol. and Mineralog. Survey [Utah Geol. Soc.] Guidebook 5, pl. 61–65. Formation consists of white or greenish quartzite and brown, green, or deep-blue-purple shale or slaty shale. Thickness 12,000 to 16,000 feet. Underlies unnamed tillite; overlies "the Metamorphic complex."

M. D. Crittenden, Jr., B. J. Sharp, and F. C. Calkins, 1952, Utah Geol. Soc. Guidebook 8, p. 3–4, pl. 1. Term Big Cottonwood series is here proposed as designation for 16,000-foot sequence of alternating rusty-weathering white or greenish quartzites and variegated red, greenish, and blue-purple shales that crop out in lower gorge of Big Cottonwood Canyon. Unconformably overlies Little Willow series (new); underlies Mineral Fork tillite (new). Precambrian.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 36, 37 (fig. 2). Big Cottonwood series discussed in Uinta-Wasatch Mountain junction and part of central Utah. Diagram shows Big Cottonwood above Little Willow series and below Mineral Fork tillite and Mutual quartzite in Wasatch Mountains and below Sheeprock series in Sheeprock Mountains. Correlates with Uinta Mountain group in eastern Uinta Mountains.

Name proposed for sequence which crops out in lower gorge of Big Cottonwood Canyon, in Wasatch Mountains.

Big Cottonwood Formation[1]

Upper Cretaceous: Southwestern Minnesota.

Original reference: F. W. Sardeson, 1908, Geol. Soc. America Bull., v. 19, p. 221–242.

Outcrops on Big Cottonwood River and in neighboring parts of Minnesota Valley.

Big Cottonwood Canyon Series

See **Big Cottonwood Formation.**

Big Creek Shale Member (of Carbondale Formation)[1]

Big Creek Shale (in Carbondale Group)

Pennsylvanian: Western and northern Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 108–110, geol. sections 18, 19, 44. Included in Brereton cyclothem, Carbondale group. Thickness 10 to 30 feet; in Havana quadrangle 11 feet thick. Upper part of underlying Cuba sandstone is commonly shaly, and boundary between it and Big Creek shale is indefinite at many places. Stratigraphically below Herrin (No. 6) coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), pl. 1. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Carbondale is redefined as formation and includes Big Creek shale member which lies above Vermilionville sandstone member and below Herrin (No. 6) coal member.

Type locality: Along Big Creek in T. 7 N., R. 4 E., Canton quadrangle, Fulton County. Named from outcrops along Big Creek in T. 7 N., R. 4 E., Fulton County.

†Big Deciper Calcareous Sands[1]

Upper Cretaceous (Gulf Series): Southern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 77, 79, 188.

Named for exposures in bluffs of Big Deciper Creek, 6 miles south of Arkadelphia, Clark County.

†Big De Gray horizon[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann, Rept. 1888, v. 2, p. 79, 81, 188.

Named for occurrence in bed of Big De Gray Creek, near McCaulley's, Clark County.

Big Elk Sandstone Member (of Colorado Shale)[1]

Upper Cretaceous: Central southern Montana.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 691–F, p. 189, 195–198.

H. D. Hadley, P. J. Lewis, and R. B. Larsen, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 135. Big Elk sandstone and Mosby sandstone of central Montana probably equivalent to part of Frontier formation.

Named for exposures in Big Elk Dome, in west part of Musselshell Valley.

Bigelow Formation (in Council Grove Group)[1]

Permian: Northeastern Kansas and southeastern Nebraska.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21-23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 65. Proposed that Bigelow be dropped as stratigraphic term and that Crouse limestone, Blue Rapids shale, and Funston limestone be recognized as formations. Gives derivation of name.

Named from Bigelow, Marshall County, Kans.

Big Falls Picritic Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 231 (table), 238–241, pl. 1. Characterized by prominent phenocrysts of augite and olivine. Commonly very vesicular pahoehoe, locally aa. Typically consists of many thin flow units ranging in thickness from 1 or 2 feet to 20 feet. Maximum thickness about 134 feet. Basal unit of series; lies on eroded surface of Kula lavas; in sea cliff east of Hanawi Stream fills gorge cut completely through

Kula lavas into Honomanu basalts. Stratigraphically below Makapipi basalts (new).

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 77–78. Exposed along narrow band with outcrop area of about 0.1 square mile along east side of Hanawi Gulch, in Nahiku area along northeast side of island. Pleistocene(?).

Named for occurrence at Big Falls on Hanawi Stream, Haleakala (East Maui) volcano.

Bigford Member (of Mount Selman Formation)[1]

Eocene, middle: Southern Texas.

Original reference: A. C. Trowbridge, 1923, Geol. Soc. America Bull., v. 34, p. 75; 1923, U.S. Geol. Survey Prof. Paper 131–B, p. 92.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 243–C, p. 37. Because of similarity of their stratigraphic position above Carrizo sand and similarity of ferruginous beds partly composing them, Reklaw and Bigford members of the Mount Selman have been regarded as contemporaneous. Geographic and stratigraphic positions of the fossiliferous ferruginous sandstones north of Leming, Atascosa County, suggest that they represent eastward extension of Bigford from Frio County. If Leming and Scruggs Creek localities should prove to represent same zone, then on the assumption that the conglomerate is basal part of Reklaw, it would appear that the Bigford is not exact equivalent of the Reklaw, but is older and intervenes between the Carrizo sand and the Reklaw.

Named for Bigford Ranch, Webb County.

Bigfork Chert[1]

Middle Ordovician: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557; 1909, Slates of Arkansas; Arkansas Geol. Survey, p. 30, 35.

B. H. Harlton, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 4, p. 781 (fig. 2), 782, 783–787. Geographically extended into Ouachita Mountains, southeastern Oklahoma, where it is well exposed at Black Knob Ridge and in the Potato Hills. At Black Knob Ridge, light- to dark-gray hard cryptocrystalline well-bedded cherty highly siliceous limestone with thin layers of coarsely crystalline limestone; upper part consists of alternating chert and marly shale or shale beds ranging from 1 inch to 2 feet in thickness. About 600 feet thick. Conformably underlies Polk Creek shale; overlies Womble shale. Upper Ordovician.

Named for exposures over large area around Bigfork post office, Montgomery County, Ark.

Big Glass Mountain Complex[1]

Recent: Northern California.

Original reference: H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 280–282.

In Modoc Lava Bed quadrangle.

Bigheart Sandstone Member (of Tallant Formation)

Bigheart Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Central northern Oklahoma.

Original reference: L. C. Snider, 1911, Oklahoma Geol. Survey Bull. 7, p. 221.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119–120, 121–122. Reallocated to member status in Tallant formation (new).

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 32–39, pl. 1. Basal member of Tallant. Revard sandstone member lies near top of formation. Average thickness between 10 and 35 feet.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 21–22, pls. In Pawnee County, Bigheart is thick resistant bed of fine- to coarse-grained sandstone. Massive to well bedded to crossbedded; contains silty or shaly streaks. Thickness 50 to 72 feet. Basal member of Tallant. Separated from overlying Revard sandstone member by unnamed shale member approximately 100 feet thick.

Named for exposures west of Barnsdall (formerly called Bigheart), Osage County.

Big Hill Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 117 (fig. 17), 119, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined. Big Hill is second in known sequence; younger than Emery Peak and older than Mud Hill.

Big Hill is deeply eroded cone composed of tuff, spatters, and minor amounts of lava, Union County.

Big Hill Beds[1] or Member (of Richmond Formation)

Big Hill Limestone

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Michigan Univ. Mus. Geol. Contr., v. 2, no. 8, p. 115–150.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 14 (table). Table shows Big Hill [member] of Richmond formation; occurs above Stonington [member].

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Chart shows Big Hill limestone overlying Ogontz limestone.

Beds exposed from crest of Hinkins Hill (also known as Big Hill) north to east end of Maywood road, Delta County.

Bighorn Dolomite,[1] Limestone, or Group

Upper Ordovician: Wyoming and southern Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

C. W. Tomlinson, 1917, Jour. Geology, v. 25, no. 2, p. 113, 118 (fig. 2); no. 3, p. 253–257. Bighorn dolomite divisible into nine members. Members 5 to 7 constitute a distinct and widely developed unit. In Goose Creek Ridge section, there is little ground for differentiating these three from each other but lowest Richmond fauna occurs in beds there marked

as member 6. In Crandall Creek and Dead Indian Creek sections, there is conspicuous surface of disconformity with a basal breccia, at base of member 6. It probably represents the hiatus which was inferred by Darton between Trenton and Richmond members of the Bighorn. In Teton Range, there is an unconformity at base of member 6. Blackwelder proposes recognition of members 6 and 7 in that region, and of corresponding strata in Gros Ventre Range, as a distinct formation, to be called the Leigh.

Eliot Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8, no. 13, p. 419–420. From Teton Range eastward at least to middle of Wind River Mountains and north into Absaroka Range, the massive member, the Bighorn dolomite, is overlain by a thin persistent layer, the Leigh dolomite member. The Leigh is commonly 30 to 40 feet thick, and, in most if not in all localities, is limited both above and below by disconformities.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1092. In Wind River Canyon area, Wyoming, Big Horn [Bighorn] dolomite overlies Boysen formation (new).

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 17-20, pl. 17. Formation in southern Absaroka Range, Wyo., comprises three members: Lander sandstone, about 7 feet high; massive middle dolomite member, 180 feet thick; and Leigh dolomite member, 25½ feet thick. Overlies Gallatin formation; underlies Darby formation.

Erling Dorf and Christina Lochman, 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 543, 554 (fig. 2). In southern Montana, overlies Grove Creek formation (new).

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 129. Bighorn dolomite in this report [Wind River Mountains] is 200 to 300 feet thick. Overlies Lander sandstone; and underlies Darby formation. No lithologic or faunal unit comparable with Leigh dolomite member of Gros Ventre Range recognized in area of report.

H. R. Wanless, R. I. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 14–15, pls. Bighorn dolomite is prominent in eastern Teton and southwest Gros Ventre Ranges where it overlies Boysen limestone (formation). Also exposed in Snake River Canyon, on either side of St. John thrust, and in the sheets west of Ferry Peak and Needle Peak thrusts. It is oldest exposed stratum both in northern Grayback Ridge, resting on Darby thrust where it overlies overturned Cretaceous Bear River shales, and in Shepherd Creek on western side of Hoback Range, where it is partially exposed in faulted anticline about one-half mile east of Hoback fault. Also exposed in southwestern and West Jackson Hole Buttes. Thickness 60 to 620 feet. Upper part of Bighorn was designated Leigh member by Tomlinson (1917), but, since its Ordovician age is doubted, it is herein considered separate formation and its thickness is not included in above-mentioned thicknesses. Leigh formation is overlain by Darby formation.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 45–48, pl. 6. Described in Crazy Woman Creek area, Johnson County, Wyo., where it overlies Gallatin limestone and Gros Ventre formation, undivided, and unconformably underlies Madison limestone. Consists of three major units: basal 65 feet, light-gray to brick-red, very fine-grained to coarse-

grained almost pure quartz sandstone; middle, about 250 feet of dense massive dolomite; upper, about 40 feet of white-weathering slabby argillaceous dolomite.

M. M. Knechtel, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1994–1995. In Little Rocky Mountains, Mont., overlies Emerson formation (new). Upper Ordovician.

R. J. Ross, Jr., 1957, U.S. Geol. Survey Bull. 1021–M, p. 446 (fig. 68), 447–448. Discussion of Ordovician fossils from wells in Willston basin, eastern Montana. Term Bighorn group used to include (ascending) Red River and Stony Mountain formations in subsurface. Overlies Winnipeg formation.

P. W. Richards and C. L. Nieschmidt, 1957, Billings Geol. Soc. Guidebook 8th Ann. Field Conf., p. 54–62. Bighorn dolomite crops out in south-central Montana and northern Wyoming throughout Absaroka Range, Beartooth and Pryor Mountains, and all but southern part of Bighorn Mountains. Missing from Big Snowy and Little Belt Mountains and Bridger Range in Montana; occurrence west of Yellowstone National Park spotty. Maximum thickness about 500 feet in Bighorn Mountains near Montana-Wyoming border east of map area. Thinner southward, westward, and northward from that area. Merges eastward into Red River and Stony Mountain formations. Bighorn is restricted for this report to area north of Wind River basin, Wyoming—that is, north of approximately the 43°30′ parallel of latitude—to the predominantly carbonate rocks. As thus restricted, divided into two main units which are distinguished in map area except in Pryor Mountains and on north flank of Beartooth Mountains. Lower three-fourths of lower unit is massive cliff-forming dolomite, and upper one-fourth is thin-bedded dolomite; unit is 210 to 260 feet thick. Massive lower part of lower unit is evidently Tomlinson's units 3 and 4, and white blocky dolomite at top of lower member is Tomlinson's unit 5. Upper unit is a 1- to 3-fold sequence of lower unit, but the massive- and thin-bedded parts are neither as thick nor as continuous in upper unit as in the lower. Upper unit, as here described, includes Tomlinson's units 6 to 9 inclusive. Tomlinson said his units 6 and 7 are Leigh dolomite member. However, the writers [Richards and Nieschmidt] do not believe that these two units are necessarily the stratigraphic equivalent of Leigh dolomite member as defined in Teton Range by Blackwelder, and name Leigh is not applied in area of this report. Overlies Cambrian Grove Creek formation throughout Beartooth Mountains and adjacent areas; underlies Devonian strata throughout all but far southeast corner of area; in that area and to the south, underlies Madison limestone. Unconformably underlies Devonian strata. Unconformity marked in some places by channel deposits which, in Park County, Wyo., were named Beartooth Butte formation by Dorf (1934). Jefferson formation overlies Beartooth Butte formation and the Bighorn beyond edges of Beartooth Butte formation.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 13–17, pls. Thickness 370 to 395 feet in Buffalo-Lake De Smet area, Wyoming. Includes sandstone member at base, massive cliff-forming dolomite member in middle, and thin-bedded dolomite and dolomitic limestone member at top. Overlies Gallatin and Gros Ventre formations, undifferentiated; underlies Madison limestone.

Named for exposures in Bighorn Mountains, Wyo.

†Bighorn glacial epoch[1]

Pleistocene (pre-Wisconsin): Colorado.

Original references: W. W. Atwood and K. F. Mather, 1912, Science, new ser., v. 35, p. 315; 1912, Jour. Geology, v. 20, p. 388; 1912, Geol. Soc. America Bull., v. 23, p. 732.

Biglow Glacial Substage

Pleistocene (Tazewell): West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 329–331, fig. 2, table 4. Time of Wisconsin glaciation in Frying Pan Valley during which outwash deposits and Biglow moraines were deposited. Older than Ivanhoe glacial substage (new); younger than Thomasville glacial substage (new).

Deposits mapped in vicinity of Biglow. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Big Mountain Shale Member (of Keyser Limestone)[1]

Lower Devonian: Northern West Virginia and western Virginia.

Original reference: F. M. Swartz, 1929, U.S. Geol. Survey Prof. Paper 158–C, p. 29.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 38, 42–44, 226. Dark thin-bedded calcareous shale with thin limestone bands and locally partly knobby or irregular bedding. Relatively unfossiliferous limestones; contacts with adjacent units are sharp. Passes laterally into lower part of Clifton Forge sandstone of Alleghany County, Va., and adjacent areas in West Virginia.

Named from Big Mountain about 1½ miles west of village of Upper Tract, Pendleton County, W. Va.

Bignell Loess

Bignell Formation (in Sanborn Group)

Bignell Silt Member (of Sanborn Formation)

Pleistocene and Recent: Southwestern Nebraska and northwestern Kansas.

C. B. Schultz and T. M. Stout, 1945, Am. Jour. Sci., v. 243, no. 5, p. 241–244. Formation consists of gray loess. Separated from "Peorian" loess by prominent soil and overlain by complex top soil.

J. C. Frye and O. S. Fent, 1947, Kansas Geol. Survey Bull. 70, p. 50–51. Geographically extended into Kansas where it is considered silt member of Sanborn formation. Occurs above Brady soil at top of Peoria silt member. Thickness in Rice County, 1½ feet.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 138–140. Member forms thin discontinuous widely distributed deposits over northwestern part of Kansas. Commonly less than 10 feet thick; resembles underlying Peoria loess in lithology; contains distinctive, though sparse, molluscan fauna. Rests on Brady soil. Caryan-Mankatoan.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Formation at top of Sanborn group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as Bignell Formation. [Kansas does not use term Sanborn group].

Type locality: About 1.7 miles due south of Bignell, southeast of North Platte, in E½E½ sec. 3, T. 12 N., R. 29 W., Lincoln County, Nebr.

Big Oak Flat Shale and Sandstone Member (of Panoche Group)

Upper Cretaceous: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 200, 203–204, 226 (fig. 5), pl. 3. Lower part, 300 to 350 feet thick, is interbedded brownish sandstone and clay-shale, with limestone concretions; upper part is foraminiferal clay-shale, 200 to 300 feet thick. Unconformably overlies Call sandstone member (new) on southwest limb of Butts Ranch syncline; underlies Lodo formation. Considered younger than Butts Ranch shale (new); may be younger than Moreno shale which does not appear on southwest side of syncline.

Type locality: Small northeast-trending canyon 1 mile northwest of Big Oak Flat, San Benito County. Named for Big Oak Flat. Exposed only on southwest side of Butts Ranch syncline.

Big Rock Conglomerate Member (of Kiawa Mountain Formation)

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 1, 10, 24–25, pl. 1. Consists of dark- to medium-gray quartz-pebble conglomerate with intercalated slightly feldspathic quartzite. Most pebbles are light-gray quartz; a few are red and black quartz. Crossbedding common, and current bedding commonly well defined by laminae of iron oxide as well as by layers of differing grain size. Pebbles mostly in the 1- to 5-inch range are well to poorly sorted and highly rounded. Thickness 50 to 200 feet. Underlies lower quartzite member; overlies Ortega quartzite; appears to pinch out east of Poso Spring.

Extends along its strike from NE¼ sec. 20, T. 27 N., R. 8 E., to Big Rock syncline (0.2 mile northwest of Big Rock) and north to Poso anticline; also in SE¼SW¼ sec. 23, T. 27 N., R. 8 E., Las Tablas quadrangle.

Big Run Sandstone

Pennsylvanian (Monongahela Series): Eastern Ohio.

A. T. Cross, W. H. Smith, and Thomas Arkle, Jr., 1950, Field guide for special conference on the stratigraphy, sedimentation, and nomenclature of the Upper Pennsylvanian and Lower Permian strata (Monongahela, Washington, and Greene series) in the northern portion of the Dunkard Basin of Ohio, West Virginia, and Pennsylvania: West Virginia Geol. and Econ. Survey, Sec. 12–A, 12–B, Stop 15 [pl. 1]. Big Run sandstone shown on profile of Uniontown to middle Benwood strata on Ohio Route 7, north of Powhatan. Description reads Lower Uniontown (Big Run sandstone). Columnar section [pl. 1] shows Big Run sandstone above Lower Uniontown coal and below Uniontown coal (No. 10).

Big Saline Formation (in Bend or Marble Falls Group)

Big Saline Group

Big Saline Member (of Marble Falls Formation)

Pennsylvanian: North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 83–85. In much of north-central Texas, type Marble

Falls beds are unconformably overlain by group of shales, sandstone, and limestone, which is herein named Big Saline group. Underlies Smithwick group. Big Saline beds have commonly been included with the Marble Falls. Group is represented by some 50 feet of fusulinid-bearing limestones and shales in east-central McCulloch County; beds become more shaly eastward and identity at outcrop becomes less certain. Northward in subsurface, beds attain thickness of at least 400 feet in Ranger area and are divisible into two formations De Leon and Sipe Springs (both new). Lampasas series.

F. B. Plummer, 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 33, p. 6, 7; 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 65, 67, 68, 73. Member of Marble Falls formation. Overlies Sloan member (new); underlies Lemons Bluff member (new).

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143–145. Formation, east of Cavern Ridge, includes (ascending) Gibbons conglomerate, Aylor oolite, Lemons Bluff spiculite, and Brister limestone members; west of Cavern Ridge includes (ascending) Gibbons, Brook Ranch, Lemons Bluff, and Soldiers members. Overlies Sloan formation; underlies Smithwick formation. Bend (Atoka) group.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 56 (fig. 13), 57–77. Here assigned to Marble Falls group, Bend series.

Type locality: Near mouth of Big Saline Creek in eastern Kimble County.

Big Snowy Group[1] or Formation

Mississippian and Pennsylvanian: Central Montana.

Original reference: H. W. Scott, 1935, Geol. Soc. America Proc. 1934, p. 367.

O. A. Seager, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 863. In subsurface in Cedar Creek anticline, southeastern Montana, Big Snowy group includes (ascending) Charles (new), Kibbey, and Otter formations. Underlies Amsden formation; overlies Madison (Pahasapa of Black Hills).

L. L. Sloss, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 65 (chart), 67, 68 (cross section). Restricted at base to exclude Charles formation (subsurface and surface?) which is here assigned to Madison group. As restricted, includes (ascending) Kibbey, Otter, and Heath formations. Underlies unit referred to as lower Amsden.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 329–349. Big Snowy group of Scott is expanded and redefined to include, in ascending order, not only Kibbey sandstone, Otter formation, and Heath formation of his original report, but also three overlying formations—Cameron Creek, Alaska Bench limestone, and Devils Pocket formation. Scott's (1935) Amsden consisted of a lower red shale, siltstone, and sandstone member (Cameron Creek of this report) and an upper gray limestone member (Freeman's Alaska Bench limestone). Underlies Triassic(?) or Permian(?) and Pennsylvanian undifferentiated, or locally Ellis group; overlies units of Madison group. Thickness 1,509 feet at standard section herein suggested. Mississippian and Pennsylvanian.

O. D. Blake, 1959, Billings, Geol. Soc. Guidebook 10th Ann. Field Conf., p. 64 (fig. 1), 65–68. Includes unit termed Lombard facies.

Standard section: Composite of Stonehouse Ranch and State Road No. 25 sections. Upper part of section was measured in secs. 31 and 32,

T. 11 N., R. 21 E., and lower part was measured in sec. 30, T. 11 N., R. 21 E., and sec. 25, T. 11 N., R. 20 E., Big Snowy Mountains. Named for extensive distribution and exposures in Big Snowy Mountains. Also exposed in Little Belt Mountains, Castle Mountains, and Lombard Hills.

Big Spring Member (of Conococheague Formation)
See Big Spring Station Member (of Conococheague Formation)

Big Springs Limestone Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 44, 47.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 153. Big Springs limestone member of Lecompton formation; underlies Queen Hill shale member; overlies Doniphan shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20, fig. 5. Thickness about 1 foot in Iowa, Missouri, and Nebraska; average about 2 feet in Kansas. Type locality stated. G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24.

Commonly one massive light- to dark-gray argillaceous bed. Very fossiliferous in some outcrops. Thickness 1 to 1½ feet. Underlies Queen Hill shale member; overlies Doniphan shale member.

Type locality: North of Big Springs, Douglas County, Kans.

Big Spring Station Member (of Conococheague Formation)

Upper Cambrian: Northwestern Maryland and southwestern Pennsylvania.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources, Washington County [Rept. 14], p. 45, 55–56. Name Big Spring member applied to basal unit of the Conococheague as described in section measured at Big Spring, Md. Consists mainly of dolomite, shale, sandstone beds, oolite and cryptozoon limestone. Thickness 312 feet. Underlies dolomite beds in middle part of formation; overlies Elbrook formation. Name credited to J. L. Wilson.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 307–308, pl. 3. Formally proposed as Big Spring Station member. Member is best defined by abundant beds of platy yellow-weathering dolomitic siltstone or silty dolomite and coarsely arenaceous dolomite or siliceous orthoquartzite; some of the latter beds are 4 to 5 feet thick, although generally the rock type occurs in thinner layers interbedded with typical laminated limestone of the higher Conococheague. Upper boundary arbitrarily drawn at top of uppermost orthoquartzite or very arenaceous limestone within lower group of Conococheague sandstones; lower limit of member (and formation) arbitrarily drawn at lowest of these sandstone beds; the buff-yellow weathering silty dolomite in the Big Spring Station is the same type as that in underlying Elbrook formation, and boundary between the two units is gradational if sandy layers are not considered.

Carlylè Gray and A. A. Socolow, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Snitz Creek member of Conococheague has

same stratigraphic position of, and is lithologically similar to, Big Spring Station member (Wilson, 1952) of Conococheague formation.

Type section: At railroad cuts north of and in fields west of Big Spring Station on Western Maryland Railroad about 3 miles south of Clear Spring, Washington County, Md.

Big Spruce Knob Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 214, 221–223.

Named for exposure at base of Big Spruce Knob, Pocahontas County.

Big Spruce Knob Shale[1]

Mississippian: Southern West Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 214, 223–224.

Exposed on Big Spruce Knob, Pocahontas County.

Big Stone Gap Member (of Chattanooga Shale)[1]

Mississippian (Kinderhookian): Southern Tennessee and southwestern Virginia.

Original reference: J. H. Swartz, 1927, Am. Jour. Sci., 5th, v. 14, p. 485–499.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 93, 94, 96, 97). Shown on correlation chart as overlying Olinger shale and locally the Chemung. Mississippian (Kinderhookian).

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 26. At locality 228 (near Apison, Hamilton County, Tenn.), black shale identified as Big Stone Gap member of Chattanooga by Swartz is placed in Maury formation as herein defined. This stratigraphic assignment made because beds in question either contain conodonts like those of Maury formation of Tennessee or have lithology similar to that formation.

Extends continuously from Chattanooga area to Big Stone Gap, Va., and beyond.

Big Stone Gap Shale[1] or Siltstone

Upper Devonian and Lower Mississippian: Southwestern Virginia.

Original reference: G. W. Stose, 1923, Virginia Geol. Survey Bull. 24.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 143–144, pl. 15. Stose (1923) named Big Stone Gap shale from Big Stone Gap, Va. Swartz (1926 [1927]) proposed that Big Stone Gap be used as name for upper member of Chattanooga formation. Present writer [Cooper] agrees with Swartz's restriction of name but doubts advisability of designating the shale as a member. Geographic distribution of unit is sufficiently extensive for shale to be regarded as formation. In Burkes Garden quadrangle [this report], Big Stone Gap shale is present only in belt immediately north of St. Clair fault. Where well exposed near south edge of Bluefield, formation consists of about 10 feet of black fissile shale. This shale was identified as Sunbury shale by Reger (1926, West Virginia Geol. Survey Rept. Mercer, Monroe and Summers Counties), but this correlation has scant supporting evidence. Writer traced black shale zone at base of the Price from Bluefield, Va., southwestward

to Duffield, Scott County and is satisfied that the black shale at Bluefield is upper part of Big Stone Gap shale of Stose and the Big Stone Gap member of Chattanooga formation of Swartz. Underlies Price formation; overlies "Chemung." Mississippian (Kinderhook).

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Described in Duffield quadrangle as Big Stone Gap siltstone. This formation was defined as shale by Stose. Consists of about 200 feet of dark-gray to grayish-black carbonaceous siltstone with some interbeds of dark-gray carbonaceous shale. Overlies a 400-foot sequence of siltstone (Portage shale as used by Stose, 1923); underlies Price siltstone. On basis of conodonts collected in Duffield quadrangle and near Big Stone Gap, Hass believed formation to be Late Devonian and Early Mississippian in age.

Named for Big Stone Gap, southwestern Virginia.

Big Thompson Metasediments

Big Thompson Schist[1]

Precambrian: Central northern Colorado.

Original reference: M. B. Fuller, 1924, Jour. Geology, v. 32, p. 51–63.

M. F. Boos, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1372. Estes Park beds (new) of Big Thompson series of metasedimentary formations and Longs Peak (Silver Plume) and Mount Olympus granitic rocks constitute bedrock of Estes Park Valley.

B. D. Hudson, 1959, Dissert, Abs., v. 19, no. 10, p. 2578. Metasediments are oldest rocks in area near mouth of Big Thompson Canyon. Quartzite, micaceous quartzite, feldspathic quartzite, quartz schist, and mica schist interbedded in a relatively undeformed sequence at least 13,000 feet thick.

Named for Big Thompson River, which, in traversing eastern slope of Front Range, has exposed a complete section of the schist.

Big Valley Bed (in Strawn Group)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 380.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg. and Field Symposium, May 11, 12, no. 70. Underlies Brown Creek bed; overlies Bull Creek sandstone. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Big Valley, Mills County.

Big Wash Andesite

Tertiary: Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 667, fig. 2. Andesite flow which lies unconformably on rhyolite tuff and breccia of Kingman series (new).

B. E. Thomas, 1953, Geol. Soc. America Bull. v. 64, no. 4, p. 408. Thickness of flow 50 to 60 feet. Platy jointing well developed in the bed.

Only occurrence is west of Chloride, on north side of mouth of Big Wash, on west flank of Cerbat Mountains, Mohave County.

Bijiki Iron-Formation Member (of Michigamme Slate)[1]

Precambrian (Animikie Series): Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 596.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 36. Lower part of Michigamme slate in Marquette district includes Bijiki iron-formation, Clarksburg volcanics, and Greenwood iron-formation members. Animikie series.

Named for exposures near mouth of Bijiki River.

Bijou Formation

Miocene-Pliocene: South Dakota.

R. E. Stevenson and L. A. Carlson, 1950, Areal geology of Bonesteel quadrangle (1:62,500): South Dakota Geol. Survey. Interbedded bentonitic clay, sandy siltstone, sandstone, and pebble conglomerate. Stratigraphically above Elk Butte member of Pierre formation and below Herrick gravels (new).

R. E. Stevenson, 1953, South Dakota Acad. Sci. Proc., v. 32, p. 86–89. Characterized by green siliceous coarse quartzose sandstone which makes up about 21 percent of formation. This siliceous sandstone occurs as discontinuous lenses. Bulk of formation consists of greenish to gray bentonitic clay. Thickness, determined from exposures and drill holes, 38 to 54 feet. Barstovian-Clarendonian.

R. E. Stevenson, 1957, South Dakota Acad. Sci. Proc., v. 36, p. 134–138. As herein revised, consists of lenses and thin beds of greenish siliceous sandstone which may be found interbedded with strata of Pliocene or Miocene age (unnamed upper Miocene, Valentine, or Ash Hollow). That is, the Bijou represents a discontinuous facies of greenish silica-cemented sandstone in Miocene and Pliocene rocks of south-central South Dakota.

Typical section: SW¼NE¼ sec. 30, T. 96 N., R. 67 W., Gregory County. Named from exposures in Bijou Hills.

Bilk Creek Sandstone Member (of Wanakah Formation)

Bilk Creek Sandstone Member (of Morrison Formation)

Upper Jurassic: Southwestern Colorado.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1748 (fig. 2), 1750, 1752 (fig. 3), 1753 (table 1). Proposed as member of Morrison formation. About 20 feet of sandstone or sandy beds capped by carnelian sandstone. Underlies Wanakah marl member; overlies Pony Express limestone member. [See La Plata sandstone.]

E. B. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 27 (table), 28–29, pl. 2. Reallocated to member status in Wanakah formation. Overlies Pony Express member and underlies unnamed marl member.

Named for exposures along highway about 6 miles west of Telluride, along San Miguel Valley, opposite mouth of Bilk Creek, Ouray County.

Billings Member (of Wellington Formation)

Permian: North-central Oklahoma.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1928. Thickness 52 feet. Underlies Antelope Flats member (new); overlies Midco (lacustrine) member (new).

W. F. Tanner, 1959, Jour. Sed. Petrology, v. 29, no. 3, p. 327 (table 1). Table shows Billings Pool member above Midco member and below Antelope Flats member.

Type locality and derivation of name not stated.

Billings Pool Member (of Wellington Formation)

See Billings Member (of Wellington Formation).

Bills Creek Beds[1] or Member (of Richmond Formation)

Bills Creek Shale

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Michigan Univ. Mus. Geology Contr., v. 2, no. 8, p. 113–150.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14 (table), 40–45. Overlie Haymeadow Creek member (new) of Trenton formation. Unit termed Haymeadow Creek was formerly included in basal Bills Creek beds. Maximum thickness of beds 80 feet; lower 20 feet are now correlated with Collingwood which some workers consider late Trenton. Thickness at type locality about 62 feet. Underlie Stonington beds [or member] of Richmond. Contact with overlying Stonington beds is disconformable.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Chart shows Bills Cheek shale below Bay de Noc limestone.

Type locality: Along Bills Creek, sec. 7, T. 41 N., R. 20 W., sec. 12, T. 41 N., R. 21 W., 5 miles northeast of Rapid River, Delta County.

Biloxi Sand[1]

Pleistocene: Southern Mississippi, and southeastern Louisiana.

Original reference: L. C. Johnson, 1891, Geol. Soc. America Bull., v. 2, p. 24-25.

Named for Biloxi, Harrison County, Miss.

Bimber Run Conglomerate Member[1] (of Venango Formation)

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 86, table opposite p. 61.

Bradford Willard, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 14, 243. Listed as member of Venango formation. Underlies North Warren shale member. Upper Devonian. Bimber Run and North Warren are part of Caster's (1934) Salamanca formational suite.

Named for occurrence on Bimber Run and south of its mouth in Watson Township, Warren County.

†Bingen Formation[1] or Sand[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas, northwestern Louisiana, and southeastern Oklahoma.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 56–58.

Named for exposures near Bingen, Hempstead County, Ark.

Bingham Quartzite[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 33–37, map sections.

Includes following units: Phoenix Limestone Lentil, Tilden Limestone Lentil, Yampa Limestone Lentil, Highland Boy Limestone Member, Commercial Limestone Member, Jordan Limestone Member, Lenox Limestone Member, and Butterfield Limestone Member.

In Bingham district.

Binghamton Drift

Binghamton Substage

Pleistocene (Wisconsin): New York and Pennsylvania.

Paul MacClintock and E. T. Apfel, 1944, Geol. Soc. America Bull., v. 55, no. 10, p. 1145 (fig. 1), 1155–1159, pl. 1. Based primarily on lithologic differences, three Wisconsin drift sheets are recognized (ascending) Olean, Binghamton, and Valley Heads. Binghamton drift differs from Olean drift in having abundance of both igneous erratics and limestone. These two constituents, being more conspicuous than the drab gray and browns of the local plateau, give Binghamton drift a brighter look.

L. C. Peltier, 1949, Pennsylvania Geol. Survey, 4th ser., Bull. G 23, p. 4 (table 1), 16 (fig. 5), 19–20, table 5. Referred to as Binghamton substage in discussion of glacial geology of Susquehanna River terraces. Discussion also of Binghamton till, sand, and loess. Overlies Olean and constitutes youngest glacial deposits in this part of Pennsylvania.

Named for exposures near Binghamton, Broome County, N.Y. Drift border passes from Ohio into Pennsylvania 16 miles southwest of Newcastle and enters New York from Pennsylvania on east side of Conewango Valley, 3½ miles east of Fentonville and 9 miles southeast of Jamestown.

Binnewater Sandstone (in Salina Formation)[1]

Silurian: Southeastern New York.

Original reference: C. A. Hartnagel, 1905, New York State Mus. Bull. 80, p. 342–357.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 46–51. Not present in Catskill and Kaaterskill quadrangles. Rock called Binnewater by field parties is of later age and is here called Fuyk sandstone a facies of the Rondout.

Named for occurrence at Binnewater, 7 miles southwest of Kingston, Ulster County.

Birch Creek Limestone Member (of Barnsdall Formation)

†Birch Creek Limestone Bed (in Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–D, p. 17–19.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 120. Reallocated to member status in Barnsdall formation (new). At state line, Barnsdall

consists of Birch Creek limestone at base and two unnamed shale members that are separated by unnamed sandy limestone less than 2 feet thick.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 29–30. Varies laterally from lens to lens; occurs at more than one horizon and represents more than one environment.

Named for exposure in bluffs on north side of Birch Creek, near eastern edge of SE¼ sec. 25, T. 24 N., R. 10 E., Osage County.

Birch Creek Schist[1]

Precambrian: Eastern and south-central Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 140–145, 224.

F. F. Barnes and others, 1951, U.S. Geol. Survey Bull. 963–E, p. 146–147, pl. 18. Oldest formation exposed in Healy-Lignite area, south-central Alaska. Unconformably underlies unnamed coal-bearing formation.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Name appears on map legend under Lower Precambrian rocks and Paleozoic rocks.

Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 8, pls. 1, 2, 3. Predominantly quartz-serite schist; locally contains layers of quartzite and black carbonaceous schist. In fault contact with Cantwell formation. Occupies east-trending belt from 3 to 12 miles wide in north part of Alaska Range.

Named for exposures in Birch Creek district, central eastern Alaska.

Bird Iron-Bearing Member (of Hemlock Formation)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Consists of oolitic hematite-chert, highly ferruginous quartzite and schist, and breccia made up of angular chert and jasper fragments in a matrix of hard blue hematite. Member attains a maximum thickness of 300 feet and lies about 1,300 feet below the top of formation. Overlain and underlain by greenstone.

Named for the Bird Exploration in sec. 13, T. 43 N., R. 32 W., Iron County.

Birdbear Formation (in Jefferson Group)

Upper Devonian: Subsurface in North Dakota and Montana.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2292 (fig. 2), 2302–2303 (fig. 4), 2318–2322. Proposed for widespread beds of light-colored finely crystalline dolomite and limestone that overlie the Duperow and underlie the Three Forks in Williston basin and central Montana. Thickness ranges from fraction of a foot to 125 feet; in type well 90 feet. Replaces term Nisku formation now restricted to type area in central Alberta.

Type section: Interval between depths of 10,310 and 10,400 feet in Mobil Producing Company's Birdwell No. 1, in sec. 22, T. 149 N., R. 91 W., Dunn County, N. Dak.

Bird Creek Limestone (in Wabaunsee Group)

Bird Creek Limestone Member (of Buck Creek Formation)[1]

Bird Creek Limestone Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–L, p. 137, pl. 21.

K. E. Masters, 1957, Shale Shaker, v. 7, no. 5, p. 8–10. Reallocated to member status in upper part of Vamoosa formation. Report covers Prague area in Lincoln and Pottawatomie Counties.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25 (table 2), 48–50, pl. 1. In Pawnee County, consists of single bed of limestone resting on Severy shale. Extends into Creek County on south, where its southern extent is not known. Thickness about 2 feet in type area; less than 1 foot to 1½ feet in Pawnee County. Underlies Hallett shale. In Wabaunsee group.

Named for exposures on valley sides of Bird Creek and tributaries in T. 27 N., R. 8 E., Osage County.

Birdhead Sandstone Member (of Cloverly Formation)

Birdhead Sandstone Member (of Thermopolis Shale)[1]

Upper Cretaceous: Central southern Montana and northern Wyoming.

Original reference: W. T. Thom, Jr., and others, 1935, U.S. Geol. Survey Bull. 856.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 43. Birdhead sandstone, which was tentatively correlated with Newcastle sandstone of Black Hills and Powder River Basin areas and Muddy sandstone of Bighorn Basin and included in Thermopolis shale by Thom and others (1935), is top of Cloverly formation as herein described. Member is mostly fine-grained sandstone, in part silty and argillaceous. Commonly 10 to 15 feet thick. Not sharply set off from underlying beds; overlain by zone of black shale with hard ironstone concretions, this shale is basal unit of Thermopolis shale.

Birdhead Coulee cuts across the sandstone in T. 3 S., R. 27 E., Yellowstone County, Mont.

Bird Mountain Grit[1]

Cambrian or Ordovician: West-central Vermont.

Original reference: T. N. Dale, 1893, U.S. Geol. Survey 13th Ann. Rept., pt. 2, p. 337–340.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1084, 1090. Considered a thick facies of Zion Hill formation of Lower Cambrian age.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 40, 41-42. Represented as several lenses of coarse clastics interbedded with rocks of Nassau formation. Name used only in lithologic sense to designate a facies of Nassau formation. Some exposures mentioned.

Exposed on top of Bird Mountain, Rutland County, on large hill 2 miles southwest, and in scattered patches and lenses nearby.

Birdsong Shale[1] (in Linden Group)

Birdsong Shale Member (of Ross Formation)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 741.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280, 282 (fig. 83), 292–296. Rank reduced to member status in Ross formation (new). Conformably overlies Rockhouse limestone member; unconformably underlies Flat Gap limestone, Harriman formation, or Camden formation; grades southward into Ross limestone member of Ross formation. Basal 8 to 10 feet of Birdsong as described by Dunbar (1919, Tennessee Div. Geology Bull. 21) is Rockhouse limestone member of this report. Thickness 25 to 40 feet; locally 60 feet. Includes interbeds referred to as Decaturville chert zone.

Typically developed along valley of Birdsong Creek, Benton County.

Bird Spring Formation[1]

Upper Mississippian, Pennsylvanian, and Lower Permian: Nevada, California, and Utah.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9, 21.

N. D. Newell, 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1056 (fig. 2). Geographically extended into Confusion Range, Utah, where it is about 2,600 feet thick and underlies Supai(?). Pennsylvanian.

R. B. Kraetsch and R. L. Jones, 1951, Utah Geol. Soc. Guidebook 6, p. 60–62. Fusulinids from Bird Spring indicate that formation transcends Pennsylvanian-Permian boundary in Confusion Range area.

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881–885. Extended into northern part of Nopah Range, Calif., where it is about 1,110 feet thick and overlies Yellowpine limestone member of Monte Cristo limestone. Lower and Middle Pennsylvanian.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42–45, pl. 1. Mapped in Ivanpah quadrangle, California. Pennsylvanian.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4–5, 7. Keeler Canyon formation (new) of Pennsylvanian to early Permian age includes rocks that have been referred to provisionally as Bird Spring(?) formation (McAllister, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–95). Bird Spring formation is not wholly Pennsylvanian but embraces Upper Mississippian and Permian.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2170. Name Ely limestone extended into Confusion Range where it replaces term Bird Spring formation.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Spring Mountain area, Nevada, underlies Spring Mountain formation (new) and overlies Illipah formation.

Mark Rich, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2039. Bird Spring formation near Lee Canyon, Clark County, Nev., consists of more than 7,000 feet of predominantly carbonate beds that show no apparent major lithologic breaks. Megafossils from basal 500 feet indicate that lower 100 feet is Chesterian in age and that Mississippian-Pennsylvanian boundary occurs within a transitional interval. Fusulinids collected from remaining 6,500 feet of formation indicate that following divisions of Pennsylvanian and Permian are represented: Morrowan, Atokan, Desmoinesian, Missourian, Virgilian, Wolfcampian, and Leonardian. Pennsylvanian-Permian boundary is also gradational. A total of 2,600 feet of Chesterian and Pennsylvanian beds and 4,500 feet of Per-

mian is present. Upper limit of formation could not be determined because of truncation by faulting.

Underlies large area in Bird Spring Range, Nev.

†Birdsville Formation[1] or Group[1]

Mississippian: Western Kentucky and southeastern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, ser. 2, p. 109.

Named for Birdsville, Livingston County, Ky.

Birkmose Member (of Franconia Formation)

Upper Cambrian: Central Wisconsin and eastern Minnesota.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. [1]; 1953, Jour. Paleontology, v. 27, no. 4, p. 554, 555 (fig. 2); 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 862–863, measured sections. Consists of two rock types: greensand, a fine-grained crossbedded glauconitic sandstone; and wormstone, a massive buff to orange glauconitic sandstone that contains linear masses of gray silt; top of member contains a 2-foot bed of glauconitic, dolomitic, flat-pebble conglomerate. Thickness at type locality 27 feet; in Houston County, Minn., 10 to 18 feet. Overlies Woodhill member (new); underlies Tomah sandstone and shale member (new).

Type section: Along State Highway 35, center sec. 25, T. 29 N., R. 20 W., St. Croix County, Wis. Named from exposures north of Birkmose Park in Hudson, Wis.

†Birmingham Breccia[1]

Lower Ordovician: Northern central Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. Cahaba coal field, p. 152.

Named for exposures at Birmingham, Jefferson County.

Birmingham Red Bed (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland and Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 63, pl. 6.

Birmingham Shale Member (of Conemaugh Formation)[1]

Birmingham redbed member

Birmingham shale member

Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 79.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 57–58, geol. map. Birmingham shale member (of Conemaugh series) shown on geologic column of Ohio as interval between Skelly limestone member below and Elk Lick shale and limestone member above. Inasmuch as latter members are not represented over much of Ohio, the Birmingham usually includes all strata between Skelly limestone and Morgantown sandstone; in many areas, a development of thick sandstones occurs throughout interval from Gaysport limestone, or Ames limestone, to top of Morgan-

town or even stratigraphically higher. In Morgan County [this report], where Skelly limestone is present, the Birmingham consists of 10 to 18 feet of variegated gray to chocolate-brown clay shale which is partly sandy and locally contains siderite nodules.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 147–148. Member of Elk Lick cyclothem in report on Athens County. Stephenson (1876) named Birmingham member from Birmingham Station near Pittsburgh, Pa. Its stratigraphic position, broadly limited, is between Duquesne and Elk Lick coals, and it may coalesce with redbeds above and below to fill much of interval between Ames limestone and Pittsburgh coal. Johnson (1929, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 27) has shown that in type area there is facies relationship between redbed and (or) shale and sandstone and that in places sandstone largely or entirely replaces redbed lithology. Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) reported that the Morgantown (Upper Grafton of present report) locally replaces Birmingham redbed in eastern Ohio. Thickness as much as 22½ feet.

Named for exposures at Birmingham Station, west of Pittsburgh, Allegheny County, Pa.

Bisbee Group[1] or Formation

Lower Cretaceous (Comanche Series): Southeastern Arizona and southwestern New Mexico.

Original reference: E. T. Dumble, 1902, Am. Inst. Mining Engrs. Trans., v. 31, p. 696–715.

A. A. Stoyanow, 1937, Geol. Soc. America Proc. 1936, p. 296, 297 (table). Group includes (ascending) Morita, Mural, and Hay Flat (new) formations.

B. S. Butler, E. D. Wilson, and C. A. Rasor, 1938, Arizona Bur. Mines Bull. 143, Geol. Ser. 10, p. 24-26. Sandstone and shale of Bisbee group intruded by Uncle Sam porphyry and Schieffelin granodiorite (both new).

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 527–540; 1947, U.S. Geol. Survey Prof. Paper 208, p. 13 (table), 16–26, pl. 1. In Little Hatchet Mountains, N. Mex., group includes (ascending) Broken Jug limestone, Ringbone shale, Hidalgo volcanics, Howells Ridge formation, Corbett sandstone, Playas Peak formation, and Skunk Ranch formation (all new).

James Gilluly, 1945, Am. Jour. Sci., v. 243, no. 12, p. 645–646. Formation, in Tombstone area, consists of series of gray, brown, and red-brown sandstones interfingering with shale and a minor amount of limestone; locally a basal conglomerate. Thickness about 3,000 feet. Unconformably underlies Bronco volcanics (new); unconformably overlies Pennsylvanian Naco limestone.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8–12. Sequence in group is (ascending) Glance conglomerate, Morita formation, Lowell formation (new), Mural limestone, and Cintura formation.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 70–79. In central Cochise County, Ariz., group includes (ascending) Glance conglomerate, Morita formation, Mural limestone, and Cintura formation. Where units are not differentiated, Bisbee is mapped as formation, about 3,600 feet thick; unconformably overlies Naco group.

F. F. Sabins, Jr., 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1323, 1324 (table 1), 1325, pl. 1. In Cochise Head and western part of Vanar quadrangle, Arizona, group is about 2,600 feet thick and includes Glance conglomerate at base and undifferentiated rocks above. Unconformably overlies older rocks; underlies Nipper formation (new). Where Nipper formation is absent underlies Faraway Ranch formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 43–53, pl. 1. In Peloncillo Mountains, N. Mex., and Ariz., group is divided into (ascending) McGhee Peak formation, Carbonate Hill limestone, Still Ridge formation, and Johnny Bull sandstone (all new). Formations have not been correlated with Ransome's or Stoyanow's formations in southeastern Arizona, nor with Lasky's formations in Little Hatchet Mountains. Overlies Naco group which here includes Chiricahua limestone at top; underlies Upper Cretaceous volcanic sequence.

Named for exposures at Bisbee, Ariz.

Biscara intrusive andesite

Miocene(?) or Pliocene(?): North-central New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 64, pl. 1. Eastward forked dike of andesine-hornblende-biotite andesite porphyry. Dike consists of breccia in which fragments of tuff, conglomerate, and dark felsite are cemented by andesite porphyry. Thickness about 350 feet at western end, where the two forks join; north fork about 150 feet and south fork about 100 feet. Intrudes Biscara member (new) of Los Pinos formation.

In Canon del Agua, 2 miles northeast of Las Tablas, Las Tablas quadrangle, Rio Arriba County.

Biscara Member (of Los Pinos Formation)

Miocene(?) or Pliocene(?): North-central New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 44, pl. 1. Interlayered tuffaceous sandstone, tuff, conglomerate, and volcanic flow breccia. Conglomerate, with fragments of gray, brown, and dark-red andesite and quartz latite, graywacke, and tuff forms most of the unit. Maximum observed thickness 650 to 700 feet on west side of Canon del Agua. Successively overlapped from south to north by Jarita basalt member (new), an associated gray tuff, and Cordito member (new). Name credited to Butler (unpub. dissert.).

Named after exposure in Biscara Canyon about 1 to 5 miles from its mouth (Butler). These strata of the type locality, however, are here included in Biscara-Esquibel member (new). Mapped in lower Tusas Valley east of Tusas Canyon, from 1.3 miles north of Petaca to a point about 3.5 miles north-northwest of Las Tablas, Las Tablas quadrangle, Rio Arriba County.

Biscara-Esquibel member (of Los Pinos Formation)

Miocene(?) or Pliocene(?): North-central New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 45–46, pl. 1. Consists of interbedded conglomerate, tuff, and graywacke. Conglomerate with fragments of andesite, latite, tuff, sandstone, and flow breccia. Thickness about 300 feet near head of the Rio Tusas and about 1,100 feet in northeastern part of T. 28 N., R. 8 E. Laps onto Precambrian rocks in vicinity of Hopewell. A composite of two members

that were named by Butler (unpub. dissert.) after type areas in Biscara and Esquibel Canyons.

Exposed from SW. cor. T. 28 N., R. 9 E., to northern boundary and part of the western boundary of the Las Tablas quadrangle, Rio Arriba County.

Bisher Limestone

Bisher Formation[1]

Middle Silurian: Southwestern Ohio and northern Kentucky.

Original reference: A. F. Foerste, 1917, Ohio Jour. Sci., v. 17, p. 189, 190.

A. C. McFarlan and W. H. White, 1952, Kentucky Geol. Survey, ser. 9, Bull. 10, p. 12, 13. Bisher formation or dolomite discussed in report dealing with Boyle-Duffin-Ohio shale relationships.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Formation shown on correlation chart above Ribolt shale and below Lilley formation. Niagaran series.

Typically exposed northeast of Bisher Dam, about 1 mile south of Hillsboro, Highland County, Ohio.

Bishop Conglomerate[1]

Oligocene or Miocene: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 44, 62, 169.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 578 (fig. 2), 616–617. Crops out in Strawberry Valley quadrangle, Utah. Where best exposed about 100 feet thick. Rests unconformably on older formations, and in mapped area commonly has gentle north dip; this dip, together with slight lithologic difference, is main basis for separating unit from Uinta formation.

M. D. Picard, 1957, Jour. Sed. Petrology, v. 27, no. 4, p. 373. Oligocene-Miocene(?).

Caps Bishop Mountain, now known as Pine Mountain, Sweetwater County, Wyo.

Bishop sandstone[1]

Upper Jurassic: Northeastern Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 301.

Flamingo Gorge area. Derivation of name not stated.

Bishop Tuff

Pleistocene: East-central California.

C. M. Gilbert, 1938, Geol. Soc. America Bull., v. 49, no. 12, p. 1833–1860. Name applied to welded rhyolite tuff having areal extent of 400 square miles and average thickness of 500 feet. In upper parts, pumice lapilli are imbedded in porous vitric-crystal matrix. Thick sections show structural and textural gradation from top to bottom, wherein, at base vitric constituents are compressed, distorted, and aligned in the horizontal plane, and structure becomes very compact; sorting poor; bedding conspicuously absent; well-developed columnar jointing is distinctive feature.

W. C. Putnam, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1939. In sequence of events, Bishop tuff is shown occurring above Sherwin till.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1281, 1286 (fig. 4), 1289–1290. Sequence shows Bishop tuff as erupted between Aeolian Buttes (new) and Sherwin glacial stage.

W. C. Putnam, 1960, California Univ. Pubs., Geol. Sci., v. 34, no. 5, p. 235–237, map 1. Bishop tuff was erupted a short time after Sherwin glacial stage, being emplaced as a succession of nueés ardentes with maximum thickness of more than 750 feet in Owens Gorge, where base is unexposed. Followed by Tahoe glacial stage.

Occurs in area between Bishop and Mono Lake.

Bishop Brook Limestone[1] (in Manlius Group)

Bishop Brook Limestone Member (of Manlius Limestone)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 27, 32.

G. H. Davis 3d, 1953, New York State Mus. Circ. 35, p. 8, 10. Discussion of contact between Manlius limestone and Coeymans limestone in upper New York State. In section measured in quarry at Manlius, units exposed are Bishop Brook limestone, Pools Brook limestone, and Jamesville limestone. Pools Brook and Jamesville represent upper two members of the Manlius while Bishop Brook limestone is considered Coeymans in age. Boundary between Manlius limestone and Helderbergian limestone exposed in this area is marked by conspicuous disconformity which occurs between Pools Brook and Bishop Brook limestones. Although Bishop Brook is definitely Helderbergian in age, no conclusive evidence that unit is western extension of Coeymans was found.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7; 1956, Dissert. Abs., v. 16, no. 1, p. 102. Coeymans limestone of central New York, overlying Jamesville member of Manlius, is entirely younger than Coeymans of eastern New York. Name Deansboro is proposed for this part of Coeymans. "Bishop Brook" is merely reappearance of the Deansboro at Manlius beneath pre-Onondaga unconformity.

Exposed on hillside east of Manlius village, Onondaga County. Named for Bishop Brook northeast of Manlius.

Bishop Creek Granite

Upper Jurassic or Lower Cretaceous(?): Eastern California.

G. A. Schroter, 1938, Eng. Mining Jour., v. 139, no. 4, p. 43. Even granular to porphyritic quartz monzonite; locally as acidic as granite or as basic as diorite.

Occurs on east flank of Sierra Nevada Mountains, southwest of Bishop, in Inyo County.

Bishop Mountain Conglomerate[1]

Miocene(?): Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 44, 62, 109.

Caps Bishop Mountain now known as Pine Mountain, Sweetwater County, southwestern Wyoming.

Bishops Cap Member (of Magdalena Formation)

Pennsylvanian (Strawn): Western Texas.

L. A. Nelson. 1937, Colorado Univ. Studies, v. 25, no. 1, p. 89. In Franklin Mountains, Texas, formation divided into (ascending) La Tuna, Berino, and Bishops Cap members.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 166–168, 170 (fig. 5). Predominantly limestone with minor amounts of sandstone and conglomerate; fossiliferous. Thickness about 625 feet. Between exposed top of formation and base of exposed Permian Hueco, thickness of approximately 1,800 feet of sediments, probably Pennsylvanian, is covered by alluvium. Derivation of name given.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. On basis of fusulinid studies, it seems inadvisable to apply Nelson's terms to Pennsylvanian rocks of central New Mexico.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 25. Lower part of Bishops Cap is middle Strawn (Upper Pennsylvanian), but no diagnostic fossils have been reported from upper 392 feet.

Named for Bishops Cap Peak about opposite Filmore, Dona Ana County, N. Mex.

Bishops Lodge Member (of Tesuque Formation)

Miocene, middle(?): Central New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 148 (chart). On chart only. Near base of formation. Age shown as Miocene.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118. Just north of Santa Fe, 50 to 530 feet of light-gray volcanic-derived sandstone and silt, with minor tuff beds, were measured by Kottlowski (Spiegel and Baldwin, unpub. ms.). This tuffaceous unit in places rests conformably on as much as 100 feet of pinkish-tan Precambrian-derived sandstone typical of the Tesuque formation, although Cabot (1938) extended Picuris tuff southward to include exposures just north of Santa Fe, Kottlowski is proposing name Bishops Lodge member for following reasons: (1) Bishops Lodge member is interbedded with lower part of Tesuque; (2) Cabot's treatment of Picuris tuff is generalized, whereas study of Santa Fe area is detailed; and (3) exact correlation with type Picuris tuff is not possible at present.

W. W. Boyer, 1959, Jour. Sed. Petrology, v. 29, no. 1, p. 64–72. Discussion of playa deposit in Bishops Lodge member of Tesuque. Discovery of marked disconformity at top of playa beds separating them from overlying Tesuque formation, coupled with changes in lithology, mode of sedimentation, and nature of terrain supplying the sediments suggests that Bishops Lodge member and beds underlying it should be separated from Tesuque formation.

In Santa Fe region.

Bison Banded Member[1] (of Hennessey Shale)

Permian: Central northern Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 786–799.

Named for fact that it is exposed on all sides of Bison, Garfield County.

Bissell Formation (in Tropico Group)

Miocene or Pliocene: Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138, 141–142. Arkosic sandstone, granitic conglomerate, green-gray siltstone, interbedded limestone, dolomite, chert, and siliceous shale; nonfossiliferous, may be in part a lacustrine facies of Fiss fanglomerate (new). Thickness about 845 feet. Conformably overlies Gem Hill formation (new); unconformably underlies fanglomerate of probable Pleistocene age.

Type locality: An east-trending ridge in N½ sec. 11, T. 10 N., R. 11 W., in Bissell Hills, Rosamond quadrangle, Kern County.

Bissett Conglomerate[1]

Triassic: Western Texas.

Original reference: P. B. King, 1927, Am. Jour. Sci., 5th ser., v. 14, p. 212–221.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 663. Bissett conglomerate, when first described, was considered to be of Permian age, but was shown to be separated from Permian limestones below and from the Cretaceous above by unconformities. Subsequent study of vertebrates and plants from one locality in formation demonstrates that they are Triassic in age, and Bissett is now so classified. Some exposures to the northwest that have been mapped as Bissett may be much younger and belong to basal Cretaceous (Trinity).

Named for exposures on northwest and northeast flanks of Bissett Mountain, southwestern part of Glass Mountains.

Bistineau Member (of Hall Summit Formation)

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

P. D. Meager and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Named in stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 59. Typically calcareous silt and shale. Attains maximum thickness of 100 feet in type area. Overlies Grand Bayou member; contact gradational. Largely covered by Quaternary deposits over northern half of Sabine uplift. Paleocene. Type locality designated. Mapped in Texas.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 132–134, pl. 10. Includes all sediments stratigraphically between Grand Bayou member and overlying basal sand of Marthaville formation; beds are conformable with and transitional into overlying and underlying sediments.

Type locality: Exposures in T. 15 N., R. 10 W., in southwestern Bienville Parish, La., and particularly those in secs. 9 and 10 along Louisiana Highways 5650, 933, and 1154, from Ringold to Lake Bistineau. Outcrop belt extends into Shelby County, Tex.

Bitter Creek Formation[1]

Triassic or Jurassic: Northwestern British Columbia, Canada, and southeastern Alaska.

Original references: R. G. McConnell, 1911, Canada Geol. Survey Summ. Rept. 1910, p. 63; 1912, Canada Geol. Survey Summ. Rept. 1911, p. 57; 1913, Canada Geol. Survey Mem. 32, p. 12.

Portland Canal region, British Columbia.

†Bitter Creek Group[1]

Eocene: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original references: E. D. Cope, 1872, Philadelphia Acad. Nat. Sci. Proc., v. 24, p. 279; 1872, Am. Philos. Soc. Proc., p. 481.

Exposed along Bitter Creek, a small tributary of Green River in Wyoming, from Black Butte northwest to Salt Wells Station on Union Pacific Railroad and at some other points west of Salt Wells, Sweetwater County, Wyo.

Bitter Creek Sandstone, Formation, Beds, or Sand

Miocene, middle: Southern California.

T. W. Dibblee, Jr., 1951, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec. [Guidebook], Stop 2, p. 1–2. Consists of light-buff medium-grained semifriable arkosic sandstone containing reefs of *Ostrea bourgoisii*, *Pecten ostrellanus*, and several species of *Astrodapsis*. Formation is sandy facies of Monterey shale in Cuyama Valley. Thickness about 1,400 feet. Underlies Santa Margarita sandstone; overlies Monterey shale. [Road log accompanying report refers to Bitter Creek sands.]

I. T. Schwade, 1954, California Div. Mines Bull. 170, map sheet 1. Middle Miocene sediments in Cuyama Valley exhibit considerable lateral variation both in outcrop and subsurface. Westernmost exposures shown on map are entirely Monterey shale, chiefly siliceous; in subsurface, a short distance to east, the first fingers of sandstone, locally called Bitter Creek, have been noticed. Largely at expense of the shale, but in addition with each unit exhibiting considerable thickening, the sandstones become dominant sedimentary feature of Middle Miocene section in central part of Cuyama Valley and hills to south. On north side of Caliente Mountain, the Bitter Creek forms prominent part of section, but less dominantly so than in area to south. This unit, made up chiefly of fine silty locally crossbedded fossiliferous sandstone, is considered to represent a large middle Miocene delta. To east, Bitter Creek beds interfinger with, and progressively grade into terrestrial conglomerates and red beds locally called Caliente formation.

D. E. Savage, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1845. Shown on chart as marine formation unconformably underlying Caliente formation. Thickness about 1,000 feet.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2991. Preoccupied term Bitter Creek replaced by Branch Canyon formation (new).

Type locality: At Bitter Creek, Cuyama Valley. Crops out prominently on both sides of Salisbury Canyon.

Bitterroot period[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46, p. 203.

Bitterwater Formation

Pliocene, upper, and Quaternary: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Bivouac Formation

Pliocene, upper, or Pleistocene: Northwestern Wyoming.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1899, 1907–1911, fig. 1. Slightly lithified conglomerate with minor amounts of very soft sandstone, siltstone, claystone, and pumicite, and one welded tuff. Conglomerate is brownish gray, soft, porous, and poorly stratified. Welded rhyolite tuff is most conspicuous feature of formation, and crops out in cliffs on north and east sides of Signal Mountain where it is about 60 feet thick. Tuff is about 700 feet above lowest exposures of formation. Minimum thickness for formation on Signal Mountain is about 1,000 feet. Unconformably overlain and surrounded by several sequences of Pleistocene glacial and interglacial deposits. Unconformably overlies Teewinot formation (new).

Type section: On Signal Mountain, secs. 19 and 20, T. 45 N., R. 114 W., Teton County, south of town of Moran and east of Jackson Lake. Name derived from Bivouac Peak, a prominent peak in Teton Range, directly west of type section.

Biwabik Iron-Formation[1] (in Animikie Group)

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1901, U.S. Geol. Survey Ann. Rept., pt. 3, p. 353, 358–370.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1044–1050. Animikie group comprises (ascending) Pokegama quartzite, Biwabik iron-formation series, and Virginia slate. Detailed discussion of nature of contact of Biwabik iron-bearing formation with Virginia slate. Later Precambrian.

Named for Biwabik mine, one of earliest and largest mines located on formation, Mesabi district. Biwabik is Chippewa word for piece or fragment of iron.

Blach Ranch Limestone Member (of Thrifty Formation)[1]

Blach Ranch Limestone (in Graham Group)

Upper Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132; 1922, Jour Geology, v. 30, p. 23, 31.

Wallace Lee, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 58–61. Blach Ranch limestone member is first reliable datum above Avis sandstone member. In southern part of Young County, consists of two limestones separated by 2 to 3 feet of bluish clay. Separated from overlying Breckenridge limestone member by unnamed interval of shale and sandstone.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 4. Shown on generalized columnar section of Brazos River area as Blach Ranch limestone in Graham group. Occurs below Breckenridge limestone and above Ivan limestone.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 14–17, pl. 1. Plummer and Moore (1921) proposed term Blach Ranch for "a limestone which occurs about 30 feet in most sections above the Ivan member." They described the limestone from "typical exposures in vicinity of Blach Brothers Ranch east of Breckenridge." However, type locality that is given for section (id., p. 156) measured on "Blach Brothers Ranch four miles east of Crystal Falls." Plummer and Moore described the limestone as light gray, massive, weathering to large buff or brown slabs or rounded boulders, and rather fossiliferous. They reported average thickness to be 3 or 4 to as much as 8 feet. Type Blach Ranch limestone redescribed and locality noted. Blach Ranch limestone is uniform persistent unit throughout area. Lower limestone is about 1.4 feet thick and separated by about 1 foot of shale from upper 0.8- to 1-foot limestone bed. About 1 foot of platy, argillaceous, fossiliferous limestone commonly occurs at top of upper bed. Separated from overlying Breckenridge limestone member by unnamed shale member 30 to 50 feet thick.

Type section (redescribed): On original Black Brothers Ranch, now two ranches owned by heirs Jack and Bill Black and B. H. Trammell of Breckenridge. Type section is 3¾ miles east of Crystal Falls, northeast of Breckenridge in north-central Stephens County. Ranch name was misspelled in original description. Limestone crops out in north-south belt across Black and Trammell Ranches. New type section is in and near railroad cut on Chicago, Rock Island, and Pacific Railroad.

Black Flint Member (of Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: H. Morningstar, 1922, Ohio Geol. Survey, 4th ser., Bull. 25, p. 130.

Crops out in Jackson County and southwestern part of Vinton County.

Black Bay Gabbro (in Beaver Bay Complex)

Precambrian: Northeastern Minnesota.

H. M. Gehman, 1958, Minnesota Univ., Center for Continuation Study, Apr. 21–22, p. 1. Generally coarse-grained with numerous coarser pegmatitic zones. Youngest intrusion of the complex. Forms dikes and small sills surrounding and intruding Beaver Bay ferrogabbro (new).

In southeastern Lake County.

Black Bear Quartz Gabbro

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 195–196, 235. Moderately dark-colored rock with average grain size between 1 and 2 millimeters. Contains scattered crystals of dark-green amphibole with maximum length about 7 millimeters. Cuts Elkhorn Ridge argillite; brecciated contacts sharp. Assumed to be older than Bald Mountain tonalite (new).

Characteristically exposed near Black Bear mine, on southeast slopes of Hunt Mountain, in Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

†Black Bluff Group, Clay, or Series (in Midway Group)[1]

Eocene, lower: Southern Alabama.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 61–62.

Named for exposures at Black Bluff, on Sucarnoochee Creek, at its junction with Tombigbee River, in Sumter County.

Black Butte Flow

Age not stated: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 310. Hornblende-mica dacite. Discussed under general heading of pre-Lassen dacite flows which include Manzanita dacites, Crescent Cliffs flow, Loomis Peak flow, etc.

Exposure of pre-Lassen dacite is mapped in vicinity Black Butte, Tehama County, Lassen Volcanic National Park.

Black Butte Gravel

Black Butte Till

Eocene: Southwestern Montana.

H. W. Scott, 1938, Jour. Geology, v. 46, no. 4, p. 628–635. Unconsolidated glacial deposits composed of rocks ranging in size from clay particles to boulders 5 feet in diameter. Underlies mid-Tertiary volcanics and rests upon upturned truncated Lower Cretaceous sediments. Tentatively correlated with Ridgway and Gunnison tillites of Colorado.

J. A. Mann, 1954, Yellowstone-Bighorn Research Proj. Contr. 190, p. 37–41. Proposed that name be changed to Black Butte gravel because theory of glacial origin calls for conditions of topography and climate which are not only difficult to explain but which are seemingly in opposition to available evidence.

Type locality: West side of Black Buttes, a prominent physiographic feature that rises 1,000 feet above surrounding area, in Gravelly Range of Tobacco Root Mountains.

†Black Butte Quartzite[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 160.

Caps Black Butte, southwest of Black Butte Station, on Union Pacific Railroad, Sweetwater County.

Black Butte Tongue (of Mancos Shale)

Black Butte Tongue (of Rock Springs Formation)

Upper Cretaceous: Southwestern Wyoming.

L. A. Hale, 1950, Wyoming Geol. Soc. Guidebook 5th Ann. Field Conf., p. 52–53, fig. 1. Tongue of Rock Springs formation. Sediments are characteristic of deposition in shallow-water near-shore environment. Shale is commonly sandy and contains much carbonaceous material. Thickness 860 feet. Overlies Chimney Rock tongue (new).

L. A. Hale, 1955, Wyoming Geol. Soc. Guidebook 10th Ann. Field Conf., p. 90 (fig. 1), 92, 93 (fig. 3). Lithologically similar to Blair formation, both being zones of lateral and vertical transition between typical marine and continental lithology. Equivalent to Rangely tongue (new) of Mancos. Figure 3 shows Black Butte tongue of Mancos.

Named for exposures along Black Butte Creek, sec. 36, T. 18 N., R. 102 W., Sweetwater County. Occupies strike valley between Chimney Rock escarpment and cliffs of overlying Ericson formation.

Black Canyon Group

Tertiary(?) (pre-Pliocene): Northwestern Arizona and southeastern Nevada.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1417–1419. Complex assemblage of andesitic lava flows, volcanic breccias (both flow breccias and tuff-breccias), and tuffaceous sandstone layers, with numerous intrusive masses. Underlies Muddy Creek formation with angular unconformity.

F. A. Nickell, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 12, p. 1804 (fig. 2). Includes monzonite, andesite, latite, basalt, and breccia.

Exposed in upper Black Canyon, Mohave County, Ariz., and Clark County, Nev.

Black Canyon Schist[1]

Precambrian (Gunnison River Series): Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Occurs throughout area, with many interruptions, from Cochetopa Creek down Gunnison nearly to mouth of Smiths Fork.

Black Crater Formation[1]

Tertiary, upper: Central northern Oregon.

Original reference: E. T. Hodge, 1927, Geol. Soc. America Bull., v. 38, p. 163.

The basalts of Black Crater cover large area on east slope of Cascade Mountains.

Black Creek Formation[1]

Upper Cretaceous: Eastern South Carolina and western North Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 13, 14.

C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867, p. 25–39. Consists principally of very dark gray laminated clay and micaceous sand. Clay predominates at typical exposures, which represent lower part of formation, but sand is more abundant in Snow Hill member at top. No reliable estimates of thickness in South Carolina [this report]. Unconformably overlies Tuscaloosa formation; unconformably underlies Peedee formation or younger deposits.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2178–2184. In South Carolina, Middendorf member of Black Creek formation (herein revived as equivalent of upper part of Cooke's (1936) Tuscaloosa formation) is shown to contain plant remains essentially equivalent to those of lower Black Creek formation of North Carolina; lower part of Cooke's Tuscaloosa is herein referred to as Lower Cretaceous(?) (undifferentiated). Includes Snow Hill member at top. Underlies Peedee formation.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243-B, p. 21. Beds mapped as Black Creek by Cooke (1936) in western Sumter County, S.C., are now regarded as Black Mingo as herein restricted.

P. M. Brown, 1959, North Carolina Div. Mineral Resources Bull. 73, p. 9 (table 1), 10–11. Described in Greenville area where it is exposed along streams in northern part of Greene and Pitt Counties. North and east of Pitt County, formation has been recognized only in subsurface. Thick-

ness 75 to 150 feet. Comprises an unnamed lower member and Snow Hill marl member at top. Unconformably overlies Tuscaloosa formation, exhibiting transgressive offlap relationship; underlies Peedee formation.

C. E. Brett, 1959, Elisha Mitchell Sci. Soc. Jour., v. 75, no. 2, p. 69–70. Upper Cretaceous formations of North Carolina Coastal Plain are (ascending) Middendorf, Black Creek shale, and Peedee. On basis of present study, it is believed that term Snow Hill calcareous member of Black Creek formation should be dropped from literature and that sediments at Snow Hill be included in Peedee formation. Division of either Black Creek or Peedee formations into members is not warranted. Term Black Creek formation should connote dark-gray to black laminated shales with intercalations of clean sand lying conformably beneath Peedee formation.

Named for exposures along Black Creek in Darlington and Florence Counties, S.C.

†Black Earth Dolomite Member (of St. Lawrence Formation)[1]

Upper Cambrian (Croixan): Southern Wisconsin and northern Illinois.

Original reference: E. O. Ulrich, 1916, Geol. Soc. America Bull., v. 27, p. 477–478.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 169 (fig. 2), 173, 180, 181, 182. Basal member of formation. Commonly sandy dolomite and interbedded dolomitic siltstone and fine-grained sandstone; in vicinity of Black Earth and Madison and at localities along Mississippi Valley, generally massive, brown to buff, slightly glauconitic, with algal structures locally. Distinctly glauconitic facies occur along Minnesota River valley, especially at St. Lawrence where beds described as St. Lawrence limestone by Winchell resemble upper strata of Franconia formation (Reno member of Berg, 1954). In basinward facies, where it rests directly on Franconia greensand, the Black Earth contains only small amounts of interbedded dolomitic siltstone and sandstone; elsewhere, in shoreward direction member is higher in the stratigraphic column and rests on strata of Lodi member. Thickness ranges from 8 to 13 feet in basinward facies, as at St. Lawrence, Lake City, Gotham, Spring Green, and Madison; shoreward to north thins to one-half to 3 feet at Goodenough Hill, Wilton, and Menomonie.

Well developed west of Madison in hills bordering valley of Black Earth Creek, between Black Earth and Mazomanie, Dane County, Wis.

Blackfoot Formation[1]

Blackfoot Limestone Member (of Siyeh Limestone)

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. D. Walcott, 1906, Geol. Soc. America Bull., v. 17, p. 5, 9, 11.

C. E. Erdmann, 1944, U.S. Geol. Survey Water Supply Paper 866–B, p. 48. One of several names used for upper limestone member of Siyeh limestone. In Belt series.

Named for exposures in canyon of North Fork of Blackfoot River, where entire section is exposed. In Mission Range.

Blackfoot Canyon facies (of Belt Series)

Precambrian: Western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. American Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into

facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Blackfoot Canyon facies characterized by development of Grinnell and Appekunny silt-clay argillites in place of the calcareous Chamberlain, and by great thickness of Siyeh, Spokane, and Sheppard, or Helena.

In Glacier National Park.

Blackfootian series[1]

Precambrian (Belt Series): Montana, and Alberta, Canada.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 217, 218.

Blackford Formation

Blackford Member (of Cliffield Formation or Lurich Formation)

Blackford facies (of Murfreesboro Formation)

Middle Ordovician: Southwestern Virginia, northwestern Georgia, and northeastern Tennessee.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 126, 127, 132–133. Blackford facies of Murfreesboro is commonly composed, in lower 70 feet or less, of a heterogenous sequence of red shale, red mottled argillaceous dolomite, gray shale, gray clay, and gray magnesian crumbly limestone; basal bed is, in places, a massive layer or two, as much as 5 feet thick, of dull gray dolomitic rock containing many angular fragments of residual chert. Above variegated lower part of facies is 100 to 300 feet of layers of chert which is derived from thin-bedded limestone. Occurs, in general, southeast of belt in which St. Clair facies (new) is found. Well exposed in Scott, Russell and Tazewell Counties.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 823–826, 862–863, 864, 884 (fig. 3). Butts (1940) included in the Blackford the basal clastics, ash-gray shale, and blocky chert beds as recognized in Tazewell County. Assignment to the Murfreesboro is incorrect, and reference to the Murfreesboro age of Blackford facies should be discontinued. It is herein proposed to use the name Blackford for the same succession but to drop the facies designation in favor of term member of Cliffield formation (new). As defined, member includes zones 1 to 3 of the Cliffield. Thickness as much as 165 feet. Overlies Five Oaks limestone member (new); disconformable on Beekmantown.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 55–57, pl. 8. Blackford is used herein as name of formation occurring between Clinch and Walker Mountains, where it includes beds of same age as included in Blackford member of Cliffield formation as recognized northwest of Clinch Mountain. Underlies Five Oaks herein given formational rank. Thickness in Burkes Garden quadrangle not more than 60 feet; probably averages less than 25 feet.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 42. Restricted to the succession of ash-gray shales and underlying basal clastics; zone of blocky chert formerly classed with the Blackford is here named Elway limestone.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1145–1148. Geographically extended into northeastern Tennessee.

A. C. Munyan, 1951, Georgia Geol. Survey Bull. 57, p. 54–59. Formation geographically extended into Georgia where it overlies Newala formation and in some areas Knox dolomite.

A. T. Allen, 1953, Georgia Geol. Survey Bull. 60, p. 179. In Graysville area, Blackford is thin red argillaceous limestone with few scattered grains of sand. Overlies Knox dolomite.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 69, 95 (fig. 8). Basal member of Lurich formation (new).

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Blackford formation as mapped in Duffield quadrangle includes Tumbez limestone.

Well exposed along U.S. Route 19 at several places between Pounding Mill Branch and Pisgah Chapel, Tazewell County, Va., and near Blackford, Russell County.

Blackford Stage

Ordovician (Chazyan): Virginia.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 93, 94, 95. Name given to provincial stage in Virginia which includes rocks between the Canadian [series] and Elway and Lincolnshire formations of the type Ashby [stage]. Name used in place of Marmor stage, which is based on formations in Tennessee, and has type section isolated from other post-Canadian stages of Appalachian region. Older than Ashby stage; these two believed to be Chazyan but not to constitute the whole of that series. Approximately equivalent to lower part of St. Paul group (Neuman, 1951).

Name probably derived from Blackford, 2 miles southeast of Honaker, Russell County, for which Blackford formation is named.

Black Hand Formation[1] or Sandstone

Mississippian: Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d, v. 16, p. 216, 217.

Gordon Rittenhouse, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 58. Incidental mention of Black Hand sandstone in discussion of distribution of types of Berea sand in West Virginia, eastern Ohio, and western Pennsylvania.

Probably named for Black Hand, Licking County.

Black Hand Member[1] (of Cuyahoga Formation)

Mississippian: Central and southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 667–682, 757–779.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 49–50. Seven lithologic facies, each subdivided into a varying number of members and submembers are recognized in Cuyahoga formation. Black Hand shale is member of Killbuck shale facies (new); Black Hand conglomerate is member of River Styx (new), Toboso, and Hocking Valley conglomerate facies. Overlies Armstrong sandstone member. Thickness 75 to 80 feet.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Crossbedded pebbly sandstone. Uppermost member of Cuyahoga. In Cuyahoga, Summit, Medina, and Lorain Counties, term Wooster shale member (new) is used in place of Black Hand, because term Black Hand is restricted to the pebbly sandstone. Intertongues with Wooster shale and, in parts

of Wayne, Medina, and Ashland Counties, the sandstone is completely replaced by shale.

Named for exposures at Black Hand, Licking County.

Blackhawk Breccia[1]

Pleistocene: Southern California.

Original reference: A. O. Woodford and T. F. Harriss, 1928, California Univ. Pub., Dept. Geol. Sci. Bull., v. 17, p. 267, 279–283.

Typically developed at mouth of Blackhawk Canyon, San Bernardino County.

Blackhawk Formation (in Mesaverde Group)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, p. 443.

D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852, p. 10 (table), 12–14. In Book Cliffs coal field, formation includes all but lower part of unit as exposed a few miles to west where first defined. Consists of three sandstone-bearing members; both lower and middle members overlain by tongues of shale that locally contain coal. In eastern Utah, sandstones give way to Mancos shale.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, figs. 2, 3, pl. 3. Base of formation, as redefined in Book Cliffs, is at base of Spring Canyon sandstone of Clark (1928, U.S. Geol. Survey Bull. 793). In most outcrops, formation overlain disconformably by Castlegate member of Price River formation. Consists of six prominent littoral marine sandstone tongues and many lesser ones, all of which project eastward into Mancos, where they lose their identity by grading into shale. Above each of them and below next succeeding littoral marine sandstone, lagoonal deposits of sandstone, shale, and coal are developed. Six principal members are (descending) Desert (new), Grassy (new), Sunnyside (new), Kenilworth (new), Aberdeen, and Spring Canyon (new). This division possible only where basal littoral marine sandstones are developed. Not included in Mesaverde group—a term no longer used in Book Cliffs. Of Montana age.

Named for prominent exposures near Blackhawk, a mining community on east front of Wasatch Plateau. Also exposed in Book Cliffs.

Blackhawkian[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1930, Pan-Am. Geologist, v. 54, p. 377.

Black Hill Rhyolite[1]

Tertiary: Colorado.

Original reference: W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 349.

Forms Black Hill, about 18 miles southeast of Leadville, Lake County.

Black Hill Shale[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1885, Washburn Coll. Lab. Nat. History, v. 1, no. 3, p. 90.

Named for Black Hill, Comanche County.

Blackhorse shales[1]

Upper Cretaceous: Central northern South Dakota and southwestern North Dakota.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 37, no. 1, p. 63–64.

Blackhorse Butte is conspicuous landmark in Schanasse County, S. Dak.

Blackiston Formation (in New Albany Shale)

Blackiston Member (of New Albany Shale)

Upper Devonian: Southeastern Indiana, northern Kentucky, and southern Ohio.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 837, 840 (fig. 3), 842–847, 860 (fig. 4), 868, 877. Contains two unnamed members with different facies of black shale. Layers of gray shale are interbedded with black shale of both members in middle third of formation. There are 40 or more layers of gray shale from one-half to 8 inches thick, separated by black shale 1 inch to 5 feet thick; total thickness of this zone is 27 feet. Thickness of formation 75 feet. Disconformably overlies Blocher formation (new); underlies Sanderson formation (new). In parts of Kentucky, overlies Trousdale formation; thickness in Bullitt County 35 feet.

H. H. Murray and others, 1955, Indiana Geol. Survey Field Conf. Guidebook, 8, p. 43, pl. 1. Indiana Geological Survey uses term Blackiston with member rank.

Well exposed in vicinity of Blackiston Mill, old land-mark and recreation center, on Silver Creek, Clark County, Ind. Section from base of Blackiston to top of New Albany is exposed from Armstrong's bend along Silver Creek to Blackiston Mill and west along Mount Tabor Creek to a point near Mount Tabor Church. Middle zone of gray shale is persistent throughout Indiana, Kentucky, Ohio, and Tennessee.

Blackjack Basalt[1]

Miocene: Southeastern Oregon.

Original references: K. Bryan, 1929, U.S. Geol. Survey Water-Supply Paper 597, p. 55; 1930, Jour. Geology, v. 39, p. 504.

Named for fact it caps Blackjack Butte, Malheur County.

Blackjack Creek cyclothem

See Blackjack Creek Limestone Member (of Fort Scott Limestone)

Blackjack Creek Limestone Member (of Fort Scott Limestone)

Pennsylvanian (Des Moines Series): Western Missouri, southwestern Iowa, eastern Kansas, and northeastern Oklahoma.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2), 36–37, 67. Proposed for lowermost limestone in Fort Scott. Occurs below Houx limestone member (new). Base of Marmaton group in Kansas and Henrietta group in Missouri. Traced into Appanoose County, Iowa.

J. M. Jewett, 1951, Kansas Geol. Survey Bull. 38, p. 304–305. Underlies Little Osage shale member (new). Overlies Cherokee shale. Thickness about 5 feet in Bourbon County; 16 feet or more in Labette County.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 99. Blackjack Creek cyclothem consists of sandy shale, underclay, coal (Mulky

bed), black shale, and limestone (Blackjack Creek limestone) belonging in lower part of Fort Scott limestone. Average thickness about 15 feet.

F. C. Greene and W. B. Howe, 1952, Missouri Geol. Survey and Water Resources Inf. Circ. 8, p. 2, 19. Thickness in Missouri about 7 feet. Forms base of Marmaton group.

W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Generalized section of strata in Carroll and Livingston Counties, Mo., shows Blackjack Creek limestone member overlying Excello formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 33, fig. 5. One of thickest and most persistent limestones in Des Moines series in Iowa. Light gray to light blue gray; weathers brown to buff; varies from massive to slabby. Thickness 1 to 4 feet. Base of formation; separated from Houx limestone member shale interval 2 to 10 feet thick.

Type locality: Outcrops in Johnson County, Mo., 4 miles southeast of Fayetteville, along Blackjack Creek.

Blackjack Knob Member (of Theodosia Formation)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 25, 31, pl. 2. Upper member of formation. Overlies Lutie member (new); unconformably underlies Cotter formation. Thickness as much as 180 feet. Includes Gainesville sandstone (new) near base; upper part is a monotonous sequence of alternating gray, slightly cherty, finely crystalline dolomite and argillaceous dolomite.

Type section: On north side of Blackjack Knob, Protem quadrangle, in eastern Taney County, Mo.

Blackjack School Sandstone Member (of Atoka Formation)[1]

Middle Pennsylvanian: Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 56. Thin massively bedded sandstone. Thickness 25 to 40 feet in type area. Overlies unnamed shale above Webber[s] Falls member; underlies unnamed shale at top of formation.

Named for exposures at and around Blackjack School, sec. 9, T. 11 N., R. 19 E., Muskogee County.

Black Knob Dolomite (in Pacheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12, 27. Yellow dolomite, pinkish when fresh, in places silicified. Thickness in Ninety One Hills area 30 feet; on Black Knob Ridge 56 feet. Overlies Cienda limestone (new); underlies Black Knob quartzite (new).

In standard section of Lowell formation in the Ninety One Hills and exposed on Black Knob Ridge, Cochise County. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Black Knob Quartzite (in Pacheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12, 27. Greenish quartzite in places overlain with buff and white speckled sandstone. Contains large silicified tree trunks. Whitish-gray limestone at base. Thickness in Ninety One Hills area 30 feet; on Black Knob Ridge, where it consists of buff and white quartzite beds, 412 feet. Underlies Joserita member (new) and overlies Black Knob dolomite (new).

In standard section of Lowell formation in Ninety One Hills and exposed on Black Knob Ridge. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Black Lake lagunal facies.

Middle Devonian: Northeastern Michigan.

[G. M. Ehlers], 1938, Michigan Acad. Sci. Arts and Letters Sec. Geology and Mineralogy [Guidebook] 8th Ann. Field Excursion, [fig. 2] after p. 8. Shown on columnar section between the Rockport below and the Ferron Point above.

W. A. Kelly, 1940, Michigan Acad. Sci. Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion, [fig. 1]. Probaby a lagunal facies of the Rockport.

Occurs in Black Lake Quarry, Black Lake-Afton area.

Blacklead Limestone[1]

Mississippian and Pennsylvanian: Northern Idaho.

Original reference: A. L. Anderson, 1930, Idaho Bur. Mines and Geology Pamph. 34.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 701, chart. Age shown on chart as Mississippian and Pennsylvanian.

Lies far back in Clearwater Mountains at head of Cayuse Creek, a tributary of North Fork of Clearwater River. Also present in a high valley between Blacklead Peak and Rhodes Creek, Orofino region.

Blackleaf Formation (in Colorado Group)

Blackleaf Sandy Member (of Colorado Shale)[1]

Lower Cretaceous: Northwestern and central Montana.

Original reference: E. Stebinger, 1918, U.S. Geol. Survey Bull. 691-E, p. 154, 158-164.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2787-2793; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89-90. Rank raised to formation and subdivided into (ascending) Flood, Taft Hill glauconitic, Vaughn bentonitic, and Bootlegger members (all new). Overlies Kootenai formation with obscure disconformity having hiatus that may be as much as 100 feet; underlier Marias River shale (new). Ranges in thickness on Sweetgrass arch from 600 feet north of Cut Bank to more than 800 feet south and east of Conrad.

Named for exposures along Blackleaf Creek in sec. 18, T. 26 N., R. 8 W., and vicinity, Teton County. Formation occurs in country between Missouri River and international boundary and between Rocky Mountain front and about Range 8 East.

Black Mesa Basalt[1]

Quaternary: Western Oklahoma and northern New Mexico.

Original reference: A. C. Shead, 1923, Oklahoma Univ. Bull. 271, new ser., p. 108–113.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. In Abiquiu quadrangle, New Mexico, Quaternary formations overlie pre-Quaternary rock with angular unconformity, and comprise Canjilon till (new); Canones andesite (new), Vallecito basalt (new), and Black Mesa basalt, which were poured out high-level erosion surfaces; Puye gravel (new), which overlies erosion surface at an intermediate level, and is overlain, locally, by Bandelier rhyolite tuff (new), and Santa Clara basalt (new).

Named for exposures on Black Mesa, extreme northwestern part of Oklahoma Panhandle.

Black Mingo Formation[1]

Eocene, lower: Eastern South Carolina.

Original references: E. Sloan, 1905, Geognostic map of South Carolina: South Carolina Geol. Survey; 1907, Summ. Mineral Resources of South Carolina, p. 12, 16; 1908, Catalogue of mineral localities of South Carolina: South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449.

C. A. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20–21. Black Mingo was referred to as being of Wilcox age (Cooke, 1936, U.S. Geol. Survey Bull. 867) because of presence of *Ostrea arrosis* Aldrich. Although this oyster was stated by Aldrich to be from the Nanafalia, and has since been found to be restricted to it, in the correlation table Black Mingo was placed opposite Tuscahoma sand of Alabama because of occurrence in both of *Turritella mortoni* Conrad, a species now known to be abundant in both the Tuscahoma and Nanafalia. Mapped with this oyster-bearing bed were underlying siliceous clay shales and an overlying massive red sand now known to be of early Claiborne age. A revised map would show the Black Mingo to be confined to a much smaller area, chiefly along valley floors. Beds mapped by Cooke (1936) as Black Creek (Cretaceous) in western Sumter County are now regarded by MacNeil as Black Mingo as here restricted to the siliceous clay-shale and oyster-bearing bed, whereas the overlying more widely distributed sands in Richland, Lee, Sumter, Clarendon, and Williamsburg Counties that were mapped as Black Mingo are now placed by MacNeil in the Congaree formation of early Claiborne age. Some beds in Warley Hill section, considered by Cooke (1936) to be McBean, are now recognized as belonging to Black Mingo. Black Mingo formation, as mapped by Cooke (1936), is now known to have included some beds of early Claiborne age, and (even as here restricted) may include beds of both early Eocene and Paleocene ages. Further subdivision of formation is deferred until more definite evidence of Paleocene age is produced. If lower shales of Black Mingo should prove to be of Paleocene age, one of Sloan's names (1907, 1908) Rhems shale or Lang Syne shale may be available. Included in Wilcox.

Exposed along Black River from Brewington Lake, Clarendon County, to mouth of Black Mingo Creek, up which it is exposed to a point between Rhems and General Marion Bridge.

Black Mountain Andesite

Pliocene(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 49. Black Mountain andesite appears to underlie Childs latite (new) at north end of Childs Mountain. Elsewhere, rests on the latite, and, though the latite may be merely an intercalation in the Black Mountain, it is equally possible that apparent occurrence of the Black Mountain beneath the latite is due to faulting.

At north end of Childs Mountain, Ajo quadrangle, Pima County.

Black Mountain Basalt Flow[1]

Pleistocene: Southern California.

Original reference: C. L. Baker, 1912, California Univ. Pub., Dept. Geol. Bull., v. 7, p. 121–142.

C. D. Hulin, 1925, California State Mining Bur. Bull. 95, p. 20–61. Derivation of name given. Very late Pliocene or early Pleistocene.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 30, pls. 1, 2, 3. Described in Saltdale quadrangle as a black to gray-black fine-grained diabase-textured vesicular basalt flow, 50 to 150 feet thick; no superjacent strata. Younger than Ricardo formation and older than oldest terrace deposits in area. Probably Pleistocene.

Named for flows on Black Mountain, 7 miles west of El Paso Peak, Kern County.

Black Mountain Granite[1]

Black Mountain Leucogranodiorite

Age not stated: Southeastern Vermont.

Original reference: C. H. Richardson, 1933, Vermont State Geologist 18th Rept., p. 349–357.

M. S. Church, 1937, Jour. Geology, v. 45, no. 7, p. 763–774. Described as a leucogranodiorite which intrudes interbedded rather gneissoid schists. Texture generally medium grained. Outcrop area described.

Forms Black Mountain and occurs on both sides of the West River at village of West Dummerston, Windham County.

Black Mountain Volcanics[1]

Triassic, Jurassic or Cretaceous: Southern California.

Original reference: M. A. Hanna, 1926, California Univ. Pub. Geol. Sci. Bull., v. 16, no. 7, p. 187–246.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 22–23. Name Black Mountain preoccupied. Unit renamed Santiago Peak volcanics.

Well developed on Black Mountain, north part of La Jolla quadrangle, San Diego County.

Black Patch Grit[1]

Lower Cambrian: Eastern New York and western Vermont.

Original reference: T. N. Dale, 1899, U.S. Geol. Survey 19th Ann. Rept., chart opposite p. 178.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 55. Locally, West Castleton formation contains lenses of a dark-gray calcareous grit with conspicuous rounded quartz grains. Dale (1899) named such beds Black Patch grit.

Black Peak Granodiorite and Quartz Diorite

Cretaceous: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 16–17. Occurs on eastern and western borders of Skagit gneiss. On eastern border, is similar to Chilliwack granodiorite. On west has apparently formed Skagit gneiss, just as Chilliwack rocks have on opposite side of gneiss region. Original eastern contact of Black Peak granodiorite and quartz diorite not preserved because younger intrusive granite occurs (Golden Horn granodiorite, new). To north, down Granite Creek, the Black Peak granodiorite narrows rapidly, and, in lower Granite Creek, across Ruby Creek, and in upper Skagit Valley (Ross Lake), it is reduced to narrow migmatitic belt in which patches of directionless granodiorite have grown in schists and amphibolites which separate Skagit gneiss from Cretaceous phyllites and slates to east.

Black Peak is on border between Chelan County and Skagit County.

Black Point Ash[1]

See Diamond Head Ash.

Black Point Basalt

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, p. 13, pl. 2. Oldest of three extensive lava-flow units filling old canyons and gullies carved in Belkofski tuff (new) and intrusive diorite stocks. Basalt is dark-reddish-brown dense even-textured rock composed of abundant very small phenocrysts; contains a higher percentage of phenocrysts than the other two flows. Crops out south of Arch Point basalt (new).

Crops out at tidewater in Long John Lagoon and along the beach in Chinaman Lagoon in vicinity of Pavlof Volcano, Alaska Peninsula. Forms large domical hill near Black Point.

Black Point Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrog. Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 78. Thin lava flow of nepheline basanite, 6 to 25 feet thick, and associated dike of similar composition. Rests on reef limestone correlated with plus 95-foot (Kaena) stand of sea, and on Diamond Head tuff. Overlain by beach limestone of plus 25-foot (Waimanalo) stand of sea.

Name after Black (Kupikipikio) Point, on southeast side of Diamond Head, which consists chiefly of this lava. Exposed over about 40 acres on south side of island, 9½ miles west of Makapuu Head.

Black Point Dolomite Member (of Cherry Creek Series)

Precambrian: Southwestern Montana.

E. S. Perry, 1948, Montana Bur. Mines and Geology Mem. 27, p. 7. Name suggested for dolomitic marble occurring in Cherry Creek series. Weathers to dirty-brown granular surfaces which look dark in distance. Bedding at Black Point nearly vertical. Repetition of beds, either by folding or faulting, may account for the 1½ mile width of the outcrop.

In area about 5 miles long and 1½ miles wide, between Johnny Gulch and Cherry Creek, Madison County. Marble forms conspicuous ridge known locally as Black Point.

Black Point Limestone

Pleistocene: Oahu Island, Hawaii.

H. T. Stearns, 1940, Hawaii Div. Hyrdography Bull. 5, p. 53; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 78–79. Fossiliferous reef limestone. Underlies Diamond Head tuff and Black Point basalt. Extends to altitude of about 48 feet.

Type locality: East shore of Black (Kupikipikio) Point. Limited exposures on Black Point, on southeast side of Diamond Head, on south coast of Oahu, 9½ miles west of Makapuu Head. Highest marine limestone known on leeward side of Koolau Range.

†Black Prairie Series[1]

Upper Cretaceous (Gulf Series): Texas and Arkansas.

Original reference: R. T. Hill, 1889, Texas Geol. Survey Bull. 4, p. xii–xiv.

Named for Black Prairie of eastern Texas and Arkansas.

Black Prince Limestone

Upper Mississippian or Lower Pennsylvanian(?): Southeastern Arizona.

T. M. Romslo, 1949, U.S. Bur. Mines Rept. Inv. 4505, p. 5. Incidental mention. Limestones of Carboniferous period consisting of Escabrosa, Black Prince, and Naco formations in order named, overlie Martin limestone in Johnson Camp area.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 13–15. Comprises basal shale member and upper limestone member. Shale, 10 to 20 feet thick, is red to maroon or purple with scattered nodules or pebbles of chert and limestone, lenses of chert conglomerate and, locally thin beds of limestone. Limestone unit consists of 100 to 140 feet of nearly pure limestone in 1- to 4-foot beds. Limestone is medium to coarse grained and light gray to pink; pink beds most conspicuous in upper part. Thickness: 119 feet in Gunnison Hills; 131 and 155 feet in Little Dragoons; 168 feet in Johnny Lyon Hills. Separated from overlying Horquilla limestone (new) of Naco group by 30 to 65 feet of weak rocks which generally are concealed and form topographic sags. Underlies Escabrosa limestone, contact drawn at base of thin but persistent shale member which contrasts with pure limestone beds above and below. Where shale is missing, it is difficult to separate the Black Prince and Escabrosa.

Type section: On west slope of Gunnison Peak 4½ miles southeast of Black Prince mine (from which unit takes its name) in Johnson mining district at east base of Little Dragoon Mountains, central Cochise County.

Black River Group[1] or Formation

Middle Ordovician: New York and Pennsylvania, and Ontario, Canada.

Original reference: L. Vanuxem, 1842, Geology of New York, pt. 3, p. 38-45.

C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 525, 533, 537. In central Pennsylvania, includes Rodman limestone.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 249–251. Black River group comprises (ascending) Pamelia, Lowville, and Chaumont formations. Underlies Trenton group; overlies Beekmantownian.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 178–199. In Virginia only the Lowville-Moccasin and Chambersburg limestones can be definitely recognized as members of Black River group. Eggleston limestone may correspond to Watertown and Amsterdam limestones of New York and also to Chambersburg limestone. Underlies Martinsburg shale; overlies Blount group.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Group in central Pennsylvania includes Valentine limestone, 0 to 145 feet (Lowville); Benner limestone (new) (Pamelia), comprising Stover and Snyder members. Mohawkian series. Underlies Nealmont limestone of Trenton group; overlies "Carlim group," Chazyan(?) series.

F. P. Young, Jr., 1943, Am. Jour. Sci., v. 241, no. 3, p. 143–166; no. 4, p. 211–240. Black River group, with overlying Trenton group, constitutes Mohawkian series of Middle Ordovician. Formations of group, Pamelia, Lowville, and Chaumont, have their type localities in New York. In northwestern New York, Black River group, or some part of it, is present as a belt extending from north of Ingham Mills, Herkimer County, northwestward along Black River valley to Watertown, N.Y., and Thousand Island region. Interrupted by St. Lawrence River, it continues westward across southern Ontario to Lake Simcoe area. Probable that group is also represented on Manitoulin and St. Joseph Islands, Lake Huron. Beds are thus present nearly continuously for distance of about 120 miles in New York and 150 miles in southeastern Ontario.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 189, 192–193 (table 1), 194 (table 2). Group, in central Pennsylvania includes Benner limestone below and Curtin limestone (new) above. The Curtin contains Valley View limestone member (new) and Valentine limestone member. Overlies Chazyan Hatter formation; underlies Nealmont limestone of Trenton group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. In Tazewell County, Va., strata embraced by Chazyan and Black River groups of Butts (1940) are divisible into 29 distinctive zones, most of which have distinctive faunal and lithologic features. Detailed work led to recognition of inconsistencies in use of stratigraphic names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Revised stratigraphic nomenclature proposed. Name Lowville should not be used in area until regional studies demonstrate true relationships of supposedly Lowville beds to Pamelia-Lowville-Chaumont succession of New York and Ontario. Name Lowville-Moccasin not acceptable because it implies that Moccasin red beds are of Lowville age.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1401. Rocks younger than Canadian or Beekmantownian and older than Cincinnatian series are commonly referred to Middle Ordovician and placed in two series: Chazyan and Mohawkian. Proposed that latter be divided into Bolarian and Trentonian. Term Black River does not lend itself to conversion to series name (Black Riverian). Suggested that term Bolarian series be used for Chazyan to Trentonian interval.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13–14, 17–22. Black River formation represented by Bony Falls member (new). Underlies Chandler Falls member (new) of Trenton formation.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 66, no. 3, p. 247–298, chart 2. Middle Ordovician strata along Black River valley, west of Adirondacks, has long been considered standard for this part of column in North America, lower part constituting Black River stage and upper part Trenton stage. Kay has proposed to reject Black River as major unit in standard section and replace it with Bolarian series. Thus he would recognize in Middle Ordovician not one series (Champlainian) but three—Chazyan, Bolarian, and Trentonian. Pros and cons of proposal discussed. Majority of committee favored retaining traditional three stages—Chazyan, Black River, and Trentonian on present chart. Black River and Trentonian compose the Mohawkian stage.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7–9, chart 1. Terms Chazyan and Black River stages not used in this report. Interval subdivided into Marmor, Ashley, Porterfield, and Wilderness stages (all new). Trenton stage restricted by removal of Rockland which has mostly fossils derived from underlying Black River and Witten. Term Black River used on correlation chart to include the Pamelia, Lowville, and Chaumont.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 65–96. Discussion of Ordovician Highgate Springs sequence of Vermont and Quebec and Ordovician classification. Blackriveran series seems to be contained in Bolarian series of the Appalachians, but lowest Bolarian seems older and equivalent to upper Chazyan. Isle La Motte formation classified as Blackriveran and correlated with Chaumont limestone of Black River group of New York.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30, 32. Black River group in northern New York divided into three formations, Pamelia, Lowville, and Chaumont, which have been treated as stages. Cooper (1956) divided rocks that he considered younger than type Chazyan into Ashley, Porterfield, and Wilderness "stages," the latter extending into the lowest Trenton of New York; these stages are in continuous stratigraphic succession in the Appalachians, but their correlation with New York is uncertain. On the other hand, the Pamelian, Lowvillian, and Chaumontian are quite provincial and relatively sparse in fauna; methods of carrying correlations to them and distinguishing their equivalents are inadequate. Blackriveran series comprises (ascending) Pamelian, Lowvillian, and Chaumontian stages.

Named for exposures in cliffs of Black River, N.Y.

†Black River Iron-Bearing Schists[1]

†Black River Iron-Bearing Series[1]

†Black River Falls Iron-Bearing Schists[1]

Precambrian (lower? Huronian): Southwestern Wisconsin.

Original reference: C. R. Van Hise, 1892, U.S. Geol. Survey Bull. 86, p. 190, 195, pl. 3, map.

Probably named for exposures at Black River Falls, Jackson County.

Black River Stage

Blackriveran Series

See **Black River Group.**

†Black Rock Diabase[1]

Black Rock Diabase Breccia (in Granby Tuff)

Triassic: Central Massachusetts.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, Mon. 29, p. 17–18, pl. 34.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 496–497, pl. 1. Diabase breccia consisting of fragments of diabase, tuffaceous diabase, tuff and sedimentary rocks in matrix of vesicular or compact diabase. Cuts sediments above Holyoke diabase sheet and basal members of Granby tuff; relation to diabase flow in Granby tuff unknown. Triassic.

Named for Black Rock south of Mount Holyoke, Mount Holyoke quadrangle.

Black Rock Formation[1]

Lower Ordovician: Northern Arkansas.

Original reference: G. C. Branner, 1929, Geologic map of Arkansas.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 53). Shown on correlation chart above Smithville limestone and below Everton formation. Chazyan.

Mapped at and around Black Rock, Lawrence County.

Blackrock Limestone[1]

Precambrian: Southeastern Idaho.

Original reference: A. L. Anderson, 1928, Idaho Bur. Mines and Geology Pamph. 28, p. 4.

J. C. Ludlum, 1942, Jour. Geology, v. 50, no. 1, p. 92–93. Overlies Pocatello formation (new); unconformably underlies Brigham quartzite. Maximum thickness 535 feet. Precambrian. Spelling Blackrock used rather than Black Rock as used by Anderson (1928) because former spelling now appears on U.S. Geological Survey topographic map of Pocatello quadrangle.

Named because of occurrence along Blackrock Creek, about 2 miles northeast of Portneuf Siding. Best exposed on north side, where it can be traced up Blackrock Creek several miles.

Blackrock Quartzite

Carboniferous(?): Northeastern Nevada.

A. E. Granger and others, 1957, Nevada Bur. Mines Bull. 54, p. 113, pl. 14. Discussion of Elko County. A thrust fault crops out south of Rio Tinto mine and divides Paleozoic rocks into two groups of formations which as yet cannot be correlated. The "footwall" quartzite is only formation of upper plate group that crops out in area shown on plate 14. This is Blackrock quartzite of Stephens (unpub. rept.) Rocks are light-colored medium-grained quartzite. Stephens estimates minimum thickness of 1,000 feet.

Type locality and derivation of name not stated.

Blacksburg Schist[1]

Ordovician to Mississippian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith and D. B. Sterrett *in* G. F. Loughlin and others, 1921, North Carolina Geol. and Econ. Survey Bull. 28, p. 28, 73.

T. L. Kesler, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 756, 763 (fig. 2). Incidental mention in report on metamorphic rocks in central Carolina piedmont.

U.S. Geological Survey currently designates the age of the Blacksburg as Ordovician to Mississippian on the basis of a study now in progress.

Named for development in Blacksburg, Cherokee County, S.C.

Blacks Fork Glaciation

Blacks Fork glacial stage[1]

Pleistocene: Northeastern Utah and southwestern Wyoming.

Original reference: W. H. Bradley, 1936, U.S. Geol. Survey Prof. Paper 185.

Ernest Antevs, 1945, Am. Jour. Sci., v. 243-A, table 2. Shown on correlation chart as older than Smith Fork stage (Wisconsin).

U.S. Geological Survey has amended the name Blacks Fork glacial stage to Blacks Fork Glaciation to comply with Stratigraphic Code adopted in 1961.

Named for extensive moraines left by its glaciers in valley of Blacks Fork, Utah.

Blacks Fork Member (of Bridger Formation)[1]

Eocene: Southwestern Wyoming.

Original reference: H. E. Wood 2d 1934, Am. Mus. Nat. History Bull. 67, art. 5, p. 241–242.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 15, pl. 1. Basal member of Bridger. Underlies Twin Buttes member. Early Bridgerian.

Named from Black's Fork of Green River which flows past most of best known exposures.

Blacksmith Limestone[1]

Middle Cambrian: Northeastern Utah and southeastern Idaho.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6, 7.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1112–1113, 1117 (fig. 4), 1121. As amended, 450 feet thick at type section. Consists of white-gray, dull-steel-gray, and in upper 60 feet dark-lead-gray fine- to medium-grained usually thick-bedded dolomite and interbedded magnesian limestone. Overlies Ute limestone (emended); underlies Bloomington limestone.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130, 1133. Described in Logan quadrangle, Utah, where it forms prominent cliffs. Thickness near Call's Fort 800 feet; on High Creek 710 feet.

Type locality: Blacksmith Fork Canyon, about 8 miles above its mouth and 15 miles east of Hyrum, Cache County, Utah.

Blacksnake Sandstone Member (of Hance Formation)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 80, pl. 16.

Cumberland Gap district.

Blackstone Series[1]

Precambrian(?): Eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 8, 104–109.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 9-13, geol. map; A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Name revived for stratified metamorphosed sedimentary and igneous rocks of Precambrian(?) age in Pawtucket quadrangle. Includes (ascending) Mussey Brook schist (new), Westboro quartzite, Sneech Pond schist (new), Hunting Hill greenstone (new), and related rocks. Unconformably underlies Pennsylvanian rocks. Cut by two groups of intrusive rocks. Replaces Marlboro formation of Emerson (1917) which is abandoned in this area; includes Westboro quartzite, which Emerson placed below the Marlboro, in a higher stratigraphic position.

A. W. Quinn, 1953, New York Acad. Sci. Trans., ser. 2, v. 15, no. 8, p. 266. Thickness about 10,000 feet in type area.

G. E. Moore, Jr., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Metasedimentary rocks of Hope Valley quadrangle, which occur as inclusions on roof pendants in Hope Valley alaskite gneiss and other intrusives, are correlated with Blackstone series on basis of similarity in lithology, structure, and metamorphism. Blackstone series in Hopewell quadrangle includes wide variety of lithologic types. In most parts of area, these types are intimately interlayered and are not mapped separately.

Named for typical development in lower course of Blackstone River between Woonsocket and Pawtucket, Providence County.

Blacksville Limestone (in Washington Formation[1] or Group)

Permian: Northern West Virginia and southwestern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 36.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser. Bull. C–26, p. 135, 150. Lies 210 feet above top of Waynesburg coal which is considered base of Washington group. Thickness including local coals 5 to 20 feet. Occurs below Middle Marietta sandstone and coals and above Lower Marietta sandstone.

Named for village of Blacksville, Monongalia County, W. Va.

Blacktail Formation[1]

Precambrian (Belt Series): Northern Idaho.

Original references: J. L. Gillson, 1925, Am. Min., v. 10, p. 189; 1927, Jour. Geology, v. 35, no. 1, p. 1–32.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 6 (fig. 4). Shown on correlation chart of Belt series in Idaho. Thickness 8,300 feet. Correlates with Creston formation in Boundary County and Priest River National Forest and with St. Regis formation in Coeur d'Alene Mountains, Idaho and Mont. Occurs above Burke formation and below Wallace formation in Pend Oreille region.

Type locality: Blacktail Mountain, near Talache.

Blacktail Formation

Cenozoic(?): Southeastern Arizona.

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1217. Thick section of andesitic and dacitic lavas, breccias, and tuffs. Part of formation may be equivalent to Bonita Park formation (new). Also may be correlative with Faraway Ranch formation. Name credited to Raydon (unpub. thesis).

In Portal area, Cochise County.

Blacktail Granite Gneiss

Precambrian (pre-Beltian): Southwestern Montana.

E. W. Heinrich, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1329. Pre-Beltian red granite cutting both Pony and Cherry Creek rocks.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 351. Name Dillon granite gneiss introduced by Henrich (1953) to replace term Blacktail previously used for same unit (Heinrich, 1950) because latter term is preoccupied.

Near Dillon Beaverhead County.

Blacktail Deer Creek Basalts

Miocene, lower: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 374, pl. 1. Named for several basalt flows that are associated with Blacktail Deer Creek formation. Composed of dark locally vesicular groundmass with phenocrysts of feldspar.

Exposed in a northeast-southwest zone northwest of the Snowcrest Range, between U.S. Highway 91 and Blacktail Creek, Beaverhead County.

†Blacktail Deer Creek Beds[1]

Blacktail Deer Creek Formation

Miocene, lower: Southwestern Montana.

Original reference: E. Douglass, 1902, Am. Phil. Soc. Trans., v. 20, new ser., pt. 3, p. 237–245.

C. W. Hibbard, and K. A. Keenmon, 1950, Michigan Univ. Mus. Paleontology Contr., v. 8, no. 7, p. 193–204. Termed Blacktail Deer Creek formation. Thickness at type section, herein designated, about 400 feet; lower and upper limits not definitely established. Beds dip 5° W.; nearby underlying basalts dip to west as much as 30°. Beds from which vertebrate remains were removed consist of varying sequence of light-colored clays, volcanic ash, sandstones, and fine conglomerates; no fossils found in upper 370 feet of beds although they are lithologically similar to fossil-bearing beds. Lower Miocene.

Type section: Near center sec. 8, T. 11 S., R. 6 W., Beaverhead County. Map by the Forest Service, 1947, shows creek as Dry Blacktail Creek. Beds are exposed in west flank of gentle anticline and crop out one-half mile west of West Fork Road, at a point one-half mile southwest of junction of East Fork and West Fork Roads which follow upper tributaries of Blacktail Creek. This is locality described by Douglass.

†Blackwater Formation[1]

Pennsylvanian: Northeastern West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

On Blackwater River below Davis, W. Va.

Blackwater Shale and Limestone[1] (in Kanawha Group)

Pennsylvanian: Northeastern West Virginia.

Original reference: D. B. Reger, 1923, West Virginia Geol. Survey Rept. Tucker County, p. 198, 209–210.

J. C. Ludlum, 1958, West Virginia Geol. Survey State Park Ser. Bull. 6, p. 23. Thickness 32 feet. Overlies Lower Gilbert sandstone; underlies Winifrede limestone horizon. Kanawha group. Pottsville series.

Named for exposures on north side of Blackwater River, 2 miles southwest of Davis and one-half mile below Blackwater Falls, Tucker County.

Blackwater Creek Shale (in Little Osage Shale Member of Fort Scott Formation)

Backwater Creek Shale Member (of Fort Scott Formation)

Pennsylvanian (Des Moines Series): Northwestern Missouri.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Gray argillaceous shale; locally red. Thickness 19 to 25 feet. Below Higginsville limestone and above Houx limestone. Name appears as Backwater Creek.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6, fig. 1. Shale at top of Little Osage member of Fort Scott formation. A channel-type sandstone, herein named Flint Hill, occurs above the Blackwater Creek from northern Boone County into southeastern Grundy County.

Type locality and derivation of name not given. First noted in Jackson and Cass Counties.

†Bladen Formation[1]

Bladen Member (of Black Creek Formation)

Upper Cretaceous: Coastal Plain of North Carolina and South Carolina.

Original reference: L. W. Stephenson, 1907, Johns Hopkins Univ. Circ. 71, p. 93–99.

S. D. Heron, Jr., 1958, South Carolina Div. Geology Bull., v. 2, nos. 11–12, p. 85, chart 1. Stephenson's (1907) term Bladen is here applied to lower member of Black Creek formation.

S. D. Heron, Jr., and W. H. Wheeler, 1959, Geol. Soc. America, Southeastern Sec. Guidebook for Coastal Plain Field Trip, p. 5–6, 19. Consists of alternating thin beds of clay and sand, masses of relatively pure loose sand, lignitized wood, and marcasite in basal portion followed by medium to coarse sand and clayey sand; more than 50 percent of member is sand. Thickness about 16 feet. Outcrop relations of Cape Fear, Middendorf, and Bladen units are open to several interpretations; view that Middendorf represents an updip part of the Bladen seems preferable. Bladen rests on the Cape Fear in downdip exposures, and Middendorf rests on the Cape Fear in updip exposures in Fort Bragg.

Named for exposures in Bladen County, N.C., especially along Cape Fear River.

Blaine Gypsum or **Formation**[1] (in Nippewalla, El Reno, or Pease River Group)

Blaine Gypsum (in Double Mountain Group)

Permian: Western Oklahoma, southern Kansas, and northern Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 47.

Noel Evans, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 405–432. Formation includes Medicine Lodge, Shimer, Lovedale (new), and Haskew (new) gypsum members.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1468–1469. In central and west-central Oklahoma, includes (ascending) Medicine Lodge, Alabaster (new), Shimer, Lovedale, and Haskew members. Thickness about 125 feet.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Mapped in Double Mountain group.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1764 (fig. 3), 1766, 1793–1799. In Kansas, included in Salt Fork division of Cimarron series. Includes (ascending) Medicine Lodge, Nescatunga (new), Shimer, and Haskew gypsum members. Overlies Flowerpot shale; underlies Dog Creek shales.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 3). Included in El Reno (San Andres) group in Texas.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Included in El Reno group in Texas; Double Mountain group abandoned.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 158, 161 (fig. 4). In Kansas, included in Nippewalla group. Comprises (ascending) Medicine Lodge, Nescatunga, Shimer, and Haskew gypsum members. Thickness about 50 feet. Underlies Dog Creek shale; overlies Flowerpot shale.

Robert Roth, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 893–907. Included in Pease River group in Texas.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 16–28, pl. 1. In Carter area, redefined to include all strata, characterized by thick gypsum beds, that lie between Flowerpot shale below and Dog Creek shale above. Comprises (ascending) Haystack gypsum, Cedartop gypsum, Collingsworth gypsum, Mangum dolomite, and Van Vacter gypsum (new) members. Three intervening shale beds are unnamed. The thin Chaney and Kiser gypsums are excluded from the Blaine and placed in underlying Flowerpot shale. Thickness 130 to 140 feet. El Reno group.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 24 (fig. 16), 27–34, pl. 1. Described in Harper County where it consists of four gypsum members interbedded with red shales and some dolomite, which lie above the Flowerpot shale and below the Dog Creek. Named members are (ascending) Medicine Lodge, Nescatunga, Shimer, and Haskew. Thickness about 90 feet. El Reno group. Guadalupian.

Type locality: In Salt Creek (Henquenet's) Canyon, northern Blaine County, Okla.

Blair Formation (in Mesaverde Group)[1]

Upper Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

W. R. Hansen and M. G. Bonilla, 1954, Colorado Sci. Soc. Proc., v. 17, no. 1, p. 4 (fig. 1), 9–10. Geographically extended into Daggett County, Utah, where it is about 360 feet thick in Flaming Gorge area; underlies Rock Springs formation, and overlies Hilliard shale. Toward the east, intertongues with upper part of Hilliard shale, and at east end of Antelope Flat is entirely replaced by the Hilliard.

Named for exposures at Blair Ranch, east of Aspen Mountain, Sweetwater County, Wyo.

Blakeley Formation[1]

Blakeley Stage

Oligocene: Western and southwestern Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 114–115. Type section of the Blakeley comprises sandstones, shales, and conglomerates, exposed in sea cliffs along entrance to Bremerton Inlet, an arm of Puget Sound. Lowermost beds occur at Orchard Point and consist of conglomerates; uppermost strata are also composed of conglomerates cropping out at north entrance of Blakeley Harbor on southern portion of Bainbridge Island. Fossiliferous horizon within formation from which bulk of fauna of the Blakeley have been obtained, occurs at Restoration Point about one-third the thickness of the formation downward from the top. Term Blakeley was applied by Weaver (1912) to section consisting of about 8,000 feet of shales, sandstones, and conglomerates at Restoration Point. At the time that report was written, the writer [Weaver] had in mind the entire sequence of beds between Port Blakeley and Orchard Point, but as result of incomplete statement referred only to Restoration Point. Formation has thickness of 8,900 feet including about 1,800 feet of conglomerate at base and 1,300 feet of conglomerate at top. Between are 4,800 feet of massive and stratified sandy shales, and thick members of interstratified conglomerate. It is possible lower Orchard Point conglomerate (new) may belong to middle Oligocene, and represent equivalent of Lyre formation (new).

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, chart 11. Shown on correlation chart as stage and formation.

J. W. Durham, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 113. Faunal studies indicate upper part of Twin River formation is younger than fossiliferous type Blakeley formation.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1340–1341. Weaver (1912) applied name Blakeley formation to Bainbridge Island section consisting of approximately 8,000 feet of conglomerates, sandstones, siltstones, and shales. Later, Weaver included in Blakeley a basal conglomeratic unit exposed at Orchard Point. Strata consisting of type Blakeley, as recognized by Weaver, can be grouped into three units. Lowermost 845 feet consists of well-bedded, hard, marine, gray sandstones, and massive conglomerates, the Orchard Point member. Middle unit consists of about 4,000 feet of marine hard massive gray-tan siltstone interbedded with thin hard fine-grained sandstone; soft

limonitic-stained sandstone largely covered with beach gravels; and massive dark-gray silty shale. This unit is Restoration Point member and contains the typical Blakeley molluscan faunule. Upper unit consists of about 4,650 feet of massive nonmarine conglomerates interbedded with thin gray sandstones, and soft carbonaceous shale. Recommended that Blakeley be restricted to Orchard Point and Restoration Point members, and that overlying nonmarine conglomeratic interval be referred to a new formation.

R. D. Brown, Jr., and H. D. Gower, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2496–2497. Blakeley formation as used by Weaver is included in redefined Twin River formation.

Type section: Restoration Point, Kitsap County, opposite Seattle, at entrance to Bremerton Navy Yard. Highest strata crop out on north shores of Blakeley Harbor.

Blakely Sandstone[1]

Lower Ordovician: Southwestern Arkansas and southeastern Oklahoma.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 676.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 23–24. As defined by Miser (1917, U.S. Geol. Survey Bull. 660), lies stratigraphically above Mazarn shale and below Womble shale. In Oklahoma, Honess (1923, Oklahoma Geol. Survey Bull. 32) mentioned two general outcrops of Blakely. One in sec. 16, T. 5 S., R. 23 E., and southwest therefrom, where Honess noticed that the only good exposure is the lower 10 to 15 feet at bottom of cliff on Glover Creek. A series of beds distinct lithologically from Mazarn shale below and Womble siltstone above was noted by present writer [Pitt] near above location. This could be designated as separate formation, but, if it were designated in this way, it is recommended that it not be called Blakely because of findings of current field work in Blakely type area. Other occurrence of Honess' Blakely sandstone is in sec. 25, T. 5 S., R. 23 E., and parts of neighboring sections. Honess noted that "there is some doubt about correlation with the beds to the north" because the "sandstones are not bronze colored." Present writer disagrees with Honess' correlation. Honess' two occurrences of Blakely sandstone are not similar lithologically because the outcrops in the two areas represent two stratigraphic units rather than one stratigraphic unit with several facies. Outcrop that Honess describes as Blakely sandstone consists of one sandstone bed 15 feet thick, which is not at all similar to the 400 feet of interbedded shale and sandstone that Miser describes as Blakely at type locality.

Named for Blakely Mountain, Garland County, Ark.

Blanca Tuff[1]

Miocene: Southern California.

Original reference: W. W. Rand, 1931, Mining in California, v. 27, no. 2, p. 217.

On Santa Cruz Island. Derivation of name not stated.

Blancan Age

Pliocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term, based on the local fauna at "Mt. Blanco" and adjoining draws, near "old rock house," north of Crawfish Draw, Crosby

County, Tex. Covers an interval in the upper Pliocene above the Hemphillian age. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence, see under Puercan.]

Blanchester Member (of Waynesville Formation)

Blanchester division (in Richmond Group)[1]

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

Original reference: A. F. Foerste, 1909, Denison Univ. Sci. Lab. Bull. 14, p. 291.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as uppermost member of Waynesville formation. Overlies Clarksville member; underlies Liberty formation.

Named for Blanchester, Clinton County, Ohio.

Blanco Formation[1]

Pliocene, middle: Texas and Kansas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxxi, pl. 3.

G. L. Evans and G. E. Meade, 1944, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 485–507. Blanco beds consist mainly of well-bedded light-gray calcareous sands and clays with some fresh-water limestones, tuffs, diatomite, and coarse gravels. Thickness 56 to 74 feet. Unconformably underlain by reddish-brown sands and clays of middle Pliocene and overlain by widespread sheet of surface sands of probably eolian origin. Nebraskan age. Pleistocene age assignment based upon Meade's study of faunas. Blanco beds are believed to be lacustrine deposits laid down in broad shallow basins rather than deposits of a large stream valley as was interpreted by earlier writers.

G. L. Evans, 1949, West Texas Geol. Soc. Guidebook Field Trip 2, Nov. 6–9, p. 7–8. Unconformably overlies Bridwell formation (new).

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 58–68. In Kansas, as in other areas of the Great Plains, deposits correlated with Blanco formation commonly are coarse textured in lower part and grade upward into finer textured clastics. Although conformable and gradational, these contrasting lithologies merit recognition as named members. In Nebraska, equivalent units are named Holdrege and Fullerton formations; in Kansas, these names are used to designate comparable members of Blanco formation. In central Kansas, Blanco formation was described by Fent (1950) who proposed name Chase Channel formation, containing Holdrege and Fullerton members, for these deposits in Rice County. In this area, formation known primarily from test hole data. South and southeast of Rice County, the Blanco crops out along valleys of Arkansas, Chickaskia, and Ninnescah Rivers in Harper, Kingman, Reno, and Sedgwick Counties. Quantitatively, the Blanco in Kansas has its maximum development in southwestern area where it attains maximum thickness of more than 250 feet. In this area, Smith (1940) described and named Rexroad formation from exposures now classed as Blanco formation. Frye and Hibbard (1941) redescribed these beds as Rexroad member of Ogallala formation. At type locality and west of Channing, Tex., in central Meade County, Kans., and in Rice County, Kans., Blanco beds are

overlain by Meade formation (in Texas classed as Tule), including Sappa member with Pearlette volcanic ash bed. At all of these localities, unconformable relationships of Blanco to Pliocene Ogallala formation is clear. Pleistocene (Nebraskan).

Named for Blanco Canyon, Dickens County, and Mount Blanco post office, Crosby County, Tex.

Blanco Sandstone (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as underlying Cubierto shale (new) and overlying Papel Blanco shale (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Light-colored medium- and coarse-grained sandstone 337 feet thick. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon in southeastern Puente Hills, between Chino and the Santa Ana River, San Bernardino County.

Blanco Basin Formation[1]

Oligocene(?): Southwestern Colorado.

Original reference: E. S. Larsen, 1935, U.S. Geol. Survey Bull. 843.

F. B. Van Houton, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 387 (table 1), 388. There is no evidence for assigning Telluride and apparently equivalent Blanco Basin formation an Oligocene(?) age. They are more probably arkosic border facies of upper Paleocene and lower Eocene San Jose (Wasatch formation).

Named for development about Blanco Basin, central part of Summitville quadrangle.

†Blanco Canyon Beds[1]

Pliocene: Panhandle of Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxxi, pl. 3.

Named for Blanco Canyon, Dickens County, and Mount Blanco post office, Crosby County.

†Blan[d]ford Limestone[1]

Precambrian: Western Massachusetts.

Original reference: E. Hitchcock, 1883, Rept. Geol., Min., Bot., and Zool. of Massachusetts, p. 305.

Exposed in northwestern part of town of Blan[d]ford, Hampden County.

Blandford Serpentine and Pyroxenite[1]

Age(?): Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 85.

Blaylock Sandstone[1]

Silurian: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, (abs.) Geol. Soc. America Bull., v. 19, p. 557.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Silurian.

W. D. Pitt, 1956, Ardmore Geol. Soc. Guidebook Ouachita Mountains Field Conf., p. 39. Consists of thin-bedded sandstones and dark shales which weather red or brown. Sandstones are silty, normally greenish gray or brown on fresh fracture. Thickness 670 to slightly over 800 feet. Overlies Polk Creek shale; underlies Missouri Mountain shale.

Named for Blaylock Mountain, Montgomery County, Ark.

Bledsoe Limestone[1]

Silurian (Niagaran): Western and central Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 269–270, fig. 80. In this report, all occurrences of post-Waldron Silurian strata in Central Basin are called Bledsoe limestone. Thickness 18 feet at Bakers Station, 35 feet at Shackle Island, and 80 feet at Bransford. Conformably overlies Waldron shale; unconformably overlain by either Pegram formation or Chattanooga shale.

Named for Bledsoe, Sumner County.

Blind Lake Glaciation or Drift

Pleistocene, upper: South-central Utah.

R. F. Flint and C. S. Denny, 1958, U.S. Geol. Survey Bull. 1061-D, p. 117 (fig. 25), 125–126, pl. 6. Drift consists of three small deposits marked at their peripheries by end moraines varying from a few feet to 60 feet in height. Largest mass extends only 1 mile beyond toe of cliff, down to an altitude of 9,900 to 10,200 feet, and includes basins of Blind and Pear Lakes. Second deposit marked by moraine that forms basin of Fish Creek Lake. Third includes small basin of Clark Lake. Pinedale(?) stage.

Type locality: In Fish Creek-Grover drift lobe, on flanks of Boulder Mountain, Wayne and Garfield Counties.

†Bliss Basalt[1] or Volcanics

Pleistocene: Southern Idaho.

Original references: H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932); 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 78–79, pl. 5. Thickness of volcanics about 100 feet. Contemporaneous with McKinney basalt and probably a part of it.

Type locality: Bliss Cone and Bliss Bridge, sec. 11, T. 6 S., R. 12 E., Twin Falls County, also Bliss Spring, Gooding County.

Bliss Sandstone[1]

Bliss Formation

Upper Cambrian and Ordovician: Western Texas and southern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 27.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 153–156. Type Bliss has hitherto been classed as Cambrian, but paleontological evidence for this is questionable. Type locality may be Ordovician.

H. E. Rothrock, C. H. Johnson, and A. D. Hahn, 1946, New Mexico Bur. Mines Mineral Resources Bull. 21, p. 19–20. In this report, Bliss sandstone in New Mexico is considered to be of Cambrian age because of (1) valid evidence in Silver City area and in Sierra Caballos, (2) presence of thick sandstones of known Cambrian age in southeastern Arizona, and (3) lithologic and stratigraphic similarity between Silver City and Sierra Caballos occurrences and outcrops of basal sandstones called Bliss in Cooks Peak and in Mimbres, Florida, Organ, and San Andres Mountains.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 67–69, 369 [1946]. Age of Bliss sandstone remains unsettled, but evidence seems slightly to favor its tentative consideration as Lower Ordovician.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2200–2213. Sandstone underlies Sierrite limestone (new) of El Paso group. Upper Cambrian.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 31 (table), 33–39. Designated as formation because of diverse lithology. Overlies Precambrian; underlies Sierrite formation of El Paso group. Thickness 110 to 160 feet. Cambrian. Area of report is Caballo Mountains.

R. H. Flower, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 2054–2055. Paleontological evidence indicates that base of Bliss may be as old as middle of Franconia and its top may extend into basal Ordovician.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 14-16. Bliss sandstone in San Andres Mountains considered to be Ordovician in age. At base of Bliss, however, are unfossiliferous beds lithologically similar to those bearing Upper Cambrian fossils in Caballo and San Diego Mountains. Summary discussion of unit.

Named for Fort Bliss, southeastern part of Franklin Mountains, El Paso County, Tex.

Blocher Formation (in New Albany Shale)

Blocher Member (of New Albany Shale)

Middle Devonian: Southeastern Indiana.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 837, 840–842. Thinly laminated black shale that locally contains sandstone lenses ½ to 1 inch thick in basal part. Contains conodont fauna. Commonly 8 to 10 feet thick, but ranges from 2 to 15 feet. Locally includes, at top, an additional bed 1 to 3 feet thick composed of black shale and layers of sandstone. Underlies Blackiston formation (new) with contact disconformable; overlies limestones of Hamilton age; at type locality overlies Swanville limestone.

H. H. Murray and others, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 43, pl. 1. Indiana Geological Survey uses term Blocher with member rank.

Type section: One and one-half miles southeast of Blocher, Scott County, 1 mile east of Baltimore and Ohio Railroad, on Highway 50.

Block Limestone[1] Member (of Cherryvale Formation)

Block Limestone Member (of Sarpy Formation)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guide Book, p. 85, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 94–95. Member of Cherryvale; underlies Wea shale member; overlies Fontana shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma with proviso that some differences may be required by regional variation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 38. In Nebraska, basal member of Sarpy formation (new). Underlies Wea shale member of Sarpy; overlies Fontana formation; thickness one-third to two-thirds foot. Thickness in Iowa 4 feet. Type locality stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Gray limestone nodules enclosed in gray shale matrix. Thickness one-half foot. Member of Cherryvale; underlies Wea shale member; overlies Fontana shale member.

Type locality: Roadcuts near center south line sec. 6, T. 18 S., R. 24 E., and center west line sec. 18, T. 19 S., R. 23 E., Miami County, Kans. Named for hamlet of Block, Miami County.

Blockhouse Shale

Middle Ordovician: Eastern Tennessee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145, 148–154, table 3, pl. 28. Dark-gray calcareous shale with thin beds and lenses of dark-gray dense limestone forms main body of unit 150 to 950 feet thick. In southwestern part of Tellico-Sevier belt, these fine-grained rocks are partly replaced by fine- to coarse-grained Toqua sandstone member (new) which underlies unnamed shale member. Thin argillaceous limestone forms basal member, and term Whitesburg limestone member is applied to it. Overlies Lenoir limestone; underlies Tellico formation. Blockhouse shale as defined in this report was included by Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16) and Rodgers (1953) in lower part of Athens shale.

Type section: Base of section 800 feet southwest of bench mark F132Y (elevation 972 feet) extending southeastward up a gullied hillside, Blockhouse quadrangle, Blount County.

Bloody Run zone[1]

Upper Devonian: North-central Iowa.

Original reference: C. L. Fenton and C. L. Webster, 1924, Univ. Michigan Pub., Contr. Mus. Geol., v. 1, frontispiece, map.

Bloomfield Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: W. Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 242.

M. T. Sturgeon and others 1958, Ohio Geol. Survey Bull. 57, p. 120–121. Member of Anderson cyclothem, Conemaugh series. Underlies Anderson clay member; overlies Bakerstown shale and (or) sandstone member.

According to Waagé (1950, Maryland Dept. Geology, Mines and Water Resources Bull. 9) Hennen and Reger (1914) named an equivalent limestone in Preston County, W. Va., the Albright limestone. Thus, Albright has precedence over Bloomfield. Recommended that Albright replace Bloomfield if and when positive correlation is determined.

Named for exposures west of Bloomfield, Muskingum County.

Bloomfield sand[1]

Eocene: Southeastern Missouri.

Original reference: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30.

Named for Bloomfield, Stoddard County.

Bloomfield Sandstone (in Cayuga Group)[1]

Silurian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F_2, p. 54, 401.

Underlies New Bloomfield, and exposed on road to Newport, one-half mile east of town. Perry County.

Bloomingdale Limestone Member[1] (of Conococheague-Copper Ridge formation)

Upper Cambrian: Eastern Tennessee.

Original reference: C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 4, p. 478–479, 492, 496.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 3, 18. Abandoned. Morristown and Bloomingdale limestone members (Oder, 1934) are parts of the Copper Ridge or Conococheague; use of these terms does not seem warranted.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 33. It is now thought that most of strata placed in Bloomingdale by Oder belong in lower part of Chepultepec dolomite as now recognized.

Type section: Along a branch of Reedy Creek 1½ miles northwest of Bloomingdale 4 miles northeast of Kingsport, Sullivan County.

Bloomington Drift, Substage

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 158–159. Consists largely of pink till, locally underlain by outwash gravel of advancing glacier and overlain by outwash gravel of retreating glacier. Maximum thickness about 50 feet. Most commonly overlies earlier Wisconsin deposits, but in large areas rests directly on bedrock, and in some places overlies Sangamon deposits and Illinoian drift; mostly overlain by Cropsey, Farm Ridge, Chatsworth, and Marseilles drifts. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Leland Horberg, 1951, Illinois Geol. Survey Bull. 75, pt. 1, p. 19. In Peoria area, Bloomington drift is listed as older than Metamora drift and younger than Leroy drift.

J. L. Hough, 1958, Geology of the Great Lakes: Urbana, Univ. Illinois Press, p. 94. Listed as glacial substage (late Tazewell).

Named for Bloomington, McLean County. Widely distributed throughout Marseilles-Ottawa-Streater area.

Bloomington Formation[1]

Middle Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6, 7.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1110–1112, 1117 (fig. 4), 1121–1122. Described in Blacksmith Fork area, Utah, where it is 1,275 feet thick; Hodges member about 163 feet thick. Overlies Blacksmith dolomite (emended); underlies Nounan dolomite.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 651–653, 672, 673 (fig. 3). Consists of basal tawny-olive shale and interbedded thin layers of light- to dark-gray limestone (Hodges shale member), overlain by middle unit of thinly to thickly bedded, light- to dark-gray limestone about 720 feet thick, overlain by an upper tawny-olive shale unit with some interbedded platy limestone, the Calls Fort member (new). Total thickness 1,495 feet. Overlies Blacksmith dolomite; underlies Nounan formation.

Type locality: About 6 miles west of Bloomington, Bear Lake County, Idaho. Bloomington Creek, near type locality, passes through formation. Crops out throughout southeastern Idaho and northeastern Utah as far south as northern margin of Great Salt Lake and Brigham City. Recognized in Lakeside Range, on west margin of Great Salt Lake.

Bloomsburg Redbeds (in Cayuga Group)[1]

Bloomsburg Formation (in Cayuga Group)

Upper Silurian: Central and southern Pennsylvania, western Maryland, western Virginia, and northern West Virginia.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 252.

C. K. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1184, measured section. Red sandstone and shale. Thicknesses: about 2,000 feet at Lehigh Gap; 1,815 feet southwest of New Ringgold; and 1,900 feet near Delaware Water Gap. Underlies and intertongues with Poxono Island shale; overlies [southeastern Pennsylvania] Clinton shale and Tuscarora sandstone at Schuylkill River and Shawangunk conglomerate at Delaware River.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 149–150. Term Bloomsburg facies applied to red phase of Cayugan series. This term replaces units previously called Bloomsburg "shale" or Bloomsburg "sandstone." Green or brown sandstone of western Silurian belt cannot properly be called "Bloomsburg" as it is not the true facies to which that name is now restricted. Term Williamsport sandstone is herein revived and redefined to include the green or brown sandstone. Williamsport is basal member of Cayugan group. Identity of Williamsport in eastern Silurian outcrops is obliterated by or absorbed in red nonmarine Bloomsburg facies.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Niagaran and Cayugan.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 77. Bloomsburg formation in Cayuga group. Has been considered member of Wills Creek in Maryland. Thickness 20 to 200 feet. Underlies Wills Creek shale; overlies McKenzie formation.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 20, 22, 31, pl. 1. Formation, in central Pennsylvania, consists of red fine-grained siltstone with some interbedded sandstone and shale. Lower part of section generally calcareous and commonly contains green interbeds, lenses, and blebs, while upper part is commonly very sandy. In Loysville quadrangle, a lenticular clean white quartzose sandstone (Bridgeport member) occurs in middle of unit. Thickness 1,000 feet at Susquehanna Gap; 500 feet in Loysville area; 200 to 400 feet in west-central part of state. Underlies Wills Creek formation; overlies Mifflin formation (new) in Mifflinton [Mifflintown] area; elsewhere overlies McKenzie formation. Eastward, the Bloomsburg includes more and more of both the McKenzie and the Wills Creek until in eastern Pennsylvania the Bloomsburg occupies a 2,000-foot section.

Named for exposures at Bloomsburg, Columbia County, Pa.

Bloomsdale Formation (in Plattin Group)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2046–2048. Named as lowermost formation of group. Dominantly fine-textured well-bedded dolomite, with interbeds of light-gray-weathering oolitic and carbonate pebble-bearing calcilutite; green shale layers common; sparsely fossiliferous. Thickness at type locality 61 feet. Overlies Rock Levee formation; overlapped by Beckett formation (new).

Type section: In bed of stream rising in SW¼NE¼ sec. 15, T. 38 N., R. 8 E., 3½ miles east of Bloomsdale, near Belleville School, Ste. Genevieve County.

Blossburg[1]

Blossburg Red Beds

Upper Devonian: New York and central northern Pennsylvania.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 99, 279, 282, 357.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Blossburg red beds in New York. Above "Mansfield beds." Upper Devonian.

First mentioned in Tioga County, Pa.

Blossom Sand[1]

Blossom Sand (in Austin Group)

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: C. H. Gordon, 1909, Am. Jour. Sci., 4th, v. 27, p. 371, 373.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart above Bonham equivalents and below Brownstown marl.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 35, fig. 1. Included in Austin group. Foraminifera described.

Named for Blossom, Lamar County.

†Blount Group[1]

Middle Ordovician: Eastern Tennessee, Alabama, northwestern Georgia, western Virginia, and West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 379, 382, 413, 567, 576, 627, pl. 27.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 23 (table 1), 147–183. Group comprises (ascending) Holston limestone, Whitesburg limestone, Athens shale, Tellico sandstone, Ottosee limestone—Sevier shale. Nowhere, so far as known, are all formations present in continuous vertical section. Overlies Stones River group; underlies Black River group. Chazyan series.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Revised stratigraphic nomenclature proposed for lower Middle Ordovician succession of Tazewell County and other parts of southwestern Virginia. Further use of terms Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Lowville-Moccasin seems inadvisable. In Tazewell County, part of Ulrich's Blount group (upper Chazy) occurs beneath beds containing fauna of Murfreesboro limestone of Central basin of Tennessee.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 27–29, geol. map. Group in Georgia comprises (ascending) Holston marble, Athens shale, Tellico formation, and Ottosee (Sevier) shale. Overlies Stones River group.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. No complete section of Blount group has ever been found; at present the idea that such a unit exists, intermediate between the Chazy and Black River and represented only in southern Appalachians, has been completely discarded.

Named for Blount County, Tenn.

Blounts Creek Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 168–170, 174, geol. map. Uppermost member of formation. Consists of group of silty clays and sands; some beds as much as 10 feet thick. Thickness about 500 feet. Overlies Castor Creek member (new); underlies Quaternary deposits.

Well exposed south of Hinestone in northern slopes of Blounts Creek, Rapides Parish.

Blowing Rock Gneiss[1]

Precambrian: Western North Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 3.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 18; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Consists of two varieties, one containing large porphyritic crystals of orthoclase feldspar embedded in groundmass of quartz, feldspar, biotite, and muscovite, and the other consisting of the same minerals in grains of uniform size. Precambrian(?)

Named for Blowing Rock in Cranberry quadrangle, Watauga County.

†Blowout Mountain Sandstone (in Double Mountain Group)[1]

Permian: Central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 95, 96, 98, pl.

Named for exposure in Blowout Mountain, southwest of Merkel, Taylor County.

Bloyd Shale[1] or Formation

Lower Pennsylvanian (Morrow Series): Northwestern Arkansas and eastern Oklahoma.

Original reference: A. H. Purdue, 1907, U.S. Geol. Survey Geol. Atlas, Folio 154.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66, p. 38–39, strat. sections. Formation geographically extended into northeastern Oklahoma, where it contains representatives of both the Brentwood and Kessler limestone lentils as recognized in Washington County, Ark. Thickness 191 feet at Arkansas-Oklahoma line; thins westward.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1942–1945, 1948 (fig. 2). Shale consists of (ascending) Brentwood limestone member, Woolsey member (new) composed of terrestrial sediments, and an unnamed shale division, which includes Kessler limestone lentil and which represents the upper half to two-thirds of formation. Overlies Prairie Grove member (new) of Hale formation; underlies Greenland sandstone member (new) of Atoka formation.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 80–82, strat. sections, pls. 4, 5. Formation described and mapped on south and west flanks of Ozark uplift. Traced around various outliers and fault blocks from Arkansas line westward to Arkansas River valley, northward to Mayes-Wagoner County line, where it is beveled by pre-Atoka erosion. A sequence of alternating shales and limestones; thin coal bed. Maximum thickness 225 feet in Stilwell area; 58 feet at Braggs Mountain. Conformable and gradational with underlying Hale; unconformable with overlying Atoka.

Named from Bloyd Mountain, 9 miles southwest of Fayetteville, Washington County, Ark.

†Blue chert series[1]

Devonian(?): Northwestern California.

Original reference: O. H. Hershey, 1906, Am. Jour. Sci., 4th, v. 21, p. 58–66. Klamath Mountains. Named for its most characteristic constituent, blue chert.

Blue conglomerate (in Conococheague Formation)

Upper Cambrian: Central Pennsylvania.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 149 (fig. 3), 150. Local name applied to conglomerate in lower part of Conococheague in Cornwall district.

Blue Ball Fire Clay (in Allegheny Formation)[1]

Pennsylvanian: Central Pennsylvania.

Original reference: H. M. Chance, 1884, Pennsylvania 2d Geol. Survey Rept. H_7.

In Clearfield County.

Blue Beach Conglomerate

Cretaceous: Virgin Islands.

P. T. Cleve, 1871, Kongl Svenska Vetenscaps Akad. Handlengar, v. 9, no. 12, p. 4–5. Dark-bluish-green conglomerate on breccia. Thickness as much as 2,000 meters. Cretaceous.

R. W. Imlay, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 1007. Similar to Mount Eagle series on St. Croix.

D. J. Cederstrom, 1950, U.S. Geol. Survey Water-Supply Paper 1067, p. 17. Term "blue beach" was originally used by Cleve (1871) to apply to conglomerate or breccia having angular pieces of dark porphyry or felsite and rounded scoriaceous stones cemented together by greenish matrix, probably derived from decomposed hornblende, which is widely distributed in St. Thomas. Term has since been used loosely and is now used by natives of St. Croix to apply to all older dark indurated rocks of the island.

Exposed on St. Thomas Island.

Bluebell Dolomite[1]

Upper Ordovician, Silurian, and Devonian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

Paul Billingsley *in* J. M. Boutwell, 1933, 16th Internat. Geol. Cong. [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Subdivided into (ascending) Eagle, Beecher, Dora, and Noah members.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 11 (fig. 3), 12, pl. 4. Described in Tintic mining district, where it is 350 to 600 feet thick. Separated into two members of nearly equal thickness by bed of crinkly-laminated medium- and light-gray dolomite about 10 feet thick. Lower member chiefly light- to medium-gray-weathering, thin- to medium-bedded, medium- to fine-banded dolomite; upper member principally medium- to dark-gray, medium- to thick-bedded, medium- to coarse-grained dolomite. Overlies Fish Haven dolomite; underlies Victoria formation. Includes beds that contain fossils of Late Ordovician, Silurian, and Devonian age, but systemic boundaries within formation cannot be recognized by lithologic differences.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 143–144. Because of loose manner in which name Bluebell (or Blue Bell) has been used stratigraphically and because field names Eagle, Beecher, Dora, and Noah dolomites are inappropriate as formal stratigraphic names, it is proposed that name Bluebell (or Blue Bell) be suppressed and that well-defined and time-rock established names as Fish Haven, Laketown, Sevy, and Simonson be applied in area of this report [Fivemile Pass and North Boulter Mountains quadrangles].

Named for Bluebell mine near Eureka, Tintic district.

Blueberry Mountain Argillite[1]

Lower(?) Devonian: Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1905, Geology of Littleton, N.H., Univ. Press, Cambridge.

Blueberry Mountain is northern part of ridge 2 miles west of Littleton, Grafton County.

Blueberry Mountain Series[1]

Silurian and Devonian: Northwestern New Hampshire.

Original reference: F. H. Lahee. 1913. Am. Jour. Sci., 4th, v. 36, p. 231–250.

Blueberry Mountain is northern part of ridge 2 miles west of Littleton, Grafton County.

†Bluebird Aplite[1]

Eocene: Montana.

Original references: W. H. Weed, 1899, Jour. Geology, v. 7, p. 744–747; 1903, U.S. Geol. Survey Bull. 213, p. 170.

In Butte district.

Bluebird Dolomite[1]

Middle Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 7–8. Described in East Tintic Mountains, where it is 150 to 220 feet thick, overlies Herkimer limestone, and underlies Cole Canyon dolomite. Consists of dusky blue-gray medium-grained dolomite studded with short white dolomite rods a centimeter or so long and 1 to 2 centimeters in diameter; white rods are straight, slightly curved, or branched and resemble minute twigs. Middle Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 19, 20–21. In Stansbury Mountains, consists of dark-gray medium-crystalline dolomite, 75 to 80 feet thick, at base of Cole Canyon formation; overlies Bowman limestone.

Well exposed along backbone of Bluebird Spur for nearly 1,000 feet, north of Eureka Gulch and west of Cole Canyon, Tintic district.

Bluebonnet Member (of Lake Waco Formation)

Cretaceous (Gulf Series): Central Texas.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Ser., no. 4, p. 122–123, 139 (fig. 17), 141 (fig. 18). Consists of limestone flagstones interbedded with calcareous shale and bentonites. Thickness 12 to 18 feet. Underlies Cloice member (new); overlies Pepper formation.

Type area and section: Along Bosque Escarpment from old South Bosque brickyard southwest into Moody Hills, then southward past Moody, McLennan County; type section is opposite Baggetts Station, on east side of McGregor-Moody Road (State Highway 17), about 4½ miles south-southeast of McGregor.

†Blue Canyon Formation[1]

Mississippian: Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on Mississippian correlation chart as underlying Tightner formation in Colfax area.

Named for exposures at village of Blue Canyon, Placer County.

Bluecastle Sandstone Member (of Neslen Formation)

Bluecastle Sandstone Member (of Price River Formation)

Bluecastle Sandstone Bed (in Price River Formation)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11, 14, 17, pls. 10, 11, 12. In western Book Cliffs

(Utah, west of Green River), the Bluecastle is a member at top of Price River formation; in central Book Cliffs (Utah, east of Green River) it is a member in upper part of Neslen formation.

Named for Bluecastle Canyon, Book Cliffs.

Blue Creek Coal Member (of Mansfield Formation)

Pennsylvanian: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 25, 72. Important marker bed in upper part of Mansfield in Huron area. Thickness 4⅔ feet at type section. Lies approximately 100 feet above base of upper Mansfield in a sequence of sandstones with wavy bedding.

Type section: SW¼NW¼ sec. 10, T. 1 N., R. 3 W., in abanoned strip mine at west end of ridge, Martin County. Named for exposures at headwaters of Blue Creek.

Blue Creek series[1]

Cambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 138–140.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Abandoned by Oklahoma Geological Survey. Unit is Reagan sandstone and lower sandy part of the Honey Creek formation. No series concept is warranted.

Named for Blue Creek, Comanche County.

Blue Creek Canyon Group

Cambrian: Oklahoma.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 19. Name used to include (ascending) Fort Sill limestone, Royer dolomite, Signal Mountain limestone, and Butterly dolomite. Overlies Timbered Hills group. Name credited to E. A. Frederickson (unpub. thesis).

Derivation of name not stated.

Blue Cut Shale[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 380.

Named for Blue cut, a deep railway cut a few miles south-southwest of Belvidere, Kiowa County.

Blue Earth Siltstone[1]

Ordovician: Southern Minnesota.

Original reference: L. H. Powell, 1935, St. Paul Inst. Sci. Mus., Sci. Bull. 1.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 50 (fig. 13), 54–55. Bed of white to greenish very fine grained silty shale commonly referred to as siltstone. Seldom more than 2 feet thick; 6 inches in section in quarry on Minnesota River, Le Sueur County. Underlies Oneota dolomite; overlies Kasota sandstone, but, where that is lacking, is in direct contact with Jordan sandstone.

Named for exposures along Blue Earth River, near Mankato.

Bluefield Shale[1] or Formation

Bluefield Group

Upper Mississippian: Southern West Virginia, eastern Kentucky, and southwestern Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 26, p. 3.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 255, 262–265. Bluefield group is largest subdivision of Mauch Chunk series in county. Thickness 900 to 1,200 feet. Includes (ascending): Lillydale shale, Webster Springs sandstone, Reynolds limestone, and Droop sandstone members. Overlies Greenbrier; underlies Hinton group.

R. H. Wilpolt and D. W. Marden, 1959, U.S. Geol. Survey Bull. 1072–K, p. 596–597, 598 (fig. 26), geol. section, pls. 28, 29. Referred to as formation because of heterogeneous character of rocks. Thickness 118 to 449 feet. Overlies Greenbrier limestone; underlies Stony Gap sandstone member of Hinton formation. Geographically extended into Kentucky where it is 191 feet thick on Pine Mountain near Whitesburg. Probably early Chester age.

Named for exposures at Bluefield, Mercer County, W. Va.

†Blue Gate Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of the Henry Mountains: U.S. Geog. and Geol. Survey of the Rocky Mountain region, p. 4 [2d ed. 1880].

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota(?) sandstone in Henry Mountains, Gilbert (1877) applied the local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," "Tununk sandstone," and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation; "Masuk shale," with the Lewis shale; and Masuk sandstone, with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe entire succession corresponds to Mancos shale. Blue Gate sandstone consists of yellow to brown irregularly bedded medium to massive sandstone. Thickness 230 to 1,000 feet.

H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164, p. 108. In Kaiparowits region, Blue Gate sandstone is uppermost member of Mancos. Thickness 276 feet on east side of Circle Cliffs, Garfield County. Overlies "Blue Gate shale" of Gilbert.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 84. Emery sandstone member extended into Henry Mountains; replaces Blue Gate sandstone as used by Gilbert.

Probably named for occurrence on Blue Gate Plateau, Henry Mountains.

Blue Gate Shale Member (of Mancos Shale)

†Blue Gate Shale (in Mancos Shale)[1]

Upper Cretaceous: Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of the Henry Mountains: U.S. Geog. and Geol. Survey of the Rocky Mountain region, p. 4 [2d ed. 1880].

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota(?) sandstone in Henry Mountains, Gilbert (1877) applied the local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," "Tununk sandstone," and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation; "Masuk shale" with the Lewis shale; and Masuk sandstone, with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe entire succession corresponds to Mancos shale. Thickness of "Blue Gate shale" 1,100 to 1,200 feet.

H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164, p. 108. In Kaiparowits region, "Blue Gate shale" of Gilbert overlies Tununk sandstone member of Mancos shale and underlies Blue Gate sandstone member of Mancos. Thickness 1,100 feet on east side of Circle Cliffs, Garfield County.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8 (table). Generalized section of exposed sedimentary rocks in Henry Mountains structural basin shows Blue Gate shale member of Mancos shale above Ferron sandstone member and below Emery sandstone member. Thickness 1,500 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 37, 83–84, pl. 1. Composed almost wholly of dark-gray finely laminated marine shale. Shale includes some very thin beds of bentonite, shaly sandstone, and sandy or shaly limestone. Thickness about 1,400 feet. Overlies Ferron sandstone member; underlies Emery sandstone member. Ferron sandstone replaces Gilbert's (1877) Tununk sandstone and Emery sandstone replaces Gilbert's, (1877) Bluegate [Blue Gate] sandstone.

In Blue Gate Plateau, Henry Mountains region.

Blue Grass Group[1]

Middle Ordovician: Central Kentucky.

Original reference: S. S. Lyon, 1873, Ohio Geol. Survey, v. 1, pt. 1, p. 119–120.

Named for Blue grass region about Lexington.

Blue Hill Granite Porphyry[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. O. Crosby, 1880, Boston Soc. Nat. History Occ. Papers 3, with map.

W. H. Dennen, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 550, 551. Referred to as Blue Hills porphyry.

Occurs on higher hills of Blue Hills Range.

Blue Hill Shale Member (of Carlile Shale)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: W. N. Logan, 1897, Kansas Univ. Geol. Survey, v. 2, p. 218, 225, 228, 229.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 24. Clayey gray-black to dark-gray noncalcareous shale; abundant ordinary and septarian concretions and selenite crystals. Contains Codell sandstone zone in upper part. Thickness 75 feet in Hamilton County to 200 feet in Russell County. Overlies Fairport chalky shale member; underlies Fort Hayes limestone member of Niobrara formation.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 121. In Baca County, Colo., member constitutes more than half the formation and consists of dark-gray to black fissile clay shale having a few thin layers of brown platy shale; zone of gray to light-brown septarian concretions about 15 to 20 feet below top of shale. Underlies Codell sandstone member.

Apparently named Blue Hills in Mitchell, Russell, and Republic Counties, Kans.

†Blue Hills Complex[1]

Cambrian and later and older?: Eastern Massachusetts.

Original reference: W. O. Crosby, 1900, Boston Soc. Nat. History Occ. Papers, v. 1, pt. 3.

Includes the Blue Hills proper and extends thence eastward across Quincy and northern parts of Braintree and Weymouth, Suffolk County.

Bluejacket cyclothem

See **Bluejacket Sandstone Member** (of Boggy Shale or Formation).

Bluejacket Sandstone Member (of Boggy Shale or Formation)[1]

Bluejacket Sandstone Member (of Krebs Formation)

Bluejacket Formation (in Cherokee Group or Krebs Group)

Bluejacket Sandstone Member (of Cherokee Shale)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southeastern Kansas, and southwestern Missouri.

Original reference: A. W. McCoy, 1921, Am. Assoc. Petroleum Geologists Bull., v. 5, no. 5, p. 541-550.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 21-22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193. Cherokee group divided into 15 cyclic formational units. Bluejacket formation (cyclothem), fourth in sequence (ascending), overlies the Columbus and underlies the Knifeton. Average thickness 68 feet. Includes Bluejacket sandstone at base. [For complete sequence see Cherokee group.]

W. G. Pierce and W. H. Courtier, 1938, Kansas Geol. Survey Bull. 24, p. 27-30, pl. 1. Bluejacket sandstone has been mapped northward from type locality to Oklahoma-Kansas line. Although Bluejacket cannot be

traced with certainty as continuous unit in Kansas, name is applied to prominent sandstone exposed just east and south of Columbus, and that caps the Timbered Hills 2 miles southwest of Columbus. Base of Bluejacket as shown on plate 1 represents base of fairly thick sandstone unit. It was not mapped northeastward beyond sec. 33, T. 32 S., R. 24 E., about 4 miles northeast of Columbus. In places the sandstone is underlain by Rowe coal bed. Term Columbus sandstone was proposed by Haworth and Kirk (1894) for the sandstone exposed southeast of Columbus but was defined rather loosely and would probably include both Little Cabin and Bluejacket sandstone members. Thickness between 20 and 50 feet. Base is 50 to 100 feet below Weir-Pittsburg coal.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2087-2091. Type section revised. As originally defined by Ohern (1914, unpub. ms.), type section of formation includes several sandstone beds, some of which are similar to the Bluejacket, and actual unit called Bluejacket is not clearly differentiated. Trace of base of Bluejacket sandstone, as shown on Ohern's unpublished map and on Geologic map of Oklahoma (1926) in vicinity of Bluejacket, Vinita, and Whiteoak, delineates base of sandstone that occurs 30 to 35 feet below the Bluejacket, as here restricted, in type section. Lower sandstone grades into shale southward, and south of Craig County the Bluejacket line on the "Geologic map of Oklahoma" consistently marks base of Bluejacket sandstone as restricted in this paper. Same conditions obtain northward, and Bluejacket sandstone, restricted, is continuous with Columbus sandstone of Haworth and Crane (1898, Kansas Univ. Geol. Survey, v. 3) as mapped by Pierce and Courtier (1937, Kansas Geol. Survey Bull. 28 [1938, Kansas Geol. Survey Bull. 24]). Bed which apparently should be regarded as Bluejacket sandstone is a well-defined lithologic and mappable unit typically exposed in NE¼NE¼ sec. 25, T. 27 N., R. 20 E., along road from Bluejacket west to Pyramid Corners, in east slope of Timbered Hill, on Oklahoma Highway 25, in Craig County. In Oklahoma, Bluejacket sandstone is member of Cherokee formation and lies above Little Cabin sandstone member and below Broken Arrow coal member; in Kansas, Bluejacket is formation in Cherokee group and lies between Rowe coal below and Weir-Pittsburg coal above.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic column as Bluejacket formation in Krebs group. Overlies Drywood formation; underlies Seville formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as sandstone member of Boggy formation.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 39–43, measured sections. Formation includes beds directly above Dry Wood coal and extending to top of Bluejacket coal. Succession includes Bluejacket sandstone (Ohern, 1914; Howe, 1951) from which formation takes its name. Overlies Dry Wood formation; underlies Seville formation. Krebs subgroup of Cherokee group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as Bluejacket sandstone in Krebs formation.

Type locality: NE¼NE¼ sec. 25, T. 27 N., R. 20 E., along road from Bluejacket west to Pyramid Corners, on east slope of Timbered Hill, Craig County. Okla.

Bluelick Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 114.

In Castleman Basin.

Blue Mountain Gravel

Quaternary: Northwestern Arizona.

Donaldson Koons, 1948, Plateau, v. 20, no. 4, p. 54 (fig. 1), 58. Bedded deposits of well-rounded pebbles and cobbles of granite, gneiss, schist, and red and white quartzite, up to 20 inches in the long diameter. Deposits generally deeply weathered. Maximum measured thickness 150 feet, but generally somewhat thinner. Found at elevations ranging from 5,775 feet near Blue Mountain to 7,125 feet near the Pinnacle.

Erich Blissenbach, 1952, Plateau, v. 24, no. 4, p. 121. Underlies Blue Mountain lavas and volcanics.

Named after Blue Mountain, Coconino County, where formation is well exposed.

Blue Mountain Lavas, Volcanics

[Pliocene or later]: Northwestern Arizona.

Erich Blissenbach, 1952, Plateau, v. 24, no. 4, p. 121. Mentioned as overlying Blue Mountain gravels.

Exposed at Blue Mountain, Coconino County.

Bluepoint Limestone[1]

Upper Mississippian: Southeastern Nevada.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th, v. 1, p. 46; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 930 (table 1). Chiefly dark-gray limestone. About 500 feet thick. Overlies Rogers Spring limestone; underlies Callville limestone.

Named for town of Bluepoint, Clark County, Muddy Mountains area.

Blue Rapids Shale (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 22.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 65. Proposed that Bigelow be dropped as stratigraphic term and that Crouse limestone, Blue Rapids shale, and Funston limestone be recognized as formations.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Gray, green, and red shale; contains local limestones and locally a coal bed in Geary County. Thickness 15 to 30 feet. Underlies Funston limestone; overlies Crouse limestone. Wolfcamp series.

Type locality: In cuts of Highway 77, about 1½ miles north of Blue Rapids, Marshall County, Kans.

Blue Ridge Conglomerates[1]

Cambrian: Pennsylvania.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2, p. xxiv.

Blue Ridge Member (of Crack Canyon Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert, Abs., v. 16, no. 10, p. 1885. Listed as lower member of formation. Underlies Grizzly Creek (new); overlies Sulfur Creek formation (new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

†Blue Ridge Sandstone[1]

Ordovician and Silurian: Northeastern West Virginia, western Maryland, and northern Virginia.

Original reference: A. Keith and H. R. Geiger, 1891, Geol. Soc. America Bull., v. 2, p. 155–164.

†Blue Ridge Shale[1]

Ordovician: Northeastern West Virginia, western Maryland, and northern Virginia.

Original reference: A. Keith and H. R. Geiger, 1891, Geol. Soc. America Bull., v. 2, p. 155–164.

Blue River Group

Mississippian (Chester Series): South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 48–51, pl. 1. Comprises (ascending) St. Louis limestone, Ste. Genevieve limestone, and Paoli limestone (amended). Only upper 70 feet of group exposed in Huron area; well records show group to be about 400 feet thick. Underlies West Baden group.

Well exposed along banks of Blue River which drains parts of Washington, Harrison, and Crawford Counties.

Blue Springs Muscovite Schist or Formation

Precambrian: Central New Mexico.

J. T. Stark and E. C. Dapples, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1936. Underlies White Ridge quartzite (new); overlies Sais quartzite (new); intruded by Los Pinos granite (new).

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1130–1133, pl. 1. Massive and brittle beds of red and gray slates and siltstones characterize basal parts of Blue Springs schist. Central parts largely green, sericitic schists in which some zones are predominently contorted and crenulated. Schistose beds intercalated with more massive slates and arenaceous siltstones. Many beds spotted with biotite and blebs of granulated white quartz. Near top of formation are beds of dense red and gray arenaceous slates, which become increasingly schistose as overlying White Ridge quartzite is approached. Thickness ranges from about 300 feet, between Abo Pass and Highway 60, to nearly 4,000 feet in vicinity of Sierra Montosa.

Named for exposures at Blue Springs, a large seepage area where water issues from Blue Springs schist, north of Highway 60 at western flank of Los Pinos Mountains.

Blue Springs Shale Member (of Matfield Shale)

Blue Springs Shale (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 38.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 45. Middle member of Matfield. Shale, chiefly red and gray, and relatively minor amount of limestone, except in southern Kansas where several limestone beds occur in upper part of member; farther north, member is less calcareous and limestone is absent; fossils occur in thin limestones and in gray shale beds in southern part of outcrop area. Thickness about 30 feet. Overlies Kinney limestone member; underlies Florence limestone member of Barneston limestone. Wolfcamp series.

Type locality: In foot of Blue River bluffs southeast of Blue Springs, Gage County, Nebr.

Bluestone facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 125–132. Intermediate between Stanton facies (new) to south-southwest and Vanceburg facies to north. Consists of smooth and regular siltstone layers in lower third; remainder composed of undifferentiated silty shale and soft siltstone, shaly to massive. Thickness, as shown by composite sections, about 300 feet. Includes Henley shale member and Farmers siltstone member (new) near base. Underlies Christy Creek siltstone member of Brodhead formation, Morehead facies (all new); overlies Sunbury black shale.

Name derived from village of Bluestone, western Rowan County, where excellent section of lower part of formation is exposed at and adjoining the quarry of Kentucky Bluestone Co. No one locality shows a good continuous exposure of entire formation.

Bluestone Formation[1] (in Pennington Group)

Bluestone Group

Upper Mississippian: Southern West Virginia, eastern Kentucky, and southwestern Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 26.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 259–260. Bluestone group (Mauch Chunk series) overlies Princeton group; from southeast to northwest, successively older horizons are in contact with basal beds of Pottsville series. Thickness 80 to 675 feet.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 181–187, pl. 15. Reger (1926, West Virginia Geol. Survey [County Rept.] Mercer, Monroe, and Summers Counties) named many subdivisions of the Bluestone in West Virginia. In present report (Burkes Garden quadrangle, Virginia), these units are redefined and renamed as members of Blue-

stone formation (ascending): Pride shale, Pipestem shale, Glady Fork sandstone, Mud Fork, Belcher, Bratton sandstone, and Bent Mountain. Conformable with underlying Pennington; in Tazewell County underlies Pennsylvanian Lee formation in normal sequence; in Burkes Garden quadrangle has been faulted out along southeastern edge of Pennsylvanian belt.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Age of Bluestone formation given as Upper Mississippian.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Assigned to Pennington herein raised to group rank; uppermost formation in group. Overlies Princeton sandstone.

R. H. Wilpolt and D. W. Marden, 1959, U.S. Geol. Survey Bull. 1072–K, p. 598 (fig. 26), 602–603, geol. sections, pls. 28, 29. Interbedded shale, mudstone, siltstone, sandstone, and limestone; impure coal beds. Thickness (measured sections) 228 to 692 feet. Conformable above Princeton sandstone; regionally several hundred feet of beds in upper part may have been truncated before basal sandstone of Pottsville was deposited. Geographically extended into Kentucky.

Well exposed along Bluestone River, Mercer County, W. Va.

Blue Water Basalt Flow[1]

Pleistocene: West-central New Mexico.

Original reference: R. L. Nichols, 1936, Jour. Geology, v. 44, no. 5, p. 628.

In San Jose Valley between Blue Water and the Rio Puerco, Valencia County.

Bluewater Formation

Permian: New Mexico and Arizona.

S. B. Talmage and T. P. Wootton, 1937, New Mexico Bur. Mines Mineral Resources Bull. 12, p. 30. Name applied to so-called Moenkopi of previous reports. Consists largely of red, brown, and purplish shales but includes some beds of sandstone and conglomerate. Thickness about 1,000 feet in Zuni Mountains. Not recognized east of Rio Grande.

Derivation of name not stated.

Bluff Bed[1]
Bluff Formation or Limestone } (in Trinity Group)

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 727, 736.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1000–1003. Formation described in northern Quitman Mountains, where it is 1,500 to 1,800 feet thick. Underlies Cox formation; overlies Yucca formation. Both Bluff and Finlay formations have been called Finlay by Baker (1927). Taff (1891) divided rocks in Quitman Gap into Mountain bed and Quitman bed. Mountain bed is equivalent to Yucca formation; Quitman bed is equivalent to lower part of Bluff formation.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 16–21. Preoccupied name Bluff replaced by Bluff Mesa formation.

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. Formation described in Pinto Canyon area, Presidio County, where

it consists of 200 feet of very light gray thick-bedded limestone overlain by 450 feet of dark-gray nodular *Orbitolina*-bearing limestone interbedded with light-colored crossbedded sandstone. Overlies Yucca formation; underlies Cox formation.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 291. Bluff limestone underlies Tarantula gravel (new).

Named for Bluff Mesa, El Paso County.

Bluff Bone Bed (in Wichita Group)[1]

Permian: Central northern Texas.

Original reference: J. A. Udden and D. M. Phillips, 1912, Texas Univ. Bull. 246, p. 35–42.

Named for Bluff Creek, south of Electra, Wichita County.

Bluff Sandstone (in San Rafael Group)

Bluff Sandstone Member (of Entrada Sandstone)

Bluff Sandstone Member (of Morrison Formation)[1]

Upper Jurassic: Sotheastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 21.

H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 58, pl. 15. In San Juan County, Utah, is basal member of Morrison. Typically one massive bed 200 to 350 feet thick. Underlies Recapture shale member (new); overlies Summerville(?) formation.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 959–960, table 1. As here interpreted, the Bluff is local phase of the Entrada. This correlation is based on regional considerations, tracing of units, and lithologic pecularities. Bluff can be traced southward into Carrizo Mountains, thinning from about 250 to about 15 feet. At Horse Mesa, Ariz., is separated by about 175 feet of sediments from Todilto limestone. Table shows Bluff sandstone in San Rafael group.

W. B. Hoover, 1950, New Mexico Geol. Soc. Guidebook 1st Field Conf., p. 77–80. Entrada, at type locality, is overlain by Curtis and Summerville. Curtis apparently grades into Summerville, and Summerville, in part, grades into Moab tongue of Entrada. Farther south, Entrada divides again into a lower bed, Entrada proper, and Bluff sandstone member. Name Red Mesa is introduced for the crinkly shale and sandstone beds, 100 feet thick, between Entrada and Bluff member. Crinkly beds of Red Mesa are similar in appearance to Carmel at Moab which led Stokes (1944) to conclude that Bluff and Entrada were one and same bed.

J. W. Harshbarger, C. A. Repenning, and R. L. Jackson, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 97. In Navajo country, Summerville formation, Bluff sandstone member, and Recapture shale member of Morrison formation grade laterally southward into a distinct sand facies here named Cow Springs sandstone.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009-E, p. 133–134. Included in San Rafael group. West of Gallup, N. Mex., the Bluff constitutes an inseparable part of Cow Springs sandstone. It has also been observed to tongue and grade into Summerville formation in southeastern Utah, and part of Bluff tongues with overlying Salt Wash mem-

ber of Morrison formation in northeastern Arizona. Thus the sandstone unit is related to both Summerville and Morrison formations. Bluff sandstone and correlative Junction Creek sandstone are here arbitrarily assigned to San Rafael group.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 313, 315 (fig. 60). In Gallup-Albuquerque area, considered of formational rank. Underlies Recapture member of Morrison, and over most of area is conformable with it; near Laguna, interfingers with Recapture.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 42–43. In this report [Navajo country], Bluff sandstone believed to be tongue of Cow Springs sandstone, extending northward from main mass of Cow Springs, but, because of its homogeneous and mappable character and its areal extent, it is considered a separate formation and assigned to upper part of San Rafael group. Ranges in thickness from few feet to about 300 feet.

Named for exposures that form cap rock of cliffs at Bluff, San Juan County, Utah.

Bluff Creek Shale Member (of Graham Formation)[1]

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 400.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 118–119. Bluff Creek shale member was defined by Drake as including shale interval from top of his Home Creek limestone to base of his *Campophyllum* beds, the name being derived from locality south of Colorado River, where his term "Home Creek limestone" was used consistently. Name was used by Plummer and Moore (1921, Texas Univ. Bull. 2132) to include beds from top of their Home Creek limestone (a higher limestone than Home Creek limestone on Home Creek) to base of Gunsight limestone, and that usage is followed in this report [Brown and Coleman Counties]. Thickness 47 feet. Overlies Home Creek limestone member of Caddo Creek formation.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Shown on columnar section, Brown and Coleman Counties, below Gunsight limestone and above Home Creek limestone member of Caddo Creek formation. Thickness about 90 feet. Consists of shale, limestone and sandstone; shale is gray and very fossiliferous above upper limestone, with ammonoids, gastropods, brachiopods, pelecypods abundant, *Conularia* and shark teeth rare. Upper limestone is gray, oolitic, foraminiferal, and massive and contains fusulinids, "seaweed" structures, and fossil fragments; called Bunger limestone by Bullard and Cuyler (1935, Texas Univ. Bull. 3501). Lower limestone thinner, ferruginous, foraminiferal, and fusulinid-bearing. Sandstones near base lenticular and channel filling near Colorado River.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 69–70, pl. 27. Bluff Creek shale member was first described by Drake (1893) as Bluff Creek bed from exposures along tributary of Colorado River in McCulloch County. Plummer and Moore (1921, Texas Univ. Bull 2132) called the member Bluff Creek shale and stated that a thin yellow

limestone in middle of unit may be equivalent to Bunger limestone member in Young and Stephens Counties. Bullard and Cuyler (1935, Texas Univ. Bull. 3501) retained name Bunger for bed in McCulloch County that they said is unlikely to be continuous with one at type locality in Young County but occupies same stratigraphic position. The shale above this Bunger they termed Upper Bluff Creek shale and the shale below, Lower Bluff Creek shale. They named a persistent ferruginous limestone bed lying 15 to 20 feet below their Bunger limestone and 35 feet above base of their Lower Bluff Creek shale the White Ranch limestone. Hudnall and Pirtle (1929, Geologic map of Coleman County) called a limestone unit in this interval in Brown County the North Leon limestone, believing it to be correlative with bed in Eastland County named North Leon by Reeves (1922). Cheney (1950, Abilene Geol. Soc. [Guidebook] Nov. 2–4) and Cheney and Eargle (1951, Geologic map of Brown County) added North Leon and Gonzales to list of limestones in lower part of Graham formation in Brown County. As many as six thin limestone units in lower part of Bluff Creek shale member are traceable for considerable distances across Brown and Coleman Counties [this report], but most of these are discontinuous. Lenticular beds of sandstone are also found in several stratigraphic positions. Exact correlation of the limestones in lower part of Bluff Creek could not be determined because of abrupt changes in intervals of shale between them. Hence formal usage of individual names for these beds whose type localities are chiefly in Brazos River valley is not recommended for Colorado River valley until more definite correlations can be established. Bluff Creek shale of present report ranges in thickness from about 90 feet along Colorado River to about 140 feet in north-central Brown County. Underlies Gunsight limestone member; overlies Home Creek limestone member of Caddo Creek formation.

Named for Bluff Creek, McCulloch County.

Bluff Dale Sand (in Travis Peak Formation)[1]

Lower Cretaceous (Comanche Series): Central northern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 152, 154, 462. 463, 464, 474, 491.

Named for Bluff Dale, Erath County.

Bluff Mesa Formation (in Trinity Group)

Lower Cretaceous: Southwestern Texas.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 12 (table 1), 16–19, 21, pls. 1, 8. Term used to designate unit previously called Bluff beds by Taff (1891) and Bluff formation by Smith (1940). Name Bluff preoccupied. In Eagle Mountains area, consists of black nodular limestone weathering blue gray, limestone pebble conglomerates, brown shales, and some sandstones; limestones contain abundant *Orbitolina*, and some rudistid reef beds. Thickness 147 to a little more than 1,000 feet; greatest thickness is exposed on northeastern front of mountains north of Spar Valley. Conformable upon Yucca formation and unconformable upon Permian(?) beds where Yucca is missing; grades upward into quartzites of Cox sandstone through series of interbedded shales and thin quartzitic sandstones.

Bluff beds named from exposures at Bluff Mesa, El Paso County.

Bluff Point Siltstone Bed (in West River Shale Member of Genesee Formation)

Bluff Point Flagstone[1] Member (of Standish Shale and Flags)

Upper Devonian: Western and west-central New York.

P. D. Torrey and others, 1932, Am. Petroleum Inst. Div. Production Paper 826–4A, p. 16, figs. 6, 7. Thin persistent member of the Standish. Occurs above Crosby sandstone [member].

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2825. Highly cross-laminated ripple-marked layer of siltstone 1 to 2 inches thick is present at base of upper third of West River shale member of Genesee formation in most exposures of member between Lake Erie and Canandaigua Lake. This key bed, which is present in more than 500 square miles in western and west-central New York, was traced eastward to Keuka Lake where it was found to be the 3- to 4-inch Bluff Point flagstone of Torrey and others (1932), the same bed that was named Keuka flagstone by Fox (1932). Torrey's Bluff Point flagstone is present as far east as Plum Point Creek, one-half mile west of village of Himrod, where it is 2½ feet above top of Ithaca member of Genesee. Thick-bedded fossilferous siltstones at top of Ithaca member near Ithaca are at approximately same stratigraphic position as Torrey's Bluff Point flagstone.

U.S. Geological Survey currently classifies the Bluff Point Siltstone as a bed in the West River Shale Member of the Genesee Formation on the basis of a study now in progress.

Type locality not stated.

Bluffport Marl Member (of Demopolis Chalk)

Upper Cretaceous: Western Alabama and eastern Mississippi.

W. H. Monroe, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2740–2742. Bed of calcareous, more or less sandy, silty clay about 65 feet thick, that rests on typical Demopolis chalk and gradationally underlies calcareous clayey sand of Ripley formation; lithology varies from very clayey chalk to compact very chalky clay.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 53–59, pls. 1, 5, 6, 10. Described in Kemper County where it is about 50 feet thick. Underlies Ripley formation.

Type locality: On Bluffport road in NW¼ sec. 27, T. 19 N., R. 1 W., Sumter County, Ala., about 6½ miles due east of Livingston. Crops out in many of raised blocks of Livingston fault zone. Named for Bluffport Bluff along Tombigbee River.

†Bluff Springs Granite[1]

Post-Carboniferous: Eastern Alabama.

Original reference: W. F. Prouty, 1923, Alabama Geol. Survey County Rept. 1, p. 16, 51, 52, 53, 62, 65.

Named for development around Bluff Springs, Clay County.

Blufftown Formation (in Selma Group)

Blufftown Marl[1]

Upper Cretaceous: Western Georgia and eastern Alabama.

Original reference: J. O. Veatch, 1909, Georgia Geol. Survey Bull. 18, p. 86, 88–89.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1648–1649. Geographically extended into Alabama. Blufftown formation grades westward into lower part of Selma chalk. As defined here, Blufftown includes additional beds below the marl (as originally defined) that were correlated with upper part of Eutaw formation by Veatch and with "typical beds of Eutaw" by Stephenson (1911 Georgia Geol. Survey Bull. 26). These beds consist of irregularly bedded sands and clays, in part lignitic, and at their base are coarse pebbly sands and sandstones. Unconformably underlies Cusseta formation, which overlaps it toward northeast in Georgia.

D. H. Eargle, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 105. In eastern Alabama, Blufftown grades laterally into Mooreville chalk and basal part of Demopolis chalk. Intertonging relationships discussed in detail. Overlain by Cusseta member of Ripley formation. Included in Salem group.

D. H. Eargle, 1955, U.S. Geol. Survey Bull. 1014, p. 32–43, pls. 1, 2. Described in Georgia where, in Chattahoochee River valley, it consists of basal unit of crossbedded coarse sand, about 150 feet thick, overlain by laminated more or less sandy carbonaceous highly micaceous fossiliferous clay, about 260 feet thick. Toward the east, upper clay member grades rapidly laterally into unfossiliferous coarse sand that is difficult to distinguish either from basal sand member or overlying Cusseta sand. Historical summary of usage of name.

Named for exposures at Blufftown, Stewart County, Ga. In Georgia, crops out in belt from Chattahoochee River valley east-northeastward to Flint River; east of Flint River, becomes indistinguishable from underlying Eutaw formation and overlying Cusseta sand.

Board Cabin Formation

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1502–1504. Quartzose, feldspathic, and volcanic sandstones, tuffaceous wackes, fine and coarse conglomerates, pyroclastic rocks, and thin basaltic lavas, so intimately interbedded and interfingered that accurate mapping is exceedingly difficult. Intraformational unconformaties common, and most conglomerates, sandstones, and wackes contain angular fragments of immediately underlying rock. Rocks of Board Cabin formation, Flying W formation (new), and parts of Haigler formation (new) so similar that the only reliable distinction is their stratigraphic position. Porphyritic lava the most distinctive and abundant rock type. Sedimentary rocks become coarser grained upward in section, and there are none finer than conglomerate in upper half of formation. Typical sedimentary rock is coarse, relatively well sorted, and composed of locally derived materials. Volcanic rock facies more prominent to the west, and there is little sedimentary rock in formation west of Board Cabin Draw. Thickness 250 to 1,820 feet. Conformably overlies Houden formation (new); underlies Haigler formation with slight unconformity.

Type section: On Board Cabin Draw between approximate elevations of 4,550 and 4,750 feet, Diamond Butte quadrangle. Another good, but thinner, section on Turkey Creek in southern part of quadrangle. Name derived from Board Cabin Draw, at southeastern foot of Diamond Butte.

Boardman Formation

Lower Ordovician (Canadian): West-central Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 13, 24–27. Name proposed to include all rocks lying stratigraphically between underlying Clarendon Springs dolomite and overlying Bascom formation. Divided into (ascending) Sutherland Falls marble, Intermediate dolomite, and Columbian marble members. Subdivisions used as defined by Bain (1931), and names retained because of their economic importance in marble belt. Total thickness approximately 900 feet.

Type locality: On southwestern slope of Boardman Hill in Clarendon about 1¼ miles S. 50° W. on top of hill, Rutland County. Formation crops out in band that extends from northern to southern boundary of Castleton quadrangle from Pittsford Township through Proctor and Center Rutland to Clarendon Township.

Boarman Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone or dolomite about 4½ feet thick. Shown on columnar section as underlying Establishment member (new) and overlying Brickeys member (new).

In copy of guidebook used by compiler, a handwritten note states that Brickeys member overlies Boarman member. Thus, Boarman would be basal member of Mifflin formation and would overlie Oglesby member of Pecatonica formation. Since the compiler had no way to determine what changes, if any, had been made in other copies of guidebook, it was impossible to be certain of true stratigraphic relation.

Occurs in Dixon-Oregon area.

Bob Crystalline Limestone Member (of Brownsport Formation)[1]

Bob Formation (in Brownsport Group)

Middle Silurian: Western and central Tennessee.

Original reference: W. F. Pate and R. S. Bassler, 1908, U.S. Natl. Mus. Proc., v. 34, p. 410–432.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, Chart 3. Shown on correlation chart as formation in Brownsport group.

T. W. Amsden, 1949, Yale Univ., Peabody Mus. Nat. History Bull. 5, p. 25. In area of this report [western Tennessee], there does not appear to be any valid basis for subdividing the Brownsport into three members or formations. It is proposed that terms "Beech River," "Bob," and "Lobelville" be abandoned.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 262–264, figs. 2, 81. Bob formation included in Brownsport group. Typically a massive-bedded silt-free medium- to coarse-grained gray crystalline limestone with glassy appearance; locally contains red specks and green grains of gluconite [glauconite]; at some localities entire formation consists of limestone interbedded with shale. Thickness 5 to 30 feet average 25 feet. Throughout most of outcrop belt is a continuous blanket of limestone, but in some areas appears to pinch and swell, possibly to extent of being locally absent or represented only by an alternation of limestone and shale deposited contemporaneously with massive phase elsewhere. Bob limestone is conformable with both Beech

River and Lobelville formations; in several localities, grades into both by progressive interbedding. Where Lobelville is absent, the Bob is unconformably overlain either by Decatur limestone, a Devonian formation, or Chattanooga shale. Pate and Bassler (1908) named Bob limestone for bluff one-half mile below Bobs Landing along west bank of Tennessee River in Decatur County. Type section given by Pate and Bassler (p. 421), however, is composed of 20 feet of Dixon and 40 feet of Beech River, but no Bob limestone as recognized elsewhere by these writers nor as recognized and mapped by Miser, Jewell, and present writer. As shown in this report in section 3, *A'–A''*, figure 81, Bob limestone occurs on hill above the bluff, the Beech River being 80 feet thick and the Bob 5 to 25, increasing in thickness northward; the Bob is overlain by the Lobelville. Foerste (1903) named Gant limestone and Gant bed from exposures in Wayne County. Gant limestone included 30 feet of limestone and is equivalent to Bob limestone as recognized by Miser, Jewell, Wilson. and by Pate and Bassler at some localities. If name Bob had not become so well established, it would be recommended here that Bob limestone be dropped in preference to Gant.

Named for Bob Landing, Decatur County.

Bobcat Hill Conglomerate

Cretaceous or Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 55–58, table 1, pl. 1. Interbedded impure volcanic arkose sandstone and conglomerate. Conglomerate characterized by presence of fragments of limestone and volcanic rocks. Sandstones characteristically medium-bedded fine-grained light-grayish-green to yellowish-gray slightly calcareous. A 1-foot bed of limestone, which in places consists entirely of algal remains, occurs near base of formation in eastern part of outcrop area. Thickens from 724 feet in western part of area to 1,138 feet near North Star mines. Unconformably overlies unnamed volcanic rocks.

Named from exposures on north and west sides of Bobcat Hill, near corner common to secs. 25, 26, 35, and 36, T. 24 S., R. 21 W. Better exposed in S½ sec. 27, in vicinity of North Star mines, and extends east and west across southern parts of secs. 26, 27, and 28, T. 24 S., R. 21 W., central Peloncillo Mountains, Hidalgo County.

Bobs Ridge Member (of Huntersville Chert)

Lower Devonian (Onesquethaw): West Virginia.

J. M. Dennison, 1960, Dissert, Abs., v. 21, no. 3, p. 593. Glauconitic quartz sandstone. Accumulated over site of Browns Mountain anticline which was shoal during late Onesquethaw time.

Named for outcrops on Bobs Ridge, Greenbrier County.

Bobtail Quartz Latite Member (of Gem Hill Formation)

Miocene(?): Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138 (fig. 2), 140–141. Felsitic to porphyritic rock predominantly cream white in color, but locally tan, pink, brown, or pale green. Latite makes up several large volcanic plugs, a number of small plugs, pods, and dikes intrusive through pre-Tertiary granitic rocks into the Gem Hill; also occurs as several short lentils of flow breccia in the formation. Older than Fiss fanglomerate (new) which it does not intrude.

Type locality: Soledad Mountain, Rosamond quadrangle, secs. 6 and 7, T. 10 N., R. 12 W., San Bernardino Base and Meridian, Kern County. Name derived from Bobtail mines on west slope of Soledad Mountain. Many scattered buttes within 10 miles of Soledad Mountain are remnants of volcanic plugs made up of Bobtail quartz latite.

Bocas [Formation]

Pliocene: Panamá.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (correlation chart). Name appears on correlation chart.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 5–6. Underfined name for strata of Pliocene age.

On Bocas Island.

Bodega Diorite[1]

Pre-Tertiary: Northern California.

Original Reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 43.

C. C. Higgins, 1952, California Univ., Dept. Geol. Sci. Bull., v. 29, no. 5, p. 200, fig. 7. Described with pre-Tertiary rocks of area as being of ancient but unknown age. At Point Reyes, nonconformably overlain sands and shales of Miocene Monterey formation.

Exposures limited to Bodega Head and Point Reyes Peninsula, lower Russian River region.

Bodega Bay deposits[1]

Quaternary: Western California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 76.

Bodega Bay, Marin County.

†Bodeville Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvi. 255–267, pl. 3.

Named for Bodeville, Mason County.

Bodine Sandstone

Ordovician: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Abandoned by Oklahoma Geological Survey. Eldridge (1901, U.S. Geol. Survey 22d Ann. Rept., pt. 1, p. 274) applied name of an asphaltic sandstone pit in Murray County to an asphaltic sandstone in Simpson group. Probably a bed in Bromide formation.

Bogachiel Formation[1]

Cretaceous(?): Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 160.

Greatest development in Bogachiel Valley, near headwaters of that stream.

Boggs Member (of Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Southeastern Ohio.

Original reference: W. Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 70.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 31, table 1. Included at top of Lower Mercer cyclothem in Perry County. Thickness about 1 foot. Overlies unnamed shale; underlies Flint Ridge shale and (or) sandstone.

Named because it is correlated with Boggs iron ore of Scioto County.

Boggs Mountain Flows (in Clear Lake Volcanic Series)

Quaternary: Northern California.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), pl. 7. Dark-gray porphyritic andesitic lavas 100 to 500 feet thick. Shown on columnar section above Perini Hill flows (new) and below Cobb Mountain volcanics (new), but age relations of individual units of series are imperfectly known because some units are isolated and contacts of contiguous flows are commonly obscured by sliding.

Vicinity of Boggs Mountain, Lower Lake quadrangle, in Coast Range, about 70 miles north of San Francisco.

Boggy Shale[1] **or Formation** (in Krebs Group)

Pennsylvanian (Des Moines Series): Central southern and eastern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1889, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 438.

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 504, 510–511. Includes (ascending) shale, Crekola sandstone member (new), shale, Inola sandstone member, shale, Taft sandstone member (new).

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 51–57. Includes Bluejacket sandstone member near base.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 54–62. Maximum thickness more than 4,000 feet in Le Flore County; top eroded.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523, 1524. Uppermost formation in Krebs group (new). Overlies Savanna formation; underlies Thurman sandstone.

E. W. Reed, S. L. Schoff, and C. C. Branson, 1955, Oklahoma Geol. Survey Bull. 72, p. 68. Formation, as defined by Oklahoma Geological Survey, comprises strata from base of Bluejacket sandstone member to unconformity at base of Calaniss group.

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J, p. 333–335, pl. 16. In Oklahoma, exposed in wide arcuate belt from southeastern Pontotoc County and central and northern Coal County through Pittsburg, Haskell, and McIntosh Counties to northwestern Muskogee County. From there it has been mapped northward to Kansas line. Large outliers remain in Sansbois syncline in Haskell and Latimer Counties, where more than 2,000 feet of formation is present, and in Cavanal syncline in LeFlore County, where as much as 3,000 feet of rocks in formation make up much of Cavanal Mountain. Complete continuous section in Pittsburg County is about 2,850 feet thick. Overlies Savanna formation; underlies Thurman sandstone.

Named for exposures along North Boggy Creek, Pittsburg and Atoka Counties, Okla.

Bogota cyclothem (in McLeansboro Group)

Bogota cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 19–24. Lies above Cohn cyclothem (new) and below Newton cyclothem (new). Contains two cyclothems which are referred to as upper and lower Bogota. Includes Bogota limestone and Bogota shale.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2). Included in Mattoon formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: A few miles southwest of Bogota, Jasper County.

Bogota Limestone Member (of Mattoon Formation)

Bogota Limestone (in McLeansboro Group)

Pennsylvanian: Central and southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 19–24. Limestone in Bogota cyclothem in McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 41, 51 (table 1). Member of Mattoon formation (new). Occurs above Effingham limestone member and below Greenup limestone member. Thickness at type locality about 3½ feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NE¼NE¼ sec. 17, T. 5 N., R. 8 E., a few miles southwest of Bogota, Jasper County.

†Bogus Tongue (of Cutler Formation)[1]

Permian: Central eastern Utah.

Original reference: A. A. Baker, 1933, U.S. Geol. Survey Bull. 841.

A. A. Baker, 1946, U.S. Geol. Survey Bull. 951, p. 43. Name Bogus abandoned in favor of name Organ Rock tongue; it is evident that red beds formerly included in the Bogus are continuous with Organ Rock tongue at its type locality.

Crops out in Bogus pocket, SW cor. T. 30 S., R. 21 E., San Juan County.

Bohemia Conglomerate (in Portage Lake Lava Series)

Bohemia Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 3, 30, 52, 66, 72, 83, 99, pls. 4, 7.

J. C. Wright and H. R. Cornwall, 1954, Bedrock geology of the Bruneau Creek quadrangle, Michigan: U.S. Geol. Survey Geol. Quad. Map [GQ–35]. Included in Portage Lake lava series.

Named for the fact that it caps Bohemian Range, in Keweenaw County.

Bohemia Porphyrite[1] (in Bohemian Range Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 40, 72.

Named for the fact that it occurs north of Mount Bohemia, Keweenaw County.

Bohemian Range Group[1]

Precambrian (Keweenawan): Northern Michigan and probably northern Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 179–187, pls. 17, 18.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Name Portage Lake lava series (new) proposed to include Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports. These subdivisions are quite arbitrary and depend on continuity of individual flows or conglomerate beds for validity. They are not useful for purpose of this report.

Named for the fact that its rocks compose Bohemian Range, Keweenaw County, Mich.

†Bohicket Marl Sands[1]

Pleistocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20, 21.

Named for exposures in Bohicket Creek, near Rockville, Charleston County.

Bohío Formation

Bohío Conglomerate[1]

Oligocene, lower and upper: Panamá.

Original references (Bujio Formation): R. T. Hill, 1898, Harvard Coll. Bull. Mus. Comp. Zool., v. 28, no. 5, p. 183; (Bohío Formation): D. F. MacDonald, 1913, Geol. Soc. America Bull., v. 24, p. 708.

H. N. Coryell and J. R. Imbich, 1937, Jour. Paleontology, v. 11, no. 4, p. 289–305. Ross and Reeves (1931, U.S. Geol. Survey Prof. Paper 821–B) gave name Bohío to entire group of sediments in Chagres Valley above Madden Dam, and referred them to the Oligocene. Samples of Foraminifera collected from Bohío show that it contains both an Eocene and Oligocene fauna. Bohío formation is restricted to include only Oligocene sediments. Eocene strata are herein named Tranquilla shale.

W. P. Woodring and T. F Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 228–232, 246 (fig. 2). Formation consists of massive or poorly bedded conglomerate, tuffaceous sandstone, and tuffaceous siltstone. Estimated thickness as much as 1,000 feet. Overlies Gatuncillo formation; base of the Bohío not exposed along Panama Canal. Underlies Caimito formation. Grades laterally into Bas Obispo formation. Upper Eocene and lower Oligocene. Bohío was first named by Hill (1898) who used spelling Bujio.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 24–29. Basal part of Bohío in Quebrancha syncline contains smaller Foraminifera of early Oligocene age and upper part of formation in Pacific coastal and Gatún Lake areas, respectively, contains late Oligocene larger Foraminifera and mollusks. Whether formation represents so great a time span in each of areas where it crops out is not known at present. It represents, however, more than the early Oligocene age previously suggested (Woodring and Thompson, 1949). That it does

not include all of the Oligocene is shown by late Oligocene age of overlying Caimito formation.

Type region: Bohío Peninsula. Bohío or Bohío Soldado, was a station on original line of Panamá Railroad, near southwest end of ridge forming present Bohío Peninsula. Many localities described by early writers, including French quarries at Bohío and excavation at near-by lock site, are covered by Gatún Lake.

Boice Shale (in Buckner Group)

Mississippian (Kinderhook Series): Subsurface in northeastern Kansas and southwestern Nebraska.

E. C. Reed, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 3, p. 348–349. Name applied to subsurface sequence previously referred to the Hannibal. Consists predominantly of shale with minor amounts of siltstone and sandstone near top; base is marked by zone of hematite concretions or oolites in part embedded in brick-red shale. Occurs between depths of 2,041 and 2,072 in type well and between depths of 2,225 and 2,283 feet in cotype locality. Underlies Chouteau limestone; overlies Fabius group. Placed in lower part of Buckner group of Kinderhook series, according to Marvin Weller's Mississippian correlation chart (Nat. Research Council, Apr. 10, 1945). [Compiler was unable to locate reference to Buckner group.]

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 111. Geographically extended into northeastern Kansas. Strata conformably underlie Compton limestone or occur disconformably beneath upper Sedalia and disconformably overlies deeply eroded Chattanooga. Maximum known thickness 110 feet near Nebraska border in Brown County.

Type locality: Pawnee Royalty Co. Boice well No. 1, located in center of NE¼NE¼ sec. 18, T. 1 N., R. 16 E., Richardson County, Nebr. Cotype locality: Pawnee Royalty Co. Meyers well No. 1, in center of NW¼NW¼ sec. 24, T. 1 N., R. 15 E.

Bois Blanc Formation

Bois Blanc Formation (in Detroit River Group)

Middle Devonian: Michigan.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 34, 35 (table 1), 80–109. Proposed for a Lower or Middle Devonian formation occupying position between Lower Devonian Garden Island formation (new), or Upper Silurian St. Ignace formation (new) where Garden Island is absent, and the Lower or Middle Devonian Detroit River group. Lower part consists of interbedded chert and dolomite; middle composed of limestone, dolomitic limestones, and a few beds of dolomite; strata range in color from light gray to light buff and contain nodules and irregular masses of chert, which is more abundant in some beds than others; upper part predominantly limestone. Total thickness probably not less than 325 or more than 400 feet. Numerous large blocks of the Bois Blanc occur in Mackinac breccia. Onesquethaw group.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 2 (fig. 2), 7. Stratigraphically restricted at top to exclude noncherty limestone and dolomite now included in base of Amherstburg.

W. N. Melhorn, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 819 (fig. 1). Shown on generalized stratigraphic section of Middle Devonian as formation at base of Detroit River group.

Named for exposures on Bois Blanc Island situated in Lake Huron about 2½ miles southeast of Mackinac Island. Present on northern shore of Southern Peninsula between point on Lake Huron about 26 miles southeast of Mackinaw City and Waugoshance or Crane Island, 16 miles west of this city.

Bois d'Arc Limestone[1] (in Hunton Group)

Lower Devonian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1911, Am. Jour. Sci., 4th, v. 32, p. 256–268.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 132, 134. Overlies Cravatt formation of Kite group (both new). Reeds considered Cravatt as basal part of Bois d'Arc.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7, 38–47. Subdivided to include Cravatt member below and Fittstown member (new) above. Thickness 45 to 200 feet with at least part of this variation caused by facies gradation from Bois d'Arc into Haragan formation. Underlies Frisco formation; overlies Haragan. Reeds (1926 Am. Mus. Nat. History Jour., v. 26) designated type locality as along Bois d'Arc Creek, sec. 4, T. 2 N., R. 6 E.; but this must be an error since Bois d'Arc Creek is not present in section 4; however, it is well exposed on north bank of this creek in sec. 11, T. 2 N., R. 6 E., and presumably this was location to which he referred. Type section designated.

T. W. Amsden, 1958, Oklahoma Geol. Survey Bull. 82, 110 p. Bois d'Arc formation consists of two members or lithofacies, lower cherty argillaceous calcilutite (Cravatt member) and upper calcarenite (Fittstown member). Both stratigraphic and faunal evidence indicate that these are facies of one another, and that entire formation is facies of Haragan formation. Brachiopod fauna described.

Type section: Sec. 4, T. 2 N., R. 6 E., starting at top of Cedar Hill and extending north along banks of Chimneyhill Creek. Named for exposures along Bois d'Arc Creek, Pontotoc County.

Boise Granite[1]

Jurassic or Cretaceous: Southwestern Idaho.

Original reference. I. C. Russell, 1902, U.S. Geol. Survey Bull. 199, p. 39.

In rugged mountains which lie to north and east of Boise, extends eastward from this area and occupies an extensive and exceedingly rugged region lying north of Mountain Home.

Boise Sandstone[1]

Pliocene(?): Southwestern Idaho.

Original reference: V. R. D. Kirkham, 1928, Idaho Bur. Mines and Geol. Pamph. 29, p. 1.

Bokchito Formation[1]

Lower Cretaceous (Comanche Series): Southeastern and central Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Overlies Caddo limestone; underlies Bennington limestone.

Named for Bokchito Creek, near Bokchito, Bryan County.

Bolander Group

Pennsylvanian (Des Moines Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Bull. 17, p. 27 (table 2), 51–55. Proposed for group of rocks of upper part of Des Moines series between top of Armendaris group (new) and base of Missouri series (above). At type section, composed largely of gray to light-gray fossiliferous limestone, several beds of fossiliferous gray shale, and one well-developed bed of conglomerate to highly conglomeratic sandstone about 70 feet below top of group. Thickness at type locality about 233 feet.

Type locality: Just west of large box canyon in central part of Whiskey Canyon in north portion of Mud Springs Mountains, in south-central part of sec. 1, T. 13 S., R. 5 W., Sierra County. Name derived from small deserted village of Bolander, about 8 miles northeast of Mud Springs Mountains.

Bolanos Pyroclastic Member (of Umatac Formation)

Bolanos (Balanos) (Baranos) Beds, Andesite, or Formation

Miocene, lower: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 48, 49 (fig. 37). table 4 [English translation in library of U.S. Geol. Survey, p. 57, 58]; S. Hanzawa in Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 25. At typical outcrop beds consist of (descending) massive, nonstratified agglomerate with some limestone fragments, andesite lava with columnar structure, tuff with abundant limestone fragments, and thick layer of andesite. Conformably underlie Nagas beds. Correlated with Marino agglomerate on Tinian Island, and Manila agglomerate on Rota Island.

U.S. Geological Survey currently classifies the Bolanos as a member of Umatac Formation and designates the age as lower Miocene on the basis of a study now in progress.

Typical outcrop: West side of Mount Bolanos, Guam.

Bolarian Series or Epoch

Middle Ordovician: Eastern North America.

Marshall Kay, 1947, (abs.), Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1198–1199; 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1401, 1402 (fig. 2), 1406–1411. Series comprises rocks younger than Lincolnshire, about late Chazyan, and older than Nealmont, early Trentonian, in the Virginias and Pennsylvania, and time equivalents. Includes Hatterian (lower Bolarian) and Hunterian (upper Bolarian) subseries. Mohawkian series divided into Bolarian and Trentonian series. Term Bolarian used in preference to term Black Riveran.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 77–84, 100. Whether the Bolarian is a series, subseries, or stage depends on conception of each term, as well as on demand for categories in classification. Bolarian epoch has two stages, earlier (Hatterian) marked by relative southeasterly tilting and latter (Bennerian) by gradual north-

westerly tilting. Bolarian rocks are in two groups. Lower has three limestone formations: Ward Cove, Peery, and Benbolt. Upper Bolarian has two limestones: McGlone and McGraw (both new).

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 65–96. Discussion of Ordovician Highgate Springs sequence of Vermont and Quebec and its bearing on the classification of stages and series in Ordovician System. "Porterfield" and pre-Trentonian part of "Wilderness" stage constitute type Bolarian. Black Riveran series seems to be contained in Bolarian series of Appalachians, but lowest Bolarian seems older and equivalent to upper Chazyan.

Named for Bolar Cove, Highland and Bath Counties, Va.

Boley Conglomerate Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Central Oklahoma.

R. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 82–83, pl. 1. Basal member of Vamoosa formation. Consists mostly of subangular to well-rounded white chert pebbles and cobbles, some which are as large as 6 inches in diameter. Upper limits of member are not always definite and locally grade into sandstone lenses of overlying undifferentiated beds. Overlies units of Tallant and Barnsdall formations. Thickness 50 to 60 feet.

Type locality: Sec. 20, T. 12 N., R. 8 E. Excellent exposure capping promontory in northeastern part of sec. 21, T. 12 N., R. 8 E. Named from town of Boley which is situated on the member in sec. 20.

Bolin Sandstone Member (of Roubidoux Formation)[1]

Lower Ordovician: Central Missouri.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 50.

Named for exposures on Bolin Creek, Miller County.

Bolinas Sandstone[1]

Jurassic(?): Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

San Francisco region. Probably named for Bolinas Ridge.

Bolivar cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 17. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, ser. 4, Bull. 48, p. 54–55, table 1, geol. map. Includes (ascending) Upper Freeport shale and (or) sandstone, 20 feet; Bolivar clay, 1 to 10 feet; and Bolivar coal. Occurs below Upper Freeport cyclothem and above Lower Freeport cyclothem. In area of this report [Perry County], Allegheny series is described on cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 84–88. Bolivar cyclothem in Athens County, includes (ascending) Bolivar shale and (or) sandstone, Shawnee limestone, Bolivar underclay, Bolivar coal members. In sequence, occurs above Lower Freeport cyclothem and below Upper Freeport cyclothem. In area of

this report, Allegheny series is described on cyclothemic basis; 13 cyclothems are named. [For complete sequence see Brookville cyclothem.]

Probably named for Bolivar fire clay.

Bolivar Fire Clay (in Allegheny Group)

Bolivar Fire Clay (in Allegheny Formation)[1]

Bolivar underclay or clay member

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 159–160.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 75. Fire clay included in Allegheny group in report on Fayette County. In many older reports, name Bolivar fire clay has been so loosely used that much confusion has developed. Going back to original use of name, it becomes evident that Bolivar fire clay lies considerable distance below Upper Freeport coal, whereas clay immediately under coal should be called Upper Freeport fire clay. Bolivar fire clay horizon lies 20 to 50 feet below Upper Freeport coal.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 54–55, table 1. Clay member of Bolivar cyclothem in report on Perry County. Average thickness 5½ feet. Patchy distribution at most exposures; overlain by Upper Freeport limestone; locally sandstone lies above the clay. Bolivar coal not present above clay at any outcrop.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 87. Bolivar underclay member of Bolivar cyclothem, Allegheny series, is about 4 feet thick in Athens County [this report]. In Ohio, the Ortons (1884, Ohio Geol. Survey, v. 5, Economic Geology) seem to have applied name Bolivar to this underclay, but White (1891) is credited later with establishing name in geologic literature. Bolivar underclay and overlying thin and seldom present Bolivar coal have been traced in discontinuous distribution across eastern Ohio. Occurs above Shawnee limestone.

Named for occurrence near Bolivar, Westmoreland County, Pa.

Bolivar Sandstone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 42.

At and around Bolivar, Polk County.

Bolivar Sandstone (in Allegheny Formation)[1]

Bolivar shale and (or) sandstone member

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 84. In Ohio, shale and sandstone that occur in interval between Lower Freeport coal and Bolivar underclay are called Upper Freeport. However, there are two shale and sandstone members separated by Bolivar cyclothem in interval between Lower and Upper Freeport coals.

Wherever Bolivar members are absent, these two shale and sandstone members coalesce, and it is impossible to distinguish them as separate units. Where it is impossible to separate the two shale and sandstone members, Upper Freeport can and should be applied as a name, but where the two can be recognized the lower shale and sandstone are herein called Bolivar. This lower member may correlate with Butler sandstone in Pennsylvania. Exposures of Bolivar shale and sandstone member of Bolivar cyclothem in Athens County [this report] are confined almost entirely to Waterloo and York Townships. Average thickness of member about 12 feet. Occurs below horizon of Shawnee limestone member.

Probably named for occurrence near Bolivar, Westmoreland County, Pa.

Bollibokka Group

Permian: Northwestern California.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Name proposed to include basic pyroclastic rocks, basic flows, and sparsely fossiliferous interbedded sedimentary rocks which have been referred to separately as Nosoni and Dekkas formations. These names are retained for formational subdivisions of group to be used where recognizable. Where black shale of the Nosoni is not present it is not always possible to separate the two formations and term "Bollibokka group, undivided" is more appropriate than one formation name. Thickness more than 10,000 feet in type section. In Bollibokka area, group is conformable with underlying McCloud limestone and overlying Pit shale. Fossiliferous beds dated as early Guadalupian, middle Permian. Upper unfossiliferous part may be late Permian, Triassic, or both. Smith (1894) included these rocks in the "Carboniferous shales" of his Pit formation. Diller (1906) who named the Dekkas and Nosoni stated that they were alike and separated the two formations on basis of occurrence of *Fusulina* (now *Parafusulina*) which he considered indicative of Nosoni formation. Occurrence of fossils is unsuitable criterion for recognition of formations and was not reliable even in 1906 because *Parafusulina* does occur near top of Dekkas andesite as mapped by Diller. Lithology is main criterion for subdivision and mapping of Bollibokka group.

Type section: Along Nosoni Creek, Redding quadrangle, Shasta County. Named for Bollibokka Mountain, Bollibokka Mountain quadrangle.

Bolsa Quartzite[1]

Middle Cambrian: Southeastern Arizona and southwestern New Mexico.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 28–30.

J. R. Cooper, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 31, fig. 13. Deposited on surface of considerable relief on Apache group (Dripping Spring quartzite). Thickness varies abruptly from 335 to less than 50 feet in Johnson Camp area, Cochise County.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 14–15, pls. 5, 11, 12. In central Cochise County, rocks commonly crossbedded, and beds range from few inches to as much as 10 feet in thickness, average 2 to 4 feet. Rests on smooth surface carved across Precambrian rocks, largely Pinal schist. Underlies Abrigo limestone with transitional contact.

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 469–472, fig. 4. Transgresses upward through time (Lower Cambrian? to Upper Cambrian) in west to east section through Dos Cabezas and Chiricahua Mountains.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 18–21, tables 1, 2, pl. 1. Described from central Peloncillo Mountains of New Mexico. Arkosic and orthoquartzitic sandstone and conglomerate containing some glauconite and thin shale beds in middle part of unit. Thickness ranges from 60 to 400 feet. Underlies El Paso limestone. Of Middle and Upper Cambrian age.

Well exposed in Bolsa Canyon, on southwest side of Escabrosa Ridge, Bisbee quadrangle, Cochise County, Ariz.

†Bolton Gneiss[1]

Late Carboniferous or post-Carboniferous: Eastern Massachusetts.

Original reference: B. K. Emerson and J. H. Perry, 1903, Geology of Worcester, p. 79, map.

Named for town of Bolton, which it extends through.

Bolton Igneous Series[1] or Group

Upper Ordovician or post-Ordovician: Southeastern Quebec, Canada, and northeastern Vermont.

T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 11, 12. Bolton igneous series consists of large masses of gray finely crystalline metabasalt, metagabbro, and metaperidotite. Contains pillow structures and breccias; flow structure identified. Younger than Magog slates; metaperidotite intrudes Sutton schists. Upper Ordovician or post-Ordovician.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 38–41, pl. 1. Geographically extended into Vermont where it is referred to as igneous group. Consists of fine- to medium-grained metadiorites and related rocks in area west of Lake Memphremagog. Devonian or younger.

Occurs in vicinity of Bolton, southeastern Quebec.

Bolton Schist[1]

Bolton Formation or Group

Mississippian(?) or older: Central Connecticut.

Original reference: J. G. Percival, 1842, Connecticut Geol. Survey Rept., p. 229–333, map.

H. M. Mikami and R. Digman, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1487. In Branford-Killingworth area, Connecticut, pre-Triassic Bolton formation lies stratigraphically above Middletown gneiss and consists of schist and quartzites. Contact between formations conformable.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Age considered probably older than Upper Devonian; designated Paleozoic(?) in geologic map legend.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042-Q, p. 619, 620–624, pl. 56. Pegmatites in Middletown area cut metasediments of Bolton schist of pre-Mississippian(?) age and, in ascending order of sequence, mafic gneisses, Glastonbury granite gneiss, Maromas granite gneiss, and Monson gneiss. Position of formations in stratigraphic column cannot be determined with accuracy; maximum age is indicated by their relation to the pegmatites, which have been dated by uranium-

and thorium-lead ratios as about 260 million years old, presumably Mississippian. Predominantly mica-schist with interbedded layers of quartzite and amphibolite-bearing gneiss. Estimated thickness 1,400 to 4,300 feet. Intruded by Maromas granite gneiss. Crops out as narrow band in northern part of Middletown area, and near the Straits in Connecticut River; divides into two broader bands that enclose northern end of Killingworth dome. West boundary of unit is westward-dipping normal fault of Triassic age. Band of schist extending northward from Collins Hill to village of South Glastonbury is cut on north by a Triassic fault. These two areas of schist are separated by narrow belt of mafic gneiss; easternmost body of schist can be followed northward beyond mapped area to type locality at Bolton Notch.

R. M. Gates and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 21–24, fig. 3. Recent study in Middle Haddam quadrangle east of Middletown has resulted in major revision of interpretation of pre-Triassic rocks of area. Some features from maps of Percival (1842) and Westgate (1899, ms.), such as Percival's distinction between schist at and northeast of Great Hill and that to south and west, and Westgate's mapping of Maromas gneiss and its environs. Common mapping practice has been to lump all schist together as Bolton. This was done on Connecticut map of 1956. The Bolton is herein raised to group rank and geographically restricted to schist in Great Hill-Bolton Notch belt. Remaining schist is named Collins Hill formation. Group as herein defined consists of three units. Lower unit, which is Lower or Middle Ordovician, is well-banded quartzite and quartz-sericite above and conglomeratic quartzite below. Middle unit, which is Middle Silurian, is laminated calcareous biotite gneiss, granulite, and schist, showing deep pits and weathered surfaces due to solution of masses of calcite marble. Upper unit, which is Lower Devonian, is gray nonrusty graphitic garnet-staurolite two-mica schist and some platy quartz-serite schist. Unconformably overlies Collins Hill formation.

Named for exposures in western part of town of Bolton, Tolland County.

Bommer Member (of Topanga Formation)

Miocene, middle: Southern California.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. Predominantly thick-bedded coarse-grained sandstone and grit which contains thin lenticular pebble beds. Thin beds of fine- to medium-grained sandstone commonly separate coarse-grained sandstone beds in middle and upper parts of member. Maximum thickness about 2,000 feet. Conformably underlies Los Trancos member (new); overlies Vaqueros formation; contact gradational where exposed in Moro Canyon.

Type area: In large fault block extending from upper Moro Canyon to mouth of Bommer Canyon, Orange County. Named for Bommer Canyon, which joins Sand Canyon Wash at north margin of San Joaquin Hills.

Bomoseen Greywacke or Grit Member (of Bull Formation)

Bomoseen Grit[1]

Bomoseen Grit Member (of Schodack Formation)

Lower Cambrian: Southwestern Vermont and eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70, map.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland 1942, New York State Mus. Bull. 331, p. 64–65; Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 65–68. Considered member of Schodack formation.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 46–47, pl. 2. Bomoseen grit crops out along western part of Castleton quadrangle in irregular-shaped pattern from Hampton, N.Y., at south to point of Pines on western shore of Lake Bomoseen. Kaiser (1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1) mapped Bomoseen in outcrop 1 mile west of West Castleton. This outcrop, which is type locality, extends westward into Whitehall quadrangle. Minimum thickness about 200 feet. Underlies Mettawee slate; in many places, gradational contact between the two requires arbitrary definition. Base not exposed, presumably overlies Nassau formation.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329–330. First distinguished by Dale (1889, U.S. Geol. Survey Ann. Rept., v. 19, pt. 3B) as "Olive grit," and assigned to base of Cambrian in Washington County, unit was named by Ruedemann (1914) from type exposures near Lake Bomoseen, Vt. Here it consists of medium-grained angular quartz grains, with subordinate amount of feldspar set in sericitic, somewhat calcareous, matrix and characterized by abundant specks of hematite and graphite; locally intercalated green and red slates. There is suggestion of cyclical bedding. Some beds of medium- to coarse-textured calcareous orthoquartzite, flecked with hematite, limonite, and graphite are present. These beds are seldom more than 1 inch thick, but some are as much as 55 feet. Weathers brick red. Thickness probably 500 feet. Here interpreted as facies of Nassau formation farther south. Kaiser (1945) suggested that Bomoseen may be equivalent of Rensselaer grit whose age has long been in dispute.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1. Referred to as greywacke member of Bull formation. West of Lake Bomoseen is lowest exposed unit and underlies Mettawee member; east of Lake Bomoseen and north of Pine Pond thrust, it is demonstrably within Mettawee member. Bomoseen graywacke west of Lake Bomoseen conceivably belongs to lower horizon, stratigraphically replacing Biddie Knob formation (new); on other hand, it may merely be part of a thickened section of Bull formation, still underlain by the (unexposed) Mettawee member. Underlies Zion Hill member.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 53–54. Referred to as grit member of Bull formation. Is lowest rock unit exposed in Taconic sequence in Washington County, N.Y.

Type locality: West side of Lake Bomoseen, Castleton quadrangle, Rutland County, Vt.

†Bon Air measures[1]

Pennsylvanian: Southeastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 148–151, 167, 168.

Named for mines in White County.

Bonair Sandstone (in Lee Group)[1]

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: M. R. Campbell, 1899, U.S. Geol. Survey Geol. Atlas, Folio 53, p. 3.

V. H. Johnson, 1946, Coal deposits of Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Survey Prelim. map. Geographically extended into northern Georgia where it is 150 to 200 feet thick. Underlies Vandever shale; overlies Whitwell shale.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4. Sandstone that has been called "Bon Air" at Bon Air, White County, is equivalent to Sewanee conglomerate; because name Sewanee has priority, name Bon Air is discontinued.

Named for Bon Air, White County, Tenn. [Board on Geographic Names gives Bon Air as correct spelling.]

Bonanza Latite[1]

Tertiary: Southern Colorado.

Original reference: H. B. Patton, 1916, Colorado Geol. Survey Bull. 9, p. 21–63.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, the volcanics in order of succession are Rawley andesite, Bonanza latite, Squirrel Gulch latite, Porphyry Peak rhyolite, and Bremer [Brewer] Creek latite. In South Bonanza district, the volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and Bonanza atite is replaced by Hayden Peak latite.

Bonanza district, Saguache County.

Bonanza King Formation[1] **or Dolomite**

Middle and Upper Cambrian: Southeastern California and southeastern Nevada.

Original reference: J. C. Hazzard and J. F. Mason, 1936, Geol. Soc. America Bull., v. 47, no. 2, p. 229–240.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 277 (fig. 3c), 316–318. Extended into Nopah and Resting Springs area, Inyo County, Calif. Thickness 1,515 feet. Underlies Cornfield Springs formation: overlies Cadiz formation.

J. C. Hazzard and J. Mason, 1953, Am. Jour. Sci., v. 251, no. 9, p. 643–655. Geographically extended into Goodsprings area, Nevada, where it lies within Goodsprings dolomite of Hewett (1931).

A. R. Palmer and J. C. Hazzard, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 10, p. 2494–2499. On basis of paleontological data, age of Bonanza King formation at its type locality is designated as Middle and Upper Cambrian. On basis of this evidence, names Cornfield Springs and Bonanza King were misapplied in Nopah Range area. Here units so designated should now be considered as unnamed upper and lower divisions, respectively, of Bonanza King formation. Hence, in Nopah area, Bonanza King underlies Nopah formation.

First described in Providence and Marble Mountains, San Bernardino County, Calif. Named for Bonanza King mine, east side of Providence Mountains.

Bonaparte Marble[1]

Mississippian: Southeastern Iowa.

Original reference: C. H. Gordon, 1895, Iowa Geol. Survey, v. 4, p. 211.

Appears at Des Moines River level on south side, about half way between Bentonsport and Bonaparte, Van Buren County.

Bond Formation (in McLeansboro Group)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 38–39, 50, pl. 1, geol. sections. Proposed for strata extending from base of Shoal Creek limestone member to top of Millersville limestone member. Characterized in area of typical development by thick limestones. Thickness in type area nearly 300 feet; east of La Salle anticline 75 feet or less. Overlies Modesto formation and underlies Mattoon formation (both new). Members—central and southwestern Illinois (ascending): Shoal Creek limestone, McWain sandstone, Sorento limestone (new) Bunje limestone (new), Flat Creek coal (new), Witt coal (new), Coffeen limestone (new), and Millersville limestone; southeastern and eastern—Shoal Creek limestone, Mount Carmel sandstone, Flannigan coal, Reel limestone, Livingston limestone, and Millersville limestone; northern Illinois—Hall limestone and La Salle limestone. Presentation of new rock-stratigraphic classification for Pennsylvanian of Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type section: Composite of seven exposures (geol. section 8) in Bond, Montgomery, and Christian Counties. Named for Bond County. Reference section: Core from drill hole 59, Peabody Coal Co. NW¼NE¼ NW¼ sec. 33, T. 11 N., R. 1 E., Pana quadrangle, Christian County.

†Bone Canyon Member[1] or Limestone[1]

Permian: Western Texas.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 921, 922, 925.

In Bone Canyon, on west side of Guadalupe Mountains.

†Bone Lake Crystalline Schists[1]

Precambrian (middle Huronian): Northwestern Michigan.

Original reference: J. M. Clements, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 60.

Best developed in northern part of Crystal Falls district, in vicinity of Bone Lake.

Bone Spring Limestone[1]

Permian (Leonard Series): Western Texas and southeastern New Mexico.

Original reference: W. G. Blanchard, Jr., and M. J. Davis, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 962, pls. 10, 11.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 566–575, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 13–27, pls. Consists largely of limestones of varied types complexly interbedded and interfingered. Those laid down on shelf area outside Delaware basin, now exposed on Guadalupe Mountains and Sierra Diablo, are of different facies from those laid down within basin, now exposed in Delaware Mountains. Underlies Delaware Mountain group; overlies Hueco

limestone and in some areas Wolfcamp series, undifferentiated. In Delaware Mountains, and as far north as Bone Canyon, exposed parts of formation are black cherty limestone in thin beds, with partings and a few members of shaly limestone and silic shale north of Bone Canyon; in Guadalupe Mountains, upper part of black limestone is replaced by thick-bedded gray limestone, Victorio Peak gray member, which forms capping stratum of Sierra Diablo. At top is Cutoff shaly member (new). Thickness several thousand feet.

D. W. Boyd, 1958, New Mexico Bur. Mines Mineral Resources Bull. 49, p. 3 (table 1), 12–14, pl. 1. Victorio Peak and Cutoff members mapped in Otero County, N. Mex.

Named for Bone Springs Canyon, which opens in sec. 2, Block 66, northwestern part of Culberson County, Tex.

Bone Valley Gravel[1] or Formation

Pliocene, middle: Southern central Florida.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 138–141, table.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 18 (table), 203–208. Gravel makes up only small fraction of deposit; hence unit is here termed formation. Thickness about 50 feet. In type area, Bone Valley lies unconformably on limestone bedrock that is supposed to represent Hawthorn formation; farther north it presumably lies on Tampa and Suwannee limestones. Unconformably overlain by Pleistocene terrace deposits ranging in age from Sunderland to Pamlico. Probably merges southward into Caloosahatchee formation, but there are no known exposures in supposed transition area.

M. H. Bergendahl, 1956, U.S. Geol. Survey Bull. 1030–B, p. 70 (fig. 7), 79–84. Formation described in De Soto and Hardee Counties. Thickness as much as 35 feet. Generally, formation is considered to be Pliocene in age, but, until Miocene-Pliocene boundary is reestablished, age of formation cannot be categorically stated.

K. B. Kitner and L. J. McGreevy, 1959, U.S. Geol. Survey Bull. 1074–C, p. 65. Hawthorn formation of this report [area between Hernando and Hardee Counties, Fla.] includes (1) Hawthorn formation as redefined by Cooke (1945), (2) middle Miocene rocks in hard-rock phosphate belt including those generally assigned to Alachua formation, and (3) middle Miocene rocks in land-pebble phosphate district including noncalcareous rocks which have not always been distinguished from Bone Valley formation.

Named for exposures at town of Bone Valley, west of Bartow, Polk County.

Bonham Marl[1]

Bonham Clay (in Austin Group)

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: L. W. Stephenson, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, p. 8.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Chart shows Bonham marl below the Gober tongue of Austin chalk and above the Ector tongue.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 35. Foraminifera described. Bonham clay listed in Austin group.

Name for exposures a short distance north of town of Bonham, Fannin County, and for fact that town is located on the clay.

Bonita Beds (in Gila Conglomerate)

Pliocene(?): Southeastern Arizona.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. Massive conglomerate characterized by basaltic and rhyolitic fragments. Range in thickness from about 400 to 800 feet. Disconformably underlie Solomonsville beds. At least pre-Blancan, probably Pliocene age. Name credited to W. L. Van Horn and L. A. Heindl (unpub. theses).

In eastern part of Safford Valley [Graham County].

Bonita Sandstone Member (of Franciscan Formation)

Bonita Sandstone (in Franciscan Group)[1]

Jurassic and Cretaceous: Northern California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

U.S. Geological Survey currently classifies the Bonita Sandstone as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures at Point Bonita, on north shore of Golden Gate.

Bonita Park Formation.

Cenozoic: Southeastern Arizona.

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1216 (table 1), pl. 1. Discussion of sequence of rocks in Chiricahua National Monument. Chiricahua limestone is succeeded by thick section of Lower Cretaceous Bisbee group with recognizable Glance conglomerate at base, and in turn, by section of what appears to be Morita formation. This sequence of Lower Cretaceous rocks is apparently similar to Outlaw formation (Raydon, unpub. thesis) described from area east of Paradise. Above Bisbee group is a 300-foot sequence of red beds and associated tuff named Bonita Park formation (Waller, unpub. thesis). May be equivalent to some of volcanic sediments of Raydon's Blacktail formation. The Bonita Park unconformably underlies Faraway Rock formation in Hands Pass region, just east of the Monument.

Mapped at Bonita Park, Chiricahua National Monument, Cochise County.

Bonnellian series[1]

Lower Cretaceous: Texas.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 138–139.

Named for Mount Bonnell, near Austin, Travis County.

Bonner Quartzite (in Missoula Group)

Precambrian (Belt Series): Western Montana.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Pink crossbedded feldspathic quartzite; forms blocky rubble; outcrops relatively rare. Underlies McNamara argillite; overlies Miller Peak argillite.

Mapped in Bonner quadrangle. Type locality and derivation of name not given.

Bonner Springs Shale[1] or **Formation** (in Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 111. In Kansas City group. Underlies Merriam limestone member of Plattsburg formation; overlies Farley limestone member of Wyandotte formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 34. Thickness in Nebraska 8 to 10 feet

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. In Schildberg quarry, NW¼SE¼ sec. 5, T. 75 N., R. 29 W., Madison County, consists of 4 feet of olive to dark-gray shale with a thin coallike layer near top; lower 3 feet contains numerous limestone nodules.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24–25, fig. 5. Uppermost formation in Kansas City group. Consists of gray to black shale overlain by maroon shale that commonly contains limestone nodules Thickness commonly 10 feet. Overlies Wyandotte limestone; underlies Plattsburg limestone.

Type locality: Cement plant northeast of Bonner Springs, Wyandotte County, Kans.

Bonneterre Dolomite[1]

Upper Cambrian: Southeastern Missouri.

Original reference: F. L. Nason, 1901, Am. Jour. Sci., 4th, v. 12, p. 358–361.

Josiah Bridge, 1936, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Underlies Davis formation of Elvins group.

G. F. Brightman, 1937, (abs.) Missouri Acad. Sci. Proc., v. 3, no. 4, p. 120; 1938, Jour. Geology, v. 46, no. 3, pt. 1 p. 248–267. Includes Tom Sauk limestone member (new) at base.

Christina Lochman, 1940, Jour. Paleontology, v. 14, no. 1, p. 1–53. Formation varies in thickness throughout area, for it overlaps Lamotte sandstone and is to a certain degree still affected by irregularities in Precambrian surface. Average thickness 375 feet; maximum thickness 448 feet of Delassus on Bonneterre plain. Thickness decreases regularly southward with average of 200 feet in Madison County and minimum of 50 feet where unit lies directly on rhyolite porphyry. Two-fold lithic division recognized: basal 50 feet, which is intricate sequence of interbedded and intergrading glauconitic sandstones, fine gray and yellow shales, fossiliferous crystalline limestone, and barren white or pink dolomites; and a 200- to 300-foot upper part, which is essentially a massive-bedded barren crystalline dolomite. Basal 50 feet carries late *Cedaria* fauna of more than 61 species. Upper Cambrian.

Named for exposures at Bonneterre, St. Francois County.

Bonnetian Age and Stage

Middle Cambrian: North America.

B. F. Howell and J. F. Mason, 1938, Jour. Paleontology, v. 12, no. 3, p. 297. Lower *Paradoxides bennetti* fauna, with *Dawsonia* and *Ehmania*, together with faunas which are correlated with them, are assigned a new age and stage name, Bonnetian.

Term taken from original name for Highland Range of Nevada.

†Bonneville Beds[1]

†Bonneville Group[1]

See **Lake Bonneville Beds.**

Bonneville Formation (in Lake Bonneville Group)

Pleistocene: West-central Utah.

C. K. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 21. Includes those deposits that accumulated in Lake Bonneville at its highest stage. Consists of gravel containing some cobbles and boulders in sandy matrix. Younger than Alpine formation and older than Provo formation (both new). Name credited to H. J. Bissell (unpub. thesis).

C. B. Hunt, H. D. Varnes, and H. E. Thomas, 1953, U.S. Geol. Survey Prof. Paper 257–A, p. 13, 20–21, pl. 1. Includes those deposits that accumulated during what Gilbert (1890, U.S. Geol. Survey Mon. 1) referred to as Bonneville stage. Thickness about 20 feet except at Point of the Mountains where formation was deposited in spit 300 feet high and extending 1 mile west from end of Traverse Mountains. Overlies Alpine or older formations. Included in Lake Bonneville group.

Forms thin and discontinuous beach deposit along old Lake Bonneville shore line. Deposits encircle Lake Mountain.

Bonpas Limestone Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), 82, pl. 1. Proposed to replace name Calhoun limestone, in order to restrict name Calhoun to underlying coal. Stratigraphically below Omega limestone member. Medium gray, weathers with reddish cast; dense to finely crystalline, thick bedded; tends to be shaly in lower part. Thickness 3 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NE¼NE¼ sec. 6, T. 2 N., R. 14 W., Richland County. Named from Bonpas Creek, about 1½ miles east of type outcrop.

Bonsall Tonalite

Upper Cretaceous: Southern California.

C. S. Hurlbut, Jr., 1935, Am. Mineralogist, v. 20, no. 9, p. 611–613. Medium-grained plutonic rock presenting in outcrop a color of varying shades of gray which distinguishes it in the field from other intrusives. Characterized by dark inclusions. Shows marginal assimilation at contact with San Marcos Mountain gabbro which it intrudes.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, table facing p. 630. In Late Mesozoic plutonic sequence in central and northwestern San Diego County, Bonsall tonalite is listed as older than Lakeview tonalite and younger than Green Valley tonalite.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 58–62, pl. 1. In this report, name Bonsall tonalite replaces name Perris quartz diorite as used by Dudley (1935) and Val Verde tonalite used by Osborn (1939). Intruded by Woodson Mountain granodiorite and Indian Mountain granodiorite. Considered younger than Lakeview Mountain tonalite. Upper Cretaceous.

Richard Merriam, 1958, California Div. Mines Bull., 177, p. 14, 16 (fig. 2), Described and mapped in Santa Ysabel quadrangle. Younger than Green Valley tonalite. Cretaceous.

Name derived from village of Bonsall located slightly west of central portion of San Luis Rey quadrangle. Tonalite underlies approximately 100 square miles in San Luis Rey quadrangle; also present in Elsinore and Ramona quadrangles.

Bonta Formation

Miocene, upper(?): Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Hornblende and pyroxene andesite, volcanic conglomerate and mudflow breccia. Thickness about 750 feet. Unconformable below Penman formation (new); rests unconformably on Delleker formation (new) and all older rocks; unconformities marked by faulting.

Cordell Durrell, 1959, California Univ. Pub. Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 172–174. Predominantly andesite mudflow breccia, volcanic conglomerate, and volcanic fanglomerate. Thickness 100 to 750 feet. Underlies Penman formation. Rests in various places on granitic and metamorphic rocks and on Lovejoy, Ingalls (new), and Delleker formations. In many areas, lies across faults between two of older formations; in other areas has been faulted showing renewed movements on the faults. Upper Miocene on basis of fossil flora.

Named for Bonta Creek in south-central part of Blairsden quadrangle, Most representative area is in secs. 28 and 33, T. 23 N., R. 13 E.

Bony Falls Member (of Black River Formation)

Middle Ordovician: Northern Michigan.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14, 16, 17–22. Section at Bony Falls consists of about 40 feet of limestone, some of which is argillaceous and some finely crystalline dolomitic; a 2-inch layer of bentonite occurs about middle of section, and this may mark top of Black River. Evidence of subaerial erosion appears at several levels throughout section, and a very obvious disconformity near middle of section may represent a time break of considerable duration. Underlies Chandler Falls member (new) of Trenton formation. Separation of Black River rocks from Trenton above presents difficult problem; rocks of the two formations are commonly distinguished on basis of faunal changes that are not always very significant; deposition was practically continuous at some localities from Black River to Trenton time, and dividing line between the two formations becomes an arbitrary one.

Type locality: Sec 1, T. 41 N., R. 24 W., at Bony Falls on Escanaba River, Delta County.

Boone Formation[1]

Boone Limestone[1] or Chert

Lower and Upper Mississippian: Northern Arkansas, southwestern Missouri, and eastern Oklahoma.

Original reference: J. C. Branner and F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xiii, 27–37.

L. M. Cline, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 9, p. 1132. St. Joe limestone, formerly considered member of Boone, here raised to formation rank. Term Boone should be suppressed as synonym of term Osage.

J. A. Straczek and D. M. Kinney, 1950, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–1. Boone chert mapped in Batesville manganese district. Includes St. Joe limestone member, locally, at base.

E. B. Brewster and N. F. Williams, 1951, Guidebook to the Paleozoic rocks of northwest Arkansas: Arkansas Resources Devel. Comm., p. 13, 14. Formation consists of limestone and chert which vary in relative proportions both horizontally and vertically. Thickness 300 to 350 feet in most of northern Arkansas. Includes Short Creek oolite member in upper part and St. Joe limestone member in basal part. In Yellville quadrangle, basal member of Boone lies at some place on every one of formations preceding it in stratigraphic section except the Joachim, Cotter, and Jefferson City. In northwestern Arkansas overlain by Batesville sandstone, Hindsville limestone, or Fayetteville shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Formation mapped in Oklahoma. In Ottawa County, includes at top some beds equivalent in part at least to Moorefield formation of several counties farther south and in northeastern part of state.

E. E. Glick, S. E. Frezon, B. R. Haley, 1956, Kansas Geol. Soc. Guidebook 20th Field Conf., cross section. Lower and Upper Mississippian.

R. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 1, 14 (fig. 2), 40–41. Osagean series, frequently referred to as "Boone chert," includes St. Joe, Reeds Spring, and Keokuk formations.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1959, Deutsche Geol. Gesell. Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Chart shows Boone formation comprises (ascending) Reeds Spring, Grand Falls, and Short Creek members. Overlies Northview shale; underlies Carterville formation.

Named for extensive development in Boone County, Ark.

Boone Creek Limestone Member (of Palo Pinto Limestone)[1]

Pennsylvanian: Central northern Texas.

Original reference: J. M. Armstrong, 1929, Texas Bur. Econ. Geology, geol. map of Jack County.

Jack and Wise Counties, Brazos River region.

Boone Gap facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 119–121. Predominantly shale with minor amounts of limestone, siltstone, and clay. Thickness ranges from about 125 feet in Rockcastle County to nearly 275 feet in northeastern Estill County. Merges with Dicks River facies (new) on west and with Stanton facies (new) on east.

Underlies Conway Cut siltstone member of Brodhead formation, Irvine facies (all new); overlies New Albany shale.

Name derived from Boone Gap, at line between Rockcastle and Madison Counties, where there are excellent exposures in deep cuts on both sides of tunnel of Louisville and Nashville Railroad, and along U.S. Highway 25. Base of formation, in contact with New Albany shale, is exposed less than 1 mile north of tunnel, and top is exposed at roadcut a few feet above highway level at gap.

Booneville Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow and H. M. Chance, 1896, New York Acad. Sci. Trans., v. 15, p. 51–52

Probably named for Booneville, Logan County, Ark.

Bootlegger Member (of Blackleaf Formation)

Lower Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2791–2793; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90. Predominantly interbedded medium-gray sandstone, gray siltstone, and dark-gray shale; massive sandstone at base. A few thin layers of chert-pebble conglomerate present. Beds of bentonite common in upper half of member and one bed attains thickness of 10 feet. Widespread thin sandstone at top, in which finely fragmented fish bones are very abundant, is diagnostic feature. Thickness 330 feet in composite type section. Overlies Vaughn bentonitic member (new); underlies Floweree member (new) of Marias River shale (new).

Composite type section: Begins near place where Bootlegger Trail crosses outcrop of member at NE cor. sec. 1, T. 21 N., R. 3 E., Cascade County, and extends westward for about 15 miles toward Muddy Creek along upper part of a south-facing escarpment. Bootlegger Trail, from which member is named, is a secondary road extending from Great Falls north toward Canada.

Bootlegger Cove Clay

Pleistocene: Alaska.

R. D. Miller and Ernest Dobrovolny, 1959, U.S. Geol. Survey Bull. 1093, p. 12 (table 1), 14–15, 35–48, pls. 1, 3, 5, 6, 9. Extensive blue-gray clay of lacustrine or estuarine origin. Thickness 14 to 126 feet. Separates the Knik from overlying Naptowne glacial deposits. Shows interglacial weathering. Pre-Wisconsin.

Typical sections are in SW¼NE¼ sec. 23, T. 14 N., R. 4 W., near Bootlegger Cove, Anchorage area. Exposed almost continuously from point about three-fourths mile southeast of Point Woronzof northward to point about one-half mile southwest of Eagle River Flats; north of the Flats exposed discontinuously in bluffs.

Boott Member (of Littleton Formation)

Lower Devonian: North-central New Hampshire.

M. P. Billings and others, 1945, Geologic map and structure sections of the Mount Washington quadrangle (1:62,500): New Hampshire State Plan. Devel. Comm. and Highway Dept. Consists of diopside granulite, diopside-actinolite granulite, actinolite granulite, actinolite-biotite schist,

biotite schist and biotite-pyrite schist. Occurs near middle of Littleton formation.

M. P. Billings and others, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 264–266. Maximum thickness 65 feet. Type locality cited.

Named from Boott Spur 1.2 miles south-southeast of summit of Mount Washington, Coos County. Exposed in narrow belt extending north-northeast from Boott Spur Trail to within a few hundred feet of Cutler River in Tuckerman ravine.

Bopesta Formation[1]

Miocene, upper: Southern California.

Original reference: J. P. Buwalda, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 310.

J. P. Buwalda and G. E. Lewis, 1955, U.S. Geol. Survey Prof. Paper 264–G, p. 148. Consists of tan and white fine and coarse quartzose sandstones containing some ash and volcanic debris, a few conglomerate beds, and some gray sandy shale beds. Thickness probably not less than 3,500 feet. Beds moderately deformed, with dips as much as 30°. Probably conformable on Kinnick formation; overlain by basic lavas, probably unconformably. Type section designated; derivation of name given.

Type section: From confluence of Cache Creek and its East Fork (which heads on south side of Cache Peak) in NW¼ sec. 1, T. 32 S., R. 34 E., to north side of Cache Peak, which is in sec. 20, T. 31 S., R. 35 E. Named from Bopesta Ridge, southwest of Cache Peak, Kern County.

Boquillas Flags[1]

Boquillas Formation

Upper Cretaceous: Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 29–33.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1141–1143, pl. 1. Formation described in Buck Hill quadrangle. Overlies Buda limestone; underlies Buck Hill volcanics (Pruett formation). How much of Boquillas is Eagle Ford and how much Austin equivalent not determined.

C. G. Moon, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 157–170, pl. 1. Boquillas-Terlingua problem discussed. A 50-foot rock unit, herein named Fizzle Flat lentil, occurs in middle of Boquillas-Terlingua sequence in Agua Fria quadrangle.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 10–12, pl. 1. Boquillas flags described in Terlingua district. Thickness about 1,000 feet. Divided into upper and lower member, plane of division being top of thin sandy limestone bed that represents faunal zone characterized by ammonite (*Crioceras*), found nowhere else in formation. This division of Boquillas into members is not a subdivision of Adkins' (Sellards, Adkins, and Plummer, 1933, Texas Univ. Bull. 3232) Boquillas flags, which includes only lower member; instead it is an extension of his and Udden's definition of formation to include rocks considered by them as more properly belonging to an overlying formation. Beds mapped as Boquillas flags therefore include lower part of what Adkins called Terlingua formation (restricted). Overlies Buda limestone; underlies Terlingua clay.

Named for Boquillas, Brewster County, on Tormillo Creek, Chisos Mountains quadrangle.

Boracho Limestone (in Sixshooter Group)

Cretaceous (Comanche Series): Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Name applied to strata lying between Finlay limestone below and Buda limestone above in Sixshooter group (new). Name credited to J. P. Brand and R. K. DeFord (in press). Described in area of this report (Wylie Mountains and vicinity) as hard pale-yellowish-brown fine-micrograined fossiliferous limestone with thin bands of marl. Approximate thickness 180 to 330 feet.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 379-385. Described in Kent quadrangle where it comprises (ascending) Levinson limestone and San Martine members (both new). Middle formation in Sixshooter group. Overlies Finlay limestone; underlies Buda limestone. Deviation of name.

Name derived from Boracho Station on Texas and Pacific Railroad about 10½ miles west of Kent, Culberson County.

Boracho Sandstone

Cretaceous (Comanche Series): Western Texas.

W. E. Tipton, 1951, *in* West Texas Geol. Soc. Guidebook Fall Field Trip, Oct. 26–27, p. 29 (geol. map) Named on map legend.

Culberson County.

Borden Group[1] **or Formation**

Lower and Upper Mississippian: Indiana and Kentucky.

Original reference: E. R. Cumings, 1922, Handb. Indiana Geology, pt. 4, p. 408, 470 (footnote), 487–490, 492, 531, chart.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 1–248. In Kentucky, comprises (ascending) New Providence formation, Brodhead formation (embracing Locust Point and Carwood divisions of Indiana classification), Floyds Knob formation, and Muldraugh formation (embracing Lower Harrodsburg division and Edwardsville division of Indiana classification). Underlies Harrodsburg (restricted) of Warsaw age, Salem formation, St. Louis limestone, or Ste. Genevieve limestone; overlies Rockford limestone (in Indiana), New Albany shale, Bedford, or Sunbury shale. Age given as Osage. Report deals specifically with 225-mile belt in Kentucky, immediately bordering Lexington Plain and also discusses Lower Mississippian as a whole in east-central interior.

D. J. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 40 (table 7), 44. In southern Indiana, group comprises five formations (ascending): New Providence shale, Locust Point, Carwood, Floyds Knob, and Edwardsville. Group undifferentiated in northern Indiana. Overlies Rockford limestone: underlies Harrodsburg limestone. Osage series.

Well exposed near village of Borden, Clark County, Ind.

Borden Sandstone (in Monongahela Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 7.

Lies a short distance above Borden coal in Georges Creek basin.

†Border Conglomerate (in Newark Group)[1]

Upper Triassic: Eastern Virginia.

Original reference: J. K. Roberts, 1923, Pan-Am. Geologist, v. 39, p. 185–200.

Extends in a broken manner from Potomac River at Point of Rocks to Carolina line.

Boring Agglomerate

Pliocene, upper, or Pleistocene, lower: Northwestern Oregon.

R. C. Treasher, 1942, Oregon Dept. Geology and Mineral Industries G. M. I. Short Paper 7, p. 10, geol. map. Structureless mass with tuffaceous matrix containing cobbles and fragments of lava and pieces of wood that are so unaltered that they may be burned.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Thickness as much as 100 feet. Lies immediately above Troutdale formation on ridges and hillslopes except where it is intracanyon; lies immediately below Boring lava and represents an opening phase of Boring lava volcanism.

Occurs in Portland area.

Boring Lava

Pliocene, upper, to Pleistocene, lower(?): Northwestern Oregon.

R. C. Treasher, 1942, Oregon Dept. Geology and Mineral Industries G. M. I. Short Paper 7, p. 10, geol. map. Name applied to series of lava flows that spread from number of vents over long period of time.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Described as gray basalts containing abundant olivine phenocrysts. Thickness as much as 100 feet. Overlies Troutdale formation and Boring agglomerate; older than terrace gravels and glacial outwash.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 10, 12, pl. 2. Interbedded with Troutdale formation; at its type locality, lava underlies Portland Hills silt member of Troutdale; at Crown Point, a 30-foot flow of Boring lava is referred to as Crown Point member of the Troutdale; in southern part of area, the lava overlies Molalla formation. Age restricted to upper Pliocene.

D. E. Trimble, 1957, U.S. Geol. Survey Geol. Quad. Map GQ-104. Described in Portland quadrangle. Younger than lower Pliocene Troutdale formation; in Sandy River area overlain by deposits thought to be early or middle Pleistocene. Lavas therefore may be wholly Pliocene in age or they may be in part early Pleistocene.

Named for occurrence on Boring Hills southeast of Portland. Caps Troutdale Hills, east of Willamette River; caps Portland Hills and covers Oswego Lake depression; also intracanyon in three canyons in Portland Hills.

Borrego Formation

Pliocene, upper, or (?)Pleistocene, lower: Southern California.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1782. Nonmarine mudstone, siltstone, sandstones, and conglomerates probably unconformably overlying all older rocks. Thickness as much as 7,600 feet.

J. W. Durham, 1950, Geol. Soc. America Mem. 43, table facing p. 20. Upper Pliocene.

L. A. Tarbet, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 261 (fig. 40), 262. Lower Pleistocene(?). Thickness 8,600 feet. Shown on columnar section as overlying Palm Spring formation and underlying alluvium lake deposits.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 23 (fig. 2), 24, pl. 2. Mapped as lacustrine facies of Palm Spring formation. In type section, Borrego lake beds grade downward into terrestrial beds of Palm Spring facies and are overlain by Ocotillo conglomerate (new). Formation reaches maximum thickness of 6,000 feet in Borrego Badlands, and thins eastward to 2,000 feet.

Type section: Borrego Badlands, Imperial Valley.

Boscabel Boulder Beds[1]

Upper Triassic: Eastern Virginia.

Original reference: N. S. Shaler and J. B. Woodworth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 424–425.

Well exposed at Boscabel Ferry, Richmond Basin.

Boskydell Sandstone (in Tradewater Group)

Boskydell marine horizon (in Pottsville Formation)

Pennsylvanian: Southwestern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 34, 76. Boskydell marine horizon—a calcareous marine sandstone in upper Pottsville, between Finnie sandstone above and Willis coal.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, *in* C. O. Dunbar and L. G. Henbest, Illinois Geol Survey Bull. 67, p. 17 (fig. 3), 20. Listed as sandstone in Tradewater group.

R. M. Kosanke and others, 1950, Illinois Geol. Survey Rept. Inv. 214, p. 31. Name dropped from formal usage.

Exposed 1 mile southwest of Boskydell, Jackson County.

†Bosque division[1]

Lower Cretaceous (Comanche Series): Oklahoma and Texas.

Original reference: J. A. Taff, 1892, Texas Geol. Survey 3d Ann. Rept., p. 272–273, 281–325.

Named for Bosque River.

Bossardville Limestone (in Cayuga Group)[1]

Silurian: Northeastern Pennsylvania and northern New Jersey.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 77, 141–145.

C. K. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1183, measured sections. Keyser limestone and its correlates are underlain in area [southeastern Pennsylvania] in descending order by Bossardville limestone, Poxono Island shale, and Bloomsburg red beds. Where typically developed in vicinity of Delaware Water Gay, the Bossardville consists of three parts. Major (central) beds are blue-black dense limestone. Underlying these beds, at many places, are thin-bedded gray finely striculate and somewhat shaly limestones. Overlying central beds, locally, is a few feet of thick-bedded impure limestone, weathering yellowish. White (1882) describes green shales, the Deckers Ferry "shale" which present writers have not seen, as lying at top of formation. Poxono Island shale and Bossardville limestone are similar to, and homotaxial

with, Wills Creek shale and Tonoloway limestone, respectively, of central Pennsylvania and Maryland but lie in a different province; the corresponding formations differ in their time limits; both are believed to be later than Wills Creek shale.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 253. Bossardville limestone of previous West Virginia reports is replaced by Tonoloway limestone.

Named for Bossardville, Monroe County, Pa.

Bossier Formation (in Cotton Valley Group)

Upper Jurassic: Subsurface in western Louisiana, southern Arkansas, and eastern Texas.

F. M. Swain. 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 582–594. Includes the marine dark-gray to black shale and sandstone and shoreward equivalents of these rocks beneath Schuler formation and above Buckner formation or its basinward equivalent. In type well, occurs between depths of 6,515 and 8,140 feet. Thickness varies from knife edge where it is overlapped by Schuler formation to almost 2,000 feet on flank of North Lisbon field in east-central Claiborne Parish, La. Relationship to underlying Buckner formation not clear; in some areas the Bossier rests directly on Smackover limestone.

Type well: Phillips Petroleum Co. Kendrick No. 1, C., NE¼SW¼ sec. 22, T. 19 N., R. 11 W., Bossier Parish, La., Bellevue Field Deep Test.

†Boston Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 53–57, 61, 81, 84, 86, chart.

Named for occurrence in Albany and Boston mine, Houghton County.

Boston Glacial Substage

Pleistocene (Wisconsin): Northeastern Massachusetts.

S. S. Judson, Jr., 1949, Peabody Foundation for Archeology Papers, v. 4, no. 1, p. 12–23. Name proposed for substage which includes genetically related deposits of till, clay, sand, and gravel. Older than Lexington glacial substage (new). Relation to glacial sequences in other areas of North America unknown.

Named for good exposures in Boston area. No type locality designated because of temporary nature of artificial exposures.

†Boston Group[1]

Mississippian and Pennsylvanian: Northwestern Arkansas and northeastern Oklahoma.

Original reference: J. C. Branner, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xii.

Named for Boston Mountains, Washington County, Ark.

Boston Basin Series[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. E. Hobbs, 1899, Am. Geologist, v. 23, p. 109–113.

East of west rim of Boston Basin.

Boston Bay Group[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. E. Hobbs, 1899, Am. Geol., v. 23, p. 109–113.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6, column 5a. Age shown as Pennsylvanian but is uncertain; may include Devonian, Mississippian, and Permian.

Occurs in Boston Basin which borders Boston Bay.

Boston Neck Granite[1]

Upper Carboniferous or post-Carboniferous: Southern Rhode Island.

Original reference: F. H. Lahee, 1912, Am. Jour. Sci., 4th, v. 33, p. 365, 449, 454–469.

Occurs at various places along west coast of Narragansett Bay from Watson's pier southward, and inland on Little Neck, Boston Neck, and Tower Hill.

Bostwick Conglomerate or Beds (in Lake Murray Formation)

Bostwick Limestone (in Dornick Hills Group)

Bostwick Member (of Dornick Hills Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 14.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as Bostwick limestone in Dornick Hills group. Lampasas series.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 140, 141 (fig. 3) Rank reduced to member status in Lake Murray formation (new). Underlies Griffin sandstone member (new).

Lynn Jacobsen, 1959, Oklahoma Geol. Survey Bull. 79, p. 32–33. Bostwick conglomerate at base of Lake Murray formation is most prominent exposed unit in Ardmore basin. Consists of limestone and chert conglomerate, sandstone, limestone, and shale. Maximum thickness 500 feet.

Type locality: On Bostwick dairy farm, in W½NE¼ sec. 11, T. 5 S., R. 1 E., Carter County.

Botetourt Formation

Botetourt Limestone Member (of Edinburg Formation)

Middle Ordovician: Western Virginia and eastern Tennessee.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 80, 103, 106. Botetourt limestone member proposed for brown-weathering granular limestone above Lincolnshire formation and below beds of Liberty Hall type. Thickness 15 to 75 feet (type section).

G. A. Cooper, 1956 Smithsonian Misc. Colln., v. 127, pt. 1, p. 49–50. Rank raised to formation. In Catawba Valley northeast of Blacksburg, underlies or interfingers with calcarenites of Effna formation. At Edinburg dam section about 1 mile below Edinburg and at Tumbling Run 1½ miles southwest of Strasburg, Va., dark thin-bedded limestone occurs between granular beds thought to be Botetourt and the cherty Lincolnshire; these

beds are here placed in Botetourt formation. Can be recognized in parts of Tennessee as at type section of the Whitesburg of Ulrich; at this place its overlies the Lenoir and occurs at the base of Ulrich's Whitesburg formation.

Type section: In Botetourt County, Va., on deeply gullied hillsides about 0.25 miles south of Dunkard Church and 6.0 miles S. 80° W. of Natural Bridge.

Botijas Limestone Member (of Coamo Formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 149–150. Rudistid-bearing limestone that occurs locally in lower red part of formation in north-central Puerto Rico. Name credited to Briggs and Gelabert (in preparation).

North-central part of island.

Bouchard Formation (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082-I, p. 567–568, pl. 28. Olive-gray, olive-brown thin- to medium-bedded sericitic quartzite and interbedded dark-olive-gray to olive-black argillite more abundant near bottom and top of section. A few beds of vitreous white quartzite and dark-gray fissile shale. Weathers rusty brown to olive drab. Thickness about 4,000 feet. Conformably overlies Sloway formation (new); unconformably underlies vitreous quartzite of Middle Cambrian age.

Type section: In secs. 24 and 25, T. 16 N., R. 26 W. Named for exposures near Bouchard Lake in sec. 23, T. 17 N., R. 27 W., St. Regis-Superior area, Mineral County.

Boucher Formation

Middle Cambrian: Northwestern Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Name used only on correlation chart. Underlies St. Albans shale; overlies Parker slate. Name credited to Shaw (unpub. thesis).

Boucher Tongue [of Muav Formation]

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 101–102. Composed of thin beds of rusty-brown dolomite. On fresh surface, dolomite appears steely gray and typically even grained, with crystals averaging 0.25 or 0.30 mm. In places, grades into brownish siltstone. Younger than Parashant tongue (new).

Extends southeastward from vicinity of Garnet Canyon at least as far as Cottonwood Canyon, a distance of 25 miles. Grand Canyon area.

Boulder Creek Granite or **Granodiorite**

Boulder Creek Granite (in Pikes Peak Group)

Boulder Creek Granite Gneiss[1]

Precambrian: Central northern Colorado.

Original reference: M. F. Boos and C. M. Boos, 1934, Geol. Soc. America Bull., v. 45, no. 2, p. 305–306.

J. M. Bray, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 768 (fig. 1), 769–770. In this report, Pikes Peak group includes (ascending) Boulder

Creek granite and Overland Mountain granite (new). Younger than Swandyke hornblende gneiss.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 25–27, pl. 1. Commonly dark-gray faintly banded rock that ranges from quartz monzonite to sodic granite. Chiefly coarse-grained primary gneiss, which is locally porphyritic. Near centers of large masses, gneissic structure is not prominent, and rarely color changes to pinkish gray or pink becoming indistinguishable from facies of Pikes Peak granite.

Crops out widely on Boulder Creek, on east flank of Front Range, west and southwest of Boulder, Boulder County.

†Boulder Pass Formation[1]

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta, Canada.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1900. Term Missoula antedates and reduces to synonymy the Boulder Pass formation.

Section made up from near Boulder Pass, south of Ahern Pass, Glacier National Park, Mont., and in Waterton Lakes National Park, Alberta.

Boulder River Sandstone Member (of Colorado Shale)

Lower Cretaceous: Southwestern Montana.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 415–416, pl. 34. Discussion of area east and southeast of Livingston, Mont. Here Colorado shale is divided into 10 units, and these are compared, where possible, with Black Hills and central Montana or Bighorn Basin formations. Unit 7, a thick-bedded or massive sandstone about 100 feet thick, is herein named Boulder River sandstone member. Forms cliffs and ridges between less resistant shale sequence below and thin-bedded sandstone above. On south slope of a hill west of West Boulder River in NE¼ (unsurveyed) sec. 26, T. 3 S., R. 11 E., Park County, member is about 65 feet thick and consists of gray to yellowish-brown mostly fine-grained sandstone. Above it, and below crest of hill, are 145 feet of thin-bedded, in part shaly, sandstone.

Section measured in SE¼ sec. 11, T. 3 S., R. 12 E., in McLeod Basin quadrangle along west side of Boulder River valley. Member forms almost continuous ridge from Boulder River westward to Yellowstone River south of Livingston.

Boulder Wash Group

Precambrian(?) or Tertiary(?): Southeastern Nevada.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, p. 1407–1409. Stratified series, lower part of which is dark-gray compact heavy dolomite that weathers rusty yellow brown, and is interrupted by thin layers of greenish compact shale 3 or 4 feet above base of unit; maximum thickness 200 feet. Above dolomite and separated from it by highly irregular surface of erosion is coarse breccia which fills valleys in the dolomite; thickness several hundred feet and probably exceeds 1,000 feet. Total thickness possibly exceeds 2,000 feet. Unconformably overlies Precambrian schist. Precambrian(?).

F. A. Nickell, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 12, p. 1804 (fig. 2). Breccia, dolomite, andesite, rhyolite, and intrusives. Tertiary(?).

North of Colorado River Canyon and west of Boulder Wash, Clark County.

Bouldin Member (of Lake Waco Formation)

Cretaceous (Gulf Series): Central Texas.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Ser., no. 4, p. 120–121, 139 (fig. 17), 141 (fig. 18). Proposed for upper member of formation. Composed of interbedded grayish-white to brownish silty limestone and silty shales with bentonites. Thickness at type locality about 9 feet. Northward from Travis County, a flagstone member near to or identical with stratigraphic position of type Bouldin flags occurs at scattered localities across Williamson, Bell, and McLennan Counties; as exposed in Blue Cut north of Moody, this limestone flag unit is approximately 14 feet thick. Overlies Cloice member (new); underlies emended South Bosque formation.

Type locality and section: Bouldin Creek and diversion cut near the Missouri Pacific-Missouri, Kansas and Texas Railroad, between Milton Street and Barton Springs Road, Austin, Travis County.

Boundary Argillite[1] (in Stevens Series)

Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 81, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 611. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for Metaline quadrangle. Part of Boundary argillite is considered correlative to Metaline limestone, part correlative to Maitlen phyllite, and part correlative with Gypsum quartzite.

Probably named for its occurrence near international boundary, Stevens County.

Boundary Granodiorite[1] (in Coast Range Intrusives)

Jurassic or Cretaceous: Southeastern Alaska.

Original reference: A. F. Buddington, 1929, U.S. Geol. Survey Bull. 807, p. 32–33, 55–59, maps.

F. M. Byers, Jr., and C. L. Sainsbury, 1956, U.S. Geol. Survey Bull. 1024–F, p. 126. Mentioned in report on tungsten deposits of Hyder district. In upper part of Coast Range intrusives.

Named for exposures along both sides and at head of Boundary Glacier from about 1 mile above its foot; Hyder district.

Boundary Shale

Eocene, upper: Western Washington.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 123, 124, 125, 126. Mentioned in discussion of stratigraphy in Lyre River area. In measured stratigraphic section of Crescent, Lyre, and Lincoln formations in canyon of Lyre River, Clallam County, the Lyre formation is said to rest conformably upon Boundary shale, which forms uppermost part of middle Eocene Crescent formation.

W. S. Drugg, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1682. Boundary shale, in Hoko River area, is in fault contact with Crescent beds. Siltstones of Boundary shale grade upward into Lyre conglomerate.

Derivation of name not stated.

Boundary Peak Granite[1]

Middle or Late Mesozoic: Central eastern California.

Original reference: G. H. Anderson, 1935, Pan-Am. Geologist, v. 64, no. 1, p. 66.

G. H. Anderson, 1937, Geol. Soc. America Bull., v. 48, no. 1, p. 8–11. The granites [Pelliser and Boundary Peak] are probably equivalent in age to the Sierra Batholith—middle or upper Mesozoic. Derivation of name given.

Composes Montgomery Peak and Boundary Peak, at extreme end of Inyo Range.

Bouquet Canon Breccia[1]

Miocene(?): Southern California

Original reference: A. O. Woodford, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 212.

Lower Bouquet Canon, 30 miles north of Los Angeles and 5 miles northeast of Saugus.

Bourbon Group or Formation[1]

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 90, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028. Suppressed in favor of Pleasonton group.

Named for Bourbon County, Kans.

Bourbon series[1]

Middle Ordovician: Kentucky.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 231.

Named for Bourbon County.

Bow Formation or Group[1]

[Upper Cretaceous]: Southern Wyoming.

Original references: A. C. Veatch, 1907, Jour. Geology, v. 15, p. 548; 1907, Am. Jour. Sci., 4th, v. 24, p. 18–22; C. F. Bowen, 1918, U.S. Geol. Survey Prof. Paper 108, p. 229.

Medicine Bow River.

Bowen Formation

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 840–841, 876–877, 884 (fig. 3), pl. 5. In Tazewell County, strata embraced by Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1,) are subdivided into (ascending) 29 zones. Name Bowen formation is applied to zones 20 and 21; lower zone is brown-weathering calcareous sandstone and upper is red mudrock tongue; these are 14 feet and 60 feet thick, respectively. The sandstone pinches

out 8 miles northeast of Russell-Tazewell County line; beyond this point and northeastward to Burkes Garden, Marys Chapel, and Five Oaks, the Bowen is represented only by tongue of red mudrock. Where both zones of the Bowen occur, there is evidence of disconformity between sandstones of Bowen and underlying buff shales of Wardell formation (new); in middle part of Tazewell County, the hiatus between the buff shales and overlying red mudrocks is indicated by absence of zone of brown mudstone; east of meridian of Tazewell, the hiatus includes part of red mudrock which pinches out entirely a few miles northeast; contact with overlying limestones of Witten limestone (new) are conformable. Throughout its extent in Virginia, southwest of Bluefield, beds herein named Bowen formation have been classified by Butts as lower part of the Lowville-Moccasin.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1171–1172. Southwest from Tazewell, Va., the Bowen is traced in both Copper Creek and St. Paul belts into Tennessee. Sandstone, ordinarily less than 15 feet thick in Virginia, thickens gradually into Tennessee. Mudrock phase varies from about 40 to 100 feet in thickness, locally attains thickness of about 175 feet at Thorn Hill. At Heiskell, Tenn., both sandstone and claystone phases are present between underlying Wardell and overlying Witten limestone. In Knoxville belt, allochthonous to Saltville thrust, the Bowen is present in several places between Knoxville and Lenoir City, and thickness may be as much as 200 feet in places. The sandstone occurs at top of the Sevier and is separated from maroon Moccasin claystone by a few feet of limestone probably of Witten age.

Type section: Along State Highway 91, one-half mile south of intersection with County Road 604, Tazewell County, Va. Name derived from Bowen Cove at northwest base of Short Mountain and along County Road 609, west of Maiden Spring.

Bowes Member (of Piper Formation)

Middle Jurassic: Central and eastern Montana (subsurface and surface).

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 97, 102–103. Displays varying lithologies, being represented in Williston basin by red to varicolored shale facies which grade westward into sandstone and sandy oolitic limestone on east flank of Sweetgrass arch. In type section, consists of (descending) 18 feet of light-brown finely crystalline to fragmental limestone, very sandy to argillaceous in part with few thin stringers of light-gray calcareous sandstone; 7 feet of light-gray fine- to coarse-grained very calcareous sandstone; 20 feet of light-gray oolitic to sandy limestone with thin beds of calcareous sandstone; and 12 feet of light-brown fine-grained calcareous sandstone grading downward into light-gray sandy and partly oolitic limestone. Becomes increasingly sandy and somewhat variable in thickness west of type well; eastward becomes interbedded with shale and eventually grades into varicolored shale, thickness uniform. Conformably overlies Firemoon limestone member (new) in Williston basin and most of north-central Montana; southward it overlaps Firemoon member and unconformably overlies Madison limestone. Underlies Rierdon formation.

Type section: The interval 3,360 to 3,417 feet in Northern Ordnance No. 1 Guertzgen well, SW¼NW¼NE¼ sec. 2, T. 31 N., R. 19 E., Blaine County, Montana.

Bowhan Sandstone Member (of Vamoosa Formation)

Bowhan Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series) : Northeastern Oklahoma and southeastern Kansas.

Original reference: M. I. Goldman and H. M. Robinson, 1920, U.S. Geol. Survey Bull. 686–Y, p. 361–362, pl. 51.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 48, pl. 1. Reallocated to Vamoosa formation. Occurs 110 to 140 feet above Cheshewalla sandstone member. Together with overlying Jonesburg sandstone member, the Bowhan extends northward across State line into Kansas.

Named for exposures at Bowhan Point, sec. 16, T. 28 N., R. 11 E., Osage County, Okla.

Bowie Shale Member (of Mesaverde Formation)[1]

Upper Cretaceous: Central western Colorado.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 341, p. 320 (table), 322.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. Strata near village of Baldwin previously identified as Bowie herein named Baldwin sandstone member of Mesaverde formation.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 19. Resting on Rollins sandstone member of Mesaverde of Lee (1912, U.S. Geol. Survey Bull. 510) in Grand Mesa field lie (ascending) Bowie shale member, Paonia shale member, and undifferentiated upper Mesaverde. Lee distinguished Bowie shale as of marine and brackish-water origin and the Paonia as fresh-water origin. Paonia member rests, according to Lee, on Rollins sandstone member in western part of Grand Mesa area, but toward the east, Bowie member appears and gradually thickens eastward. According to Boyer (written commun.) Lee misidentified his units in western part of Grand Mesa area. Upper member of Sego sandstone of present report was mistaken for the Rollins, and strata between upper Sego and Rollins were referred to Bowie shale member.

Typically exposed at Bowie, Delta County.

Bowknot Bed (in Church Rock Member of Chinle Formation)

Upper Triassic: Southeastern Utah.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 447 (fig. 3), 459; J. H. Stewart and others, 1959, U.S. Geol. Survey Bull. 1046–Q, p. 503 (fig. 73), 518, 519, 520 (fig. 79). Prominent sandstone unit in middle part of Church Rock member.

Present near junction of Green and Colorado Rivers.

Bowler Formation[1]

Permian and Triassic: Central southern Montana.

Original reference: J. P. Rowe, 1906, Montana Univ. Bull. 37, geol. ser. No. 2, p. 81.

Type locality not stated, but judging from list of occurrences on page 16 it is town of Bowler, Carbon County.

Bowling Green Limestone Member (of Edgewood Limestone)[1]

Lower Silurian: Northeastern Missouri and southwestern Illinois.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 62.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 16, 19, 20, 21. In Bowling Green quadrangle, typically a brown to

dusky-yellow dolomite or dolomitic limestone that is normally gray-blue-green on fresh exposure. Thickness 2 to 40 feet. Underlies Cyrene member; overlies Maquoketa formation; in some areas relationship is uncomformable.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 99. In some areas, underlies Cuivre shale (new).

Named for exposures near Bowling Green, Pike County, Mo.

Bowman Limestone[1]

Middle Cambrian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Survey Prof. Paper 173.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 20. Term Bowman extended into Stansbury Range where it is used to include a series of olive-drab shale and interbedded limestone between Herkimer formation below and Bluebird formation above. Thickness approximately 435 feet; apparently wedges out completely to south. Well exposed in headwaters of Timpie Valley and southward into Muskrat Canyon.

Named for exposures in Bowman Gulch northwest of Ophir, Oquirrh region, Tooele County.

Bowmanstown Chert (in Onondaga Group)

Bowmanstown Chert Member (of Onondaga Formation)

Lower or Middle Devonian: Eastern Pennsylvania.

F. M. Swartz, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 52, fig. 17. Chert about 60 feet thick; underlies Palmerton sandstone; overlies Oriskany conglomerate. Onondaga group. Middle Devonian.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 1145–1146, 1147, 1150, 1151, 1153, 1157. Detailed descriptions of several sections given. Thickness varies from 13 to 111 feet.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart gives age as Lower or Middle Devonian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation as mapped includes Bowmanstown chert member in Lehigh Gap area.

Type locality not stated, but unit described near Bowmanstown, Carbon County.

Bowmanville Interglacial Substage

Pleistocene (Wisconsin): North-central United States.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529, 549, 550. Name introduced for the Cary-Mankato intraglacial substage. Name was used by Baker (1920, Illinois Univ. Bull., v. 17, no. 41) for low-water stage of Lake Chicago which occurred when Cary glacier receded to north and cleared the Straits of Mackinac. Presentation of classification of Wisconsin glacial stage. Report also gives consideration to other classifications, including one proposed by Frye and Willman (1960, Illinois Geol. Survey Circ. 285).

Bowring Limestone Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 43–44, pl. 1. Name applied to limestone unit occurring above Cheshewalla sandstone member in Lake Hulah area. Thickness 1 to 2 feet.

Type section: In NE¼ sec. 10, T. 28 N., R. 11 E., Osage County. Named for village of Bowring.

Bowser Formation (in Tuxedni Group)

Bowser Member (of Tuxedni Formation)

Middle(?) and Upper Jurassic: Central southern Alaska.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Consists of thick-bedded to massive sandstone and conglomerate units 100 to 300 feet thick, interbedded with siltstone units 100 to 600 feet thick. Cliff-forming sandstone unit, 500 to 800 feet thick, forms top of member. Siltstone is dark gray, or light gray where calcareous, and weathers light brown. Sandstone partly light gray, partly very dark gray to black. Thickness of member about 2,600 feet. Underlies Tonnie siltstone member; overlies Cynthia Falls sandstone member.

U.S. Geological Survey currently classifies the Bowser as a formation in Tuxedni Group and designates its age as Middle(?) and Upper Jurassic on the basis of a study now in progress.

Crops out over large area of Iniskin Peninsula and is well exposed in valley of Bowser Creek.

Box Member (of Percha Shale)

Upper Devonian or Lower Mississippian: Southwestern New Mexico.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 95. Commonly composed of gray to green calcareous shales with intercalated lenses and nodules of limestone. Upper part of Percha shale. Overlies Ready Pay member (new) with gradational contact.

F. V. Stevenson, 1945, Jour Geology, v. 53, no. 4, p. 241, 243, figs. 2, 13. Upper Devonian age. Becomes progressively more calcareous to the west of Hillsboro; on Bear Mountain, northwest of Silver City, interbedded in shale are many massive beds of limestone, one attaining maximum of 16 feet. Total thickness 46½ feet. Unconformably underlies Lake Valley limestone. Derivation of name given.

M. A. Stainbrook, 1947. Jour. Paleontology, v. 21, no. 4, p. 298. Upper, lighter shales of Percha termed Bella by Keyes (1908). There is little doubt that Bella and Box were proposed for identical division of Percha, and there is little reason to replace earlier name. Percha of early Mississippian age.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 59 (fig. 28), 79 (fig. 39). Underlies Caballero formation and Andrecito member (new) of Lake Valley formation in parts of southwestern New Mexico.

Named for "The Box," the narrow canyon in Mimbres Mountains through which Percha Creek flows eastward into Rio Grande.

Box Butte Member (of Sheep Creek Formation)

Miocene: Northwestern Nebraska.

R. C. Cady, 1940, Am. Jour. Sci., v. 238, no. 9, p. 663–667. Proposed for member in uppermost part of formation. At type section, consists of three parts: lower, 30 to 40 feet, red and green clay with white concretions, limy sandy silt containing thin beds of brown blocky sandstone, and lumpy brown sandstone that weathers into a honeycomb ledge;

middle, 25 feet, lumpy and blocky brown sandstone in beds less than 2 feet thick containing two honeycomb limy ledges; and upper, 40 feet, partly covered, predominantly green clay with limy white concretions. Exposures showing middle sandstone zone are limited to northern part of Box Butte County, where Niobrara Valley cuts it; elsewhere member consists wholly of clay. Sheep Creek formation, exclusive of Box Butte member, fills narrow channels in top of Marsland formation. Top of Marsland is a white limy slabby caprock as much as 5 feet thick; in most exposures the Box Butte rests upon this cap rock. Sheep Creek channel was filled with brick-red silt and sand; at top of channel fill, the silt was cemented with lime; red clay of lower zone of Box Butte member rests upon this cemented zone. Unit occupies position in geologic column of area between earliest recognized Pliocene (Ogallala) beds and latest known Miocene (Sheep Creek) beds.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 131–132. Uppermost member of formation. No direct contact between the Box Butte and the Sand Canyon member (new) was observed. Topographically higher outcrops of Box Butte clays north of outcrops of Sand Canyon member at its type locality are considered as indicating higher stratigraphic position of the former.

Type section: In sec. 27, T. 28 N., R. 49 W., Box Butte County.

Box Canyon Member (of Mutual Quartzite)

Precambrian: Northeastern Utah.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2737 (fig. 2), 2738. Sequence of buff quartzitic sandstones and brown micaceous shales at top of Mutual quartzite. Intertongues in places with purple beds. Thickness 820 feet at Box Canyon. Underlies Red Pine shale (new).

Top of member exposed precisely at mouth of Box Canyon, a tributary to Red Pine Creek near forks in Smith and Morehouse Canyon of western Uinta Mountains. Member exposed upstream from mouth of Box Canyon.

Box Canyon Rhyolite Tuff

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 29–30, pl. 1. Described as a typical ignimbrite or welded tuff. Structure is massive; color is cream, gray, or pink. Throughout its occurrence, it forms a plate 40 to 75 feet thick. Lies conformably on Mimbres Peak rhyolite, except in its northernmost exposures, where it lies on Kneeling Nun rhyolite.

Found only in upper 4 miles of Box Canyon, Dwyer quadrangle. Largest outcrop is on southeast slope of Mimbres Peak, where its thickness is about 75 feet.

Box Elder Limestone[1]

Lower Ordovician: Northeastern Utah.

Original reference: E. Blackwelder, 1910, Geol. Soc. America Bull., v. 21, p. 519.

Northern Wasatch Mountains.

Box Springs Complex

Precambrian(?): Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 477. Metadiorite-granite complex. The complex dips 50° to 70° into the mountainside so that the exposed thickness is at least 1,500 feet. In northern part of mountains, a granite stock, nearly 2 miles across, cuts the complex, and Perris quartz diorite cuts it on southwest. Tentatively regarded as early Precambrian, but may be much younger.

Well exposed in Perris block in steep southwestern face of Box Springs Mountains, east of Riverside, Riverside County.

Boyer glaciation

Boyer till[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 284.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 69, no. 2, p. 129. Referred to as glaciation.

Boyle Limestone[1]

Middle Devonian: Central Kentucky.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10, 92.

A. C. McFarlan and W. H. White, 1952, Kentucky Geol. Survey, ser. 9, Bull. 10, p. 5–16. Discussion of Doyle-Duffin-Ohio shale relationships. In Kentucky outcrop overlap is by Jeffersonville limestone in west and Boyle limestone in south and east. Locally rests on Waynesville or Estill.

Named for Boyle County.

Boyles Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Northern central Alabama.

Original reference: Charles Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 27. In Warrier field, the thick basal sand of the Pottsville is called Boyles sandstone member.

Named for exposure at Boyles Gap, north of Birmingham, Jefferson County.

Boylston Schist[1]

Carboniferous: Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 61, 67–68, map.

Eastern part of Worcester County.

Boysen Formation

Upper Cambrian: North-central and northwestern Wyoming.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1092–1096, 1101 (fig. 3), 1104. Replaces name Gallatin formation. Consists of Upper Cambrian rocks in Wind River Canyon which lie between the Depass (Middle Cambrian) and Big Horn (Ordovician) formations. Rocks are massive limestones, intraformational conglomerates, and shales in basal 182 feet (Maurice member); shales, thin limestones, and thick-bedded intraformational conglomerates in overlying 308 feet (Snowy Range member); maroon and buff dolomitic shales, mudstones, and edgewise conglomerates in upper 40 feet (Grove Creek member).

Helen Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1539 (strat. column), 1541, 1543, 1544, 1546 (fig. 2), 1547. Described

in Teton County where it is 102 to 181 feet thick; overlies Gros Ventre formation and underlies Bighorn dolomite. Not subdivided in this area.

Type locality: East of Smith's cabin, approximately 2 miles north of Boysen Dam, Fremont County, Wyo.

Bozeman Lake Beds[1]

Oligocene, lower, to Pleistocene: Central southern and southwestern Montana.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110, pl. 1.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 15. Loose term for entire middle and late Cenozoic section northwest of Yellowstone Park in Gallatin and Broadwater Counties, Mont., including beds ranging in age from early Chadronian to Pleistocene and devoid of lacustrine deposits (except the *Leuciscus turneri* lake beds).

Named for exposures in vicinity of Bozeman, Gallatin County.

Brackett Member (of Stowe Formation)

Lower Cambrian(?): West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 66, pl. 1. Dark-green albite-epidote-calcite-chlorite schist.

Named for exposures in Brackett Brook. Occurs along eastern border of Rochester-East Middlebury area.

Bracks Rhyolite (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 25–26. Name proposed for rhyolite overlying Chambers tuff (new). Rhyolite is characteristically light olive gray to greenish black; locally dark reddish brown. Maximum thickness about 300 feet (in vicinity of San Carlos); lenses out on the northwest, north, and south; eastward, dips underground. Underlies Capote Mountain tuff (new).

Type locality: Vicinity of San Carlos, on Vieja Rim east of basin, Presidio County. Name derived from Bracks Canyon which cuts through rhyolite outcrop just west of San Carlos.

Brad Formation (in Canyon Group)[1]

Brad Group

Upper Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24–31, 35.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 108–115. As redefined herein, formation consists only of shale member at base and overlying Ranger limestone member (Drake's Home Creek of the type locality). Cedarton shale and Winchell member (including Clear Creek limestone of Drake and lower or limestone-bearing part of Placid shale member of Plummer and Moore) are included in typical Graford formation of Brazos River basin. Beds included in "shale member" represent upper part of Placid shale of Plummer and Moore, some sandstone, and the Cherty limestone of Drake. Underlies Caddo Creek formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88 Rank raised to group. Includes Ranger limestone and Placid shale. Underlies Caddo Creek group; overlies Graford group.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. Shown on composite section of Brown and Coleman Counties as Brad formation in Canyon group. Thickness about 125 feet. Includes Ranger limestone and Placid shale members. Underlies Caddo Creek formation; overlies Winchell limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 66–67, pl. 27. In Brown and Coleman Counties, comprises (ascending) Placid shale member and Ranger limestone member. Overlies Winchell limestone; underlies Caddo Creek formation. Thickness about 130 feet in southwestern Brown County; about 105 feet in central Brown County; not completely exposed northeast of Pecan Bayou.

Named for Brad, Palo Pinto County, Brazos River region.

†Braddyville Limestone (in Shawnee Formation)[1]

Pennsylvanian: Southwestern Iowa and northwestern Missouri.

Original reference: G. L. Smith, 1909, Iowa Geol. Survey, v. 19, p. 617, 618, 623, 629, 632.

Named for exposures at Braddyville, Page County, Iowa.

Bradford Group[1]

Devonian: New York.

Original reference: C. Schuchert and C. O. Dunbar, 1933, A textbook of geology, pt. 2, Historical geology: New York, John Wiley and Sons, Inc., p. 199, 203, 204.

†Bradford Schist[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1898, Am. Assoc. Adv. Sci. Proc., v. 47, p. 295–296.

Named for Bradford, Orange County.

†Bradfordian[1] Series

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: G. H. Girty, 1904, Science, new ser., v. 19, p. 24.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 12, pt. 1, chart 4. Bradfordian series (part) shown on correlation chart. Includes Conewango stage. Follows Chautauquan series.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 148. Report discusses geology of Coxsackie quadrangle, New York. Above "Portage" (Naples) beds in western New York occur marine Chemung and post-Chemung beds (Chautauquan, Bradfordian) which reach their maximum thickness in Pennsylvania (3,500 feet in central part) and thin greatly westward.

Bradley Granodiorite

Upper Jurassic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 52–59. Varies in composition from quartz diorite to quartz monzonite; varies in texture and structure from granulated, sheared, and strongly foliated to granitoid and little foliated. Cut by small dikes and sills genetically related to San Jacinto batholith. Cuts Palm Canyon complex (new) usually in form of sills. Probably correlative with Fargo Canyon diorite (new).

Named for exposures in Bradley Canyon, south of Cathedral City, in Palm Springs-Indio area, Riverside County.

†Bradshaw Granite[1]

Precambrian: Central Arizona.

Original reference: T. A. Jagger, Jr., and C. Palache, 1905, U.S. Geol. Survey Geol. Atlas, Folio 126.

U.S. Geological Survey has abandoned the term Bradshaw Granite on the basis of a study now in progress.

Named for Bradshaw Mountains in which it is well displayed, Yavapai County.

Bradshaw Limestone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 397.

Well exposed in Talcott district, Summers County, in bluff south of Greenbrier River, just west of Stony Creek and 0.3 mile southwest of Bargers Springs. Named for association with Bradshaw sandstone.

Bradshaw Sandstone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 394.

Type locality: In vicinity of Indian Mills and along Bradshaw Creek, there being a cliff on the road which ascends the mountain immediately north of Indian Mills and the mouth of Bradshaw Creek, Summers County, W. Va. Also observed in Mercer and Monroe Counties, and in Tazewell County, Va.

Bradshaw Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 398.

Type locality: On mountain road immediately north of Indian Mills, Summers County, W. Va. Also in Mercer, Monroe Counties, and in Tazewell County, Va.

Bradshaw Mountain Complex

Age not given: Southwestern Utah.

K. C. Condie, 1959, The Compass, v. 36, no. 3, p. 185, 186, 191–192. Composed of tonalite, granodiorite, and adamellite; gneisses and schists are also locally abundant. Large limestone and marble inclusions found within the complex. Basic projection of Mineral Range pluton.

Outcrops in Bradshaw mining district immediately southwest of Pass Canyon; in Mineral Range located in Beaver and Millard Counties.

Brady Soil

Pleistocene (Wisconsin): Central Nebraska.

C. B. Schultz and T. M. Stout, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 568 (fig. 2), 570. Proposed for the 1.5-foot buried soil at top of Peorian loess and below Bignell loess.

Type locality: Same as for Bignell loess, that is, Bignell Hill section, southeast of North Platte, 1.7 miles south of Bignell, in E½E½ sec. 3, T. 12 N., R. 29 W., Lincoln County.

Bradyan Interglacial Substage or Subage

Pleistocene (Wisconsin): Midcontinent.

A. B. Leonard, 1951, Jour. Geology, v. 59, no. 4, p. 325. Interval during which Brady soil was formed. This was likely a post-Tazewellian-pre-Caryan (or pre-Mankatoan) interval.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 132–135. Bradyan substage (subage) is interglacial interval of relatively short duration characterized by stable soil-forming conditions. It divides Wisconsinan into two unequal parts.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 358–364. Bradyan interglacial interval is most significant break in sedimentation in Midcontinent region during post-Sangamonian time. Provincial classification of post-Sangamonian into Scandian, Bradyan, and Almenan subages is proposed for use in Midcontinent.

Brady soil was named from exposures in loess bluffs south of Platte River valley south of Bignell, sec. 3, T. 12 N. R,. 29 W., Lincoln County, Nebr.

Bragdon Formation[1]

Mississippian: Northwestern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 236, 238.

A. R. Kinkel, Jr., W. E. Hall, and J. P. Albers, 1956, U.S. Geol. Survey Prof. Paper 285, p. 1, 38–41, pl. 1. Composed of interstratified shale, siltstone, sandstone, grit, conglomerate, a small amount of rhyolite tuff, and a small flow of mafic lava. Beds of shale make up more than 75 percent of formation. Thickness 3,500 feet in mapped area; only lower part of formation present. Overlies Kennett formation, but, where Kennett was either not deposited or was locally eroded, the Bragdon rests upon either Balaklala rhyolite or Copley greenstone.

Named from community of Bragdon on Trinity River 8 miles south of Trinity Center, Weaverville quadrangle. Formation occurs as an arcuate band 17 miles long and as much as 4 miles wide at north end of West Shasta district, Shasta County.

Brainard Member (of Maquoketa Shale)

Brainard Shale (in Maquoketa Group)[1]

Upper Ordovician: Northeastern Iowa, northwestern Illinois, and western Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 97.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as member of Maquoketa formation. Underlies Neda shale member; overlies Fort Atkinson limestone member.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 27–28, pl. 3. Described in Dubuque South quadrangle, Iowa-Illinois, where it is rank reduced to member status in Maquoketa shale. Consists of grayish-green and pale-blue soft dolomitic shale. Thickness as much as 135 feet. Underlies Neda member; overlies brown shaly unit in lower part of the Maquoketa.

Named for exposures near Brainard, Fayette County, Iowa.

Brainerd Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: P. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 32.

North side of valley near mouth of Brainerd Tunnel, on Lefthand Creek about a mile east of Ward and farther north in Tuscarora Gulch, Ward district, Boulder County.

Braintree Argillite

Braintree Slate[1]

Middle Cambrian: Eastern Massachusetts.

Original reference: N. S. Shaler, 1871, Boston Soc. Nat. History Proc., v. 13, p. 173, 175.

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–5]. Referred to as argillite.

Named for occurrence in Braintree, Norfolk County.

Brallier Shale (in Susquehanna Group)

Brallier Shale (in Portage Group)[1]

Brallier Member (of Fort Littleton Formation)

Upper Devonian: Central Pennsylvania, Virginia and West Virginia.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th ser., v. 46, p. 523, 531, 536.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 210, 216–217. Member of Fort Littleton formation. Overlies Harrell member; underlies Losh Run member.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 44–46, pl. 3. Formation described in Draper Mountain area, where it is 1,500 feet thick and consists of olive-drab siliceous shale and even-bedded siltstone and sandstone. Underlies Chemung; overlies Millboro shale (new).

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 412–445. Geographically extended into West Virginia where it replaces "Portage shales" or "Portage series" of previous reports. Overlies Harrell shale; underlies Chemung. Thickness as much as 2,900 feet (Randolph County).

R. R. Conlin and others, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 274, 276. Includes Stone Creek member (new).

U.S. Geological Survey currently classifies the Brallier as a formation in Susquehanna Group on the basis of a study now in progress.

Named for railway station 6 miles northeast of Everett, Bedford County, Pa.

Branch Canyon Formation

Miocene, middle: Southern California.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2991–2993. On south side of Cuyama Valley and on northeast flank of Caliente Range, Monterey shale grades laterally eastward into marine sandstone which in turn grades eastward into continental Caliente formation; this marine sandstone is herein designated Branch Canyon formation; as transitional facies includes minor fingers of marine shales and continental claystones and sandstones. At type section, comprises units mapped by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) as

(descending) lower "Neroly," "Cierbo," "Briones," "Temblor," and "Vaqueros;" section is 3,000 feet thick. Southeast of type locality, between Branch and Salisbury Canyons, formation is divisible into two units separated by a 750-foot interval of Monterey shale that contains Relizian microfauna; lower unit (mapped as Vaqueros by English, 1916, U.S. Geol. Survey Bull. 621–M) consists of about 1,200 feet of medium- to coarse-grained thick-bedded sandstone containing a *Turritella ocoyana* fauna and lies directly on Cretaceous sandstone; upper unit consists of about 1,400 feet of medium-grained sandstone that conformably underlies basal shale of Santa Margarita formation; on northeast flank of Caliente Range formation consists of about 1,500 feet of sandstone that contains three amygdaloidal basalt flows up to 50 feet thick (triple basalt flows of Eaton) which serve as key beds. Formation at its type locality is Relizian and possibly Luisian (middle Miocene), and upper 100 feet may be as young as upper Miocene (Eaton's lower "Neroly"). Preoccupied term Bitter Creek has been used for unit herein designated as Branch Canyon.

Type section: Near Branch Canyon on south side of Cuyama Valley near south Cuyama oil field, Cuyama Ranch quadrangle.

Branch Pond Gneiss[1] or Formation

Cambrian: Central southern Maine.

Original reference: E. H. Perkins and E. S. C. Smith, 1925, Am. Jour. Sci., 5th, v. 9, p. 204–228.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 110, 140, table 1. Mentioned in report on Lewiston, Maine, region. Quartz-feldspar-biotite gneiss of Cambrian Pejepscot formation is in part at least equivalent to Branch Pond formation of Perkins.

Named for exposures near Branch Pond in West Palermo, Waldo County.

Branchtown Clay[1]

Pliocene(?): Southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 258–272, 296–309.

In village of Branchtown [a suburb of Philadelphia].

Brandon Lignite or (residual) Formation[1]

Tertiary, lower: West-central Vermont.

Original reference: Edward Hitchcock, 1861, Rept. Geol. Vermont, v. 1.

Alfred Traverse and E. S. Barghoorn, 1953, Jour. Paleontology, v. 27, no. 2, p. 289–293. Lower Tertiary (probably Oligocene) age assigned to lignite.

Well exposed around town of Brandon, northern Rutland County.

Brandt Sandstone (in Kingsley member of Wellsburg monothem)

Upper Devonian (Chautauquan): Northeastern Pennsylvania.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 46–47. Somewhat massive sandstone, which splits along low-angled crossbedding diastems and shale partings into commercial flagstones; marine fauna. Thickness about 30 feet. Occurs in lower part of member above Starrucca sandstone member of Cayuta monothem.

Composite section described is near Lanesboro, Susquehanna County.

Brandy Run Sandstone (in Chester Group)[1]

Mississippian: Southwestern Indiana and northern Kentucky.

Original reference: C. A. Malott, 1919, Indiana Univ. Studies, v. 6, no. 40, p. 7–20.

Well developed in region of Marengo on Brandy Run Creek, Ind.

Brandywine Formation[1] or Gravel

Pliocene(?): Atlantic Coastal Plain from Delaware to Georgia.

Original reference: W. B. Clark, 1915, Am. Jour. Sci., 4th, v. 40, p. 499, 506.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Mineral Resources Bull. 10, p. 39–42. Described in Prince Georges County, Md., and District of Columbia. Gravel is predominant component in this area, therefore term gravel is preferred rather than formation; gravel is commonly overlain by silt. Thickness about 40 feet. Main body lies unconformably on Chesapeake group; outliers in District of Columbia overlap the Miocene and lie on Patuxent formation and crystalline rocks. Because Brandywine lies on Chesapeake group, it must be younger than Miocene, unless, possibly it was deposited during concluding part of that epoch. Because it is highest extensive sheet of river gravel in which present Potomac Valley has been cut, it presumably antedates the Pleistocene era; no fossils have been found to verify age assignment; unit is here referred to as Pliocene.

J. T. Hack, 1955, U.S. Geol. Survey Prof. Paper 267–A, p. 10–17, pl. 1. Described in Brandywine area where it forms surface of the uplands and consists of lower gravel member 10 to 50 feet thick and upper loam member that averages 15 feet in thickness. Overlies North Keys sand (new) which had been mapped as part of the Brandywine by some workers and as part of the Sunderland by others. Base of formation is defined by lowest gravel or coarse sand in the section, even though beds of fine sand identical with the North Keys occur in many places interbedded with the gravel; although formation as here defined may contain a disconformity and hiatus above the base, it is believed that this definition is only one practical for areal mapping and conforms closely to original definition. No basis is found for separating the Brandywine from the Sunderland; both formations at their type localities are underlain by North Keys sand of Miocene(?) age. Age given as Pliocene(?) although field evidence justifies only statement that it may be Miocene, Pliocene, or Pleistocene.

Typically developed in vicinity of Brandywine, Prince Georges County, Md.

Branford Granite Gneiss[1]

Branford Quartz Monzonite

Precambrian: South-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 146, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as a granitic gneiss. Fine- to medium-grained well-foliated gray gneiss. Part of East Haven granitic body, a structural unit. Pre-Triassic.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 13–14, 24–25, 50–51, pl. 1. Discussion of Branford-Stony Creek massif, an igneous body composed of Stony Creek granite and Branford quartz monzonite; a facies of the latter is designated Lighthouse quartz monzonite.

Extensive outcrops in Branford Township, New Haven County.

Brannon Limestone Member (of Cynthiana Formation)

Brannon Cherty Member (of Flanagan Limestone)[1]

Brannon Limestone (in Lexington Limestone)

Middle Ordovician: North-central Kentucky.

Original reference: A. M. Miller, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 324.

D. K. Hamilton, 1948, Econ. Geology, v. 43, p. 41 (fig. 2), 42. Referred to as Brannon limestone; consists of finely crystalline siliceous limestone which weathers to very cherty residue. Thickness about 15 feet. Overlies Benson limestone; underlies Woodburn limestone.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1636–1637. Forms middle part of Lexington limestone. Fine-grained siliceous gnarly limestone with much shale in lower part. On weathering, gives rise to conspicuous zone of chert drift and forms greater part of Campbell's (1898) Flanagan chert. Thickness 15 to 20 feet; in some places 30 feet. Includes Woodburn phosphatic member. On the north in Bourbon, Harrison, Franklin, and Fayette Counties, the Brannon fades in a short distance as a useful lithologic unit. Woodburn also thins. Recognition of these beds becomes difficult as Brannon wedges out (lithologic change), but horizon is still well marked wherever *Stromatocerium* and its associates of upper Benson are presented. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of the Cynthiana. This includes lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

Named for exposures at Brannon Station, Jessamine County.

Brannon Limestone Member (in Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

Type locality not stated.

Brannon Bridge Limestone Member (of Lazy Bend Formation)

Brannon Bridge Limestone (in Millsap Lake Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 16.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Lazy Bend formation. Occurs below "Buck Creek sandstone" in Grindstone Creek formation and above Dennis Bridge limestone member of Lazy Bend.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 17–18, fig. 3, pl. 4. Composed of two limestones separated by shale and discontinuous sand bodies. Lower limestone is 15 feet thick and shale is 22 feet thick (measured at Steussy Scarp where ranch road crosses scarp approximately 1½ miles west of Brazos River); a lensing sandstone in upper part of shale has maximum thickness of 4 feet in exposures in drainage immediately south of Meek Bend; upper limestone is 17 feet

thick (in quarry on top of cliffs south of Brazos River at Meek Bend). Overlies Steussy shale member; underlies sandstone and shales of Grindstone Creek formation. Type section established.

Type section: Succession of beds exposed in Steussy Scarp, a prominent feature northwest of Rocky Creek west of Brazos River. Name derived from former highway bridge on Brazos River at a point three-fourths mile south of present Highway 80 bridge, Parker County. Outcrop of member extends south of U.S. Highway 80 along west side of meander of Brazos River forming Meek Bend; on west side of Brazos River outcrops are in bluffs along west and south sides of Meek Bend; southeast edge of outcrop forms Steussy Scarp which begins near river and extends southwestward across county line.

Bransford Sandstone Bed (in Gassaway Member of Chattanooga Formation)

Bransford Sandstone Member (of Gassaway Formation)

Upper Devonian: Central Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 884, pl. 1. Layer of sandstone 2 to 4 inches thick at base of the Gassaway (new). Overlies Dowelltown shale (new); from Nashville extends southward with the Gassaway but without the underlying Dowelltown.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 11. Name Bransford sandstone not used in present report [Chattanooga shale and Maury formation]; bed so designated by Campbell is not named.

U.S. Geological Survey currently classifies the Bransford Sandstone as a bed in the Gassaway Member of the Chattanooga Formation on the basis of a study now in progress.

Type section: At bridge and along a small stream northwest of bridge, along Highway 31E, 2 miles north of Bransford, Sumner County.

Brassfield Limestone[1] **or Dolomite**

Lower Silurian: Central Kentucky, central northern Arkansas, southern Indiana, southwestern Ohio, and southern Tennessee.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 156; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 27.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Albion series.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 116–117, chart facing p. 108. Present at surface in extended area in southwestern Ohio. Trend of outcrop is northeastward from Indiana-Ohio line near Fairhaven across Preble and Montgomery Counties into central Miami County, thence southeastward across Clark, Greene, Clinton, Highland, and Adams Counties to Ohio River near Rome. Thickness 20 to 60 feet; average 20 feet. Underlies Dayton formation, Niagara group.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 34, 35–36. Thickness 20 feet at type section. Thickens northward to 40 or even 50 feet in Adams and Highland Counties, Ohio, and then thins westward into Indiana. In southern Blue Grass, the Brassfield thins westward and is eliminated from sections near Stanford, where the Devonian overlaps on Ordovician. Underlies Plum Creek shale.

E. B. Branson and C. C. Branson, 1947, Jour. Paleontology, v. 21, no. 6, p. 549–556. Brassfield herein considered to consist of lower dolomitic limestone, including *Whitfieldella* bed, and Plum Creek clay member above. Underlies Oldham limestone. Conodonts described. Lower Silurian.

C. W. Wilson, Jr., 1948, Geol. Soc. America Bull., v. 59, no. 8, p. 752, 755, 756. Discussion of channel-filling sediments, south-central Tennessee. Brassfield limestone was deposited as blanket over south-central Tennessee, resting unconformably upon sandstone member of Mannie shale, or where sandstone member is absent, upon underlying Mannie shale. Locally the Brassfield rests on Fernvale limestone in regional stratigraphic succession but not within limits of Pulaski channel. Overlies the Richmond throughout practically entire length of Pulaski channel. Consists of thinly bedded blue-gray finely crystalline limestone containing many species of corals. Maximum thickness 45 feet along Pulaski channel. Underlies Mississippian Medinan series.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 239–244. Northwestward across central Tennessee, the Brassfield becomes dolomitic and in Perry County and vicinity develops basal zone of coarse-grained limestone. Commonly cherty and glauconitic. Lies between overlying Osgood formation or Chattanooga shale, and underlying Mannie or Fernvale formations, or Leipers formation where the Richmond formations are absent as in parts of Columbia quadrangle. Thickness 20 to 50 feet.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 20–21. Niagaran in Illinois is underlain by late Alexandrian formations equivalent to Brassfield limestone of Kentucky and Indiana. These are Sexton Creek limestone in southern half of State and its dolomitic equivalent, Kankakee dolomite in northern part of State.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Feld Conf., Guidebook 6, p. 14, pl. 1. Shown on generalized stratigraphic column of Ordovician and Silurian rocks exposed in Jefferson and Switzerland Counties. Thickness 0 to 11 feet. Underlies Osgood formation; overlies Whitewater formation.

Named for exposures along Louisville and Atlantic Railroad between Brassfield and Panola, Madison County, Ky.

Brasstown Schist[1]

Lower Cambrian: Western North Carolina, central northern Georgia, and eastern Tennessee.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 4.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 285. Green phyllite, slate, and ottrelite-mica schist overlie Big Butt (Tusquitee) quartzite in Murphy syncline. Keith (1907) separated these rocks into Brasstown schist and Valleytown formation. Only locally is there lithologic criteria for separating these rocks into two formations. The phyllites and schists for the most part are closely folded and have prominently developed schistosity which obscures bedding, so that on stratigraphic evidence available they are not readily divisible. In this report, the two formations are treated as Valleytown formation, the more widely used name.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Included in Talladega series believed to be Precambrian.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 48–51. In Mineral Bluff quadrangle, Ga., Keith's (1907) sequence is not entirely applicable. Rocks mapped by LaForge and Phalen (1913, U.S. Geol. Survey Geol. Atlas, Folio 187) as Valleytown formation belong to four formations: Brasstown, Andrews schist, Nottely quartzite, and Mineral Bluff (new). As originally defined, the Valleytown is without definite lower boundary and is lithologically indistinguishable from underlying beds; name Valleytown is not retained. Rocks between Tusquitee quartzite and Murphy marble all conform to Keith's description of the Brasstown, and they are renamed the Brasstown formation.

J. L. Stuckey and S. G. Conrad, 1958, North Carodina Div. Mineral Resources Bull. 71, p. 31–32; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Lower Cambrian(?).

Named for exposures on Brasstown Creek, Clay County, N.C. In Mineral Bluff quadrangle, Ga., crops out in two belts, one on each limb of Murphy syncline.

Brattleboro Phyllite[1]

Ordovician: Southeastern Vermont.

Original reference: C. H: Richardson, 1929, Vermont State Geologist 16th Rept., p. 232.

Named because Brattleboro Township is practically all covered with a fine-grained graphitic phyllite schist.

Bratton Sandstone (in Bluestone Formation)[1]

Bratton Sandstone Member (of Bluestone Formation)

Mississippian (Chesterian): Southeastern West Virginia and southern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 293, 317.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 185, pl. 15. Geographically extended into Virginia and redefined as member of Bluestone formation. Thickness about 10 feet. Overlies Belcher member; underlies Bent Mountain member (new). Consists of greenish-gray micaceous silty sandstone.

Type locality: Near extreme head of Bratton Branch of Brush Creek, Mercer County, W. Va.

Bratton Shale (in Bluestone Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 318.

Type locality: Near extreme head of Bratton Branch of Brush Creek, Mercer County, W. Va.

Brave Boat Harbor Biotite Granite[1]

Carboniferous(?): Southwestern Maine.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 148, 149, 154.

Occurs on northeast side of Brave Boat Harbor, Kittery Township, York County.

Brawley Formation

Pleistocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, p. 23 (fig. 2), 24, 25, pl. 2. Defined as the lacustrine and continental basinward facies of Ocotillo conglomerate (new); at type section about 2,000 feet of light-gray claystone and thin interbeds of buff sandstone are exposed; in Superstition Hills, composed of lacustrine and terrestrial clays, sands, and pebble gravels, and base is not exposed. Around Superstition Mountain, Brawley formation, basal part of which is Ocotillo conglomerate facies, unconformably overlaps Imperial formation, Alverson lava (new), and Split Mountain formation onto diorite; southeastward and adjacent to Superstition Mountain fault, Ocotillo-Brawley series lies unconformably on Borrego clays, and an angular discordance of as much as 60° is exposed north of fault.

Type section: West of U.S. Highway 99 and west of the south end of the Salton Sea, Imperial County.

Braxton Formation[1]

Pennsylvanian: Northern West Virginia.

Original reference: J. A. Taff and A. H. Brooks, 1896, U.S. Geol. Survey Geol. Atlas, Folio 34.

In greater part of Braxton County.

Brayman Shale[1]

Silurian: Eastern New York.

Original reference: A. W. Grabau, 1906, New York State Mus. Bull. 92, p. 101.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 9 (table 7), 13. Thickness 9 feet in Albany County. Overlies Indian Ladder formation; underlies Cobleskill limestone. Silurian.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW–22, p. 10 (table 2), 14–15. In Shoharie County, gradationally overlies Schenectady formation and underlies Cobleskill limestone. Thickness 20 to 40 feet. Upper Ordovician(?).

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 3–14. Brayman is here regarded as eastern extension of Bertie and upper Camillus formations. Discontinuation of name "Brayman" as an Ordovician residual soil is advocated. Proposed here that name Brayman be applied to undifferentiated strata of Camillus and Bertie age in area from Vanhornesville, Herkimer County, to Gallupville, Schoharie County. Brayman lies first upon Ordovician strata in type area and at Sharon Springs. West of Cherry Valley, it lies upon progressively younger strata of Middle and Upper Silurian. At western border of Richfield Springs quadrangle, the Lockport, Vernon, Camillus, and Bertie have all appeared in section beneath the Cobleskill. Thickness about 135 feet at Vanhornesville; 80 feet at Sharon Springs; 17 feet at Gallupville; only a few feet of uppermost Brayman exposed at type section. Thins eastward; diminution due to loss of strata from base so that Brayman includes more time stratigraphically in its western exposures. Everywhere conformably underlies Cobleskill. Upper Silurian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Shown on correlation chart as Upper Silurian.

Type locality: Along County road one-half mile west of Howes Cave. Named for Braymanville, Cobleskill County.

Brazer Limestone[1] or Dolomite

Mississippian: Northeastern Utah, eastern and south-central Idaho, and southwestern Wyoming.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 413.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 22–24, pls. 1, 6. Brazer limestone, in Randolph quadrangle, Utah-Wyoming, consists of massive gray siliceous limestone and sandstone; cherty in places; lower part thin-bedded and shaly, locally phosphatic. Thickness 1,100 feet. Overlies Madison limestone; underlies Wells formation.

J. S. Williams, 1943, Geol. Soc. America Bull., v. 54, no. 4, 610–612, measured sections. Brazer formation at type locality (herein considered to be Brazer Canyon) is 500 feet thick; neither top nor bottom of formation exposed. Overlies Madison formation; underlies Morgan or Wells formation. Traced eastward nearly to Colorado State line; thickness varies greatly over compartively short distances.

J. S. Williams and J. S. Yolton, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 8, p. 1143–1155. Thickness 3,700 feet in section at Dry Lake, Logan quadrangle, Utah. Five units or faunal zones described. Formation at Dry Lake section includes rocks of Iowan and Chesterian age, extending probably from an equivalent of the Warsaw to latest Chester. Underlies Wells formation.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2161–2162. Beds exposed in southwestern Montana appear to be correlative with those described by Ross (1934, Geol. Soc. America Bull., v. 45, no. 5) in Idaho and are here tentatively assigned to the Brazer. However, neither the southwestern Montana nor the Idaho beds bear much resemblance to type Brazer; a new term seems to be required. Thickness 1,718 feet in Beaverhead County, Mont.

W. L. Stokes, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 16. Westernmost exposures of formation are near Rockland, Idaho. Thickness at least 4,000 feet in east-central Idaho; thinner in Wyoming where the Sacajawea may represent a featheredge. Upper Mississippian.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51–57. In southeastern Idaho, the Brazer should be classed as a formation and placed in Madison group containing, in addition to the Brazer, the Mission Canyon and Lodgepole formations. In northern Utah, Upper Mississippian strata formerly included in the Brazer are subdivided into a Chester and a Meramec series on basis of regional correlation and faunal suites. The Brazer should be restricted to rocks of Meramec age and to a facies consisting predominantly of partially dolomitized limestone, siliceous limestone, and calcareous sandstone. Brazer facies is an intermediate stage between dominantly sandstone Humbug formation of north-central Utah and upper Madison limestone of Wyoming. Section of rocks of Chester age formerly included with the Brazer (Williams, 1943; Williams and Yolton, 1945) are raised to group rank, consisting of (ascending) unit 3, Long Trail

formation; unit 4, unnamed thin- to medium-bedded cherty limestone sequence; unit 5, Manning Canyon formation. Units 1 and 2 are classed as members of the Brazer as defined in this paper.

W. J. Sando, J. T. Dutro, Jr., and W. C. Gere, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2741–2769. Brazer dolomite in its type area consists of about 850 feet of dolomite with a few beds of quartz sandstone and limestone near top. Divided into three members (unnamed) in Crawford Mountains, Utah. Member 1 consists mainly of thin-bedded cherty fine-grained dolomite weathering dark-yellowish brown; member 2, thick-bedded medium- to coarse-crystalline crinoidal cherty dolomite weathering mostly yellowish gray: member 3 consists of several distinct rock types that are interbedded, most common type being thin-bedded fine-grained dolomite weathering dark yellowish brown. Overlies Lodgepole limestone. Underlies sandstones and carbonate rocks that are referred to Wells formation as used by McKelvey and others (1956). Lower two-thirds of formation has yielded fauna of Early Mississippian age that suggests correlation with Mission Canyon limestone of type Madison group; upper third of formation contains fauna of uncertain affinities, interpreted as Late Mississippian in age. Inasmuch as Brazer cannot be recognized on lithologic or faunal basis outside type area, it is herein recommended that name be restricted to Mississippian dolomite sequence in Crawford Mountains. New nomenclature should be devised for Upper Mississippian limestone-sandstone facies, perviously called Brazer, in northern Cordilleran region. Richardson (1913, 1941) did not indicate precise type locality nor give detailed section in either of his papers on Randolph quadrangle. Recent interpretations of type Brazer have been based on Williams statement (1943) that type section is at mouth of Brazer Canyon where the formation is incomplete because of faulting. Reasons presented for regarding this interpretation as incorrect and site for type section suggested.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. Discussion of Late Paleozoic stratigraphy and paleotectonics of central and eastern Idaho. Milligen, Muldoon (new), Wood River, and Lemhi (new) formation recognized. Lemhi formation replaces term Brazer.

C. P. Ross, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B232. Discussion of interfingering Carboniferous strata in Mackay quadrangle, Idaho. Rocks commonly called Brazer limestone are widespread from interrupted zone trending nearly north through middle of quadrangle well to north and eastward into Montana. In Mackay quadrangle, their thickness exceeds 8,000 feet. They consist mainly of limestone but include some quartzite and conglomerate of Mississippian age. As originally used in central Idaho (Ross, 1934, Geol. Soc. America Bull., v. 45, no. 5), the Brazer limestone is of Late Mississippian age, but, in localities far to northeast of Mackay quadrangle, limestone that has not yet been mapped separately from the Brazer limestone has yielded fossils of Pennsylvanian and Permian age. In that part of Idaho, the Brazer limestone together with these younger associated beds may have an aggregate thickness of more than 10,000 feet. In Mackay quadrangle, rocks that were mapped as Brazer are now known on basis of paleontologic evidence to be largely of Early to Late Mississippian age, and in several outcrops they even include rocks of Pennsylvanian age; the Pennsylvanian limestone, however, cannot be distinguished in map-

ping from limestone of Mississippian age without far more refined work than has been practicable so far.

Type section (Sando, Dutro, and Gere): NW¼ sec. 20, T. 11 N., R. 8 E., Rich County, Utah. Named for exposures in Brazer Canyon, Rich County, Utah.

Brazil Formation[1]

Brazil Group

Middle Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. Includes Minshall limestone (new).

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (Column 25). Shown on correlation chart as Brazil formation. Includes strata from base of Connellton coal to a little above top of Minshall limestone. Underlies Staunton formation; overlies Mansfield formation.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 89, 90. Referred to as Brazil group. Contains Grandview limestone (new) near top.

F. E. Kottlowski, 1959, U.S. Geol. Survey Coal Inv. Map C–28. As defined by Cumings (1922, Indiana Dept. Conserv. Spec. Pub. 21, pt. 4) formation includes rocks between base of Lower Black coal and unconformity at top of Coal II. In type area, formation is about 75 feet thick and includes four principal named coals (ascending): Lower Block, Upper Block, Minshall, and Coal II. Between Minshall coal and Coal II is Minshall limestone. In strictest sense, unconformity at top of Brazil is not at top of Coal II but at base of prominent sandstone that lies a few feet below Coal III. In Coal City quadrangle, this sandstone, which is basal member of overlying Staunton formation, generally rests on Minshall limestone member, on the gray or black shale beneath the limestone, or on Minshall coal. Hence, thickness of formation in Coal City quadrangle ranges from 35 to 94 feet. Overlies Mansfield formation.

H. C. Hutchinson, 1960, Indiana Geol. Survey Bull. 16, p. 12–21, pl. 1. Formation described in Brazil quadrangle where it ranges from 40 to 90 feet in thickness and includes commercially mined coals, the Minshall and Coal II, and Perth limestone member (new) which closely overlies Minshall coal. Overlies Mansfield formation and underlies Staunton formation.

Named for Brazil, Clay County.

Brazil Limestone[1]

Pennsylvanian: Central western Indiana.

Original reference: F. C. Greene, 1911, Indiana Acad. Sci. Proc. 1910, p. 169–171.

Named for Brazil, Clay County.

Brazil Branch Breccia[1]

Cretaceous: Central northern Arkansas.

Original references: C. Croneis and M. Billings, 1929, Jour. Geology, v. 37, p. 543, 554; 1930, Arkansas Geol. Survey Bull. 3, p. 158–160.

Crops out in W½SE¼ sec. 29, T. 4 N., R. 17 W., about 3 miles south by west of Perryville, in valley of Brazil Branch, a perennial tributary of Fourche la Fave River, on land owned by J. R. Myers, Perry County.

†Brazos Sandstone[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

Named for widely distributed exposures along Brazos River, especially the high cliff at Inspiration Point, 8 miles due south of Mineral Wells.

†Brazos Series[1]

Upper Permian and Triassic: Texas, southern Kansas, eastern New Mexico, and Oklahoma.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 100–103.

Named for Brazos River, central northern Texas.

Brazos River Conglomerate Member (of Garner Formation)[1]

Brazos River Sandstone Member (of Garner Formation)

Middle Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

R. J. Cordell and others, 1954, Abilene Geol. Soc. Guidebook Nov. 19–20, fig. 2. Faunal break occurs in Brazos River sandstone and conglomerate. Part of unit is assigned to East Mountain shale and part retained in Garner formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 21–22, fig. 3, pl. 1. Referred to as sandstone member of Garner in report on Parker County. Essentially massive and crossbedded with lenses and beds of coarse conglomerate and minor shale beds; in some areas, conglomerate is missing. Thickness uniformly 25 to 30 feet. Overlies Mingus shale member; underlies East Mountain formation.

Named for exposures along Brazos River, especially cliff at Inspiration Point, 8 miles south of Mineral Wells, Palo Pinto County.

Breakwater Quartzite[1]

Precambrian (upper Huronian): Northeastern Wisconsin.

Original reference: C. K. Keith, R. J. Lund, and A. Leith, 1935, U.S. Geol. Survey Prof. Paper 184, p. 4.

Named for its location near Breakwater Falls on Pine River, Florence County.

Breathitt Formation or Group

Breathitt Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southeastern Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 47.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 82, 88, 94. Magoffin shale and limestone, Kendrick shale, and Elkins Fork shale are listed in Breathitt formation.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 22). Correlation chart shows Lost Creek limestone and Flint

Ridge flint in upper part of Breathitt formation in Kentucky River valley.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 64, 65, 76, 136, 153. Includes Whetstone Creek shale member (new) in Whitley County area. In Letcher County, includes Bee Tree shale.

R. E. Hauser, 1953, Kentucky Geol. Survey, ser. 9, Bull. 13, p. 11 (fig. 2), 13–28. In Paintsville quadrangle, named units, not including coals are (ascending) Quakertown shale, Campbell Creek limestone, Elkins Fork shale, Kendrick shale, and Magoffin limestone.

J. A. Baker, 1955, U.S. Geol. Survey Water-Supply Paper 1257, p. 32–36. At type locality, the Breathitt includes rocks of Pottsville age only. However, no upper boundary has been defined, and formation includes rocks of Allegheny age in other localities. In Paintsville area, all consolidated rocks above massive sandstones of Lee formation are included in the Breathitt.

Named from exposures in Breathitt County.

†Breckenridge Formation (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. C. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Near east end of Breckenridge oil field.

Breckenridge Limestone Member (of Thrifty Formation)[1]

Breckenridge Formation (in Thrifty Group)

Upper Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 152, 154, 155, 160; 1922, Jour. Geology, v. 30, p. 24.

Wallace Lee, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 54, 61. Upper part of Thrifty formation, in Brazos River area, contains several beds of limestone, including Ivan and Blach Ranch members and, at top. Breckenridge limestone member. Thickness of Breckenridge varies from 5 feet near Crystal Falls to 1½ feet near McCann Bridge. Underlies Harpersville formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Rank raised to formation in Thrifty group. Underlies Chaffin formation; overlies Speck Mountain formation.

D. A. Myers, 1958, Jour. Paleontology, v. 32, no. 4, p. 678 (fig. 1). Shown on stratigraphic column as member of Thrifty formation. Occurs below Chaffin member and above Speck Mountain member.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 7 (fig. 2), 8 (fig. 3), 18–20, pls. 1, 2. Plummer (1919) applied name "Breckenridge formation" to a section containing three persistent limestone beds and one local limestone, thick shale beds, and lenticular sandstones above his "Gunsight" limestone. The three limestone beds which "form escarpments around east end of Breckenridge oil field" (idem) are the Breckenridge, Blach Ranch, and Ivan limestones of Plummer and Moore's (1921) classification. Breckenridge limestone member was defined by Plummer and Moore as upper limestone of Thrifty formation. It was described as gray, massive, and resistant, from 3 to 4 feet thick, and lying 25 to 45 feet above Blach Ranch member. Plummer and Moore did not include measured section of Brecken-

ridge limestone in its type area, and nearest sections to it were measured at type Blach Ranch area, 10½ miles northeast of Breckenridge and "in escarpment 2 miles northeast of Harpersville" (idem, p. 156), about 8 or 9 miles south of Breckenridge. Line labeled "Breckenridge limestone" on Plummer and Moore's plate 1 is not outcrop of Breckenridge limestone according to their type description but is the outcrop of Blach Ranch limestone. Bradish (1937, Geologic map of Brown County) and Plummer and others (1949, Texas Univ. Bur. Econ. Geology Pub. 4915, pl. 4) traced outcrop of type Breckenridge limestone in type area and Lee (1938) traced Breckenridge limestone in northern Stephens County. Mapping for present report shows that the limestone which Plummer and Moore labeled "Breckenridge" in each of their measured sections in Stephens and Young Counties correlates with their type Breckenridge. Hence, the inconsistency between type description of Breckenridge limestone and outcrop map is interpreted as mislabeling and not an error in type description. Type reference section herein described. Breckenridge outcrop is prominent escarpment throughout most of area. The resistant massive mottled bed of Breckenridge member that caps this escarpment and many outliers is of uniform lithology and thickness. This limestone bed averages 1.8 feet and weathers into angular irregular fragments, usually mottled gray to orange or reddish brown. About 1 foot of nodular or irregularly bedded limestone occurs above and below the massive mottled bed except near Breckenridge, where these limestone units thicken to 3 or 4 feet. Overlies unnamed shale member; underlies Quinn clay member of Harpersville formation.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 72–73, pl. 27. Breckenridge limestone member was named by Plummer and Moore (1921) for a gray massive resistant limestone, 3 or 4 feet thick, forming prominent escarpment in and about Breckenridge in Stephens County. They considered it easily traceable to northeast and south and possibly identifiable with upper Chaffin bed of Drake (1893) in Colorado River valley. Bullard and Cuyler (1935, Texas Univ. Bull. 3501) followed Plummer and Moore's correlations, and the bed they mapped as Breckenridge through northern McCulloch County is the Chaffin limestone of Drake (1893). Cheney and Eargle (1951, Geologic map of Brown County) mapped the Breckenridge and showed it in the interval between their Chaffin and Speck Mountain limestones. Breckenridge was mapped for present report as far southwest as Home Creek and was found to be correlative with the bed Drake considered the lower Chaffin limestone. From vicinity of Home Creek southwest to Colorado River in southeastern Coleman County, this limestone and shale immediately above and below it is removed by channel erosion and channel filled by Parks Mountain sandstone member. Breckenridge not recognized south of Colorado River. Breckenridge is 20 to 40 feet above Speck Mountain limestone member. Beds that intervene between Breckenridge and Chaffin members in Brown County and north of Home Creek in eastern Coleman County are red clay. Plummer and Bradley (1949) named this Quinn clay for exposures in Eastland County.

Type reference section (Brown): On Harris Veale property, near south city limits of Breckenridge, west of U.S. Highway 183, Stephens County. Lower part of section measured from base of Blach Ranch limestone at road level on west side U.S. Highway 183 westward to pond excavated in Breckenridge limestone at top of prominent escarpment (fig. 5, beds

1A–5A). Upper part of section offset westward along outcrop of massive mottled bed of Breckenridge (fig. 5, bed 5A); upper interval measured from base of bioclastic limestone bed of Breckenridge, exposed in gully 1, northwest 20 yards, then southwest to sandstone above Crystal Falls limestone at top of isolated hill (fig. 5, beds 5B–12). All three units of Breckenridge (beds 5A, B, and C) are partly exposed in gullies 2 and 3, beds 5B and 5C are best exposed in gully 1. Makes prominent escarpment in and about town of Breckenridge, Stephens County.

Brecksville Shale (in Orangeville Shale Member of Cuyahoga Formation)

†Brecksville Shale Member (of Orangeville Shale)[1]

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 69, 98, 127.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 137. Noted as Brecksville shale in Orangeville member of Cuyahoga.

Named for Brecksville, Cuyahoga County.

Breezy Hill cyclothem

See **Breezy Hill Limestone Member** (of Cabaniss Formation)

Breezy Hill Limestone Member (of Cabaniss Formation)

Breezy Hill Limestone Member (of Senora Formation)

Breezy Hill Limestone Member (of Cherokee Shale)

Breezy Hill Limestone Member (of Mulky Formation)

Pennsylvanian (Des Moines Series): Kansas, Missouri, and Oklahoma.

W. G. Pierce and W. H. Courtier, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 17; 1938, Kansas Geol. Survey Bull. 24, p. 33–35. Breezy Hill limestone member is about 5 feet below top of the Cherokee; in most places it consists of 6 inches to 2 feet of gray impure concretionary to nodular limestone but may exhibit considerable variation in thickness and character of material. In most places it is from 1 to 3 feet below Fort Scott coal; where coal is absent, Breezy Hill maintains its same stratigraphic position and is from 4 to 8 feet below top of the Cherokee. Underlain by Squirrel sand of drillers.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2091–2092. Member of Cherokee formation. Geographically extended into northern Oklahoma where it is essentially a single massive bed about 3 feet thick. Overlies Kinnison shale member (new); underlies covered interval to base of lower limestone member of Fort Scott formation (Blackjack Creek). Has been identified as lower Fort Scott in northern Oklahoma.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 99. Included in Breezy Hill cyclothem.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Shown as Breezy Hill limestone in Mulky coal cycle of Senora formation in Oklahoma. Occurs above Kinnison shale. Mulky coal and underclay not present in Oklahoma.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 84–87, measured sections. Reallocated to member status in Mulky formation. Occurs below underclay of Mulky coal, where latter is present, and above Lagonda ("Squirrel") sandstone in southeastern Kansas or above Kinni-

son shale in northern Oklahoma. Known in western and northern Missouri only from scattered exposures.

J. V. A. Trumbul', 1957, U.S. Geol. Survey Bull. 1042–J. pl. 16. Member of Senora formation in Oklahoma.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as member of Cabaniss formation.

Named for exposures at Breezy Hill, southwest of Mulberry, Crawford County, Kans.

Breien Member (of Hell Creek Formation)

Upper Cretaceous: Southwestern North Dakota.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 14–15. Consists of two beds of gray sand separated by gray bentonite. Maximum thickness 31 feet. Interfingers with basal part of formation; base occurs about 20 feet above base of Hell Creek.

Named for occurrence near village of Breien in T. 134, N., R. 82 W., Morton County.

Breitenbush Series or Tuffs

Oligocene to Miocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 704, 705, 709 (fig. 2), 713 (fig. 3). Dominantly tuffaceous; basal exposed part consists of rhyolitic lavas and pyroclastics. Thickness about 7,500 feet. Along Breitenbush River, underlies Sardine series (new); contact gradational. In some areas unconformably underlies Outerson basalts (new).

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 9–10, fig. 1 (geol. map). Referred to as tuffs; about 7,500 feet of water-worked, land-laid tuffs, breccias, and conglomerates, interlayered with lava flows. Although upper beds are Miocene in part, most of tuffs are probably Oligocene, and some may be as old as Eocene. Mapped as Oligocene-Miocene. Type section stated.

Type section: Along Breitenbush River between French and Fox Creeks which are 1 and 5½ miles, respectively, east of Detroit, Marion County.

Bremen Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Northern central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175.

Named for exposures in Bremen northwest corner of Birmingham quadrangle, Cullman County.

Bremo Quartzite

Silurian or younger: Central Virginia.

G. W. Stose and A. J. Stose, 1948, Am. Jour. Sci., v. 246, no. 7, p. 397–401, 408. Quartzite, about 400 feet thick, that overlies Arvonia slate. Consists of three units: upper and lower, each about 150 feet thick, of thin-bedded quartzite and interbedded knotted slate closely folded and a middle unit of massive quartzite, about 100 feet thick, with a few shale partings; vertical. Structure interpreted as isoclinal syncline.

Named for occurrence at Bremo Bluff, a prominent cliff of quartzite which rises 150 feet above floor of James River at point just east of bridge over river on U.S. Highway 15, Fluvanna County.

Brentwood Limestone Member (of Bloyd Shale)[1]

Lower Pennsylvanian (Morrow Series): Northwestern Arkansas and northeastern Oklahoma.

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 28, 109.

C. A. Moore, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 3, p. 427–430. Geographically extended into Adair County, Okla., where it is defined to include shale and limestone members of the Bloyd between top of Hale formation and base of Kessler member of the Bloyd. Here consists of blue-black fissile clay shale with thin discontinuous limestone beds. On Bugger Mountain, exposed part of Brentwood is 65 feet thick.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66, p. 39. The Brentwood loses its identity in Oklahoma and becomes indistinguishable in a sequence of alternating, thin, discontinuous limestones and interbedded shale of the lower Bloyd.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1942–1943. Further described in area of type locality where it is recognizable largely by its position between Prairie Grove member (new) of Hale formation below and terrestrial sediments above that comprise newly defined Woolsey member of the Bloyd.

Named from exposures in vicinity of Brentwood Station, Washington County, Ark.

Brereton cyclothem (in Carbondale Formation)

Brereton cyclothem[1] (in Carbondale Group)

Pennsylvanian: Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 182, 192.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). In list of Upper Pennsylvanian cyclothems, occurs below Jamestown cyclothem (new).

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 60–61, 103–113, pl. 5. Described in Beardstown, Glasford, Havana, and Vermont quadrangles, where it includes (ascending) Cuba sandstone, Big Creek shale, Herrin (No. 6) coal, Brereton limestone, and Sheffield shale. Underlies Pokeberry cyclothem believed to be equivalent to Jamestown cyclothem. Derivation of name and type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Carbondale formation (redefined). Above St. David cyclothem and below Jamestown cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type section: Along Middle Branch of Copperas Creek, 2 miles northeast of Brereton, in NE¼SE¼NE¼ sec. 1, T. 7 N., R. 4 E., Glasford quadrangle, Fulton County.

Brereton Limestone Member (of Carbondale Formation)

Brereton Limestone (in McLeansboro Formation)[1]

Brereton Limestone (in McLeansboro Group)

Brereton Limestone (in Petersburg Formation)

Pennsylvanian: Central western Illinois and southwestern Indiana.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as limestone in Petersburg formation in Indiana.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 111–112. Included in Brereton cyclothem, McLeansboro group. Overlain and underlain by unnamed shale units. Stratigraphically below Sheffield shale (new).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 48 (table 1), 65, pl. 1. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Carbondale redefined as formation and includes Brereton limestone member. Name Brereton is extended to caprock of No. 6 coal in southern Illinois to replace name Herrin, now restricted to Herrin (No. 6) coal member. Underlies Jamestown coal member in southern Illinois and Lawson shale member (new) in western and northern Illinois. Thickness 3½ feet.

Type locality: East bank Middle Copperas Creek, SE¼NE¼ sec. 1, T. 7 N., R. 4 E., Fulton County, Ill.

Brevard Schist[1]

Brevard Series

Lower Cambrian: Western North Carolina, northwestern Georgia, and northwestern South Carolina.

Original reference: A. Keith, 1905, U.S. Geol. Survey Geol. Atlas, Folio 124, p. 5.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 23–27. Discussion of crystalline rocks of Georgia. Rocks are grouped into 11 belts, in part using names proposed by Adams (1933, Jour. Geology, v. 41, no. 2). Brevard series occupies belt averaging about 2 miles in width and extending from Habersham County southwestward across state into Alabama. Series includes biotite gneiss, mica schist, quartzite, chlorite schist, and marble. Brevard schist was mapped as Cambrian by Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 147) but is similar to schists in Carolina series. Brevard schist traced southwestward into Alabama where it is included in Ashland and Wedowee formations. Keith believed Brevard schist rested unconformably on Carolina gneiss and old granites, but no evidence of this unconformity is to be found in Georgia. Henderson granite gneiss in North Carolina and Lithonia granite gneiss in Georgia are instrusive into Brevard schist. Name Brevard is retained, but author [Crickmay] believes that Brevard series is essentially part of Carolina series and is Precambrian.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 31; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000); North Carolina Div. Mineral Resources. Fine-grained black and dark schist with lenses of limestone varying from a few hundred feet to more than 1 mile in length and up to 250 feet in thickness. Lower Cambrian(?).

Named for exposures near Brevard, Transylvania County, N.C.

Brewer Phyllite

Brewer Phyllite Member (of Talladega Slate)[1]

Precambrian or Paleozoic: Northeastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 52, map.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226. Rank raised to formation. Overlies Waxahatchee slate; underlies Wash Creek slate (new). Thickness 200 to 500 feet.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 20, 21. Overlies Waxahatchee slate. Underlies Wash Creek slate. Thickness 200 to 500 feet. In Talladega series.

Named for exposures at Brewer School, in Columbiana quadrangle, Chilton County.

Brewer Creek Latite[1]

Tertiary: Southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, the volcanics in order of succession are Rawley andesite, Bonanza latite, Squirrel Gulch latite, Porphyry Peak rhyolite, and Bremer [Brewer] Creek latite. In South Bonanza district, volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and Bonanza latite is replaced by Hayden Peak latite.

Exposed north of and westward along Brewer Creek, Saguache County.

Brewer Dock Limestone (in Clinton Group)

Brewer Dock Member[1] (of Reynales Limestone)

Middle Silurian: West-central New York.

Original reference: H. E. Alling and J. E. Hoffmeister, 1932, 16th Int. Geol. Cong. Guidebook 4, p. 106, 107, 108, chart opposite p. 6.

D. W. Fisher, 1953, Buffalo Soc. Nat. Sci. Bull., v. 21, no. 2, p. 27 (fig. 1), 31–32. Argillaceous limestone with many shale partings. Shale is greenish gray in contrast to bright-green shale of underlying Maplewood. Thickness 3 feet in Genesee Gorge; thins eastward to 2½ feet at Glen Edythe; not identified outside Rochester area. Fauna is similar to the Lower Reynales (Reynales limestone of Niagara Gorge) with which it is correlated as being a more argillaceous near-shore phase. Middle Silurian.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 47. Suggested that Brewer Dock, defined by Sanford (1935, Jour. Geology, v. 43, no. 2) as member of Reynales, be retained for discussing local geology of Rochester and vicinity. In that area, Brewer Dock is separated from rest of Reynales by the Furnaceville. In other parts of western New York where that condition does not exist, use of Brewer Dock is not justified.

D. W. Fisher, 1959, New York State Mus. Sci. Service Map and Chart Ser., no. 1. Included in Clinton group. Middle Silurian.

Typically exposed in Genesee Gorge near Brewer Dock, vicinity of Rochester, Monroe County.

Brewerton Shale[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 28 (table 3). Listed on correlation chart showing development of Niagaran nomenclature.

Exposed at Brewerton, Onondaga County.

†Brewerville Sandstone (in Chester Group)[1]

Mississippian: Southwestern Illinois and southeastern Missouri.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 121.

Named for Brewerville Township, Randolph County, Ill., where it is well exposed in Mississippi River bluffs.

†Brewster Formation[1]

Middle Ordovician: Southwestern Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Bose, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 35, 37.

Named for exposures in Brewster County.

Brezee Phyllite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 399.

Named for Brezee Mill Creek, which flows out of northeast end of Taconic Range, 3 miles south-southwest of Brandon, Rutland County.

Brian Head Formation

Miocene(?): Southwestern Utah.

H. E. Gregory, 1944, Am. Jour. Sci., v. 242, no. 11, p. 591–597, 599, 601, 602. Series of white, calcareous, and siliceous shalelike beds overlain by gray igneous agglomerates which in places form surface of plateaus and in other places extend upward to capping sheets of black lava. Thickness about 80 feet in Antimony Canyon; 520 feet in Horse Creek Canyon; 968 feet in North Branch of Limekiln Gulch. Overlies Wasatch formation.

H. E. Gregory, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 983–986, 987–988, 989. Forms almost entire surface of Markagunt Plateau. Along westward-facing cliffs of Sevier Plateau, where entire formation is exposed, stratified calcareous and tuffaceous rocks are separated from overlying dark-gray coarse agglomerate by erosional unconformity believed to be regional in extent. Because of this persistent time break, it has been suggested that Brian Head be restricted to stratified beds and agglomerate correlated with Bullion Canyon volcanics of Tushar and northern Sevier Plateaus.

R. L. Threet, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1386. At type locality, formation includes about 500 feet of interbedded volcanic ash and chalcedony, dacite lava, andesite breccia, and sheeted rhyolitic vitrophyre and tuff. The sheeted vitrophyre at top of type section is a glassy basal zone of the rhyolitic welded tuff caprock of Brian Head Peak. The andesite breccia and dacite lava immediately beneath the sheeted vitrophyre are a local agglomeratic phase of massive andesite lavas which constitute basal formation in group of Tertiary

flows and welded tuffs which cap southern High Plateaus. Inasmuch as type Brian Head includes considerable thickness of rocks which are part of overlying group of flows and welded tuffs, it is suggested that term Brian Head formation be restricted, redefined, or abandoned.

Name derived from Brian Head, prominent projection of Markagunt Plateau near Cedar Breaks National Monument.

Briarcliff Dolomite

Upper Cambrian: Southeastern New York.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212; 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1817. Dominantly light dolomites with some dark beds. Fossils indicate a horizon not earlier than middle Franconian nor later than middle Trempealeauian state, probably early Trempealeauian. Thickness 700 to 1,000 feet. Occurs below Halcyon Lake calc-dolomite (new) and above White Plains formation (new).

Described in area of Stissing Mountain, Dutchess County.

Briar Hill Coal Member (of Carbondale Formation)

Pennsylvanian: Western Kentucky and southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 47 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above St. David limestone member and below Vermilionville sandstone member. Coal named by Glenn (1912, Kentucky Geol. Survey Bull. 17). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: In mines at DeKoven, Shawneetown quadrangle, Union County, Ky.

Briar Hill cyclothem (in Carbondale Formation)

Pennsylvanian: Southwestern and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 52 (table 2), pl. 1. Proposed for unit formerly termed Crab Orchard cyclothem. Contains Briar Hill (No. 5) coal member. Occurs above St. David cyclothem and below Brereton cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Name derived from Briar Hill near village of DeKoven, Union County, Ky.

Briceville Shale

Briceville Formation

Briceville Shale (in Pottsville Group)[1]

Pennsylvanian: Eastern Tennessee.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 25, p. 4.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 58–63. Briceville formation includes 500 to 1,000 feet of strata, predominantly shale. Underlies Jellico formation; overlies Lee group. Term Briceville seems to have been applied to strata down to Corbin sandstone near Oneida and Helenwood, Scott County, but farther south it seems to have been extended down to Rockcastle sandstone. Recommended that term Duskin

Creek be used for strata between the Corbin and Rockcastle where position of Corbin can be determined.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1958, Pennsylvanian Geology of Cumberland Plateau: Tennessee Div. Geology [Folio], p. 1. As result of recent field work, formation names Briceville, Jellico, Scott, and Anderson are discontinued and complete new classification is presented. Strata termed Briceville are included in Slatestone group (new).

U.S. Geological Survey has discontinued the use of the term Pottsville Group in Tennessee.

Named for occurrence at Briceville, Anderson County.

Brickeys Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone or dolomite; thin- to medium-bedded. Thickness about 2 feet. Shown on columnar section as underlying Boarman member (new) of Mifflin formation and overlying Oglesby member (new) of Pecatonica formation.

In copy of guidebook used by compiler, a handwritten note states Brickeys member overlies Boarman member. Since compiler had no way to determine what changes, if any, had been made in other copies of guidebook, it was impossible to be certain of true stratigraphic relation.

Occurs in Dixon-Oregon area.

Brick Yard Limestone[1]

Pennsylvanian: Northern central Texas.

Original reference: W. G. Wender, 1929, Texas Bur. Econ. Geology, geol. map of Eastland County.

Bridalveil Granite[1]

Cretaceous: Northern California.

Original reference: H. W. Turner, 1899, Jour. Geology, v. 7, p. 154.

U.S. Geological Survey currently designates the age of the Bridalveil Granite as Cretaceous on the basis of a study now in progress.

Forms brink of Bridalveil Fall in Yosemite National Park.

Bridgeburg horizon[1]

Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

Derivation of name not stated.

Bridge Creek Limestone Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 67.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. In Hamilton County, Kans., Pfeifer shale member and underlying Jetmore chalk member are thicker than farther east; they cannot be distinguished and have been together designated the Bridge Creek limestone member, having a total thickness of 74 feet.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 117–119. In Baca County, Colo., member contains alternating beds of chalky limestone and limy shale with a few thin layers of bentonite;

limestone beds are 3 to 12 inches thick and are separated by 6 inches to 6 feet of shale. Thickness 62 feet along Two Butte Creek; thickens eastward to 74 feet in Hamilton County, Kans.; thins westward to 35 feet in Model anticline in Las Animas County. Overlies Hartland shale member.

Named for exposures in Bridge Creek northwest of Medway, Hamilton County, Kans.

Bridge Creek Shales[1]

Oligocene or Miocene: Central northern Oregon.

Original references: R. W. Chaney, 1927, Carnegie Inst. Washington Pub. 346; 1927, Pub. 349, p. 1–22.

John Day Basin.

Bridgeport Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. Bose, 1918, Texas Univ. Bull. 175, p. 12–13.

Exposed in western part of East Bridgeport, Wise County.

Bridgeport Member (of Bloomsburg Formation)

Bridgeport Sandstone (in Wills Creek Shale)[1]

Silurian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F_2, p. 57–58.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5. Reallocated to member status in Bloomsburg formation. Occurs near middle of formation.

Named for exposures near Bridgeport, Perry County.

Bridger Formation[1]

Eocene, middle and upper(?): Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original references: F. V. Hayden, 1869, U.S. Geol. Survey Terr. 3d Ann. Rept., p. 191 of 1873 ed.; Henry Engelmann, 1876, (Fort Bridger series) *in* Appendix 1 of a report of explorations across the Great Basin of the territory of Utah for a direct wagon route from Camp Floyd to Genoa, in Carson Valley, in 1859, by Capt. James H. Simpson, Engineer Dept., U.S. Army: Washington, U.S. Govt. Printing Office, p. 287–291.

W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168, p. 19–22. In part of Piceance Creek basin, Colorado, rocks of Green River formation are overlain by 400 feet of sandy beds of fluviatile origin that appear to be lithologically and stratigraphically equivalent to basal beds of Bridger formation of Uinta basin. In eastern part of Uinta basin, lower part of Bridger is brown massive sandstone about 800 feet thick. Upper part of formation consists of greenish, drab, red, maroon, ash-gray, and buff sandy mudstone. Locally, contact between Bridger and underlying Green River has been distorted by differential compaction. Underlies Uinta formation.

H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, p. 241–242. In southwestern Wyoming, subdivided into Blacks Fork member below and Twin Buttes member above.

R. L. Nace, 1939, Wyoming Geol. Survey Bull. 27, p. 11 (table), 19–21, pl. 1. For purposes of this report [Red Desert], Bridger formation is divided

into upper and lower parts, but terms "upper" and "lower" are not intended to indicate time relation to typical Bridger formation in Bridger basin. They are lithologic divisions of formation as it is developed in map area. Lower Bridger is an alternation of somber-colored sandstones, clays, mudstones, shales, and limestones. Upper Bridger is predominantly sandstone and shale. Thickness 670 to 765 feet. Overlies Morrow Creek tongue of Green River; disconformably underlies Continental Peak formation (new). Middle Eocene.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 416. Discussion of Green River and Uinta formations in Duchesne, Uintah, and Wasatch Counties, Utah. Uinta formation comprises thick sequence of chiefly fluviatile beds, but includes varying amount of lacustrine beds. Westward from Colorado State line to the Green River, where formation has been most studied, it contains three recognized vertebrate faunal zones of middle to late Eocene age, and surface exposures indicate thickness of 1,500 to 2,000 feet. This sequence conformably overlies Green River formation as was formerly divided by U.S. Geological Survey into Bridger and Uinta formations. More general recent usage has been to refer entire sequence to Uinta formation, which usage is followed here.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 101, 103. Overlies Morrow Creek member of Green River formation in central part of Great Divide basin, Sweetwater County, Wyo.; underlies Browns Park formation. Thickness 60 to 100 feet.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1074. Overlies Laney shale member of Green River in Bridger basin. Term Morrow Creek abandoned.

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 136. Formation discussed in report on paleontological exploration and dating of early Tertiary deposits in basins adjacent to Uinta Mountains.

Named for exposures in vicinity of Fort Bridger, Uinta County, Wyo.

Bridgerian Age

Eocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 10, pl. 1. Provincial time term, based on the Bridger formation of southwestern Wyoming (of a redefinition of Bridgerian "series" of C. R. Keyes), or more specifically, the time of deposition of Blacks Fork and Twin Buttes members of Bridger formation (Eocene) with enclosed faunas. Covers time interval between Eocene Wasatchian (older) and Uintan ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

†Bridgerian series[1]

[Tertiary]: Colorado, Utah, and Wyoming.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 279, 309.

Bridgetimber Gravel[1]

Pliocene or Pleistocene: Southwestern Colorado.

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Mapped as Pliocene or Pleistocene.

Caps Bridge Timber Mountain southwest of Durango.

Bridgeton Formation (in Columbia Group)[1]

Pleistocene: New Jersey.

Original reference: R. D. Salisbury, 1898, New Jersey Geol. Survey Ann. Rept. State Geologist 1897, p. 13–15.

J. H. C. Martens, 1956, Rutgers Univ. Bur. Mineral Research Bull. 6, p. 72–74. Oldest Pleistocene formation in southern New Jersey. Commonly occurs immediately below surface with no younger formations, or only a small amount of windblown sand, overlying it; in Cumberland and Cape May Counties is overlain by Cape May formation; unconformably overlies Cohansey and Kirkwood formations. Composed mostly of coarse sand deposited by rivers. Maximum thickness 60 feet; commonly less than 30 feet. Glassboro phase as described by Salisbury and Knapp (1917, New Jersey Geol. Survey, v. 8) includes greater part of formation.

Named for exposures at Bridgeton, Cumberland County.

Bridgewater Member (of Marcellus Shale)[1]

Middle Devonian: Central eastern New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th ser., v. 19, p. 133, 219.

R. E. Stevenson, 1948, New York State Sci. Service Rept. Inv. 1, p. 2 (table 1). Underlies Solsville member; overlies Chittenango member.

Named for exposures on Seabridge Farm 2¼ miles west of Bridgewater, Oneida County.

Bridle Formation

Precambrian (Yavapai Series): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 7–10, pl. 3. Metamorphosed series of amygdaloidal and massive flows of andesite and basalt and intercalated sedimentary rocks and rhyolitic tuff. Includes belt of chlorite-biotite schist mapped separately as "spotted schist" (pl. 3). Sedimentary rocks were predominantly deposited in water; they have become schistose rocks in which chlorite and sericite are chief foliated minerals. Thickness 3,000 feet in mapped area; greater thickness exposed in unmapped area south of Bridle Creek. Oldest formation of Yavapai series; underlies Butte Falls tuff (new). Intruded by Dick rhyolite and Lawler Peak granite (both new). Mass of King Peak rhyolite (new) exposed west of Niagara Creek is essentially concordont with southwestern belt of Bridle formation, but evidence proves that rhyolite is intrusive.

Crops out in two belts in southern part of Bagdad area, Yavapai County. Named from Bridle Creek.

Bridport Dolomite Member (of Chipman Formation)

Bridport Dolomite (in Beekmantown Group)

Lower Ordovician: West-central Vermont and northwestern New York.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 539, 540, 545–546. Corresponds to Division E of "Calciferous" of Brainerd and Seely (1890, Am. Mus. Nat. History Bull., v. 3). Includes beds of fine-

grained dolomite, 1 or 2 feet thick, weathering drab, yellowish, or brown. Occasional fossiliferous pure limestone layers. Rarely thin layers of slate. Maximum thickness 500 feet. Underlies Crown Point limestone; conformably overlies Bascom formation (new). Upper contact of Bridport is in most places a distinct stratigraphic break, above which may be any of the formations of the Chazy or Black River-Trenton that crop out in area occupied by Bridport.

Marshall Kay, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1476. Bridport dolomite formation along Lake Champlain is uppermost part of Beekmantown, Canadian series. Underlies quartz arenites and calcarenites of basal Chazy Day Point within and west of Lake Champlain in Vermont and New York. Beldens calcite marble is a calcitic facies of the Bridport.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Rank reduced to member status in the Chipman herein reduced to rank of formation. Consists of massive dolomitic beds, which in Cornwall area interfinger with limestones (Burchards, Weybridge, and Beldens) of Chipman formation. Beekmantown age. [See Chipman formation, this reference.]

Named for wide exposures on hills in southeastern part of town of Bridport, Addison County, Vt.

Bridwell Formation

Pliocene, middle: Western Texas.

G. L. Evans, 1949, West Texas Geol. Soc. Guidebook Field Trip 2, Nov. 6–9, p. 4 (table 1), 6–7. Bedded, unconsolidated sand and clay with thick channel gravel occurring both at base and at higher levels; characteristically reddish brown; locally a few gray highly calcareous members, including caliche cap rock. Thickness at type locality 155 feet; locally pinches out against higher relief features on bed rock surface which extends well above upper level of Couch formation (new). Underlies Blanco formation.

D. C. Van Siclen, 1957, Jour. Geology, v. 65, no. 1, p. 49 (fig. 2), 51, 52. Thickness 75 feet. Stratigraphic section lists formation under heading Pliocene (Miocene?).

Typically exposed on Fowler Ranch, 10 miles north of Crosbyton, Crosby County. Named for Bridwell Ranch in Blanco Canyon.

Brier Slate Member (of Vulcan Iron-Formation)[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. As defined here, Vulcan iron-formation includes (ascending) Traders iron-bearing member, Brier slate member, Curry iron-bearing member, and Loretto slate member.

Named for Brier Hill, Menominee district, [Dickinson County].

†Brier Creek Marl[1]

Oligocene and Miocene: Southeastern Georgia and western South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources

of South Carolina, p. 12, 18, name only, not defined; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 435, 464, 465.

Typically exhibited along Brier Creek, near Jacksonboro, Ga.

Brierfield Dolomite[1]

Upper Cambrian: North-central Alabama.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 628, 633, 634, pl. 27.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 17. *Cryptozoon* masses are only indications of organisms present; consequently age determination not possible. Seems Brierfield should be regarded as closely associated with the Ketona and should have stratigraphic position between Nolichucky and Copper Ridge.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart below Ketona dolomite. Middle Cambrian.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 23. Listed with formations of Cambrian or Ordovician age.

Named for exposures on Mahan Creek in Vicinity of Brierfield, Bibb County.

Brier Hill Sandstone (in Washington Group)

Permian (Dunkard): Southwestern Pennsylvania.

W. O. Hickok, 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, ser. 4, Bull. C–26, p. 152. Name proposed for heavy-bedded to massive gray coarse-grained, slightly micaceous sandstone in upper part of Washington group. Thickness 10 to 30 feet; average about 15 feet. Underlies Upper Washington limestone; overlies Jollytown coal. Noted by Stevenson (1876) in his Washington County group but not named.

Well exposed in roadcuts on hilltop northwest of Brier Hill, Fayette County, for which settlement it is named.

Briggs Formation

Lower Permian: Western Texas.

C. C. Albritton, Jr., 1937, Jour. Paleontology, v. 11, no. 1, p. 19. Section in Malone Mountains shows Briggs formation consists of gypsum with interbedded limestones. Thickness more than 300 feet. Separated from Upper Jurassic Malone formation (emended) by unconformity.

C. C. Albritton, Jr., 1938, Geol. Soc. America Bull., v. 49, no. 12, pt. 1, p. 1753–1757. Includes minimum of 630 feet of anhydrite and gypsum with interbedded limestone; base of formation not exposed. Interbedded bodies of limestone range from laminae of microscopic dimensions to lenses more than 100 feet thick and several miles in width. Three lenses of sufficient magnitude to be mapped and considered as members are described (ascending): Black limestone member as much as 150 feet thick; black brecciated limestone member as much as 80 feet thick; and buff limestone member. At least in part equivalent to Leonard formation in Glass Mountains.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 994–995. In northern Quitman Mountains, consists only of medial black brecciated limestone member. Thickness about 200 feet.

Named for Briggs (now Gypsum) Switch on Southern Pacific Railroad, Hudspeth County, Malone Mountains area.

Brigham Quartzite[1]

Lower(?) and Middle Cambrian: Northeastern Utah and southeastern Idaho.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6, 7.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1115–1116, 1117 (fig. 4), 1118. Walcott's (1908) Blacksmith Fork section restudied. Base of Brigham not exposed. Estimated thickness 1,000 feet. Underlies Langston limestone (emended).

A. J. Eardley and R. A. Hatch, 1940, Geol. Soc. America Bull., v. 51, no. 6, p. 809–812. Described in Bakers Canyon (which may have been Walcott's type locality for Brigham quartzite). Underlies Langston limestone. Total thickness below limestone 1,775 feet.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 7–8, pl. 1. Described in Randolph quadrangle, where it is about 1,600 feet thick, base not exposed. Underlies Langston limestone.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table). Table of summary formations in Logan quadrangle, Utah, lists Brigham quartzite (Waucobian) above Precambrian Big Cottonwood Canyon series.

W. L. Stokes, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 14. Summary discussion. Although no fossils known, great thickness suggests span of deposition from at least early to middle Cambrian time. Probably passes into Flathead quartzite to north and east. Up to 6,000 feet thick with base not exposed.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 667. In area of this report [northern Utah and southeastern Idaho], all but uppermost shaly units of so-called Brigham quartzite are assigned to Prospect Mountain quartzite.

Type locality: West front of Wasatch Range, northeast of Brigham, Box Elder County, Utah.

Brigham Hill Graywacke

Lower Cambrian: Western Vermont.

E. C. Jacobs, 1935, (abs.) Geol. Soc. America Proc. 1934, p. 85. In Green Mountains, westernmost nappe is made up of Cheshire quartzite, of Lower Cambrian age, infolded with a fine-grained graywacke, which has been traced from Essex Junction into southern Quebec, where it is known as Gilman "quartzite." In Vermont, this rock has been named Brigham Hill graywacke.

E. C. Jacobs, [1937], Vermont State Geologist 20th Rept., p. 100–101. Yellowish to dark-gray very fine-grained graywacke, often with thin bandings of argillaceous material. Phase of Cheshire quartzite, not a formation. Age designated. Exposures described and derivation of name given.

Named for exposure on Brigham Hill, Essex Township, Chittenden County. Crops out intermittently in Green Mountains from Lake Dunmore north to Quebec border. Makes up Arrowhead Mountain as a klippe thrust onto Upper Cambrian slate.

Bright Angel Shale (in Tonto Group)[1]

Bright Angel Group

Middle Cambrian: Northern Arizona, southeastern California, and southern Nevada.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, p. 1797. Since Lyndon formation does not continue eastward from western Grand Canyon to Granite Gorge region as cartographic unit, underlying and overlying Pioche and Chisholm shales in latter area merge into Bright Angel shale. Thus beyond eastern limit of Lyndon in Grand Canyon, Bright Angel is recognized as corresponding to combined Pioche, Lyndon, and Chisholm formations to the west.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 17, 20–21, 80–84. Thickness varies considerably from place to place owing to lateral changes in lithology along time planes. Both base and top of formation rise stratigraphically, but at irregular rate, from west to east. Thickness 325 feet at type locality. Intertongues with Muav limestone to west. Includes Flour Sack member (new) and Meriwitica and Tincanebits tongues (new).

H. E. Wheeler and E. M. Beesley, 1948, Geol. Soc. America Bull., v. 59, no. 1, p. 75, 77–78. Bright Angel group defined as predominantly argillaceous strata which lie between underlying Prospect Mountain quartzite and overlying Middle Cambrian limestone. This lithogenetic unit ranges in age from partly Precambrian in Nopah Range of southeastern California to entirely Middle Cambrian in Grand Canyon of Arizona.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2e), 2414. Includes Chisholm shale member in parts of Grand Canyon.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 32, 34–35, fig. 4, pl. 1. Widely distributed throughout eastern half of Ivanpah quadrangle, California and Nevada, where shale attains maximum thickness of about 420 feet.

Named for Bright Angel Canyon in walls of which formation is well exposed; Arizona.

Bright Diamond Limestone (in Morrison Formation)[1]

Upper Jurassic: Southwestern Colorado.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

Name probably derived from Bright Diamond mine.

Bright Diamond Quartzite (in Morrison Formation)[1]

Upper Jurassic: Southwestern Colorado.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

Probably named from Bright Diamond mine.

Brighton Melaphyr (in Boston Bay Group)[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. W. Dodge, 1881, Boston Soc. Nat. History Proc., v. 21, p. 205–208.

Named for occurrence at Brighton.

Brightseat Formation

Paleocene: Eastern Maryland.

R. R. Bennett and G. G. Collins, 1952, Washington Acad. Sci. Jour., v. 42, no. 4, p. 114–116. Dark-gray micaceous sandy clay. Thickness 4 to 8 feet. Unconformably underlies Eocene Aquia greensand; unconformably overlies Upper Cretaceous Monmouth formation.

Type locality: One mile west-southwest of Brightseat, Md., and one-fifth mile south of Sheriff Road.

Brimfield Schist[1]

Pre-Pennsylvanian: Central Massachusetts, northern Connecticut, and southern New Hampshire.

Original reference. B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 17, pl. 24, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 76–80, pl. 1. Believed to be late Precambrian or early Paleozoic.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 20. Proposed that Brimfield schist be restricted to areas where the schist is not known to be equivalent to Worcester formation as redefined in this report [Hudson and Maynard quadrangles, Massachusetts]. Brimfield schist of previous reports dealing with this area are referred to as "mica schist facies" of redefined Worcester. Carboniferous.

M. E. Willard, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–85. Intruded by Belchertown tonalite at type locality of the Belchertown.

Named for occurrence at Brimfield, Mass.

Brindle Pup Andesite (in Ash Creek Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 14, pl. 1. Dark-gray rock which weathers to light-brown surfaces on which cream-colored plagioclase phenocrysts are conspicuous. Groundmass aphanitic to very finely crystalline. Vesicles and quartz amygdules present, increasing in abundance near flow tops. Intercalated Buzzard and Deception rhyolitic flows and basaltic flows similar to Shea basalt. Basaltic flows highly vesicular greenish-black lava containing sparse plagioclase phenocrysts in finely crystalline groundmass. Thickness ranges from about 2,500 feet in widest outcrop to a wedge line. Underlies Deception rhyolite; overlies Buzzard rhyolite (new).

Named and defined from Brindle Pup Gulch, Jerome area, Yavapai County, where it is well exposed. Occurs as thick lense to south of Mingus Mountain.

Brine Creek Formation

Cretaceous: Northern Alaska.

T. C. Hiestand, 1957, Oil and Gas Jour., v. 55, no. 49, p. 194 (table 1). Name appears only on table. Nonmarine. Included with formations assigned Lower and Upper Cretaceous age.

Under heading Arctic foothills and coastal plain.

Briones Sandstone (in San Pablo Group)[1]

Briones Stage or Substage

Miocene, upper: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 199–200. The Monterey comprises three substages (ascending): Briones, Cierbo, and Neroly. Substages can be recognized strandward by distinctive echinoderm faunas and by a number of more or less distinctive mollusks.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 75–78. Shown on table as underlying Cierbo sandstone and overlying Rodeo shale. Includes Hercules shale member. In San Pablo group.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 39–41, pl. 1. Described in San Jose-Mount Hamilton area as thick series of massive coarse-grained fossiliferous sandstones and sandy shales. Thickness 3,400 to 5,000 feet. Unit crops out almost without interruption for entire length of Tularcitos syncline; on west limb it rests on Monterey formation; on east limb rests for considerable distances on Cretaceous Berryessa formation (new). Underlies Orinda formation, slight angular unconformity; in some areas underlies Packwood gravels (new).

J. W. Durham, 1954, California Div. Mines Bull. 170, chap, 3, p. 24 (fig. 2), 25 (fig. 3), 26 (fig. 4). Listed as megafaunal stage. Follows Temblor and precedes Cierbo.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Map GQ–88. Described in Hayward quadrangle as pale-yellow thick-bedded coarse calcareous arkosic sandstone; discontinuous pebble conglomerate. Thickness ranges from 500 to 1,500 feet. Overlies Rodeo shale. In this report, the San Pablo is considered a formation overlying the Briones.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 21–25, fig. 2, geol. map. Formation crops out in northwestern corner and southern half of Pleasanton area. Thickness about 2,000 feet in northern area and 5,000 feet in southern area. Divided into three members: upper, fine-grained sandstone; middle, gray to brown conglomerate fossiliferous calcareous lithic wacke; upper, fine-grained sandstone and interbedded silty claystone. Overlies Hambre sandstone. Near Calaveras Reservoir, transgressively overlaps older Tertiary formations and rests on Niles Canyon formation (new). Underlies Leona rhyolite, Livermore gravels, and in Tularcitos syncline, Orinda formation. Upper Miocene. Term San Pablo group not used in this report.

Named for exposures in Briones Hills, Contra Costa County.

Brisbois Formation

Upper Triassic: Northeastern Oregon.

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Upper Triassic sequence includes Begg, Brisbois, and Rail Cabin formations. Thickness of sequence, which is overlain by Lower Jurassic Graylock formation (new), is nearly 15,000 feet.

Type locality and derivation of name not stated. Report discusses Izee area, Grant County.

Briscoe Glacial Substage

Pleistocene (Wisconsin): Central Colorado.

Q. D. Singewald, 1950, U.S. Geol. Survey Bull. 955–D, p. 120, pl. 9 [1951]. Times of maximum ice advance and of two principal ice stands during retreat are called Fairplay, Briscoe, and Alma substages, respectively, of Wisconsin stage of glaciation. The Briscoe represents time covered by deposition of Briscoe moraines.

In northwestern Park County. Moraines present only in Platte, Sacramento, Horseshoe, and Middle Tarryall Valleys.

Brister Limestone Member (of Big Saline Formation)

Lower Pennsylvanian: Central Texas.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143, 144; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2), 198. Medium- to thick-bedded coarsely crystalline crinoidal limestone made up of conglomeratelike nodules and crinoidal detritus with very irregular bedding planes and other characteristics which suggest reeflike origin. Total thickness 50 to 75 feet. Overlies Lemons Bluff member east of Cavern Ridge; underlies Smithwick formation.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 71–73. Referred to as Brister Bluff lentil. Thickness at designated type locality 20 feet.

Type section: At Rough Creek crossing on Bend-San Saba road, San Saba County.

Brister Bluff Lentil (in Big Saline Formation)

See Brister Limestone Member (of Big Saline Formation).

†Bristol Formation[1]

Pliocene: Northern Florida.

Original reference: E. H. Sellards, 1918, Florida Geol. Survey 10th and 11th Ann. Rept., p. 51.

Typically exposed in vicinity of Bristol, Liberty County.

Bristol Granite Gneiss[1]

Pre-Triassic: Central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 104–105, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as granitoid gneiss with layers and patches of hornblende-plagioclase gneiss occurring locally, especially near borders. Pre-Triassic. Derivation of name.

Named for town of Bristol, Hartford County.

Bristol Limestone (in Washington Formation)[1]

Bristol limestone member

Permian: Northern West Virginia and Eastern Ohio.

Original reference: R. V. Hennen, 1912, West Virginia Geol. Survey Rept. Doddridge and Harrison Counties, p. 168.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 213–215. Member of Washington cyclothem in report on Athens County. Tentatively correlated with Bristol limestone of Hennen.

Thickness about 5½ feet. Occurs above a redbed and shale member and below Washington fire-clay shale member.

Named for Bristol, Harrison County, W. Va.

Bristol Bay Silts and Gravels[1]

Pleistocene: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 177–178.

Extent from Togiak Bay to Bristol Bay.

Bristol Pass Limestone[1]

Lower Mississippian: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 20, map.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). On correlation chart of recommended revision of stratigraphic units pertaining to the Great Basin, Bristol Pass limestone is shown equivalent to Joana limestone member of White Pine shale. Joana is recommended term. Pioche district as used in this report extends north to Dutch John Mountain, about 40 miles north of Pioche.

Named for occurrence at Bristol Pass, in summit of hill immediately north of bench mark 6149, Pioche district, Lincoln County.

†Bristow Formation[1]

Pennsylvanian: Central Oklahoma.

Original reference: A. E. Fath, 1925, U.S. Geol. Survey Bull. 759, p. 13–15.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Rejected by Oklahoma Geological Survey. Essentially upper part of Vamoosa formation. Name preoccupied by Bristow shale and sandstone of Indiana and Kentucky.

Named for Bristow, Creek County.

Bristow Shale and Sandstone (in Chester Group)[1]

Mississippian: Southwestern Indiana and western central Kentucky.

Original reference: W. N. Logan, 1924, Indiana Dept. Conserv. Pub. 42, p. 11, 125.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Replaced by Palestine sandstone. Local Indiana names of upper Chester are dropped and formations given names of standard Chester column.

Named for exposures near village of Bristow, Perry County, Ind.

Brite Ignimbrite (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 26, 28. Name proposed for ignimbrite underlying Petan basalt and overlying Capote Mountain tuff (new). Resembles sanidine rhyolite porphyry; in thin section matrix shows glass shards and other pyroclastic material. Thickness about 100 feet. Locally overlain by a post-volcanic gravel.

Type locality: Top of Capote Mountain, Rim Rock country, Presidio County. Name derived from Brite Ranch.

Briton Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone or dolomite. Thickness 10 feet. Shown on columnar section as overlying Hazelwood member (new) and underlying Dement member (new) of Grand Detour formation (new).

Occurs in the Dixon-Oregon area.

Britton Clay[1]

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 425.

C. C. Albritton, Jr., and others, 1941, Field and Lab., v. 10, no. 1, p. 23. As originally defined, the Arcadia Park included 20 feet of bluish-gray clay at its base; this clay would seem to be more logically grouped with the Britton, from which it cannot be distinguished lithologically. With some adjustment regarding boundary between these two units, the Tarrant, Britton, and Arcadia Park might stand as members of Eagle Ford formation.

W. L. Turner, 1951, Field and Lab., v. 19, no. 2, p. 54. Abandoned in Eagle Ford quadrangle.

Type locality: Britton, northwestern part of Ellis County.

Broadalbin (passage) Beds

Upper Cambrian or Lower Ordovician (Cambrovician): Central New York.

W. J. Miller, 1911, New York State Mus. Bull. 153, p. 29. Incidental mention as transition beds in Theresa formation.

A. W. Grabau, 1936, Paleozoic formations in the light of the pulsation theory, pt. 1, Caledonian and St. Lawrence geosynclines: Peiping, China, Univ. Press, Natl. Univ. Peking, p. 322 (fig. 7), 325–327, 350. The Theresa in Mohawk Valley sections is believed not to be of same age as true Theresa of northern Adirondack Embayment and is referred to as "Theresa" or Broadalbin passage beds. Constitute passage beds from upper Potsdam to Little Falls dolomite. Consist of alternating sandstones and dolomites. Thickness 150 to 250 feet; greatest thickness where Hoyt member of Theresa is not developed.

Occurs in Mohawk Valley, especially in Broadalbin quadrangle.

Broad Branch series[1]

Precambrian: District of Columbia.

Original reference: W. J. McGee, G. H. Williams, and N. H. Daron, 1893, 5th Internat. Geol. Cong., p. 244.

Broad Ford Sandstone

Broad Ford Sandstone (in Pocono Sandstone)[1]

Devonian or Mississippian (Kinderhookian): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1925, Econ. Geology, v. 20, p. 778–779.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 170, chart 5 (columns 98, 99). Generally included in the Pocono, but its Mississippian age at type locality has been doubted. Shown on correlation chart in Pocono series (Kinderhookian) below Lindside sandstone and above Sunbury shale.

Lynn Glover, 1953, Virginia Jour. Sci., v. 4, new ser., no. 4, p. 259–260. Broadford [Broad Ford] is unfossiliferous at its type locality. By use of stratigraphic position and key beds, the Broadford has been located in six measured sections northeast of Broadford, and in each a Conewango fauna has been found. Generally the real Broadford sandstone in Virginia has been mapped as part of "Chemung formation," and younger Mississippian units have been mistakenly identified as the Broadford.

Type locality: At line between Smyth and Tazewell Counties, Va., about one-half mile north of Broad Ford village where Laurel Creek of Holston River cuts gap through ridge known as Pine Mountain on west and Brushy Mountain on east.

Broad Top series[1]

Carboniferous: Pennsylvania.

Original reference: H. D. Rogers, 1836, Pennsylvania State Geologist 12th Ann. Rept., p. 16–18.

Broadwater Formation

Pleistocene, lower: Western Nebraska.

C. B. Schultz and T. M. Stout, 1945, Am. Jour. Sci., v. 243, no. 5, p. 232–237. Proposed for sediments of early Pleistocene age. Sediments which constitute Broadwater were deposited in following order: basal gravel member, composed of reddish-brown crystalline gravels; Lisco member (new) consisting of diatomaceous marl and peat, with sand and silt lenses; and upper gravel member. Thickness at type locality 65 to 69 feet. Ogallala sediments were deeply eroded before deposition of Broadwater.

C. B. Schultz and T. M. Stout, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 553–588. Discussion of Pleistocene mammals and terraces in Great Plains. Unconformity between Kimball and Broadwater formations is most significant stratigraphic break in upper Tertiary and Pleistocene deposits of western Nebraska and Great Plains in general; likewise faunal break between the two formations is most important one paleontologically in same area. This break is believed to be Pliocene-Pleistocene boundary.

Type locality: At Broadwater locality of University of Nebraska State Museum, quarry 1, in NE¼ sec. 20, T. 19 N., R. 47 W., Morrill County.

Broadway Alluvium

Pleistocene (late Wisconsin): Northeastern Colorado.

G. R. Scott, 1960, Geol. Soc. America Bull., v. 70, no. 10, p. 1543. Consists of 12 to 15 feet of reddish-brown fine- to coarse-grained sand and some pebbles. Younger than Louviers alluvium (new).

Type locality: Gravel pit in SE¼ sec. 30, T. 2 S., R. 67 W. Named from Broadway Avenue on Broadway terrace, which lies 25 feet above South Platte River in Denver.

Brock Shale[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Atlas, Folio 138.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert., v. 27, p. 436; 1960, California Div. Mines Spec. Rept. 63, p. 6 (figs. 3, 4), 7–8, pl. 1. Underlies Hawkins Creek member (new) of Modin formation (redefined); overlies Hosselkus limestone. Estimated thickness 400 feet.

Named from Brock Mountain, Redding quadrangle, between Squaw Creek and Pit River.

Brocklebank Granite

Upper Devonian(?): East-central Vermont.

C. G. Doll, [1945], Vermont State Geologist 24th Rept., p. 20–21. Light-gray medium-grained binary granite.

Named from good exposures in several quarries in vicinity of Brocklebank Hill, 4 miles south-southeast of village of Chelsea, Strafford quadrangle.

Brodhead Formation (in Borden Group)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 135–191, pls. 15, 16. Name proposed for a generalized unit in Kentucky which lies between New Providence formation below and Floyds Knob formation above. Falls within Burlington-Keokuk range of general Mississippian column. Comprises rock equivalent to combined Locust Point and Carwood units of Borden group in Indiana, and includes both Rosewood shale and Holtsclaw sandstone of Butts (1915) in Jefferson County and much of New Providence group as described by Butts (1922, Kentucky Geol. Survey, ser. 6, v. 7) for Kentucky. Composed mostly of silty shale, shaly siltstone, massive siltstone, and fine-grained sandstone with many variations from place to place produced by lateral transitions in facies. Thickness ranges from 135 to 270 feet. Unit is thinnest along axis of Cincinnati Arch from where it is progressively thicker both east and west. Includes following members (not in sequence): Caney Creek, Christy Creek siltstone, Clementsville limestone, Combs Mountain siltstone, Conway Cut siltstone, Culver Springs shale, Frenchburg siltstone, Ginseng siltstone, Haldeman siltstone, Indian Fort shale, Lebanon Junction siltstone, McKinney Knob, Perry Branch siltstone, and Rolling Fork limestone. Differentiated into six facies (in order of occurrence along outcrop belt around Lexington Plain from Indiana to Ohio): Holtsclaw Hill, Pilot Knob, Athertonville, Liberty, Irvine, and Morehead.

Type section: Starting at sandstone quarry just east of bridge over Dicks River, at Louisville and Nashville Railroad Station, Brodhead, Rockcastle County, and along road up hill east-southeast. Name derived from town of Brodhead.

Brodhead Member (of Marcellus Formation)

Middle Devonian: East-central Pennsylvania.

Bradford Willard, 1938, Pennsylvania Geol. Survey, ser. 4, Bull. G–11, p. 17. Name proposed for very finely arenaceous dark-gray nonfissile phase of formation. Bedding generally obscured. Exhibits subconchoidal fracture. May carry bands of small concretions. Devonian. Also referred to as Brodhead Creek member.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 139 ,170–171. Thickness 20 to 30 feet. Middle Devonian.

Well exposed in quarry on north side of Stroudsburg and beyond, up Highway 90 along west bank of Brodhead Creek, Monroe County. Named for Brodhead Creek valley.

Brodhead Creek Member (of Marcellus Formation)

See Brodhead Member (of Marcellus Formation).

Brodhead Creek Member (of Tully Formation)

Upper Devonian: East-central Pennsylvania.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 30, 31, 32. Middle member of formation. Variable lithology; consists of shales and sandy shales changing eastward to fine sandstone at East Stroudsburg. Contains lense of dense hard limestone. Thickness about 75 feet at type section where appears to include whole of Tully. Overlies Weissport member (new) on Pohopoco Creek east of Lehighton. Grades into Trimmers Rock sandstone east of Stroudsburg.

Type section: On Brodhead Creek 3 miles northwest of East Stroudsburg, Monroe County.

†Broken Arrow Formation[1]

Pennsylvania (Des Moines Series): Northeastern Oklahoma.

Original reference: R. H. Wood, 1925, Oklahoma Geol. Survey Bull. 35, p. 71.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Abandoned by Oklahoma Geological Survey. Name was given to facies of Labette shale and Nowata shale in area where Oologah and Lenapah were not recognized. Term is not useful, and name is one of those applied to Croweburg coal bed.

Named for Broken Arrow, Tulsa County.

Broken Jug Limestone (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 531, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 16–18, pl. 1. In general, consists of limestone, pure, shaly, and sandy, interbedded with sandstone, shale, and conglomerate. Coarse limestone conglomerate prominent locally. Red to green shale and sandstone present at three horizons in Eureka district. Thickness approximately 3,400 feet in Sylvanite district and perhaps more than 5,000 feet in Eureka district. Overlain by Howells Ridge formation (new) in Sylvanite district and by Ringbone shale (new) and Hidalgo volcanics (new) in Eureka district. Trinity age.

Named from Broken Jug Pass in Sylvanite part of Little Hatchet Mountains, where formation occupies several square miles on east side of the crest. Makes up dissected chain of hills and ridges that front northeast corner of range, in Eureka district.

Brokeoff Andesite[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, p. 71 (map).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 674. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta, v. 8, p. 77 (table 2), 78 (table 3), 79, 80 (table 4). Listed on tables and mentioned in text in report on uranium geochemistry of Lassen volcanic rocks.

Brokeoff Mountain is in Lassen Volcanic National Park.

Bromide Formation[1] (in Simpson Group)

Middle Ordovician: Central southern and southwestern Oklahoma.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

C. E. Decker, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 4, p. 655–656, measured sections. Outcrops are more widespread than those of any other formation of Simpson group. Measured sections show thickness varies from 87½ feet to 674½ feet. Uppermost formation of group; overlies Tulip Creek formation.

A. R. Loeblich, 1942, Jour. Paleontology, v. 16, no. 4, p. 413–436. Formation, as used in this report, is same as that defined and mapped by Decker and Merritt (1931, Oklahoma Geol. Survey Bull. 55) and thus includes typical Bromide, Criner, and Cool Creek formations of Ulrich. At type section, herein described for first time, formation includes 15 beds with total thickness of 127½ feet; underlies Viola limestone; base of section covered. Evidence presetned by bryozoa suggests lower Trenton age, and fauna is closely allied to Decorah of Minnesota. Review of previous stratigraphic work.

R. S. Bassler, 1943, Am. Jour. Sci., v. 241, no. 11, p. 694–695. Black River age on basis of cystids.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 100, 135 (table 5). Discussion of Athens graptolites in Bromide formation. Trenton in age.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 120–123, chart 1. Consists of sandstone. shale, and limestone, latter predominating at least in upper part. Thickest at west end of Arbuckle Mountains where it measures 647 feet. Subdivided into two members: Mountain Lake below and Pooleville above (both new). Overlies Tulip Creek formation; underlies Viola formation. Bromide has been variously placed from Chazyan to Trenton. Brachiopod evidence does not support Loeblich's (1942) conclusion of a lower Trenton age. Chart shows Bromide spans interval from upper part of Chazyan to upper part of Bolarian.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 84–94, fig. 1, charts 1, 2. Loeblich (1942) measured and described type section. Topmost 10 to 18 feet of dense, thin-bedded limestone of Loeblich's beds 2 and 3 are quite probably Corbin Ranch formation (new) of this report. Also, it is quite possible that lower part of section (plus covered section at base) involves some normal or faulted Tulip Creek strata. U.S. Highway 77 Bromide section is 427 feet thick and subdivisible into a 55- to 60-foot basal sandstone and a 370-foot section of overlying shales and limestones; West Spring Creek section is 420 feet thick and subdivisible into same basal sandstone 60 to 75 feet thick, and overlying shale and limestone section 355 feet thick. Disconformable contact with both underlying Tulip Creek and overlying Corbin Ranch. Ostracoda discussed. Fossils indicate an age essentially Blackriverian.

Type section: Along old road on hill northwest of old Galbraith Hotel in town of Bromide, in sec. 32, T. 1 S., R. 8 E., Johnston County. Section is exposed as faulted inlier in upper Simpson.

Bromley Shale (in Cynthiana Formation)[1]

Bromley Shale Member (of Cynthiana Formation)

Middle Ordovician: Northern Kentucky and southwestern Ohio.

Original reference: R. S. Bassler, 1906, U.S. Nat. Mus. Proc., v. 30, p. 9.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1642–1643. Division of the Cynthiana. Consists of 30 feet of drab and blue shales in lower part of bank of Ohio River at Cincinnati. Some of the shales and fine-grained siliceous, earthy and commonly gnarly limestones of lower Cynthiana in northern Bluegrass and also in northern Madison County have been regarded as Bromley, perhaps not too accurately. The Bromley is a facies of lower Greendale and has its own distinctive fauna. Pre-Cincinnatian.

D. K. Hamilton, 1950. Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of the Cynthiana. This includes lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Bromley, Gratz, and Rogers Gap.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 265, 267. Bromley shale appears to be local facies which crosses major faunal zone boundary and may well be discarded as formational name. Cincinnatian series should be extended downward to embrace Cynthiana formation.

Well exposed along river just below Bromley, Kenton County, Ky.

Broncho Mountain Granite[1]

Precambrian: Colorado.

Original reference: R. D. Crawford and P. G. Worcester, 1916, Colorado Geol. Survey Bull. 10.

Exposed on Broncho Mountain, Gold Brick district, Gunnison County.

Bronco Volcanics

Cretaceous or lower Tertiary: Southeastern Arizona.

James Gilluly, 1945, Am. Jour. Sci., v. 243, no. 12, p. 643, 645, 648. Consists dominantly of andesite flow breccias and flows in lower part and of quartz latite flows and tuffs in upper part. These is interfingering of the two varieties of rock; andesitic rocks constitute about two-thirds of the formation. Thickness 5,000 to 6,000 feet. Unconformably overlies Bisbee formation. Intruded by Uncle Sam porphyry.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 87–90, pl. 5. At the base, formation locally has a conglomerate composed mainly of volcanic material. Invaded, deformed, and altered by Uncle Sam porphyry, Schieffelin granodiorite, and andesite porphyry east-northeast of Bronco Hill. Typical exposure designated.

Typically exposed northeast and north of Bronco Hill, Tombstone area, central Cochise County. Outcrop of formation in this area covers about 3½ square miles. Smaller bodies found in other parts of central Cochise County.

Bronson Formation or Group[1]

Bronson Subgroup (in Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Kansas, southern Iowa, western Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 238, p. 1, 17, 21.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2029, 2031 (fig. 4). Strata included in Kansas City group as now defined are divisible into three main parts of subequal thickness, which are treated as subgroups (ascending): Bronson, Linn (new), and Zarah (new). Bronson extends from base of Hertha formation to top of Dennis formation and includes (ascending) Hertha, Ladore, Swope, Galesburg, and Dennis formations. Uppermost Bronson unit (Winterset limestone) extends as far southward as T. 8 N. in Oklahoma, but Hertha disappears before Kansas-Oklahoma State line is reached. South of point where Hertha disappears, lower Missourian deposits are referred to Skiatook group and are named (ascending) Seminole formation, Checkerboard limestone, Coffeyville formation, Dennis formation, Cherryvale shale, and Drum limestone. Oklahoma Geological Survey uses Hogshooter (instead of Dennis) and Dewey as a formation name, rather than member of Drum limestone.

Type region: Vicinity of Bronson, Bourbon County, Kans.

Brook Lentil (in Big Saline Formation)

See Brook Ranch Member (of Big Saline Formation).

†Brooke Formation[1]

Lower Cretaceous: Northeastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 321.

Vicinity of Brooke Station, 9 miles north of Fredericksburg, Spotsylvania County.

Brookfield Diorite[1]

Brookfield Diorite Gneiss

Brookfield Plutonic Series

Pre-Triassic: Western Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 107, map.

E. N. Cameron, 1951, Connecticut Geol. Nat. History Survey Bull. 76, p. 13. Included in Mount Prospect complex and not mapped by name.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as diorite gneiss. Generally dark or speckled fine- to medium-grained gneiss, mostly layered, locally schistose. Interlayered with and cut by bodies of light rock of similar composition but with more potash feldspar, especially as large porphyroblasts. Associated with small bodies of biotite hornblendite and pyroxenite in Mount Prospect and West Torrington areas. Pre-Triassic. Derivation of name stated.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 31–38, map. Redefined as Brookfield plutonic series. Occurs in well-defined plutons, four of which crop out in Danbury quadrangle [this report].

Named for town of Brookfield, Fairfield County.

Brookline Conglomerate Member (of Roxbury Conglomerate)[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 56–57.

Extensively exposed at Brookline, Suffolk County.

Brooklyn Gneiss[1]

Precambrian or early Paleozoic: Southern New York.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 7.

T. W. Fluhr, 1057, Geol. Soc. America Eng. Geology Case Histories No. 1, p. 2, 7 (fig. 1). Bedrock formations in Queens midtown tunnel, New York, include Fordham gneiss, Hell-Gate dolomite, Brooklyn injection gneiss, Inwood limestone, and Manhattan schist. All formations are highly folded, faulted, and metamorphosed. There is disagreement regarding age of formations, but they are here considered to be early Paleozoic. Brooklyn injection gneiss is mixed rock produced from the Fordham by intrusion and injection of Ravenswood granodiorite.

Occurs in New York City.

Brook Ranch Member (of Big Saline Formation)

Pennsylvanian: Central Texas.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143 (table), 144–145; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2), 197 (fig. 2), 198. Typically very hard subcrystalline dark-gray, nearly black cherty limestone. Total thickness 15 to 25 feet. Overlies Gibbons conglomerate member, west side of Cavern Ridge; underlies Lemons Bluff member.

F. B. Plummer, 1950, Texas Uni. Bur. Econ. Geology Pub. 4239, p. 64. Brook lentil makes up basal layers of Big Saline in Kimble, Mason, and McCulloch Counties. Occurs between Gibbons conglomerate lentil and Lemons Bluff member, where it is present, and otherwise between Gibbons conglomerate or older rocks and Soldiers Hole limestone beds. Member extends from mouth of Big Saline Creek in Kimble County to Little Brady Creek south of Rochelle in McCulloch County where it pinches out against Ellenburger uplift. Thickness at designated type locality 22 to 25 feet.

Type locality: Along abandoned highway 3½ miles south and 1 mile east of Brady and ¾ mile northwest of Brook Ranch headquarters, McCulloch County.

Brooks Bed[1]

Mississippian: Northwestern Kentucky.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908, 1909, p. 83.

Derivation of name not explained; may be from Brooks, Bullitt County.

Brooks Lake Glaciation

Pleistocene (late Wisconsin): Southwestern Alaska.

E. H. Muller *in* T. L. Pewé and others, 1953, U.S. Geol. Survey Circ. 289, p. 2-3, 13 (table 1). Four major glaciations tentatively recognized in northern part of Alaska Peninsula. Brooks Lake, last major glaciation of Aleutian Range, succeeded Mak Hill glaciation (new). In lowlands

moraine front rises prominently from well-developed outwash plain. Morainic system controls drainage in eastern part of lowlands and encloses basins of Brooks, Naknek, and other large piedmont lakes. Moraines of this glaciation are the most prominent and least modified in lowland. Boulders abundantly exposed on surface of moraine and drainage of moraine belt completely unintegrated, indicating relatively short interval since recession of glaciers.

Named for large lake 36 miles east-southeast of Naknek, northern Alaska Peninsula.

Brookville Clay (in Allegheny Formation)[1]

Brookville Clay (in Pottsville Formation)

Brookville clay or underclay member

Pennsylvanian: Eastern Ohio and western Pennsylvania.

[Original reference]: Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 125–128.

G. W. White, 1949, Ohio Geol. Survey, 4th ser., Bull. 47, p. 160–169, geol. map. In Holmes County is uppermost member of Pottsville formation. Average thickness 6 feet 5 inches. Lies immediately below Brookville coal which in turn underlies Putnam Hill limestone; typically rests on white thin-bedded micaceous clay-bonded sandstone; at some localities rests immediately upon Tionesta coal.

N. K. Flint, 1951, Ohio Geol. Survey, ser. 4, Bull. 48, p. 40, 41, table 1. Included in Brookville cyclothem, Allegheny series, in Perry County. Lies stratigraphically above Homewood sandstone, base of which is considered boundary between the Pottsville and Allegheny series.

R. E. Lamborn, 1956, Ohio Geol. Survey Bull. 55, p. 54–66, geol. map. Termed Brookville clay member of Pottsville series. Thickness in Tuscarawas County 2 to 12 feet. Lies about 74 feet above Lower Mercer limestone, 45 feet below Upper Mercer limestone, and about 55 feet below Lower Kittanning coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 51. Underclay member of Brookville cyclothem in report on Athens County. Thickness 2½ feet. Overlies Homewood sandstone member; underlies Brookville (No. 4) coal or Putnam Hill limestone member. Allegheny series.

Described by Stout in Muskingum County, Ohio.

Brookville cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 6. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40–42, table 1, geol. map. Includes (ascending) Homewood shale and (or) sandstone, 15 feet; Brookville clay, 4 feet; Brookville coal; Putnam Hill limestone, 1 to 6 feet. Occurs above Tionesta cyclothem of Pottsville series and below Clarion cyclothem. In area of report, Allegheny series is described on a cyclothemic basis; nine cyclothems are named (ascending):

Brookville, Clarion, Scrubgrass, Lower Kittanning, Strasburg, Middle Kittanning, Lower Freeport, Bolivar, and Upper Freeport.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 50–53. In Athens County, includes (ascending) Homewood sandstone, Brookville underclay, Brookville (No. 4) coal, Putnam Hill limestone member. Occurs above Tionesta cyclothem of Pottsville series. In area of this report, Allegheny series is described on a cyclothemic basis; 13 cyclothems are named (ascending): Brookville, Ogan, Winters(?), Clarion, Scrubgrass, Lawrence, Lower Kittanning, Strasburg, Middle Kittanning, Upper Kittanning, Lower Freeport, Bolivar, and Upper Freeport.

Name derived from Brookville, Jefferson County, Pa. Rogers (1858, Geology of Pennsylvania, v. 3, pt. 1) used name Brookville for the coal.

Brookville terrane[1]

Cretaceous: Kansas.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

Derivation of name not stated but probably Brookville, Saline County.

Broom Creek Group

Permian: Eastern Wyoming, northeastern Colorado, and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, 18, 19 (fig. 6), 21, 37, 45. Consists of interbedded limestones and sandstones. Comprises interval from base of Cassa group to top of Wendover group (both new). Age uncertain (Pennsylvanian or Permian). Thickness 14 to 75 feet.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull, 14, p. 37, 38 (fig. 15). Stratigraphically expanded to include a few higher beds than included in original definition, placing top at an unconformity located in the overlying Cassa group. Thickness exposed on Broom Creek 85 to 101 feet. Permian.

Type locality: In Broom Creek valley, sec. 10, T. 28 N., R. 66 W., Platte County, Wyo.

Broomhill facies[1] (of New Providence Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 100–103.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Correlation chart lists Broom Hill [Broomhill] facies of New Providence formation.

Name derived from village of Broomhill, SW cor. sec. 5, T. 1 S., R. 6 E., Clark County.

Brophy Canyon Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Shown in list as underlying Fiske Creek formation and overlying Davis Creek formation (both new). Upper Jurassic and Cretaceous section about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Brougher Dacite[1]

Miocene, upper(?): Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 44, 50, map.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Oddie rhyolite, as described in this report, includes Brougher dacite of Spurr.

Composes Butler, Brougher, Siebert, and Golden Mountains, Tonopah district.

Brown Bear Leader Sandstone (in Frontier Formation)

Upper Cretaceous: Southern Idaho.

T. K. Kiilsgaard, 1951, Idaho Bur. Mines and Geology Pamph. 92, p. 17, 32. Massive resistant sandstone about 80 feet thick. First massive sandstone underlying the important coal beds in Frontier formation.

Crops out as ribs, crossing ridge crests on western side of Horseshoe Creek Basin, and extends north of Superior Creek to southern side of Packsaddle Creek near Pintar mine. In vicinity of Brown Bear mine and Brown Bear Creek, Horseshoe Creek district, Teton County.

Brown County Bed (in Valentine Formation)

Pliocene: Northwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 137. Name applied to a 2-foot bed of diatomaceous marl from arboreous flora was collected by Chaney and Elias (1936, Carnegie Inst. Washington Pub. 487). A slightly lower horizon than Niobrara River channel sand in the Valentine.

Brown Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 381.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 71. Predominantly white sandstone 240 feet thick. Overlies Big Valley bed; underlies Spring Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 27, pl. 58. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Brown Creek, Mills County.

Browne Glaciation

Pleistocene: Central southern Alaska.

Clyde Wahrhaftig, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 7, 13 (table 1); Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 16–17, 22–26, pls. 2, 3, 5. Four distinct glacial advances separated by marked ice withdrawals recognized along Nenana River. Browne, the earliest recognized, preceded Dry Creek glaciation (new). Deposits are granite blocks, largest of which are 40 feet in length.

Blocks rest on terraces 500 feet above Nenana River at Browne, 1,000 feet above river near Ferry, and 2,500 feet above river at Lignite Creek, 6 miles north of Healy.

Browning Sandstone Member (of Spoon Formation)

Browning Sandstone (in Carbondale Formation)

Pennsylvanian: Western Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 26, 78. Eastward-trending channel sandstone in lower Carbondale, about 5 feet below Colchester (No. 2) coal. Deposits locally truncate lower Carbondale and Pottsville strata and rest on pre-Pennsylvanian.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 10. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), 62, pl. 1. Reallocated to member status in Spoon formation (new). Stratigraphically above Abingdon coal member. Thickness 8⅔ feet.

Type locality: Sec. 18, T. 2 N., R. 1 E., Browning Township, Schuyler County.

Brown Mountain Sandstone (in Panoche Formation or Group)

Brown Mountain Sandstone Member (of Moreno Grande Formation)

Upper Cretaceous: Central California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Listed as uppermost of 10 subdivisions of Panoche formation (or group). Underlies Dosados member of Moreno formation; overlies Ragged Valley shale. Name credited to J. Q. Anderson.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 31. Southward from Pacheco Pass to Coalinga region, Moreno Grande formation (new) includes restricted Moreno, Brown Mountain sandstone, and *Pachydiscus* silt (also called Ragged Valley shale) as members.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Brown Mountain sandstone, a poorly defined stratigraphic unit of late Upper Cretaceous, is included in uppermost part of Panoche formation of this report [Ortigalita Peak quadrangle].

Occurs in Coalinga-Ortigalito area, San Joaquin Valley.

Browns Mills Limestone Member (of Row Park Limestone)

Middle Ordovician: Central southern Pennsylvania.

F. M. Swartz and R. R. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 4, 5. Dark-gray limestone. Overlies Social Island limestone member (new); underlies New Market limestone. Name credited to J. G. Palacas (unpub. thesis).

In Franklin County.

Browns Park Formation[1]

Miocene(?): Northeastern Utah, northwestern Colorado, and southern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern part of Uinta Mountains, p. 40, 44, 168.

W. H. Bradley, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 32. Mapped in Carbon and Sweetwater Counties, Wyo. Formation was laid

down on eroded surface that cuts older slightly deformed Eocene rocks, but was deformed by subsequent movements that affected both Browns Park and older rocks. Miocene(?).

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p. 685, 686 (table). In Dinosaur National Monument, consists of friable chalk-white to grayish crossbedded sandstones, in part tuffaceous; lake, fluviatile, and some eolian deposits; cherty sandstones and chert beds and concretions; basal conglomerate composed of conglomeratic sandstone and quartzite from Uinta Mountain group. Unconformably overlies Bishop(?) conglomerate; unconformably underlies Quaternary alluvium. In northeast corner of Monument, Browns Park lies on Precambrian Uinta Mountain group with angular discordance. Thickness 1,200 feet. Pliocene.

B. D. Carey, Jr., 1955, Intermountain Assoc. Petroleum Geologists Guidebook 6th Field Conf., p. 47–49. Commonly two units: lower, conglomerate of variable thickness which consists primarily of Precambrian cobbles; upper, composed of beds of chalky-white and grayish-white sandstone, tuffaceous sandstone, thin beds of chert and occasional beds of vitric tuff and fresh-water limestone. Thickness of basal conglomerate 0 to 300 feet; aggregate thickness of upper unit 1,200 feet. Powell estimated 1,800 feet, and this appears to be fairly representative for northwestern Colorado. Unconformably overlies all formations from Precambrian through middle Eocene Bridger formation. Suggestion before Society of Vertebrate Paleontologists to consider formation as middle Miocene (Hemingfordian) and perhaps, partly lower Miocene (Arikareean) in age.

Well developed in Browns Park, northwestern Colorado and northeastern Utah.

Browns Point Formation

Miocene: Northwestern Washington.

S. L. Glover, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2022–2023. Name applied to marine sedimentary series in strata designated by earlier workers as part of Hoh formation. At type section, comprises about 5,000 feet of moderately cemented buff to gray arkosic sandstones and thin-bedded dark-gray mudstones. Here strata are on south flank of northwesterly trending anticline; some beds are vertical or overturned; formation includes similar rocks, not before described, that form Destruction Island, and also 1,500 feet of exposures at Grenville Bay. Comparative studies indicate the Browns Point is younger than Hoh formation, older than immediately overlying early Pleistocene Taholah or late Pleistocene Queets beds, and older than Pliocene Quinault formation.

Type section: Olympic Peninsula along 3 miles of coast from NE¼ sec. 33 to SW cor. sec. 16, T. 25 N., R. 13 W., Jefferson County.

Brownsport Formation[1]

Brownsport Group

Middle Silurian: West-central Tennessee and northeastern Mississippi.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 566–583, 681–708.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Brownsport group shown on correlation chart as comprising (ascending)

Beech River formation, Bob formation, Lobelville formation, and Decatur limestone.

T. W. Amsden, 1949, Yale Univ., Peabody Mus. Nat. History Bull. 5, p. 138. Described in Decatur, Perry, Wayne, and Hardin Counties, Tenn., as Brownsport formation. Consists of about 100 feet of thin-bedded argillaceous limestones and calcareous and shales with lenses of thick-bedded nonargillaceous limestone. Overlies Dixon formation with apparent conformity; underlies Decatur limestone with apparent conformity. Present investigation does not reveal any satisfactory lithologic or faunal basis for division of Brownsport into formations or members, and it is proposed that terms "Beech River," "Bob", and "Lobelville" be abandoned.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 257–270, fig. 2 From a study of Foerste's descriptions of his Brownsport bed, it is apparent that he included all the beds that today comprise the Beech River, Bob, Lobelville, and Decatur formations. Brownsport group as used in this report includes these four units as formations. Overlain by formations of the Devonian or by Chattanooga shale; overlies Wayne group.

Named for exposures in vicinity of Brownsport Furnace, Perryville quadrangle, Decatur County, Tenn.

Brownstown Marl[1] or Formation

Brownstown Marl (in Austin Group)

Upper Cretaceous (Gulf Series): Southwestern Arkansas, northwestern Louisiana, southwestern Oklahoma, and northeastern Texas.

Original references: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 86–87, 188; 1894, Geol. Soc. America Bull., v. 5, p. 302, pl. 12; 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 340.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Correlation chart does not show Brownstown marl as outcropping in Louisiana.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 36. Brownstown marl included in Austin group. Foraminifera described.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Brownstown and Ozan formations mapped undifferentiated.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 46–48, pl. 1. Brownstown and Ozan formations undifferentiated in McCurtain County. In Arkansas, Brownstown rests unconformably on Tokio formation; this unconformity not recognized in McCurtain County.

First described in vicinity of Brownstown, Sevier County, Ark.

Brownstown Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Central-western West Virginia.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 586.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 78, pl. 7. In Kanawha group a little below Campbell Creek coal. Derivation of name given.

Named from Brownstown (now called Marmet), Kanawha County.

Brownstown Hills Sandstone Member[1] (of Edwardsville Formation)

Mississippian (Osagean): Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 172, 174, 175, 237, 240, 245.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Brownstown Hills sandstone and Dry Creek sandstone members included in Medora Knob facies of formation.

Named for fact it caps Brownstown Hills of south-central Jackson County.

†Browntown Sandstone (in Monongahela Formation)[1]

Pennsylvanian: Northern West Virginia, eastern Ohio, and southwestern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 58.

Exposed along bed and bluffs of Ten Mile Creek, at and below Brownstown, Harrison County, W. Va.

Brownville Limestone Member (of Wood Siding Formation)

Brownville Limestone (in Wabaunsee Group)[1]

Brownville Limestone Member (of Konawa Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and north-central Oklahoma.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 17, 29.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 43. Overlies Wood Siding formation (new).

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273–2275. Rank reduced to member status in Wood Siding formation (redefined). Overlies Pony Creek shale member; underlies Towle shale member of Onaga formation (new).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 67–71. Member described in Pawnee County where it is a single limestone unit. Thickness less than 1 foot to as much as 15 feet. Overlies Pony Creek shale member; underlies Permian Admire shale. Continuous from southeastern Nebraska to north-central Oklahoma, where it has been traced as far south as North Canadian River; south of river, the "Prague" of Seminole County is probably continuation of Brownville.

A. E. West, 1960, Shale Shaker, v. 11, no. 3, p. 4–6. Basal member of Konawa formation in report on Lincoln County, Okla. Underlies Americus(?) limestone. Stratigraphically above Grayhorse limestone. Thickness less than 1 foot to more than 3 feet.

Type locality: In Missouri River bluffs southwest of railway station at Brownville, Nemaha County, Nebr.

Brownville Slate[1]

Age(?): Maine.

Original reference: C. T. Jackson, 1837, Geol. rept. public lands of Maine, v. 1, p. 37.

†Brownwood division[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept. p. lxvii, pl. 3.

Named for Brownwood, Brown County.

Brownwood Shale Member (of Graford Formation)[1]

Brownwood Shale (in Canyon Group)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 389.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 94–95. Referred to as Brownwood shale member in Canyon group. Shale is quite sandy throughout, contains at least a dozen sandstone lentils and layers and one conglomerate bed designated as Rough Mountain conglomerate. Thickness measured 3½ miles north of Rochelle, 325 feet. Overlies Rochelle conglomerate; underlies Adams Branch limestone.

R. J. Cordell and D. A. Zimmerman, 1954, Abilene Geol. Soc. Guidebook, Nov. 19–20, p. 47–49. On basis of faunal studies in Brown County, the lower Brownwood is probably late Strawn and upper Brownwood early Canyon. Base of conglomerate separating the two parts of the Brownwood should apparently be regarded as Strawn-Canyon contact.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook Apr. 17–19, p. 51. Shown on composite section of Brown and Coleman Counties as member of Graford formation. Underlies Adams Branch limestone member; is base of section here described. Thickness about 200 feet. Consists of silty gray to red fissile shale; contains sandstone beds locally, and coquinas of crinoid columnals, brachiopods, and pelecypods. Fusulinid-bearing limestone about 60 feet below top, 1.2 miles east of Winchell.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 63–64, pl. 27. Drake (1893) placed Brownwood bed in Canyon division of Cummins (1891). He included in it shale and some sandstone which overlie both the Rochelle conglomerate and his Coral limestone bed (Capps limestone lentil of Plummer and Moore, 1921). Drake's Brownwood bed is practically identical with unit that has been considered by later geologists as Brownwood shale member. Plummer and Moore used term Brownwood shale in sense that Drake used it but considered the Rochelle conglomerate to underlie their Capps limestone lentil. Some geologists [see the bibliography of this report] have considered base of Brownwood shale to be top of Capps limestone lentil. Most geologists have considered base farther south, where the Capps is absent, to be the base of Rochelle conglomerate. Name Brownwood shale member is proposed for formal adoption in area of present report [Brown and Coleman Counties] because of lateral continuity of the member, its conspicuous topographic expression, its consistent relationship to other traceable units, and also because of wide usage of name at present time. Recommended that base of member be drawn at top of Capps limestone lentil of Plummer and Moore (1921). Also proposed that top of Brownwood be drawn at base of Adams Branch limestone member. In Brown County, basal beds of Brownwood member are gray shale containing marine fossils. They grade upward into red shale containing several beds of impure limestone and beds of sandstone. About 50 feet above base are additional beds of gray shale containing marine fauna, including brachiopod genus *Chonetina*. This shale is overlain alternately by lenticular beds of sandstone and a calcareous bed that appears in different places to be a desiccation breccia of limestone fragments, a cemented mass of algal(?) limestone pebbles, an impure clastic limestone, a sandy limestone, or (as in Winchell area) a bed of gray limestone 2 feet thick containing fusulinids. This is the limestone considered to be the Palo Pinto

equivalent by Nickell (1938, Texas Univ. Bur. Econ, Geology Pub. 3801) and by Cheney and Eargle (1951, West Texas Geol. Soc. Guidebook Spring Field Trip, June 1–2). Above this carbonate bed, and in many places cutting into it, is conglomeratic sandstone. Mostly gray silty shale and some lenticular beds of sandstone occupy interval from the conglomeratic sandstone, near middle part of the Brownwood, to base of Adams Branch member. This part of the Brownwood was called lower member of Graford formation by Nickell (1938). Thickness about 225 feet along Colorado River; about 300 feet in central part of Brown County where entire unit is exposed.

Named for Brownwood, Brown County.

Brownwood Canyon[1]

Carboniferous: Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii, pl. 3.

In vicinity of Brownwood, Brown County.

Bruja Island Diorite or Dolerite

Oligocene or Miocene: Panamá.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 26. Diorite represents massive dike that has cut through and distorted lower beds of Gatún sandstone.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2), 901. Referred to as dolerite. Lower Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 326. Oligocene or Miocene.

Quarried on Bruja Grande Island, in Gatún Lake, C.Z.

Brujo Limestone (in Mayagüez Group)

Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull. 71, no. 3, p. 337, pl. 1. Contains massive- to thick-bedded microcoquina, pellet limestone, some calcilutite, and minor wacke and mudstone. Lithologically the Brujo is identical with Cotui limestone member (new) of San Germán formation; the two are differentiated only by structural or age relationships. At type section, limestone probably dips northwest beneath a series containing conglomerate, limestone, breccia, and volcanic rock, part of San Germán formation. Southeast of El Brujo ridge the El Brujo fault separates the limestone from another area of San Germán formation to the south. Turonian to Campanian.

Type section: Near El Brujo where the microcoquina forms ridge trending northeast.

Brule Formation[1] or **Clay**[1] (in White River Group)

Oligocene, middle and upper: South Dakota, northeastern Colorado, western Nebraska, and eastern Wyoming.

Original reference: N. H. Darton, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 736, 755–759.

A. L. Lugn, 1938, Am. Jour. Sci., v. 36, 5th ser., no. 213, p. 227. Upper formation of White River group. Thickness 500 to 600 feet. Contains *Leptauchenia* and *Oreodon* beds. Overlies Chadron formation. Underlies Gering formation of Arikaree group.

C. B. Schultz and T. M. Stout, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1921; 1941, Guide for a field conference on the Tertiary and Pleistocene of Nebraska: Nebraska Univ. State Mus. Spec. Rept., p. 4 (table 1), 37. Formation, in Nebraska, subdivided into Orella member below and Whitney member above (both new). Overlies Chadron formation; contact between the two formations provisionally drawn at base of certain continuous purple-tinted white, sometimes silicified, limestone layers, which is upper of several such limestone beds in lower part of local section.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 38–46. Darton did not specify type locality. For practical purposes, Darton's (1899) "Round Top to Adelia Station" section, near Crawford, Sioux County, Nebr., should be considered type locality. Brule formation, in this typical area, approximately 480 feet thick. This same area was used for type definitions of Brule subdivisions. Orella and Whitney members overlie Chadron formation. Writers depart from their 1938 action in defining base of Brule as base of "purplish white layers" and suggest top of "purplish white layer" as redefined plane of division between Chadron and Brule. Locally Whitney member is capped by unit herein named Bayard paleosol complex. Middle and Upper Oligocene.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle (1:62,500): South Dakota Geol. Survey. Underlies Sharps formation (new). Consists of at least 200 feet of interbedded pinkish to greenish clays and sands. In White River group.

Named for Brule Indians who once roamed over Pine Ridge Indian Reservation in southern South Dakota.

Brule Schists[1]

Brule Volcanics[1]

Precambrian: Northwestern Michigan.

Original reference: R. C. Allen, 1910, Michigan Geol. and Biol. Survey Pub. 3, geol. ser. 2, p. 34.

Named for exposures north and south of Brule River. Iron River district.

Bruno Limestone (in Chase Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 38, 40.

Named from exposures on Bruno Creek, a few miles northeast of Florence, Kans.

Brunswick Conglomerate (in Newark Group)[1]

Upper Triassic: Eastern Pennsylvania.

Original reference: E. T. Wherry, 1914, B. L. Miller, Anniversary history of Lehigh County, v. 1, chap. 1, p. 8.

Crops out in region adjoining Boyertown Hills, Berks County.

Brunswick Formation (in Newark Group).

Brunswick Shale[1] or lithofacies (of Newark Group)

Upper Triassic: New Jersey and southeastern Pennsylvania.

Original references: H. B. Kummel, 1897, New Jersey Geol. Survey Ann. Rept. State Geologist 1896, p. 47–55; 1897, Jour. Geology, v. 5, p. 547–549.

D. B. McLaughlin and Bradford Willard, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 43. Interpretation of Newark group implies: (1) Brunswick and Lockatong were largely formed contemporaneously as red torrential and nonred paludal facies respectively; (2) Stockton and early Brunswick sedimentations were also to a degree contemporaneous; and (3) Newark is not a group of three distinct formations successively deposited, but a series of interfingering, in part contemporaneously formed, continental facies.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook for Field Trips Atlantic City Mtg., p. 44–46, 50–51, pl. 1. Formation includes Perkasie member near top and Graters member near middle. Much of formation is soft bright-red argillaceous shale with interbeds of thin- to medium-bedded siltstone; lower part of section contains large amount of thick-bedded tough red argillite with several dark-gray interbedded members; some gray, greenish, and bluish shale occurs high in section. Distribution noted.

D. B. McLaughlin, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 90–108, pls. Brunswick lithofacies discussed in detail in Bucks County, Pa.

Named for exposures in valley of Raritan, near New Brunswick, Middlesex County, N.J. In New Jersey, occurs in three belts separated by faults and by outcrop of Stockton and Lockatong in respective fault blocks. Owing to dying out of Hopewell fault in both directions, two southern belts merge in Pennsylvania and at northeast end of Sourland Mountain in New Jersey. Southern belt crosses Delaware near Washington Crossing. Middle belt extends northward from Hopewell fault to 1½ miles north of Lambertville where it is cut off by Flemington fault; west of the Delaware, shale of this band is bordered on northwest side by Paleozoic rocks of the floor, brought up by the fault. Northern band crosses Delaware north of Point Pleasant, Pa., and has width of about 10 miles north to Triassic border north of Milford, N.J. In Pennsylvania, continues as wide unbroken band through Bucks, Montgomery, into Berks County.

Brush Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Name applied to thin unit formerly designated as Middle DeLong coal. Stratigraphically above Hermon coal member (new), formerly designated as Lower DeLong coal, and below DeLong coal member, formerly designated as Upper DeLong coal. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Brush Creek, secs. 6 and 8, T. 9 N., R. 2 E., Knox County.

Brush cyclothem (in Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 52 (table 2), pl. 1. Name applied to cyclothem formerly called Middle DeLong. Above Hermon cyclothem (new) and below DeLong cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian

strata in Illinois. Cyclical classification independent of rock-stratigraphic classification.

Type locality: Along Brush Creek, secs. 6 and 8, T. 9 N., R. 2 E., Knox County.

Brush formation[1]

Upper Jurassic: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 301.

Derivation of name not stated.

Brush Creek Clay (in Conemaugh Formation)[1]

Brush Creek Fire Clay (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 62–65, table 1. Brush Creek clay listed as member of Brush Creek cyclothem in report on Perry County.

Brush Creek limestone was named for occurrence along Brush Creek, Cranberry Township, Butler County, Pa.

Brush Creek cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 11, 15. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 62–65, table 1, geol. map. Includes (ascending) Brush Creek shale, 17 feet; Brush Creek clay and Brush Creek coal (both absent in Perry County); and Brush Creek limestone, 3 inches to 10 feet. Occurs above Mason cyclothem and below Wilgus cyclothem. In area of this report, Conemaugh series is described on cyclothemic basis; seven cyclothems are named. [For sequence see Mahoning cyclothem.]

Exposed in Perry County.

Brush Creek Fire Clay Shale (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 315.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. Survey Rept. Inv. 17, p. 14. Brush Creek clay is light gray and varies from plastic to hard. Underlies Brush Creek coal. Conemaugh series.

Brush Creek Limestone Member (of Conemaugh Formation)[1]

Brush Creek limestone member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 34.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 62, table 1. Limestone member of Brush Creek cyclothem in report on Perry County. Average thickness about 2 feet. Marine fauna. Conemaugh series.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 32–37. Discussed as Brush Creek limestone member, Conemaugh series, in report on Morgan County. Commonly consists of two limestones, each from 6 inches to 1½ feet thick, separated by 4 to 8 feet of shale, clay shale, or sandstone. Locally some exposures have only lower bed from 1 to 1½ feet thick. Occurs above Brush Creek coal and below Buffalo sandstone and shale. In earlier years of geological work in tracing strata from Maryland, Pennsylvania, and West Virginia into Ohio, there was much difference of opinion as to correlation of lower Conemaugh beds. Term Brush Creek was applied variously to Cambridge limestone, to the true Brush Creek limestone, and to Mahoning limestone. Much of this miscorrelation resulted from lack of knowledge that the well-established Cambridge limestone changed in character and became discontinuous westward in Ohio. As a result, the true Brush Creek was called Cambridge, and term Brush Creek was applied to the still lower Mahoning limestone. Coals were involved also in changes in terminology over the years. Regional changes in lithology of Brush Creek limestone member added further difficulty to the correlations. Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) discussed some of these difficulties in correlation.

See Lower Brush Creek Limestone and Upper Brush Creek Limestone.

Named for exposures along Brush Creek, Cranberry Township, Butler County, Pa.

Brush Creek Red Bed (in Conemaugh Formation)[1]

Pennsylvanian: Southern Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 58, pls. 6, 7.

See Lower Brush Creek redbed member.

Somerset, Somerset County.

Brush Creek Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 305–308.

Allegheny County.

Brush Creek Shale (in Conemaugh Formation)[1]

Brush Creek shale and sandstone member

Brush Creek shale member

Pennsylvanian: Northern West Virginia, western Maryland, and eastern Ohio.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 309.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 62. Basal member of Brush Creek cyclothem in report on Perry County. Average thickness 17 feet. Typically buff to greenish sandy or clayey shale. Lies between Mason coal and Brush Creek limestone.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 31. Brush Creek shale and sandstone member occupies interval between base of Brush Creek limestone and top of Mason coal. In early geological reports on Ohio, Mason coal was one of the beds to which name Brush Creek coal was applied, as in original description. Thickness of Brush Creek shale and

sandstone varies from 6 to 14 feet in eastern York Township, Morgan County [this report], where Mason coal is best developed. In some exposures, member consists of gray to dark-gray shales. In most of the area, the lithology varies from sandy shale with siderite nodules to shaly thin-bedded sandstone or to more massive sandstone phase. Changes from shale to sandstone are rapid. Above Mason coal and below Brush Creek coal. Conemaugh series.

Named for association with Brush Creek limestone and coal.

Brush Hollow Limestone

Cenozoic (probably Quaternary): Southwestern Colorado.

W. F. Tanner, 1954, Oklahoma Acad. Sci. Proc., v. 35, p. 95 [1955]. Limestone of continental origin. Unconformably overlies sandstones and conglomerates of Cretaceous and Pennsylvanian age. Thickness varies from a few inches to approximately 25 feet. Formation includes three facies: conglomerate, travertine, and medium- to fine-crystalline limestone. Color is buff to tan. Locally the surface has appearance of caliche.

Crops out in Canon City area in T. 18 S., Rs. 69 and 70 W. Named after Brush Hollow Reservoir in T. 18 S., R. 69 W.

Brushy Basin Shale Member (of Morrison Formation)[1]

Upper Jurassic: Southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 59, pl. 15, strat. sections.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 93. In San Miguel and Montrose Counties, Colo., overlies Salt Wash member and underlies Burro Canyon formation (new). Average thickness about 400 feet.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf. p. 13 (chart), 38; 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 17–18, pl 1. Described in Thoreau quadrangle, New Mexico, where average thickness is about 100 feet. Grades laterally into thin-bedded sandstone to west and south, and into siltstone and mudstone to east and north. Overlies Prewitt sandstone member (new); underlies Dakota(?) sandstone.

W. L. Stokes, 1952, Utah Geol. and Mineralog. Survey Bull. 46, p. 9 (table 1), 11–12, pl. 1. In Thompsons area, overlies Salt Wash sandstone member and underlies Cedar Mountain formation. Consists of mudstone, varicolored, bentonitic, with few lenses of siltstone, sandstone, and conglomerate. Thickness 306 feet.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 155–156. Constitutes upper part of Morrison in region of this study [Colorado Plateau], where it is present in western Colorado, eastern Utah, northern New Mexico, and part of northeastern Arizona. To southwest, has been removed by post-Morrison erosion. Eastern and northeastern boundary is arbitrary line drawn where Salt Wash member loses its identity and cannot be distinguished from upper part of Morrison. Member is predominantly variegated claystone containing varying amounts of silt and sand. Thickness varies over the Plateau—more than 600 feet at Vernal, Utah, and 450 feet in southwestern Colorado.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 314, 315 (fig. 60), 320–321, 323–324, 326, 329, 332–333. In Laguna,

N. Mex., area, Recapture, Westwater Canyon, and most of Brushy Basin members are present in stratigraphic interval previously considered as Recapture. Sandstone previously considered as Westwater Canyon is at top of Brushy Basin and is known locally as Jackpile ore-bearing bed. Thickness ranges from 0 to about 370 feet; thickness largely determined by amount of deformation and erosion before deposition of Dakota sandstone.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 55, strat. sections. Present in northeastern and eastern parts of Navajo country. Intertongues with Westwater Canyon member; underlies Burro Canyon formation and where that is absent Dakota sandstone. Thicknesses: 194 feet at McElmo Creek; 156 feet in Carrizo Mountains area; 148 feet at Toadlena; 51 feet at Thoreau.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–221. In Moqui SE quadrangle, Montezuma County, Colo., member is 150 to 300 feet thick and consists of varicolored bentonitic mudstone with a few conglomeratic sandstone lenses. Overlies Westwater Canyon sandstone member. Intertongues with overlying Burro Canyon formation.

Named for exposures in Brushy Basin, near Blanding, San Juan County, Utah.

Brushy Canyon Formation (in Delaware Mountain Group)

Lower Permian (Guadalupe Series): Western Texas.

P. B. King *in* R. K. DeFord and E. R. Russell, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 4 (fig. 2), 8. Delaware Mountain group divided into (ascending) Brushy Canyon, Cherry Canyon, and Bell Canyon formations (all new).

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 577–579, 585 (fig. 7), 586–588, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215 p. 28–30, pl. 3 [1949]. Characterized by many sandstone beds that are coarser grained than those elsewhere in group; individual beds are lenticular and pinch out within short distances; many sections include as many as dozen beds of sandstone of various thicknesses, but others contain only a few; sandstones extend to top of a formation. Thickness 1,000 feet. Conformably overlies Bone Spring formation with Cutoff shaly member (new) forming transition zone between: overlaps northwestward on to Bone Spring.

Named for Brushy Canyon, 6 miles south-southeast of Guadalupe Peak, Culberson County; canyon drains westward down Delaware Mountains escarpment and crosses whole thickness of formation.

†Brushy Creek Chert[1]

Middle Devonian: Southeastern Oklahoma.

Original reference: E. O. Ulrich, 1927, Oklahoma Geol. Survey Bull. 45, p. 30.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Abandoned by Oklahoma Geological Survey. Name preoccupied by Pennsylvanian sandstone in Illinois. Unit now called Pinetop chert.

Named for exposures on Brushy Creek, Pittsburg County.

Brushy Creek Sandstone (in McLeansboro Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 256–258.

Exposed on north flank of ridge along Brushy Creek at Town Hall near center of Brushy Township, and at other places.

†Brushy Mountain measures (in Pottsville Group)[1]

Pennsylvanian: Southeastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 149–153, 167, 169.

Named for Brushy Mountain, Morgan County.

Brussels Formation

Pleistocene (Sangamon? and Illinoian): West-central Illinois and east-central Missouri.

W. W. Rubey, 1952, U.S. Geol. Survey Prof. Paper 218, p. 82–87, pl. 1. Proposed for thick series of well-laminated silts which locally contains much sand and gravel. Lithology varies but in general has fairly characteristic development in each of four regions. Most typical and most widespread facies is developed near Brussels. Here, lower third or fourth of formation is massive calcareous clay, and upper part an alternating series of laminated and massive beds of silt, clay, and fine sand. Maximum thickness 75 feet. Formation is younger than parts of Illinoian till and as old or older than Sangamon(?) loess.

Named for exposures near Brussels, Calhoun County, Ill. Widespread throughout Hardin and Brussels quadrangles. Deposits recognized in Lincoln and St. Charles Counties, Mo., and downstream to St. Louis.

Bruton Formation (in Fresnal Group)

Pennsylvanian (Virgil Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 79–82. Term introduced for the red shales, arkosic sandstones and conglomerates, with interbedded nodular to irregularly bedded limestones, which occur between top of the Moya formation (new) below and base of the Permian Wolfcamp above. In eastern part of Oscura Mountains, grades southward laterally into limestones, sandstones, and shales of lower part of Fresnal group. Locally underlies Abo formation. Thickness at type locality 113 feet; in Abo Canyon about 120 feet.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5, p. 17–18. Upper 40 feet of Bruton as defined by Thompson (1942) is transferred to Bursum formation. A lower part of the Bursum as defined by Wilpolt and others is here retained in the Bruton.

Type locality: Northeast side of Oscura Mountains in SE¼ sec. 32, T. 5 S., R. 6 E., Socorro County. Name derived from Bruton Tank on northeast side of Oscura Mountains.

Bryan Sand (in Yegua Formation)

Bryan Sandstone (in Yegua Group)

Eocene (Claiborne): Eastern Texas.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, pt. 2, p. 853 (fig. 131), 856. Lenticular body of sand at base of Yegua formation. Overlies Mount Tabor member (new) of Crockett formation.

Discussion of Yegua problem; author favors placing Crockett-Yegua boundary at base of Bryan sand.

A. A. Matthews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 3, geol. map. Rank raised to formation in Yegua group. At type locality, medium- to coarse-grained, well-sorted, irregularly bedded, coarsely laminated, uniformly crossbedded nearly white sandstone of characteristic deltaic origin. Locally, includes an 8-inch red iron sandstone bed. Contains petrified wood. Estimated thickness 553 feet. Lenticular along strike but not absent except where cut out by faulting. Overlies Smetana sandstone (new); underlies Easterwood shales (new).

Type locality: Along State Highway 21 from 2.1 to 3.75 miles west of court house, Brazos County.

†Bryant limestone[1]

Middle Ordovician: Central eastern Missouri.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 61.

Named for exposures along Bryant Creek, Lincoln County.

Bryant Lake Limestone[1]

Precambrian: New York.

Original reference: H. L. Alling, 1927, Geol. Soc. America Bull. v. 38, p. 798, 800.

Derivation of name not stated and not indicated on map.

Bryantsville Breccia or Bed (in Levias Member of Ste. Genevieve Limestone)

Mississippian (Meramec): Southern Indiana.,

J. B. Patton, 1949, Indiana Div. Geology Prog. Rept. 3, p. 9–10. Uppermost bed of Levias is brown rubbly brecciated dense limestone termed Bryantsville bed by C. A. Malott (unpub. ms.) and marks Meramec-Chester contact where Aux Vases is absent.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 9, 95, 96. Bryantsville breccia applied to persistent bed that is characteristically present at top of Levias member. Commonly 4 feet thick and has uneven base above a thin shale break; usually highly brecciated at top and has loose shaly and nodular facies a few inches thick at very top; frequently quite cherty, chert being flintlike, and the masses partly brecciated and arranged more or less obliquely with the bedding; lower part usually less brecciated than top and well cemented into hard limestone. Contains *Platycrinus penicillus* columnals and colonies of *Lithostrotion harmodites*. This latter fossil has been listed by Butts and Ulrich in Fredonia limestone, but it seems probable that these authors confused the sandstones in many of their sections and that their described occurrence of this fossil actually is in top of Levias instead of top of Fredonia; it has not been observed below Bryantsville in southern Indiana. Butts, Ulrich, and Weller recognized a limestone breccia in the interval in Indiana and Kentucky but did not apply name to it It is quite probable that Bryantsville breccia may extend continuously southward from Ohio River and westward about the whole of eastern and southern outcrop about Illinois basin. Type exposures noted.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 21, 30–36, pl. 1. Field separation of the Levias member of the Ste. Genevieve

limestone from younger Paoli limestone is dependent upon recognition of Aux Vases formation, if it is present, or of the Bryantsville breccia. Where Bryantsville is exposed, it is best stratigraphic marker in locating Meramec-Chester boundary as currently defined. Detailed description of unit; thickness as much as 12 feet.

Type exposures: NW¼NW¼ sec. 25, T. 4 N., R. 2 W., north side of U.S. Highway 50, about 1 mile southwest of Bryantsville, Lawrence County, Ind.; Richard Burton quarry section SW¼NW¼ sec. 20, T. 4 N., R. 1 W., north of road, 1¼ miles east of Bryantsville; Hixon quarry, SE¼NE¼ sec. 20, T. 4 N., R. 1 W., 2 miles east of Bryantsville.

Bryn Mawr Gravel[1]

Pliocene (?): Southeastern Pennsylvania, northern Delaware, and northeastern Maryland.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 258–272, 277–278, 288, 296–309.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 37–39. Described in Prince Georges County, Md., and District of Columbia where it consists of coarse poorly sorted pebbles in red sand and silt; bright-red color distinguishes it from pink or yellow Brandywine formation with which it is nowhere in contact. The farther inland parts lie unconformably on crystalline rocks of the Piedmont; extends eastward onto eroded surface of Patuxent formation; forms surface of ground wherever it occurs. Formation may be Miocene or older but is here assigned to Pliocene(?)

R. M. Overbeck and T. H. Slaughter, 1958, Maryland Dept. Geology, Mines and Water Resources Bull. 21, p. 84–85. In Cecil County, rests unconformably on Patuxent, Patapsco, and Raritan formations; locally, as at Bay View, lies on schists and intrusive rocks.

First described in vicinity of Bryn Mawr, Pa.

Bryson Formation

Bryson Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Northeastern Tennessee and southeastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 44, 208, pl. 40–A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 111–114, 138. Highest Pennsylvanian subdivision in Cumberland Gap coal field. Overlies Hignite formation. Partially equivalent to Anderson formation of Tennessee.

Named for Bryson Peak, Claiborne County, Tenn.

Búcaro Formation

Eocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg v. 8, Abt. 4a, no. 29, p. 134 (correlation chart). Name Búcaro appears in correlation chart. Underlies Tonosi formation.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 235–236. Referred to as Bucarú formation. Exposed thickness of Eocene rocks north of Guanico Point is about 2,000 feet. Lower beds are coarse dark-gray sandstones, conglomerates, and sandy shales. These beds are followed by about 1,500 feet of blue-green or black shales with thin gritty

sandstones; in their lower part are several fossil zones, the lower about 50 feet above base of section. Underlies David formation.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 327. On north side of Point near Bucarú, is in fault contact with volcanics; to south grades downward into volcanics. Lexicon uses Búcaro as preferred spelling.

Near village of Búcaro, Los Santos Province.

Bucarú Formation

See Búcaro Formation.

Bucatunna Clay Member (of Byram Formation)[1]

Bucatunna Formation or Clay

Oligocene, middle: Southeastern Mississippi and southwestern Alabama.

Original reference: B. W. Blanpied and others, 1934, Shreveport Geol. Soc. Guidebook 11th Ann. Field Trip, p. 3, 4, 12–16, charts.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1316, 1332–1341. Uppermost member of Byram formation. Unconformably overlies and in some areas grades into unnamed marl member; underlies Chickasawhay limestone. Near Leaf River, Miss., cuts out or overlapped by Catahoula sandstone. Thickness 11 to 55 feet.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 700, 702 (fig. 1). Referred to as Bucatunna clay. Overlies Byram formation. Included in Vicksburg stage.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. Name Hennessey Bayou member proposed for lower Bucatunna transgressive unit heretofore included in Byram formation.

Type locality: Along Bucatunna Creek, north of Denham post office, which is located in sec. 19, T. 8 N., R. 5 W., Wayne County, Miss.

Buchanan Gravel[1]

Pleistocene (Kansan): Eastern and central Iowa.

Original reference: S. Calvin, 1896, Iowa Acad. Sci. Proc., v. 3, p. 58–60.

A. E. Flint *in* A. V. Heyl, Jr., and others, 1959, U.S. Geol. Survey Prof. Paper 309, p. 25. Buchanan gravels considered to be of Kansan age.

Named for Buchanan County.

Buchanan Hill Conglomerate[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: J. P. Lesley, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1489–1536.

Caps Buchanan Hill, just south of New York line.

Buck Tongue (of Mancos Shale)[1]

Buck Formation

Buck Shale Member (of Price River Formation)

Upper Cretaceous: Central eastern Utah and central western Colorado.

Original reference: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23, 32.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, p. 1 (facing p. 1011). Shown on correlation chart as formation.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2), 2417. Member of Price River formation. Stated that term "tongue" is misleading when used in formal designation and that there should be no implication that the Buck shale is part of Mancos as lithostratigraphic or map unit. Montana age.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 180 (fig. 2), 182. Buck tongue of Mancos occurs above Castlegate member and below Sego member of Blackhawk formation. From its western edge near Woodside, Utah, the tongue thickens eastward to maximum of 380 feet at West Salt Creek, Colo., where it passes into main body of the Mancos.

Named for Buck Canyon, T. 19 S., R. 23 E., Utah.

†Buck Creek Formation[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 78.

U.S. Geological Survey has abandoned the name Buck Creek formation.

Named for exposures along Buck Creek in northeastern part of Osage County.

Buck Creek Sandstone[1]

Buck Creek Sandstone Member (of Grindstone Creek Formation)

Pennsylvanian (Strawn Series): Central northern Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 162.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as basal member of Grindstone Creek formation. Occurs below Santos limestone member and above Brannon Bridge limestone member of Lazy Bend formation.

Crops out on Buck Creek in southwestern part of Parker County.

Buckeye Shale (in Sumner Group)[1]

Buckeye Shale Member (of Wellington Shale)

Permian: Southeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. Guidebook 10th Ann. Field Conf., p. 12 (fig. 4).

J. L. Garlough and G. L. Taylor, 1941, *in* Stratigraphic type oil fields; Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 87 (table 2). Table lists rocks of Sumner group at their outcrop, 200 miles east of Hugoton gas field; Wellington shale is divided into (ascending) Buckeye shale, Carlton limestone, shale, and Geuda salt.

Buck Hill Volcanic Series

Eocene, upper, Oligocene and younger(?): Western Texas.

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Oct. 29–31, p. 13–22. Name applied to Tertiary volcanic succession unconformably overlying Boquillas formation. Includes (ascending) Pruett formation with its intercalated flows (Crossen trachyte, Sheep Canyon basalt, and Potato Hill andesite), Cottonwood Spring basalt, Duff formation, Mitchell Mesa rhyolite, Tascotal formation, and Rawls basalt. Eocene to Miocene(?). [See Green Valley volcanic series.]

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1143–1145, 1170, pl. 1. Described in Buck Hill quadrangle where Mitchell Mesa rhyolite is uppermost unit. Thickness 2,000 feet or more. Flows came into region from north, and thus mapped boundaries probably represent their original southern limits closely; flows were eroded in part and weathered before being covered with ash. In Buck Hill and Jordan Gap quadrangles, series has been folded into broad northwest-plunging nose. Lower Tertiary. Pruett is tentatively assigned to Eocene and the Duff to Oligocene. Derivation of name.

R. L. Erickson, 1953, Geol. Soc. America Bull., v. 64, no. 12, pt. 1, p. 1358 (table), 1361–1371, pl. 1. Series described in Tascotal Mesa quadrangle where it includes (ascending) Pruett tuff (formation), Duff tuff (formation), Mitchell Mesa tuff-flow, Tascotal tuff (formation), and Rawls basalt. Thickness about 3,900 feet. Overlies Boquillas formation; angular unconformity. Underlies Quaternary gravels. Eocene(?), Oligocene, Miocene(?).

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 542–543, pl. 1. Described in Cathedral Mountain quadrangle where Rawls basalt is uppermost unit. Crossen trachyte, Sheep Canyon basalt, and Potato Hill andesite, considered intercalated flows in Pruett formation by Goldich and Elms, are here given formational status, and name Pruett is restricted to the tuff, sandstone, conglomerate, and limestone below Crossen trachyte. Aggregate thickness more than 4,600 feet. Overlies Boquillas formation; angular unconformity. Top of Eocene is placed at disconformity between Crossen trachyte and Sheep Canyon basalt. Suggested that overlying lava and tuff layers are Oligocene and younger(?).

Named for outcrops in Buck Hill quadrangle, Brewster County, Tex.

Buckhorn Asphalt

Pennsylvanian: Southern Oklahoma.

H. J. Smith, 1938, The cephalopod fauna of the Buckhorn asphalt: Dept. Geology and Paleontology, Chicago Univ., p. 1, 3. Asphalt deposit containing cephalopod fauna; main fossil-bearing bed is shaly limestone; thin veneer of calcium carbonate gives rocks a white appearance, but on fresh exposure rocks are black.

A. G. Fisher and Robert Finley, Jr., 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1887. Buckhorn sediment of Oklan age was laid down as shell breccia in argillaceous and sandy matrix, grading upward into gravel; faulting of Arbuckle orogeny permitted Ordovician oil to saturate the sediment.

Occurs in abandoned quarry in sec. 2, T. 1 S., R. 3 E., about 3 miles south of Sulphur, Murray County. Region is on northern flank of Ardmore basin.

Buckhorn Conglomerate (in Cedar Mountain Group)

Buckhorn Conglomerate Member (of Cedar Mountain Formation)

Lower Cretaceous(?): Central eastern Utah.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 958, 965–966, pl. 4. At type locality, unit is 20 to 30 feet thick, irregularly bedded with minor sandy lentils, but generally present as single massive stratum. Underlies Cedar Mountain shale (new); overlies Brushy Basin shale

member of Morrison. Together with Cedar Mountain shale comprises Cedar Mountain group (new).

W. L. Stokes, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1773, 1774. Rank reduced to member status in Cedar Mountain formation.

Type locality: Buckhorn Flat at southwest flank of Cedar Mountain, Emery County. Prominent in northern part of San Rafael area where it caps Cedar Mountain, a tabular mass of Jurassic sediments about 75 square miles in extent.

†Buckhorn Limestone[1]

Lower Mississippian: Central northern Utah.

Original reference: F. M. Wichman, 1920, Eng. and Mining Jour. v. 110, no. 12, p. 563.

Ophir mining district.

Buckhorn Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9. Dolomite, argillaceous, with green shale partings; contains bentonite zone. About 6 feet thick. Shown on columnar section (fig. 3) as underlying St. James member (new) and overlying Glenhaven member (new) of Guttenberg formation.

In the copy of the guidebook used by the compiler, in figure 3 the name Buckhorn had been crossed out and the name Red Oak written in. Likewise, the name Glenhaven had been crossed out and the name Garnet written in. Thus, the sequence would read (descending) St. James, Red Oak, Garnet. However, in figure 9, the name Glenhaven had not been changed. Since the compiler had no way to determine what changes, if any, had been made in other copies of the guidebook, it was impossible to be certain which names were to be retained.

Occurs in Dixon-Oregon area.

†Buckingham Marl or Limestone

Miocene, upper: Florida.

W. C. Mansfield, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1916; 1939, Florida Geol. Survey Bull. 18, p. 11–16. Proposed for limestone cropping out in Lee County. Believed to be uppermost Miocene. Underlies Tamiami limestone. Fossils listed.

G. G. Parker, 1951, Am. Water Works Assoc. Jour., v. 43, no. 10, p. 823. Tamiami formation as herein defined includes Buckingham limestone of Mansfield.

Type locality: Quarry near State Highway 25, one-half mile west of Orange River, sec. 5, T. 44 S., R. 26 E., Lee County.

Buck Island Member (of Davis Creek Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Upper member of formation. Overlies Baldy Mountain member (new); underlies Brophy Canyon formation (new). The Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Buck Lodge diabase[1]

Upper Triassic: Central northern Maryland.

Original reference: C. R. Keyes, 1891, Geol. Soc. America Bull., v. 2, p. 320.

East of Sugarloaf Mountain, Frederick County.

Buck Mountain Granite

Precambrian(?): Northwestern Wyoming.

C. C. Bradley, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 36–37. Name applied to granite in Buck Mountain stock. A pink or white granite resembling alaskite.

Named for Buck Mountain in Grand Teton National Park.

Buckner Formation

Buckner Member (of Haynesville Formation)

Upper Jurassic: Subsurface in Arkansas, Louisiana, Mississippi, and Texas.

H. K. Shearer, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 6, p. 724. Formation, approximately 200 feet thick, is characterized by anhydrite with shale and dolomitic limestone. Overlies Smackover limestone; underlies Cotton Valley formation.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 959 (fig. 2), 960 (fig. 3), 966. Maximum thickness penetrated in Arkansas 270 feet. Pre-Comanche.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 158. Jurassic(?).

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 21–25, cross sections. Presumably Upper Jurassic.

R. W. Imlay, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 11, p. 1437 (table 1), 1451–1458. Detailed discussion with Jurassic formations of Gulf Coast region. Upper Jurassic (Kimmeridgian).

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 578 (table 1), 592, strat. sections, chart. Underlies Bossier formation (new) of Cotton Valley group. Upper Jurassic.

T. H. Philpott and R. T. Hazzard, 1949, Shreveport Geol. Soc. Guidebook 17th Ann. Field Trip, fig. 5 (correlation shart). Chart shows Buckner as basal member of Haynesville formation (new).

Named after Buckner field, Columbia County, Ark.

Buckner Group

See Boice Formation.

†Buck Point Sandstone Member (of Nelagoney Formation)

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: F. R. Clark, 1918, U.S. Geol. Survey Bull. 686–I, p. 94.

Buck Point Sandstone is considered the equivalent of Okesa Sandstone, and name is abandoned.

Well exposed at Buck Point and elsewhere around edges of main divide between Sand and Buck Creeks in T. 26 N., 11 E., Osage County.

Buckrange Sand Lentil (of Ozan Formation)[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: C. H. Dane, 1926, U.S. Geol. Survey Press Bull. 8823, Sept. 10.

Crops out short distance north of village of Buckrange, Howard County; also 1 mile northeast of village, on road to Nashville.

†Buck Ridge Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 80–91, 118.

Forms Buck Ridge.

Buck Ridge Schist

Precambrian (Archean?): Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, Tennessee Valley Auth. Div. Geology Bull. 4, p. 12, 14. Rather variable both in composition and texture, but usually is fine textured and composed of secondary micas, chlorites, and feldspars. Includes Bearwallow schist (new).

Named from Buck Ridge in Spruce Pine quadrangle, where it has its largest outcrops.

Bucks Granodiorite

Late Jurassic(?): Northern California.

Anna Hietanen, 1951, Geol. Soc. America Bull., v. 62, no. 6, pl. 1. Shown on map as Bucks granodiorite.

Occurs on Feather River in Merrimac area, Plumas National Forest, Butte and Plumas Counties.

Bucks Bridge Member (of Tribes Hill Formation)

Bucks Bridge (mixed) Beds[1]

Lower Ordovician (Beekmantown): Northern New York.

Original reference: G. H. Chadwick, 1915, Geol. Soc. America Bull., v. 26, p. 289–291.

R. R. Wheeler, 1946, Harvard Univ. Summ. of Theses 1942, p. 144. Middle member of Tribes Hill formation in St. Lawrence Valley. Underlies Ogdensburg member; overlies Heuvelton member.

Apparently named for Bucks Bridge on Nettle Creek in St. Lawrence Valley.

Buckshot Ignimbrite (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 20. Name proposed for rhyolite porphyry, 40 to 75 feet thick, that caps Buckshot Rim. Fresh rock is grayish red to moderate yellowish brown; weathered surface, pale to dark reddish brown; locally a dusky green layer of brittle glassy rock is present at base. In thin section, matrix shows glass shards and other pyroclastic material. Overlies Colmena tuff (new); underlies Chambers tuff (new).

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Described in Van Horn Mountains area where it forms a resistant cap rock from 3 to 20 feet thick. Overlies Colmena formation. Crops out only on southern flanks of Colquitt syncline in the Sierra Vieja.

Type locality: Four miles east of Candelaria, Rim Rock country, Presidio County.

Buckskin Schist

Pre-Ordovician(?): North-central Washington.

E. A. Youngberg and T. L. Wilson, 1952, Econ. Geology, v. 47, no. 1, p. 2–4, 12. Name applied to series of quartz-amphibole schists containing two horizons of intermittent marble beds and calcareous schist. Mapping indicates beds may be 3,000 to 3,500 feet thick. Age sequence not clear; it would appear that Fernow unit (new) is older than less metamorphosed Buckskin and Martin Ridge schists; this would require that beds be overturned as Fernow gneisses lie stratigraphically above the schists.

Named for occurrence in vicinity of Buckskin Mountain, near Holden, Chelan County.

Buckskinian series

Cretaceous (Mid-Cretacic): Northwestern Kansas, and eastern Colorado.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 76, no. 4, p. 304 (chart). Includes Gove chalk below and Wallace shales above; thickness about 700 feet. Occurs above Pueblan series and unconformably below Rawlinsian series.

Charles Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 207. Includes a great section of dark shales, exposed in eastern Colorado and northwestern Kansas, usually called vaguely and erroneously the Pierre formation. Section covers a large but indefinite part of the median part of Asiniboine centrum shales. There is doubtless another series between the Buckskinian and the top of Apishapa shale member of Pueblan series.

Name derived from a way station in Wallace County, Kans.

Buckskin Mountain Formation

Permian (Wolfcampian): Northeastern Nevada.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no 10, p. 1693–1697. Proposed for a 1,200-foot uniform sequence of yellow-tan quartzose calcisiltites and minor gray calcarenite beds of Wolfcampian age conformably overlying Pennsylvanian-Permian Strathearn formation and conformably overlain by Permian Beacon Flat formation (new).

Type section: On north side of Humboldt River at Carlin Canyon loop area; base in NW¼NW¼SW¼ sec. 22, T. 33 N., R. 53 E., and top in NW¼SE¼NW¼ sec. 22, Elko County. Crops out prominently on Buckskin Mountain, 3 miles south of type locality.

Bucksport Formation

Age not stated: Eastern Maine.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Thin-banded limey quartzite-uniform bands of light-greenish and dark-gray to purple bands. Lighter bands are quartz rich, and original calcareous minerals have been recrystallized to form lime silicates, mostly diopside; darker bands are quartz and biotite rich, and purple tints are due to finely divided biotite. Overlies Penobscot formation; appears to be overlain and interbedded with unit referred to as Veazie formation (new). Name credited to J. M. Trefethen (1950, Preliminary map of Bucksport area, Maine: Maine Univ.). [Compiler was unable to locate this reference.]

Report covers portions of Hancock and Penobscot Counties.

Buck Spring Formation

Cambrian: South-central Wyoming.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Soc. Guidebook 9th Ann. Field Conf., chart 2; A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Soc. Guidebook 10th Ann Field Conf., p. 38. Name applied to facies equivalents of Gros Ventre group in south-central Wyoming. Contains brown to red sandstone, siltstone with minor amounts of glauconite, and no limestone; by comparison Gros Ventre group contains green fissile highly glauconitic shales and much limestone. Where Death Canyon limestone is missing, entire shale sequence may be called Gros Ventre formation, but where these rocks are in brown to red sand and siltstone facies name Buck Spring is applied. Thickness at type locality 106 feet.

Type locality: Near Buck Spring in SE¼ sec. 4, T. 22 N., R. 88 W., in northwestern part of Rawlins uplift.

Buda Limestone (in Washita Group)[1]

Buda Limestone (in Sixshooter Group)

Upper Cretaceous (Comanche Series): Southeastern Texas, and northern Mexico.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Bull. 164, p. 18.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Correlation chart shows Buda limestone in Washita group, Upper Cretaceous (lower Cenomanian). Overlies Grayson shale. Present in Chihuahua, Mex.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1140–1141, pl. 1. Described in Buck Hill quadrangle, Texas, where it is 65 to 68 feet thick. Disconformably overlies Grayson clay; disconformably underlies Boquillas formation. Lower Cretaceous.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 10 (table 1), 13, 31, pl. 1. Described in Eagle Mountains, Hudspeth County, where it underlies Eagle Ford formation and overlies Eagle Mountains sandstone member (new) of Grayson formation. Maximum thickness 225 feet. Upper Cretaceous.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21. In Wylie Mountains and vicinity, uppermost formation in Sixshooter group (new). Overlies Boracho formation (new); overlain with angular discordance by Tertiary volcanic strata. Thickness 40 to 150 feet.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 385–386. Described in Kent quadrangle where it is uppermost formation in Sixshooter group. Unconformably overlies San Martine member (new) of Boracho formation; unconformably underlies Boquillas flags. Thickness 160 feet. Cenomanian.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 10, pl. 1. Described in Terlingua district, Texas, where it is commonly 90 feet thick, overlies Grayson formation and underlies Boquillas flags. Comanche series, Upper Cretaceous.

A. P. Noyes, Jr., and Keith Young, 1960, Texas Jour. Sci., v. 12, nos. 1–2, p. 70 (fig. 3), 74 (fig. 5), 90–92. Described in Purgatory Creek area, Texas, where it is 40 feet thick, overlies Del Rio clay and unconformably underlies Eagle Ford formation.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 41–42, pl. 2. At Grayson Bluff, southern Denton County, Tex., the Buda consists of clastic coquinitic buff to yellow limestone about 18 inches thick. Unconformable with underlying Denison formation; contact with overlying Woodbine is irregular surface of erosion. Washita group. Upper Cretaceous.

Named for Buda, Hays County, Tex.

Buell Limestone

Eocene, upper: Eastern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 8 (pl. 4), 9–11. Dense gray rock with both carbonaceous and clastic fragments. Weathers brown near surface. Estimated thickness 20 feet. Deposit is similar in appearance and composition to Dallas limestone (new) 10½ miles to southwest. Both appear to lie disconformably on older basalt. Fossils occur in Buell limestone but have not been identified. If Buell does occupy stratigraphic position similar to Dallas limestone, it would be of upper Eocene age.

Occurs about 2 miles west of Buell and 3½ miles southeast of Willamina, Polk County, a short distance south of State Highway 22. Extensively quarried.

Buena Vista Sandstone Member (of Cuyahoga Formation)[1]

Buena Vista Sandstone Member (of Logan Formation)

Buena Vista Siltstone Member (of New Providence Formation)

Mississippian: Southern Ohio and north-central Kentucky.

Original reference: E. Orton, 1874, Ohio Geol. Survey, v. 2, pt. 1, p. 615, 618, 626.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 78, 133, pl. 6. Buena Vista siltstone considered member of New Providence formation in area of Vanceburg facies in Kentucky. Overlies Henley member; underlies Rarden member; [Stockdale] cannot clearly justify Hyde's recognition of the Buena Vista in Lewis County; this is partly because of difficulty in distinguishing overlying "Rarden shale member" of Hyde in Kentucky. Considered Lower Mississippian.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 60–61, 62. Buena Vista sandstone considered basal member of Logan formation. In area of Vanceburg facies, underlies Rarden shale member; in area of Scioto Valley facies, underlies Portsmouth shale member.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 24, 25. Here considered member of Cuyahoga formation in areas of Scioto Valley and Vanceburg facies where it overlies Henley shale member; in Scioto Valley facies, underlies Portsmouth shale member; in Vanceburg facies, underlies Rarden shale member. Editor's note states that Hyde (1921, Ohio Geol. Survey Bull. 23) correlated Buena Vista sandstone with Berne and lower part of Byer in discussion geology of Camp Sherman quadrangle; such a correlation would necessitate placing Rarden, Vanceburg, Churn Creek, and most of Portsmouth shale in Logan formation.

Named for Buena Vista, Scioto County, Ohio.

†Buena Vista Shale[1]

Lower and Middle Cambrian: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

Named for Buena Vista, Rockbridge County.

†Buffalo Cement Bed[1]

Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

Buffalo, Erie County.

Buffalo Formation (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, p. 24–25, pl. 4.

Punxsutawney quadrangle.

†Buffalo Glaciation, Drift, or Till

Buffalo Glacial Stage[1]

Pleistocene: Rocky Mountain region.

Original reference: E. Blackwelder, 1915, Jour. Geology, v. 23, p. 310, 328–336.

John de la Montagne, 1956, Wyoming Geol. Soc. Guidebook 11th Ann. Field Conf., p. 29–30. Glacial sequence in Jackson Hole area (ascending): Buffalo, Bull Lake, and Pinedale.

G. M. Richmond, 1957, Internat. Assoc. for Quarternary Research, 5th Cong., Madrid, p. 157; 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1371–1382. Pleistocene deposits in Rocky Mountain region are grouped into three stages: Buffalo (oldest), Bull Lake, and Pinedale, each with characteristic topographic expression and soil development. Buffalo stage includes till sheets of three ancient glaciations. Lower and middle sheets are precanyon and the upper is of intracanyon or postcanyon age. Where stratigraphically superimposed, each of these tills is overlain by thick strongly developed reddish clay soil.

Named for occurrence of drift along Buffalo Fork or Snake River in Wyoming.

Buffalo Granite[1]

Precambrian: Central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 36, map.

In vicinity of Buffalo Lithia Springs, Mecklenburg County, Va.

Buffalo Sandstone Member (of Conemaugh Formation)[1]

Buffalo shale and (or) sandstone member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 33.

M. T. Sturgeon and others, 1958, Ohio Div. Geology Bull. 57, p. 95 (table 11), 114. Referred to as Buffalo shale and (or) sandstone member of Wilgus cyclothem in report on Athens County. White (1878) used name Buffalo for thick sandstone between Brush Creek and Cambridge (Pine Creek in Pennsylvania) limestones. Adams (1903) called shale between Cambridge limestone and Brush Creek coal Buffalo shale. In Ohio, both the sandstone and shale between the Brush Creek and Cambridge limestones are called Buffalo although name is commonly considered as applied to sandstone. Flint's (1951) description of Buffalo shale in Perry County fits that of Meyersdale redbed rather than that of Buffalo member. Term Buffalo is used in this report for both shale and sandstone. Thickness of member varies from 7 to 8 feet to almost 43 feet. Meyersdale redbed member, which overlies Buffalo sandstone in Pennsylvania, is not present in Athens County. Conemaugh series.

Attains maximum development along Buffalo Creek, in Buffalo Township, Butler County, Pa.

Buffalo shale[1]

Upper Ordovician and lower Silurian: Northeastern Missouri and southwestern Illinois.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 61.

Named for Buffalo Creek, Pike County, Mo.

Buffalo Shales (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: T. K. Adams, 1903, Mines and Minerals, v. 23, p. 360.

N. K. Flint, 1951, Ohio Div. Geology, ser. 4, Bull. 48, p. 65, Table 1. Buffalo shale member included in Wilgus cyclothem in Perry County. Term Buffalo has previously been restricted to massive cliff-forming sandstone, but in this report shale occurring in the same interval is also called Buffalo. Thickness 23 to 52 feet. Consists of shale or clay shale of various gray, green, purple, and red shades. Contains numerous hematite, siderite, and limonite nodules some of which are calcareous. Conemaugh series.

M. T. Sturgeon and others, 1958, Ohio Div. Geology Bull. 57, p. 114. Flint's (1951) description of Buffalo shale in Perry County fits the Meyersdale redbed rather than that of Buffalo member.

Exposed near Pittsburgh, Allegheny County.

Buffalo Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 384.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Mtg., p. 71. Clay, 125 feet thick. Underlies Wilbarger Creek bed; overlies Rough Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in com-

mon use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Buffalo Creek, Mills County.

Buffalo Creek Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian (Pottsville Series): Southwestern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 143.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 78. Marine limestone here considered to be of lower Allegheny age.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). In this report, the Kanawha is considered a group in Pottsville series.

Named for association with Buffalo coal, Lee district, Mingo County.

†Buffalo Creek Sandstone Member (of Conemaugh Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: G. H. Ashley, 1908, Pennsylvania Topog. and Geol. Survey Comm. Rept. 1906–1908, p. 161.

In region of Buffalo Creek, Butler County.

Buffalo Hart Substage

Buffalo Hart Till

Pleistocene (Illinoian): Illinois.

M. M. Leighton and H. B. Willman, 1949, *in* Itinerary State Geologists Field Conference on late Cenozoic Geology of Mississippi Valley, p. 7 (table 1); 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). Illinoian stage is divided into (ascending) Loveland, Payson, Jacksonville, and Buffalo Hart substages.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 125 (fig. 50), 139, geol. sections 50–52, 58, 61, 64, 66, 69. Buffalo Hart moraine extends through northeast part of Beardstown quadrangle and northward through west part of Vermont quadrangle. Buffalo Hart deposits also form surface drift through all upland areas of Havana and Glasford quadrangles. Outwash deposits scarce, but some gravel and sand occurs over older Illinoian till and under Farmdale or Peorian loess in small ravines north and south of Vermont. Buffalo Hart till cannot be differentiated from older Illinoian tills, except locally where intra-Illinoian gravel, sand, and silt deposits are deposited. Derivation of name given.

Named for Buffalo Hart in northern Sangamon County.

Buffalo Hill Sandstone (in Clear Fork Group)[1]

Permian: Central and central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, opposite p. 96.

Named for Buffalo Hills, Taylor County.

Buffalo Hump Formation (in Deer Trail Group)

Precambrian (Belt Series): Northeastern Washington.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as uppermost of five formations in group. Overlies Stensgar dolomite.

Report discusses magnesite belt of Stevens County.

Buffalo Peaks Andesite[1]

Oligocene, lower(?): Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 900, 990, 999, 1000.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 103–105, pl. 1. On Hall Buttes, andesite varies from gray to black, with phenocrysts of hornblende and pryoxene. Flow structure common, and platy jointing often well developed. Small amounts of agglomeratic material at base of volcanics. Thickness between 500 and 600 feet at westernmost end of West Hall Butte and decreases to between 200 and 300 feet at east end of East Hall Butte; much thicker on Buffalo Peaks. An early Oligocene age is suggested.

Lies on truncated surface of Paleozoic strata affected by syncline extending northerly from valley of Trout Creek in sec. 3, T. 14 S., R. 77 W., past Pony Spring, to northeast spur of Buffalo Peaks in Salt Creek area, Park and Chaffee Counties.

Buffalo River Series[1] or Group

Ordovician: Northern Arkansas.

Originial reference (Big Buffalo Series): R. S. Bassler, 1915, U.S. Natl. Mus. Bull. 92, v. 2, pls. 1, 2.

J. S. Cullison, 1938, Jour. Paleontology, v. 12, no. 3, p. 219–228. Buffalo River group as originally defined by Ulrich (1911) included Joachim dolomite at top, St. Peter sandstone, and Everton sandstone and dolmite. McQueen (1937) has described Dutchtown formation, which lies unconformably between the Joachim and the St. Peter and Everton of Ulrich's section. The Dutchtown is only formation of Buffalo River group that contains fossils in abundance.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 113–114. Buffalo River series consists of (ascending) Everton, St. Peter, Dutchtown, and Joachim formations. Originally Big Buffalo series, but name of Big Buffalo River, after which group is named, was changed to Buffalo River.

Ulrich (1911, Geol. Soc. America Bull. v. 22, pl. 27) did not use term Big Buffalo Series. He showed an unnamed epoch preceding the Chazyan and succeeding the Canadian. This unnamed epoch comprised (ascending) Everton, St. Peter, and Joachim Formations. Bassler's Big Buffalo Series comprises (ascending) Sneeds, Everton, St. Peter, and Jasper Formation.

Named for exposures on Buffalo River in Newton County. River was formerly called Big Buffalo.

†Buffalo Run Limestone[1]

Upper Cambrian: Central Pennsylvania.

Original reference: C. D. Walcott, 1916, Smithsonian Misc. Colln. v. 64, no. 3, Pub. 2370, p. 165.

Two miles north of Benore post office, Center County.

Buffalo Springs Formation (in Conococheague Group)

Buffalo Springs Member (of Conococheague Formation)

Upper Cambrian: Southeastern Pennsylvania.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of the Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol.

Survey, 4th ser., Atlas 167–D. Consists of dirty-white or pinkish-gray to medium-gray crystalline limestone, commonly with laminae, alternating with yellowish-gray to light-olive-gray weathered dolomite and magnesian limestone; dolomite is fine to medium crystalline and commonly light gray on fresh surface; thin sandy limestone or silty limestone beds occur locally. Light-olive-gray weathering shaly limestone interbeds present in many outcrops. The white to pinkish-gray limestones commonly grade laterally into very light-gray limestone. Light-blue-gray limestone common near top of member. Estimated thickness more than 700 feet; base of member not exposed in quadrangle; partial section (type section) 247 feet. Underlies Snitz Creek member (new); oldest exposed Cambrian limestone in quadrangle.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Upper Cambrian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Conococheague group.

Type section: Partial section measured along old trolley line about 0.7 mile southeast of Buffalo Springs, Lebanon County. No satisfactory type section available in Lebanon County, but best partial section has been measured and used as type section.

Buffalo Wallow Formation[1]

Upper Mississippian: Western central Kentucky and southern Indiana.

Original reference: Charles Butts, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, p. 112.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 840. Name Buffalo Wallow has been used for all of the Chester above Tar Springs sandstone in southeastern part of Eastern Interior basin, but as all of the formations of the Elvira group with the possible exception of the Vienna and Waltersburg can be identified at type locality of the Buffalo Wallow, the name has little value.

Preston McGrain and F. H. Walker, 1954, Kentucky Geol. Soc. Field Trip, April 1954, p. 28. Leitchfield formation differs from Buffalo Wallow (Butts, 1917) in that it includes the Tar Springs as basal member.

Named for Buffalo Wallow, a circquelike excavation in the shales of the formation on highway, 2 miles west of Cloverport, Breckenridge County, Ky.

Buffkin Formation[1]

Buffkin Limestone (in Wabash Formation)

Pennsylvanian: Southwestern Indiana.

Original reference: Marshall Harrell, 1935, Indiana Div. Geology Pub. 133, p. 73 (chart).

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 78. Gives derivation of name.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Correlation chart shows Buffkin limestone in Wabash formation; occurs above Parker limestone and below Grayville limestone.

F. D. Spencer, 1953, U.S. Geol. Survey Circ. 266, p. 14 (fig. 4). Column credited to C. E. Wier (1944–51) shows Buffkin formation at top of section above New Haven formation.

Named for Buffkin, Posey County.

Bufkin Limestone

See Buffkin Formation.

Bug Scuffle Limestone Member (of Gobbler Formation)

Pennsylvanian: Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Consists of massive gray cherty limestone which grades laterally into sandstone and shale.

In Sacramento Mountains, Otero County.

Bujio Formation

See **Bohío Formation.**

Buldir Volcanics

Quaternary(?): Southwestern Alaska.

R. R. Coats, 1953, U.S. Geol. Survey Bull. 989–A, p. 8, 13–14, fig. 2. In general, rocks are pale-gray dense holocrystalline olivine basalts and olivine-hypersthene basalts. Flows generally thin, averaging less than 10 feet. Interstratified with lava flows on sea cliffs northeast of Kittiwake Pond, at an altitude of 760 feet, are layers of essential basaltic lapilli, consisting of hyalophyric olivine basalt.

Associated with Buldir Volcano and parasitic cone (Hill 1350) to northeast of main cone, which contributed largely to construction of southwestern part of Buldir Island, in western Aleutian Islands.

†Bulger Limestone (in Monongahela Formation)[1]

Upper Pennsylvanian: Southwestern Pennsylvania and eastern Ohio.

Original reference: W. T. Griswold and M. J. Munn, 1907, U.S. Geol. Survey Bull. 318, p. 38–39, 70.

Named for exposures at Bulger, Washington County, Pa.

Bulitan Stage

See Bulitian Stage.

Bulitian Stage

Paleocene: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903; 1954, Pacific Petroleum Geologist, v. 8, no. 11, p. 1. Named as one of six stages, based on foraminiferal assemblages, in the lower Tertiary of California. Includes interval between Eocene Juniperan [Juniperian] stage above and Paleocene Ynezian stage. Also spelled Bulitan.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 29–32, 75, 92, fig. 7, tables. Bulitian stage follows Ynezian. Includes two zones, *Bulimina bradburgi* below, and *Valvulineria wilcoxensis* above. Stage generally correlates with Laiming's (1939, 6th Pacific Sci. Cong. Proc., v. 2) "D-Zone." Strata of type Bulitian include Anita shale superjacent to strata of topmost Ynezian and subjacent to the 20 feet of siltstone

immediately underlying Sierra Blanca limestone. Followed by Penutian stage (name proposed to replace Juniperian stage).

Type area: In Canada el Bulito, Santa Barbara County.

Bull Slate[1]

Bull Formation or Group

Lower Cambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 401.

E-an Zen, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1829–1830. Revised stratigraphic sequence proposed for north end of slate belt in Taconic Range consists of three major units: Biddie Knob formation (base), Bull formation, and Hooker black slate.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1–2. Formation includes (ascending) Castleton conglomerate (new), Mudd Pond (new), Zion Hill, Bomoseen graywacke, and Mettawee members. Overlies Biddie Knob formation; underlies West Castleton formation (new).

J. G. Elam, 1960, Dissert. Abs., v. 21, no. 6, p. 1523–1524. Discussion of Troy South and East Greenbush quadrangles, New York. Stratigraphic section divided into four groups and previously described dominant formational names have been elevated to group status. Groups are Bull (Lower Cambrian), West Castleton (Lower Cambrian-Upper Cambrian), Poultney (Lower Ordovician), and Normanskill (Middle Ordovician).

Named for quarry on Bull Hill, 2 miles north of Castleton, Castleton quadrangle.

Bullard Limestone[1]

Pennsylvanian: Utah.

Original reference: O. P. Peterson, 1924, Am. Inst. Min. and Met. Engrs. Trans., v. 70, p. 915.

Bingham district.

Bullard Peak Series

Precambrian: Southwestern New Mexico.

C. H. Hewitt, 1959, New Mexico Bur. Mines Mineral Resources Bull. 60, p. 12–35, 104–105, pl. 1. Rock types that make up Bullard Peak series grouped into five mappable units: (1) quartz-feldspar gneiss, biotite gneiss, quartzite, muscovite schist, and biotite schist; (2) sillimanite gneiss; (3) hornblende gneiss and amphibolite gneiss; (4) granite gneiss; and (5) migmatite and undifferentiated metamorphic rocks. Rocks of series have been intruded and are bounded by granite and related rocks of Burro Mountains granite batholith. Older than Ash Creek series (new).

Crops out along crest, west flank, and north end of Big Burro Mountains in parts of T. 18 S., R. 17 W.; T. 18 S., R. 16 W.; T. 19 S., R. 17 W.; and T. 19 S., R. 16 W., Grant County. Named from exposures in general area of Bullard Peak.

Bull Creek Limestone[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: F. C. Greene, 1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 121.

C. C. Branson, 1955, The Hopper, v. 15, nos. 10–11, p. 129. Abandoned. Name is preoccupied by Bull Creek sandstone of Drake (1893) in the Strawn of Texas. Bull Creek is a small tributary of Bird Creek. The bed is Birch Creek limestone of Bowen (1918), the valid name for the member.

Well exposed on Bull Creek, in northwestern part of T. 23 N., R. 11 E., Osage County.

Bull Creek Sand (in Hell Creek Member of Lance Formation)

Cretaceous: Northwestern South Dakota.

E. P. Rothrock, 1937, South Dakota Geol. Survey Rept. Inv. 28, p. 10. Uniform medium-grained golden-yellow sand in upper part of Hell Creek member.

Area of report is Harding County.

Bull Creek Sandstone (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 3, p. 374, 379.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Mtg., p. 72. Largely floggy layers. Thickness 50 to 75 feet. Overlies Horse Creek clays and shales; underlies Bill Valley bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Bull Creek, Mills County.

Bull Creek Sandy Limestone (in Greenhorn Formation)

Upper Cretaceous: Southeastern Montana and northeastern Wyoming.

M. N. Bramlette and W. W. Rubey *in* R. C. Moore, 1949, Geol. Soc. America Mem. 39, p. 27 (fig. 18). In lower chalk marl facies of formation. Older than Stoneville Flats limestone (new).

Carter County, Mont., and Crook County, Wyo.

Bull-Domingo Agglomerate or Breccia

Age not stated: South-central Colorado.

W. C. Peters, 1953, Econ. Geology, v. 48, no. 7, p. 599–600. Agglomerate composed of boulders of gneiss, syenite, and pegmatite held in a solid and impermeable matrix of finer material all derived from Precambrian rocks cut by the pipe. Pipe is which agglomerate accumulated interpreted as the site of a boiling spring which formed in an area of intersecting faults and enlarged to present size by churning rock debris.

D. L. Reynolds, 1954, Am. Jour. Sci., v. 252, no. 10, p. 587. Referred to as breccia.

Limited to an irregular and relatively narrow pipe (1,000 feet of known depth and 100 to 200 feet in diameter) in Silver Cliff mining district, Custer County.

Bullhead Member (of Fox Hills Formation)

Upper Cretaceous: South Dakota.

R. E. Stevenson, 1957, Areal geology of the McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Consists of thin beds of buff bentonitic silty clay and clayey silts alternating with thin beds of buff, fine, subgraywacke sands. Thickness 400 feet. Overlies Timber Lake member; underlies Colgate member.

Bull Hill Gneiss[1]

Bull Hill Member (of Hoosac Formation)

Cambrian or Lower Ordovician: Southern Vermont.

Original reference: C. H. Richardson, 1931, Vermont State Geologist 17th Rept., p. 221.

J. B. Thompson, Jr., 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for field trips in New England, p. 41. Rank reduced. Described as microcline augen gneiss believed to be metamorphosed rhyolite and rhyolite tuff. Maximum thickness 1,000 feet. Occurs near base of Hoosac formation. Cambrian or Lower Ordovician.

Type locality: On Bull Hill east of northeast of village of Grafton and north of village of Cambridgeport, Saxtons River quadrangle.

Bullington Member (of Magdalena Formation)

Bullington facies (of Morrison Formation)

Pennsylvanian: Central northern New Mexico.

L. L. Ray and J. F. Smith, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 184–185. Limestone conglomerate composed of subrounded prismatic fragments of limestone, some almost lithographic in character, embedded in a light-gray to buff matrix of compact limestone. Fragments have maximum length of about 3 inches and breadth of 1 inch. In places, pebbles are smaller shapeless masses of light-buff limestone. Occasionally conglomerate is slightly reddish. Lies stratigraphically above all, or near top of, the "red beds" of the formation and below a sugary yellow sandstone which is presumably near top of formation.

J. F. Smith, Jr., and L. L. Ray, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 898. Along North Fork of Cimarroncito Creek in Cimarron Range, Bullington member of Magdalena crops out approximately 100 feet below Magdalena-Dakota contact.

K. G. Brill, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 828. On Cimarroncito Creek, Dakota sandstone is in contact with Morrison formation, and Bullington conglomerate here, as in type locality, is a coarse-grained facies of Morrison formation.

First described from exposures in southern part of Moreno Valley and along western valley wall to a point about 1½ miles north of Comanche Creek, Colfax and Taos Counties.

Bullion Dolomite Member (of Monte Cristo Limestone)[1]

Bullion Member (of Monte Cristo Dolomite)

Bullion Limestone Member (of Monte Cristo Limestone)

Lower Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 18.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881, 883 (fig. 2). Geographically extended into Nopah Range, Inyo County, Calif., where it is described as limestone 515 feet thick; overlies Anchor limestone member and underlies Yellowpine limestone member (Arrowhead limestone member not recognized in area).

Charles Deiss, 1952, U.S. Geol. Survey Bull. 973–C, p. 116-117, pl. 13. Member described in Sloan district, Nevada, where it is 445 feet thick, overlies Anchor member; uppermost unit of formation; underlies Bird Spring formation. Consists essentially of dolomite.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42. Described in Ivanpah quadrangle (California-Nevada) where it is nearly pure dolomite. Overlies Anchor limestone member; underlies Arrowhead limestone member.

Named for Bullion mine, sec. 23, T. 25 S., R. 58 E., Goodsprings quadrangle, Clark County, Nev.

Bullion Butte Bed (in Sentinel Butte Shale Member of Fort Union Formation)

Paleocene: Southwestern North Dakota.

E. P. Beroni and H. L. Bauer, Jr., 1952, U.S. Atomic Energy Comm. TEI Rept. 123, p. 6, figs. 2, 4. Thickness about 15 feet at Bullion Butte. Contains uraniferous lignite.

Named for occurrence on Bullion Butte, Golden Valley County.

Bullion Canyon Volcanics

Bullion Canyon Series

Miocene(?): Central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 441–446. Volcanics vary greatly from place to place in proportion of flows to pyroclastics. Total thickness at least 5,000 feet. In eastern part of Tushar Mountains, three distinct parts distinguished, and here includes Delano Peak latite member (new). Overlies Carmel shale and limestone, Navajo sandstone, and Wasatch formation. Underlies (in central part) Mount Belknap rhyolite (new); on west in contact with Roger Peak basaltic breccia and Joe Lott tuff (both new); on east in contact with Dry Hollow latite (new). Tertiary.

P. F. Kerr and others, 1957, Geol. Soc. America Spec. Paper 65, p. 14-22, pl. 1. For purpose of this report, to follow variations in alterations, Bullion Canyon series is divided into 12 members. Rock Candy latite and agglomerate applied to one member, others unnamed.

D. P. McGookey, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 5, p. 595, 605–607, 609–615. Gray Gulch formation as designated by Spieker (1949) includes strata equivalent to Bald Knoll formation of Gilliland (1951), part of Bullion Canyon volcanics of Callaghan (1939) and a previously unnamed interval mapped as Gray Gulch(?) by Lautenschlager (1952, unpub. thesis). Proposed that (1) term Gray Gulch be abandoned; (2) term Bald Knoll formation be used for lower part of interval formerly assigned to Gray Gulch; (3) name Dipping Vat formation (new) be applied to upper coarse interval of lacustrine beds formerly included in Gray Gulch formation; and (4) fluvial beds equivalent to Bullion Cayon volcanics be included in Bullion Canyon volcanics, clastics. Term Bullion Canyon volcanics, clastics is used herein for the sequence of mudflows, conglomerate tuffaceous sandstone,

and tuff that disconformably overlies Dipping Vat formation. Section that crops out along Little Lost Creek and Lost Creek is divisible into three distinct units. Thickness about 2,510 feet. Term Bullion Canyon volcanics, lava flows, is used herein for a sequence of igneous rock that appears to have been extruded as lava flows. This sequence lies disconformably on the Bullion Canyon volcanics, clastics. These extrusive rocks are designated as upper member of a sequence that is believed equivalent to Bullion Canyon volcanics as defined in type area near Marysvale. Based on stratigraphic position, Bullion Canyon volcanics, clastics are believed early middle Tertiary. Relations suggest that the lava flows are middle Tertiary, probably Oligocene.

U.S. Geological Survey currently classifies the Bullion Canyon Volcanics as Miocene(?) on the basis of restudy of the area.

Named for Bullion Canyon, west of Marysvale, Piute County.

Bull Lake Glaciation or **Drift**

Bull Lake glacial stage[1]

Pleistocene: Rocky Mountain region.

Original reference: E. Blackwelder, 1915, Jour. Geology, v. 23, p. 310, 325–340.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip Oct. 4–5, correlation chart. Bull Lake stage comprises an early Bull Lake substage, Porcupine Ranch substage (new), and late Bull Lake substage. Bull Lake stage is preceded by Buffalo stage and followed by Lackey Creek stage (new).

John de la Montagne, 1956, Wyoming Geol. Soc. Guidebook 11th Ann. Field Conf., p. 30. Glacial sequence in Jackson Hole area (ascending) Buffalo, Bull Lake, and Pinedale.

G. M. Richmond, 1957, Internat. Assoc. for Quaternary Research, 5th Cong., Madrid, p. 175; 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1371–1382. Pleistocene deposits in Rocky Mountain region are grouped into three stages: Buffalo (oldest), Bull Lake, and Pinedale, each with characteristic topographic expression and soil development. Bull Lake stage comprises well-developed mature moraines that are commonly the outermost on the canyon floors. Deposits are separable into two substages, which, where superimposed, are each overlain by mature zonal soils.

G. M. Richmond, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B223–B224. Discussion of correlation of alpine and continental glacial deposits of Glacier National Park and adjacent high plains, Montana. Deposits of two late Pleistocene alpine glaciations are correlated with Bull Lake and Pinedale glaciations of Wyoming. The older, Bull Lake, consists of two distinct advances separated by a major recession. Its two sets of moraines can be traced northeast from mountain front for 18 miles to point where the younger overlaps the older and merges with continental drift of same age. Drift is probably older than Farmdale loess of Illinois, dated as between 22,900±900 years to 26,100±600 years.

Moraines of stage well exposed in vicinity of Bull Lake, on northern slope of Wind River Range.

Bull Lake Creek Shales[1]

Cambrian: Western Wyoming.

Original reference: E. B. Branson, 1917, Geol. Soc. America Bull., v. 28, p. 347–350.

In Wind River Mountains. Probably named from Bull Lake Creek.

Bull Mountain Andesitic Series

Tertiary: Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 667. Comprises oldest Tertiary eruptive rocks in area. Consists of flows, tuffs, and breccias predominantly andesitic in composition. Rests upon surface cut on Cerbat complex (new); disconformably underlies Kingman series (new).

B. E. Thomas, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 407, pl. 1. Consists mostly of flows of medium-gray to grayish-red purple andesite, with some dark-gray basalt members. Intercalated with flows and especially abundant in basal section are beds of pink and red scoriaceous breccia and yellow to red tuff and lapilli. Strata reach thickness of almost 1,000 feet in northernmost extension of Kingman Mesa. Farther north, series occurs as isolated small cappings of ridges and buttes with maximum thickness of 350 feet. Geographic distribution discussed.

Named after Bull Mountain, which is capped by rocks of the series. Occurs along east side of Cerbat Mountains, Mohave County.

†Bull Mountain Series[1]

Eocene: Central southern Montana.

Original reference: W. Lindgren, 1886, U.S. Tenth Census, v. 15, p. 745, pl. 60.

In Bull Mountains and adjacent territory, Yellowstone County.

Bull Pond Limestone[1]

Age(?): New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, pl. 45.

From Monticello, Sullivan County, to Croton River near Bulls Bridge, Westchester County.

Bull Run Glacial Epoch

Pleistocene: Central northern Oregon.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 835, 841 (table 1). Second of five glacial epochs. Occurs in interval between Cascadian and Willamettian epochs. During Bull Run epoch, erupted lavas were mostly andesitic; they are named Cascan volcanics.

Bull Run Shales (in Newark Group)[1]

Upper Triassic: Northeastern Virginia.

Original reference: J. K. Roberts, 1923, Pan-Am. Geologist, v. 39, p. 185–200.

Crops out over Bull Run Battlefield, Prince William County.

Bull Shoals Mountain Chert Bed (in Powell Dolomite)

Lower Ordovician: Central northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 39, pls. 2, 12 (fig. 2). Delicately banded chert nodule bed occurring above base of Powell dolomite.

Well exposed on road over Bull Shoals Mountain, in SE¼ sec. 19, T. 20 N., R. 15 W., Marion County.

Bullwagon Dolomite Member (of Vale Formation)

Bullwagon Dolomite (in Clear Fork Group)[1]

Permian (Leonard Series): North-central Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 96–97, pl.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank reduced to member status in Vale formation.

Named for Bullwagon Creek, Taylor County.

Bullwhacker Member (of Windfall Formation)

Upper Cambrian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 20, 21, 22, pl. 2. Composed of a rather uniform sequence of thin-bedded platy or shaly limestone, some of which is slightly silty; on fresh fracture, color ranges from medium light to medium dark gray. Shaly or sandy partings and thin interbeds weather to buff or pinkish, and whole member has a collective yellowish-tan color that is distinctive. Limestone beds are from ¼ to 1 inch thick and are fine grained to subporcellaneous in texture. Commonly 400 feet thick throughout area. At Eureka it appears to be conformable with both Catlin member (new) below and Pogonip group above.

Named from exposures in vicinity of Bullwhacker mine, Eureka mining district, Eureka County.

Bully Hill Rhyolite[1]

Middle and Late Triassic: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

J. P. Albers, 1953, California Div. Mines Spec. Rept. 29, p. 5–7, pls. 1, 5. Name Bully Hill rhyolite restored as formal stratigraphic unit. Formation considered largely extrusive soda rhyolite and soda rhyolite porphyry rather than intrusive alaskite and alaskite porphyry (as it was considered by Graton who abandoned the name in 1910). Thickness (in Afterthought mine) about 1,100 feet. Lies with apparent conformity between older Dekkas andesite and younger Pit formation.

M. A. Murphy, W. P. Popenoe, and J. P. Albers, 1957, Sacramento Geol. Soc. Ann. Field Trip May 25–26, p. 12. Noted as being in fault contact with Pit formation near Afterthought mine.

Occurs in Bully Hill region, Shasta County.

†Bully Hill Volcanics[1]

Age(?): Northern California.

Original reference: J. S. Diller, 1905,. Am. Jour. Sci., 4th, v. 19, p. 380–385. Redding quadrangle.

Bumpnose Limestone Member (of Crystal River Formation)

Eocene, upper: Northwestern Florida.

W. E. Moore, 1955, Florida Geol. Survey Bull. 37, p. 19 (fig. 4), 21 (table 1), 30, 36–42. Beds younger than the Crystal River of Puri occur in Jackson County at top of Ocala group. These beds are here named Bumpnose limestone and constitute uppermost member of formation. Contains *Lepidocyclina (Nephrolepidina) chaperi* Lemoine and R. Douville. Occurs

above *Asterocyclina* zone of Crystal River and below Marianna limestone which contains *Lepidocyclina (Lepidocyclina) mantelli* (Morton). Soft easily crumbled white limestone generally more granular than typical Marianna. Thickness ranges from 0 to 15 feet; appranently thins to southeast where it is replaced in subsurface by Gadsden limestone southeast of Cypress fault.

H. S. Puri, 1957, Florida Geol. Survey Bull. 38, p. 33–34. Moore's Bumpnose member is not stratigraphically valid because beds for which name was proposed are not younger than the Crystal River of Puri since they underlie Marianna limestone of Oligocene age. The interval is a faunizone, and exactly the same beds are defined by MacNeil (1944, Am. Assoc. Petroleum Geologists Bull., v. 28, p. 1313) as *Lepidocyclina fragilis* faunizone at same outcrop.

Type locality: Quarry near center of W½ sec. 23, T. 5 N., R. 11 W., Jackson County. Named for exposures along and near Bumpnose Road north and west of Marianna.

†Buncombe Group[1]

Precambrian and Cambrian(?): Western North Carolina.

Original reference: W. C. Kerr, 1869, North Carolina Geol. Survey Rept. 2, p. 13–35.

Occupies larger part of great transmontane plateau between Blue Ridge and Smoky Mountains.

†Bunger Formation (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Named for Bunger, Young County.

Bunger Limestone Member (of Graham Formation)[1]

Bunger Formation (in Graham Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Graham group. Overlies North Leon formation; underlies post-Bunger cycles 1 to 7.

E. L. Thackery, 1951, West Texas Geol. Soc. Guidebook, June 1–2, p. 14–15, chart. Chart shows Bunger limestone in Graham group above Gonzales limestone and below Gunsight limestone in Brazos River outcrop section; thins toward Colorado River section.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook May 25–26, fig. 4. Generalized columnar section shows Bunger limestone in Graham group stratigraphically above Salem School limestone and below unit termed Number 3 limestone.

Named for Bunger, Young County.

Bunje cyclothem (in Bond Formation)

Bunje cyclothem (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Name appears in list of cyclothems in McLeansboro group. Occurs below Flat Creek cyclothem and above Sorento cyclothem (new).

H. R. Wanless, 1956, Illinois Geol. Survey Circ. 217, p. 6, 7, 11, pl. 1. Simon (1946, unpub. thesis) worked out sequence above Shoal Creek limestone in Bond County and proposed terms (ascending) Sorento, Bunje, and Flat Creek for cyclothemic units in lower half of interval. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 52 (table 2), pl. 1. In Bond formation (new). Above Sorento cyclothem and below Flat Creek cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: S½ sec. 7, T. 6 N., R. 4 W., Bond County. Named for village of Bunje.

Bunje Limestone Member (of Bond Formation)

Pennsylvanian: Central and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 72, pl. 1. Name applied to limestone member that lies stratigraphically above Sorento limestone member (new) and below Flat Creek coal member (new). Olive gray or bluish gray; cone-in-cone structure throughout. Thickness as much as 18 inches. Name credited to J. A. Simon (unpub. ms.). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE¼SW¼ sec. 7, T. 6 N., R. 4 W., Bond County. Named for exposures about 1 mile south of village of Bunje.

Bunker Andesite[1]

Eocene: Central southern Colorado.

Original references: W. Cross, 1890. Colorado Sci. Soc. Proc., v. 3, pt. 3, p. 272; 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 289.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, the volcanics, in order of decreasing age, consist of Rosita fragmental andesite, Bunker massive andesite, Fairview diorite in dikes cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Forms greater part of Rosita Hills, Silver Cliff-Rosita region.

Bunker Hill Volcanics

See Jonestown Volcanics.

Burbank Member (of Cuyahoga Formation)[1]

Mississippian: North-central Ohio.

Original reference: G. W. Conrey, 1921, Ohio Geol. Survey, 4th ser., Bull. 24, p. 50.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 49. Included in Killbuck shale facies (new) of the Cuyahoga. Consists of series of alternating gray arenaceous shales and buff-gray fine-grained sandstones and siltstones with maximum

exposed thickness of 150 feet. Base not exposed. Underlies Armstrong sandstone member.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Discussion of stratigraphy and paleontology of Cuyahoga formation. Term Burbank not used since it refers to strata lithically and faunally idential with upper part of Meadville member.

Named for Burbank in northern part of Wayne County.

Burchards Member (of Chipman Formation)

Burchards Limestone (in Chipman Group)

Lower Ordovician: West-central Vermont.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Middle Ordovician limestones of west-central Vermont have been described and mapped by Cady (1945, Geol. Soc. America Bull., v. 56, no. 5), who included Crown Point, Beldens, and Middlebury formations in Chazy "group." Inasmuch as first-named formation is structurally separated from Crown Point limestone of type locality and other outcrops in New York and is succeeded by Beldens formation rather than by Valcour limestone, it is here proposed that "Crown Point" formation east of Champlain thrust in west-central Vermont be designated Burchards limestone. Consists of about 150 feet of somewhat magnesian limestone that has species of *Maclurites*. Underlies Beldens formation. Basal formation of Chipman group (new).

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 28–29. Dark-gray and white finely banded marble with few thin brown-weathering dolomite beds. Questionably overlies Bascom formation disconformably. Only surface exposure on eastern edge of West Rutland athletic field.

Marshall Kay *in* W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 263, chart 2 (column 15). Lower Ordovician (Canadian).

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Rank reduced to member status in the Chipman herein reduced to rank of formation. Characterized by limestone with dolomitic markings. Mapping in Sudbury-Brandon area shows that sequence of the Burchards, Weybridge, and Beldens members, though generally about that order, is locally much varied. Bridport dolomite member interfingers with the limestone members. Beekmantown age.

Named from stream that enters Lemon Fair River, 3 miles west of type locality in belt of outcrop between Cornwall village and The Ledges, Addison County.

†Burches Ferry Marl[1]

Upper Cretaceous: Northeastern South Carolina and eastern North Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 14.

Named for exposures at Burches Ferry, on west side of Peedee River, in Florence County, S.C.

Burden Conglomerate[1]

Lower Cambrian: Eastern New York.

Original reference: A. W. Grabau, 1903, New York State Mus. Bull. 69, p. 1034.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 221, p. 43–62. In Catskill quadrangle, following sequence distinguished (ascending): Nassau beds, Burden iron ore, Bomoseen grit, Burden conglomerate (Grabau), Schodack shale and limestone, and Zion Hill quartzite. Zion Hill quartzite, Schodack shale and limestone, Burden conglomerate, and Bomoseen grit are intimately connected and interfolded. Seems practicable to extend term Schodack formation to include as members the beds that occur associated or interbedded with it. Burden iron ore formation consists of limonite and siderite iron ore between Nassau and Schodack beds. Occurs in belt extending from southern base of Mount Tom to Church Hill, about 4 miles in all. Grabau united under name Burden conglomerate the beds at Burden iron mine of earliest Schodack age with those of later Schodack age found at Claverack Creek and north of Becraft Mountain. All are of Schodack age and not of Normanskill age.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 330–331. Name Burden originally given by Grabau (1903) to a conglomerate of limestone pebbles in calcite matrix with imbedded rounded quartz sand grains. Grabau was uncertain of age but asserted it to be Ordovician and possible correlate of Rysedorph conglomerate. Ruedemann (1942) used name Burden for an iron ore of local stratigraphic significance in Columbia County. Questionable whether the two workers were speaking of same unit. Type area reexamined and modifications of previous interpretations presented. An excellent section reveals sideritic and limonitic rock with imbedded subangular fragments of limestone, shale, and grit occupying position between interbedded sandy shales and thin quartzites below (Nassau) and a calcitic ferruginous orthoquartzite with abundant quartz crystals above (Zion Hill). In opposition to Ruedemann's views, the writer [Fisher] found no evidence of Schodack formation. It is here suggested that the Burden iron ore denotes a residual soil which accumulated on a Lower Cambrian erosional surface; the hiatus represents Middle and Upper Cambrian times. Ferruginous nature of the Zion Hill explained as iron oxide incorporated in an initial transgressive clastic deposit. Overyling Zion Hill, in turn, are bonafide graptolite-bearing strata of Schaghticoke and Deepkill age.

Named for occurrence at Burden iron mines, 5 miles south of Hudson. Columbia County.

Burditt Marl[1]

Burditt Marl (in Austin Group)

Upper Cretaceous (Gulf Series): Central Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 407, 441, 442, 449.

Keith Young and Edward Marks, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 3, p. 477, 480 (fig. 2), 486–487. Report is biostratigraphic study of Austin group in Williamson County. Chart shows group comprises Austin chalk and Burditt marl. Thickness of Burditt 45 feet. Faunal change from Austin chalk to Burditt marl abrupt.

C. L. Durham, Jr., 1955, Corpus Christi Geol. Soc. [Guidebook] Ann. Field Trip, March 11–12, [p. 57], pl. 16. In Travis County, overlies Dessau formation (new).

D. L. Frizzell, 1956, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 38. Foraminifera described. Burditt marl listed in Austin group.

Type locality: Along Little Walnut Creek downstream from Austin-Cameron Road, Travis County. Named from Burditt School.

Burge Sands Member (of Ogallala Formation)[1]

Burge Channel Member (of Valentine Formation)

Pliocene: Northern Nebraska.

Original reference: F. W. Johnson, 1936, Am. Jour. Sci., 5th, v. 31, p. 467–473.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, p. 223, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1260, 1264 (table 1). Referred to as Burge channel member of Valentine formation redefined and assigned to Ogallala group (redefined). Occurs at top of formation.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 137–138. Highest known fauna from the Valentine comes from Burge channel quarries. It seems best not to consider the Burge a channel member but merely a channel within the undivided Valentine.

Type locality: Burge quarry, on Snake River, southwest of Valentine, Cherry County.

Burgen Limestone[1]

Lower Ordovician: Central Oklahoma.

Original reference: J. P. Boyle, 1939, Oklahoma Geol. Survey Bull. 40KK.

Present over entire area of Okfuskee County.

Burgen Sandstone[1]

Lower or Middle Ordovician: Northeastern Oklahoma.

Original reference: J. A. Taff, 1905, U.S. Geol. Survey Geol. Atlas, Folio 122.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 16 (fig. 3), 20–22, pls. 2, 3, 4. Described on southwestern flank of Ozark uplift. Predominantly sandstone with minor amounts of shale and thin dolomitic limestone; thin beds of green fissile shale and sandy dolomite present in upper parts. Thickness 72 feet near Qualls where entire thickness is exposed; 26 feet along Spring Creek in sec. 12, T. 19 N., R. 20 E.; outside mapped area thickness of 100 feet reported. Unconformably overlies Cotter dolomite; conformably succeeded by Tyner shale in southern exposures; truncated by pre-Chattanooga erosion north of T. 19 N., where it is succeeded by Sylamore sandstone member of Chattanooga. Age assignment and correlation not certain; precise dating is dependent upon correct correlation of overlying Tyner; if Tyner is equivalent of Bromide, then Burgen is probably equivalent to lower Bromide sand (Tulip Creek). Chart shows Champlainian series.

Named for exposures in Burgen Hollow, 6 miles northeast of Talequah, northern Cherokee County.

Burgess Oolite Member (of Bangor Limestone)[1]

Mississippian: Northwestern Alabama.

Original reference: W. B. Jones, 1928, Alabama Geol. Survey Circ. 8, p. 13–15.

W. B. Jones, 1939, Econ. Geology, v. 34, no. 5, p. 575, 576. Thickness 0 to 40 feet. Underlies unnamed blue fossilferous limestone; separated from underlying Rockwood oolite by unnamed blue fossiliferous limestone 100 feet thick.

Type locality: Burgess quarry, on hill about 3 miles east of Russellville, Franklin County.

Burgner Formation

Pennsylvanian (Atoka): Southwestern Missouri.

W. V. Searight and E. J. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2127–2131. Section from cuttings and cores shows formation to consist of black shale, black siltstone, coal, limestone, and clay. Thickness as much as 67 feet. Occurs as sink fillings in Mississippian formation. Megafauna related to both Morrowan and Desmoinesian but cannot be certainly correlated with either; microfauna includes specimens of *Millerella* and primitive *Fusulinella*; considered post-Morrowan pre-Desmoinesian or Atokan.

Named for occurrence on the Burgner land, Jasper County.

Burgoon Group[1]

Mississippian: Pennsylvania.

Original reference: J. D. Sisler and others, 1933, Pennsylvania Geol. Survey, 4th, Bull. M–19, p. 8.

Named because it is cut through by valley of Burgoon Run above Kittanning Point, Blair County.

Burgoon Sandstone (in Pocono Group)

Burgoon Formation (in Pocono Group)

Burgoon Group

Burgoon Sandstone Member (of Pocono Formation)[1]

Mississippian: Western Pennsylvania, southeastern Ohio, and northern West Virginia.

Original reference: C. Butts, 1904, U.S. Geol. Survey Geol. Atlas, Folio 115.

R. M. Leggette, 1936, Pennsylvania Geol. Survey, 4th ser., Bull. W–3, p. 38–39. In many parts of area [northwestern Pennsylvania], Burgoon sandstone is top formation of Pocono group. As much as 450 feet thick in places. Overlies Cuyahoga formation. In Crawford and adjoining counties, Shenango sandstone of I. C. White marks top of Ponoco and is probably equivalent to part of Burgoon sandstone.

R. E. Sherrill and L. S. Matteson, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. 122, p. 7–8. Referred to as Burgoon group in Pocono series. Thickness 250 to 270 feet in area of this report [Hillards quadrangle]. Upper 75 to 100 feet of group is Burgoon sandstone member. Below this sandstone is Hempfield (Shenango) shale member, 75 to 100 feet thick. Lower 75 to 90 feet of group is Shenango sandstone member. Overlies Cuyahoga group; underlies Lower Connoquenessing sandstone of Pottsville series.

R. C. Bolger and C. E. Prouty, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 125. In Cameron County, Burgoon sandstone is topmost unit of Pocono group. Thickness 90 to 100 feet in south; 25 to 30 feet in north. Directly overlies Patton formation.

J. L. Dally, 1956, Dissert. Abs., v. 16, no. 12, p. 2425. Pocono group discussed in West Virginia. In northern part of State, group is represented by Manheim formation (new) and Burgoon formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania ,1 : 250,000) : Pennsylvania Geol. Survey, 4th ser. Map legend shows Burgoon formation in Pocono group.

Named for exposures in valley of Burgoon Run, above Kittanning Point, Blair County, Pa.

Burica Sandstones

Miocene, upper, or Pliocene, lower: Panamá.

R. A. Terry, 1941, Geog. Rev., v. 31, no. 3, p. 381 (fig. 5). Name Burica listed on map explanation. Upper Miocene.

A. A. Olsson, 1942, Bulls. Am. Paleontology, v. 27, no. 106, p. 173–175 (21–23). Sandstone transitional with overlying Charco Azul shales. Base of sandstones and basement on which they rest not exposed. Age tentatively considered as lower Pliocene or uppermost Miocene.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, Geol. Sci., p. 234 (chart). Lower part sandstones and conglomerate; upper part tuffaceous shale.

Crop out on Burica Peninsula, Panamá, at or near Burica Point and Burica Island.

Burke Formation (in Ravalli Group)[1]

Precambrian (Belt Series) : Northeastern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 32–34, pl. 11. Light-gray flaggy fine-grained sandstones and shales, mostly greenish, with variable amount of purple quartzitic sandstone and white quartzite. Shallow water features throughout. Thickness about 2,000 feet. Overlies Prichard slate; underlies Revett quartzite.

C. F. Calkins, 1908, U.S. Geol. Survey Bull. 384, p. 38. Lowermost formation in Ravalli group.

J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–P, p. 728–729, pl. 57. Described in Shoshone County, Idaho, where is is between 2,220 and 2,500 feet thick. Chiefly thin-bedded light- to greenish-gray fine-grained argillaceous quartzite and some white to light-purple thick-bedded quartzite. Contacts with underlying Prichard formation and overlying Revett quartzite transitional.

Typically developed along Canyon Creek from Burke to Gem, Idaho.

Burkes Garden Limestone Member (of Benbolt Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 835, 836, 869, 871, 879, 884 (fig. 3). In Tazewell County, strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Burkes Garden limestone member is applied to zones 12 and 13. At type locality, these zones, the *Chasmatopora*, and the crossbedded limestone, are 47 and 63 feet, respectively. In Burkes Garden and Thompson Valley, member is 100 to 200 feet thick; in median belts, thins from about 100 feet near Russell-Tazewell county line to 60 feet at Tazewell; thin or absent on northwest side of Clear Fork Valley east of Gratton. Overlies

Shannondale limestone member (new); underlies Gratton limestone (new).

Type locality: Along County Road 637 and Pounding Mill Branch, immediately south of U.S. Route 19, Tazewell County. Named from Burkes Garden Creek about 1½ miles south of Gose Mill.

Burkesville Limestone Lentil (in Cumberland Sandstone)

Upper Ordovician: South-central Kentucky.

W. R. Jillson, 1951, The Burkesville limestone: Frankfort, Ky., Roberts Printing Co., p. 5–15. Upper 3 feet of lentil consist of gray compact dolomitic bouldery fossiliferous limestone; lower 3 feet consist of grayish to reddish soft limy shale with a 1-inch layer of chert.

W. R. Jillson, 1953, The Haggard limestone: Frankfort, Ky., Roberts Printing Co., [p. 2]. About 70 feet below top of Cumberland and about 40 feet below Haggard limestone (new).

Exposed on P. A. Davis property within southern limits of Burkesville, Cumberland County.

Burket Black Shale Member (of Harrell Shale)[1]

Burket Shale Member (of Rush Formation)

Upper Devonian: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 523, 536.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 201, 218–219. Member of Rush formation. Intergrades with Tully member. Underlies Harrell member of Fort Littleton formation.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Rush formation includes Burket shale member and Tully limestone member.

Named for exposures at Burket, a suburb of Altoona, Blair County.

Burkeville Beds[1]

Miocene, upper, and Pliocene(?): Eastern Texas and western Louisiana.

Original reference: A. C. Veatch, 1902, Louisiana Geol. Survey, pt. 6, Rept. for 1902, p. 136, pl. 37.

A. C. Ellisor, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 4, p. 494-495. This [Burkville] horizon has been traced in subsurface from Terry Field in Orange County, south of Burkville to Calhoun County. Name *Potamides matsoni* zone suggested for this horizon in subsurface where it is 400 or more feet thick. Since Veatch and others have recognized Burkville beds as mappable unit and have described sections and fauna, it is no doubt worthy of rank of formation. However, it seems inadvisable to introduce a new formation without further fieldwork.

Named for Burkeville [correct spelling], Newton County, Tex.

Burley Lake Beds[1]

Pleistocene: Southern Idaho.

Original reference: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; H. T. Stearns, 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

E. G. Crosthwaite, 1956, Ground-water possibilities south of the Snake River between Twin Falls and Pocatello, Idaho: U.S. Geol. Survey Circ. 371, p. 6, 7. Described as unconsolidated to well-compacted clay, silt, sand

and fine gravel. Intercalated basalt layers occur 150 to 325 feet below surface and at bottom of sequence. Geographic area noted.

Known only from drill holes in vicinity of Burley (Cassia County) and Rupert and Paul (Minidoka County).

Burlingame Limestone Member (of Bern Limestone)

Burlingame Limestone (in Shawnee Group)

Burlingame Limestone (in Wabaunsee Group)

Burlingame Limestone Member (of Wabaunsee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: J. G. Hall, 1896, Kansas Univ. Geol. Survey, v. 1, p. 105.

G. E. Condra, 1933, Nebraska Geol. Survey Paper 8, p. 5, 10; G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45–46. In Nebraska, comprises (ascending) Taylor Branch limestone, Winnebago shale, and South Fork limestone.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 309 (fig. 14). Graphic section of Pennsylvanian in Adams County shows Burlingame limestone occurring below Soldier Creek shale and above Silver Lake shale.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 32). Correlation chart shows Burlingame limestone in Shawnee group in Missouri.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20. Assigned to Wabaunsee group when that group was redefined for Missouri.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 18. Three limestones and two shales now included in Soldier Creek shale were formerly included in the Burlingame.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276–2277. Rank reduced to member status in Bern limestone (new). Underlies Soldier Creek shale member; overlies Silver Lake shale member of Scranton shale (reintroduced as a formation).

H. G. Hershey and others, 1960, Iowa State Highway Research Board Bull. 15, p. 13, fig. 5. Consists of three limestone beds separated by shale. Upper limestone, about 6 inches thick, is dark gray and finely crystalline, contains fossil fragments, and is underlain by dark-gray clayey shale about 1½ feet thick. The lower two limestones are separated by calcareous laminated gray shale about 5 feet thick. Upper of the two limestones is gray, argillaceous, and blocky; lower is concretionary, sandy, and fragmental. Total thickness 12 feet. Underlies Soldier Creek shale; overlies Silver Lake shale. Wabaunsee group.

Type locality: Burlingame, Osage County, Kans. Limestone makes a prominent escarpment that crosses west part of Burlingame.

†Burlingame Shale[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 278, pl. 20; 1895, Am. Jour. Sci., 3d, v. 50, p. 461, pl. opposite p. 466.

Named for Burlingame, Osage County, Kans.

Burlington Limestone

Burlington Limestone (in Osage Group)[1]

Lower Mississippian (Osage Series): Iowa, Illinois, Kentucky, and Missouri.

Original reference: D. D. Owen, 1852, Rept. Geol. Survey Wisconsin, Iowa, and Minnesota, p. 90–140.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132–133. Included in Osage group, Valmeyer series.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. In Mississippian standard section, Burlington limestone is included in Osagean series. Occurs above the Fern Glen formation and below Keokuk limestone.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2163–2168. Discussion of stratigraphy of Lower Mississippian rocks in southwestern Missouri. Burlington limestone ranges in thickness from a trace to 145 feet; thickest in Springfield area. Thins southward from Springfield and disappears from section between Mount Vernon, Lawrence County. and the Tri-State mining district. Divided into six faunal zones that are correlated with equivalent zones in northeastern Missouri. Rests unconformably on Reeds Spring formation in southern part of area. Reeds Spring and St. Joe formations pinch out a short distance north of Springfield, Greene Conuty, and north of here the formation rests unconformably on Northview or Sedalia formations. Keokuk limestone rests with apparent conformity on Burlington limestone in southwestern part of area. Elsewhere the Burlington is either surface formation or is covered by thin veneer of Pennsylvanian sediments. Osagean.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71–80. Presentation of revision of early Mississippian nomenclature in western Missouri. Kaiser (1950) proposed that name Pierson be dropped, assigning the more dolomitic lower beds to the Sedalia and the upper beds to the St. Joe. Kaiser considered the entire St. Joe to be Osagean and the Sedalia to be Kinderhookian. Thus he placed a series line in the middle of the Pierson of Weller. In present report, the Pierson is accepted as defined by Weller and base of Osagean is placed at Pierson-Northview contact. The Pierson is extended northward to include the silty dolomitic limestone unit which lies between the Northview and the Burlington in west-central Missouri. This unit was included in upper Sedalia of west-central Missouri by Moore (1928, Missouri Bur. Geology and Mines, 2d ser., v. 21) and Kaiser (1950). Hence, Burlington directly overlies Pierson.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 42–47. Formation described in Bowling Green quadrangle where it is 53 to 61 feet thick. Consists of thin- to massive-bedded coarsely crystalline brown to light-gray limestone with chert nodules and lenses. In most of quadrangle, covered by glacial drift, loess, and its own chert residuum. Lies upon undulatory surface of Hannibal formation in that part of quadrangle north of southern boundary of T. 53 N., south of this area overlies Chouteau formation with gradational contact. Osagean series.

Named for exposures at Burlington, Des Moines County, Iowa.

†Burlington Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ., Quart., v. 2, p. 110, 120–121, 125.

Named for Burlington, Coffey County.

†Burlington Limestone (in Chemung Formation)[1]

Upper Devonian: Central northern Pennsylvania.

Original reference: A. Sherwood, 1878, Pennsylvania 2d Geol. Survey Rept. G, p. 37.

Occurs about 1 mile east of Burlington on farms of W. B. Kline, J. Morley, and C. E. Campbell and at other places in Bradford County.

Burls Creek Shale Member[1] (of Katalla Formation)

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 772–775, 779.

D. J. Miller, D. L. Rossman, and C. A. Hickcox, 1945, Preliminary report on petroleum possibilities in the Katalla area, Alaska: U.S. Geol. Survey, p. 7 (table), 10–11; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Restricted to massive gray shale and associated glauconitic sandstone that lie conformably between the Basin Creek (new) and organic shale members. Lower contact drawn at base of lowest bed of massive glauconitic sandstone or at top of highest bed of gray sandstone of Basin Creek type. Partly sandy shale forms major part of member except near head of east fork of Burls Creek and along Burls Creek-Chilkat Creek ridge, where total thickness of glauconitic sandstone beds nearly equals thickness of shale. Lens-shaped calcareous concretions, averaging more than 2 feet across, abundant in shale. Lithology and thickness range widely in Katalla area. Thickness between 160 and 260 feet near head of west fork of Burls Creek; increases to maximum of perhaps 1,000 feet in western part of area. Oil company geologists (unpub. mss.) have used term Burls Creek formation to include Basin Creek sandstone and shale below and Cannon-ball shale above.

Best exposed on Burls Creek, Controller Bay region.

Burnam Limestone

Upper Ordovician: Central Texas.

V. E. Barnes, P. E. Cloud, Jr., and Helen Duncan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 1030–1043. Coarse-grained and yellowish to light-brownish-gray or almost white; contains pale yellowish-orange stylolites and angular to rounded pebbles and blebs of fine-grained yellowish-gray to pearl-gray limestone; fossiliferous. Thickness unknown; outcrops are collapsed into older rocks. Directly underlies Stribling formation; bedding is approximately parallel between the two units, and both formations dip steeply southward; relations at base of Burnam are uncertain; may rest directly on Honeycut formation or other rocks may intervene between the two units.

Type locality: (Only known occurrence) is midway between Austin and Llano, along Burnam Branch of Doublehorn Creek, southern Burnet County, 4.7 miles airline south-southeast of Marble Falls.

Burned Mountain Metarhyolite

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 14, 54–56, pl. 1. Ranges from brick red to light pink but generally is reddish orange; relict, commonly drag-folded flow bands clearly visible in most outcrops. Intruded older Moppin metavolcanics (new) as sills and dikes; possibly some small flows. The layers of metarhyolite almost everywhere concordant with underlying and overlying strata. Previously called Vallecitos rhyolite, but here renamed because the earlier name was preempted.

Exposed on La Jarita Mesa, in Canada del Oso, in La Jara Canyon, along Vallecitos Canyon near Escondida Creek, and in areas immediately south of Jawbone Mountain near head of Buckhorn Gulch in Las Tablas quadrangle and in area immediately to the south. Named after exposures on northwest side of Burned Mountain, in sec. 8, T. 28 N., R. 7 E., Las Tablas quadrangle.

Burnet Marble[1]

Cambrian and Ordovician: Central Texas.

Original reference: B. F. Shumard, 1861, Am. Jour. Sci., 2d, v. 32, p. 214.

Named for exposures at Burnet and neighboring parts of Burnet County.

†Burnetan System[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lv, 255–267, pl. 3.

Named for Burnet County.

Burnett Formation (in Puget Group)[1]

Eocene: Western Washington.

Original reference: Bailey Willis and G. O. Smith, 1899, U.S. Geol. Survey Geol. Atlas, Folio 54.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 63–64. Youngest formation of group in Carbon River area. Composed of shales and sandstones approximately 5,000 feet thick. Underlies lavas and Pleistocene glacial deposits; overlies Wilkeson sandstone. Formations in Carbon Canyon have been folded into anticlines and synclines with a general northwesterly trend.

Named for exposures on South Prairie Creek, near Burnett, Tacoma quadrangle.

Burns Formation (in Silverton Group)

Burns Quartz Latite or Latite Tuff[1] (in Silverton Volcanic Series)

Tertiary, middle or upper: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

E. S. Larsen, Jr., 1949, Am. Geophys. Union Trans., v. 30, no. 6, p. 863. Burns quartz latite listed in Silverton volcanic series in report on San Juan Mountains, Colo. Overlies Eureka rhyolite; underlies unnamed pyroxene quartz latite.

U.S. Geological Survey currently classifies the Burns as a formation in Silverton Group and designates the age as middle or late Tertiary on the basis of a study now in progress.

Named for exposures in Burns Gulch, Silverton quadrangle.

Burnt Lava Flow

Recent: Northern California.

M. A. Peabody, 1931, Geog. Rev., v. 21, no. 2, p. 269–270. Recent flow in the Modoc Lava field.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 272, 275, pl. 1. Mentioned as the most recent of a group of basalt eruptions or flows for which term Modoc basalt is proposed.

C. A. Anderson, 1941, California Univ., Dept. Geol. Sci. Bull., v. 25, no. 7, p. 371, geol. map. Covers an area of about 14 square miles.

Occurs in Modoc Lava field.

Burnt Limestone

Lower Cretaceous (Comanchean): Southern Texas.

Charles Schuchert, [1943], Stratigraphy of the eastern and central United States: New York, John Wiley and Sons, p. 957. Incidental mention in short discussion of Buda limestone. Suggests name be abandoned. [Compiler was unable to locate an earlier reference to the name.]

Burnt Bluff Formation[1]

Burnt Bluff Group

Middle Silurian (Niagaran Series): Northern Michigan and Wisconsin.

Original reference: G. M. Ehlers, 1921, Geol. Soc. America Bull., v. 32, p. 129.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Burnt Bluff group (Wisconsin and Michigan) includes Byron dolomite below and Hendricks dolomite above.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Field Excursion, p. 2 (table), 7–19, 31 (fig. 2). Group includes (ascending) Lime Island dolomite (new), Byron dolomite, and Hendricks dolomite. Thickness about 310 feet. Underlies Manistique group; overlies Cataract group.

Named for exposures in high cliff called Burnt Bluff, on east shore of Big Bay de Noc, Delta County, Mich.

Burnt Branch Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. P. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 375.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Mtg., p. 72. Flaggy sandstones 125 feet thick; about 25 feet of clay at base. Overlies Lynch Creek bed, where present; underlies Elliott Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or

"beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Burnt Branch, in Lampasas County, or vicinity.

Burnt Canyon Breccia

Quaternary: Southern California.

C. R. Allen, 1954, California Div. Mines Bull. 170, map sheet 20. Shown on map legend as a landslide deposit.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 325 (table 1), 332, pls. 1, 3. Described in San Gorgonio Pass area as a dissected landslide deposit. Maximum thickness about 100 feet. Rests partly on crystalline complex and partly on Heights fanglomerate.

Report covers San Andreas fault zone in San Gorgonio Pass, Riverside County.

Burnt Canyon Member (of Highland Peak Formation)

Burnt Canyon Formation (in Ophir Group)

Burnt Canyon Limestone

Middle Cambrian: Southeastern Nevada and western Utah.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 36–38, fig. 5. Dark-gray to black, thin- to medium-bedded limestone. Previously termed basal or "C" unit of Highland Peak limestone as restricted by Wheeler (1940). Recognition of overlying Dome and Swasey limestones in the Highland Peak requires that unit be given formational rank. Thickness 225 to 420 feet. Overlies Burrows limestone; conformably underlies Dome limestone. In House Range, Utah, formation consists of uppermost 225 feet of Howell limestone as emended by Deiss (1938).

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 35, 45–46, pl. 1, measured sections. Formation included in Ophir group in Sheeprock Mountains where it overlies Millard formation and underlies Dome limestone. Thickness 178 to 221 feet. Basal 21 feet may represent Burrows limestone.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 49, 50 (fig. 4). Proposed that name Chisholm be applied to unit in House Range that Wheeler (1948) designated as Burnt Canyon limestone. Correlation chart (fig. 4) shows Wheeler's Burnt Canyon in Wah Wah Range replaced by Whirlwind (new) and Swasey formations; in Pioche district, Wheeler's Burnt Canyon is replaced by part of Burrows formation, Whirlwind formation, and lower part of Highland Peak formation.

U.S. Geological Survey currently classifies the Burnt Canyon as a member of Highland Peak Limestone on the basis of a study now in progress.

Named for typical exposures in Burnt Canyon on west slope of Highland Range, Pioche district, Nevada.

Burnt Gulch Conglomerate

Miocene or Pliocene: Northwestern Wyoming.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 143, fig. 2. Alluvial fan remnants.

Made up in the main of boulders, gravel, and sand almost without stratification. Boulders more than 20 feet in diameter have been measured, but they decrease in size away from mountains. Thickness on Dinwoody Creek 300 feet.

Type locality: At west end of Table Mountain on Burnt Gulch, after which deposits are named. Present along east slope of Wind River Mountains, Fremont County. Best exposures on Dinwoody Creek.

Burnt Meadow Syenite[1]

Post-Carboniferous: Maine.

Original reference: F. W. Toppan, 1932, Geology of Maine, Dept. Geology, Union Coll., Schenectady, p. 26.

Burnt Mill Shale (in Crooked Fork Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes beds between top of Crossville sandstone and base of Coalfield sandstone (new). Thickness 35 to 130 feet. Hooper coal occurs near base of shale. In northern part of Barthell Southwest quadrangle, overlying Coalfield sandstone is missing and Burnt Mill and Glenmary shale (new) form a single unit; this composite unit in turn is truncated by overlying Wartburg sandstone which locally rests on the Crossville.

Named from exposures near Burnt Mill Bridge in Robbins and Oneida South quadrangles, Scott County.

Burnt Ridge Sandstone Member (of Rose Hill Formation)

Silurian: Central Pennsylvania.

H. H. Arndt, 1959, Geol Soc. America Guidebook Pittsburgh Mtg., p. 28, 29, 30. Name applied to sandstone in middle part of Rose Hill. Unit previously called Center iron sandstone (Swartz, 1931). Thickness 90 feet in Burnt Ridge section. Thins to 10 feet in Mifflintown quadrangle, and is poorly represented, if at all, to west in section at Mount Union. Name credited to J. T. Miller.

Reference section: Burnt Ridge.

Burnt River Schist[1]

Pre-Carboniferous(?): Northeastern Oregon.

Original reference: James Gilluly, 1937, U.S. Geol. Survey Bull. 879.

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America, v. 54, no. 2, p. 162–163. Discussion of late Paleozoic formations of central Oregon. Burnt River schist in eastern Oregon shows very little similarity to any of the formations under discussion (Coffee Creek, Spotted Ridge, and Coyote Butte) beyond occurrence of limestone and conglomerates. Indefinite age.

Named for exposures in Burnt River Canyon, T. 11 and 12 S., R. 41 E., Baker quadrangle, Baker County.

Burntside Granite Gneiss[1]

Precambrian (Huronian): Northeastern Minnesota.

Original reference: F. F. Grout, 1926, Minnesota Geol. Survey Bull. 21, p. 29.

Burntside Lake, Vermilion district.

†Burpee Formation[1]

Eocene, middle: Northwestern Oregon.

Original reference: H. G. Schenck, 1927, California Univ. Pub. Dept. Geol. Sci. Bull., v. 16, no. 12, p. 455, 456.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Described in coastal area between Cape Foulweather and Cape Kiwanda as about 5,000 feet thick and consisting of rhythmically bedded arkosic sandstone and intercalated siltstone and, locally, interbedded volcanic material. Conformably overlies Siletz River volcanic series; underlies Nestucca formation (new), angular unconformity.

H. E. Vokes, Hans Norbisrath, and P. D. Snavely, Jr., 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 88. Described in Newport-Waldport area, where it is oldest strata exposed and covers more than one-half of area mapped and greater part of Toledo and Tidewater quadrangles. Thickness 6,000 to 7,000 feet; base not exposed. Overlies Moody shale member of Toledo. Eocene.

U.S. Geological Survey has abandoned the term Burpee on the basis of a study now in progress.

Type locality: Rock quarry on Southern Pacific Railroad at Burpee Station, on east bank of Yaquina River, Lincoln County, midway between Toledo and Elk City.

Burr Limestone Member[1] (of Grenola Limestone)

Permian: Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Underlies Salem Point shale member; overlies Legion shale member. Thickness 8 to 15 feet. Wolfcamp series.

Type locality: Bluffs and ravines west of South Fork of Little Nemaha River, in sec. 20, at point one-fourth mile west of north-south road. 2½ miles northwest of Burr, Otoe County, Nebr.

Burrego Formation (in Hansonburg Group)

Pennsylvanian (Missouri Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 64, 65. Term proposed for the massive to massively bedded and nodular limestones that overlie the Council Spring limestone (new) and underlie the red shales and arkosic red sandstones at base of Story formation (new). At type locality, formation is almost entirely limestone; in Mocking Bird Gap area, contains several thick sandstones and, on Cadronito Hill, contains several thick shale strata. Thickness about 52 feet.

Type locality: North of Burrego Spring on northeast side of Oscura Mountains, in SE¼ sec. 31, T. 5 S., R. 6 E., Socorro County.

Burro Gravel and Tuff[1]

Tertiary(?): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 67.

Named for Burro Mesa, Brewster County.

Burro quartzite[1]

Cambrian(?): Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 4, 5.

Derivation of name not given.

Burroak Shale[1] **Member** (of Deer Creek Limestone)

Pennsylvanian (Virgil Series): Southwestern Iowa, eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 8, 20, 53–54, figs. 1, 2.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 48. Burroak shale member of Deer Creek limestone underlies Ervine Creek limestone member and overlies Haynies limestone member. Burroak pinches out in southeastern Nebraska where Haynies limestone unites with the Ervine Creek.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035. Member of Deer Creek formation; overlies Haynies limestone member; underlies Larsh shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. Kansas uses Larsh-Burroak shale member for interval.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. In Missouri, interval between Rock Bluff limestone member and uppermost limestone of the Deer Creek is occupied by shale. This shale has been treated by Missouri Geological Survey as the Rock Bluff-Ervine Creek interval with implication that intervening Haynies limestone is absent in Missouri. The shale is now called Larsh-Burroak, but the Missouri Survey recognizes possibility that the Burroak shale member may be absent in Missouri and that the uppermost limestone of the Deer Creek may include both the Haynies and Ervine Creek members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17, fig. 5. Burroak shale not everywhere differentiated in southwestern Iowa because of absence in some areas of Haynies limestone, which results in the coalescing of Burroak and Larsh shales. Where Haynies is present, as near Thurman, Burroak shale is bluish gray, argillaceous, and fossiliferous. Thickness about 1 foot near Thurman.

Type locality: Roadcuts and ravines near Burr Oak School, E½ sec. 21, T. 71 N., R. 43 W., Fremont County, Iowa, about 6 miles south of Pacific Junction, and about 3½ miles north of Bartlett, Mills County.

Burro Canyon Formation

Lower Cretaceous: Southwestern Colorado, northeastern Arizona, northwestern New Mexico, and southeastern Utah.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 93. Proposed to designate relatively thin sequence of rocks of probable Lower Cretaceous age lying between Morrison formation (Brushy Basin member) and Dakota sandstone. Includes essentially the same rocks as those designated post-McElmo by Coffin (1921, Colorado

Geol. Survey Bull. 16). Consists of alternating conglomerate, sandstone, shale, limestone, and chert. Thickness 150 to 260 feet. Sandstones and conglomerates are gray, yellow, and brown; shales faintly varicolored, mainly purple and green.

E. B. Ekren and F. N. Houser, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 192–201. Described in Four Corners area where it is present in all four States. Thickness 140 to 206 feet. Intertongues with Brushy Basin member of Morrison. In Utah and Colorado, includes Karla Kay member (new) at base.

R. G. Young, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 157–158. This study indicates that two names, Cedar Mountain formation and Burro Canyon formation, have been applied to same physically continuous unit, which can be traced over wide areas of Colorado Plateau with no significant change in character. Proposed here to drop name Burro Canyon and retain older name Cedar Mountain for these noncarbonaceous deposits.

Type locality: Burro Canyon, sec. 29, T. 44 N., R. 18 W., San Miguel County, Colo.

Burro Mesa Riebeckite

Tertiary: Southwestern Texas.

J. D. Martinez, E. H. Statham, and L. G. Howell, 1960, Texas Univ. Bur. Econ. Geology Pub. 6017, p. 38–39, 44 (fig. 38). Incidental mention in paleomagnetic study of Tertiary volcanics in Big Bend National Park.

Burro Mountains granite

Precambrian: Southwestern New Mexico.

Term used many times in discussion of Bullard Peak Series and Ash Creek Series. Probably refers to granite in Burro Mountains granite batholite.

Burroughs Dolomite[1]

Lower Silurian: Northwestern Illinois and western Wisconsin.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, no. 7, p. 533.

Near top of Burrough's Bluff, at north end of Savannah, Carroll County, Ill. Also in and above Charles Miles' quarry near southeast edge of same city.

Burroughs Limestone Member (of Modesto Formation)

Burroughs Beds (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

J. M. Weller, 1946, *in* C. L. Cooper, Illinois Geol. Survey Bull. 70, p. 13. Name appears in a list of beds above the Shoal Creek limestone in Macoupin County. Name credited to J. R. Ball.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 29, 37–38, 85. Succession of beds between the Carlinville and Macoupin cyclothems; beds do not seem to belong to either cyclothem, nor do they comprise enough conventional units to be classed as a cyclothem. Beds consist regularly of three members: a basal sandstone or sandy shale, a middle limestone, and a top shale. Thickness about 6 feet.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 38, 45 (table 1), 68, pl. 1. Name Burroughs limestone member of Modesto formation (new) restricted to middle sandy unit of strata

formerly called Burroughs beds. Occurs above Carlinville limestone member and below Womac coal member (new). Thickness as much as 3 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: NW¼SW¼ sec. 27, T. 10 N., R. 7 W., Carlinville quadrangle, Macoupin County.

Burrows Member (of Highland Peak Formation)

Burrows Dolomite

Burrows Limestone (in Ophir Group)

Middle Cambrian: Southeastern Nevada and northwestern Utah.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., no. 34, p. 12, 27–29. Name applied to variable thickness of strata between Peasley limestone (new) and Highland Peak unit "C" of Wheeler and Lemmon (1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31); both contacts unconformable. Consists mainly of a white and light, medium, to dark-gray, coarse-grained (sugary textured) massively bedded dolomite. Basal 29 feet (at type locality) are thinly and distinctly bedded, medium- and dark-gray, fine-grained limestone; beds vary in thickness from about 29 to 33 feet throughout district. Thickness ranges from 130 feet in Panaca Hills to about 400 feet at type section; 230 feet on southwest slope of Ely Range.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 36–38. Originally termed dolomite; studies now indicate unit is thickly to massively bedded light-colored limestone which has locally been subjected to epigenetic dolomitization. Underlies Burnt Canyon limestone (new). Geographically extended into House and Wah Wah Ranges, Utah, where it consists of the light-gray zone, 340 [335] feet thick in middle part of the "Howell limestone" (Deiss, 1938, Geol. Soc. America Bull., v. 49, p. 1145).

H. E. Wheeler and Grant Steele, 1951, Utah Geol. Soc. Guidebook 6, p. 32 (fig. 5), 35. In House Range, underlies Burnt Canyon limestone and overlies Millard limestone.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 35, 44. Burrows limestone included in Ophir group in Sheeprock Mountains although not clearly recognized in area. On basis of grain size, basal 21 feet of Burnt Canyon limestone may represent the Burrows. No unconformity was noted at or near base of Burnt Canyon lithology, but it is possible one may be present which could account for absence of Burrows lithology.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50. Wheeler's correlation of middle unit of Howell limestone with Burrows limestone of Pioche district is here considered to be incorrect because "Burrows limestone" in House Range underlies Chisholm formation, whereas in Pioche district, the Burrows limestone overlies both Chisholm and Peasley formations. Consequently, because the two units are not correlative, the "Burrows limestone" of House Range is without valid name. Proposed here that definition of Howell limestone be further restricted to include only carbonate sequence of western Utah that underlies Chisholm formation and overlies Busby and Tatow formations, or their equivalents, and

that Millard limestone be rank reduced to member of Howell. In Pioche district, the Burrows underlies Whirlwind formation (new) and overlies Peasley. Wheeler's (1948) Burnt Canyon limestone discontinued.

U.S. Geological Survey currently classifies the Burrows as a member of the Highland Peak Limestone on the basis of a study now in progress.

Type section: On northwest spur of Comet Peak, immediately south of Peasley Canyon, on west slope of Highland Range, Pioche district, Nevada. Name derived from canyon east of Comet mine, about 1 mile south of type section.

Burrows Shale

Middle Cambrian: Southeastern Nevada.

Charles Deiss, (abs.), 1937, Geol. Soc. America Proc. 1936, p. 274. Mentioned in discussion of succession of Middle Cambrian faunas in southern half of Cordilleran trough.

Present in Highland Range, Lincoln County.

Bursum Formation (in Magdalena Group)

Permian (Wolfcamp): Central and southeastern New Mexico.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. In mapped area, about 30 miles north of type section, formation consists of dark-purplish-red and green shale in beds up to 40 feet thick, separated by thinner beds of arkose, arkosic conglomerate, and gray limestone. A thin rubbly nodular purplish-gray limestone occurs locally at base. Thickness ranges from 28 to 234 feet. Underlies Abo formation; overlies upper member of Madera limestone. Age given as (Wolfcamp) Permian(?).

R. L. Bates and others, 1947, New Mexico Bur. Mines Mineral Resources Bull. 26, p. 23, pl. 1. At type locality, formation is 250 feet thick and consists of shale, conglomerate, and arkosic sandstone in lower part, and marine limestone and shale in upper part.

E. R. Lloyd, 1949, New Mexico Bur. Mines Mineral Resources Bull. 29, p. 32–33. In discussing Pennsylvanian-Permian contact, Thompson (1942, New Mexico Bur. Mines Mineral Resources Bull. 17) mentioned presence of fusulinid-bearing marine sediments of lower Wolfcamp age unconformably overlying Pennsylvanian rocks [Fresnal group] in a number of localities in south-central New Mexico. These lower Wolfcampian limestones received three different names in 1946. Kelley and Wood introduced name Red Tanks member of Madera limestone in Lucero uplift; Wilpolt and others introduced name Bursum for beds exposed in Los Pinos Mountains and vicinity of Abo Canyon; Stark and Dapples described same section and named it Aqua Torres formation. Name Bursum is preferred by New Mexico Bureau of Mines and Mineral Resources. Bruton formation (Thompson, 1942), of Pennsylvanian age, is very similar in lithology to Bursum, and it is possible that all or part of the Bruton has been included in descriptions of the Bursum. Similar section, now included in Bursum, was found by Thompson (1942) in Fresnal Canyon in northern Sacramento Mountains where it is 250 feet thick and overlies beds of upper Virgil age. It is overlain with angular unconformity by Abo formation.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Shown on composite columnar section, Sacramento Mountains, Otero County, as underlying Abo formation and overlying Holder formation

(new). Consists of shale, gray and red sandstone, limestone, and limestone conglomerate. Thickness as much as 350 feet.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5, p. 17–18. Redefined to apply only to pre-Abo (Wolfcampian) Permian rocks of New Mexico. As thus redefined, it takes in uppermost 40 feet of Bruton formation of Thompson (1942). A lower part of Bursum, as defined by Wilpolt and others, is retained in Bruton formation.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 47–49. As redefined by Thompson (1954), formation at its type locality consists of a lower 48 to 65 feet of red beds and limestones and upper massive to nodular limestones about 70 feet thick. Overlies Panther Seep formation (new).

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 25–26. In northern Sacramento Mountains, Thompson's sequence of "transition beds" consists largely of marine sequences of fossiliferous gray shale, limestone, and sandstone, whereas in central New Mexico the Bursum is predominantly red beds that occur interbedded with a few thin fusulinid-bearing limestones. In addition, upper part of "transition beds" occurring north of Tularosa are younger than "Bursum" age. Name Laborcita formation is therefore proposed for strata between top of Holder formation and top of highest marine limestone underlying main mass of Abo red beds.

Type section: Exposures just west of Bursum triangulation point, in SE¼ sec. 1, T. 6 S., R. 4 E., Oscura Mountains, Socorro County.

Burton Sandstone (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 182.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. and Econ. Survey Bull. 14, p. 17. Shown on table of summary of stratigraphic sections of Dunkard group, Harrison County. Underlies unnamed shale below Ninevah limestone; overlies Hostetter coal and (or) fire clay.

Named for Burton, Wetzel County.

Busby Quartzite[1]

Busby Quartzite or Formation (in Ophir Group)

Lower Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 28–32, fig. 5. Geographically extended into House Range area where it includes Tatow limestone (Deiss, 1938); in Wah Wah Range includes uppermost 70 feet of beds assigned to Pioche shale by Wheeler (1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1). Thickness 165 feet in House Range; 450 feet in Deep Creek Range. Overlies Pioche shale; underlies Millard limestone (new). Busby may be tongue extending southward from Prospect Mountain quartzite. Middle Cambrian.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 35, 39–41, pl. 1, measured sections. In Sheeprock Mountains, Busby quartzite or formation included in Ophir group. Comprises 146 feet of beds, mainly quartzites, sandstones, and sandy limestones. Age is

lower Middle Cambrian with strong indications that it was deposited only slightly after early Cambrian time.

U.S. Geological Survey currently considers the Busby quartzite to be Lower Cambrian in age. This designation is based on the discovery of *Olenellus* near top of quartzite in Deep Creek Range.

Named for exposures in Busby Canyon, on northeastern slope of Dutch Mountain, Gold Hill district.

Busby Quartzite Member (of Langston Formation)

Middle Cambrian: Southeastern Idaho and northern Utah.

G. B. Maxey, 1955, Dissert. Abs., v. 15, no. 4, p. 558. Incidental mention.

Bushberg Sandstone Member (of Sulphur Springs Formation)[1]

Bushberg Formation (in Sulphur Springs Group)

Lower Mississippian: Central eastern Missouri.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, 2d ser., v. 2, p. 110.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 43–46. Prior to 1933, beds here described [Boone County] as Bushberg were called Sylamore and were believed to be equivalent to Sylamore sandstone of Arkansas. Ulrich considered Bushberg to be top member of Sulphur Springs formation. In this report, the Sulphur Springs is classed as a group. In its areal extent, the Bushberg is known to lie upon the Jefferson City, Powell, Joachim, St. Peter, Plattin, Kimmswick, and Callaway formations. In Boone County, overlies Callaway limestone; underlies Chouteau formation. Estimated thickness 2 feet.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 69–71. Ulrich described Bushberg as uppermost of three members of Sulphur Springs formation. Term Sulphur Springs is herein abandoned and the Bushberg referred to as formation. Name indicates that vicinity of Bushberg was meant to be type locality, although it is reasonably certain that Ulrich was describing outcrops at Goetz Quarry near Glen Park. Type locality herein designated. Geographically restricted to outcrops in Jefferson County and closely adjacent parts of Franklin and St. Louis Counties. Bushberg provides little useful data by means of which it may be correlated with isolated, widely separated exposures. Early Mississippian age of conodont fauna described as from the "Bushberg" by Branson and Mehl (1933, Missouri Univ. Studies, v. 8, no. 4) is not questioned, but its identification as a Bushberg fauna is not supported by evidence at hand. Fauna from the "Bushberg" described by Branson (1938, Missouri Univ. Studies, v. 13, no. 4) should not be considered valid evidence of age of the Bushberg; sandstone from which fauna came is isolated and far removed from Bushberg as herein restricted, and its relationships are not clear. Average thickness about 10 feet. Unconformable upon Maquoketa, Kimmswick or "Fernvale," Grassy Creek, and Glen Park. Underlies Bachelor formation (new). Tentatively placed in Upper Devonian.

Type locality (Mehl, 1960): Outcrops at head of ravine draining into Mississippi River at Bushberg, formerly station on St. Louis, Iron Monutain, and Southern Railroad, NW¼NE¼NW¼ sec. 8, T. 41 N., R. 6 W., Jefferson County, Mo.

Busseron Sandstone Member[1] (of Shelburn Formation)

Upper Pennsylvanian: Southwestern Indiana.

Original reference: E. R. Cumings, 1922, Handb. Indiana Geology, pt. 4, Sep. Pub. 21, p. 524, 529, chart.

F. E. Kottlowski, 1954, U.S. Geol. Survey Coal Inv. Map C–11. Composed of gray to brown massive sandstone, sandy shale, and shale about 50 to 65 feet thick. Underlies a coal which in turn underlies Maria Creek limestone member; basal member of formation; overlies Coal VII at top of Dugger formation.

Probably named for village of Busseron, Knox County.

Butano Sandstone[1]

Eocene or Oligocene: Southern California.

Original reference: J. C. Branner, J. F. Newsom, and R. Arnold, 1909, U.S. Geol. Survey Geol. Atlas, Folio 163.

E. E. Brabb, 1960, Dissert. Abs., v. 21, no. 5, p. 1163. In Big Basin area, Butano sandstone of late Eocene (Narizian) age is divided into six informal units, which may prove to be members. Thickness about 9,000 feet. Overlies Locatelli formation (new); underlies San Lorenzo formation (subdivided).

Named for exposures on Butano Ridge, San Mateo County.

Butcherknife Basalt

Tertiary or younger: Southwestern Texas.

S. S. Goldich and M. A. Elms, 1949. Geol. Soc. America Bull., v. 60, no. 7, p. 1165–1168, pl. 1. Fresh, black, very fine-grained rock with conchoidal fracture. Younger than lowermost Pruett. Although cannot be correlated definitely with either Sheep Canyon basalt or the younger Cottonwood Spring basalt, it is much like them in composition.

Occurs on Butcherknife Hill, Buck Hill quadrangle, west-central Brewster County.

†Butler amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for a Captain Butler, discover of the lode.

Butler Clay Member (of Calvert Bluff Formation)

Butler Clay Member (of Rockdale Formation)[1]

Eocene, lower: Central and southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 587.

H. B. Stenzel, 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists, Mineralogists, and Soc. Econ. Geologists Joint Mtg. Guidebook, p. 52, 54. Reallocated to member status in Calvert Bluff formation. Forms basal part of formation, but top boundary indistinguishable from remainder of Calvert Bluff. Overlies Simsboro formation.

Typically exposed at town of Butler, Freestone County.

†Butler flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart complied by M. G. Wilmarth).

Copper district of Keweenaw Point.

†Butler Limestone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 49.

Present at Butler, Butler County in cut near railroad station, hence name.

Butler Sandstone Member (of Allegheny Formation)[1]

Butler Sandstone (in Allegheny Formation)

Butler Sandstone Member (of Freeport Formation)

Middle Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 40–71, 130.

G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, p. 28, pl. 4; M. N. Shaffner, 1946, Pennsylvania Topog. and Geol. Atlas 55, p. 51–65; E. G. Williams, 1960, Jour. Pateontology, v. no. 5, p. 910 (fig. 2). Member of Freeport formation.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 60, 75, fig. 21. Lies about 35 feet below Upper Freeport coal which is considered top of Allegheny group. Thickness 5 to 15 feet. In Fayette County, commonly replaced by sandy shale. Sandstone may lie above or below Bolivar fire clay.

Type locality: Town of Butler, Butler County, Pa., just below Mr. Muntz's, opposite mills of Woldo & Bros., where it has been quarried.

Butlerville quartzites[1]

Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Buttahatchie Gravel[1]

Quaternary(?): Alabama.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann, Rept. 1888, v. 2, p. 189.

Butte Formation

Permian (Wolfcampian): Eastern Nevada.

J. S. Berge, April 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 11 (fig. 3). Butte formation, as shown on correlation chart, underlies Robbers Roost formation (new) and unconformably overlies Ely limestone. Permian (Wolfcampian). Column on chart credited to G. P. Lloyd (1959, unpub. thesis).

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Underlies Murry [formation] (new); stratigraphically above Ely limestone.

Present in White River valley and Moorman Ranch areas.

Butte Gravel Member (of Sutter Formation)

Butte Gravels[1]

Tertiary, upper: Northern California.

Original reference: Howel Williams, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, p. 112–129.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34, sheet 2. Used in a restricted sense. Top 150 feet of gravels are considered a sporadic basal member of Sutter formation. Upper Tertiary.

Present at Marysville Buttes, Sutter County.

Butte Quartz Monzonite[1]

Upper Cretaceous or Paleocene: Central western Montana.

Original reference: W. H. Weed, 1899, Jour. Geology, v. 7, p. 740–750.

G. E. Becraft, 1960, U.S. Geol. Survey Mineral Inv. Field Studies Maps MF–171 and MF–172. Upper Cretaceous or Paleocene.

Prevailing rock of Butte district.

Butte Creek Basalt

Late Pleistocene and Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 45–46. Narrow flow of black vesicular olivine basalt. Thickness 10 to 150 feet. Covered by Alder Creek basalt (new).

Issued from fissure at elevation of approximately 6,000 feet on east wall of Butte Canyon, Macdoel quadrangle. Extends for about 10 miles and ends near Soule Ranch at elevation of about 4,800 feet.

Butte Creek Beds

Oligocene, upper, or Miocene, lower: Northwestern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 5. Name credited to Harper (1941, unpub. map of Molalla quadrangle). Fossils, both foraminifera and megafossils in Marquam limestone (deposit) indicate Vaqueros age, correlative with Illahe-Mehama formation of Thayer (1939) and Butte Creek beds.

W. D. Lowry, 1947, Geol. Soc. Oregon Country News Letter, v. 13, no. 1, p. 5. Mentioned as containing the Wilhoit coal.

Occurs along Butte Creek about 3 miles east of Scotts Mills, Marion County.

Butte Falls Tuff

Precambrian (Yavapai Series): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 7, 10–11, pl. 3. Largely massive- to well-bedded metamorphosed water-deposited tuff and possibility includes some flows. Several kinds of rocks have been grouped under the tuff, including quartz-sericite schist, quartz-feldspar-biotite schist, and grayish-white, gray, and purple slate. Thickness more than 2,500 feet. Younger than Bridle formation (new); underlies Hillside mica schist (new) with gradational contact. Intruded by Dick rhyolite and Lawler Peak granite (both new).

Exposed for more than 1 mile along Boulder Creek in vicinity of Butte Falls, for which these rocks have been named; Bagdad area, Yavapai County.

Butte Mountain Formation

Permian: Eastern Nevada and western Utah.

Grant Steele, 1960, Dissert, Abs., v. 20, no. 12, p. 4635. Incidental mention in stratigraphic interpretation of Pennsylvanian-Permian systems of eastern Great Basin. Subsidence continued, accompanied by deposition of

Kaibab, Butte Mountain, Phosphoria, and Gerster formations, until latest Guadalupian times, when westerly positives once again fed minor amounts of chert clastics east and south into western part of Phosphoria-Gerster deposition basin in Nevada.

Type locality and derivation of name not stated.

Butterfield Andesite Flows

Oligocene: Northern Utah.

R. E. Marsell and R. L. Threet, 1960, Geologic map of Salt Lake County, Utah (1:62,500); supp. to Bull. 69 [not yet published]: Utah Geol. and Mineralog. Survey. Named on map legend. Occurs above Knight conglomerate and below Rose Canyon latite-andesite flows.

Mapped in southern part of Salt Lake County. Largest exposure in south of Butterfield Canyon.

Butterfield Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 37, map, sections.

Exposed in Butterfield Canyon, Bingham district.

Butterly Dolomite (in Arbuckle Group)

Upper Cambrian: Southwestern Oklahoma.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1317–1318, table 1; 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 16 (table 1), 22–23. Mostly coarse dolomite with large quartz grains and thin quartz conglomerate in upper part. Color ranges from pink to yellow and gray. Thickness at type locality 286 feet; on west side of East Timbered Hills 374 feet. Overlies Signal Mountain formation: underlies Chapman Ranch member of McKenzie Hill formation. Name Butterly is substituted for Chapman Ranch, and name Chapman Ranch is used for the limestone at the base of the McKenzie because it appears that Ulrich intended the name Chapman Ranch to apply to the limestone rather than the dolomite.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 58–62. Butterly dolomite in Mill Creek-Ravia area, Johnston County, includes strata 333 to 435 feet thick that lie conformably on Royer dolomite and grade upward into limestone beds of McKenzie Hill formation.

Type section: On east side of U.S. Highway 77 in sec. 18, T. 2 S., R. 2 E., southeast of Chapman Ranch buildings, [Murray County]. Named for ranches owned by John Butterly and Butterly brothers at southeast end of West Timbered Hills, secs. 28 and 29, T. 1 S., R. 1 E.

Buttermilk Falls Limestone (in Onondaga Group)

Buttermilk Falls Limestone Member (of Onondaga Formation)

Lower or Middle Devonian: Northeastern Pennsylvania.

Bradford Willard, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–11, p. 5, 6 (fig. 3), 14, 16; 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 144–145. Because of elevation of term Onondaga to group rank, name Buttermilk Falls is introduced for those beds formerly designated as the Onondaga limestone. In Monroe County, consists of heavily bedded dark- or blue-gray limestone; contains nodules and lenses of dark chert, most abundant in middle of formation, but decreasing in upper and lower beds as these pass over respectively in the Marcellus formation and

Esopus shale. Thickness about 200 feet; thins westward to 5 feet in Lehigh River above Palmerton. Middle Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12 pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation as mapped includes Buttermilk Falls limestone member in easternmost part of State.

Crops out low on north side of Godfrey Ridge, at various places in vicinity of the Stroudsburgs, along railroads south of these boroughs, and in nearby quarries. Named for Buttermilk Falls on Marshall Creek, Monroe County. Continues east into Pike County but west only into Carbon County.

Butternut Shale Member (of Skaneateles Formation)

Middle Devonian: Central New York.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 181–182. Proposed to replace Berwyn of Cooper, 1930 (not Richards and Birk, 1925).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Butternut shale below Chenango sandstone and above Pompey shale and sandstone. Middle Devonian.

[G. A. Cooper], 1955, *in* New York State Geol. Assoc. [Guidebook] 27th Ann. Mtg., p. 10, 11. Dark-gray shale grading upward into Chenango sandstone member. Overlies Pompey member. Thickness 220 to 235 feet.

Type section: In the Cascades formed by branch of Butternut Creek, southeast of Syracuse, Tully quadrangle, Onondaga County.

Butte Valley Basalt

Late Pleistocene and Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 44–45. Black vesicular olivine basalt dotted with schollendomes. Thickness 80 feet at Juniper Lodge at bottom of Mount Hebron grade on U.S. Highway 97, where it overlies dark volcanic sand.

P. R. Wood, 1960, U.S. Geol. Survey Water-Supply Paper 1491, p. 19 (table 4), 29–31, pl. 1. Late Pleistocene and Recent.

Occurs at southern end of Butte Valley, around Jerome, Macdoel quadrangle.

Butte Valley Formation

Lower(?) Triassic: Southeastern California.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 384–385, figs. 1, 3. Consists of impure carbonates and limy argillaceous rocks thermally metamorphosed to very fine grained calc-silicate hornfelses; mostly banded rock of alternating laminae of light- and dark-gray hornfels, but locally includes massive units a few feet thick. About 4,000 feet thick. Contact between Permian Anvil Spring formation (new) and Butte Valley not exposed; east of Striped Butte, underlies Warm Spring formation (new), contact between the two gradational through as much as several hundred feet.

Exposed along east side of Butte Valley, Manly Peak quadrangle in southern Panamint Range, Inyo County.

Butting Ram Sandstone Member (of Talledega Slate)[1]

Pre-Devonian (probably Paleozoic): Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 54, 58, map.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 20. Mentioned in discussion of Talledega series.

Named for fact it is believed to form Butting Ram shoals on Coosa River, on border between Chilton and Coosa Counties, about 10 miles northeast of Clanton.

Buttle Diatomite Member (of Monterey Formation)

Miocene-Pliocene: Central western California.

Y. T. Mandra, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 6, p. 78, 79-81, 88. Proposed for diatomite, about 500 feet thick, in Monterey formation. Overlies typical Monterey cherts, shales, and thinner interbeds of diatomite. Unconformably underlies sandy conglomerate that grades upward into gray-white sandstone that has been mapped as Santa Margarita by some workers and Pancho Rico by other workers. Name Pancho Rico is preferred in this report. Delmontian.

Type locality: Buttle Canyon, in NE¼ sec., 15, T. 24 S., R. 10 E., Mount Diablo base and meridian, approximately 4 miles west southwest of Bradley, Monterey County. Locality is on southwest limb of Hames Valley syncline.

Button Mold Knob Member (of new Providence Formation)

Lower Mississippian: Northern Kentucky and southern Indiana.

J. E. Conkin, 1957, Bulls. Am. Paleontology, v. 38, no. 168, p. 114–116, 120–121. Middle member of New Providence formation, Silver Hill facies. Divisible into lower, middle, and upper parts. Consists largely of green-gray shale with ironstone lenses and concretions, some limestones; crinoidal bioherms. Thickness about 145 feet. Underlies Kenwood sandstone member; overlies Coral Ridge member (new).

Type locality: Button Mold Knob, Bullitt County, Ky. Only lower and middle parts are well exposed here.

Buttrill Ranch Member (of Dagger Flat Formation)

Upper Cambrian: Southwestern Texas.

J. L. Wilson, 1954, Jour. Paleontology, v. 28, no. 3, p. 251, 252; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 12, p. 2465. Typically a graywacke sandstone and shale sequence with a few thin sandy chocolate-weathering flags. Thickness at type locality 370 feet. Underlies Roberts Ranch member (new).

Type locality: Dagger Flat, Brewster County. Exposed along Dagger Flat anticlinorium approximately 1½ miles southeast of Buttrill's ranch.

Buttsgin Formation[1]

Eocene: Southern Texas.

Original reference: R. A. Liddle, 1921, Texas Univ. Bull. 1860, p. 82, map, and columnar section.

Typically exposed in Butts Gin, approximately 6 miles northwest from Yancey, Medina County, in bed and tributaries of branches of Seco Creek.

Butts Ranch Shale Member (of Panoche Group)

Upper Cretaceous: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 203, 226 (fig. 5), pl. 3. Consists of purplish or brownish calcareous and clay shales, thinly bedded and cut at various angles by sandstone dikes 2 or 3 feet wide; abundantly foraminiferal. Thickness at type locality 200 feet. Underlies Big Oak Flat shale member (new); overlies Call sandstone member (new).

Type locality: Along Paynes Creek 1 mile north of Butts Ranch, San Benito County. Member is exposed only along northeast limb of Butts Ranch syncline.

†Buxton Formation[1]

Pennsylvanian: Southeastern Kansas.

Original reference: F. C. Schrader and E. Haworth, 1905, U.S. Geol. Survey Bull. 260, p. 447.

Named for Buxton, Wilson County.

Buzzard Rhyolite (in Ash Creek Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 11–12, pl. 1. Outcrops in lower reaches of Black Canyon tinted in shades of red, whereas those in the headwaters are buff to cream. Contorted flow banding and amygdaloidal and vesicular structures common in flows. Fragmental structures common; some represent flow breccia. Thin sandy interbeds in breccia exposed near base of rhyolite west of Ward Pocket and three-fourths of a mile southeast of Allen Spring. Similar interbeds of sedimentary rock exposed near top of rhyolite north of Oak Wash. Megascopically rhyolitic rocks commonly porphyritic. Thickness of complete section in lower part of Black Canyon, where it overlies Gaddes basalt (new) and underlies Shea basalt, estimated at 3,500 feet.

Good exposures in Buzzard Canyon, a tributary to Black Canyon, southeast of Mingus Mountain. Excellent outcrops in Black Canyon, Jerome area, Yavapai County.

Buzzard Peak Conglomerate Member (of Topanga Formation)

Miocene, middle: Southern California.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 515–519. Sandy conglomerate and coarse-grained pebbly sandstone with a few thin beds of white siliceous siltstone. Thickness about 2,000 feet; base not exposed. Overlain with apparent conformity by either the lower member of Puente formation or by a few feet of andesite breccia or massive calcic andesite which in turn is overlain by the Puente.

Crops out in core of Buzzard Peak anticline in San Jose Hills, 5 miles west of Pomona, Los Angeles County.

Byer Member[1] (of Logan Formation)

Mississippian: Central and southern Ohio.

Original reference: J. E. Hyde, 1912, History of Fairfield County, p. 211; 1915, Jour. Geology, v. 23, p. 656, 657, 659, 678, 764–765, 771–775.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172–173; 1942. Jour. Geology, v. 50, no. 1, p. 55, 56–58. Included in Pretty Run sandstone facies (new) of formation. Underlies Allensville conglomerate member; overlies Berne conglomerate member.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 26–27. Overlies the Berne here included in Cuyahoga formation.

Named for Byer, Jackson County.

Byham limestone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61, p. 134.

In Buchanan's Ravine, north of Shaws School (Buchanan Station) and about 1½ miles north-northwest of Byham School, south of Meadville, Crawford County.

Byram Formation (in Vicksburg Group)

Byram Marl (in Vicksburg Group)[1]

Byram Member (of Vicksburg Formation)

Oligocene: Mississippi, southwestern Alabama, northwestern Florida, and Louisiana.

Original reference: T. L. Casey, 1902, Philadelphia Acad. Nat. Sci. Proc., v. 53, p. 517–518.

F. F. Mellen, 1939, Mississippi Acad. Sci. Jour., v. 1, p. 18. Member at top of Vicksburg formation.

R. O. Vernon, 1942, Florida Geol. Survey Bull. 21, p. 56. Limestone mapped as Suwannee in this report [Holmes and Washington Counties] may represent time interval equivalent to that required for deposition of Glendon limestone, Byram marl, and lower Chickasawhay marl of western Alabama and eastern Mississippi. Not possible to establish mappable units within the Suwannee.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Byram limestone, as shown on correlation chart, comprises (ascending) Glendon limestone, Byram marl, and Bucatunna clay members. Vicksburg group.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1329–1344. Byram formation as herein treated includes, in addition to marl to which name Byram was applied originally, the Glendon limestone member at base and Bucatunna clay member at top. Overlies Marianna limestone; underlies Chickasawhay limestone and Flint River formation.

W. H. Monroe, 1954, U.S. Geol. Survey Bull. 986, p. 80–98, pls. 1, 3, 4, 5. Byram formation including Glendon and Bucatunna member is present in belt across Mississippi from Warren County and southern part of Yazoo County on west to Wayne County on east. Present in western and central Alabama and has been doubtfully identified in Florida. Thickness about 110 feet. Entire section not exposed at any one place. Overlies Marianna limestone; disconformably(?) underlies Catahoula sandstone.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. In stratigraphic investigation of Vicksburgian deposits in Mississippi, Alabama, and

Florida, two sedimentary cycles were identified. District disconformity marks upper and lower boundary of each unit. Lowermost cycle extends from disconformity at base of Mint Springs-Mariana formation to similar break at top of Byram formation (this report). Uppermost cycle contains Bucatunna marl and clay facies extending to disconformity at base of overlying Catahoula and Chickasawhay formations. Name Vicksburg stage suggested to include these deposits. Name Hennessey Bayou member proposed for lower Bucatunna transgressive unit heretofore included in Byram formation.

Type locality: On right bank of Pearl River, in S½NW¼NW¼ sec. 19, T. 4 N., R. 1 E., Hinds County, Miss. Named for Byram.

Byram Gneiss

Byram Granite Gneiss[1]

Precambrian: Northern New Jersey and eastern Pennsylvania.

Original reference: A. C. Spencer, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

D. M. Fraser *in* B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 163 (fig. 30), 187–193. Described in Northampton County, Pa., where it intrudes Franklin formation, Moravian Heights formation (new), and Pochuck gneiss.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 18, 46, 50–51, pl. 5. Gray granitoid gneiss composed of microcline, microperthite, quartz and hornblende, with some pyroxene and biotite. Byram granite gneiss, Losee diorite gneiss, and Pochuck gabbro gneiss grade into one another through intermediate forms which as a rule can be recognized easily in thin sections, although they may not be distinguishable everywhere in the field. With decrease in oligoclase, the Losee phases pass into the Byram phases. Intrudes Franklin limestone and Pickering gneiss.

Bradford Willard *in* Bradford Willard and others, 1959 Pennsylvania Topog. and Geol. Survey Bull. C9, p. 219. Byram gneiss may be upper part of batholith which engulfed all but remnants of Franklin limestone and Pochuck gneiss.

Named for Byram Township, Sussex County, N.J., where good exposures occur in hills northeast of Roseville.

Byron Beds[1]

Byron Dolomite (in Burnt Bluff Group)

Middle Silurian (Niagaran): Southeastern Wisconsin and northern Michigan.

Original reference: T. C. Chamberlin, 1877, Geol. Wisconsin, v. 2, p. 345–348.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Byron dolomite included in Burnt Bluff group.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 9, 13–14. Overlies Lime Island dolomite (new); underlies Hendricks dolomite. Thickness 80 to 155 feet.

Named for Byron Township, Wis.

Byron Schist

Age not stated: West-central Maine.

Kern Jackson, 1953, Maine State Geologist Rept. 1951–1952, p. 53, 64–60. Consists of alternate layers of dark staurolitic schist and light fine-grained quartzite. Contacts between layers are alternately sharp and gradational. Schist lamellae are more readily weathered, creating a "washboard" effect. Thickness about 5,000 feet.

Named for excellent exposures in bed of Swift River in vicinity of Byron, Oxford County.

Caballero Formation

Mississippian (Kinderhook): Central southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1941, (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73–75; 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 935; no. 12, p. 2116–2117, 2122–2125, fig. 4. Soft, gray, silty, marly limestone beds which weather to rounded, nodular, rubbly chunks on fresh exposures. Interbedded soft gray shales curve around nodular limestone lumps. Upper portion of section more shaly. Maximum thickness of 60 feet developed in area between Mule and San Andres Canyons in Sacramento Mountains. Thins to about 40 feet in northern part of range and to 28 feet in southernmost part of area. Unconformably underlies Alamogordo member (new) of Lake Valley formation; unconformably overlies various members of Percha formation. Heretofore considered a part of Lake Valley formation.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 94–95; 1945, Jour. Geology, v. 53, no. 4, p. 239. Overlies Contadero formation (new).

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 9–10, fig. 5. Thickness varies from featheredge to 60 feet in central southern New Mexico. Basal part in many places contains thin layer of fissile black shale. Georgraphic distribution given.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 32. Summary paper. Extended to southern part of San Andres Mountains.

Type section: In Deadman Canyon, Sacramento Mountains, sec. 3, T. 17 S., R. 10 E., Otero County. Best developed in Sacramento Mountains, occurs in central and southern portion of San Andres Mountains, and locally in Lake Valley area. Missing elsewhere in New Mexico.

Caballo Blanco Rhyolite Tuff

Tertiary: Southwestern New Mexico.

F. J. Kuellmer and others, 1953, *in* New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 50 (map). Name appears on legend for map of Mimbres Valley.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 30–31, 32, pl. 1. Described as white, cream, or light-gray porphyritic rhyolite tuff interpreted as an ignimbrite. Matrix partly pumiceous. Reaches maximum thickness of 325 feet at Caballo Blanco in Dwyer quadrangle; thins to the west and pinches out toward the south near Box Well. According to generalized stratigraphic section Caballo Blanco rhyolite tuff is uppermost unit of eruptive suite termed Lower Volcanic series. Occurs above Rustler Canyon basalt (new). Unconformably underlies Razorback andesite and rhyolite of Upper Volcanic series. Derivation of name.

Name is taken from a mountain in secs. 25 and 36, T. 18 S., R. 11 W. (as shown on pl. 1), Dwyer quadrangle.

Caballos Novaculite[1]

Devonian and Mississippian: Southwestern Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 39.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 47–55, pls. 23, 24. Subdivided into five members (ascending): lower chert; lower novaculite; middle chert; upper novaculite; upper chert. Name Santiago chert, which had been applied to three upper members, abandoned. Thickness 200 to 600 feet. Overlies Maravillas chert; underlies Tesnus formation.

B. N. Berry and H. M. Nielson, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2254–2259. King's (1937) lower two members of Caballos form one genetic unit and upper three members from another genetic unit; proposed here to revive original terminology of Udden, Baker, and Böse and recognize two distinct formations. Name Caballos is restricted to lower formation which includes lower chert member and lower novaculite member as described by King, and term Santiago chert revived and applied to upper three members.

The U.S. Geological Survey currently designates the age of the Caballos Novaculite as Devonian and Mississippian.

Named for exposures on Horse (Caballos) Mountain, Brewster County.

Cabaniss Formation (in Cherokee Group)

Cabaniss Group

Cabaniss Subgroup (of Cherokee Group)

Pennsylvanian (Des Moines Series): Central and northeastern Oklahoma, southeastern Kansas, and western Missouri.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1524 (fig. 1), 1526. Defined to include all rocks that crop out above Krebs group (new) and below base of Marmaton group. Extends from northeast flank of Arbuckle Mountains northeastward to Kansas-Oklahoma line and comprises (ascending) Thurman sandstone, Stuart shale, and Senora formation. In northern Oklahoma, top of group is base of Fort Scott limestone; between Arkansas River and Arbuckle Mountains base is Calvin limestone. Thickness 1,000 feet in latitude of Cabaniss; thins southwestward and northeastward due to overlap of lower units by higher as well as thinning within units; about 200 feet along Arbuckle Mountains; 350 feet at Arkansas River; 160 feet at Kansas-Oklahoma line. Krebs and Cabaniss groups together are nearly but not quite the same stratigraphically as Cherokee rocks of southeastern Kansas.

W. V. Searight, 1953, *in* W. B. Howe and M. V. Searight, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Geographically extended into Carroll and Livingston Counties, Mo., where it comprises (ascending) Croweburg, Verdigris, Wheeler, Bevier, Lagonda, and Excello formations.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as comprising following formations (ascending):

Weir, Tebo, Scammon, Mineral, Robinson Branch (new), Fleming, Croweburg, Verdigris, Bevier, Lagonda, Mulky, and Excello formations. Overlies Krebs group; underlies Marmaton group. Cygnian substage.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 44–46. Term Cherokee group readopted, and Cabaniss reduced to rank of subgroup. In southeastern Kansas, Cabaniss succession extended from top of Seville limestone in Krebs subgroup to base of Blackjack Creek limestone, which is lower Marmaton. Thickness about 200 feet.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as formation in Cherokee group. Includes Tiawah limestone, Chelsea sandstone, Verdigris limestone, and Breezy Hill limestone together with several coals. Overlies Krebs formation; underlies Fort Scott limestone of Marmaton group.

Named from village of Cabaniss, in T. 6 N., R. 12 E., northwestern Pittsburg County, Okla.

Cabes Point Conglomerate lithofacies (of Louisenhoj Formation)

Upper Cretaceous: Virgin Islands.

T. W. Donnelley, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Intercalated conglomerates containing pebbles and cobbles of Water Island formation (new). Louisenhoj formation considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Cabezon Fanglomerate[1]

Quaternary: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 387–392, map.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 324 (fig. 2), 325 (table 1), 331, pls. 1, 3. Described in San Gorgonio Pass area as a gray to tan ill-sorted conglomerate rich in clasts of pegmatitic and granitic rocks. Maximum thickness about 1,500 feet. Unconformably underlies Heights fanglomerate; unconformably overlies Painted Hill formation, angular unconformity on wall of Stubby Canyon is tentatively regarded as the contact, although it may be a local angular unconformity within the Cabezon section. Type area suggested.

Type area apparently in foothills north of Cabazon, Riverside County. Fanglomerate appears to be continuous from Millard Canyon east to Whitewater and thence northward around flank of range. Post office is now spelled Cabazon, but Vaughan used the Indian spelling Cabezon and this is retained as formational name.

Cabin Shale[1]

Lower Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1066. In Deep Creek Mountains area, name Cabin shale dropped in favor of Pioche, which has priority.

Named for exposures in Cabin Gulch, south of North Pass Canyon, Gold Hill quadrangle.

Cabin Creek Sandstone[1]

[Pennsylvanian]: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Abandoned by Oklahoma Geological Survey. Name used in error by Weidman (1932, Oklahoma Geol. Survey Bull. 56, p. 23) for Little Cabin sandstone. Croneis had used name in 1930 for sursurface sandstone in Arkansas.

Cabin Hill Member (of Rose Hill Formation)

Silurian: Central Pennsylvania.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 28. In lower part of Rose Hill formation. Name credited to Miller (unpub. ms.).

Type locality and derivation of name not stated.

Cable Formation (or lake beds)[1]

Quaternary(?): Southern California.

Original reference: A. C. Lawson, 1906, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 431–462.

Named for town of Cable, Kern County.

Cable Canyon Sandstone Member (of Montoya Dolomite)

Cable Canyon Member (of Second Value Formation)

Cable Canyon Sandstone (in Montoya Group)

Upper Ordovician: Southwestern New Mexico.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2201 (table). On table only. Thickness from fraction of a foot to 50 feet. Underlies Jornada limestone (new); overlies Bat Cave limestone (new). Montoya group.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 57–59, fig. 4. Coarse-grained granulitic sandstone, medium gray on fresh exposure and contains grains of white, gray, pale-rose, smoky, and blue-gray quartz, gray chert, and dolomite. Texture ranges from well-sorted medium-grained sand to unsorted small-pebble and granule conglomerate. Latter texture more characteristic. It is everywhere one single bed, 17 to 35 feet in thickness. Its appearance at a distance is always as a dark band above the light-colored cliffs of Bat Cave formation. Conformably underlies Upham dolomite (new). Type locality and derivation of name given.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 70. Rank reduced to member of Second Value formation.

H. J. Howe, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 10, p. 2287–2296. Disconformably overlies El Paso dolomite and underlies Upham dolomite in Sacramento Mountains. Montoya group.

Type locality: Cable Canyon section from which it takes its name, opposite Sierrite mine in NW¼ sec. 10, T. 16 S., R. 4 W., Caballo Mountains.

Cabo Rojo Agglomerate Member (of San Germán Formation)

Upper Cretaceous: Southwestern Puerto Rico.

R. C. Mitchell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2972. Incidental mention.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 340–341. Agglomerate member of San Germán formation. Thickness about 50 meters. Stratigraphically below Cotui member. Upper Cretaceous. Mitchell (1954) tentatively considered member Upper Jurassic(?) because of erroneous correlation of two different outcrops of Cotui limestone with entire Cretaceous of Puerto Rico.

Type locality: In steep-walled, narrow roadcut at km. 10.1 on Route 4, 3.5 km. south of Cabo Rojo.

Cabo Rojo Stage[1]

Pleistocene: Puerto Rico.

Original reference: B. Hubbard, 1923, New York Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 96.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 318. Term introduced for late Pleistocene deposits of western Puerto Rico.

Lares district.

Cabot Head Shale Member (of Cataract Formation)[1]

Cabot Head Shale (in Cataract Group)

Cabot Head Shale (in Medina Group)

Lower Silurian: Ontario, Canada, and northern Michigan and western New York.

Original reference: A. W. Grabau, 1913, Geol. Soc. America Bull., v. 24, p. 438, 460.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1981 (fig. 2), 1982 (fig. 3), 1990–1991. Discussion of stratigraphy of Medinan group in New York and Ontario. Cabot Head shale, overlies Manitoulin dolomite and underlies Grimsby sandstone. Although name Cataract holds priority, Cabot Head has become firmly entrenched in Canadian literature, and it seems unwise to attempt to replace the name. Unit is about 75 feet at type locality; 60 feet in vicinity of Hamilton; about 50 feet at Stoney Creek. Upper 27 feet of Power Glen formation (Bolton, 1953, Canada Geol. Survey Paper 52–23) at DeCew Falls is interpreted as Cabot Head shale and 8 to 10 feet of Cabot Head shale crops out in Niagara Gorge. This is most eastward exposure of unit, for isochronous Grimsby sandstone beds replace Cabot Head east of Niagara River. In restored stratigraphic cross section (fig. 2) of Medinan group datum is Manitoulin-Cabot Head contact, the line along which dominant transgression changed to dominant regression; hence this contact most closely approaches a true time-line.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 4 (fig. 1), 6. Formation in Cataract group. Cabot Head in Northern Peninsula is recognized almost entirely from well samples. Only two outcrops are known; both occur in eastern Delta County. Thickness 13 to 18 feet near Isabella. Overlies Manitoulin dolomite; underlies Moss Lake formation (new). Alexandrian series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Included in Medina group. Overlies Rumsey Ridge shale herein given formational rank.

Named for exposures at Cabots Head on Manitoulin Islands, Ontario.

Cabotian[1] [Lavas, Red Rock, and Gabbro]

Precambrian: Eastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4, p. xiv-xx, 215, 295–298.

Named for mountain range that appears at Duluth and eastward.

Cabresto Metaquartzite

Precambrian: Central northern New Mexico.

P. F. McKinlay, [1955?], New Mexico Bur. Mines Mineral Resources Bull. 42, p. 8–10, pl. 1. Gray to cream-colored massive quartzite; in places layers of mica gneiss and graphite mica gneiss. Quartzite usually composed of 2- to 10-foot layers of coarsely crystalline glassy to milky quartz. Thickness ranges from 200 to over 1,000 feet.

Named from exposures along Cabresto Canyon, along south edge of Costilla quadrangle, Taos County.

Cacapon Sandstone Member (of Clinton Formation)[1]

Middle Silurian: Western Virginia and northern West Virginia.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Charles Butts, 1940, Virginia Geol. Survey Bull., 52, pt. 1, p. 238, 242, 243, 246. Referred to as Cacapon division of the Clinton. Included in lower part of Iron Gate facies (new). In colloquial use, term Cacapon for the part of the Clinton carrying red or iron sandstone is permissible. Thickness of division about 157 feet.

Named for exposures on slopes of Cacapon Mountain, Winchester quadrangle, Virginia and West Virginia.

†Cacaquabic granite[1]

Precambrian: Minnesota

Original reference: J. M. Clements, 1903, U.S. Geol. Survey Mon. 45.

Exposed on shores and islands of Kekekabic Lake.

Cache Formation[1]

Pliocene or Pleistocene: Northern California.

Original reference: G. F. Becker, 1888. U.S. Geol. Survey Mon. 13, p. 219.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 30–34, pls. 1, 2, 7. Described in Lower Lake quadrangle. Fresh-water deposits of gravel, silt, and clay, except near top of section where tuffaceous sediments, marl, limestone, and diatomite predominate. Thickness 300 to 6,500 feet. In some areas, overlies serpentine and sediments of Knoxville group. Shown on columnar section as underlying Clear Lake volcanic series and unconformably overlying Tejon formation.

Occurs east of Clear Lake, about North Fork of Cache Creek, Lake County.

Cachenian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 991–993, 1006. One of six stages, based on foraminiferal assemblages, in Upper Cretaceous column between top of Moreno and base of Panoche, as defined by Anderson and Pack (1915). Includes interval between Weldonian stage (new) above and Delevanian stage (new) below.

Occurs in the Great Valley in both surface and subsurface. Well developed in surface section of Cache Creek, T. 12 N., R. 4 W., Yolo County.

Cache Valley Formation (in Salt Lake Group)

Cache Valley Group[1]

Miocene and Pliocene: Southeastern Idaho and northeastern Utah.

Original reference: A. C. Peale, 1879, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept. p. 603–606, 634, 635, 640, 641.

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., p. 73, 75 (fig. 2). Formation at top of Salt Lake group. Overlies West Spring formation (new). Thickness 1,000 to 2,000 feet. Middle and upper Pliocene.

R. D. Adamson, C. T. Hardy, and J. S. Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 1, 2, 6–7. Redefined to include West Spring formation. Thickness 7,674 feet. Overlies Collinston conglomerate; underlies Mink Creek conglomerate (new). Miocene and Pliocene.

Well exposed on north side Cache Valley, northeastern Utah and southeastern Idaho, and on Bear River below middle canyon.

Cactus Granite[1]

Cactus Quartz Monzonite

Jurassic or Cretaceous: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub. Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 364–365.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5 (fig. 2), 12–13, pl. 1. Redescribed as Cactus quartz monzonite. Differentiated into three facies (in order of age of emplacement from oldest to youngest): aplite, quartz diorite, and quartz monzonite. Intrudes Baldwin gneiss and truncates the Chicopee formation (new) and Furnace limestone.

Named for Cactus Flat, San Bernardino Mountains, San Bernardino County.

Cactus Point Granite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 14, pl. 1. Commonly light gray on fresh exposures; weathered rock commonly has yellow tint. May be correlative with Big Baldy granite (new).

Crops out in area of about 5 square miles around Cactus Point, a small knob northeast of Ash Mountain Park headquarters, Sequoia National Park.

Caddell Formation (in Jackson Group)

Caddell Clay[1]

Eocene, upper: South-central Texas.

Original reference: E. T. Dumble, 1915, Geol. Soc. America Bull., v. 26, p. 462.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626–2627. Formation at base of Jackson group. Consists of glauconitic very fine sand, silt, and clay; calcareous and ferruginous concretions near base; marine beds locally interbedded with chocolate lignitic clays and sands. Underlies Wellborn sandstone. Type locality designated. Dumble's locality not located with certainty.

Type locality: Cuts along Highway 147 just west of relocated bridge, 4 miles west of site of Caddell, San Augustine County.

Caddo Limestone[1]

Lower Cretaceous (Comanche Series): Southeastern and central southern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Correlation chart shows Caddo limestone above Kiamichi formation and below Bokchito formation.

Named for Caddo, Bryan County.

†Caddo Shale[1]

Lower and Middle Ordovician: Southwestern Arkansas.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557.

Caddo Creek Formation (in Canyon Group)[1]

Caddo Creek Group

Upper Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31, 35.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geol. Pub. 3801, p. 108, 115. Formation consists of Hog Creek shale member, whose type locality is in northern Brown County, and overlying Home Creek limestone of northern Brown County, which has been correlated with limestone also called "Home Creek" occurring at same horizon in Brazos River basin in Palo Pinto County. Although these members are distinguishable in northern Brown County and in area along river, it is not practicable to separate them in much of intermediate area, for the reason that the Home Creek is broken into a number of relatively thin limestone beds interbedded with shale with no obvious dividing line between them. Thickness 69 feet. Overlies Brad formation (redefined); underlies Graham formation of Cisco group (restricted).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to group. Includes Hog Creek shale below and Home Creek limestone. Underlies Graham group; overlies Brad group.

Robert Roth, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 2. Generalized columnar section shows group including Hog Creek shales and sandstone, Home Creek limestone, and lower part of Gonzales shale.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 4. Generalized columnar section shows group including unnamed strata below Ranger limestone up to base of Salem School limestone.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–18, p. 51. Shown on columnar section of Brown and Coleman Counties as Caddo Creek formation. Includes Colony Creek shale member below and Home Creek limestone member above. Thickness about 50 feet. Underlies Graham formation; overlies Brad formation.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 67. As originally defined, formation included Drake's Hog Creek shale below Home Creek limestone member above. Because of miscorrelations in past, name Hog Creek shale should be replaced. As redefined here, formation includes (ascending) Home Creek limestone member and Colony Creek shale member. Thickness about 55 feet along Colorado River; about 75 feet in central Brown County.

Named for tributary of Brazos River in Stephens County, Brazos River region.

Caddo Gap Novaculite[1] (in Arkansas Novaculite)

Devonian(?): Southwestern Arkansas.

Original reference: C. L. Cooper, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 211.

W. H. Hass, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 12, p. 2532. Incidental mention in discussion of age of Arkansas novaculite.

Named for Caddo Gap, Montgomery County.

Caddo Pool Formation (in Kickapoo Creek Group)

Caddo Pool Formation (in Smithwick Group)

Pennsylvanian (Lampasas): North-central Texas (subsurface).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 84 (fig. 5), 86. Proposed for middle formation of Smithwick group. Consists principally of about 200 feet of dense black spicular limestone with some thin sandstones in lower part. Occurs between depths of 3,820 and 3,960 feet in type well. Overlies Eastland Lake formation (new); underlies Parks formation (new).

M. G. Cheney, 1947, Jour. Geology, v. 55, pt. 2, no. 3, p. 209. Stratigraphic section assigned to Kickapoo Creek group (new) includes the Rayville (new), Parks and Caddo Pool formations.

Some reports place the Kickapoo Creek Group in the Strawn Series.

Type well: Anzac Oil Corp. *et al.* E. S. Graham No. 1, in Allen Hines Survey, Abstract 135, central Young County. Discovery well of Caddo Pool of eastern Stephens County was completed in this black limestone which is colloquially known as the "Caddo lime"; hence the name.

Cades Sandstone

Cades Conglomerate (in Chilhowee Group)[1]

Precambrian (Ocoee Series): Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 2.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 960–961. Cades sandstone is adapted from Cades conglomerate of Keith (1895) who mapped the Cades north and south of Cades Cove and widely elsewhere in mountains. Term is here restricted to rocks mainly north and west of the cove and beneath Green-

briar fault. Sandstone lies in a similar position to rocks of Webb Mountain and Big Ridge. Around most of its periphery, the Cades is thrust over adjacent rocks but may lie with sedimentary contact on Metcalf phyllite (new) to south; its strata are inverted over wide areas. Total thickness unknown; as much as 4,000 feet exposed in some sections. Predominantly a coarse-grained feldspathic sandstone, in graded beds as much as 3 feet thick, commonly containing chips of dark fine-grained rock and pebbles of leucogranite but no grains of blue quartz; dark-gray argillaceous and silty rocks form partings between sandstone beds as well as a few units nearly 1,000 feet thick; also contains beds 10 to 50 feet thick of conglomerate characterized by well-rounded cobbles of quartzite, granite, and gneiss.

Named for exposures near Cades Cove, Blount County, Tenn.

Cadillac Granite

Mississippian: Southeastern Maine.

G. H. Chadwick, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 73. Coarse-grained red granite; lighter in color and finer grained at contacts with country rocks.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1796, 1797. Name is synonymous with undefined Cadillac Mountain granite. Younger than Prettymarsh diorite (new) which is post-Lower Devonian in age.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 175, 176–177. Age tentatively considered Mississippian.

Composes central massif of Mount Desert Island, Hancock County.

Cadiz Beds[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1934, Geol. Soc. America, Prelim. list of titles and abstracts of papers to be offered at 47th Ann. Mtg., Rochester, N.Y., Dec. 27–29, 1934, p. 12.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 2, chart 4. Shown on correlation chart between Cuba sandstone below and Hinsdale sandstone above.

Occurs on Genesee-Olean meridian in Genesee River region.

Cadiz Formation[1]

Lower and Middle Cambrian: Southeastern California.

Original reference: J. C. Hazzard and J. F. Mason, 1936, Geol. Soc America Bull., v. 47, no. 2, p. 229–240.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 31, 32, 35. Lyndon limestone geographically extended into California where it consists of member 5E of Cadiz formation (Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4); Chisholm shale also extended into area where it includes member 5F and 5G of the Cadiz (Hazzard, 1937).

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, table 1. Redefined to include all beds between top of Lower Cambrian Chambless limestone and base of Middle Cambrian Bonanza King formation. This redefinition made because, as originally defined, lower limit of formation had been established on faunal basis and not on lithology.

As redefined, formation is mappable lithologic unit in both Marble and Providence Mountains. Thickness about 690 feet.

Type section: Measured in west-east direction up west front of high limestone ridge about 2 miles north of National Old Trails Highway where it crosses Marble Mountains about 3 miles north of Cadiz, San Bernardino County.

Caesar Canyon Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 2), 98 (fig. 3). In central Nevada. Overlies Antelope Valley formation; underlies Gatecliff formation (new).

Toquima Range, Nye County.

Cagle Silt

Pleistocene (Kansan): Southwestern Indiana.

W. J. Wayne, 1958, Jour. Geology, v. 66, no. 1, p. 8, 9 (fig. 1), 10. Proglacial loess; conformably underlies Kansas stage till; overlies Pennsylvanian Mansfield formation. Consists of silt, grayish-brown, mottled locally; calcareous and abundantly fossiliferous, becoming less so in lower 1.0 foot; wood, peat, and humus common at upper contact; lenticular, pinching out toward west. Thickness 3 feet.

Type locality: Emergency spillway Cagles' Mill Reservoir, SE¼NE¼ sec. 13, T. 12 N., R. 5 W., Putnam County.

Cahil Sandstone Member (of Franciscan Formation)

Cahil Sandstone (in Franciscan Group)[1]

Jurassic and Cretaceous: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

U.S. Geological Survey currently classifies the Cahil Sandstone as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures on Cahil Ridge, San Mateo County.

Cahuenga Beds

Cretaceous(?): Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 6 (table 1), 19–20, 21 (fig. 11), pl. 1. Consists of five unnamed units: basal sedimentary breccia, coarse sandy boulder conglomerate, lens of conglomeratic sandstone, sandy pebble conglomerate, and well-bedded conglomeratic sandstone. Thickness about 5,300 feet. Except for boulder conglomerate, beds are confined to Cahuenga Peak fault block; some boulder conglomerate is exposed in southwestern part of Griffith block and in Ferndell block. A thick section of Cahuenga beds is missing at base of Topanga formation, which rests unconformably on the conglomerate in Cahuenga Peak and Ferndell blocks. Overlies Griffith beds (new); contact not exposed. Cahuenga beds are folded into broad anticline in Cahuenga Peak fault block.

Occurs in Griffith Park area, city of Los Angeles. Area is bounded on west by Cahuenga Pass and Dark Canyon. Cahuenga Peak is near western end of Santa Monica Mountains.

Caimito Formation[1]

Oligocene and Miocene: Panamá

Original reference: D. F. MacDonald, 1913, Geol. Soc. America Bull., v. 24, p. 709.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 14, Geol. Sci., p. 234 (chart). As shown on correlation chart, comprises (ascending) Chilibrillo, Caimito, and Alajuela.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div. 3d Locks Proj., pt. 2, chap. 3, p. 18–19, fig. 3–2. MacDonald (1913) considered the Caimito to overlie immediately the Emperador formation. Recent studies have indicated that this is incorrect and that the formation bears closer affinity to the Panamá tuff. These two formations overlap many of the Oligocene beds within the Pacific area of the Canal Zone, locally lying upon the Emperador and thin only because of transgressive overlap. Gradational with overlying Panamá tuff.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 232–236, 246 (fig. 2). Formation name was introduced by MacDonald (1913) but was not properly defined then or later (MacDonald, 1919, U.S. Natl. Mus. Bull. 103). Type region was not specified. Most of MacDonald's brief description of formation is description of strata on Pacific side of Canal Zone now assigned to La Boca formation. MacDonald's statement that the Caimito overlies Emperador limestone—now assigned to member rank in Culebra formation—was based on misidentification of limestone in the La Boca formation and in the Caimito itself. Caimito formation and Emperador limestone member of Culebra are nowhere in contact. On account of these confusing formation assignments, published data on fossils of Caimito and Culebra formations and Emperador limestone member are misleading or erroneous. In Madden basin, formation comprises (ascending) unnamed calcareous sandstone-siltstone, unnamed pyroclastic clay, Chilibrillo limestone, unnamed calcareous sandstone, and Alhajuela sandstone members. In Quebrancha syncline, comprises (ascending) Quebrancha limestone member and calcareous siltstone member. In Gatún Lake area and Caribbean coast, Canal Zone, comprises three unnamed members. Thickness as much as 1,000 feet. Overlies Bohío formation. Formation in Madden basin includes considerable time span—late Oligocene to late early Miocene, or possibly early middle Miocene.

Type region (Woodring and Thompson): Assumed to be region that furnished the name. Caimito, or Caimito Junction, was located on the present alignment of Panamá Railroad and Darién.

Cairo glaciation

Cairo till[1]

Pleistocene (pre-Nebraskan): North America.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 69, no. 2, p. 129. Referred to as glaciation.

Cajalco Quartz Monzonite[1]

Late Mesozoic: Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 502, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. Late Mesozoic. In plutonic series of area, the Cajalco is considered

younger than the La Posta quartz diorite and older than Lakeview quartz monzonite.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 76. Rocks called Cajalco quartz monzonite by Dudley (1935) belong to Woodson Mountain granodiorite, which is considered Cretaceous.

Covers large areas in Riverside County between Monument Peak and Arlington Mountain, including Cajalco Canyon.

Cajon Formation

Age not stated: Southern California.

R. E. Wallace, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 790. Incidental mention.

Mapped area is approximately 20 miles long and 5 miles wide along San Andreas rift between Palmdale and Elizabeth Lake, Los Angeles County.

Calais Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Quarried at Calais, Calais Township, Washington County, in quadrangle adjoining Montpelier quadrangle on east.

Calamity Formation

Pleistocene, upper: Southwestern Texas.

C. C. Albritton, Jr., and Kirk Bryan, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. On basis of disconformities in valley-fill complex, the Quaternary (late Pleistocene) has been divided into (ascending) Neville, Calamity, and Kokernot formations.

C. C. Albritton, Jr., and Kirk Bryan, 1939, Geol. Soc. America Bull., v. 50, no. 9, p. 1434–1441, 1443–1445, 1449–1450, 1453, strat. section. At type locality, consists of silt and sand with interbedded gravel and subordinate amounts of silty, humic clay. A foot of pebble and cobble gravel composed of fragments of Cretaceous limestone and Tertiary volcanic rocks marks base of section. This grades upward into 4 feet of pebbly, clayey silt and sand whose upper half is dark with humus. Upper part of section is essentially a duplication of this sequence with a second, somewhat darker, humic zone at top. Contains artifacts, buried hearths, and human skeletons. Of several cultures represented, one is Pecos River Cave dweller. Thickness at type locality 11½ feet; elsewhere along Sheep Creek and upper segment of Calamity Creek, thickness ranges from 12 to 16 feet; maximum thickness 30 feet along intermediate segment of Calamity Creek. Disconformably overlies Neville formation; disconformably underlies Kokernot formation.

C. B. Hunt, 1952, U.S. Geol. Survey Bull. 996–A, p. 6. Proposed Pleistocene-Recent boundary would be at unconformity between Neville and Calamity formations.

Type locality: Along bank of Sheep Creek, directly south of Terlingua-Alpine road crossing, Brewster County. Well exposed along banks of Sheep Creek, along Calamity Creek from Neville's House to southern end of Elephant Mountain, and along intermediate segment of Calamity Creek.

Calapooya Formation[1]

Eocene, upper, and Oligocene: Southwestern Oregon.

Original reference. F. G. Wells and A. C. Waters, 1934, U.S. Geol. Survey Bull. 850.

V. T. Allen, J. S. Loofbourow, Jr., and R. L. Nichols, 1951, U.S. Geol. Survey Circ. 143, p. 2, 3 (fig. 2). Uncomformably overlies Umpqua formation. Consists of lava flows, tuffs, breccias, mud flows, and water-laid clays, shales, sandstones, and conglomerates. Contains silicified wood, charcoal, and leaves. Thickness several thousand feet. Deposited in continental environment probably during late Eocene time.

U.S. Geological Survey currently considers the Calapooya Formation to be late Eocene and Oligocene in age.

Named for occurrence along crest of Calapooya Mountain.

Calaveras Formation[1]

Calaveras Group[1]

Upper Paleozoic (Permian in places): Northern California.

Original reference: H. W. Turner, 1893, Am. Geologist, v. 11, p. 307–324, 425.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 280–282, 283. Calaveras is name given to pre-Mesozoic bedrock of the Sierra Nevada, south of Taylorsville region. Name is catchall for Paleozoic rocks of Sierra Nevada and, hence, has no stratigraphic significance. In central part of Sierra Nevada, most of the Calaveras lies to east of the Mother Lode, which represents a late Jurrasic thrust fault which brought Calaveras westward over Jurassic rocks. West of Mother Lode country, Calaveras is brought up in the midst of Jurassic along a large compound, often highly faulted, anticline. In places, as along Cosumnes River, there is a single belt of Calaveras flanked by Amador [group], but in other places, as on Calaveras River, there are several narrow belts of Calaveras repeated by faulting. The complex anticline that exposes the Calaveras west of the Mother Lode, plunges southward from Calaveras River. On Stanislaus River, there is only a narrow faulted belt of Calaveras in the midst of the Amador and Mariposa. South of Stanislaus River, the western belt of Calaveras plunges beneath Jurassic rocks and is not again exposed. Amador group is younger than Calaveras and older than Mariposa. Uncomformably underlies Cosumnes formation (new) of Amador group.

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 7–9, pls. 1–4. The wide age span for the so-called catchall Calaveras is a result of the fact that no description exists for a type section of the formation. As a result, many different types of rocks have been mapped as Calaveras by various geologists. Term Calaveras formation is used in this report [Angels Camp and Sonora quadrangles] as it was originally defined by Turner; that is, it includes all rocks that are shown to be Paleozoic in age on basis of paleontologic or geologic evidence. In mapped area, some rocks previously assigned to Calaveras are excluded from that formation because no valid evidence of Paleozoic age has been found. Some of the rocks previously mapped as Calaveras are assigned to Cosumnes formation of Amador group.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 3, p. 177. Underlies Penman formation in Blairsden quadrangle.

Named for prominent development in Calaveras County.

†Calciferous Formation[1]

Lower Ordovician: Northwestern Michigan.

Original reference: A. C. Lane, 1907, Michigan Miner, v. 9, no. 2, p. 9.

Named for Calciferous Creek, a branch of Au Train River, Marquette region.

†Calciferous mica schist[1]

Ordovician and Silurian: Western New Hampshire and Vermont.

Original references: C. H. Hitchcock, 1870, Geol. and Min. New Hampshire 2d Ann. Rept., geol. map; 1873, Am. Assoc. Adv. Sci. Proc., v. 21, p. 134–135; 1877, Geology New Hampshire, pt. 2, p. 658–675; 1896, Jour. Geology, v. 1, p. 44–62; 1896, Geol. Soc. America Bull., v. 7, p. 510–512; 1906, Vermont Geol. Survey 5th Rept., p. 86, 115.

Southwestern New Hampshire.

Calder Creek Member (of Wells Formation)

Pennsylvanian (Springeran-Morrowan): Idaho.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Underlies Heglar Canyon member (new); overlies Milligen formation.

Present in Sublett Mountain area.

Calderwood Formation[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, 1896, Geology Fox Island, Maine, p. 12, 28–29.

Vinalhaven Island, Knox County.

Caldwell sediments

Pleistocene, upper: Southwestern Idaho.

C. N. Savage, 1958, Idaho Bur. Mines and Geology County Rept. 3, p. 20 (table 1), 27, 41, 42, 48, figs. 3, 4. Clay, silt, sand, and fine gravel, chiefly nonconsolidated. Some caliche. Thickness as much as 50 feet. Underlies Recent Snake River eruptives; overlies Nampa sediments (new).

In Boise Valley, generally below 2,500 feet elevation, Ada and Canyon Counties.

Caldwell Canyon Volcanics

Tertiary (post-Oligocene?): Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 85–86, pl. 17. Consists, for most part, of glassy laminated white, red, orange, pink, yellow, gray, and black flows. In lower part of sequence are soft buff flow breccias or lithic tuffs. Upper part consists of very fine grained laminated flows of latite or possibly rhyolite. Maximum thickness of sequence about 300 feet. Uncomformably overlies Wiggins formation (new). Youngest extrusives in region.

Name derived from Caldwell Canyon, just southwest of Wiggins Peak in southern end of Absaroka Range. Caldwell Canyon volcanic rocks of

this area confined to Wiggins Peak and vicinity. Other occurrences may be present north of mapped area.

Caldwell Knob Member (of Rockdale Formation)

Caldwell Knob Member (of Seguin Formation)[1]

Eocene, lower (Wilcox): Southeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 575, 576, 577.

M. W. Beckman and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. Redefined and reallocated to member status in Rockdale formation. As originally defined, Seguin formation straddles Midway-Wilcox boundary; a disconformity occurs within Solomon Creek member, which is here restricted to beds below the disconformity; Caldwell Knob is extended below to include all oyster and sand beds down to the disconformity. Where it is possible to recognize divisions as redefined, Caldwell Knob beds should be regarded as basal member of Rockdale formation. Where divisions cannot be differentiated, it may be necessary to continue use of Seguin formation, recognizing that it contains the break between the Midway and the Wilcox.

Type locality: Caldwell Knob 10 miles north of Bastrop and about 2 miles south of Colorado River in Bastrop County.

Caledonia Conglomerate[1] (in Bohemian Range Group)

Precambrian: Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 576, 580, 588, 593, 612, 957.

Probably named for occurrence near old Caledonia mine, Ontonagon County.

Calef Member (of Eliot Formation)

Probably Ordovician and Silurian: Southeastern New Hampshire.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 453 (fig. 2), 456, pl. 1. Chiefly black phyllite with some green quartz-chlorite phyllite. Maximum thickness 800 feet. Occurs at top of Eliot formation of Silurian(?) age. Underliies Berwick formation.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Probably Ordovician and Silurian.

Exposed in narrow belt in Mount Pawtuckaway quadrangle between villages of Epping, Rockingham County, and Lee, Stafford County. Named from Calef Road.

Calera Limestone Member (of Franciscan Formation)

Calera Limestone Member (of Cahil Sandstone)[1]

Jurassic and Cretaceous: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 5, p. 416 (table).

H. E. Thalman, 1943, (abs.) Geol. Soc. America Bull., v. 45, no. 12, pt. 2, p. 1827. Paleontological evidence indicates Upper Cretaceous age.

U.S. Geological Survey currently classifies the Calera Limestone as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures in sea cliffs at lower end of Calera Valley, San Mateo County.

Calhoun Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), 82, pl. 1. Name applied to coal immediately below Bonpas limestone member (new), Stratigraphically above Trowbridge coal member (new). Thickness 16 inches. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NE¼NE¼ sec. 6, T. 2 N., R. 14 W., Richland County. Name derived from village of Calhoun, 2 miles west of type exposure.

†Calhoun Limestone[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 28.

Name for Calhoun Bluffs, about 3 miles northeast of Topeka, Kans.

Calhoun Limestone

Pennsylvanian: Southeastern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 27 [1943]. Lenticular bed with maximum thickness of about 3 feet which overlies persistent coal in Richland and Lawrence Counties. Light gray, more or less argillaceous, and locally grades laterally into calcareous sandy shale. Provisionally correlated with Omega limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41. Replaced by Bonpas limestone member of Mattoon formation (both new). Name Calhoun restricted to underlying coal.

Named from Calhoun, Richland County.

Calhoun Shale (in Shawnee Group)

Calhoun Shale Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci Trans., v. 15, p. 29.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 22. Formation is 2 to 3 feet thick in Weeping Water Valley; about 10 feet at Kansas line. Overlies Deer Creek formation; underlies Hartford limestone (Wolf River) member of Topeka formation.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Calhoun formation is a succession of shale beds which separates Deer Creek formation from overlying Topeka formation. Jones Point shale, Sheldon limestone, and Iowa Point shale members, previously included in the Calhoun, have been found to lie above rather than below the Hartford ("Wolf River") limestone and are included in Topeka formation. Shawnee group.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 65. Included in Shawnee group. Clayey and sandy shale with minor amount of limestone and one or more coal beds. In northern Kansas a thin coal bed and much sandstone, a part of which fills channels, occur near top of forma-

tion. Dark-gray silty fossiliferous shale comprises lower part, and plant remains occur in sandy part. In southern Kansas, shale diminishes in thickness and is locally absent near Oklahoma line. Maximum thickness about 45 feet, near Kansas River. Overlies Deer Creek formation; underlies Topeka limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17, fig. 5. Dark-gray to bluish-green shale; fossiliferous. Thickness 1½ to about 3 feet. Overlies Ervine Creek limestone member of Deer Creek formation; underlies Hartford limestone member of Topeka formation. Shawnee group.

Named for Calhoun Bluffs, about 3 miles northeast of Topeka, Shawnee County, Kans.

Calico Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Calico Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Calico Formation

Miocene: Southern California.

C. W. Chesterman, 1956, California Div. Mines Bull. 174, p. 85. Pumice deposits northwest of Barstow occur in a thick series of volcanic rocks of Calico (Miocene) formation. The volcanic rocks consist mostly of tuffs and rhyolite flows; strike northwest and dip moderately to the southwest. Thickness about 270 feet (at Williams Brothers quarry). Name credited to T. W. Dibblee, Jr. (unpub. map).

Typical section exposed on steep hillside a few hundred feet east of Williams Brothers pumice quarry, 18 miles northeast of Barstow, San Bernardino County.

Calico phase (of Amargosa chaos)

Post-Miocene(?): Southern California.

L. F. Noble, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1936. Listed as a phase of Amargosa chaos, as assemblage of blocks on overthrust plate of Amargosa thrust.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 965, 968–972, pl. 3. Mosaic of fault blocks composed mostly of rhyolitic lava and tuff; a kaleidoscopic mixture of light and dark—the light shades yellowish white to buff, and dark shades dull pinkish to red; rocks are almost wholly Tertiary in age. Exposed thickness a little more than 1,000 feet. Overlies Virgin Spring phase except at two places where it forms the sole of the thrust. Contact with the Virgin Spring is sinuous and roughly parallel with outcropt of Amargosa thrust; Calico phase is folded with the Virgin Spring just as if the two units were beds in a sedimentary series. Calico and Jubilee phases are not in contact in the area, and their relative position is not known.

Occurs in Virgin Spring area near Death Valley. Name is derived from Calico Peaks in northeastern part of area. Calico phase covers about 10 square miles in area mapped.

Calico Bluff Formation[1]

Upper Mississippian: Central eastern Alaska.

Original reference: A. H. Brooks and E. M. Kindle, 1908, Geol. Soc. America Bull., v. 19, p. 292.

Helmuth Wedow, Jr., 1954, U.S. Geol. Survey Circ. 316, p. 3, pl. 1. Consists of about 1,500 feet of alternating beds of shale and limestone in Eagle-Nation area. Underlies unnamed shale, argillite, slate, and chert unit intermediate between Calico Bluff and Nation River formation.

Exposed at Calico Bluff and other points on Upper Yukon River, also on Porcupine River, Nation River region.

Calico Peak Porphyry[1]

Tertiary: Southwestern Colorado.

Original reference: W. Cross and A. C. Spencer, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, pl. 22, map.

Occurs on north slope and elsewhere in vicinity of Calico Peak, about 4 miles northwest of Rico, Dolores County.

Calico Rock Sandstone Member (of Everton Formation)[1]

Middle Ordovician: Central northern Arkansas.

Original reference: G. C. Branner, 1929, Geologic map of Arkansas: Arkansas Geol. Survey.

U.S. Geological Survey currently designates the age of the Everton Formation and its members as Middle Ordovician.

Named for outcrops in river bluffs east and west of town of Calico Rock, on White River, in western part of Izard County.

Caliente Formation

Caliente Red Beds

Miocene, lower and middle: Southern California.

T. W. Dibblee, Jr., *in* Chester Stock, 1948, Southern California Acad. Sci. Bull., v. 46, pt. 2, p. 84. Coarse gray conglomerate, gray sands, and red clays; continental. Underlie Apache formation (new).

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 35, 36 (fig. 7), 37. Described in connection with gypsum deposits in Ventura County as Caliente red beds.

I. T. Schwade, 1954, California Div. Mines Bull. 170, map sheet 1. Formation noted as occurring on eastern margin of Cuyama Valley where it overlies lower Miocene marine beds [Painted Rock formation] and in southeastern part of the valley in proximity to upper(?) Miocene nonmarine strata.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2978 (fig. 3), 2993–2995. On northeast flank of southeastern Caliente Range, Branch Canyon sandstone (new) and upper part of Painted Rock sandstone member of Vaqueros grade laterally eastward into continental redbeds; these continental beds of middle and lower Miocene are here designated as Caliente formation. At type locality, consists predominantly of claystone, sandstone, and conglomerate, with some basalt flows; thickness about 4,200

feet; lower 1,000 feet grades abruptly westward into Painted Rock sandstone; overlying 1,100 feet grades laterally northwest into Branch Canyon sandstone; underlies Quatal formation with accordant contact. In northern Cuyama Badlands area, about 3,000 feet thick and rests on beds of the Vaqueros or on Simmler redbeds; farther southeast, lies on granitic rocks. In Cuyama Badlands, formation made up of brilliantly varicolored red and green claystone, arkosic sandstone, and incoherent conglomerates of terrestrial deposition; they form the picturesque badland topography. West of Cuyama River, beds apparently grade westward into Branch Canyon and Vaqueros formations, although relationships are obscured by structural complexities; here the redbeds were mapped by English (1916) as Pato red member of Vaqueros formation.

Type locality: Caliente Range, in Midway Peak Southwest and Elkhorn quadrangles.

California Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 52, 61–65.

Forms California phacolith, Lake Bonaparte quadrangle and extends into Antwerp quadrangle. Derivation of name not stated.

Call Sandstone Member (of Panoche Group)

Upper Cretaceous: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2. p. 200, 202–203, 226 (fig. 5), pl. 3. Mainly massive brownish concretionary sandstone and some interbedded siltstones and gray clay-shale. Fairly persistent conglomerate, about 100 feet thick, occurs at base of member on northeast side of Butts Ranch syncline. Thickness 2,600 to 2,900 feet on northeast side of Butts Ranch syncline; 1,200 feet thick on southwest side of syncline. Overlies Paynes shale and sandstone member (new); underlies Butts Ranch shale member (new) on northeast side of syncline; unconformably underlies Big Oak Flat shale and sandstone member (new) on southwest limb of syncline; the unconformity cuts out about 1,200 feet of the Call within a horizontal distance of 1½ miles.

Type locality: Section exposed through Call Mountains on Paynes Creek 2 miles north of Butts Ranch, San Benito County.

Callahan Flow

Recent: Northern California.

M. A. Peacock, 1931, Geog. Review, v. 21, no. 2, p. 269–270. Recent flow in Modoc Lava field.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 370. Discussed as one of three flows grouped under term Modoc basalt. Covers area of about 10 square miles.

Occurs in Modoc Lava field.

Callaway Limestone[1]

Middle Devonian: East-central Missouri.

Original reference: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30, 43.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 30–39. Formation described in Boone County, where it consists

of three limestone facies: Cooper, Callaway, and Ashland. Underlies Bushberg formation of Sulphur Springs group; overlies Jefferson City formation.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 100 (fig. 3). Underlies Turpin sandstone member (new) of Grassy Creek formation.

Named for development in Callaway County.

Calliham Sandstone Member (of Whitsett Formation)

Calliham Sand[1]

Eocene, upper: South-central Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1315.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2633. Termed sandstone member of Whitsett. At type locality, about 22 feet of medium-grained irregularly cross-bedded sandstone is exposed in south bank of river; upper 10 feet shows concretionary induration; about 2 feet from top is fossiliferous lens containing *Corbula*-type pelecypods. Elsewhere sand is coarse grained and conglomeratic; southwest of Fashing, consists of two layers of fossiliferous very fine grained sandstone separated by 10 feet or more of silty clay; in gently sloping area around Fashing, becomes indistinguishable from Dubose member below and Fashing clay member above.

Type locality: About 0.6 mile north-northeast of village of Calliham where old Whitsett-Calliham Road crosses Frio River. Named for village of Calliham, which is near Frio River in McMullen County about 1 mile west of Live Oak County line on Farm Road 63 from Three Rivers to Tilden.

Call Mill Slate[1]

Precambrian(?) or Lower Cambrian: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 225–226.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 138–140. Fine-grained argillaceous dark-purple or nearly black usually fissile slate. Maximum thickness about 100 feet. Underlies Pinnacle graywacke; overlies Tibbit Hill schist.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Geographically extended to northwestern Vermont. Precambrian(?).

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135–1136. If present in Vermont, beds are included in Pinnacle formation.

Best exposed in gorge below Call Mill, Sutton quadrangle, Quebec.

Calloway Limestone

See **Callaway Limestone,** correct spelling.

Calls Fort Shale Member (of Bloomington Formation)

Middle Cambrian: Northwestern Utah.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 649, 651–652, 659–660, 672. Occurs at or near top of formation. High Creek section, Bear River Range, shows unit consists of limestone and shale 180 feet thick; 200 feet in Calls Fort section, Wasatch Range. Name credited to Norman Denson. (unpub. thesis).

Type locality: West side of Wellsville Mountain, near Calls Fort Monument, about 7 miles north of Brigham City, Box Elder County.

Callville Limestone[1]

Upper Mississippian, Pennsylvanian, and Lower Permian: Southeastern Nevada and northwestern Arizona.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th, v. 1, p. 47; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 930. Gray limestone, commonly thin bedded, with interbedded shale in upper part. Thickness about 2,000 feet. Underlies unnamed Permian red beds; overlies Bluepoint limestone. Pennsylvanian and Permian(?).

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 520–523. Restricted to Pennsylvanian limestones below Permian dolomitic beds. Where exposed in boundary area between Nevada and Arizona, contains two members: lower consists of thick-bedded cliff-forming commonly oolitic limestones which terminate by wedging beneath Shivwits Plateau; upper consists of silty, in many places crossbedded limestones that weather into subdued slopes. These limestones grade laterally and intertongue with lower Supai formation of Grand Canyon area. Thickness 277 to 673 feet. Sections show Callville overlies Rogers Spring limestone and Redwall limestone; underlies Pakoon limestone (new) in Grand Wash Cliffs.

Ben Bowyer, E. H. Pampeyan, and C. R. Longwell, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–138. As mapped in Clark County, Nev., includes Pakoon limestone of McNair (1951). Pennsylvanian and Permian.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Virgin Mountains, Nev., overlies Illipah formation.

U.S. Geological Survey currently designates the age of the Callville Limestone as Late Mississippian, Pennsylvanian, and Early Permian on the basis of a study now in progress.

Named for exposures in Callville Mountain, Clark County, Nev.

Caloosahatchee Marl[1] **or Formation**

Pliocene, middle: Southern and northern Florida.

Original reference: W. H. Dall, 1887, Am. Jour. Sci., 3d, v. 34, p. 161–170.

W. C. Mansfield, 1939, Florida Geol. Survey Bull. 18, p. 8, 10 (fig. 2). Overlies Tamiami formation (new). Pliocene.

R. O. Vernon, 1952, *in* A summary of the geology of Florida and a guidebook to the Cenozoic exposures of a portion of the state: Florida Geol. Survey, p. 58, 59. Prior to 1942, Pliocene series in Florida was composed of Citronelle formation, Tamiami limestone, Buckingham marl, Bone Valley gravel, Alachua formation, Charlton formation, and Caloosahtchee marl. Vernon (1942, Florida Geol. Survey Bull. 21) dated part of Citronelle as possibly early Nebraskan and the rest as Pleistocene alluvium. This fieldwork cast some doubt on dating of the "Pliocene" beds in south peninsula. Cooke (1945, Florida Geol. Survey Bull. 29) continued to recognize Alachua formation, Bone Valley formation, Buckingham marl, Caloosahatchee formation, Citronelle formation, and Tamiami as Pliocene. Presence of fresh-water mollusks in top of Caloosahatchee (as presently defined by U.S. Geological Survey) casts doubt on its present age assignment.

Recognition of upper Miocene beds in the peninsula eliminated all Pliocene beds in southern Florida except Caloosahatchee marl and Bone Valley formation. It is hoped that future fieldwork will definitely place these beds into Miocene or Pleistocene, or definitely prove them to be Pliocene in age.

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 187–193; 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 133–135, 139–144. Subdivided to include (ascending) Fort Denaud, Bee Branch, and Ayers Landing members (all new). Unconformably overlies Tamiami formation; unformably underlies Fort Thompson formation (Okaldakoochee member, new). Thickness of exposed deposits commonly less than 10 feet, but base of formation visible in only a few places; test holes show thickness of 50 to 60 feet or more east of La Belle. Pleistocene (Sangamonian). Age determination based on vertebrate fossils.

J. R. DuBar, 1958, Florida Geol. Survey Bull. 40, p. 34–37, 41 (fig. 7), 49–64, 76–82, pls. Marl is exposed almost continuously in banks of Caloosahatchee River between Fort Denaud and Fort Thompson. Thickness commonly less than 10 feet. Base exposed only in few places. Exposed beds divided into (ascending) lower marine marl, *Cyrtopleura costata* zone, oyster biostrome, brackish-water marl, Bee Branch member, and upper shell bed. Unconformably overlies Tamiami formation; unconformably underlies Fort Thompson formation. Pleistocene, primarily on basis of vertebrate fauna and to lesser degree on molluscan fauna and stratigraphic relationships.

Named for exposures on Caloosahatchee River, Lee County, especially between Labelle and Olga.

Caloso Formation

Mississippian (Kinderhook): Northern and central New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 83, 86–87. Limestone unit with maximum thickness of 86 feet. Name credited to Noble (unpub. thesis).

A. K. Armstrong, 1955, New Mexico Bur. Mines Mineral Resources Circ. 39, p. 3, 32. Term Caloso formation, as used in this paper, restricted to lower 28 feet of sandstone, shales, and dense gray limestones which contain a small Kinderhook fauna. Disconformably underlies Kelly formation; unconformably overlies Precambrian gneiss and schist.

Louise Fillman, chm., Lexicon Committee, 1958, Lexicon of pre-Pennsylvanian stratigraphic names of West Texas and southeastern New Mexico: Midland, West Texas Geol. Soc., p. 30. As defined by Noble (unpub. thesis), comprises lower member chiefly of arkose and locally conglomeratic basal sandstone or shale, and shaly limestone beds; middle member of massive or thick-bedded resistant limestone with brown-weathering cherty gray limestone bed at top; and upper member, which thins northward, generally a medium-gray medium-bedded limestone containing many nodules and lenses of white and gray chert, and in certain zones is made up largely of white coquina.

A. K. Armstrong, 1958, New Mexico Bur. Mines Mineral Resources Mem. 5, p. 3, 5–7, 9, 11–12, 14–15. Age discussion and regional correlations.

Type locality: Along Caloso Arroyo in T. 2 N., R. 2 W., Ladron Mountains.

Calumet Amygdaloid[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1907, Lake Superior Min. Inst. Proc., v. 12, p. 89–92.

E. S. Davidson and others, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–54. Included in Portage Lake lava series.

Named for occurrence at Calumet mine, Houghton County.

†Calumet Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1907, Lake Superior Min. Inst. Proc., v. 12, p. 89–92.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 678 (fig. 1). Name used on geologic section of Michigan copper district.

Named for occurrence in Calumet mine, Houghton County.

Calumet Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Calumet Granodiorite

Eocene, lower: Colorado.

C. H. Behre, Jr., E. F. Osborn, and E. H. Rainwater, 1936, Econ. Geology, v. 31, no. 8, p. 786–792. Irregular mass of granodiorite with local differentiates that intrudes Paleozoic rocks in vicinity of Calumet mine. Hand specimens show a gray medium-grained crystalline rock generally equigranular with crystals unoriented but locally trachitoid to gneissic.

Occurs at abandoned iron mine at Calumet, Chaffee County.

Calumet and Hecla Conglomerate[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1895, Michigan Geol. Survey, v. 5, pt. 1, p. 117, footnote.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

Named for occurrence in Calumet & Hecla mine, Houghton County.

Calvert Ash Bed (in Ash Hollow Member of Ogallala Formation)

Calvert Ash Bed (in Valentine Member of Ogallala Formation)

Pliocene: Northwestern Kansas.

J. S. Carey and others, 1952, Kansas Geol. Survey Bull. 96, pt. 1, p. 9–11, 24–27. Name applied to volcanic ash bed. Thickness about 22 feet. Lies in lower half of Ash Hollow member and stratigraphically lower than Reager ash bed (new).

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 251. Reallocated to Valentine member of Ogallala formation.

Name derived from pit of Wyandotte Chemicals Corp., at Calvert, northeastern Norton County.

Calvert Formation[1] (in Chesapeake Group)

Miocene, middle: Eastern Maryland, Delaware, and Virginia.

Original reference: G. B. Shattuck, 1902, Science, new ser., v. 15, p. 906.

Lincoln Dryden and R. M. Overbeck, 1948, Maryland Dept. Geology, Mines and Water Resources [Rept.] Charles County, p. 53–61. Described in Charles County, where it includes Fairhaven diatomaceous earth member and Plum Point marls member. Overlies Nanjemoy formation; underlies Pleistocene deposits.

H. F. Ferguson, 1953, Maryland Dept. Geology, Mines and Water Resources Bull. 11, p. 35. In St. Marys County, formation is silty to sandy diatomaceous clay containing some thin shell beds in upper part. Basal part, Fairhaven diatomaceous earth member, consists of thick bed of yellowish-gray clay containing many diatoms. Thickness (in wells) 110 to 140 feet. Overlain by Pleistocene sediments in northern and western parts of county and by lithologically similar Choptank formation in central and southern parts. Chesapeake group.

Named for exposures in Calvert County, Md., especially in Calvert Cliffs, bordering Chesapeake Bay.

Calvert Bluff Clay Beds (of Rockdale Formation)[1]

Calvert Bluff Formation (in Wilcox group)

Eocene, lower: Central and southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 585, 586, etc.

H. B. Stenzel, 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists Mineralogists, and Soc. Econ. Geologists Joint Mtg. Guidebook, p. 53 (geol. map), 54. Rank raised to formation. Includes Butler clay member (reallocated). Overlies Simsboro formation.

Type locality: Calvert Bluff on Brazos River, Jesse Webb League, Robertson County.

Calvertian Substage

Miocene, middle: Maryland, New Jersey, and Virginia.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 767, 768. Substage based on microfaunal assemblages; includes all sediments deposited in central Atlantic Coastal Plain province during time of accumulation of Calvert formation, type exposure of which is considered exemplary of the substage. In sequence, the Calvertian is followed by Choptankian substage.

†Calvin Sand Series[1]

Pennsylvanian: Central Oklahoma (subsurface and surface).

Original reference: A. I. Levorsen, 1927, Am. Assoc. Petroleum Geologists Bull., v. 1, no. 7, p. 658–682.

Seminole County.

Calvin Sandstone[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Central and southern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas Folio 74.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 26–30. In Okfuskee County, divided into three unnamed members: basal sandstone, thick, middle shale, and upper sandstone. Thickness about 245 feet. Underlies Wetumka shale; overlies Senora formation. Marmaton group.

Type locality: Town of Calvin, Hughes County.

Camargo Formation

Ordovician (Richmond): South-central Tennessee.

C. W. Wilson, 1948, Geol. Soc. America Bull., v. 59, no. 8, p. 742–743. Proposed by M. G. Mehl (1928, unpub. ms.) for channel-filling sediments which he considered to be Silurian. Consists predominantly of greenish-blue to olive or light-brown arenaceous shales and shaly sandstones. Locally basal members consist of considerable thickness of limestone conglomerate and heavy-bedded coarse brown sandstone; lower members are distinctly valley fills. Coarse limestone blocks of talus along valleys of pre-Camargo surface now constitute Camargo conglomerates that are plastered across eroded edges of Fernvale, Leipers, and Catheys; this conglomerate grades laterally toward center of old valleys into coarse sandstones and even shales; succeeding the fills proper is a considerable thickness of light-brown to olive or green arenaceous shale that is widespread; locally this part of formation rests directly on the Fernvale or older rocks, but, in regions where lower fill is present, there is no evident break between the two parts of the formation. Thicknesses vary between 30 feet and something more than 100 feet and are measured from lowest exposure to highest adjacent Fernvale outcrop. Ordovician (Richmond).

Well exposed in Good Hollow and branches, about 2 miles southwest of Camargo, Lincoln County. Also about one-half mile west of Coldwater on Coldwater-Blanche Road.

†Camargo Schist[1]

Precambrian and Lower Cambrian: Southeastern Pennsylvania.

Original reference: A. I. Jonas and E. B. Knopf, 1921, Washington Acad. Sci. Jour., v. 11, p. 447.

Named for village of Camargo, near Quarryville, Lancaster County.

Camas Basalt[1]

Tertiary: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 99, map.

South side of Camas Prairie, Stevens County.

Cambridge Limestone Member (of Conemaugh Formation)[1]

Pennsylvanian: Eastern Ohio, western Pennsylvania, and West Virginia.

Original reference: E. B. Andrews, 1873, Ohio Geol. Survey, v. 1, p. 262.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 116–118. Included in Wilgus cyclothem, Conemaugh series. Occurs above Wilgus coal and underclay member and below Bakerstown shale and sandstone member of Anderson cyclothem. Member has also been called Upper Cambridge limestone and Pine Creek limestone, the latter a name which is still used in Pennsylvania.

Named for exposures near Cambridge, Guernsey County, Ohio.

Cambridge Red Bed (in Conemaugh Formation[1] or Group)

Pennsylvanian: Northwestern West Virginia and southwestern Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 61, pl. 6.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 78, fig. 21. In Fayette County, occurs 230 to 250 feet above top of Upper Freeport coal, which is base of Conemaugh group. Lies below Upper Bakerstown coal and above Woods Run limestone. Thickness as much as 12 feet.

First described near Wheeling, Ohio County, W. Va.

Cambridge Slate[1] (in Boston Bay Group)

Cambridge Argillite

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: N. S. Shaler, 1871, Boston Soc. Nat. History Proc., v. 13, p. 173–175.

M. P. Billings, F. B. Loomis, Jr., and G. W. Stewart, 1939, Geol. Soc. America Bull., v. 50, no. 12, p. 1875, 1876, 1882. Referred to as argillite. Described as gray somewhat arenaceous argillite and slate. Carboniferous. Overlies Roxbury conglomerate, but latter is thrust over Cambridge in northern part of Hingham area.

Best exposed at Cambridge. Other occurrences also in Boston basin area.

Camden Chert[1]

Camden Formation

Lower or Middle Devonian: Western Kentucky and western Tennessee.

Original reference: J. M. Safford and C. Schuchert, 1899, Am. Jour. Sci., 4th, v. 7, p. 429–430.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 310–312. Camden formation consists of two contemporaneous phases of limestone and chert. Thickness 14 to 164 feet. Unconformably overlies Harriman formation; unconformably underlies Pegram formation at exposure near mouth of Standing Rock Creek and at the Whirl of Buffalo River; elsewhere underlies Chattanooga shale or Eutaw sand.

E. M. Luttrell and Ann Livesay, 1952, Kentucky Geol. Survey, ser. 9, Bull. 11, p. 5. Only known exposure of Camden chert in Kentucky is in narrow northeastward trending fault block one-fourth mile long, 0.4 mile south of Little Bear Creek on west side of Kentucky Lake, and 4½ miles above Kentucky Dam, near Aurora.

Named for exposures along Cypress Creek, southeast of Camden, Benton County, Ky.

†Camden series[1]

Upper Cretaceous and Eocene: Arkansas, Louisiana, southeastern Oklahoma, and eastern Texas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. for 1888, v. 2, p. 49–65, 177, 188.

Named for exposures in bluffs at Camden, Ouachita County, Ark.

Camelback Formation

Tertiary(?): South-central Arizona.

D. A. Holm, 1938, Oil possibilities of Arizona: Arizona State Land Dept., p. 32–33. Series of red arkosic conglomerates and sandstones. Consists of three members on Camelback Mountain (ascending): dark-maroon

arkose, lying unconformably on older granite, about 100 feet thick; middle member of lighter color, composed of coarser material, with great angular boulders, about 200 to 300 feet thick; and dark-red arkose, in part conglomeratic, with sand matrix, well-defined bedding and ripple marks, at least 200 feet thick.

Occurs on west end of Camelback Mountain in Phoenix region, Maricopa County.

Camels Hump Group

Lower Cambrian and Cambrian(?): North-central Vermont.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Composed chiefly of schist, quartzite, and gneiss. Intergrades with overlying Ottauquechee formation. Overlies Precambrian interbedded gneiss, quartzite, and greenstone unconformably.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. Described in Hyde Park quadrangle. Belvidere Mountain amphibolite is considered upper formation of group in northern part of quadrangle.

R. A. Christman, 1959, Vermont Geol. Survey Bull. 12, p. 23–37, geol. map. In Mount Mansfield quadrangle, occurs above Tibbet Hill schist and below Ottauquechee formation.

Typical section exposed in gorge of Winooski River west of and downstream from Waterbury. Named for wide occurrence on and near Camels Hump, a peak about 7 miles west of village of Waterbury in adjacent Camels Hump quadrangle. Traced about 30 miles southwestward from exposures in northwest part of Montpelier quadrangle.

Cameo Member (of Price River Formation)

Upper Cretaceous (Montana): Central western Colorado.

R. G. Young 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 188, 191, fig. 2. In Neslen facies. Uppermost coal-bearing rocks of formation; upper limit placed at boundary between coal-bearing rocks of this member and non-coal-bearing rocks of Farrer facies. The massive white-capped medium-grained cliff-forming basal littoral marine sandstone caps Mount Garfield near Palisade, first appearing near Hunter Canyon and continuing south beyond Grand Mesa; grades downward into tongue of Mancos shale, which lies disconformably on coal measures of Cozzette member (new). Above basal sandstone, near Mount Garfield, lies about 250 feet of coal-bearing rocks consisting of sandstone, sandy shale, carbonaceous shale, and coal at base of which is Cameo coal zone (C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851). About 60 feet above base of Cameo coal zone is Carbonera coal zone.

Named for exposures near town of Cameo, Mesa County.

Cameron Beds (of Tolchaco Gravels)

Quaternary: Central northern Arizona.

Parry Reiche, 1937, Am. Jour. Sci., 5th ser., v. 34, no. 200, p. 131–133, pl. 1. Medium member of Tolchaco gravels (new). Dominantly argillaceous. Partial section of upper-middle part of member, three-eights of a mile southeast of Graben Wash, is representative of bulk of beds there and to the northwest. Consists of red clays with occasional fine sand laminae; interbedded red and gray clays and buff loose massive silty very fine sands; and gray and pink bedded clays with silt partings. Individual beds range from 1 to 10 inches in thickness. Ranges in thickness up to as much as 65 feet.

In Cameron district of the Plateau Province. Lies at elevations about 170 feet above Little Colorado River profile.

Cameron Red Shale Member (of Greenbrier Series)[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 142.

Exposed in Cameron County.

Cameron Sandstone Member (of McAlester Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. C. Branson, 1957, Geology Notes, v. 17, no. 11, p. 106. Abandoned by Oklahoma Geological Survey on the basis of the fact that name is preoccupied by Mississippian Cameron red shale in Pennsylvania. No replacement of Oklahoma name has been made.

Named for exposures west and northwest of Cameron, T. 8 N., R. 26 E., LeFlore County.

Cameron Creek Formation (in Big Snowy Group)

Cameron Creek Member (of Tyler Formation)

Mississippian or Pennsylvanian: Central Montana.

H. D. Hadley and P. J. Lewis, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 142. Varicolored shale with occasional thin limestones and irregular white to ferruginous sandstones. Thickness 50 to 300 feet. Overlies Heath shale and underlies Alaska Bench limestone. Name credited to L. S. Gardner.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 233 (fig. 2), 334 (fig. 3), 335, 336 (fig. 4), 339, 343, 347. Included in Big Snowy group. Thickness at type locality herein designated 222 feet. Underlies Alaska Bench limestone; overlies Heath formation. Reasons for using Cameron Creek in preference to Tyler formation presented.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1952–1953. Rank reduced to member status in Tyler formation; overlies unnamed lower member; includes Bear Gulch tongue.

Type locality: Canyon of one of tributaries of south-draining Cameron Creek, a few hundred feet north of Stonehouse Ranch headquarters in sec. 31, T. 11 N., R. 21 E., Golden Valley, Mont., on southeast side of Big Snowy Mountains.

Camillus Shale (in Salina Group)

Camillus Shale Member (of Salina Formation)[1]

Upper Silurian: Western to east-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 18–19, chart.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Formation in Salina group. Occurs above Syracuse salt and below Bertie waterline. Cayugan series.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 7, fig. 1. Discussion of age of Brayman shale. Proposed that name Brayman be applied to undifferentiated strata of Camillus and Bertie age in area

from Vanhornesville, Herkimer County, to Gallupville, Schoharie County. Term Camillus as used herein is restricted to strata lying beneath Fiddlers Green dolomite and above Vernon shale.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Field Conf., p. 7. Upper Silurian Cayugan series (revised) contains two formations, the Salina and Bertie. Salina consists of two facies: Vernon red shales near base and the Camillus gray calcareous shales and dolomites with salt and gypsum beds above.

W. P. Leutze, 1956, Am. Assoc. Petroleum Geolgists Bull., v. 40, no. 7, p. 1694 (fig. 1). Stratigraphic column of middle Salina group in Onondaga County shows Camillus shale, 160 to 190 feet, above Syracuse formation (where recognized in outcrop). Underlies Bertie waterline. Prior to this study, most publications listed fossils from Syracuse formation as coming from Camillus shale.

W. L. Kreidler, 1957, New York State Mus. Bull. 361, p. 5. Formation contains Syracuse salt member at base.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. In Salina group. At top of Canastotan stage (new).

Named for exposures at Camillus, Onondaga County.

Camino Cielo Sandstone Member (of Juncal Formation)

Eocene, middle: Southern California.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1730 (fig. 2), 1733 (fig. 3), 1734 (fig. 4), 1751–1752. Light-gray massive arkosic lenticular sandstone. Thickness at type locality 2,300 feet; 2 miles distant, at western boundary of map area, thickness is 300 feet; and at eastern boundary, 5½ miles distant, thickness is 1,700 feet. Occurs about middle of formation; present only on southside of Santa Ynez fault.

Type section: In roadcuts of Camino Cielo and Romero Canyon Roads, from 2,900 feet N. 21° W. to 1,400 feet S. 47° W. of Romero Saddle Guard Station on crest of Santa Ynez Range, Santa Barbara County. Extends westward parallel with crest of range, past western limit of map area; north and east of type locality is interrupted by Romero Saddle fault and the Franciscan "intrusive" mass, but continues again and extends past eastern limit of map area.

Camp Member (of Denmark Formation)

Middle Ordovician (Trentonian): Northwestern New York.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p 530, 531. Name given to basal member of Denmark formation. At type locality, consists of thick hummocky beds of rubbly weathering blue-gray nodular argillaceous calcilutite and shale with thinner intercalated beds of hard pure calcilutite, calcisiltite, and a few calcarentites. Maximum thickness 12 feet. Underlies Glendale member (new); overlies Shoreham formation.

Type section: Exposures extending for more than 1 mile on banks of Mill Creek, 1 mile east of Sackets Harbor, between New York State Highway 3 and New York Central Railroad bridge. Named for Camp Mills 2 miles east of Sackets Harbor, Jefferson County.

Campagrande Limestone

Campagrande Formation (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 47.

P. B. King, 1953, *in* P. B. King and P. T. Flawn, Texas Univ. Bur. Econ. Geology Pub. 5301, p. 99–100, pls. 1, 3. Referred to as Campagrande limestone. In Van Horn area, made up of several beds of massive ledge-making light-gray limestone, in part sandy or conglomeratic, and of nodular limestone and marl; at base is conglomerate containing chert and limestone fragments largely derived from the Hueco limestone. Thickness in Streeruwitz Hills 100 to 140 feet; in other areas 30 to 60 feet. Underlies Cox sandstone.

Named for Campagrande Draw, in Finlay Mountains, El Paso County.

Campbell Creek (Lower) Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western Mercer and Summers Counties, p. 327.

Campbell Creek Limestone (in Breathitt Formation)

Campbell Creek Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: West Virginia and southeastern Kentucky.

Original reference: I. C. White, 1885, The Virginias, v. 6, p. 7–16.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 42, 60, 79, pl. 6. Slightly fossiliferous limestone 30 to 40 feet thick above Campbell Creek coal. In Kanawha group.

R. E. Hauser, 1953, Kentucky Geol. Survey, ser. 9, Bull. 13, p. 11 (fig. 2), 14–16. Zone of doorknob-shaped dense blue limestone concretions; individual concretions average 18 inches in thickness and 4½ feet in diameter. Zone occupies position near middle of a 35-foot brown shaly siltstone which locally contains lenses of sandstone. Occurs about 20 feet below Campbell Creek coal and 35 to 40 feet above Howard coal. Occurs in Paintsville quadrangle.

Named for exposures along Campbell Creek, Kanawha County, W. Va.

Campbell Mountain Rhyolite[1] (in Alboroto Group)

Miocene: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 93 (table 18). Alboroto rhyolite described in San Juan district. Lower part consists of tridymite rhyolite which includes Campbell Mountain and Willow Creek rhyolites and probably Outlet Tunnel quartz latite [all included in Alboroto group] of Creede district.

Named for Campbell Mountain, Creede district.

Campbells Ledge Black Slate (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 37–42.

At Campbell's Ledge, near Coxton, Lackawanna County.

Camp Branch Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Northern central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175.

Named for exposures along south bluff of Camp Branch, Birmingham district.

Camp Colorado Limestone Member (of Pueblo Formation)[1]

Camp Colorado Formation (in Pueblo Group)

Permian: Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 418.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Pueblo here given group status. Overlies Stockwether formation; underlies "Dothan" formation of Moran group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as limestone member of Pueblo formation. Consists of irregularly bedded fine- to medium-grained gray limestone, which commonly weathers brownish, and intervening thin beds of shale; at type locality and farther south, basal beds consist of fossiliferous shale interbedded with earthy discontinuous limestone layers; dark-blue to nearly black chert occurs commonly as nodules in upper limestone beds. Thickness 5 to 25 feet. Overlies Salt Creek Bend shale member; underlies Watts Creek shale member of Moran formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 269–270, pl. 11. Extended into Brazos River valley. Thickness 10 to 25 feet. Overlies Salt Creek Bend shale member; top of member not easily distinguished from overlying Watts Creek shale member of Moran formation.

Named for Camp Colorado, northeast of Coleman, Coleman County.

Camp Creek Group[1]

Camp Creek Series

Precambrian (Belt Series): Central western Montana.

C. D. Walcott, 1906, Geol. Soc. America Bull., v. 17, p. 3–6, 18 (table). Upper subdivision of Algonkian in Camp Creek, Mission Range section. Series consists of (descending) gray sandstones, 1,762 feet; reddish sandstones, 1,560 feet; greenish sandstones and shales and reddish sandstones 4,491 feet; gray sandstone, 700 feet; siliceous limestone, 198 feet; gray and reddish sandstones, 975 feet; and interbedded gray and reddish sandstones, 2,041 feet. Overlies Blackfoot series (new).

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 27 (chart). Thickness over 5,000 feet in Phillipsburg district.

As group in Belt series: See Idaho correlation chart complied by M. G. Wilwarth, 1932.

Described from Mission Range.

Camp Creek Shale Member (of Pueblo Formation)[1]

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 387, 416.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Consists of red and gray shale, a little sandstone and several thin beds of gray limestones; species of *Schwagerina* occur in zones from base to top. Average thickness about 80 feet. Lowermost subdivision is

shale which attains thickness of 8 to 12 feet in McCulloch County, but thins to 1 or 2 feet north of Colorado River, so as to bring overlying limestone beds of Camp Creek shale member close to Saddle Creek limestone; these limestone beds of the Camp Creek have been included with the Saddle Creek in eastern Coleman County and northward. Underlies Stockwether member. *Artinskia lilianae* Miller and Unklesbay, collected in northwestern McCulloch County, 20 feet above base of member, represents stratigraphically lowest known occurrences of this genus in North America. *Artinskia* is judged to indicate post-Pennsylvanian age of beds in which it occurs.

Named for Camp Creek, Coleman County.

Camp Davis Formation

Camp Davis Conglomerate

Pliocene, lower: Western Wyoming and southeastern Idaho.

A. J. Eardley and others, 1944, Hoback—Gros Ventre-Teton Field Conf., [geologic map]. Privately printed. Consists of conglomerates, fanglomerates, rhyolitic and andesitic flows, breccia and tuffs, and fresh-water limestone. Overlies Pass Peak conglomerate (new). Uppermost Miocene or lowermost Pliocene.

J. C. Bayless, 1950, Michigan Acad. Sci., Arts, and Letters, Papers, v. 34, p. 211 (fig. 1), 212 (table 1), 213–215. Formation geographically extended into Snake River Plains, Idaho. Includes several thousand feet of calcareous conglomerates, fanglomerates, sandstones, and fresh-water limestones. Near Alpine, contains beds of tuff, and in Calamity Point area is cut by two andesite sills 1,200 and 300 to 1,000 feet thick. Unconformably overlies Paleozoic and Mesozoic formations. At north end of Caribou Range, interbedded with or overlain by rhyolitic flows. Term Camp Davis replaces name Salt Lake formation as previously used in area. Conglomerates of map area probably correlate in age with Payette formation, and this name for the formation has priority over name Camp Davis. However, the conglomerates are lithologically similar to Camp Davis formation of western Wyoming, and name Camp Davis is herein retained. Miocene and Pliocene(?).

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 75–76, pls. In lower Hoback Valley, formation consists of (ascending) gray conglomerate which forms bold escarpments much of way from mouth of Camp Creek north to beyond Game Creek in southern Jackson Hole; interval of poorly indurated tuffaceous sand; white-weathering fresh-water limestone about 50 feet thick; upper red conglomerate at least 2,000 feet thick, best displayed on north side of lower Horse Creek about 1½ miles above Snake River. Thickness several thousand feet. Term has been extended to similar conglomerates and associated tuffs in Star, Grand, and Swan Valleys, Idaho. Late Miocene or early Pliocene. Type exposure noted.

J. D. Love, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 89–90. At type section, only basal 450 feet of several thousand is adequately exposed. In Horse Creek section, formation is more than 5,600 feet thick. Formation rests with slight angular unconformity on Lower Cretaceous rocks. Two thrust sheets composed of Triassic, Jurassic, and Cretaceous rocks involve conglomerate of Camp Davis formation. Lower thrust sheet attains maximum development between forks of Horse Creek and thins northward, wedging out in cliff face on north

side of Horse Creek. Both bottom and top contacts are exposed. Upper thrust sheet thickens northward and cuts across upper half of formation. Hoback normal fault, part of which is of Pleistocene or Recent age, has downdropped the Camp Davis between 6,000 and 10,000 feet, thereby giving the rocks a strong northeast dip. Believed to be early Pliocene; age assignment based partly on fossils and partly on structural relations.

Type section (Love, 1956): Along east side of U.S. Highway 187 in sec. 29, T. 39 N., R. 115 W., Teton County. Named after Camp Davis, University of Michigan camp along Hoback River.

Camp Ground Member (of Deese Group)

Pennsylvanian (Desmoinesian): Central southern Oklahoma.

C. L. Ramay, 1957, (abs.) Ardmore Geol. Soc. Criner Hills Field Conf., p. 45. Membor mentioned in discussion of Desmoinesian stratigraphy in Pleasant Hill syncline of Criner Hills.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc. Petroleum Geology of southern Oklahoma a symposium, v. 2, Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 33. Named credited to I. C. Hicks (oral commun., 1953), who applied it primarily to uppermost of major ridge-making sandstones of Deese group in Lake Murray State Park below Williams member—about 500 feet below that member and 1,600 feet or more above Rocky Point conglomerate. Fusulinid limestone a few inches thick present locally near base. Type locality stated.

Type locality: On east line NE¼SE¼ sec. 20, T. 5 S., R. 2 E., at east end of principal tent camp in park, Murray County.

Campito Formation

Campito Sandstone[1]

Precambrian(?) and Lower Cambrian: Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. R. Longwell, 1950, Geol. Soc. America Bull., v. 61, no. 5, pl. 1. Overlies Deep Spring formation; underlies Silver Peak group.

U.S. Geological Survey currently designates the age of the Campito Formation as Precambrian(?) and Lower Cambrian on the basis of a study now in progress.

Named for prominent exposures on Campito Mountain, Inyo Range.

Campitoan series

Precambrian (Protozoic): Eastern California.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 307 (chart). Series, consisting of 3,600 feet of sandstones. Unconformable below Barrelian series and above Deepian series.

Occurs in Death Valley region.

Camp Jenkins Schist or Formation

Lower Devonian: Central Connecticut.

G. P. Eaton and J. L. Rosenfeld, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 2, p. 170 (fig. 1), 181 (table 1). Lead gray staurolite-garnet, biotit-muscovite schist with thin interbedded "sugary" micaceous quartzites. Overlies Mine Brook formation (new). Previous workers with the exception of Percival (1842, Report on the Geology of the State of Connecticut: New Haven), grouped the sequence of rocks from Collins Hill schist through Camp Jenkins schist as a single formation, and

believed it to be intruded by Glastonbury, Maromas, and Haddom gneisses. Present work shows that these rocks represent four distinct formations, with unconformity separating Collins Hill from the others.

Camp Jenkins [now Ranger Headquarters of Meshomasic State Forest] is in Middle Haddam quadrangle, Middlesex County.

Camp Nelson Limestone[1] (in High Bridge Group)

Camp Nelson Member (of High Bridge Limestone)

Middle Ordovician: Central Kentucky.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 9, 12.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 12; D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 40–41. Lowermost formation in High Bridge (Highbridge) group. Underlies Oregon limestone. Essentially a lithographic type limestone, but contains recognizable masses of magnesian limestone. Thickness about 300 feet.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Referred to as member of High Bridge limestone.

Named for Camp Nelson, Jessamine County.

†Campobello Group[1]

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1886, Am. Jour. Sci., 3d. v. 32, p. 47–60.

Named for development on Campobello Island, off southwest coast of New Brunswick, adjacent to southeastern part of Washington County.

Camp Springs Conglomerate[1]

Triassic: Northwestern Texas.

Original reference: D. D. Christner, 1926, Texas Univ. Bull. 2607, p. 16–17.

Well exposed at Camp Springs, near center of east line of Scurry County.

Camp Supply Beds[1]

Lower Cretaceous: Western Oklahoma.

Original reference: R. T. Hill, 1895, Am. Jour. Sci., 3d, v. 50, p. 227.

Near Camp Supply, G (now Custer) County.

Campus Formation[1]

Pleistocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 398, map.

Named because of its occurrence within limits of University Campus, Berkeley [on a hill behind the area now covered with buildings].

Camp Williams unit (in Salt Lake Group)

Post-early Oligocene and pre-late Pliocene: North-central Utah.

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23, 24 (fig. 6), 26–27. Salt Lake group, in Lower Jordan Valley, is divided into (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and Travertine unit. Camp Williams is mostly mudstones and siltstones that are poorly consolidated and lesser amounts of impure sandstone; basal conglomerate, primarily of igneous detritus,

also present. Characteristically red to tan. Thickness at least 100 feet; not completely exposed in most places.

Name derived from Camp Williams military reservation. Areal extent limited and confined to Jordan Narrows and immediate vicinity. Lower Jordan Valley defined as that part of Jordan Valley northward from Traverse Mountains to Great Salt Lake. Travertine unit, as much as 20 feet thick in places; overlies both Camp Williams and Jordan Narrows units.

Camulos formation[1]

Pliocene, middle or upper: Southern California.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 43, p. 316.

Named for railway hamlet of Camulos, a few miles directly west of Saugus Junction, Santa Clara Valley, Los Angeles and Ventura Counties.

†Canaan Formation[1]

Mississippian: West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Named for exposures in Canaan Mountain, Tucker and Grant Counties, W. Va.

†Canaan Limestone or Dolomite[1]

Cambrian and Ordovician: Connecticut.

Original references: J. D. Dana, 1872, Am. Jour. Sci., 3d, v. 4, p. 370; 1874, Am. Assoc. Adv. Sci. Proc; W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Canaan Mountain Fire Clay[1]

Pennsylvanian: Northeastern West Virginia.

Original reference: D. B. Reger, 1923, West Virginia Geol. Survey Rept. Tucker County, p. 190, 191, 444.

Top of Canaan Mountain, Tucker County.

Canaan Mountain Schist

Pre-Triassic: Northwestern Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as predominantly schist; composed of quartz, oligoclase or andesine, biotite, garnet and sillimanite.

Named for Canaan Mountain in town of Canaan, Litchfield County.

Canada Hill Granite[1]

Canada Hill granite phase (of Hudson Highlands Complex)

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1919, New York State Mus. Bulls. 225–226, maps and passim.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 143–144. In place of Canada Hill, Reservoir, and Mahopac granites described by Berkey and Rice (1919), term Canada Hill granite phase of Hudson Highlands complex is used to include all rocks representative of granitic igneous activity in Hudson Highlands after Pochuck diorite phase and earlier than Storm King granite intrusion. Such generalization is

necessary because of difficulty of distinguishing the three similar granite types in the field. Typical representative of Canada Hill phase is medium-gray medium-grained biotite granite.

Type locality: Kings quarry, south of Garrison, Canada Hill, Putnam County, is in midst of granite area.

Canadaway Formation (in Arkwright Group or Chautauqua Group)

Canadaway Group[1]

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1933, Geol. Soc. America, Preliminary list of titles and abstracts of papers to be offered at 46th annual meeting, Chicago, Ill., Dec. 28–30, p. 19, 82, 83, 84.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1748–1749, chart 4. Chadwick suggests limiting Canadaway group to Dunkirk and Gowanda formations and introducing a new group name for the beds—Laona, Westfield, Shumla, and Northeast—between the Canadaway and Conneaut.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, p. 2317–2318. Discussion of stratigraphy of Cherry Creek quadrangle, New York. Canadaway group is reduced to formational status in Chautauqua group. Formation comprises (ascending) Dunkirk, South Wales, Forestville (new name to replace Gowanda), Laona, Westfield, Shumla, and Northeast members. Underlies Chadakoin formation.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 31–32. Basal formation in Arkwright group (new). Underlies Chadakoin formation. Average thickness about 1,050 feet in Chautauqua County. Chautauquan series.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 9, 10 (fig. 1). Formation, at type locality, consists of strata which lie between base of Dunkirk shale and base of Dexterville member of Chadakoin formation. Here the Canadaway consists of about 1,000 feet of strata, the lower part of which contains interbedded black and gray shale with limy concretions while upper part is composed of interbedded gray shale and siltstone. In Chautauqua County, contact between Canadaway and Chadakoin is marked by first appearance of brachiopod *Pugnoides duplicatus* in basal Dexterville. As this form does not continue eastward into Cattaraugus County, the Canadaway-Chadakoin contact is placed there at the last appearance of *Tylothyris mesacostalis* which occurs in "Machias" and Cuba members of Canadaway but which does not continue into younger Chadakoin. In type area, comprises (ascending) Dunkirk, South Wales, Gowanda, Laona, Westfield, Shumla, and Northeast members. Overlies Chemung. Perrysburg formation of Pepper and de Witt (1951) is not used in this paper because upper boundary of unit is indeterminable east of Perrysburg.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 15–18. Group, in Wellsville area, comprises (ascending) Dunkirk shale, South Wales shale, Canaserage sandstone, Hume shale, Caneadea shale, Rushford sandstone, "Machias" shale, and Cuba sandstone. Underlies Chadakoin group. Chautauquan series. Term Perrysburg not used because the Laona or its correlate has not been traced into Wellsville region.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation, as mapped in western

Pennsylvania, includes "Portage" formation of northwestern Pennsylvania.

Type section: Along Canadaway Creek, near Dunkirk, Chautauqua County, N.Y.

†Canadian Series[1]

†Canadian Period[1] or System[1]

Lower Ordovician: North America.

Original references (Period or System): J. D. Dana, 1874, Am. Jour. Sci., 3d, v. 8, p. 214; 1875, Manual of geology, 2d ed., p. 142, 163, 182; E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 647–679, pl. 27.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 1–321. Canadian [system] zoned for brachiopods. Canadian consists of lower, middle, and upper divisions. The Canadian follows the Ozarkian and precedes the Ordovician.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2. As shown on correlation chart, the Canadian is lowermost series of Ordovician system. It is succeeded by Champlainian series. Stages have not yet been established in the Canadian. Generalized standard section includes (ascending) Gasconade, Roubidoux, Jefferson City, Cotter-Smithville, and Black Rock formations.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 17–18. Believed that recognition of Canadian as distinct system would simplify problem of early Paleozoic stratigraphy. The Canadian would be a four part system, and this would leave remainder of Ordovician to be resolved in terms of Chazyan, Mohawkian, and Cincinnatian. Ordovician as thus restricted would begin with Cooper's Whiterock stage. Tentative classification of units in Canadian suggested: Gasconadian, Demingian, Jeffersonian, and Cassinian. Classification based principally on cephalopod distribution.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–32. Canadian series includes Gasconadian, Demingian, Jeffersonian, and Cassinian stages.

Named from development in Canada.

Canajoharie Shale[1] (in Trenton Group)

Middle Ordovician: Eastern New York.

Original reference: J. M. Clarke, 1911, New York State Mus. Bull. 149, p. 10–12.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 267 (fig. 11), 268–271. Formation comprises the older shales of Mohawk Valley; these overlie the lowest Sherman Fall Shoreham limestone, are of about Denmark (Sherman Fall) age, and are overlain by similar shales of Utica formations. At type section, formation includes Minaville member (new) and Fairfield member. Overlies Glens Falls formation. The Canajoharie thickens eastward, and it is believed that the Snake Hill represents an eastern more sandy facies of the Canajoharie and consists of the initial deposits of clastic rocks resulting from Vermontian (middle Trenton) orogeny; upper part of Schenectady formation contains characteristic upper Canajoharie (Fairfield) graptolites. Southward and eastward from upper West Canada Creek valley, the Den-

mark member (new) of Sherman Fall formation passes through the Dolgeville interbedded facies into the Canajoharie shale.

Named for outcrop at Canajoharie, Montgomery County.

Canal Limestone[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: C. A. Ashburner, 1886, Pennsylvania 2d Geol. Survey Ann. Rept 1885, p. 445.

Crops out on southeastern band of the canal, 800 feet southwest of mouth of Mill Creek, Luzerne County.

†Canandaigua Shale[1]

Middle Devonian: Central and western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 22 [p. 67, 1912 ed.].

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 364, 369. Incidental mention in discussion of Ledyard and Tichenor members of Ludlowville formation.

Canary Ironstone

Pennsylvanian (Allegheny Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 58. Typically calcareous concretionary ironstone. Included in Clarion cyclothem and lies below Clarion underclay member and above Clarion shale and (or) sandstone member.

Present in Athens County.

Canas Gypsum Member (of Yeso Formation)

Permian: Central New Mexico.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1660. Commonly pure white gypsum; locally, thin silt partings and thin limestone beds. Thickness 96 feet at Lomo des las Canas, 52 feet in Yeso type section, 80 feet in southern Chupadera Mesa, and 115 feet at Bent, Otero County. Disappears a short distance north of Yeso type section. Occurs above middle evaporite unit of Yeso; underlies Joyita sandstone member (new).

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. Overlies Torres member (new).

Name taken from the Loma de las Canas, a range of hills 9 miles due east of Socorro, Otero County.

Cañas Arriba Formation

Oligocene, lower: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 54. Name adopted to replace Río Descalabrados series (Hodge, 1920) for the following reasons: Hodge's term referred to Eocene, not Oligocene; name not well chosen as no outcrops occur along river in question; and strata are distinctive enough from those of Rio Jueyes and Coamo Springs to merit separate name. Estimated thickness 2,000 feet. Locally underlies Juana Díaz formation; near town of Juana Díaz, lower Oligocene is in contact with middle Oligocene Juana Díaz formation; towards southwest, the Cañas Arriba is overlain by Quaternary deposits.

Named for occurrence in Barrio Cañas Arriba, north of Cuarto Calles Coamo-Guayama district.

Canaseraga Sandstone[1] Member (of Perrysburg Formation)

Canaseraga Member (of Canadaway Formation)

Canaseraga Sandstone (in Canadaway Group)

Upper Devonian: West-central New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

W. H. Bradley, J. F. Pepper, and G. B. Richardson, 1938, U.S. Geol. Survey Bull. 899–A, p. 17, pl. 3. Unit termed Dunkirk sandstone in this report was named Canaseraga by Chadwick. Later he found the Canaseraga to be a sandy phase of the Dunkirk. He now recommends dropping term Canaseraga; this recommendation is herein followed.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Revived and redefined as sandstone member of Perrysburg formation (new). These siltstones and sandstones are a definite unit around Canaseraga in central part of State and are not represented in rock sequence in vicinity of Dunkirk in western New York. At type exposure, member consists mainly of thin-bedded to massively bedded siltstones and some interbedded silty gray shale containing a few thin layers of black shale near base; top not exposed. Toward the west in Genesee River valley, upper siltstone of Canaseraga thins and grades laterally into black, dark-gray, and blackish-gray shale of Hume member (new). East of Dalton, upper part of member becomes more massive as siltstone increases in thickness and interbedded shale decreases. In Bath and Woodhull quadrangles, underlies Canisteo member (new); underlies and interfingers with South Wales member (new) to west. Thickness 163 to about 308 feet.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 12. Member of Canadaway. Overlies South Wales member; underlies Hume member.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 18. Formation in Canadaway group.

Type exposure: On Slader Creek, south of Canaseraga, Allegany County.

Canastotan Stage

Upper Silurian (Cayugan): North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Cayugan series is divided into Canastota(n) and Murder(ian) stages. Canastota stage contains all of Salina group from base of Vernon shale to top of Camillus—Lower Cayugan of previous usage. About 850 feet of Canastotan rocks present in type area.

Type area: Sullivan, Lincoln, Oneida, and Vernon Townships near Canastota. Chittenango and Oneida quadrangles, New York.

Cañazas Formation[1]

Miocene(?): Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 247.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 328–329.

Occurs near Cañazas, Veraguas Province.

Canby Latite[1]

Oligocene(?) or Miocene(?): Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

Named for prominence in Canby Mountain, Silverton quadrangle.

Candelaria Formation[1]

Lower Triassic: Southwestern Nevada.

Original reference: S. W. Miller and H. G. Ferguson, 1936, Geol. Soc. America Bull., v. 47, p. 241–252.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of the Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Described in Coaldale quadrangle where it consists largely of dark tuffaceous sandstone with thin conglomerate lenses and some shale; locally as much as 2 feet of basal conglomerate with fragments from Palmetto formation. Unconformable above Diablo formation (new); not in contact with Middle Triassic(?) Excelsior formation, and it is presumed that the two are present on different plates of major thrust. Thickness 3,225 feet at type locality.

Type locality: About 2 miles southeast of Candelaria, Mineral County.

Candler Formation (in Evington Group)

Candler Phyllite and Schist

Paleozoic(?): South-central Virginia.

W. R. Brown, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1547. Incidental mention of phyllite and schist.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 93. Formation described as lustrous gray-green phyllite and fine- to coarse-grained schists. Some quartzites and greenstone volcanics(?). Garnet- staurolite- and chloritoid-bearing facies widespread in eastern areas. Thickness 1,500 to about 4,000 feet. Underlies Joshua schist (new); both in Evington group (new) of Paleozoic(?) age. Overlies Catoctin greenstone. Type locality designated.

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 14–16, pl. 1. Thin lenses of white quartzite and white marble and lenses of blue marble locally interbedded with phyllite.

W. R. Brown and H. C. Sunderman, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1356. Includes Esmont slate facies (new).

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 31–33, 48, pl. 1. Age shown on columnar section as Lower Paleozoic(?).

Type locality: Candler Mountain 2 miles south of Lynchburg, Campbell County, Lynchburg quadrangle.

Caneadea Member (of Perrysburg Formation)

Caneadea Member (of Canadaway Formation)

Caneadea Shale[1] (in Canadaway Group)

Upper Devonian: Southwestern New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 3, p. 200.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Rank reduced to member status in Perrysburg forma-

tion (new). Restricted to all rocks between top of Hume shale member (new) and base of Luther's Rushford sandstone which is exposed in Caneadea Gorge 3.3 miles east of Rushford. Lower part of member consists of gray siltstone ranging in thickness from 1 to 20 inches, which is interbedded with gray silty shale. Middle part is largely shale containing some siltstone. Upper part, which is exposed along Caneadea Creek below Rushford Dam, is shale containing many thin beds of siltstone. No complete exposure present. Estimated thickness 280 feet. Figure 4 shows that Caneadea, Canisteo (new), and Gowanda members, although closely related in time of deposition, are not strictly correlative throughout.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 12. Member of Canadaway formation. Overlies Hume member; underlies Rushford member.

L. V. Rickard, 1957, New York State Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 18. Formation in Canadaway group. Overlies Hume shale; underlies Rushford sandstone.

Well exposed in Caneadea Gorge, west of town of Caneadea in Angelica quadrangle, Allegany County. This is same locality as that given by Chadwick "on Caneadea Creek, just below the power dam."

Canebrake Conglomerate

Pliocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22 (fig. 1), 23, pl. 2. Defined as the coarse marginal conglomerate facies of Palm Spring and Imperial formations. Thickness at type section about 7,000 feet. Most westerly exposures are fanglomerate that laps onto and against crystalline "basement" rocks. Southeastward along strike, lower 4,000 feet of conglomerate grades into Imperial and Palm Spring formations; upper 3,700 feet persists basinward into Carrizo Valley as a gray pebble and cobble conglomerate that rests on Palm Springs formation; this conglomerate thins to about 2,500 feet on south side of Coyote Mountains. In Indio Hills, Canebrake is difficult to distinguish from overlying Ocotillo conglomerate (new). In Mecca Hills, overlaps onto Orocopia schist; southeast of Box Canyon, overlies Dos Palmas rhyolite (new); southward from Salton Sea, Truckhaven rhyolite (new) wedges into the Canebrake.

Type section: At southeastern base of Vallecito Mountain, 3 miles west of Fish Creek Wash, Imperial County. Name derived from Canebrake Wash.

Cane Creek Formation

Middle Ordovician (Mohawkian): Southwestern Virginia and northeastern Tennessee

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 51, chart 1 (facing p. 130). Mostly thin-bedded gray to dove limestone weathering to light gray; limestone layers often separated by thin shale partings. Sequence contains several bentonites; two thick ones near top. Greenish mudstone bed 30 feet thick near base. Total thickness 150 feet. Overlies Hardy Creek formation. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along L. and N. Railroad east of Cane Creek and approximately one-half mile west along railroad from Ben Hur Station, Ben Hur quadrangle, Lee County, Va.

Cane Hill Member (of Hale Formation)

Pennsylvanian (Morrow Series): Northwestern Arkansas and northeastern Oklahoma.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1938–1939, 1948 (fig. 2). Name applied to lower member of Hale formation. Composed of silt, silty sandstone, and fine-grained sandstone; locally calcareous. Bedding is generally shaly or thin and sheety, or consists of shaly siltstone alternating with thin hard beds of sandstone. Thickness ranges from thin edge to 65 feet. Unconformably underlies Prairie Grove member (new); overlies Pitkin limestone or, where the Pitkin has been removed by erosion, the Fayetteville shale.

Typically exposed in southern part of Washington County, Ark., in vicinity of Cane Hill. Well exposed beside Arkansas State Highway 59 for 3 miles along the road south of Evansville in SE¼ sec. 35, T. 13 N., R. 33 W. Extends westward a short distance into Oklahoma.

Canelo Redbeds

Cretaceous(?): Southeastern Arizona.

J. H. Feth, 1948, Am. Assoc. Petroleum Geologists Bull. v. 32, no. 1, p. 83, figs. 1, 2. Post-Permian, probably Cretaceous, sandstones, shales, conglomerates, quartzites, and thin-bedded limestones. Thickness of 1,360 feet in northern Canelo Hills. Underlie unnamed fanglomerate of Tertiary(?) age; overlie unnamed sandstones and conglomerates of Cretaceous(?) age.

Named for their characteristic occurrence in canyons of the northern Canelo Hills, approximately 25 miles northeast of Nogales and 60 miles by road southeast of Tucson.

Cane River Formation (in Claiborne Group)[1]

Eocene, middle: Western Louisiana, southern Arkansas, and eastern Texas.

Original reference: W. C. Spooner, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 1, p. 7; no. 3, p. 220, 224, 227, 235–236.

D. B. Tait, R. C. Baker, and G. A. Billingsley, 1953, U.S. Geol. Survey Circ. 241, p. 7. Geographically extended into southern Arkansas where it crops out about 5 miles north of Columbia County line.

R. F. Dinnean, 1958, Louisiana Geol. Survey Geol. Summ. no. 1, p. 5, pl. 1. Formation crops out in southwestern part of Chestnut salt dome area, Natchitoches Parish. Composite section obtained partially from auger holes on south side of dome is 107½ feet thick. Includes a lower 13-foot noncalcareous sequence of sandy blue-green and brown clay, a middle 27-foot calcareous fossiliferous member of blue-gray, green, and dark-brown glauconitic marl, and an upper 67-foot noncalcareous sequence with few glauconite beds. Overlies Carrizo formation; underlies Sparta formation. Claiborne group.

Type locality: Baden Hill on Cane River, one-half mile north of Natchitoches, Natchitoches Parish, La.

Cane Spring Formation

Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Massive dolomite and limestone, with thin-bedded impure limestone and shale in lower part. Thin lava flow near base and 20-foot

lens of dark-brown siliceous conglomerate 100 feet above base. Total thickness more than 1,000 feet. Conformably underlies Osobb formation (new); conformably overlies Augusta Mountain formation (new).

Type locality: Summit and southeast slope of Augusta Mountain in vicinity of Cane Spring, 2 miles south of quadrangle boundary.

Caney Shale[1]

Mississippian: Central southern and southeastern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

J. C. Barker, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 173–178. Formation in Lawrence uplift area has two facies, a lower calcareous siltstone phase and an upper black shale unit. Subsurface stratigraphers have referred to calcareous phase as "Mayes." This phase is exposed in only three localities, and it was not feasible to map it as separate unit; it is here referred to as "Ada Mayes." Thickness 350 to 720 feet. Unconformably overlies Welden limestone; underlies "Springer" shale.

M. K. Elias, 1956, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma, a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 57–75. Mississippian Caney shale, in northern Arbuckle Mountains, is divided into (ascending) Ahlosa (Ahloso), Delaware Creek, and Sand Branch members (new). Term Ahlosa (Ahloso) is introduced for unit commonly referred to as "Mayes" or "Ada Mayes." Overlies Welden limestone; underlies Rhoda Creek formation (new). In this area is Meramec and Chester. In southern Arbuckle Mountains, Caney shale (previous usage) contains Delaware Creek and possibly upper part of Ahloso; underlies Goddard shale.

Jerome Westheimer, 1956, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma, a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 392–393. Proposed that term Caney be restricted to those Mississippian sediments around Arbuckle Mountains overlying Sycamore limestone and that a new name be assigned to post-Caney, pre-Springer sediments. Goddard shale is now known to be time equivalent of upper part of Caney shale as developed on northeast flank of Arbuckles and is of essentially same age as Elias' lower and upper Sand Branch members of the Caney.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 3–24. Caney shale is established in region in which it was originally described by designating a type section in Arbuckle Mountain area. Five measured sections in adjacent ravines west of Viola townsite are so designated, and type sections of three members are likewise established there. Original type locality is abandoned except as source of name, and the shales which there contain exotic boulders are left under name of Johns Valley shale. Thickness at type locality about 381 feet; top of shale not preserved in type section. Shale is Mississippian consisting of Meramecian Ahloso member, Delaware Creek member (later Meramecian and early Chesterian), and late Chesterian Sand Branch member. Sycamore sandstone exposed below Caney type section is unlike Sycamore of its type area and may be facies of grading into Ahloso member, Summary of history relative to confusion in use of term Caney.

J. D. Prestridge, 1959, *in* Ardmore Geol. Soc., Petroleum Geology of southern Oklahoma, a symposium, v. 2; Tulsa, Am. Assoc. Petroleum Geologists. p. 158 (fig. 2), 161. Overlies Worthey member (new) of Sycamore formation.

Type section (Elias and Branson): Sec. 14, T. 2 S., R. 7 E., Johnston County.

Caney Creek Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. Spec. Paper 22, p. 76, 157, 159–160, 202, pls. 6, 15. Predominantly siltstone and shale. As much as 72 feet thick. Underlies Clementsville member (new); overlies unnamed shaly member. Included in Liberty facies (new) of formation.

Type locality: A prominent knob, at head of Caney Creek, 2 miles east of Lebanon, Marion County.

Caney Point Marl Member (of White Bluff Formation)

Eocene (Jacksonian): Southeastern Arkansas.

H. S. Puri, 1952, Jour. Paleontology, v. 26, no. 2, p. 202, 209. Mentioned in a list of fossil localities.

L. J. Wilbert, Jr., 1953, Arkansas Div. Geology Bull. 19, p. 39, 56–70. One of three marine facies of formation. Typically calcareous glauconitic clay containing a varied invertebrate fauna; includes the more calcareous elements of the formation. Thickness 11 to 20 feet. Occurs in basal part of formation; stratigraphically equivalent with Pastoria sand member; underlies Rison clay member in Drew and Lincoln Counties, contact gradational; sharply separated from underlying Claiborne beds by a contact that shows evidence of disconformity. Type locality designated.

Type locality: Caney Point, on Saline River, approximately 5½ miles northwest of crossroads at Rye, Cleveland County. Outcrops are largely restricted to the upland which parallels the Saline River on the west, extending from east-central Bradley County to northwestern Cleveland County.

Caneyville Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southeastern Nebraska, and northeastern Oklahoma.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic section of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg.]. Mar. 21–23, Wichita; R. C. Moore, 1935, Kansas Geol. Survey Bull. 20, table facing p. 14.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 172; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 58. Consists of three limestones and separating shales in southern part of outcrop area; two limestones and a shale elsewhere. In northern Kansas where no discernible boundary between Caneyville and Pony Creek is found, strata from base of Nebraska City limestone to base of Brownville limestone are designated Caneyville-Pony Creek, or may be called Wood Siding formation, which is defined by Nebraska Geological Survey to have limits that correspond exactly to Caneyville-Pony Creek. Thickness about 21 feet. Comprises (ascending) Nebraska City limestone member, unnamed shale, limestone, shale sequence, and Grayhorse limestone member. Underlies Pony Creek shale; overlies French Creek shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 13. In Nebraska Caneyville shale is a poorly defined member of Wood Siding formation;

thickness 6 to 10 feet. Underlies Pony Creek shale member with boundary indefinite; overlies Nebraska City limestone member.

Type locality: Sec. 11, T. 32 S., R. 8 E., Chautauqua County, Kans. Name derived from Caneyville Township.

Caneyville Shale [1] Member (of Wood Siding Formation)

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 9.

See Caneyville Limestone (in Wabaunsee Group).

Type locality: Sec. 11, T. 32 S., R. 8 E., Caneyville Township, Chautauqua County, Kans.

Canisteo Shale Member (of Perrysburg Formation)

Upper Devonian: Western and west-central New York.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Proposed for 190 feet of soft bluish-gray to olive-drab shale that overlies Canaseraga sandstone member in Greenwood, Hornell and Woodhull quadrangles. This is basal part of sequence which according to Bradley (Bradley and Pepper, 1938, U.S. Geol. Survey Bull. 899–A) was named Gowanda by Chadwick and traced by him from vicinity of Gowanda to vicinity of Canisteo. Absence of definite top to Gowanda member east of Gowanda and presence of thin layers of siltstone and shale at base of Canisteo member and top of Canaseraga between Wiscoy and Hornell indicate that the Canisteo, Caneada, and Gowanda members, although closely related in time of deposition, are not strictly correlative throughout. Above Canisteo is thick unnamed sequence of silty shale, siltstone, and sandstone; the Canisteo grades upward into this unit, which probably contains upper part of Caneadea member.

Named for occurrence in vicinity of Canisteo, Steuben County.

Canjilon Till

Quaternary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103; 1938, Jour Geology, v. 46, no. 7, p. 937 (fig. 4), 959. Named as oldest of seven Quaternary formations in area. Underlies Canones andesite (new); Quaternary formations overlie pre-Quaternary rocks with angular unconformity.

Occurs in Abiquiu quadrangle, Rio Arriba County.

Cannelton Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: I. C. White, 1885, The Virginias, v. 6, p. 8, 15.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 79. Slightly fossiliferous marine limestone; occurs near middle of Kanawha group, between Brownstown sandstone (above) and Matewan coal.

Occurs in vicinity of Cannelton, Fayette County.

Cannelton Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southwestern Indiana.

Original reference: T. C. Hopkins, 1896, Indiana Dept. Geology and Nat. Resources 20th Ann. Rept. p. 314.

Quarried at Cannelton, Perry County.

Cannelton Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 151–152, 170.

Canning Ridge Quartz Monzonite

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Name applied to quartz monzonite occurring in stock on Canning Ridge.

Occurs at south end of Wylie Mountains, Culberson County.

Canning Ridge Trachyte

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Name applied to trachyte occurring in stock on Channing Ridge.

Occurs at south end of Wylie Mountains, Culberson County.

Cannon Limestone[1]

Cannon facies (of Bigby-Cannon Limestone)

Middle Ordovician: Central and eastern Tennessee and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 417, 418, 429, pl. 27.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 80, 126–134. Bigby limestone grades laterally into Cannon limestone; the two are contemporary facies of unit here termed Bigby-Cannon limestone which overlies Hermitage formation and underlies Catheys formation. All included in Nashville group.

Well exposed southwest of Kettle Creek pool, Cannon County, Tenn.

Cannonball Member (of Fort Union Formation)

Cannonball Formation (in Fort Union Group)

Cannonball Marine Member (of Lance Formation)[1]

Paleocene: Southwestern North Dakota and northwestern South Dakota.

Original reference: E. R. Lloyd, 1914, U.S. Geol. Survey Bull. 541, p. 248, 249.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 18–20. Formation in Fort Union group. Comprises upper 250 to 300 feet of old Lance formation. Typically exposed along Cannonball River. To west, intergrades with underlying Ludlow formation; in mapped area [southern Morton County], overlies and is gradational with the Ludlow. Conformably underlies Tongue River formation.

S. K. Fox, Jr., and R. J. Ross, Jr., 1942, Jour. Paleontology, v. 16, no. 5, p. 660–673. Analysis of 64 species of foraminifera from Cannonball beds of North Dakota indicates their Midway (Paleocene) age. This supports recent evidence from paleobotany and from vertebrate paleontology, but is contrary to former belief, based on Cannonball mollusks and corals, that the Cannonball is of late Cretaceous age.

O. A. Seager and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1414, 1415, 1417. Fort Union in North Dakota represented by three members: Tongue River, Cannonball, and Ludlow. The Cannonball

and Ludlow are interfingering contemporaneous sediments of early Paleocene age.

R. E. Stevenson, 1954, Areal geology of the Morristown quadrangle (1:62,500); 1957, Geology of Ralph quadrangle (1:62,500); 1957, Geology of the McIntosh quadrangle (1:62,500); South Dakota Geol. Survey. Formation mapped in Morristown, Ralph, and McIntosh quadrangles. Thicknesses: 60 to 75 feet, 95 feet, and 170 feet in respective quadrangles. In Morristown quadrangle is top of section; interfingers with underlying Ludlow formation; in Ralph quadrangle, includes Giannonatti facies at top, interfingers with underlying Ludlow formation, and underlies Tongue River formation; top of section in McIntosh quadrangle and interfingers with underlying Ludlow.

N. H. Darton, 1951, Geologic map of South Dakota (1:500,000): Mapped as Cannonball formation.

Typically exposed in bluffs of Cannonball River, Tps. 132 and 133 N., R. 8 W., Morton County, N. Dak.

Cano Member (of Mesaverde Formation)

Upper Cretaceous: North-central New Mexico.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 463 (fig. 2), 466, pl. 1. Massive sandstone interbedded in Mancos shale. First massive sandstone characteristic of Mesaverde in area. Thickness increases southward from 25 feet in Arroyo Pinovetito to at least 225 feet southeast of Hogan.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2415–2416. By use of map patterns and symbols, Stearns (1953) implies that an unexposed cutoff separates Cano member from undifferentiated Mesaverde. Yet this so-called Mesaverde member occurs only as part of Mancos shale, with no indication that it occurs anywhere in vertical sequence as recognized part of formation of which it is a designated member.

Present only in Tongue Valley.

Canoas Siltstone Member (of Kreyenhagen Shale)

Canoas Silt

Eocene: Central California.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189 (fig. 72) [preprint 1941]. Shown on correlation chart as Canoas silt underlying "Kreyenhagen" proper and overlying the Domengine.

J. A. Cushman and S. S. Siegfus, 1942, San Diego Soc. Nat. History Trans., v. 9, no. 34, p. 390–391. Consists of greenish-gray soft crumbly clayey siltstone, with a few thin beds of light-gray fine sand. Thickness 110 feet. Basal member of Kreyenhagen; conformably overlies Avenal sandstone.

Type locality: In Garza Creek, Kings County.

Canon (Canyon) Rhyolite[1]

Miocene (Barstovian): Northwestern Nevada and southeastern Oregon.

Original reference: J. C. Merriam, 1910, California Univ. Dept. Geology Bull., v. 6, no. 2, p. 29, 30, 31–33.

D. O. Cochran, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 10 (chart), 11. Canyon rhyolite listed with Cenozoic formations of Oregon. A highly silicic dense rhyolite with characteristics suggesting

welding in some areas and with flow structures present elsewhere. Thickness about 400 feet. Overlies Steens basalt; underlies Virgin Valley formation.

Type area: Virgin Valley, Nev. Name derived from Thousand Creek Canon (Canyon), Humboldt County, Nev.

Canones Andesite

Quaternary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Named as second of seven Quaternary formations in area. Younger than Canjilon till (new); older than Vallecito basalt (new).

H. T. U. Smith, 1938, Jour. Geology, v. 46, p. 937 (fig. 4), 959. In sequence listed, Canones andesite is younger than Canjilon till and older than Hinsdale(?) and Lobato basaltic lavas (new).

Occurs in Abiquiu quadrangle, Rio Arriba County.

Canter Limestone[1]

Mississippian: Southern Ohio.

Original reference: E. B. Andrews, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 158, 163.

In Hamilton Township, Jackson County.

Canterbury Gneiss

Canterbury Granite Gneiss[1]

Pre-Pennsylvanian: Eastern Connecticut and southern Massachusetts.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 136, 142, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 54–55. Referred to as an orthogneiss. Same as Ayer granite of Thompson Township, Windham County, Conn., which extends into Massachusetts. Age considered Upper Carboniferous.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Outcrop in Thompson Township here mapped as Canterbury granitic gneiss. Pre-Triassic. Derivation of name given.

U.S. Geological Survey currently designates the age of the Canterbury Gneiss as pre-Pennsylvanian on the basis of a study now in progress.

Named for town of Canterbury, Windham County, Conn.

Cantinas Sandstone (in Asuncion Group)

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 132 [preprint 1941]. Forms upper part of Asuncion group (new) in southern Santa Lucia Range. Overlies Godfrey shales (new).

Santa Lucia Range is mountainous area, between Salinas Valley and the coast, which extends from Monterey Bay to central part of San Luis Obispo County.

Canton Phacolithic Complex[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 65–76.

Occurs in Canton, Gouverneur, and Ogdensburg quadrangles.

Canton Schist[1] or Formation

Precambrian: Northwestern Georgia.

Original reference: W. S. Bayley, 1928, Georgia Geol. Survey Bull. 43, p. 43–46, map.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, p. 1379. Canton formation is here regarded as part of the Carolina gneiss or series, which is considered Precambrian.

Well exposed in vicinity of Canton, southwestern part of Tate quadrangle, Cherokee County.

Canton Shale Member (of Carbondale Formation)[1]

Canton Shale (in Carbondale Group)

Pennsylvanian: Central and western Illinois.

Original reference: T. E. Savage, 1921, Illinois Geol. Survey Extr. from Bull. 38.

Leland Horberg, 1950, Illinois Acad. Sci. Trans., v. 43, p. 171, 174. In Henry County, underlies Tertiary gravels which generally have been referred to Lafayette formation.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 106–107, 190, 195, 196, 197. Consists of upper and lower part separated by limestone bed 4 inches to 1 foot thick. Total thickness as much as 35 feet. Underlies Cuba sandstone; overlies St. David limestone. Included in St. David cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 66, pl. 1. Carbondale redefined as formation. Canton shale member underlies Vermilionville limestone member which replaces preoccupied name Cuba sandstone.

Type locality: Center sec. 9, T. 6 N., R. 4 E., Fulton County. Named from exposures near Canton.

Cantua Sandstone Member (of Lodo Formation)

Cantua Sandstone Member (of Arroyo Hondo Formation)

Cantau Sandstone Member[1] (of Martinez? Formation)

Eocene: Southern California.

Original reference: R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603, p. 33, 59–63, map.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. Assigned to member status in Lodo formation (new). Overlies Cerros member (new); underlies Arroyo Hondo member.

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 27, 28. Assigned to member status in Arroyo Hondo formation. Lies entirely within Ragged Valley shale member; a basal portion of Ragged Valley shale, approximately 100 feet thick, appears to underlie the Cantua throughout area.

M. C. Israelsky, 1951, U.S. Geol. Survey Prof. Paper 240–A, p. 1–2. Restricted to the sandstone unit, thus excluding about 100 feet of fine-grained strata underlying the sandstone and originally included in the Cantua.

Named for fact it reaches greatest development at head of west branches of Cantua Creek, Fresno County.

†Cantua Shale[1]

Eocene or Oligocene: Southern California.

Original reference: C. C. Church, 1930, Pan-Am. Geologist, v. 54, no. 1, p. 79.

Phoenix Canyon, near Coalinga, Coalinga region.

Cantwell Formation[1]

Lower Cretaceous: Southern Alaska.

Original reference: G. H. Eldridge, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 16, map.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 235, chart 10d (column 23). Consists of several thousand feet of continental deposits and some interbedded lavas and graywacke.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Name appears on map legend under Cretaceous and Jurassic rocks undifferentiated.

Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 8–9, pls. 1, 3, 9. Formation occupies large synclinorium in center of Alaska Range. On the north, it is bounded by vertical fault which forms its contact with Birch Creek schist. Eldridge designated locality on Nenana River then known as Cantwell River as type locality.

Type locality: On Nenana River (formerly Cantwell River) about 3 or 4 miles above its junction with the Yanert Fork.

Canutillo Formation.

Middle Devonian: Texas.

L. A. Nelson, 1937, Colorado Univ. Studies, v. 25, no. 1, p. 89. Stratigraphic section in Franklin Mountains includes Devonian Canutillo formation which lies between Mississippian Helms formation and Silurian Fusselman limestone.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 163 (fig. 3), 164, 170 (fig. 5). About 175 feet of sediments consisting of cherty limestone, light brown in color, immediately overlying Fusselman; thin beds of fossiliferous gray limestone; thin bed of dense, almost black sandstone, which weathers brown; and about 40 feet of black shale, fissile shale at top of formation. Middle Devonian.

F. V. Stevenson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 18, p. 22–23. Most limited in areal extent of all Devonian formations in New Mexico. Basal part consists chiefly of massive calcareous siltstone that is overlain by thin beds of varicolored shale interbedded with massive thick beds of calcareous brown siltstone. Average thickness 25 to 30 feet. Most complete exposure, 88 feet thick, is in San Andres Canyon, San Andres Mountains. Overlies Fusselman limestone; underlies Sly Gap formation. Fauna and geologic history of southwest indicate that formation is probably early Late Devonian.

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 221–222. Sediments below Sly Gap in Sacramento and San Andres Mountains, hitherto called Canutillo from supposed correlation with Canutillo formation in Franklin Mountains of Texas, are herein named Onate formation.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 36, 37 (fig. 17). In Franklin Mountains, Tex., formation consists of approximately 15 feet of soft thin-bedded gray siltstone. Separated from

underlying Fusselman by 42 feet of cherty limestone, probably Devonian; overlain by 57 feet of soft flaky gray-black shale identical in character with part of Percha shale of Lake Valley area.

Named from town of Canutillo, Tex., on Santa Fe Railroad about 13 miles north of El Paso.

Canville Limestone[1] Member (of Dennis Limestone)

Canville Limestone Member (of Hogshooter Formation)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and northeastern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Guidebook 6th Ann. Field Conf., p. 91, 97.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40, 42. Rank reduced to member status in Dennis limestone.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 90–91. Canville limestone member of Dennis formation; underlies Stark shale member; overlies Galesburg formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. In Kansas, locally, a single layer about 1 foot thick; where thickness is greater, up to maximum of 3 feet, two or three beds may occur; member thins southward from type region.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11–12. Galesburg formation redefined to exclude Canville limestone and Stark shale formerly included in it by Missouri Geological Survey.

M. C. Oakes, 1940, (abs.) Tulsa Geol. Soc. Digest, v. 9, 51; 1952, Oklahoma Geol. Survey Bull. 69, p. 59, 60, 61. Present locally in northeastern Oklahoma where it is basal member of Hogshooter formation.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 421. In measured section near Winterset, Madison County, Canville member of Dennis formation is a bluish-gray discontinuous nodular band about 8 inches thick.

Named from exposures on Canville Creek, Neosho County, Kans.

Canyon Conglomerate[1]

Pliocene: Yellowstone National Park.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

Named for occurrence in Grand Canyon of Yellowstone River.

Canyon Group[1]

Canyon Formation[1]

Canyon Series

Upper Pennsylvanian: Central northern and central Texas.

Original reference: W. F. Cummins, 1891, Texas Geol. Survey 2d Ann. Rept., p. 361–374.

N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387–402 (repr. 1917 as Texas Univ. Bull, 1755). Canyon division comprises (ascending) Coral limestone, Rochelle conglomerate, Brownwood, Adams Branch limestone, Cedarton, Clear Creek, bed no. 7, cherty bed, Hog Creek, Home Creek, Bluff Creek, and *Campophyllum* beds. Overlies

Strawn division, with Ricker bed at top; underlies Cisco division, with Trickham bed at base.

F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull, 2132, p. 87–120; 1922, Jour. Geology, v. 30. Canyon group comprises (ascending) Graford formation (with Rochelle conglomerate, at base, Capps limestone lentil, Brownwood shale, and Adams Branch limestone); Brad formation (with Cedarton shale at base, Clear Creek limestone, Placid shale, and Ranger limestone); and Caddo Creek (with Hog Creek shale, below, and Home Creek limestone, above). Overlies Strawn group (Ricker bed at top), underlies Cisco group.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 94–118. Group includes (ascending) Palo Pinto, Graford, Brad, and Caddo Creek formations.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87–90. Rank raised to series. Comprises (ascending) Whitt (new), Graford, Brad, and Caddo Creek groups. Includes sediments above disconformity (unconformity in more positive areas) at top of Strawn series (base of Lake Pinto sandstone at Mineral Wells) and below disconformity marked by Kisinger channel (base of Cisco series) of southeast Young County. Village Bend limestone is top member of East Mountain shale of Lone Camp group (new) in Strawn series. Subdivision is thought to be approximately equivalent to Missouri series of Kansas.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 288 (fig. 1), 299. Rocks of Kawvian series (new) are widespread in North America. In north-central Texas, include the Canyon and Cisco.

R. J. Cordell and D. A. Zimmerman, 1954, Abilene Geol. Soc. Guidebook Field Trip Nov. 19–20, p. 46 (fig. 38), 47–49. In Palo Pinto County, Canyon-Strawn contact has for several years been placed at base of Lake Pinto sandstone (top of East Mountain shale). Position and correlation of Village Bend limestone (within East Mountain shale) has been used as evidence for unconformity at base of Lake Pinto sandstone. In general area of its type locality, the Village Bend occurs at variable intervals below beds identified as Lake Pinto. This variability of interval provided some postulation of erosional surface at top of East Mountain shale. Also inferring from statements by Cheney and Goss (1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 12) typical Strawn fossils, such as *Fusulina*, *Prismopora*, and *Mesolobus*, were not known above base of Lake Pinto at time of their publication. Believed from data available that logical Canyon-Strawn contact should be at base of Turkey Creek sandstone in Palo Pinto County. Turkey Creek sandstone is immediately overlain by Keechi Creek shale near top of which *Triticites* (post-Strawn age) has been found. Also concluded that lower Brownwood of Brown County is probably late Strawn age and that the upper Brownwood is early Canyon. Hence, base of conglomerate separating these two parts of Brownwood shale should be regarded as Canyon-Strawn contact. This would increase Strawn interval in Brown County about 125 feet, at expense of Canyon.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1515, 1524, pl. 1. Strawn-Canyon boundary in north-central Texas is evaluated from surface studies in Colorado River and Brazos River valleys. Zona-

tion based on fusulinids is best criterion for defining boundary. Strawn series is characterized by genus *Fusulina* and Canyon series by *Triticites*. Brachiopod *Mesolobus* and bryozoan *Prismopora* are not persistent in outcrop area; boundary is placed at three different stratigraphic positions so that locally prominent surfaces, which agree with paleontological evidence, may be used as the contact. In Colorado River valley, boundary is considered to be top of Capps limestone, which is continuous to north through Comanche County and most of Eastland County. In southern part of Brazos River valley, boundary is placed at top of "boulder" bed (of other investigators). This bed, which is present in northeastern Eastland County and southwestern Palo Pinto County, lies about 20 feet above Capps limestone. It is correlated with, and designated as, Village Bend limestone of central Palo Pinto County. In eastern Palo Pinto County, boundary is placed at base of Lake Pinto sandstone, which overlies Village Bend limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 62–68, pl. 27. Sequence of rocks now assigned to Canyon group includes most of the rocks assigned to Milburn shales and Brownwood division by Tarr (1890, Texas Geol. Survey 1st Ann. Rept.) and to Brownwood-Ranger series by Dumble (1890, Texas Geol. Survey 1st Ann. Rept.). Tarr's Brownwood division and Dumble's Brownwood-Ranger series were described as overlying their Milburn shales (later called Brownwood shale) and as including rocks that are barren of coal and that consist chiefly of limestone. Upper limit of this sequence was not definitely identified but appears to have been top of Gunsight limestone member of Graham formation, Cisco group, of presesnt classification. Drake (1893), adopting Cummins' (1891) divisions of rocks in Brazos River valley, applied term Canyon to prominent beds of limestone and intervening beds of shale of Colorado River valley, to which he gave local names and which he classified as beds. He considered base of Canyon to be top of his Coral limestone bed (Capps limestone lentil of Plummer and Moore) and top of Canyon to be his *Campophyllum* bed (Gunsight limestone member of present usage). Plummer and Moore (1921) raised Canyon to group rank, divided it into formations named for Brazos River valley localities, and further divided these into members bearing nomenclature of Drake's beds. This terminology is still widely used, though some renaming, reorganization, and redefining of units has been accomplished. Following nomenclature is recommended for formations and members (ascending): Graford formation, with Brownwood shale, Adams Branch limestone, and Cedarton shale members; Winchell limestone with lower and upper unnamed limestone members: Brad formation with Placid shale and Ranger limestone members; and Caddo Creek formation with Colony Creek shale and Homewood limestone members. Thickness about 600 feet in area of this report [Brown and Coleman Counties].

Named for Canyon, Palo Pinto County.

Canyon City Group[1]

Upper Cretaceous (Montana): Southeastern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept. p. 89–91.

Near Hardscrabble Creek, a small branch running into Arkansas River just below Canyon City, Canyon City region.

Canyon Creek Member (of San Juan Tuff)[1]

Miocene(?): Southwestern Colorado.

Original reference: W. S. Burbank, 1930, Colorado Sci. Soc. Proc., v. 12, p. 186.

Along Canyon Creek just below Camp Bird mill, Ouray district.

†Canyon Largo Group[1]

Eocene and older(?): Northwestern New Mexico and southwestern Colorado.

Original reference: W. H. Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. for 1875, pls. 35, 38.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 16, pl. 1. Term resurrected to replace San Juan "Wasatch." Tiffanian, Clarkforkian(?), and Wasatchian, of San Juan Basin, northwestern New Mexico and narrow fringe of southwestern Colorado.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 276–282. Discussion of proposal by Wood and others to reinstate term Canyon Largo and also discussion of conflicts in usage of term by early workers, Newberry, Holmes, and Keyes. It is concluded that no acceptable name for formation generally known as San Juan Basin "Wasatch" is available in previous literature. Hence, name San Jose formation is proposed.

Named for Canyon Largo, in northeastern part San Juan County and west part of Rio Arriba County, N. Mex.

Canyon Largo Sandstone[1]

Eocene: Northwestern New Mexico.

Original reference: C. R. Keyes, 1906, Geol. Soc. America Bull., v. 17, p. 725.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 273–280. Discussion of conflicts in usage of term Canyon Largo by early workers, Newberry, Holmes, and Keyes, Keyes proposed use of Canyon Largo for a part, only, of the New Mexico "Wasatch" of most other writers. He credited term to Newberry and not to Holmes. Keyes' proposal is a definitely published proposal which is valid as far as priority has any bearing. Keyes used name repeatedly in publications over a span of years, and his is most nearly continued and established use in literature. Import of Keyes' publications depends on whether Newberry or Holmes is considered as having originally established the name. Because of this confusion, no acceptable name for formation generally known as San Juan basin "Wasatch" is available in previous literature and San Jose is proposed.

Derivation of name not given.

Canyon Springs Sandstone Member (of Sundance Formation)

Canyon Springs Sandstone Member (of Rierdon Formation)

Upper Jurassic: Northwestern Wyoming and southwestern South Dakota.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 247–251, geol. sections. At type section, consists of about 26 feet of soft fine-grained calcareous fossiliferous white sandstone that underlies Stockdale Beaver member (new) and overlies Gypsum Spring formation. Thickness ranges from featheredge to about 45 feet; thickens and thins considerably in short distances, and is recognizable as a member only along southern and western margins of Black Hills.

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475. Reallocated to member status in Rierdon formation herein assigned to Sundance group.

Type locality: Conical butte about 4 miles west of Horton, Weston County, Wyo., one-fourth mile north of road from Horton to Upton, and near center sec. 23, T. 48 N., R. 62 W. Named for Canyon Springs Prairie immediately east of type locality.

†Cap au Gres standstone[1]

Lower Ordovician: Western Illinois, southeastern Iowa, and northeastern Missouri.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 60.

Typically developed at Cap au Gres, a headland on Illinois side of Mississippi River in Calhoun County, Ill.

Capay Formation[1]

Capay Stage

Eocene, lower: Northern California.

Original reference: T. H. Crook and J. M. Kirby, 1935, Geol. Soc. America Proc. 1934, p. 334–335.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 858–861. Referred to as stage based on faunal assemblages. Spans interval between Meganos stage below and Domengine stage above. Strata referable to this stage have been incorrectly correlated by Clark (1921, Jour. Geology, v. 29, no. 2) with those containing fauna of division D of Meganos group.

C. W. Merriam and F. E. Turner, 1937, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 6, p. 91–113. Discussion of middle Eocene Capay stage of northern California. Check list of species of stage in Capay Valley and Vacaville areas is given. Deposits of stage represent in several areas a discrete transgressive overlapping of marine conditions as shown by fact that beds rest both upon the Meganos and upon earlier formations. At type section of Meganos, on north side of Mount Diablo, Capay stage is either missing or represented by coal beds which have offered little or no fossil evidence of their immediate age. Locality which had yielded most of the fossils lies on west side of Capay Valley, Yolo County, and west of Tancred Station, in south-central part of sec. 28, T. 11 N., R. 3 W., Mount Diablo base and meridian.

Boris Laiming, 1940, 6th Pacific Sci. Cong., v. 2, p. 535–568. Discussion of character and distribution of smaller foraminifera in marine Eocene deposits of California. Correlation of foraminiferal zones is shown with faunal "stages" already established by paleontologists on basis of mollusca. Correlation chart shows 12 foraminiferal zones in Eocene as compared to 6 stages on basis of mollusca. Foraminiferal zones (ascending) C, B–4, B–3, and B–2 correlate with Capay stage of Clark and Vokes (1936).

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Chart shows age of Capay formation as lower Eocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 52–56, pls. Eocene sedimentary rocks of California have been separated faunally and stratigraphically into six units (Clark and Vokes, 1936). By local geologists these units are referred to (ascending) as Meganos, Capay, Do-

mengine, Transition, Tejon, and Gaviota stages. Three of these are recognized in area mapped [Coast Ranges immediately north of San Francisco Bay region]. U.S. Geological Survey recognizes, for this paper, Tejon, Domengine, and Meganos formations and Capay shale. Name Capay shale, already in literature, was recommended for adoption in this paper with reservation that it should be pointed out that this unit may be facies of the Meganos. Name Capay formation was used by Crook and Kirby (1935) for marine sediments exposed on west side of Capay Valley, Yolo County, and near Tancred Station in sec. 28, T. 11 N., R. 3 W. The section is over 600 feet thick and rests upon Upper Cretaceous beds. It is composed of invertebrate shales, sandstone, and conglomerates, and about 500 feet above base contains invertebrate fauna distinct from Domengine and Meganos formations as recognized on north side of Mount Diablo. In area of present report, Capay shale is exposed in banks of Ulatis Creek in Vaca Valley, Potrero Hills, and in Browns Valley on west side of Napa Valley. Probably middle shale member at Martinez now mapped as part of Martinez formation may be in part equivalent of the Capay. Thickness in some areas as much as 1,000 feet. Overlies Martinez formation; underlies Domengine sandstone.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Capay formation was proposed for conglomerate and estuarine deposits, possibly 2,400 feet thick, in Capay Valley, Cache Creek. Lower 600 feet contains at least four conglomerates, and near top is a 10-foot gritty mudstone with many pebbles and small gastropods. The mudstone rests upon sandstone that contains a few poorly preserved Eocene fossils and is overlain by coarse conglomerate with micaceous quartz sand matrix. *Turritella merriami* has been found only in the conglomerate with other forms, many of which are worn and generally larger than those in the mudstone. Occurrence of *T. merriami* above the mudstone is similar to that in sequence at Marysville Buttes. It is reasonably certain that the mudstone was deposited contemporaneously with at least some part of Marysville claystone member of the Meganos, and that at least lower part of Capay formation is equivalent to at least the upper part of Meganos formation (unit "E" of Clark and Woodford, 1927). Lower Eocene.

Named for occurrence in Capay Valley, west of Rumsey Hills, west of town of Winters, Yolo County.

Cape Limestone (in Maquoketa Group)

Upper Ordovician: Southeastern Missouri and southwestern Illinois.

A. M. Gutstadt, 1954, Dissert. Abs., v. 14, no. 10, p. 1683. Maquoketa group is divided into (ascending) Orchard Creek shale, Cape limestone, and Eden shale.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 523–524. Shideler (1937) applied the name Ada limestone to the Missouri "Fernvale." Templeton and Willman (1953, unpub.) reported that name Ada was preempted and proposed name Cape limestone, from Cape Girardeau, Mo. At this locality, where it is in contact with underlying Orchard Creek shale, the Cape is gray and medium crystalline and contains shale partings and abundant fossil fragments (mostly crinoid segments). Thickness 8 feet.

Well exposed at North Main and Broadway Streets, Cape Girardeau, Mo.

Cape Ann Granite[1]

Late(?) Paleozoic: Northeastern Massachusetts.

Original references: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass; B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 188–189, map.

U.S. Geological Survey currently designates the age of the Cape Ann Granite as late(?) Paleozoic on the basis of a study now in progress.

Named for occurrence at Cape Ann, Essex County.

†Cape Beauford coal measures[1]

Cretaceous: Alaska.

Original references: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 249; W. H. Dall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 819–820.

†Cape Blanco Beds[1]

Miocene: Southwestern Oregon.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 30–31.

At Cape Blanco, Port Orford quadrangle.

Cape Cod series[1]

Tertiary and Quaternary: Massachusetts.

Original reference: N. S. Shaler, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 535.

Cape Elizabeth Formation (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Named for development at Cape Elizabeth, Cumberland County.

Cape Fear Coquina

Pleistocene: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 130, 132, pls. 63, 64. Rather heavily sanded shell rock known to underlie Kure sandstone (new) or the deeper consolidated phase of this stratum; contact unconformable. Throughout most of its area, its surface is only a few feet above mean sea level, but where Inland Canal cuts across it, top attains an altitude of 22 feet above mean sea level.

Crops out on sea front between Fort Fisher and Kure's Beach fishing pier, on lower Cape Fear Peninsula.

†Cape Fear Formation[1]

Lower Cretaceous: Coastal Plain of North Carolina.

Original reference: L. W. Stephenson, 1907, Johns Hopkins Univ. Circ. 71, p. 93–99.

S. D. Heron, Jr., 1958, South Carolina Div. Geology Bull., v. 2, no. 11–12, chart 1. Age shown on correlation chart as Lower Cretaceous.

S. D. Heron, Jr., 1959, Geol. Soc. America, Southeastern Sec., Guidebook for Coastal Plain Field Trip, p. 1–2, 5–6, 16–18. Outcrop relationships of Cape Fear, Middendorf, and Bladen units are open to several interpretations. View that Middendorf represents an updip portion of Bladen member of Black Creek seems preferable. Bladen rests on Cape Fear formation in downdip exposures, and Middendorf rests on Cape Fear in updip exposures in Fort Bragg. Lower(?) Cretaceous.

Named for exposures on Cape Fear River.

†Cape Girardeau Marble[1]

Middle Ordovician: Southeastern Missouri.

Original reference: B. F. Shumard, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 2, p. 155.

Named for Cape Girardeau, Cape Girardeau County.

†Cape Girardeau Sandstone[1]

Upper Ordovician (Richmond): Southeastern Missouri.

Original reference: B. F. Shumard, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 156.

Named for Cape Girardeau, Cape Girardeau County.

Cape Horn Slate[1]

Mississippian: Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on correlation chart above Relief quartzite and below Delhi formation. Chesterian.

Named for occurrence at Cape Horn, overlooking North Fork of American River, Placer County.

Cape May Formation (in Columbia group)[1]

Pleistocene (Sangamon and Wisconsin): New Jersey and southeastern Pennsylvania.

Original reference: R. D. Salisbury, 1898, New Jersey Geol. Survey Ann. Rept. State Geologist 1897, p. 19–20.

Paul MacClintock, 1943, Jour. Geology, v. 51, no. 7, p. 458–472. From evidence in New Jersey, the Cape May seems best referred to Sangamon interglacial stage.

H. G. Richards, 1944, Acad. Nat. Sci., Philadelphia Notulae Naturae, no. 134, p. 5. Formation apparently represents entire duration of the Pleistocene between last major interglacial and the Recent. At present, formation is divided into following zones or phases: (1) interglacial marine, sand and clay with warm water fauna, last major interglacial; (2) glacial marine, sand with cold-water fauna, early Wisconsin; (3) transitional, fine sand; and (4) fluvial, sand and gravel, Wisconsin and post-Wisconsin. Future work will probably show that term Cape May formation should not be used for all these phases. Studies made in excavations of Cape May Canal.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation mapped in eastern Pennsylvania. Sands and gravels with clay and silt at base locally; includes areas of Recent alluvium and swamp deposits. Younger than Pensauken formation (Illinoian). Wisconsin stage. [Term Columbia group not used].

Named for fact it covers the whole of Cape May County, N.J.

Cape Neddick Gabbro[1]

Devonian(?): Southwestern Maine.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 151.

Occurs at Cape Neddick, York County.

Cape San Juan Limestone

Upper Cretaceous: Puerto Rico.

C. J. Maury, 1929, Science, new ser., v. 70, no. 1825, p. 609. Sequence of Upper Cretaceous sedimentaries includes San Germán deposits, Ensenada shale, Fajardo, and Cape San Juan limestones.

C. L. McGuinness, 1948, Ground-water resources of Puerto Rico: [San Juan?] Puerto Rico Aqueduct and Sewer Service, p. 174 (table). Synonym of San Diego formation.

Capetí Limestones

Oligocene, middle: Panamá.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (correlation chart). Name appears on correlation chart. Occurs below Arusa formation [or member of Tapaliza formation]. Middle Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 329. Undefined name applied to limestones in Darien area. Oligocene.

Darién area.

Capistrano Formation[1]

Miocene, upper, and Pliocene, lower: Southern California.

Original reference: A. O. Woodford, 1935, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 169, 184, 216–217.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. Subdivided to include Osa member (new). Unconformably underlies Niguel formation (new).

Named for development around Capistrano, Orange County.

Capita Shale Member (of Domengine Formation)

Eocene: Central California.

M. B. Payne, 1951, California Div. Mines. Spec. Rept. 9, p. 3, 13, 21, 22, pls. 1, 4. At type locality, comprises 50 feet of homogeneous gray shale which is firm, massive, micaceous, and in places carbonaceous. In Gres Canyon, Capita member is represented by a sand facies. Overlies Nonada sandstone member (new); underlies Chaney Ranch sandstone (new); lower and upper contacts gradational.

Type locality: In Chaney Ranch Canyon, Panoche quadrangle, Fresno County. Name taken from Capita Canyon just south of Chaney Ranch Canyon.

Capitan Limestone[1]

Permian (Guadalupe Series): Western Texas and southeastern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull., v. 9, p. 41.

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 11. Capitan and Carlsbad are names of different facies of equivalent beds. Capitan is massive reef limestone, which grades basinward into upper Delaware Mountain sandstone (Bell Canyon, new) and lagoonward into Carlsbad limestone.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 589–592, 654–656, 661–662, pl. 2. Classification of higher Guadalupe beds used in this paper differs from that used in previous reports. All beds of upper Guadalupe age were placed in Capitan limestone, a chronologic unit that included Altuda, Vidrio, and Gilliam members. Name Capitan is herein restricted to that part of former Vidrio member, or reef facies, that is upper Guadalupe (post-Word) in age, and both it and the Altuda and Gilliam are given rank of formation. This change brings usage in Glass Mountains into harmony with that of type area of Capitan in

Guadalupe Mountains, where name is restricted to a lithologic unit, the reef facies. This classification is also adopted by Lewis (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1). Where traced westward from Delaware Mountains into Guadalupe Mountains, or from Delaware basin toward its margins, sandstones and limestones of Bell Canyon formation (new) of Delaware Mountain group are replaced by light-gray thick-bedded or massive limestone of Capitan; in higher beds of Bell Canyon, the change takes place along edge of Reef escarpment.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 59–64, 75–79, pl. 3, strat. sections. Detailed discussion of geology of southern Guadalupe Mountains, Tex. Thickness 1,000 to 2,000 feet. Consists in part of compact light-gray, cream-colored, or white calcitic limestone associated with dolomitic limestones.

Named for El Capitan Peak, El Paso County, Tex.

Capitol terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg., p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703 (fig. 8), 1707–1709, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Capitol is applied to a terrace deposit younger than the Asylum (new) and older than Beaumont (Sixth Street). Thickness about 40 feet east of Austin. Traced coastward surface of terrace appears to coincide with surface of Lissie formation in Wharton County. Since term Capitol was used as a terrace by Hill and Vaughan (1898, U.S. Geol. Survey 18th Ann. Rept.), it has priority over Lissie (Deussen, 1914).

Named for occurrence near State Capitol at Austin, Travis County. Also well exposed east of Capitol, and from there eastward to Chicon Street.

Capitol Creek Shale[1]

Middle Cambrian: Montana.

Original references: A. Rothpletz, 1915, Die fauna der Belt formation bei Helena in Montana: Munich; C. D. Walcott, 1916, Smithsonian Misc. Coll. v. 64, p. 291.

Cap Mountain Limestone Member (of Riley Formation)

Cap Mountain Formation[1] (in Timbered Hills Group)

Upper Cambrian: Central Texas.

Original reference: S. Paige, 1911, U.S. Geol. Survey Bull. 450, p. 23.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 18–19. Formation included in Timbered Hills group in Oklahoma. Occurs below the Honey Creek and above the Reagan. Ulrich (1932, Geol. Soc. America Bull., v. 43, p. 742) considered this an extension of the formation by same name in Llano-Burnet area, Texas. Present only in secs. 23 and 26, T. 2 S., R. 4 E., in eastern part of Arbuckle Mountains southwest of village of Mill Creek.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ Geology Pub. 4301, p. 154 [1945]; P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 27, 29, 253, 309–310 [1946]. Redefined and reduced to member status in Riley formation (new). As redefined, includes some quite sandy beds formerly in-

cluded in Hickory sandstone. Consists of lower part made up of alternating impure dark-brown limestone and calcareous sandstone becoming more calcareous upward, and an upper part of mostly brownish-gray thick-bedded to massive limestone. Thickness 400 feet or more in Blanco County. Overlies Hickory sandstone member; underlies Lion Mountain sandstone member. Lower boundary, based on lithology, rises westward, crossing faunal zones until only about one-quarter as much of limestone is present in northwestern Gillespie County as in Blanco County; top boundary gradational but much more nearly at same time-horizon.

E. A. Frederickson, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1349, 1350–1351. Term Cap Mountain discarded in Oklahoma. Beds are considered to be dolomitic Honey Creek equivalents.

Named for Cap Mountain, Llano County.

Capote Mountain Tuff (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 26–28. Name proposed for the section of tuff overlying Bracks rhyolite (new) and underlying Brite ignimbrite (new). Outcrop characteristically threefold; upper white- to pinkish-gray member nearly 1,300 feet thick; middle red siltstone layer 10 to 40 feet thick; and lower variegated tuff member, predominantly dusky brown to grayish red purple, more than 300 feet thick. Difficult to differentiate from underlying Chambers tuff (new) on the north and south where the Bracks rhyolite is absent.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 289–291. Underlies Tarantula gravel (new).

Type section: On west face of Capote Mountain, Rim Rock country, Presidio County.

Capps Limestone Member (of Mineral Wells Formation)[1]

Capps Limestone (in Lone Camp Group)

Middle Pennsylvanian: Central Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 96, 97; 1922, Jour. Geology, v. 30, p. 24, 35.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 91, 92, 94, 95.

Member of Mineral Wells formation in report on Brazos River valley area. Member is lenticular deposit of small area and considerable variation in thickness. Overlies Ricker sandstone member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 90–91. Rochelle conglomerate and Capps and Adams Branch limestones have been miscorrelated in their type localities in Colorado River district and Brazos River district; this fact should be borne in mind in using early literature. Rochelle conglomerate may be traced northward below Capps limestone.

M. G. Cheney and D. H. Eargle, 1951, Geologic map of Brown County, Texas (1:62,500): Texas Univ. Bur. Econ. Geology. Mapped as Capps limestone at top of Lone Camp group.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1524. Strawn-Canyon boundary is drawn at top of Capps limestone in Colorado River valley.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 62, pl. 27. Capps limestone lentil, as used by Plummer and Moore (1921), extends across Brown County north of Colorado River, except where removed locally by channel erosion. Community of Early encompasses type locality. Unit has been classified as member of Mineral Wells formation, but for purposes of this report [Brown and Coleman Counties] term Mineral Wells formation is not used. In present report, Capps limestone lentil is at top of Strawn group, undifferentiated.

Named for Capps Farm, 3 miles east of Brownwood, Brown County.

Captain Creek Limestone Member[1] (of Stanton Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, pt. 1, p. 76–79.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32–33. Thickness about 2 feet in Nebraska; 4½ feet in northwestern Missouri.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 80. Dark to bluish-gray granular or dense brittle limestone; massive or even bedded; locally upper few inches is a brecciated silicified mottled pink and gray bed. Thickness along Kansas River 4½ to 5½ feet; locally in Miami County, a little more than 10 feet; near Independence, Montgomery County, a limestone 55 feet thick has been assigned to this member. Underlies Eudora shale member; overlies Vilas shale.

Type locality: On Captain Creek 2 miles east of Eudora, in roadcut near SE cor. sec. 3, T. 13 S., R. 21 E., Douglas County, Kans.

Capulin Basalts

Recent: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1354. Incidental mention only.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1023, 1031, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1057. Dark-gray to black vesicular to scoriaceous olivine basalts containing plagioclase, olivine, and magnetite, often with small plagioclase phenocrysts. Outcrops relatively fresh and unweathered, rarely etched into relief, and usually preserve the disorganized surface of flowing lava. Derivation of name and geographic distribution given.

Named after the cone and flows of Mount Capulin. Found in five localities within 25 miles of Mount Capulin, which are either at or near to Horseshoe Crater, Mount Marcy, Twin Craters (south cone), and Van Cleve, Union, and Colfax Counties.

Capulin Mountain Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 118 (fig. 18), 129, 136 (table 4). Medium dark gray to dark gray, porphyritic, and vesicular, with phenocrysts totaling about 10 percent of rock. Mentioned in discussion of Capulin basalts in Des Moines quadrangle [most of discussion refers to basalts from Capulin Mountain].

Capulin Mountain is in southwestern corner of Des Moines quadrangle, Union County.

Caraba facies (of Caimito Formation)

Oligocene, upper, to Miocene, lower: Panamá Canal Zone.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 901. Facies presumably of parts of the middle and upper members of the Caimito. Where exposed at Río Caraba consists of a thick massive very sparsely jointed sandstone-conglomerate-breccia overlain by a thick section of thin-bedded limestone and limy fine-grained sandstone. The limestone overlying the facies has fossil assemblage characteristic of the Caimito formation. If facies is later demonstrated to be a mappable unit, it should be given formational status, although it is included in Caimito formation on plate 2 (geol. map).

Typically exposed along the Río Caraba southwest of Gamboa and in gullies along south bank of Chagres Crossing Reach due south of Canal Beacons 29 and 30.

†Carbon Group[1]

Tertiary: Wyoming.

Original reference: L. Lesquereux, 1876, U.S. Geol. Survey Terr. Bull. 5, 2d ser., p. 244–248.

Carbonado Formation (in Puget Group)[1]

Eocene: Western Washington.

Original reference: Bailey Willis, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 400–436.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 55, 63, 65, 67. Lowest formation of group in Carbon River area. Underlies Wilkeson formation. Thickness in Carbonado River Canyon 1,328 feet. Formations in Carbon Canyon have been folded into anticlines and synclines with a general northwesterly trend.

Name derived from town of Carbonado, Pierce County.

Carbonate Hill Limestone (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 47–50, table 1, pl. 1. Consists largely of thin-bedded coarse- to medium-grained dark-gray sandy calcarenite which weathers brown or gray. Thin conglomeratic beds of small subangular mostly limestone pebbles occur in lower part of formation. In most areas, base of formation marked by prominent bed of brown-weathering limestone containing abundance of large oyster shells. Similar beds, 8 feet to 10 feet thick, are found throughout formation. Thickness 113 feet on northeast side of McGhee Peak; elsewhere a close approximation to average thickness is 200 feet. Conformable with both the underlying McGhee Peak formation (new) and the overlying Still Ridge formation (new).

Named from exposures in vicinity of the Carbonate Hill (McGhee) mine, on east side of Peloncillo Range in sec. 34, T. 24 S., R. 21 W. No complete section could be measured around mine. Section studies and measured in detail west of mine on upper slopes of McGhee Peak. Four other exposures in the range. Peloncillo Mountains, Hidalgo County.

Carbon Butte shales (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan.-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Comprises black shales 1,000 feet thick. Underlie Echo limestone (new); overlie Solitude limestone (new).

Forms most of the height of Carbon Butte, a prominent remnantal butte, on east side of Chuar Valley; Grand Canyon region.

Carbondale Formation[1] (in Kewanee Group)

Carbondale Group

Middle Pennsylvanian: Illinois and western Kentucky.

Original reference: E. F. Lines, 1912, Illinois Geol. Survey Bull. 17, p. 74.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 5–6. Formation, in Pike County, Ind., includes Arthur limestone (new).

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 22, 26. In Illinois, includes Browning sandstone and Hanover limestone (both new).

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36 (footnote). Principal divisions of Pennsylvanian system in Illinois (Caseyville, Tradewater, Carbondale, and McLeansboro) considered formations in previous publications are, according to present usage of Illinois Geological Survey, groups.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 34–36, 46–48 (table 1), 65–66, pl. 1. Redefined as formation to include strata between base of Colchester (No. 2) coal and top of Danville (No. 7) coal. As originally defined Carbondale included strata from bottom of Murphysboro coal to top of Herrin (No. 6) coal. Murphysboro coal was then considered equivalent to No. 2 coal of western Illinois. Intent was to use No. 2 coal as base of Carbondale, and except at Murphysboro, it was so used. Dominantly gray shale with sandstone prominent locally. Commonly 225 to 300 feet thick; in parts of northern, western, and southwestern Illinois, thins to about 125 feet, locally even less; about 400 feet thick in part of southeastern Illinois. Overlies Spoon formation (new); underlies Modesto formation (new). Members in southern Illinois (ascending): Colchester (No. 2) coal, Shawneetown coal (new), Roodhouse coal, Summum (No. 4) coal, Hanover limestone, Harrisburg (No. 5) coal, St. David limestone, Briar Hill (No. 5A) coal, Vermilionville sandstone, Herrin (No. 6) coal, Brereton limestone, Jamestown coal, Conant limestone (new), Anvil Rock sandstone, Bankston Fork limestone, Allenby coal (new), Galum limestone, and Danville (No. 7) coal. In northern and western Illinois (ascending); Colchester (No. 2) coal, Francis Creek shale, Jake Creek sandstone, Lowell coal, Oak Grove limestone, Purington shale, Pleasantview sandstone, Kerton Creek coal, Summum (No. 4) coal, Hanover limestone, Covel conglomerate, Springfield (No. 5) coal, St. David limestone, Canton shale, Vermilionville sandstone, Big Creek shale, Herrin (No. 6) coal, Brereton limestone, Lawson shale (new), Pokeberry limestone, Copperas Creek sandstone, and Danville (No. 7) coal members. In eastern Illinois (ascending): Colchester (No. 2) coal, Shawneetown coal, Summum (No. 4) coal, Harrisburg (No. 5) coal, Herrin (No. 6) coal, and Danville (No. 7) coal members. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification. Type section designated.

Type locality: Compiled from exposures in SE¼NE¼ sec. 1, T. 7 N., R. 4 E., Glasford quadrangle, and secs. 20 and 21, T. 8 N., R. 3 E., Canton quadrangle, Fulton County, Ill. Named for Carbondale, Jackson County.

Carbon Ridge Formation

Carbon Ridge Group

Permian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 2, 64–66. Proposed for rocks of Permian(?) age that occur south and east of Eureka. Probably included in "Upper Coal Measures" of Hague (1883, U.S. Geol. Survey 3d Ann. Rept.; 1892, U.S. Geol. Survey Mon. 20). Two facies distinguished: eastern, in Diamond Mountains; and western, which includes type area, south of Eureka. Both facies are unconformably overlain by Newark Canyon formation (new). In western facies, overlies Diamond Peak formation; in eastern facies, overlies Ely limestone. Composed largely of sandy or silty limestones that weather to shades of brown; dominantly thin bedded. Maximum thickness of 1,750 feet.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 91, 93 (chart 1), 102. Rank raised to group. In Carbon Ridge area, comprises (ascending) unnamed limy shales, argillaceous limestones, silts and mudstones, Riepe Spring limestone (new), Riepetown sandstone (new), and Pequop formation. Group retains same limits as recognized by Nolan and others (1956). Pennsylvanian-Permian (Missourian, Virgilian, Wolfcampian, Leonardian).

Grant Steele, 1960, Dissert. Abs., v. 20, no. 12, p. 4635. Discussion of stratigraphic interpretation of Pennsylvanian-Permian systems of eastern Great Basin. During Virgilian to earliest Wolfcampian time, following units were deposited: Strathearn, Jakes Creek (new), Carbon Ridge, Oquirrh, Ferguson Springs (new), and Pakoon.

W. B. Douglass, Jr., 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 181–183. Discussion of southern Butte Mountains area, White Pine County. Basal Permian rocks overlying disconformity at top of Ely limestone include some rocks which are Wolfcampian. These rocks, together with Leonardian and lower Wordian rocks constitute unit mapped as Carbon Ridge formation. Rocks of unit consist of monotonous alternating sequence of buff fine- to medium-grained limestones and a lesser amount of white to buff calcareous fine- to medium-grained sandstones. Thickness 997 feet. Conformably overlies Arcturus formation. On basis of fusulinid fauna, Knight (1956, Jour Paleontology, v. 30, no. 4) suggested that unit was equivalent to Arcturus formation as defined by Spencer (1917). Field evidence indicates that this is incorrect and that these rocks are more likely equivalent to "Rib Hill" formation of Ely district and also correlatable to west with Carbon Ridge formation at Eureka and Havallah formation at Battle Mountain.

Type area: On Carbon Ridge lying just north of mouth of Secret Canyon, vicinity of Eureka, Eureka County.

Carbon River [coal] Series[1]

Eocene: Western central Washington.

Original reference: B. Willis, 1886, U.S. 10th Census, v. 15, pls. 81, 84.

Puget Sound region.

Carcass Creek Glaciation or Drift

Pleistocene, upper: South-central Utah.

R. F. Flint and C. S. Denny, 1958, U.S. Geol. Survey Bull. 1061–D, p. 117 (fig. 25), 122–125, pl. 6. Distal half of Fish Creek-Grover drift lobe. Composed chiefly of till with morainal topography. Commonly has subparallel series of looped boulder-covered end moraines consisting of long laterals curving into incomplete nested terminals. Laterals approximate 50 feet in height in upstream segments and gradually become lower in downstream direction, curving into terminal ridges no more than 10 or 15 feet high. Successive moraine ridges separated by narrow swales floored with sandy alluvium and colluvium. Drift contains little outwash. Drift of Carcass Creek glaciation constitutes parent material of soils and caliche. This fact is compatible with but does not support hypothesis that this glaciation is probable correlative of Bull Lake stage in Rocky Mountains.

Mapped on flanks of Boulder Mountain, including the upper course of Carcass Creek on northeast flank of Boulder Mountain, near Grover, Wayne, and Garfield Counties.

Cardenas lava series

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist. v. 70, no. 2, p. 107 (chart), 109, 110–111. Sequence of eight lava-flows, being 100 to 250 feet thick, and separated from one another by a few feet of sandstone, 1 to 15 feet, in most instances. Total thickness 1,000 feet. Between sandstone sections of Grand Canyon series below and Chuaran series above. Marked erosional unconformities at top and bottom. Limited areal extent; lavas laterally dwindle away in all directions allowing the two unconformity planes to merge into one.

Name taken from Cardenas Butte at the base of which the full sequence is well exposed, in westward bend of Colorado River below mouth of Little Colorado River, Grand Canyon region.

Cardens Bluff Shale Member (of Hampton Formation)

Lower Cambrian: Northeastern Tennessee.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 41, pls. 1, 18. Dominantly clay shale, darker than usual shale of formation: on divides, weathers to bright orange-rusty chips. In gorges of Doe and Watauga Rivers through Iron Mountains, bedding in shale is crossed by well-marked slaty cleavage. Thickness 100 to 200 feet. Basal shale of formation. Member loses characteristic features northeastward, either by pinching out between sandstone layers or by passing into interbedded sandstone and shale.

Named for Cardens Bluff on Watauga River below Watauga Dam, Carter County. Along crest of Iron Mountains, member forms well-defined strike valley that continues northeastward as far as U.S. Highway 21, between Shady Valley and Mountain City.

Cardiff Conglomerate[1]

Ordovician(?): Maryland, Pennsylvania, and Virginia.

Original reference: E. B. Mathers, Am. Jour. Sci., 4th ser., v. 17, p. 143.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 95–96, 106; A. J. Stose and G. W. Stose, 1944, U.S. Geol.

Survey Prof. Paper 204, p. 50. Described in York County, Pa., where it underlies Peach Bottom slate and forms a narrow band between the slate and the Peters Creek schist on the flanks of a hill area of slate locally called Slate Ridge that extends from Susquehanna River southwestward 4 miles to Maryland line. Unit is closely folded. Ordovician(?). Removed from Glenarm series.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 980. In discussion of Baltimore gabbro complex, Cardiff conglomerate is included in Glenarm series, age of which is considered as probably early Paleozoic.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Present in strongly marked synclinal basin with its greatest development near Cardiff, Harford County, Md.

Cardiff Shale[1]

Cardiff Shale Member (of Marcellus Shale)

Middle Devonian: Western to east-central New York and eastern Pennsylvania.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 16.

Bradford Willard, 1937, Am. Jour. Sci., 5th, v. 33, no. 196, p. 276 (table 2). Table of Hamilton correlations in Maryland, Pennsylvania, and New York shows Cardiff shale member of Marcellus formation present in eastern Pennsylvania and central New York. At top of formation; overlies Chittenango member.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 104 [1946]. Discussion of Catskill and Kaaterskill quadrangles. Mount Marion beds are the Hamilton beds of former writers, but they are now known to represent but a part of Hamilton group and to belong to its lowest or Marcellus division. They seem to correspond roughly with Cardiff or upper Marcellus of central New York.

Well exposed in vicinity of village of Cardiff, Onondaga County.

Cardigan Gneiss

Precambrian(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 14–20; 1946, U.S. Geol. Survey Prof. Paper 209, p. 9, 10–15 [1947]. Includes rocks of many varieties, ranging in color from dark brownish gray through greenish gray to very light silvery gray and in texture from almost massive or crudely gneissic to thoroughly schistose. Commonest variety is banded, irregularly foliated rock, dark- to medium-gray on fresh fracture, with commonly a slight greenish cast caused by chlorite. On weathering, rocks become brown or dark brownish gray. Oldest formation in Ajo quadrangle, and serves as basement upon which the lavas and sedimentary rocks were deposited and as country rock for the intrusive masses. Intruded by Chico Shunie quartz monzonite and Cornelia quartz monzonite (both new); separated by faults from Concentrator volcanics (new).

Principal area of outcrop extends from Gibson Arroyo and the Cardigan prospect, from which formation is named, westward along lower southern slopes of Cardigan Peak and occupies most of the range of hills between Copper Canyon and Chico Shunie Arroyo. Exposed over about 8 square miles of quadrangle.

Careaga Sand or Sandstone

Careaga Formation

Pliocene, upper: Southern California.

C. R. Canfield, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 54, Careaga formation, an unpublished name proposed by some field geologists for a mappable yellow sand unit which occurs in Santa Maria district, section exposed at Schumann Cut in Casmalia Hills. Correlates with an upper sand unit in the Foxen called the fine sand member.

S. G. Wissler and F. E. Dreyer, 1943, California Div. Mines Bull. 118, pt. 2, p. 235 [preprint 1941]. Careaga formation (Canfield's Foxen gravel and Foxen fine sand member) consists of upper member of from 20 to 70 feet of unfossiliferous bluish-gray gravels and lower member of from 110 to 500 feet of fine-grained fossiliferous sand. In type area, separated from underlying Foxen by slight angular unconformity.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1340 (table 10), 1355–1358. Described as Careaga sandstone. Subdivided into lower fine-grained sandstone unit, designated Cebada fine-grained member, and upper coarse-grained sand and conglomerate unit, the Graciosa coarse-grained member. Thickness 50 to 1,425 feet; greatest range is in Cebada member, which is absent in places and has a maximum thickness of 1,000 feet. Conformably underlies Paso Robles formation; gradationally overlies Foxen mudstone; in some areas, discordantly overlies lower part of Sisquoc or upper member of Monterey. Type region designated.

G. F. Worts, 1951, U.S. Geol. Survey Water-Supply Paper 1000, p. 27. Discussed as Careaga sand. In most water wells, the Careaga is logged as sand—rarely as sandstone; induration is apparently a surface feature and does not extend to any appreciable depth; therefore, Careaga sand is used here rather than sandstone.

Type region: North flank of Purisima Hills south of Careaga Station on the now abandoned Pacific Coast Railroad, Santa Barbara County.

Caribbean Limestone[1]

Pliocene: Panamá.

Original reference: D. F. MacDonald, 1913, Geol. Soc. America Bull., v. 24, p. 710.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 21. Names Toro limestone and Caribbean limestone have been used to describe deposits of shell breccia or cemented coquina that overlies Gatun sandstone in region between Limon Bay and Chagres River. Formation [Toro] has been assigned to upper Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 329. Informal name for limestone in Canal Zone later named Toro limestone.

Between Limon Bay and Chagres River, C.Z.

Cariblanco Formation

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover, 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 147–149. Predominantly thick coarse conglomerates separated by sandstones and siltstones. Limestone present at three horizons: lenticular limestone containing volcanic rock

fragments is interbedded with coarse sandstone near top of the lower massive conglomerate; petroliferous limestone concretions lie in volcanic sandstone in upper part of formation; and thick lenses of silty limestone are interbedded with volcanic sandstone and siltstone near top of formation. Layer of tuff composed largely of pink plagioclase crystals lies near middle of formation. Thickness in type area about 3,000 feet. In northeastern Puerto Rico, strata here correlated with the Cariblanco may be as thick as 8,000 feet. Increase in thickness toward northeast appears to be largely result of lateral interfingering of the Cariblanco with strata believed to be equivalent to Coamo formation (new). Unconformably(?) overlies Robles formation (new); conformably underlies Coamo formation. Name credited to Lynn Glover (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. Basal 495 feet of formation extends eastward from Coamo quadrangle into westernmost part of Cayey quadrangle and crops out as massive, stratified conglomerate along upper part of steep ridge west of Vertedero where it is in a downfaulted block. Northwest of Vertedero, the conglomerate is truncated by a fault and lies in juxtaposition with Las Tetas lava member of Robles formation. Along east side of ridge west of Vertedero, conglomerate is in deposition contact with underlying siltstone of Colloa member (new) of Robles formation.

Named for outcrops along northeast-trending ridge which contains prominent peak known as Cariblanco, Coamo quadrangle.

†Caribou Formation[1]

Mississippian: Northern California.

Original reference: J. S. Diller, 1892, U.S. Geol. Survey Geol. Atlas, Folio 15 (prelim. proof sheet ed.).

Northwest of Caribou Bridge, Plumas County, in southeast part of Lassen Peak quadrangle.

Caribou Hills Glaciation

Pleistocene: Central southern Alaska.

D. B. Krinsley *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 5, 13 (table 1). Southwest part of Kenai Peninsula was glaciated three or more times during Quaternary period. Caribou Hills, the oldest recognized glaciation, preceded Swan Lake glaciation. Till exposed near heads of gullies in high ridges of the Caribou Hills. Series of successively lower marginal channels with linear lakes, lateral moraines, kame terraces on the Hills above altitude of 2,000 feet is record of several retreatal phases of this glaciation.

Found in highest parts and on slopes of Caribou Hills, southwest of Kenai Peninsula, Cook Inlet area.

Carimona Member (of Decorah Formation)

Carimona Member (of Platteville Formation)

Middle Ordovician: Southeastern Minnesota.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 759–763. Proposed for the few feet of limestone and interbedded limestone and shale at top of the Platteville and underlying green shales of Decorah formation. Limestone beds are pale yellowish brown, very fine and fine grained, and medium bedded and have smooth to broadly rippled surfaces. Limestones are separated by beds of shale that increase in thickness from bottom to

top of unit. Shales are yellowish brown to olive, calcareous, fissile, and poorly fossiliferous. Near base of member, a thin unfossiliferous chocolate-colored shale is overlain by a bed of bentonite 2 to 4 inches thick. Across Fillmore County, Minn., member thickens regularly northwestward from 3 to 6 feet and extends without much increase to the Twin Cities; thins to a few inches in southwestern Wisconsin where it underlies Spechts Ferry member of the Decorah. Where typically developed, overlies McGregor member; contact is placed below a thin yellowish-brown or chocolate-colored calcareous unfossiliferous fucoidal shale. Toward the southeast, this thin shale is separated from the bentonite by less than an inch of limestone, but, in type area and toward the northwest, two medium beds of limestone, separated by thin shale, intervene between the fucoidal shale, and the bentonite member extends upward to include highest bed of Carimona-type limestone and includes a few thin beds of greenish Decorah-type shale. The Carimona occupies same stratigraphic interval as Quimbys Mill member, but the two are lithologically distinct and not known to overlap.

A. F. Agnew, 1956. Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 49–50. Reallocated to member status in Decorah formation for following reasons: Carimona lithology is similar to that of limestone bands in Spechts Ferry member of Decorah; Carimona and Spechts Ferry wedge out eastward, and Guttenberg member thins eastward, whereas Quimbys Mill member of Platteville wedges out to west and McGregor member of Platteville thins westward; and there is a disconformity at top of Quimbys Mill member.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1032–1033. Carimona member of Platteville thins southeastward into Iowa, and at McGregor is only a few inches thick, including bentonitic limy shale that represents the Carimona bentonite; in this area, where the Spechts Ferry is a recognizable rock unit, the Carimona directly underlies it. A bentonite seam lies wholly within or underneath the Carimona member and about 4½ feet (in Fillmore County) below a bentonite in shale at base of Decorah. These bentonite beds converge southeastward and diverge northwestward; the bed in the Carimona is that one in Minnesota that has been mistakenly correlated with the Spechts Ferry bentonite in Iowa.

Typically developed in central Fillmore County, Minn. Name derived from hamlet of Carimona, 4½ miles west of Preston and in the S½ sec. 4, T. 102 N., R. 11 W.

Carl Sandstone Member (of Shenango Formation)

Mississippian (middle Meramec or younger): Northwestern Pennsylvania.

P. A. Dickey, R. E. Sherrill, and L. S. Matteson, 1943, Pennsylvania Geol. Survey, 4th ser., Bull. M–25, p. 15–16. Shenango formation in Oil City quadrangle contains three sandstones (descending): "C", or Carl; medial, or "B"; and lower, or "A". Thickness 51 feet near Carl; basal 6 feet is yellowish gray, coarse grained, and very massive, with lenticular clay nodules, and apparently disconformable with underlying shale; upper 45 feet is gray to greenish-gray and golden-brown medium- to coarse-grained sandstone with local crossbedding. Along Allegheny River in northern part of quadrangle, sandstone becomes progressively less massive, more shaly, and more poorly bedded eastward across quadrangle. Red and green shale and sandstone invade horizon of upper part of Carl at Oil City and eastward along river; at Smoky Hill, 2½ miles east of quadrangle, these continental red and green beds are prominently devel-

oped throughout sandstone. Thickness in Franklin quadrangle 30 to 50 feet; top lies about 300 feet above Corry sandstone. A disconformity may separate the Carl from underlying shale; if this is definitely established, the Carl should probably be included with overlying Patton formation.

Named for exposures at Carl, Venango County.

Carlile Shale (in Colorado Group)[1]

Carlile Shale Member (of Cody Shale, Colorado Shale, or Mancos Shale)

Carlile Formation (in Benton Group)

Upper Cretaceous: Eastern Colorado, northwestern Iowa, western Kansas, southeastern Montana, western Nebraska, northeastern New Mexico, South Dakota, and eastern Wyoming.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 565.

W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 40. Carlile shale, in north-central Kansas, comprises Fairport chalky member (new) in basal part and Blue Hill shale member above. Overlies Greenhorn limestone.

W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A, p. 4 (table). Carlile shale, in Black Hills region, comprises unnamed lower member, 75 to 125 feet thick, and Turner sandy member (new), 150 to 200 feet thick. Overlies Greenhorn formation; underlies Sage Breaks shale member (new) of Niobrara formation.

H. D. Thomas, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 9, p. 1189–1197. Upper Cretaceous shale which has been called Carlile in Laramie basin, Wyoming, overlies Frontier formation and is, in turn, overlain by beds of the Niobrara. Fauna of upper part of Frontier is of same age as that of upper type Carlile of Colorado, whereas fauna of the "Carlile" of Laramie basin is of Niobrara age. Believed that use of name Carlile should be discontinued in Laramie basin and that name Niobrara should be extended downward to embrace beds erroneously called Carlile. This basal Niobrara shale is correlated with Sage Breaks shale member of the Niobrara of the Black Hills, and name Sage Breaks is here substituted for abandoned name Carlile.

C. H. Dane, W. G. Pierce, and J. B. Reeside, Jr., 1937, U.S. Geol. Survey Prof. Paper 186–K, p. 214–220. Carlile shale in eastern Colorado comprises (ascending) Fairport chalky shale, Blue Hill shale, and Codell sandstone members. Overlies Greenhorn limestone; underlies Niobrara formation.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7), 17. Formation comprises (ascending) Fairport shale, Blue Hill shale, and Codell sandstone members. Combined thickness of Carlile in Nebraska is about 150 feet in the east, 250 feet in the southwest, and 400 to 500 feet in the northwest. Overlies Greenhorn limestone; underlies Niobrara chalk. Colorado group.

C. H. Rankin, 1944, New Mexico Bur. Mines Mineral Resources Bull. 20, p. 7, 12, measured sections. Contains Juana Lopez sandstone member (new) near top in northern New Mexico.

P. C. Petsch, 1946, South Dakota Geol. Survey Rept. Inv. 53, p. 17 (fig. 5), 43–47. Discussion of geology of Missouri Valley in South Dakota. Text refers to Benton group as comprising Graneros shale, Greenhorn limestone, and Carlile shale. Outcrop of Carlile present between Westfield and

Sioux City along east bluffs of Big Sioux River in Plymouth and Woodbury Counties, Iowa.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. Classed as member of Mancos shale in Rio Arriba County, N. Mex. Contains two subdivisions in this area. Lower, about 200 feet thick, consists largely of dark to black shale containing in basal 50 to 60 feet a group of six bentonitic clay beds. Upper, chiefly dark to black shale, weathering light brownish gray with numerous beds of hard dark-colored platy sandy limestone or calcareous sandstone. Estimated thickness about 600 feet in vicinity of El Vado. Overlies Greenhorn limestone member; underlies Niobrara calcareous shale member. Upper Cretaceous.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. Report discusses Hardin area, Big Horn and Yellowstone Counties, Mont. Carlile classified as member of Cody shale. Underlies Niobrara shale member; overlies Greenhorn calcareous member. Thickness 280 feet.

Keith Young, 1951, Jour. Paleontology, v. 25, no. 1, p. 35–68. Suggested that term Carlile shale be discontinued in southern Montana and term Frontier formation be redefined to include all rocks between top of Mowry shale and base of Niobrara formation.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2187–2192, 2197 (fig. 2). Discussion of Colorado shale of central and northwestern Montana and equivalent rocks on north flank of Black Hills. Carlile shale in Black Hills region is 550 to 650 feet thick. Divisible into a basal unnamed dark-gray shale member 75 to 155 feet thick; Turner sandy member, 185 to 260 feet thick; and Sage Breaks member, 195 to 305 feet thick. Overlies Greenhorn formation; underlies Niobrara formation.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Benton formation in northwestern Mora County, N. Mex., is represented by equivalents of Graneros shale, Greenhorn limestone, and Carlile shale.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Report covers La Veta area, Huerfano County, Colo. Carlile shale of Colorado group, consists of a shale unit, about 225 feet thick, and overlying Codell sandstone member, 5 to 10 feet thick. Overlies Greenhorn limestone; underlies Fort Hays limestone member of Niobrara formation.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Carlile shale of Colorado group, comprises (ascending) Fairport chalk, Blue Hill shale, and Codell sandstone members. Overlies Greenhorn limestone; underlies Fort Hays limestone member of Niobrara chalk. Upper Cretaceous.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 48, 55, pls. Described in Buffalo-Lake De Smet area, Wyoming, where it is classified as member of Cody shale. Thickness about 156 feet. Overlies Greenhorn calcareous member; underlies Niobrara shale member.

U.S. Geological Survey currently classifies the Carlile as a member of the Colorado Shale in Winnett-Mosby area, Montana.

Named for Carlile Spring and Carlile Station, 21 miles west of Pueblo, Colo.

Carlim Limestone[1]

Middle Ordovician: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 526, 533, 537.

R. M. Field, 1919, Am. Jour. Sci., 4th, v. 48, p. 414–417. Underlies Valentine formation (new).

Charles Butts, F. M. Swartz, and Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 96, p. 18–20, pl. 1. Underlies Bellefonte dolomite; overlies Lowville limestone. Chazy group.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. "Carlim group" includes Hatter limestone (new) above and Loysburg formation, with Clover member, below. Chazyan(?) series.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 195. Terms Carlim, Lemont, and "Lowville" have been applied to different units at various localities. Carlim limestone included Clover limestone and Hatter formation in Tyrone district, the overlying Benner and much of the Nealmont being referred to the "Lowville"; in Bellefonte district, the "Carlim" included beds from the Clover to the lower Valley View, the upper part of that member and the Valentine being classed as "Lowville" and the latter included much of the Nealmont in other sections. The Lemont member of the "Carlim" in the Tyrone district is Hostler member of Hatter formation; it is the part of Valley View limestone between metabentonites E and D at Bellefonte and a part of the Nealmont at type locality at Lemont. Confusion developed principally from misidentification of, and misunderstanding of, ranges of species of *Maclurites*, *Tetradium*, and *Cryptophragmus*.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 20. Carlim limestone is the upper Loysburg plus the Hatter in its type locality is older than the Brenner formation that underlies Valley View member of Curtin limestone. Type Lemont limestone is equivalent to most of Nealmont limestone that overlies Valentine member of Curtin limestone. Type section of Lowville is in New York; it is preferable that a local name be applied in Pennsylvania, inasmuch as precise correlation is uncertain.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Described in Huntingdon and Hollidaysburg quadrangles where it is 100 to 200 feet thick. Comprises lower unnamed member and Lemont limestone member. Overlies Bellefonte dolomite; hiatus. Underlies Lowville limestone; hiatus. Lower Ordovician.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 51. Published lists of fossils from Carlim limestone and Butts' collection in National Museum indicate that the Carlim is not Chazyan. In view of confusion, it seems best to drop Carlim in favor of Kay's terms Loysburg and Hatter.

Named for Carlim, 18 miles northeast of Williamstown, Blair County.

Carlin Formation

Pliocene, lower: Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1198, 1201, pl. 1. At least 600 feet of tuffaceous conglomerate and sandstone, rhyolitic and basaltic tuffs, diatomite shale, and limestone. Vertebrate fossils (late Clarendonian). Overlies Palisade Canyon rhyolite (new); sedimentary contact and angular unconformity. Also overlies Raine Ranch formation (new); underlies Hay Ranch formation (new).

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Beds of formation fill Carlin basin. Good exposures are present 5 miles southwest of Carlin and in area along Susie Creek. Beds in most places show small faults and gentle folds.

Carlin Canyon Formation

Permian (Leonardian and Guadalupian?): Northeastern Nevada.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 10, p. 1693, 1695 (fig. 1), 1699–1702. Proposed for 1,225-foot sequence of tan quartzose calcisiltites and massive brown cherts of Leonardian and possibly Guadalupian age. Conformably overlies Beacon Flat formation (new); unconformably underlies Miocene-Pliocene Humboldt formation.

Type section: North side of Humboldt River at Carlin Canyon; top of section in NE¼NW¼NW¼ sec. 13, from which place section runs west along side of canyon for about 2,000 feet; jumps south along chert outcrop for about 3,400 feet to another westerly trending canyon, where section runs again west for about 1,200 feet at its base in prominent north-south valley in SE¼NW¼SE¼ sec. 14, T. 33 N., R. 53 E., Elko County.

Carlinville cyclothem[1] (in McLeansboro Group)

Carlinville cyclothem (in Modesto Formation)

Pennsylvanian: Southwestern Illinois.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 801–812.

J. R. Bell, 1952, Illinois Geol. Survey Bull. 77, p. 34–37. Maximum exposed thickness in Carlinville quadrangle 37 feet. Includes Carlinville limestone. In sequence, Carlinville cyclothem overlies Trivoli cyclothem and underlies Burroughs beds. Name Shoal Creek has been used for the cyclothem in belief that Carlinville limestone was correlative of Shoal Creek limestone. However, recent studies have shown that Carlinville limestone is not correlative of Shoal Creek.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Table shows Carlinville cyclothem between the Macoupin above and the Trivoli below.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 54 (table 3), pl. 1. In Modesto formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: SW¼SW¼ sec. 35, T. 10 N., R. 7 W., Macoupin County.

Carlinville Limestone (in McLeansboro Group)

Carlinville Limestone Member (of McLeansboro Formation)[1]

Carlinville Limestone Member (of Modesto Formation)

Middle and Upper Pennsylvanian: Southwestern and central western Illinois.

Original reference: A. H. Worthen, 1873, Illinois Geol. Survey, v. 5, p. 287, 290–301, 309.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 35–37. Carlinville limestone in McLeansboro group. In Carlinville quadrangle, generally consists of an upper massive limestone bed separated from a thinner lower one by

dark shale. Locally there are three or four beds of limestone with intervening shale and then two or three of the limestone beds with intervening shale. Average total thickness 4½ feet. Included in Carlinville cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), 69, pl. 1. Reallocated to member status in Modesto formation (new). Stratigraphically below Burroughs limestone member and above Chapel (No. 8) coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SW¼SW¼ sec. 35, T. 10 N., R. 7 W., Macoupin County. Named for outcrops in vicinity of Carlinville.

Carlisle Center Formation

Carlisle Center facies (of Schoharie Formation)

Lower or Middle Devonian: East-central New York.

Winifred Goldring and R. H. Flower, 1944, Am. Jour. Sci., v. 242, no. 6, p. 340. Name proposed to replace preoccupied Sharon Springs formation of Goldring and Flower (1942).

R. E. Stevenson, 1949, New York State Sci. Service Rept. Inv. 3, p. 6. Buff to brown sandy shale, with top 6 inches being a greenish glauconitic sandy shale. Locally base is marked by glauconite bed. Thickness 5 to 45 feet. Overlies Esopus formation; underlies Springfield Center member (new) of Onondaga formation.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW–22, p. 10 (table 2). Overlies Esopus siltstone; underlies Schoharie grit. Thickness about 20 feet. Lower or Middle Devonian.

J. H. Johnsen, 1957, Dissert, Abs., v. 17, no. 10, p. 2247. Facies of Schoharie formation (redefined). Underlies Rickard facies (new). Exposed in road southwest of Little York and in cut on U.S. Route 20 about 2 miles west of Sharon Springs, just a little east of Schoharie County.

Carlos Sandstone Member[1] (of Wellborn Formation)

Eocene, upper: Southeastern Texas.

Original reference: B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 31–32, table opposite p. 17.

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 168. Renick mapped Carlos sandstone extending west from Carlos about 3 miles. Fieldwork in this area shows that the sandstone extending west from Carlos is in the Manning at a stratigraphic position about 100 to 150 feet above top of Carlos. This sandstone is here named Goodbread. Type locality discussed.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2626 (table 1), 2628. Mentioned in discussion of Wellborn sandstone, but in this report the Wellborn is considered a formation, undivided.

Type locality: About one-half mile north of road intersection at Carlos, Grimes County.

Carlotta Formation (in Wildcat Group)

Pliocene to Pleistocene: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 35–39, 113–115, pls. 1, 2. Predominantly massive nonmarine conglomerate,

sandstone, and carbonaceous claystone; some marine lenses; locally contains white volcanic ash beds. Thickness 500 to 3,000 feet. Uppermost formation of group; unconformably underlies Hookton formation (new); overlies Scotia Bluffs sandstone (new) with contact gradational.

Type section: Near town of Carlotta, Humboldt County. No complete well-exposed section exists. Principal distribution is in trough of major Eel River syncline and in western part of Fortuna quadrangle. Westward plunge of Cenozoic structures and the Little Salmon Creek fault limit eastward extent.

†Carlsbad Limestone[1] or Group

Permian (Guadalupe Series): Southeastern New Mexico and western Texas.

Original references: O. E. Meinzer, B. C. Renick, and Kirk Bryan, 1926, U.S. Geol. Survey Water-Supply Paper 580–A, p. 12–13, map; N. H. Darton, 1926, Geol. Soc. America Bull., v. 37, p. 419.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 64–69, pls. 2, 3. Limestone described and mapped in southern Guadalupe Mountains, Tex.

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 46. Group includes Seven Rivers, Yates, and Tansill formations.

P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Group described in Carlsbad Caverns East quadrangle where it comprises (ascending) Seven Rivers, Yates, and Tansill formations. Overlies Queen sandstone in northwest and toward southeast Goat Seep limestone. Underlies Salado formation; toward southeast interfingers with Capitan limestone.

Term Carlsbad Group abandoned; replaced by Artesia group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4).

Named for exposures in vicinity of Carlsbad, N. Mex.

Carlton Granophyre[1] or Porphyry

Precambrian: Southwestern Oklahoma.

Original reference: M. G. Hoffman, 1930, Oklahoma Geol. Survey Bull. 52, p. 39–48. [Hoffman also used term Carlton porphyry.]

Composes nearly all of Carlton Mountains, Wichita Mountains area.

Carlton Limestone (in Sumner Group)[1]

Carlton Limestone Member (of Wellington Formation)

Permian: Southeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 6–8. Wellington formation is subdivided into 10 members. The Carlton is the fifth in the sequence (descending). Younger than Highland shale member (new); older than Chisholm Creek shale member (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Occurs a short distance below Hutchinson salt member. Contains fossil insects. Leonard series.

Identified southward from Walton, Harvey County, to Wichita, Sedgwick County.

Carlton Porphyry[1] or Rhyolite

Carlton Mountain Porphyry

Precambrian: Southwestern Oklahoma.

Original reference (Carlton porphyry): C. N. Gould, 1904, Oklahoma Geol. Survey Dept. Geology and Nat. History 3d Bienn. Rept., p. 18, 20.

J. A. Taff, 1904, U.S. Geol. Survey Prof. Paper 31, p. 64. Carlton Mountain porphyry mentioned in discussion of igneous rocks of Wichita Mountains. Plate 2 shows granite-porphyry mapped in vicinity of Carlton Mountains, Comanche County. [May be same as Carrollton Mountain porphyry, the geographic feature now being Carlton Mountains.]

R. E. Denison, 1959, (abs.) Oklahoma Acad. Sci. Proc. 1958, p. 124–125. The Carlton is a typically porphyritic and locally perlitic rhyolite with major phenocrysts of microperthite and minor phenocrysts of quartz, orthoclase, sodic plagioclase, and magnetite. Groundmass is micro- to cryptocrystalline and occasionally a micrographic intergrowth of quartz and feldspar. Believed to be surface equivalent of one of Wichita granites.

Occurs in area of Carlton Mountain[s], Comanche County.

Carlton Slate

Precambrian: Northeastern Minnesota.

A. E. Sandberg, 1938, Geol. Soc. America Bull., v. 49, no. 5, p. 797 (fig. 2), 798, 810. The Keweenawan at Duluth rests unconformably on Carlton slate.

G. M. Schwartz, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1002–1003. Thomson formation has been referred to as Thomson slate, St. Louis slates, Cloquet slates, and Carlton slate, but Thomson slate has priority. It is here suggested that term Thomson formation replace Thomson slate.

Occurs in vicinity of Duluth.

Carltonian Formation[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: A. C. Lawson, 1893, Minnesota Geol. Nat. History Survey Bull. 8, p. xxi, 22, 23.

Named for extensive exposures in Carlton Peak, northeast Minnesota.

†Carlyle Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 119.

Named for Carlyle, Allen County.

Carmack Limestone[1]

Lower Mississippian: Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 37.

W. C. Morse, 1930, Mississippi Geol. Survey Bull. 23, passim. Term Camack Creek used interchangeably with Carmack limestone.

W. C. Morse, 1936, Mississippi Geol. Survey Bull. 32, p. 16 (pl. 1). Generalized section of Paleozoic rocks shows Carmack limestone underlying Iuka formation and overlying Devonian Whetstone Branch formation.

Named for Carmack Creek, a tributary of Tennessee River north of Whetstone Branch, Tishomingo County.

Carmack Creek Limestone

See Carmack Limestone.

Carman Quartzite (in Maquam Group)

Middle Ordovician (Chazyan): Northwestern Vermont and southeastern Quebec, Canada.

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1172. Fine-sand quartzite and argillaceous fine sandstone with some limestones toward top. Thickness 60 to 135 feet. Underlies Youngman formation (new); overlies Beldens formation.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Basal formation of Maquam group (new).

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 81. Has type section at head of Shipyard Bay in Highgate Springs area; it contains about 120 feet of thin- to medium-bedded quartz sandstone having a few argillaceous partings and includes some calcarenite beds in upper part. Section exposes contact with underlying Beldens calcitite but top is cut off by fault.

Type locality: Shipyard Bay, Highgate Springs, Franklin County, Vt.

Carmel Formation (in San Rafael Group)[1]

Middle and Upper Jurassic: Southern, central, southeastern and northeastern Utah, northeastern Arizona, western Colorado, and northwestern New Mexico.

Original references: J. Gilluly and J. B. Reeside, Jr., 1926, U.S. Geol. Survey Press Bull. 6064, March 30; 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 73–76.

E. T. McKnight, 1940, U.S. Geol. Survey Bull. 908, p. 86–89, pls. In area between Green and Colorado Rivers, the Carmel is exposed in irregular belt from Green River near mouth of the San Rafael roughly eastward to Moab fault at the Dugway northeastward across Moab anticline and Courthouse syncline. Thickness 125 feet at north end of Tenmile Butte and 152 feet near Courthouse Spring. In contrast to its lithology in San Rafael Swell and other parts of southern Utah, the Carmel contains no limestone in area of this report. It is composed chiefly of pink to red to reddish-brown muddy sandstone with, locally, considerable gray to reddish sandy mudstone. The mudstone occurs in upper part of formation near the Green River, but eastward grades into reddish-brown muddy sandstone that forms top of Carmel at Courthouse Rock. In eastern part of area, light-colored beds are subordinate to red facies and appear chiefly in basal part of formation, which toward the Green River is entirely red. These light-colored beds toward the east are largely sandstone, in part limy, and are white, yellowish white, and dirty grayish. They are interbedded with red muddy sandstones, are discontinuous along outcrop, and commonly show lenslike thickening and thinning. Overlies Navajo sandstone; underlies Entrada sandstone, apparent conformity. Upper Jurassic.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 89, 92–94, strat. sections. Described in Zion Park region where it is 200 to 300 feet thick; underlies Entrada sandstone and unconformably overlies Navajo sandstone (Temple Cap member) of Glen Canyon group. Consists of bluish-gray limestone in resistant massive beds and soft shaly beds; some argillaceous and gypsiferous shale; marine fossils. A series of flu-

vial and eolian beds formerly included in the Carmel are here treated as Temple Cap member of Navajo.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 597. In Strawberry Valley quadrangle, Utah, grades into Twin Creek limestone.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 963–964, chart 8C (columns 2–9). Formation not been accurately dated but probably corresponds to most of Middle and the earliest Upper Jurassic.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 68–70, strat sections. Described in Henry Mountains region where it is 100 to 626 feet thick. Consists of thin-bedded red sandstone, shaly sandstone and shale, thin limestone, and, in northwestern part of area, thick beds of gypsum. Unconformably overlies Navajo sandstone; underlies Entrada sandstone.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. Extended into Iron Springs district, Utah, where it includes all the strata previously called Homestake limestone. Overlies Navajo sandstone; underlies Entrada sandstone.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 33–35. Over most of Navajo country, Carmel consists of typically silty strata, but, in southwestern part of area, has different lithologic characteristics owing to introduction of locally derived sand. This variation of deposition continued during deposition of Entrada sandstone; hence, the two units are difficult to differentiate in this area. Thickness between 100 and 200 feet.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–64. Mapped in Horse Range Mesa quadrangle, Colorado, where it consists largely of red to buff nonresistant horizontally bedded siltstone, mudstone, and sandstone. Thickness 20 to 50 feet. Grades upward into Entrada sandstone; overlies Navajo sandstone.

Named for occurrence at Mount Carmel, Kane County, Utah.

Carmelo Series[1]

Upper Cretaceous: Western California.

Original reference: A. C. Lawson, 1893, California Univ. Pubs., Dept. Geol. Bull., v. 1, p. 1–59.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Mapped with Upper Cretaceous marine sediments.

Carmelo Bay region, southwest coast of San Mateo County.

†Carmen Formation

Miocene, lower: Eastern central Idaho.

A. L. Anderson, 1956, Idaho Bur. Mines and Geology Pamph. 106, p. 1, 16, 28–31, pl. 1. Consists for most part of moderately well-indurated thin-bedded fine-grained clastic rocks, mostly shales with considerable amount of intercalated sandstone and locally some conglomerate and lignite. Except for lignitic beds, rocks are light colored, mostly white or light gray. One conglomerate bed near base is some tens of feet thick. Distinguished from underlying Challis volcanics by absence of lava flows, ignimbrites, and other products of direct volcanic origin.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 21, 27. Preoccupied name Carmen replaced by Kirtley formation.

Named after settlement of Carmen. Excellent exposures above and below settlement and along Carmen Creek to east. Contained wholly within and forms floor and flanks of broad intermontane Salmon Basin, Lemhi County.

Carmichaels Formation[1]

Pleistocene (Illinoian) : Western Pennsylvania.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 82.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 153–154, pl. 1. In Fayette County, deposits occur in abandoned meanders of Monongahela and Youghiogheny Rivers. Thickness 60 to 80 feet locally but more commonly thinner.

Named for exposures at Carmichaels, Green County.

Carnahan Bayou Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 154–158, geol. map. Group of siltstones with intercalated sand lenses, local brackish-water clays, and thin tuffaceous beds. Thickness more than 125 feet. Underlies Dough Hills member (new); overlies Lena member (new).

Basal beds are typically exposed in roadcuts along U.S. Highway 71W, south of Lena, Rapides Parish. Name derived from Carnahan Bayou.

Carnahan Run Shale (in Conemaugh Formation)

Pennsylvanian: Western Pennsylvania.

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Calcareous marine shale, 1½ to 7 feet thick (5 feet at type locality); occurs 126 feet below Ames limestone, 13½ to 23½ feet above Woods Run limestone, and approximately 216 to 226 feet above Upper Freeport coal.

Type locality: About 0.7 mile north of North Vandergrift, Parks Township, Armstrong County.

Carnerada Conglomerate Member (of Marlife Shale)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec. Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Red cobble conglomerate 0 to 2,200 feet thick. At base of Marlife shale (new). Overlies Ciervo shale (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: South Branch of Moreno Gulch, Fresno County. Name derived from Carnerada Canyon.

Carneros Sandstone Member[1] (of Temblor Formation)

Miocene, or Miocene, lower: Southern California.

Original reference: G. M. Cunningham and W. F. Barbat, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 4, p. 419–421.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 9, pl. 1. Described in Bitterwater Creek area as commonly a hard medium- to fine-grained calcarenite tan to gray

sandstone. Along axial trace of McDonald anticline, minimum exposed thickness is 1,250 feet; thickness at mouth of Cedar Canyon 123 feet; change in thickness probably due to rapid change in facies; sandstone pinches out as it crosses Bitterwater Creek northwestward. Conformably overlies Santos shale member; conformably underlies Media shale member.

Named for Carneros Creek, Kern County.

Carney Lake Complex

Precambrian: Northern Michigan.

S. B. Treves, 1960, Dissert. Abs., v. 20, no. 10, p. 4080. Chiefly lower Precambrian gneisses that contain inclusions of older rocks, and minor syenite, granodiorite dikes, and pegmatites, numerous middle Precambrian metadiabase dikes and some quartz-rich pegmatite veins; a few upper Precambrian diabase dikes.

Present in Dickinson County.

†Carolina Gneiss[1] or Series

Precambrian: Northwestern North Carolina, South Carolina, northern Georgia, eastern Tennessee, and western Virginia.

Original reference: A. Keith, 1901, U.S. Geol. Survey Geol. Atlas, Folio 70, p. 2.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1379. Carolina gneiss, or Carolina series, is made up largely of biotite gneiss and mica schist, with beds of kyanite schist, quartzite, and rarely marble. Ashland, Wedowee, and Canton formations of Alabama and Georgia are here regarded as part of Carolina series.

T. L. Kesler, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 756, 775–781. Near Kings Mountain, mica schists and gneisses, previously mapped as Carolina gneiss, and hornblende gneisses previously mapped as Roan gneiss, actually constitute metamorphosed upper part of the Gaffney. Similar rocks in Beaver Creek area are apparently stratigraphically higher. Evidence in other parts of Carolina Piedmont, indicates that intrusive diorite and possibly recrystallized mafic volcanic rocks have been included in the Roan and possibly recrystallized felsic volcanic rocks in the Carolina. Names Carolina and Roan have lithologic but not stratigraphic value.

F. D. Eckelmann and J. L. Kulp, 1956, Am. Jour. Sci., v. 254, no. 5, p. 291, 314. Carolina gneiss includes all the various mica gneisses and mica schists in Spruce Pine district. Rocks are interlayered with those of the Roan gneiss, and the two types grade into each other along and across the strike. Roan-Carolina sequence (or complex) appears to be a single sedimentary unit with varying lithology, complicated by intense isoclinal folding and plastic deformation. Crosscutting relationship between the Cranberry gneiss or Henderson gneiss and the Roan-Carolina complex are entirely absent; the Cranberry and Henderson formations are in a consistent and conformable stratigraphic position below the Carolina-Roan complex as seen in Cranberry, Roan Mountain, and Mount Mitchell quadrangles.

Named for its occurrence on Piedmont Plateau in North and South Carolina.

Carolinas Limestone

Pliocene or Pleistocene: Mariana Islands (Tinian)

Risaburo Tayama, 1936, Geomorphology, geology, and coral reefs of Tinian Island together with Aguijan and Naftan Islands: Tohoku Univ., Inst. Geology and Paleontology Contr. in Japanese Language, no. 21, p. 21–26, 31 [English translation in library of U.S. Geol. Survey, p. 20–25, 31–32]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, table 3. *Halimeda* and coralline limestone. Beds dip seaward at angle of about 20°. Underlies Mariana limestone. May be Plio-Pleistocene.

Occurs on southeast coast of Tinian Island.

Caroline Limestone

Pleistocene or early Holocene: Caroline Islands (Fais).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 347 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 68, table 5 [English translation in library of U.S. Geol. Survey, p. 82]. Named on correlation chart. Coral reef limestone. Older than Fais limestone. Consists chiefly of Halimeda limestone, with lesser amounts of coral limestone. Plio-Pleistocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 26. About 3 meters thick. Twenty meters above sea level. Early Holocene.

Fais (Feys) Island, west Caroline Islands.

†Carolinian Bed[1]

Eocene: Eastern South Carolina and North Carolina.

Original reference: E. Ruffin, 1843, South Carolina Agric. Survey 1st Rept., p. 6–24.

Exposed on Ashley and Cooper Rivers and their branches, also on Santee River and its branches, and on the Savannah and its branches. Named for extensive development in Coastal Plain of South Carolina.

Carpenter Bed[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 733, 735.

Probably named for Carpenter Spring, east side of Eagle Mountain, El Paso County.

Carpenter Limestone Member (of Grayson Formation)

Upper Cretaceous: Southwestern Texas.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 11 (table 1), 27, 28, pls. 1, 8, 16. Consists of about 90 feet of nodular thin-bedded black limestone weathering blue gray and interbedded gray shales; fossiliferous. Underlies a 60-foot middle member informally referred to as the reef-limestone; conformably overlies Georgetown limestone, to which it is very similar in appearance.

Type locality: Carpenter Canyon at a point about 1 mile above Carpenter Wells, Hudspeth County.

Carpenter Creek Porphyry[1]

Post-Cretaceous(?) : Central Montana.

Original reference: L. V. Pirsson, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 501.

U.S. Geological Survey currently designates the age of Carpenter Creek Porphyry as post-Cretaceous(?) on basis of study now in progress.

Named for occurrence above Carpenter Creek, Little Belt Mountains.

Carpinteria Formation[1]

Pleistocene, upper: Southern California.

Original reference: R. W. Chaney and H. L. Mason, 1934, Carnegie Inst. Washington Pub. 415, p. 48–52 [preprint 1932].

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 38, pl. 1. Late Pleistocene.

Probably named for Carpinteria, Santa Barbara County.

†Carquinez Series[1]

Eocene: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416.

Carrasco limestone[1]

Upper Cambrian(?) : Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 5.

Well displayed back of Carrasco smelter property, near Silver City, Silver City region.

Carrigan black lands[1]

Pleistocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey, v. 2, Ann. Rept. 1888.

Carrizo Flow or Tongue (of Clayton Basalt)

Late Cenozoic: Northeastern New Mexico

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 112, 133, 134, 143 (fig. 20). East of type locality, Clayton basalt consists of many long tongues. For purposes of this report, these tongues have been named, from south to north, Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that gave rise to these basalts are unknown.

Present in eastern Union County.

†Carrizo Formation[1]

Miocene: Southern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, no. 3, chart opposite p. 226.

Named for exposures in broad valley of Carrizo Creek, immediately north of Coyote Mountain, Imperial County.

Carrizo Sand (in Claiborne Group)[1]

Carrizo Formation (in Wilcox Group)

Eocene, middle: Southern and eastern Texas and western Louisiana.

Original reference: J. Owen, 1889, Texas Geol. and Min. Survey 1st Rept. Prog., p. 70, 73–74.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 60–65 [1938]. Sand (formation) described in Leon County, Tex., where it is about 60 feet thick. Underlies Newby glauconitic sand member (new) of Reklaw formation; overlies Sabinetown formation of Wilcox group.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 47 (fig. 1), 65–68, geol. map. In this report, Carrizo formation is considered uppermost formation in Wilcox group. Overlies Sabinetown formation; underlies Reklaw formation.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 243–C, p. 37. Because of similarity of their stratigraphic position above Carrizo sand and similarity of the ferruginous beds partly composing them, Reklaw and Bigford members of Mount Selman formation have been regarded as contemporaneous. Geographic and stratigraphic positions of fossiliferous, ferruginous sandstones north of Leming, Atascosa County, suggest they represent eastward extension of the Bigford from Frio County. If the Leming and Scruggs Creek localities should prove to represent the same zone, then, on assumption that the conglomerate is basal part of Reklaw, it would appear that the Bigford is not exact equivalent of the Reklaw, but is older and intervenes between the Carrizo and the Reklaw.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 10 (fig. 3), 14 (fig. 5), 19–34. Formation (sand) described in Henrys Chapel quadrangle where it is 27 to 104 feet thick and consists of lower cross-bedded part and upper shaly level-bedded part. Overlies Wilcox group, locally, Henrys Chapel ball clay lentil (new); underlies Newby glauconitic sand member of Reklaw formation.

Type exposure: In quarries about one-half mile west of Carrizo Springs, Dimmit County, Tex.

†Carrizo Creek Beds[1]

Miocene: Southern California.

Original reference: C. R. Orcutt, 1890, California State Mining Bur. 10th Ann. Rept., p. 915.

Crops out on Carrizo Creek, but can also be seen along west side of valley around Coyote Mountains at Yuba Buttes and at Superstition Mountain as well as at San Felipe Valley, west of Salton Sea, Imperial County, and at places north of San Gorgonio Pass, in Riverside County.

Carrizo Mountain Formation

Carrizo Mountain Group

Carrizo Mountain Schist[1]

Precambrian: Western Texas.

Original reference: W. H. von Streeruwitz, 1891, Texas Geol. Survey 2d Ann. Rept. 1890, p. 681–683.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 144 (fig. 1), 145–147. Carrizo Mountain schist described in Van Horn region where it consists of a number of contrasting types of metamorphic rocks which can be mapped separately over wide areas. These rocks fall into two main groups, one of which appears to lie stratigraphically below the

other; lower group is largely of igneous origin and upper group largely sedimentary origin. Schist is overthrust northward on succeeding Allamoore limestone (new).

P. B. King and P. T. Flawn, 1953, Texas Univ. Bur. Econ. Geology Pub. 5301, p. 20–24, pl. 2. Carrizo Mountain group used in this report. Described as a body of metamorphic rocks of great thickness which in individual areas can be subdivided into a variety of rock types, most of which are mappable as separate entities. Many of these entities are well defined sedimentary units a thousand or more feet thick, which would be formations in their own right in sequence less disturbed and more widely exposed. Unit does not correspond with other formations as these are commonly differentiated in Texas. Although it is impracticable to subdivide unit into named divisions, it deserves informal designation as a group in much same manner as metamorphic units in Alaska and Canada. U.S. Geological Survey prefers term formation. Term group is used in this report without prejudice as to whatever usage may be adopted in subsequent reports of U.S. Geological Survey.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. All Precambrian rocks in Wylie Mountains and vicinity are referred to Carrizo Mountain group. Unconformably underlies Powwow conglomerate.

Named for Carrizo Mountains, El Paso County.

Carrizozo Lava Flow

Recent: South-central New Mexico.

J. E. Allen, 1951, *in* Roswell Geol. Soc. Guidebook 5th Field Trip, p. [7, 9–11]. Lava flow or malpais in all probability was extruded within last 1,000 years from base of single crater near northern end of flow. Exhibits all features commonly associated with recent flows of basaltic composition, such as flow units, pressure ridges, collapsed lava tunnels, and kipukas or steptoes of older rocks surrounded as islands by lava. Other minor surface features are ropy lava (pahoehoe), spatter cones, grooved lava, squeezeups, vesicular lava, and banded lava. Flow is approximately 44 miles long, in places up to 5 miles wide, and has average thickness of about 70 feet. Very close to 1 cubic mile in volume.

Eastern edge of flow is encountered along U.S. Highway 380, 4.2 miles west of Carrizozo.

†Carrollton Limestone[1]

Mississippian: Northwestern Arkansas.

Original reference: H. S. Williams, 1900, Arkansas Geol. Survey Ann. Rept. 1892, v. 5, p. 334–337.

Exposed in cliff in ravine in Carrollton, Carroll County.

Carrollton Mountain Porphyry[1]

Precambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135 (table), 136–137.

Bain's map shows Carrollton Mountains in eastern part of Wichita Mountains, Comanche County.

Carson Conglomerate

Tertiary, lower or middle: Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 31, 48–49, pls. 1, 3. Characteristically coarse, containing many boulders over a foot in diameter. Usually well cemented and quite resistant to processes of denudation. Matrix is light gray and resembles concrete; cement is silica. Boulders, cobbles, and pebbles consist of rhyolite, trachyte, andesite, black chert, and quartzite. Overlaps Precambrian rocks of area.

R. H. Jahns, 1946, New Mexico Bur. Mines Mineral Resources Bull. 25, p. 25. Early or middle Tertiary. Best exposures cited.

Overlaps rocks of Precambrian age along western, northern, and northeastern borders of Petaca area, Rio Arriba County. Best exposed in vicinity of Las Tablas where beds form bold cliffs and benches along lower slopes of Tusas River valley.

Carson Lava[1]

Pleistocene: Southwestern Washington.

Original reference: I. A. Williams, 1916, Oregon Bur. Mines and Geol., Min. Res. Oregon, v. 2, no. 3, p. 95–96.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2. Age shown on chart as Pleistocene.

Extends from Carson Station to Wind River Canyon, Skamania County.

Carson Creek Formation[1]

Paleozoic or Mesozoic: Northern California.

Original reference: F. A. Moss, 1927, Eng. and Mining Jour., v. 124, p. 1010–1011.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 675. Local name for bedrock series. Paleozoic or Mesozoic.

Exposed west of Carson Hill, Calaveras County.

Carsonian series[1]

Quaternary: Nevada.

Original reference: C. R. Keyes, 1923, Pan.-Am. Geologist, v. 40, p. 52, 78.

Well exposed in the valleys of the Carson and Truckee Rivers in western Nevada.

Carsonville Granite

Precambrian: Southwestern Virginia.

A. J. Stose, 1942, (abs.) Am. Geophys. Union Trans., 23d Ann. Mtg., pt. 2, p. 342. Injection complex of early Precambrian age is exposed in Elk Creek anticline in Grayson County. There, sedimentary rocks and diorite have been intruded by the Striped Rock and Carsonville granites.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 34–37, pl. 1. Narrow belt of fine-grained pink felsitic granite that intrudes the Striped Rock granite along its northern and western borders; it is interbanded with a porphyritic biotite granite which has pink microcline phenocrysts and contains xenoliths of Saddle gneiss.

Named from village of Carsonville, 2 miles north of Baxter Ferry on New River. Well exposed on road near Carsonville, near Mountain View School to west, on Rock Creek, on Roaring Branch, on a tributary to Saddle Creek, and near head of Little Peach Bottom Creek. Occurs within areas of Comers granite gneiss and Grayson granodiorite gneiss.

Carters Limestone (in Stones River Group)

Carters Limestone Member (of Lowville Limestone)[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 258–268.

Ray Bentall and J. B. Collins, 1945, Tennessee Div. Geology Oil and Gas Inv. Prelim. Chart 4, sheet 1. Rank raised to formation in Stones River group.

C. W. Wilson, 1949, Tennessee Div. Geology Bull. 56, p. 44–45. Names Tyrone and Lowville should not be used in central Tennessee; name Carters has priority over New York name, Lowville, and Kentucky name, Tyrone; name Carters limestone should be restored to formational rank and used as originally defined by Safford, that is, to include strata between overlying Hermitage formation and underlying Lebanon limestone. In central Tennessee, Carters limestone consists of upper thin-bedded unit and lower massive-bedded unit, which are referred to as Upper member and Lower member. The two members are separated by a bentonite bed, and Lower member contains two bentonite beds. Thickness of Lower member averages 50 feet; maximum thickness of Upper member 28 feet. Safford's "type locality" discussed in detail.

Named for exposures on Carters Creek, Maury County. Carters Creek arises from many several tributaries about 8 miles north of Columbia, Maury County, flows essentially southward, joining Rutherford Creek about 3½ miles north of Columbia.

†Carters Creek Limestone[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 258–268.

Named for exposures on Carters Creek, Maury County.

†Cartersville Formation[1]

Lower Cambrian: Northwestern Georgia.

Original reference: H. K. Shearer, 1918, Georgia Geol. Survey Bull. 34, p. 48–49, 128–163.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 19. Abandoned. Shearer grouped together some parts of Conasauga and Rome formations in which metasiltstone is common and designated them Cartersville formation. It has been impossible to adhere to this grouping, because Shearer's contacts transgress the strike of the rocks and his formation includes carbonate rocks, calcareous metashale, and noncalcareous metashale which, as shown herein, are stratigraphically distinct.

Named for exposures in vicinity of Cartersville, Bartow County.

Cartersville Granite[1]

Precambrian: Central Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey, prelim. ed. of geol. map of Virginia.

Mapped at and around Cartersville, Cumberland County.

Carterville Formation[1]

Upper Mississippian: Southwestern Missouri.

Original reference: C. E. Siebenthal, 1907, U.S. Geol. Survey Geol. Atlas, Folio 148.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 268–270. Consists of shaly lumpy somewhat conglomeratic and in most places oolitic limestone, calcareous shale, light to dark argillaceous arenaceous shale. and shaly sandstone, massive unindurated sandstone, massive hard sandstone, and quartzite. Thickness ranges from a few inches up to 50 feet. Occupies depressions (apparently old sink holes) in Boone formation; in all occurrences surrounded by a rim of Boone limestone.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1959, Deutsche Geol. Gesell. Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Chart shows formation, about 16 feet thick, overlying Short Creek member of Boone formation and underlying Cherokee shale.

Named for exposures west of Carterville, Jasper County.

Carthage Limestone[1]

Mississippian (Warsaw): Southwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Geol. Survey Bien. Rept., p. 30, 37, 38.

Named for exposures at Carthage, Jasper County.

Carthage Limestone (in Lisman Formation)

Carthage Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Western Kentucky and southern Illinois.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 60, 61; 1857, Kentucky Geol. Survey, v. 3, p. 18.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 26). Shown on correlation chart as limestone in Lisman formation.

Named for Carthage Settlement (no longer in existence) on Ohio River, just above mouth of Wabash River, Union County, Ky.

Carthew Member (of Altyn Formation)

Precambrian (Belt Series): Southern Alberta, Canada, and western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1883–1884, fig. 2. Magnesian limestones, dolomites, quartzites, and intermediate rocks which grade upward into basal Appekunny formation. Colors range from blue gray through buff to brown and dark brownish red; bedding thin to thick. Red beds, especially, show thin laminae. Thickness estimated at 700 to 900 feet. Overlies Hell Roaring member (new).

Type locality: Eastern cliffs of Cameronian Mountain above Cameron Creek, Waterton Lakes Park, Alberta. Well exposed on eastern face of Bertha Mountain, on slopes between Vimy Peak and the Narrows of Waterton Lake, and on northern cliffs of Gable Mountain, Glacier National Park.

Cartwright Gravel

Pleistocene (pre-Wisconsin): Northwestern North Dakota and northeastern Montana.

A. D. Howard, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 578, pl. 1. Gravel which marks paths of streams across Missouri Plateau peneplain. Caps Cartwright bench along parts of major valleys characterized by distinctive brown, water-worn pebbles.

A. D. Howard, 1960, U.S. Geol. Survey Prof. Paper 326, p. 19–21, pl. 1. Gravel and interbedded sand on Missouri Plateau peneplain. Thickness 35 to 40 feet at Cartwright locality; regional average thickness about 30 feet. Older than Crane Creek gravel; younger than Flaxville gravel. Pre-Wisconsin, Aftonian(?).

Well exposed along road that descends into Yellowstone Valley, 5 to 6 miles north of town of Cartwright in northwestern McKenzie County, N. Dak., not far from Yellowstone-Missouri confluence.

Carwood Formation[1] (in Borden Group)

Lower Mississippian: Southeastern Indiana.

Original reference: P. B. Stockdale, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 170.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 76–77, 147–192. Includes following facies (herein named): Bennettsville, Knob Creek, Evans Landing, Delaneys Creek, Sparksville, Gent, Fleener, and Kelly Hill.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Shown on correlation chart in Borden group, Osage series. Underlies Floyds Knob formation; overlies Locust Point formation.

Named from village of Carwood (Bridgeport), 4¾ miles southeast of Borden, NW¼NW¼ sec. 9, and SW¼SW¼ sec. 4, T. 1 S., R. 6 E., Clark County. Any one of numerous exposures in Clark County might serve as a "type" section; best is along Borden-Martinsburg Road, one-half mile southwest of Borden.

Cary Stade

Cary (Caryan) Substage[1] or Subage

Pleistocene (Wisconsin): Mississippi Valley.

Original reference: M. M. Leighton, 1933, Science, v. 77, p. 168.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 132. Bradyan subage (new) occurs between Tazewellian Caryan sub-ages. It divides Wisconsinian into two unequal parts. Report also mentions Cary till and Cary loess.

R. V. Ruhe, Meyer Rubin, and W. H. Scholtes, 1957, Am. Jour. Sci., v. 255, no. 10, p. 671–689. New radiocarbon dates in Iowa permit a grouping of age values and raise new problems in stratigraphic correlation of late Pleistocene deposits in Iowa and adjacent regions. An older group of ages greater than 29,000 years dates Iowan substage and pre-Iowan deposits. An old group of ages of 22,900 to 25,100 years dates the Farmdale substage. An intermediate group of ages ranges 14,000 to 17,000 years. Minimum date of Tazewell-Cary interstadial is 14,000 years. Cary maximum in southern extremity of Des Moines lobe in Iowa was 14,000 years ago. A young group of ages ranges from 11,900 to 14,000 years and record Cary glaciation in southern extremity of Des Moines lobe.

V. C. Shepps, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 167–187; V. C. Shepps and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull G–32, p. 2–59. Deposits of Cary substage in northwestern Pennsylvania include Kent, Lavery, Hiram, and Ashtabula tills.

Meyer Rubin, 1960, Am. Geophys. Union Trans., v. 41, no. 2, p. 288–289. Discussion of changes in Wisconsin glacial stage chronology by C^{14} dating. Type Mankato till dates at about 12,000 years, making it older than Valders till of Thwaites at Two Creeks, and actually placing it into Cary

substage range of ages. Because of difficulty in finding any type of break between Cary-age and Tazewell-age deposits in many places, some workers have abandoned division of the two entirely, grouping them together.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 3–4, 7. Presentation of new classification of Wisconsinan stage of Lake Michigan glacial lobe. Consists of following substages (descending): Valderan, Twocreekan, Woodfordian, Farmdalian, and Altonian. The Woodfordian includes Iowan substage of Illinois usage (but not of the type), the type Tazewell and Cary substages. Includes that part of the Cary that has recently been assigned to the Mankato (Leighton, 1957; Wright, 1957, Science, v. 125, no. 3256).

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Presentation of new classification of Wisconsin glacial stage of north-central United States. Cary glacial substage by St. Charles intraglacial substage and from younger Mankato glacial substage by Bowmanville intraglacial substage. Author [Leighton] does not agree with classification proposed by Frye and Willman (1960) in which they placed all three substages, Tazewell, Cary, and Mankato in the Woodfordian.

Name amended to Cary Stade to comply with Stratigraphic Code adopted 1961.

Name derived from town of Cary, McHenry County, Ill.

Caryville Sandstone (in Redoak Mountain Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau; Tennessee Div. Geology [folio], p. 11, 19, pls. 2, 3, 4. Thickness 60 feet near Caryville; 10 feet in Cross Mountain section; 20 feet in Walnut Mountain section. Overlies a shale unit 80 to 190 feet thick at base of group; separated from overlying Fodderstack sandstone (new) by a shale interval 50 to 150 feet thick.

Named from exposures in section above Caryville, Jacksboro quadrangle, Campbell County. A northwest-southeast belt of massive Caryville crosses Windrock, Duncan Flats, Fork Mountain, Block, and Jacksboro quadrangle.

Casadepaga Schist[1]

Pre-Paleozoic or Lower Paleozoic: Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geol. Survey Bull. 433, p. 70–75, map.

Covers 100 square miles in Solomon and Casadepaga quadrangles, one belt along east part of quadrangles and another along west part of quadrangles, Seward Peninsula.

Casa Larga Marls

Eocene, upper: Panamá Canal Zone.

[T. F. Thompson] 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 8. Oldest known sedimentary formations known to rest upon the Basement Complex occur within the vicinity of the Tranquilla shales, which formerly cropped out at a point in the Chagres River Valley now inundated by the waters of Madden Lake, and in so-called Casa Larga marls to the southeast of Tranquilla shale locality. On basis of their fossil content, the marls are considered to be upper Eocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 329. Expression used by Thompson was "so-called Casa Larga marls." An undefined name for calcareous strata in Gatuncillo formations.

Madden basin.

†Cascade Formation[1]

Precambrian: Northwestern Michigan.

Original reference: M. E. Wadsworth, 1890, Lake Superior along the south shore, by Julian Ralph, p. 77–99; 1st ed., 1890; 2d ed. 1891.

Well exposed at Cascade Range, Marquette district.

†Cascade Formation[1]

Lower Cretaceous: Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

Kiril Spiroff, 1938, Econ. Geology, v. 33, no. 5, p. 558 (fig. 2). Mapped as Cretaceous in Barker mining district, Hughesville, Montana.

Named for development in Cascade County; Little Belt Mountains and Fort Benton region.

†Cascade Sandstone (in Chemung Formation)[1]

Cascade sandstone member (of Cayuta monothem)

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G–5, p. 74–79, 82, 98.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 47. Reallocated to base of Cayuta monothem. Described near Lanesboro as usually massive coarse gray to olive-green sandstone; highly micaceous and usually stained with iron oxide. Made up of several lenses not individually traceable for great distance, yet unit as whole is very persistent. Layers of coarse flat pebbles and conglomeratic layers locally developed. Underlies Owego shale member (new). [Shown as equivalent to lower part of Owego in fig. 7.] Also termed Cascade Creek sandstone member.

Forms cliffs which wall in Cascade Creek at Erie Railroad crossing, Susquehanna County.

Cascade Creek Sandstone (in Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original references: J. J. Stevenson, 1892, Am. Geologist, v. 9, p. 22; 1892, Am. Assoc. Adv. Sci. Proc., v. 40, p. 235.

Susquehanna and Wayne Counties.

Cascades Formation[1] or Andesite

Pleistocene: Central northern Oregon and southwestern Washington.

Original reference: I. A. Williams, 1916, Oregon Bur. Mines and Geology, Mineral Resources Oregon, v. 2, no. 3.

1959, Dept. Geology and Mineral Resources Bull. 50, p. 9, 11. Cascade andesite (Cascan) listed in Cenozoic formations of Oregon.

Occurs in Cascade Mountains.

Cascadia Formation[1]

Oligocene and Miocene(?): Central northern Oregon.

Original reference: E. T. Hodge, 1928, Pan-Am. Geologist, v. 49, p. 341–356.

Exposed near Cascadia, Linn County.

Cascadian Stage[1] or Glacial Epoch

Pleistocene: Central northern Oregon.

Original reference: E. T. Hodge, 1930, Monthly Weather Rev., v. 58, p. 405–411.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 834–835, 841 (table 1). Oldest of five glacial epochs; followed by Bull Run glacial epoch.

Cascadilla Shale Member (of Ithaca Formation)

Cascadilla Shale Member[1] (of Ithaca facies subgroup)

Upper Devonian: South-central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Member of Ithaca formation. Underlies Williams Brook member; overlies Six Mile shale member. Thickness 150 feet.

Occurs in Ithaca region. Probably named for Cascadilla Gorge at Ithaca, Tompkins County.

Cascajo Conglomerate Member (of San Joaquin Formation)

Pliocene, upper: Southern California.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 49–54, pl. 3 [1941]. Unit of conglomerate and sandstone, generally blue, lying at base of San Joaquin formation. Average thickness 50 feet, but at places considerably greater. Overlies Etchegoin formation.

Type locality: Cascajo Hill, on west flank of South Dome, Kettleman Hills. South Dome is the northern part of the anticline that is overlapped by the alluvium of San Joaquin Valley.

Cascan Formation

Pliocene or Pleistocene: Central northern Oregon.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 841 (table 1), 842 (fig. 4), 879–886. Mnemonic name proposed for formation composed chiefly of andesitic lava flows that lie on top of Dalles and Troutdale formations and are older than Mount Hood formation.

E. T. Hodge, 1940, Oregon State Coll. Studies in Geology Mon. 1 [map with text]. Described in Madras quadrangle where it lies conformably upon Madras formation and unconformably upon all older formations. Older than a Recent unit termed the Intracanyon formation.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 7, pl. 2. Pliocene.

Type locality: Cascade Mountains of northern Oregon.

Casco Bay Group[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Includes (ascending) Cape Elizabeth Formation, Spring Point Greenstone, Diamond Island Slate, Scarboro Phyllite, Spurwink Limestone, Jewell Phyllite, and Mackworth Slate.

Named for development in and around Casco Bay, Cumberland County.

Casey Limestone[1]

Middle Devonian: Southern central Kentucky.

Original reference: T. E. Savage, 1930, Kentucky Geol. Survey, ser. 6, v. 33, p. 12, 143–144.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, chart 4. Shown on correlation chart below Duffin limestone and above Boyle limestone.

J. M. Weller, 1944, Illinois Geol. Survey Bull. 68, p. 211. Southward in Kentucky it [Sellersburg limestone] loses its typical lithologic and faunal characters and may be overlapped by the Casey limestone.

Well exposed in southwestern part of Casey County.

Caseyville Formation (in McCormick Group)

Caseyville Sandstone (in Pottsville Group)[1]

Caseyville Group

Lower Pennsylvanian: Southeastern Illinois and western Kentucky.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 48, 49, 62, pl.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36–39. Group includes (ascending) Lusk, Battery Rock, and Pounds formations. Maximum thickness more than 400 feet in parts of Pope and Hardin Counties; thins irregularly westward to not more than 200 feet in northern Union County. Underlies Tradewater group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 28–30, 44 (table 1), 61–62, pl. 1. Defined as formation in McCormick group (new). Includes strata from base of Pennsylvanian to top of Pounds sandstone member. Corresponds to Caseyville formation as defined by Lee (1916, Geology of the Shawneetown quadrangle in Kentucky; Kentucky Geol. Survey) and probably to strata referred to as Caseyville conglomerate by Owen (1856). Caseyville as previously used in Illinois (Weller, 1940) is thus redefined to exclude 40 to 60 feet of strata (including Reynoldsburg coal) above Pounds sandstone and below Grindstaff sandstone that are here included in overlying Abbott formation (new). Characterized by dominance of sandstone and prominent development of sandy shale and siltstone. Thickness commonly 350 feet. In southeastern area, includes (ascending) Lusk shale, Battery Rock sandstone, Sellers limestone, Gentry coal (new), and Pounds sandstone members; in southwestern area includes (ascending) Wayside sandstone, Battery Rock sandstone, Drury shale, and Pounds sandstone members. Type area defined by Lee (1916). Supplementary section given.

U.S. Geological Survey has abandoned use of the term Pottsville in Kentucky and Illinois.

Type area (Lee, 1916): Measured from outcrops on Illinois shore of Ohio River between mouth of Saline River and Gentry's Landing below Battery Rock, T. 11 S., R. 10 E., Shawneetown quadrangle, Hardin County. Reference section: Along railroad cut of Illinois Central Railroad from tunnel, NW¼SW¼SE¼ sec. 31, T. 11 S., R. 5 E., southward to

NE¼SE¼NE¼ sec. 18, T. 12 S., R. 5 E., Brownfield and Harrisburg quadrangles, Pope County, Ill.

Cashaqua Shale Member (of Sonyea Formation)

Cashaqua Formation (in Naples Group)

Cashaqua Shale[1]

Upper Devonian: Western and central New York.

Original reference: J. Hall, 1840, New York Geol. Survey 4th Rept., p. 390–391, 409, 423, 452–455.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 12. Cashaqua shale includes (ascending) unnamed shale member, Rock Stream flagstone member (new), and Parrish limestone lentil.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Rank reduced to member status in Sonyea formation. Hall (1840) gave formational name Cashaqua to soft gray mudrock and shale that crops out along lower part of Cashaqua Creek (spelled Keshequa on recent topographic maps) near Sonyea in west-central Livingston County. As originally defined by Hall and as subsequently used by other geologists in western two-thirds of area covered by present report, Cashaqua shale included, in terms of nomenclature of this report, all rocks between Middlesex shale member of Sonyea formation and base of Rhinestreet shale member of West Falls formation. In Livingston and Ontario Counties and west half of Yates County, Hall's Cashaqua shale included in ascending order units herein assigned to Pulteney shale (new), Rock Stream siltstone, and Cashaqua shale members of Sonyea formation. In eastern half of Yates County, Hall's Cashaqua included parts of West River shale and underlying Geneseo shale. Hall's Cashaqua is redesignated Cashaqua shale member of Sonyea. Name is herein restricted to the medium-gray to medium-greenish-gray mudrock and shale facies that crop out at type exposure of Hall's Cashaqua near Sonyea. In Erie County, directly overlies Middlesex shale member; between southwestern Genesee County and eastern Livingston County, overlies Pulteney shale member; from eastern Livingston County to Keuka Lake, overlies Rock Stream siltstone member. Thickness 35 to 159 feet. Reference section designated.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 13–18. Formation included in Naples group. Overlies Middlesex shale; underlies Rhinestreet black shale. Subdivided to include Sawmill Creek (new), Rock Stream, and Rye Point (new) members. Thickness 28 to 480 feet; thickens from shore of Lake Erie to Seneca Lake.

Named for exposures on Cashaqua Creek, Livingston County, above junction of Genesee Valley Canal. Reference section: Buck Creek in Morris Township, 3 miles southwest of Sonyea, Livingston County.

Casitas Formation

Pleistocene: Southern California.

J. E. Upson, 1951, U.S. Geol. Survey Water-Supply Paper 1108, p. 21–23, table facing p. 12, pl. 1. Body of considerably deformed red continental deposits consisting of clay, silt, sand and gravel. Thickness in measured sections 188 to 401 feet; about 1,000 feet thick beneath Shepard Mesa and may be more than 3,000 feet thick beneath alluvial plain farther south. Underlies older alluvium, terrace deposits, and younger alluvium; overlies Santa Barbara formation; east of Rincon Creek, overlaps and cuts

out Santa Barbara and rests on Rincon shale and older formations at least at margins of Santa Barbara basin.

Extensively exposed in valley of Rincon, Carpinteria, and Gobernador Creeks, Santa Barbara County.

Casmalia Gypsiferous Shale or Redbeds[1]

Miocene: Southern California.

Original reference: H. W. Hoots and S. C. Herold, 1935, Geology of natural gas: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 156.

Occurs in Casmalia Hills, Santa Maria district.

†Cason Limestone[1]

Silurian: Northern Arkansas.

Original reference: H. S. Williams, 1894, Am. Jour. Sci., 3d, v. 48, p. 325–331.

Named for Cason tract, near Batesville, Independence County.

Cason Shale[1]

Upper Ordovician: Northern Arkansas.

Original reference: H. S. Williams, 1894, Am. Jour. Sci., 3d, v. 48, p. 325–331.

E. B. Brewster and N. F. Williams, 1951, Guidebook to the Paleozoic rocks of northwest Arkansas [Shreveport Geol. Soc. 19th Ann. Field Trip]: Arkansas Resources Devel. Comm., Div. Geology, p. 13. Black and blue-gray shale and thin argillaceous platy limestone. Thickness as much as 23 feet. Unconformable on the Fernvale limestone, and in most places in this area unconformably overlain by St. Joe limestone.

Named for Cason tract, near Batesville, Independence County.

Casper Formation[1]

Pennsylvanian and Permian: Southeastern Wyoming.

Original reference: N. H. Darton, 1908, Geol. Soc. America Bull., v. 19, p. 407, 413, 414, 416, 418–430.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 10–11; 1950, Bull. 13–A, p. 11. Section measured in Laramie Range, Wyo., south of Union Pacific Railroad, 18 miles west of Cheyenne. According to Colorado terminology, upper formations of section would be classed under Ingleside formation, but in Wyoming this part of section plus equivalent of the Fountain is called Casper as revised by Knight (1929, Wyoming Univ. Pub. Sci. Geology, v. 1, no. 1). Hence, name Casper is used for Pennsylvanian in Laramie Range to include Ingleside and Fountain formations.

H. D. Thomas, 1948, Wyoming Geol. Assoc. Guidebook 3d Ann. Field Conf., p. 88–89. in Casper Mountain-Alcova area, the Casper is 400 to 500 feet thick; this is comparable to combined thickness of Amsden and Tensleep to the west. Many geologists have divided section in this area into Amsden and Tensleep. Basal bed, commonly sandstone, rests on eroded surface of Madison. Lower part of Casper comprises thin interbedded limestones and sandstones resembling Amsden; upper part is thick tan cross-bedded sandstone which seems lithologically identical to Tensleep of areas to west. Entire Casper of this area seems to be completely younger than any part of Tensleep. Fusulinids (*Triticites*) have been collected from Casper.

M. L. Thompson, H. D. Thomas, and J. W. Harrison, 1953, Wyoming Geol. Survey Bull. 46, p. 5–55. Formation comprises alternating succession of beds made up principally of crossbedded sandstones and fossiliferous limestones. Thickness 500 to over 1,000 feet. Rests unconformably on Mississippian limestone (Madison) along northern part of Laramie Range. Mississippian rocks thin southward, and south of Little Medicine section the Casper everywhere rests on Precambrian rocks. In northern part of range, overlain unconformably by Opeche shale, but evidence of such break becomes less clear in southern part of range. Fusulinid faunas indicate formation ranges from Middle Pennsylvanian (Desmoinesian) to Lower Permian (Wolfcampian).

R. S. Agatston, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 535–549. Formation includes all beds from top of Madison limestone to base of Permian (Opeche) red shales. Fusulinid data, correlated with midcontinent fauna, suggest that formation spans Middle and Upper Pennsylvanian and part of Lower Permian. Subdivided into lower, middle, and upper divisions. Lower division present throughout most of southeastern Wyoming and exposed along flanks of Laramie Range throughout Laramie and Shirley basin regions. Composed of four major rock types (in order of importance); arkose, sandstone, shale, and limestone, Middle division represented throughout Laramie Mountain and Basin region, Shirley basin, and southeastern part of Wind River basin. Where definable, thickness 100 to 300 feet, and strata consist mainly of carbonates separated by thin sandstone interbeds which underlie upper Casper interbedded cherty dolomite and sandstone with local disconformity. Age thought to be Upper Pennsylvanian. Upper division exposed throughout Laramie Mountains and adjacent basins. The section, 230 to 500 feet thick, is sandstone, limestone, and dolomite. Red sandstone, shaly sandstone, and shale (200 to 400 feet thick) overlie presently recognized upper limit of the Casper along east flank of Laramie Mountains, but underlie Opeche shale and Minnekahta limestone. They have been included in Broom Creek and Cassa groups by Condra and others (1940).

C. A. Burk and H. D. Thomas, 1956, Wyoming Geol. Survey Rept. Inv. 6, p. 3–11. Underlies Goose Egg formation (new).

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of stratigraphy of Pennsylvanian system in northeastern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Suggested that Quadrant and Casper formational names be abandoned and Tensleep-Amsden-Sacajawea terminology extended to include strata formerly referred to by these names.

E. K. Maughan and R. F. Wilson, 1960, *in* Guide to the geology of Colorado: Rocky Mountain Assoc. Geologists, p. 36 (fig. 2), 38–39 (fig. 3). 40 (table 1), 41. Mississippian, Pennsylvanian, and Permian.

Named for occurrence in Casper Range.

Cass Limestone[1] (in Douglas Group)

Pennsylvanian (Virgil Series): Southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 41, 58.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29–30. When named in 1927, exact age relation of the Cass was not known, but since that time it has been found that this subdivision is cyclothemal formation com-

posed of three members (ascending): Shoemaker limestone (redefined), Little Pawnee shale (new), and Haskell limestone. Thickness 17 feet or more. Underlies Robbins shale; overlies Plattford formation.

Type locality: Platte River bluffs and Burlington quarries located 1½ to 2 miles northwest of South Bend, Cass County.

Cassa Group

Permian: Eastern Wyoming, northeastern Colorado, and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, 19, 45. Comprises upper 180 feet of Division I of Hartville "formation" (Condra and Reed, 1935). Thickness ranges from 175 to 328 feet. Underlies Phosphoria group; overlies Broom Creek group (new). Consists of Owl Canyon formation (new) below, Lyons sandstone above.

Type locality: Buckshot Canyon (also called Ragan Canyon), T. 29 N., R. 67 W., 3 miles northeast of Cassa, Platte County, Wyo.

Cassadaga Group

Cassadaga Stage

Upper Devonian (Chautauquan): North America.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1734, chart 4. Devonian subdivided into 10 stages of which the Cassadaga is ninth in sequence (ascending). [For complete sequence see Helderberg stage, this reference.] Follows Chemung stage and is succeeded by Conewango. Embraces sequence from Dunkirk shale to Wolf Creek-Panama conglomerate. Includes Canadaway and Conneaut groups.

A. T. Cross and J. H. Hoskins, 1951, Jour. Paleontology, v. 25, no. 6, p. 718 (fig. 3). Shown on composite stratigraphic column of western New York and northwestern Pennsylvania as Cassadaga group. Includes Canadaway and Conneaut formations. Overlies Chemung group; underlies Conewango group.

Type section (stage): Headwaters and valley of Cassadaga Creek in Dunkirk, Chautauqua, and Jamestown quadrangles, New York.

Cassel Hill Member (of Catahoula Formation)

Miocene: East-central Louisiana.

W. D. Chawner, 1936, Louisiana Dept. Conserv. Geol. Bull. 9, p. 121–122. Loose, noncalcareous sands and sandy clays which commonly contain considerable silicified wood; occurs at base of the Catahoula. Thickness as much as 45 feet; near Cassel Hill 15 to 25 feet thick. Unconformably overlies Vicksburg formation. Separated from overlying Chalk Hills member (new) by an interval of massive sandstone and gray tuff.

Well developed in vicinity of Cassel Hill, NE¼ sec. 9, T. 10 N., R. 5 E., Catahoula Parish.

Cassin Formation[1]

Lower Ordovician: West-central Vermont and northeastern New York.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95, p. 362.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Geographically extended to northeastern New York.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 266. Usage of name summarized.

Typically exposed at old Fort Cassin, Addison County, Vt.

Cassinian Series or Stage

Ordovician (Canadian) : North America.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 18. Divisions within Canadian system favor natural division into four major units: Gasconadian, Demingian, Jeffersonian, and Cassinian. The Cassinian include the Fort Cassin and Providence Island beds of Champlain Valley and Smithville and Black Rock of northern Arkansas. Classification based principally on cephalopod distribution.

Canadian series includes Gasconadian, Demingian, Jeffersonian, and Cassinian stages. Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–32.

Cassville Shale Member (of Washington Formation)[1]

Cassville Shale (in Washington Group)

Cassville shale member

Pennsylvanian: Northern West Virginia, eastern Ohio, and southwestern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 41.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. 26–C, p. 135, 145. Basal unit of Washington group. Overlies Waynesburg coal; underlies Waynesburg sandstone from which it is separated locally by Elm Grove limestone. Thickness as much as 25 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 89–90. Cassville shale member is basal unit of Washington series of the Permian in Ohio. Conformably overlies Waynesburg (No. 11) coal; underlies Elm Grove limestone member. Thickness in Morgan County 3 to 6 feet.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2), Cassville shale in Washington formation listed in stratigraphic summary of Dunkard group in Harrison County. At base of formation. Thickness 0 to 15 feet.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg. p. 118 (table 2). Cassville shale listed in Washington series. Permian.

U.S. Geological Survey currently designates the age of the Cassville Shale Member of Washington Formation as Pennsylvanian on the basis of a study now in progress.

Named for exposures in vicinity of Cassville, Monongalia County, W. Va.

Castaic Formation

Miocene, upper: Southern California.

Peter Dehlinger, 1952, California Div. Mines Spec. Rept. 26, p. 5 (footnote). Incidental mention.

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. Consists of shale with interbedded sandstone and minor beds of pebble conglomerate. Thickness at least 7,000 feet. Conformably underlies Ridge Basin group (new) with an interfingering contact that is marked by an abrupt upward increase in the proportion of sandstone beds; unconformably

overlies Mint Canyon formation. Previous investigators have included the Castaic in the Modelo, but it differs lithologically from Modelo of Ventura and thus can be differentiated.

Type locality: Along lower reaches of Castaic Canyon north of Castaic, Ridge basin area. Los Angeles and Ventura Counties. Crops out only northeast of San Gabriel fault.

Castalia Sand

Pleistocene, upper: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 130–131, pls. 63, 64. Vertical cliff exposes four layers (or horizons) which show progressively decreasing consolidation upward; each lies unconformably on the preceding. Maximum thickness of exposure a little more than 9 feet. Castalia sand is a stratum exhibiting marked variations in thickness, consolidation, and color. A large part of layer is poorly consolidated and consists of gray dark mottled medium sand. Underlies Pine sand (new); overlies Kure sandstone (new).

Exposed between Kure's Beach fishing pier and Ethyl Dow Bromine Plant on lower Cape Fear Peninsula.

Castanea Sandstone[1]

Lower Silurian (Albion Series): Central Pennsylvania.

Original reference: F. M. Swartz, 1934, Geol. Soc. America Bull., v. 45, p. 83, 91, 102, 109.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart at top of Albion series; underlies Rose Hill shale at base of Clinton group; lies above Tuscarora (Clinch) sandstone.

Named for Castanea, a suburb of Lock Haven, Clinton County.

Castile Gypsum[1] or Formation

Castile Anhydrite[1]

Permian (Ochoa Series): Western Texas and southeastern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 43.

W. B. Lang, 1949, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1569-1572. Base of Salado formation redefined. Anhydrite included in top of Castile (Lang, 1937) is included in base of Salado. This redefinition of Salado confines Castile to Delaware basin.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 586, 609, 611, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 68–69, 89–91, pl. 3. Formation, as now defined, includes beds in lower part of Ochoa series that are confined in extent to Delaware basin and overlap sloping surface of Capitan limestone along its margins. Also overlies Bell Canyon formation (new) of Delaware group. Salado includes higher beds, which occur both in the basin and beyond its margins. As thus defined, Castile is dominantly anhydrite-bearing and Salado dominantly salt-bearing but these distinctions are not absolute. Drill records indicate that formation has maximum thickness of between 1,500 to 2,000 feet near center of basin.

Named for Castile Spring, El Paso County, Tex.

Castine Volcanics[1]

Castine Formation

Cambrian(?) : South-central Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 5.

P. S. Wingard, 1958, Kansas Acad. Sci. Trans., v. 61, no. 3, p. 330–333. Castine formation, previously designated as Cambrian, now tentatively designated as either Middle or Upper Silurian. Overlies Ellsworth formation.

Named for exposures on Castine Peninsula, Hancock County.

Castiyo Limestone

Aquitanian : Mariana Islands (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 52, table 4 [English translation in library of U.S. Geol. Survey, p. 62].

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 25. Castiyo is coralliferous, foraminiferal, and algal limestone. *Miogypsina* limestone and Tinian formation of Tayama (1936) and Lasso limestone of Tayama (1952) should be included in this formation. Aquitanian. Type locality stated. Refer to K. Asano (1939, Jubil. Pub. Yabe's 60th Birthday).

Type locality : Puntan Casityo, Tinian Island.

Castle Granite[1]

Miocene or Pliocene : Central southern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

F. C. Armstrong, 1957, Econ. Geology, v. 52, no. 3, p. 221. In Castle Mountains, Flathead quartzite occurs near Castle granite and locally has been thermally metamorphosed by it.

Forms central core of Castle Mountain, Little Belt Mountains.

†Castle Limestone Member (of Madison Limestone)[1]

Lower Mississippian : Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 314–315. Strata called Mission Canyon are lithologically and faunally identical with Weed's Castle limestone; because latter term has been discarded, it is proposed that term Mission Canyon be applied throughout Montana and northern Wyoming.

Named for town of Castle, Little Belt Mountains quadrangle, where it is well developed.

Castle Rhyolite

Tertiary : Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1053, 1059, pl. 1. Compact rhyolite, the ground mass of which ranges in texture from glassy to micrographic or diffuse spherulitic. Underlies Meadow rhyolitic

tuff (new). Elkhorn basalt (new) is probably intermediate in age between Castle rhyolite and Cataract basalt (new).

Exposed in cliffs below Third Cataract in Gardiner River, Yellowstone Park.

Castle Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat, Internat., v. 6, Océanie, fasc. 2, p. 79. Bedded cinders, bombs and spatter composing a partly eroded cinder cone from which lava flow of nepheline basalt, more than 100 feet thick, extends for half a mile. Unconformably overlies rocks of Kailua volcanic series. Distribution noted.

Named for occurrence on Castle Ranch. Covers area of about one-half square mile north of Ulumawao Peak, on northeast side of Koolau Range about 10 miles northwest of Makapuu Head.

Castle Creek Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942. Carnegie Inst. Washington Pub. 540, p. 92–93. Castle Creek flows (pumice flows) were products of glowing avalanches that descended southwest flank of Mount Mazama into valley of Castle Creek. The flows traveled 18 miles before they joined flows of Rogue River valley. They were prevented from spreading northward by high ridge of lava, but southward they overflowed gorge of Castle Creek and spilled into valley of Union Creek, which they filled to maximum depth of 250 feet. Pumice flows spread all the way down Castle Creek, but later scoria flows did not extend beyond park boundary, a distance of about 7 miles. Glowing avalanches of pumice and scoria were part of final activity of Mount Mazama and followed what is termed the main pumice fall.

Castle Creek flows westward from Crater Lake.

†Castlegate coal group (in Blackhawk Formation)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

In Book Cliffs.

Castlegate Sandstone (in Mesaverde Group)

Castlegate Member (of Price River Formation)

Castlegate Sandstone Member (of Price River Formation)[1]

Upper Cretaceous: Eastern central Utah and western central Colorado.

Original reference: J. B. Forrester, 1918, Utah Acad. Sci. Trans., v. 1, p. 24.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 130–131. Age definitely fixed as Montana and probably late Montana.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187, 188–189, figs. 2, 3, pl. 3. Referred to as member instead of sandstone member because it includes coal-bearing rocks throughout considerable part of its outcrop. Primarily a massive crossbedded white or pink sandstone which changes from coarse to fine grained as traced eastward. This part of member belonging to Farrer facies (new), represents inland flood-plain deposits

and is replaced for a few miles east of Green River by lagoonal deposits which contain a few thin coals. These, in turn, are replaced eastward in vicinity of Thompsons by littoral marine bar sandstones. This part of Castlegate, as well as thin topmost lagoonal deposit present from Desert east to Cottonwood Canyon, is placed in Neslen facies (new). Member separated from remainder of formation in Beckwith Plateau by Buck tongue of Mancos shale, which thickens eastward. Member thins eastward and disappears in Mancos near West Salt Creek, Colo. From western end of Book Cliffs to Green River, composed mainly of nonmarine sandstone. Near Green River, it passed into lagoonal deposits. Three littoral marine bar sandstones interfinger eastward into Mancos, as far as Salt Creek, Colo. Thickness of member ranges from about 500 feet at Castlegate to featheredge near West Salt Creek.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11 (table), 13–14, pls. Price River formation restricted by removal of Castlegate sandstone, which is raised to formational rank. Thickness at type locality about 400 feet. In area of this report [Book Cliffs], its thickness ranges up to 190 feet. Eastward from Westwater Wash, where it is about 70 feet thick, formation thins rapidly, and at Utah-Colorado State line it is 30 feet thick; at mouth of West Salt Creek, it is discontinuous. Ranges from massive conglomeratic sandstone at Castlegate to fine-grained siltstone at east boundary of Utah and passes into entirely shaly beds in Colorado. Underlies Buck tongue of Mancos shale in Beckwith Plateau to Colorado line.

Named from Castlegate, Carbon County, Utah, where it forms gatelike passage in Price River Canyon about 2 miles above the town.

Castle Hayne Limestone

Castle Hayne Marl[1]

Eocene, middle and upper: Coastal Plain of North Carolina and South Carolina.

Original reference: B. L. Miller, 1910, Geol. Soc. America Bull., v. 20, p. 674–675.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 25–26. Geographically extended into South Carolina, where it is recognized only in artificial exposures. At pit of Carolina Cement & Lime Company, Harleyville, Dorchester County, unconformably underlies Cooper marl, is 46 feet thick, and consists of buff-gray tough to hard crumbly fossiliferous limestone overlying a gray soft fine-grained granular limestone. Considered upper Claiborne.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in Coastal Plain of North Carolina, Oct. 8–9, p. 9, 28, 30, 36. Described in coastal plain of North Carolina where it underlies Yorktown formation near Pollicksville. Includes shell bed composed of valves and fragments of *Ostrea georgiana* Conrad in a reddish sandy matrix. This is section from which Miller (Clark and others, 1912, North Carolina Geol. and Econ. Survey, v. 3) designated Trent marl as middle Eocene. Kellum (1926, U.S. Geol. Survey Prof. Paper 143) concluded that the Trent was early Miocene, separated from underlying Castle Hayne of Jackson age by erosional unconformity. Kellum's Trent species came from vicinity of Silverdale, a locality not mentioned by Miller and which is about 17 miles from type locality along Trent River. Recent work has shown that Kellum's Trent (lower Miocene) is nonexistent and that unit designated by Kellum as lower Miocene is in part of Castle Hayne age and in part of

Yorktown age. Original Trent of Miller is here moved from middle Eocene to upper Eocene and included in Castle Hayne although considered a distinctive facies of it.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 44–45; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500.000): North Carolina Div. Mineral Resources. Mapped as middle and upper Eocene. As mapped, included Castle Hayne and Trent formations of older maps.

Named for exposures at Castle Hayne, New Hanover County, N.C.

Castle Hill Andesite[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 114, 169, 174.

Lies between Aroostook River and the State road from Ashland to Presque Isle, partly in Castle Hill Township and partly in Wade Plantation, Aroostook County.

Castle Hill Tuff[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 119, 120–121, 122–125.

Exposed in open fields and along roadside about 1 mile west of Castle Hill Hotel, on Castle Hill Ridge, Aroostook County.

Castle Rock Conglomerate[1]

Oligocene, lower: Eastern Colorado.

Original reference: W. T. Lee, 1902, Am. Geologist, v. 29, p. 96–109.

H. E. Woods 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 16, pl. 1. Oligocene, Chadronian.

Named for typical development on Castle Rock Butte, Douglas County.

Castleton Conglomerate Member (of Bull Formation)

Lower Cambrian: Western Vermont and eastern New York.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Limestone-pebble, slate-matrix, intraformational conglomerate. Pebbles carry early Cambrian *Elliptocephala* fauna. Thickness probably not more than 20 feet. Overlies Mudd Pond member (new); occurs near top of formation below West Castleton formation (new).

Probably named for Castleton River, Vt.

Castle Valley Stage

Recent: Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, correlation chart. In proposed time-stratigraphic standard for Rocky Mountains, the Recent epoch includes (ascending) Castle Valley, Temple Lake, Spanish Valley, and Gannett Peak stages.

Twin Lakes area.

Castner Limestone

Precambrian: Southwestern Texas.

R. L. Harbour, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1786 (fig. 1), 1787–1788, 1789. Oldest rocks exposed in Franklin Moun-

tains. Includes limestone, hornfels, and chert, as well as diabase sills; contains moundlike algal structures near base. Thickness about 1,112 feet. Underlies Mundy breccia (new). Rests on intrusive granite. Term limestone considered preferable to formation despite the fact that limestone comprises little more than half the thickness of unit at type locality.

Type locality: One and one-half miles southeast of North Franklin Mountain and one-half mile northwest of point at which Fusselman Canyon issues from mountains. Named from exposures in Castner Range on Fort Bliss Military Reservation. Outcrops limited to northern half of Franklin Mountain by faults and intrusive granite. South of Castner Range, fault in Fusselman Canyon drops Castner below level of Quaternary deposits.

Casto Volcanics[1]

Permian(?): Central Idaho.

Original reference: C. P. Ross, 1927, Idaho Bur. Mines and Geology Pamph. 25.

C. P. Ross, 1934, U.S. Geol. Survey Bull. 854, p. 28–35, pl. 1. Coarse conglomerate present in a few places in Casto quadrangle. One bed of limestone noted. Underlie Challis volcanics; unconformable above old sedimentary rocks; cut by Idaho batholith. Thickness 2,000 to 5,000 feet.

Covers large area in Casto quadrangle.

Castor Creek Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 164–168, 174, geol. map. Brackish-water calcareous clays and noncalcareous silts. Thickness at least 200 feet. Underlies Blounts Creek member (new); overlies Williamson Creek member (new).

Well exposed in southern valley wall of Castor Creek in Tps. 3 and 4, R. 2 W., Rapides Parish.

Castro Shale Member (of Alhambra Formation)

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 53–54, pl. 4–A. Brownish-gray silty shale becoming somewhat arenaceous toward top. Thickness at type section 145 feet. Underlies Roop sandstone member (new) with contact gradational; overlies Escobar sandstone (new).

Type section: West limb of Pacheco syncline, short distance east of the east portal or Muir Tunnel, near Martinez, Contra Costa County.

Catahoula Group[1]

Oligocene and Miocene(?): Southeastern Mississippi.

Original reference: B. W. Blanpied and others, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip. p. 4.

Catahoula Sandstone,[1] **Tuff,**[1] or **Formation**

Miocene, Miocene(?), and Oligocene(?): Louisiana, southern Alabama, Mississippi, and eastern Texas.

Original reference: A. C. Veatch, 1905, Louisiana Geol. Survey Bull. 1, Rept. 1905, p. 84, 85, 90.

F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 715–720. Formation, in eastern Texas, divided into two members Chita (new) and Onalaska. In

south Texas, divided into three members (ascending): Gant, Soledad, and Chusa.

B. W. Blanpied, chm., 1934, Shreveport Geol. Soc. [Guidebook] 11th Ann. Field Trip p. 12–22. Catahoula group, Clarke and Wayne Counties, Miss., comprises (ascending) Bucatunna member, Lower Chickasawhay member, Upper Chickasawhay member, and "Catahoula." Overlies Vicksburg group; underlies Citronelle.

B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 67, table facing p. 17. In southeastern Texas, includes Dunlap Quarry sandstone member.

W. D. Chawner, 1936, Louisiana Dept. Conserv., Geol. Bull. 9, p. 110–134. In Catahoula Parish, formation is composed largely of tuffaceous sandstones, sands, and clays, with some loose sands and hard silicified sandstones. Maximum thickness 350 feet. Includes Cassel Hill member (new) in lower part and Chalk Hills member (new) above. Unconformably underlies Citronelle(?) formation.

H. N. Fisk, 1938, Louisiana Dept. Conserv., Geol. Bull. 10, p. 142–149. In Grant and La Salle Parishes, Catahoula formation comprises two mappable units, lower tuffaceous siltstone member and an upper thicker member composed of lenticular sands, clays, and silts. Grades downward into sands and clays of Vicksburg group. Underlies Montgomery member (new) of Pleistocene.

H. N. Fisk, 1940, Louisiana Dept. Conserv., Geol. Bull. 18, p. 143–147. Lower formation in Grand Gulf group in report on Avoyelles and Rapides Parishes. Underlies Fleming formation. Name Catahoula became widely used and has appeared in literature of adjacent coastwise States. Its usage can be justly criticized because lower limit of formation has never been accurately defined and upper limit was not and cannot be established from type locality where beds pass beneath Mississippi River flood plain. No section published permits a lithologic correlation to be established, yet usage of name has been extended into subsurface on lithology. Only part of Catahoula formation found at surface in Rapides Parish is upper 100 feet of siltstones and intercalated sand lentils exposed in northwestern top of parish. Catahoula-Vicksburg contact not exposed in Rapides Parish and lower limit of Catahoula in subsurface is arbitrarily placed on first appearance of Vicksburg fossils.

F. W. Bates and J. B. Wharton, Jr., 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 8, p. 1136–1138. Term Catahoula group should be dropped, leaving Gulf Coast Miocene composed of three formations: Fleming, Catahoula, and Chickasawhay. Believed that there is not sufficient evidence of sufficient lithologic or paleontologic change to warrant placing division between Miocene and Oligocene strata at base of Fleming; hence, entire Catahoula should be considered Miocene in age. Subsurface data.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1). 1344–1354, "Upper Chickasawhay" of Shreveport Geological Soc. Guidebook 11th Ann. Field Trip is herein named Paynes Hammock sand. This sand intertongues at west with nonfossiliferous beds referred to Catahoula sandstone and with the Paynes Hammock tongue below Catahoula tongue. Paynes Hammock sand and equivalent beds on west referred to Catahoula sandstone are correlated with Tampa limestone. Upper part of Catahoula may be Alum Bluff in age. Miocene.

W. L. Russell, 1957, Gulf Coast Assoc., Geol. Soc. Trans., v. 7, p. 65–72. Formation described in Grimes, Brazos, and Burleson Counties, Tex. Thickness about 350 feet in Grimes County. Basil member is Chita, 10 to 50 feet thick. About 70 to 100 feet above Chita in south-central Brazos County is Dunlap sandstone, 0 to 40 feet thick. About 175 feet above base of Catahoula is Corough sandstone (new), 0 to 40 feet thick. Overlies Whitsett formation; underlies Oakville formation.

D. H. Eargle and J. L. Snider, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 30, p. 14. Catahoula tuff described in Karnes County. Thickness about 480 feet. Unconformably overlies and progressively overlaps underlying Frio clay and upper part of Jackson formation. Underlies Oakville sandstone. Because of stratigraphic relations, believed to be early Miocene.

G. R. Pinkley, 1958, South Texas Geol. Soc. [Guidebook] Fall Field Trip, p. 35, 37. Formation, in Fashing field, Atascosa County, includes Gueydan ash member at base.

U.S. Geological Survey currently designates the age of the Catahoula as Miocene(?) and Oligocene(?) in some areas on the basis of a study now in progress.

Named for typical development in Catahoula Parish, La.

Cataldo Quartzite[1]

Precambrian (Belt Series): Northern Idaho and central eastern Washington.

Original references: O. H. Hershey, 1912, Geol. Soc. America Bull., v. 23, p. 526; 1912, Am. Jour. Sci., 4th, v. 34, p. 264–267.

Exposed over a great area, beginning a little above mouth of Pine Creek, and thence nearly to station of Rose Lake; also occurs near town of Tekoa, Wash. Probably named for town of Cataldo, Kootenai County, Idaho.

Catalina Gneiss

Precambrian: Southeastern Arizona.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 110–113. Term Catalina gneiss describes the gneissic rocks that make up the core of Santa Catalina Mountains and extend southeastward from Mount Lemmon into Tanque Verde and Rincon Mountains. Divided into three general types: banded augen gneiss, augen gneiss, and granitic gneiss-gneissic granite.

Area: Santa Catalina Mountains.

Catalina Granite

Post-Cretaceous: Southeastern Arizona.

F. L. Peirce, 1958, Dissert. Abs., v. 19, no. 2, p. 300. Orogeny which apparently took place during Laramide time was accompanied by emplacement of Leatherwood quartz diorite (new) which was followed by emplacement of Catalina granite. Some border phases of the granite apparently represent replacement of sediments, and some of the granite was igneous as shown by the chilled borders of dikes of the granite that cut the Leatherwood quartz diorite (new).

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 114. Characterized by two different facies: northern exposures, according to Peirce, are

hypidiomorphic granular granodiorite, containing mainly quartz, orthoclase, and oligoclase; outcrops on the south are of crystalloblastic granite, composed of abundant quartz and orthoclase.

In Santa Catalina Mountains [Pima County].

Catalina Schist

Catalina metamorphic facies (of Franciscan Series)[1]

Mesozoic or older: Southern California.

Original reference: A. O. Woodford, 1924, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 3.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 13, Woodford (1924) designated the metamorphic rocks of Palos Verdes Hills and the more extensive rocks of Santa Catalina Island the Catalina metamorphic facies of the Franciscan. Absence of unaltered sedimentary rocks indicates that metamorphics are older than Franciscan. Name Catalina schist considered more appropriate term.

J. E. Schoellhamer and A. O. Woodford, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–117. Mesozoic or older.

Occurs on Catalina Island, off coast of southern California, and in San Pedro Hill and Palos Verdes Hills on adjacent mainland.

Catalina Schist Breccia[1]

Miocene, lower(?): Southern California.

Original reference: A. O. Woodford, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 211–212.

Southeast end of Catalina Island.

Catamount Schist[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. N. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs above Swede Pond quartzite and below Bear Pond schist.

Type locality: Catamount Mountain, west of Pettersville, Warren County.

Cataract Basalt (in Gardiner River Rhyolite-Basalt Complex)

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1050, 1055–1056, pls. 1, 2. Name applied to basalt of Gardiner River rhyolite-basalt complex (new). Normal facies is massive medium-grained basalt, carrying abundant phenocrysts of plagioclase and ferromagnesian minerals. Younger than Meadow rhyolitic tuff (new) and older than Sheepeaters basalt (new). Contemporaneous with Lodgepole rhyolite (new); overlies Elkhorn basalt (new).

Present on Gardiner River, Yellowstone Park. Uncontaminated phase occurs at Second Cataract, about 700 feet downstream from complex at First Cataract. Crops out at frequent intervals several miles southward upgrade of wide tributary valley.

Cataract Formation[1]

Cataract Group

Lower Silurian: Ontario, Canada, and northern Michigan and western New York.

Original reference: C. Schuchert, 1913, Geol. Soc. America Bull., v. 24, p. 107.

G. V. Cohee, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 33, sheet 2. In Michigan, formation crops out in extreme eastward extension of Northern Peninsula on east side of Drummond Island, Chippewa County, and in a few places to west in Delta and Luce Counties. Rocks are light-brown to brownish-gray dense to finely crystalline dolomite that is cherty in part.

G. M. Ehlers, 1948, Michigan Geol Soc. [Guidebook] Ann. Field Trip, June 18, 19. 20, 21. Cataract group listed on Silurian chart of Northern Peninsula, Mich. Includes Mayville dolomite. Mayville comprises (ascending) Manitoulin dolomite, Cabot Head shale, and Dyer Bay dolomite; thicknesses of these units are given from subsurface data. Underlies Burnt Bluff group. Alexandrian series.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1984. Discussion of stratigraphy of Medinan group in New York and Ontario. Recommended that names Albion, Alexandrian, Anticostian, Cataract, and Power Glen be suppressed.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 4 (fig. 1), 5–7. Group in northern Michigan comprises (ascending) Manitoulin dolomite, Cabot Head shale, and Moss Lake formation (new). Thickness 110 to 200 feet. Underlies Burnt Bluff group with Lime Island dolomite (new) at base. Term Mayville not used in this classification. Alexandrian series.

Well exposed at Cataract, Ontario.

†Cataract Falls Sandstone (in Ste. Genevieve Formation)

Mississippian: Southwestern Indiana.

C. A. Malott, 1945, (abs.) Indiana Acad. Sci. Trans., v. 55, p. 77 [1946]. Proposed for a persistent sandstone, ranging from 1 foot to more than 30 feet in thickness, that occupies nearly the middle one-third of the formation.

C. A. Malott, 1946, Jour. Geology, v. 54, no. 5, p. 323. Unit referred to as "Cataract Falls sandstone" is directly correlated with Rosiclare sandstone of southern Illinois.

Occurs at double falls of Mill Creek near Cataract, Owen County.

Catawissa Reds[1] or Red Beds

Upper Devonian: Northeastern Pennsylvania and eastern New York.

Original reference: G. H. Chadwick, 1932, Eastern States Oil and Gas Weekly, v. 1, no. 17, p. 7.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Catawissa red beds; occur below Montrose red beds and above Katsberg red beds; equivalent to Cayuta shale and sandstone.

Crops out at Catawissa, Columbia County, Pa., south of Susquehanna River. Also present in western Catskills along Delaware River.

Cathedral Granite[1]

Tertiary: Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 7, p. 329–376.

Cathedral Bluffs Tongue (of Wasatch Formation)[1]

Cathedral Bluffs Tongue (of Knight Formation)

Eocene, lower and middle: Southwestern Wyoming and northwestern Colorado.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

W. J. Morris, 1955, Dissert. Abs., v. 15, no. 3, p. 394. Name Knight formation extended from Bridger basin to include dominantly fluviatile Wasatchian deposits of Washakie basin. Hence Cathedral Bluffs is considered tongue of Knight formation.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 101, 102. Overlies Tipton tongue of Green River formation; underlies and interfingers with Laney shale member and Morrow Creek member of Green River; intertongues laterally with Battle Spring formation (new). Thickness as much as 900 feet. Has yielded some fossils thought by some to be early Eocene and by others to be middle Eocene.

Forms highly colored escarpment of Laney Rim and Cathedral Bluffs, Sweetwater County, Wyo.

Cathedral Peak Granite[1] (in Tuolumne Intrusive Series)

Cretaceous: East-central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 126–127, map.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2121, 2122, 2123 (fig. 1). Discussed in paper dealing with potassium-argon dating of igneous rocks. Age given as 83.7 millions of years. Younger than Half Dome quartz monzonite and older than Johnson granite porphyry and Hoffman quartz monzonite (new).

Named for fact it composes Cathedral Peak and adjoining parts of Cathedral Range in Yosemite National Park.

Cathedral Valley Agglomerate

Tertiary, upper: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, p. 12, pl. 2. Thick sequence of agglomerate beds with subordinate tuff beds and lava flows; rocks are predominantly basalt and basaltic andesite. Beds dip north toward Bering Sea at angles of a few degrees. Probably comparable in age to Belkofski tuff (new) but direct evidence is lacking.

Type region: Cathedral Valley in vicinity of Pavlof Volcano, Alaska Peninsula.

Catheys Limestone[1]

Catheys Limestone (in Nashville Group)

Middle Ordovician: West-central Tennessee.

Original reference: C. W. Hayes and E. O. Ulrich, 1903, U.S. Geol. Survey Geol. Atlas, Folio 95.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 136–157. Six major facies recognized: shaly, laminated siltstone, granular, clayey, dove-colored, nodular, and pale-colored. Facies do not occur as stratigraphic units in chronological order but rather are interbedded with each other and may recur in both vertical and lateral distribution. In general, the Catheys thickens eastward from featheredge covered by younger sediments somewhere between Perry-Wayne-Hardin Counties and Maury-Giles Counties to as much as 250 feet in Sequatchie Valley. Overlies Bigby-Cannon limestone, being in contact with Bigby facies in western part and with Cannon facies in eastern part. Underlies Leipers formation. In Nashville group, Hayes and Ulrich did not specify type section. Bassler (1932, Tennessee Div. Geology Bull. 38) suggested section at Columbia. In present study, two sections are measured along Catheys Creek, each of which would serve as type section. Section along Dry Fork 65 feet; section along north slope of spur overlooking Catheys Creek 69 feet.

Suggested type sections (Wilson): Along road up Dry Fork Creek and up hill to east, beginning about 500 feet south of intersection of Dry Fork and Catheys Creek 1 mile west of Isom, Maury County. On slope of spur overlooking Catheys Creek between Ivory Hollow and Shannon Branch about one-fourth mile southeast of Taylorsville, and about 2 miles east of Isom. Named for Catheys Creek, Lewis and Maury Counties.

Cat Hill Gneissoid Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1911, New York State Mus. Bull. 146, p. 52, 57.

Occurs in Garrison district, Putnam County. Probably named for occurrence at Cat Hill.

Cativa Marl (in Gatún Formation)

Miocene, middle: Panamá.

H. N. Coryell and Suzanne Fields, 1937, Am. Mus. Novitates no. 956, p. 1. Fossiliferous marl in lower part of Gatún formation.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 330–331. Undefined name for calcareous siltstone in Gatún formation.

Catlin Member (of Windfall Formation)

Upper Cambrian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 20–21, 22, pl. 2. Composed of interbedded massive limestone, in part cherty, and thin-bedded shaly and sandy limestone. The massive limestone beds are for the most part fine grained although some are coarser grained; some of the coarser beds are crowded with trilobite fragments. The thinner bedded limestones are light to medium gray and have sandy interbeds that weather to brown or pinkish brown. Thickness 250 feet throughout the area around Eureka. Member is in

sharp though normal contact with Dunderberg shale below and is conformable with Bullwhacker member (new) above.

Named from exposures near the Catlin shaft of the Croesus mine in New York Canyon, Eureka mining district, Eureka County.

Cat Mountain Rhyolite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 729–731, pl. 1. Cliff forming series of rhyolite flows and mud flows. When fresh, rhyolites are red, and the mud flows or breccias are red or buff. Weathers dark reddish brown on steep slopes and many shades of purple, brown, buff, red, blue, and even white on more subdued slopes. Breccia at the base and tuff at the top. Thickness in Cat Mountain-Golden Gate Mountain area at least 700 to 800 feet; farther south, thickness between 200 and 300 feet. Usually rests either on overthrust mass of Cretaceous sedimentary and volcanic rocks or, where thrust has been removed by erosion, directly on truncated edges of sedimentary rock. Underlies Safford tuff (new); unconformably overlies Amole arkose (new).

Well exposed on Cat Mountain and Golden Gate Mountain. Most conspicuous and one of the most widespread formations in Tucson Mountains, Pima County.

Catoctin Greenstone, Formation, or **Metabasalt**

Catoctin Schist[1]

Catoctin Series

Precambrian: Western Maryland, northern Virginia, and northeastern West Virginia.

Original reference: A. Keith and H. R. Geiger, 1891, Geol. Soc. America Bull., v. 2, p. 155–164.

A. S. Furcron, 1939, Virginia Geol. Survey Bull. 54, p. 19–28. Catoctin series, in Warrenton quadrangle, divided into Warrenton agglomerate member (new) at base and basalt flows now altered to metabasalt or "greenstone" schist. Underlies Loudoun formation; overlies Fauquier formation (new).

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12], Carroll and Frederick Counties, p. 20–22. Catoctin metabasalt described in Frederick County where it is exposed in area between South and Catoctin Mountains. Underlies Loudoun formation. Overlies Swift Run tuff. The volcanic series, comprising Catoctin basalt, aporhyolite, and Swift Run tuff, overlies granitic injection complex of early Precambrian age.

R. O. Bloomer and R. D. Bloomer, 1947, Jour. Geology, v. 55, no. 2, p. 94–106. Formation in central Virginia consists of undetermined thickness of hydrothermally altered andesite classed as propylite. Underlain by variable thickness of both metamorphosed and unmetamorphosed conglomerate, sandstone, tuff, and andesite to which name Oronoco formation is assigned. In northern Virginia, the Catoctin is overlain by Loudoun formation. In central Virginia, the Unicoi, which is at least partly equivalent to the Loudoun, crops out along western flanks of Blue Ridge but is not exposed in Catoctin outcrop belt. In western part of Piedmont province, the Catoctin overlies the Lynchburg. Catoctin may be Cambrian in age.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 12–14, 15 (fig. 5), pl. 1. Described in Elkton area, Virginia, as Catoctin greenstone. Consists of altered lava, largely basaltic in composition, and associated pyroclastic sediments. Thickness 0 to 1,000 feet; maximum thickness on slopes of Blue Ridge in southeast part of area. Underlies Loudoun formation of Chilhowee group; overlies Swift Run formation.

R. O. Bloomer, 1950, Am. Jour. Sci., v. 248, no. 11, p. 753–783. The Catoctin is exposed in two parallel belts that extend into central Virginia. One belt caps main mass of the Blue Ridge, and the other occurs in an alignment of ridges about 20 miles to the southeast. In central Virginia, northwestern belt of Catoctin is thrust upon Chilhowee group, but farther northeast it underlies the Loudoun. In some places, the Catoctin in northwestern belt overlies the Swift Run or granitized complex. Elsewhere, the granitized complex has been thrust upon the Catoctin and base is unexposed. Catoctin in central Virginia is exposed on both limbs of major anticlinal fold that has been truncated by erosion, at least, to combined thickness of Catoctin and Lynchburg formations. Generally believed that there is significant hiatus between Catoctin formation and Chilhowee series. The Catoctin and concordantly underlying Lynchburg and Swift Run formations are defined as late Precambrian and the Chilhowee as Lower Cambrian. Although age classification may be correct, there is evidence of continuous sequence from base of Lynchburg into Chilhowee. This relationship may appear to be refuted where Chilhowee rests with conspicuous unconformity upon granitized complex definitely older than late Precambrian. However, this unconformity is an inclined surface that cuts across formation boundaries. Lynchburg and Catoctin overlap this surface from east to west. Hence, absence or restricted thickness of Catoctin beneath the Chilhowee in certain sections is not due to interval of erosion between the two formations, but to location of sections with respect to margin of overlap. In places, there appears to be complete section between Catoctin in the Blue Ridge and the Wissahickon in the Piedmont of central Virginia. No continuous faults, including Martic overthrust have been identified. The Catoctin is not everywhere separated from the Wissahickon or the Lynchburg from the Wissahickon by faults. In this report, term Oronoco is abandoned in favor of Swift Run formation. Not certain whether Catoctin is late Precambrian or Cambrian.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1). In James River synclinorium, Catoctin greenstone underlies Candler formation of Evington group (both new); overlies Lynchburg gneiss.

J. C. Reed, Jr., 1955, Geol. Soc. America Bull., v. 66, no. 7, p. 871–896, pl. 1. Formation described near Luray, Va., where it unconformably overlies granitic rocks and is not intruded by them, as has been suggested by some earlier workers. No important time break is indicated between deposition of Catoctin formation and overlying Cambrian sediments (Chilhowee group). Catoctin may be early Cambrian.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 22–28, pl. 1. Catoctin greenstone described in Lynchburg quadrangle. Catoctin is at top of Lynchburg formation but intertongues, in part, with upper Lynchburg and overlying Candler formation. Lynchburg and Catoctin are referred to as "Late Precambrian" group which overlies Virginia Blue Ridge complex (new) and underlies Lower Paleozoic(?) Evington group.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 12 (table 1), 14, 16. Catoctin greenstone described in Rockingham County. Overlies Swift Run formation; underlies Loudoun formation of Chilhowee group. Cambrian or Precambrian.

Named for Catoctin Mountain, Loudoun County, Va., and Frederick County, Md.

Catron Formation (in Breathitt Group)

Catron Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southeastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 41, 207, pl. XLA.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 96–99, 138. Underlies Hignite formation; overlies Mingo formation. Report contains measured sections, correlation charts, and plates.

U. S. Geological Survey currently classifies the Catron as a formation in Breathitt Group on the basis of a study now in progress.

Named for exposures on Coon Branch of Catron Creek in Black Mountains, Harlan County.

Catskill Formation[1] **or Redbeds** (in Susquehanna Group)

Middle and Upper Devonian and Lower Mississippian: New York, Maryland, New Jersey, and Pennsylvania.

Original reference: W. W. Mather, 1840, New York Geol. Survey 4th Rept., p. 212, 213, 227–233.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19. Catskill, as used in this report, is defined broadly as the continental magnafacies of the Devonian. In Pennsylvania, it is divisible into several clearly separable and distinct units. These are all well exposed and typically developed. Their relative ages are fixed through the fact that in practically all cases they are traceable into fossiliferous marine beds. Many of these divisions, known and named by I. C. White, are of long standing, have a well-established place in the literature, and take precedence over any other system of Catskill terminology previously misapplied to Pennsylvania. No doubt some of Chadwick's divisions are valid and may even be close correlates with terms used in this report. However, names drawn from the section in Catskill Mountains have no place in the nomenclature in Pennsylvania's continental Devonian sequence. Thickness varies through process of progressive off-lap. Featheredge is encountered in traversing west from Potter into McKean and Warren Counties; pinching out is observed in Conemaugh gorge west of Johnstown; similar conditions are also reported in Fayette County. Thickest section, about 6,200 feet, is along Lehigh River, Carbon County. Limits of Catskill vary radically. Top is drawn where red or green Catskill sandstones and shales yield to gray, usually conglomeratic Pocono. At base, continental beds intertongue with marine, neritic facies of the Devonian which changes progressively from early Middle Devonian in New Jersey to Portage in upper Delaware Valley, earliest Chemung in Susquehanna Valley above Harrisburg, very late Chemung on Allegheny Front and progressively later Chautauquan from north-central to northwestern Pennsylvania. Some units included in Catskill facies are the Mount Pleasant red shale, Honesdale sandstone, Cherry Ridge

red beds, Damascus red shale, Shohola formation, Delaware River flags. Analomink red shale, and New Milford formation.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 333. Discussion of geology of Appalachian Valley in Virginia. Term Hampshire formation is used in preference to term Catskill. Chadwick (1933, Am. Jour. Sci., 5th, v. 36; 1936, New York State Mus. Bull. 307) demonstrated that Catskill formation of type locality corresponds mainly to Hamilton and Portage formations and that Chemung and Hampshire are younger than true Catskill. Thus, if they [Chemung and Hampshire] were ever present in eastern New York, they would have overlain the Catskill and extended above top of present Catskill Mountains. Hence, name Catskill cannot be properly applied to red rocks described in this report under restored name Hampshire formation.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1993–1994; H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 528. Darton's (1892) term Hampshire formation is herein revived for rocks previously called Catskill formation in West Virginia. It is appropriate to refer to post-Chemung red beds of West Virginia as the Catskill facies, but, because term facies refers to an equivalent of some other formations, there must be some definite post-Chemung horizon of which the local "Catskill" beds can be regarded as the nonmarine equivalent.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. In this report [Hollidaysburg and Huntingdon quadrangles, Pennsylvania], term Hampshire formation is used in preference to term Catskill. Use of Hampshire conforms with present usage of Virginia Geological Survey.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept.] Washington County, p. 92. Thickness about 3,800 feet in Washington County. Lower Catskill rocks consist of brownish-red in part arkosic sandstones alternating with red argillaceous shale including occasional bands of greenish shale; upper part of formation contains more greenish-gray sandstone and shale alternating with red rocks. Catskill continental beds seem to be nonmarine equivalent of the upper Devonian contemporaneous and intertonguing with marine sediments ranging from Hamilton to Chemung and in part post-Chemung. Underlies Pocono group.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 16. In Maryland, only the post-Chemung part of the Devonian remains in the red-bed facies. As there is no unanimity of opinion as to how name Catskill should be applied in New York area, it seems preferable to use name Hampshire in Garrett County, which is only a few miles from type area of Hampshire.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., Field Trip 1, p. 3. Included in Susquehanna group. Pennsylvania Geological Survey currently limits use of term Catskill to the thick brownish- and grayish-red units which characterize middle and upper parts of the Middle and Upper Devonian red-bed sequence. Light-colored sandstone, such as Honesdale and Elk Mountain members, known in the east are included in the Catskill only in those areas where they are underlain by a thick all-red unit. Correlation of members in eastern part of the State with those in central part is complicated and is reserved for future detailed mapping. Overlies transition beds in group; underlies Pocono formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation mapped in central and eastern Pennsylvania. Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in east. Included in Susquehanna group; map bracket shows Catskill above unnamed marine beds and below Oswayo formation. As mapped, marine beds, which consist of gray to olive-brown shales, graywackes, and sandstones, contain "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock with Tully limestone at base, Upper Devonian.

Named for development in Catskill Mountains, Greene County, N.Y.

†Catskill (Delthyris) Shaly Limestone[1]

Catskill Shaly Limestone Member (of New Scotland Formation)

Lower Devonian: Eastern New York.

Original reference: L. Vanuxem, 1842, Geology of New York, pt. 3, p. 120–122.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 71–75. Name Catskill shaly limestone member applied to upper member of New Scotland. Overlies Kalkberg limestone member. Thickness about 120 feet.

Type exposure: On the Catskill at mouth of main gorge of Austin's glen, Catskill. Named for occurrence on Catskill Creek, near Madison, Greene County.

Cattaraugus Formation[1]

Cattaraugus Shale or Formation (in Conewango Group)

Devonian: Southwestern New York and northern Pennsylvania.

Original reference: J. M. Clarke, 1902, New York State Mus. Bull. 52, p. 524–528.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 53–63, charts, geol. map. Formation in Conewangan series. Computed thickness about 370 feet in Wellsville area, though no outcrop shows more than 10 feet of rock. Comprises three principal rock types: (1) flat pebble conglomerates of Upper Devonian age, (2) crossbedded thinly laminated green sandstones, and (3) red shale. Includes Wolf Creek conglomerate member at base and Salamanca conglomerate member in upper part. Overlies Germania formation; underlies Oswayo formation.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30 (table), 33. Basal formation in Conewango group, Chautauquan series. Comprises (ascending) Panama conglomerate, Amity, Salamanca conglomerate, and Saegerstown members. Thickness about 300 feet. Underlies Oswayo formation; overlies Chadakoin formation of Arkwright group (new). Upper Devonian. Area of report, Chautauqua County.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 19. In Wellsville area, considered middle formation in Conewango group. Overlies Wolf Creek conglomerate; underlies Oswayo shale. Thickness about 375 feet in Genesee River valley. Westward in Salamanca and Olean quadrangles, the Cattaraugus has been subdivided into (ascending) Amity shale, Saegerstown shale, and Salamanca conglomerate.

I. H. Tesmer, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1651. Series of structure-contour maps drawn on base of each of several

successive conglomerates in southwestern New York and northwestern Pennsylvania suggests following stratigraphic sequence (ascending) for Cattaraugus formation: Le Boeuf conglomerate, unnamed member (mostly shale and siltstone), Woodcock-Bimber Run-Dutchmans conglomerate, unnamed member (mostly shale and siltstone), Panama conglomerate, unnamed member (mostly shale and siltstone), Wrightsville-Wolf Creek conglomerate, unnamed member (mostly shale and siltstone), Riceville shale, Corry-Pope Hollow conglomerate, Orangeville shale, Sharpsville sandstone, unnamed member (mostly shale and siltstone), Salamanca conglomerate, unnamed member (mostly shale and siltstone) Killbuck conglomerate, and unnamed member (mostly shale and siltstone). Overlies Chadakoin formation; underlies Oswayo formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. In western Pennsylvania, consists of red, gray, and brown shale and sandstone with proportion of red decreasing westward. Includes Venango sands of drillers and Salamanca sandstone and conglomerate; some limestone in Crawford and Erie Counties. Upper Devonian.

Named for development in Cattaraugus County, N.Y.

Cattaraugus parafacies[1]

Devonian or Carboniferous: Southwestern New York and northern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61.

Named for development in Cattaraugus County, N.Y.

Cattasauqua Limestone[1]

Ordovician: Southeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey G_6, p. 153.

The name of the town is spelled Catasauqua, Lehigh County.

Cattron Diorite

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties Rept., p. 17, 18. Altered to hornblende diorite in most of its extent. Intruded Saddle gneiss (new). Injected, intruded, and replaced by series of granitic intrusions. In places, pink pegmatite cuts across unit that contains intrusions of white aplite. By metasomatic replacement, diorite has become hypersthene granodiorite with microcline metacrysts which contain inclusions of andesine, hypersthene, and other primary minerals of the diorite.

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 25–26, pl. 1. Fine-grained grayish-green gneissic rock in which milky-gray feldspar and green hornblende are only minerals discernible to unaided eye. Diorite contains injection of both white and pink aplite which is composed of microcline and quartz. This resulted in two varieties of injection gneiss that have been mapped separately.

Named from Cattrons Mill on Elk Creek, where one of larger outcrops occurs. Injection gneiss formed by intrusion of white aplite in diorite exposed in vicinity of Salem Church, Cattrons Mill, on northwest side of Brierpatch Mountain, and east of Fallville. Migmatite formed by pink

aplite injection seen near Bennington Mill, south of Elk Creek village, and southwest of Fallville.

†Cavanal Group[1]

Cavaniol Group[1]

Pennsylvanian: Central eastern Oklahoma and western Arkansas.

Original reference: N. F. Drake, 1897, Am. Phil. Soc. Proc., v. 36, p. 371, 388.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Group concept is not useful and has not been employed.

Named for Cavanal Mountains, northern part of Le Flore County, Okla.

†Cave Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow and F. Hawn, 1865, Kansas Geol. Survey Rept. on Miami County, p. 7.

Apparently named for occurrence in it of many caves and crevices from which bold springs usually flow.

Cave Creek Formation

Cenozoic(?): Southeastern Arizona.

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1217. Rhyolitic tuffs and welded tuffs 4,500 feet thick. Probably correlative with Rhyolite Canyon formation in Chiricahua National Monument. Name credited to Raydon (unpub. thesis).

In Cave Creek area, Cochise County.

Cave Creek Formation (in Cimarron Group)[1]

Permian: Central southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 27.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1751, 1793. Cragin's "Cave Creek formation" is identical with Blaine formation of Oklahoma. It is here divided into (ascending) Medicine Lodge, Nescatunga, Shimer, and Haskew gypsums. Cave Creek has priority, but the Blaine has wider accepted usage.

Named for Cave Creek, Comanche County, Kans.

Cavendish Schist[1]

Upper Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 210, 223.

In roadcut a few rods north of Gassetts Station, Windsor County.

Cave Springs Sandstone[1]

Pennsylvanian: Southern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 66.

In vicinity of Cave Springs, Elk County.

†Caw Caw Formation[1] or Sands[1]

Eocene, middle: Central South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449.

Named for exposures at Caw Caw Swamp, Orangeburg County.

Cawker terrane[1]

Cretaceous: Kansas.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

Derivation of name not stated, but probably Cawker City, Mitchell County.

Cawood Sandstone Member (of Hance Formation)[1]

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 37, 120, 158.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 65, 66, 67, 69, 77, 138. Massive sandstone about 200 feet above base of formation.

Forms massive bluffs along Martins Fork of Cumberland River at Cawood, Harlan County, Ky.

Cayey Siltstone Member (of Robles Formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. Thick sequence of rocks consisting principally of siltstone. About 300 to 350 meters thick in north-central part of quadrangle but thins toward southwest where it intertongues with Lapa lava member and consists of three tongues: one beneath the lava, another separates the two flows making up the lava, and a third overlies the lava. Lower and middle tongues pinch out southwestward within the quadrangle. Also includes layers of sandstone and volcanic breccia and locally a conglomerate at top. Overlies Río Matón formation.

Named for exposures along Highway 1, southwest of Cayey, beginning at Quebrada Santo Domingo and ending at the Río Matón, Cayey quadrangle.

Cayey Tuffs

Cretaceous: Puerto Rico.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 319. Berkey (1915, New York Acad. Sci. Annals, v. 26, p. 29) suggested name for an extensive development of tuffs in vicinity of Cayey, but term has not been used since. [Term Sierra de Cayey tuffs is used on page 61.]

Cayuga Group[1] **or Dolomite**

Cayuga Series

Upper Silurian and Lower Devonian: New York, western Maryland, Pennsylvania, and Virginia.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 145–257. Cayugan formations of West Virginia are Williamsport sandstone (redefined), Bloomsburg red-bed facies, and Wills Creek and Tonoloway limestones. Total thickness varies from 170 to more than 1,250 feet. Upper Silurian.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Cayugan series used for uppermost division of Silurian system. Includes interval above Niagaran series.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 154–159, pls. In this report [Rose Hill district, Lee County], upper part of Cayuga is missing owing to faulting, and subdivision of beds of Cayuga age is not practical. Because of dominance of dolomite in sequence, unit is called Cayuga dolomite. Consists in general of basal sandstone several feet thick overlain by about 20 feet of blue-weathering limestone and then by thick-bedded dolomite that varies in thickness because it lies directly beneath overthrust fault plane. Not possible to determine true stratigraphic thickness in mapped area; where present, ranges from thin film to possible 90 feet. Thickness outside mapped area indicates that formation thins from northeast to southwest in Wise and Lee Counties. Unconformably overlies Clinton shale. Cayuga is youngest Silurian formation in region. In northeastern Lee County, underlies Lower Devonian Helderberg limestone; farther northeast in Virginia other Devonian formations are present in section. Despite length of hiatus contact of Brallier shale and Cayuga dolomite at Hagan is seemingly conformable.

L. V. Rickard, 1955, New York State Geol. Assoc. 27th Ann. Mtg., p. 7. In central New York, Upper Silurian Cayugan series (revised) contains Salina and Bertie formations. Underlies Helderbergian series (revised) of Lower Devonian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. New York Silurian, standard reference section for United States, is divided into two series, an older, Niagaran, and a younger, Cayugan. This is departure from earlier usages involving three series. Cayugan series divided into two stages: Canastota(n) and Murder(ian) (both new). Rondout and Manlius formations, formerly included in Silurian are now placed in Early Devonian.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 11 (table 1), 47. In Rockingham County, group comprises Bloomsburg formation and overlying Tonoloway limestone. Thickness 220 to 600 feet. Overlies Clinton formation.

U. S. Geological Survey currently designates the age of the Cayuga Series as Late Silurian and Early Devonian on the basis of a study now in progress.

Typically exposed at north end of Cayuga Lake, N.Y.

Cayuse Flow

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, p. 50 (fig. 4), 54. Discussion of volcanoes of Three Sisters region. Name applied to flow from Cayuse Cone.

Cayuse Cone is southeast of South Sister Mountain.

Cayuse Limestone

Precambrian (Belt Series): Northwestern Montana.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 211, 213 (table 1), 215–216. Dull-gray crystalline buff-tan-weathering dolomite interbedded with pale-maroon and green-gray fissile argillite which grades upward into alternating zones of shaly bedded calcareous argillite and

finally passes into sideritic and dolomitic hard marble; upper part blue- and dull-gray thick-bedded finely oolitic, coarsely crystalline algal limestone which shows typical bioherm structure. Thickness 1,000 to 2,100 feet; entire thickness exposed throughout distance of only 4 miles on upper part of hills west of South Fork and south of West Fork of Sun River. Unconformably overlies Miller Peak argillite north and south of Deer Creek; north of West Fork of Sun River, Cayuse is thrust upon Mississippian Hannan limestone and shale of Lower Cretaceous Kootenai along Lewis overthrust. Underlies Hoadley formation (new) with contact probably gradational. Miller Peak argillite, Cayuse limestone, Hoadley formation, and Ahorn quartzite (new) are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931) in Sapphire and Garnett Ranges. Report covers southwestern Saypo quadrangle.

Name derived from Cayuse Creek, tributary of South Fork of Flathead River in northern part of Ovando quadrangle, where formation is thickest.

Cayuta Shale Member (of Chemung Formation)[1]

Cayuta Formation (in Chemung Group)

Cayuta monothem

Upper Devonian: Western New York and northern Pennsylvania.

Original reference: H. S. Williams, 1906, Science, new ser., v. 24, p. 365–372.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32, 33. Rank raised to formation in Chemung group. Geographically extended to Pennsylvania.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 47. Termed a monothem. Includes Starrucca shale member at top, Owego shale member below, and Cascade [also called Cascade Creek] sandstone member at base. Underlies Wellsburg monothem.

Exposed along Cayuta Creek from Cayuta Lake, Schuyler County, N.Y., to creek's discharge into Susquehanna River.

Cazenovia Group[1]

Cazenovia Stage

Middle Devonian (Erian): Eastern North America.

Original references: T. A. Conrad, 1841, New York Geol. Survey 5th Rept., p. 31; L. Vanuxem, 1842, Geology of New York, pt. 3, p. 150–160.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. Cazenovia group of Conrad (1841) and Vanuxem (1842) revived and used as a stage term. As used here, includes strata from top of Onondaga to base of Centerfield, or the Marcellus and Skaneateles formations. In this report, the Devonian is subdivided into 10 stages of which the Cazenovia is fourth in sequence (ascending). Follows the Onesquethaw (new) and is succeeded by the Tioughnioga (new). [For complete sequence see Helderberg stage this reference.]

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv. Geol. Survey Div. 44, Geol. Ser. 37, p. 35 (table 1). In Mackinac Straits region, Michigan, Cazenovia group includes Dundee limestone. Overlies Detroit River group.

A. T. Cross and J. H. Hoskins, 1951, Jour. Paleontology, v. 25, no. 6, p. 718 (fig. 3). Shown on composite stratigraphic column of western New York and northwestern Pennsylvania as Cazenovia group including Marcellus and Skaneateles formations. Underlies the Tioughnioga group.

Type section (stage): In township of Cazenovia, N.Y., where entire sequence occurs. Group named for exposures at town of Cazenovia.

Cebada Fine-Grained Member (of Careaga Sandstone)

Pliocene, upper: Southern California.

W. P. Woodring, W. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1356–1358; W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 10, 32, 42–47, pl. 1. Consists of fine-grained generally massive soft sandstone; lower part typically very fine grained and light gray, but most of sandstone is light yellowish brown. Maximum thickness 1,000 feet. Lower member of Careaga. Gradationally overlies Foxen mudstone, and on north flank of eastern Purisima Hills overlaps part of Sisquoc formation; underlies Graciosa member of Careaga.

Type region: On north flank of Purisima Hills south of Careaga Station on the now abandoned Pacific Coast Railroad, Santa Maria district.

Cedar Formation[1]

Upper Triassic: Northern California.

Original references: J. S. Diller, 1892, Prelim. proof-sheet ed. of U.S. Geol. Survey Lassen Peak folio; 1895, pub. as U.S. Geol. Survey Geol. Atlas, Folio 15.

Named for exposures on Cedar Creek, along toll road between Redding and Round Mountain, Lassen Peak region.

†Cedar Limestone[1]

Middle and Upper Devonian: Eastern Iowa.

Original reference: D. D. Owen, 1852, Rept. Geol. Survey Wisconsin, Iowa, and Minnesota. p. xix.

Named for valley of Cedar River, eastern Iowa.

Cedar Bay Granite[1]

Mesozoic(?): Southeastern Alaska.

Original reference: U. S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 41–43, 46.

Surrounds two-thirds of Cedar Bay and forms core of neck of land between Wells Bay and passage northwest of Glacier Island, Prince William Sound region.

Cedar Butte Basalt[1]

Pleistocene: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30 (table), 69, pl. 6. Aphanitic blue pahoehoe basalt with fresh green olivine phenocrysts. Thickness about 200 feet.

Type locality: Cedar Butte, T. 8 S., R. 29 E., Power County.

Cedar City Tongue (of Kayenta Formation)

Upper Triassic(?) : Southwestern Utah.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2521–2522. Largely nonresistant mudstone and siltstone. Mudstone and silty mudstone, which make up major part of total thickness, are reddish brown locally streaked and spotted light gray; siltstone, which forms beds 1 to 5 feet thick, is moderate reddish orange to light gray and is mottled with white in some places. In Chinle section along Coal Creek, measured by Thomas and Taylor (1946) and redescribed by Gregory (1950, Utah Geol. and Mineralog. Survey Bull. 37), rocks here assigned to Cedar City tongue are designated as units 28, 29, and 30; and units 23, 24, and 25, respectively. Thickness 425 feet along Coal Creek but 720 feet in Shurtz Creek, 5 miles south; this increase in thickness accompanies decrease in thickness of underlying Shurtz sandstone tongue (new) of Navajo sandstone.

U. S. Geological Survey currently considers the Cedar City tongue to be Upper Triassic(?). This age designation is made on basis of recent studies of the Kayenta.

Type locality: About 2 miles east of Cedar City, Iron County, directly east of the Red Hill. State Highway 14 crosses type locality a few hundred feet below power plant of Southern Utah Power Co.

Cedar Cliff Limestone Lens (in Wills Creek Shale)[1]

Cedar Cliff Limestone Member (of Williamsport Sandstone)

Upper Silurian : Western Maryland and northern West Virginia.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey, Silurian Volume, p. 41.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 152, 162, 192. Reallocated to member status in Williamsport sandstone (redefined). Present in middle part of formation in area near Cumberland, Md.

Well exposed at Cedar Cliff, southwest of Cumberland, Allegany County, Md.

Cedar Creek Argillite[1] (in Stevens Series)

Cambrian : Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 80, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 602 (table 4), 609–611, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Parker and Cannon (1943) for Metaline quadrangle. Correlative with Maitlen phyllite are parts of Weaver's Northport limestone, Boundary argillite, Deep Lake argillite, and all of Cedar Creek argillite.

Exposed along road up Cedar Creek to Frisco-Standard mine and on north slopes of Red Top Mountain, Stevens County.

†Cedar Creek Beds[1]

Cedar Creek facies (of Brule Formation)

Cedar Creek Member (of White River Formation)

Oligocene, middle : Northeastern Colorado.

Original reference: W. D. Matthew, 1901, Am. Mus. Nat. History Mem., v. 1, pt. 7, p. 355–374, 444.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 16, pl. 1. Referred to as Cedar Creek facies of lower Brule formation. Apparently higher in volcanic ash than typical Orella member of Brule in Nebraska-South Dakota area. If considered valid and appropriate member name, it would have priority over Orella.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 14–16. Proposed here to use term Cedar Creek member of White River formation for the beds of Orellan age, composed of pink and tan sandstones and silts, that lie above disconformity separating Horsetail Creek member from this member or above the grayish-white silts where no disconformity is evident and that lie below a "white marker" which is lowest bed of Vista member (new). These deposits are, seemingly, Matthews's (1901) Cedar Creek beds, which Woods and others (1941) called Cedar Creek facies of Brule formation. Data on typical exposures. Location of Cedar Creek beds described by Matthew not definitely known.

Typically exposed in secs. 29 and 21, T. 11 N., R. 53 W., Logan County. Named for Cedar Creek, Logan County.

Cedar Creek Limestone[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 12, 21, 36.

Best developed at type locality on Cedar Creek 1½ miles southwest of town of Cedar Creek, Cass County.

Cedar Fort Member (of Oquirrh Formation)

Pennsylvanian (Desmoinesian): Northwestern Utah.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 108–115, pls. 1, 2. Predominantly orthoquartzites, with subordinate amounts of cherty and argillaceous limestones, and some crystalline limestones and bioclastic limestones. Thickness 1,371 feet at type locality. Overlies Meadow Canyon member and underlies Lewiston Peak member (both new).

Type locality: On east limb of Pole Canyon syncline (west limb of West Canyon anticline) in sec. 36, T. 5 S., R. 3 W., Utah County. Section measured on spur south of small east-trending canyon bearing local name of Spring Creek. Named for exposures northwest of town of Cedar Fort.

Cedar Grove Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 169–178.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91, 95, 104. Cedar Grove sandstones included in Kanawha group.

Named for its association with Cedar Grove coal, Cedar Grove, Kanawha County.

Cedar Hill Serpentinite

Lower Paleozoic: Northern Maryland and southeastern Pennsylvania.

D. M. Lapham, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., p. 35–38. Cedar Hill serpentinite is within easternmost serpentinite belt of two such belts which trend northeast from Maryland into

Pennsylvania. Western belt trends approximately N. 30° E., is about 4 miles long and composed of small serpentine lenses separated by Peters Creek formation. Eastern serpentinite is essentially continuous, extending northeastward from Susquehanna River for about 15 miles and trending about N. 80° E. At Cedar Hill, contact with Peters Creek schist lies just north of Cedar Hill quarry. Further to the east, the serpentinite is in contact with Wissahickon schist. Both schist formations are believed to be lower Paleozoic in age.

Named for occurrence at Cedar Hill, Cecil County, Md.

Cedar Hills Anhydrite[1]

Permian: Central Kansas.

Original reference: R. G. Moss, 1932, Kansas Geol. Survey Bull. 19.

In Ness and Hodgeman Counties.

Cedar Hills Sandstone Member (of Hennessey Shale)

Cedar Hills Sandstone (in Cimarron Group)[1]

Cedar Hills Sandstone (in Nippewalla Group)

Permian: Southern Kansas and northern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p 3, 24.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782, 1789–1791. Assigned to Nippewalla group (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 39. Consists of feldspathic sandstone, siltstone, and silty shale, chiefly red, containing beds of white sandstone in upper and lower parts; upper part contains "snow balls" of white gypsum; shaly siltstone separates the more resistant and more massive coarse siltstone and very fine sandstone. Thickness about 180 feet. Underlies Flowerpot shale; overlies Salt Plain formation. Nippewalla group, Leonard series.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as sandstone member of Hennessey shale.

Named for Cedar Hills, Barber County, Kans.

Cedar Keys Limestone

Cedar Keys Formation

Paleocene: Northern and central Florida (subsurface).

W. S. Cole, 1944, Florida Geol. Survey Bull. 26, p. 27–28. Term Cedar Keys formation is designed to cover rocks encountered in wells in peninsular and northern Florida from first appearance of *Borelis* fauna to top of Upper Cretaceous. Thickness 570 feet in Hilliard Turpentine Company No. (W–336) and 566 feet in Cedar Keys No. 2 (W–355).

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1699, 1704, 1708. Cedar Keys limestone overlies Lawson limestone (new) and underlies Oldsmar limestone (new).

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 84–86. Cedar Keys formation, as used in this report, covers interval extending from top of *Borelis* fauna, or top of a characteristic lithology, to top of the Cretaceous, which, in Levy County, is upper Lawson limestone. Cole's Cedar Keys is thus expanded by inclusion of an indefinite thickness of beds at top and contracted by exclusion of upper Lawson. Applin (1944) applied

name Cedar Keys to a similar interval and with this usage formation is much more uniform in its occurrence and thickness. Florida Geological Survey has accepted new definition but retains original name. Paleocene.

Type well and derivation of name not given.

Cedar Mesa Sandstone Member (of Cutler Formation)[1]

Cedar Mesa Formation (in Cutler Group)

Permian: Southeastern Utah.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1420, 1421, 1423, 1441, 1445, 1446.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2054, 2055. In revised terminology in Four Corners region, Cedar Mesa is raised to formation in Cutler group. Occurs above Halgaito formation.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1855. Thickness of member about 800 feet in Monument Valley. Underlies Organ Rock tongue and overlies Halgaito tongue; in some areas overlies Rico formation.

Well exposed on Cedar Mesa, Utah, on San Juan River, west of Mexican Hat (Bluff post office).

†Cedar Mountain Beds[1]

Miocene, upper: Central Nevada.

Original references: J. C. Merriam, 1914, California Univ. Pub., Bull. Dept. Geol., v. 8, no. 12, p. 277; 1916, v. 9, p. 163–172.

Cedar Mountains.

Cedar Mountain Complex

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1487–1489, pl. 1. Name applied to youngest of three groups of Precambrian igneous and metamorphic rocks exposed in Minnesota River valley. Consists of several small roughly circular intrusives; largest forms prominent knob called Cedar Mountain. Gabbro-diorite makes up bulk of rock in Cedar Mountain and forms outer shell 500 feet thick surrounding a granite core. Well-developed banding or primary flow structure is characteristic of Cedar Mountain gabbro and related types in other localities. Complex considered younger than rock types grouped in Minnesota Valley granite series.

Crops out in area south and southeast of Franklin, in Renville, Redwood, and Brown Counties.

Cedar Mountain Formation

Cedar Mountain Shale or Formation (in Dakota Group or Cedar Mountain Group)

Lower Cretaceous: Central Utah and northwestern Colorado.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 966–967, 989, table 1. Term Cedar Mountain shale proposed to include variegated beds between Buckhorn conglomerate (new) below and Dakota(?). Predominantly shale. Thins eastward: 272 feet at type locality: 100 feet, Cisco, Utah; 25 feet, Blue Mountain, Colo. Shale-conglomerate contact sharp

though position of boundary depends on local position of conglomerates and may vary within vertical interval of 100 feet or more. Upper contact variable; in places is gradational into Dakota(?) beds; elsewhere is sharp but irregular. Together with Buckhorn conglomerate comprises Cedar Mountain group (new).

W. L. Stokes, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1774. Formation redefined to include Buckhorn conglomerate reduced to member status. Name applicable to Lower Cretaceous sediments of Utah west of Colorado River. For region east of Colorado River to an undetermined position in central Colorado, name Burro Canyon formation is applicable.

W. L. Stokes, 1952, Utah Geol. and Mineralog. Survey Bull. 46, p. 9 (table 1), 19–20, pl. 1. Described in Thompsons area where it is 110 feet thick; overlies Brushy Basin shale member of Morrison and underlies Dakota sandstone. Buckhorn conglomerate not represented in this area.

R. G. Young, 1959, Rocky Mountain Assoc. Geologists' 11th Field Conf., Symposium, p. 17–21. Formation described in Grand Junction area, Colorado, where it disconformably underlies Naturita formation (new). Consists of basal conglomeratic sandstone unit and overlying variegated mudstone unit. In most localities, basal sandstone is massive cliff-forming unit with undulatory base and sharply defined upper surface. Farther west in Utah, three such sandstones, separated by mudstone units, are present in formation. These sandstones are termed Lower, Middle, and Upper Cedar Mountain sandstones. Lower, which is probably equivalent to Stokes' Buckhorn is present in deeper scours in Grand Junction area and is directly overlain in these scours by Middle sandstone. Where Lower sandstone is absent, the Middle sandstone constitutes the basal sandstone. Where only Middle sandstone is present basal unit averages about 25 feet thick, but where both sandstones are present it may be as much as 80 feet thick. Mudstone unit averages about 35 feet in Grand Junction area but slightly thicker along western edge. Included in Dakota group.

R. G. Young, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 157–171, 180–181, 183, 188. Considered facies of Dakota group. Upper part of formation passes laterally into lower part of Naturita formation herein also considered facies of Dakota group. Proposed also to drop name Burro Canyon formation and retain older name Cedar Mountain formation for noncarbonaceous deposits of Dakota group throughout Colorado Plateau.

Type section: Southwest flank of Cedar Mountain, Emery County, Utah, just north of Buckhorn Reservoir.

Cedar Mountain Group

Lower Cretaceous(?): Colorado and Utah.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 987–989. Recommended that Buckhorn conglomerate and Cedar Mountain shales (both new) be called Cedar Mountain group and tentatively classed as Lower Cretaceous. On generalized section, group is above Morrison formation and below Dakota(?) sandstone.

Type area not stated. Cedar Mountain shale has its greatest development in central Utah and northwestern Colorado.

Cedar Park Member[1] (of Walnut Clay)

Lower Cretaceous (Comanche Series) : Eastern Texas.

Original reference : W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 331.

V. E. Barnes, 1958, Texas Univ. Bur. Econ. Geology Guidebook 1, p. 24. Thickness commonly 10 feet or less.

Type locality : Quarries about 2 miles northwest of Cedar Park, Williamson County.

†Cedar Point Shales and Shaly Limestones[1]

Permian : Central Kansas.

Original reference : L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Probably named for Cedar Point, Chase County.

Cedar Rapids phase (of Otis Limestone)[1]

Middle Devonian : Central eastern Iowa.

Original reference : W. H. Norton, 1921, Iowa Geol. Survey, v. 27, p. 378.

In quarries at Cedar Rapids and at numerous other exposures.

Cedar Spring Member (of Cove Mountain Formation)

Tertiary : Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1). White and pink airfall tuff, sediments, and green-tan-purple rhyolite vitric tuff. Thickness 300 feet. Upper part of formation; overlies Pilot Creek basalt member (new).

Occurs in Washington County. Type locality and derivation of name not stated.

Cedarton Shale Member (of Graford Formation)[1]

Cedarton Shale (in Graford Group)

Upper Pennsylvanian : Central Texas.

Original reference : N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 391.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 104–105. Underlies Winchell shale member (new).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Graford group. Overlies Adams Branch formation ; underlies Winchell formation.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. In Brown and Coleman Counties, member consists of shale, red in upper part and gray in lower part. Upper part locally contains fern leaf prints; lower part contains crinoid debris and a few fusulinids. Thickness about 70 feet. Overlies Adams Branch limestone member; underlies unnamed limestone at base of Winchell limestone.

Named for Cedarton, Brown County.

Cedartop Gypsum Member (of Blaine Gypsum)[1]

Permian : Southwestern Oklahoma and western Texas.

Original reference : C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 56.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 686 (table 1). Table of upper Leonard series in Kansas, Oklahoma, and Texas shows Cedartop member above Medicine Lodge member and below Acme member.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 30. Shown on correlation chart of West Texas.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 22–23, pl. 1. New type locality designated. Present study shows that Haystack gypsum caps Cedartop Butte and since all rocks younger than Haystack have been eroded away, this butte cannot be type locality for what is here called Cedartop gypsum. At newly selected type locality, member is 10½ feet thick, separated from underlying Haystack gypsum member by 12½ feet of red and gray-green shale and from overlying Collingsworth gypsum member by 13½ feet of shale.

Type locality (redesignated): In bluffs about 250 yards north of Cedartop Butte, in the SE¼SE¼ sec. 35, T. 8 N., R. 21 W., Beckham County, Okla.

Cedar Vale Shale[1] Member (of Scranton Shale)

Cedar Vale Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, p. 53.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 212. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Overlies Happy Hollow limestone; underlies Rulo limestone. Average thickness 25 feet.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p 309 (fig. 14). Stratigraphic section shows occurrence in Adams County, Iowa.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 2274 (fig. 1), 2277. Rank reduced to member status in Scranton shale here reintroduced as a formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Underlies Rulo limestone member: overlies Happy Hollow limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 14, fig. 5. Cedar Vale shale, Wabaunsee group, is marked by Elmo coal at top. Shale is gray and blocky and contains nodular limestone near top and center. Thickness 18 feet in drill hole near Coin. Overlies Happy Hollow limestone; underlies Silver Lake shale. Rulo limestone, which underlies Silver Lake in some areas has not been identified in Iowa.

Type locality: East of Cedar Vale, Chautauqua County, Kans.

Cedar Valley Limestone[1]

Cedar Valley Formation

Middle Devonian: Eastern Iowa, southwestern Illinois, and southeastern Minnesota.

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 11th Ann. Rept., pt. 1, p. 314.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 94–97. Geographically extended into southeastern Minnesota where it covers southwestern corner of Fillmore County, about

three-quarters of Mower County, and part of southeastern Freeborn County. Thickness generalized section about 100 feet. Senecan series.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1750–1751, chart 4. Shown on correlation chart as Middle Devonian. However, age of Cedar Valley has long been a moot question. Known fauna of Cedar Valley contains no fossils of unequivocal late Devonian age. Evidence for age based on position of Independence shale leads to difficulties. Independence shale contains Chemung fauna, but Stainbrook (1935) believes that the Independence is stratigraphically below the Cedar Valley. Others believe that the Independence represents fillings of caverns in the Cedar Valley and that it is therefore younger than formation it seemingly underlies.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 185–187. Formation includes (ascending) Linwood, Littleton, and Coralville members. Overlies Independence shale, probably unconformably; in some areas, overlies Davenport member of Wapsipinicon; in some areas, overlies Spring Grove member where Davenport has been eroded; in northern and western Iowa, may rest on Maquoketa or even Galena where it overlaps the Wapsipinicon. Stratigraphically below Shellrock formation. Upper Devonian.

D. L. Dunn, 1959, Jour. Paleontology, v. 33, no. 6, p. 1001–1017. Discussion of Devonian chitinozoans from Cedar Valley formation in Iowa. In this area, formation includes (ascending) Solon, Rapid, and Coralville members. Investigators are not in agreement concerning age of the Cedar Valley. Correlations discussed. Investigators who support cave-filling origin of underlying Independence shale, hold the Cedar Valley to lie conformably upon Davenport member of Wapsipinicon. The Cedar Valley overlaps the Silurian and Ordovician to north.

Named for exposures in valley of Cedar River, Iowa.

Cedarville Andesite[1]

Miocene: Northeastern California.

Original reference: H. A. Powers, 1932, Am. Min., v. 17, no. 7, p. 253–282.

In Modoc lava-bed quadrangle.

Cedarville Dolomite

Cedarville Dolomite (in Durbin Group)

Cedarville Limestone[1]

Middle Silurian: Southwestern Ohio and southeastern Indiana.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 277–278, 301, 304–306.

D. A. Busch, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1976. Stratigraphically expanded below to include 43 feet of dolomite formerly included in the Huntington dolomite, as exposed at Ridgeville, Randolph County, Ind. As redefined, total thickness of Cedarville formation is 95 feet.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as uppermost unit in Durbin group. Underlies Peebles dolomite.

Edwin Kirk, 1946, Washington Acad. Sci. Jour., v. 35, no. 2, p. 34. Referred to as Cedarville dolomite and noted as occurring in Indiana.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci. Geology Sec. Guidebook 35th Ann. Field Conf., p. 13, 17–19, 21. Silurian section in Yellow Springs region shows Cedarville dolomite, as much as 50 feet thick, above Springfield dolomite. Top of section. Niagaran.

Well exposed at Cedarville, Greene County, Ohio.

Cedarville Sandstone (in Monongahela Formation)[1]

Pennsylvanian: Northern West Virginia and western Maryland.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 124.

Forms cliff at east end of Cedarville, Gilmer County, W. Va.

Cedarville Series[1]

Oligocene, middle, or Miocene: Northeastern California.

Original reference: R. J. Russell, 1928, California Univ. Pub., Dept. Geol. Sci. Bull., v. 17, no. 11, p. 402–416, map.

C. A. Anderson, 1941, California Univ. Pub., Dept. Geol. Sci. Bull., v. 25, no. 7, p. 352–353. Described in discussion of basement rocks of Medicine Lake Highland area. Exposures outside mapped area indicate Cedarville series probably underlie the highland. Character of underlying rocks unknown. Older than Warner basalt.

D. I. Axelrod, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1936. Lower Cedarville contains flora that is apparently mid-Oligocene in age.

Mapped over a large part of Warner Range, west of Cedarville, Modoc County.

Ceja Glorieta sandstone[1]

Permian: New Mexico.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 4, p. 263.

†Cement shale[1]

Upper Devonian: Western Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 289.

Takes title from [exposures on?] Cement Mountain, a few miles from Crested Butte, Gunnison County.

Cement City Limestone Member (of Drum Limestone)

Cement City Limestone Bed (in Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: H. Hinds and F. C. Greene, 1915, Missouri Bur. Geology and Mines, v. 13, 2d ser., p. 7, 27–28, 118.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030, 2031 (fig. 4). Member of Drum limestone. Underlies Corbin City limestone member; overlies Quivira shale member of Cherryvale formation. Northeastward tracing proves that Dewey member of the Drum is the same as limestone called Cement City in Kansas City area. Dewey has priority over Cement City (Hinds and Greene, 1915) and is recognized as a formational unit by Oklahoma Geological Survey. Kansas Geological Survey has used Cement City for lower member of Drum limestone and Cement City was recognized by the inter-state conference

(May, 1947). Kansas proposes to deviate from the interstate classification by adopting Dewey instead of Cement City. Other State surveys will continue to recognize Cement City until question of stratigraphic identity of the type of this unit (near Kansas City) and the Dewey is removed.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. Thickness near Winterset, Iowa, 6 feet; Sarpy County, Nebr., 11 feet. Persists southward into Oklahoma. Type locality stated.

Type locality: In cement plant quarry at Cement City, Jackson County, Mo.

Cemetery Limestone[1]

Upper Cambrian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 437.

Named for occurrence at Elkhorn cemetery, Elkhorn region.

Centennial Limestone[1]

Middle and Upper Cambrian and Lower Ordovician: Central northern Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

Probably named for Centennial mine, Tintic district.

Centennial Series

Precambrian: Southeastern Wyoming.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Name proposed for metalimestone schist series intruded by older gray granites and lying stratigraphically below Deep Lake metaquartzite. Occurs below Snowy Range series (new).

Area is west, northwest, and north of Centennial, Medicine Bow Mountains, Albany County.

Centennial School Sandstone and Shale Member (of Bald Eagle Sandstone)

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58p. Lower member of Bald Eagle in vicinity of Tyrone Gap. Underlies Spring Mount sandstone member (new). Overlies Reedsville shale. [Swartz refers to his 1955 report *in* Pennsylvania Geologists guidebook 21st Ann. Field Conf. Compiler was unable to locate this reference.]

Type locality and derivation of name not given.

Centerfield Coral Bed

See **Mahantango Formation** (in Hamilton Group).

Centerfield Limestone Member (of Ludlowville Shale)[1]

Centerfield Formation

Middle Devonian: Central and western New York and eastern Pennsylvania.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 22.

G. A. Cooper and A. S. Warthin, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 876 (fig. 2), 877–878. Formation, at type section, consists of 5 feet of alternating shale and limestone bands, the latter as much as 4 inches thick. This is overlain by about 6 feet of sandy limestone abounding in

corals. Formation thins westward to 4½ feet at Blossom in Erie County where it is mostly limestone. West of Blossom on Lake Erie shore, approximate position of the Centerfield is marked by a thin layer of limestone containing abundant *Styliolina*. East of type section, sand content increases, and differentiation into alternate bands of shale and limestone disappears. On Seneca and Cayuga Lakes, formation is fairly homogeneous sandy limestone about 30 feet thick. In Erie County, N.Y., overlies Levanna shale and underlies Ledyard shale; at Skaneateles Lake, overlies Butternut shale and underlies a coral bed. Where exposed in eastern Pennsylvania near Stroudsburg, consists of 23 feet of bluish calcareous sandstone containing corals.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455. Referred to as formation. Underlies Ledyard formation; overlies Levanna formation. Ostracodes discussed.

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 3–4. Member occurs at base of Ludlowville shale. Thickness at type locality 20 feet. Underlies Ledyard member. Contains lowest occurrence of trepostomatous Bryozoa known in Hamilton group.

Type section: On Schaffer Creek, about 1 mile north of Centerfield, Canandaigua quadrangle, New York.

Center Hall Formation[1]

See Centre Hall Member (of Nealmont Limestone).

Center Iron Sandstone (in Clinton Formation)[1]

Center Iron Sandstone (in Rose Hill Shale)

Middle Silurian: Central southern Pennsylvania.

Original reference: C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, p. 625, 628, 629, 634, 638.

F. M. Swartz and H. J. Hambleton, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 19, 21–22, 27. At Center, about 36 feet of Center iron sandstones are exposed along road where Center member was originally measured; 2 miles south of New Germantown where road crosses plunging nose of anticlinal Rising Mountain, the sandstone is more than 60 feet thick and occurs in upper part of Rose Hill shale about 150 to 210 feet below Keefer sandstone; thickens eastward to 210 feet at Susquehanna Gap; thins and gradually disappears northwest of Center and New Germantown.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 29. Unit renamed Burnt Ridge sandstone member of Rose Hill.

Named from exposures south of Center village, Perry County.

Center Peak Conglomerate Member (of Panoche Formation)

Lower Cretaceous: Southern California.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 15). Shown on correlation chart at base of Panoche formation. Underlies Curry Mountain shale member.

Centerpoint volcanic facies (of Eagleford Formation)

Upper Cretaceous: Southwestern Arkansas.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 143, 147–148. Red and gray clays with interbedded pebbly tuffaceous sandstones. Overlies the Trinity; underlies Tokio formation. Name im-

plies that this group of rocks is a volcanic facies of the Eagleford formation of northeast Texas. Unit has commonly been referred to as the volcanic "Woodbine."

Settlement of Centerpoint in Howard County is located within the area of the outcrops and within relatively short distances of the upper and lower contacts of the formation.

Centerville Clay

Centerville Formation[1]

Lower Silurian (Albion Series): Southwestern Ohio and southeastern Indiana.

Original reference: A. F. Foerste, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 173, 184–185.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Centerville clay; stratigraphically below Brassfield limestone. Included in Albion series.

Named from exposures east of Centerville, Montgomery County, Ohio.

Centerville Limestone[1]

Silurian (Niagaran): Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402, 407.

Named for exposures at Centerville, Hickman County.

Centinela Gravels[1]

Pleistocene: Southern California.

Original reference: A. J. Tieje, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 5, p. 510.

Exposed south of Centinela Creek, Los Angeles County.

†Central Limestone and Shale Group[1]

Lower, Middle, and Upper Ordovician: Central and eastern Tennessee.

Original reference: J. M. Safford, 1856, Geology Reconn. Tennessee 1st Rept., p. 149, 154–156.

Named for central basin of middle Tennessee.

Central City Granite[1]

Central City Quartz Bostonite

Precambrian(?): Central northern Colorado.

Original references: J. Underhill, 1906, Univ. Colorado Studies, v. 3, no. 4, p. 272; 1906, Colorado Sci. Soc. Proc., v. 8, p. 103–122.

George Phair, 1952, U.S. Geological Survey Trace Elements Inv. Rept. TEI–247, p. 26. Referred to as quartz bostonite.

Occurs only on each side and a little south of head of Spring Gulch, just south of Central City Railroad station, Gilpin County.

Central Fee sandstone unit (in Sycamore Canyon Member of Puente Formation)

Miocene, upper: Southern California.

C. J. Kundert, 1952, California Div. Mines Spec. Rept. 18, p. 6 (fig. 2), 7, pl. 2. Series of sandstone and sandy siltstone beds in upper part of

Sycamore Canyon member. Thickness approximately 1,050 feet. Underlies Hoover conglomerate unit (new) of Sycamore Canyon member.

Occurs in Whittier-La Habra area, south of Whittier fault, Los Angeles County.

Centralia cyclothem (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

J. R. Ball, 1943, Illinois Acad. Sci. Trans., v. 36, no. 2, p. 147, 148. In sequence in Carlinville quadrangle. Centralia cyclothem occurs below Macoupin cyclothem and above Shoal Creek cyclothem. Thickness about 5 feet; cyclothem not fully developed in quadrangle. The included fossiliferous limestone [probably Centralia limestone] is about 17 feet above the Shoal Creek limestone.

Type locality and derivation of name not given.

Centralia Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: J. R. Ball, 1934, Illinois Acad. Sci. Trans., v. 26, no. 3, p. 97.

Derivation of name not stated, but probably is Centralia, southwest corner of Marion County.

Centralian Epoch or Series[1]

Pleistocene (Illinoian and Sangamonian): Illinois and Iowa.

Original reference: G. F. Kay, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 449–452.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38. In Iowa and Illinois, the Pleistocene is classed as a period (system) and four epochs (series) are used to include a glacial-interglacial pair each. These are Grandian (Nebraskan and Aftonian), Ottumwan (Kansan and Yarmouthian). Centralian (Illinoian and Sangamonian), and Eldoran (Wisconsinan and Recent). Of these units, each of the first three essentially coincides with a glacial cycle; present data indicate that the youngest (Eldoran) includes two distinct cycles, each of which is complex within itself. These terms have not been adopted for official use in Kansas partly because of this inconsistency and partly because retention of Quaternary as the System-Period with Pleistocene as its contained Series-Epoch would necessitate erection of new category of names to include these terms and thus produce further complication of classification system.

Named for Centralia, Marion County, Ill.

†Central Mine Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 80–81, chart.

Houghton County.

Central Mine Group[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 689.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Name Portage Lake lava series (new) proposed

to include Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports. These older subdivisions are quite arbitrary and depend on continuity of individual flows or conglomerate beds for validity. They are not useful for purpose of this report.

Well exposed in workings of Central mine on a cross-fissure, exposing a good section (secs. 24, 25, 36, T. 58 N., R. 31 W.).

Central Valley Beds[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 187.

Derivation of name not stated.

Central Valley Sandstone

Lower Devonian : Southeastern New York.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 728–730, 731 (fig. 2). Consists of white-weathering, mottled violet sandstone with a 1-foot bed of white-weathering chert at top of unit. Fossiliferous. Thickness about 25 feet. Lower contact covered; sandstone may rest on beds of New Scotland age or may rest on strata of pre-New Scotland, Upper Silurian age. Underlies Connelly conglomerate, contact abrupt.

Type section: In Thruway cut at Highland Mills, Orange County. This is only known exposure of unit. Name derived from Central Valley. Section is located on eastern side of Green Pond-Schunemunk Mountain outlier.

Centre Hall Member (of Nealmont Limestone)

Middle Ordovician : Central and central southern Pennsylvania.

Original reference (Center Hall) : R. M. Field, 1919, Am. Jour. Sci., 4th, v. 48, p. 404, 417–419, 422.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3; no. 2, p. 97–101, 103. Rank reduced to member of Nealmont limestone. Overlies Oak Hall member (new) ; underlies Rodman member. Thickness about 45 feet.

Named for village of Centre [Center] Hall, Centre County.

Centre Point division[1]

Pleistocene : Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 29, 35–42, 188.

Named for exposures at Centre Point, Howard County.

Cerbat Complex

Precambrian : Northwestern Arizona.

B. E. Thomas, 1949, Economic Geology, v. 44, no. 8, p. 666, fig. 2; 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 393–403, pl. 1. Basement assemblage of metamorphic and igneous rocks. Oldest-rocks of vertical to steeply dipping layers of hornblende-diopside schist and amphibolite, biotite schist, quartzite, and lit-par-lit gneiss. These rocks typically occur together but in no particular sequence. Layered rocks are intruded by granite magma, and granite gneiss is predominant rock type in complex. Perhaps fifty percent of gneiss is migmatite, whereas balance is believed to be orthogneiss. Thick sheets of pegmatite injected between layers of metamorphic rocks in many places. Aplite or aplitic granite commonly associated with pegmatite dikes. Diabase dikes, ranging in width from few feet to 150 feet, also common. Narrow zones of mylonite scattered throughout complex. The coarsely porphyritic Diana granite (new), which is

preserved in the schists in western half of Chloride district, is only unit of complex that was mapped separately. Capped along extreme eastern and southern borders of range by isolated Tertiary volcanic rocks including Bull Mountain series (new). Intruded by Ithaca Peak granite porphyry (new).

Forms bulk of Cerbat Mountain, Mohave County.

Cerro Glaciation

Cerro Till[1]

Cerro glacial stage[1]

Pleistocene (pre-Wisconsin) : Southwestern Colorado.

Original references: W. W. Atwood and K. F. Mather, 1915, U.S. Geol. Survey Prof. Paper 95, p. 14, pl. 1; 1924, Geol. Soc. America Bull., v. 35, p. 122; 1932, U.S. Geol. Survey Prof. Paper 166.

K. F. Mather, 1957, New Mexico Geol. Soc. Guidebook 8th Field Conf., p. 106. Cerro glacial stage mentioned in report on geomorphology of San Juan Mountains. First of three Pleistocene glaciations identified in area. Older than Durango glacial stage.

Named for Cerro Summit, about 12 miles east of Montrose, Montrose County.

Cerro Gigante Basalt

Oligocene or Miocene : Panamá.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2), 901–902. Unit is discussed under general heading "Bruja Island dolerite, Cerro Gigante basalt, and related igneous rocks." These include lower Miocene flows, plugs, and dikes of basic rock, hard and generally moderately joined; unconformable below Gatun formation and above upper Caimito member. "Basalt" is used in this paper as a field term applied to basic fine-grained igneous rocks including "andesite" and "basalt."

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 330. Oligocene or Miocene. Derivation of name.

In Gatún Lake area. Cerro Gigante is name of peak about 8 kilometers southwest of Barro Colorado Island.

Cerro Gordo Clay[1]

Lower Cretaceous (Comanche Series) : Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 111, 188.

Underlies the poor lands from Cerro Gordo, Little River County, to within 6 miles of Rocky Comfort, extending east to Cane Creek.

Cerro Gordo Substage[1]

Cerro Gordo Member (of Lime Creek Formation)

Upper Devonian : Central northern Iowa.

Original reference: C. L. Fenton, 1919, Am. Jour. Sci., 4th, v. 48, p. 355–376.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (fig. 1), 187. Middle member of Lime Creek formation. Overlies Juniper Hill member; underlies Owen limestone member. Consists of fossiliferous shale.

Named for exposures in Cerro Gordo County.

Cerros Shale Member (of Lodo Formation)

Paleocene and Eocene: Southern California.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. Named as basal member of newly defined Lodo formation. Underlies Cantua sandstone member.

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1722–1727, 1734, 1738. Described as lithologically identical with the Lodo and recognizable as a distinct cartographic unit only where it is overlain by the Cantua sandstone. Anderson and Pack (1915) mapped the unit as basal part of the Cantua. Thickness at type locality about 630 feet. Overlies Moreno shale.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. Described at type section as consisting of about 50 feet of massive highly glauconitic siltstone and sandy siltstone overlain by 523 feet of gray claystone; a 4-foot medium-grained arkosic sandstone is present 194 feet above base. Paleocene and Eocene.

Type locality: Cerros Hill on west side of Tumey Gulch at the west corner sec. 14, T. 16 S., R. 12 E., M. D. B. and M., Fresno County. No geographic names were available, so the conspicuous hill where the member is exposed was named Cerros Hill.

Cerrotejonian Stage

Pliocene, early: California.

D. E. Savage, 1955, California Univ. Pubs. Geol. Sci., v. 31, no. 1, p. 11–19. Stage based on mammalian faunal assemblage. Subjacent to Montediablan stage (new). Contemporaneous with earlier part of North America Clarendonian age of Wood and others (1941).

Type section: In nonmarine and marine deposits mapped as Santa Margarita by Hoots (1930) in Tejon Hills, Kern County. This is 100 miles from type exposure of Santa Margarita formation.

Chacha Limestone

Pleistocene or early Holocene: Mariana Islands (Saipan).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Chatcha limestone named on correlation chart. Pleistocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 57–58, table 4 [English translation in library of U.S. Geol. Survey, p. 68–69]. Raised coral reef limestone. Consists primarily of corals and lesser amounts of *Halimeda* on Saipan but on other islands consists primarily of *Halimeda* and secondarily of corals. Correlated with Rota limestone on Rota, Sonson limestone on Tinian, and Barrigada limestone on Guam. Younger than Mariana limestone.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 26. Early Holocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 88. Tanapag limestone as used in this report includes rocks which Tayama called Chacha limestone.

Type locality: Chacha, Saipan.

Chaco marl[1]

Eocene: Northwestern New Mexico.

Original reference: C. R. Keyes, 1906, Geol. Soc. America Bull., v. 17, p. 725.

Derivation of name not given.

†Chacra Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: C. H. Dane, 1936, U.S. Geol. Survey Bull. 860-C.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2158–2159. Beds that were included in Chacra sandstone member by Dane (1936) appear to be about equivalent to combined upper two southward-extending tongues of Cliff House sandstone northeast of Newcomb. Cliff House sandstone of Mesaverde group, therefore, will replace Chacra sandstone member throughout the former extent of that unit.

In Chacra Mesa coal field.

Chacra[1] terrane

Cretaceous: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geological formations of New Mexico; Des Moines, Robert Henderson, State Printer.

San Juan region.

Chadakoin Beds[1]

Chadakoin Formation (in Arkwright Group)

Chadakoin Group

Upper Devonian: Western New York and northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 32–33; 1955, New York State Mus. Sci. Service Circ. 42, p. 11, 12. Upper formation in Arkwright group (new). Composed of approximately 420 feet of gray siltstone beds with some interbedded gray shale, especially near top of formation. Comprises Dexterville member below and Ellicott member above. Overlies Canadaway formation; underlies Cattaraugus formation of Conewango group. Chautauquan series.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 18–19. Rank raised to group. Includes beds between base of Wellsville formation and Germania formation. Approximately same as Conneaut group (Chadwick, 1934, Bulls. Am. Paleontology, v. 21, no. 71). Comprises (ascending) Wellsville formation, Hinsdale sandstone, Whitesville formation, and Germania formation. Thickness about 585 feet. Overlies Canadaway group; underlies Conewango group. Chautauquan series.

Named for exposures in quarries at Dexterville (Jamestown) on Chadakoin River, Chautauqua County, N.Y.

Chadron Formation[1] (in White River Group)

Oligocene, lower: Western Nebraska, northeastern Colorado, Montana, South Dakota, North Dakota, and eastern Wyoming.

Original reference: N. H. Darton, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 736, 759, pl. 82.

C. B. Schultz and T. M. Stout, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1921. In northwestern Nebraska, contact between Chadron and overlying Brule is provisionally drawn at base of a certain continuous purple-tinted white sometimes silicified limestone layer, which is the upper of several such limestone beds in lower part of the local section.

R. L. Nace, 1939, Wyoming Geol. Survey Bull. 27, p. 31–35, 43. Described in Red Desert area, Wyoming, where it is about 218 feet thick and includes Beaver Divide conglomerate member (new) in basal part. Disconformable above Continental Peak formation.

John Clark, 1954, Carnegie Mus. Annals, v. 33, art. 11, p. 197. In Big Badlands area, South Dakota, subdivided into (ascending) Ahearn, Crazy Johnson, and Peanut Peak members, standard section designated for South Dakota.

N. M. Denson and others, 1955, U.S. Geol. Survey Coal Inv. Map C–33. Mapped in Billings and Golden Valley Counties, N. Dak.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 25–38, figs. 3, 10, tables 1, 2. Darton did not specify type locality for Chadron. He stated in 1931 (Wilmarth, 1938, p. 393) that the formation was named for exposures at Chadron, Nebr. However his 1899 illustration of section at Chadron does not show exposure of this formation and his text references show no familiarity with the outcrops shown on his map near there. For all practical purposes his knowledge of the Chadron seems to have been derived in northwestern Nebraska from his "Adelia" section, northwest of Crawford, Sioux County, Nebr. "Adelia" section is section used for discussion in present report. Detailed description in western Nebraska. Three divisions, lower, middle, and upper, recognized. Lower is essentially Yoder of Schlaikjer (1935) and Ahearn of Clark (1954); middle is probably only in part equivalent to Crazy Johnson of Clark (1954); upper corresponds closely to Peanut Peak of Clark. Thickness 143 to 209 feet. Underlies Brule formation. Writers depart from their 1938 action in defining base of Brule as base of upper purplish-white layer and top of upper purplish-white layer is herein suggested as redefined plane of division between Chadron and Brule. In Crawford, Nebraska area, overlies Cretaceous Pierre shale; in Torrington area, Wyoming, underlies Cretaceous Lance formation.

L. J. Bjorklund and R. F. Brown, 1957, U.S. Geol. Survey Water-Supply Paper 1378, p. 26. Underlies flood plain of South Platte River from near Proctor, Colo., eastward to Sedgwick, Colo. Exposures are abundant north of river from Sterling to Proctor.

W. T. Thom, Jr., 1957, Billings Geol. Soc. Guidebook 8th Ann. Field Conf., p. 11 (table 1). Geographically extended into Crazy Mountain Basin, Mont., where it consists chiefly of volcanic ash, silt, and sand.

Standard section: In Big Badlands on south fork of Indian Creek, from sec. 34, T. 3 S., R. 12 E., to sec. 10, T. 4 S., R. 12 E., Pennington County, S. Dak. Named for exposures at Chadron, Dawes County, Nebr.

Chadronian Age

Oligocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 11, pl. 1. Provincial time term, based on the Chadron formation, type locality near Chadron, Nebraska. Includes the old term "*Titanotherium*

beds," used in its more extended sense. Covers the interval between the Duchesnean (Eocene) and Orellan (Oligocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan.]

Type area: Northwestern Nebraska and southwestern South Dakota.

Chaffee Formation[1]

Upper Devonian: Central Colorado.

Original reference: E. Kirk, 1931, Am. Jour. Sci., 5th, v. 22, p. 229–230.

Ogden Tweto and T. S. Lovering, 1947, Colorado Mining Resources Board [Bull.], p. 380 (chart). In Gilman district, includes Parting quartzite member below and Dyer dolomite member above. Thickness about 120 feet. Overlies Harding sandstone; underlies Gilman sandstone member (new) of Leadville limestone.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 169–177. Described in Pando area where it unconformably overlies Harding quartzite or Peerless formation and unconformably underlies Gilman sandstone member of Leadville dolomite. Comprises two members. Parting quartzite below and Dyer dolomite above. Thickness 118 to 137 feet.

I. N. Mackay, 1953, Colorado School Mines Quart., v. 48, no. 4, p. 21–28, pls. Described in Eagle and Pitkin Counties, where it disconformably overlies Manitou dolomite and is in contact with overlying Leadville limestone along an erosional surface. Includes Parting and Dyer members. Thickness 216 to 233 feet.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 13–15. Described in Garfield quadrangle where it is 150 to 250 feet thick and includes both Parting quartzite and Dyer dolomite members. Erosional unconformities of low relief separate it from underlying Fremont dolomite and overlying Leadville limestone.

Named for Chaffee County where it is well exposed south of Arkansas River about 5 miles southeast of Salida, and on western slope of Monarch Mountain, at Monarch, about 15 miles southwest of Salida.

Chaffin Limestone Member (of Thrifty Formation)[1]

Chaffin Formation (in Thrifty Group)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 410–412.

C. O. Nickell, 1938, *in* Wallace Lee and others, Texas Univ. Bur. Econ Geology Pub. 3801, p. 127–128. Chaffin limestone member, at type locality, crops out above Chaffin coal and is 20 feet thick, Within 200 yards to the north, it is cut out by unconformity and replaced by sandstone of later age. Where Chaffin limestone reappears east of Rockwood, two limestones are present, separated by 12 feet of shale. Some observers have considered these two beds to represent bifurcation of the Chaffin as it appears south of Colorado River, but presence of carbonaceous shale in position of Chaffin coal below the thick upper limestone near Rockwood suggests that lower bed there may be a separate limestone bed in Lohn shale member. Plummer and Moore (1921, Texas Univ. Bull. 2132) correlated upper and lower limestone beds of split Chaffin limestone with Breckenridge limestone and Blach Ranch limestone, respectively, of Brazos River basin, where the Blach Ranch, like the Chaffin, has a thin

coaly bed below it. Top member of Thrifty formation. Overlies Parks Mountain sandstone member; underlies Harpersville formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Rank raised to formation in Thrifty group. Underlies Obregon formation (new); overlies Breckenridge formation. Consists of an upper thin limestone member about 20 feet above a thicker limestone member, both fusulinid-bearing; these are separated from basal Parks Mountain sandstone member by shale.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Shown on composite stratigraphic section of Brown and Coleman Counties as limestone member at top of Thrifty formation. Consists of gray, slabby limestone, commonly purple blotched; fusulinids and "seaweed" structures abundant. Overlies Parks Mountain sandstone member; underlies Waldrip shale member of Permian Pueblo formation.

D. A. Meyers, 1958, Jour. Paleontology, v. 32, no. 4, p. 678 (fig. 1). Member shown on stratigraphic column as occurring above Breckenridge member.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 215–D, p. 74, pl. 27. Drake (1893) traced the Chaffin limestone across Coleman and Brown Counties. From vicinity of Home Creek northward, he found two limestones and called the lower one the lower Chaffin limestone. The lower Chaffin is here correlated with Breckenridge limestone member. The generally persistent upper part of Chaffin limestone member has been variously called Breckenridge limestone (Plummer and Moore), Upper Crystal Falls limestone (Hudnall and Pirtle, 1929, Geologic map of Coleman County; 1931, Geologic map of Brown County), Chaffin limestone (Sellards, 1933, Texas Univ. Bull. 3232), Breckenridge limestone (Bullard and Cuyler, 1935, Texas Univ. Bull. 3501), and Crystal Falls limestone (Chaney, 1950, Abilene Geol. Soc. Guidebook Nov. 2–4). Chaffin limestone member immediately south of Colorado River ranges from about 15 feet in thickness at Chaffin mines to about 7 feet at Waldrip. At this locality, it is a slabby irregularly bedded gray limestone, stained purplish red. Contains abundant fusulinids and thin wavy structures of clear calcite. These structures characterize bed over most of Coleman County. Thins northward. Average thickness 1 to 2 feet in Brown County. Overlies Parks Mountain sandstone member; underlies Waldrip shale member of Pueblo formation.

Named for Chaffin coal mine, 2 miles east of Waldrip, McCulloch County.

Chagres Alluvium

Pleistocene and Recent: Panamá.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2), 904. Alluvial deposits of interbedded clays, silts, sands, and gravels, variably loose to well compacted. Intergrades locally with Atlantic muck. Table 2 shows thickness of Chagres alluvium, Chagres gravel, Atlantic muck, and Pacific muck 300 feet. Pleistocene and Recent.

Present along Chagres River valley and its tributaries, the Río Gatún, and Río Trinidad, and other principal valleys, vicinity of Lake Gatún.

Chagres Sandstone[1]

Pliocene, lower: Panamá.

Original reference: D. F. MacDonald, 1919, U.S. Nat. Mus. Bull. 103, p. 532.

W. P. Woodring, and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 244, 246 (fig. 2). Includes Toro limestone

member at base. Chagres proper above Toro member consists of very massive mostly fine-grained sandstone and some siltstone. Thickness difficult to determine; MacDonald considered it to be 1,000 feet or more. Overlies and partly overlaps Gatún formation; base sharply defined. Fossil evidence indicates late Miocene age; however, it may be early Pliocene if the coastal Gatún west of Canal Zone is late Miocene.

W. P. Woodring, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–1; 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 12, 47–50, pl. 1. Lower Pliocene.

Named for exposures that overlook coast from Toro Point to mouth of Río Chagres. Outcrop area lies west of Canal, and extends from Canal Zone southwestward along Caribbean coast to between Río Indio and Río Miguel.

Chagrin magnafacies[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 28.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 46. An attempt to apply Caster's (1934) system of facies classification to Genesee rocks of New York was not wholly successful. The Chagrin magnafacies not recognized.

Chagrin Shale[1]

Chagrin Shale Member (of Ohio Formation)

Upper Devonian: Northern Ohio and western Pennsylvania.

Original reference: C. S. Prosser, 1903, Jour. Geology, v. 11, p. 521.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 37–42; Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 131, chart facing p. 108. Member of Ohio formation. Overlies Huron member; underlies Cleveland member.

Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 17; K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 19–22. In vicinity of Cleveland, the Chagrin is composed largely of soft gray shale and mudstone containing small limy nodules and some gray siltstones that range in thickness from ½ to 3 inches. Although well records show the Chagrin to be about 500 feet thick in eastern Cuyahoga County, only 200 feet of the shale is exposed above level of Lake Erie. In Ashtabula and Trumbull Counties adjacent to Ohio-Pennsylvania State line, about 1,200 feet of Chagrin is exposed. Massively bedded white or gray siltstones and silty mudrock in upper part of Chagrin have been traced eastward into Crawford County, Pa., into rocks that were named Riceville by White (1881). Underlies Cleveland member of Ohio shale; base of Chagrin not exposed in Ohio.

Named for exposures on Chagrin River, Cuyahoga County, Ohio.

Chainman Shale[1]

Chainman Shale (in White Pine Group)

Chainman Shale Member (of White Pine Shale)

Upper Mississippian: Eastern Nevada, eastern California, and western Utah.

Original reference: A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 24, 26, map.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 21 (fig. 4), 23. Geographically extended into House and Confusion Ranges, Utah, where it is about 1,200 feet thick, overlies Joanna (Joana) limestone and underlies Bird Spring limestone.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v 37, no. 1, p. 147 (fig. 2). Shown as member of White Pine shale on correlation chart of recommended revision of stratigraphic units in Great Basin.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 69–70. Term Chainman shale extended into Eureka district, Nevada, and applied to basal black shale of Upper Mississippian sequence where this unit can be mapped separately (mapped in two areas only). Elsewhere equivalent beds are included in Chainman and Diamond Peak formations undifferentiated. Predominantly black shale with thin interbeds of brown sandstone. Apparent thickness at mouth of Secret Canyon about 5,000 feet. Base not exposed in this western belt, western limit being marked either by igneous rocks or by fault contact with lower Paleozoic rocks. In Windfall Canyon, Permian(?) rocks rest directly on Chainman shale or Diamond Peak formation.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4 (table 1), 5. Geographically extended into Inyo Mountains, Calif., where it is more than 1,000 feet thick; underlies Pennsylvanian Keeler Canyon formation (new) and overlies Perdido formation. Consists of dark-gray silty shale and phyllite with limestone interbeds. Late Mississippian.

W. M. Winfrey, Jr., 1958, Am. Assoc. Petroleum Geologists Rocky Mountain Sec. 8th Ann. Mtg., p. 77, 78 (fig. 2). Uncomformably underlies Sheep Pass formation (new).

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2172 (fig. 2), 2173. In Confusion Range, underlies Ely limestone, used in this report to replace Bird Spring formation.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). Illipah formation overlies Chainman in Gold Hill district and Confusion Range, Utah, and Moorman Ranch area, Nevada.

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 81–90. Discussion of following aspects of Chainman stratigraphy: history and problems of stratigraphic nomenclature, paleotectonic setting, and geosynclinal concepts, regional distribution and sediments, and paleontologic correlations. The Chainman is recognized as a valid stratigraphic unit. Diamond Peak and Scotty Wash are referred to as facies within the Chainman. White Pine shale seems to be correlative to Pilot shale, Joana limestone, and Chainman formation; if so, White Pine should be suppressed. Any combination of names for mutually intercalated units within the Chainman may be used, for instance: (1) refer to Chainman-Diamond Peak formations undifferentiated; (2) refer to Chainman with Diamond Peak facies, and so on; (3) refer to Chainman with molasse facies, meiorogenic facies, dark euxinic shale facies, and so on, or (4) as the least favorable combination, consider Chainman, Diamond Peak, Scotty Wash as distinct formations.

The author [Sadlick] prefers a combination of procedures 2 and 3. There are lithologic units in the Chainman as thin as 5 feet and others as thick as 120 feet that persist for as much as 150 miles laterally. These units have not been mapped in all instances. One of these units is referred to as "Skunk Springs limestone band" becauses, in Confusion Mountains, the Skunk Springs water tank is on this unit which is about 15 feet at that locality.

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pubs. Geol. Sci., v. 38, no. 2, p. 89–150. Discussion of Quartz Spring area, Inyo County, Calif. Formations, Tin Mountain limestone, Perdido formation, and Rest Spring shale as defined by McAllister (1952), are utilized in discussion and description of rocks in the area. On the other hand, Joana limestone, Peers Spring formation, and Chainman shale, with somewhat different limits, are the formations to which these same rocks would be assigned in a regional discussion of Mississippian stratigraphy in the Great Basin. For purposes of expressing regional stratigraphic relationships, many already proposed stratigraphic names are redundant. Figure 5 presents condensed set of already proposed names as restricted and applied to units of regional significance. Names Peers Spring formation and Chainman shale are retained for formational units within a White Pine group, although these three names have frequently been employed in a synonymous sense.

Named for Chainman mine, near Lane, Ely quadrangle, Nevada. South of Eureka, occurs in discontinuous band from Windfall Canyon to mouth of Secret Canyon, and in Tollhouse Canyon east of Newark Mountain.

Chalfin Member (of Salem Limestone)

Mississippian (Valmeyer Series): Southwestern Illinois.

J. W. Baxter, 1959, Dissert. Abs., v. 19, no. 11, p. 2910. Salem limestone is subdivided into four members [sequence not indicated] to which names Kidd, Fults, Chalfin, and Rocher are assigned. Chalfin member is composed of calcilutites, calcisiltites, and calcarenites containing a predominence of microcrystalline, nonskeletal grains, believed to have been formed by the progressive cementation of chemically precipitated carbonate.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2–3, 7, 10, 24–27, pl. 1. Consists of varying thicknesses of fine-grained limestone; fine- to medium-grained, fossiliferous, locally oolitic limestone, and semilithographic limestone some of it brecciated. Thickness 30 to 57 feet. Conformably overlies Fults member; conformably underlies Rocher member.

Type section: In Mississippi Bluffs, 1 mile southeast of Chalfin Bridge in NE¼ SW¼ sec. 7, T. 4 S., R. 10 W., Monroe County.

†Chalk Bluff Formation[1]

Permian (Wolfcampian Series): Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7. [As defined in this reference includes (ascending) Queen sandstone, Seven Rivers, and Three Twins (new) members.]

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 9. Lang's term Chalk Bluff is a suitable synonym for Whitehorse if one is needed. In this symposium, Whitehorse group of West Texas and New Mexico is divided into (ascending) Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

R. K. DeFord and G. D. Riggs, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1713. Lang's Three Twins member of Chalk Bluff seems to include both Tansill and Yates sand, but if so, the two units are described as intergradational, and superposition of Tansill on Yates is not clearly recognized. Lang's Chalk Bluff is essentially the Whitehorse group of subsurface geologists.

N. D. Newell, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 43–45; P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112, Queen sandstone considered of formational rank.

N. D. Newell, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 46; P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Seven Rivers raised to formational rank in Carlsbad group.

Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) proposed to replace terms Whitehorse, Chalk Bluff, and Bernal in Guadalupe Mountains of New Mexico and West Texas.

Well exposed in Chalk Bluff, on eastern bank of Pecos River southeast of Artesia, Eddy County.

Chalk Creek Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 138, 139 (fig. 1), 140, 143 (fig. 2), 145 (fig. 3). Sequence of gray to tan, medium-grained to conglomeratic sandstone alternating with claystone varying in shades of gray, pink, maroon, and green. Sequence has been considered by some workers as belonging to Kelvin formation. Thickness 3,150 feet; entire member is present on east (upthrown) side of "Great" fault. Only 800 to 900 feet present on overturned east flank of anticline. Remainder of section, approximately 2,300 feet, has been omitted by a thrust fault. Wegemann (1915, U.S. Geol. Survey Bull. 581–E) concluded that only 850 feet of strata separated the basal sand (Longwall) from the "Wasatch" coal bed, and later writers followed his thinking. Well data, heretofore unavailable, has made clarification possible. Overlies Spring Canyon member (new); underlies Coalville member (new) with transitional contact.

Named for typical exposures on north side of Chalk Valley between Spring Hollow fault and the "Great" fault, Coalville anticline, Summit County.

Chalk Hills Member (of Catahoula Formation)

Miocene: East-central Louisiana.

W. D. Chawner, 1936, Louisiana Dept. Conserv. Geol. Bull. 9, p. 122–124. Name given to bed of white or cream-colored volcanic ash or tuff about 8 feet thick that occurs near the top of formation. Separated from underlying Cassel Hill member (new) by an interval of gray tuff or tuffaceous siltstone, and massive medium- to coarse-grained sandstone.

Prominently exposed in the Chalk Hills through secs. 7, 16, 17, 18 and 21, T. 10 N., R. 5 E., Catahoula Parish. Extends westward into La Salle Parish and then thins out.

Chalk Mountain Dacite[1]

Recent(?): Northern California.

Original reference: C. A. Anderson, 1936, Geol. Soc. America Bull., v. 47, no. 5, p. 656–657.

Composes most of Chalk Mountain, a small conical hill rising 400 feet east of North Fork of the Cache Creek, Lake County.

Chalk Mountain Nevadite[1]

Eocene: Colorado.

Original reference: W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 345–349.

Forms mass of Chalk Mountain, Eagle and Summit Counties.

Challis Volcanics[1]

Eocene(?), Oligocene, and Miocene, lower(?): Southern central Idaho.

Original reference: C. P. Ross, 1930, Idaho Bur. Mines and Geology Pamph. 33.

C. P. Ross, 1934, U.S. Geol. Survey Bull. 854, p. 46–53, pl. 1. Volcanics comprise all Tertiary volcanic rocks in Casto quadrangle except Snake River basalt. Includes Yankee Fork rhyolite member. No complete section exposed. Thicknesses: about 3,400 feet on Camas Creek; 1,482 feet on Merino Creek. Overlie Casto volcanics. Oligocene(?).

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1095, 1120–1121, pl. 1. Described in Borah Peak quadrangle. Divided into (ascending) latite-andesite member, about 1,000 feet; basalt and related flows, about 2,500 feet; and Germer tuffaceous member, from knife-edge to over 500 feet. Locally succeeded by Donkey fanglomerate (new).

A. L. Anderson, 1956, Idaho Bur. Mines and Geology Pamph. 106, p. 18–28, pl. 1. Age given as Oligocene for exposures in Salmon quadrangle. As in other localities, the formation can be subdivided into units of somewhat variable composition, recognizable as equivalent to similar units in other parts of the region. Yankee Fork rhyolite member missing. Ignimbrites not common. Underlies Carmen formation (new).

A. L. Anderson, 1957, Idaho Bur. Mines and Geology Pamph. 112, p. 16. In Baker quadrangle, unconformably underlies Kenney formation (new).

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 15, 22–25. In North Fork quadrangle, unconformably overlies Kriley formation (new) and underlies Geertson beds. Thickness 0 to 800 feet. Age of Challis still under study.

U.S. Geological Survey currently designates the age of the Challis Volcanics as Eocene(?), Oligocene, and early Miocene(?) on the basis of a study now in progress.

Named for Challis National Forest and town of Challis, Custer County.

Chalmers Quartz Monzonite

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 84–85, pl. 1. Fine-grained equigranular rock with clearly visible quartz, feldspar, biotite, and hornblende. Varies from pinkish gray through bluish gray to olive green. There are no exposures of Chalmers in place, but abundant float on hills indentifies the underlying rock masses. Surrounding sedimentary rocks are Pierre shale, Fox Hills sandstone, and Denver formation. Shown on plate 1 as Chalmers granite.

Named for occurrences in Chalmers Ridge, in sec. 13, T. 11 S., R. 76 W., and Bald Knob, 1 mile to the north, South Park, Park County.

Chalybeate Limestone Member (of Porters Creek Formation)

Chalybeate Limestone Member (of Clayton Formation)

Paleocene: Eastern Mississippi and western Alabama.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–196, p. 9–10. Proposed to designate beds of the Clayton formation that are in Mississippi and west of the Tombigbee River in Alabama. Consists of hard crystalline extremely fossiliferous limestone, interbedded soft to tough marls, dark leaf-bearing shales, glauconitic sand, and fossiliferous siltstone at top. Thickness at type locality about 80 feet; thins southward to less than 10 feet in Clay County, Miss.; from there southeastward along strike to Tombigbee River, thickens to about 25 feet. Mississippi Geological Survey reports for Tippah, Union, and Pontotoc Counties divided the Clayton into two unnamed members, a basal limestone and marl member and an upper marl, clay, and sand member. The highest fossiliferous siltstone here included in Chalybeate member was regarded as base of the Porters Creek clay in Mississippi reports. This siltstone is here included in the Clayton in order to make base of the clay the base of the Porters Creek throughout Mississippi. Chalybeate may include equivalents of only the lower beds of Pine Barren member.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 37, 38, 39. Reallocated to member status in Porters Creek formation because Clayton formation is not recognized west of central Alabama. Exposed in Sumter County, Ala., where it rests on eroded surface of Cretaceous Prairie Bluff chalk.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 88, pl. 5. Chalybeate limestone member of Clayton formation used in this report.

Type locality: Ravine just north of main street of Chalybeate, probably in south-center of sec. 3, T. 2 S., R. 4 E., Tippah County, Miss.

Chama Clay[1]

Miocene(?): Northwestern New Mexico.

Original reference: C. R. Keyes, 1906, Geol. Soc. America Bull., v. 17, p. 725.

Derivation of name not given.

Chaman series[1]

Eocene: Arizona, Colorado, and New Mexico.

Original reference: C. R. Keyes, 1907, Iowa Acad. Sci. Proc., v. 14, p. 223–228.

Derivation of name not stated.

Chamberlain Shale[1]

Precambrian (Belt Series): Central southern Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Mapped only in Little Belt Mountain region where it is sole unit that can be correlated with Ravalli group.

Type localities: On ridges between Chamberlain and Sawmill Creeks, southeast of Neihart. In Little Belt Mountains.

Chambers Tuff (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3), 20–21, 23–25. Name proposed for formation that comprises strata between top of Buckshot ignimbrite (new) and base of Bracks rhyolite (new). Tuff is moderate to well bedded, pale yellowish brown, grayish green, and pale red to dark reddish brown. In southern part of area, contains a persistent layer of coarse sandstone with lenses of cobble conglomerate about 130 feet above base. Thickness 558 feet. Where Buckshot is absent, the Chambers (new) and Colmena (new) may be differentiated by identifying the horizon of the Buckshot; where identity of Buckshot horizon is problematic, lithostratigraphic name of Vieja will still be applicable to combined sequence; similiarly, where Bracks rhyolite is absent, the undifferentiated Vieja may serve as a map unit; the Chambers-Capote Mountain contact can be established in some places but not everywhere. Although superposition demonstrates that the Chambers is younger than the Colmena, fossils seem to indicate the same geologic age.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Described in Van Horn Mountains area where it consists of a lower member 510 feet thick and an upper member 140 feet thick. Includes local basalt flow about 100 feet thick in northernmost exposure. About 40 feet of Pantera trachyte is interbedded in Chambers tuff in northern Sierra Vieja. Overlies Buckshot ignimbrite.

Type locality: About 12 miles north of Candelaria, Rim Rock country, Presidio County. Name derived from Chambers Ranch.

Chambersburg Limestone[1]

Middle Ordovician: Central southern Pennsylvania, western Maryland, and northwestern Virginia.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 211.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 195–201. In Chambersburg area, the Chambersburg limestone, as name was originally applied, included all limestone between Stones River limestone and Martinsburg shale, thus including Lowville limestone in lower part. The Lowville part was definitely distinguished in the description as the 150 feet at base carrying distinctive Lowville fossils *Cryptophragmus antiquatus* Raymond (*Beatricea gracilis* Ulrich) and *Tetradium cellulosum* (Hall). At present, only part of original Chambersburg above the Lowville is included by Ulrich in the Chambersburg; hence, the Chambersburg is herewith redefined to apply only to part of original Chambersburg limestone overlying the part of Lowville age. Underlies Martinsburg shale. Thickness 563 feet on Tumbling Run, 1½ miles southwest off Strasburg. Overlies Lenoir limestone; underlies Martinsburg shale (Trenton member).

L. C. Craig, 1941, Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1963–1964. Chambersburg limestone divided into three formations with their type sections 2 miles southwest of Marion, Pa. Formations (ascending): Shippensburg (new), Mercersburg (new), and Greencastle.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 35–114. Discussion of stratigraphy of Shenandoah Valley. Study shows that so-called Athens and Whitesburg, as developed near Harrisonburg, are laterally continuous with greater part of Chambersburg limestone, which is supposed to be younger than the Athens. New classification

is proposed for lower Middle Ordovician. Lincolnshire limestone includes lower beds of Chambersburg as identified by Butts (1940); Edinburg formation (new) corresponds to substantial part of Chambersburg formation of Pennsylvania; Oranda formation (new) corresponds to the "*Christiania*" [*Bimuria*] bed of Chambersburg limestone of southern Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 707–779. Type section of Chambersburg limestone was divided into three formations, Shippensburg, Mercersburg, and Greencastle (Craig, 1941) as result of fundamental disagreement with previous faunule zone correlations. Shippensburg and Mercersburg are redefined, and term Greencastle discarded in favor of Oranda. Report describes these units in detail and gives geologic section.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14], Washington County, p. 63–66. Thickness 100 to 225 feet. Underlies Martinsburg shale; overlies New Market limestone.

F. M. Swartz and R. B. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 1–14. In Franklin County, overlies St. Paul group, geographically extended into area, where it replaces Stones River limestone as mapped by Stose (1909, U.S. Geol. Survey Geol. Atlas, Folio 170).

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation as mapped consists of dark-gray thin-bedded limestones (Oranda) at top; gray argillaceous limestone (Mercersburg) in middle; dark-gray cobbly thin, irregularly bedded limestone (Shippensburg) below. Occurs only southwest of Susquehanna River.

Named for exposures west of Chambersburg, Franklin County, Pa.

Chambless Limestone

Lower Cambrian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 241. Listed as an algal limestone 170 to 220 feet thick underlying Cadiz formation and overlying Kelso shale (new).

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 30 (table 1), pl. 3. Described as massive light- to dark-gray limestone in beds 1 to 10 feet thick. Underlies Cadiz formation (redefined); overlies Latham shale (new) which replaces preoccupied name Kelso. Type locality designated.

Type locality: About 2 miles northeast of Chambless at an old quarry which is on north side of a large wash and near its mouth. Named after Chambless Station on U.S. Highway 66, approximately 12 miles east of Amboy, San Bernardino County.

†Chamiso Formation[1]

Chamiso Member (of Mesaverde Formation)

Upper Cretaceous: Southwestern New Mexico.

Original reference: D. E. Winchester, 1920, U.S. Geol. Survey Bull. 716–A.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 71. Winchester's Chamiso formation, comprising 1,850 feet of continental rocks of Montana age overlying Bell Mountain sandstone, is here reduced to rank of member in Mesaverde formation.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 191. Abandoned in favor of Crevasse Canyon formation for Alamosa Creek area.

Named for Chamiso Creek, T. 2 N., R. 9 W., Socorro County.

Champ Clark Group

Mississippian (Kinderhook Series) : Eastern Missouri and western Illinois.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1). 14–20. Proposed for succession of conformable formations that overlies unconformity at top of Devonian-Silurian strata and underlies unconformity at top of Louisiana limestone. Comprises (ascending) Sylamore, Grassy Creek, Saverton, and Louisiana formations. Underlies Hannibal group. As thus defined, group includes strata believed by some to be Mississippian and by others to be Devonian. Coincides with Fabius group of Weller and others (1948) named for outcrops on Fabius River in Marion County, Mo. Formations included in this group [Fabius] are not exposed along Fabius River. Because name Fabius has been introduced so recently and because exposures at Louisiana are excellent and much better known, it seems desirable to drop name Fabius.

A. J. Scott, 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Study of conodont zones indicate Devonian-Mississippian boundary should be placed at base of Glen Park formation and that Champ Clark group, which includes Sylamore, Grassy Creek, Saverton, and Louisiana formations be considered youngest Devonian series in Illinois.

Name is derived from Champ Clark Bridge at Louisiana, Mo. All formations of group are exposed in Mississippi River bluff at Louisiana, 1,000 feet northwest of bridge in NE¼ sec. 18, T. 54 N., R. 1 W., Pike County, Mo.

Champion Shell Bed (in Kiowa Shale)[1]

Cretaceous (Comanche Series) : Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 358–371.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 28. Occurs at base of Kiowa shale in type area.

Named for Champion Draw, an arroyo on Medicine Lodge River crossed by Atchison, Topeka, and Santa Fe Railway at Belvidere, Kiowa County.

†Champlain Group[1]

Cambrian, Ordovician, and probably some Silurian: New York.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, Geology of the second district, p. 99–126, 429.

Named for Lake Champlain.

Champlainian Series

Champlainic System[1]

Middle Ordovician: North America.

Original references: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, Geology of the second district, p. 100–101, 102–126, 429; J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 875, 876; Charles Schuchert and Joseph Barrell, 1914, Am. Jour. Sci., 4th ser., v. 38, no. 223, p. 16, 25 (table 1).

Charles Schuchert, 1943, Stratigraphy of the Eastern and Central United States: New York, John Wiley and Sons, Inc., p. 38–42. Emmons included in Champlain group all formations from base of Potsdam (Upper Cambrian) to base of Ontario group (Silurian). In present book, term Champlainian is used to embrace Chazy and Mohawk stages. Middle Ordovician.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2. Ordovician comprises three series (ascending): Canadian, Champlainian, and Cincinnatian. Champlainian has two stages, Chazy and Mohawkian. Chart shows Mohawkian divided into Black River and Trentonian.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Chazyan, Blackriveran, and Trentonian succeed the Canadian in New York, and are classified as separate series, or as two series (Chazyan and Mohawkian) or as one (Champlainian).

Name derived from Lake Champlain.

Chana Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 12. Dolomite, nonargillaceous, sandy, thick-bedded. Thickness about 6 feet. Shown on columnar section as underlying Dane member (new) and overlying Hennepin member (new).

Occurs in Dixon-Oregon area.

Chanac Formation[1]

Pliocene: Southern California.

Original reference: J. C. Merriam, J. P. Buwalda, and B. L. Clark, 1916, California Univ. Pub., Dept. Geol. Bull., v. 10, p. 111–115.

H. E. Wood 2d and others, 1941, Geol Soc. America Bull., v. 52, no. 1, p. 17, pl. Clarendonian (lower Pliocene).

Exposed along Chanac Creek, Tejon Hills, Fresno County.

Chances Branch Dolomite Member (of Maynardville Limestone)

Upper Cambrian: Southwestern Virginia and northeastern Tennessee.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Prelim. Map 76 (2 sheets). Gray fine-crystalline laminated dolomite with interbedded mottled limestone near base and interbedded dark coarse-crystalline dolomite near top. Thickness 142–172 feet. Overlies Low Hollow limestone member (new); underlies Copper Ridge dolomite.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 37–39; R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 16, 89, 90, pl. 1. Thickness given as much as 209 feet. Type locality and derivation of name given.

Type section: In Rose Hill district, Lee County, Va. Name derived from Chances Branch in western part of district, where a complete section is exposed in roadcut a few hundred feet east of creek and just south of Smith Chapel. Also exposed along Low Hollow, and along Fourmile Creek both north and south of Fourmile fenster and south of Virginia-Tennessee State line.

Chanchelulla Formation[1]

Devonian(?): Northwestern California.

Original reference: N. E. A. Hinds, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 292.

D. P. Cox, 1956, Dissert. Abs., v. 16, no. 10, p. 1884. Pennsylvanian.

Name suggested because of wide exposure on and near Chanchelulla Peak in northeast corner Red Bluff quadrangle, Klamath Mountains.

Chanchelulla Greenstone[1] or Meta-Andesite[1]

Devonian(?): Northwestern California.

Original references: N. E. A. Hinds, 1932, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 20, no. 11, p. 375–410; 1933, California Jour. Mines and Geology, v. 29, nos. 1, 2.

Named because of wide exposure on and near Chanchelulla Peak in northeast corner of Red Bluff quadrangle.

†Chandler Formation[1]

Pennsylvanian: Central Oklahoma.

Original reference: C. T. Kirk, 1904, Oklahoma Dept. Geol. and Nat. Hist. 3d Bien. Rept., p. 9.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. System boundary not established and concept not useful.

Named for Chandler, Lincoln County.

Chandler Formation (in Nanushuk Group)

Lower and Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 154, figs. 2, 3. Most of formation in southern exposures is nonmarine sandstone and conglomerate. To the north, it grades into shale with interbedded sandstone and coal. Contains a few fresh- to brackish-water mollusks in northerly exposures. Thickness along Chandler River about 4,700 feet but includes units of marine strata of Umiat formation (new). Intertongues northward with Umiat formation in two major (marine) tongues—Hatbox (new) below and Niakogon (new) above—and several minor tongues (unnamed). Overlies Tuktu member (new) of Umiat formation in southern part of outcrop area. Underlies Prince Creek and Schrader Bluff formations (new). Lower and Lower(?) Cretaceous.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 237, fig. 2. Redefined. Northward and eastward, it intertongues with, and grades into marine equivalents, the Grandstand and Ninuluk formations (new). Lithologic unit remains much the same as originally defined, but lower tongue renamed Killik tongue (new) and type localities for both major tongues have been changed. Lower and Upper Cretaceous.

Type locality: On Chandler River where river crosses Northern Foothills section of Arctic Foothills province.

Chandler Falls Member (of Trenton Formation)

Middle Ordovician: Northern Michigan.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14, 23–25. At Chandler Falls, consists of 45 feet of limestone, dolomite, shale and shaly limestone; calcareous layers vary in thickness from 1 to 18 inches and occur chiefly in lower part of section;

shale and argillaceous limestone make up central and upper portions of exposure. Conglomerate about 5 feet thick occurs about 11 feet above base. This conglomerate probably marks base of Trenton. Underlies Groos Quarry member (new); overlies Bony Falls member (new) of Black River formation. Deposition was practically continuous at some localities from Black River to Trenton time and dividing line between the two formations becomes an arbitrary one.

Type locality: At Chandler Falls, T. 39, N., 22 W., Delta County, on Escanaba River, 3 miles north of Escanaba. Chandler Falls is site of hydroelectric powerplant.

Chaney Gypsum Member (of Blaine Gypsum)[1]

Chaney Gypsum Member (of Flowerpot Shale)

Permian: Southwestern Oklahoma and western Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 41, 55.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 30. Shown on chart as member of Flowerpot shale in western Texas.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 15–16, 17 (fig. 3), 18, pl. 1. Described in Carter area, Oklahoma, as gray white massive gypsum 1 to 3 feet thick, 42 to 50 feet below top of Flowerpot; stratigraphically below Kiser gypsum member. Blaine formation redefined in this report.

Name derived from Chaney Salt Plain on Elm Fork of Red River, 4 miles east of Texas line, Harmon County, Okla.

Chaney Ranch Sandstone

Eocene: Central California.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 3, 15–18, 21, 22, pl. 4. White, fine- to medium-grained, anauxitic sandstone. Measured thickness at type section 232 feet. Disconformably underlies Kreyenhagen formation; conformably overlies Capita member (new) of Domengine formation. North of Chaney Ranch Canyon toward Gres Canyon, the Temblor overlaps both the Kreyenhagen and the Chaney Ranch; in this area only 20 feet of the Chaney Ranch are exposed.

Type section: Chaney Ranch Canyon in NW cor. sec. 19, T. 14 S., R. 12 E., Panoche quadrangle, Fresno County. Named from nearby Chaney Ranch.

Chaneysville Sandstone Member[1] (of Mahantango Formation)

Middle Devonian: South-central Pennsylvania.

Original references: Bradford Willard, 1935, Geol. Soc. America Proc. 1934, p. 361; 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1279, 1282, 1283.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Gander Run shale and below Frame shale. Middle Devonian.

Named for village (which is also spelled Cheneysville) in Bedford County.

Channahon Limestone[1]

Lower Silurian: Northeastern Illinois.

Original reference: T. E. Savage, 1910, Illinois Geol. Survey Bull. 16, p. 334.

Outcrops in south bank of Des Plaines River, 1 mile southeast of Channahon, Will County.

Chanute Formation (in Ochelata Group)

Chanute Shale (in Kansas City Group)[1]

Chanute Shale Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 109.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table), 43. Lowermost formation in Ochelata group. Thickness about 200 feet near Kansas-Oklahoma State line; 40 feet or less in vicinity of Bartlesville. Normally overlies Drum limestone and underlies Iola limestone. Over Chautauqua Arch County, in parts of which Drum limestone is absent, a prominent sandstone that forms lower part of Chanute is here named Noxie sandstone lentil; near State line, includes Cottage Grove sandstone in upper part.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 294 (table), 295. Chanute shale as used here [Adams County] follows practice of Missouri Survey in including all beds between Wyandotte above and Westerville below. Includes Raytown and Cement City limestones which may be present in section but are difficult to recognize in well logs. Kansas City group.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, shows Chanute shale comprises (ascending) Quivera shale, Cement City limestone, Union Station shale (new), Paola limestone, Muncie Creek shale, Raytown limestone, and Liberty Memorial shale (new) members. Overlies Cherryvale shale, which includes Westerville limestone at top; underlies Iola limestone. Kansas City group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032–2033; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 12–13. Miscorrelation of Iola formation by Haworth and Bennett (1908, Kansas Univ. Geol. Survey, v. 9) in tracing limestone in this part of section northeastward to Kansas City has been responsible for long standing error in nomenclature of Missourian units in northeastern Kansas and northwestern Missouri. Settlement of Iola problem has led to changes in Missouri Survey's classification of middle and upper units of Kansas City group so as to bring interstate agreement in nomenclature. Union Station shale (Clair, 1943) is suppressed because it is synonymn for Chanute shale as a whole. Paola limestone, Muncie Creek shale, and Raytown limestone, which were classed as members of Chanute shale, are recognized as belonging to Iola formation. Liberty Memorial shale (Clair, 1943) is suppressed as junior synonym of Lane shale. Thus, Chanute shale overlies Drum limestone and underlies Iola formation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 36. Thickness of formation 6 to 7 feet east of Louisville, Nebr.; about 10 feet near Kansas City; 25 feet in northeastern Kansas; about 100 feet in southern Kansas.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness about 2 feet in Madison and Adair

Counties, Iowa. Underlies Iola formation; overlies Drum formation. Kansas City group.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 28–31, pls. 1, 2, measured sections. Rocks assigned to Chanute formation, in Oklahoma, were included by Ohern (1910) in lower part of Ochelata member of his Ramona formation (southern area) and in lower part of unnamed interval between Dewey and Avant limestone lentils of Copan member of his Wann formation (northern area). According to classification used on Geologic Map of Oklahoma (Miser, 1926), these beds lie at base of Ochelata formation (Ochelata group), occupying lower part of interval between Dewey and Avant limestones. On Geologic Map of Oklahoma, (Miser, 1954), they are shown as Chanute formation, lying between Dewey formation below and Iola limestone (formation) above. Thickness in Creek County 45 to 110 feet. Formation crops out across Oklahoma in direction slightly west of south from Kansas-Oklahoma line to North Canadian River. Name is not applied farther south.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Consists of greenish-gray, fossiliferous upper shale bed of varying thickness separated from lower greenish-gray shale by thin coal smut. Thickness about 5 feet. Underlies Iola limestone; overlies Drum limestone. Kansas City Group.

Named for development in vicinity of Chanute, Neosho County, Kans.

Chaos Crags Dacites

Cenozoic: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 298, 343, 380; R. D. Evans and Howel Williams, 1935, Am. Jour. Sci., 5th, v. 29, no. 173, p. 449, 450, 451. Dacite described at and in vicinity of Chaos Crags.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, nos. 1–2, p. 77 (table 2), 79, 80. Listed on tables and mentioned in text in report on uranium geochemistry of Lassen volcanic rocks.

Chaos Crags are in northwestern part of Lassen Volcanic National Park.

Chaos Jumbles Flows, Dacite

Recent: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 356. Name applied to flows forming Chaos Jumbles. Age of Jumbles approximately 200 years.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta, v. 8, p. 77 (table 2). Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Chaos Jumbles is in northwestern part of Lassen Volcanic National Park.

Chaparral Volcanics (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 30–31, pl. 1. Comprises interbedded rhyolitic and andesitic tuffaceous sedimentary rocks. Andesitic tuffaceous rock somewhat variable in texture, structure, and mineral composition. Most abundant type is fine-grained well-foliated fissile rock that ranges in color from green or greenish gray to green mottled with irregular patches and streaks of grayish yellow green or pale yellowish green. Intercalated in these finer grained

andesitic tuffaceous rocks in subordinate amounts are beds from 1 to 50 feet thick of medium- to coarse-grained andestic tuff. Rhyolitic tuffaceous rock is fine-grained finely laminated fissile phyllite that ranges in lithologic composition from relatively pure rhyolitic rock to mixed rhyolitic and andesitic rock; yellowish gray to very light gray, and locally has greenish cast. Thickness not known nor can it be approximated. Lies between two major faults, Chaparral on northwest and Spud on southeast.

Named from exposures in Chaparral Gulch, Jerome area, Yavapai County. Crops out in northeastward-trending belt in southwest corner of area. Crops out over strike length of 4½ miles and over width ranging from 1,500 to 3,500 feet.

Chapel Coal Member (of Modesto Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 38, 49 (table 1), pl. 1. Replaces name Trivoli (No. 8) coal so that name Trivoli can be retained for the sandstone. In southeastern area, occurs above Trivoli sandstone member and below New Haven coal member; in southwestern area, above the Trivoli and below Carlinville limestone member; in western and northern area, above the Trivoli and below Cramer limestone member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SW¼ sec. 3, T. 8 N., R. 5 E., Peoria County. Name derived from Graham Chapel, about 2 miles north of type locality.

Chapel Rock Member (of Munising Formation)

Upper Cambrian: Northern Michigan.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Survey Div. Pub. 51, p. 6 (fig. 1), 77–95, 114, fig. 70. Well-sorted medium-grained sandstone characterized by large-scale crossbedding. Varying amounts of scattered pebbles near base of section. Thickness from 40 to 60 feet along Pictured Rocks and throughout most of Alger County. Thins gradually to the east. Underlies Miners Castle member (new); overlies Jacobsville formation.

Type locality: Chapel Rock near eastern end of Pictured Rocks cliffs in Alger County. Name derived from Chapel Rock, of type locality, which is along southern coast of Lake Superior.

Chapin Member (of Hampton Formation)

Chapin Beds (in Kinderhook Group)[1]

Mississippian (Kinderhook): Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52, 91, 104, 108.

L. R. Laudon, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 246; L. R. Laudon and B. H. Beane, 1937, Iowa Univ. Studies in Nat. History, v. 17, no. 6, p. 236–237. Hampton is redefined by excluding from it the North Hill member, as exposed at Burlington, and the lower gray limestone ledges of Chapin member of north-central Iowa which are correlatives of the Chouteau of Missouri. As thus restricted, the Hampton includes the dolomitic upper part of the Chapin, the Maynes Creek, Eagle City, and Iowa Falls members. [This restriction of the Hampton seemingly restricts the Chapin.]

Named for exposures in abandoned quarry 1 mile west of Chapin, Franklin County.

Chapin Wash Formation

Pliocene, lower(?): West-central Arizona.

S. G. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 14 (table 2), 23–34, pls. 1, 2. Alluvial-fan and playa deposits—fanglomerate, conglomerate, sandstone, siltstone, mudstone, clay, and limestone; in part gypsiferous. Consists mainly of pink to red and brown clay, mudstone, siltstone, and sandstone, with gradations into one another. Thickness ranges from fraction of a foot to possibly 1,500 feet or more. Rests with angular unconformity upon older rocks. Overlain in part conformably by Cobwebb basalt (new) and in part unconformably by Sandtrap conglomerate (new) and younger rocks. These formations assigned to Pliocene because they rest with angular unconformity upon Miocene(?) rocks and are overlain with angular unconformity by early Pleistocene(?) basalt. Because Chapin Wash formation is oldest of the formations, it is tentatively assigned to lower Pliocene. Shown on plate 1 as Pliocene(?) and on plate 2 as early Pliocene(?).

Named for exposures along Chapin Wash in Artillery Mountains, about 30 miles east of Colorado River. Formation crops out roughly in form of elongated "U," 6 to 7 miles long and 3 to 5 miles wide, in valley between Rawhide and Artillery Mountains.

Chapman Dolomite[1]

Permian: Central Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 353, 358.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Oklahoma Geological Survey abandoned name in its earlier sense. Not a recognizable unit. If validated, name would preoccupy Chapman sandstone of Maine.

Named for Chapman's amphitheater, at head of Salt Creek, Blaine County.

Chapman Sandstone[1]

Lower Devonian: Northeastern Maine.

Original reference: H. S. Williams, 1899, Am. Jour. Sci., 4th ser., v. 8, p. 360, footnote.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Square Lake limestone and below Moose River sandstone.

Type locality: Along east bank of south branch of Presque Isle Brook, about 1 mile from south line of Chapman Township and about 1 mile west of Tweedy on road running southwest from Presque Isle, Aroostook County.

Chapman Trachyte[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 109, 110, 162–163.

Occurs in northwest corner of Chapman Township, Aroostook County.

Chapman Gulch Glaciation

Pleistocene (Cochrane?): West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 333–334, 340, fig. 2, table 4. Time of post-Wisconsin glaciation in Frying Pan Valley. Older than the

climatic optimum and Neoglaciation; younger than Hell Gate glacial substage (new). Marked by moraine and outwash deposits.

Name derived from a till deposit at 11,400 feet in Chapman Gulch. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Chapman Ranch Formation[1] (in Arbuckle Group)

Chapman Ranch Member (of McKenzie Hill Formation)

Lower Ordovician: Central southern Oklahoma.

Original reference: Josiah Bridge, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 7, p. 982–983.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1313, table 1; 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 16 (table 1). Reallocated to McKenzie Hill as basal member of formation, because it seems apparent that Ulrich intended to apply this name to the heavy limestone beds above the dolomite rather than for the dolomite; name Butterly is proposed for the underlying dolomite. Underlies McMichel member (new).

Named from Chapman Ranch on U.S. Highway 77, Murray County.

Chapman Ridge Sandstone

Middle Ordovician: Eastern Tennessee.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Qual. Map GQ–76; 1960, Map GQ–126. New formational name for strata in the Knoxville area that were previously called Tellico sandstone; this renaming is outgrowth of belief that the sandstone now included in the Chapman Ridge does not correlate with Tellico sandstone at its type locality. Consists of from 700 to 900 feet of calcareous sandstone interbedded with shale and silty shale. Includes all strata below lower tongue of Ottosee shale, or where this unit is missing, between the Holston "marble" through to the contact of sandstone with the shale and limestone beds of the Ottosee.

Type locality: Exposures along Alcoa Pike, State Highway 73, where highway cuts through Chapman Ridge south of Looney Island, Knoxville quadrangle [Knox County].

Chapparal Sandstone (in Saavedra Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11. White saccharoidal sandstone weathering into round-edge slabs. Large fossil tree trunks. Thickness 24 feet.

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Chappel Limestone

Chappel Formation[1]

Lower Mississippian: Central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 91–92, 96.

F. B. Plummer, 1939, *in* West Texas Geol. Soc. [Guidebook] Nov. 11–12, p. 15. Subdivided to include Ives conglomerate at base.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 27, 42, 44 (fig. 2), 49–52. Proposed here that unit formerly designated Chappel formation be termed Chappel limestone because unit is persistently calcitic and that Ives conglomerate member be termed Ives breccia, a unit of formational rank. At type locality, Chappel is approximately 24 inches thick and consists of crinoidal limestone wherein abundant to scattered larger pelmatozoan fragments are tightly bonded by a matrix of fine-grained limestone; upper 10 to 11 inches is tough, medium- to dark-gray rock with brownish, olive, or bluish cast, fairly typical of much of the Chappel on east side of Llano uplift; lower 13 to 14 inches have been leached to a marly appearance and a lighter yellowish gray color. At type locality, Chappel is directly overlain by about 50 feet of shales of Barnett formation; a few hundred feet to the south, a lens of Ives breccia intervenes between the Chappel and the Honeycut. In eastern half of Llano uplift, the Chappel is similar to type section, but thickness may be as much as 14 feet, although it seldom exceeds 3 to 5. In eastern areas overlaps Honeycut, but, in western areas, overlaps limestone of Gorman formation. Because limestones of Gorman formation are readily soluble, the Chappel is commonly preserved in solution structures that developed previous to Barnett time. Approximately 45 feet of Chappel was measured in one of these structural sinks about 1,500 feet east of Joe Davis Hollow on north bank of San Saba River in McCulloch County.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 20–32. Chappel formation differentiated into two facies: normal and sink-hole; the facies are determined in part, at least, by topography of Ellenburger surface on which Chappel was deposited. Subdivided into four members (ascending): King Creek marl (new), Ives conglomerate, Espey Creek limestone (new), and Whites Crossing coquina (new). Lower Mississippian, ranges perhaps from lower Kinderhook through Burlington.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, pl. 1. Overlies Houy formation (new). King Creek marl member of Plummer's (1950) Chappel formation is surely identified only at its type locality where it constitutes a few inches of the Houy formation.

W. H. Hass, 1959, U.S. Geol. Survey Prof. Paper 294–J, p. 365–396. Discussion of conodont fauna of the Chappel. Also discusses formation as described by Cloud and Barnes (1948) with relationship to formation as described by Plummer (1950).

Type locality: Three miles southeast of San Saba, San Saba County. Name derived from village of Chappel. Exposed at many places along east, north, and west margins of Llano uplift.

Chaquaqua Member[1] (of Lykins Formation)

Triassic(?): Southeastern Colorado.

Original reference: J. T. Duce, 1924, Colorado Geol. Survey Bull. 27, pt. 3, p. 81–82.

Named for exposures in Chaquaqua Canyon, Las Animas County.

Chaquaqua shale[1]

Upper Jurassic: Northeastern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geological formation of New Mexico, p. 3, 6.

Exposed in Chaquaqua Canyon in northeast New Mexico.

Charcoal Canyon Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3). Discussion of Paleozoic continental margin in central Nevada. Clipper Canyon sequence comprises (ascending) Charcoal Canyon, Petes Summit, Sams Spring, and Joes Canyon formations (all new). Clipper Canyon sequence is isolated by surrounding Tertiary volcanic rocks.

Clipper Canyon, Toquima Range, Nye and Lander Counties.

Charco Azul Formation

Pliocene: Panamá and Costa Rica.

R. A. Terry, 1941, Geog. Rev., v. 31, no. 3, p. 381 (fig. 5), 382; A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 249–250. Base is heavy conglomerate; grades upward into sandstones and foraminiferal shales. Maximum thickness more than 4,000 feet. Overlies Armuelles formation. Pliocene.

Along shore of Charco Azul Bay and elsewhere in Burica Peninsula. Extends into Costa Rica.

Chardon Siltstone Member (of Orangeville Shale)

Chardon Sandstone[1] Member (of Orangeville Shale)

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 219–229.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1363–1364; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 42. Renamed Chardon siltstone member. Consists of thin- to thick-bedded gray siltstones and intercalated silty shale. Thickness about 8 feet. Occurs in Orangeville about 30 feet above Berea sandstone. Lithologically similar to Aurora member; names Chardon and Aurora may have been applied to different parts of a single unit.

Typically exposed in Stebbins Gulch near Chardon, in northwestern Geauga County.

Chariton Conglomerate Member (of Pleasanton Formation)[1]

Chariton Conglomerate (in Pleasanton Group)

Pennsylvanian (Missouri Series): Southeastern Iowa and northern Missouri.

Original reference: H. F. Bain, 1896, Iowa Geol. Survey, v. 5, p. 394–398.

L. M. Cline, 1951, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 30. Referred to as Chariton conglomerate in Pleasanton group.

Named for exposures along Chariton River near mouth of Snort Creek, Appanoose County, Iowa.

Charles Formation (in Madison Group)
Charles Formation (in Big Snowy Group)

Mississippian: Subsurface in central and eastern Montana and adjacent areas.

O. A. Seager, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 861–864. Term introduced to describe series of interbedded limestones, dolomite, anhydrite, and shales that lie between basal member (Kibbey) of Scott's Big Snowy group and the Madison. Lies at depths of 6,350 to 6,815 feet in Carter Oil Co.'s Northern Pacific test No. 1, sec. 19, T. 4 N., R. 62 E., Fallon County, Mont. Possible that Charles sediment fills gap between Madison and Big Snowy time and should be included in Madison; however, widespread development of porosity in upper part of Madison indicates that the time break is here; hence, Charles is considered basal member of Big Snowy group.

L. L. Sloss, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 65 (chart), 66–67, 68 (cross sections). Assigned to Madison group. Overlies Mission Canyon limestone. Reconsideration of relationships strongly suggests that the Charles is recognizable in many outcrop areas of central and western Montana.

J. M. Andrichuk, 1958, Habitat of Oil: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 230. Perry and Sloss (1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10) defined Charles in type well between depths of 3,050 and 3,810 feet. Nordquist (1953, Billings Geol. Soc. Guidebook 4th Ann. Field Conf.) showed that depth of 3,050 feet in type well marks top of so-called Kibbey limestone. In this report, boundaries of Charles in type well are selected at 3,200 and 3,800 feet in agreement with Nordquist.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 330–332, 333 (fig. 2). This report follows Sloss and places Charles in Madison group. Formation is believed to be transitional laterally in subsurface into upper beds of Mission Canyon limestone, middle unit of Madison group as here recognized.

Named for occurrence in Arro Oil and Refining Co. and California's Co. Charles No. 4 [referred to by later authors as type well], sec. 21, T. 15 N., R. 30 E., Garfield County, Mont.

Charleston Sandstone[1]

Pennsylvanian: Western West Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 508.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 79. Massive sandstone near Charleston, Kanawha County, W. Va., formed where Buffalo and Mahoning (Conemaugh), Freeport, and East Lynn (Allegheny), and Roaring Creek (Kanawha) sandstones join to form one sandstone bluff, the intervening coals and shales being absent.

Named for exposures at Charleston, Kanawha County.

Charlevoix Limestone

Charlevoix Stage[1]

Middle Devonian: Northwestern Michigan.

Original reference: E. R. Pohl, 1930, U.S. Nat. Mus. Proc., v. 76, art. 14, p. 2–25.

L. S. Sloss, 1939, Jour. Paleontology, v. 13, no. 1, p. 52. For purposes of this report, Pohl's divisions of Traverse beds, Petoskey, Charlevoix, and Gravel Point are referred to as faunal zones.

G. A. Cooper and A. S. Warthin *in* G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1752, chart 4. Charlevoix limestone occurs on shore of Lake Michigan in Emmet and Charlevoix Counties between the "upper blue shale" (zone 6) of Gravel Point limestone and base of Petoskey limestone; the "upper blue shale" is correlated with upper Alpena (approximately Dock Street clay) of Alpena County; lower part of Petoskey at Bayshore is correlated with Norway Point formation of Alpena County. Thus Charlevoix occupies position of Four Mile Dam limestone. It is suggested that Charlevoix may represent a western shore phase of Four Mile Dam although there is no fossil evidence to support this contention.

Probably named for Charlevoix County.

Charlottesville Formation

[Precambrian]: Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 140. Overlies Johnson Mill graphite schist (new); underlies Catoctin schist.

Discussion of structure and stratigraphy of the Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is an overturned anticline, with axial plane dipping 28° to southeast, and a thrust fault bordering it on its western edge.

Charlton Formation[1]

Pliocene: Southeastern Georgia and northeastern Florida.

Original reference: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 60, 392–400.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 72. Mapped in Georgia as Pliocene.

R. O. Vernon, 1952, *in* A summary of the geology of Florida and a guidebook to the Cenozoic exposures of a portion of the state: Florida Geol. Survey, p. 58, 59. Prior to 1942, Pliocene series in Florida was considered composed of Citronelle formation, Tamiami limestone, Buckingham marl, Bone Valley gravel, Alachua formation, Charlton formation, and Caloosahatchee marl. Additional well data and fieldwork has presented evidence that places beds formerly called Tamiami limestone, Buckingham marl, and upper beds of Hawthorn into Tamiami formation. The Charlton is similar in fauna and lithology to the Buckingham and is also placed in the upper Miocene.

Named for exposures in Charlton County, Ga.

Charrette Limestone[1]

Middle Ordovician: Eastern Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Rept. 1855–1871, p. 49–50.

Named for Charrette, Warren County.

Charter Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 156. Name applied to the coarse-grained to conglomeratic uppermost member of formation. Type section extends from depths of 1,381 to 1,648 feet. Thickness of member 145 to 315 feet. Overlies Gunn member (new); underlies Eau Claire formation.

Type well: McQueen No. 1 (well 6) in SW¼NE¼NE¼ sec. 27, T. 42 N., R. 3 E., DeKalb County. Name derived from Charter Oak School, 3½ miles north of type well.

Chartresan series[1]

Mississippian: Illinois.

Original reference: C. R. Keyes, 1933, Pan-Am. Geologist, v. 60, no. 1, p. 45, 49.

Name derived from old French Fort Chartres, which once occupied a spot near mouth of Kaskaskia River just above the present hamlet of Chester.

Chase Group[1]

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 771–786.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 68–71; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41–45. Stratigraphically expanded upward to include the Odell and Nolans formation; that is, the upper boundary is at top of Herington limestone member of Nolans limestone. As redefined, includes (ascending) Wreford limestone, Matfield shale, Barneston limestone, Doyle shale, Winfield limestone, Odell shale, and Nolans limestone. Underlies Wellington formation of Sumner group (Leonard series); overlies Speiser shale of Council Grove group (Wolfcamp series). Thickness in Kansas about 335 feet.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. In Oklahoma, Herington limestone and Fort Riley limestone are only units of group mapped.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 73 (table 3), 105–119. As presently defined, group includes beds from base of Wreford limestone upward to top of Nolans (Herington) limestone. In southern Kansas and northern Oklahoma, group consists of over 340 feet of red and green shales and persistent chert-bearing limestones. Southward, limestones thin and chert content diminishes abruptly. In Pawnee County, includes (ascending) Wreford limestone, Matfield shale, Fort Riley limestone, Doyle shale, and Winfield limestone. Wolfcamp series. South of Pawnee County, rocks of group grade laterally into Asher formation of central Oklahoma.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 229–235. Suggested that term Lyon series be used for Permian rocks in Kansas, Oklahoma, and Nebraska. Series would comprise Admire, Council Grove, and Chase groups.

Named for Chase County, Kans.

Chase Channel Formation

Pleistocene (Nebraskan and Aftonian): Central Kansas (subsurface).

R. C. Moore, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1278. Deposits established as age equivalents of the Blanco formation

(type locality in Texas) are termed Rexroad formation in Oklahoma and southwestern Kansas, Chase Channel formation (Holdrege and Fullerton members) in central Kansas, and Broadwater formation or Holdrege and Fullerton formations in Nebraska.

O. S. Fent, 1950, Kansas Geol. Survey Bull. 85, p. 64, 127, 128, 129. In type well, is lowermost Pleistocene. Occurs below Grand Island member of Meade formation and above Permian Harper sandstone. Thickness 59 feet.

Type well: Test hole 20–9–10dc (N) in SW¼SE¼ sec. 10, T. 20 S., R. 9 W., drilled by Kansas Geological Survey, October 1946. Type locality is buried filled valley named Chase Channel from its development at town of Chase, Rice County.

Chatcha Limestone

See Chacha Limestone

Chatham Granite[1] or Group

Upper Devonian(?): East-central New Hampshire.

Original reference: M. P. Billings, 1928, Am. Acad. Arts Sci. Proc., v. 63, p. 82, map.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1892–1893. Referred to as a group which includes quartz diorite, granodiorite, and quartz monzonite. A petrographically distinct unit, but not mapped separately from Meredith porphyritic granite and pegmatites of the area. Assigned to New Hampshire magma series in Belknap Mountains.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 378. Granite includes Winnipesaukee quartz diorite of Winnipesaukee region.

M. P. Billings, 1945, Am. Jour. Sci., 5th ser., v. 243–A, p. 43. Upper Devonian(?).

Crops out in Chatham Township, North Conway quadrangle.

†Chatham series[1]

Upper Triassic: North Carolina.

Original reference: E. Emmons, 1857, Am. Geology, p. iv, v, vi, 19.

Chatham County.

Chatham Hill Formation

Middle Ordovician (Mohawkian): Southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 53, chart 1 (facing p. 130). Base of formation generally not well exposed; transitional with underlying black graptolitic shales of Rich Valley formation (new). Upper part is cherty dark-bluish-gray limestone. Top prominently defined by succeeding ledges of calcarenite forming lower part of Wassum formation (new). Total thickness about 450 feet. Occurs in area for which Porterfield stage is named. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Two miles south of Chatham Hill, Chatham Hill (TVA 218–NE) quadrangle. Named from exposures adjacent to Viriginia Highway 16 along lower northwestern slopes of Walker Mountain.

Chatsworth Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 162. Consists largely of till. Thickness probably

as much as 40 feet. Overlies Bloomington and Farm Ridge drifts; underlies Marseilles drift. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Occurs in moraine along east side of Streater quadrangle, La Salle County. Named for village of Chatsworth, which is located on moraine, in southeastern Livingston County.

†Chattahoochee Bed (proper)[1]

Miocene, lower: Northwestern Florida and southwestern Georgia.

Original reference: A. F. Foerste, 1894, Am. Jour. Sci., 3d, v. 48, p. 41–54.

Named for exposures at Old Chattahoochee Landing, Gadsden County, Fla.

†Chattahoochee Formation[1]

Eocene, lower: Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, map.

Type locality not stated.

Chattahoochee facies (of Tampa Stage)

†Chattahoochee Formation[1]

Miocene, lower: Florida and Georgia.

Original reference: D. W. Langdon, Jr., 1889, Am. Jour. Sci., 3d, v. 38, p. 322-324.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table 1), 17–20, figs. Term Chattahoochee revived to include updip silty and clayey facies of Tampa stage. Thickness 119 feet near Jim Woodruff Dam, Fla. Name St. Marks is here revived to include calcareous downdip facies of Tampa stage.

C. W. Hendry, Jr., and J. W. Yon., Jr., 1958, Florida Geol. Survey Rept. Inv. 16, p. 28–33. Detailed discussion in vicinity of Jim Woodruff Reservoir. Facies underlies clastics of Hawthorn formation and unconformably overlies Suwannee limestone. Exposed thickness about 160 feet. Type locality stated.

Type locality: Jim Woodruff Dam section located on dam access road in SW¼ sec. 29, T. 4 N., R. 6 W., directly below U.S. Engineers office on east side of Apalachicola River. Named for exposures along Chattahoochee River, especially at Chattahoochee Landing, Gadsden County, Fla.

Chattanooga Shale[1]

Upper Devonian and Mississippian: Tennessee, Alabama, Arkansas, Kentucky, Mississippi, and Oklahoma.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143.

J. H. Swartz, 1924, Am. Jour. Sci., 5th ser., v. 7, no. 37, p. 24–30. In type area, Chattanooga shale is overlain by thin hard gray shale containing *Lingula melie*. This shale is herein named Glendale. This shale has been regarded as part of overlying Fort Payne chert. Glendale is lower Cuyahogan in age. In type area and along Cumberland escarpment, the Chattanooga is divisible into at least three members: upper black shale of Sunbury (in places perhaps post-Sunbury) age: lower black shale of Cleveland (and in places perhaps pre-Cleveland) age; and middle gray clay shale of Bedford-Berea age. Upper part of Chattanooga in Clinch Mountain area is of late Cuyahogan age. Maury shale is separated from

Chattanooga by marked unconformity which increases to west and decreases to east, probably disappearing before eastern Tennessee is reached. It [Maury] is basal Ridgetop, not upper member of Chattanooga.

J. H. Swartz, 1927, Am. Jour. Sci., 5th ser., v. 14, no. 84, p. 485–499. Big Stone Gap shale of Ulrich and Stose (1923) has been shown by direct and continuous tracing to be northward continuation of Chattanooga shale of type area. Big Stone Gap shale abandoned for prior term Chattanooga shale. Thoughout whole area, Chattanooga shale is divisible into three members: upper black shale member to which term Big Stone Gap is here restricted; midde gray shale member here called Olinger member; and lower black shale member here designated Cumberland Gap member. Olinger member is same age as Cumberland Gap member, with which it intertongues to south. Big Stone Gap member separated from underlying Olinger member by unconformity which is most marked in southeastern Tennessee and which may be absent in northeastern Tennessee and southwestern Virginia.

K. E. Born and H. B. Burwell, 1939, Tennessee Div. Geology Bull. 47, p. 48–49. Chattanooga shale, throughout most of central Tennessee, consists of three members: thin conglomeratic phosphatic dark-colored sandstone at base (Hardin sandstone); ubiquitous black shale member; and thin green phosphatic nodular soft shale unit at top (Maury green shale). In Clay County, underlies Fort Payne formation and overlies the Richmond group: Mississippian (Kinderhook group).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1752–1753, chart 4. At its type section (Swartz, 1924) determined Chattanooga shale to be in part Upper Devonian and in part Lower Mississippian. Here section consists of about 11 feet of shale; the lowest 8 feet corresponds to Cleveland shale; next overlying 9 inches of mottled shale are assigned to the Bedford-Berea; next three-eighths inch of black shale is said to be of Sunbury age; over the Sunbury 2⅓ feet of hard shale (Glendale) is correlated with lower Cuyahoga of Ohio. These are long-ranging correlations and are not based on best of evidence, but, if Swartz is correct, main body of the Chattanooga at its type locality is correlated with Cleveland shale, which is herein regarded as Devonian. Correlation of these black shales is so difficult that age of each occurrence must be considered on its own merits. In northeastern Arkansas, black shales called Chattanooga contain Middle Devonian or lowest Upper Devonian fossils; these occurrences should be renamed or referred to Trousdale shale, Geneseo equivalent in west Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 880–895. Belt of outcrop of Chattanooga shale extends from Cumberland, Monroe, and Allen Counties, Ky., through Clay, Macon, and Sumner Counties, Tenn.; encircles Central basin along the Highland Rim, and joins again from Lincoln to Hardin County before entering Alabama, where it extends to Birmingham. Crops out in eastern Tennessee from Chattanooga to Cumberland Gap and along Clinch Mountain, extending into Virginia. Type Chattanooga is detached from both the shale of eastern Tennessee and that around Central basin and has not been correlated definitely with either. Thickness 20 to 35 feet in Chattanooga district, but only 10 feet exposed in type section on Cameron Hill; it is not a representative section for any region. Chattanooga shale has same time limits as New Albany shale in Indiana and Kentucky. All divisions of

the New Albany, their stratigraphic relations, and lithic characters are duplicated in the Chattanooga. Terms New Albany and Chattanooga may be used interchangeably. Chattanooga in central Tennessee comprises (ascending) Trousdale, Dowelltown (new), Gassaway (new), Eulie (new), and Westmoreland (new) formations. Underlies Maury or New Providence shale.

W. H. Hass, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1189. Chattanooga shale in vicinity of Chattanooga, consists of three members: upper and lower black shale, and a middle gray shale. Conodonts present in all three members. Conodonts were collected at type locality in Chattanooga and near Apison, 16 miles east of Chattanooga. At Apison locality, upper black shale member contains lower Mississippian conodonts and is correlated with Sunbury shale of Ohio. Lower black shale at both localities contains conodonts that correlate it with Huron shale of Ohio, a formation classified as Upper Devonian by U.S. Geological Survey. Middle gray shale contains Huron conodonts, but its age is equivocal as J. H. Swartz has reported macrofossils from it which he considers to be of early Mississippian age. Presence of Huron conodonts in lower black shale member of Chattanooga shale is younger than the black shale sequence of the North Central States.

G. G. Huffman, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 448. In Muskogee County, Okla., unconformably overlies Sylvan shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Chattanooga shale (Mississippian and Devonian) mapped in northeastern and central eastern Oklahoma.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 2–23. First reference to Chattanooga shale is brief. It appears as part of descriptive matter on geologic column that the "Chattanooga black shale" is of Devonian age, that it is overlain by Fort Payne chert of Carboniferous age and underlain by Rockwood formation of Silurian age, and that it is 35 feet thick. The "Chattanooga black shale" consists of two lithologic units: upper gray shale, 3 to 4 feet thick, and a lower black shale. Swartz (1924) named upper gray-shale unit of Hayes' Chattanooga the Glendale shale. Swartz was of the opinion that beds he identified as Glendale were, prior to his work, a part of Fort Payne chert. Name Glendale shale not used in present report; beds so named by Swartz are called Maury formation. At reference section herein designated, Chattanooga consists of lower Dowelltown member and upper Gassaway member. Thickness throughout much of area 25 to 35 feet. In some areas, includes Hardin sandstone member (about 16 feet thick) below the Dowelltown. As delimited in present report, the Chattanooga shale of type locality (locality 226) is the Cumberland Gap member of Swartz's (1927) section. The immediately overlying beds which Swartz assigned to his Olinger and Big Stone Gap members are herein placed in Maury formation. Underlies Maury formation; the two problably are separated by a unconformity throughout much of south-central Tennessee and north-central Alabama. Considered to be of Late Devonian age though oldest beds could be of late Middle Devonian. Conodonts discussed.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 30–33. Name, as applied in Alabama, includes sandstone and black shale deposits that occur stratigraphically between Red Mountain formation of Silurian age and Fort Payne chert of Mississippian age.

Overlies Chickamauga limestone in northwestern part of Madison County. Thickness about 8 feet in Madison County. Devonian.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 38–40, pls. 1, 2, 4, 5. Formation described on south and west flanks of Ozark uplift where it is as much as 70 feet thick and consists of basal Sylamore sandstone member and overlying black shale member. Unconformably underlies St. Joe or Reeds Spring limestone; unconformably overlies beds ranging in age from Lower Ordovician Cotter, as near Spavinaw, to Sallisaw formation of Devonian age near Marble City. Kinderhookian.

G. G. Huffman and J. M. Starke, Jr., 1960, Oklahoma Geology Notes, v. 20, no. 7, p. 159-163. Proposed that term Chattanooga be retained for Late Devonian-Early Mississippian lying immediately below the St. Joe group and that the formation be divided into two members; the lower, or Sylamore, sandstone member and the upper, or Noel, black shale member.

J. C. Cobb and J. L. Kulp, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 223–224. Discussion of U-Pb age of Chattanooga shale. Possible that true age of the Chattanooga is about 350 million years.

Type locality: Hillside exposure at north end of Cameron Hill, Chattanooga, Hamilton County, Tenn. Standard section: Cut on Tennessee Highway 26, at east approach to Sligo Bridge over Caney Fork, 7.1 miles east of courthouse at Smithville, DeKalb County, Tenn.

Chattanoogan Series[1]

Devonian-Mississippian: North America.

Original references: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 29; C. Schuchert, 1924, Textbook geology, p. 335.

Chauga zone[1]

Cambrian(?): Northwestern South Carolina.

Original reference: C. E. Sloan, 1905, South Carolina Geol. Survey, geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2.

Named for exposures along upper half of Chauga River, Oconee County.

Chaumont Formation[1] or Limestone (in Black River Group)

Middle Ordovician: New York, and Ontario, Canada.

Original references: G. M. Kay, 1929, Jour. Geology, v. 37, no. 7, p. 644–671; 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 9, p. 1214.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, pl. 2. Plate 2 shows Chaumont underlies Amsterdam limestone in Lake Champlain region.

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 588 (fig. 2), 593 (table 2), 594 (table 3), 595–597, 599. Uppermost formation of Black River group in New York. Separable into two members, Leray and Watertown limestones, only in limited area near Watertown. Underlies Rockland formation (type section in Ontario); overlies Lowville. Geographically extended into Ontario.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 24. Name was proposed to include (ascending) Leray, Glenburnie, and Watertown members. Leray consists of 13 feet of heavy-bedded dark-brownish-gray to black limestone containing chert. In type region of Chaumont, Leray is separated from Watertown by 2 feet of fossiliferous shale, the Glenburnie. Watertown comprises 13 feet of massive limestone. Outside type

area, it is difficult to separate Leray and Watertown. Underlies Rockland formation; overlies Lowville.

D. W. Fisher, 1957, New York State Mus. Bull. 359, p. 13–15. Discussion of Mohawkian (Middle Ordovician) biostratigraphy of Wells outlier, Hamilton County. Chaumont limestone consists of about 9 feet of massive blocky argillicalcilutite with much black chert. Not certain whether the Chaumont at this locality consists of the Leray or Watertown members, or includes both. Overlies Lowville limestone; underlies Rockland (Napanee) limestone.

Named for Chaumont Bay, Lake Ontario, Jefferson County, N.Y.

Chaumontian Stage

Ordovician (Black Riveran): New York.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 94 (table 3). Name used in list of stage names for uppermost division of Black Riveran series. Younger than Lowvillian [stage]; older than Rocklandian stage of Trentonian series.

Name probably derived from Chaumont Bay, Lake Ontario, Jefferson County, for which Chaumont formation is named.

†Chautauqua Conglomerate[1]

Pennsylvanian: New York.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 89, 96.

Probably Chautauqua County.

†Chautauqua Sandstone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams and E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 57–60.

Named for Chautauqua Sandstone Hills, which extend through parts of Chautauqua, Woodson, Wilson, Montgomery, Greenwood, and Elk Counties.

Chautauquan Group[1]

Chautauquan Series

Chautauquan Stage

Upper Devonian: North America.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 54, 60–61, table (facing p. 62). Chautauquan series embraces strata from base of Chemung to base of Bradfordian series of former classifications. Chautauquan was viewed by New York State geologists as marking close of Devonian and overlying Bradfordian was considered of Mississippian age. Name Bradfordian series is here abandoned, and term Conewango series is applied to Devonian part of the Bradfordian "series." Conewango series is a closing phase of Upper Devonian sedimentation in New York and Pennsylvania. Chautauquan series comprises Girard stage below and Chadakoin stage above.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey 4th ser., Bull. G–19, p. 240–253. Major units of Chautauquan stage (division) of marine Upper Devonian

in northwestern, north-central, and central Pennsylvania are (ascending) Chemung, Canadaway, Conneaut, and Conewango groups.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. As shown on correlation chart, Devonian comprises (ascending) Ulsterian, Erian Senecan, Chautauquan, and Bradfordian (in part) series. Chautauquan comprises Cassadaga (new) and Conewango stages. Upper Devonian.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2317–2318. Chautauquan series reduced to Chautauqua group and incorporated in upper part of Senecan series.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 12, p. 8, 9. Chautauquan series redefined to include all Upper Devonian rocks. As redefined, includes in western New York (ascending) Seneca, Arkwright, and Conewango groups. Occurs above Middle Devonian Erian series.

L. V. Rickard, 1957, New York State Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17. General stratigraphic column of Wellsville area shows Chautauquan series comprises (ascending) Canadaway, Chadakoin, and Conewango groups. Above Senecan series; below Knapp "formation," Kinderhookian series.

Named for exposures in Chautauqua County, N.Y.

Chaves shale[1]

Permian: Southeastern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 258; 1915, Conspectus of the geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 3, 6.

In Guadalupe Mountains. Derivation of name not given.

Chavez Member (of Morrison Formation)

Upper Jurassic: Northwestern New Mexico.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 38. Series of variegated sandstone and siltstone beds underlying Prewitt sandstone member (new) and overlying Thoreau formation (new).

C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 15–16, pl. 1. Alternating variegated greenish siltstone, purplish-to-reddish sandy mudstone, and white-to-buff coarse-grained conglomeratic sandstone; locally, units contain silty layers and mud-ball zones; much sandy material is strongly laminated; variegated red, purple, and green mudstone bed about 15 feet thick present near top of formation; beds of sandstone are 3 to 6 feet thick; siltstone 1 to 3 feet, mudstone layers 3 inches to 2 feet. Thickness 160 feet at type section (herein designated); thins to west; about 200 feet along eastern boundary of quadrangle; less than 100 feet near Chaco Canyon Road.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 18. Upper Jurassic.

Type section: In sec. 19, T. 14 N., R. 13 W., south of Mount Powell near western edge of Thoreau quandrangle. Named for exposures on crest of Chako Canyon Road about 5 miles north of Chavez Siding on Atchison, Topeka, and Santa Fe Railway.

Chazy Group[1] or Limestone[1]

Middle Ordovician: Eastern New York and western Vermont.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geology 2d dist., p. 107, 315, 429.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, 119–178. Series includes Stones River group with Murfreesboro, Mosheim, and Lenior limestones, and Blount group with Holston limestone, Whitesburg limestone, Athens formation, and Ottosee limestone. Overlies Beekmantown group; underlies Lowville-Moccasin formation of Black River group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–866. In Tazewell County, Va., strata embraced by the Chazyan and Black River groups of Butts (1940) are divisible into 29 distinctive zones. Detailed work indicated that supposedly diagnostic criteria for recognition of the Chazyan and Black River formations of Ulrich and Butts are unreliable and that succession of formations given by Ulrich and Butts is incorrect. The newly recognized zones are grouped into eight formations (ascending): Cliffield, with Blackford, Five Oaks, Lincolnshire, Ward Cove and Peery members; Benbolt limestone with Shannondale and Burkes Garden members; Gratton limestone; Witten limestone; Moccasin formation; and Eggleston formation. Terms Stones River, Murphreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville and Lowville-Moccasin should not be used in Tazewell County and other parts of southwestern Virginia. The succession beds described is clearly post-Beekmantown, but beds above *Camarocladia* zone (upper part of Witten) may by younger than hitherto believed. Moccasin and Eggleston may be early Trenton but present evidence not conclusive. Boundary between Chazy and Black River not clearly defined in Tazewell County. Series and group classification of formations can be made only after regional studies between New York localities and Tazewell County have been completed.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 522 (fig. 3), 524 (table), 548–554. Chazy group, in eastern New York, comprises (ascending) Day Point, Crown Point, and Valcour limestones. Inasmuch as Day Point beds thin and pinch out, north of west-central Vermont, and inasmuch as Valcour undergoes considerable change in lithology and obliteration of fossils eastward from Lake Champlain, Crown Point limestone is only term used along Lake Champlain appropriate in west-central Vermont [this report]. Here Chazyan sequence (Chazy group) is Crown Point limestone, Beldens formation with Weybridge member (both new), and Middlebury limestone (new). Overlies Beekmantown group (Beekmantownian).

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1171–1172. Highgate Springs sequence of Middle Ordovician rocks lies structurally below and west of thrusts bounding the Rosenberg, Philipsburg, and Granby slices for 100 miles from Chittendon County, Vt., to Bagot County, Quebec. Three formations are Chazyan: Beldens, Carman (new), and Youngman (new). Disconformably overlying Chazyan at Highgate Springs is 80 feet of Isle la Motte limestone having Trenton fossils.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 35–114. In proposed reclassification, lower Middle Ordovician of Shenandoah Valley is divided into six time-stratigraphic units (ascending) New Market limestone (new), Whistle Creek limestone (new), Lincolnshire limestone, Edinburg formation (new), Oranda formation (new), and Collierstown limestone (new). At least part of New Market

limestone is linked with part of New York Chazy and type Lenoir; Lincolnshire seems to be post-Chazy. Whistle Creek, if at all Chazy, could be represented only in upper part of the Valcour; probably Whistle Creek, as well as some of succeeding beds, is younger than Chazy and older than typical Black River.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1198. Bolarian series (new, Bolar Valley, Va.) comprises rocks younger than Lincolnshire, about late Chazyan, and older than Nealmont, early Trentonian.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Cady (1945) included Crown Point, Beldens, and Middlebury formations in Chazy "group" in west-central Vermont. Name Crown Point is herein replaced by Burchards limestone, and the Burchards and Beldens are included in Chipman group (new). Kay (1945) studied "Chazy" rocks of northern Lake Champlain and described the Carman quartzite and Youngman formation as succeeding the Beldens in Highgate Springs slice. Carman and Youngman compose Maquam group (new). Chazy sequence in New York is Day Point, Crown Point, and Valcour. Inasmuch as these three sequences have been called Chazy for nearly a century, it is recommended that Chazyan series consists of Chipman and Maquam groups, as well as the Chazyan series of New York. This use of Chazy is considered to have priority over the Chazyan of Grabau (1909) which added the Black River group and of Ulrich (1911) which was a composite of widely scattered stratigraphic units.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1400–1406. Rocks younger than Canadian or Beekmantownian and older than Cincinnatian series are commonly referred to Middle Ordovician and placed in two series, Chazyan and Mohawkian. The Mohawkian is herein divided into Bolarian and Trentonian series. Chazyan, as originally defined, included Black River group as well as Chazy, but name should be restricted to the latter. Chazyan has two groups, Chipman and Maquam. The Chipman, present in Vermont and southeastern Quebec, is thought to be older than base of Chazy limestone in New York, correlated Maquam group of Vermont. Black River and Trenton formations in New York and Ontario lie with regional unconformity on the Chazyan, Canadian, and Upper Cambrian, and Precambrian. The Chazy, Black River, and Trenton commonly have been classified as groups of Middle Ordovician. They are comparable in stratigraphic magnitude and are separated by persistent regional unconformities. The Chazyan along Allegheny synclinorium includes Five Oaks-Blackford and Lincolnshire formations. Chazyan is followed by Bolarian series which term is used in preference to Black Riveran.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 66, no. 3, p. 253–254, chart 2. In type area, in Champlain Valley, Chazyan stage includes about 1,000 feet of relatively pure thick-bedded limestone. These deposits are separated from shale belt on the east by major thrust zone (Logan's Line) and from contemporaneous deposits both north and south by gap of more than 100 miles. Hence, recognition of Chazyan rocks outside Champlain Valley rests entirely on faunal criteria. Chazyan fauna has turned out to be somewhat restricted, and provincial facies not clearly recognizable elsewhere. This is illustrated by Lincolnshire formation of Virginia and Tennessee which has been referred to Chazyan by most students and is so placed in present chart but which Cooper

believes should be lifted to base of Black River stage because of numerous faunal affinites with that stage that are unknown in type Chazyan. In Champlain Valley, the middle Chazyan, Crown Point, limestone is characterized by gastropod *Maclurites magnus*. In this region, there is no similar species above or below and, thus, from early days of Ordovician stratigraphy, *Maclurites magnus* came to be regarded as guide to Middle Chazyan. It is now known that similar large species of *Maclurites* occur higher in Ordovician in central and southern Appalachians, *Tetradium cellulosum* and *Cryptophragmus* led Ulrich and others to identify Lowville formation in Appalachians and central basin of Tennessee. In southern Appalachians *Cryptophragmus* is common in Witten formation, which was hitherto called Lowville. On basis of its supposed Lowville age, all rocks below were placed in Chazyan. This accounted for Chazyan age of Ottosee and Athens of Virginia. The latter formations with *Nemagraptus* and other graptolites of Normanskill assemblage were thus dated as Chazyan. Similarly, the Carters formation of Tennessee was dated as Lowville because of abundant *Tetradium cellulosum* in its lower beds. By this correlation, entire Stones River group was assigned to Chazyan in spite of fact that Stones River contained no Chazyan species other than *Maclurites*. Now known that *Cryptophragmus* and *T. cellulosum* have considerable range. Fauna of Witten limestone accompanying *Cryptophragmus* is that of the Chaumont or Rockland beds, and Carters limestone is now recognized as equivalent to Tyrone limestone and correlated with Rockland. Result has been to leave scope of Chazyan stage outside Champlain Valley in confusion and uncertainty. Suggested that it might be desirable to abandon Chazyan as stage name in standard section and choose term with new type section somewhere in central or southern Appalachian trough. However, name Chazyan stage is retained for present chart.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 1, 7–8, chart 1. Five stage terms proposed (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness. Older terms, Chazyan and Black River, are no longer useful because they have been so defined that they do not describe the stratigraphy. Recent studies have shown that Chazyan of Ulrich included rocks from Chazyan to Trenton and that Black River of Ulrich was in large part of Trenton age. Grabau's (1909) usage of Chazyan included Black River, which is herein regarded more closely related to overlying Rockland than to Chazy group below. Ulrich's (1911) conception of Chazy was for interval between Lowville and top of Canadian (Beekmantown or Knox dolomite) which is far too inclusive. Marmor stage includes Chazy group of rocks and its correlatives. Ashby stage includes Elway and Lincolnshire formations which Kay (1948) placed in his Chazyan.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 55–106. Middle Ordovician limestones of the Chazyan, Bolarian, and Trentonian series are exposed in western anticlines in Appalachian Mountains of West Virginia and in Virginia northeast of the New River. The Chazyan comprises Lurich formation or group (new) with Blackford, Elway, and Five Oaks formations, and overlying Lincolnshire formation. In Appalachian Valley, the Chazyan includes St. Paul group and Lincolnshire formation. The Chazyan epoch is represented in two stages, the Lurichian and Lincolnshirian.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, p. 65–96. Discussion of Ordovician classification. Chazyan series corresponds to the Chazy limestone as originally used for rocks above the Calciferous and below the Black River near Lake Champlain. Classification of rocks younger than Canadian and older than Trentonian concerns sequences (a) along Lake Champlain, containing type Chazy, (b) northwestern New York, containing typical Black River and Trenton, and (c) Appalachians, particularly the Virginias, where there are type sections of the Bolarian series and a number of recently named stages (Cooper, 1956). Classification and correlation discussed within past few years (Cooper, 1956; Kay, 1956; Twenhofel and others, 1954) must be reconsidered. Chazy limestones lie on the Canadian along Lake Champlain; now that Canadian age of Beldens limestone has been recognized, there is no problem in placement of boundaries. Chazy lies on a regional unconformity with an overlapping basal quartz sandstone. Chazy has long been divided into three lithologic and faunal stages (Brainerd and Seely, 1888, Am. Geologist, v. 2) which were given "substage" names Day Point, Crown Point, and Valcour (Cushing, 1905). As stages, these have been called Dayan, Crownian and Valcourian (Oxley, 1952, unpub. thesis). Appalachian region has been thought to have fuller sequences of post-Canadian rocks than New York, but recent studies cast doubt on this assumption. If an Appalachian standard were established, it would be possible to correlate to New York sequences but there are problems of correlation within Appalachian sections. To the southwest, there is disagreement whether base of Trentonian is within Witten formation or at top. Cooper (1956) placed lowest Trentonian as well as Black River equivalents in Wilderness stage. Kay (1947) defined Bolarian series as extending from top of Lincolnshire limestone to base of Nealmont which seems lowest Trentonian. Lincolnshire was classified as Chazyan. Rocks younger than Canadian have been assigned by Cooper (1956) to Marmor, Ashby, Porterfield, and Wilderness stages. Because type Marmor is isolated from that of others, the rocks between the Elway and Lincolnshire formations of type Ashby are herein referred to as Blackford "stage." Thus, Virginia sequence consists of Blackford, Ashby, Porterfield, and Wilderness stages. If Youngman formation and St. Dominique limestone of Highgate Springs sequence are Chazyan, as they seem, they contain fossils that have been considered distinctive of Marmor, Ashby, and Porterfield stages in Appalachians, rather than of Marmor alone. Fossils in Youngman generally resemble those in the Porterfield; those in St. Dominique resemble those in type Chazy and the "Ashby". The Highgate sequence suggests that base of Bolarian series may be within upper Chazyan series rather than above it. In the north, it is possible to subdivide Chazyan and Blackriveran series each into three stages. In the Appalachians, it is best to establish provincial stages from single sequence as in the Virginias; Blackford, Ashby, and Porterfield are in such a sequence. Place of Marmor stage is in dispute. Porterfield and pre-Trentonian part of Wilderness constitute type Bolarian series. Blackford and Ashby stages are believed to be Chazyan but not to constitute the whole of that series; they are in a provincial series that is approximately St. Paul group (Neuman, 1951).

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. In west-central Vermont, Chipman formation, with Burchards, Weybridge, Beldens, and Bridport members, is Beekmantown rather than

Chazy as stated in previous reports. In this area, the Middlebury limestone is Chazy.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Chazyan series or "Chazy stage" was divided into three "substages" by Cushing that have become Dayan, Crownian, and Valcourian stages (Oxley and Kay, 1959), recognizable in type area by their distinctive fossil assemblages. Cooper (1956) places whole type Chazy in his Marmor "stage" considering the succeeding Ashby and Porterfield "stages" of southern Appalachians to be post-Chazy and at least partly pre-Black River. But fossils thought diagnostic of Porterfield "stage" are in argillaceous strata of type Chazyan (Kay, 1958). Cooper introduced an earlier post-Canadian "stage," the Whiterock, below the Marmor, basing it on faunas found in Nevada; whether these are older than type Chazyan, or represent different faunal facies or province is difficult to determine because of their isolation. Flower (1957, New Mexico Bur. Mines Mineral Resources Mem. 2) concurs in believing them younger than Canadian and older than Dayan; the Whiterockian is so placed in table in present report. Chazyan series comprises (ascending) Whiterockian, Dayan, Crownian, and Valcourian stages; occurs above Canadian series and below Blackriveran.

Named for exposures at Chazy, Clinton County, N.Y.

Chazyan Series[1], Stage, Epoch

Middle Ordovician: North America.

Original reference: A. W. Grabau, 1909, Jour. Geology, v. 17, no. 3; E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22.

See **Chazy Group** or **Limestone.**

Cheaha Sandstone Member (of Talladega Slate)[1]

Cheaha Quartzite Member (of Talladega Series)

Paleozoic(?): Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Special Rept. 14, p. 54, 58, map.

R. H. Griffin, 1951, Alabama Geol. Survey Bull. 63, p. 28–30. Described in the Hillabee area where Talladega series is divided into Cheaha quartzite, Erin slate, and a group of quartzites, phyllites, and slates lying below, between, and above the two members. Maximum thickness of quartzites about 2,600 feet; variations in thickness caused in part by folding and thrust faulting. Upper limit of Cheaha placed at point in section where phyllite becomes dominant rock type owing to the marked diminution in number and thickness of the quartzite beds; boundary is expressed topographically by the generally well-defined eastern base of Talladega-Rebecca Mountain.

Named from fact that Cheaha Mountain, Clay County, is formed by the sandstone.

Checkerboard Limestone (in Pleasanton Group)

Checkerboard Limestone (in Skiatook Group)

Checkerboard Limestone Member (of Coffeyville Formation)[1]

Pennsylvanian ((Missouri Series): Northeastern and central Oklahoma, and southern Kansas.

Original reference: L. L. Hutchinson, 1911, Oklahoma Geol. Survey Bull. 2, p. 151–164.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table), 42. Rank raised to formation in Skiatook group. Overlies Seminole sandstone; underlies Coffeyville shale (restricted).

M. C. Oakes and J. M. Jewett, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 634 (fig. 1), 638–639. Geographically extended into southern Kansas where it overlies Hepler sandstone.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 91. In Kansas, included in Pleasanton group; underlies shales below Knobtown sandstone. Thickness ranges from featheredge to about 6 feet.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 16–17. Name Checkerboard seems to have crept into general usage without formal definition. Hutchinson (1911) made reference to it by name. Smith (1914, U.S. Geol. Survey Bull. 541) used name without describing it, Fath and Emery (1917, Oklahoma Geol. Survey Bull. 35) described the Checkerboard and designated type exposure. Checkerboard limestone in Creek County [this report] is single bed about 2½ feet thick. Conformably overlies Seminole formation; conformably underlies Coffeyville formation. Skiatook group.

Type locality: Exposures along Checkerboard Creek in T. 15 N., R. 11 E., Washington County, Okla.

Chediski White Sandstone Member (of Troy Quartzite)[1]

Middle Cambrian: Central eastern Arizona.

Original reference: F. F. Burchard, 1931, U.S. Geol. Survey Bull. 821–C.

Age currently considered by U.S. Geological Survey to be Middle Cambrian.

Forms cliff on northeast face of Chediski Mountain, Fort Apache Indian Reservation.

Chehalis Formation[1]

Miocene, lower: Southwestern Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 100. As a result of later studies, Chehalis formation has been abandoned as a stratigraphic name.

Named for Chehalis River in Chehalis, Grays Harbor County.

Chehalis Sandstone[1]

Eocene: Southwestern Washington.

Original reference: A. C. Lawson, 1894, Am. Geologist, v. 13, p. 436–437.

In vicinity of Chehalis, Lewis County.

Chelan (batholithic) Complex

Chelan Granodiorite[1]

Upper Jurassic(?): Central Washington.

Original reference: A. C. Waters, 1932, Jour. Geology, v. 40, no. 7, p. 605.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165. Northeastern contact of Chelan batholithic complex makes straight line N. 40°–45° W. across Methow quadrangle from near its southeast corner. Granitic

rocks of complex can be traced southwest into area mapped by Waters (1932) as Chelan granodiorite. Detailed study of granitic rocks was not made in quadrangle, but some samples revealed that rock is true biotite granodiorite of medium grain and quite different from typical basic granodiorite described by Waters. Waters assigned Chelan granodiorite of type area to Jurassic(?). Some granite rocks of Chelan complex in Methow quadrangle apparently cut formations as young as Upper Cretaceous.

Named from Chelan Mountains, Chelan County, where it is typically exposed.

Chelsea Sandstone Member (of Senora Formation or Cabaniss Formation)

Chelsea Sandstone Lentil (of Cherokee Formation)[1]

Chelsea Sandstone Member (of Scammon Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southeastern Kansas, and southwestern Missouri.

Original reference: G. C. Clark and C. L. Cooper, 1927, Oklahoma Geol. Survey Bull. 40–H, fig. 3.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Included in Scammon formation (new) above Tiawah limestone.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 53, 57–58, 59. In Scammon formation. Present in exposures in strip mines in Crawford County, Kans., and Barton County, Mo., where in many areas it rests upon an erosion surface extending down through lower beds and locally through the Tiawah limestone and underlying Tebo coal. Typically a gray to brown very fine grained micaceous finely to coarsely crossbedded sandstone. Thickness 5 to 30 feet.

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J, pl. 16. Shown on correlation chart as sandstone member near base of Senora formation. The Cherokee formation of former usage in northeastern Oklahoma included rocks from the McAlester through the Senora formation.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Member of Cabaniss formation in Kansas.

Forms prominent escarpment from upper branches of Whiteoak Creek, thence south and west to Chelsea, Rogers County, Okla.

Cheltenham Clay Member (of Spoon Formation)

Cheltenham Fire Clay[1]

Cheltenham Formation (in Cherokee Group)

Pennsylvanian: Missouri and Illinois.

Original reference: H. A. Wheeler, 1896, Missouri Geol. Survey, v. 11, 1st ser., p. 247.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, v. 28, 2d ser., p. 39–71, pl. 6. Rank raised to formation Cherokee group. Made up of three distinct clays: lower, very dark or fairly dark, black, brown, or gray semiflint and flint fire clay; middle, light-gray fairly hard semiplastic clay, 6 to 20 feet thick; and upper, light- to dark-gray plastic clay, 0 to 15 feet. Overlies Graydon formation; underlies Loutre formation (new).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1). Name Cheltenham clay member of Spoon formation (new) is applied locally to dominantly clay unit that is composite of several underclay members. Stratigraphic range varies from place to place. In southwestern Illinois, occurs above DeKoven coal member (new); in western Illinois, occurs above Browning sandstone member.

Named for fire-clay seam in Cheltenham district in southern part of St. Louis, Mo.

Chemard Lake Lignite Lentil (of Naborton Formation)

Paleocene (Midway): Northwestern Louisiana.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13, 14. Lentil at top of Naborton formation.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 98–100, pl. 4. Consists of lignite and lignitic clays that interfinger and mutually replace each other or are both replaced by other sediments in upper part of Naborton. Maximum thickness 10 feet. Limited at top by basal sands of Dolet Hills member of Logansport formation.

Type locality: One mile northwest of Chemard Lake at Coal Bed Springs in bluffs facing Dolet Brake and Dolet Bayou, in NW¼ sec. 3, T. 11 N., R. 11 W., 2½ miles southwest of Evelyn and 2 miles northwest of Rambin's store, De Soto Parish. Has been traced around outcrop area of Naborton formation from Chemard Lake to Rockdale.

Chemehuevi Formation

Chemehuevi Gravel[1]

Pleistocene: Western Arizona and southeastern Nevada.

Original reference: W. T. Lee, 1908, U.S. Geol. Survey Bull. 352, p. 18.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1443–1450. Chemehuevi formation consists chiefly of sand, silt, and clay. Strongly unconformable on the old river gravels.

C. R. Longwell, 1946, Am. Jour. Sci., v. 244, no. 12, p. 820 (fig. 2), 827. Although sediments are unconsolidated and easily eroded, hundreds of remnants lie at various levels along the valley below the Grand Canyon.

Named for Chemehuevi Valley, south of The Needles, along the Colorado River, Mohave County, Ariz.

Chemehuevis Formation

See Chemehuevi Formation.

Chemung Formation[1]

Chemung Formation (in Conneaut Group or Seneca Group)

Chemung Stage

Upper Devonian: New York, western Maryland, Pennsylvania, and Virginia.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 322–326.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 246, 247. Group, in south-central New York and adjacent Pennsylvania, consists of Cayuta formation and Wellsburg formation with Fall Creek conglomerate locally at top.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 322–333. Chemung, except where removed by erosion on the anticlines, persists throughout full width of Appalachian Valley northwest of Little North Mountain in Virginia and West Virginia, and in the continuation of that belt southwest to vicinity of New River. Approximate thickness 2,000 feet in its full development in Appalachian Valley. In West Virginia, thins out entirely near Narrows of New River. In Virginia, overlies Brallier shale; underlies Hampshire (Catskill) formation.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1734, chart 4. Devonian subdivided into 10 stages that represent grouping of formations on faunal and paleogeographic basis. Group term Chemung is elevated to stage rank because of widespread and distinctive character of its fossils. Stage has same limits that Chadwick (1935, Am. Mid. Nat., v. 16, no. 6) gave to group. Chemung stage follows Finger Lakes stage (new) and is followed by Cassadaga (new) stage.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Formation described in Hollidaysburg and Huntingdon quadrangles, Pennsylvania, where it is 2,400 to 3,500 feet thick. Includes Piney Ridge sandstone, Allegrippis sandstone, and Saxton conglomerate members. Overlies Brallier shale; underlies Hampshire formation.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept.] Washington County, p. 91–92; T. W. Amsden, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept.] Washington County, p. 99 (table 4), 122. Uppermost member of Jennings formation. Overlies Parkhead member; underlies Catskill formation.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 31. Oldest rocks in Chautauqua County, N.Y., are assigned to Seneca group. The group is divided into four formations, youngest of which is Chemung. The Chemung in turn is divided into three formations; the two youngest, Angola shale and Hanover shale are exposed in Chautauqua County. Pipe Creek shale included in Hanover shale. Thickness about 340 feet. Underlies Dunkirk shale member of Canadaway group.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1). Chemung formation includes Wiscoy member in some areas and Hanover member in others.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Conneaut group includes "pink rock" of drillers and "Chemung" and "Girard" formations of northwestern Pennsylvania.

Named for occurrence in valley of Chemung River and in town of Chemung, Chemung County, N.Y.

Chenango Sandstone Member (of Skaneateles Formation)

Middle Devonian: Central New York.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Proposed to replace Colgate sandstone of Cooper, 1930 (not Calvert, 1912).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Chenango sandstone above Butternut shale and below Stone Mill limestone. Middle Devonian.

[G. A. Cooper], 1955, *in* New York State Geol. Assoc. [Guidebook] 27th Ann. Mtg., p. 10, 11. Uppermost member of formation. Grades downward into Butternut member. Thickness 60 feet.

Type section: Quarry at top of hill just south of buildings on Colgate University campus and overlooking Chenango Valley to northwest, Hamilton County.

Cheneyan Stage

Paleocene: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 967–982, 1005. A stage, based on a foraminiferal assemblage. Comprises beds below base of Martinez and top of typical Moreno shale. Occurs above Upper Cretaceous Ciervian stage (new).

Occurs in Great Valley in both surface and subsurface. Named from Jergins Oil Co.'s Cheney Ranch Well 1, sec. 29, T. 14 S., R. 13 E. [Fresno County].

Cheney Gulch Granite

Precambrian: West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 19–20, pl. 3. Fine- to medium-grained biotite granite with a hypidiomorphic granular texture. Occurs as small masses intrusive into Lawler Peak granite (new). Intrudes Hillside mica schist (new).

Largest outcrops lie in a belt 1 mile long and nearly one-half mile wide in upper part of Mineral Creek basin. Named from exposures along west bank of Cheney Gulch, a tributary to Mineral Creek, Bagdad area, Yavapai County.

Chengwatana Series[1]

Precambrian (Keweenawan): Eastern Minnesota.

Original reference: C. W. Hall, 1900, Am. Assoc. Adv. Sci. Proc., v. 49, p. 191.

Crops out on Snake River at Chengwatana, Pine County.

Chepultepec Dolomite[1] (in Knox Group)

Chepultepec Formation

Lower Ordovician: Northern Alabama, Georgia, eastern Tennessee, western Virginia, and southern West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 549, 638–640, pl. 27.

W. P. Woodward, 1939, West Virginia Geol. Survey [Rept.], v. 12; p. 9, 10–11. Discussed with Cambro-Ordovician limestones. In northeastern belt, overlies Conococheague formation; underlies middle Beekmantown, or Canadian (Nittany dolomite). Included in or represents, what has been mapped as Stonehenge member of Beekmantown group.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 56 (table 5), 57–58, pt. 1, pls. Included in Knox group. Underlies Longview dolomite; overlies Copper Ridge dolomite. Consists largely of well-bedded fairly light mostly fine- to medium-grained dolomite, much of it slightly silty; thin layers of dark dolomite; dark bluish aphanitic limestone prominent in upper part in southeastern belts. Thickness commonly 700 to 750 feet.

A. T. Allen, 1953, Georgia Geol. Survey Bull. 60, p. 185–186. Geographically extended into Georgia where it is referred to as formation. Near Graysville, Catoosa County, approximately 1,400 feet thick, only upper 153 feet measured. Overlies Copper Ridge formation; underlies Longview formation.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 47–54, pls. Dolomite described in Rose Hill district where it forms roughly parallel belts on opposite sides of axis of Powell Valley anticline. Two-fold division apparent in all sections: lower or sandy member and upper or argillaceous dolomite member. Thickness 697 to 776 feet. Overlies Copper Ridge dolomite; underlies Longview dolomite.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 11 (table 1), 26–29. Thickness 266 to about 500 feet in Rockingham County. Overlies Conococheague limestone; underlies Beekmantown formation.

Named for exposures near Chepultepec, Blount County, Ala., 30 miles northeast of Birmingham.

Chequamegon Sandstone[1] (in Bayfield Group)

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 33.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1479, 1481. Uppermost formation in Bayfield group. Thickness 1,000 feet. Overlies Devils Island sandstone.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 147. Examination of evidence on which Thwaites established his Chequamegon formation reveals that his Chequamegon brownstone formation is none other than Port Wing brownstone member (new) of Orienta formation repeated by faulting. Contact of Chequamegon formation with the supposedly underlying Devils Island formation is reported by Thwaites only from type locality, Devils Island. The beds here that he [Thwaites] considers to be Chequamegon, he assigns to basal Chequamegon. Suggested in present report that these basal beds are Devils Island formation rather than the Chequamegon brownstone and that a fault contact lies offshore to the south and there separates the Devils Island from the brownstone that forms southern islands of Apostle group. Chequamegon formation is dropped from Bayfield group.

Named from exposures on Chequamegon Bay.

†Cheraw Cobbles[1]

Pliocene(?) and Pleistocene: Northeastern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies, published in 1908 in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20.

Named for development around Cheraw, Chesterfield County.

†Cherokee Limestone[1]

Cambrian (probably lower): Northwestern South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 432.

†Cherokee Limestone[1]

Mississippian: Southeastern Kansas and southwestern Missouri.

Original reference: W. P. Jenney, 1893, Am. Inst. Mining Engrs. Trans., v. 22 (author's ed. August 1893), p. 178, 186, 191–202.

Named for Cherokee County, Kans.

Cherokee Shale[1] or Group

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and southeastern Nebraska.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 105–106.

W. G. Pierce and W. H. Courtier, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 17; 1938, Kansas Geol. Survey Bull. 24, p. 33–35, fig. 2. Cherokee shale, southeastern Kansas, includes Little Cabin sandstone member near base. Bluejacket sandstone member near middle, and Breezy Hill limestone member (new) at top. Thickness about 425 feet. Overlies Mississippian limestone; underlies Fort Scott limestone.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18–23; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193–195. Group in southeastern Kansas subdivided into 15 formations or cyclothems (cyclic formational units) as follows (ascending): Riverton, Neutral, Columbus, Bluejacket, Knifeton, Weir-Pittsburg, Pilot, Scammon, Mineral, Fleming, Coalvale, Croweburg, Ardmore, Bevier, and Mulky.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 29–92. pls. 5, 6, measured sections. Group, as defined in this report, is composed of several new formations. Names of well-known coal beds have been used in order to reduce to minimum the introduction of new names. Sequence (ascending) unnamed shale and sandstone of local occurence, Graydon formation, Cheltenham, Loutre (new), Tebo (new), Ardmore, Bevier, and Lagonda. Group is restricted by removal of Squirrel sandstone which is placed in overlying Henrietta group.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 31). Correlation chart shows that group in Iowa includes Munterville and Seahorne limestones.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 37–47. Group is defined to include all strata from base of Pennsylvanian north of Kansas-Oklahoma line to base of Fort Scott limestone. In Kansas, comprises 16 cyclothems. Classification is modified from that of Abernathy (1937) in that Croweburg and Ardmore are combined into Ardmore cyclothem; Stice cyclothem (new) occurs above the Bevier; term Mulky is discarded and terms Breezy Hill and Blackjack Creek are used.

T. R. Beveridge, 1951, Missouri Geol. Survey and Water Resources, v. 32, 2d ser., p. 51–55, pl. 11. Cherokee group, in Weaubleau Creek area, comprises Dederick subgroup (undifferentiated) and Graydon formation. Overlies Burlington formation; underlies Tertiary(?) unconsolidated upland gravels.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2087. Formation in northern Oklahoma includes (ascending) older Pennsylvanian units, Little Cabin sandstone, Bluejacket sandstone, Broken Arrow coal, Verdigris limestone, sandstone (Squirrel sand), Iron Post coal, Kinnison shale (new), and Breezy Hill limestone members.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 68–90. McQueen defined top of the Cherokee as the base of Squirrel sandstone, but this boundary is not now recognized by Missouri Geological Survey. Cherokee is defined as extending from base of Pennsylvanian to base of Fort Scott.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1526. Rocks of Krebs and Cabaniss groups (both new) are nearly

but not quite the same, stratigraphically, as Cherokee rocks of southeastern Kansas. Hartshorne sandstone and possibly some lower McAlester rocks are older than any Cherokee rocks of Kansas; Thurman sandstone, Stuart shale, and lower part of Senora formation are probably not represented in Cherokee rocks of Kansas because of progressive northward overlap in post-Boggy rocks. Otherwise the Krebs and Cabaniss rocks are equivalent to Cherokee rocks of Kansas.

W. V. Searight, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2747–2749. In reclassification of Desmoinesian (Pennsylvanian) of northern midcontinent, term Cherokee is replaced by Krebs and Cabaniss groups.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, 132 p. Term Cherokee readopted for Kansas and Missouri. Krebs and Cabaniss relegated to subgroup status. Cherokee subdivided into (ascending) Riverton, Warner, Rowe, Dry Wood, Bluejacket, Seville, Weir, Tebo, Scammon, Mineral, Robinson Branch, Fleming, Croweburg, Verdigris, Bevier, Lagonda, Mulky, and Excello formations. Underlies Marmaton group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Chart shows that group in Kansas includes Krebs and Cabaniss formations.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 34, fig. 5. Section between base of Marmaton group to top of Mississippian system is designated Cherokee group. Although this may include a part of either the Atoka or Morrow series, Iowa Geological Survey has not differentiated them. Other States have further subdivided the Cherokee in Krebs-Cabaniss subgroups. Mulky coal, Bedford coal, Bevier coal, Ardmore limestone, and Whitebreast coal have been recognized.

Named for exposures in Cherokee County, Kans.

†Cherokee Slates[1]

Lower Cambrian: Western North Carolina.

Original reference: W. C. Kerr, 1869, North Carolina Geol. Survey Rept. 2, p. 13–35.

Named for development in Cherokee County, along Valley River.

Cherric period[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46, p. 207.

Cherry shale[1]

Lower Ordovician: Eastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 78.

Fully exposed on Cherry Creek, north of Ely, White Pine County.

Cherry Canyon Formation (in Delaware Mountain Group)

Lower Permian (Guadalupe Series): Western Texas and southern New Mexico.

P. B. King *in* R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 4 (fig. 2), 8. Delaware Mountain group divided into (ascending) Brushy Canyon, Cherry Canyon, and Bell Canyon formations (all new).

P. B. King *in* F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 92. Subdivided into (ascending) Getaway, South Wells, and Manzanita (new) members.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 579–581 (fig. 7), pl. 2. Consists largely of sandstone with several prominent limestone members; sandstones are fine grained, thin bedded, and finely laminated and have straight smooth bedding planes; in lower half, ripple marking and channeling is common feature; limestones are commonly interbedded with the sandstones, either in nodules and thin lenticular layers or in members that locally have considerable prominence. Thickness about 1,000 feet. Overlies Brushy Canyon formation; underlies Bell Canyon formation. Along west side of Guadalupe Mountains, members of formation thicken northward, the intervening sandstones disappear, and the units coalesce into a solid mass, here termed the Goat Seep limestone.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 38, pl. 3 [1949]. On west side of Guadalupe Mountains, upper three-fourths of Cherry Canyon interfingers with the Goat Seep; lower fourth persists as a layer of sandstone 200 or 300 feet thick; its outcrop extends northward past Cutoff Mountain into New Mexico and forms a weak sandy break in the limestone succession.

Named for Cherry Canyon, a shallow gorge that drains eastward from Pine Spring, south of new route of U.S. Highway 62, to a point 3 miles east of D Ranch headquarters, where gorge joins Lamar Canyon, Culberson County, Tex. Crops out in wide belt along crest of Delaware Mountains and forms upper half of slope below the Capitan limestone cliffs near Guadalupe Peak.

Cherry Canyon Schists

Precambrian: Western Utah and eastern Nevada.

R. B. Nelson, 1959, Dissert. Abs., v. 20, no. 3, p. 997. Name appears only in stratigraphic section. Thickness over 3,000 feet. Underlies unnamed metaquartzite; overlies Trout Creek schists (new).

Stratigraphic section covers northern Snake Range and the Kern Mountains in eastern Nevada and southern Deep Creek Range in western Utah.

Cherry Creek Group[1]

Cherry Creek Metamorphics or Gneiss

Cherry Creek Series

Precambrian: Central southern and southwestern Montana.

Original reference: A. C. Peale, 1896, U.S. Geol. Survey Geol. Atlas, Folio 24.

E. S. Perry, 1948, Montana Bur. Mines and Geology Mem. 27, p. 2–3. Series includes Axes Creek phase (new) in area of Axes Creek, Beaverhead County.

E. W. Heinrich, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1329. Cut by Blacktail granite gneiss (new).

E. W. Heinrich, 1949, Montana Bur. Mines and Geology Mem. 30, p. 6–8. Thickness of series about 30,000 feet in southern end of Ruby Range; contains seven main marble horizons. Younger than Pony series.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 20, 27, 29, 34. South of line connecting Melrose, Whitehall, Three Forks, and Livingston, series underlies Flathead sandstone.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 350–351, pl. 1. Group described and mapped

in Lima region, Montana. Intruded by Dillon granite gneiss (term replaces Blacktail granite gneiss, preoccupied). Stratigraphic relations between Pony group and Cherry Creek not clear in this area.

R. R. Reid, 1957, Montana Bur. Mines and Geology Mem. 36, p. 4–7, 14, geol. map. Metamorphics and gneiss mapped and described in Tobacco Root Mountains. Within map area, Cherry Creek and Pony metamorphics are separated by a seemingly continuous greenish quartzite layer with only small isoclinal folds present within it. Foliation in Cherry Creek metamorphics appears to be everywhere parallel to that in Pony metamorphics in vicinity of contact. Discordance suggested by Tansley and Schafer (1933, Montana Bur. Mines and Geology Mem. 9) not observed. Most significant structural fact is that Cherry Creek metamorphics dip beneath Pony metamorphics. Unless some kind of large scale structural overturning has occurred, Cherry Creek metamorphics in Tobacco Root Mountains, are older than Pony metamorphics (in range in which their type locality has been defined). This is contrary to generally accepted opinion.

First described in vicinity of Cherry Creek, southwestern corner Three Forks quadrangle.

Cherry Creek Member (of Venango Formation)

Upper Devonian (Conewangan): Southwestern New York.

I. H. Tesmer, 1954, Dissert, Abs., v. 14, no. 12, p. 2317, 2318. Name proposed for succession of gray siltstones and shales which overlie Panama conglomerate member.

Occurs in Cherry Creek quadrangle.

Cherry Mound shale

Cretaceous: Northeastern Texas.

F. E. Lozo, 1951, Fondren Sci. Ser. 4, p. 74. Exposures of post-Grayson clay or shale of Bergquist (1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98) in Grayson County at Pawpaw Branch and along Rock Creek in northwestern part of county, near Pottsboro cutoff railroad underpass of M. K. & T., at type locality of foraminifera *Flabellammina denisonensis* in city of Denison, and in branch of Choctaw Creek north of Cherry Mound, northeastern Grayson County, are believed to be contemporaneous and as such are informally called Cherry Mound shale. Evidence indicates this shale is Buda equivalent.

Cherry Ridge Conglomerate[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 64.

Caps Collins high knob just west of Cherry Ridge post office, Wayne County.

Cherry Ridge Group[1]

Cherry Ridge Redbeds (in Catskill facies group)

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 64.

Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 577–581. Cherry Ridge red beds applied to dominantly red succession of somewhat varied lithology which separates Elk Mountain and Honesdale sandstones. Unit discussed under heading of Catskill facies group.

Bradford Willard and R. E. Stevenson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2272. Sequence lists Cherry Ridge red shale, 275 feet thick, in interval between Honesdale and Elk Mountain sandstones.

Well exposed near Cherry Ridge post office, Wayne County.

Cherry Ridge Limestone[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 65–66.

Extends over large part of Wayne County. Probably named from Cherry Ridge post office.

Cherry Ridge Red Shale[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania Geol. Survey Rept. G_5, p. 66.

Probably named from Cherry Ridge post office, Wayne County.

Cherry Ridge Sandstone[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 64.

Forms a conspicuous rock ledge at hundreds of places in all parts of Wayne County. Probably named from Cherry Ridge post office, Wayne County.

Cherry Ridge Shales[1] (in Cherry Ridge Group)

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 64.

Probably named for Cherry Ridge post office, Wayne County.

Cherryvale Shale[1] (in Kansas City Group)

Cherryvale Shale (in Skiatook Group)

Cherryvale Shale Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 47–48, 102.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table), 42. Included in Skiatook group. Occurs between Dennis limestone below and Drum (equivalent to Dewey) limestone above. Precisely equivalent to Nellie Bly formation (Gould, 1925, from unpub. ms. of D. W. Ohern) of northeastern Oklahoma, which by misunderstanding of section near Coffeyville was formerly thought to be an expansion of shale equivalent to part of Drum of Kansas. Thickness about 90 feet at Cherryvale; 10 feet or less west of Coffeyville; southward increases to about 125 feet east of Bartlesville and to more than 300 feet in latitude of Tulsa.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, Mo., shows Cherryvale shale, in Kansas City group, comprises (ascending) Fontana shale,

Block limestone, Wea shale, and Westerville limestone members. Overlies Dennis limestone; underlies Chanute shale.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 191. South of Linn County, where Westerville and Block limestones have not been identified, the interval between the Drum and Winterset limestones is known as Fontana-Quivira or Cherryvale shale. Near Cherryvale, unit comprises about 60 feet of bluish-gray silty shale containing layers of blue dense limestone near top.

R. C. Moore, 1948. Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030, 2031 (fig. 4). Cherryvale formation (shale), at type locality, consists entirely of shale, but farther north there are persistent limestones (Block, Westerville) that extend into Iowa and Nebraska. Formation, as recognized by interstate agreement of Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947, comprises (ascending) Fontana shale, Block limestone, Wea shale, Westerville limestone, and Quivira shale members. Overlies Dennis formation; underlies Drum limestone. Kansas City group. Classification of Missourian strata in northern Oklahoma diverges from interstate usage.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420–421. Thickness of formation about 24½ feet in Madison and Adair Counties, Iowa. Comprises (ascending) Wea-Fontana members, Westerville limestone, and Quivira shale members. Overlies Dennis formation; underlies Drum formation. Kansas City group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Comprises (ascending) Fontana shale, Block limestone, and Wea shale members. Members not differentiated in Madison County but tentatively identified in Crescent quarry, Pottawatamie County. Formation in Madison County consists of thinly bedded dark-gray shale with several thin beds of dense dark-blue-gray fossiliferous limestone. *Derbyia* and *Chonetes* abundant, latter occurring in such large numbers as to form thin coquinalike zones. Thickness about 9 feet. Underlies Westerville limestone; overlies Dennis limestone.

Named for exposures in vicinity of Cherryvale, Montgomery County, Kans.

Cherry Valley Limestone Member (or Marcellus Shale)[1]

Middle Devonian: Central and east-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, chart.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 179–180. West of Onesquethaw Creek limestones of the Stony Hollow member (new) of Marcellus become the Cherry Valley limestone as exposed in Stony Creek, Schoharie Valley.

L. V. Rickard, 1952, Am. Jour. Sci., v. 250, no. 7, p. 511–522. Overlies Union Springs member; underlies Chittenango shale. Thickness at type section 4⅔ feet; 14 to 25 feet in Berne quadrangle. This study shows Cherry Valley limestone extends farther east than was previously known. It was found at 19 new localities in Schoharie and Albany Counties.

Type section: Cox's Ravine, three-fourths mile northwest of Cherry Valley, Otsego County.

Cherryville Quartz Monzonite

Mississippian(?) to Permian(?): Western North Carolina and western South Carolina.

W. R. Griffitts and W. C. Overstreet, 1952, Am. Jour. Sci., v. 250, no. 11, p. 783–786, 787. A monazite-free rock in which three varieties have been recognized: the commonest, a gray even-grained massive to faintly gneissic muscovite-biotite rock; a muscovite-quartz monzonite; and a quartz-biotite. Unit was included in Whiteside granite as mapped by Keith and Sterrett (1931, U.S. Geol. Survey Bull. 660–D); hence, Whiteside granite is herein restricted to area of its type locality. Considered to be very late Paleozoic and younger than Toluca quartz monzonite (new).

W. C. Overstreet and W. R. Griffitts, 1955, Geol. Soc. America Guidebook 1955 Ann. Mtg., p. 566. A probable Devonian age (about 285 million years) was obtained on a sample of monazite from the Cherryville quartz monzonite.

J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped as Paleozoic.

U.S. Geological Survey currently designates the age of the Cherryville as Mississippian(?) to Permian(?) on the basis of a study now in progress.

Named for exposures near Cherryville, Gaston County, N.C.

Chesapeake Group[1]

Miocene, middle and upper: Delaware, eastern Maryland, North Carolina, and Virginia.

Original reference: N. H. Darton, 1891, Geol. Soc. America Bull., v. 2, p. 431–450, map.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 33–37. Described in Prince Georges County and District of Columbia. Comprises (ascending) Calvert, Choptank, and St. Marys formations. Overlaps unconformably across Eocene Nanjemoy formation and Aquia greensand and Upper Cretaceous Monmouth formation on to the Patapsco formation of Potomac group; overlain unconformably by Brandywine formation or by Pleistocene sand and gravel.

L. W. Stephenson and F. S. MacNeil, 1954, Geol. Soc. America Bull., v. 65, no. 8, p. 733–738. Yorktown formation geographically extended into eastern Maryland. [Hence, group in Maryland includes four formations as it does in Virginia.]

Named for fact that strata border the Chesapeake Bay in Maryland and Virginia.

Cheshewalla Sandstone Member (of Vamoosa Formation)

Cheshewalla Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: D. E. Winchester, K. C. Heald and others, 1918, U.S. Geol. Survey Bull. 686–G, p. 60–61.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 41–43, pl. 1. Reallocated to member status in Vamoosa formation. Commonly a buff thin-bedded to massive, crossbedded fine to very fine grained sandstone or siltstone. Thickness 7 to 20 feet; average 15 feet. In northeastern part of county, closely overlain by Bowring limestone member (new); since the Bowring is commonly absent, best criteria for identifying Cheshewalla is position: 60 to 100 feet below top of Labadie limestone member; beyond northern limit of the Labadie, the Bowring is at many

places present 5 to 15 feet above top of Cheshewalla; overlies Tallant formation.

Named for exposures along Cheshewalla and Nelagoney Creeks, SE¼ sec. 10, T. 25N., R. 10 E., in east central Osage County.

Cheshire Quartzite[1]

Lower Cambrian: Western Massachusetts, western Connecticut, southeastern New York, and southwestern Vermont.

Original references: B. K. Emerson, 1892, U.S. Geol. Survey Hawley sheet, that is, proof sheets of geologic maps and text intended for a geological folio, but never completed and published in that form, although cited in U.S. Geol. Survey Bull. 191, 1902; 1898, U.S. Geol. Survey Mon. 29, p. 18; 1899, U.S. Geol. Survey Bull. 159.

E. C. Jacobs, 1935, (abs.) Geol. Soc. America Proc. 1934, p. 85. In Green Mountains, westernmost nappe is made up of Cheshire quartzite, infolded with a fine-grained graywacke, which has been traced from Essex Junction into southern Quebec, where it is known as Gilman "quartzite." In Vermont, this rock has been named Brigham Hill graywacke.

E. C. Jacobs, [1937], Vermont State Geologist 20th Rept., p. 100–101. Includes Brigham Hill graywacke phase.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 649–666. Concluded that roots of Taconic thrust fault most probably lie between dolomite of Pico Peak series (new) and Cheshire quartzite.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 526–528. In stratigraphic succesion in west-central Vermont, Cheshire quartzite, about 1,000 feet thick, occurs above "Mendon series" and below Dunham dolomite.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 12 (fig. 2), 13 (table 1), 17–18, geol. map. Thickness in Castleton area about 400 feet. Underlies Dunham dolomite; overlies Mendon series with unconformity. As defined here, the Cheshire contains only massive pure quartzite, and subjacent dark-gray quartzites and phyllites hitherto included in Cheshire by other workers are assigned to underlying Mendon series.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 21 (table 1), 36–38. Thickness about 1,000 feet in Green Mountain anticlinorium. Underlies Dunham dolomite; contact transitional; grades downward into Moosalamoo member of Mendon formation; where Moosalamoo member is absent, Cheshire rests on Forestdale member.

Typical exposures at and near Cheshire, Berkshire County, Mass.

†Cheshire Schist[1]

[Middle Ordovician]: Massachusetts.

Original reference: R. Pumpelly, 1894, U.S. Geol. Survey Mon. 23.

Cheshire, Berkshire County.

Chester Amphibolite[1]

Original references: B. K. Emerson, 1892, U.S. Geol. Survey Hawley sheet, that is, proof sheets of geologic maps and text intended for a geologic folio, but never completed and published in that form, although cited in U.S. Geol. Survey Bull. 191, 1902; 1894, U.S. Geol. Survey Mon. 23, p. 29–30; 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 78–156, pl. 34.

Named for occurrence at Chester, Mass.

Chester Hornblendite

Age not stated: South-central Connecticut.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 50. Black medium- to coarse-grained igneous rock. Crops out within an area of Sterling gneiss for about 100 feet in a dikelike exposure.

Only outcrop is east of Saybrook State Highway and south of road leading from village of Chester to the Chester Railroad Station, town of Chester, Middlesex County.

†Chester Sandstone[1]

Mississippian: Illinois and Missouri.

Original reference: G. C. Swallow, 1858, Am. Assoc. Adv. Sci. Proc., v. 11, pt. 2, p. 5.

Named for exposures at Chester, Randolph County, Ill.

Chester Series

Chester Group[1]

Upper Mississippian: Illinois, Indiana, Iowa, Kentucky, Missouri, and Tennessee.

Original reference: A. H. Worthen, 1860, Am. Assoc. Adv. Sci. Proc., v. 13, p. 312–313.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 134–137. Chester series comprises (ascending) New Design, Homberg, and Elvira groups (all new). Chester series everywhere overlies Meramec strata (herein classified as group in Valmeyer series) unconformably, and in Monroe County, Ill., it overlaps from the Ste. Genevieve onto the St. Louis. Pennsylvanian strata are everywhere separated from older beds in upper Mississippi valley by an unconformity. In southwestern Illinois, the Chester series is completely overlapped, and Pennsylvanian beds rest upon all formations from the Kinkaid to Ste. Genevieve or possibly St. Louis limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 91–196, chart 5. In standard Mississippian section, Chesterian series comprises (ascending) New Design, Homberg, and Elvira groups and some post-Elvira strata. The group names introduced by Weller (1939) have had little usage to date. Following formations included in standard section (ascending): Aux Vases sandstone, Renault limestone, Bethel sandstone, Paint Creek formation. Cypress sandstone, Golconda formation, Hardinsburg sandstone, Glen Dean limestone, Tar Springs sandstone, Vienna limestone, Waltersburg sandstone, Menard limestone, Palestine sandstone, Clore formation, Degonia sandstone, and Kinkaid limstone. Chesterian series follows Meramecian series.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 35–52. In southern Indiana, rocks of Chester series have been subdivided into many formations, most of which are too thin to map on scales ordinarily used. Since names are well established in Indiana geologic literature, it is considered best to form mapping units by combining formations into groups rather than to alter the established names. In area of this report [Huron area, south-central Indiana], exposed rocks of late Mississippian age divided into (descending) Stephensport, West Baden, and Blue River (new) groups. Bound-

ary between Chester series and underlying Meramec series falls within Blue River group.

Named for Chester, Randolph County, Ill.

Chester County Gneiss[1]

Precambrian(?): Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc. 1900, pt. 1.

Well exposed in William's quarry, on Phoenixville Branch of Pennsylvania Railroad near Aldham Station.

Chesterfield Group[1]

Upper Triassic: Eastern Virginia.

Original reference: N. S. Shaler and J. B. Woodworth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 435–436.

In Richmond Basin.

Chesterfield Limestone[1]

Precambrian: Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199, p. 114–115, fig. 25.

Adirondack Mountains.

Chesterian Series

See **Chester Series.**

Chestnut Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 10.

Named for Chestnut Ridge, Jefferson County.

†Chestnut Hill Schists and Gneisses[1]

Precambrian (Glenarm Series): Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2nd Geol. Survey Rept. C_6, p. 24–27, map.

Judith Weiss, 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1691. Discussion of structure, petrology, and metamorphism of the Wissahickon schist. Chestnut Hill schists correspond to the rocks of the garnet and staurolite zones of this paper.

Extends from vicinity of Chestnut Hill to Delaware County line at Bryn Mawr.

Chestnut Ridge Sandstone

Lower Mississippian (Kinderhook): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 16–17. Name will probably be used, following more definitive study of area, for unit here termed Sandstone J. Consists of massive nonfossiliferous crossbedded sandstones with few interbedded gray micaceous thin-bedded shales; formerly included in upper part of Pocono formation. Thickness 142 to 700 feet. Underlies Loyalhanna limestone; disconformably overlies Conglomerate I (Lick Run conglomerate).

Well exposed in flanks of Chestnut Ridge in gorges of Youghiogheny River, Fayette County, and Conemaugh River, forming border of Indiana and Westmoreland Counties, and along Route 40 over crest of ridge east of Uniontown, Fayette County.

Chesuncook Limestone

Silurian: North-central Maine.

Bradford Willard, 1945, Jour. Paleontology, v. 19, no. 1, p. 67–68. Described as limestone, fossiliferous in part. Total thickness about 350 feet. Part of Ripogenus [Ripogenous] series. Associated igneous intrusives. Age designated Silurian. Name attributed to L. W. Fisher (written commun., 1941).

A. J. Boucot, 1954, Am. Jour. Sci., v. 252, no. 3, p. 144–148. Discussion of stratigraphic relationships with Toppan's Ripogenous [Ripogenus] series, and Fisher's Chesuncook limestone and Ripogenus volcanics.

Occurs along shore of Chesuncook Lake, Piscataquis County.

Chetoh Formation

Miocene, lower, to Pliocene, lower: Northeastern Arizona and northwestern New Mexico.

P. W. Howell, 1959, Dissert. Abs., v. 20, no. 2, p. 641. Composed largely of sands and silts with lenses of white, rhyolitic ash. Much of the ash converted to montmorillonite. Younger than Zuni pebble zone (new); older than Bidahochi formation.

In Chetoh country, a section of Colorado Plateau north of Little Colorado River, extending from Zuni Uplift west to Painted Desert.

Chetopa shales[1]

Middle Pennsylvanian: Kansas.

Original references: C. R. Keyes, 1931, Pan-Am. Geologist, v. 56, p. 349; 1932, v. 57, p. 217, 219, 223.

Named for railroad station near Kansas-Oklahoma line, across Grand River from Cherokee County.

Chewacla Marble[1]

Precambrian: Eastern Alabama.

Original reference: W. F. Prouty, 1916, Alabama Geol. Survey Bull. 18, p. 94–95.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 14. Incidental mention in discussion of Hollis quartzite with which it is associated in Alabama.

First described in vicinity of Olepika, Lee County.

Chewaucan Formation[1]

Pleistocene: Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed along Chewaucan River in vicinity of Chewaucan Marsh, Lake County.

Chewelah Argillite[1] (in Stevens Series)

Upper Mississippian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 63, map.

K. P. McLaughlin and M. E. Simons, 1951, Jour. Paleontology, v. 25, no. 4, p. 515. Age designated as Upper Mississippian on basis of faunal collections.

Exposed between North and South forks of Chewelah Creek and to north and south of Chewelah, Stevens County.

Cheyenne Sandstone[1]

Cheyenne Sandstone Member (of Purgatoire Formation)

Lower Cretaceous: Southwestern Kansas, southeastern Colorado, and western Oklahoma.

Original reference: F. W. Cragin, 1889, Washburn Coll. Lab. Nat. History Bull. 2, no. 10, p. 65.

Bruce Latta, 1947, Kansas Geol. Survey Bull. 65, p. 75-86. In Kiowa County, Cheyenne sandstone unconformably overlies Permian Whitehorse sandstone and conformably underlies Kiowa shale. Thickness 32½ to 94 feet.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County as member of Purgatoire formation.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 17 (table 3), 97-99. Extended into Baca County, Colo., where it is lower member of Purgatoire formation. Underlies Kiowa shale member; overlies Morrison formation. Thickness 50 to 134 feet.

Named for Cheyenne Rock at Belvidere, Kiowa County, Kans.

Chicago Formation[1]

Silurian (Niagaran): Northeastern Illinois.

Original reference: D. O. Taylor, 1930, Illinois Acad. Sci. Trans., v. 22, p. 473-477.

Chicago area, Cook County.

†Chicago Group[1]

Silurian: New York.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 28.

Chicago Limestone[1]

Lower Mississippian: Central northern Utah.

Original reference: S. G. Olmstead, 1921, Econ. Geology, v. 16, p. 443, 452, 453.

Ophir district.

Chicago Mound Formation

Permian (Big Blue Series): Northeastern Kansas and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 36 (fig. 14), 37. Name used for formation between West Branch shale above, and Towle shale below. Includes (ascending) Falls City limestone, Hawxby shale, and Aspinwall limestone. Thickness about 22 feet. Names Falls City, Hawxby, and Aspinwall were given for what were supposed to be members, but Moore ranked them on a cyclothemic basis as formations in Kansas. It is believed that they are members of a formation in

Nebraska and Kansas, and formational name Chicago Mound is applied to them.

Crops out in slopes and cuts along Highway 10, southeast of Chicago Mound, a well-known topographic feature southwest of Maple Hill, Wabaunsee County, Kans.

Chickachoc Chert

Chickachoc Chert Lentil (in Atoka Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 903. In extreme northwestern Ouachitas, this formation [Wapanucka], together with the Barnett Hill formation (new), as well as the Primrose, was erroneously designated by Taff (1902, U.S. Geol. Survey Geol. Atlas, Folio 79) as Chickachoc chert lentils. Since proper position of beds, now designated as Primrose, Wapanucka, and Barnett Hill, has been established, it seems advisable to discard Chickachoc as a formational name.

T. A. Hendricks, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 66, sheet 3. Rank raised to formation. Described in block southeast of Katy Club fault in western part of Ouachita Mountains where it overlies Springer formation and underlies Atoka formation. Consists of greenish gray to tan clay shale that weathers to a tan clay and contains beds and lenses of spiculite; where fresh, spiculite is dark bluish gray and very hard; where weathered, resembles a coarse-grained sandstone or porous chert. As many as 10 beds of spiculite, each more than 5 feet thick, are present locally. In general, base of a bed of spiculite, about 10 feet thick, is assumed to be base of formation; a bed of spiculite 20 to 50 feet thick is present in middle part; a massive spiculite bed 30 to 120 feet thick constitutes top member. Estimated thickness 600 feet.

Named for post office called Chickachoc in 1901 and located at or near present station of Chockie on Missouri, Kansas, and Texas Railroad, just east of border of Coalgate quadrangle, Atoka County.

Chickahominy Formation

Eocene, upper: Southeastern Virginia (subsurface).

J. A. Cushman and D. J. Cederstrom, 1945, Virginia Geol. Survey Bull. 67, p. 2–3. Proposed for beds approximately 80 feet thick that consist of blue, gray, and dull-brown clays containing a fauna of Jackson age. Overlain by Miocene Chesapeake group; underlain by lower and middle Eocene Pamunkey group.

Type locality: Wells 2 and 4 at Navy Mine Depot, Yorktown, York County.

Chickaloon Formation[1]

Eocene or Paleocene(?): Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 500, p. 15, 42–52, map.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Age given as Paleocene(?) on map legend.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 14–18, pls. 1, 2. Comprises between 3,000 and 5,000 feet of claystone, siltstone, sandstone, a few thin beds of fine-grained conglomerate, and many beds of coal in Wishbone Hill district. Underlies Wishbone formation (new); in fault contact with Arkose Ridge formation (new). Of continental

origin and contains abundant flora that may be either Paleocene or Eocene in age.

Covers greater part of valley of Chickaloon River south of Castle Mountain, Cook Inlet region.

Chickamauga Limestone[1]

Middle and Upper Ordovician: Eastern Tennessee, northern Alabama, northwestern Georgia, and southwestern Virginia.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143, 148.

Charles Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175. In north-central Alabama, includes Attalla chert conglomerate member at base.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 18–19, geol, map. In its type area, the Chickamauga includes a number of stratigraphic units elsewhere recognized. They are named (in descending order) and grouped into map units on accompanying geologic map as follows: Maysville formation, Trenton limestone, Lowville limestone, Lebanon limestone, Lenoir (Ridley) limestone, Mosheim limestone, Murfreesboro limestone, and Newala limestone.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 64–97, pls. Mapped in eastern Tennessee. Occurs above Knox group and below Reedsville shale. Equivalents to the east are (ascending) Lenoir limestone, Holston formation, Ottosee shale, Moccasin formation, and Martinsburg shale. Explanatory text gives detailed explanation of previous usage of term and present status of stratigraphy of the Chickamauga. Middle Ordovician.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 144–145. Discussion of Middle Ordovician rocks of Tellico-Sevier belt, eastern Tennessee, and analysis of stratigraphic nomenclature. Recent work indicates that Keith's Athens shale, Tellico sandstone, Sevier shale, and Bays sandstone of southeastern belt (under discussion) are equivalents of Keith's Chickamauga and Moccasin limestone of northwestern belts.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 53–56. Except for Butts' use of name Chickamauga in Alabama, term Chickamauga has passed into disuse. Name was used so broadly throughout Southern Appalachians that it lost its value when Middle and Upper Ordovician limestones and shales were studied in detail. As originally defined by Hayes, term embraced all strata between Knox and Rockwood formations. This included what is now known as the Murfreesboro, Lenoir, Mosheim, Lebanon, Lowville, Trenton, and Upper Ordovician.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 56–57. As originally defined, Chickamauga included all limestone above Knox dolomite and beneath Sevier shale (which at that time was extended to include Martinsburg and Reedsville shales) and in this sense was used in all folios of southern Appalachian region beginning with Hayes (1894, Folio 2) and ending with Butts (1910, Folio 175). The Chickamauga as mapped in the folios, included equivalents of Kingsport and Mascot formations of this report [Mascot-Jefferson City zinc district, Tennessee] in those areas in southeastern Tennessee, northwestern Georgia, and northeastern Alabama where they were represented by Newala limestone (Butts and Gildersleeve, 1948). With close of folio mapping in Appalachian region, name Chickamauga fell into disuse, but it was revived by

Rodgers (1953) as a convenient general term for mapping. Unit, as now defined, includes limestone strata of Middle and Late Ordovician age. Unit is thinnest along southeastern edge of Appalachian Valley where it represents a very short span of time; it is thickest in sections near Cumberland Plateau Front where it represents practically all of Middle and Late Ordovician time. Ulrich, about 1900, began dividing Chickamauga limestone into a number of formations. Some of these were described by him in 1911 (Geol. Soc. America Bull., v. 22); others appeared only as names in correlation charts; and others were names used in note books and unpublished manuscripts. Only a few were ever adequately described, and fewer still have been mapped in detail. Ulrich's general concept of stratigraphy of the Chickamauga limestone was given by him in 1911; by Butts (1928, Washington Acad. Sci. Jour., v. 18, no. 37); and by Ulrich (1930, U.S. Natl. Mus. Proc., v. 76, art. 21). In general, Ulrich believed that strata included in Chickamauga group consisted of a few widely distributed formations at base, correlating with formations of Black River or later age elsewhere, and a great thickness of strata in between not equivalent to any formations elsewhere, the so-called Blount group, wedged in middle between Chazy and Black River beds. No complete section of the Blount has even been found, and at present the idea that such a unit exists has been discarded. Present theory is that a thick limestone sequence, Chickamauga limestone, developed in central and western parts of Appalachian Valley of east Tennessee and adjacent states and that this grades laterally southeastward into a complementary shale and sandstone sequence, the Sevier shale and higher formations, developed along the southeastern side of valley. The two sequences intertongue in a central belt, and by close of Middle Ordovician time shale deposition had lapped westward almost completely across the valley. In Mascot-Jefferson City district, the Chickamauga limestone—the Middle Ordovician limestone sequence—is made up of three units originally classed as formations: Mosheim limestone, Lenoir limestone, and Holston marble. In present report, the Mosheim is regarded as a member of the Lenoir.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey Rept. 3, p. 21–25. Chickamauga limestone, as used in this report [Madison County], includes deposits that have stratigraphic paleontologic relation to same rocks in interior basin of Tennessee and Kentucky. Formation includes thick sequence of rocks, primarily limestone, which lie below Red Mountain formation of Silurian age and, in Hamilton County, Tenn., is known to lie above Newala limestone of Early Ordovician age. In area of outcrop in Madison County, Red Mountain limestone is missing, and the Chickamauga lies unconformably below Chattanooga shale. Complete thickness does not crop out in county.

G. B. Martin, 1960, Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 201–205. In northwestern Alabama, upper part of "Chickamauga" limestone, a catchall term, can be divided into Leipers and Fernvale formations on basis of diagnostic bryozoan species. Recommended that use of name "Chickamauga" be avoided in favor of Leipers and Fernvale formations.

Named for exposures along Chickamauga Creek east of Chattanooga, Tenn., and branches of that creek in Ringgold quadrangle, Georgia.

†Chickasaw Formation[1] or Group[1]
†Chickasawan Formation[1] or Stage[1]

Eocene: Mississippi, southern Alabama, Arkansas, and Louisiana.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 344–345.

Named "for the four Chickasaw bluffs, of which Memphis bluff is the last," along Mississippi River in northwestern Mississippi, within the the "Chickasaw Purchase."

Chickasaw Creek Shale or Formation (in Stanley Group)

Mississippian (Meramecian): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856, 874–878. Name Chickasaw Creek siliceous shale proposed for uppermost formation in group. Measurable thickness at type locality about 270 feet; thins along southern rim of Tuskahoma syncline to only a few feet. Overlies Moyers formation (new); contact not exposed at type locality but is well exposed at site designated as second type locality. Underlies Wildhorse Mountain formation (new) of Jackfork group. Included in Pushmataha series (new). Bendian period.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 38–40. Formation consists of from 80 to more than 300 feet of dark-blue-gray shales interbedded with thinner laminated black siliceous shales, containing some cherty beds, and with sandstones. Thickness 270 feet at type locality; thins eastward to where it is only a few feet thick at south end of Tuskahoma syncline, and then thickens eastward in Kiamichi Mountain and in Botukola syncline. Overlies Moyers formation; underlies Wildhorse Mountain formation of Jackfork group. Mississippian (Meramecian).

Type locality: Immediately south of Chickasaw Creek in center of south line of the SW¼, 600 feet north of section line of sec. 7, T. 1 S., R. 13 E., Atoka County. Second type locality: Center of W½NE¼NE¼ sec. 26, T. 1 S., R. 12 E.

Chickasawhay Limestone

Chickasawhay Formation (in Limestone Creek Group)

Chickasawhay Marl (in Vicksburg Group)

Chickasawhay Marl Member (of Byram Marl)[1]

Oligocene, upper: Southeastern Mississippi and southwestern Alabama.

Original reference: B. W. Blanpied and others, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip, p. 3, 4, 12, 16–19, charts.

B. W. Blanpied and R. T. Hazzard, 1938, (abs.) Am. Assoc. Petroleum Geologists 23d Ann. Mtg., Program, p. 11. Chickasawhay formation included in Limestone Creek group. Overlies Bucatunna formation. Miocene.

C. W. Cooke, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1560, 1561. Lower Chickasawhay beds are equivalent of Flint River formation of Alabama, Georgia, and Florida and of Suwannee limestone of Florida. Considered to be of Vicksburg age. Oligocene-Miocene boundary discussed. Oligocene.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1314, 1315 (fig. 1), 1346–1349. Chickasawhay limestone as herein defined is Lower Chickasawhay of Shreveport Geological Society Guidebook (1934); the Upper Chickasawhay is renamed Paynes Hammock sand. Overlies

Bucatunna clay member of Byram formation. Thickness about 15 to 20 feet. Believed that too many names are in use for equivalents of Chickasawhay limestone in southeast. Name Chickasawhay limestone could replace Flint River formation and unless Suwannee is emended to include the Byram, it could replace that name as well. Upper Oligocene.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1). Age shown as Late Oligocene.

Type section (Lower Chickasawhay): On Highway 45, 3 miles north of Waynesboro, Wayne County, Miss. Named for exposures on Chickasawhay River.

Chickasha Formation[1] (in El Reno Group)

Permian: Central southern and southwestern Oklahoma.

Original reference: C. N. Gould, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 324–341, map.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 51–54, fig. 4 (correlation chart), pl. 1. Described in Grady and Stephens Counties where it crops out in a broad band circling southeastern end of Anadarko basin and has a maximum width of about 30 miles. An extremely heterogeneous mixture of sandstones, shales, siltstone, and siltstone conglomerates. Thickness in area of type locality 135 to 230 feet. Overlies Duncan sandstone; contact gradational. Conformable with overlying Dog Creek shale and Blaine formation undifferentiated.

Type locality: Southwestern part of T. 4 N., R. 5 W., Grady County. Named because city of Chickasha is built on formation.

Chickies Quartzite[1] **or Slate**

Lower Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1876, Pennsylvania 2d Geol. Survey Rept. A., p. 60.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 34 (chart), 36–43; A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 6–13, pl. 1. Described as quartzite north of Hanover-York Valley and as slate south of Hanover-York Valley. In both areas, includes Hellam conglomerate member at base. Thickness about 350 feet to about 1,000 feet. Overlies Precambrian; in some areas, base not exposed. Underlies Harpers phyllite.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1361. Chickies quartzite used rather than Hardyston in Buckingham area, Bucks County, Carries basal conglomerate believed to be the Hellam.

Bradford Willard and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 10, 38–41. Term Chickies quartzite used in Buckingham and Langhorne areas, Bucks County. Approximately correlative of Hardyston quartzite but distinguished by its basal member, Hellam conglomerate. Only recorded fossils: *Scolithus* and *Olenellus*. Thickness about 900 feet. Upper contact not exposed; lower contact, now hidden, is said to be with Precambrian crystalline rocks.

Name from outcrops at Chickies Rock above Columbia on Susquehanna River, Lancaster County.

Chico Formation[1]

Chico Group[1]

Chico Series[1]

Lower(?) and Upper Cretaceous: Northern California.

Original reference: W. M. Gabb, 1869, California Geol. Survey Pal., v. 2, p. XIV, as reported by J. D. Whitney from unpublished paper by Gabb, and footnote by Gabb, on p. 129.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Chico series is nowhere found in single section but on the whole aggregates 25,000 feet or more. Begins with unconformity and overlaps in late Albian time; embraces all succeeding stages known in Europe, probably up to highest. Subdivided into Gaines group (new), western Shasta County, 5,300 feet; Panoche group, Diablo Range, 14,700 feet; Moreno group, Diablo Range, 5,000 feet.

F. M. Anderson, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863; 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 394–398. Marine Upper Cretaceous detrital deposits in California and Oregon constitute Chico series. It is well represented in Great Valley of California where it has aggregate thickness of 26,700 feet. Representative exposures lie along west border of valley, generally in monclinal attitude, for about 400 miles. Divided into three major groups: Pioneer (new), Panoche, and Orestimba (new).

J. A. Taff, G. D. Hanna, and C. M. Cross, 1940, Geol. Soc. America Bull., v. 51, no. 9, p. 1311–1328. Results of study show that Chico Creek must be considered type locality of Chico formation (group). Cretaceous rocks exposed in Chico Creek comprise series of clastics 2,000 feet in thickness, resting unconformably on older Sierra Nevada metamorphics and covered by Tertiary volcanics. Fauna is abundant, but only meager evidence exists to correlate it with other Cretaceous localities in central valley of California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Chico series includes following formations (ascending): Golden Gate, Mills, Sites, Funks, Guinda, and Forbes (all new). Discussion of area on west side of Sacramento Valley south of Willows, Glenn County.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 1, p. 130–134 [preprint 1941]. For many years, Upper Cretaceous was known practically everywhere in Coast Ranges as the Chico although it was frequently recognized that the various occurrences were not always equivalent to Chico Creek section in Butte County. In 1915, term Panoche was introduced for Cretaceous along west side of San Joaquin Valley north of Coalinga. Later work has shown that Panoche, as mapped at that time, includes Knoxville, Paskenta, and Horsetown and extends across several disconformities. Recently term Chico series has been used for all Upper Cretaceous and the Panoche as upper group of this series. This usage makes the Chico include beds separated by disconformity which locally becomes pronounced unconformity. Terms Pacheco and Asuncion groups are proposed for the Upper Cretaceous of central Coast Ranges. The groups are separated by event termed Santa Lucian orogeny.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 1, p. 183–186 [preprint 1941]. Chico series divided into Pioneer (lowest), Panoche, and Moreno groups. Groups are subdivided into stages based on distribution of faunas. Depositional hiatus separates Chico from underlying Shasta series.

J. M. Kirby, 1943, California Div. Mines Bull. 118, pt. 3, p. 601–605; 606–608. Term Chico group used in these reports [Rumsey Hills and Sites anticline areas] to include formations named in reference by Kirby (1942) cited above. Overlies Horsetown formation of Shasta group. Upper Cretaceous.

J. M. Kirby 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 279–305. Discussion of stratigraphy of Chico series on west side of Sacramento Valley. Scope of term Chico series as herein applied conforms to that established by F. M. Anderson in that it includes all Upper Cretaceous sediments exposed along west side of Sacramento Valley and elsewhere in California. Seems certain that both Pioneer and Panoche groups of Anderson (Pacheco and lower Asuncion groups of Taliaferro) are represented along west side of Sacramento Valley. Moreno group (and its equivalent, the upper Asuncion group) has not been found in area under discussion, nor at any locality elsewhere in Sacramento Valley. Formational units of series are (descending) Forbes, Guinda, Funks, Sites, Yolo (replaces preoccupied name Mills), and Venado (replaces preoccupied name Golden Gate). Evidence of mid-Cretaceous disturbance of Santa Lucian orogeny, postulated by Taliaferro as separating Chico and Shasta series and as basis for his Pacheco and Asuncion groups, respectively, in Santa Lucia Range and elsewhere in Central Coast Ranges, is meager in area of this report. Maximum age range of series appears to be from Albian to lower Campanian.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18 (table 3), 39–46, pls. Most typically developed exposures of Chico formation in area of this report [Coast Ranges immediately north of San Francisco Bay region] are on eastern slopes of Vaca Mountains. Thickness 9,000 to 12,000 feet. Chico strata exposed in Martinez syncline east and west of Martinez belong to upper part of sequence and are overlain with slight unconformity by Martinez formation.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 31. Term Chico has been so broadly applied that it no longer has resonable stratigraphic significance. Hence, in this report [San Jose-Mount Hamilton area], term Oakland conglomerate is used instead of conglomerate member of Chico as was used by Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193), and overlying Cretaceous rocks are named Berryessa formation.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Most extensive formation mapped in Haywood quadrangle; it is monotonous succession of biotitic arkosic sandstone and clay shale with minor siltstone and a few lenses of conglomerate overlying Oakland conglomerate. These rocks are designated Chico formation of Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193) although name is not entirely satisfactory. Thickness at least 2,000 feet; may be as much as 6,000; appears to thicken southeastward. In most places, overlain by Sobrante sandstone. If Chico is time-rock term, it should be properly applied only to Upper Cretaceous part of post-Oakland, pre-Tertiary section near Hayward and another name should be given to any Lower Cretaceous beds present. Lower(?) and Upper Cretaceous.

D. L. Peck, R. M. Imlay, and W. P. Popenoe, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1968–1984. Upper Cretaceous rocks in Siskiyou County, Calif., and in adjoining Jackson County, Oreg., are herein defined as Hornbrook formation. A new name to differentiate

them from Chico formation in California is justified by their remote position and by their complete lack of faunas in common with Chico at its type section. Chico should be abandoned as group or series name because it has been used with many different meanings. It may be retained as formational name for rocks at and near type locality on Chico Creek. Thus restricted, the name is applied to rocks of late Coniacian to early Campanian age exposed in small area including Chico Creek, Butte Creek, Mill Creek, Deer Creek, Pence (or Pentz) ranch, and Tuscan Springs.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 8. Discussion of geology of Pleasanton area, Alameda and Contra Costa Counties. Rocks previously referred to as "Chico formation" are recognized as constituting two distinct formations, Niles Canyon and Del Valle (both new).

C. A. Hall, Jr., D. L. Jones, and S. A. Brooks, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2855, 2859. Sedimentary rocks of Cretaceous age exposed along Pacific Coast south of Pescadero Point, Calif., were originally assigned to Chico formation by Branner, Arnold, and Newsom (1909, U.S. Geol. Survey Geol. Atlas, Folio 163). Application of this term to beds lithologically different, located nearly 200 miles from type locality of Chico formation, is unwarrented in absence of established continuity between the two sections. Name Pigeon Point formation is herein proposed for the beds exposed south of Pescadero Point, San Mateo County.

Type locality (Taff, Hanna, and Cross): In canyon of Chico Creek, 8 to 16 miles northeast of Chico, Butte County. Chico Creek has cut gorge 1,000 to 1,500 feet deep through late Tertiary lava flows and tuff beds of Tuscan formation, exposing the Chico.

Chico Phonolites

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1355. Occur as flows chiefly. Incidental mention only.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1023, 1034–1036, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1073–1077. Green, fine-grained, porphyritic, soda-rich extrusives and intrusives with large feldspar phenocrysts. Some pyroxene needles. Heavily jointed. Quaternary age. Derivation of name and geographic distribution given.

Named after excellent exposures in township of Chico. Occur abundantly in triangular area between Laughlin Peak, Temples Peak, and Turkey Mountain in eastern Colfax County.

Chico Creek Beds (in Panoche Group)

Upper Cretaceous (Chico Series): Northern California.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Incidental mention.

Occurs in Diablo Range.

Chicoma Volcanic Formation

Tertiary, middle: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103; 1938, Jour. Geology, v. 46, no. 7, p. 939–940. Consists mainly of andesite and

latite flows; maximum thickness several thousand feet. Probably oldest of the four Tertiary formations named in area; succeeded by Ortega formation (new). Tertiary formations overlie pre-Tertiary rocks with angular unconformity. Rocks represent much eroded and partly buried remnants of volcanic field which dominated ancestral Valles Mountains.

Occurs in Abiquiu quadrangle, Rio Arriba County. Forms Abiquiu and Chicoma Peaks.

Chico Martinez Chert Member (of Monterey Formation)

Miocene (Mohnian-Delmontian): Southern California.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, Road log, topog. profile, columnar section, map. Overlies Antelope shale member; underlies Chico Martinez (Belridge) diatomite. Thickness about 700 feet. McDonald shale, Antelope shale, and Chico Martinez chert members are equivalent to McLure shale member of Monterey.

Occurs along Chico Martinez Creek, Kern County.

Chicopee Formation

Pre-Carboniferous(?): Southern California.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5, 7–10, pl. 1. Lime silicate-bearing quartzites and cross-laminated quartzites which crop out beneath the Saragossa thrust in Chicopee Canyon. These quartzites were included in Saragossa quartzite by Vaughan (1922). Thickness about 1,000 feet. In fault contact with older Baldwin gneiss (new) except in two localities where the quartzite overlies gneiss by what may be depositional contact. Stratigraphically underlies Furnace limestone. Locally intruded by Cactus quartz monzonite.

J. F. Richmond, 1955, Dissert. Abs., v. 15, no. 3, p. 394; 1960, California Div. Mines Spec. Rept. 65, p. 11. Replaced by term Chicopee Canyon; name Chicopee preempted.

Type locality: Chicopee Canyon, near Baldwin Lake, San Bernardino Mountains, San Bernardino County.

Chicopee Shale[1]

Upper Triassic: Central Massachusetts and central Connecticut.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Name replaced by Turners Falls sandstone (new) in Greenfield and northern part of Mount Toby quadrangles. Unit can not be traced into this area from its type area.

Best exposed along railroad cut near Holyoke Dam, Mass. Extends southward through Chicopee, Mass.

Chicopee Canyon Formation

Pre-Carboniferous: Southern California.

J. F. Richmond, 1955, Dissert. Abs., v. 15, no. 3, p. 394; 1960, California Div. Mines Spec. Rept. 65, p. 11–15, pl. 1. Name Chicopee formation proposed by Guillou (1953) for series of metamorphosed quartzites beneath gray marble of Furnace formation in Johnston Grade area about 7 miles northeast of Delamar Mountain. Name Chicopee is preempted and it is here proposed that name be amended to Chicopee Canyon. Rocks similar to those described by Guillou are poorly exposed

in same stratigraphic position over area of a square mile on eastern and southeastern flanks of Delamar Mountain; upper part of Chicopee Canyon crops out north of Bertha Peak. Two members recognized. Lower, minimum thickness 1,000 feet, consists of crossbedded quartzite, thin-bedded quartzite, and micaceous quartzites; intruded at base by tonalite porphyry. Upper, consists of two distinctive units, 370 feet of massive quartzite overlain by 75 feet of andalusite-bearing rock. Conformably underlies Furnace formation. No fossils found in formation. Tops of beds established by truncated crossbedding indicate that strata are right side up across measured sections. As lower part of Furnace formation is Mississippian, Chicopee Canyon is early Mississippian or pre-Mississippian.

Exposed in San Bernardino Mountains, north of Big Bear Lake, San Bernardino County. Name derived from Chicopee Canyon. Quartzites exposed principally in faulted eroded anticline overturned to northwest.

Chico Ridge Limestone (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 31.

Forms extensive upland known as Chico Ridge, south of Chico and north of Lake Bridgeport Dam, Wise County.

Chico Shunie Quartz Monzonite

Mesozoic(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 23–27, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 17–20, pl. 3 [1947]. The typical quartz monzonite is slightly foliated to massive and coarsely porphyritic. Light pinkish gray on fresh fracture and weathers to light brown. Conspicuous crystals of pink feldspar an inch or less in length occur in coarse groundmass. Other intrusive rocks of comparable structure mapped with this formation but may include rocks of several ages. Intrusive into Cardigan gneiss (new); intruded by border facies of Cornelia quartz monzonite (new). Underlies Daniels conglomerate (new).

Named from representative exposures in the Chico Shunie Hills, and is exposed over wide area in the southwestern part of the Ajo quadrangle, Pima County.

†Chico-Tejon series[1]

Upper Cretaceous and Eocene: California.

Original reference: C. A. White, 1889, U.S. Geol. Survey Bull. 51, p. 11–14.

Chief Consolidated Limestone[1]

Ordovician: Central northern Utah.

Original reference: G. W. Crane. 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

Probably named for Chief Consolidated mine.

Chignik Formation[1]

Upper Cretaceous: Southwestern Alaska.

Original reference: W. W. Atwood, 1911, U.S. Geol. Survey Bull. 467, p. 24, 41–48, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000) : U.S. Geol. Survey. Appears on map legend.

Type section: In Whalers Creek, one-half mile from shore of Chignik Lagoon; Alaska Peninsula.

Chikaskia Sandstone Member (of Harper Sandstone)

Permian (Leonard Series) : Southern Kansas and northern Oklahoma.

G. H. Norton, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557. Member, 100 to 125 feet thick, is marked by benches of red sandstone separated by red and gray shales; contains numerous geoidal sugary-dolomite concretionary lentils. Overlies Stone Corral member; underlies Kingman sandstone member (new).

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782–1785. Basal member of Harper sandstone (restricted). Has threefold character: (1) highly variable sand and shale section at base; (2) a series of bench-forming well-cemented even-bedded red sandstones; and (3) white sandstones, dolomite lentils and concretions in red shale. Type locality designated.

Type locality: In sec. 10, T. 31 S., R. 6 W., Harper County, Kans. Named for exposures along Chickaskia River.

Childress Dolomite Member (of Marlow Formation)

Childress Dolomite Member (of Dog Creek Shale)[1]

Permian (Guadalupe Series) : Northern and central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 952, pl. 10.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Assigned to Marlow formation at base of Whitehorse group. Guadalupe series.

Named for outcrops in and around Childress, Childress County.

Childs Latite

Pliocene(?) : Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 47–48, pl. 1. Augite, latite, coarsely porphyritic, in thick flows, from 30 to 80 feet thick, of aa and block lava. Rocks are light gray to reddish and weather dark brown, with conspicuous mottling. Maximum exposed thickness about 700 feet. Appears to rest on Black Mountain andesite (new) at north end of Childs Mountain. Elsewhere the Black Mountain rests on the latite. It is possible that apparent occurrence of the Black Mountain beneath it is due to faulting. Also underlies Daniels conglomerate (new) in Childs Mountain.

James Gilluly, 1946, U.S. Geol. Survey Prof. Paper 209, p. 44–45, pl. 3 [1947]. In two northern localities, the latite is overlain by Batamote andesite flows. In the canyon 6½ miles west of Batamote well, on north side of Childs Mountain, the latite appears to rest on the Batamote andesite, suggesting that the latite is merely an intercalation in the Batamote series. This apparent anomaly may be due to faulting.

Flows are widespread in Ajo region from Crater Mountains north of Ajo quadrangle to Puerto Blanco Hills south of it. In Ajo quadrangle, Pima County, the largest exposures are along west slope of Childs Mountain, from which formation is named.

†Chilhowee Conglomerate[1]

Lower Cambrian: Southeastern Tennessee.

Original reference: A. Keith, 1895, Philos. Soc. Washington Bull., v. 12, p. 75, pl. 1.

Chilhowee Group[1]

Lower Cambrian and Lower Cambrian(?): Eastern Tennessee, Maryland, western North Carolina, and Virginia.

Original reference: J. M. Safford, 1856, Geol. Reconn. Tennessee 1st Rept., p. 149, 152–153.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 26–40. Name extended into Virginia although the group there may not be exactly equivalent to group in Chilhowee Mountain, Tenn. Two sets of formation names have been given individual members of group in Virginia. Names used north of Roanoke are: Loudoun formation, Weverton sandstone, Harpers shale, and Antietam sandstone; names south of Roanoke: Unicoi formation, Hampton shale, and Erwin quartzite. The Unicoi is equivalent to the Loudoun and Weverton. Basal Cambrian. Underlies Shady-Tomstown dolomite.

G. W. Stose and A. J. Stose, 1947. Am. Jour. Sci., v. 245, no. 10, p. 626. In Hot Springs area, North Carolina, group comprises (ascending) Vann quartzite (new), Sandsuck shale, Cochran quartzite, Nebo quartzite, Murray shale, Hesse quartzite, Shady dolomite, and Rome formation. Unconformable above early Precambrian granite gneiss. Lower Cambrian.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 14–23, pl. 1. Described in Elkton area, Virginia, where it comprises (ascending) Loudoun, Weverton, and Harper formations and Antietam quartzite. Overlies Catoctin greenstone; underlies Tomstown dolomite. Base of group considered base of Cambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, pls. Group mapped in eastern Tennessee. Overlies Ocoee series and Mount Rogers volcanic complex or, where they are absent, the crystalline complex. Southwestern sequence comprises (ascending) Cochran conglomerate, Nichols shale, Nebo sandstone, Murray shale, and Hesse sandstone with Helenmode member at top. Northeastern sequence comprises (ascending) Unicoi, Hampton, and Erwin formations; Erwin formation has Helenmode member at top. Underlies Shady dolomite. Lower Cambrian.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 964. Group has for many years been classed by U.S. Geological Survey as Cambrian on basis of occurrence of trilobites, brachiopods, and other fossils in its upper part, the occurrence of *Scolithus* in upper and middle parts, the sedimentary homogeneity of the group, and presence in many places of well-marked unconformity at base. Relations are confused, however, because in places the Chilhowee lies on earlier sedimentary and volcanic rocks with only minor unconformity, or even conformably, and many geologists have termed these earlier rocks Cambrian also; the underlying Ocoee was thus placed in the Cambrian by Keith. Paleontological data to fix as Cambrian the age of the Chilhowee group itself are decisive only for its upper part. U.S. Geological Survey now restricts beds classed as Cambrian to those for which paleontological data are available. Helenmode formation at top of Chilhowee group is classed as Cambrian, and remaining unfossiliferous formations are termed Precambrian(?); group as a whole is classed as Cambrian and Precambrian(?).

P. B. King and H. W. Ferguson, 1960, U. S. Geol. Survey Prof. Paper 311, p. 28, 32–45, pl. 1. In area of this report [Carter and Johnson Counties, Tenn.], group comprises (ascending) Unicoi, Hampton, and Erwin formations. Overlies Mount Rogers volcanic group; underlies Shady dolomite. Lower Cambrian.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. In Blockhouse quadrangle, Tennessee, includes (ascending) Cochran formation, Nichols shale, Nebo quartzite, Murray shale, Hesse quartzite, and Helenmode formation. Overlies Wilhite formation of Walden Creek group; sequence broken by faulting. Underlies Maryvale limestone of Conasauga group; sequence broken by faulting. Most of Chilhowee group is now questionably assigned to Early Cambrian because recoverable fossils of Early Cambrian age are confined to Helenmode formation. Lower Cambrian and Lower Cambrian(?). An age determination of 584±30 million years was made from rubidium-strontium ratio in glauconite from sample of Murray shale.

Named for Chilhowee Mountain, Sevier and Blount Counties, Tenn.

Chilibrillo Limestone Member (of Caimito Formation)

Chilibrillo [Limestone or Formation]

Miocene, lower: Panamá.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (correlation chart). Name Chilibrillo used on correlation chart.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 235, 246 (fig. 12); W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 32, pl. 1. Chilibrillo limestone member is the Emperador limestone of Reeves and Ross (1930, U.S. Geol. Survey Bull. 821) and Chilibrillo formation of Kellogg (1931, Final report on field investigations of the Madden Dam and Reservoir site at Alhajuela, Panama Canal Zone: Panama Canal Rept.). Maximum thickness 100 feet; pinches out on either side of Madden basin. Overlies unnamed pyroclastics clay member; underlies unnamed calcareous siltstone member. Fossil evidence favors Miocene age, presumably early Miocene. Type region noted.

Type region: East side of Madden basin, between Madden Lake and Río Chilibrillo, C.Z.

Chillicothe till[1]

Pleistocene: Ohio to Minnesota and northern Wisconsin.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203.

Chilliwack Granodiorite[1] and Quartz Diorite

Lower Cretaceous and younger: Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Astronomer 1910, v. 2.

H. A. Coombs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1948. Daly concluded Chilliwack granodiorite might have been intruded as late as Miocene; equally probable is a Jurassic age which corresponds with numerous other batholiths in Cascade Range.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 14–16. Discussion of geology of northern Cascades of Washington. Chilliwack

granodiorite and quartz diorite are at least in part later than Lower Cretaceous. Younger than Skagit gneisses.

First described from occurrence at Chilliwack Lake, British Columbia.

Chilliwack Group

Carboniferous: Southern British Columbia, Canada, and northern Washington.

C. E. Cairnes, 1944, Hope [quadrangle], Yale and Westminster districts, British Columbia (1:253,440): Canada Geol. Survey Map 737–A. Described in Yale and New Westminster districts, British Columbia. Series is predominantly sedimentary and has provided collections of marine forms regarded as most probably Upper Carboniferous though they may be Permian. Extent of group beyond its type area has not been determined. It is part of a belt of strata which, particularly north and west of Fraser River, is so greatly deformed and altered that it could not be subdivided in spite of the fact that poorly preserved fossil remains indicate presence of younger beds. A large body of volcanic rocks is apparently interbedded with Chilliwack strata at international boundary.

W. R. Danner, 1958, Dissert. Abs., v. 18, no. 1, p. 195. Chilliwack group in northwestern Whatcom County, Wash., is in part divisible into a lower formation of clastics, volcanics, and limestones containing fusulinids, endothyroids, algae, corals, brachiopods, and large crinoid stems of probable early Pennsylvanian or late Mississippian age and an upper formation composed mostly of clastics and limestones containing fusulinids and bryozoa of early Permian (Wolfcampian) age.

It is not clear what relationship the Chilliwack group bears to units described as Chilliwack series and Chilliwack volcanic formation.

Chilliwack Series[1]

Carboniferous and older(?): Southern British Columbia, Canada, and central northern Washington.

R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, p. 507–516, maps 15, 16, 17. From Skagit River to gravel plain traversed by lower Fraser River, the Boundary belt crosses a number of formations which range in age from Miocene to Carboniferous, if not to Precambrian. Oldest fossiliferous sediments so far discovered date from Upper Carboniferous; these belong to thick group of rocks here named Chilliwack series, most of which are believed to be Carboniferous. A thick andesitic group forms upper part of Chilliwack series as exposed near Tamihy Creek and is named Chilliwack volcanic formation. Certain phases of Chilliwack series are probably contemporaneous with Hozomeen series. The Slesse diorite and the Chilliwack granodiorite are both in batholithic intrusive relation to Chilliwack series. Map 16 shows Chilliwack series extending south of international boundary.

H. A. Coombs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1497. Carbonaceous phyllites crop out at widely scattered localities in vicinity of Mount Baker. Daly's (1912) Chilliwack series (not to be confused with Chilliwack volcanic formation), only 5 miles north of phyllites under Mount Baker, is composed of slates, phyllites, and limestones. It is probable that phyllites surrounding Mount Baker belong in this same general sequence.

Named for exposures along Chilliwack River, Skagit Mountain Range, British Columbia.

Chilliwack Volcanic Formation[1]

Upper Carboniferous: Southern British Columbia, Canada, and central northern Washington.

R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, p. 507, 521–522, map 16. A thick andesitic group forms upper part of Chilliwack series as exposed near Tamihy Creek and is here named Chilliwack volcanic formation. Consists mainly of thick, massive flows, which are so welded and altered as to make individual flows difficult to distinguish. Lavas are commonly amygdaloidal, with calcite filling pores; many andesites have been altered to typical greenstones and green schists; augite has relations and abundance observed in olivine-free basalts. Estimated thickness at least 2,000 feet. Map 16 shows formations extending south of international boundary.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 16–17. List shows Carboniferous sequence in northern Washington (ascending) Hozomeen series, Chilliwack volcanic formation, and Vedder greenstone. Text states that "associated with Chilliwack series are altered gabbro masses termed Vedder formation." [Use of term Chilliwack is not clear here.]

H. A. Coombs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1496–1497. Older rocks project above surface of Mount Baker lavas in vicinity of Herman Mountain. This older rock is part of a series containing greenstone, sandstone, and graywacke. Greenstone may correspond to Daly's (1912) Chilliwack volcanic formation, type area of which is only 6 miles north of Herman Mountain; it is also possible that the greenstone may correspond to Daly's (1912) Vedder greenstone located 18 miles to northwest.

Named for exposures along Chilliwack River, British Columbia.

Chilton Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Western West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2–A, p. 271.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 81, 104. Massive sandstones in Kanawha group.

Probably named for occurrence at Chilton, Kanawha County.

Chimneyhill Limestone[1] (in Hunton Group)

Silurian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1911, Am. Jour. Sci., 4th, v. 32, p. 256–268.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132–134. Subdivided into (ascending) Hawkins, Keel, Cochrane, and Dillard members (all new). Underlies Henryhouse formation; unconformably overlies Sylvan shale. Alexandrian-Niagaran.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7–25; 1960, Oklahoma Geol. Survey Bull. 84, pt. 6, p. 27–66. Formation is complicated stratigraphic sequence which includes several members separated from one another by unconformities. Considering these complications, it might be advisable to drop name and elevate each member to rank of formation. However, Chimneyhill is retained here because it makes convenient stratigraphic unit. All members are similar in lithology, being fairly pure limestones with low silt and clay content.

Comprises (ascending) Ideal Quarry (replaces Maxwell's preoccupied Hawkins limestone), Keel, Cochrane, and Clarita (replaces Maxwell's preoccupied Dillard) members. Thickness 60 feet at type locality with all members present; 70 feet at old Hunton townsite, all members present; 70 feet southwest of Wapanucka, Clarita member absent. Overlies Sylvan formation; underlies Henryhouse, Haragan, or Bois d'Arc formation. Chimneyhill includes strata which represent a rather long time span, probably including representatives of both the Lower and Middle Silurian. Reeds stated type locality was at confluence of three small creeks, sec. 4, T. 2 N., R. 6 E., but this section number is in error; only Chimneyhill present in section 4 is in southwest corner and this outcrop is not on the creek. There are exposures of formation along Chimneyhill Creek in SE¼ sec. 5, T. 2 N., R. 6 E., and this is probably locality referred to by Reeds and is here designated type section.

Type locality: SE¼ sec. 5, T. 2 N., R. 6 E., Pontotoc County. Named for Chimneyhill Creek which crosses formation in northeastern corner of Arbuckle Mountains.

Chimney Rock Tongue (of Rock Springs Formation)

Upper Cretaceous: Southwestern Wyoming.

L. A. Hale, 1950, Wyoming Geol. Soc. Guidebook 5th Ann. Field Conf., p. 52, fig. 1. Sandstone tongue of the Rock Springs; extends into Mancos shale; underlies Black Butte tongue (new).

L. A. Hale, 1955, Wyoming Geol. Soc. Guidebook 10th Ann. Field Conf., p. 90 (fig. 1), 91 (fig. 2), 92, 93 (fig. 3). Name applied to prominent littoral and epineritic sandstones which project eastward from main body of Rock Springs into marine shales. Composed of three prominent cliff-forming reddish-brown sandstones; each successive sandstone projects farther into enclosing shale before losing its identity. Contact with overlying Black Butte tongue sharp.

Named for Chimney Rock, sec. 6, T. 16 N., R. 102 W., Sweetwater County. Forms prominent hogback in Linwood-Spring Gap area.

China Mountain Formation

Lower and Middle(?) Triassic: North-central Nevada.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]; H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Conglomerate, sandstone, shale, and yellowish, impure dolomite. At base, fanglomerate and conglomerate up to 100 feet thick, containing chert and quartzite fragments up to 2 feet in diameter. May include at top the thinned equivalent of Favret formation. Thickness about 500 feet. Overlies Koipato and Havallah formations with angular unconformity.

Type locality: West slope of China Mountain, Golconda quadrangle.

China Ranch Beds

Quaternary: Southeastern California.

J. F. Mason, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 336 (table 1), pl. 2. Light-colored saline clays with bedded gypsum; lacustrine origin. Thickness about 1,200 feet. Unconformably overlain by Quaternary gravel beds; uncomformable below unnamed lake beds.

Occurs in Tecopa area, in southeasternmost corner of Inyo County.

Chinati Series[1]

Permian: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Mineral Survey Bull. 8, p. 10–25.

J. W. Skinner, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 180–188. Udden recognized three formational divisions in Chinati series (ascending): Cieneguita, Alta, and Cibolo. He assigned entire series to Permian. Present report is a study of section selected by Udden as type of all three of his formations. Concluded that Udden's original age assignment was very nearly correct, much more so than later correlations based on fossils collected from exposures other than type locality.

Described in Shafter district, Chinati Mountains, Presidio County.

Chinati Mountain Volcanic Series or Group

Tertiary: Western Texas.

C. C. Rix, 1952, Geologic map of Chinati Peak quadrangle, Presidio County, Texas (1:48,000): Texas Univ. Bur. Econ. Geology, Prelim, ed. As shown on map legend, Chinati Mountain volcanic series occurs above Buck Hill volcanic series. Oligocene and younger.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 558. Chinati Mountain series in Chinati Mountains may be same age as Rawls basalt.

D. L. Amsbury, 1957, Dissert, Abs., v. 17, no. 9, p. 1981. Chinati Mountain group (emended) overlies Petan trachyte (new).

D. L. Amsbury, 1958, Texas Bur. Econ. Geology Quad. Map 22. Chinati Mountain group, composed of more than 3,500 feet of plagioclase trachyte, rhyolite, and tuff, crops out south of Shely fault to form Chinati Mountains. Group is here expanded to include 1,500 feet of plagioclase trachyte, tuff, and local basal conglomerate which are probably older than lowest unit at type locality as designated by Rix (1953, unpub. thesis). Where base is exposed, group overlies Comanche strata; in fault contact with older Shely group (new). Older than Allen intrusive complex.

First mapped in Chinati Peak quadrangle, Presidio County.

Chinitna Shale,[1] Siltstone, or **Formation**

Chinitna Shale Member (of Shelikof Formation)

Upper Jurassic: Central southern Alaska.

Original reference: G. C. Martin and F. K. Katz, 1912, U.S. Geol. Survey Bull. 485, p. 65, table opposite p. 30, map.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 202 (table 1), 207. Member of Shelikof formation. Gray shale with stringers of fine and coarse sandstone and buff-weathering limestone. Thin porphyry sill intrudes section at Wide Bay. Thickness 400 to 1,300 feet. Overlies Tuxedni sandstone on Iniskin-Chinitna Peninsula. Underlies unnamed gray sandy shale unit of Shelikof.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Chinitna siltstone consists of approximately 2,000 feet of arenaceous siltstone which lies conformably between Tuxedni and Naknek formations in area between Chinitna and Iniskin Bays.

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 49–51, table 5 facing p. 60. Tonnie member, which previously was assigned to Tuxedni formation, forms roughly lower third of Chinitna formation. Formation

underlies Naknek formation in Cook Inlet region and as mapped at Matanuska Valley may include beds older than typical Chinitna.

Well exposed on west side of Chisik Island, on both shores of Chinitna and Oil Bays, and on east shore of Iniskin Bay. Occurs in area extending from Iniskin Bay to Tuxedni Bay, Cook Inlet region.

Chinle Formation[1] (in Dockum Group)

Upper Triassic: Northern Arizona, southwestern Colorado, southeastern Nevada, northern New Mexico, and Utah.

Original reference: H. E. Gregory, 1915, Am. Jour. Sci., 4th, v. 40, p. 102.

H. R. Stagner, 1941, *in* L. H. Daugherty, Carnegie Inst. Washington Pub. 526, p. 10, 11–12. In Blue Forest locality, Arizona, three units are recognized in Chinle formation: lower bentonitic shale zone; Newspaper Rock sandstone (new) leaf shale unit; and upper bentonitic shale zone.

H. E. Thomas and G. H. Taylor, 1946, U.S. Geol. Survey Water-Supply Paper 993, p. 20, 22–23. Described in Cedar City and Parowan Valleys, Utah, where it is 1,950 feet thick, overlies Shinarump conglomerate and underlies Navajo sandstone. Section in Coal Creek Canyon described in detail (beds numbered 15 through 30). No perceptible stratigraphic break noted between Chinle and Navajo. Between shaly sandstones and sandy shales that are typical of Chinle and massive beds that are clearly identifiable as Navajo, there is transition zone several hundred feet thick which might doubtfully be included in either formation. This transition zone, represented in Coal Creek section by beds 26 to 30 is here assigned to Chinle, although beds 26 and most of 27 are quite similar to typical Navajo.

J. M. Gorman and R. C. Robeck, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 44. Assigned to Dockum group.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. In Lucero uplift comprises two members: red shale below and sandstone member here named Correo. Overlies Shinarump conglomerate; underlies Wingate sandstone.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Described in Sandoval and Rio Arriba Counties, N. Mex., where it unconformably overlies Cutler, Yeso, and San Andres formations and underlies Wingate(?) sandstone. Lower part of formation divided into (ascending) Agua Zarca sandstone member, Salitral shale tongue, and Poleo sandstone lentil (all new).

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 62. In Quay County, N. Mex., subdivided into two members: lower, unnamed; upper, herein named Redonda. Overlies Santa Rosa sandstone; underlies Wingate(?) sandstone.

H. E. Gregory and N. C. Williams, 1947, Geol. Soc. America Bull., v. 58, no. 3, p. 227–228. Described in Zion National Monument where it is subdivided into four members: lower unnamed sandstone, 20 to 60 feet; Petrified Forest member (new), 300 to 400 feet; Springdale sandstone member (new) 40 to 180 feet; and upper sandstones, 500 to 800 feet. Overlies Shinarump conglomerate; underlies Navajo sandstone.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34, 35. In Muddy Mountains, Nev., the Chinle formation with Shinarump member at base is 1,500 to 2,500 feet or more thick. Underlies Aztec sandstone; overlies Moenkopi formation. In Frenchman Mountain area, underlies Thumb formation (new) with angular unconformity.

P. D. Procter, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 18–38, pl. 2. In Silver Reef area, Utah, Chinle formation consists of about 1,100 feet of alternating sandstones and shales with exception of two small beds of cherty limestone. On basis of color and lithology, formation is subdivided into a lower member consisting predominantly of dark-red shales and minor interbedded red sandstones 265 feet thick overlying Shinarump formation, a prominent 5- to 15-foot bed of white arkosic sandstone, 10 to 15 feet of purplish- to bluish-gray bentonitic shales with included banded chert, 310 feet of deep-red to brick-red sandstone and shales with an included 1-foot bed of white silicified limestone, 65 feet of buff weathering to white sandstone overlain by 35 feet of lavender to purple sandstone together known as Silver Reef sandstone (Reeside and Bassler, 1922, U.S. Geol. Survey Prof. Paper 129) and an upper Chinle which consists of more than 400 feet of red shales and sandstones with some white, friable sandstone beds locally more than 10 feet thick. Lower Chinle subdivided into (ascending) Hartley shales and sandstones, Fire Clay Hill bentonitic shales, and Trail Hill sandstone members (all new). These members do not have wide areal extent. Upper Chinle subdivided into (ascending) Silver Reef sandstone, and Duffin sandstone and shale (new) members.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwestern Mora County, N. Mex., conformably overlies Santa Rosa sandstone; underlies Naranjo formation (new). Thickness 640 feet.

J. H. Stewart and J. F. Smith, Jr., 1954, Intermountain Assoc. Petroleum Geologists [Guidebook] 5th Ann. Field Conf., p. 29–33. Chinle in southeastern Utah has been divided into six units (ascending): claystone and sandstone unit, a sandstone commonly called "Moss Back," variegated claystone unit, reddish-orange unit, limy unit, and reddish siltstone unit. Four of these units appear to be correlative with the four divisions of Chinle recognized by Gregory (1917, U.S. Geol. Survey Prof. Paper 93) in Navajo Indian Reservation of Arizona. Claystone and sandstone unit is equivalent to "D" division, the variegated claystone unit equivalent to "C" division, the limy unit equivalent to "B" division, and reddish siltstone unit equivalent to "A" division. Overlies Moenkopi; underlies Wingate.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2518–2519, 2520, 2522. As restricted herein, includes beds between top of Shinarump conglomerate and disconformity at base of Moenave formation (Dinosaur Canyon member). At Kanab, and elsewhere in southwestern Utah, restricted Chinle includes only lower part of Chinle as mapped by Gregory (1950, U.S. Geol. Survey Prof. Paper 220). Units 26 and 27 of Coal Creek Canyon section of Chinle (Thomas and Taylor, 1946) are here designated Shurtz sandstone tongue of Navajo sandstone; units 28, 29, and 30 of Thomas and Taylor's section are here designated Cedar City tongue of Kayenta formation.

R. C. Robeck, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 10, p. 2499, 2502 (fig. 2). In Temple Mountain area, Utah, comprises (ascending) Temple Mountain (new), Moss Back, and Church Rock members. Overlies Moenkopi formation; underlies Wingate sandstone.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (table), 5–7. Contact between Chinle formation and Glen Canyon group in Navajo country lies between Gregory's "A" and "B" (1917, U.S. Geol. Survey Prof. Paper 93) divisions of the

Chinle. Rocks long assigned to Chinle formation are therefore included in Glen Canyon group. The "A" division has been reassigned to Wingate sandstone and is herein named Rock Point member of Wingate. This reassignment of the Chinle "A" was based upon intertonguing between the Wingate sandstone and the Chinle "A" in several areas.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 441–462. Discussion of proposed nomenclautre of part of Upper Triassic strata in southeastern Utah. Chinle is subdivided into (ascending) Temple Mountain, Shinarump, Monitor Butte, Moss Back, Petrified Forest, Owl Rock, and Church Rock members. Overlies Moenkopi formation; underlies Wingate sandstone.

J. A. Momper, 1957, Four Corners Geol. Soc. [Guidebook] 2d Field Conf., p. 86 (chart), 91, 92. Agua Zarca and Salitral members removed from Chinle and assigned to Moenkopi formation.

J. P. Akers, M. E. Cooley, and C. A. Repenning, 1958, New Mexico Geol. Soc. Guidebook 9th Field Conf., p. 91. Chart shows that Chinle in St. Johns area, Black Mesa basin, comprises (ascending) Shinarump, Mesa Redondo, and Petrified Forest members.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1838, 1841, 1845. In salt anticline region, overlies Pariott member (new) of Moenkopi.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2004–2005. Stratigraphic nomenclature revised in Tucumcari-Sabinoso area, New Mexico. Chinle stratigraphically restricted above to exclude Redonda member which is herein given formation rank.

Named for Chinle Valley, northeastern Arizona.

Chinook Pass Diorite Porphyry

See Keechelus Andesitic Series.

Chino Quarry Limestone[1]

Upper Paleozoic(?): Southern California.

Original reference: J. W. Daly, 1935, Am. Mineralogist, v. 20, no. 9, p. 638–647, map.

A. O. Woodford, R. A. Crippen, and K. B. Garner, 1941, Am. Mineralogist, v. 26, no. 6, p. 351, 354–355. Probably Upper Paleozoic.

Well exposed in Chino Quarry at Crestmore, Riverside County.

Chino Quarry Quartzite[1]

Paleozoic(?): Southern California.

Original reference: J. W. Daly, 1935, Am. Min., v. 20, no. 9, p. 638–647, map.

Named for quarry at Crestmore.

Chipman Formation

Chipman Group

Lower Ordovician: West-central Vermont.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Group named to include the Burchards (new) and succeeding Beldens limestone and dolomites. Underlies Middlebury limestone. Chazyan series.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci. v. 258, no. 10, p. 728–739. Chipman formation of west-central Vermont is rock unit in uppermost

part of Lower Ordovician, of Beekmantown age, between underlying Bascom formation and overlying rocks of Middle Ordovician (Chazy) age. Structural setting is Middlebury synclinorium and adjacent areas to west. Characterized by four principal rock types: buff to brown, sharply defined, and laterally persistent beds of massive dolomite; white to blue-gray limestone; gray limestone with thin interbeds of sandy limestone; and blue-gray limestone with irregular spots of dolomite. These lithofacies are interbedded in type section. Formation was first referred to as group (Kay and Cady, 1947) but is herein reduced to formation rank. Beldens formation and Weybridge member of Beldens (Cady, 1945), the Burchards limestone (Kay and Cady, 1947), and Bridport dolomite (Cady, 1945) are redefined as members of Chipman. Weybridge and Burchards have not been mapped north of Middlebury synclinorium, whereas Beldens and Bridport are considered formations in northwestern Vermont (Kay, 1958) that correlate in time with all or part of Chipman formation. All units of Chipman overlie Bascom formation and underlie Middlebury limestone. In Cornwall area, the Chipman is exposed in belt of discontinuous outcrops of rock of Beekmantown age that extends from about 1 mile south of village of Cornwall through The Ledges into town of Weybridge. Chipman is in section that, at latitude of The Ledges, includes three Cambrian formations—Winooski dolomite, Danby formation, and Clarendon Springs dolomite—as well as Ordovician formations of Beekmantown, Chazy, Black River, and Trenton age. Distribution and relationships of units are about as described and mapped by Cady (1945), though their terminology is partly changed. Shelburne is referred to as a formation; the "Crown Point limestone" becomes Burchards member of Chipman formation; and Orwell limestone is now assumed to be Black River age rather than Trenton. Cutting and Bascom formations and Bridport dolomite member are as mapped by Cady (1945) at Bascoms Ledge, but Middlebury limestone is expanded westward and downward stratigraphically to top of Bridport and includes rocks that had been interpreted as "Crown Point limestone" and "Beldens formation." Orwell limestone on summit of De Long Hill was misidentified as Beldens during previous mapping. The first and apparently the correct, interpretation of stratigraphic relationships of Beldens and Burchards members to Bridport member was given by Augustus Wing (*in* Dana, 1877, Am. Jour. Sci., 3d, v. 13, no. 77; no. 78). One of the purposes of present paper is to call attention to Wing's conclusions in further support of the inclusion of the Bridport as a member of Chipman and the time-stratigraphic unity of the various lithofacies of the Chipman. Wing referred to both the Bridport and the Beldens as unit 6, the "*Rhynchonella* beds" and left no doubt that the two are to be correlated. Beneath the Beldens in section near and north of Cornwall village is Burchards, a limestone that Wing referred to as unit 5c. He mentioned the local occurrence of this unit in The Ledges north of Cornwall. Recent mapping shows that the Burchards is a lithofacies extensive enough to be mapped as member of the Chipman north and south of village of Cornwall. Also in section near and north of Cornwall is Weybridge member (Cady, 1945), which was referred to by Wing as the "striped stratum" in the "*Rhynchonella* beds." Wing also mentioned the "striped stratum" in the "*Rhynchonella* beds" at Bascoms Ledge. There the "*Rhynchonella* beds" are now known as Bridport member of Chipman. Brainerd (1891, Geol. Soc. America Bull., v. 2, p. 293–300) assigned a Chazy age to Zone 4 of Bascom formation ("Calciferous D4") and to whole sequence now known as Burchards and Beldens

members of Chipman in The Ledges north of Cornwall village. This incorrectly made these units younger than Bascom Zone 4 and Bridport (Beekmantown) of section at Bascoms Ledge. Cady (1945) recognized Zone 4 of the Bascom in The Ledges in Cornwall but followed Brainerd in correlating Wing's unit 5c (the Burchards) with Crown Point limestone of middle Chazy age. The Beldens was mistakenly extrapolated into section east of and stratigraphically above the Bridport southwest of De Long Hill (Cady, 1945). The rock above the Bridport here is actually Middlebury limestone, which is of Chazy age. Kay and Cady (1947) proposed that the "Crown Point" formation east of Champlain thrust in west-central Vermont be designated Burchards limestone with type locality in belt of outcrop between Cornwall village and The Ledges. This seemed advisable because of structural separation from typical Crown Point limestone. Kay (1950; 1958) recognized fauna in the Weybridge supporting a late Beekmantown age as well as stratigraphic correlation of the Weybridge and the Beldens with Bridport. Rock of Chazy age in vicinity of Shoreham village is structurally isolated from Middlebury limestone and lithically and faunally like the typical Crown Point limestone; it is here continued as the Crown Point.

Named from Chipman Hill in outcrop belt north of Middlebury village, Addison County.

Chipola Formation (in Alum Bluff Group)[1]

Chipola facies (of Alum Bluff Stage)

Miocene, lower: Northwestern Florida and southeastern Alabama.

Original reference: Julia Gardner, 1926, U.S. Geol. Survey Prof. Paper 142, p. 1–2.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 161–167. Typical part of formation is fine blue-gray to yellow sand crowded with shells. This facies appears to be confined to vicinity of Chipola and Apalachicola Rivers, where it lies at base of formation and is about 10 feet thick. Beds above it are less fossiliferous, and the sand is more or less cemented by calcium carbonate. Farther west are two principal facies—sandy limestone, which for most part is buried beneath younger deposits, and a coarse light-colored sandy facies including lenses of light-colored or variegated clay; this latter facies may be littoral equivalent of the limestone. Thickness at least 20 feet; as much as 56 feet has been reported. Seems to merge laterally into Hawthorn formation. Underlies Shoal River formation; directly and unconformably overlain by Duplin marl from Washington County eastward.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 22–24. A facies in Alum Bluff stage. At type locality, facies is blue-gray to yellowish-brown highly fossiliferous marl studded with molluscan shells; thickness about 28 feet. This marly facies is restricted to vicinity of Chipola and Apalachicola Rivers. Farther west Cooke (1945) recognized two facies: sandy limestone which for the most part is buried and light-colored coarse sandy facies with lenses of clay. Lower Miocene.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 2). Table shows Chipola as middle Miocene.

Type locality: McClelland's Farm, near Bailey's ferry, northern Calhoun County, Fla. Named for exposures on Chipola River, Jackson County. Type locality of facies: Tenmile Creek, from bridge to one-half mile

below bridge on Marianna-Clarksville Road, 2,376 feet south of NW cor. sec. 12, T. 1, N., R. 10 W., 22 miles south of Marianna, Calhoun County.

†Chipola Marl Member (of Chipola Formation)[1]

Miocene, lower: Northern Florida and southeastern Alabama.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 112–113, 120, 122, 157, 324.

Named for exposures on Chipola River, especially at McClelland Farm, south of Tenmile Creek, Jackson County, Fla.

†Chippewa Felsite (in Ashbed Group)[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: W. C. Gordon, 1905, Michigan Acad. Sci. 7th Rept., p. 188–195.

Crops out only in Black River and on Chippewa Bluff near Bessemer, Gogebic County.

Chippewa Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 86.

Exposed in valley of Chippewa Creek, Hammond quadrangle. Derivation of name not stated.

†Chippewa Porphyry (in Ashbed Group)[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: F. E. Wright and A. C. Lane, 1909, Michigan Geol. Survey Rept. State Board 1908, pl. 1.

Porcupine Mountains.

Chippewa Quartzite[1]

Precambrian (upper? Huronian): Central northern Wisconsin.

Original reference: E. T. Sweet, 1876, Wisconsin Acad. Sci. Trans., v. 3, p. 40–55.

Named for exposures on Chippewa River, Chippewa County.

†Chiquito sandstone

Precambrian (Chuaran series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Lowermost beds are shallow-water deposits with abundant ripple marked bedding planes. Massive sandstones follow; then shaly sandstones. Thickness 300 to 400 feet. Underlies Gunther dolomite (new); overlies Cardenas lava series (new).

[C. R.] Keyes, 1939, Pan-Am. Geologist, v. 71, no. 1, p. 69. Name previously used for another unit and is abandoned in favor of the new name Aguja sandstone.

Name derived from the Rio Colorado Chiquito or Little Colorado River, opposite the mouth of which the strata are well exposed.

Chiquito sandstones[1]

Permian (Aubreyan series): Northern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 336.

Named for exposures in lower valley of Rio Chiquito Colorado in Grand Canyon region.

Chiricahua Limestone[1] (in Naco Group)

Permian: Southeastern Arizona and southwestern New Mexico.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 532, 536.

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, pt. 1, p. 498. Concha limestone is undoubtedly same unit which Stoyanow (1926, Am. Jour. Sci., 5th, v. 12; 1936) mentioned from the Chiricahua Mountains and correlated with the Kaibab. He proposed Chiricahua limestone for these beds, but no type section was ever designated or described, and term has seldom been used by later writers. Suggested that terms Chiricahua limestone and Snyder Hill formation be suppressed and that term Concha limestone be used for the light-colored cherty limestones of southeast Arizona that contain Kaibab fauna and overlie Scherrer formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 41–43, pl. 1. Included in Naco group. In Peloncillo Mountains, term Chiricahua limestone is used for cherty limestone overlying Scherrer quartzite. Belived that Chiricahua limestone and Concha limestone are same stratigraphic unit and that the terms are synonymous; because of priority, term Chiricahua limestone should be retained. In Peloncillo Mountains, consists principally of thick-bedded light-gray medium-grained limestone containing irregularly shaped grayish-pink chert nodules. Estimated thickness 800 feet. Underlies McGhee Peak formation (new) of Bisbee group; intruded by Cienega Peak granite (new).

Exposed in Chiricahua Mountains near New Mexico border.

Chiricahuan series[1]

Upper Cambrian: Arizona and New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 4, 6.

Chisholm Shale[1]

Chisholm Formation

Chisholm Shale (in Bright Angel Group)

Middle Cambrian: Eastern Nevada, northwestern Arizona, southeastern California, and western Utah.

Original reference: C. D. Walcott, 1916, Smithsonian Misc. Colln., v. 64, no. 5, Pub. 2420, p. 409–410.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1158 (fig. 6), 1160. Thickness emended [type section] 137 feet. Overlies Lyndon limestone; underlies Highland Peak limestone.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., no. 34, p. 12 (fig. 2), 14–15. Underlies Peasley limestone (new); Highland Peak limestone restricted to exclude Peasley.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, p. 1794, 1816–1817, pl. 1. Geographically extended into western Grand Canyon area, Arizona, where it is about 99 feet thick. Underlies Peasley limestone and overlies Lyndon shale.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 32, 35. Geographically extended into Wah Wah Range, Utah, where it is 56 feet thick. Not distinguished from Peasley and Lyndon limestones

in House Range, and here the undifferentiated unit is named Millard limestone. Through discovery of Lyndon limestone in southeastern California, the Chisholm could be differentiated there. In Nopah-Johnnie region, Chisholm shale includes members 5F and 5G of Hazzard's (1937, California Jour. Mines and Geology, v. 33, no. 4) Cadiz formation.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2), 2414. Generalized discussion of designation of stratigraphic units. Chisholm shale is included in Bright Angel group in one area, and classed as member of Bright Angel shale in another area.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 339, pls. 32, 33. In Nye and Clark Counties, Nev., underlies Jangle limestone (new); conformably overlies Lyndon limestone.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 48 (fig. 3), 49–50. Proposed here that name Chisholm formation be applied to unit in House Range that Wheeler (1948) designated as Burnt Canyon limestone. Wheeler assigned only a 35-foot shale unit to the Chisholm in the Wah Wah Range. A second 10-foot shale bed with a *Glossopleura* fauna occurs about 150 feet above Chisholm shale of Wheeler. Proposed here that the entire 195-foot shale and limestone sequence be assignd to Chisholm formation. Elsewhere in eastern Great Basin, Chisholm shale occurs in middle of Millard limestone of Cohenour (1959) in Sheeprock Range and of Rigby (1958) in Stansbury Mountains. Further east, the Chisholm merges into lower part of Ophir shale and in Tintic and Ophir districts; to the west, the shales finger out. As defined in this paper, the Chisholm underlies the Dome and overlies the Howell in the House and Wah Wah Ranges and underlies the Peasley and overlies the Lyndon in Pioche district.

Type locality: Vicinity Chisholm mine and Half Moon Gulch, 2 to 3 miles northwest of Pioche, Nev.

Chisholm Creek Shale Member (of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5, 11–12. Soft blocky drab claylike shales which weather greenish. Locally, thin zones of red clay. Thickness approximately 40 feet. Underlies Carlton limestone member; overlies Annelly gypsum member (new).

Type locality: Along east branch of Chisholm Creek, beginning in SW sec. 35, T. 26 S., R. 1 E., Kechi Township.

Chisik Conglomerate Member (of Naknek Formation)[1]

Chisik Member (of Naknek Formation)

Upper Jurassic: Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 485, p. 68–69.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Chisik member, 300 to 600 feet thick, consists of a sandstone and a conglomerate facies. On south shore of Chinitna Bay and on Oil Bay, member almost entirely of sandstone. On east shore of Iniskin Bay, member consists of conglomerate which extends as a tongue into the sandstone. Conglomerate facies traced eastward to within 2 miles of Iniskin Bay, where it gradually interfingers with sandstone. Underlies unnamed siltstone member.

A. S. Keller amd H. N. Reiser, 1959, U.S. Geol. Survey Bull. 1058–G, p. 269–270, 287, pls. 29, 30. Martin and Katz (1912) originally applied name Chisik to a conglomerate at base of Naknek formation and treated it as a unit of formational rank overlying Chinitna shale and underlying Naknek formation. Martin (1926, U.S. Geol. Survey Bull. 776) treated the Chisik conglomerate as basal member of Naknek formation, and this is its present usage. The Chisik consists of irregularly banded marine conglomerate which, north of area of this report [Katmai region], may be as much as 1,000 feet thick. Underlies unnamed member of Naknek.

Type locality on Chisik Island, Cook Inlet region.

Chisna Formation[1]

Carboniferous: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 33, map.

Crops out at head of Chisna River and in hills east and west of the Chisna, central Copper River region.

Chisos Volcanics

Chisos Beds[1]

Upper Cretaceous and Tertiary: Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 60–67.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 16–17, pl. 1. Volcanics described in Terlingua district where they consist of lava flows, tuffs, and interbedded sedimentary rocks. Principal occurrence is at Fresno mine, where they unconformably overlap Boquillas flags. South of mapped area volcanics overlie Tornillo rocks in apparent conformity. Thickness not determined. Age cannot be closely estimated; probably ranges through uppermost Cretaceous well into Tertiary.

Named for Chisos Mountains, Brewster County.

Chispa Andesite[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 64.

Chispa Hills, Goldfield district.

Chispa Summit Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 271, 426, 431.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 23. Described in Van Horn Mountains. Formation is a marine sequence of flaggy limestone and calcareous shale that crops out in narrow band along western margin of mountains and in northwest-trending belt in central Van Horns south of Willoughby Windgap. Thickness at Chispa Summit 840 feet; section incomplete. Lower 150 feet composed predominantly of pale yellowish-brown flaggy fossiliferous microcrystalline limestone with interbeds of calcareous, illitic shale; above lower 150 feet limestone content decreases and rocks are mostly grayish-orange, gypsi-

ferous, calcareous illitic shale. Lies disconformably on Buda limestone; contact sharp. Underlies Tertiary Colmena formation.

First described in Chispa Summit region, western Jeff Davis County.

Chita Sand Member (of Catahoula Formation)[1]

Miocene: Eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 715, 717.

F. E. Smith, 1958, Soc. Econ. Paleontologists Mineralogists and Houston Geol. Soc. Guidebook Ann. Field Trip, p. 9 (columnar section), 13–14. Basal member of Catahoula. Underlies Onalaska clay member. Thickness 10 to 80 feet. Age of Catahoula, as used in Texas and Louisiana, is still in question. Columnar section of field trip area [Brazos River valley] shows Oakville-Catahoula as Miocene.

Type locality: Exposures along north facing escarpment near Chita, Trinity County.

Chitistone Limestone[1]

Upper Triassic: Eastern Alaska.

Original reference: O Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 426.

F.H. Moffit, 1938, U.S. Geol. Survey Bull. 894, p. 44–52, pl. 2. Bluish-gray limestone, prevailingly in thicker beds and with fewer and thinner shale partings than the overlying Nizina limestone. Black chert bodies of irregular form numerous in places. Thickness 1,900 feet in Nizina district.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Exposed at junction of Nizina and Chitistone Rivers, hence the name. Nizina-Tanana region.

Chitka Point Formation

Tertiary or Quaternary: Alaska.

H. A. Powers, R. R. Coats, and W. H. Nelson, 1960, U.S. Geol. Survey Bull. 1028–P, p. 539–541. pl. 69. Lava flows and flow breccia of porphyritic andesite, interbedded with marine conglomerate; conglomerate confined to lower part of formation; lava flows and breccia emplaced above water form upper part; at type section, contains carbonized broken fragments of woody material. No complete section compiled but thickness probably exceeds 1,000 feet. Overlies Amchitka formation (new) with angular unconformity, and dikes of porphyritic rock similar to lava of Chitka Point cut Banjo Point formation (new) and Amchitka formation; south of Chitka Point, underlies gravel deposit of hornblende andesite. Age estimated as middle to late Tertiary; no evidence to rule out possibility that formation might be early Quaternary.

Type locality: At Chitka Point, Amchitka Island (Aleutian Islands). Underlies most of mountainous west half of island.

Chittenango Member (of Marcellus Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 131, 219.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Identification of Stony Hollow member (new) as sandstone equivalent of Cherry Valley limestone helps clarify section along Catskill Front. Beds hitherto classified as "Marcellus" shale (Bakoven of Chadwick) immediately underlie the Stony Hollow member and are now proved to be equivalent of Union Springs member. The Stony Hollow underlies Mount Marion formation of Grabau at its type section; consequently the Mount Marion is interpreted as sandy facies of Chittenango black shale member overlying the Cherry Valley to the west.

G. A. Cooper, 1943, *in* Winifred Goldring, New York State Mus. Bull. 332, p. 249 [1946]. Name Berne member was designated to cover the gray sandy equivalents of the Union Springs, Cherry Valley, and Chittenango members. Now that the Cherry Valley equivalent has been definitely recognized, the name Berne must be restricted wholly to the Chittenango sandy shale equivalent about 100 to 150 feet thick.

R. E. Stevenson, 1948, New York State Sci. Service Rept. Inv. 1, p. 2 (chart). Chart shows Chittenango member overlies Cherry Valley and underlies Bridgewater member.

Type section: In small gully 0.7 mile north of village of Chittenango Falls, Madison County.

Chiulos Shale Member (of Great Blue Formation)

Upper Mississippian: Western Utah.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 90–93, 170, 172, 174–175, pls. 1, 21. Primarily black fissile shale with many interbedded ribs of quartzite near center. Thickness about 1,818 feet. Overlies a lower limestone member about 911 feet thick; in fault contact with upper limestone member that is about 1,410 feet thick.

Described in Sheeprock Mountains, Tooele and Juab Counties.

Chiva Chiva Andesite

Oligocene or Miocene: Panamá.

[T. F. Thompson] 1943, Panama Canal, Spec. Eng Div., 3d Lock Proj., pt. 2, chap. 3, p. 26. Light-gray andesite porphyry. In intrusive contact with an agglomerate of basement complex. Occurs as thick dike or elongated plug. Pre-Pliocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 331–332. Type locality stated. Oligocene or Miocene.

Type locality: Quarry 6.5 kilometers northeast of Pedro Miguel, C.Z. Chiva Chiva is name of group of houses about 3 kilometers northeast of Pedro Miguel. Road that runs by quarry is called Chiva Chiva Road.

Chiwapa Sandstone Member (of Ripley Formation)

Upper Cretaceous: Northeastern Mississippi.

F. F. Mellen, 1958, Mississippi Geol. Survey Bull. 85, p. 49–54. Proposed for a sand or sandstone member at top of Ripley formation throughout outcrop belt of the unit in Clay, Chickasaw, Union, and Tippah Counties. Characteristically a "bored" or "horseshoe" limestone or calcareous sandstone; irregularly indurated. Thickness approximately 80 feet. Overlies Ripley marlstone; coarseness of Chiwapa sands suggests possibility of unconformity; separated from overlying Prairie Bluff-Owl Creek by sharp contact that may represent an unconformity or diastem.

Type locality: On branch of Chiwapa Creek at old CWA rock quarry 1½ miles south of Pontotoc in NW¼NW¼ sec. 16, T. 10 S., R. 3 E., Pontotoc County.

Chiwaukum Schist

Pre-Ordovician: Central Washington.

B. M. Page, 1940, Stanford Univ. Abs. Dissert., v. 15, p. 118. Mainly quartz feldspar, biotite, and graphite. Younger than Swakane gneiss.

R. M. Pratt, 1959, Dissert. Abs., v. 19, no. 12, p. 3278. Oldest rock units in Mount Stuart area are Chiwaukum schist and Peshastin slate. The Chiwaukum is a banded staurolite-kyanite-garnet-bearing quartz-biotite schist characterized by much carbonaceous matter and numerous quartz lenses.

First described in area northwest of Wenatchee, Chelan County. Mount Stuart area includes parts of Chelan, Kittitas, and King Counties.

Chloride Formation[1]

Devonian or Mississippian(?): Southwestern New Mexico.

Original reference: C. R. Keyes, 1904, Am. Jour Sci., 4th, v. 18, p. 360–362.

Probably named for town in northwestern part of Sierra County.

Chloride Granite

Precambrian(?): Northwestern Arizona.

M. G. Dings, 1951, U.S. Geol. Survey Bull, 978–E, p. 129–130, pl. 18. Light-gray medium-grained gneissoid granite. Gneissic structure, which is general conforms to schistosity of older folded rocks, in many places grades into a schist as borders of older rocks are approached. Locally granite shows considerable variation in texture, ranging from fine to moderately coarse. Weathers yellowish brown. Has intruded amphibolite and older granite gneisses. Formerly a part of Ithaca Peak porphyry.

Exposed north and northwest of Chloride, in Wallapai mining district, Mohave County.

Chloridian series[1]

Upper Cambrian: Arizona and New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 4, 6.

Chloropagus Formation

Miocene, upper, to Pliocene, lower: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 95–97, 138–139, figs. 5, 6, 8. Section exposed in Green Hill area is (ascending) basalt more than 500 feet; breccia and agglomerate, 500 feet; basalt, 200 feet; tuff and breccia grading to siliceous shale, 50 feet; basalt, 450 feet; siliceous shale, 5 feet; tuffaceous sandstone and shale, 15 feet; basalt, 200 feet. Aggregate thickness over 1,920 feet. Base not exposed in Hot Springs Range but supposedly rests on basement rock. Conformably underlies Desert Peak formation (new). Southwest of Fallon, conformably overlies Old Gregory formation (new). Rocks show several important facies changes as they are traced away from Chloropagus.

Type area in middle foothills of Hot Springs (Kawsoh) Mountains 1 to 2 miles north of Desert Peak, in vicinity of Green Hill *(chloropagus)*, Desert Peak quadrangle. Identified over wide area in western Trinity

Range to north, and also crops out 30 miles north of Desert Peak, and adjacent hills to northeast and southwest.

†Choccolocco Shale[1]

Lower Cambrian: Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 148, map.

Named for Choccolocco, Calhoun County.

Chocolay Group

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Oldest of the four groups in the series. As defined here, equivalent to the Lower Huronian of earlier reports. Comprises (ascending) Fern Creek formation, Sturgeon quartzite, and Randville dolomite and their stratigraphic equivalents. In parts of Iron and Dickinson Counties, only unit of group is Randville dolomite (in southern Iron County, its partial correlative, the Saunders formation); Mesnard quartzite and Kona dolomite, exposed at Mount Chocolay and adjacent area to the west, are accepted as direct correlatives of Sturgeon quartizite and Randville dolomite. Group unconformably overlies post-Dickinson granitic rocks; underlies Menominee group.

Named for Mount Chocolay and for Chocolay Junction on the Duluth, South Shore, and Atlantic Railroad, about 3 miles southeast of Marquette, Marquette County.

Chocorua Granite[1]

Upper Devonian or Upper Carboniferous: Northern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Geology of New Hampshire, pt. 1, p. 508–545.

Well exposed on Mount Chocorua, Carroll County.

†Choctaw Buhrstone (in Claiborne Group)[1]

Eocene, middle: Southern Alabama and Mississippi.

Original reference: W. J. McGee, 1890, Am. Jour. Sci., 3d, v. 40, p. 27, 30, 32.

Name probably derived from the broad belt of the formation across Choctaw County, Ala.

†Choctaw Limestone[1]

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: F. W. Cragin, 1894, Colorado Coll. Studies, v. 5, p. 41.

Named for Choctaw Creek, Grayson County.

†Choctawhatchee Formation[1]

Choctawhatchee Stage

Miocene, middle and upper. Western and northeastern Florida.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 114–122, table.

R. H. Smith, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 264, 269–272. Term Permenters Farm beds proposed for beds that lie above *Arca* zone in Choctawhatchee formation. Beds have been assigned to overlying *Ecphora* zone by earlier workers. Formation includes (as-

cending) *Yoldia* zone, *Arca* zone, Permenters Farm beds, *Ecphora* zone, and *Cancellaria* zone.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 168. Name Choctawhatchee formation abandoned. *Yoldia* and *Arca* zones transferred to Shoal River formation; *Ecphora* and *Cancellaria* zones classified as Duplin marl.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table), 18 (fig. 2), 27–36, fig. 3. Choctawhatchee stage includes all Miocene sediments of post-Alum Bluff age in Florida panhandle and their equivalents in Central and Western Gulf States. In Florida panhandle, four biofacies, *Yoldia*, *Arca*, *Ecphora*, and *Cancellaria*, are recognized. These biofacies considered faunizones within Choctawhatchee formation. Type exposure of formation designated as type exposure of stage. Term Permenters Farm beds dropped.

Named for exposure on Choctawhatchee River, Walton County.

Chokecherry Dolomite[1]

Chokecherry Dolostone

Upper Cambrian and Ordovician(?): Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 24. Chokecherry dolomite is equivalent to both Notch Peak limestone (Upper Cambrian) and Pogonip group of Lower Ordovician age. Proposed that Cambrian part of Chokecherry dolomite be renamed Notch Peak and Ordovician part be renamed Pogonip formation.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1067–1068. Cambro-Ordovician boundary lies within the Chokecherry dolostone; approximately lower third of formation is Late Cambrian and remainder Early Ordovician, the boundary being at change from thick-bedded to thin-bedded rocks. Overlies Hicks formation. Discussion of Deep Creek Mountains area.

L. F. Hintze, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 50. Recommended that terms Chokecherry dolomite and Opohonga limestone be abandoned in Gold Hill and Tintic mining districts.

A. R. Palmer, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B290. In Deep Creek Range, Utah, Chokecherry dolomite overlies Corset Spring shale, geographically extended into this area.

U.S. Geological Survey currently designates the age of the Chokecherry Dolomite as Upper Cambrian and Ordovician(?) on the basis of faunal studies.

Named for exposures in Chokecherry Canyon just south of Gold Hill quadrangle.

Cholla Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 10, 16, pl. 27. Consists of following divisions (ascending): white shaly sandstone with numerous fragments of silicified wood, buff-streaked sandstone, platy

thin-bedded shale, crossbedded and streaked sandstone, light-buff limestone, crumbly yellow shale, gray limestone, friable light-yellow sandstone, crossbedded pinkish sandstone, platy light-colored sandstone, and massive crossbedded sandstone. Thickness 68 feet. Underlies unnamed shale and sandstone division; overlies unnamed limestone and sandstone division.

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Cholla Canyon Tongue (of Cliff House Sandstone)

Upper Cretaceous: Northwestern New Mexico.

P. T. Hays and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144, sheet 1. Described as small tongue of Cliff House sandstone in Menefee formation. As a result of this tonguing, approximately 60 feet of beds at top of Menefee formation are replaced northeastward by Cliff House sandstone. Contacts are sharp.

Exposed within southeasterly trending band about one-half mile wide and about 3 miles southwest of edge of Barker Dome tongue. These exposures are along southwestern flanks of Barker and Southern Ute Domes and are especially well developed at the head of Cholla Canyon, in secs. 9, 10, and 15, T. 31 N., R. 14 W., San Juan County.

Chopaka Basic Intrusives[1]

Carboniferous(?): Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Caps Chopaka Mountain, Wash.

Chopaka Schist[1]

Carboniferous(?): Central northern Washington.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Caps Chopaka Mountain.

Choptank Formation[1] (in Chesapeake Group)

Miocene, middle: Eastern Maryland and Virginia.

Original reference: G. B. Shattuck, 1902, Science, new ser., v. 15, p. 906.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 77–78. Consists of fine yellow quartz sand, bluish-green sandy clay, slate-colored clay, and, locally, ledges of indurated material. Two well-defined fossil zones. Thickness variable; 50 feet at Nomini Cliffs, Va., where entire formation is exposed between St. Mary's formation above and Calvert formation below.

L. W. Stephenson and F. S. MacNeil, 1954, Geol. Soc. America Bull., v. 65, no. 8, p. 733–738. Yorktown formation geographically extended into Maryland where it transgresses both the St. Marys and Choptank formations.

Named for exposures on Choptank River, Md., a short distance below Dover Bridge, Talbot County.

Choptankian Substage

Miocene, middle: Maryland, New Jersey, and Virginia.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 767, 768. Substage based on microfaunal assemblages; includes all sediments deposited in central Atlantic Coastal Plain province during time of accumulation of Choptank formation, type exposure of which is considered exemplary of the substage. In sequence, the Choptankian succeeds Calvertian substage and is followed by St. Marysan substage.

Chorrera Basalt

Oligocene or Miocene: Panamá.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2). Listed on correlation chart together with Cerro Gigante basalt and Bruja dolerite. Units are unconformable below Gatún formation and above upper Caimito members. Lower Miocene. "Basalt" is used in this paper as field term applied to basic fine-grained igneous rocks including "andesite" and "basalt."

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat. v. 5, Amérique Latine, fasc. 2a, p. 332. Oligocene or Miocene.

Occurs in Gatún Lake area.

Chota Formation

Middle Ordovician: Eastern Tennessee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 141, 145 (chart), 157–160, pls, 27, 28. Name applied to a unit which is formed dominantly of gray quartzose calcarenite, 550 to 900 feet thick, and which is underlain by Tellico formation and overlain by Sevier formation. Formation is thinnest in northeast part of homocline; thickens to northeast to 650 feet 3 miles southwest of its truncation by Guess Creek fault; at type locality 900 feet. This is same unit as "sandstone lentil of the Sevier formation" of Keith (1895, 1896) and Holston formation of Rodgers (1953) as mapped in this area.

Type locality: Near Chota School, on Tennessee Highway 72, Vonore quadrangle, Monroe County.

†Chouteau Group[1]

Mississippian: Missouri.

Original reference: G. C. Broadhead, 1874, Missouri Geol. Survey, v. 1, p. 26–65.

Chouteau Limestone[1]

Chouteau Group

Chouteau Limestone (in Easley Group or Sulphur Springs Group)

Lower Mississippian: Central and eastern Missouri and southwestern Illinois.

Original reference: G. C. Swallow, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 1, p. 101, sections opposite p. 98, 103.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3. p. 189–202. Formation in southwestern part of State includes (ascending) Compton, Northview, Pierson, and Reeds Spring members; in southeastern part of State, includes Fern Glen member; in central part of State, includes

Sedalia member; in northeastern part of State, undifferentiated. Underlies Burlington limestone; overlies Hannibal shale or Bushberg sandstone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. Chouteau limestone included in Easley group (new). In standard Mississippian section, occurs above Maple Mill shale and below Gilmore City limestone.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 46–56. Formation described in Boone County, where it is as much as 68 feet thick. In this report, name Chouteau is used in unrestricted sense of Swallow. Term is applied to the limestone between the Bushberg sandstone and Burlington limestone. In Sulphur Springs group. Weller placed the Chouteau in Easley group, but this term has not been generally accepted in Missouri. Kinderhookian.

E. L. Clark and T. R. Beveridge, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71–75. [Reprinted from Kansas Geol. Soc. Guidebook 16th Regional Field Conf.] Redefined as group to include (ascending) Compton, Sedalia, and Northview formations. This usage follows Broadhead (1874) by using Chouteau in unrestricted sense and ranking it as a group. At the time that Moore (1928) restricted the Chouteau, he believed the Kinderhookian-Osagean line to be between the Chouteau (restricted) or Compton and Sedalia. The Kinderhookian-Osagean line is now believed to be at the top of the Northview. Overlies Sylamore formation; underlies Pierson formation.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 31–35. Chouteau is used in this report for the limestone that in western and central Illinois rests conformably on Maple Mill formation and in eastern and southern Illinois on New Albany formation. Uppermost limestone of Kinderhook series in these areas and is unconformably overlain by Osage group of Valmeyer series.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 39–42. Formation described in Bowling Green quadrangle where it is as much as 25 feet thick. Overlies Hannibal formation; underlies Burlington formation. The Reeds Spring and Pierson formations are not of Chouteau age, as Branson (1944) believed, but are younger than the Chouteau.

Charles Collinson and A. J. Scott, 1958, Illinois Geol. Survey Circ. 254, p. 3, 5–6. In southern Illinois, Chouteau limestone underlies State Pond member (new) of Springville formation and is uppermost unit in Kinderhook series. Thin and discontinuous; thickness not more than 2 or 3 feet.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook Field Trip St. Louis Mtg., p. 24 (fig. 3), 46 (fig. 8), 49–51. Described in western Illinois where it is as much as 70 feet thick. Overlies Hannibal shale; underlies Sedalia formation. Beds to which name Chouteau is applied in Illinois probably correlate with Compton limestone of Chouteau group in type area.

Named for Chouteau Springs, Cooper County, Mo.

†Chowan Formation (in Columbia Group)[1]

Pleistocene: Eastern North Carolina, eastern Maryland, and eastern Virginia.

Original reference: W. B. Clark, 1910, Geol. Soc. America Bull., v. 20, p. 651.

Named for Chowan River, N.C.

Choza Formation[1] (in Clear Fork Group)

Lower Permian (Leonard Series): Central and central northern Texas.

Original reference: J. W. Beede and V. V. Waite, 1918, Texas Univ. Bull. 1816, p. 49, map.

M. G. Cheney, 1940, Am Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Assigned to Clear Fork group. Underlies San Angelo sandstone of El Reno group; overlies Vale formation. Includes Merkel dolomite member. Leonard series.

E. C. Olson, 1951, Jour. Geology, v. 59, no. 2, p. 178–181. Vertebrate fauna discussed.

C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, chart 7. Chart shows Choza formation below San Angelo [sandstone] of Pease River group; El Reno group not used in Texas.

Named for Choza Mountain, near Tennyson, Coke County.

Christine Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

H. D. McCallum, 1947, South Texas [Geol. Soc. Guidebook] 14th Ann. Mtg. Field Trip, p. 5. Third member of the Yegua. Contact with underlying Cistern member (new) is within a graben.

Named for town of Christine, Atascosa County.

Christy Creek Siltstone Member (of Brodhead Formation)

Lower Mississippian: Northeastern Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 179, 180–182, pl. 17. Massive siltstone at base of Brodhead formation, Morehead facies (new). Commonly 80 to 90 feet thick; 130 feet thick at type locality. Underlies Frenchburg siltstone member (new).

Typical exposure: Steep valley bluff and hillside slope above north side of Christy Creek valley, immediately north of State Highway 32, just east of Deep Fork Branch, 3¾ miles east of Morehead, Rowan County. Name taken from Christy Creek, a tributary to Triplett Creek. Can be traced northward to Ohio River where it is at horizon of Byer member of Logan formation in Scioto County, Ohio.

Chrysler Limestone

†Chysler Waterlime[1]

Upper Silurian and Lower Devonian: Central New York.

Original reference: G. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, p. 81.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 534, chart 3. Term Chrysler was proposed by Chadwick for beds here called Rondout. Beds called Rondout in this column include more than those to which name has latterly been confined in type region in east, but agree with those to which name was originally applied there; hence, Chadwick now considers his term Chrysler to be superfluous.

U.S. Geolgical Survey currently designates the age of the Chrysler Limestone as Upper Silurian and Lower Devonian on the basis of a study now in progress.

Named for Chryslers Glen, Syracuse quadrangle.

Chuar Group[1]

Chuar Series

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: C. D. Walcott, 1883, Am. Jour. Sci., v. 26, p. 439–442, 484.

J. F. Mason, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 350. Incidental mention of Chuar series.

C. E. Van Gundy, 1941, Geol. Soc. America Bull., v. 62, no. 8, p. 953, 954, pl. 1. Upper group of Grand Canyon series. Stratigraphically restricted; lower member reassigned to Nankoweap group. Thickness in Basalt Canyon, 5,098 to 5,323 feet. Disconformably overlies Nankoweap group.

Named for Chuar Valley, Grand Canyon region.

Chuarian series[1]

Precambrian: Northern Arizona and New Mexico.

[Original reference]: C. R. Keyes, 1906. Am. Jour. Sci., 4th ser., v. 21, p. 298.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107, 109, 111. In Grand Canyon of Arizona, Chuaran series includes the following formations: Chiquito, Gunther, Jupiter, Oso, Venus, Marble, and Final. Older than Kwaguntan series (new); younger than Cardenas lava series (new).

Grand Canyon region.

Chubb Siltstone Member (of Maroon Formation)[1]

Chubb Siltstone Member (of Minturn Formation)

Pennsylvanian or Permian: Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 971–1009.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleontology Contr., v. 6, no. 4, p. 59–70. Mentioned in discussion of some Paleozoic plants from central Colorado and their stratigraphic significance. Plants are not proof of Permian or even late Pennsylvanian age.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 43, pls. 1, 8. Described in South Park area where it is 1,827 feet thick at type locality. Underlies Pony Spring siltstone member; overlies Coffman conglomerate here included at top of Weber(?) formation.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 820, 836, pls. 1, 8. Chubb siltstone considered member of Minturn formation in this report [Permo-Pennsylvanian zeugogeosyncline, Colorado and New Mexico]. Underlies Pony siltstone member and overlies Coffman conglomerate here considered member of Minturn. Assumed to be Desmoinesian because of position in section.

Type locality (Stark and others): East side of Chubb Gulch in sec. 16, T. 13 S., R. 77 W., Park and Chaffee Counties.

Chubbuck Marble Member (of Essex Series)

Precambrian: Southern California.

J. C. Hazzard and E. F. Dosch, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 309. A marble, quartzite, and schist unit, 500 to 600 feet thick. Middle member of series; overlies a basal quartz-feldspar-biotite gneiss and underlies an upper 5,000-foot unit of quartz-feldspar-biotite gneiss.

Occurs in the Piute and Old Woman Mountains, San Bernardino County. [Probably named from Chubbuck on the Santa Fe Railroad.]

Chuckanut Formation[1]

Eocene: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. in Geology, v. 2, p. 93, 136–138.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 75–90. pl. 11. Essentially massive crossbedded to stratified medium- to coarse-grained grayish-brown to brownish-gray sandstone; subordinate amounts of sandy shales, varying in color from gray to light and dark brown; lenses of conglomerate locally as much as 100 feet thick. Two type sections measured: along Chuckanut Drive on east shore of Samish Bay, thickness 11,272 feet, and along west shore of Lake Whatcom, thickness 8,930 feet. Field and drill hole evidence indicates total thickness may be more than 16,000 feet in western Whatcom County. Formation may represent time interval beginning in late Cretaceous and continuing into middle or possible late Eocene. Overlies schists and igneous rocks.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 59). Listed on Cretaceous correlation chart with note that unit may be all Tertiary.

Well exposed along Chuckanut Drive on Pacific Highway, western Whatcom County.

Chuckwalla Complex

Precambrian: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 16–20. Diorite-granite complex, locally including migmatities and banded gneiss and some involved metasediments. In Maria Mountains, unconformably underlies Paleozoic Maria formation (new); in Orocopia Mountains, in fault contact with Orocopia schist (new), considered younger. In Little San Bernardino Mountains, Chuckwalla complex is cut by Fargo Canyon diorite (new).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 491. Granite of Chuckwalla complex named Berdoo granite.

Named for exposure in Chuckwalla Mountains, Palm Springs-Blythe area, Riverside County.

Chuctanunda Creek Dolomite or Formation

Lower Ordovician (Lower Canadian): East-central New York.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 77, 90–92. Name proposed for sequence of medium- to thick-bedded buff-weathering blue-gray medium-grained dolomites. Lower half is dark-blue to gray variegated noncherty coarse dolomarenite, locally laminated; small amounts of silt and angular sand present. Upper half is a siliceous dolomilutite, fine- to medium-grained, brownish-gray to blue-gray, and markedly cherty with much interstitial silica; chert mainly stringy or hackly. Thickness 40 feet at type locality. Unconformably underlies Cranesville dolomite (new); unconformably overlies Tribes Hill forma-

tion (Fonda member, new). Offlaps Tribes Hill formation in a northward direction.

Named for exposure along North Chuctanunda Creek within city of Amsterdam, Montgomery County.

Chuctenunda[1]

Chuctenunda Shale Member (of Canajoharie Shale)

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann and C. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 119. Referred to as Chuctenunda shale member of Canajoharie. Overlies Fort Plain shale member; underlies Gansevoort shale member.

Type locality and derivation of name not given but may have been named from Chuctenunda Creek near Amsterdam, Montgomery County.

Chucunaque Formation

Miocene or Pliocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie. Heidelberg, v. 8, Abt. 4a, no. 29, p. 133, 134 (correlation chart). Underlies Piliguilla conglomerate; overlies Pucro sandstone. Upper Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 332. Undefined name; also used by Terry (1956, California Acad. Sci. Occasional Paper 23) without definition. Miocene or Pliocene.

In Darién area.

Chugwater Formation[1]

Chugwater Group

Permian and Triassic: Wyoming, Colorado, and central southern Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 12, 41–48, pl. 17. In present discussion [southern margin Absaroka Range], term Chugwater formation is applied to all strata between Dinwoody and Sundance formations. Thickness 1,250 feet. Comprises (ascending) Red Peak (new), Crow Mountain (new), Popo Agie, and Gypsum Spring (new) members. Triassic.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2; 1950, Nebraska Geol. Survey Bull. 13–A, p. 2 (fig. 2), 3. Chugwater as now used in Wyoming is synonymous with Spearfish (redefined). Freezeout tongue of Chugwater is here designated as a member or formation in Phosphoria group.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 133–136. Rank raised to group. Compromises (ascending) Dinwoody formation, Red Peak formation, Alcova dolomite, Crow Mountain formation, Popo Agie formation, Wyopo formation (new), and Gypsum Spring formation. Overlies Phosphoria; underlies Sundance. Triassic.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 17. Name, Chugwater, has been used as both a group and a formation name by various investigators. Some authors have included the Dinwoody formation in the Chugwater along with four younger

Triassic units—the Red Peak, Alcova. Crow Mountain and Popo Agie—and two Jurassic formations—the Nugget ("Wyopo") and Gypsum Spring. Chugwater as used in present report [central Wyoming] is considered to be a formation 1,000 to 1,250 feet thick, overlying Dinwoody formation and underlying the Nugget, Gypsum Spring, and younger Jurassic formations. Comprises (ascending) Red Peak, Alcova, and Popo Agie members. Triassic.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 51–52, pl. 6. Formation described in Crazy Woman Creek area, Johnson County, Wyo., where it overlies Permian red shale and gypsum sequence and is unconformably overlain by Gypsum Spring formation. Thickness 750 to more than 800 feet. In most places, divisible into three units (ascending): Red Peak, Alcova, and Crow Mountain members. Threefold division feasible only where Alcova member is present. Triassic.

C. A. Burk and H. D. Thomas, 1956, Wyoming Geol. Survey Rept. Inv. 6, p. 5, 6 (fig. 1). Overlies Goose Egg formation (new) at type section of Goose Egg formation.

N. C. Privrasky and others, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 52–54. Chugwater, as redefined by Darton (1908) for Laramie basin, included sediments between Jurassic Sundance formation and Permian Forelle limestone. Chugwater of present report is restricted to sediments beneath the Sundance and above Goose Egg formation which includes, in part, Forelle limestone member, lower unnamed shale member, Ervay limestone member, and upper unnamed shale member. Formation comprises (ascending) Red Peak shale, Alcova limestone, Crow Mountain sandstone, and Popo Agie shale.

W. P. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 26–28, pls. Formation, in Buffalo-Lake De Smet area, Wyoming, consists chiefly of dark-red siltstone, sandstone, and shale. Forms conspicuous band of red outcrops adjacent to east flank of Bighorn Mountains in southwestern, west-central, and northwestern parts of area. Thickness 810 feet. Three members recognized: lower, similar to Red Peak member in central Wyoming; middle, tentatively correlated with Alcova member; and upper, similar to Crow Mountain member in central Wyoming. Unconformably underlies Gypsum Spring formation; overlies unnamed sequence of red shale, siltstone, and gypsum, about 180 feet thick, which unconformably overlies Tensleep sandstone. Triassic.

T. A. Steven, 1960, U.S. Geol. Survey Bull. 1082–F, p. 338–339, pl. 12. Described in Northgate district, Jackson County, Colo., where it is about 690 feet thick on northern flank of Sentinal Mountain. Nonmarine strata chiefly impure red shales and sandstones. Underlies Sundance formation; overlies Forelle(?) limestone. Permian and Triassic.

Named for Chugwater Creek near Iron Mountain, Wyo.

Chumway Rhyolite

Oligocene: Central Colorado.

J. E. Bever, 1954, Dissert. Abs., v. 14, no. 7, p. 1088. Oligocene extrusive rocks are here named Guffey volcanics with the upper section correlated with Thirty-nine Mile andesite series, and the lower section here designated the Chumway rhyolite. They covered most of area with flows and tuffs thousands of feet thick.

Guffey area [Park County].

†Chupadera Formation[1]

Permian: New Mexico.

Original reference: E. H. Wells, 1919 [1920], New Mexico State School Mines Bull. 3, p. 10–11, 17–18.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 668 (footnote). Term abandoned.

Christina Lochman-Balk, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 100. Recent mapping has recognized the Yeso, Glorieta, and San Andres formations; term Chupadera has lapsed from usage and should be abandoned.

Named for Chupadera Mesa, eastern Socorro County.

Church Limestone Member (of Howard Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, Iowa, southern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull., 2d ser., v. 1, p. 42, 54.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 170 (fig. 34), 173–174. Most persistent and important limestone member of Howard formation. Commonly a single massive bed of dark-blue to blue-gray limestone. Thickness ranges from about 1½ to 6 feet, the average a little more than 2 feet. Underlies Winzeler shale member; overlies Aarde shale member. Where Bachelor Creek limestone is absent and Aarde shale cannot be differentiated, Church limestone is considered as forming basal unit of the Howard, resting on Severy-Aarde shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 19. Mentioned as occurring in Iowa and Missouri.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 19–20. Church, Winzeler, and Utopia members of Howard limestone are readily distinguishable in Missouri as the two thin limestones with intervening shale described as units of the Howard by McQueen and Greene (1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5).

Named for Church Farm, on Turner Creek, southeast of Du Bois, Nebr.

Church Creek Beds

Eocene to Oligocene: Southern California.

Parry Reiche, 1937, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 7, p. 144–146, geol. map. Sandstones and siltstones; lower part buff heavy-bedded well-cemented feldspathic sandstone; upper part interbedded buff and gray finer less well indurated sandstones and siltstones, with minor dark gray mudstones. Thickness about 600 feet. Bounded above by Church Creek fault and below by depositional contact with crystalline basement.

Area of study is Santa Lucia quadrangle, southwestern Monterey County.

Church Rock Member (of Chinle Formation)

Upper Triassic: Northeastern Arizona, southwestern Colorado, and southeastern Utah.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 448 (fig. 4), 459–460, 461 (fig. 8). Described in southeastern Utah where

it is composed of pale-reddish-brown and light-brown very fine grained sandy siltstone; siltstone may be structureless, horizontally laminated to very thick bedded, or, in places, ripple laminated. Sandstone more common in northern part of southeastern Utah where it includes unit termed Bowknot bed. Thickness ranges from wedge-edge to 400 feet in Utah. Conformably overlies Owl Rock member in most of southeastern Utah. Conformably overlies Moss Back member in San Rafael Swell, and unconformably overlies Moenkopi formation in Moab area. Disconformably underlies Wingate sandstone. Member thickens abruptly north of Elk Ridge area, probably by incorporating strata which are equivalent to Owl Rock farther south. Extends into Monument Valley, Ariz. Rock Point member of Wingate sandstone, which is largely, or entirely, the same unit as Church Rock member, is present in large part of Arizona and locally extends into west-central New Mexico. Name Church Rock is used in southeastern Utah and in areas in Arizona north of Laguna Creek, and name Rock Point member of Wingate is used in New Mexico and in areas of Arizona south of Laguna Creek. Church Rock member corresponds to A division of Chinle formation described by Gregory (1917 U.S. Geol. Survey Prof. Paper 93). Name credited to Witkind and Thaden.

J. H. Stewart and others, 1959, U.S. Geol. Survey Bull. 1046–Q, p. 517–520. In San Juan County, Utah, includes Hite bed (new).

Named for exposures in Monument Valley area, Arizona. In west-central Colorado, constitutes entire Chinle formation.

Church Run Conglomerate[1]

Pennsylvanian: Pennsylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38–40.

In hilltops at Church Run, Warren County.

Churn Creek Member[1] (of Cuyahoga Formation)

Churn Creek Shale Member (of New Providence Formation)

Churn Creek Siltstone and Shale Member (of Logan Formation)

Lower Mississippian: Southern Ohio and northeastern Kentucky.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 763.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 134, pl. 6. In upper part of New Providence column in Lewis County, Ky., siltstone beds become fewer as well as thinner, with argillaceous to silty shale becoming prevalent; no sharp break occurs between these two divisions. This upper zone, 75 to 100 feet thick, is interpreted as the "Churn Creek" of Hyde (1915) and termed Churn Creek shale member. Occurs above Vanceburg siltstone member in Vanceburg facies of formation. Considered Lower Mississippian.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 63–64. Churn Creek siltstone and shale member included in Vanceburg facies of Logan formation in Ohio. Underlies Vinton sandstone member; overlies Vanceburg siltstone member, but no dependable horizon separates the two, distinction being made on basis of larger sandstone content of Vanceburg.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 25. Here considered member of Cuyahoga formation in Vanceburg facies. Editor's

note states Hyde (1921, Ohio Geol. Survey Bull. 23) correlated Buena Vista sandstone with Berne and lower portion of Byer in discussing geology of Camp Sherman quadrangle; such a correlation would necessitate placing Rarden, Vanceburg, Churn Creek, and most of Portsmouth shale in Logan formation.

Named for Churn Creek, southeastern Adams County, Ohio.

Chusa Tuff Member (of Catahoula Tuff)[1]

Oligocene or Miocene, lower: Southwestern Texas.

Original reference: T. L. Bailey, 1926, Texas Univ. Bull. 2645, p. 65, 89–105, 178–179.

Named for exposures on slopes of La Chusa Mesa, in southeastern McMullen County.

Chuska Sandstone[1]

Pliocene(?): Northwestern New Mexico and northeastern Arizona.

Original reference: H. E. Gregory, 1916, U.S. Geol. Survey Water-Supply Paper 380.

J. T. Hack, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 350. Tentatively correlated with Bidahochi formation.

J. E. Allen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 11, p. 2569–2571. Overlies Tohatchi formation with angular unconformity. Thickness about 1,100 feet. Pliocene(?).

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 97–99. Massive crossbedded silica-cemented sandstone about 1,000 feet thick. Overlies, commonly with marked angular unconformity, formations ranging from Summerville upwards to Tohatchi formation of Mesaverde group. The Chuska is penetrated and overlain by volcanic rocks in vicinity of Washington Pass, 6 miles north of area [Tohatchi quadrangle]. Similar Tertiary beds occur between Gallup and Zuni 40 miles to south. Widespread similar sediments interbedded with volcanic debris near White Cone, Ariz., contain fossils indicative of an upper or middle Pliocene age. Chuska believed to be of upper Tertiary and probably Pliocene age.

C. A. Repenning and J. H. Irwin, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1821–1826. Because Bidahochi and Chuska formations are associated with apparently contemporaneous volcanic rocks and are lithologically similar, and because of the apparent comparison of the surfaces upon which the Bidahochi formation, the Chuska sandstone, and the Tertiary rocks of the Zuni Plateau were deposited, it is believed that the Chuska should tentatively be considered equivalent to lower member of Bidahochi.

H. E. Wright, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1829 (fig. 2), 1830, 1831. Gradationally overlies Deza formation (new).

H. E. Wright, Jr., 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 413–434. As restricted herein, forms cap rock of Chuska Mountains, which extend 60 miles along Arizona-New Mexico State line north of Gallup, N. Mex. Maximum thickness about 1,750 feet. Unfossiliferous; crossbedded throughout; contains no shale or conglomerate interbeds; several thin ash beds. Restricted Chuska and underlying Deza formation, together forming Gregory's Chuska sandstone, truncate Mesaverde group (Upper Cretaceous) and are unconformably overlain by middle or upper Pliocene

volcanics. Suggested Miocene(?) age based on physiographic data. Discussion of origin of Chuska sandstone. Theory of correlation of Chuska and Bidahochi considered unacceptable.

C. A. Repenning, J. F. Lance, and J. H. Irwin, 1958, New Mexico Geol. Soc. Guidebook 9th Field Conf., p. 123–129. Hack (1942) tentatively correlated the Chuska with the Bidahochi. Repenning and Irwin (1954) accepted and elaborated these correlations to the extent of tentatively correlating the Chuska with lower member of Bidahochi. Although this correlation seems within reason in light of present information, the reasoning used to defend it is, in some respect, in error. Formation currently assigned a Pliocene(?) age until more convincing evidence becomes available.

Named for Chuska Peak, McKinley County, N. Mex.

Cialitos Limestone

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 47, 48 (table 4). A distinctive creamy-white, coarsely crystalline limestone.

Occurs in Barrio Cialtos, Arecibo district.

Cibao Formation in Río Guatemala Group)

Cibao Limestone[1] or Marl

Oligocene and Miocene: Puerto Rico.

Original reference: B. Hubbard, 1920, Science, new ser., v. 51, p. 396.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas. Inv. Prelim. Map 85. Cibao marl included in Río Guatemala group (new). Consists of soft argillaceous marls, chalky limestones, and local thin beds of sand and clay. Best developed in inter-bioherm area and in western and eastern clastic basins. Maximum thickness approximately 230 meters midway between the Río Manatí and Río Indio in inter-bioherm area. Westward, entirely replaced by Lares limestone of western bioherm area. Upper 50 meters of Cibao continues in outcrop across eastern bioherm into eastern clastic basin. The Cibao becomes increasingly impure toward eastern extremity of outcrop area. Near eastern extremity, overlaps San Sebastián formation and rests on uneven surface of Cretaceous rocks. Transitional into upper Lares limestone. In western clastic area, contains sequence of predominantly clastic sediments herein named Guajataco member. Cibao marl is absent in vicinity of town of Florida, where western bioherm persisted until deposition of Aguada limestone (new) began. Some beds of the Cibao intervene between eastern bioherm and Aguada limestone. Middle Oligocene-lower Miocene, top uncertain.

Type locality: In barrio Cibao, north of Lares.

Cibola limestone[1]

Silurian(?): Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State printer, p. 3, 6.

Crops out at Cibola mill, at Silver City, Grant County.

Cibolo Formation[1]

Permian: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10–25.

J. W. Skinner, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 180–188. Contact with underlying Alta transitional. All except uppermost part of Cibolo of Udden is regarded as upper Wolfcamp in age. At type section, upper member of Cibolo is overthrust on limestones of upper Permian (Capitan) age.

C. C. Rix, 1952, Geologic map of Chinati Peak quadrangle, Presidio County, Texas: Texas Univ. Bur. Econ. Geology, Prelim. ed. Stratigraphically below Ross Mine formation (new). Leonard series.

Named for Cibolo Creek and Cibolo Ranch, Presidio County.

Cienda Limestone (in Pacheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12. Minutely clastic argillaceous limestone with glauconite in matrix and numerous larger inclusions of broken shell and chert. Weathers into round-edged slabs. Very rich in silicified ammonites. Thickness 4 feet. Underlies Black Knob dolomite (new); overlies Tusonimo limestone (new).

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Cienega Peak Granite

Cretaceous or Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 12–13, table 1, pl. 1. Holocrystalline equigranular fine-grained light-pink rock with hypidiomorphic texture. Intrudes Chiricahua limestone and basal conglomerate and sandstone of McGhee Peak formation (new). Probably intrusive into Granite Gap granite (new) in area south of Preacher Mountain fault. Lenses out north of Cienega Peak.

Forms an almost vertical sill or laccolith which makes up Cienega Peak, a prominent landmark on western side of Peloncillo Mountains just north of Granite Gap, Hidalgo County.

Cieneguilla Formation

Pennsylvanian (Des Moines): Northern New Mexico.

J. A. Young, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1247. Arkose, arkosic sandstone, arenaceous, carbonaceous, and calcareous shale, and thin beds of limestone. Thickness more than 2,200 feet. Upper beds interfinger with lower beds of a thick sequence of red arenaceous shale.

Exposed in valley of Coyote Creek, north of Black Lake, northern Sangre de Cristo Mountains.

Cieneguilla Limburgite.

Tertiary: North-central New Mexico.

C. E. Stearns, 1953, Am. Jour. Sci., v. 251, no. 6, p. 424 (fig. 3), 445–451. Proposed for series of flows and ejectamenta, with associated waterlaid beds, exposed in vicinity of La Cienega. Thickness at type locality 590 feet. At Cieneguilla, overlain with angular unconformity by Pleistocene

alluvium of Santa Fe Plateau, Pleistocene basalt of the Mesa Negra, and by younger alluvium in Santa Fe Creek. Base of section not exposed; maximum stratigraphic interval concealed estimated to be 50 feet. Underlain by Espinaso volcanics (new) and separated from them by time interval during which a small body of augite quartz latite was intruded, solidified, and exposed by subsequent erosion. Appears to be Oligocene or earliest Miocene.

Type locality: Canyon of Santa Fe Creek between settlements of Canyon and Cieneguilla, Cerrillos Hills, Galisteo-Tonque area.

Cieneguita Formation

Cieneguita Beds[1]

Middle and Upper Pennsylvanian: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10–25.

C. C. Rix, 1952, Geologic map of Chinati Peak quadrangle, Presidio County, Texas (1:48,000): Texas Univ. Bur. Econ. Geology, Prelim. ed. Formation consists of quartz-pebble conglomerate, coarse sandstone, sandy shale, and reef limestone. Underlies Alta formation. Strawn-Canyon (?), Cisco series.

Named for Cieneguita Ranch, Presidio County.

Cierbo Sandstone (in San Pablo Group)[1]

Cierbo Stage or Substage

Miocene, upper: Western California.

Original reference: B. L. Clark, 1921, Jour. Geology, v. 29, p. 586–614.

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 199–200. The Monterey comprises three substages (ascending): Briones, Cierbo, and Neroly. Substages can be recognized strandward by distinctive echinoderm faunas and by a number of more or less distinctive mollusks.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 40–42, pls. Formation described in Tesla quadrangle. Unit herein called Cierbo was described as undifferentiated Miocene by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603). A transgressive formation structurally involved in the regional folding and faulting. Rests with angular unconformity on Panoche; overlain conformably to unconformably by Neroly formation. Estimated maximum thickness about 500 feet. San Pablo group.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 78–80, pls. 11–13. Exposed in southern parts of Carquinez and Mare Island quadrangles and rests with erosional unconformity on Briones sandstone. In San Pablo area, approximately 900 feet thick; consists of basal unit composed of alternating layers of fine- and coarse-grained brownish-gray sandstone; upper 160 feet is yellowish- and brownish-gray concretionary medium-grained sandstone; crossbedded pebbly and conglomeratic sandstone rests on the concretionary sandstones, and the contact is regarded as top of Cierbo. Underlies Neroly sandstone. In Los Medanos Hills, unconformably overlies Markley sandstone.

J. W. Durham, 1954, California Div. Mines Bull. 170, chap. 3, p. 24 (fig. 2), 26 (fig. 4). Listed as megafaunal stage. Follows Briones and precedes Neroly.

C. A. Hall, Jr., 1958, California Univ. Pub. Geol. Sci., v. 34, no. 1, p. 26–27, fig. 2, geol. map. In Pleasanton area, the Cierbo is 750 to 2,000 feet thick. Overlies Briones formation; underlies Neroly sandstone. In some areas, underlies Livermore gravels with angular discordance. Upper Miocene. Term San Pablo group not used in this report. Considered advisable to redefine term San Pablo formation and designate Cierbo and Neroly as members.

Type section: South side of Canada del Cierbo near Carquinez Straits, Carquinez quadrangle, San Francisco Bay region.

Ciervian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 982–985, 1005. Uppermost of six stages, based on foraminiferal assemblages, in Upper Cretaceous column between top of Moreno and base of Panoche, as defined by Anderson and Pack (1915). Stage corresponds to Moreno shale at its type locality. Lower part of stage is represented by three facies, one composed of shales and the others of silty shales and silts. Includes interval between Paleocene Cheneyan stage (new) and Upper Cretaceous Ingramian stage (new).

Occurs in Great Valley in both surface and subsurface. Named after Ciervo Hills [Fresno County], in vicinity of which wells furnished typical material. Stage is well represented in upper 2,100 feet of Cretaceous strata exposed in Moreno Gulch, Fresno County.

Ciervo Shale (in Panoche Group)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Green shale and brownish-green sandstone. Thickness 3,470 feet. Includes Ortigalita sandstone member (new). Overlies Benito sandstone (new); underlies Marlife shale (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: Papanatas Canyon. Name derived from Ciervo Mountain in south-central sec. 5, T. 17 S., R. 13 E., Fresno County.

Cima Sandstone Lentil (in Dos Palos Shale Member of Moreno Formation)

Upper Cretaceous or Paleocene(?): Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1953; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 4), 9, 22–23, pls. 2, 3, 4, 5. A 60-foot lens lying 185 feet below top of Dos Palos shale member (new). On the basis of this mapping, it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch.

Type locality: Escarpado Canyon, secs. 7 and 8, T. 15 S., R. 12 E., Panoche Hills, Fresno County. Escarpado Canyon is 6 miles south of Moreno Gulch and 2 miles north of Panoche Creek. Cima is Spanish word for peak given to hill 1,800 feet south and 50 feet west of NE cor. sec. 7.

Cimarron Anhydrite (in Hennessey Formation)

Permian: Western Oklahoma.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). Shown on cross section as occurring near the base of the formation.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 106. Rejected by Oklahoma Geological Survey. Name preoccupied; used by Cragin (1896) for a Permian group in Kansas and by Keyes (1904) for the Permian of New Mexico.

Occurs in Woods County.

†Cimarron Formation[1]

Permian: New Mexico.

Original reference. C. R. Keyes, 1904, Am. Jour. Sci., 4th, v. 18, p. 360–362.

†Cimarron Group[1]

Cimarron Series

Permian: Central southern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 18–48.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677, 1678. Cimarron series of northern Midcontinent region should be abandoned and its constituent strata reclassified as belonging to Leonard series and Guadalupe series.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1764 (fig. 3), 1766–1814. Succeeding Milan limestone, top member of Wellington formation, without a break, are red shales and sandstones and higher evaporite beds of Kansas which constitute Cimarron series, which includes all succeeding Permian redbeds of the state, divided by Cragin (1896) into Salt Fork and Kiger divisions. Series comprises (ascending) Ninnescah shale, Stone Corral dolomite, Nippewalla group (new, which includes Harper sandstone redefined, Salt Plain formation, Cedar Hills sandstone, and Flowerpot shale), Blaine formation, Whitehorse formation, Day Creek dolomite, and Big Basin formation. Overlies Big Blue series.

G. E. Condra and E. C. Reed, 1959, Nebraska Geol. Survey Bull. 14A, p. 24–30. Formations of Cimarron series are well developed in northern Oklahoma and southern Kansas from which some of them extend subsurface to southern and western Nebraska and grade into Permian redbed section of Rocky Mountain, Laramie Range, Hartville, and Black Hills regions. Correlations discussed.

Named for Cimarron River.

Cimarron Creek Latite[1]

Miocene or Pliocene: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1907, U.S. Geol. Survey Geol. Atlas, Folio 153.

Exposed in drainage of Cimarron Creek in Ouray and Lake City quadrangles.

Cimarronian series[1]

Carboniferous: Texas.

Original reference: C. R. Keyes, 1909, Iowa Acad. Sci. Proc., v. 16, p. 159, 163.

Rio Grande Valley.

†Cincinnati Beds (proper)[1]

Middle and Upper Ordovician: Southwestern Ohio and north-central Kentucky.

Original reference: E. Orton, 1873, Ohio Geological Survey, v. 1, p. 370–387.

Named for exposures at Cincinnati, Ohio.

Cincinnati Group[1]

Upper Ordovician: Cincinnati arch region (surface and subsurface).

Original reference: F. B. Meek and A. H. Worthen, 1865, Philadelphia Acad. Nat. Sci. Proc., v. 17, p. 155.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, p. 513–547. Term Cincinnati group revived for body of rocks continuous with Cincinnatian series in Cincinnati arch region. In subsurface, group is composed of (descending) Maysville-Richmond formation and Eden shale. Exact relationships of Cincinnati group to underlying Trenton group not precisely known. Correlated with Maquoketa group.

Type locality: Region about Cincinnati, Ohio.

†Cincinnati Limestone[1]

Upper Ordovician: Southwestern Ohio.

Original reference: W. W. Mather, 1859, Rept. State House Artesian Well at Columbus, Ohio, p. 6.

Cincinnatian Series[1]

Cincinnatian Epoch[1]

Upper Ordovician: North America.

Original references: F. B. Meek and A. H. Worthen, 1865, Philadelphia Acad. Nat. Sci. Proc., v. 17, p. 155; J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 876, 877.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 90–93. Cincinnatian series as developed in Minnesota is essentially Maquoketa formation, which is often considered a group or series.

R. H. Flower, 1946, Bulls. Am. Paleontology, v. 29, no. 116, p. 107–120. Cincinnatian series comprises Covington subseries with Eden and Maysville groups, and Richmond subseries with Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations. Systematic description of cephalopods.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 2, chart 2. As shown on correlation chart, Cincinnatian series comprises Edenian, Maysvillian, Richmondian, and Gamachian (in Canada) stages.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, p. 513–547. Name Cincinnatian series, a time-stratigraphic term, is restricted to rocks of Late Ordovician age, wherever they occur. Most of "formations" assigned to Cincinnatian series are actually biostratigraphic zones. Name Cincinnati group revived for body of rocks continuous with type Cincinnatian series in Cincinnati arch region.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1068. There is general agreement as to how local section in Cincinnati region should be subdivided into formational units, but there are differences of opinion as to how these formations should be named and grouped into

larger units. If reference section of Cincinnatian in Cincinnati region is considered to include all strata between Point Pleasant (Cynthiana) beds and the Brassfield and their lateral equivalents, eight reasonably distinct formational units can be recognized in sequence. In ascending order, these are Eden, Fairview, McMillan, Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations. Eden formation may be considered reference standard for an early Cincinnatian Eden stage; Fairview and McMillan formations constitute standard for medial Cincinnatian Maysville stage; the Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define Richmond stage of Cincinnatian. Eden, Fairview, and McMillan rocks constitute Covington group, which contains standard section of both Eden and Maysville stages.

M. P. Weiss and C. E. Norman, 1960, Ohio Geol. Survey Inf. Circ. 26, p. 1–14, chart 1. Report traces development of stratigraphic classification of Ordovician rocks in Cincinnati region.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Cincinnatian series comprises Edenian, Maysvillian, and Richmondian stages. Boundary between Trentonian and Cincinnatian series has been defined variably because of selection of differing horizons in known successions and varying correlations between type sections in separated areas. Boundary in North America is taken invariably as separating "Middle" and "Upper" Ordovician, although in European terms assuming the Caradocian to be "Middle," the American boundary lies within the Cincinnatian under any definition of series. With respect to base of Cincinnatian or "Upper Ordovician," using New York stages as applied herein, the boundary has ranged from the base to the top of the Pictonian. In present report, the lower series boundary is placed above all the Utica; the Pictonian is placed at top of Trentonian.

Type locality: Region about Cincinnati, Ohio.

Cincinnatus Sandstone[1]

Upper Devonian: Central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 24, chart.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown as shale and sandstone. Underlies Kattel shale.

Typical exposures along Otselic River. Named from Cincinnatus Township, Cortland County.

Cinder Cone Basalts, Lavas, Tuffs

Recent: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci. v. 21, no. 8, p. 225, 374, 375. Names applied to basalts at Cinder Cone. Latest activity at Chaos Crags and Cinder Cone belongs to last few centuries.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta, v. 8, p. 82. Mentioned in report on uranium geochemistry of Lassen volcanic rocks.

Cinder Cone is in Lassen Volcanic National Park.

Cinnamon Ridge Member (of Flat Ridge Formation)

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 48, 49, 51–52, pls. 1, 60. Blue dense basalt, with veins of epidote and red jasper, a green amygdaloidal basalt with epidote-filled vesicles,

and a tuff. These are underlain by an agglomerate and flow breccia containing angular blocks of purplish-blue flow-banded vesicular basalt, of red rhyolite, of red jasper, and of granite, in epidotic groundmass. Thickness about 190 feet. Beds thin out east of Wolfpen Branch. Lies near base of formation.

Named from Cinnamon Ridge, 1 mile west of Gossan Lead district. Occurs west of Comers Rock-Blue Spring Gap Road and northwest of Comers Rock village, Gossan Lead district. Section measured on Cinnamon Ridge, Mouth of Wilson quadrangle, Grayson County.

Cintura Formation[1] (in Bisbee Group)

Lower Cretaceous (Comanche Series): Southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 56, 68.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8 (table), 76, pl. 1. Top of Bisbee group. Occupies less than 2 square miles of area of this report [central Cochise County]; forms eastern slopes of Mule Mountains. Consists of sandstone, mudstone, and a few thin limestone beds. As much as 1,800 feet thick in Bisbee quadrangle but only a few hundred feet of basal part represented in area of this survey. Overlies Mural limestone, contact transitional, first thick sandstone in transitional series selected as base of Cintura; underlies Quaternary.

Named for Cintura Hill near northern edge of Bisbee quadrangle.

Cinturan series[1]

Lower Cretaceous: Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 125–140.

Circle Volcanics[1]

Lower Mississippian: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1930, U.S. Geol. Survey Bull. 816, p. 85.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Named for exposures along east bank of Yukon River for about 15 miles upstream from Circle, Eagle-Circle district.

Cisco Group[1]

Cisco Formation[1]

Cisco Series

Upper Pennsylvanian: Central northern and central Texas.

Original reference: E. T. Dumble, 1890 Texas Geol. Survey 1st Ann. Rept., p. lvii, pl. 3.

Wallace Lee and C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geol. Pub. 3801, p. 12–90, 118–134. Group, in Brazos River valley and Colorado River valley, includes (ascending) Graham, Thrifty, Harpersville, and Pueblo formations. Moran and Putnam formations formerly included in the Pennsylvanian are now placed in the Permian, thus restricting definition of Cisco group.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 90–92. Cisco series includes Pennsylvanian sediments above widespread disconformity which followed deposition of Home Creek limestone of Caddo Creek group, Canyon series. The Cisco is intended

to be approximate Texas equivalent of Virgil series of northern midcontinent region. Upper boundary for series and Pennsylvanian system is placed at disconformity in Harpersville formation about Waldrip-Newcastle coal zone and below *Schwagerina*-bearing "Waldrip limestone No. 3" and Saddle Creek limestone. As thus defined, Permian-Pennsylvanian boundary is 40 to 150 feet below Saddle Creek limestone. "Harpersville" beds below boundary are assigned to Obregon (new) and Chaffin formations of Thrifty group; those above systemic boundary are assigned to Saddle Creek formation of expanded Pueblo group. Series comprises Graham and Thrifty groups.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 288 (fig. 1), 299. Rocks of Kawvian series (new) are widespread in North America. In north-central Texas, series includes the Canyon and Cisco groups.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. In Colorado River area, Texas, base of rocks classed as Permian lies about 50 feet below Saddle Creek limestone member of Pueblo formation. Beds between Saddle Creek units and boundary at base of Permian are assigned to Waldrip shale member of Pueblo. First limestone above disconformity is a 1-foot fusuline-bearing limestone called Waldrip No. 3 limestone by Drake (1893). Disconformity marks top of Cisco group. In accordance with Cheney's (1940) classification, term Harpersville is suppressed.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 68–74, pl. 27. Drake (1893, Texas Geol. Survey 4th Ann. Rept., pt. 1) referred lower part of what is now considered Cisco group, including his Bluff Creek and Campophyllum beds, to Cummins' (1891) Canyon division. To Cummins' Cisco division he referred the rocks from base of his Trickham bed up to base of his Coleman Junction bed (Coleman Junction limestone of Putnam formation, Wichita group, Moore, 1949). Plummer and Moore (1921, Texas Univ. Bull 2132) reclassified Drake's beds as members and considered his Bluff Creek bed to be a member of their Graham formation. Gunsight limestone (Plummer, 1919) and the newly named Wayland shale were also included in Graham formation which they placed in Cisco group. Plummer and Moore (1921) placed upper boundary of Cisco at top of their Coleman Junction limestone. Thus they considered Cisco group to consist of all beds from their Home Creek limestone to top of their Coleman Junction limestone. They placed in Thrifty formation all beds between their Wayland shale and top of Breckenridge limestone (Drake's Chaffin bed). Their Harpersville formation consisted of Drake's Waldrip and Saddle Creek beds. They also included the Pueblo, Moran, and Putnam formations in this Cisco group. Sellards (1933, Texas Univ. Bull. 3232) considered top of Home Creek as base of Cisco group, but lowered top of Cisco to top of Plummer and Moore's (1921) Camp Colorado limestone of Pueblo formation. Bullard and Cuyler (1935, Texas Univ. Bull. 3501) retained these boundaries but raised Graham-Thrifty boundary to top of Speck Mountain limestone member. Present report [Brown and Coleman Counties] places top of Thrifty formation of Cisco group at top of Chaffin limestone member, the most persistent mappable unit in that part of stratigraphic sequence, and uppermost unit in which distinctive Pennsylvanian fusulinids have been found. Because boundary between Permian and Pennsylvanian is obscure and probably gradational, no definite upper

boundary between the two systems has been drawn. Formations and members of Cisco group as recommended in this report are (ascending) Graham formation with Bluff Creek shale, Gunsight limestone, Wayland shale, and Ivan limestone members; and Thrifty formation with Speck Mountain limestone, Breckenridge limestone, Parks Mountain sandstone, and Chaffin limestone members. Overlies Caddo Creek formation of Canyon group; underlies Pueblo formation of Wichita group. Thickness about 400 feet.

Named for Cisco, Eastland County.

Cisco Branch facies[1] (of Floyds Knob Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 210–219.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Correlation chart lists Cisco Branch facies of Floyds Knob formation.

Name derived from Cisco Branch, a tributary to Salt Creek which flows mainly across secs. 9, 17, and 18, T. 7 N., R. 1 E., Monroe County.

Cisco Lake Sandstone

Pennsylvanian: North-central Texas.

F. B. Plummer, 1947, Jour. Geology, v. 55, no. 3, pt. 2. p. 194 (table 1). Name appears on table of Pennsylvanian formations.

F. B. Plummer, H. B. Bradley, and F. K. Pence, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 8, pls. 2, 6. In Eastland County, the Cisco Lake sandstone directly overlies the lower Crystal Falls limestone; in Brown County overlies Curry clay.

First mentioned as cropping out at Cisco Lake spillway, Eastland County.

Cisneros Basalt (in Hinsdale Series)

Pliocene: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 51–53, pl. 1. Dark-gray slightly vesicular porphyritic olivine basalt. Thickness 10 to 30 feet. Overlies Cordito member (new) of Los Pinos formation with slight angular unconformity. Not overlain by younger rocks and original upper surfaces have been destroyed. Name credited to Butler (unpub. dissert.).

Named for Cisneros Park, in NW¼ T. 29 N., R. 8 E. Found in Las Tablas quadrangle, west and north of Canon del Agua, and in extreme NE cor. secs. 16 and 17, T. 29 N., R. 9 E.

Cistern Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

H. D. McCallum, 1947, South Texas [Geol. Soc. Guidebook] 14th Ann. Mtg. Field Trip, p. 4, 5. Black to gray sandy clay. Member is downthrown on the Imogene fault and overlies the so-called Dime Box member.

Derivation of name not stated. Dime Box member occurs in Lee County.

†Citico Conglomerate[1]

Citico Conglomerate Member (of Sandsuck Shale)

Lower Cambrian: Eastern Tennessee and western North Carolina.

Original reference. A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 2.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 29. In eastern Tennessee, Citico conglomerate may be used as a member name for conglomerate beds and lenses within Sandsuck shale, especially south of Miller Cove fault.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 954. Citico, as used by Keith, is abandoned.

Named for Citico Creek, Monroe County, Tenn.

Citronelle Formation[1]

Pliocene: Gulf Coastal Plain from eastern Texas to Virginia, inclusive.

Original reference: G. C. Matson and E. W. Berry, 1916, U.S. Geol. Survey Prof. Paper 98–L, p. 167–208.

C. J. Roy, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1553–1559. Type locality of Citronelle, as designated by Matson and Berry (1916), is significant mainly because of exposure of plant-bearing clays near Lamberts Station about 5 miles south of Citronelle, Ala. Flora from these clays was correlated with Pliocene by Berry. Recent studies have shown that these clays are faulted and overlain unconformably by sand of the so-called Citronelle formation. Structural evidence indicates that the clays are older than the sands, hence, flora of the clays can not be used to correlate the sands. Suggested that term Citronelle, as formation name, be dropped.

G. F. Brown and others, 1944, Mississippi Geol. Survey Bull. 60, p. 45, 46, 54–59. Graham Ferry formation (new) of Pliocene and Pleistocene age disconformably underlies Citronelle formation.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Citronelle formation of Mississippi and Alabama and the unnamed fluvial (?) sands of Georgia may be of early Pleistocene age. Citronelle and unnamed sands shown on chart as Pliocene.

C. W. Carlston, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1119–1121, pl. 1. Late Pliocene or early Pleistocene.

R. O. Vernon, 1952, *in* A summary of the geology of Florida and a guidebook to the Cenozoic exposures of a portion of the State: Florida Geol. Survey, p. 59. Prior to 1942, Pliocene series in Florida was composed of Citronelle formation, Tamiami limestone, Buckingham marl, Bone Valley gravel, Alachua formation. Charlton formation, and Caloosahatchie marl. Vernon (1942) dated a part of Citronelle formation as possibly early Nebraskan and the remainder as Pleistocene alluvium. This fieldwork cast some doubt on dating of "Pliocene" beds in south peninsula. Cooke (1945, Florida Geol. Survey Bull. 29) continued to recognize these units as Pliocene.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1882. Citronelle, of south Mississippi and Alabama, which was considered to be, in part, a residual formation (Doering, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 5), is now recognized to be equivalent of Willis formation of Texas and Louisiana. Name Citronelle has priority, and it is herein used for combined Citronelle-Willis. Formation was originally correlated as Pliocene in age by Matson and Berry (1916) on evidence of single fossiliferous outcrop located a few miles south of Citronelle. Doering (1935) pointed out that the fossil bed appeared to

be a part of the underlying formation. This opinion was concurred with by later investigators. Citronelle is now believed to be Pleistocene.

V. T. Stringfield and P. E. LaMoreaux, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 742–757. Age discussion. Red Bluff locality on Perdido Bay, Baldwin County, Ala., described by Matson and Berry (1916), restudied. Here, as much as 45 feet of Citronelle exposed. Exposures show that bed containing fossil plants is underlain by orange-colored sand and clay typical of Citronelle. Flora considered to be Pliocene in age. In addition to fossil evidence, oldest marine terrace of Pleistocene age in Florida is underlain by Citronelle formation, indicating that formation is older than oldest Pleistocene.

J. A. Doering, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 764–786. Age problem discussed. Fossil evidence supports no more than a pre-Nebraskan determination, thus making an early Pleistocene correlation as plausible as one of late Pliocene.

K. B. Ketner and L. J. McGreevy, 1959, U.S. Geol. Survey Bull. 1074–C. p. 71–72. Cooke and Mossom (1929, Florida Geol. Survey 20th Ann. Rept.), assigned certain clayey, micaceous sands of peninsular Florida to the Citronelle. However, Citronelle formation of Pliocene or later age, apparently does not extend into peninsular Florida. Clayey, micaceous sand, which has been considered an equivalent of Citronelle, is late middle Miocene or early late Miocene in age.

J. A. Doering, 1960, Jour. Geology, v. 60, no. 2, p. 182–201. Citronelle formation of eastern Gulf Coast region extends northward across coastal plains of Georgia, South Carolina, North Carolina, and Virginia, as gravelly sand formation 100 feet thick, covering 30,000 square miles of upland area. These deposits were shown on early geological maps as the Lafayette or Altamaha formation, of late Pliocene or early Pleistocene age. In more recent geological reports, the deposits have been ignored or included in underlying Tertiary or Cretaceous formations; miscorrelations at State boundaries are involved in these later interpretations. Determinations made on basis of plant fossils indicate early Pleistocene (preglacial) age.

Type locality: Exposures around Citronelle, Mobile County, Ala., especially along Mobile and Ohio Railroad for a distance of 3 or 4 miles.

City Bluffs Shale (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri and southwestern Iowa.

Original reference: G. L. Smith, 1909, Iowa Geol. Survey, v. 19, p. 613, 615, 617, 622, 631.

Named for City Bluffs, now known as Burlington Junction, Nodaway County, Mo.

City Creek Limestone

Upper Devonian: Central northern Utah.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 8, pls. 1, 2. Fossiliferous gray shaly limestone. Medium to thick bedded, and commonly shows an incipient large-scale-pencil fracture at right angles to the bedding. Weathers to mottled olive tan. Thickness 160 feet. Overlies Swan Peak(?) quartzite with apparent conformity. Underlies Madison limestone.

J. E. Brooks, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 55. In areas of Becks Spur and City Creek

Canyon, Edvalson (1947, unpub. thesis) described section of Upper Devonian rocks to which he applied name Becks formation. The Becks underlies the Madison and rests on quartzose sandstones and quartzites which were provisionally referred to Swan Peak quartzite. Granger and Sharp (1952) applied name City Creek to these same rocks. Granger (1953) abandoned name City Creek and applied name Pinyon Peak.

Granger (1953), U.S. Geol. Survey Circ. 296 did not use term City Creek. It may be inferred from this report that he abandoned term City Creek in favor of Pinyon Peak.

On the Salt Lake Salient and in City Creek Canyon in Wasatch Mountains east of Salt Lake City.

City Creek Series

Precambrian: Central Arizona.

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118 (table), 1126–1127. Series of shale beds with some interbedded quartzite. At northern base of Mazatzal Mountains, series comprises (ascending) well-stratified grayish-black to purplish siliceous shale member at least 800 feet thick; 15-foot member of alternating shale and novaculitic quartzite; thin-bedded friable maroon shale member about 50 feet thick; 10-foot member of alternating novaculitic quartzite and shale; and thin-bedded maroon to purple shale member with some interbedded quartzite, apparent thickness at least 1,000 feet. Farther northwest, in bluffs fronting East Verde River, series consist of very thin bedded friable grayish-green shale; thickness of this member not determined. Total thickness about 2,000 feet. Relation of series to other Precambrian rocks unknown. Unconformably underlies Tapeats sandstone; appears only in fault contact with Yaeger greenstone.

At northern base of Mazatzal Mountains on western side of City Creek (long 111°30′W.).

Clackamas Gravels

Pleistocene: Northwestern Oregon.

R. C. Treasher, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2034. Name applied to gravels deposited from eroded Troutdale formation in Clackamas Valley.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Described as poorly indurated, rudely bedded conglomerate; this lack of structure is principal feature distinguishing Clackamas from the Troutdale. Thickness as much as 100 feet.

Forms cover on terraces east of Carver; west of Carver, forms cover on terraces to Clackamas; northwest of Clackamas forms valley fill.

Claflin Ranch Formation

Tertiary: Southeastern Arizona.

Kenyon Richard and J. H. Courtright, 1960, Arizona Geol. Soc. Digest, v. 3, p. 1, 6. A thick series of clastic beds unconformably underlying Silver Bell formation. Enclosed within these thin- to thick-bedded clastics are angular blocks of andesite-schist conglomerate over 50 feet in length and 25 feet in thickness. Resembles Tucson Mountain chaos as it is exposed one-half mile south of Gates Pass.

Present in Silver Bell area and in South Tucson Mountains.

Claggett Formation[1] **or Shale** (in Montana Group)

Claggett Shale Member (of Cody Shale)

Upper Cretaceous: Central Montana and northern Wyoming.

Original reference: J. B. Hatcher and T. W. Stanton, 1903, Science, new ser., v. 18, p. 211–215.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. In Hardin area, Big Horn and Yellowstone Counties, Wyo., considered upper member of Cody shale. Thickness 367 feet. Overlies shale member equivalent to Eagle sandstone; underlies Parkman sandstone.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Claggett shale mapped in northwestern Wyoming.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 115. Claggett shale described on northwest flank of Sweetgrass arch, northwestern Montana. Commonly medium gray, soft, and silty. Thickness 420 feet on Goosebill Butte; 90 feet in western part of Sweetgrass Hills. Overlies Eagle sandstone; underlies Judith River formation.

Named for old Fort Claggett (now called Judith), at mouth of Judith River, Mont.

Claiborne Group[1]

Eocene, middle: Gulf Coastal Plain from Georgia to southern Texas.

Original reference: T. A. Conrad, 1847, Philadelphia Acad. Nat. Sci. Proc., v. 3, p. 280–282.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 58–160. Group comprises (ascending) Carrizo sand; Reklaw formation with Newby glauconitic sand and Marquez shale members (both new); Queen City sand with Omen glauconitic sand member; Weches glauconite marl with Tyus marl, Viesca glauconitic marl and Therrill clay members (all new); Sparta sand; Stone City beds (formation); Crockett formation with Wheelock marl, Landrum shale, Spiller sand, and Mount Tabor shale members (all new); and Yegua formation. Overlies Sabinetown shale of Wilcox group; underlies Uvalde(?) formation. Middle Eocene.

C. W. Cooke, 1939, Jour. Paleontology, v. 13, no. 3, p. 337-340. Gosport sand of Alabama, heretofore classified as topmost formation of Claiborne group (Eocene), and only known formation of "upper Claiborne" age, proves to be nearly equivalent to Moodys marl of Mississippi, the basal formation of Jackson group. Recommended that name Gosport be replaced by Moodys and that Claiborne group be restricted to formations heretofore classified as lower Claiborne.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. In Quitman fault zone, group includes Tallahatta formation, Zilpha clay, Winona sand, Kosciusko sand, Wautubbee formation, and Cockfield formation.

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1732–1733. Avon Park limestone, Tallahassee limestone (with nonfossiliferous facies) and Lake City limestone (early middle Eocene) represent Claiborne group in Florida Peninsula, and where all three units are present they appear to make, in most places, a conformable sequence. In J. S. Cosden's Lawson well No. 1, Marion County, beds of lignite occurring at contact of Lake City with nonfossiliferous limestone are believed to indicate local unconformity. Along northeast coast of Florida and in south half of peninsula, nonfossiliferous limestone is not present and the Avon Park rests on Lake City limestone.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 10–11. Group, in Alabama, comprises (ascending) Tallahatta, Lisbon, and Gosport formations. Overlies Hatchetigbee formation of Wilcox group; underlies Moodys Branch marl of Jackson group.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. As mapped, group includes Tallahatta formation, Zilpha clay, Winona sand, Neshoba sand, Sparta sand, Cook Mountain formation, and Cockfield formation.

E. H. Rainwater, chm., 1945, Southeastern Geol. Soc. [Guidebook] 3d Field Trip, p. 47–51. Claiborne group in subsurface in western Florida is subdivided into Lisbon and Tallahatta formations in accordance with usage in Alabama. Overlying Gosport formation also was formerly included in Claiborne, but is now generally considered lower Jackson in age. Overlies Wilcox group not subdivided in subsurface of western Florida.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Group, in Alabama and Georgia, comprises (ascending) Tallahatta formation, Lisbon formation, and Gosport sand.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 88–111. Rocks assigned to Claiborne group of peninsular Florida differ in faunal content and lithology from those recognized throughout Gulf Coast elsewhere. In general, Claiborne group of northern and peninsular Florida is composed of carbonates and evaporites and that of western Gulf Coast is composed of clastics, largely sands and clays. An occasional fossil common to both sections support stage-age assignments, but these are insufficient to allow extension of Gulf Coast formational nomenclature to carbonate rocks of Florida. Applin and Applin (1944) erected three formations in Claiborne group: Lake City limestone (early middle Eocene), Tallahassee limestone (late middle Eocene), and Avon Park limestone (late middle Eocene). In western Florida, Claiborne group is not present at surface, but two-fold division can be recognized in subsurface, Gosport at top and Lisbon formation at base. Disconformably underlies Moodys Branch formation of Jackson group. Claiborne-Jackson contact discussed [see Jackson group].

G. E. Murray *in* W. C. Holland, L. W. Hough, and G. E. Murray, 1952, Louisiana Dept. Conserv. Geol. Bull. 27, p. 77–78, pls. 11, 12. Current usage of Claiborne group is in time-stratigraphic sense, including within its limits many lithologic types deposited during several advances and retreats of sea. Recommended that Claiborne be utilized strictly as group name for clastic facies in central and western Gulf Coast Plain below Jackson stage and above Wilcox group. So used, it would be partially the arenaceous counterpart of calcareous Lisbon group of eastern Gulf Coast.

James Turner, 1952, Mississippi Geol. Survey Bull. 76, p. 10. In Yalobusha County, Claiborne [group] includes (ascending) Meridian formation, Tallahatta, Winona, Zilpha, and Kosciusko formations.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 85–94, maps. Group, in Sabine Parish, comprises (ascending) Cane River, Sparta, Cook Mountain (with Dodson member equivalent, Milams and Saline Bayou members), and Cockfield formations. Overlies Wilcox group (rock term); underlies Jackson group.

Named for exposures at Claiborne Bluff and Claiborne Landing, on Alabama River, Monroe County, Ala.

†Claiborne Sand (in Claiborne Group)[1]

Eocene, middle: Southern Alabama and Mississippi.

Original reference: T. A. Conrad, 1847, Philadelphia Acad. Nat. Sci. Proc., v. 3, p. 280–281.

G. D. Harris, 1940, Science, v. 92, no. 2386, p. 257–258. Name Claiborne in geologic literature discussed. Possibly name Claiborne sands should not be abandoned.

Named for exposures at Claiborne Bluff, on Alabama River, in Monroe County, Ala.

Claiborne Stage, Age

Eocene, middle: Gulf Coastal Plain from Georgia to southern Texas.

G. E. Murray, 1953, Mississippi Geol. Soc. [Guidebook] 10th Field Trip, p. 54. In discussing subsurface stratigraphy of Beauregard and Allen Parishes, La., Murray (1952) used Claiborne as a rock-unit term and utilized three unnamed stages between Jackson and Sabine stages. This usage is improper and should not be followed. Instead, Claiborne stage should consist of all deposits in Gulf and Atlantic Coastal Plain province formed during fluctuations of middle Eocene sea, beginning with close of withdrawal of Sabinian sea and ending with first transgression of Jacksonian sea. The Reklaw-Queen City, Cane River-Sparta, and Cook Mountain-Cockfield cycles of deposition, and their demonstrable equivalents should be considered substages. Type exposures of Gosport, Lisbon, and Tallahatta formations in Alabama, exposures at Claiborne Bluff and Claiborne Landing on Alabama River, Monroe County, Ala., and type exposures of Reklaw, Queen City, Winona-Zilpha-Weches-Cane River, Sparta, Cook Mountain, and Yegua-Cockfield formations in Mississippi, Louisiana, and Texas are exemplary of the stage. Claiborne age includes all time covered by deposition of these deposits.

Clallam Formation[1]

Miocene: Northwestern Washington.

Original reference: R. Arnold, 1906, Geol. Soc. America Bull. v. 17, p. 451–468, map.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 118, 173, 175. Recent studies indicate that sandstones and shales occurring along sea-cliffs between Clallam Bay and Pysht are probably correlative, at least in part, with middle Miocene Astoria formation of southwestern Washington and western Oregon. Former broad usage of name Clallam should be restricted to Miocene part of stratigraphic section along northern side of Olympic Peninsula. May become desirable to abandon name

Clallam and use only term Astoria formation. Massive sandstones, conglomerates, shaly and pebbly sandstones, and interstratified clay shales constitute greater part of formation. Appears to be unconformable upon Oligocene shales. Uppermost beds have been largely removed by erosion.

R. D. Brown, Jr., and H. D. Gower, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2492, 2494, 2511. Conformably overlies Twin River (redefined).

H. D. Gower, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–129. Described in Pysht quadrangle. Term used in restricted sense of Weaver (1937). Thick-bedded and crossbedded light-olive-gray fine- to coarse-grained sandstones. Estimated thickness more than 2,500 feet. Overlies Twin River formation. Much of coastal section highly deformed and inland poorly exposed. Miocene.

Well exposed in region between Clallam Bay and Pillar Point, Clallam County.

Clan Alpine Volcanics

Miocene, middle to upper(?): Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 182–183, pls. 10, 11. Include rhyolite, quartz latite and dacite tuffs, breccias, and flows. Rhyolites range in color from pale yellowish brown to dark yellowish brown and pale red. Thickness of individual flows ranges from few feet up to 40 feet, the tuffs from few inches to massive beds of 40 feet or more. Quartz latites range in color from medium light gray to light brownish gray, brownish gray, and pale red purple and may well represent the dominant volcanic. Total thickness in excess of 3,000 feet in southern part of range and increases northward. Oldest rock in area; unconformably underlies Middlegate formation (new).

Named for exposures in southern parts of Clan Alpine Range. Extends well to northward to form important part of that mountain mass. Churchill County.

Clancy Granodiorite

Upper Cretaceous: Southwestern Montana.

Adolph Knopf, 1957, Am. Jour. Sci., v. 255, no. 2, p. 81, 91–92, map facing p. 88. A light-gray coarse-grained rock in which quartz is conspicuous. Represents the second intrusion of the Boulder bathylith. Cuts the older Unionville granodiorite (new).

Named from the Kain quarry on Clancy Creek, Jefferson County.

Claremont Shale (in Monterey Group)[1]

Miocene, middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 69 (table 14), 70, pl. 11. Described in Contra Costa County where it occurs as band about 1,000 feet wide southwest of Pinole and trends northwestward toward shore of San Pablo Bay. Fine-grained light-colored moderately hard slightly bituminous shale locally containing thin layers of grit and fine conglomerate; east of Berkeley, formation is a series of alternating thin layers of siliceous shale or chert and partings of shale. Probable average thickness south of San Pablo Bay 800 feet. Conformably underlies Oursan sandstone; overlies Sobrante sandstone.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. In Hayward quadrangle, Claremont shale ranges in thickness from 150 to 300 feet. Mapped for convenience as Claremont, though quite possibly from a younger formation of Monterey group, is a siliceous mudstone containing ovoid masses that may be diatoms; it crops out between Leona rhyolite and serpentine in hill above Hayward High School, several miles west of main Tertiary outcrops. Conformably overlies Sobrante sandstone; underlies unnamed middle sandstone and shale of Monterey group.

C. A. Hall, Jr., 1958, California Univ. Pubs., Geol. Sci., v. 34, no. 1, p. 16–18, fig. 2, geol. map. Claremont shale, in Pleasanton area, Alameda and Contra Costa Counties, is about 700 feet thick. Overlies Sobrante sandstone; underlies Oursan sandstone. Term Monterey group not considered appropriate in this area.

Named for exposure on Claremont Creek, Concord quadrangle.

†Claremore Formation[1]

Pennsylvanian: Northeastern and central eastern Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 7, 10.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. A vaguely defined unit including Fort Scott limestone and subjacent strata. Abandoned by Oklahoma Geological Survey.

Named for Claremore, Rogers County.

Clarendon Beds[1]

Pliocene: Texas.

Original reference: J. W. Gidley, 1903, Am. Mus. Nat. History Bull., v. 19, p. 632–635.

Named for Clarendon, Donley County.

Clarendon Dolomite

Cambrian: West-central Vermont.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. [Guidebook] 34th Ann. Field Mtg., p. 8. Name applied to massive gray-weathering dolomite which represents most of lower half of Rutland formation in this area. Dolomite contains small percentage of coarse sand grains. Thickness 2,000 to 3,000 feet.

Best exposed in Clarendon and along Tinmouth Channel, Rutland County.

Clarendon Gravel[1]

Pleistocene: Northwestern Pennsylvania.

Original reference: E. H. Williams, Jr., 1920, Am. Philos. Soc. Proc., v. 59, p. 62, 73.

Named for Clarendon, Warren County.

Clarendonian Age

Pliocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term, based on the Clarendon local fauna (and member?), near Clarendon, Donley County, Texas. Covers the interval between the Barstovian (Miocene) and Hemphillian (Pliocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units,

for the North American continental Tertiary. [For sequence see under Puercan.]

D. I. Axelrod, 1957, Am. Jour. Sci., v. 255, no. 10, p. 695 (fig. 1). Table shows Clarendonian as late Miocene and early Pliocene. Determination based on paleoclimatic analyses of sequences of Late Tertiary floras.

Clarendon Springs Dolomite[1] (in Stockbridge Group)

Upper Cambrian: West-cental Vermont and Massachusetts

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 397.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 536–539. Keith included in Clarendon Springs all dolomite beds between uppermost sandy strata of limestones of overlying Shelburne marble. In some localities along western side of area, the dolomite includes horizons both above and below a sandstone. Rogers (1937, Geol. Soc. America Bull., v. 48, no. 11) indicates stratigraphic break above the dark-gray dolomites and suggests that the sandstone is basal to certain of the higher strata. Break was not noted in eastern area. Upper strata of dolomite facies grade laterally into limestones and marbles. Thicknesses: 120 feet at Brandon, 80 feet at Middlebury, 45 feet at New Haven.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 23–24. In Castleton area, unit is 130 to 175 feet thick. Overlies Danby formation; underlies Boardman formation (new).

A. B. Shaw, 1951, Jour. Paleontology, v. 25, no. 1, p. 97. Includes Milton dolomite facies.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 21 (table 1), 42. In this report [vicinity of Rochester and East Middlebury], name Clarendon Springs is used according to definition of Cady (1945). Thickness about 200 feet. Top of section in western sequence. Overlies Danby formation.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. In Cheshire quadrangle, Massachusetts, included in Stockbridge group. Thickness 0 to 800 feet. Contact with underlying Kitchen Brook dolomite (new) not observed; underlies Shelburne marble.

Type locality: Clarendon Springs, Rutland County, Vt.

Clarion Clay (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania, Ohio, and West Virginia.

Original reference: W. G. Platt, 1880, Pennsylvania 2d Geol. Survey Rept. H_5.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 44, table 1. Clarion clay listed as member of Clarion cyclothem in Perry County. Underlies Clarion (No. 4a) coal; overlies Canary ironstone. Allegheny series.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. Survey Rept. Inv. 17, p. 16. Clarion underclay mentioned in report on high-alumina clays of West Virginia. Samples collected in Randolph County. Basal member of Allegheny series.

Name derived from Clarion, Clarion County, Pa.

†Clarion coal group[1] (in Allegheny Formation)

Pennsylvanian (Allegheny Series): Southeastern Ohio and southwestern and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 56–59. Rogers (1858) used Clarion as a group name for beds between the Freeport (Lower?) sandstone above and Tionesta sandstone below. As originally defined, it included beds now assigned to Brookville, Lower, Middle, and Upper Kittanning, Lawrence, and Scrubgrass cyclothems. Clarion cyclothem is restricted to the members lying between Scrubgrass and Winters cyclothems.

Type area: Clarion River valley, western Pennsylvania.

Clarion cyclothem or cyclic group

Pennsylvanian (Allegheny Series): Southeastern Ohio and southwestern Pennsylvania.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 6. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 44, table 1, geol. map. Includes Clarion shale and sandstone, 42 feet, Canary ironstone; Clarion clay, 3 feet, and Clarion (no. 4a) coal. Occurs below Scrubgrass cyclothem and above Brookville cyclothem. In area of this report, the Allegheny series is described on a cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

E. G. Williams, 1957, Dissert. Abs., v. 17, no. 12, p. 2982. Clarion cyclic group recognized in Clearfield Basin, Pennsylvania.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 56–59. Rogers (1858, Geology of Pennsylvania, v. 2, pt. 1) used Clarion as a group name for beds between the Freeport (Lower?) sandstone above and Tionesta sandstone below. As originally defined, it included beds now assigned to Brookville, Lower, Middle, and Upper Kittanning, Lawrence, and Scrubgrass cyclothems. Clarion cyclothem is now restricted to four members lying between Scrubgrass and Winters cyclothems. Members (ascending) Clarion shale and (or) sandstone, Canary ironstone, Clarion underclay, and Clarion (No. 4a) coal members. In this report, the Allegheny series is described on a cyclothemic basis; 13 cyclothems are name. [For sequence see Brookville cyclothem.]

First described in Perry County, Ohio.

Clarion Formation[1] (in Allegheny Group)

Pennsylvanian: Pennsylvania.

G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, no. 25, p. 1108; 1926, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 65, p. 29, pl. 4. Clarion formation, Allegheny group, comprises (ascending) Brookville or A coal, Clarion sandstone, Clarion or "A" coal, and Vanport limestone. Overlies Homewood formation which includes Homewood sandstone; underlies Kittanning formation.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 40–45. Lowermost formation in Allegheny group. Includes strata from base of Lower Kittanning clay to base of clay beneath Brookville coal. Comprises (ascending) Brookville coal, Clarion sandstone, Clarion clay, Lower Clarion coal, Upper Clarion coal, Vanport limestone, Lower Kittanning sandstone. Thickness 120 to 145 feet. Underlies Kittanning formation; overlies Homewood sandstone of Pottsville series. Area of report Brookville quadrangle.

E. G. Williams and R. P. Nickelsen, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 36–50. Discussion of correlation of Pottsville and lower Allegheny series in Clearfield and Centre Counties. Clarion formation (Allegheny series) which overlies the Pottsville is 65 to 190 feet thick and consists of cyclic sequences of clay, coal, shale, siltstone, silty shale, and sandstone. Includes (ascending) Brookville coal, Clarion sandstone, Clarion coal, Vanport limestone, and Kittanning sandstone. Underlies Kittanning formation. Reference sections designated. Stratigraphic nomenclature of Clarion formation is more confused and uncertain than that of other formations of the Allegheny. This is due partly to inherent complexity of formation, partly to rather loose definition and description of type sections and partly to questionable correlations between type sections.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips, Pittsburgh Mtg., p. 70 (fig. 5), 71. Allegheny group comprises (ascending) Clarion, Kittanning, and Freeport formations. The Clarion overlies Mercer formation of Pottsville group.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). Formation includes (ascending) Clarion coals, Clarion sandstone, Vanport limestone, and Lower Kittanning sandstone. Overlies Mercer formation, which has Homewood sandstone and shale at top; underlies Kittanning formation, which has Lower Kittanning coal in lower part.

Reference section (31): Northeast rectangle of Glen Richey quadrangle, Clearfield County, in coal strip mines on western end of large hill, one-half mile east of Krebs. Reference section (32): In south-central rectangle of Clearfield quadrangle, Clearfield County, in coal strip mines on a small hill 0.4 mile northeast of mouth of Clearfield Creek. Name derived from Clarion, Clarion County.

Clarion Sandstone Member (of Allegheny Formation)[1]

Clarion Sandstone (in Clarion Formation)

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and West Virginia.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K_3, p. 25, 38.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 50. Sandstone between Clarion coals and Brookville coal in Clarion formation. Thickness 5 to 25 feet thick. Not always present, in which case the horizon is shale or sandy shale. In some areas, cuts out part or all of Brookville coal. Area of report is Brookville quadrangle.

Wilber Stout, Karl Ver Steeg and G. F. Lamb, 1944, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Generalized section of Ohio lists Clarion sandstone below Canary ore and above Winters coal.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22. Clarion sandstone listed with recognizable members of Allegheny formation in Harrison County. Occurs above Clarion coal and below Vanport limestone.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). As shown on generalized section of Allegheny group, Clarion formation in-

cludes (ascending) Clarion coals, Clarion sandstone, Vanport limestone, and Lower Kittanning sandstone.

Name derived from Clarion, Clarion County, Pa.

Clarion shale and (or) sandstone

See Clarion cyclothem.

Clarita Limestone

Oligocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 133, 134 (correlation chart). Underlies Arusa formation. Middle Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 332. Undefined name. Oligocene. Note on derivation of name.

Río Clarita is small stream about 30 kilometers east southeast of El Real de Santa Maria, in Darién area.

Clarita Member (of Chimneyhill Limestone)

Middle(?) Silurian: South-central Oklahoma.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 19–25, fig 4; 1960, Oklahoma Geol. Survey Bull. 84, pt. 6, p. 52–67. Name proposed to replace Maxwell's (1936) preoccupied name Dillard. Fossiliferous limestone ranging from fine calcilutite to coarse calcarenite. Most common facies is calcilutite. Thickness varies; commonly less than 20 feet; maximum thickness 45 feet (on Lawrence uplift). Unconformably overlies Cochrane; base of Clarita marked by a few inches of shale or shaly limestone. Unconformably underlies Hunton marlstone; at some places it is the Henryhouse and at other places the Haragan that overlies the Clarita.

Type locality: About 3 miles west of Clarita, Coal County, in vicinity of old Hunton townsite NW¼ sec. 8, T. 1 S., R. 8 E. This is not same as type locality designated for the Dillard.

Clark Formation[1]

Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 26, p. 3.

Named for Clark Gap, in Flat Top Mountain, Mercer County, W. Va.

Clark Canyon Lavas

Tertiary, upper, or Pleistocene: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 377, pl. 1. Name applied to sheet of dense, aphanitic basaltic lava.

Crops out along Clark Canyon, near Armstead, Beaverhead County.

†Clark County littorals[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 79–83.

Named for exposures in Clark County.

†Clark Fork Beds[1]

Clark Fork Beds or Member (of Polecat Bench Formation)

Paleocene: North-central Wyoming.

Original reference: W. Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 204.

G. L. Jepson, 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 237–238. Uppermost unit of Polecat Bench formation (new). Occurs 3,000 to 3,500 feet above base of formation. Overlies Silver Coulee beds (or member); underlies Eocene Gray Bull beds. Clark Fork fauna appears in uppermost 500 feet of formation and seems to be increasingly abundant toward top of Clark Fork beds.

F. B. Van Houten, 1944, Geol. Soc. America Bull., v. 55, no. 2, p. 178, pl. 2. Beds underlie Willwood formation (new).

Named for Clark Fork basin.

Clarkforkian Age

Paleocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 9, pl. 1. Provincial time term, based on the Clark Fork member (and faunal zone) of the Polecat Bench formation, type locality, scarp forming divide between Bighorn and Clark Fork basins and exposures near its base, Park County, Wyoming. Includes the interval between the Tiffanian (Paleocene) and Wasatchian (Eocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan.]

Clark Island Granite

Age not stated: Southern Maine.

F. Chayes, 1952, Jour. Geology, v. 60, no. 3, p. 215–217, 218, 220, 225, 253. Discussion of finer grained calcalkaline granites of New England. Detailed petrographic description given of Clark Island granite.

Specimens collected at Clark Island, Knox County.

Clark Peak Schist[1]

Paleozoic and Triassic(?): Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 93, 94, 247.

Exposed in Juneau district. Named for Clark Peak, Juneau district.

Clark Reservation Member (of Manlius Limestone)

Clark Reservation Limestone[1] (in Manlius Group)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 26, 27, 30–35.

G. H. Davis 3d, 1953, New York State Mus. Circ. 35, p. 10. Termed a member of Manlius limestone.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 2 (columnar section), 4–5. Jamesville limestone and Clark Reservation limestone grouped under heading of transitional beds between Manlius group below and Helderberg group above.

Type section: In cliff south of lake which is in Clark Reservation State Park, west of Jamesville, Onondaga County.

Clarksburg Fire Clay Shale (in Conemaugh Formation)[1]

Clarksburg underclay member

Pennsylvanian: Northern West Virginia and eastern Ohio

Original reference: R. V. Hennen, 1912, West Virginia Geol. Survey Rept. Doddridge and Harrison Counties, p. 236.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 152. Member of Little Clarksburg cyclothem in report on Athens County. Light- to dark-gray clay or clay shale. Commonly massive and may be calcareous, micaceous, silty, and sandy. Maximum thickness less than 3 feet; average 10 inches. Associated with some development of Little Clarksburg coal, above, and (or) redbed, below. Conemaugh series.

Named for association with Little Clarksburg coal.

Clarksburg Limestone Member (of Conemaugh Formation)[1]

Clarksburg limestone member

Upper Pennsylvanian: Western West Virginia, western Maryland, eastern Ohio, and southwestern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 88.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 33; D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 59–60, geol. map. Reports refer to unit as Clarksburg limestone or limestone member of Conemaugh series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 152. Member of Little Clarksburg cyclothem in report on Athens County. Thickness 6 inches to 10 feet; average 4½ feet. Above Clarksburg redbed member and below Clarksburg underclay member. In type area, 20 to 30 feet thick, directly underlies Little Clarksburg coal, and separated from Morgantown sandstone below by 25 to 40 feet of soft shales. Conemaugh series.

Well exposed along bed of Elk and West Fork River, in vicinity of Clarksburg, Harrison County, W. Va.

Clarksburg Red Shale (in Conemaugh Formation)[1]

Clarksburg redbed member

Pennsylvanian: West Virginia and southwestern Pennsylvania.

Original reference: R. V. Hennen, 1912, West Virginia Geol. Survey Rept. Doddridge and Harrison Counties, p. 240.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 152. Redbed member of Little Clarksburg cyclothem in report on Athens County. The member is one of the rather thick and conspicuous redbeds that locally more or less unite to fill interval between Ames limestone and Connellsville sandstone and even up to Pittsburgh coal. Thicknesses range from less than 5 feet to more than 32 feet. Below Clarksburg limestone and above Morgantown sandstone and shale member. Conemaugh series.

Named for Clarksburg, Harrison County, W. Va.

Clarksburg Volcanics[1] Member (of Michigamme Slate)

Precambrian (Animikie Series): Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 604.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 36. Lower part of Michigamme slate in Marquette district, includes Bijiki iron-formation, Clarksburg volcanics, and Greenwood iron-formation members. Included in Animikie series.

Named for exposures east and west from Clarksburg, Marquette County.

Clarks Mill Beds[1]

Lower Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F_2, p. 59–62, 181–184.

Exposed at Clark's Mill, Centre Township, Perry County.

Clarks Spring Member (of Secret Canyon Shale)

Middle Cambrian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 14–16, pl. 2. Thin-bedded limestone with prominent yellow or red argillaceous partings. The thin limestone bands are commonly one-fourth to one-half inch thick and rarely exceed 2 inches in thickness. Limestone is fined grained, silty, and blue, contrasting markedly with the yellow, or more rarely, red clay partings, which range from one-eighth to one-fourth inch thick. Locally mottled with yellow or red patches. Thickness probably 425 to 450 feet. Contacts between Clarks Spring member and lower shale member below and Hamburg dolomite above are gradational.

Type locality: Especially good exposures of the member provided by road-cuts in upper New York Canyon, just north of Clarks Spring, from which the member takes its name, Eureka mining district, Eureka County.

Clarkston Gravels, deposits

Clarkston Stage

Pleistocene (pre-Wisconsin): Eastern Washington and western Idaho.

R. L. Lupher, 1944, Geol. Soc. America Bull., v. 55, no. 12, p. 1433–1455. Stream and lake deposits older than scabland-Touchet stage [of Snake River Canyon] are well developed in Lewiston-Clarkston region about 100 miles above mouth or Snake River. Immediately southwest of Clarkston, an abandoned course of Snake River is filled with gravel to depth of at least 425 feet. The Clarkston gravels, except near canyon sides and in local tributary canyons, are composed of nearly equal amounts of basalt and pre-Tertiary igneous and metamorphic rocks. Occasional large angular erratics imbedded in stream gravels indicate that Clarkston fill accumulated during a glacial stage. The Clarkston stage is probably pre-Wisconsin.

R. L. Lupher, 1945, Jour. Geology, v. 53, no. 5, p. 337–348. Clarkston stage defined as an episode of proglacial aggradation, especially time during which Clarkston deposits accumulated. Followed earlier Pleistocene deposition, deformation, and dissection but antedated Wisconsin stage. Stream gravels (Clarkston) accumulated to depth of more than 400 feet in Snake River Canyon and in lower parts of most tributary canyons.

Type area: Center of area is at Clarkston, Wash.

Clarksville Member (of Waynesville Formation)

Clarksville division (in Richmond Group)[1]

Upper Ordovician: North-central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1909, Denison Univ. Sci. Lab. Bull. 14, p. 292.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as middle member of Waynesville formation. Underlies Blanchester member; overlies Fort Ancient member.

Named for Clarksville, Clinton County, Ohio.

Clarno Formation[1]

Eocene: Central northern Oregon.

Original references: J. C. Merriam, 1901, Geol. Soc. America Bull., v. 12, p. 496–497; 1901, California Univ. Pub., Bull. Dept. Geol., v. 2, no. 9, p. 285.

W. D. Wilkinson, 1939, Geologic map of the Round Mountain quadrangle, Oregon (1:96,000): Oregon Dept. Geology and Mineral Industries. Underlies John Day formation. Stratigraphic position and presence of fossil leaves indicate Eocene age.

A. C. Waters and others, 1951, U.S. Geol. Survey Bull. 969–E, p. 111–115, pl. 21. Oldest rocks in Horse Heaven district are andesites, tuffs, and tuffaceous sediments that constitute a part of Eocene Clarno formation. Within area the Clarno appears at surface chiefly along a strip about 4 miles long and 1½ to 2 miles wide lying between Cherry Creek and Horse Heaven Mountain. In central and western part of area, it is buried beneath andesite flows and rhyolite volcanoes that make up the higher ridges. In southern part of area, erosion has cut deeply enough to reveal large patches of Clarno rocks. Uptilted beds between southeastern corner and northern edge of area are 5,800 feet thick; base and top not exposed; nearly all measured units vary greatly in thickness along strike. Subdivided into four units. Unit 1, the oldest, consists of andesite flows interbedded with layers of clay; thickness about 600 feet. Unit 2 consists of about 1,350 feet of tuffs and a few andesite flows. Unit 3 about 1,700 feet thick. Unit 4 consists of white coarse-grained tuffs and sandy tuffs that are largely rhyolitic in composition; thickness at least 2,100 feet, top not exposed.

Typically exposed at Clarno's Ferry, on the John Day, east of Antelope near town of Fossil, on Cherry Creek and Burnt Ranch.

Claron Limestone[1] **or Formation**

Eocene(?): Southwestern Utah.

Original reference: C. K. Leith and E. C. Harder, 1908, U.S. Geol. Survey Bull. 338, p. 41.

E. F. Cook, 1952, Utah Geol. Soc. Guidebook 7, p. 96. In Pine Valley Mountains, Washington County, overlies Kaiparowits formation. Forms pink band 460 feet thick, consisting largely of lacustrine limestones with iron-stained basal conglomerate 30 to 80 feet thick. Eastward overlies successively older formations until it rests directly on Navajo sandstone.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. Claron formation consists of conglomerate, red and gray sandstone and siltstone, and pink and white limestone; aggregate thickness about 1,400 feet in Granite Mountain area. Essentially identical in lithology with, and probably equivalent to, Eocene Wasatch formation at Cedar Breaks (Pink Cliffs) in Colorado Plateau. Overlies Iron Springs formation which replaces Pinto sandstone abandoned in area. Conformably underlies sequence of lava flows and pyroclastic rocks. Eocene(?).

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 37–38. Formation consists of as much as 1,500 feet of fluvial and lacustrine sediments. In Pine Valley Mountains, underlies Quichapa group (new) with disconformity; overlies Kaiparowits formation; in some areas, appears to grade into the Kaiparowits, but in other places an erosion surface is present at base of Claron; where the unconformity is angular, basal Claron cuts sharply across a surface of low relief developed on truncated formations down to Navajo sandstone. Three-fold division: an upper white limestone and calcareous marl; pink calcareous sandstone; and basal pink conglomerate. Thickness 0 to 1,000 feet; average 500 feet. Upper Cretaceous(?).

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 100–103. Underlies Needles Range formation (new) and in some areas Isom formation (new).

C. M. Tschanz, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B295. Studies indicate that lacustrine limestone near top of Claron is Oligocene or earliest Miocene, instead of Eocene as formerly believed.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 32–36. Although Claron (Wasatch) formation is listed as Cenozoic, the lower part of it may be Late Cretaceous. No evidence by which precise age of Claron in southwest Utah can be determined. The Claron unconformably overlies formations from Kaiparowits down to Navajo sandstone; it is overlain conformably or accordantly by Quichapa formation. lower member of which has zircon age of 28 million years. Age range could be very Late Cretaceous to Oligocene.

Occurs at and around Mount Claron, Iron Springs region, Iron County.

Clarysville Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland and northeastern West Virginia.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

Exposed in Hoffman Drainage Tunnel at Clarysville, Allegany County, Md.

Claverack Conglomerate (in Schodack Formation)

Cambrian: Eastern New York.

G. H. Chadwick, 1946, Am. Jour. Sci., v. 244, no. 8, p. 585. Name given to limestone conglomerate in upper part of Schodack formation. Has been mistakenly termed Burden conglomerate.

Type locality: Ham's Mills [Catskill quadrangle].

Clay City Siltstone Member (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 122, 123–124. Thin persistent calcareous siltstone 1½ to 5 feet above base of New Providence formation, Stanton facies (new). Thickness 6 inches to 3 feet. In some areas, overlies Henley shale member.

Well exposed along secondary road, one-half mile northeast of Clay City, Powell County.

Clay Creek Limestone[1] Member (of Kanwaka Shale)

Pennsylvanian (Virgil Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas, Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 94, 96 (table).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24. Thickness about 1 foot in Weeping Water valley, Cass County.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii, 17. Overlies Jackson Park shale member; underlies Stull shale member.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 62 (fig. 23), 67. Dark-blue to bluish-gray limestone, commonly massive and dense; fusulines locally abundant. Thickness as much as 5 feet. Underlies Stull shale member; overlies Jackson Park shale member.

Type locality: Clay Creek, about 1 mile west of Atchison, Atchison County, Kans. Persistent as far southward as Osage County, Kans.

Claymont Clay Bed (in Silverado Formation)

Paleocene: Southern California.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Pisolitic sandy clay. At type locality, 4 to 6½ feet thick and is about 165 feet above base of formation. Clay is underlain gradationally by coarse-grained pebbly quartz-anauxite mudstone and grades upward into coarse-grained quartzose sandstone also containing some anauxite.

Type locality: On Claymont property of Gladding McBean Co. located near divide between Gypsum Creek and Sierra Canyon, northwestern Santa Ana Mountains, Orange County.

Claypole Hills Sandstone (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 7. Coarse massive sandstone. Overlies St. Wendells limestone; underlies Friendsville coal.

Type locality and derivation of name not stated.

Claypool Formation[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 9.

Covers large area to south and east of Claypool, Jefferson County.

Clay Spur Bentonite Bed (in Mowry Shale)[1]

Clay Spur Bed (in Belle Fourche Shale)

Lower Cretaceous: Northeastern Wyoming, southeastern Montana, and western South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165, p. 4.

M. M. Knechtel and S. H. Patterson, 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-36. Clay Spur bentonite bed is one of uppermost strata of Mowry shale. Bed is present at or near surface almost everywhere in vicinity of contact between Mowry and Belle Fourche shales as mapped in this report [northern Black Hills district, Montana, Wyoming, and South Dakota]. Thickness as much as 7 feet, but commonly 2 to 4 feet. Although thickness in a few places is less than 2 inches, no outcrop of uppermost Mowry strata has yet been noted at which this bed is missing. Lower Cretaceous.

86–87. Clay Spur bentonite bed occurs in Belle Fourche-type shale; seems more logical to include it in the Belle Fourche than in the Mowry.

Named for exposures near Clay Spur, sec. 30, T. 47 N., R. 63 W., Weston County, Wyo.

Claysville Limestone Member (of Greene Formation)[1]

Permian: Western Pennsylvania.

Original reference: W. T. Griswold and M. J. Munn, 1907, U.S. Geol. Survey Bull. 318, p. 78.

Named from town in Donegal Township, Washington County.

Clayton Basalts

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.), Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1354. Predominantly olivine basalts but include olivine basalts with quartz inclusions, analcime basanite, nepheline basalts, haüyne basalt, and olivine-free basalts.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1023, 1028–1030, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1059. At least 75 percent, by estimate, are medium-gray to black, fine- to medium-grained, slightly vesicular olivine basalts occurring as surface flows and scoria cones. Most vesicular flows weather to a red brown; less vesicular flow rock tends to remain black. Age, derivation of name, and geographic distribution given.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141 (sheet 2). Flows range from 10 to 50 feet in thickness and average about 20 feet.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 71–72, 75, 77–79, 115–116, 118, 126–127, 133–135, 137. Undifferentiated Clayton basalt caps broad mesas throughout central Union County. Individual sheets were named for ease of discussion although they are petrographically nearly identical: Carrizo, Herringa, Clayton Mesa (original type Clayton basalt of Collins), Apache, Seneca, and Gap flows.

Named after outcrops on large Folsom-Clayton Mesa near town of Clayton, Union County. Also occur in Colfax County.

Clayton Clay[1]

Pleistocene, upper: Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

Exposed at Clayton, Hartford County.

Clayton Formation (in Midway Group)[1]

Paleocene: Southern Alabama, southwestern Georgia, northeastern Mississippi, southeastern Missouri, and southern Tennessee.

Original reference: D. W. Langdon, 1891, Geol. Soc. America Bull., v. 2, p. 589–605.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 43, 44. Exposed at a few places in southern Illinois but probably generally present at base of Tertiary sediments. Characteristically a more or less marly glauconitic sand generally about 5 to 8 feet thick. Formerly considered

J. D. Haun, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p.

member of Porters Creek formation. Overlies McNairy formation; underlies Porters Creek clay.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Age shown as Paleocene.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 6–10. East of Butler County, Ala., name Clayton is used for all of Midway beds. In Butler County and westward in Alabama and Mississippi, it is used only for beds below Porters Creek clay. In Butler and Wilcox Counties, includes McBryde limestone member and Pine Barren member (both new). In western Alabama and Mississippi, the Clayton is represented by single unit, Chalybeate limestone member (new). In western Alabama and east-central Mississippi, the Clayton thins to a few feet and may be overlapped by Porters Creek clay in places. From Chickasaw County northward in Mississippi, formation thickens and in northern Mississippi is probably 60 feet thick. At Clayton, Ala., section consists of lower zone of about 35 feet of sand and limestone, grading from noncalcareous, *Halymenites*-bearing sand at base, through coarse sandy limestone to sand-free hard white limestone at top, and an upper zone of about 15 feet of hackly gray clay. Formation thickens eastward to nearly 130 feet in Chattahoochee River, where upper clay is represented by smooth-textured argillaceous limestone. In northern Mississippi, includes a bed of calcareous siltstone formerly regarded by Mississippi Geological Survey as base of Porters Creek. This revision is made to make base of the clay consistently the base of the Porters Creek in Mississippi and also because this siltstone carries the large nautiloid *Hercoglossa ulrichi*, a marker for upper part of Clayton in central Alabama. Underlies Porters Creek clay.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Clayton in Mississippi, Alabama, and Georgia. In Georgia, undifferentiated; in Alabama, includes Pine Barren member below and McBryde limestone member above; in Mississippi includes Chalybeate limestone member. Underlies and interfingers with Porters Creek clay.

L. W. Stephenson, 1955, U.S. Geol. Survey Prof. Paper 274–E, p. 98, 100, 101. In Stoddard County, Mo., underlies Porters Creek clay and unconformably overlies Owl Creek formation. Thickness 5 to 10 feet. In Pulaski County, Ill., unconformably overlies McNairy sand.

Type locality: Cut on Central Georgia Railroad about 1 mile east of Clayton, Barbour County, Ala.

Clayton Sandstone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 298, 383.

Type locality: On waters of Griffith Creek, on road that descends into this valley, 1.2 miles northeast of Clayton, Summers County. Also occurs in Mercer and Monroe Counties ,W. Va., and in Giles County, Va.

Clayton Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 298, 384.

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Type locality: On waters of Griffith Creek, on road that descends into this valley 1.2 miles northeast of Clayton, Summers County. Also occurs in Mercer and Monroe Counties.

Clayton Mesa Flow or Tongue (of Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 1, 12, 133, 134, 143 (fig. 20). East of type locality, Clayton basalt consists of many long tongues. For purposes of this report, these tongues have been named, from south to north, Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that gave rise to these basalts are unknown.

Present in eastern Union County.

†Clayton Peak Quartz Diorite[1]

Upper Cretaceous or Tertiary, lower: Northern central Utah.

Original references: S. F. Emmons, 1903, Am. Jour. Sci., 4th, v. 16, p. 141–147; F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 85–143.

In Park City and adjacent districts, Summit County.

Claytonville Dolomite[1] (in Whitehorse Group)

Permian (Guadalupe Series): Central northern Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 26, pl. 1.

T. S. Jones, 1953. Stratigraphy of the Permian Basin of west Texas: West Texas Geol. Soc. p. 30 (fig. 9). Shown on chart as occurring near top of Whitehorse group.

Caps escarpment 2 miles west of Sweetwater, Nolan County; also at town of Claytonville, Fisher County.

Claytonville Gypsum (in Double Mountain Group)[1]

Permian: Central northern Texas.

Original reference: H. T. Morley, 1929, Texas Bur. Econ. Geology, geol. map of Fisher County.

Fisher County.

Clear Branch Sandstone[1]

Lower Devonian: Northern central Alabama.

Original references: C. Butts, 1927, Am. Jour. Sci., 5th, v. 14, p. 366, 367; 1927, U.S. Geol. Survey Geol. Atlas, Folio 221.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart below Frog Mountain sandstone.

Named for exposures at Clear Branch Gap through Red Mountain in Jefferson County, 5 miles south-southwest of Bessemer, Jefferson County.

Clear Creek Gneiss[1]

Precambrian: Central northern Colorado.

Original references: J. Underhill, 1906, Colorado Univ. Studies, v. 3, no. 4, p. 270; 1906, Colorado Sci. Soc. Proc., v. 8, p. 103–122.

Occurs along Clear Creek, Jefferson and Clear Creek Counties.

Clear Creek Gravels

See **Moncrief Member** (of Wasatch Formation)

Clear Creek Greenstone[1]

Mississippian(?): Northwestern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 226, 233, 238.

Probably named for exposures on or near Clear Creek, Shasta County.

Clear Creek Limestone[1] or Chert

Clear Creek Chert (in Ulsterian Group)

Lower or Middle Devonian: Southwestern Illinois and southeastern Missouri.

Original reference: A. H. Worthen, 1866, Illinois Geol. Survey, v. 1, p. 126–129.

J. M. Weller, 1940, *in* J. M. Weller and G. E. Ekblaw, Illinois Geol. Survey Rept. Inv. 70, p. 7, 14–15; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 24. Described in Illinois as Clear Creek chert in Ulsterian group; most extensively exposed and probably thickest of Devonian formations. Consists principally of novaculitic chert with variable amounts of fine-grained siliceous limestone. Thickness not accurately measured; not less than 300 feet and may attain maximum considerably in excess of that figure. Unconformably overlies Backbone limestone; underlies Dutch Creek sandstone. Grassy Knob and Clear Creek cherts are so similar they are difficult to differentiate except where intervening Backbone limestone or its cherty equivalent can be identified.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown as Lower or Middle Devonian.

Carey Croneis, 1944, Illinois Geol. Survey Bull. 68, p. 103 (chart), 114–115. Described in southeastern Missouri as Clear Creek chert; outcrops restricted to Perry County; largest exposure is between Wittenberg and mouth of Apple Creek where syncline carries the Bailey below the surface. Consists of white to buff to chrome yellow thin-bedded chert with brown to reddish ferruginous bands and some concretionary limonitic masses; strata range from about 1 inch to 1 foot in thickness and include thin interbedded layers of deeply weathered siliceous limestone and ferruginous clay. Thickness about 300 feet. At most places, superjacent strata have been largely removed either by erosion or through faulting. Thus, contact with Dutch Creek and Grand Tower beds cannot be studied satisfactorily; top of formation can be determined approximately in some areas by position of residual sandstone blocks probably marking the Dutch Creek beds that separate the Clear Creek from overlying Grand Tower formation; some older strata may have been included in Clear Creek and in places it may have been mistaken for Bailey and Grassy Knob strata. Disconformably overlies Bailey formation.

Named from exposures on Clear Creek, Union County, Ill.

†Clear Creek Limestone Member (of Graford Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 392.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 97, 105. The group of limestones in upper part

of Winchell member of Graford includes the Clear Creek limestone of Drake (1893) and Plummer and Moore (1921, Texas Univ. Bull. 2132) plus some higher beds heretofore included in Placid shale member of Plummer and Moore.

Named for Clear Creek, Brown County.

†Clear Creek Sandstone (in Cherokee Shale)[1]

Pennsylvanian: Western Missouri.

Original reference: G. C. Broadhead, 1874, Missouri Geol. Survey, v. 1, p. 57–61, 69, 100.

Named for exposures on Clear Creek, Vernon County.

Clear Creek Series[1]

Mississippian(?): Northwestern California.

Original reference: O. H. Hershey, 1903, Am. Geologist, v. 31, p. 231–245.

Southern part of Klamath Mountains.

Clear Creek Volcanic Series[1]

Triassic(?): Northwestern California.

Original reference: O. H. Hershey, 1904, Am. Geologist, v. 33, p. 248–256, 347–360.

Trinity and Shasta Counties.

†Clear Fork Group[1]

Pennsylvanian: Western Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Iron Ores, pt. 2, p. 169, 170.

Named for exposures on Clear Fork, 6 miles southwest of Kansas City.

Clear Fork Group[1]

Clear Fork Formation[1]

Lower Permian (Leonard Series): Central and central northern Texas.

Original reference: E. T. Dumble and W. F. Cummins, 1890, Texas Geol. Survey 1st Ann. Rept., p. 188, pl. 3.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42. Term Wichita group (restricted) used for beds of Leonard age between base of Clear Fork group and top of Wolfcamp series. Cheney proposes to abandon term Wichita. Clear Fork group comprises (ascending) Arroyo formation about 250 feet; Vale formation, with Bullwagon dolomite at top and about 360 feet of red shale below; and Choza formation.

L. R. Page and J. R. Adams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 57. Underlies San Andres group.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 97. Clear Fork group includes (ascending) Arroyo, Vale, and Choza formations. Overlies Lueders group; underlies El Reno (San Andres) group. Leonard.

Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412; 1945, Geol. Soc. America Bull., v. 56, no. 9, p. 898, 905. Overlies Wichita group; underlies Pease River group.

C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, chart 7 (column 74). Correlation chart shows Clear Fork group in Texas comprises (ascending) Arroyo, Vale, and Choza formations;

underlies Pease River group; overlies Wichita group. Name not used in Oklahoma. Leonardian.

Probably named for Clear Fork of Brazos River, Jones and Shakelford Counties, Tex.

Clear Lake Sediments[1]

Pleistocene: Northern California.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 201–202.

Lake County.

Clear Lake Volcanic series

Quaternary: Northern California.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 34–35. Shown on columnar section as comprising (ascending) rhyolite tuff, olivine basalt, Perini Hill flows (new), Boggs Mountain flows (new), Cobb Mountain volcanics (new), pyroxene dacite, obsidian, and Konocti volcanics (new). Age relations of individual units are imperfectly known because some units are isolated and contacts of contiguous flows are commonly obscured by sliding. Rhyolite tuffs and olivine basalt flows are intercalated with uppermost Cache beds; apparently younger than Sonoma volcanics (of middle or upper Pliocene age).

Report covers area of Lower Lake quadrangle, in Coast Ranges, about 70 miles north of San Francisco.

Cleary Coal Member (of Menefee Formation)

Upper Cretaceous: Northwestern New Mexico.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2149, 2157, fig. 3. Proposed for the beds formerly included in upper part of the Gibson coal member of Mesaverde formation which overlie the Point Lookout sandstone in southern part of San Juan Basin. Coal-bearing sandstone and shale unit, 250 to 300 feet thick.

Named from abandoned Cleary mine in SW¼ sec. 31, T. 19 N., R. 1 W., San Juan Basin; 2 miles west of La Ventana.

Cle Elum Formation

Cretaceous: Central Washington.

R. L. Lupher, 1944, Washington Div. Geology Rept. Inv. 11, p. 7, 12–15, pl. 2. Conglomerate, breccia, mudstone, and shale; arenaceous deposits rare; conglomerates predominate in east and argillaceous materials in west. Commonly less than 15 feet thick. Underlies Swauk formation; overlies a basement composed of peridotite and serpentine.

Occurs as series of restricted exposures that extend from upper Peshastin Creek near Blewett Pass westward to Cle Elum River Canyon, Chelan and Kittitas Counties.

Cleetwood Dacite Flow, Lava

Cleetwood Cove Dacite Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 38–39. Cleetwood Cove dacite is one of final flows of Mount Mazama. Lava is a black, yellow, or brown glass and is broken and rough on top. Fills an old valley at head of Cleetwood Cove; has thickness of over

300 feet in middle and tapers to thin edge on both sides. Extends from rim of Crater Lake northeastward for nearly 3 miles where it disappears beneath the plain of pumice and glacial material. Forms crest of rim for nearly a mile, extending upon both sides of Cleetwood Cove, where it makes prominent cliffs. Upper part of sides of Cleetwood Cove is a cliff of dacite, beneath which is a layer of pumice succeeded downward by 350 feet or more of exposed andesitic flows. These subdacite lavas are continuous around head of cove, but are not exposed. At head of cove, they are covered by dacite which flowed down inner slope of rim from caved-in tunnel of Rugged Crest to lake. Some distance above lake, upon both sides, the flow and platy structure of the dacite overlying andesite dip toward central stream, which in places dips toward lake at angle of 35° and lies parallel to present surface. [See Sun Creek Dacite Flow.]

J. E. Allen, 1936, Jour. Geology, v. 44, no. 8, p. 741–744. Diller believed that Cleetwood flow was in process of extrusion at time of collapse of Mount Mazama. The still motile lava poured back down into newly formed caldera, producing structure he labeled "backflow." This feature was used as evidence for theory of collapse of Mount Mazama as opposed to explosion. Suggested herein that the "backflow" is simply filling of the inclined vent of Cleetwood flow, which apparently came up along an east-west fissure dipping steeply southward into prehistoric mountain and which was subsequently exposed in crater wall.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 50–52, 62, 63, 120, 138, pl. 1. In sections northwest of the Wineglass, the Wineglass welded tuff overlies Cleetwood lava (flow).

Cleetwood Cove is on northern rim of Crater Lake.

Clem Creek Sandstone Tongue (of Wann Formation)

Clem Creek Sandstone Member (of Ochelata Formation)[1]

Clem Creek Sandstone Member (of Wann Formation)

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: W. B. Emery, 1918, U.S. Geol. Survey Bull. 686–B, p. 2, 3.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 14 (table 1), 15 (fig. 3), 17–18. Member of Wann formation in report on Pawnee County. Overlies "Washington Irving" member or in some places separated from it by as much as 38 feet of silty maroon shale. Underlies an unnamed section of gray shale, the topmost unit of the Wann.

Named for exposures along Clem Creek in northwestern part of T. 23 N., R. 11 E., Osage County.

Clement Member (of Grand Detour Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 3. Shown on columnar section as underlying Hely member (new) and overlying Stillman member (new).

Occurs in Dixon-Oregon area.

Clementsville Limestone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 160–162, pls. 6, 15. Limestone 10 to 15 feet thick. Included in Liberty facies

(new) of formation. At type section, Clementsville underlies a 60-foot unnamed silty shale unit and overlies a 25-foot unnamed shale unit. Stratigraphically above Caney Creek member (new).

Type section: At Clementsville, along State Highway 70 (and adjacent slopes) from Woods Creek valley to upland; base of section one-half mile southeast of Clementsville; top of section one-half mile farther along highway. Named from village in western Casey County, 1 mile from Adair County line.

Cleopatra Quartz Porphyry[1]

Precambrian: Central Arizona.

Original references: L. E. Reber, Jr., 1920, Am. Inst. Mining Engrs. Trans.; J. L. Fearing, Jr., 1926, Econ. Geology, v. 21, p. 757–773.

L. E. Reber, Jr., 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 59, 62. May have been early differentiation product of Bradshaw granite.

Jerome district.

Clermont Group (in Allegheny Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1882, Am. Philos. Soc. Proc., v. 19, p. 337–348.

Elk County.

Clermont Limestone (in Allegheny Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1880, Pennsylvania 2d Geol. Survey Rept. R, p. 46, 128.

In vicinity of Clermont, McKean County.

Clermont Shale (in Maquoketa Group)[1]

Clermont Shale Member (of Maquoketa Formation)

Upper Ordovician: Northeastern Iowa.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 98.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as shale member of Maquoketa formation. Overlies Elgin shaly limestone member; underlies Fort Atkinson limestone member.

Named for exposures at Clermont, Fayette County.

Cleveland magnafacies[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 28–29.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 46. The complete succession of magnafacies as outlined by Caster for southern New York and northwestern Pennsylvania is not represented in the Genesee group. At Cayuga Lake, except for the Geneseo shale, the group is presumably within the Big Bend magnafacies. Westward, the rock changes to black and dark-gray thin-bedded shales which fit the description of the Cleveland magnafacies of Caster. The Geneseo and Middlesex black shale bands correspond to the Cleveland magnafacies; black shales of the Hamilton, notably the Marcellus, are likewise Cleveland type. If the facies are to be given names and more or less specific

boundaries, the Geneseo and Middlesex black shales may be considered tongues extending eastward from the main mass of the Cleveland magnafacies. The Rhinestreet black shale, higher in the Devonian of western New York, may also be considered a tongue of the Cleveland magnafacies.

Name derived from Cleveland shale.

Cleveland Member (of Ohio Shale)

Cleveland Shale[1]

Upper Devonian: Northern Ohio.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 19, 21.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 37; Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 141. Ohio shale has been divided into three parts: Cleveland shale, Chagrin shale, and Huron shale.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1352–1353. At type locality, Cleveland member consists of about 60 feet of tough bituminous black shale. Thins eastward to featheredge west of Ohio-Pennsylvania line. Overlies Chagrin shale, and in some areas contact is sharply defined and in others there is transition zone; underlies Bedford shale.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 15, 16. In outcrops along Rocky River north of Berea, Ohio, Cleveland member is 100 feet thick. Upper part is typically hard dull-grayish-black shale which weathers to thin chips that are commonly stained rusty reddish brown. Lower part of member, which was called Olmsted member by Cushing (Cushing, Leverett, and Van Horn, 1931, U.S. Geol. Survey Bull. 818), contains, in addition to black shale, many beds of bluish-gray or gray clay shale that range in thickness from an inch to several feet; some gray to brown siltstones; many small nodules of pyrite; and several thin siliceous limestones that are characterized by cone-in-cone structure. Conodont fauna found in upper 25 feet of Cushing's Olmsted member is identical with conodont fauna of the Cleveland (Hass, 1947, Jour. Paleontology, v. 21, no. 2). The Cleveland and Huron members are practically identical in lithologic character, and in Erie and Lorain Counties the contact between these two black shales is drawn arbitrarily below lowest cone-in-cone layer and above uppermost zone containing large septarian concretions.

Named for exposures at Cleveland, Cuyahoga County.

Cleveland Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 75, 172.

Crops out along north bank of Little Kanawha River at Cleveland, Webster County.

Cleveland County red lands[1]

Eocene: Southeastern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 58–59.

Named for exposures at O. H. Mark's place, Red Land Township, Cleveland County.

Cleveland Gulch Quartzite Member (of Hopewell Series)

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 42, pl. 3. A particularly prominent quartzite in the series. Of sedimentary origin. Interspersed with Picuris basalts and Vallecitos rhyolites.

Exposed between Tusas and Kiawa Mountains, Petaca area, Rio Arriba County.

Clews Fanglomerate

Miocene: Southern California.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 15–18, pls. 1, 2. Consists of lower unit of fine-grained tuffaceous sediments, middle unit of ridge-forming reddish-brown fanglomerate, which volumetrically constitutes about 90 percent of formation, and upper unit of sandstone with included tuff beds. Thickness 560 to 660 feet. Unconformably overlies pre-Tertiary plutonic rocks; wedges out westward between plutonic rocks and Alvord Peak basalt (new); where Alvord Peak is missing, Clews is overlain by Spanish Canyon formation (new). Middle Tertiary, possibly early or middle Miocene.

Type locality: Clews Ridge, southeastern part of Alvord Mountains, San Bernardino County.

†Click series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvii, 274, pl. 3.

Probably named for Click, Llano County.

Cliff House Sandstone (in Mesaverde Group)[1]

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

Original reference: A. J. Collier, 1919, U.S. Geol. Bull. 691–K.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144. In Barker Dome-Fruitland area, New Mexico, includes (ascending) Barker Dome, Cholla Canyon, Beechatuda and Ute Canyon tongues (all new). Overlies and intertongues with Menefee formation; underlies and intertongues with Lewis shale.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2158–2159. Nomenclature of Mesaverde group in San Juan Basin, N. Mex., revised. Name Cliff House sandstone replaces Chacra sandstone throughout former extent of that unit.

Named for exposures in canyons above the cliff houses of Mesa Verde National Park, Montezuma County, Colo.

Cliffield Formation

Cliffield Group

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 823–833, 862–868, 884 (fig. 3), pl. 5. In Tazewell County, the strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29

zones. Name Cliffield is proposed for zones 1 through 9, including the succession from the base of basal clastics to top of second zone of calcilutite. Facies variations whereby lithologically distinctive zones grade locally into a thickness of indistinguishable calcilutites prevent succession herein assigned to the Cliffield from being subdidived into mappable formations. Where various zones are distinct, as in most parts of Tazewell County, five members are recognized (ascending): Blackford, Five Oaks limestone, Lincolnshire limestone, Ward Cove limestone, and Peery limestone (all new). Maximum thickness 1,142 feet south of St. Clair Station; minimum thickness 345 feet, on northwest side of Thompson Valley. Underlies Benbolt limestone (new); contact a disconformity; disconformable upon Beekmantown dolomite; top of Beekmantown is an erosion surface with maximum relief of about 200 feet. As here defined, includes beds which Butts has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 54–71. Cliffield group is used to apply to middle Ordovician formations southeast of Clinch Mountain, in Burkes Garden quadrangle. As thus used, includes Blackford, Five Oaks, Lincolnshire, Effna, Whitesburg, Athens, and Peery formations. Approximately equivalent to Butts' (1940) Mosheim-Lenoir-Holston-Whitesburg-Athens succession of the southeastern belts of Appalachian Valley.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1145–1160. Cliffield group in southeastern Virginia and northeastern Tennessee includes Blackford, Five Oaks, Lincolnshire, Thompson Valley (new), Ward Cove (restricted), and Peery formations.

Type section: Exposures along Pounding Mill Branch and U.S. Route 19, south of Norfolk and Western underpass; top is exposed at intersection of U.S. Route 19 and County Road 637, and base is exposed along east side of U.S. Route 19 about 50 yards south of highway underpass. Name taken from Cliffield, a store and station along Norfolk and Western Railroad, about 8 miles southwest of North Tazewell, Tazewell County, Va.

†Cliffwood Clays[1]

Upper Cretaceous: Northeastern New Jersey.

Original reference: H. B. Kummel and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 166.

Exposed in clay pits about Cliffwood and at Cliffwood Point on south shore of Raritan Bay.

Clifton Formation[1]

Middle Silurian: West-central Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1876, Elements of geology of Tennessee, p. 108, 142–146.

Named for exposures at Clifton, Wayne County.

Clifton Forge Sandstone Member (of Keyser Limestone)[1]

Lower Devonian: Central western Virginia and West Virginia.

Original reference: F. M. Swartz, 1929, U.S. Geol. Survey Prof. Paper 158–C, p. 29.

P. H. Price and E. T.Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 206. Present in Greenbrier County, W. Va.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 38, 42–44. Big Mountain shale member, which maintains its identity into Bath County, Va., is believed to pass literally into lower portion of Clifton Forge sandstone of Alleghany County, Va., and adjacent areas.

F. G. Lesure, 1957, Virginia Polytechnic Inst. Engineering Expt. Sta. Ser. 118, p. 45. Commonly white to medium-light-gray fine-grained porous crossbedded and cross-laminated sandstone; some medium-dark-gray fine-grained argillaceous limestone. Thickness 79 feet in Clifton Forge iron district. Underlies unnamed upper part of Keyser; overlies Tonoloway limestone.

Named for exposures at Clifton Forge, Va.

†Clifty Conglomerate Lentil[1] (in Lee Formation)

Pennsylvanian: Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33B, p. 370–371.

White County.

Clifty Limestone[1]

Middle Devonian: Northwestern Arkansas.

Original reference: H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

H. D. Miser, 1944, Illinois Geol. Survey Bull. 68, p. 132, 134 (fig. 27). Sandy compact light-bluish-gray fossiliferous limestone. Maximum thickness 2½ feet. Overlies Penters chert; underlies Sylamore sandstone member of Chattanooga shale.

Named for East Fork of Little Clifty Creek, Eureka Springs quadrangle, Carroll County.

†Clifty Shale[1]

Pennsylvanian: Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33B, p 370–371.

Clifty and Bon Air, White County.

Climax Porphyry

Tertiary(?): Colorado.

E. J. Eisenach and Edward Matsen, 1954, Mining Eng., v. 6, no. 3, p. 27; J. W. Vanderwilt and R. U. King, 1955, Mining Eng., v. 7, no. 1, p. 43–44; S. W. Wallace and others, 1960, *in* Guide to the geology of Colorado: Rocky Mountain Assoc. Geologists, p. 238–252. Name applied to porphyry in Climax stock.

Well displayed in Climax mine at Climax, Lake County.

†Clinch Red Shale[1]

Upper Ordovician: Eastern Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 297, 298.

Named for exposures on Clinch Mountain, Hancock and Hawkins Counties.

Clinch Sandstone[1] **or Quartzite**

Lower and Middle Silurian: Eastern Tennessee, southwestern Virginia, and southern West Virginia.

Original reference: J. M. Safford, 1856, Geological Reconnaissance of Tennessee 1st Rept., p. 157.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey and Gas Inv. Prelim. Map 76. Sandstone, in Rose Hill district, Lee County, Va., is 257 feet thick and includes Hagan and Poor Valley Ridge members (both new). Overlies Sequatchie formation; underlies Clinton shale.

John Rodgers, 1953, Tennessee Div. Geol. Bull. 58, pt. 1, p. 100–104, pls. Safford's description makes it clear that in Clinch Mountain area he included in the Clinch the whole thickness of rocks now classed in the Silurian system. Keith (1896, Morrison folio; 1901, Maynard folio) followed this same usage in mapping this belt. Probably both lower and middle Silurian rocks are included. A few feet of upper Silurian or even lower Devonian is present at top, but representatives of the different series do not appear to be separately mappable. On present map the whole unit in this belt is mapped as Clinch sandstone. Clinch sandstone and Rockwood formation are mainly contemporaneous phases of lower and middle Silurian. In areas intermediate between the two type localities, they grade into each other, though in any one section the sandstone lies chiefly below. Thickness of Clinch sandstone about 500 feet on Clinch Mountain. Overlies Juniata formation.

Named for exposures on Clinch Mountain, Hancock and Hawkins Counties, Tenn., and Scott County, Va.

†Clinch Mountain Sandstone[1]

Upper Ordovician and Silurian: Eastern Tennessee and western Virginia.

Original reference: J. M. Safford, 1856, Geol. Reconn. Tennessee 1st Rept., p. 157.

Named for exposures on Clinch Mountain, Hancock and Hawkins Counties, Tenn., and Scott County, Va.

†Cline[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 114.

Probably named for Cline, Uvalde County.

Clinetop Algal Limestone Member (of Dotsero Formation)

Upper Cambrian: Central northwestern Colorado.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 893, 898, 899–904. Proposed for ledge-forming algal limestone and conglomerate unit, 3 to 5 feet thick, at top of Dotsero formation. At most places, lower half of member consists of course flat-pebble conglomerate, and upper half consists of crystalline to dense algal limestone with a crinkly wavy structure. Overlies Glenwood Canyon member (new). Underlies Dead Horse conglomerate member (new) of Manitou formation.

Type locality: In Clinetop area, Garfield County, where unit trends northeastward across NE¼ sec. 35, T. 3 S., R. 90 W., about 1 mile east of Clinetop Road and SW¼ sec. 23, T. 3 S., R. 90 W., near Sixmile Lake.

†Clingman Conglomerate (in Chilhowee Group)[1]

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: Arthur Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 280–281. In Knoxville and Mount Guyot quadrangles, Keith (1895, Mount

Guyot folio, unpub.) mapped three conglomerates, the Cades, Thunderhead, and Clingman, which, in region to the south he later classified as Great Smoky quartzite. Cades conglomerate is lower member of Great Smoky quartzite. Thunderhead conglomerate forms the middle and upper members. Nantahala slate, which overlies upper members of Great Smoky, was called Hazel slate. The quartzite, which lies east of Nantahala slate at Newfound Gap, Keith called Clingman conglomerate, and he interpreted the quartzite as overlying the Nantahala (Hazel) slate. Structural evidence shows that these beds are overturned and that the quartzite here is the upper member of the Great Smoky on the east overturned limb of a syncline enclosing Nantahala slate. South of Newfound Gap, upper quartzite member is exposed at Mount Collins on Park Road that leads to Clingman Dome. Southwest of Mount Collins, Nantahala slate is in narrow syncline, on south limb of which are exposed the underlying upper quartzite of Great Smoky formation, and, farther south, the middle (conglomerate) beds. These conglomeratic beds in outcrops at Parking Overlook at Clingmans Dome are massive micaceous quartzite in 20-foot beds. It is these beds that Keith (Mount Guyot folio) called Clingman conglomerate, which he regarded as upper member of the Great Smoky and so mapped it at Clingmans Dome on crest of Great Smoky Mountains to west. The conglomeratic quartzite that crops out at Clingmans Dome is identical in lithologic character and stratigraphic position with middle member of Great Smoky quartzite exposed on U.S. Highway 276 and lies well down in the quartzite.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 958. Keith originally placed upper part of sequence here termed Great Smoky group in Hazel slate and Clingman conglomerate; these names are now abandoned. Clingman conglomerate was supposed to be highest stratigraphic unit in Great Smoky Mountains. Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 143) merged it with his Great Smoky conglomerate, apparently on assumption that it had been duplicated structurally. At Clingmans Dome and other parts of the mountains, coarse sandstone overlies, in stratigraphic sequence, argillaceous rocks that are here classed as parts of Anakeesta formation (new). It is believed that these units of coarse sandstone are layers of Thunderhead lithology that intertongue at varying stratigraphic levels with Anakeesta. The type Clingman is probably equivalent to upper beds of Thunderhead sandstone and lower part of Anakeesta formation on Mount Le Conte, but other units mapped as Clingman lie at different and higher levels. It seems best to class these, depending on locality, as beds in the Anakeesta, as tongues of the Thunderhead, or as unnamed parts of the Great Smoky group.

Named for Clingmans Dome, Swain County, N.C.

Clinton Formation, Shale, or Group

Clinton Formation (in Niagara Group)[1]

Clinton Formation (in Red Mountain Group)

Middle Silurian: New York to northeastern Tennessee; also Michigan.

Original reference: T. A. Conrad, 1839, Philadelphia Acad. Nat. Sci. Jour., v. 8, pt. 1, p. 228–235.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 22 (fig. 6). Group includes Willowvale shale (new) in Clyde and Sodus Bay quadrangles.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 50–145. Clinton group, in Niagaran series, comprises (ascending) Rose Hill for-

mation, Keefer sandstone, and Rochester shale. Occurs above Tuscarora sandstone of Medinan series.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 535, chart 3. In this report [Silurian correlation chart], term Clinton is used as group in central and western New York and from central Pennsylvania to northeastern Tennessee and shown to include many formations. From southeastern Tennessee to northwestern Georgia, the Clinton is shown as a formation in Red Mountain group.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (2 sheets). In Rose Hill oil field, Virginia, Clinton shale, overlies Poor Valley Ridge member (new) of Clinch sandstone. Underlies Cayuga dolomite.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 5–190. A comprehensive report on Clinton group of western and central New York. Included in Niagaran series. Overlies Albion group; underlies Lockport group. units discussed are the Thorold, Oneida, Neahga, Maplewood, Furnaceville iron ore, Reynales, Bear Creek, Sodus (lower and upper), Wolcott limestone, Westmoreland (new), Willowvale, Dawes (new), Kirkland, Herkimer, and Rochester.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Clinton group, in Niagaran series. Comprises (ascending) Osgood, Laurel, and Waldron formations. Overlies Medina group; underlies Louisville formation.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 79–83. Clinton shale, in Lee County, Va., includes about 400 feet of shale and sandstone lying between Clinch sandstone below and Hancock dolomite above.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1982 (fig. 3), 1993. Discussion of stratigraphy of Medinan group, New York and Ontario. Silurian system is divided into Medinan, Clinton, and Niagara groups, the three comprising Ontarian series. Clintonian [Clinton] group comprises (ascending) Reynales, Irondequoit, Rochester, and Decew formations in vicinity of Hamilton; Neahga, Reynales, Irondequoit, and Decew, at Decew Falls; Thorold (part), Neahga, Reynales, Irondequoit, Rochester, and Decew at Niagara Gorge; and Thorold, Maplewood, Furnaceville, Reynales, Sodus, Williamson, Irondequoit, Rochester, and Decew in Genesee Gorge. For mapping purposes, Grimsby-Thorold contact is retained as Medinan-Clinton boundary.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. No. 1. Rock units of New York Silurian are divided into (ascending) Medina, Clinton, Lockport, Salina, and Bertie groups. Lower and middle parts of Clinton group are in Ontarian stage; upper Clinton strata are in Tonawanda(n) stage (new). Because Thorold of Gillette (1947) is not continuous with type Thorold at Thorold, Ontario, name Kodak (Chadwick, 1917) is revived for basal sandstone of Clinton group in New York. Term Wallington is proposed for limestone formerly regarded as Reynales at Rochester and eastward. Niagaran series.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Clinton group includes Rose Hill formation, Keefer sandstone, and Rochester shale.

Characteristically exposed around Clinton, Oneida County, N.Y.

Clinton Granitic Gneiss

Pre-Triassic: South-central Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as red or pink medium- to coarse-grained platy gneiss; composed of pink microcline, quartz, white oligoclase or albite, and biotite.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 25, 51, pls. 1, 2. Described in Guilford quadrangle where is has concordant relationship with Haddam tonalite.

Named for town of Clinton, Middlesex County.

†Clinton Quartzites[1]

Silurian: Eastern New York.

Original reference: C. A. Hartnagel, 1905, New York State Mus. Bull. 80, p. 346.

Clipper Gap Formation[1]

Mississippian(?): Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283. Cosumnes formation (new) rests unconformably on the Calaveras (Clipper Gap) formation.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on correlation chart in Chesterian series.

Named for exposures at village of Clipper Gap, Placer County.

Cloice Member (of Lake Waco Formation)

Cretaceous (Gulf Series): Central Texas.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Series, no. 4, p. 122, 139 (fig. 17), 144 (fig. 18). Consists of dark, silty, calcareous shales with subordinate limestone beds. Thickness 35 feet. Middle member of formation; underlies Bouldin member (new); overlies Bluebonnet member (new).

Type section: Cloice Branch, McLennan County; type area is along the Bosque Escarpment southwest to Moody Hills.

†Cloquet Slate[1]

Precambrian (upper Huronian): Northeastern Minnesota.

Original reference: J.E. Spurr, 1894, Am. Jour. Sci., 3d, v. 48, p. 159–166.

Exposed along St. Louis River not far from Duluth, near Thomason, Carlton, and Cloquet, Carlton County.

Clore Limestone[1]

Clore Sandstone (in Elvira Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, and western Kentucky.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 129.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 838–839. Assigned to Elvira group (new). In standard Mississippian section, underlies Degonia sandstone and overlies

Palestine sandstone. Recognized as distinct formation as far east as central Christian County, Ky. Farther east, overlying Degonia is not distinguishable, and beds from base of Clore to top of Chester constitute one of thickest limestone sections of Chester series in Eastern Interior basin. This consists of 250 to 300 feet of light- to dark-gray or locally bluish limestone with lenticular shale and sandstone strata and some chert. East of Logan County, Ky., this part of geologic column becomes predominantly shale, and Clore formation has not been differentiated from remainder of Elvira group. In Indiana, the Clore is known as the Gennet Creek formation and consists of 10 to 35 feet of predominantly shaly beds.

C. A. Malott, 1952, Stratigraphy of Ste. Genevieve and Chester formations of southern Indiana: Ann. Arbor, Mich., The Edwards Letter Shop, p. 6. Name Clore limestone extended to Indiana and applied to shale and limestone interval underlying Degonia sandstone and overlying Palestine sandstone. [This appears to be interval to which name Gennet Creek was applied.]

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Clore limestone shown on stratigraphic column of upper Chester rocks in Indiana as 10 to 35 feet of soft greenish-gray shale and thin beds of yellow impure limestone. Term Elvira group not applied in Indiana.

Named for Clore School, Randolph County, Ill. Typically exposed in heads of ravines along southwest side of high ridge extending from Clore School to Randolph County Farm.

Closed Volcanics

Tertiary: Northwestern Wyoming.

R. D. Krushensky, 1960, Dissert. Abs., v. 21, no. 4, p. 849. Volcanic breccias and some sandstones and conglomerates. Overlie Squaw flows (new); underlie unit referred to as post-Closed volcanics.

Hurrican Mesa area, Park County.

Cloudburst Formation

Upper Cretaceous(?) and Tertiary: Southeastern Arizona.

J. D. Pelletier, 1957, Mining Engineer, v. 9, no. 7, p. 760. Contains two members. Upper member is conglomerate made up mainly of quartz monzonite fragments but containing some fragments of older rocks in area. Matrix tends to be arkosic, but granitic sand and gravel not uncommon. Con glomerate poorly cemented but relatively well sorted, having beds of sand and gravel alternating with beds of larger boulders. Tuff beds in conglomerate and in the underlying member, which is composed of interbedded flows, flow breccias, and conglomerate. Unconformably underlies Gila(?) conglomerate.

At San Manuel mine [just south of town of Tiger].

Cloudcap Dacite Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 34, 35. Cloud Cap, on eastern crest of rim, marks point of departure of stream of dacite which spreads to northeast. It forms large part of Redcloud Cliff, which takes its name from the reddish-yellow tuff or tuffaceous dacite that underlies principal flow. This flow, which appears to

be made up of at least three streams, forms prominent cliff for over one-half mile along rim of Crater Lake and has thickness of over 300 feet. It appears to form one-third of inner slope of crest. This flow presents series of cliffs about its borders, especially on northwest. [See Sun Creek Dacite Flow.]

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 40, 54. Cloudcap and Redcloud dacites were erupted after andesitic phase of Mazama's activity had come to end. Cloudcap flow is older than the much thicker Redcloud flow (lava).

Cloudcap is on eastern side of Crater Lake.

Cloud Chief Formation

Cloud Chief Gypsum[1] (in Double Mountain Group or Whitehorse Group)

Cloud Chief Gypsum Member (of Whitehorse Formation)

Permian: Southwestern Oklahoma and northern Texas.

Original reference: C. N. Gould, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 324–341, map.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Mapped in Double Mountain group.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21 no. 4, p. 421–433. Cloud Chief formation mentioned in general discussion of loose application of Kansas formation names in Texas.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1527–1529. Upper member of Whitehorse group. Cloud Chief dolomite facies of Weatherford area should not be considered as Quartermaster as was proposed by Green (1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11). Overlies Rush Springs sandstone; underlies Doxey shale of Quartermaster group.

Robert Roth, N. D. Newell, and B. H. Burma, 1941, Jour. Paleontology, v. 15, no. 3, p. 313. Table shows Cloud Chief gypsum as member of Whitehorse formation. Whitehorse and Quartermaster formations are placed in Custer group.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 668, pl. 2. Uppermost formation in Whitehorse group. Term Double Mountain group abandoned.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Formation as mapped includes Day Creek dolomite member in northwestern Oklahoma and Weatherford member in central western part. Shown above Whitehorse group.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 75–77. In Grady County, formation is about 15 feet thick. Unconformably overlies Rush Springs sandstone. Crops out in widely scattered outliers so only lower part is present.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 40–43. In Harper County, name Cloud Chief formation applied to dolomite, red shale, and gypsum overlying Whitehorse group. Thickness 25 feet; only lower part present. Includes Day Creek dolomite member at base. Doubtfully referred to Ochoan series. Correlated with Taloga formation and Day Creek dolomite of Kansas.

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C. O. Dunbar, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, chart 7. Permian. Correlation chart shows Cloud Chief present in Oklahoma but not in Texas.

Typically exposed near town of Cloud Chief, Washita County, Okla.

Cloudy Pass Diorite

Tertiary: North-central Washington.

E. A. Youngberg and T. L. Wilson, 1952, Econ. Geology, v. 47, no. 1, p. 4 (fig. 2), 5. Named on map legend. Believed to be related to Tertiary Cloudy Pass intrusives which are exposed to west of area.

Occurs at Holden mine, at Holden, Chelan County.

Clough Formation or **Quartzite**

Clough Conglomerate[1]

Lower Silurian: Western New Hampshire, north-central Massachusetts, and southeastern Vermont.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 468, 481–483. Further description of conglomerate.

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 119, 129–130. Termed a formation in Mount Cube quadrangle, New Hampshire, because considerable mica-schist is present and conglomerate beds are subordinate. Thickness 600 to 1,200 feet in this area.

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–3]. Formation geographically extended to Massachusetts. Age shown as Silurian.

G. E. Moore, Jr., 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1617, 1626–1628, pl. 1. Termed a quartzite in Keene-Brattleboro area, New Hampshire-Vermont, since quartzite more abundant than quartz conglomerate, quartz-mica schist and mica schist.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000) U.S. Geol. Survey. Mapped as quartzite. Represented in chlorite metamorphic zone by gray to white quartzite and quartz conglomerate. More coarsely crystalline white quartzite and quartz conglomerate in garnet and staurolite zones where mica schist with biotite, garnet and (or) staurolite also occurs. Similar schist with sillimanite rather than staurolite occurs in the sillimanite zone.

A. J. Boucot and others, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 855–870. Upper part of Clough formation at Skitchewaug Mountain, near Springfield, Vt., and on Croydon Mountain, near Claremont, N.H., contains fossils of Silurian or Devonian age. On lithologic basis, it is probable that lower part of Bernardston formation, including the conglomerates, quartzites, and calcareous quartzite, is lateral equivalent of Clough formation and that limestone associated with Bernardston formation is lateral equivalent of Fitch formation. If Clough formation at Skitchewaug Mountain were of Devonian age, the stratigraphy of Connecticut Valley region would be complicated by fact that the Clough and overlying Fitch formations elsewhere are of Silurian age.

Named for Clough Hill district, Moosilauke quadrangle, New Hampshire.

Clovelly Stage

Miocene: Southeastern Louisiana (subsurface).

C. M. McLean, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 241, 242 (fig. 1), 243. A stage name, based on faunal assemblages occurring in the sediments commonly termed "Lower" Miocene in the subsurface of southeastern Louisiana. Duck Lake and Napoleonville stages proposed as replacements for the "Middle" and "Upper" Miocene respectively. Names were selected arbitrarily only because the denoted fields demonstrate representative sections for each; nothing in way of principal producing members is implied.

Clover Formation

Oligocene(?): Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Andesite mudflow breccia about 550 feet thick. Unconformable below Delleker formation (new), unconformity marked by faulting. Lies on Lovejoy basalt (new) and other older rocks.

Occurs in Grizzly Mountains and to the northwest in Blairsden quadrangle, Plumas County.

Clover Member (of Loysburg Formation)

Middle Ordovician (Chazyan): Central and south-central Pennsylvania.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Laminated, rather pure limestone. Thickness 46 feet at type locality. Upper member of formation; overlies unnamed lower member.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3, 4, 5, 7. Upper member of formation. Principally sublithographic, somewhat magnesian limestone in Centre, Huntingdon, and northern Blair Counties. White-weathering dense laminated sublithographic limestone occurs north of Union Furnace. Thickness 40 to 80 feet in type section. Overlies "tiger-striped" beds of the formation; underlies Eyer member of Hatter formation. Formerly included in Carlim limestone of the Tyrone district. Derivation of name.

Type section: At Union Furnace, Huntingdon County. Named for Clover Creek east of Williamsburg, Blair County.

Clover Quartzites[1]

Clover Canyon Quartzites[1]

Precambrian: Northwestern Nevada.

Original reference: C. King, 1878, U.S. Geol. Expl. 40th Par., v. 1, p. 69.

Humboldt Range, Pershing County.

Clover Creek Granodiorite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11, pl. 1. Chiefly granodiorite; distinguished by salt and pepper appearance resulting from imperfectly formed hornblende and sphere crystals sprinkled through the rock. Finer fabric was significant factor in separating these rocks from mineralogically similar Giant Forest pluton.

Three small masses totaling about a square mile crop out near West Fork of Clover Creek and south of Colony Meadow, Sequoia National Park.

Clover Creek Greenstone[1]

Permian: Northeastern Oregon.

Original reference: James Gilluly, 1937, U.S. Geol. Survey Bull. 879.

W. D. Smith and J. E. Allen, 1941, Oregon Dept. Geology and Mineral Industries Bull. 12, p. 6 (fig. 2), 7–8. Described in Wallowa Lake quadrangle where it is 3,000 to 5,000 feet thick. Base not observed. Conformably underlies a unit termed Lower Sedimentary Series, or where series is lacking unconformably underlies Martin Bridge formation.

Named for exposures along Clover Creek in secs. 24, 25, 26, and 35, T. 7 S., R. 42 E., Baker County.

Clover Creek Limestone (in Chester Group)[1]

Mississippian: Western central Kentucky.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908 and 1909, p. 83, 85.

Named for exposures at mouth of Clover Creek, Breckinridge County.

Cloverly Formation[1]

Cloverly Group

Lower Cretaceous: Central eastern, and northern Wyoming and central southern Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 42–45. In Bighorn Canyon-Hardin area, Montana-Wyoming, formation is 300 to 400 feet thick, includes Pryor conglomerate member at base and Birdhead sandstone member at top. Overlies Morrison formation; underlies Thermopolis shale. Lupton (1916, U.S. Geol. Survey Bull. 621) called the 20 feet of sandstone at top of Darton's type Cloverly Greybull sandstone. This unit has been called member of Cloverly but not always top member. Overlying Greybull sandstone member in Bighorn Basin is unit of shales and rusty-weathering sandstones which Darton called "rusty series" or "rusty beds." The "rusty beds" have been included in Thermopolis shale by some workers and in Greybull sandstone by other workers. If Cloverly formation from Birdhead sandstone down to the variegated beds is correlative with Darton's "rusty beds," then Cloverly in Bighorn Canyon-Hardin area includes strata younger than type Cloverly. Inclusion of "rusty beds" in the Cloverly constitutes a redefinition of Cloverly as described by Darton. This redefinition is justifiable because Darton's upper unit of Cloverly, the Greybull sandstone member, is not readily separated in many localities from underlying "rusty beds." Top of Cloverly—if it is to occur at a lithologic break of considerable area extent—should be placed either below Greybull sandstone member and above variegated beds in middle of Cloverly or below black Skull Creek shale (or its stratigraphic equivalent) and above the so-called rusty beds.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 56–57. In Johnson County, Wyo., overlies Morrison formation and underlies Skull Creek shale. Thickness 135 to 165 feet.

A. B. Shaw, 1957, Rocky Mountain Assoc. Geologists Guidebook to geology of North and Middle Parks Basin, Colorado, p. 48, 49 (fig. 1). Base of Cretaceous comprises tripartite unit traditionally divided into Lakota sandstone, Fuson shale, and Dakota sandstone. In Laramie Basin, same division is recognizable, but the three names are not used; instead, entire unit is called Cloverly formation. In this report, both sets of

names are used for North Park, Colo., but Cloverly is elevated to rank of group.

R. M. Moberly, Jr., 1958, Dissert. Abs., v. 18, no. 1, p. 198. Includes Little Sheep mudstone (new), Pryor conglomerate tongue, and Lovell member (new).

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 35–37. Described in Buffalo-Lake DeSmet area, Johnson and Sheridan Counties, Wyo., where it is 156½ feet thick, overlies Morrison formation, and underlies Skull Creek shale.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1143 (fig. 2), 1145–1149, pl. 1. As redefined here, includes nonmarine sedimentary rocks which lie above Morrison formation and below Sykes Mountain formation (new). Comprises (ascending) Little Sheep Mountain (new), Pryor conglomerate, and Himes (new) members. Thickness 382 feet at type locality.

D. L. Eicher, 1960, Yale Univ. Peabody Mus. Nat. History Bull. 15, p. 5–11, 13, 15–16. Underlies rusty beds of Thermopolis shale.

Arthur Mirsky, 1960, Dissert. Abs. v. 21, no. 4, p. 850–851. Formation, in southern Big Horn Mountains, Wyo., includes Otter Creek sandstone member (new) in lower part. Upper part of Cloverly is referred to as the Mudstone member. Overlies Morrison formation; underlies Rusty Beds member of Thermopolis.

Type locality: Near Cloverly, about 15 miles northeast of Basin, Bighorn County, Wyo.

Clovis Beds

Clovis Formation

Pleistocene: Central eastern New Mexico.

Ernst Antevs, 1936, Acad. Nat. Sci. Philadelphia Proc., v. 87, p. 305–306 [1935]. A generalized profile comprises (descending) several feet of red-brown wind-blown sand; a few feet of blue-gray clay—a lake deposit—forming one to three distinct beds (containing bones of mammoth and extinct bison, mollusks, diatoms, Folsom points, other points and charcoal and burned animal bones); and yellow sand with bones of horse and camel but without artifacts.

Ernst Antevs *in* H. M. Wormington, 1949, Denver Mus. Nat. History Pop. Ser. 4, p. 189. The beds which contain the old artifacts, extinct horse, camel, bison, and mammoth, diatoms and mollusks are separated by disconformities from beds below and above and constitute the Clovis formation.

Exposed some 15 miles southwest of Clovis and an equal distance to the southeast.

Cloyd Conglomerate Member (of Price Formation)

Mississippian (Kinderhookian): Southwestern Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 343–346, 347. Coarse-grained white quartz sandstone having lenses and layers of conglomerate with quartz pebbles as much as 1½ inches in diameter; lies at base of formation. Name Ingles conglomerate has been applied to this sandstone because similar sandstone occurs in Ingles Mountain a few miles southeast of Radford; sandstone in Ingles Mountain, how-

ever, is Clinch sandstone; hence, name Cloyd is here substituted for Ingles.

Lynn Glover, 1953, (abs.) Virginia Jour. Sci., new ser., v. 4, p. 260–261. Rusty-weathering flaggy marine sandstones and shales overlie the Devonian Broadford sandstone and are terminated by the Cloyd member of Mississippian Price formation.

Named for exposures in Cloyd Mountain, the part of Little Walker Mountain southwest of New River in Pulaski County.

Clugston Limestone[1]

Paleozoic(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 71, map.

Mapped around headwaters of Clugston Creek, Stevens County.

Clyde Formation (in Wichita Group)[1]

Clyde Group

Permian (Wolfcamp Series): Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 192, 197–198, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 94. Rank raised to group. Includes Grape Creek formation below and Talpa formation above. Underlies Lueders group; overlies Belle Plains group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as a formation where it is 500 feet thick and consists of regular beds of moderately hard medium- to fine-grained gray limestones, in layers 1 to about 10 feet, alternating with shale and marl beds of about same thickness. Includes strata above Bead Mountain limestone member of Belle Plains formation to base of Lueders limestone. Comprises Grape Creek limestone member below and Talpa limestone member above. Division of the Clyde into members in this area is not as natural as in country north of Abilene; in area herein mapped, units might appropriately be treated as formations.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 274–276, pls. 11, 12. Described in Brazos River area. Includes all rocks between top of Bead Mountain limestone member of underlying Belle Plains formation and base of overlying Lueders limestone. Thickness 220 feet in northwestern Callahan County; 225 feet in west-central Throckmorton County. Includes five members (ascending): unnamed shale, Grape Creek limestone, unnamed shale, Talpa limestone, and unnamed shale. Wichita group.

Named for town of Clyde, 8 miles west of Baird, Callahan County.

Coachella Fanglomerate[1]

Miocene, upper(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 386–387, 391, map.

W. P. Woodring, 1932, Carnegie Inst. Washington Pub. 418, p. 12, 25. Discussion of age of marine Tertiary deposits of Colorado Desert, Calif. Vaughan considered Coachella fanglomerate to be Quaternary age. It is much older and occupies same stratigraphic position as "Indio formation" (Buwalda and Stanton, 1930). Paleontological evidence points to the

conclusion that the marine beds of Colorado Desert are of Miocene age. There is little on which to base a conclusion as to what part of coastal Miocene section is represented, but evidence indicates late Vaqueros age, that is, late lower Miocene. The "Indio formation" and "Coachella fanglomerate" occupy the same stratigraphic position with reference to marine beds [Imperial formation; late lower Miocene] as the Palm Spring formation (new) which overlies the Imperial, but because both are closer to head of trough, their base may lie at lower horizon.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 323–326, pls. 1, 4. Described in San Gorgonio Pass area where it is composed of two members; an upper, 3,750 feet thick, consisting of massive conglomerate with interlayered flows of olivine basalt and associated dikes, and a lower, 850 feet thick, consisting of well-indurated massive conglomerate and basal breccia of gray schist fragments. Fanglomerate shows marked lateral variation in composition. In typical section noted, eastward-dipping Coachella beds lie with depositional contact on crystalline complex and to the east are unconformably overlain by Painted Hill formation. Some rocks mapped by Vaughan as Coachella fanglomerate belong to younger units in section, but formational name is retained for the prominent cliff-forming beds exposed along east wall of Whitewater Canyon near trout farm. No fossils have been found in the Coachella, but its unconformable position beneath early Pliocene(?) Imperial formation and its high degree of induration and well-developed jointing suggest an age at least as old as late Miocene. Map bracket shows upper Miocene(?); figure 2 shows upper Miocene; table 1 shows upper Miocene(?).

Typical section exposed in Whitewater Canyon near trout farm, Riverside County. Rocks crop out over area of about 6 square miles north of Painted Hill and east of Whitewater River. Named for Coachella Valley.

Coahuila Group

Coahuila Series

Lower Cretaceous: Southwestern Texas, and Coahuila, Durango, and Nuevo Leon, Mexico.

R. W. Imlay, 1940, Geol. Soc. America Bull., v. 51, no. 1, p. 124–125. Proposed as a group term to designate Lower Cretaceous strata older than Trinity as that term is generally understood in Texas. Includes strata older than *Dufrenoya texana* zone which were deposited in ancestral Gulf of Mexico, in Mexican sea, and in closely connected waters.

R. W. Imlay, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 1005–1007, chart 10a. Redefined as Coahuila series and subdivided into Nuevo Leon and Durango groups. This usage retains Comanche series in sense originally defined by Hill, emphasizes magnitude of Coahuila time, and permits convenient grouping of Mexican formations.

Named after Mexican state of Coahuila, where it is fully developed in both near-shore and off-shore facies. Crops out in small areas in southwestern Texas.

Coahuila Silt[1]

Pleistocene: Southern California.

Original reference: G. D. Hanna, 1926, California Acad. Sci. Proc., 4th ser., v. 14, no. 18, p. 435.

Exposed where San Diego-El Centro Highway crosses New River about 1 mile west of El Centro, Imperial County.

Coalbank Hill Member (of Molas Formation)

Mississippian-Pennsylvanian: Southwestern Colorado.

W. M. Merrill and Richard W. Winar, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2115 (fig. 4), 2116–2119. Basal member of formation. Includes red mudstones and siltstones containing solution-rounded limestone boulders and chert fragments and overlying structureless mudstones and siltstones. This is "transition zone" mentioned by earlier writers; the "rubble breccia" of upper Redwall and the "residual soil" in lower part of basal member of Naco (Huddle and Dobrovolny, 1952, U.S. Geol. Survey Prof. Paper 233–D); and lowest member of Molas as subdivided by Wengerd and Strickland (1954). Thickness about 56 feet at type locality; 13 feet at Stag Mesa; 5 feet at Ouray. Underlies middle unnamed member; unconformably overlies Leadville limestone. Where Leadville is absent, overlies Ouray limestone; contact appears gradational. No fossils. Age defined only by stratigraphic position, post-Leadville, pre-middle Molas. Mississippian-Pennsylvanian boundary probably contained within it or overlying member.

Type area: Coalbank Hill on U.S. Highway 550, 33 miles north of Durango County.

Coal Bluff Marl Member (of Naheola Formation)

Coal Bluff Beds (in Nanafalia Formation)

†Coal Bluff Beds or Series[1]
Coal Bluff Formation } (in Wilcox Group)

Paleocene: Southern Alabama.

Original reference: D. W. Langdon, Jr., 1894, Alabama Geol. Survey Rept. on Coastal Plain, p. 421.

J. E. Brantly, 1920, Alabama Geol. Survey Bull. 22, p. 148–150. Nanafalia divisible into three phases based both on lithology and fossil content. Lowest of the three phases is referred to as Coal Bluff beds, and two upper phases as Gullette Bluff beds. Smith used term Coal Bluff to apply to lignite beds at base of Nanafalia. In present report, name is extended to include all strata (42 to 70 feet) below Gullette Bluff beds.

J. A. Cushman, 1944, Cushman Lab. Foram. Research Contr., v. 20, pt. 2, p. 29–52. Allocated to member status in Naheola formation. Deposits, from which fauna herein described as collected, have been considered lower part of Coal Bluff beds of Langdon and Ackerman formation of Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2). Paleocene.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour., v. 16, p. 42. "Coal Bluff beds" listed as uppermost unit in Naheola formation. Overlies "Oak Hill beds".

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 13–14. Name Coal Bluff marl member is restricted to lower glauconitic sandy marls and shales of Brantly (1920). The upper coarse sands are considered to be of Wilcox age. Thickness varies from place to place, probably averages 35 feet. Present at top of formation. Traced from western Butler County west to eastern Choctaw County, beyond which it becomes nonfossiliferous and is not differentiated from rest of Naheola.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 42, 44, 48–49, 51 (fig. 7). Member described in Choctaw County where it consists of fine- to medium-grained marine

sand and thin platy limonite zones; disconformably overlies lignite at top of Oak Hill member (new); unconformable with overlying glauconitic sand and marl of Nanafalia formation of Wilcox group or with gravelly basal sand member of Nanafalia where it is present. Thickness 60 feet.

W. F. Roux, Jr., 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Coal Bluff formation, Wilcox group, consists of lower glauconitic and upper nonglauconitic members. Overlies Naheola formation; underlies Nanafalia formation.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 79–95. Term "Coal Bluff Section" was used by Smith (1886, Alabama Geol. Survey Bull. 1) and "Coal Bluff beds" was used by Brantly (1920) to designate 40 to 70 feet of glauconitic sand, crossbedded sand, and laminated clay and sandy clay that overlie Oak Hill member. Lignite at bottom of the "Coal Bluff beds" is now included in Oak Hill member, and a bed 20 feet or more thick, of yellow to white crossbedded sand with clay pebbles 10 to 40 feet above the lignite bed is now included in Nanafalia formation as Gravel Creek sand member (new). The intervening beds make Coal Bluff marl member.

Named from Coal Bluff, on west side of Alabama River in sec. 7, T. 11 N., R. 7 E., Wilcox County.

Coalburg Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Western West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2–a, p. 271, 468.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91, 104. Upper and lower Coalburg sandstones in Kanawha group. Lower unit typically exposed in Logan and Mingo Counties.

Probably named from occurrence at Coalburg, Kanawha County.

Coalburg Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: D. B. Reger, 1921, West Virginia Geol. Survey Rept. Nicholas County, p. 243.

At Mollie Frame Farm mine, 0.3 mile west of Birch River village, and at south end of Powell Mountain, on Brushy Fork of Muddlety Creek, Nicholas County.

Coal City Limestone (in Henrietta Group)

Coal City Limestone Bed (in Pawnee Limestone Member of Oologah Formation)

Coal City Limestone Member (of Pawnee Limestone)

Pennsylvanian (Des Moines Series): Southeastern Iowa and northeastern Missouri.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 59–60, 63, 64. Light-blue-gray hard finely crystalline limestone in two massive beds; weathers buff; fossiliferous. About 2 feet thick. At type locality, base of limestone is about 12 feet above top of Mystic coal. In Putnam County, Mo., lies several feet below underclay of Worland cyclothem and is separated from underlying Pawnee limestone by several feet of shales. Henrietta group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 7. In Missouri, Coal City limestone member of Pawnee limestone is lateral equivalent of the Laberdie

member; term Coal City has priority, and Laberdie is suppressed in favor of Coal City. Overlies Mine Creek shale member; underlies Bandera formation.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 15, 16 (fig. 2). In Nowata County, Okla., considered a bed in Pawnee limestone member of Oologah formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull., 15, p. 31, fig. 5. Uppermost member of Pawnee limestone. Thickness 2 to 2½ feet in Appanoose County; about 1 foot in Madison County. Overlies Mine Creek shale member. Underlies Bandera shale.

Type section: In east bluff of Chariton River in SE¼ sec. 16, T. 67 N., R. 16 W., near Coal City in southeastern Appanoose County, Iowa.

Coal Creek Limestone[1] **Member** (of Topeka Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 42, 52, 53.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 164–165. Coal Creek limestone member of Topeka formation; overlies Holt shale member; underlies Severy shale of Wabaunsee group. This classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. In Kansas, consists of light-bluish-gray limestone and nodular shale or dark-blue massive limestone which weathers light bluish gray or brown. Thickness 2 to 5 feet. Not positively identified south of Kansas River.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull., 15, p. 15, fig. 5. Medium- to dark-gray dense limestones interbedded with fossiliferous shales; locally contains dark chert. Thickness 5 to 6 feet. Upper unit of Topeka; overlies Holt shale member.

Type locality: About three-fourths mile north of Union, Cass County, Nebr.

Coal Creek Quartzite[1]

Precambrian: Central northern Colorado.

Original reference: M. F. Boos and C. M. Boos, 1934, Geol. Soc. America Bull., v. 45, no. 2, p. 306.

G. D. Fraser, 1949, (abs.), Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1960. Fine-grained quartz-muscovite-biotite schist interbedded with the quartzite contains a few garnet crystals and, locally, abundant cordierite. Believed to be younger than Idaho Springs formation and older than some of the granite in the area. Outcrop area described.

Crops out in triangular area 7 miles long and up to 3 miles wide near mouth of Coal Creek Canyon, Jefferson and Boulder Counties.

Coal Creek Serpentine

Precambrian: Central Texas.

V. E. Barnes, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 53 (geol. map.) Named and mapped in Cut Off Gap area.

Frederick Romberg and V. E. Barnes, 1949, Geophysics, v. 14, no. 2, p. 152–154, fig. 1. Discussed as Coal Creek serpentine mass. Bordered along south and for the western half of its distance along north by Big Branch

gneiss; for remainder of distance on northern side, bordered by Packsaddle schist.

V. E. Barnes, [1952?]. Geologic map of the Willow City quadrangle, Gillespie and Llano Counties, Texas (1:31,168): Texas Univ. Bur. Econ. Geology. Only about 15 percent of mass is in Willow City quadrangle. The rest is in Blowout quadrangle.

V. E. Barnes, [1952?], Geologic map of the Blowout quadrangle, Blanco, Gillespie, and Llano Counties, Texas (1:31,680): Texas Univ. Bur. Econ. Geology. Age of serpentine is in question. It is cut by aplites, pegmatites, and quartz bodies derived from Town Mountain granite, making it the older. Its outcrop shape is that of an intrusive into Big Branch gneiss but it is not proven that Big Branch gneiss did not actually assimilate the Packsaddle schist from around the serpentine.

Name derived from Coal Creek, an intermittent stream which crosses the mass in Willow City quadrangle.

Coaldale Chert

Ordovician(?): Central western Nevada.

B. M. Page, 1949, (abs.) Geol. Soc. America Bull., v. 60. no. 12, pt. 2, p. 1943. Mentioned in discussion of structure of Candelaria district. Numerous pre-Permian contortions and faults occur in unit.

Candelaria district, Mineral County.

Coaledo Formation (in Arago Group)[1]

Eocene, upper: Southwestern Oregon.

Original reference: J. S. Diller, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 319–320.

F. E. Turner, 1938, Geol. Soc. America Spec. Paper 10, p. 27–31. As exposed in sea cliffs about Cape Arago and Sunset Bay, comprises three divisions. Lower, approximately 1,600 feet thick, consists principally of sandstone with subordinate amounts of shale; middle, about 3,200 feet thick, predominantly soft fine sandstone and shales; upper, about 1,200 feet, principally medium and coarse sandstone with occasional thin beds of shale and one 10-foot bed of low-grade lignite. Contact with overlying Bassendorf shales obscured. Fauna discussed.

J. E. Allen and E. M. Baldwin, 1944, Oregon Dept. Geology and Mineral Industries Bull. 27, p. 21–27, pls. 1, 5. Lower, middle, and upper members mapped and described in Coos Bay quadrangle. Thickness about 6,015 feet. Underlies Bastendorf [Bastendorff] shale; unconformable above Umpqua formation. Upper Eocene.

D. C. Duncan, 1953, U.S. Geol. Survey Bull. 982–B, p. 58–60, pl. 5. Thickness about 5,600 feet where exposed along sea cliffs at mouth of Coos Bay. Overlies Umpqua formation; underlies Bastendorf [Bastendorff] shale. Late Eocene.

Well exposed in vicinity of Coaledo, Coos County.

Coalfield Sandstone (in Crooked Fork Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes both massive and thin phases. Thickness 30 to 60

feet; in Crooked Fork section 42 feet; west of Oneida and in southeast part of Barthell Southwest quadrangle thins to 10 or 15 feet. In Morgan County, sandstone locally splits into two or three benches. Underlies Glenmary shale (new); overlies Burnt Mill shale (new).

Underlies town of Coalfield, Petros quadrangle, Morgan County.

†Coalinga Beds[1]

Miocene and Pliocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 174–185.

Named for exposures north, northwest, and west of Coalinga, Fresno County.

Coalmont Formation[1]

Paleocene-Eocene: Northern Colorado.

Original reference: A. L. Beekly, 1915, U.S. Geol. Survey Bull. 596, p. 20, 49–71.

R. F. Walters, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basins, Colorado, p. 86–87. Continental deposits of heterogeneous lithology with sandstone predominant. On basis of floral fossil evidence, has been considered Paleocene in age; no diagnostic vertebrates found. It is possible, on basis of regional geologic history, that uppermost part of formation is lower Eocene (Wasatch) in age.

W. J. Hail, Jr., and E. B. Leopold, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B260–B261. Presence of Paleocene leaves indicates Paleocene age for lower part of formation; presence of pollen of *Platycarya*. Gramineae, and *Tilia crassipites* indicate upper part of formation is Eocene. Formation has aggregate thickness of as much as 9,000 feet in parts of North Park. Unconformably overlies rocks mostly of Cretaceous age and is unconformably overlain locally by White River formation of Oligocene age and by North Park formation of late Miocene age.

Well exposed along North Platte River, North Park. Name derived from Coalmont, Jackson County.

Coalvale Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. The Coalvale, 11th in the sequence (ascending), occurs below the Croweburg and above the Fleming. Average thickness 9 feet. Includes coal here named Arcadia. [For complete sequence see Cherokee group.]

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 45. Overlies Fleming cyclothem and underlies Ardmore cyclothem redefined to include Croweburg cyclothem of Abernathy (1937).

Type locality and derivation of name not given. Cherokee outcrop in Kansas covers an area of about 1,000 square miles and includes parts of Labette, Bourbon, Crawford, and Cherokee Counties.

Coal Valley Formation (in Wassuk Group)

Pliocene, lower and middle: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 29–33, 64–66, figs. 2, 3, and 4. Consists of five mappable lithologic units (ascend-

ing): alternating conglomerate, sandstone, lake beds, with hornblende andesite pyroclastics and flows, rhyolite tuffs—thickness 850 feet; grit and andesite tuff—thickness 150 feet; sandstone, diatomaceous shale, pebble conglomerate, and andesite tuff—thickness 1,350 feet; sandstone—thickness 575 feet; and alternating sandstone, conglomerate, diatomaceous shale, andesite tuff, granitic breccia—thickness 400 feet. Aggregate thickness 3,325 feet. Conformably underlies Morgan Ranch formation (new) and unconformably overlies Aldrich Station formation (new). Chart shows Coal Valley overlying and interfingering with Kate Peak andesite. Represents a deposit which records a change from subaerial and fluviatile to lacustrine conditions within a short distance, a change comparable to that found in small lake-delta deposit.

D. I. Axelrod, 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 2, p. 97–104. In Verdi area, overlies Kate Peak andesite.

D. I. Axelrod and W. S. Ting, 1960, California Univ. Pubs. Geol. Sci., v. 39, no. 1, p. 3. In fault contact with upper Pliocene Wichman formation (new).

Type area in Coal Valley adjacent to Lewis Terrace, which lies 4 miles south of Morgan's Ranch, Hawthorne quadrangle.

Coalville Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 138, 139 (fig. 2), 145 (fig. 3). Marine sandstone and coal of late Greenhorn age. Thickness 175 feet (east) to 223 feet (west). Contains the prominent "Wasatch" coal. Overlies Chalk Creek member (new); contact transitional. Underlies Allan Hollow shale member (new). Comprises units 11–13 as described by Wegemann (1915, U.S. Geol. Survey Bull. 581, pt. 2), and Cobban and Reeside (1952).

Well exposed in ridge that strikes N. 35 E., from Coalville townsite, Summit County.

Coamo Formation

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 149-152. Chiefly massive tuff breccias and bedded tuffs including ashflow deposits. Between Ciales and Orocovis, formation is characterized by abundance of tuffs, tuff breccias, and volcanic conglomerates and by an extensive and thick basal sequence of redbeds including numerous ashflows. In north-central Puerto Rico consists of two distinct parts: lower, mostly red, sequence that consists principally of andesitic tuffs (mostly ashflows) and an upper massive nonred sequence of poorly stratified andesitic tuff breccia; locally in lower red part of formation is rudistid-bearing Botijas limestone member (new). Along southern flank of Puerto Rico anticlinorium, conformably overlies Cariblanco formation (new); along north side of anticlinorium, strata tentatively assigned to the Coamo lie in several fault blocks; eastward along its northern belt of outcrops, strata equivalent to the Coamo both thin and interfinger into upper part of strata correlated with the Cariblanco. Southeast of Rio Piedras, identity of Coamo is lost. Because of this interfingering and thinning, thickness of the Coamo ranges from a few inches to approximately 7,000 feet. Appears to be gradational into

overlying rocks of probable early Tertiary age. Name credited to Lynn Glover (in press).

Named for outcrops in and near Coamo in south-central Puerto Rico.

Coamo Tuff Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Ann., v. 26, p. 19, 61.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47. In Ponce district, underlies Guayabal limestone and overlies Peñuelas shale. Thickness 300 feet.

Well developed in vicinity of Coamo Reservoir near Coamo Springs.

Coamo Springs Limestone Member (of Naranjo Formation)

Coamo Springs Limestone Series[1]

Eocene, middle: Puerto Rico.

Original reference: E. T. Hodge, 1920, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 2, p. 153.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 52, 54. Underlies Canas Arriba formation (new); overlies Rio Jueyes series. Thickness 1,000 feet. On basis of fossil evidence, age is considered to be Eocene, probably upper. Term "series" is taken from original surveys but is misnomer.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 73–77. Member of Naranjo formation (new). Overlies Miramar member (new). Interfingers with Río Descalabrado member and is also overlain by it. Mitchell (1922, New York Acad. Sci. Scientific survey of Porto Rico and the Virgin Islands, v. 1) called slightly different facies of the limestone both Coama (equivalent to Coamo) tuff limestone and Guayabal limestone. Older name of Hodge takes priority. Hodge did not select type area; type area for amended Coamo Springs is herein designated.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 84. Member of Naranjo formation. Consists of 0 to 3,800 feet of pure massive algal limestone, characteristically white, but may vary to gray, red, or pale orange. Overlies Los Puertos member (new). Traced for about 60 kilometers from Salinas to southeast part of Jayuya quadrangle.

Type area: Northwest end of Cerro de las Cuevas. Excellent exposures occur at quarries along Camino Naranjo in this area. Named from a thermal spring in Coamo River Water Gap, Coamo-Guayama district.

Coane Formation (in Veredas Group)

Pennsylvanian (Missouri Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 58 (fig. 6), 59–61. Name applied to basal formation of group. At type locality, consists of light-bluish-gray to gray cherty limestone; in other areas, lower part of formation contains clastic beds of gray shales and sandstones. Thickness varies from about 58 feet at type section to more than 100 feet in the Ladron Mountains. Underlies Adobe formation (new); overlies Bolander group (new).

Type locality: West face of northwest side of Oscura Mountains, eastern part of SE¼ sec. 36, T. 5 S., R. 5 E., Socorro County.

Coasters Harbor Island Arkose[1]

Carboniferous: Southern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 380.

Occurs at south end of Coasters Harbor Island.

Coast Range Diorite[1]

Age(?): Alaska.

Original reference: A. C. Spencer, 1906, U.S. Geol. Survey Bull., 287, map opposite p. 12.

Coast Range Intrusives[1]

Jurassic or Cretaceous: Southeastern Alaska, and British Columbia and Yukon Territory, Canada.

Original reference: A. F. Buddington, 1929, U.S. Geol. Survey Bull. 807, p. 116–119.

Hyder district, Alaska.

†Coata Sandstone Member (of Atoka Formation)[1]

See Coody Sandstone Member.

Cobb Mountain Volcanics (in Clear Lake Volcanic Series)

Quaternary: Northern California.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 47, pl. 7. Rhyolite flows and tuffs about 200 to 1,500 feet thick. Shown on columnar section above Boggs Mountain flows (new) and below a 100 to 300 foot unit of pyroxene dacite; age relations of individual units of series are imperfectly known because some units are isolated and contacts of contiguous flows are commonly obscured by sliding.

Vicinity of Cobb Mountain, Lower Lake quadrangle, in Coast Ranges, about 70 miles north of San Francisco.

Cobham conglomerate member[1] (of Knapp formational suite)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 61, 112, 116, 117, table opposite p. 61.

Exposed along southeast and southwest faces of Cobham Hill, at Glade, Warren County.

Cobleskill Limestone or **Dolomite**[1]

Upper Silurian (Cayuga Series): New York, and Ontario, Canada.

Original reference: C. Schuchert, 1903, Am. Geologist, v. 31, p. 160–175.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 9–10, 11, 13, fig. 1. In the west, overlies Bertie limestone; eastward overlies Brayman shale (redefined). Underlies Rondout dolomite.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Lower Devonian Helderbergian series (revised) consists of nine formations, five of which are present in central New York: Cobleskill, Rondout, Manlius, Coeymans, and Kalkberg. Cobleskill consists of nearly barren central and western dolomite facies, 10 to 17 feet thick.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Shown on correlation chart as Upper Silurian, Murderian stage (new).

Named for exposures on Cobleskill Creek, Schoharie County, N.Y.

Cobourg Limestone[1] (in Trenton Group)

Middle Ordovician: Ontario, Canada, and northwestern New York.

Original reference: P. E. Raymond, 1921, Canada Geol. Survey Mus. Bull. 31, Geol. Ser. 38, p. 1.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 277–281. Term Cobourg limestone replaced "Picton limestone" which had been applied to the heavy-bedded limestones with gastropod fauna and underlying thinner bedded limestone with *Rafinesquina deltoidea* exposed at Picton, Ontario. Term Picton preoccupied. Formation separable into two members here designated as Hallowell and Hillier. In standard section of Trenton group, occurs above Sherman Fall formation and below Collingwood shale.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 601–602. Along West Canada Creek, N.Y., the Cobourg is subdivided into Rust and Steuben members (both new). Overlies Russia member (new) of Denmark formation. Underlies Holland Patent (upper Utica). Thickness 175 feet.

Named for Cobourg, Northumberland County, Ontario.

Cobourgian (Cobourg) Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Stage in later Trenton. Followed by Collingwood and Gloucester stages.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 277–283, 293, 298. Discussion of stratigraphy of Trenton group. List of formations of Cobourg age. Cobourg time [followed Sherman Fall] marked by retreat of sea from Adirondack arch into Ontarian basin. In Cobourg stage, the arch continued to rise, and trough on east was restricted by incursion of sediments on its eastern side; boreal faunas again invaded northern part of region. Cobourg followed by Collingwood and Gloucester stages.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1415. Stage in upper Trentonian. Most of true Utica is Cobourgian.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30–31. Probably term stage is too high an order for the named divisions of the Trentonian; they can be considered substages of a smaller number of stages. The Cobourg-Collingwood-Gloucester seems to be time-equivalent of Utica group but name Utica is strongly associated with black shale facies. Hence, uppermost Trentonian stage is designated Pictorian. The Cobourgian forms most of section in gorge at Trenton Falls.

Name derived from Cobourg, Ontario, Canada, from which Cobourg limestone was named.

†Cobscook Series[1]

Silurian and Devonian: Southeastern Maine.

Original reference: N. S. Shaler, 1886, Am. Jour. Sci., 3d, v. 32, p. 44–60.

Named for development in Cobscook Bay district, east coast of Washington County.

Cobscook Bay Series[1]

Silurian and Devonian: Southeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 34–35.

On extreme southeast coast.

Coburn Formation[1] or Limestone (in Trenton Group)

Middle Ordovician: Central and south-central Pennsylvania.

Original reference: R. M. Field, 1919, Am. Jour. Sci., 4th, v. 48, p. 404, 420.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3 (fig. 3); no. 2, p. 114. Coburn limestone comprises the somewhat coquinal limestone succeeding the Salona and underlying black shale of Antes formation (new). Section at type locality has not been described, and only section at Salona seems to have been studied adequately. Here thickness is 300 feet. Correlated with Cobourg limestone of Ontario. Trenton group. Mohawkian.

Named from town in Center [Centre] County.

Cobwebb Basalt

Pliocene, lower(?): West-central Arizona.

S. G. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 14 (table 2), 34–35, pls. 1, 2. Hypersthene(?)-augite-olivine basalt. Most of rock is gray to brown and fine-grained to aphanitic and contains only a few vesicles, but where relatively thick the upper part is black, mostly is aphanitic, and highly vesicular. Maximum thickness about 250 feet. Lies conformably upon Chapin Wash formation (new), but overlaps onto Artillery formation (new) along Burro Wash, where Chapin Wash formation thins out. Unconformably underlies Sandtrap conglomerate (new). Because of its conformity with Chapin Wash formation, it is thought to belong to same geologic epoch as that formation and, therefore, to be tentatively of lower Pliocene age. Shown on plate 1 as Pliocene(?) and on plate 2 as early Pliocene(?).

Named from exposure on Cobwebb Hill, in upper Chapin Wash in Artillery Mountains, about 30 miles east of Colorado River.

Cocalico Shale[1]

Ordovician: Southeastern Pennsylvania.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 365.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1568. Cocalico shale is known by this name only along a 24-mile belt centering about 30 miles east-southeast of Harrisburg. Rests on Beekmantown, and is perhaps 1,000 feet thick, with its summit everywhere truncated by present level of erosion, so that relations to overlying sediments are not directly established.

Named for exposures on Cocalico Creek, Lancaster County.

Cochahee Sandstone Member (of Vamoosa Formation)

Cochahee Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: D. E. Winchester, K. C. Heald, and others, 1918, U.S. Geol. Survey Bull. 686–G, p. 60.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 47–48, pl. 1. Reallocated to Vamoosa formation. Near type locality, the Cochahee is a buff thin- to medium-bedded fine-grained sandstone exhibiting "bar structure," ripple marks, and crossbedding. In T. 24 N., member consists of at least 10 feet of buff sandstone and may include a 12-foot contorted sandstone separated from the lower bed by 20 feet of shale. Occurs above Jonesburg sandstone member and below Wynona sandstone member.

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Named for exposures on headwaters of Cochahee Creek, in southwest part of T. 25 N., R. 10 E., Osage County. [Probably considered type locality by Tanner.]

Cochise Formation[1]

Middle Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 466, 479, 480, 482.

D. J. Cederstrom, 1946, Am. Jour. Sci., v. 244, no. 9, p. 607. Represented by 50 feet of poorly exposed shales beneath Abrigo formation in Dragoon Mountains.

Type locality: Whetstone Mountains, Cochise and Pima Counties.

Cochise limestones[1]

Lower Cretaceous (Comanche Series): Southeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 336.

Probably named for exposures at or near Cochise, Cochise County.

Cochise Peak Quartz Monzonite

Triassic or Jurassic: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 9, 63–65, pl. 5. Generally light greenish gray, weathering to rather dark-grayish-brown colors. Generally spangled with conspicuous flesh-colored crystals of microcline as much as 4 centimeters long. Abundance of crystals ranges greatly. In places, rock grades into mylonites. Most contacts are faults and thus give little direct clue to original intrusive relations. Older than Stronghold granite with which it is in contact in three areas of Pearce quadrangle.

Crops out in belt extending from northern side of Cochise Peak, south-southeastward for nearly 3 miles, to the divide at Middle Pass, central Cochise County. Belt ranges in width from about 1,000 feet to nearly one-half mile. Numerous other small bodies and blocks recognized in area but are too small to be mapped.

Cochran Formation

Cochran Conglomerate[1]
Cochran Quartzite } (in Chilhowee Group)

Lower Cambrian(?): Eastern Tennessee and western North Carolina.

Original reference: A Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, p. 626 (table), 628–629 (fig. 1). Cochran quartzite listed with rocks exposed in Hot Springs window, North Carolina. Thickness 1,200 to 1,400 feet. Includes Nichols shale and quartzite lentil of Keith. Overlies Sandsuck shale; underlies Nebo quartzite. Lower Cambrian.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13 (table 3). Two sets of formation names for Lower Cambrian clastic rocks are in current usage in eastern Tennessee and western North Carolina. The northeast Tennessee names, Unicoi, Hampton, and Erwin, are used in this report for same rocks which Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) and Stose and Stose (1947) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountains area, Blount and Sevier Counties, Tenn. Hot Springs area lies

midway between type localities for each group of names. Cochran conglomerate included in Unicoi formation of this report.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962. Base of Cochran formation redefined at higher level, at base of persistent beds of arkose and quartzite, in part maroon; shale, sandstone, and conglomerate beneath is redefind as Sandsuck formation. Cambrian and Precambrian(?).

U.S. Geological Survey currently designates the age of the Cochran Formation as Early Cambrian(?) on the basis of a study now in progress.

Type locality (Rodgers, 1953): Cochran Creek on south side of Chilhowee Mountain, Blount County, Tenn. Makes crest of mountain northwest of lower course of creek.

Cochrane Glacial Substage

Pleistocene (Wisconsin): North America.

Kirk Bryan and L. R. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 70; Kirk Bryan, 1941, Smithsonian Misc. Colln., v. 99, no. 23, p. 57 (table 1). Cochrane glacial substage mentioned in discussion of Folsom culture of late glacial age. Long Draw glacial substage of Colorado is considered equivalent of the Cochrane and Fennoscandian substages, to which an age of 10,000 years may be assigned.

T. N. V. Karlstrom, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1582. Radiocarbon determinations give Wisconsin glaciations beginning 7,000 B.C. (Cochrane). "Little ice age" began 3,500 B.C.

T. N. V. Karlstrom and Meyer Rubin, 1955, (abs.) Geol. Soc. America Bull. v. 66, no. 12, pt. 2, p. 1582; T. N. V. Karlstrom, 1956, U.S. Geol. Survey Bull. 1021–J, p. 303–330. Precise position of Cochrane readvances in Pleistocene continental chronology has long been uncertain. Recent radiocarbon results indicate that the Cochrane preceded rather than followed the Altithermal climatic period and suggest that the Cochrane be considered a Wisconsin event of substage rank. Radiocarbon dates also substantiate correlation of the Mankato with Fennoscandian substage of European chronology, and correlation of the Cochrane with a post-Fennoscandian climatic event.

M. M. Leighton, 1957, Jour. Geology, v. 65, no. 1, p. 109. Cochran[e] excluded from classification of Wisconsin stage because it is believed to represent only a minor incident in final climatic adjustment to present intraglacial stage, the Recent.

Name derived from Cochrane, Ontario.

Cochrane Limestone Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 133. White to grayish-white, but locally bluish- or greenish-gray, massive crystalline limestone containing glauconite. Average thickness 12 to 15 feet. Unconformably underlies Dillard limestone member (new); conformably overlies Keel limestone member (new).

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 4 (fig. 2), 6 (fig. 3), 13 (fig. 5), 16–19. Unconformably underlies Clarita member (name replaces Maxwell's preoccupied Dillard); unconformably overlies Keel member. Type locality stated.

Type section: SE¼ sec. 5, T. 2 N., R. 6 E. [Pontotoc County]. Well exposed along banks of small tributary entering Chimneyhill Creek.

Cockeysville Marble[1]

Cockeysville Formation

Lower Paleozoic(?): (Glenarm Series): Maryland, northern Delaware, southeastern Pennsylvania, and northeastern Virginia.

Original reference: G. H. Williams and N. H. Darton, 1892, U.S. Geol. Survey map of Baltimore and vicinity, to accompany "Guide to Baltimore" prepared for Baltimore meeting Am. Inst. Mining Engineers, Feb. 1892.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 55. On geologic map of Carroll County (1928), all marble and limestone exposed in crystalline rocks of Piedmont upland are mapped as Cockeysville, but name Cockeysville is now restricted to narrow band of marble overlying Setters formation in southeast corner of Carroll County. Marble in northeastern Carroll County is now mapped as Wakefield marble, and in western part of Carroll County and eastern part of Frederick County, where marble is associated with volcanic rocks, the albite-chlorite schist facies of the Wissahickon formation, and the Marburg schist, it is mapped as Wakefield marble and Silver Run limestone on the Frederick County geologic map (1938). Thickness estimated 400 feet.

W. C. Rasmussen and others, 1957, Delaware Geol. Survey Bull. 6, v. 1, p. 95 (table 13), 96 (fig. 21), 100–102, pls. Cockeysville marble crops out in two places in Delaware, one near Hockessin in headwaters of Mill Creek and the other in valley of Pike Creek at foot of Pleasant Hill. Underlies Wissahickon formation. Glenarm series. Precambrian(?).

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1027–1052. Formation is sequence of intricately folded carbonate-rich metasedimentary rocks about 750 feet thick and of pre-Silurian age. Formation lies near base of Glenarm series which mantles five elongated domes of Precambrian(?) basement gneiss at eastern edge of Piedmont province. Overlies Setters formation; underlies Wissahickon formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably lower Paleozoic.

Named for exposures at Cockeysville, Baltimore County, Md.

Cockeysville Volcanics[1]

Precambrian: Maryland.

Original reference: E. B. Mathews, 1963, Geologic map of Maryland: Maryland Geol. Survey.

Cockfield Formation (in Claiborne Group)[1]

Cockfield Formation (in Yegua Group)

Eocene, middle: Northwestern Louisiana, Mississippi, and eastern Texas.

Original reference: T. W. Vaughan, 1895, Am. Geologist, v. 15, p. 220.

J. Huner, Jr., 1939, Louisiana Geol. Survey Bull. 15, p. 119–142. Described in Caldwell and Winn Parishes, La., where it overlies Little Natches member (new) of Cook Mountain formation. Underlies Jackson

group. Name Cockfield has been in common use in Louisiana since 1905, although there have been many suggestions to alter it.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 68–73. In this report, formation is expanded to include all beds below Moodys Branch of basal Jackson and above the Wautubbee. This usage is in agreement with usage of term Cockfield in Louisiana where type section is located. Term Cockfield does not have priority over either Yegua or Lufkin but is well established in Louisiana literature and is preferred over Yegua in this report. Cockfield of Mississippi has been considered both a member of Lisbon formation and a separate formation. Formation maintains thickness of about 50 feet across Clarke County and gradually thickens northwestward from this area to maximum of about 450 feet in Holmes and Yazoo Counties.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Formation shown on correlation chart in Mississippi; overlies Gordon Creek shale member of Cook Mountain formation; underlies Moodys Branch marl.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 1, 4. Included in Yegua group. In Brazos County, overlies Easterwood shales (new); underlies Rock Prairie sandstone (new) of Jackson group. Estimated thickness 723 feet.

U.S. Geological Survey has restored the term Cockfield for use in Mississippi, Louisiana, and Arkansas to replace the term Yegua which is restricted to Texas.

Named for Cockfield Ferry on Red River, near Petite Ecore, Winn Parish, La.

†Cockfield Lignite[1]

Eocene, middle: Louisiana and Mississippi.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 77.

Named for Cockfield Ferry, Winn County, La.

Cockfield Ferry Beds[1]

Eocene, middle: Northwestern Louisiana, Mississippi, and eastern Texas.

Original reference: T. W. Vaughan, 1895, Am. Geologist, v. 15, p. 220.

Named for Cockfield Ferry, on Red River, near Petite Ecore, Winn County, La.

Cockrum Sandstone (in Dakota Group)

Upper Cretaceous: Southwestern Kansas and southeastern Colorado.

B. F. Latta, 1941, Kansas Geol. Survey Bull. 37, p. 21 (table 1), 73–79, pl. 1. Name introduced to designate sandstone that overlies Kiowa shale; classed as uppermost division of the Dakota, here considered a group, and includes beds that have formerly been designated under name of Dakota sandstone. Composed of fine- to medium-grained light-tan, buff, brown, or reddish-brown sandstone, commonly ferruginous, and light-colored shale or clay. Thickness as much as 125 feet. In Stanton County, disconformably underlies Ogallala formation; in Hamilton County, conformably underlies Graneros shale; basal contact not exposed in Stanton County but is exposed in Prowers County, Colo.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Rocks which comprise Dakota formation, Kiowa

shale, and Cheyenne sandstone formerly were classed as Dakota group. Use of this grouping has been discontinued. Cockrum sandstone of southwestern Kansas is equivalent in age to part of Dakota formation.

Named from outcrops along Cockrum Branch of Bear Creek in S½ sec. 9, T. 29 S., R. 43 W., and from outcrops along Bear Creek in southwestern Stanton County, Kans.

Cocoa Sand Member (of Yazoo Clay)

Cocoa Sand Member (of Jackson Formation)[1]

Eocene, upper: Southwestern Alabama and eastern Mississippi.

Original reference: J. A. Cushman, 1925, Cushman Lab. Foram. Research Contr., v. 1, pt. 3, p. 65–69.

[U. B. Hughes] 1940, Mississippi Geol. Soc. [Guidebook] Field Trip Feb. 10 and 11, second day's field trip, p. 2. Referred to as sand member of Yazoo clay.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12; F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1). Correlation chart shows Cocoa sand member of Yazoo clay.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. In Choctaw County, Ala., member consists of lower marly fine-grained sand phase and upper coarser calcareous sand phase. Lower phase, 10 to 20 feet thick, is clayey and marly fine-grained micaceous sand that is bluish gray or greenish blue on fresh outcrop; upper phase, 20 to 50 feet thick, is medium-grained calcareous sand containing irregular ledges of glauconitic limestone and marl at top.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839. In Mississippi and Alabama, Cocoa sand member is overlain by Pachuta marl member and underlain by North Creek clay member (both new).

Named for abandoned country post office called Cocoa, which stood in SW¼ sec. 13, T. 11 N., R. 5 W., Choctaw County, Ala., about 2½ miles east of Melvin, on road to Gilberton.

Coconino Sandstone (in Aubrey Group)[1]

Permian: Arizona, southeastern Nevada, and southern Utah.

Original reference: N. H. Darton, 1910, U.S. Geol. Survey Bull. 435, p. 21, 27.

E. D. McKee, 1938, Carnegie Inst. Washington Pub. 492, p. 14–17. Conformably underlies Toroweap formation (new).

E. D. Koons, 1945, Geol. Soc. American Bull., v. 56, no. 2, p. 154. In Grand Canyon area, overlies Hermit shale and underlies Toroweap formation. Thickness 100 feet in eastern part of area, thinning westward to 50 feet along Queantoweap Valley.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 532–534. Type section not designated by Darton or by later workers. Section at Aubrey Cliffs can be considered as type section, because it is near place where Marvine (1875, U.S. Geog. and Geol. Surveys West of 100th Meridian, v. 3, pt. 2) studied rocks he designated Aubrey group of which the Coconino is a member. Thickness 405 at Aubrey Cliffs section. Lowest beds in abrupt contact with Supai redbeds.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 46. In Henry Mountains region, Utah, is as much as 600 feet thick. Consists of tangentially cross-laminated gray to white

fine-grained quartz sandstone. Believed to be equivalent to and grade laterally into Cutler formation to east. Underlies Kaibab limestone. Base of section in this report.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 540–543. Described in Clarkdale quadrangle, Arizona, where it is 500 to 650 feet thick. Conformably overlies Supai formation and passes laterally into its upper part through intertonguing. Underlies Toroweap formation, contact sharp. McKee (1934, Carnegie Inst. Washington Pub. 440) reported thickness of 1,000 feet at Pine, Ariz.; this is thickest section known.

Type section (McNair): Aubrey Cliffs, Coconino County, Ariz. Underlies entire Coconino Plateau as well as extensive plateau country north of Grand Canyon.

Codell Sandstone Member (of Benton Shale)

Codell Sandstone Member (of Carlile Shale)[1]

Upper Cretaceous: Western Kansas, eastern Colorado, and southeastern South Dakota.

Original reference: N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 28, 64.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull, 89, p. 24. Referred to as Codell sandstone zone in Blue Hill shale member of Carlile shale.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (column 53). Shown on correlation chart as member at top of Benton shale, Morgan County, Colo.

R. C. Barkley, 1953, South Dakota Geol. Survey Rept. Inv. 72, p. 17, 18. Thickness about 6 feet where exposed in Davison County. Occurs at top of Carlile.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 16 (table 3), 121. Uppermost member of Carlile shale. In Baca County, Colo., consists of 2½ to 3 feet of light-tan to rusty-brown hard finely crystalline limestone containing a few sand grains. Overlies Blue Hill shale member; underlies Fort Hays limestone member of Niobrara formation.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks Basin, Colorado, p. 53, pl. 1. Upper member of Benton formation in Red Dirt Creek area, Grand County, Colo. Thickness about 46 feet. Underlies Fort Hays member of Niobrara.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as uppermost member of Carlile shale. Overlies Blue Hill shale member; underlies Fort Hays limestone member of Niobrara chalk.

Named for exposures in bluffs along Saline Valley in Ellis County, Kans., 5 miles south and west of Codell.

Codorus Limestone[1]

Cambrian and Ordovician: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 454.

Codorus Creek, York County.

Cody Shale[1] (in Colorado Group or Montana Group)

Upper Cretaceous: Wyoming and Montana.

Original reference: C. T. Lupton, 1916, U.S. Geol. Survey Bull. 621, p. 166, 171, table.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 126 (fig. 2), 138. In Wind River Mountains, consists of about 4,500 feet of dark-gray shales interbedded with thin sandstone members. Overlies Frontier formation; underlies Mesaverde formation. Name Cody preferred to Steele because Cody was described as resting on the Frontier in Bighorn basin whereas the Steele was described as resting on the Niobrara. Near Wind River Mountains, there is no lower division that should be differentiated as Niobrara formation although fossils of Niobrara age are present.

S. K. Fox, Jr., 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1967. Analysis of 94 species of late Cretaceous Foraminifera from three well-exposed sections of Cody shale in northern Wyoming and southern Montana indicates correlation of the Cody with Niobrara chalk of Great Plains and with upper part of Alberta shale of Canada. Correlation of entire Cody shale with the Niobrara supports Reeside's conclusions from mollusk evidence but is contrary to frequent practice of designating the lower Cody as Carlile in age.

C. J. Hares and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 51. Stratigraphic section [southeastern part of Wind River basin and adjacent area in central Wyoming] shows that Cody shale overlies Wall Creek sandstone member of Frontier formation and underlies Parkman sandstone member of Mesaverde formation. Includes Shannon sandstone member in upper part. Term Cody as used here replaces terms Carlile shale, Niobrara shale, and Steele shale as used in this area by Hares (1916, U.S. Geol. Survey Bull. 1641–I.)

G. R. Downs, 1947, Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 138, 139. Consists of series of gray to black marine shales, shaly buff sandstones (upper part only), gray calcareous shale, and a few thin bentonites. Maximum thickness about 3,500 feet at type locality; thins to about 2,600 feet in southeastern part of Bighorn basin. Unconformably overlies Frontier formation and conformably underlies Mesaverde formation. Near Elk basin oil field and Montana-Wyoming line, Claggett shale, Eagle sandstone, and Telegraph Creek formation occupy same stratigraphic interval as upper part of Cody elsewhere in Bighorn basin. Near city of Cody, the Eagle sandstone and Telegraph Creek sandy shale "shale out," and the shale facies are included in the Cody as there defined. The buff to gray Claggett sandy shale equivalent forms top of the Cody shale. Montana group.

J. D. Love and others, 1948, Wyoming Geol. Survey Bull. 40, p. 5–8, 41. Measured sections show that Cody shale underlies Bacon Ridge sandstone (new) in southeast part of Jackson Hole area. Overlies Frontier formation. This contact is established in conformity with U.S. Geological Survey classification and common usage for central Wyoming. At type area of Frontier, this contact may come well down within the Frontier. Contact is arbitrarily placed at approximate point below which sandstones predominate and above which sandy shales predominate. This contact is gradational within an interval of approximately 20 feet. Maximum thickness 2,211 feet.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map OM–111; P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 50–62, pls. 1, 2. Cody shale, in Bighorn River Canyon, Hardin area, Big Horn County, Mont., comprises (ascending) lower shale, 205 feet; Greenhorn calcareous member, 97 feet; Carlile shale

member, 280 feet; Niobrara shale member, 409 feet; Telegraph Creek member, 867 feet; shale member equivalent to Eagle sandstone, 375 feet; Claggett shale member, 367 feet. Overlies Frontier formation; underlies Parkman sandstone. Colorado and Montana groups.

J. B. Wilson, 1951, Wyoming Geol. Survey Rept. Inv. 3, p. 3–11. In Powder River basin, includes Shannon sandstone and Sussex sandstone members. Sussex is known primarily in subsurface.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 61–63, pls. 6, 8. Described in Crazy Woman area, Johnson County, Wyo., where it is about 3,670 feet thick, overlies Frontier formation and underlies Parkman sandstone. Includes Shannon sandstone member.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Cody, as mapped in northeastern Wyoming, includes Shannon sandstone member 2,000 feet above base and Sussex sandstone member 2,500 feet above base.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 12 (fig. 3), 15, 16, 17–34, pls. 1, 2. Described in Hardin district, Montana and Wyoming where it includes all units between Mowry shale and Judith River formation. As thus defined, the Cody comprises (ascending) Belle Fourche shale, Greenhorn calcareous shale, Carlile and Niobrara shale (undifferentiated), Telegraph Creek shale, unnamed sandy shale, and Claggett shale members. Colorado and Montana groups. Strata formerly designated Frontier formation are assigned to Belle Fourche member. Following changes in local nomenclature favored by the authors have not been adopted by the Geological Survey: elimination of name "Cody shale"; introduction of name Steele shale to designate a formation containing the three members of the Cody (Telegraph Creek, unnamed member, and Claggett member) that fall within Montana group; promotion to formation rank of each of the three members of the Cody (Belle Fourche, Greenhorn, and Carlile-Niobrara) that are included in the Colorado group.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 46–57, pls. 1, 3. Formation includes sequence of marine sandstone and shale of Late Cretaceous age which in Buffalo-Lake De Smet area overlies conglomeratic sandstone of Frontier formation and underlies Parkman sandstone. Intense folding and faulting at some places and poor exposures at other prevent reliable measurement of thickness of formation in Buffalo-Lake De Smet area; thickness about 3,550 feet near Elgin Creek about 3 miles south of area. Seven members recognized (ascending): unnamed lower shale, Greenhorn calcareous, Carlile shale, Niobrara shale, unnamed sandstone and shale, Shannon sandstone, unnamed upper shale. Colorado and Montana groups.

Named for exposures at Cody, Park County, Wyo.

Coe Group

Middle Silurian (Niagaran): Northwestern Illinois.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 9 (fig. 2), 18. Includes all Niagaran formations in the clastic-free sedimentation belt. As here defined, comprises the Waukesha, Racine, and Port Byron formations as Savage (1926, Geol. Soc. America Bull., v. 37) differentiated them. Interreef rocks of group are distinguished by brownish-gray color, low terrigenous clastic content, absence of chert, and limited facies variations; differ from Bainbridge group in

being predominantly dolomite. [Report deals with Niagaran reefs in Illinois and their relation to oil accumulation; much data relative to thickness and distribution of units are based on subsurface studies.]

Typical strata are well exposed in Coe Township, Whiteside County, especially in bluff extending eastward from Cordova and crossing the township in secs. 1–4, T. 19 N., R. 2 E.

Coetas Formation[1]

Pliocene: Western Texas

Original reference: L. T. Patton, 1923, Texas Univ. Bull. 2330, p. 80–86.

Well exposed on Coetas Creek, in eastern part of Potter County.

Coeur d'Alene facies (of Belt Series)

Precambrian: Northern Idaho and western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Coeur d'Alene facies characterized by sandstones and argillaceous beds throughout the Striped Peak (lower Spokane), by reduction of carbonate rocks in the Siyeh equivalent (lower Wallace), and by tripartite division of Ravalli. which is clastic throughout. Closely related to Purcell.

In Coeur D'Alene region.

†Coeur d'Alene Series[1]

Precambrian (Belt Series): Northeastern Idaho and central western Montana.

Original reference: D. F. MacDonald, 1906, U.S. Geol. Survey Bull. 285, p. 42–43.

Coeur d'Alene Mountains region, Idaho.

Coeymans Limestone (in Helderberg Group)[1]

Coeymans Limestone Member (of Helderberg Limestone)

Lower Devonian: Eastern New York, western Maryland, New Jersey, eastern Pennsylvania, Virginia, and northern West Virginia.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 51–55, 89. Includes Stormville sandstone member at top in Monroe County and Elbow Ridge sandstone member (new) in Franklin County. Thicknesses: 40 feet at Nearpass quarries. New Jersey; 80 feet, Monroe County; 40 to 50 feet, Carbon County; 3 to 10 feet, central and south-central Pennsylvania; 50 to 55 feet near Monterey, Va. Overlies Keyser limestone; underlies New Scotland formation.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 274–276. Member is limited at top by New Scotland limestone or Healing Springs sandstone where present at base of New Scotland. Overlies Keyser limestone member. Thickness 17 to 50 feet.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 32, 67–82. Coeymans formation of this report is a well-defined lithologic unit that apparently can be traced continuously in several belts from Pennsylvania across Maryland into West Virginia and western Virginia. Consists of limestone with sandstone facies in northwestern belts.

Thickness as much as 35 feet. Overlies Keyser limestone; underlies New Scotland limestone. Helderberg group.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 83. Member consists of blue massive crystalline and very fossiliferous limestone, some chert, and sandstone bed near base. Thickness 8 to 13 feet. Underlies New Scotland limestone member; overlies Keyser limestone.

L. V. Rickard, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1608. Westward from Helderbergs of eastern New York, Coeymans limestone thickens to nearly 100 feet at Cherry Valley. The thickened Coeymans splits into three parts: lower and middle parts grade laterally into Olney, Elmwood, Clark Reservation, and Jamesville members of type Manlius; upper part continues westward to Chittenango Falls. Thus, most of Manlius in central New York is facies of Coeymans of eastern New York. Lower Devonian. Silurian-Devonian boundary appears to be stratigraphically lower than is currently placed.

L. V. Rickard, 1955, New York State Geol. Assoc. 27th Ann Mtg., p. 7. Helderbergian series (revised) consists of nine formations, only five of which are present in central New York: Cobleskill, Rondout, Manlius, Coeymans, and Kalkberg. New Scotland (restricted), Becraft, Alsen, and Port Ewen are not present in central New York. Coeymans limestone of central New York, overlying Jamesville member of Manlius, is entirely younger than Coeymans of eastern New York. Name Deansboro is proposed for this part of the Coeymans. Underlies Kalkberg cherty limestone. Helderbergian series.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. Coeymans formation thickens to nearly 100 feet at Cherry Valley. Slightly further, the Coeymans splits into three parts. Lower part, for which name Dayville limestone is proposed, grades laterally into Olney limestone of Syracuse area. Middle part rapidly changes into the Elmwood, Clark Reservation, and Jamesville members of the Manlius. For upper beds, which continue westward as far as Chittenango Falls, name Deansboro limestone is proposed. Base of Devonian system of New York is apparently not at base of Coeymans limestone of eastern part of state where it had been placed for many years. Present information indicates that underlying Rondout and Cobleskill formations are probably also Devonian in age.

F. G. Lesure, 1957, Virginia Polytechnic Inst. Bull., Engineering Expt. Sta. Ser. 118, p. 20 (table 2), 46–47. In Clifton Forge district, underlies Healing Springs sandstone and overlies Keyser formation. Thickness 12 to 20 feet. Helderberg group. Lower Devonian.

W. A. Oliver, Jr., 1960, Jour. Paleontology, v. 34, no. 1, p. 59–100. Oldest formation in Helderberg group in eastern New York. West of Albany area, higher formations of group (New Scotland and Becraft limestones) and Oriskany group are cut out one by one by pre-Onondaga erosion until, in area between Oriskany Falls and Manlius, the Coeymans limestone is overlain directly by Onondaga limestone, except where local patches of Oriskany intervene. A bioherm or reef facies is present in Coeymans at several places within Oriskany Falls-Manlius area. This facies has not previously been noted in print. Rugose coral fauna described. Fauna strongly suggests Early Devonian age.

Named for exposures at Coeymans, Albany County, N.Y.

Coffee Sand[1]
Coffee Formation } (in Selma Group)

Upper Cretaceous: Western Tennessee and northeastern Mississippi.

Original reference: J. M. Safford, 1864, Am. Jour. Sci., 2d, v. 37, p. 361, 362–363.

L. W. Stephenson and W. H. Monroe, 1940, Mississippi Geol. Survey Bull. 40, p. 140–147. Crops out in Mississippi in belt about 10 miles wide west of Eutaw formation and east of Selma chalk except in central Lee County where it intertongues and merges with lower part of Selma chalk. Includes Tupelo tongue. Average thickness about 200 feet in Prentiss and Alcorn Counties.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Included in Selma group.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22, 26, 40–52, pl. 4. Formation described in Prentiss County where it is about 27 feet thick. Disconformably overlies Tombigbee sand member of Eutaw formation; conformably underlies Demopolis formation.

Named for exposures at Coffee Landing, Hardin County, Tenn.

Coffee Creek Formation

Mississippian: Central Oregon.

C. W. Merriam, 1942, Jour. Paleontology, v. 16, no. 3, p. 372. Marine limestones and sandstones 900 to 1,000 feet thick. Disconformably underlies Spotted Ridge formation (new). Lower Carboniferous.

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 149–151. Type section shows about 75 feet of strata dipping about 53° NW.; these outcrops probably represent higher part of formation. Thickness difficult to determine due to deformation; estimate is based on width of outcrop in anticlines on Coffee Creek and north of Coyote Butte, where in latter locality strata are nearly vertical. Base of formation nowhere exposed.

Type section: In sec. 30, T. 18 S., R. 25 E., one-fourth mile east of spring at Mills sheep camp, southeast of Paulina, Crook County. Named for exposures on Coffee Creek which enters Grindstone Creek south of Wade Butte.

Coffee Mill Hammock Marl Member (of Fort Thompson Formation)

Coffee Mill Hammock Marl[1]

Pleistocene: Southern Florida.

Original reference: E. H. Sellards, 1919, Florida Geol. Survey 12th Ann. Rept. p. 73, 74.

G. C. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 73. Name Coffee Mill Hammock marl revived and given member status in Fort Thompson formation. Member is contemporaneous with upper part of Anastasia formation.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136 (fig. 4), 145, 146–147. At type locality and at most river localities, Coffee Mill Hammock marl conformably overlies a fresh-water marl or limestone and is, in turn, overlain unconformably by sands of Pamlico formation or by Lake Flirt marls. Thickness at type locality 3 to 6 feet; in some areas, marl does not form actual bed but is preserved as fillings in solution holes and pockets in limestone below.

In this report, all Fort Thompson deposits that underlie Coffee Mill Hammock marl have been grouped together and named Okaldakoochee marl.

Named for exposures at Goodno's Landing, Fort Thompson, and at Coffee Mill Hammock, De Soto County, 12 miles above Labelle. [Referred to as type locality by some authors.]

Coffeen Limestone Member (of Bond Formation)

Pennsylvanian: Central and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 71, pl. 1. Name applied to limestone overlying Witt coal member (new). Thickness as much as 20 inches. Stratigraphically below Millersville limestone member. Name credited to H. J. Gluskoter (unpub. ms.). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NW¼SE¼ sec. 7, T. 8 N., R. 2 W., Montgomery County. Named from village of Coffeen, 5 miles southwest of type exposure.

Coffee Ranch[1]

Pliocene: Western Texas.

Original reference: R. D. Reed, 1933, Geology of California, p. 303.

In Hemphill County.

Coffeyville Formation[1] (in Skiatook Group)

Pennsylvanian (Missouri Series): Southeastern Kansas and northeastern and central Oklahoma.

Original reference: F. C. Schrader and Erasmus Haworth, 1905, U.S. Geol. Survey Bull. 260, p. 448.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guide Book 11th Ann. Field Conf., p. 39, 40. Name Coffeyville restricted to strata between top of Checkerboard limestone below and base of (Hogshooter) Dennis formation above. Included in Skiatook group.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 33–39. Consists of seven zones, four of shale and three of sandstone. Thickness 175 to 235 feet. In all but a few localities, the Winterset (upper) member of Hogshooter is the capping bed, but locally the Coffeyville is succeeded by the Canville, Stark, or Lost City members.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 57–60. In Tulsa County, consists of five zones, two of sandstone, and three of shale. Thickness as much as 440 feet.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 63–70. Coffeyville, in Seminole County, is made up of six lithologic units. De Nay limestone member, a shale, a middle (No. 1) sandstone, a shale, an upper (No. 2) sandstone, and a shale. Maximum thickness 260 feet. Overlies Seminole formation; underlies Nellie Bly formation. Interval designated by Morgan (1924, Oklahoma Bur. Geology Bull. 2) as Francis formation is herein described under headings of Coffeyville and Nellie Bly.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 14, 17–20, pls. 1, 2. Described in Creek County where it conformably overlies Checkerboard limestone and conformably underlies Hogshooter formation. Shiatook

group. Thickness 375 to 500 feet. Name Coffeyville not in current use in Kansas.

Named for exposures at Coffeyville, Montgomery County, Kans. Mapped as far south as Okfuskee County, Okla.

†Coffeyville Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth and J. Bennett, 1908, Kansas Acad. Sci. Trans., v. 21, pt. 1, p. 74.

Named for Coffeyville, Montgomery County.

Coffin Butte Volcanics

Eocene, middle: Northwestern Oregon.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 3–5. Proposed for a complex of basaltic flows, breccias, tuffs, and tuffaceous shales that make up eastern edge of Coast Range in northwest part of quadrangle. Thickness on Coffin Butte about 600 feet; formation crops out across a belt at least 2 and perhaps 3½ miles wide in direction perpendicular to regional strike; if moderate dip persists, uniformly thickness may be 5,000 to 10,000 feet, or at steeper angles, 10,000 to 15,000 feet. Stratigraphic relationship not clear; regional contact inferred to be a high-angle fault contact, probably a thrust. Correlation with Siletz River volcanic series (Snavely and Baldwin, 1948) to northwest appears reasonabe; because the two are disconnected and are not yet known to be exactly contemporaneous, separate names are retained.

Type locality: Coffin Butte, Albany quadrangle, where volcanics are exposed in several large cuts and quarries. Volcanics extend southwesterly from Coffin Butte on northeast through Vineyard Hill and other ridges north and northwest of Corvallis to vicinity of Philomath and Wren, and westward across northern Benton County.

Coffman Conglomerate Member (of Maroon Formation)[1]

Coffman Conglomerate Member (of Minturn Formation)

Coffman Conglomerate Member (of Weber ? Formation)

Pennsylvanian: Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 971–1009.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleont. Contr., v. 6, no. 4, p. 60. Contains *Calamites* and *Lepidodendron* which tentatively date bed as Pennsylvanian.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 35 (table 7), 39 (table 10), 40–41, 150, pl. 8. Reallocated to member status in unit termed Weber(?) formation. Overlies middle unnamed shale and limestone member; underlies Chubb siltstone member of Maroon formation. Arkosic conglomerate with interbedded sandstone and shale. Thickness 20 to 1,000 feet. Pennsylvanian.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 811, 814, 820, 836. Reallocated to member status in Minturn formation. Basal unit of formation; underlies Chubb siltstone member.

Type section: In unnamed valley in sec. 24, T. 13 S., R. 77 W., about 2 miles north of Coffman Park, Chaffee and Park Counties.

Coggon Limestone[1] Member (of Wapsipincon Formation)

Middle Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1894, Iowa Acad. Sci. Proc., v. 1, pt. 4, p. 23, 24.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 38–40. Lowermost member of Wapsipinicon. Underlies Otis limestone member; overlies Gower formation. Bertam member of Norton (1895) is here considered a local phase of the Coggan. Age shown on chart as Middle Devonian(?).

Type exposures at Coggon, Linn County, at crossing of Buffalo River by Illinois Central Railway.

Cohansey Sand[1]

Miocene(?) and Pliocene(?): New Jersey.

Original reference: H. B. Kummel and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 137.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 4 (fig. 2), 61. Thickness 100 to 250 feet. Chiefly quartz sand with local beds of clay and gravel. Overlies Kirkwood formation; underlies Beacon Hill gravel. Chart shows age as middle Miocene.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 766, 771. Classified as upper Miocene but is probably a diachronic facies including beds of middle and late Miocene.

J. P. Owens and J. P. Minard, 1960, Johns Hopkins Univ. Studies in Geology No. 18, p. 27. Age of Cohansey sand is problematical. May be late Miocene or younger, perhaps Pliocene.

Named for exposures along Cohansey Creek, Cumberland County.

Coharie Formation (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: L. W. Stephenson, 1912, North Carolina Geol. Survey, v. 3, p. 273–277.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook for South Carolina Coastal Plain Field Trip, Nov. 16–17, table 1, following p. 1. In sequence listed for South Carolina and Middle Atlantic Coast, Coharie occurs below Sunderland and above Hazelhurst.

Named for Great Coharie Creek, a tributary of Black River in North Carolina.

Cohn Coal Member (of Mattoon Formation)

Pennsylvanian: Eastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), 83, pl. 1. Name applied to coal member in lower part of formation. Stratigraphically below Merom sandstone member. Thickness 2 inches. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼ sec. 1, T. 11 N., R. 12 W., Clark County. Exposure is 2 miles southeast of Cohn, now called Livingston.

Cohn cyclothem (in McLeansboro Group)

Cohn cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 18–19; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). Occurs above the LaSalle cyclothem and below the Bogota cyclothem (new). Total thickness 7½ inches.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In lower part of Mattoon formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: About 2 miles northwest of Cohn in NE¼ sec. 1, T. 11 N., R. 12 W., Clark County.

Cohutta Conglomerate[1]

Lower Cambrian(?): Northwestern Georgia.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 3, pl. 3, p. 4.

A. S. Furcron and K. H. Teague, 1947, Georgia Geol. Survey Bull. 53, p. 19. Several zones of pebbles and cobbles occur in Ocoee series of Murray County; they are unusual and represent an inconspicuous part of the series. Perusal of Hayes unpublished report of Dalton quadrangle indicates that these local conglomerates represent his "Cohutta conglomerate," but it is questionable if they have sufficient stratigraphic continuity to deserve formational recognition.

Probably named for Cohutta Mountain, Gilmer and Fannin Counties.

Cohutta Schist

Precambrian; Northwestern Georgia.

A. S. Furcron, K. H. Teague, and J. L. Calver, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1195. Thrust faults supplementary to the mapped overthrust, which separates the eastern crystalline block from known Paleozoic sediments of the Great Valley, bring up a Precambrian biotite augen gneiss, Fort Mountain gneiss, intruded by granite upon which Ocoee rocks are unconformable. Talc deposits and associated schists, Cohutta schist, occur in upthrust block of Fort Mountain gneiss but not in Ocoee series.

A. S. Furcron and K. H. Teague, 1947, Georgia Geol. Survey Bull. 53, p. 6–9, pl. 1. Cohutta schist, believed to be oldest formation in area (Murray County), represents remnants of a metasedimentary formation which is included in Fort Mountain gneiss. Intruded by Corbin granite. Derivation of name given.

Named from Cohutta Mountain one of southernmost conspicuous elevations of Great Smoky Mountains. Formation contains talc deposits in Fort and Cohutta Mountain districts.

Coker Formation (in Tuscaloosa Group)

Upper Cretaceous: West-central Alabama.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37. Consists of apparently nonmarine beds above the Eoline formation (new) and below the Gordo formation (new). Thickness 150 to 250 feet. Examples of varied lithology are (1) basal strongly cross-bedded channel sand, upper part locally finely laminated and containing macerated plant remains; (2) massive carbonaceous and varicolored clay containing nodules of granular siderite; locally clay occupies a channel

which in places may extend to base of formation; (3) interbedded purple and gray mottled clay and highly crossbedded fine-grained micaceous yellow sand containing brecciated clay; (4) bentonite bed near base in one area; and (5) local occurrences of chert gravel which resemble gravel of the Gordo. The gravel is tentatively retained in the Coker because of the strikingly abrupt and widespread appearance of gravel in the Gordo; further investigations may indicate advisability of redefining contact so as to include all of the gravel and coarse sand in the Gordo.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 197–200. At designated type locality, both top and bottom contacts are well exposed.

C. W. Drennen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 536. Stratigraphically extended below to include all outcropping pre-Gordo sediments of the Tuscaloosa group except sediments designated Vick formation (Conant, 1946), which may be Tuscaloosa in age. Coker thus consists regionally of a lower Eoline member and an upper unnamed member.

Type locality: Section on road from Spring Hill School in secs. 21 and 22, T. 21 S., R. 11 W., 3 miles south of Coker, Tuscaloosa County.

Coki Point megabreccia lithofacies (of Tutu Formation)

Upper Cretaceous: Virgin Islands.

T. W. Donnelley, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. An intercalated slumped mass of andesite and limestone blocks, which have neritic fauna of corals, gastropods, pelecypods (including rudistid *Caprinuloidea*), and echinoids, and is of apparent Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Colbert cyclothem

Lower Pennsylvanian: Southern Illinois.

H. R. Wanless, 1956, Illinois Geol. Survey Circ. 217, p. 5, pl. 1. Substituted for former cyclothem name, Davis, because latter name is preempted. Underlies Dekoven cyclothem; overlies Stonefort cyclothem. Includes Davis coal bed which name is retained.

Type section: One-half mile west of Colbert School in the SE¼SW¼ sec. 23, T. 10 S., R. 7 E., Saline County.

Colbert Porphyry[1]

Precambrian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1926, Am. Mus. Nat. History Jour., v. 26, p. 470–474, map.

R. E. Denison, 1959, (abs.) Oklahoma Acad. Sci. Proc. 1958, p. 124. Incidental mention in discussion of rhyolites of Oklahoma.

Occurs in Arbuckle Mountains. Derivation of name not stated.

Colchester Coal Member (of Carbondale Formation)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 36, 46 (table 1), 62, 67, pl. 1. Basal member of Carbondale formation (redefined). Occurs below Shawneetown coal member (new) or below Francis Creek shale member. In western and northern area, replaces LaSalle (No. 2) coal so that name LaSalle can be retained for LaSalle

limestone. Thickness about 2 feet. Coal named by Worthen (1868, *in* Geology and Paleontology, v. 3, Illinois Geol. Survey). Presentation of new rock-stratigraphic classisfication of Pennsylvanian strata in Illinois.

Type locality: Secs. 12 and 13, T. 5 N., R. 4 W., Colchester quadrangle, McDonough County.

†Colchester Formation[1]

Lower Cambrian: Northwestern Vermont.

Original reference: A. Keith, 1923, Am. Jour. Sci., 5th, v. 5, p. 110, 129.

Named for good exposures 1 to 2 miles north of Colchester village in town of Colchester, Chittenden County.

Cold Spring horizon[1]

Miocene or Pliocene: Eastern Texas.

Original reference: E. T. Dumble, 1915, Geol. Soc. America Bull., v. 26, p. 468, 470, 472, 473, 476.

West of Trinity River, San Jacinto County.

Cold Springs Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

Cold Springs area, Kiowa County.

Coldwater Formation

Coldwater Sandstone Member (of Tejon Formation)[1]

Eocene: Southern California.

Original reference: W. S. W. Kew, 1924, U.S. Geol. Survey Bull. 753.

W. C. Putnam, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 697 (fig. 3). Shown on columnar section of Ventura region as underlying Sespe formation and overlying Cozy Dell member. Thickness 1,500 to 2,000 feet. Member of Tejon formation.

F. R. Kelley, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 1, p. 6. Sediments locally known as Coldwater in Santa Barbara County redefined as Sacate formation.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1924. Referred to as Coldwater formation. Type locality stated.

Type locality: On Coldwater Creek, a westerly branch of lower Sespe Creek, 5½ miles northwest of Fillmore, Ventura County.

Coldwater Shale[1]

Coldwater Formation

Mississippian: Southern Michigan.

Original reference: A. C. Lane as reported by M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66.

V. B. Monnett, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 4, p. 630 (fig. 1), 636–651. Formation consists of the gray and gray-blue shales underlying Marshall formation in all parts of Southern Peninsula of Michigan. At most places, overlies black shale of Sunbury formation, but locally, especially in western and southwestern Michigan, it directly overlies Ellsworth green shale or Antrim black shale. Character of Coldwater sediments changes from east to west. Western facies consists of 565 to 1,080 feet of shale, in many places calcareous, with some interbedded

dolomites; eastern facies characterized by siltstones and fine-grained sandstones interbedded with the shales; red shales and siltstones common in upper sediments of facies. A redbed at base of formation is only zone that can be recognized in both western and eastern facies. Kinderhook. Subsurface data.

Named for exposures on Coldwater River, in Branch and Hinsdale Counties.

Colebrooke Schist[1]

Pre-Cretaceous: Southwestern Oregon.

Original reference: J. S. Diller, 1903, U.S. Geol. Survey Geol. Atlas, Folio 89.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2784. In Port Orford area, basal beds of Days Creek formation (new) containing *Buchia crassicollis* Keyserling rest generally on Riddle formation, but locally overlap onto Colebrooke schist. Contact with Colebrooke schist is masked by slumping of the schist and is inferred from mapping. Contact of Days Creek with Galice formation and Colebrooke schist is interpreted as angular unconformity.

W. P. Irwin, 1960, California Div. Mines Bull. 179, p. 30. Colebrooke schist is considered correlative with South Fork Mountain schist (new). Colebrooke schist occurs in Port Orford quadrangle, Oregon, principally in two areas surrounded by sandstone and shales of Myrtle formation of Diller that ranges from late Late Jurassic to Cretaceous in age. Diller (1903, U.S. Geol. Survey Geol. Atlas, Folio 89) described the Colebrooke as sericite schists, phyllites, and slates that were derived from sedimentary rocks, and he considered it equivalent to schists along South Fork of Trinity River. On geologic map of Oregon, Wells (1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–38) discarded name Colebrooke schist and showed those areas of rocks as having been derived from Rogue formation, which consists of lava flows, tuff, agglomerate, flow breccia, mostly of dacitic and andesitic composition, and of Jurassic age. He described rocks formerly named Colebrooke schist as banded crystalline rocks made up of dark hornblende-rich layers and light siliceous layers. Colebrooke schist is overlain unconformably by Myrtle formation of Diller.

Colebrooke Butte and surrounding country in Port Orford quadrangle are mapped as in this formation.

†Cole Camp Sandstone (in Van Buren Formation)[1]

Lower Ordovician (Beekmantown): Central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 364–369.

Named for outcrops on Cole Camp Creek, Cole County.

Cole Canyon Dolomite[1]

Middle Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 8. Described in East Tintic Mountains, where it conformably overlies Bluebird dolomite and concordantly underlies Opex formation. As mapped by U.S. Geological Survey, it is 830 to about 900 feet thick and includes lower dolomite member of Opex dolomite as defined by Loughlin (1930). Lower 600 feet consists of alternating beds of light-gray laminated dolomite

resembling Dagmar limestone and massive dusky-blue-gray commonly "twiggy" dolomite resembling the Bluebird; light-gray beds weathering creamy white are 1 foot or so to about 25 feet thick, but one bed is 60 to 90 feet thick; dark-colored beds are 10 to 30 feet thick. Zone that was formerly considered part of Opex is 125 to about 300 feet thick, consists chiefly of dusky blue-gray dolomite with some "twiggy" beds, some beds of mottled crossbedded dusky-blue-gray dolomite, and few, if any, interlayered white beds. Base of Cole Canyon is placed at base of lowest creamy-white laminated dolomite, and top is placed at base of sequence of thin-bedded limestones and dolomites of Opex. Middle Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 14 (fig. 3), 21–22, geol. map. In Stansbury Mountains, 320 to 370 feet thick; underlies Opex formation and overlies Bluebird dolomite. Mapped as originally used by Loughlin.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 25–26, 29 (fig. 9), pl. 1. In southern Oquirrh Mountains, about 200 feet thick; underlies Opex dolomite and overlies Bluebird dolomite. Cole Canyon dolomite of type area as originally defined by Loughlin (1919) probably correlates well with the rocks here included in the formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 52–53, pls. 1, 17. Described in Sheeprock Mountains where it is about 899 feet thick and consists of nearly equal parts of dolomite and limestone. Overlies Marjum formation; in fault contact with Opex formation.

Named for exposures along west slope of Cole Canyon, which extends north from Eureka Gulch three-fourths mile west of Eureka, Tintic district, Juab County.

Coleman Bed, Clay, or Limestone (in Admiral Formation)[1]

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 421, 424.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 96. Name Jim Ned shale proposed to replace Drake's Coleman bed; name Coleman preoccupied.

Named for Coleman, Coleman County.

†Coleman division[1]

Permian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii, pl. 3.

Named for Coleman County and for occurrence near town of Coleman.

Coleman Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: F. and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 286, 292.

Probably named for exposures at or near Coleman, Somerset County.

Coleman Junction Limestone Member (of Putnam Formation)[1]

Coleman Junction Formation (in Putnam Group)

Permian (Wolfcamp Series): Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Putnam group. Underlies Hords Creek formation in Admiral group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as member of Putnam formation. Consists of two to four subdivisions of limestone that are separated by thin shales. Thickness 8 to 25 feet. Overlies Santa Anna Branch shale member; underlies Lost Creek shale member of Admiral formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081-G, p. 271–272, pl. 11. Extended into Brazos River valley where it is 4 to 15 feet thick. Overlies Santa Anna Branch shale member. In area of present report, the Admiral formation cannot easily be distinguished from underlying Putnam formation or overlying Belle Plains formation; therefore; the Coleman Junction limestone member of the Putnam, the four members of the Admiral formation, and Jim Ned shale member of Belle Plains formation have been mapped as one unit.

Named for Coleman Junction, Coleman County.

Coleraine Shale or Formation

Upper Cretaceous (Colorado Series): Minnesota.

C. R. Stauffer *in* C. R. Stauffer and G. A. Thiel, 1933, Minnesota Geol. Survey Bull. 23, p. 18. Name appears in geologic column of Minnesota as Coleraine (Pierre) shale. Stratigraphically above Dakota sandstone.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 8 (geol. column), 104–105. Discussed as Coleraine formation in Colorado series. Mostly iron-bearing shales but includes conglomerates and sandstones; some shales fossiliferous. Thickness in Itasca County about 32 feet and here consists mostly of conglomerates and iron ore and occurs above Precambrian Biwabik formation; in Stearns County, about 73 feet and here consists mostly of argillaceous shales (data taken from well). Geologic column shows Coleraine (Benton) formation stratigraphically above Dakota formation. Underlies drift, sands, gravels, and boulder beds.

H. R. Bergquist, 1944, Jour. Paleontology, v. 18, no. 1, p. 7, 8–9. Coleraine formation as used in this report includes all Cretaceous conglomerates of Mesabi Range as well as the shales. Probably more than 100 feet thick. Shales occur only in upper part of Cretaceous sediments in western part of area; conglomerate exposures seem to be more extensive and are only representative of formation in eastern part. Section in Canisteo-Walker pits near Coleraine was considered as type, but subsequent mining has removed much of the Cretaceous.

Well exposed in opencut mines at Coleraine and Calumet, Itasca County.

Coles Brook Limestone[1]

Precambrian: Western Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 27–28.

Well exposed 1 mile northwest of Bancroft Station, in Middlefield, where Boston and Albany Railroad cuts off a loop of Westfield River and Coles Brook enters this loop from north.

Colesburg dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 150.

Charles Schuchert, 1943, Stratigraphy of the Eastern and Central United States: New York, John Wiley and Sons, p. 697. Listed with abandoned names. Lower Silurian (Alexandrian).

Named for Colesburg, Delaware County.

Colestin Formation

Eocene, upper: Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Stratified water-deposited tuffs and conglomerates derived from volcanic rocks; contains a few interbedded flows. Varies in thickness and in some places is absent; maximum thickness is 2,000 feet in valley of Cottonwood Creek. Transitional with overlying Roxy formation (new); gradationally overlies Umpqua formation.

Well exposed both in natural cliffs and road cuts along former and present U.S. Highway 99, in valley of Cottonwood Creek, Jackson County. Name derived from Colestin Springs.

Colfax Formation[1]

Upper Jurassic: Northern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, charts facing p. 217, 221.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 975. Upper part of Mariposa slate was separated by Smith (1910), as Colfax formation, apparently because it contained ammonite *Perisphinctes colfaxi* Hyatt, which he and Crickmay (1931, Am. Philos. Soc. Proc., v. 70, no. 1) considered Portlandian. Such an age assignment needs checking by additional fossil collecting because type of *P. colfaxi* is reported to be lost and original description and illustrations are not adequate for generic determination.

Occurs in Gold Belt region, northern Sierra Nevada.

Colgate Member (of Fox Hills Sandstone)[1]

Upper Cretaceous: Eastern Montana, southwestern North Dakota, northwestern South Dakota, and western Wyoming.

Original reference: W. R. Calvert, 1912, U.S. Geol. Survey Bull. 471, p. 189–198.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 10, pls. 1, 3. In McCone County, Mont., member is about 80 feet thick. Upper member of Fox Hills; overlies an unnamed basal member; underlies Hell Creek member of Lance formation. Footnote (page 10) states that since present report was written the Hell Creek has been raised to rank of formation in the official classification of the Geological Survey.

C. P. Bromley, 1955, U.S. Atomic Energy Comm. [Pub.] RME–1066 (rev.), p. 7 (fig. 2). Mapped in Niobrara County, Wyo.

R. E. Stevenson, 1957, Areal geology of McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Geographically extended into McIntosh quadrangle, South Dakota, where it caps several small buttes and rims the lower Hump Creek and White Shirt Creek valleys. Varies from gray

calcareous or siliceous graywacke sandstone to a buff or white subgraywacke sand. Characterized by clay seams, carbonaceous streaks, clay pebble layers, cross-lamination, oscillation ripple marks, wood fragments, and *Inoceramus*. Thickness not more than 15 feet. Overlies Bullhead member.

Typically developed between Colgate Station and Glendive, Dawson County, Mont.

†Colgate Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 219, 221.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Name abandoned. Replaced by Chenango sandstone member.

Named from exposures on campus of Colgate University.

Colina Limestone (in Naco Group)

Permian: Southeastern Arizona and southwestern New Mexico.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 1, 23–25, 38–41; James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 42–44, pl. 5. Most characteristic lithologic feature is dominance of dense limestone that appears very dark gray to almost black on fresh fracture. It seems safe to conclude that in central Cochise County any continuous such limestone that is as much as 25 feet thick is part of the Colina limestone. Generally weathers dark gray but locally weathers light gray or almost white. Contains abundance of gastropods, especially of a very large *Omphalotrochus*. Thickness at type section 633 feet. Lower boundary of Colina taken arbitrarily at highest of the dolomite beds that weather to an orange-red surface. Overlies Earp formation (new); underlies Epitaph dolomite (new) with gradational contact and underlies Scherrer formation with sharp contact. Age considered as Wolfcamp (Permian?) and Leonard(?).

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 38–39, tables 1, 2, pl. 1. Crops out on western slope of main ridge of Peloncillo Mountains and north and east of Cienega Peak, N. Mex. Incomplete section north of Cienega Peak 504 feet thick. Mapped as Permian.

Type section: On west slope of Colina Ridge (from which named), in Tombstone Hills, 4,000 feet south of Horquilla Peak, Ariz.

Collao Member (of Robles Formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I-319. A succession of rocks consisting of siltstone and fine-grained sandstone, lenses of conglomerate, a unit of limestone, and unit of lapilli tuff characterized by reddish-brown color. A thin andesite lava is interstratified with the siltstone northeast of Vertedero. Estimated thickness about 200 meters. Overlies Las Tetas lava member; underlies Cariblanco formation (new).

Type section: Begins on Highway 1 at point 1.1 kilometers S. 75° E. of intersection of Highway 1 and Highway 162 and extends northwestward along banks of Highway 1 and Highway 162 and up north side of ridge south of Highway 162 to top of ridge above prominent outcrops of limestone, Cayey quadrangle.

Collazo Shale[1]

Tertiary: Puerto Rico.

Original reference: C. A. Reeds, 1916, New York Acad. Sci. Annals, v. 26, p. 437 [1915].

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 321. Name apparently synonymous with San Sebastián shales. Name not now used.

College Hill Limestone[1]

Upper Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 276.

Well exposed on College Hill, Nashville, Davidson County.

College Point Stage[1]

Pleistocene: Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, p. 621–663.

Nassau County and Borough of Queens, Long Island.

Collier Flows

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, p. 62. Discussion of volcanoes of Three Sisters region. Name is applied to flows from Collier Cone.

Collier Cone is between North Sister Mountain and Yapoah Cone.

Collier Limestone Member (of Collier Formation)

Cambrian(?): Southeastern Oklahoma.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 16–18, pl. 1. Consists largely of interbedded fissile shale and dark-bluish-gray finely crystalline limestone at top of Collier formation. Thickness 50 to 150 feet. Contact with Crystal Mountain sandstone above is generally traceable in mapped area (Ouachita Mountains) and it is recommended that unit be considered a separate formation if it also proves traceable in type area of Collier shale in Arkansas.

Prominent outcrops occur along west side of ridge in NW¼ sec. 27, T. 5 S., R. 23 E., McCurtain County.

Collier Shale[1]

Collier Formation

Cambrian: Southwestern Arkansas and southeastern Oklahoma.

Original references: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, no. 557; 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 31.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 15–18, pl. 1. Described in Ouachita Mountains of Oklahoma as Collier shale formation. Overlies Lukfata sandstone (new). Lower part consists of variegated normally brown fissile shale which locally contains numerous laminations of siltstone, sandstone, and silty limestone about 180 feet thick. Upper part is a limestone varying in thickness from 50 to 150 feet and termed the Collier limestone, upper member of Collier shale. Limestone underlies Crystal Mountain sandstone and forms prominent outcrops in mapped area. It is

recommended that the limestone be considered a separate formation if it also proves traceable in the type area of the Collier shale. Cambrian(?).

Named for Collier Creek, Montgomery County, Ark.

Collierstown Limestone

Middle Ordovician: Western Virginia.

B. N. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 85 (fig. 7), 90, 104. Predominantly shell limestone and medium-grained calcarenite with intercalated buff argillaceous limestones and buff shales, some of which are probably metabentonites. Thickness commonly less than 75 feet; at type locality 58 feet. Overlies Edinburg formation (new); underlies Martinsburg formation.

Type locality: North of State Highway 251, about 2 miles east of Collierstown (8 miles west of Lexington), Rockbridge County, Va. In Shenandoah Valley, occurs in westernmost belt of Middle Ordovician limestone, along foot of Little North Mountain; thicker and more widespread in middle and western belts of James River district.

Collings Ranch Conglomerate

Pennsylvanian (Virgil Series): Southern Oklahoma.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2035–2045. Thick-bedded limestone boulder conglomerate; nonfossiliferous. Thickness about 2,000 feet. Complete section nowhere exposed because of erosion at top and faulting locally at base. Rests with pronounced angular unconformity upon steeply dipping rocks of Arbuckle anticline. Exposed beneath conglomerate are West Spring Creek formation of Arbuckle group; Joins, Oil Creek, McLish, Tulip Creek, and Bromide formations of Simpson group; and Viola limestone. Underlies Vanoss limestone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped with rocks of Virgil age.

Type area: Sec. 25, T. 1 S., R. 1 E. Named from Ellsworth Collings Ranch [Murray County], near U.S. Highway 77.

Collingston Conglomerate

See Collinston Conglomerate.

Collingsworth Gypsum Member (of Blaine Formation)[1]

Permian: Southwestern Oklahoma and central northern Texas.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 356, footnote.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 23–24, pl. 1. Described in Carter area, Oklahoma, as massive white gypsum 22 feet thick, underlain by an unnamed gray dolomite 1 foot thick and overlain by an unnamed red shale unit generally 15 feet thick. Occurs below the Mangum dolomite member and above the Cedartop gypsum member.

Named from Collingsworth County, Tex., just west of Greer County, Okla., where the gypsum is well exposed.

Collingwood Formation[1]

Upper Ordovician: Ontario, Canada, and surface and subsurface in Michigan and subsurface in Wisconsin.

Original reference: P. E. Raymond, 1912, Canada Geol. Survey Summ. Rept. 1911, p. 354.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 250 (fig. 8), 283–284. Consists of alternating beds of limestone and shale. In type section, overlain by Blue Mountain shale. Thickness 26 feet at type section. Underlies Gloucester shale. Believed to persist from Collingwood to shore of Lake Ontario. In Jefferson County, N.Y., there are many exposures of contact of Deer River black shale on upper Cobourg limestone along Sandy Creek; former is considered to be of Collingwood age. In Oneida County, Holland Patent shale, upper member of Utica formation, is, in its lower part, of Collingwood age. In present report, included in Trenton group, above Cobourg limestone and below Gloucester shale. Mohawkian series. Middle Ordovician.

A. E. Wilson, 1946, Canada Geol. Survey Mem. 241, p. 28. Eastview and Billings formations of Ottawa-St. Lawrence Lowland represent continuous sequence of beds. Together they make up former Collingwood and Gloucester of the basin. They are defined by lithology, the Eastview being limestone interbedded with shale and the Billings all shale. Terms Collingwood and Gloucester are retained as time terms.

G. V. Cohee, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 33. In subsurface of southeastern Michigan, the Upper Ordovician rocks are about 750 feet thick and are divided into three units: Utica, Lorraine, and Queenston shales. The dark-gray to black Utica is 150 to 200 feet thick. It thins northward, and, in Northern Peninsula, Bruce Peninsula, and on Manitoulin and adjacent islands, it is represented by Collingwood formation. Collingwood was identified in one well in Door County, Wis., but could not be identified farther south. In southwestern Ontario, beds of Upper Ordovician age crop out locally on Manitoulin and adjacent islands, along shore of Georgian Bay, and southeastward in Ontario where they are divided into (ascending) Collingwood, Gloucester, Dundas, Meaford, and Queenston formations. The Collingwood, 30 to 40 feet thick, was formerly assigned to Utica because of its lithologic similarity to the Utica of New York. According to Sproule (1936, Canada Geol. Survey Mem. 202), the Collingwood rests on Trenton limestone. At north edge of Sheguindah, Manitoulin Island, Ontario, the Collingwood rests on the Precambrian. Overlying Collingwood are dark-brown to black shales which in earlier reports were referred to as Gloucester formation. In recent reports, the Canada Geological Survey includes both Collingwood and Gloucester in Billings formation which is 100 to 270 feet thick in southwestern Ontario. Kay (1937) correlates the Collingwood and Gloucester with the Trenton of New York.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Shown on correlation chart in Northern Peninsula of Michigan. Occurs above Stewartville limestone. Trentonian.

B. A. Liberty, 1954, Michigan Geol. Soc. [Guidebook] Ann. Field Trip June 19–20, p. 7–17. Discussion of Ordovician of Manitoulin Island. Collingwood has been used in Ontario nomenclature as time term. In present report, strata of this unit comprise rock unit to which name Collingwood is applied. Unit is about 22 feet thick, but thickness varies over short distances. Where it lies, under transgressive overlap conditions, on apices of Precambrian quartzite ridges, thickness may be only a few inches. Contact with overlying Sheguindah formation.

Well exposed at Collingwood, Ontario.

Collingwoodian (Collingwood) Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Collingwood and Gloucester are stages in latest Trenton.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30–31. Trenton group was divided by Raymond (1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56) into succession of faunal zones that he thought time-stratigraphic but which he called formations. In time, these became stages: Rocklandian, Kirkfieldian, Shorehamian, Denmarkian, Cobourgian, Collingwoodian, and Gloucesterian of Kay (1937; 1943; 1948). The Cobourg-Collingwood-Gloucester seems to be time-equivalent to Utica group, but name Utica is strongly associated with black shale facies. Hence, term Pictonian stage is applied to uppermost Trentonian.

Name derived from Collingwood, Ontario, Canada, for which Collingwood formation was named.

Collins Hill Formation

Middle or Upper Ordovician(?): Central Connecticut.

John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. and Nat. History Survey Bull. 84, p. 19, 20, 21, 22, 24, fig. 3. Rusty-weathering graphitic garnetiferous two-mica schist, commonly containing sillimanite and (or) kyanite. Commonly has basal conglomerate gneiss associated with overlying well-banded unit consisting of fine-grained quartzite with manganiferous garnet and cummingtonite and of laminated amphibolite with relatively large garnets locally. Persistent amphibolite and calc-silicate layers in lower part. Interbedded calc-silicate and fine-grained biotite-muscovite-gneiss abundant to west in upper part. Unconformably overlain by Bolton group from Great Hill north. Rests unconformably on Middletown formation and on granitic rocks (Glastonbury and Maromas gneisses), which have discordant, possibly intrusive, contacts with Middletown but fail to transgress into the Collins Hill along many miles of mutual contact. Unit has been included in Bolton schist by many recent workers. Middle Ordovician(?).

G. P. Eaton and J. L. Rosenfeld, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 2, p. 170 (fig. 1), 171 (table 1). Unconformably underlies Great Hill formation (new). Unconformably overlies Glastonbury and Maromas formations. Previous workers with the exception of Percival (1842, Report on the Geology of the State of Connecticut: New Haven) grouped the sequence of rocks from Collins Hill schist through Camp Jenkins schist as a single formation, and believed it to be intruded by Glastonbury, Maromas, and Haddom gneisses. Present work shows that these rocks represent four distinct formations, with unconformity separating Collins Hill from the others.

Named from Collins Hill in central Portland, Middlesex County.

Collinston Conglomerate (in Salt Lake Group)

Miocene, upper, and Pliocene, lower: Northeastern Utah.

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 73, 75 (fig. 2). Collingston conglomerate consists of about 2,500 feet of boulder and cobble conglomerate with a white calcareous and tuffaceous(?) matrix. Unconformably underlies West Spring formation (new); in fault contact with upper Paleozoic rocks in Cache

Valley; at north end of Wellsville Mountain overlies Wasatch group. Name credited to J. S. Williams (unpub. ms.).

R. D. Adamson, C. T. Hardy, and J. S. Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 1 (table 2), 2 (table 1), 4–6, 9 (fig. 3). Collinston conglomerate intertongues with Cache Valley formation herein considered to include unit formerly termed West Spring formation. Thickness about 1,500 feet. Poorly exposed.

Type area: Northern end of Wellsville Mountains, Cache County.

Collinsville cyclothem (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 11; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, (table 1). In sequence, occurs below Shoal Creek cyclothem and above Trivoli cyclothem. Thickness about 42 feet.

Named from exposures along Canteen Creek, near Collinsville, Madison County.

Collinsville Granite Gneiss[1]

Pre-Triassic: North-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 105–107 and map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as a gneiss. Pre-Triassic.

Well-exposed at Collinsville, Hartford County.

Collinsville Limestone[1] (in McLeansboro Formation)

Collinsville Limestone (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

Original reference: A. H. Worthen, 1873, Illinois Geol. Survey, v. 5, p. 315.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as formation in McLeansboro group; stratigraphically below Shoal Creek limestone and above Trivoli limestone.

First described near Collinsville, Madison County.

Collores Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. R. Fettke, 1924, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 149.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). Thickness 300 feet. Lower part equivalent to La Muda limestone and upper part equivalent to Trujillo Alto limestone of Fajardo district.

Named for typical development in barrio of Collores de Piedras, Humacoa district.

Collores Member (of Augustinillo Formation)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 94–96; 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 84–85. Consists largely of thin-bedded hard buff- to creamy-

colored argillaceous limestones with some layers of reddish-brown calcareous mudstones and siltstones. Layers and lenses of Coamo Springs limestone not uncommon. Thickness about 6,800 feet. To the west, interfingers with Monserrate member (new) of Augustinillo. Overlies and interfingers with Guayo member of Naranjo formation (both new). Middle Eocene.

Type locality: At Camino Collores bed of the Río Guayo near bend. Crops out in northwest part of Ponce quadrangle. Named for Poblado Collores, 1.4 kilometers southwest of Cerro Augustinillo.

Colma Formation

Pleistocene, upper: Central western California.

J. Schlocker, M. G. Bonilla, and D. H. Radbruch, 1958, U.S. Geol. Survey Misc. Geol. Inv. Map I–272. Sequence of unconsolidated sand deposits that are similar in appearance and physical properties and occupy approximately the same stratigraphic position; they may not all be contemporaneous. Fine- to medium-grained sand with minor amounts of clay; evenly spaced horizontal or nearly horizontal bedding or continuous inclined bedding; rarely massive; in places includes clay beds 6 inches to 5 feet thick. On Angel Island, thickness 5 to 50 feet; at north end of Ocean Beach, at least 40 feet thick and appears to thicken and dip gently southward under dune sand of Golden Gate Park.

Occurs on Angel Island and at several points on San Francisco Peninsula. Name derived from town of Colma, 4½ miles south of San Francisco North quadrangle near center of area in which formation is best developed.

Colmar shales[1]

Upper Ordovician: Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 217–222.

Colmena Tuff or Formation (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13 (fig. 3), 17, 19–20. Named proposed for beds of rhyolitic tuff-conglomerate. Described as light brown, interbedded with variegated tuff principal colors of which are brown, pink, and red; near mouth of Capote Creek, contains beds of tuffaceous nonmarine limestone 4 to 10 feet thick; near Loma Plata, contains beds of silty claystone and a layer of glassy flow-rock. Deposited on rough topography of Gill breccia (new), consequently is missing in some places, though its thickness exceeds 450 feet in others. In most places, overlain by Buckshot ignimbrite (new); where Buckshot is absent, the Colmena is overlain by Chambers tuff (new).

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Described in Van Horn Mountains area, where it is 190 to 310 feet thick. Rests on Chispa Summit formation in the northern Sierra Vieja; on Cox limestone, Finlay limestone, Benevides formation, Eagle Mountains sandstone, Buda limestone, and Chispa Summit formation in isolated outcrops along eastern margin of Van Horns northward to Hammer Handle Canyon; on Eagle Mountains sandstone, Buda limestone, and Chispa Summit formation directly west of Willoughby Wind gap along the western margin; and on Cox sandstone at southeastern and southwestern flanks of Colquitt syncline.

Type locality: Four miles due east of Candelaria, Rim Rock country, Presidio County. Name derived from Colmena Canyon.

†Colob Sandstone[1]

Jurassic(?): Southwestern Utah.

Original reference: E. Huntington and J. W. Goldthwait, 1903, Jour. Geology, v. 11, p. 46–63.

Name probably derived from Colob Creek on Colob Plateau (spelled Kolob on some maps), Washington County.

Colony Creek Shale Member (of Caddo Creek Formation)

Colony Creek Shale

Upper Pennsylvanian: West-central Texas.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 20. Proposed that name Colony Creek shale be given to beds between Ranger and Home Creek limestones and that name Hog Creek shale, misapplied by Drake and others, be dropped.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. Shown on columnar section, Brown and Coleman Counties, as Colony Creek shale member of Caddo Creek formation. Underlies Home Creek limestone member; overlies Ranger limestone member of Brad formation. Thickness about 20 feet. Mainly gray shale; locally contains thin beds of sandstone; not present in areas of reefs of Ranger limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 67. Because of confusion that has resulted from miscorrelations of Home Creek limestone and misapplication of term "Hog Creek," adoption of Cheney's term Colony Creek shale is herein recommended for shale member below Home Creek limestone member. Unit is gray shale that contains conspicuous fine-grained thinly to thickly and irregularly bedded sandstone near top. In southern part of area, Colony Creek is about 25 feet thick; locally, member is absent and Home Creek limestone member is contiguous with limestone members of Brad formation. Average thickness of member about 60 feet in north-central Brown County.

Type area: Branching headwaters of Colony Creek in vicinity of Colony School, 4 miles west of Ranger in northeastern Eastland County.

Colony School Conglomerate (in Strawn Group)

Pennsylvanian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 85. Basal conglomerate that occurs at contact of the Strawn and Marble Falls limestone. Made up of well-rounded pebbles ranging from size of large sand grains to 1 inch in diameter and set in matrix of reddish brown sand. Thickness about 1 foot.

Located 0.15 mile east of Colony School, San Saba County.

†Colorado Conglomerate[1]

Pennsylvanian: Pennsylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38–40, 46.

In hilltops at Colorado, Warren County.

Colorado Group,[1] Shale,[1] or Formation[1]

Lower and Upper Cretaceous: Colorado, Idaho, Iowa, Kansas, Montana, Nebraska, New Mexico, North Dakota, South Dakota, and Wyoming.

Original reference: F. V. Hayden, 1876, U.S. Geol. and Geog. Survey Terr. 8th Ann. Rept., p. 45.

Eugene Stebinger, 1919, U.S. Geol. Survey Bull. 691–E, p. 154 (table), 157–164. Colorado shale, in Birch Creek-Sun River area, Montana, overlies Kootenai formation and underlies Virgelle sandstone of Montana group. Thickness about 1,800 feet. Includes Blackleaf sandy member (new) at base.

C. F. Bowen, 1919, U.S. Geol. Survey Bull. 691–F, p. 189 (table), 195–197. Colorado shale, in Musselshell Valley, Mont., is about 2,200 feet thick, overlies Kootenai formation and underlies Eagle sandstone of Montana group. Includes Big Elk sandstone member (new). Upper Cretaceous.

A. J. Collier and S. H. Cathcart, 1922, U.S. Geol. Survey Bull. 736–F, p. 172 (table). Group, in Little Rocky Mountain region, Montana, comprises (ascending) Thermopolis, Mowry, and Warm Creek (new) shales. Overlies Kootenai formation; underlies Eagle sandstone of Montana group. Upper Cretaceous.

S. G. Lasky, 1936, U.S. Geol. Survey Bull. 870, p. 23–26, pl. 1. Colorado formation, in Bayard area, New Mexico, rests upon Beartooth quartzite with apparent disconformity. Upper limit is either present land surface or an older erosion surface buried under volcanic rocks of region, so that full thickness is not present. Separable into two mappable units: an upper sandstone member and a lower shale member. Thickness 320 to 450 feet.

C. H. Rankin, 1944, New Mexico Bur. Mines Mineral Resources Bull. 20, p. 5–26. Colorado group, in this report [northern New Mexico], comprises (ascending) Graneros shale, Greenhorn limestone, Carlile shale, and Niobrara formation. Overlies Dakota(?) sandstone. Top of Niobrara not recognized with certainty. In previous reports on Cretaceous rocks of New Mexico, writers have followed nomenclature established by Cross (1901 [1899], U.S. Geol. Survey Geol. Atlas, Folio 60) and have described all rocks between Dakota sandstone and Mesaverde coal measures as Mancos shale. Present study reveals that all divisions of Colorado group (Mancos shale) as described in southern Colorado, except Fort Hayes limestone and Apishapa shale, can be recognized in northern New Mexico.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. As shown on correlation chart, Colorado group comprises Mowry shale and Warm Creek shale. Overlies Thermopolis shale; underlies Telegraph Creek formation. Upper Cretaceous.

W. A. Cobban and J. B. Reeside, Jr., 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1892–1893. Uncrushed ammonites have been collected from Mowry shale and equivalent rocks at several localities in Colorado, Wyoming, and Montana. These collections show that impressions and crushed internal molds of ammonites previously assigned to Upper Cretaceous genera *Metoicoceras*, *Acompsoceras*, and *Neocardioceras* (as *Kanabiceros*) belong to Lower Cretaceous genera *Gastroplites* and *Neogastroplites*. Largest collection of *Gastroplites* from United States consists of more than 1,400 uncrushed specimens from a single concretion in the Colorado shale near Harlowton, Mont. In northwestern Colorado, it [*Gastroplites*] occurs in middle of Mowry member of Mancos shale; in Wyoming, known from Aspen shale along western edge of Green River basin, and from Mowry on western margin of Bighorn basin, eastern flank of Black Hills. In Montana, genus occurs in Mowry shale in Pryor Mountain and in Colorado shale on Middle Dome, southeast of Harlowton. Largest collection of *Neogastroplites*, containing 800 specimens, is from

concretions in Mowry shale near Cody, Wyo. Genus occurs in Aspen shale in Green River basin, and in Mowry shale in Wind River basin and along eastern flank of Bighorn Mountains, in Thermopolis shale in Bighorn Mountains, in Mowry shale near Pryor Mountains, and in Colorado shale in Livingston area, in Judith Basin, and near Great Falls.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2170–2198. Colorado shale of central and northwestern Montana and equivalent rocks on north flank of Black Hills are dominantly dark-gray marine shales. It has been customary to treat Colorado shale as a single formation, with one or two members. Detailed studies show that Colorado shale is divisible into many lithologic units that can be correlated with standard section in Black Hills. Formation in Black Hills that are equivalent to Colorado shale are (ascending) Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b. Reference sequence for Upper Cretaceous, Western Interior, North America, shows Colorado group comprises (ascending) Belle Fourche shale, Greenhorn limestone, Carlile shale, and Niobrara formation. Occurs above Lower Cretaceous Mowry shale and below Telegraph Creek formation.

W. A. Cobban, 1953, U.S. Geol. Survey Prof. Paper 243–D, p. 45–54. Colorado shale, near Mosby, Mont., is 1,930 feet thick, and includes Mosby sandstone member 743 feet below top. Cenomanian ammonite fauna.

R. B. Johnson and G. J. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map 146. Colorado group, in Huerfano County, Colo., comprises (ascending) Graneros shale, Greenhorn limestone, Carlile shale, Niobrara formation. Overlies Dakota sandstone; underlies Pierre shale of Montana group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Colorado group mapped in northwestern Oklahoma. Exposed part equivalent to Greenhorn limestone and Graneros shale.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 24, 34 (fig. 3). Colorado shale, in Lake Valley quadrangle, overlies Sarten formation. Upper Cretaceous (Benton age).

J. P. Greis, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 449–450. In Williston basin, Colorado group, which formerly included all of Graneros formation around Black Hills, has now been restricted to Upper Cretaceous and includes Belle Fourche shale, together with overlying Greenhorn, Carlile, and Niobrara formations. Term Belle Fourche shale now used in the basin wherever underlying Mowry can be differentiated, except in Little Rocky Mountains where name lower Warm Creek shale is applied.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. As mapped, Colorado group comprises (ascending) Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Colorado shale includes equivalents of Fall River, Skull Creek, Newcastle, Mowry, Belle Fourche, Greenhorn, Carlile, and Niobrara formations and locally Telegraph Creek formation.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 414–417. Colorado shale described in area east and southeast of Livingston, Mont. Name

Colorado shale has been used in parts of Montana for thick predominantly shale sequence that lies above Kootenai formation, and, in most places, below Virgelle sandstone or Eagle sandstone; locally underlies Telegraph Creek sandstone. Colorado shale, which includes sandstone, particularly in west-central Montana, contains both Lower and Upper Cretaceous strata; its vertical range, therefore, does not coincide with Upper Cretaceous Colorado group. Cobban (1951) compared Colorado shale of central Montana with equivalent rocks of Black Hills. From his report, it is evident that some formational names of Black Hills can be used as members of Colorado shale in central Montana. Some formation names in use in Bighorn basin, Wyoming, are not common to Black Hills and central Montana areas but have been used around Pryor Mountains and Bighorn Mountains. In present report, Colorado shale has been divided into 10 units, and these are compared, where possible, with Black Hills and central Montana or Bighorn basin formations. Unit 7, about 100 feet thick, is herein named Boulder River sandstone member.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 26–28, pls. 1, 2. Formation described in southern Elkhorn Mountains, Mont. Subdivided into three map units: lower black shale, 215 to 325 feet thick; sand and siliceous mudstone, 610 to 920 feet thick; and upper black shale unit, 265 to 390 feet. Overlies Kootenai formation, probably with slight erosional unconformity. Grades upward into sequence of feldspathic sandstone and tuff beds herein named Slim Sam formation. Where Slim Sam formation is absent, the Colorado underlies Elkhorn Mountains volcanics (new). Colorado formation as herein used includes beds of both Early and Late Cretaceous age.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2786–2796. Colorado group revised on Sweetgrass arch, Montana. Rocks formerly assigned to Colorado shale are divided into lower unit, Blackleaf formation with four named members, and an upper unit, Marias River formation (new) with four named members. Overlies Kootenai formation; underlies Telegraph Creek formation. Early Late Cretaceous.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Group comprises (ascending) Graneros shale, Greenhorn limestone, Carlile shale, and Niobrara chalk. Overlies Dakota formation; underlies Pierre shale of Montana group.

J. B. Reeside, Jr., and W. A. Cobban, 1960, U.S. Geol. Survey Prof. Paper 355, p. 8–11. Colorado shale, in Teigen area, central Montana, includes Arrow Creek member (new) which underlies Mowry member.

Mineral Research and Devel. Dept. Rept. 12, pt. 2, p. 33–38, 41–42. In southwestern Montana includes Geyser bentonite bed (new) and Greenhorn bentonite bed (new). Great Northern Railway Co. Mineral Resources Research and Development Department. 1960, Great Northern Railway Co.

Colorado shale, in Winnett-Mosby area, Montana, includes following members: Skull Creek Shale, Mowry Shale, Belle Fourche Shale, Mosby Sandstone, Carlile Shale, and Niobrara Shale. In area of Bearpaw Mountains, includes following members: Fall River Sandstone, Skull Creek Shale, Newcastle Sandstone, Mowry Shale, Belle Fourche Shale, Greenhorn Limestone, Carlile Shale, Niobrara Shale, and Telegraph Creek.

Named for exposures along eastern base of Colorado or Front Range, Colo.

†Colorado Series[1]

Upper Cretaceous: Colorado.

Original reference: G. H. Ashley, 1923, Eng. and Min. Jour.-Press, v. 115, no. 25, p. 1106–1108.

Colpitts Group

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 247–255. Name applied to sequence of limestone, sandstone, and shale which crops out only between Snow Mountain and Suplee in western end of pre-Tertiary area. Less than 500 feet thick in most places; may exceed 800 feet of Freeman Creek. Comprises two formations: Weberg below and Warm Springs above (both new). In type area, Colpitts lies across narrow southwestern part of eastward-trending Mowich anticline. Along western part of anticline, Colpitts lies upon Mowich group and below Hyde formation (new) without appreciable angular discordance. Where Mowich group is absent, as along Warm Springs Creek and in Camp Creek valley, Colpitts lies upon Triassic and Paleozoic beds with high-angle discordance.

Type area: On east side of Warm Springs Creek valley in secs. 19, 20, 29, and 30, T. 18 S., R. 26 E., Crook County. Named for Willard Colpitts Ranch on upper Warm Springs Creek.

Colquitt Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 271, 441, 452.

Type locality: On Colquitt Ranch below Chispa Summit, western Jeff Davis County.

Colter Formation

Miocene, middle: Northwestern Wyoming.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1899, 1904–1907, fig. 1. Sequence of gray, green, and brown water-laid pyroclastic rock, sandstone, and claystone. Characterized throughout by abundance of mafic volcanic material, both in lithic fragments and in tuff. Thickness in vicinity of type section 7,000 feet, exclusive of basal part of formation which is so distorted by basalt intrusions that character and thickness of the rocks have not been adequately determined. Unconformably overlain by rocks of middle Pliocene age and unconformably overlies all older rocks. On East Fork of Pilgrim Creek, unconformably overlies Pinyon conglomerate of Paleocene age.

Type section: On Pilgrim Creek about 5 miles northeast of Colter Bay, on Jackson Lake, from which the formation takes its name. Section extends eastward from east face of Pilgrim Peak across Pilgrim Creek for distance of about 1 mile, and lies in secs. 20, 21, 22, 27, 28, and 29, T. 46 N., R. 114 W., unsurveyed, Teton County.

Colton Formation

Eocene: Central Utah.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 120–121, pls. 2, 3. Consists of reddish-pink sandstones and shales. Varies greatly in thickness; about 3,400 feet near town of Green River, Utah; near Soldier Summit, disappears into Green River formation. Believed to be equivalent in age to part of Green River formation with which it interfingers on

its upper boundary. May correlate with unit herein referred to as Uinta(?). Exposed in extreme southwestern part of Uinta basin. Forms base of Roan Cliffs from Price River to Roan Plateau in Colorado.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 139. Formal proposal of name. Gray, pepper-and-salt sandstone, greenish-buff sandstone, and siltstone that commonly weathers golden brown, and shale ranging from deep red to variegated and gray. Thickness 1,500 feet at Kyune, 2 miles east of Colton, where it underlies Green River formation; overlies Flagstaff formation; both contacts clearly defined; westward, grades laterally into beds of Green River type. In some areas, overlies North Horn formation. Unit has been referred to as an upper member of Wasatch formation.

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 135. Spieker's Colton formation may be westward continuation, in Utah, of (upper portion?) De Beque formation.

Named for exposures in hills north of Colton at head of Price Canyon, Utah County.

†Columbia Granite[1]

Precambrian: Central Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. geol. map of Virginia.

G. W. Stose and A. J .Stose, 1948, Am. Jour. Sci., v. 246, no. 7, p. 405–406. In Arvonia slate district, granite near Carys Brook had been termed Columbia granite by Jonas (1932). However, it differs from Columbia granite in texture and composition. The contact of the two granites is an overthrust fault on which the Columbia granite and associated rocks rode northwestward over the granite at Carys Brook and the Peters Creek formation.

Named for occurrence at Columbia, on Fluvanna-Goochland County line, north of James River.

Columbia Group[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original references: W. J. McGee, 1886, Rept. Health Office District of Columbia for 1885, p. 20; 1886, Am. Jour. Sci., 3d v. 31, p. 473.

C. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 31–32. Quaternary system in Virginia Coastal Plain is represented chiefly by deposits of sand and clay that mantle the older formations to a height of about 270 feet above sea level. They are collectively called Columbia group. Units included are Brandywine, Coharie, Sunderland, Wicomico, Penholoway, Talbot, and Pamlico formations.

Other units included in group are: Bridgeton, Cape May, and Pensauken Formations.

Named for District of Columbia.

Columbia Ford Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Derivation of name not stated.

Columbian Marble[1]

Columbian Marble Member (of Boardman Formation)

Columbian Marble Member (of Shelburne Formation)

Lower Ordovician: West-central Vermont.

G. W. Bain, 1931, Am. Jour. Sci., 5th ser., v. 22, no. 132, p. 508, 509, 510, 511. In list of formations, Columbian deposit (marble) overlies Intermediate limestone and underlies West Blue deposit. Ordovician (Chazy).

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 25–26, 27. Rank reduced to member at top of Boardman formation (new). Generally white-weathering white and blue-gray marble; occasional threads of green silicates wind irregularly through the white marble. Maximum thickness 600 feet. Underlies Bascom formation; overlies Intermediate dolomite member of Boardman. Lower Ordovician.

J. B. Thompson, Jr., 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 75 (table 1). In Clarendon-Dorset area, is uppermost member of Shelburne formation. Thickness 200 to 250 feet. Overlies Intermediate dolomite member.

Occurs in Addison and Rutland Counties.

Columbiana Formation

Middle Ordovician (Mohawkian): Central Alabama.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 57, chart 1 (facing p. 130). Black graptolitic shale. Thickness a few inches to 325 feet. Disconformably underlies Frog Mountain sandstone; overlies Pratt Ferry formation (new). Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Just west of Simpson Springs 2½ miles northwest of Calera, Shelby County. Named from Columbiana 15-minute quadrangle in which east side of Calera is located.

Columbia River Basalt[1]

Miocene and Pliocene(?): Oregon, Washington, and northern Idaho.

Original reference: I. C. Russell, 1893, U.S. Geol. Survey Bull. 108, p. 20–22, map.

R. C. Treasher, 1942, Geologic map of Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. In Portland area, underlies Troutdale formation.

W. C. Warren and Hans Norbisrath, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 233–234. Overlies Scappoose formation (new) in upper Nehalem River valley. Thickness as much as 1,000 feet.

E. M. Baldwin, 1950, Oregon Country Geol. Soc. News Letter, v. 16, no. 11, p. 93. Underlies Molalla formation (new).

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 3–5, pls. 1, 2. Discussion of lower Columbia River valley, Oregon and Washington. Term Columbia River basalt used in present report to apply only to the Miocene flows as restricted by Merriam (1901, California Univ. Pub., Bull. Geology Dept., v. 2, no. 9) and Lindgren (1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2). Basalt is interbedded with Astoria formation of middle Miocene age. Total thickness of basalt flows as much as 1,000 feet in Portland area; 2,000 feet in Columbia River Gorge. Columbia River basalts in vicinity of Salem and Stayton,

Oreg., were named Stayton lavas by Thayer (1939) because Columbia River basalt had not then been traced into that area. Now seems advisable to drop name Stayton lavas in preference to Columbia River basalt. In Columbia River Gorge, the basalt lies on erosional surface cut in sediments of Eagle Creek formation (lower Miocene). In central Oregon, the Columbia River basalt lies on erosion surface developed on John Day formation of late Oligocene or early Miocene. Middle and upper Miocene.

H. H. Waldron and L. M. Gard, Jr., 1954, U.S. Geol. Survey Geol. Quad. Map GQ–48. Mapped in Hay quadrangle, Washington, where it may be as much as 5,000 feet thick.

T. P. Thayer, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Maps MF–49 and MF–50. Mapped in Aldrich Mountain and Mount Vernon quadrangles, Oregon, where it underlies Mascall formation and unconformably overlies unnamed volcanic conglomerate. Middle Miocene.

Howel Williams, 1957, A geologic map of the Bend quadrangle, Oregon, and a reconnaissance geologic map of the central portion of the High Cascade Mountains (1:125,000): Oregon Dept. Geology and Mineral Industries. Southern edge of Columbia River basalt plateau passes through northeast corner of Bend quadrangle, where thin, scattered outliers rest conformably or with only slight disconformity on John Day formation. Maximum thickness 300 feet. Middle Miocene.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 15–16. In early geologic studies, such names as Columbia lava and Columbia River basalt were applied to mass of dominantly basaltic rocks in region drained by Columbia River. As originally defined (Russell, 1893), this unit included Snake River basalt. Current usage in Idaho restricts term to unit that consists mainly of flows of basaltic and kindred composition that extend interruptedly from vicinity of South Mountain, Owhyee County, through western Idaho at least as far north as Kootenai County. Maximum thickness of lava in the unit as thus limited probably more than 3,000 feet. Flows are associated with sedimentary beds which in some places reach thicknesses in excess of 1,000 feet. These sedimentary beds include strata that in southern Idaho have been referred to Payette formation (Miocene and Pliocene?) and others farther north that contain flora typical of Latah formation (middle or upper Miocene). Younger than Challis volcanics.

J. W. Hosterman and others, 1960, U.S. Geol. Survey Bull. 1091, p. 7, pls. 3, 4, 5. Although Columbia River basalt may range in age from Miocene to Pliocene, it is considered to be product of many closely related eruptions and is classed as one formation. Thickness ranges from several feet at flanks of steptoes and embayments along eastern margin of Columbia Plateau to more than 1 mile near center where subsidence is greatest. In general vicinity of clay deposits in Washington and Idaho, the Latah formation is interbedded with Columbia River basalt.

Columbia River valley.

Columbus Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 21; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. The Columbus,

third in the sequence (ascending), occurs above the Neutral and below the Bluejacket. Average thickness 30 feet. Includes Columbus coal. [For complete sequence see Cherokee group.]

Type locality and derivation of name not given. Cherokee outcrop in Kansas covers an area of about 1,000 square miles and includes parts of Labette, Bourbon, Crawford, and Cherokee Counties.

Columbus Limestone[1]

Middle Devonian: Central and north-central Ohio, and Ontario, Canada.

Original reference: W. W. Mather, 1859, Rept. State House Artesian Well at Columbus, Ohio, p. 25.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 128–129, chart facing p. 108. Comprises Bellepoint, Marblehead, and Venice members. Thickness 80 to 125 feet. Overlies Lucas formation; underlies Delaware formation; in some area, Marcellus formation is present between the Columbus and Delaware.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 280–282. In Logan County, includes East Liberty bone bed near top.

Wilber Stout and R. A. Schoenlaub, 1945, Ohio Geol. Survey, 4th ser., Bull. 46, p. 21. In southwestern Delaware County, comprises Bellepoint, Eversole, and Klondike members.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 119–126. Discussion of paleoecological analysis of Devonian rocks of Columbus region. Chart shows that Columbus formation, 105 feet thick, comprises (ascending) Bellepoint, Eversole, and Delhi (Klondike) members. Underlies Delaware formation; overlies Silurian (Monroe formation).

R. C. Moore, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 309 (fig. 2). Columnar section shows that Columbus formation, 105 feet thick, comprises (ascending) Bellepoint, Eversole, and Delhi members.

G. M. Ehlers, E. C. Stumm, and R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northwestern Ohio: Ann Arbor, Mich., Edwards Brothers, Inc., p. 9. Prosser (1903, Jour. Geology, v. 11) believed that beds in northwestern Ohio which he called Columbus were same beds that Mather (1859) and Newberry (1873) described by that name from quarries in vicinity of Columbus. As now recognized, Columbus limestone is absent in northwestern Ohio, and the younger Dundee limestone was the one to which Prosser referred.

G. A. Stewart, 1955, Ohio Jour. Sci., v. 55, no. 3, p. 147–179. Discussion of age relations of middle Devonian limestones in Ohio. In central Ohio, the Columbus comprises (ascending) Bellepoint, Eversole(?), and Delhi members; in north-central Ohio comprises (ascending) Bellepoint, Marblehead, and Venice members. Maximum thickness 105 feet. Underlies Delaware limestone. Overlies Bass Island (Silurian) series. Gives review of terminology.

C. R. Stauffer, 1957, Jour. Geology, v. 65, no. 4, p. 376–383. Overlies Detroit River group in northern Ohio and in Ontario. Was correlated with Onondaga limestone of New York by James Hall and others. True Onondaga is now known to occur beneath horizon of Detroit River group in Mackinac Straits region of Michigan and throughout most of its occurrence in Ontario. Eastward along line of major axis of Lake Erie, the Detroit River group pinches out, and Columbus limestone lies directly on Onondaga limestone in Norfolk and Haldimand Counties, Ont.

Named for exposures at Columbus, Ohio.

†Columbus Marl[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 84–86.

Named for Columbus, Hempstead County.

Columbus Quartzite[1]

Pennsylvanian: Central northern Utah.

Original reference: L. A. Palmer, 1906, Mines and Min., v. 26, p. 438–439.

Probably named for Columbus Consolidated Mine.

†Columbus Sand[1]

Upper Cretaceous: New Jersey.

Original reference: G. N. Knapp, as reported by R. D. Salisbury, 1899, New Jersey Geol. Survey Ann. Rept. State Geologist, 1898, p. 35, 36.

Named for occurrence at Columbus, Burlington County.

†Columbus Sandstone (in Cherokee Shale)[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 106.

Named for outcrops along Brush Creek, east of Columbus, Cherokee County.

†Colville Granite or Granodiorite[1]

Cretaceous: Northeastern Washington.

Original reference: J. T. Pardee, 1918, U.S. Geol. Survey Bull. 677.

W. H. Irwin, 1938, Geol. Soc. America Bull., v. 49, no. 11, p. 1628, 1637–1638. Coarse-grained granite, exposed at Grand Coulee Dam and southward in Grand Coulee, represents a marginal facies of Colville batholith and should be known as Colville granite. Cut by vertical dikes composed of a fine-grained slightly porphyritic granite.

Name derived from Colville batholith in Colville Indian Reservation.

Colville Group

Colville Series[1]

Upper Cretaceous: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 248.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 164–167, figs. 2, 3. Redefined as Colville group, basal member of which is distinctive unit consisting of black shale with limestone interbeds. Lithologically, group includes clastic rocks ranging from shale to conglomerate, limestone, low-grade oil shale, and coal. Total thickness about 5,200 feet. Divided into nonmarine Prince Creek formation (new) and marine Schrader Bluff formation (new), which are approximately of equivalent age. Formations intertongue and are not always readily distinguishable. Unconformably overlies Nanushuk group; underlies Sagavanirktok (new) and Gubik formations. Type exposures cited. Now evident from faunal analyses that rocks are all of Upper Cretaceous age.

C. L. Whittington, 1956, *in* George Gryc and others, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 244–246, figs. 2, 3, 4. Nonmarine Tuluvak

tongue of Prince Creek formation, recognizable in nearly all pertinent surface and subsurface sections, is wedge dividing marine rocks of group into two major formations: Seabee formation below and Schrader Bluff formation above.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 69–70, 126, pls. 8, 9, 18. Prince Creek formation is only representative of group in Utukok-Corwin region.

Type exposures: Along Colville River from approximately the junction with Prince Creek east and north to 70th parallel. Well exposed in river cuts; on Colville River, cuts form bluffs that are nearly continuous from Umiat north to Ocean Point. Extend west to about longitude of Ikpikpuk River and east to Canning River.

Colville Quartzite[1]

Mississippian(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 68, map.

K. P. McLaughlin and Merton E. Simons, 1951, Jour. Paleontology, v. 24, no. 4, p. 515 (table 1). Mississippian(?) age determination made on basis of fossils collected in limestone occurring in Colville quartzite.

Mapped near Colville, Stevens County.

Colvin Limestone Member (of Washington Formation)[1]

Colvin Run Limestone[1] (in Washington Group)

Permian: Southwestern Pennsylvania and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 23, 39.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135, 147, 177, 485. Colvin Run limestone in Washington group described in Klondike district, Fayette County, where it is composed of light- and dark-gray massive limestone beds separated by light calcareous shales. Ranges in thickness from 0 to 12 feet; averages 5 feet. Lies 75 feet above Waynesburg coal and 20 to 25 feet below Woodglen limestone (new).

Named for exposures along Colvin Run, Greene County, Pa.

Colwood Formation[1]

Recent: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. Geology, v. 2.

San Juan Islands.

Comanche Series[1]

Lower and Upper Cretaceous: Gulf Coastal Plain.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d ser., v. 33, p. 298.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. In terms of European equivalents, Comanche series includes Gargasian, Albian, and Lower Cenomanian stages. Succeeds Coahuila series of Mexico. Includes (ascending) Trinity, Fredericksburg, and Washita groups.

Named for Comanche County, Tex.

Comanche Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 385.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Mtg., p. 72. About 300 feet thick, divided into three parts by 8 to 10 feet of hard massive sandstone associated with 10 to 15 feet of shaly friable sandstone and clay. Underlies Antelope Creek bed; overlies Wilbarker Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Comanche Creek, Mills County.

†Comanche Peak Group[1]

Lower Cretaceous (Comanche Series): Central Texas.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 583, 584.

Named for Comanche Peak, Hood County.

Comanche Peak Limestone (in Fredericksburg Group)[1]

Lower Cretaceous (Comanche Series): Eastern Texas.

Original reference: R. T. Hill, 1889, Texas Geol. Survey Bull. 4, p. xiv, xvii-xix.

W. O. George, 1952, U.S. Geol. Survey Water-Supply Paper 1138, p. 14 (table 7), 22. Described in Comal County where it is composed chiefly of hard gray-white massive limestone; beds of marl containing *Exogyra texana* Roemer present locally. Thickness 20 to 55 feet; average 40 feet. Conformably overlies Walnut clay, similarity of beds to Walnut clay make it difficult to define lower limits of Comanche Peak. Conformably overlies Edwards limestone.

F. E. Lozo and others, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, 226 p. Discussed in symposium on Edwards limestone. Hill (1891, Geol. Soc. America Bull., v. 2) emended Comanche Peak formation to exclude most of older strata (Walnut and Glen Rose) originally included in Comanche Peak group by Shumard (1860). White chalky limestone of type section is 100 feet thick and is essentially same facies represented by Goodland limestones from Tarrant County north. Comanche Peak thins to south as Edwards limestone thickens and, in Colorado Valley area, encroaches on underlying marly limestones of Walnut strata. Fredericksburg group.

Named for Comanche Peak, Hood County.

†Combahee Shale[1]

Miocene, lower and upper: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South

Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, name only, not defined; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 435, 464, 465.

Probably named for exposures on Combahee River, Colleton County.

Combe Sandstone[1]

Upper Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175, table 2. Shown on paleotectonic map as overlying Foreman formation.

Type locality: Combe Canyon, north of Mount Jura.

Combined Metals Member (of Pioche Shale)

Combined Metals Bed[1]

Lower Cambrian: Southeastern Nevada.

Original reference: L. G. Westgate and Adolph Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 54–55.

A. R. Palmer, 1958, Jour. Paleontology, v. 32, no. 1, p. 154, 155. Considered a member of Pioche shale.

Pioche district, Highland Peak and Pioche quadrangles.

Combs Limestone[1]

Upper Devonian: Northeastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1742. Listed with names not included on Devonian correlation chart.

Named for Combs Peak in vicinity of Eureka, Eureka County.

Combs Mountain Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 169, 170–171, pl. 15. Predominantly siltstone with lesser amounts of shale and limestone. Thickness 75 to 90 feet. Underlies Indian Fort shale member (new); overlies Conway Cut siltstone member (new). Included in Irvine facies (new) of Brodhead formation.

Type locality: Along secondary road leading to ridge between Floyds Branch and Carpenters Hollow; top of section 1 mile south of Webb School, 8 miles east of Berea, 2¼ miles south of Combs Mountain, Madison County. Name taken from Combs Mountain, a topographic outlier developed on a fault block in southeastern part of Madison County.

Comerio Beds[1]

Lower Cretaceous(?): Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

Comers Granite Gneiss

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 37–38, pl. 1. Equigranular to porphyritic rock which consists of pink microcline and quartz in greenish-gray matrix composed of chlorite and epidote.

Quartz usually has blue color. Injected with pink pegmatite related to Carsonville granite. May be composite rock formed by partial replacement of older rocks by Carsonville granite. Contains less mafic minerals than Carsonville granite, otherwise the two rocks are similar in mineral content.

Named from Comers Rock village in northwestern part of Independence quadrangle. Occurs in wide area in northwestern part of Elk Creek anticline, northwest of Point Lookout Mountain. Well exposed on Elk Creek and its tributaries, south and southeast of Elk Creek village, and on Turkey Fork east of Tims Knob.

Comet Shale

Middle Cambrian: Southeastern Nevada.

J. F. Mason *in* A. W. Grabau, 1936, Paleozoic formations in the light of the pulsation theory, v. 1, Lower and Middle pulsations: 2d ed., Peiping, China, University Press, Natl. Univ. Peking, p. 274–276. Predominantly shaly beds 545 feet thick. Underlies Lyndon limestone; overlies Forlorn Hope shale (new). Pioche shale of Walcott (1908), and Westgate and Knopf (1927) includes Comet shale, Forlorn Hope shale, and Pioche shale as used here.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1149, 1152–1154, 1158 (fig. 6), 1159, 1160. Thickness at type locality herein designated 370 feet. Overlies Pioche shale (restricted); underlies Lyndon limestone. Base of Comet is 4-foot zone of fossiliferous, gray oolitic limestone banded rusty brown; above this, formation consists of interbedded drab- and green-tan, micaceous, arenaceous, chunky and some fissile shale, and much arenaceous limestone, which is purer and increases in amount upward so that upper 65 feet consists largely of limestone. Derivation of name given.

Type locality: On west face of divide between Burrows Canyon and Lyndon Gulch, Highland Range. Section well exposed and undisturbed by faults. Name derived from Comet mine on west side of Highland Range.

Comet Creek Bed[1]

Lower Cretaceous: Western Oklahoma.

Original reference: R. T. Hill, 1895, Am. Jour. Sci., 3d., v: 50, p. 228.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Oklahoma Geological Survey abandoned name in its earlier sense.

Named for Comet Creek in Custer County.

Commerce Sandstone[1]

Tertiary: Southeastern Missouri.

Original reference: C. L. Drake, 1918, Missouri Bur. Geol. and Mines, v. 15, 2d ser., p. 191.

Well exposed in cuts on St. Louis and San Francisco Railroad in and just north of Commerce, Scott County.

Commercial Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 40, maps, sections.

Probably named for Commercial mine, Bingham district.

Commonwealth Ore Formation[1]

Age(?): Northern Michigan.

Original reference: C. L. Rominger, 1881, Michigan Geol. Survey, v. 4, pt. 2, p. 223.

Commonwealth mine, Menominee iron region.

†Como Beds[1]

Lower Cretaceous: Wyoming.

Original reference: W. B. Scott, 1897, Introduction to geology, p. 477, 491.

Compton Limestone[1]

Compton Formation (in Chouteau or St. Joe Group)

Compton Limestone Member (of Chouteau Formation)

Mississippian: Southwestern Missouri.

Original reference: R. C. Moore, 1928, Missouri Bur. Geology and Mines, v. 21, 2d ser., p. 60, 108–109, 111, 118–122, 131, 158.

J. G. Grohskopf, E. L. Clark, and S. Ellison, 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., App. 4, p. 9. Average thickness about 15 feet in Barry County. May rest upon Chattanooga, Sylamore, Fortune (new), or Cotter. Oldest limestone of Mississippian age known in southwestern Missouri and represents lower 10 to 15 feet of beds called St. Joe in northern Arkansas.

E. B. Branson, 1938, Missouri Univ. Studies, v. 13, no. 3, p. 10; 1944, v. 19, no. 3, p. 179 (fig. 3), 193. Compton represents lower part of Chouteau and should not be considered a separate formation. Underlies Northview member.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71, 72 (fig. 1), 73, 75 [reprinted from Kansas Geol. Soc. Guidebook 16th Field Conf.]. Chouteau is redefined as group to include (ascending) Compton, Sedalia, and Northview formations. Usage of name Compton is extended laterally to replace the "Chouteau (restricted)" of previous literature. Original type area is along James River in vicinity of now nonexistent Compton post office which stood in NW¼NW¼SE¼ sec. 9, T. 29 N., R. 19 W., Webster County. The Compton is not exposed in immediate vicinity of namesake post office site, and type section is herein redesignated. In Christian and Barry Counties, the St. Joe is raised to rank of group comprising (ascending) Compton, Northview, and Pierson formations.

Type section (Beveridge and Clark): Center SE¼SE¼S½ sec., 3, T. 29 N., R. 19 E., on northwest side of gravel road, Webster County. This section is 2 miles northeast of Compton post office site, and shows the Compton in its entirety. Named for exposures along James River in vicinity of Compton, near west line of Webster County.

Comstock Formation

Eocene: Western Oregon.

P. E. Turner, 1938, Geol. Soc. America Spec. Paper 10, p. 21–22, 23. Name proposed for approximately 1,000 feet of nonmarine sediments that occur between overpass south of Comstock and first outcrops of base of Fisher formation, and for a comparable thickness of similar continental beds stratigraphically below base of Fisher along line of its outcrop from Coyote Creek, 20 miles northwest of Comstock, to vicinity of London about 8 miles southeast. Beds consists of sandstones, tuffs, and locally

shaly silts. The Fisher is identified on basis of lithologic similarity to type occurrence west of Eugene. Relations of Comstock to formations above and below not entirely clear. At Hill 506 in Cottage Grove quadrangle, the Fisher lies with angular discordance upon the Comstock. Contact with underlying Spencer formation not directly observable. Evidence suggests that Comstock rests with angular discordance upon underlying marine Eocene and that it overlaps successively older beds along the line of its exposure from Coyote Creek to London.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Meyers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Included in redefined Spencer formation. Area discussed is in Cottage Grove, Elmira, and Eugene quadrangles.

Comus Formation

Lower and Middle Ordovician: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]; H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Interbedded chert, slate, and argillite. Chert is dark gray, green, brown, and black. Slate and argillite are dark gray, green, or black. Estimated thickness more than 2,000 feet. In thrust contact with Valmy formation (new) and unconformably overlain by Battle formation (new).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2831–2832. Comus formation was mapped in Golconda quadrangle (Ferguson, Roberts, and Muller, 1952) as in normal contact with Preble formation of Middle or Late Cambrian age. Restudy of type locality has shown that the contact is a high-angle fault. Upper Cambrian rocks that may have been present between Preble and Comus have been cut out along the fault. The chert and shale unit of northwest side of Battle Mountain, originally assigned to Comus, is now referred to upper part of Valmy formation.

Type locality: Near Comus, in Golconda quadrangle, Humboldt County.

Comyn Formation (in Marble Falls Group)

Pennsylvanian (Morrow): North-central Texas (subsurface).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 84 (fig. 5), 85. Name applied to subsurface section of Marble Falls group in Ranger area. Occurs between depths of 4,132 and 4,320 feet in type well. Underlies DeLeon Springs formation (new) of Big Saline group.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 211. Plummer (1944, Texas Univ. Bur. Econ Geology Pub. 4401) assigned name Sloan to outcropping Morrowan rocks and this name should replace Comyn.

G. L. Turner, 1957, Abilene and Fort Worth Geol. Soc. Guidebook Joint Field Trip, p. 63–64. Problem of whether the Comyn is Morrowan or late Mississippian has not been definitely resolved.

Type well: Roxana Petroleum Co. Seaman No. 1, Palo Pinto County. Name derived from town in Comanche County.

Conanicut Arkose[1]

Carboniferous: Southern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 380.

Occurs on eastern side of Mackerel Cove, Conanicut Island.

Conant Limestone Member (of Carbondale Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), pl. 1. Proposed for limestone formerly called Jamestown. Name Jamestown to be used for coal member underlying the Conant. Stratigraphically below Anvil Rock sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NW¼NE¼ sec. 34, T. 5 S., R. 4 W., Perry County. Name derived from village of Conant about 2 miles east of type outcrop.

Conasauga Shale,[1] Limestone,[1] Formation, or **Group**

Middle and Upper Cambrian: Northeastern Georgia, northern Alabama, eastern Tennessee, and southwestern Virginia.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143, 144–148.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 17–19, pl. 1. Described in Cartersville district, Georgia, as Conasauga formation. Consists largely of metashale containing unevenly distributed thin and thick beds of weakly calcareous metasiltstone. Maximum thickness 2,000 feet; top not exposed. Overlies Rome formation.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 47–53. In eastern Tennessee, the Conasauga varies in lithology and three phases are recognized: northwestern phase largely of shale, central phase of alternating shale and limestone formations, and southeastern phase principally of dolomite but including some limestone and shale. In northwestern phase, Conasauga shale includes Pumpkin Valley shale member below and Maynardville limestone member above. In central phase (between Knoxville and Morristown, and north of Clinch Mountain), Conasauga group consists of six formations (ascending): Pumpkin Valley shale, Rutledge limestone, Rogersville shale, Maryville limestone, Nolichucky shale, and Maynardville limestone. Southeast boundary of central phase is marked by disappearance of Rogersville shale and merging of Maryville and Rutledge formations, here largely dolomite, into Honaker dolomite. In southeastern phase, sequence is (ascending) Honaker dolomite, Nolichucky shale, and Maynardville limestone. To the northeast, in Virginia, the shale units thin to disappearance until the whole is carbonate rock with some shaly dolomite beds (the Elbrook dolomite). Overlies Rome formation; underlies Copper Ridge dolomite and to southeast Conococheague limestone.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 28–33. Term Conasauga shale extended into western Lee County, Va., where it is applied to beds previously called Nolichucky shale. Only upper half of Conasauga exposed; underlies Low Hollow limestone member of Maynardville limestone.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 54. Conasauga group is an interfingering complex of shale, limestone and dolomite, mainly of Middle Cambrian but partly of Late Cambrian age, of which Elbrook dolomite, Honaker dolomite, and Nolichucky shale are representatives in northeasternmost Tennessee [this report]. In this region, group is exposed in two separate areas: one to north along

southeast edge of Appalachian Valley, and the other to southwest near Elizabethton, in trough of Stony Creek syncline. In northern occurrence, the interval is all dolomite, the Elbrook; to the southwest, the Nolichucky shale is at top and underlying dolomite is Honaker.

Named for exposures in Conasauga Valley, Dalton quadrangle, northwestern Georgia.

Conasaugan Series

Middle Cambrian: Southeastern United States.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Palaeocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines: Peiping, China, Univ. Press, Natl. Univ. Peking, p. 10, 282. Both the Nolichucky and Conasauga are here referred to the Middle Cambrian and for this series, as developed in southern Appalachian geosyncline, name Conasaugan is proposed; succeds the Stonehengian.

Concentrator Volcanics

Cretaceous(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 27–32, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 22–25, pl. 3 [1947]. Andesite, keratophyre and quartz keratophyre flows, breccias, and tuffs, highly altered and of complex structure. Rocks range in color from white through buff and gray to red and brown. Flow breccias most abundant, tuffs next, and flows subordinate. Several hundred to perhaps over 3,000 feet thick. Younger than Cardigan gneiss (new); intruded by Cornelia quartz monzonite (new).

Named from conspicuous outcrops on Concentrator Mountain, southeast of Ajo, Ajo quadrangle, Pima County. Exposed in two relatively small areas, aggregating less than 2 square miles.

Concha Limestone (in Naco Group)

Concha Limestone (in Snyder Group)

Permian: Southeastern Arizona.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 1, 29–30, 42–43. In Naco group. Lower beds, for most part, are fine-grained calcareous sandstone which weathers gray; probably nowhere more than 50 feet thick. Above basal sandy beds, formation consists of gray medium-grained highly fossiliferous limestone which contains abundant irregular nodules of light-colored chert weathering pale brown. Thickness at type section 129½ feet. Overlies Scherrer formation (new); unconformably underlies Glance conglomerate of Bisbee group.

D. L. Bryant, 1955, Dissert Abs., v. 15, no. 7, p. 1224. Excluded from Naco group because it is not present in type area of original Naco. Type Concha equivalent to only basal part of an additional 1,000 feet of limestone in other localities. Concha limestone (expanded) assigned to Snyder Hill group.

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 498. Suggested that terms Chiricahua limestone and Snyder Hill formation be suppressed and term Concha limestone be used for the light-colored cherty limestones of southeast Arizona that contain Kaibab fauna and overlies Scherrer formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 41–43. Believed that Concha limestone and Chiricahua limestone are same stratigraphic unit and that terms are synonymous; term Chiricahua has priority. In this report [central Peloncillo Mountains], term Chiricahua is used for cherty limestone overlying Scherrer quartzite and considered uppermost unit of Naco group.

Type section: On east end of Concha Ridge, a conspicuous transverse spur of Scherrer Ridge in Gunnison Hills, NW¼ sec. 28, T. 15 S., R. 23 E., central Cochise County.

Conch Point Shale

Miocene, lower: Panamá.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 52, 77. Massive poorly bedded soft gray clay shale underlying Bastimentos shale which it resembles closely. On Columbus Island, surface structure is gently rounded dome on which early Miocene Conch Point shale crops out at crest, over an area of about 1 mile, surrounded by middle Miocene Bastimentos shale. Seismograph survey indicates structure is cut by fault striking N. 24° E.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 332. Miocene. If these strata are same age as early part of Uscari shale of Costa Rica, name Conch Point should be suppressed. Note on derivation of name.

Conch Point is on west side of Isla de Colón, 8 kilometers northwest of town of Bocas del Toro.

Concord Formation[1]

Oligocene: Western California.

Original reference: B. L. Clark, 1918. California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

G. C. Lutz, 1951, California Univ., Dept. Geol. Sci. Bull., v. 28, no. 13, p. 373, 374, 381. Mentioned as underlying Sobrante sandstone in southwest limb and in part of northeast limb of Bear Creek anticline. Overlies Kirker tuff. Described as fine- to medium-grained buff-colored mottled sandstone. May be several hundred feet thick.

Occurs in San Francisco Bay region.

Concord Granite[1] (in New Hampshire Plutonic Series)

Upper Devonian(?): Central and southern New Hampshire.

Original reference: C. H. Hitchcock, 1873, Rept. Geol. Survey New Hampshire 1872, p. 9, 12.

Katharine Fowler-Lunn and Louise Kingsley, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1369, 1371–1373. Assigned to New Hampshire magma series.

Katharine Fowler-Billings, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1250, 1268–1270, pl. 1. Summary discussion.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Mapped together with Bickford granite; unit designated "binary granite" on map. Included in New Hampshire plutonic series.

City of Concord is in outcrop area.

Concreto Shale[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 238, p. 20.

Named for Concreto, Allen County.

Condor Member (of Highland Peak Formation)

Condor Formation (in Ophir Group)

Condor Member (of Swasey Limestone)

Middle Cambrian: Eastern Nevada and western Utah.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 39, fig. 5. Name applied to lowermost 117 feet of type Swasey as described by Deiss (1938). Consists largely of thinly interbedded calcareous, argillaceous, and arenaceous strata. Underlies unnamed upper part of Swasey; overlies Dome limestone. This unit, although more dolomitic, was referred to as Highland Peak unit "F" in Pioche district by Wheeler and Lemmon (Nevada Univ. Bull., Geology and Mining Ser., no. 31).

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 35, 46–47, pl. 1, measured sections. In Sheeprock Mountains, rank raised to formation in Ophir group. Thickness 107 to 135 feet. Overlies Dome limestone.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 47, 51. Name Condor as used by Wheeler (1948) and Cohenour (1959) replaced by Whirlwind formation (new).

U.S. Geological Survey currently classifies the Condor as a member of Highland Peak Formation on the basis of a study now in progress.

Type section: In Panaca Hills, Pioche district, Nevada. Name derived from Condor Canyon, about 2 miles north of type section; member is exposed on north wall near mouth of canyon. Recognized in Wah Wah and House Ranges, Utah.

Cone Calcareous Member (of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2794; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 91. Chiefly highly calcareous dark-gray shale at type section. Other less abundant but easily recognized lithologies include persistent bed of large septarian concretions of dark-gray limestone at base; a widespread 4-foot-thick bed of white bentonite 12 feet above base; and several layers of thin-bedded ledge-forming clastic fossiliferous limestone at top. It is the so-called Greenhorn of Sweetgrass arch. About 54 feet thick at type section. Underlies Ferdig shale member (new); overlies Floweree member (new).

Type section: On south side of small conical hill below U.S. Geological Survey vertical angle bench mark (VABM) Cone in NW¼ sec. 13, T. 22 N., R. 1 W., Vaughn quadrangle, Teton County.

Conecuh Sands[1]

Pleistocene: Southeastern Alabama.

Original reference: E. A. Smith, L. C. Johnson, and D. W. Langdon, Jr., 1894, Alabama Geol. Survey Rept. Coastal Plain, p. 27, 56–57.

Probably named for Conecuh River.

Conejo Volcanics[1]

Miocene: Southern California.

Original reference: N. L. Taliaferro, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 800–801.

O. P. Jenkins and others, 1949, California Div. Mines Bull. 142, p. 140. Composed of basalt flows and pyroclastics with minor basalt and andesite dikes. Overlies olivine basalt which in turn overlies Topanga formation.

W. E. Kennett *in* L. E. Redwine and others, 1952, Cenozoic correlation section paralleling north and south margins, western Ventura basin, from Point Conception to Ventura and Channel Islands, California: Am. Assoc. Petroleum Geologists, Pacific Sec., sheet 2. Cited on chart as underlying Monterey formation and overlying Rincon formation on San Miguel and Santa Rosa Islands. Thickness 2,500 to 2,900 feet.

Occurs in Conejo Mountains, western end of Santa Monica Mountains.

Conejos Formation (in Potosi Volcanic Group)

Conejos Andesite (in Potosi Volcanic Series)[1]

Conejos Quartz Latite (in Potosi Volcanic Series)

Tertiary, middle or upper: Southwestern Colorado and northern New Mexico.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 38–39.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 96–102, pl. 1. Redescribed as quartz latite. Geographically extended into New Mexico where it becomes thinner and is predominantly a sand and gravel formation. Greatest thickness about 4,000 feet in basin at head of Rio Blanco in central part of Summitville quadrangle, Colorado. Thickness of 3,000 feet or more in central area and thins in all directions from central part, but, except on extreme edges of formation, is rarely less than 1,000 feet thick. Underlies Beidell quartz latite.

T. A. Steven and J. C. Ratte, 1960, U.S. Geol. Survey Prof. Paper 343, p. 10, 11–13, pl. 2. Term Conejos formation considered more appropriate than petrographic term quartz latite. In Summitville district, formation consists largely of flat-lying dark rhyolitic rocks. Underlies Fisher quartz latite. Middle or later Tertiary.

W. R. Muehlberger and others, 1960, New Mexico Geol. Soc. Guidebook 11th Ann. Field Conf., p. 100. In Brazos Peak quadrangle, New Mexico, the Conejos quartz latite underlies Toltec andesite member (new) of Treasure Mountain rhyolite.

Named for exposures along Conejos River. Most widely distributed and best exposed in Summitville, Conejos, and Del Norte quadrangles, Colorado. In general way, outcrops confined to an area about 130 miles long in north and south dimension; about 60 miles wide in northern third, and about 50 miles wide just north of Colorado-New Mexico State line.

Conemaugh Formation[1]

Conemaugh Group or Series

Pennsylvanian: Pennsylvania, western Maryland, eastern Ohio, northern Virginia, and western West Virginia.

Original reference: F. Platt, 1875, Pennsylvania 2d Geol. Survey Rept. H, p. 8.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 181–211. Conemaugh series in Ohio varies from 350 feet in southern part of Lawrence County to 518 feet at eastern edge of Jefferson County. Comprises 39 members including 12 coal beds.

W. O. Hickok, 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 77–99. Group described in Fayette County, Pa. Consists of sandstone, red and gray shale, limestone, thin coal beds, and small amounts of low-grade fire clay. Base is at top of Upper Freeport coal and top at base of Pittsburgh coal. Divided into nine parts (ascending): Mahoning, Buffalo, Saltsburg, Grafton, Barton, Morgantown, Lonaconing, Connellsville, and one which has not been named but which contains Little Pittsburgh coal.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 665, 666, chart 6. Referred to as series. Above Allegheny and below Monongahela.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 57–72, table 1. Conemaugh series, in Perry County, described on cyclothemic basis. Comprises seven cyclothems. [For sequence see Mahoning cyclothem.] About one-half the strata in the series are present in county.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 28–34. Conemaugh series described in eastern Ohio. Following limestone members are discussed (ascending): Mahoning, Cambridge, Bloomfield, Ewing, Ames, Gaysport, Elk Lick, Clarksburg, Summerfield, and Pittsburgh. Cyclothemic classification not used in this report.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 53–65. Only complete section of formation in Maryland is in Georges Creek-Upper Potomac basin where it ranges from 825 to 925 feet in thickness. Includes claystone, shale, sandstone, fresh-water limestone, red shale, marine shale, and coal beds. Lower and upper members recognized. Lower member extends from top of Upper Freeport coal to top of Barton coal, and upper member comprises strata between Barton coal and base of Pittsburgh coal.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 24–65. Entire series present in Morgan County. Strata included in series extend from Upper Freeport (No. 7) coal to base of Pittsburgh (No. 8) coal. Total thickness 365 feet. Forty-two members described (including coal members). Cyclothemic classification not used in this report.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 93-157. Series described in Athens County. Thickness about 545 feet. Fifteen cyclothems described. [For sequence see Mahoning cyclothem.]

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Formation in vicinity of Pittsburgh includes (ascending) Nadine limestone (new), Woods Run limestone, and Carnahan Run shale (new).

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 11–13. Series consists of gray and tan sandstones, red and tan shales, some limestones, clays, and several thin coal seams. Average thickness about 600 feet. Main outcrop area is irregular belt extending through central part of state from Preston to Wayne County. Underlies Monongahela series; overlies Allegheny series.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4), 71, fig. 9. Group, between 600 and 900 feet thick, differs from the Pottsville and Allegheny, in that it contains red beds and more persistent marine beds, the latter being good stratigraphic guides. Such marine beds include Brush Creek, Cambridge, and Ames limestone which grade eastward into marine shale facies. Ames limestone represents highest known occurence of marine strata in coal measures of Pennsylvania. This persistent bed is present throughout Conemaugh belts of western Pennsylvania, West Virginia, Ohio, and Kentucky. There is faunal evidence for Conemaugh equivalents in northern anthracite field of eastern Pennsylvania and Eastern Interior Coal basin of Illinois. Overlies Allegheny group; underlies Monongahela group.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Conemaugh formation consists of cyclic sequences of red and gray shales and siltstones with thin limestones and coals; massive Mahoning sandstone commonly present at base; Ames limestone present in middle of sections; Brush Creek limestone in lower part of section.

Named for exposures along Conemaugh River, Pa.

Conestoga Limestone[1]

Cambrian(?) and Lower Ordovician: Southeastern Pennsylvania.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 365–366.

A. I. Jonas and G. W. Stose, 1936, Geol. Soc. America Bull., v. 47, no. 10, p. 1671–1673. On basis of fossils collected at Henderson, Conestoga limestone in Chester Valley is of Beekmantown age (upper Canadian of Ulrich). In Norristown area, the Conestoga overlies Elbrook limestone and Ledger dolomite, and southwestward, near Coatesville, overlaps older limestones down to Antietam quartzite and Harpers phyllite. Chester Valley lies south of Mine Ridge anticline, which extends from New Providence eastward to Valley Forge. The Conestoga of type locality, in the Lancaster, York, and Hanover Valleys, lies north of Mine Ridge axis, and its southwestern end is in strike with Frederick Valley, although separated from it by an area of Triassic rocks. Without fossil evidence, it cannot be decided whether the Conestoga or area north of Mine Ridge is of Beekmantown age, as that of Chester Valley, or whether it is in part older, and of Upper Cambrian and basal Ordovician age, like the limestones of Frederick Valley. The Conestoga is not known to be faunal equivalent of Frederick limestone and cannot at present be correlated with it.

B. L. Miller, 1937, Geol. Soc. America Bull., v. 47, supplement, p. 2017–2019. Discussion of the above paper by Jonas and Stose. This author [Miller] believes Conestoga limestones are of Ordovician age, younger than Beekmantown and older than the Martinsburg and to be correlated with Jacksonburg of Lehigh Valley.

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 34–38, pl. 1. Described in Hanover-York district where it is poorly exposed and no continuous section can be measured. Unconformable on underlying formations—Kinzers formation, Ledger dolomite, Vintage dolomite, and Antietam quartzite. Lower Ordovician(?); may be in part Upper Cambrian.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation mapped as Ordovician.

Named for outcrops along Conestoga Creek south of Lancaster.

Conewago Conglomerate Member (of Gettysburg Shale)

Conewago Group[1]

Upper Triassic: South-central Pennsylvania.

Original reference: G. H. Ashley, 1931, Pennsylvania Topog. and Geol. Survey, ser. 4, Bull. G–1, p. 77.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. C–67, p. 107, 115, 118. Member of Gettysburg shale. Consists of thick lenticular zone in which are numerous beds of hard red pebbly arkosic sandstone and conglomerate. Conglomerate beds of the Conewago begin to appear southwest of Airy Hill School at western border of York County. They thicken northeastward and just beyond Harmony Grove make a ridge 400 feet higher than lowland that is crossed by York-Dillsburg Road. Hard conglomerate beds increase in number and thickness northeastward and form Conewago Mountain, a ridge attaining 1,050 feet altitude at its highest point, south and southeast of Andersontown. Conglomerates thin rapidly northeastward and finger into red shale and sandstone, and high ridge ends in two low spurs northwest of Strinetown. Maximum thickness 7,300 feet. Stratigraphically below Heidlersburg member.

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 56. Derivation of name.

Named for Conewago Hills in New Cumberland quadrangle.

Conewango Clay[1]

Pleistocene: Northwestern Pennsylvania.

Original reference: E. H. Williams, Jr., 1920, Am. Philos. Soc. Proc., v. 59, p. 62, 63.

Named for Conewango Creek, Warren County.

Conewango Formation[1]

Conewango Group, Series, or Stage

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original references: C. Butts, 1908, Pennsylvania Topog. and Geol. Survey Rept. 1906–1908, p. 191, 198; 1910, U.S. Geol. Survey Geol. Atlas, Folio 172.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Generalized succession for marine Upper Devonian of northwestern Pennsylvania (and southwestern New York) shows Conewango group comprises (ascending) Panama conglomerate, Venango and Riceville formations. Occurs above Conneaut group.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1734, chart 4. Term Conewango is herein elevated to rank of stage. Occurs above Cassadaga stage (new). Bradfordian series, Upper Devonian.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 50–67. Conewangan series includes Cattaraugus and Oswayo formations. Upper Devonian.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30–33. Group comprises (ascending) Cattaraugus, Oswayo, and Knapp formations. Underlies Arkwright group (new). Chautauquan series. Upper Devonian.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 19–20. Group comprises (ascending) Wolf Creek conglomerate, Cattaraugus shale, and Oswayo shale. Overlies Chadakoin group; underlies Lower Mississippian Knapp "formation." Approximately same as Venango group (Carll, 1880).

Named for exposures in valley walls and uplands bordering Conewango Creek, south of New York boundary.

Coney Limestone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Mercer, Monroe, and Summers Counties, p. 298, 379.

Type locality: In vicinity of Avis, just opposite Coney Island, Summers County.

Coney Shale (in Bluefield Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 298, 380.

Type locality: On east side of New River, just east of Avis and just opposite Coney Island, Summers County. Also exposed in Mercer and Monroe Counties, W. Va., and in Giles and Tazewell Counties, Va.

Confederate Limestone (in Hoxbar Group or Deese Group)

Confederate Limestone Member (of Hoxbar Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 697, chart 6 (column 37). Reallocated to Deese group and given formational status. Base of Hoxbar is drawn above the Confederate limestone, rather than just below it, as the boundary between Desmoinesian and Missourian deposits preferably should coincide with the Deese-Hoxbar contact.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2). Formation at base of Hoxbar group, Missouri series. At type locality, the Confederate comprises 30 feet of finely crystalline limestone varying from thin bedded to massive and from cream to dark tan in color; overlying 10 feet of calcareous shale with 2 feet or more of dense gray limestone at base. Crinerville beds (or member) occur 400 to 500 feet above base of Hoxbar.

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 221. In Cement Pool area, Caddo and Grady Counties, the Confederate overlies West Arm formation (new) of Deese group.

Named because it is well exposed a short distance west of Oklahoma Confederate Veterans Home, in SE¼ sec. 36, T. 4 S., R. 1 E., on southwest outskirts of Ardmore, Carter County.

†Congaree Clay Member[1] (of McBean Formation)

Eocene, upper: Eastern Georgia.

Original references: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 267; 1915, U.S. Geol. Survey Water-Supply Paper 341, p. 77, 268.

Named for Congaree, Richland County, S.C.

Congaree Formation

†Congaree Shales[1] or phase[1]

Eocene, middle: Central southern South Dakota.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published 1908 in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 16.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 21–23. Though Sloan's Congaree phase was vaguely defined, he evidently intended to include in it clay, sand, and buhrstone of early Claiborne age. Veatch and Stephenson (1911, Georgia Geol. Survey Bull. 26) accepted Congaree in this sense for use in Georgia and described Congaree clay as basal member of McBean formation, oldest formation of Claiborne age known to them there. How much of their Congaree is Claiborne is still uncertain. Cooke and Shearer (1918, U.S. Geol. Survey Prof. Paper 120–C) supposed that all their Congaree was Jackson and transferred it to Barnwell formation under name of Twiggs clay member. Later Cooke (1943, U.S. Geol. Survey Bull. 941) restored that facies consisting of thin-bedded or laminated sand and clay to McBean formation. It now appears that deposits of Claiborne and Jackson age have never been properly delimited in either Georgia or South Carolina. A large part of the deposits in Georgia mapped as Barnwell is of Claiborne age. This includes much of Twiggs clay member of Barnwell of eastern Georgia. Name Congaree is here revived and deemed of formational rank because it is equivalent to the Tallahatta formation of Mississippi and Alabama. Term formation is preferred to clay or shale because much sand as well as clay and shale are included. At designated typical exposure, formation is 21 feet thick and unconformably underlies Warley Hill marl. Overlies Black Mingo formation. Included in lower Claiborne.

Typical exposure: Section in roadcut west of Halfway Swamp one-half mile east of Creston, Calhoun County, S.C. Name derived from Congaree River.

Conglomerate Point Breccia

Pliocene: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. In a deeply eroded volcanic neck which intruded the Grotto batholith.

In Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Congo Cay Limestone Member (of Tutu Formation)

Upper Cretaceous: Virgin Islands.

T. W. Donnelley, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Thickness 100 to

300 feet. Occurs near top of formation. Virgin Island group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Conneaut Group[1] or Formation

Conneaut Stage

Upper Devonian: Northeastern Ohio, southwestern New York, and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 136.

G. H. Chadwick, 1936, New York State Mus. Bull. 307, p. 78, 96. Group includes Cotton formation (new).

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 44. Referred to as Conneaut stage of Chautauquan series.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 27–50. Group, in Wellsville quadrangle, comprises (ascending) Wellsville formation (new), Hinsdale sandstone, Whitesville formation (new), "Catskill" sedimentation, and Germania formation (new). Embraces strata between Cuba formation of Canadaway group below and Cattaraugus formation above.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 11-12. In Cherry Creek quadrangle, Chadakoin formation contains about 420 feet of siltstone and shales which lie between top of Northeast shale member of Canadaway formation and base of Panama conglomerate member of Cattaraugus formation. These strata are equivalent to Conneaut group of Caster (1934). As Chadakoin formation is here assigned to Arkwright group, term "Conneaut group" has no status.

Hugo Greiner, 1957, Yale Univ. Peabody Mus. Nat. History Bull. 11, p. 9 (table), 10, 54–55. Discussion of evolution and paleoecology of *Spirifer disjunctus* in Catskill delta. Collections were made from Conneaut stage which according to table includes Cuba standstone, Volusia (Girard) shale, Lillibridge sandstone, Dexterville shale, Hinsdale sandstone, Ellicott shale, and "Chadakoin" formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Conneaut group, as mapped, consists of alternating gray, brown, greenish, and purplish shales and siltstones; includes "pink rock" of drillers and "Chemung" and "Girard" formations of northwestern Pennsylvania.

Named for exposures on Conneaut Creek in Ohio and Pennsylvania.

†Conneaut limestone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61.

Connell Sandstone Member (of Oil Creek Formation)

Middle Ordovician: Western Texas (subsurface).

R. H. Schweers, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 12, p. 2029–2036. Medium- to coarse-grained sandstone at base of Oil Creek formation. Thickness 40 feet at type locality.

Type locality: Texas Co. W. E. Connell No. 33 in NE¼NE¼ sec. 1, Block B–22, Public School Land Survey, Jordan area, Ector County, between 8,822 and 8,862 feet.

Connellsville Member (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Topog. and Geol. Atlas 27, p. 31.

Pittsburgh area.

Connellsville Red Bed (in Conemaugh Formation)[1]

Connellsville redbed member

Pennsylvanian: Western Pennsylvania, southeastern Ohio, and northern West Virginia.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 6.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 154. Referred to as Connellsville redbed member of Little Waynesburg cyclothem in report on Athens County. At places, the interval between the Little Clarksburg and Pittsburgh coals is occupied almost entirely by redbeds. The lowermost of these is Connellsville redbed. whose position is equivalent to upper part of Connellsville sandstone. Average thickness 8 feet.

Name probably derived from Connellsville, Fayette County, Pa.

Connellsville Sandstone Member (of Conemaugh Formation)[1]

Connellsville sandstone and shale member

Upper Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1876, Pennsylvania 2d Geol. Survey Rept. L.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 60–61, geol. map. In Morgan County, Connellsville sandstone and shale member of Conemaugh series occupies interval between Clarksburg coal and Lower Pittsburgh limestone. Predominantly gray to tan, micaceous, sandy shales with beds of shaly, thin to platy bedded sandstones; rapid facies changes occur in interval so that local areas consist of erratic developments of thick sequences of sandstones separated by sandy shales. Thickness 20 to 40 feet. In most of county, base of member can be placed only approximately; top of member is indefinite because of rapid changes in character of Lower Pittsburgh interval.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 153–154. Referred to as shale and sandstone member of Lower Little Pittsburgh cyclothem in report on Athens County.

Well exposed in town of Connellsville, Fayette County, Pa. Also caps hills in Ligonier Valley, southwestern Pennsylvania.

Connelly Conglomerate

Connelly Conglomerate (in Oriskany Group)[1]

Lower Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1908, Science, new ser., v. 28, p. 346–348.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 730–732. Thickness 45½ feet at Highland Mills, N.Y. Overlies Central Valley sandstone (new); underlies Highland Mills member (new) of Esopus formation. Oriskany age. [Oriskany group not used in this report.]

Typically exposed on hill above South Rondout (Connelly post office), Rhinebeck quadrangle, Ulster County, and in creek bank opposite.

Conner facies (of Dunham Dolomite)

Lower Cambrian: Northwestern Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Named used only on correlation chart. Underlies Mallett facies of Dunham dolomite; overlies Gilman quartzite. Refers to Shaw (unpub. thesis, 1949).

Connoquenessing Formation (in Pottsville Group)

Connoquenessing Sandstone Member (of Pottsville Formation)[1]

Connoquenessing Sandstone

Lower Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 151. Columnar section, Donegal quadrangle, shows Connoquenessing sandstone, Pottsville series, underlying the Mercer and overlying Mauch Chunk.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 53, p. 43–46, geol. map. Eastward from Stark County, the Massillon (Conoquenessing) sandstone is well developed on outcrop in Ohio and western Pennsylvania. In Beaver County, Pa., it was described as Connoquenessing sandstone by White (1878) and divided into Upper and Lower Connoquenessing sandstone with Quakertown coal between. Southwest from Stark County, the Massillon is irregularly present but found close above the Quakertown coal and thus corresponds in position to the Connoquenessing sandstone of Pennsylvania.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 68–71. Formation in Pottsville group. Underlies Mercer formation. The Connoquenessing, where most complete, is about 175 feet thick and consists of two sandstones, the Upper and Lower Connoquenessing separated, by Quakertown coal and shales.

Exposed along bed of Connoquenessing Creek, Lawrence County, Pa.

Conococheague Group

Conococheague Limestone[1] (in Knox Group)

Upper Cambrian: Central southern Pennsylvania, western Maryland, Tennessee, and northwestern Virginia.

Original reference: G. W. Stose, 1908, Jour. Geology, v. 16, p. 701.

C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 5, p. 478–479, 492, 493, 496. Conococheague-Copper Ridge formation in eastern Tennessee contains Morristown below and Bloomingdale members. Overlies Maynardville limestone; underlies Chepultepec formation.

B. N. Cooper, 1936, Virginia Geol. Survey Bull. 46–L, p. 136–137, pl. 14. Referred to as formation in Marion area where it consists chiefly of thick-bedded coarsely crystalline gray cherty dolomite but contains characteristic beds of limestone, sandstone, and edgewise conglomerate. Thickness about 1,200 feet. Unconformably overlies Nolichucky formation; conformably underlies Chepultepec formation. Ozarkian.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 13–17, pls. 1, 3. Formation described in Draper Mountain area where it is about 1,500 feet thick. Overlies Elbrook formation; underlies Nittany dolomite. Cambrian. Virginia Geological Survey has discontinued use of Ozarkian as systematic term.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 86–90. In Virginia, the Conococheague limestone includes all strata between Elbrook dolomite or Nolichucky below and Chepultepec limestone above. Predominant characteristic is thick-bedded blue limestone which forms about 75 percent of formation. Thickness 2,013 feet in Washington County. Conococheague of Virginia is correlated with that of Pennsylvania and Tennessee and with Gatesburg dolomite of central Pennsylvania. Conococheague is correlated with Copper Ridge dolomite of northwestern belts of Appalachian Valley in Virginia.

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 169–190. Conococheague limestone described in West Virginia where it crops out in Berkeley and Jefferson Counties. Overlies Elbrook limestone; underlies Chepultepec-Stonehenge limestone. Thickness 1,800 to 2,000 feet.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 33–34, pl. 1. In Elkton area, Virginia, overlies Elbrook dolomite and underlies Beekmantown dolomite (including Chepultepec limestone). Thickness about 2,000 feet.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County Rept. 14, p. 45–57. Conococheague limestone described in Washington County, where it is as much as 1,913 feet thick. Includes Big Spring member (new) in lower part. Overlies Elbrook formation; underlies Beekmantown limestone.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 305–316. Discussion of Conococheague formation in Shenandoah-Cumberland Valley of Virginia, West Virginia, Maryland, and Pennsylvania. Includes Big Spring Station member (replaces term Big Spring member) in lower part in Maryland and Pennsylvania. A section of the formation, 1,650 feet thick, measured by Stose just west of village of Scotland on Conococheague Creek, 3 miles northeast of Chambersburg, Pa., became unofficially the type section, although the section is incomplete and its lower part is structurally distorted. Minor anticlinal axis passes through the village exposing lower part of Conococheague on both its flanks. Beds across axis are covered, and section cannot be traced across it at Scotland. Stose overestimated height of fold, believing that underlying Elbrook formation was exposed along it south of Scotland (1909, map). Fossils of Trempealeauian age (high in Conococheague) discovered within this supposed Elbrook inlier 1½ miles north of Stonehenge village indicate that structure is relatively small. Therefore, on west limb of this minor fold at Scotland, less of lower Conococheague is repeated than Stose believed and his estimated total thickness is too small. About 500 feet of lower Conococheague (a part of Big Spring Station member at base) is present on east flank of fold at Musser Farm, on east edge of Scotland village. These beds are not present in Stose's section. Big Spring Station section of this report is almost complete and is about 1,900 feet thick. General facies change from west to east from arenaceous dolomite (Gatesburg formation) to silt-laminated limestone (Conococheague formation) is indicated in geosyncline. Trilobites identified from Warrior, upper Elbrook, and lowest Conococheague formations,

indicate Dresbachian age for these beds. Trilobites of Franconian age from middle Gatesburg and lower Conococheague show more complex relationships. Trempealeauian trilobites are identified from upper Conococheague.

G. W. Stose, 1953, Geology of the Carlisle quadrangle, Pennsylvania: U.S. Geol. Survey Geol. Quad. Map [GQ–28]. Conococheague limestone crops out in irregular belt that extends entirely across north-central part of quadrangle, bordering the belt of Elbrook limestone on north. Distinctive feature of Conococheague is occurrence of Cryptozoon beds, made up of rather pure blue limestone, up to 4 or 6 inches thick, showing concentric layers, convex upward. Partial section exposed at Bonnybrook about 784 feet. Map legend gives thickness about 2,000 feet. Underlies Beekmantown limestone; overlies Elbrook limestone. Upper Cambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 61–63, pls. As mapped in southeastern Tennessee, about 1,100 feet or more thick. Included in Knox group. Underlies Jonesboro limestone; overlies Maynardville limestone. Corresponds roughly to Copper Ridge dolomite to northwest.

Josiah Bridge, 1956. U.S. Geol. Survey Prof. Paper 277, p. 33. Oder's (1934) Morristown seems to correspond to entire Copper Ridge as herein delimited, and his Bloomingdale is now thought to belong to lower part of Chepultepec dolomite as now recognized. Limestone facies of the Copper Ridge is commonly known as the Conococheague limestone, which name has been extended from Pennsylvania into Virginia and Tennessee.

W. J. Sando, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 838 (fig. 2), 839. Formation, in vicinity of Chambersburg, Pa., stratigraphically restricted at top to exclude beds previously referred to as "upper member of Conococheague;" these beds are herein named Stoufferstown member of Stonehenge.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. In Richland and adjacent quadrangles, formation is subdivided into (ascending) Buffalo Springs, Snitz Creek, Schaefferstown, Millbach, and Richland members (all new). Underlies Stonehenge formation of Beekmantown group. Base of Cambrian not exposed in Richland quadrangle.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–151. Formation divided into five members (ascending): Buffalo Springs, Snitz Creek, Schaefferstown, Millbach, and Richland. Not certain that all of these members belong with Conococheague as defined by Stose (1908). At Cornwall iron mines, south of Lebanon, the Conococheague contains two units known locally as Mill Hill slate and Blue conglomerate.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Conococheague group. Includes Buffalo Springs, Snitz Creek, Schaefferstown, Millbach, and Richland formations.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 55–56, 126, pl. 1. Included in Knox group. Thickness in Denton Valley, Va., 2,200 feet. Underlies Jonesboro limestone; overlies Conasauga group. Mapped in northeastern Tennessee.

Named for Conococheague Creek in Scotland, Franklin County, Pa.

Conover Slate[1]

Precambrian (upper Huronian): Northeastern Wisconsin.

Original reference: R. C. Allen and L. P. Barrett, 1915, Michigan Geol. and Biol. Suvey Pub. 18, geol. ser. 15, p. 123–129.

Conover district, Vilas County.

Conowingo Breccia

Age not stated: Northeastern Maryland.

O. P. Bricker and others, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., p. 8, 11. Mentioned in road log (stop 2). Occurs at contact zone with Port Deposit granodiorite.

Occurs near Conowingo Dam on Susquehanna River, Cecil County, Md.

Conquista Clay Member (of McElroy Formation)

Eocene: South-central Texas.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2626 (table 1), 2631. Substituted for preempted Falls City shales (Ellisor, 1933). At type locality, consists of about 70 feet of pale-yellowish-brown to chocolate bentonitic clay. Overlies Dilworth sandstone member; underlies Stones Switch sandstone member of Whitsett formation.

Type locality: Bluff adjoining historic Conquista Crossing on San Antonio River 3¾ miles southwest of Falls City, Karnes County. This is same type locality as Falls City shales.

Conshohocken Clay[1]

Ordovician(?), or Cretaceous(?): Southeastern Pennsylvania.

Original references: T. C. Hopkins, 1899, Am. Geologist, v. 23, p. 102; 1899, Science, new ser., v. 9, p. 139; 1900, Geol. Soc. America Bull., v. 10, p. 480–482; 1900, Pennsylvania State Coll. Ann. Rept. 1899–1900.

Occurs on hill north of Conshohocken, Montgomery County.

Contadero Formation

Upper Devonian: Central southern New Mexico.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 94–95. Series of carbonaceous shales and limestones. Basal gray limestone beds conformably overlie Sly Gap formation, and gray calcareous shales comprising top beds of formation unconformably underlie Caballero formation. Possibly a different facies of Ready Pay member (new) of Percha shale.

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 239–241, fig. 2. Thickness at type section 66½ feet. Type section location further described. In a north-south cross section, formation roughly resembles shape of shallow bowl. Upper Devonian.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 35 (fig. 16), 53, 55 (fig. 25). Underlies Alamogordo formation and Andrecito member (new) of Lake Valley formation in parts of San Andres Mountains.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 30–31. Type Contadero formation revised to exclude upper beds containing Percha fauna and to include at base barren silty shales that locally exhibit sharp contact with underlying Sly Gap formation.

At Rhodes Canyon, 45 feet of section measured. Formation thins to the north and south, pinching out north of Sly Gap and south of Dead Man Canyon.

Type section: In S½ sec. 8, T. 13 S., R. 4 E., on north slope of Rhodes Canyon, near an abandoned mining claim. Noted only in central part of San Andres Mountains.

Contention Series[1]

Lower Cretaceous(?): Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

Tombstone district. Derivation of name not stated.

Continental Peak Formation

Eocene, upper(?): West-central Wyoming.

R. L. Nace, 1939, Wyoming Geol. Survey Bull. 27, p. 11 (chart), 21–25, pl. 1. Reddish-brown, gray, and green fine- to medium-grained thin- to thick-bedded and massive, blocky, and crossbedded tuff and tuffaceous sandstone. Thickness 145 to 250 feet. Disconformably overlies Bridger formation; disconformably underlies Beaver Divide conglomerate member (new) of Chadron formation.

Type section: West side of Continental Peak near center sec. 35, T. 27 N., R. 101 W., Fremont County.

Contra Costa Group

Miocene, upper, to Pliocene, middle: Northern California.

C. R. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 6 (fig. 3), 14–15. Lawson (1914) mapped and described continental deposits within Las Trampas Ridge area as Orinda formation. Lawson and Palache (1902) designated lower Pliocene silt, sandstone, and conglomerate in Berkeley Hills as type Orinda. Subsequent work to the east by D. E. Savage and others (unpub. rept.) [1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2] has shown need for revision of terminology. They suggest term Contra Costa group to include five formations, the Orinda being at base. Within Las Trampas Ridge area only two of the five formations, Orinda and Mulholland, are recognized, the Grizzly Peak, Siesta, and Bald Peak formations being absent. Overlies San Pablo group.

Type locality not stated.

Contra Costa Lake Bed[1]

Pliocene: Western California.

Original reference: J. G. Cooper, 1894, California Acad. Sci. Proc., 2d ser., v. 4, p. 169.

Exposed on northeast slope of hills west of San Pablo Creek, forming body between Contra Costa and Alameda Counties in that part of its course about 4½ miles northeast of State University, San Francisco Bay region.

Converse Formation (in Wilcox Group)

Paleocene, middle: West-central Louisiana.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 55–58. Consists of fine- to medium-grained sand which can be either massive, thin, or crossbedded. Contains lenses of clay or silt sufficiently calcareous locally to produce caliche. Thickness at least 155 feet in vicinity of Converse (100 feet plus in water wells and at least 55 feet along State Highway 174); traced in subsurface as far as Negreet, where it attains

thickness of 232 feet. Overlies Cow Bayou formation; underlies Lime Hill formation.

H. V. Andersen, ed., 1960, Type localities project unit 1: Baton Rouge, La., Soc. Econ Paleontologists and Mineralogists, Gulf Coast Sec., p. [14–15]. Middle Paleocene.

Type locality: Series of outcrops along State Highway 174 starting at city limits of Converse, 0.55 mile west of K.C.S. Railroad crossing and extending westward for a distance of 1.7 miles. This includes three major outcrops in secs. 8 and 9, T. 9 N., R. 13 W., Sabine Parish.

Conway Formation

Conway Schist[1]

Ordovician and Silurian(?): Western Massachusetts, southwestern New Hampshire, and southeastern Vermont.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, Mon. 29, p. 183–225.

M. E. Willard, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–85. Redefined as a formation containing four lithologic members, in order of decreasing age: schist-quartzite, schist-marble, amphibolite, and phyllite members. Detailed lithologic descriptions. Ordovician and Silurian(?).

Named for development along the rivers in Conway and Deerfield, Franklin County, Mass.

Conway Granite[1] (in White Mountain Plutonic-Volcanic Series)

Mississippian(?): Northern and central New Hampshire.

Original references: C. H. Hitchcock, 1874, The geology of New Hampshire, pt. 1, p. 508–545; 1877, pt. 2, p. 142–143.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Belongs to White Mountain plutonic-volcanic series of Mississippian(?) age.

Named for town of Conway, Carroll County.

Conway Cut Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 169–170, pl. 15. Massive siltstone 75 feet thick. Basal member of Brodhead formation, Irvine facies (new). Underlies Combs Mountain siltstone member (new); overlies New Providence formation, Boone Gap facies (new).

Name derived from Conway Cut of Louisville and Nashville Railroad, just south of Conway, northern Rockcastle County. Unit is well exposed at Boone Gap on Rockcastle-Madison County line, where it forms the cliff rock and hillside above cut for U.S. Highway 25.

Cooda Sandstone

See Coody Sandstone.

Coody Sandstone Member (of Atoka Formation)[1]

Middle Pennsylvanian: Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 27–28. Basal member of Atoka formation. Thickness 15 to 115

feet. Separated from overlying Pope Chapel sandstone member by unnamed shale 35 to 72 feet thick. Unconformable with underlying Morrow group.

Named for exposures along Coody (Coata) Creek in secs. 34 and 35, T. 15 N., R. 19 E., Muskogee County.

Cooke Grainite[1]

Precambrian: Central southern Montana.

Original reference: T. S. Lovering, 1930, U.S. Geol. Survey Bull. 811–A, p. 17.

W. H. Parsons and E. L. Bryden, 1952, Michigan Acad. Sci., Arts and Letters, Papers, v. 37, p. 253. Cited as Cooke City granite, a pinkish rock with no gneissic structure.

Well exposed near Cooke in southeastern corner of Park County.

Cooke City Granite

See **Cooke Granite.**

Cook Inlet Gravels[1]

Pleistocene: Central southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 174–175.

Extends from Cook Inlet along drainage basin of Skwentna River as far as Tordrillo Mountain, Cook Inlet region.

Cook Mountain Formation (in Claiborne Group)[1]

Eocene, middle: Southern and eastern Texas, northwestern Louisiana, and eastern Mississippi.

Original reference: W. Kennedy, 1892, Texas Geol. Survey 3d Ann. Rept., p. 54–57.

J. Huner, Jr., 1939, Louisiana Geol. Survey Bull. 15, p. 84–110. In Caldwell and Winn Parishes, La., divided into (ascending) Dodson (new), Milams, Saline Bayou, and Little Natches (new) members. Thickness 99 to 185 feet. Overlies Sparta sand; underlies Cockfield formation.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1663–1675. Cook Mountain formation replaces term Crockett formation. Name Cook Mountain believed to be preferable because of more extensive usage in Texas and Louisiana. Wheelock marl, Landrum shale, Spiller sand, and Mount Tabor shale, previously defined as members of Crockett, are here reallocated to Cook Mountain formation.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 261–263. In south Texas, divided into (ascending) Garceno sandstone, Veleno, and Falcon sandstone members (all new). Thickness 1,700 feet. Overlies Mount Selman formation; underlies La Perla shale member (new) of Yegua formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. As mapped, overlies Sparta sand and underlies Cockfield formation.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows that Cook Mountain in Mississippi includes (ascending) Archusa marl, Potterchitto sand, and Gordon Creek shale members. Overlies Sparta sand; underlies Cockfield formation. Mississippi

Geological Survey uses Wautubbee formation instead of Cook Mountain and Kosciusko sand instead of Sparta sand.

Named for Cook Mountain, Houston County, Tex.

Cook Ranch Formation[1]

Oligocene, middle: Southwestern Montana.

Original reference: A. E. Wood, 1933, Jour. Mammalogy, v. 14, no. 2, p. 134–135.

Jean Hough, 1955, Jour. Paleontology, v. 29, no. 1, p. 26–28. Cook Ranch formation of Wood is included in Sage Creek formation as redefined in this paper.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 373, 374, pl. 1. Rhyolitic lava flows and volcanic tuff and breccia associated with Cook Ranch formation are here named Cook Ranch rhyolites and Cook Ranch volcanics, respectively.

First described from locality near Cook Sheep Co., Home Ranch, 8.1 miles north and east of Dell Railroad station, T. 12 S., R. 33 E., secs. 27 and 34, Beaverhead County.

Cook Ranch Rhyolites

Oligocene, middle: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 373, pl. 1. Pink and buff rhyolitic lava flows that are intercalated between pyroclastic deposits that have been correlated with the Cook Ranch formation.

Exposed on the southwest side of the Blacktail Range, Beaverhead County.

Cook Ranch Volcanics

Oligocene, middle: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 374, pl. 1. Named for beds of volcanic tuff and white acidic volcanic breccia associated with sediments of Cook Ranch formation. Some volcanic ash present at type locality. Northward, the ash content increases, and the formation grades into interbedded tuffs, volcanic breccias, and agglomerates at the foot, on the slopes, and near the crest of the Blacktail Range.

Type locality: At south end of Red Rock Mountains. [The compiler notes that the unit is not mapped at the south end of Red Rock Mountains but that it is mapped around the southern end of the Blacktail Range]. These rocks probably once covered entire southeastern end of the Blacktail Range, Beaverhead County.

Cooks Canyon Agglomerate[1]

Upper Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Type locality: Ridge between Cooks Canyon and Lights Creek, Mount Jura.

Cooks Peak Granodiorite Porphyry

Tertiary: Southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, pl. 1. Name appears on explanation of map.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38

p. 39. Described as porphyritic andesine and green hornblende partly altered to biotite and chlorite. Groundmass consists of andesine, quartz, orthoclase, and magnetite. Younger than Colorado shale and older than Rubio Peak volcanic rocks.

Mapped on flanks of Cooks Peak, Cooks Range, Lake Valley quadrangle.

Cool Creek Formation[1] (in Arbuckle Group)

Lower Ordovician: Southern Oklahoma.

Original reference: E. O. Ulrich, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 105.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56. Included in Arbuckle group. Occurs above Wolf Creek dolomite and below Alden limestone.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 25, measured sections; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1319–1320, table 1. Consists primarily of thin beds of limestone, some of which are shaly and sandy. Thickness 1,513 to 1,687 feet in Arbuckles; 1,015 feet in Wichitas. Underlies Kindblade formation (new). Overlies Strange formation (new) or where Strange is absent, the McKenzie Hill. Type locality and derivation of name given.

Type section: Sec. 18, T. 2 S., R. 2 E., along U.S. Highway 77 about 4 miles north of Springer. Named for Cool Creek, headwaters of which flow across the formation about 6 miles north of Springer, Carter County.

Cooledge Chalk[1]

Upper Cretaceous: Eastern Texas.

Original reference: J. A. Waters and W. A. Reiter, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, p. 322–323.

Well exposed 3 miles northwest of Cooledge, on main road to Hubbard, Limestone County.

Coombs Limestone Member (of Islesboro Formation)[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 2–3.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in area of Rockland quadrangle, Knox County, is (ascending) Islesboro formation containing Coombs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, a siliceous limestone member above the quartzite, and Rockport limestone member at top.

Named for exposures near Coombs Point, on northeastern shore of Islesboro, Waldo County.

Coon Creek Tongue (of Ripley Formation)[1]

Upper Cretaceous: Western Tennessee and northern Mississippi.

Original reference: B. Wade, 1917, Johns Hopkins Univ. Circ., new ser., Whole No. 293, p. 74, 101.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Correlation chart shows Coon Creek tongue as occurring in Tennessee and Mississippi.

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 13–15. Wade (1917) recognized two divisions of Ripley formation below McNairy

sand member in southern Tennessee: "Ferruginous clay horizon" immediately below the NcNairy and a "Coon Creek horizon" immediately above the Selma chalk. Wade (1926 U.S. Geol. Survey Prof. Paper 137) lumped these two horizons into Coon Creek tongue. Wade stated that Coon Creek tongue thinned northward but was recognizable at Kentucky line and that the ferruginous clay merged north into the McNairy. Whitlach (1940, Tennessee Div. Geology Bull. 49) misinterpreted this statement and assumed Wade to mean the whole of the Coon Creek was lost northward. The ferruginous clay appears to be merely a transition zone between typical Coon Creek tongue and McNairy sand member and, as treated in this report, is included in McNairy sand from which it becomes indistinguishable both to the north and to the south. At type locality Coon Creek tongue is typified by massive dark- to bluish-gray micaceous glauconitic calcareous fossiliferous silty sand beds which some authors have called "marls." Lower part of unit is gradational into transitional clay in lower part of Ripley and thin interbeds of sand and sandy clay are common. At top of tongue, generally unfossiliferous noncalcareous thin-bedded sand is common. Coon Creek varies in age along outcrop belt; at type locality, sand contains *Exogyra cancellata* Stephenson; in Mississippi, a few miles south of State line, member lies entirely above that zone. Sand of Coon Creek grades upward through thinner bedded lighter colored sand and clay beds into McNairy sand member. Thickness as much as 60 feet.

Named for exposures along Coon Creek, McNairy County, Tenn.

Coonewah Bed (in Annona Chalk)

Upper Cretaceous: Northern Mississippi.

F. F. Mellen, 1958, Mississippi Geol. Survey Bull. 85, p. 29-40. Name applied to a 2-foot bed of relatively pure chalk near top of the Annona.

Type locality: West valley wall of Coonewah Creek approximately at the SE cor. SW¼ sec. 22, T. 10 S., R. 5 E., Lee County, 2½ miles west of Verona.

Cooney Quartz Latite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures in canyon of Mineral Creek near old mining camp of Cooney, Mogollon district.

Coon Mountain Sandstone Member (of Pueblo Formation)[1]

Coon Mountain Sandstone Member (of Stockwether Formation)

Permian (Wolfcamp Series): Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 417.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to Stockwether, which is here given formational status in Pueblo group (redefined) and assigned to the Permian.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 75, 76. Member of Pueblo formation in report on Brown and Coleman Counties where it is placed above Camp Creek shale member and below Stockwether limestone member. In northern Brown County, extensive channel erosion has removed Saddle Creek limestone member in many places, especially over wide area on Coon Mountain. In places, channel erosion has cut

down to within about 50 feet of Chaffin limestone member of Thrifty formation. The sandstone and conglomerate deposited in these channels was called Coon Mountain bed by Drake (1893). Plummer and Moore (1921, Texas Univ. Bull. 2132) considered it of Cretaceous age. As the unit was not extensively exposed in area mapped by Moore (1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80), he did not use the name. Exact relations of Coon Mountain sandstone member to beds surrounding it are only partially known. The thick body may be a complex of two or more channels, the later one or ones superposed on the earlier in the outcrop area. The member is tentatively placed in the section where Drake placed it until future detailed work explains its relations more exactly.

Named for Coon Mountain, Brown County.

Cooper Limestone[1]

Middle Devonian: Central and northeastern Missouri.

Original reference: G. C. Swallow, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 1, p. 108, 196.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 136–138. Thickness as much as 30 feet, rarely more than 20; average less than 15. Formation not continuous but represents erosional remnants. Unconformable on Jefferson City over most of its extent in central Missouri, though locally rests on St. Peter sandstone; in northeastern Missouri, unconformable on Kimmswick and Maquoketa and locally unconformable below Ashland formation; unconformably underlies Callaway limestone in Boone and Cooper Counties but westward it is unconformable below Bushberg sandstone.

Named for exposures in Cooper County.

Cooper Marl[1]

Oligocene: Eastern South Carolina and eastern Georgia.

Original reference: M. Tuomey, 1848, South Carolina Agr. Survey 1st Rept., p. 162–169, 190, 211.

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 40 (chart), 74–76. Geographically extended into Georgia where thickness is about 33 feet. Thickness in South Carolina 76 feet. Unconformably underlies Flint River formation; overlies Ocala formation with apparent conformity; contact with Barnwell formation not observed, but presumably is younger than Sandersville member (new) and perhaps conformable with it.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Shown on correlation chart in upper part of Jackson group in Georgia. Eocene.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 27–28. Cooper marl, currently referred to late Eocene (Jackson), is reassigned to early Oligocene(?) on basis of its mollusks, foraminifers, and cetaceans. In some areas, unconformably overlies Castle Hayne limestone.

L. N. Smith and H. S. Johnson, 1958, Carolina Geol. Soc. Guidebook, p. [5]. Shown on correlation chart as Eocene (Jackson).

H. E. Malde, 1959, U.S. Geol. Survey Bull. 1079, p. 7–26, pl. 1. Cooper marl, oldest exposed formation in Charleston phosphate area, South

Carolina, is a soft, very fine grained, impure carbonate deposit. Dips southward from 8 to 14 feet per mile and overlies beds of Eocene age upturned on the north. Thickness 200 feet near Charleston; thins and pinches out 20 miles north; thickens southwestward to at least 280 feet. Unconformably underlies Ladson formation (new); in other areas, underlies Duplin marl, unnamed lower Miocene(?) sandy limestone, or Hawthorn(?) formation. Paleontologic evidence indicates that Cooper marl is of Oligocene age, basal beds exposed inland at Harleyville being early Oligocene and higher beds nearer the coast late Oligocene.

Named for exposures along Cooper River, S.C.

Cooper Creek Limestone (in Henrietta Group)

Cooper Creek Limestone (in Marmaton Group)

Pennsylvanian (Des Moines Series): Iowa and northern Missouri.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 27 (fig. 2), 62, 65, 69. Proposed for Bain's (1896, Iowa Geol. Survey, v. 5) "Floating rock." Consists of light-gray fragmental nodular limestone admixed with green clay; algal. Separated from underlying Worland limestone and overlying Exline limestone (new) by intervals containing clay and shale. Thickness 2 to 4 feet in Appanoose County, Iowa. Not well developed in Putnam County, Mo., and, if present, represented only by nodular limestone. Included in Henrietta group.

W. B. Howe, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 9, p. 14. Sni Mills limestone is correlated with Cooper Creek limestone of southern Iowa on basis of lithologic similarity and position in stratigraphic succession. Cooper Creek (in Marmaton group) has been correlated with Lonsdale limestone of western Illinois. These correlations extend recognition of upper member of Lenapah (Sni Mills limestone) into Iowa and probably Illinois. Name Sni Mills has priority over Cooper Creek, and name Cooper Creek should be suppressed.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30, fig. 5. Lenapah limestone is represented in Iowa by Cooper Creek limestone (Sni Mills in Missouri). Thickness 3 to 5 feet, Madison County; 7 feet, Appanoose County.

Named for occurrence along tributary ravines of Cooper Creek, in pastures in vicinity of Centerville, Appanoose County, Iowa.

Cooper Peak Dolomite

Lower Devonian: Northeastern Nevada.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 35–36, pl. 1. Name applied to dolomite in Cooper Peak structural unit in Roberts Mountains. Similar to dolomites of Lone Mountain formation. At Cooper Peak, light-gray dolomites are thrust over lower Nevada formation along Cooper Peak thrust. No fossils found at Cooper Peak, but 2½ miles west in same ridge a well-preserved fauna indicates Lower Devonian age, not far from Oriskany stage, but possibly as old as Helderberg.

Roberts Mountains, Eureka County.

Coopers Lake Limestone Member[1] (of Jefferson Limestone)

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 43.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4 (facing p. 1788). Correlation chart shows age as Upper Devonian.

Type locality: On southeast slope of southwestern peak of White Ridge, in SW¼ sec. 16, T. 22 N., R. 11 W. Named for the fact that it forms a large part of Jefferson limestone over northeastern part of Coopers Lake quadrangle, especially in Powell County.

Coos Conglomerate[1]

Coos Conglomerate Lentil (in Empire Formation)

Pliocene, lower: Southwestern Oregon.

Original reference: W. H. Dall, 1897, U.S. Geol. Survey 18th Rept., pt. 2, p. 336–343.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, chart 11. Coos conglomerate considered a lens in Empire formation.

Exposed at Fossil Point, Coos Bay region, Coos County.

Coos Group[1] or Quartzite[1]

Paleozoic(?): Northern New Hampshire.

Original reference: C. H. Hitchcock, 1870, 2d Ann. Rept. Geol. and Min. New Hampshire, p. 34, map.

Extends over large part of Coos County and southwestward across western part of New Hampshire to Massachusetts line.

†Coosa Shale[1]

Middle and Upper Cambrian: Western Georgia and eastern Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 148, map, structure sec. facing p. 162.

Named for Coosa Valley, between Rome, Ga., and Gadsden, Ala.

†Coosa Valley[1] (Shales and Sandstones)

Lower, Middle, and Upper Cambrian: Eastern Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, geog. map of Alabama.

Named for Coosa Valley.

Copake Limestone[1]

Lower Ordovician: Southeastern New York.

Original reference: J. D. Dana, 1879, Am. Jour. Sci., 3d, v. 1, p. 376–383.

J. D. Weaver, 1957, Geol. Soc. America Bull., v. 68, no. 6, p. 734–736, pl. 1. Described in area of type section. Owing to structural complexity and to absence of diagnostic fossils, accurate stratigraphic definition of term is difficult, but Copake limestone may be defined as series of dolomitic limestones with about 90 feet of irregularly crossbedded sandy dolomites at its base and containing worm borings and a planispiral gastropod resembling *Ophileta*. Thickness at type section 212 feet; top not exposed. Younger than Pine Plains formation.

Type section: On southern end of Tom Hill, northeast of Copake, Columbia County. Upper part of section is well exposed in small quarry near junction of Route 22 and road leading to town; base of section is in a series of small cliffs about 500 feet west of main quarry.

†Copan Formation[1]

Pennsylvanian: Northeastern and central Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 29.

Named for Copan, Washington County.

Copco Basalts

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 48. Name applied to basalts erupted in vicinity of present Copco Lake. Basalts are characterized by abundant clusters of large olivine and plagioclase crystals. Otherwise essentially similar to Plutos Cave, Butte Creek, and Butte Valley basalts (all new).

Copco Lake is in northwestern part of Macdoel quadrangle, Siskiyou County.

Copeland Formation

Age not stated: Eastern Maine.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Whitish gray muscovite quartz schist with interbedded quartzite; locally may contain minor biotite and chlorite. Name credited to J. M. Trefethen (1950, Preliminary map of Bucksport area, Maine: Maine Univ.). [Compiler was unable to locate this reference.]

Report covers parts of Hancock and Penobscot Counties.

Copenhagen Formation

Middle Ordovician: Northeastern Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 28. Overlies Antelope Valley limestone (new) in Antelope Valley, Nev. Name credited to C. W. Merriam (unpub. ms.).

G. W. Webb, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2339–2340. Underlies Eureka quartzite. Thickness about 600 feet; no completely exposed section found. Localities and fossils noted.

Probably named for occurrence in Copenhagen Canyon, in Monitor Range, Eureka County. Well exposed on west face of Antelope Range, across valley and on the east, and about seven-eights of a mile south of Eureka County line.

Coplay Limestone[1]

Lower and Middle Ordovician: Southeastern Pennsylvania.

Original reference: E. T. Wherry, 1909, Science, new ser., v. 30, p. 416.

Bradford Willard, 1958, Pennsylvania Acad. Sci., v. 32, p. 177, 179–182. Proposed to reinstate Coplay formation for Lower and lower Middle Ordovician beds between Upper Cambrian Allentown and Middle Ordovician Jacksonburg formations. Name Beekmantown, as applied to these beds, is inappropriate because of lack of correlation with type Beekmantown and because of presence of post-Beekmantown fossils. Coplay is a high-magnesium carbonate rock; colors vary through blue, medium to light gray, rarely dark gray, black or pinkish; beds range from dense through arenaceous; many strata are crystalline or marbloid; commonly massive bedded. No known section is complete; at type locality, calculated thickness about 1,500 feet.

Type locality: Along west bank of Lehigh River in vicinity of towns of Coplay and West Catasauqua, Lehigh County. Formation crosses central Northampton and Lehigh Counties in broad east-west belt which

separates underlying Allentown (south) from overlying Jacksonburg (north).

Copley Greenstone

Copley Meta-Andesite[1]

Copley Metavolcanics

Devonian(?): Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. R. Kinkel, Jr., and J. P. Albers, 1951, California Div. Mines Spec. Rept. 14, p. 4. Named Copley meta-andesite by Diller (1906) unit is renamed Copley greenstone because it is a greenish metamorphosed rock in which primary ferromagnesian minerals have been altered to chlorite and epidote.

A. R. Kinkel, Jr., W. E. Hall, and J. P. Albers, 1956, U.S. Geol. Survey Prof. Paper 285, p. 1, 9–17, pl. 1. Composed of volcanic flows, volcanic breccia, and tuff of intermediate and basic composition, and a few beds of shale and rhyolitic tuff; lower part of formation contains massive flows, and upper part contains much pillow lava and pyroclastic material. Thickness at least 3,700 feet; base not exposed in mapped area (Shasta County). Conformably underlies Balaklala and in some areas interfingers with it.

I. E. Klein, 1960, Sacramento Geol. Soc. [Guidebook] Field Trip June 3, 4, and 5, p. 11. Intruded by Mule Mountain granite (new).

Named for occurrence in vicinity of Copley, Redding quadrangle.

Copperas Creek Sandstone Member (of Carbondale Formation)

Copperas Creek Sandstone (in McLeansboro Group)

Copperas Creek Shale and Sandstone (in McLeansboro Formation)[1]

Pennsylvanian: Western and central Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 112, 114, 194. Savage applied name Copperas Creek to shale and overlying sandstone; Copperas Creek is herein restricted to the sandstone unit, and name Sheffield applied to the shale. The sandstone is light olive green to brownish gray; commonly has brown limonitic specks, is massive and locally, crossbedded; and has channel and nonchannel phases. Thickness 3 to 27 feet; it is thickest where it cuts out Sheffield shale, Brereton limestone, and dark shale and rests directly on Herrin (No. 6) coal. Included in Sparland cyclothem, near base. McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), 65, pl. 1. Reallocated to member status in Carbondale formation (redefined). Stratigraphically below Danville (No. 7) coal member and above Pokeberry limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Along Copperas Creek, Glasford quadrangle, Fulton County.

Copper Belle Monzonite Porphyry

Triassic or Jurassic: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 60–63, pl. 5. Hand specimens of the monozonite porphyry differ greatly owing to diversity of metamorphism. Ranges from light gray through buff to dark greenish gray, or even uniform pink; texture, however, remains remarkably constant in all varieties, being characterized by conspicuous phenocrysts of feldspar (1 to 10 millimeters in length). Groundmass everywhere clearly crystalline but aphanitic. Most exposed bedrock contacts are with Escabrosa limestone. All exposed contacts in Gleeson district are faults.

Named for exposures on and near the Copper Belle claim, on west slope of Gleeson Ridge in Gleeson district, central Cochise County. Outcrops form nearly complete elliptical ring on lower slopes of Gleeson Ridge. Smaller outcrops in alluvial areas to east and northeast, and considerable body exposed in Courtland district near and east of abandoned post office. Other smaller bodies exposed in the county.

Copper City Flow (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Persistent lava flow of exceptional thickness, about 500 feet. Overlies St. Louis conglomerate.

J. C. Wright and H. R. Cornwall, 1954, Bedrock geology of the Bruneau Creek quadrangle, Michigan: U.S. Geol. Survey Geol. Quad. Map [GQ–35]. Ophitic basalt flow with numerous pegmatitic layers in the upper half in Bruneau Creek quadrangle.

Mapped in vicinity of Copper City, Ahmeek quadrangle, Houghton County.

Cooper Creek Beds[1]

Precambrian (upper Keweenawan): Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 42, 43, 44, 67.

Named for exposures on Copper Creek, Douglas County.

Copper Creek Member (of Muldoon Formation)

Lower Mississippian: Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Basal member of formation consisting of clastics. Thickness 860 feet. Underlies Garfield member (new); overlies Milligen formation.

Deposited in Muldoon trough, aligned N. 30° W.

Copper Harbor Conglomerate

Copper Harbor Group[1]

Precambrian (upper Keweenawan): Northwestern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 690.

W. S. White, 1952, Jour. Sed. Petrology, v. 22, no. 4, p. 190. Conglomerate about 4,000 feet thick; contains a few lava flows. Overlies newly defined Portage Lake lava series; underlies younger shales and sandstones of the Keweenawan series.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27 [1954]. Red to brown boulder conglomerate with subordinate amounts of pebble conglomerate and beds of coarse arkosic sandstone; most of the detrital material is rhyolitic in composition; three units of mafic flows distinguished. Underlies Nonesuch shale. Designated as upper Keweenawan.

Named for exposures around Copper Harbor, Keweenaw County.

Copperhill Formation (in Great Smoky Group)

Precambrian: Southeastern Tennessee, central northern Georgia, and southwestern North Carolina.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 9–21, pl. 1, map. Consists of massive beds of metagraywacke or biotite gneiss, mica schist, metaconglomerate, micaceous quartzite, metaarkose, and occasional dark slates: includes epidote-amphibolite sill. Estimated thickness 2,000 to 5,000 feet; base not exposed. Underlies Hughes Gap formation (new), transition zone a few hundred feet thick.

Named after town of Copperhill, Polk County, Tenn., in vicinity of which formation is well exposed.

Copper Mountain Greenstone or Amphibolite Schist[1]

Age(?): Southeastern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 414–415.

Copper Mountain, Prince William Sound region.

†Copper Mountain Porphyry[1]

Eocene: Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Geol. Atlas, Spec. Folio 48.

On Copper Mountain, Tenmile district.

Copper Queen Limestone[1]

Upper Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 469–471, 480–482.

F. W. Galbraith and W. B. Loring, 1951, Arizona Bur. Mines Bull. 158, Geol. Ser. 19, p. 30. Thickness in Swisshelm district 175 feet.

Named for Copper Queen mining area of Bisbee, where it is a good horizon.

Copper Ridge Dolomite[1] (in Knox Group)

Upper Cambrian: Eastern Tennessee, Alabama, northwestern Georgia, and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 548, 635–636, pl. 27.

C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 5, p. 476–479. Discussion of subdivision of Knox dolomite in east Tennessee. Conococheague-Copper Ridge formation, which overlies Maynardville limestone (new), is subdivided into Morristown dolomite and Bloomingdale limestone members (both new).

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226. Described in Montevallo-Columbiana quadrangles, Alabama, where it is 1,750 feet thick, overlies Ketona dolomite (Bibb dolomite absent in this area), and underlies Chepultepec dolomite.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 90–95. Copper Ridge overlies Nolichucky shale and extends upward to Chepultepec limestone. Northwest of Greendale syncline, Washington County, the Copper Ridge and Beekmantown form continuous vertical mass 2,400 feet thick with no recognizable break between them. Occurrence of Chepultepec fossils at or very near middle of similar section in Tennessee, 3½ miles southeast of Cumberland Gap, proves mass is about equally Copper Ridge and Beekmantown. Equivalent to Conococheague.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76; R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 17–20, pl. 1, geol. sections. Basal formation of Knox group. In Lee County, Va., underlies Chepultepec dolomite; overlies Chances Branch dolomite member (new) of Maynardville limestone. Thickness 840 feet. Upper Cambrian.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 3, 14–19. Stratigraphic section at Lee Valley, Hawkins County. This section is compared with Thorn Hill section (which includes type locality of Copper Ridge) as measured by Hall and Amick (1934, Tennessee Acad. Sci. Jour., v. 9). Thickness of Copper Ridge 925 feet. Underlies Chepultepec dolomite; overlies Maynardville member of Nolichucky shale.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 227, p. 25–29, chart 1, pl. 1. Described in Mascot-Jefferson City zinc district, Tennessee, where it is 943 feet thick; overlies Maynardville limestone member of Nolichucky shale and underlies Chepultepec dolomite. As thus defined, the formation in the type section is specifically units 203 to 304 of Hall and Amick's (1934) section. Unit could be logically divided into two members: a thick lower member composed mainly of dark thick-bedded cherty dolomite and an upper member consisting of light-colored thinner bedded dolomite, also chert-bearing and containing many arenaceous beds. If such a division were made, break would come within unit 282 in Thorn Hill section and at base of unit 148 in Lee Valley section (Rodgers and Kent, 1948). Oder (1934) divided Copper Ridge into two members, Morristown and Bloomingdale. Oder's Morristown seems to correspond approximately to entire Copper Ridge as here delimited. Bloomingdale member is now thought to belong to lower part of Chepultepec dolomite as now recognized. Copper Ridge is dolomite in type area, and this dolomitic phase extends along western side of Appalachian Valley in East Tennessee and southeastward into and across Mascot-Jefferson City district. To southeast of this area, beds of limestone wedge into section and on eastern side of Appalachian Valley, particularly in belts southeast of Bays Mountain syncline, entire formation is slightly magnesian limestone. This limestone extends northeastward along eastern side of Appalachian Valley into Virginia, and in the central and northern parts of that State it extends progressively into western belts as well until, in northern Virginia, Maryland, and southern Pennsylvania, the limestone phase extends almost entirely across the Appalachian Valley. This limestone facies is commonly known as Conococheague limestone. and that name has been extended from Pennsylvania into Virginia and Tennessee. Ulrich recognized presence of Conococheague limestone in these areas but contended it was older than Copper Ridge dolomite and that it thinned westward and was overlapped unconformably by the Copper Ridge. Historical summary of usage of name and notes on type locality. Ulrich proposed term Copper Ridge chert for his

second division of Knox dolomite of eastern Tennessee and southwestern Virginia. Name was taken from Copper Ridge, the long, narrow, monoclinal ridge at northwest base of Clinch Mountain, recognizable as distinct topographic feature from Russell County, Va., to a few miles west of Knoxville. East of gap at Speers Ferry, Va., where Troublesome Creek cuts through ridge to join Clinch River, the ridge is known as Moccasin Ridge, and name Copper Ridge is transferred to next structural belt to northwest (see Estillville 30 minute quadrangle and Clinchport and Duffield 7½-minute quadrangles). Type locality is along "the road from Bean Station to Evans Ferry, on Clinch River" (Ulrich, 1911, p. 636), now U.S. Highway 25–E. It is shown on Morristown folio (Keith, 1896) and on Avondale 7½-minute quadrangle sheet of TVA series. Wilmarth, 1938 (U.S. Geol. Survey Bull. 896) states formation was "named for Copper Ridge, northeast of Knoxville, Tenn.," and Resser (1938, Geol. Soc. America Bull. Spec. Paper 15) says that "type locality for Copper Ridge formation is on Copper Ridge, Knox County, Tenn., (Ulrich, 1911)." Cooper (1944, Virginia Geol. Survey Bull. 60) makes similar statement. The only section of formation on Copper Ridge mentioned by Ulrich in his original description is the one in Grainger County, discussed in this report. Ulrich stated to writer [Bridge] on several occasions that this is section to which he was referring in the "Revision" and that he regarded it as type section.

Type locality (Butts. 1940): Gorge of Forked Deer Creek through Copper Ridge, 1 mile northwest of Thorn Hill, Grainger County, Tenn., and 13 miles northwest of Morristown.

Type locality (Bridge, 1956): Along road from Bean Station to Evans Ferry, on Clinch River (Ulrich, 1911), now U.S. Highway 25–E. This locality is now submerged by Cherokee Lake, and Bean Station is a new location, more than 1 mile to the west.

Ulrich (1911, p. 635, 636) states "The resistant character and finally great abundance of this chert [Copper Ridge] almost invariably gives rise to broad and long ridges, among which that known as Copper Ridge, in northeast Tennessee, is the excellent example chosen to supply the name and type of the member or formation. The road from Beans Station to Evans Ferry, on Clinch River (see Morristown quadrangle), follows Indian Creek, where it cuts through Copper Ridge, Tenn."

Copper River Silts and Gravels[1]

Pleistocene: Southeastern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 410–412.

Along Copper River above Taral and on tributaries of that part of river, Copper River region.

Copps Formation

Copps Group[1]

Precambrian: Northwestern Wisconsin and northwestern Michigan.

Original reference: R. C. Allen and L. P. Barrett, 1915, Jour. Geology, v. 23, p. 697.

G. I. Atwater, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 171–179. Referred to as a formation made up of graywacke and gray slate with Copps conglomerate at base.

Named for Copps mine, sec. 15, T. 47 N., R. 43 W., Wisconsin.

Coqui Limestone[1]

Age(?): Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 29.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 322. Berkey suggested name for limestone occurring near Coqui, but term has not been used since.

Coquille Formation

Pleistocene: Southwestern Oregon.

E. M. Baldwin, 1945, Jour. Geology, v. 53, no. 1, p. 39–42. Name proposed for estuarine deposits which unconformably underlie Elk River beds (restricted) just north of mount of Coquille River. Formation consists of conglomerate, sand, and thin-bedded sandy clay; stumps, logs, peat, and other woody material common. Total exposed thickness probably more than 200 feet; measured section 93 feet; dip as high as 25°. At mouth of Whiskey Run, the Coquille unconformably overlies Umpqua formation and unconformably underlies Elk River beds.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Crops out along sea cliff near Cape Kiwanda where it consists of poorly sorted coarse sand and gravel, together with peat, carbonaceous shale, and clay. Minimum thickness about 30 feet. Rests with angular unconformity upon mudstone of Oligocene age. Also occsurs near Nestucca Bay in a sea cave cut in basaltic sandstone of Nestucca formation (new). Formation is a Pleistocene estuarine fill.

Named for exposures between Whiskey Run and Cut Creek just north of mouth of Coquille River, Coos County.

Coralline Falls Limestone[1]

Devonian: Kentucky.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 95–97.

Coral Ridge Member (of New Providence Formation)

Lower Mississsippian: Northern Kentucky and southern Indiana.

J. E. Conkin, 1957, Bulls. Am. Paleontology, v. 38, no. 168, p. 114–116, 119–120, 152. Basal member of New Providence formation, Silver Hills facies. Divisible into two parts, lower and upper, on basis of fauna. Consists largely of green- to blue-gray shales; ironstone lenses, ironstone cone-in-cones, and ironstone nodules common in upper part but virtually lacking in lower part. Thickness as much as 52 feet. Underlies Button Mold Knob member (new); overlies Underwood-Falling Run formations.

Type locality: East quarry of Coral Ridge Brick and Tile Co., Coral Ridge, Jefferson County, Ky. Base not exposed at type section.

Coralville Limestone[1]

Coralville Limestone Member (of Cedar Valley Formation)

Upper Devonian: Central eastern Iowa.

Original references: C. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149; 1913, Iowa Acad. Sci. Proc., v. 20, p. 205, 206.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1751, chart 4. Shown on correlation chart as uppermost member of Cedar Valley formation. Overlies Rapid limestone member. Correlated

with Callaway limestone of Missouri. Middle Devonian. Age of entire Cedar Valley is difficult to establish, and dating of some of its parts presents problems.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (chart), 185. Three members of the Cedar Valley are recognized: Linwood, Littleton, and Coralville.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 157. Independence shale is stratigraphically below the Cedar Valley and above the Wapsipinicon. The Independence by its fossils is lower Upper Devonian; hence, the Cedar Valley is Upper Devonian in age and post-Independence.

Typically exposed in quarries about 1 mile northeast of Coralville, Johnson County.

Corbett Sandstone (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 533–534, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 23–24, pl. 1. Chiefly sandstone, in part quartzitic and massive, and variably black, brown, and white in color. Ripple marks and crossbedding common. In part, the formation contains beds of shale that alternate with the sand and range from 1 to 15 feet in thickness. Includes several limestone members in eastern part of Eureka section. Thickness is 4,000 feet in Sylvanite section, where full original thickness is present, and ranges from 1,500 to 3,000 feet in Eureka section. Disconformably underlies Playas Peak formation (new) and conformably overlies Howells Ridge formation (new). Trinity age.

Named from Corbett Ranch at Granite Pass, Sylvanite district, in Little Hatchet Mountains.

Corbin Conglomerate (in Briceville Formation)

Corbin Conglomerate Lentil[1] or Member (of Lee Formation)

Pennsylvanian: Central Kentucky and northern Tennessee.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 3.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 686, chart 6 (column 18). Corbin conglomerate, prominent in Kentucky, extends into northern Tennessee, where it is included in basal part of Briceville formation.

Named for Corbin, Whitley County, Ky.

Corbin Granite[1]

Precambrian: Northwestern Georgia.

Original reference: C. W. Hayes, 1901, Am. Inst. Mining Engineers Trans., v. 30, p. 406–410.

A. S. Furcron and K. H. Teague, 1947, Georgia Geol. Survey Bull. 53, p. 12–14, pl. 1. Intrudes Cohutta schist and Fort Mountain gneiss.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 277. Corbin granite is exposed southwest of Salem Church granite and just east of the Cartersville overthrust, along which the Corbin granite is sheared to an augen gneiss and some layers to a seritic or graphitic schist; basal beds of Pine Log conglomerate rest on that

granite which is brought up in an anticline. Salem Church granite resembles phases of Corbin granite and, because of this similarity, has been called Corbin granite (Furcon and Teague, 1945, Georgia Geol. Survey Bull. 51). The Corbin is here considered a hybrid rock and regarded as part of injection complex that occurs below Hurricane graywacke (new).

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 41. Strongly gneissic aggregate of feldspar, smoky-blue quartz, biotite, augite, and garnet. Intrusive into Talladega series.

Named for development around Corbin, Bartow County.

Corbin City Limestone[1] Member (of Drum Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas and northwestern Missouri.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guide Book, p. 92, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030; 1949, Kansas Geol. Survey Bull. 83, p. 99–100. Predominantly a crossbedded oolite locally 40 feet or more thick. Disconformably overlies Dewey limestone member; underlies Chanute formation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. Type locality stated. Unit absent in Nebraska.

Type locality: Corbin City, 2 miles south of Cherryvale, Montgomery County, Kans.

Corbin Ranch Formation (in Simpson Group)

Middle Ordovician: Southern Oklahoma.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 7, 55, 94–101, fig. 1. Cooper (1956) subdivided the Bromide into Mountain Lake and overlying Pooleville members. Mountain Lake is essentially Ulrich's Cool Creek; Pooleville appears to be essentially Ulrich's Criner formation plus his Webster (name preempted). Corbin Ranch formation is erected to include topmost Simpson dense limestone (with shale breaks) in stratigraphic position between underlying Bromide Pooleville member and overlying Viola limestone. Appears to be exact equivalent of Edson's (1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf.) unnamed formation of lower Prosser age; it is topmost limestone of Ulrich's Webster; comprises topmost 15 to 20 feet of Cooper's Pooleville member. Thickness at type locality 19 feet; 24 feet on Colbert Creek, southwest of Davis. Disconformable relationship with underlying Bromide Pooleville and overlying Viola limestone.

Type section: On Carleton W. Corbin Ranch, on west side of Oklahoma Highway 99, 3 miles south of Fittstown, Pontotoc County.

Corcoran Clay Member (of Tulare Formation)

Pliocene, upper, and Pleistocene(?): Southern California (subsurface).

J. W. Frink and Harry A. Kues, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2357–2371. Massive greenish-gray silty clay, highly diatomaceous. Thickness 50 to 120 feet. Lies 200 to 800 feet beneath the surface and extends over an area greater than 4,000 square miles.

U.S. Geological Survey currently classifies the Corcoran Clay as a member of Tulare Formation on the basis of a study now in progress.

Type section: W½ cor. sec. 15, T. 15 S., R. 14 E., U.S. Bureau of Reclamation test hole. Named for town of Corcoran, Kings County, near which it was first recognized.

Corcoran Member (of Price River Formation)

Upper Cretaceous (Montana): Central western Colorado.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 188, 190–191, fig. 2. Unit of littoral marine sandstone and associated coal-bearing rocks which lies above Sego member and is separated from it by thin tongue of Mancos shale with disconformity at its base; underlies Cozzette member (new) and is separated from it by tongue of Mancos shale. Average thickness about 100 feet. At the base, a massive littoral marine sandstone tongue grades downward and eastward into Mancos; first appears near Big Salt Wash and is traceable eastward into Grand Mesa where it disappears; where overlain by coal measures, commonly pure white, and miners call it the "White Pioneer." Series of offshore bar sandstones appears above it near Watson Creek in Grand Mesa and forms eastern limit of the 50 feet or so of coal-bearing rocks. Erdmann (1934, U.S. Geol. Survey Bull. 851) described main coal zone of member as series of overlapping and isolated lenses of coal in thick deposit of carbonaceous shale and called it the Palisade coal. In Neslen facies.

Named from exposures near old Corcoran mine north of Palisade, Mesa County. In Book Cliffs.

Cordell Dolomite or Formation (in Manistique Group)

Cordell Member[1] (of Manistique Formation)

Middle Silurian (Niagaran): Northern Michigan and eastern Wisconsin, and Ontario, Canada.

Original reference: R. B. Newcombe, 1933, Michigan Geol. Survey Pub. 38, p. 23, 37.

R. R. Shrock, 1940, Wisconsin Acad. Sci., Arts, and Letters, Trans., v. 32, p. 207–208, pl. 3. Geographically extended into eastern Wisconsin. Dark-gray thin- and uneven-bedded somewhat saccharoidal dolomite; silicified fossils; chert nodules and lenses common in lower half. Thickness about 45 feet. Overlies Schoolcraft member; underlies Racine dolomite.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 536, chart 3. Cordell dolomite and Schoolcraft dolomite replace term Waukesha in eastern Wisconsin.

G. M. Ehlers, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (chart), p. 19–20, 21–22, 28. Rank raised to formation in Manistique group. Thickness at type section (herein designated) about 77 feet. Overlies Schoolcraft dolomite; underlies Engadine dolomite. Traced from northeastern Wisconsin to region of Owen Sound, Ontario.

Type section: Abandoned quarry of Scott Quarry Co., excavated in north side of outlier of formation in SW¼ sec. 29, T. 44 N., R. 4 W., about 1 mile southeast of Cordell, Chippewa County, Mich.

Cordito Member (of Los Pinos Formation)

Pliocene: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 38, 48–50, pl. 1. Rhyolite-fragment conglomerate, tuff, and sandstone with minor rhyolite flows. Maximum thickness about 600 feet. Uncon-

formably underlies Cisneros (new) and Dorado (new) basalts; disconformably overlies Jarita basalt (new) and Biscara (new) and Biscara-Esquibel (new) members of Los Pinos formation. Name credited to Butler (unpub. dissert.).

Named from exposures in Canyon de Cordito, 4 miles south of Tres Piedras, Las Tablas quadrangle.

Cordova Dolomite

Silurian (Niagaran): Northwestern Illinois and northeastern Iowa.

T. E. Savage, *in* C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 537, chart 3. Proposed for beds formerly called Waukesha dolomite in northwestern Illinois and Iowa. Underlies Port Byron dolomite; overlies Joliet dolomite (restricted).

Well exposed in quarry of U.S. Gypsum Co., 1½ miles south of Cordova, Rock Island Ill.

Corduroy Member (of Supai Formation)

[Permian]: Central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 86–88. Uppermost member of Supai in Fossil Creek and Fort Apache areas. Overlies Apache [Fort Apache] member. Name credited to S. S. Winters (unpub. thesis).

Type locality and derivation of name not stated. Winters (1951, Plateau, v. 24, no. 1) described, but did not name, an uppermost member of Supai exposed west of Corduroy Creek, Fort Apache Indian Reservation.

Coriba formation[1]

Miocene: Central northern Oregon and southern Washington.

Original reference: E. T. Hodge, 1931, Geol. Soc. America Bull., v. 42, p. 991, footnote.

Corinth Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia and western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 574.

Named for exposures at east end of cut on Baltimore & Ohio Railroad at Corinth, W. Va.

Cork Hill Gneiss

Precambrian: Northern New Jersey.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 468, 469, fig. 18. Graphitic gneiss, garnet gneiss, and pyroxene gneiss at Mount Eve. Light pyroxene gneiss north of McAfee. Thickness, 500 feet at Glenwood, 1,000 feet at Franklin, 800 feet at Sterling, and 1,900 feet at Limecrest. Underlies Wildcat marble (new); overlies Franklin marble.

In Franklin-Sterling area.

Corliss Conglomerate[1]

Corliss Conglomerate Member (of Morses Line Slate)

Corliss Limestone Breccia

Lower Ordovician: Northwestern Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 377.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1015, 1021, 1045, 1074–1075. Described as a limestone breccia. Name should not be applied to depositional basal breccias in other areas; applicable only at type locality. Thickness about 30 feet. Presumably underlain by Highgate slate and overlain by a dark slate, which may be Grandge formation (new).

A. B. Shaw, 1951, Jour. Paleontology, v. 25, no. 1, p. 98. Corliss breccia abandoned as a formation. Included in Morses Line slate as a local lens.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 553, pl. 1. Member of Morses Line slate. Middle(?) Ordovician.

Type locality: Corliss Ledge, 5 miles northeast of St. Albans, Franklin County.

Corn Creek Limestone (of Placid Formation)

Pennsylvanian (Canyon): North-central Texas.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51 (columnar section). Incidental mention. Name credited to W. A. Jenkins, Jr. (unpub. thesis).

Section is of Permian rocks along Colorado River.

Cornelia Quartz Monzonite

Tertiary, lower (?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9 p. 15 (table 1), 32–38, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 25–33, pl. 3 [1947]. Made up of several varieties of rocks that range from fine-grained equigranular quartz diorite through equigranular quartz monzonite and porphyritic quartz monzonite to aplite and pegmatite. Has dioritic border facies. Contacts between monzonite and diorite nearly everywhere sharp and clean cut and are easier to draw than those between keratophyre and diorite. The equigranular facies of quartz monzonite, which is preponderant, commonly is light pinkish gray but ranges from white, chalky varieties to green-gray rocks. Intrudes Concentrator volcanics (new) in neighborhood of the New Cornelia mine; farther west invades Cardigan gneiss (new), and 1½ miles above Tule well the border facies cuts the Chico Shunie quartz monzonite (new). Unconformably underlies Locomotive fanglomerate (new), Daniels conglomerate (new), and probably the Sneed andesite (new).

Exposed over area of about 6 square miles, embracing much of the Little Ajo Mountains, Ajo quadrangle, Pima County. Most easterly exposure is at southeast end of the New Cornelia mine, south of Ajo.

Cornell Member[1] (of Portage Formation)

Cornell Shale and Sandstone

Upper Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 10, 57–62.

G. A. Cooper and others, 1942, Geols. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown as shale and sandstone; above Sherburne sandstone and below Ithaca shale.

Type locality: On south side of Fall Creek Gorge, not far from Cornell University campus, Ithaca. Named from outcrops at foot of Ithaca Falls near mouth of gorge.

Cornell Ranch Member (of Sycamore Formation)

Mississippian: Central southern Oklahoma.

J. D. Prestridge, 1959, *in* Petroleum Geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 158 (fig. 2), 159–161, 163. Comprises up to 80 feet of silty to sandy, clayey, cherty limestones, dolomitic claystones, and dark-gray calcareous clayey shales; at base is a soft green shale, locally pyritic and glauconitic, that lies with apparent conformity on Woodford formation. Above green shale is a series of gray silty, clayey dolomitic limestones that are locally glauconitic. Remainder of member consists of alternating beds of dark-gray calcareous shales and silty, clayey limestones; it is in this sequence that bulk of chert in Sycamore occurs. Underlies Worthey member (new).

Type section: On Cornell Ranch, SE¼SE¼SE¼ sec. 25, T. 2 S., R. 1 E., 2 miles north of Springer, Carter County.

Cornett Basalt Member (of Flat Ridge Formation)

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 48, 49, 50, 51, pls. 1, 60. Green amygdaloidal basalt flow, or series of flows, whose vesicles are filled by quartz and epidote. In some places, a few feet of green quartzite occur at base. West of Cornett Store, member contains beds of purple and green tuffaceous slate. Generally occurs at base of formation.

Name from Cornett Store (erroneously named Cornell Store on Mouth of Wilson quadrangle) 3 miles southwest of Cinnamon Ridge. Mapped in extreme western part of Gossan Lead district.

Cornfield Series[1]

Tertiary or Pleistocene: Northeastern Arizona.

Original reference: A. B. Reagan, 1932, Kansas Acad. Sci. Trans., v. 35, 253–258.

Cornfield Harbor Clays[1]

Pleistocene: Eastern Maryland.

Original references: W. H. Dall, 1897, 55th Cong., 2d sess., H. Doc. 5; 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 336, table opposite p. 334.

Cornfield Harbor, near Federalsburg, Caroline County.

Cornfield Springs Formation[1]

Upper Cambrian: Southeastern California and southeastern Nevada.

Original reference: J. C. Hazzard and J. F. Mason, 1936, Geol. Soc. America Bull., v. 47, no. 2, p. 229–240.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 318–320, p. 277 (fig. 3C). Extended into Nopah and Resting Springs area, Inyo County, Calif. Thickness 2,957 feet. Overlies Bonanza King formation; underlies Nopah formation (new).

J. C. Hazzard and J. F. Mason, 1953, Am. Jour. Sci., v. 251, no. 9, p. 643–655. Geographically extended into Goodsprings area, Nevada, where it lies within Goodsprings dolomite of Hewett (1931).

A. R. Palmer and J. C. Hazzard, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2494–2499. On basis of paleontological data, age of Cornfield Springs formation at its type locality is designated as Upper Cambrian. On basis of this evidence, name Cornfield Springs was misapplied in Nopah area. Unit designated Cornfield Springs in Nopah area should now be considered an unnamed division in upper part of Bonanza King formation.

Named for good exposures east of Cornfield Springs, Providence Mountains, San Bernardino County, Calif.

Corning Creek zone (in Negaunee Formation)[1]

Precambrian (middle Huronian): Northern Michigan.

Original reference: J. L. Adler, 1935, Jour. Geology, v. 43, no. 2, p. 113–132. Type locality not stated. Map shows Corning Creek and West Corning Creek, Marquette County.

Cornish sandstone member[1]

Permian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 18.

Named for occurrence in vicinity of Cornish, Jefferson County.

Cornishville Formation

Cornishville Limestone Member (of Perryville Formation)[1]

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1912, Denison Univ. Sci. Lab. Bull. 17, p. 23, 31, 33, 36, 132, 133.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1635–1636. The Cornishville with its supposedly recurrent upper Benson fauna is actually uppermost Benson and the entire Perryville is a Benson facies.

J. A. Stokley and F. H. Walker, 1953, Kentucky Geol. Survey, ser. 9, Rept. Inv. 8, p. 44–45. At Harrodsburg, Mercer County, the Cornishville formation is 6 feet thick; overlies Salvisa formation.

Named for Cornishville, Mercer County.

†Cornwall Limestones[1]

Silurian and Devonian: Southeastern New York.

Original reference: E. C. Eckel, 1902, New York State Geologist 20th Ann. Rept., p. 148.

Name probably taken from some one of the places in Orange County that bears the name Cornwall.

Cornwall Shale[1]

Cornwall Shale (in Onondaga Formation or Group)

Middle Devonian: Southeastern New York, and northern New Jersey.

Original reference: C. A. Hartnagel, 1907, New York State Mus. Bull. 107, p. 39–54.

Bradford Willard, 1937, Am. Jour. Sci., v. 33, no. 196, p. 271, 272. In proposed succession in Green Pond Mountain area, New Jersey, Cornwall shale is assigned to Onondaga formation. Overlies Kanouse sandstone and conglomerate.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 138. Referred to as Cornwall member of Onondaga group.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows age as Lower or Middle Devonian.

Named for occurrence at Cornwall, Orange County, N.Y.

†Cornwall Slates[1]

Upper Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley and E. V. d'Invilliers, 1886, Pennsylvania 2d Geol. Survey Rept. 1885, p. 526.

Exposed in railroad cut at Cornwall Station, Lebanon County.

Coronado Quartzite[1]

Upper Cambrian: Central eastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43, p. 59.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 478. Fossil evidence may suggest a Middle Cambrian age for the unit.

Several areas of this formation crown summit and westerly slope of Coronado Mountain, northwest of Morenci, Greenlee County.

Corough Sandstone Member (of Catahoula Formation)

Miocene (?): East-central Texas.

W. L. Russell, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 68, fig. 3. Name applied to sandstone occurring roughly 175 feet above base of Catahoula. Thickness 0 to 40 feet.

Type locality: Where a road crosses member about 2½ miles west-southwest of Erwin, Grimes County. Name derived from land survey at type locality.

Corozal Limestone[1]

Paleocene or Eocene: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 23.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). Upper Cretaceous.

R. C. Mitchell, 1956, Am. Assoc. Petroleum Geologists Bul., v. 50, 12, p. 2971. Upper Paleocene or lower Eocene. This age determination credited to Kaye (1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1) who described limestone section at Corozal.

Present in San Juan district.

†Corral Sandstone (in Cheyenne Sandstone)[1]

Lower Cretaceous (Comanche): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 366.

Named for the natural corral, a short box canyon on Lanphier claim, in southeastern corner of Kiowa County.

Corral Creek Glacial Substage

Pleistocene (Wisconsin): Southern Rocky Mountains.

L. L. Ray, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 314. Two stages of glaciation believed to be of Wisconsin age recognized along northern Front Range. Younger is termed Corral Creek, and older Home.

L. L. Ray, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; Kirk Bryan and L. L. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 33–34; L. L. Ray, 1940, Geol. Soc. America Bull., v. 51, no. 12, pt. 1, 1860–

1862. Represents third of five substages in southern Rocky Mountains. Preceded by Home substage and followed by Long Draw substage.

Named for moraine in valley of Corral Creek, Cache la Poudre Valley.

Corral Hollow Shales[1] (in Franciscan Formation)

Jurassic(?): Western California.

Original reference: C. F. Tolman, Jr., 1915, Nature and science on Pacific coast: San Francisco, Elder and Co., p. 45.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 15. Incidental mention in discussion of Franciscan formation in San Jose-Mount Hamilton area.

First described in Alameda County [near Livermore].

Correo Sandstone Member (of Chinle Formation)

Upper Triassic: West-central New Mexico.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Dark-brown and buff medium to massive crossbedded standstone, 90 to 120 feet thick. Overlies unnamed red shale member; disconformably underlies Wingate sandstone.

Caswell Silver, 1948, Am. Assoc. Petroleum Geologist Bull., v. 32, no. 1, p. 72, 73, fig. 2. Interbedded sandstone and conglomerate. Unevenly and irregularly crossbedded. Pinches out westward. Derivation of name given.

Named from exposures 1 mile north of settlement of Correo, Valencia County. Crops out along lower bench at south edge of Mesa Gigante, north of Correo.

†Corrigan Formation[1]

Lower Devonian: Western Maryland.

Original reference: A. W. Grabau, 1910, Michigan Geol. and Biol. Survey Pub. 2, geol. ser. 1, p. 231, 234.

Named for occurrence at Corriganville, Allegany County.

Corrigan Formation[1]

Oligocene and Miocene(?): Eastern Texas.

Original reference: E. T. Dumble, 1911, Texas Acad. Sci., v. 11, p. 51.

J. W. Stovall, 1948, Am. Jour. Sci., v. 246, no. 1, p. 84. At least a part of the Corrigan beds were deposited in Oligocene seas.

Named for Corrigan, Polk County.

Corry Sandstone[1]

Corry Formation (in Pocono Group)

Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 92–94.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1347–1369; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 40. At type locality, consists of about 20 feet of gray and white siltstone and some interbedded fine-grained sandstone. At many places, the Corry can be separated into three units: lower of massively bedded siltstones and fine-grained sandstones; medial of thinner bedded siltstones intercalated in silty mudrock and silty shale; and upper of massive siltstones separated by some thin shaly partings.

Westward from type locality, the Corry thins and, in area between Riceville and Strand School, grades laterally into Shellhammer Hollow formation (new). Throughout most of outcrop, overlies Riceville shale; contact conformable. Underlies Orangeville shale (Hungry Run sandstone member, new, or Bartholomew siltstone member, new). The Corry can be considered an eastward facies of Berea sandstone.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey. Mapped in Pocono group.

Type locality: Colgrove quarry (now abandoned), 1 mile south of Corry, Erie County.

Corryville Shale Member (of McMillan Formation)[1]

Corryville Formation (in Maysville Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and northern Kentucky.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 75, 83.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington Ky., Kentucky Univ., p. 11. Corryville listed with formations exposed in northern Kentucky.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf., Guidebook 6, pl. 1. Shown on chart of Ordovician rocks exposed in Jefferson and Switzerland Counties as Corryville formation in Maysville group. Blue dense to crystalline limestone beds and blue-gray soft gray clay shale; fossiliferous. Thickness 20 to 45 feet. Underlies Mount Auburn formation; overlies Bellevue formation.

Named for Corryville, near Cincinnati, Ohio.

Corset Spring Shale

Upper Cambrian: East-central Nevada and western Utah.

Harald Drewes and A. R. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 106 (fig. 2), 108 (fig. 3), 115–116, 117. A 65-foot unit of olive-gray predominantly clay shale with characteristic pencil fracture that overlies Johns Wash limestone (new); near middle of formation, 5 to 15 feet of medium-gray thick-bedded medium-coarse, crystalline, and clastic limestones separate a lower shale unit from an upper one. Distribution irregular because thrust fault commonly follows unit. Undisturbed sections show sharp lower contact and a gradational upper contact with overlying (unnamed) cherty limestone. Upper contact is placed at highest shale in a sequence of alternating shale and limestone lenses.

Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 224 (fig. 2), 226–227, pl. 1. Trilobite assemblage indicates early Trempealeau age. Formation probably correlative of part of Dunderberg shale of Eureka district and part of Mendha formation of Pioche district.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 21–22. Dunderberg shale is basal Franconian and is equivalent to a sandstone, shale, and limestone unit about 600 feet above base of Mendha limestone at Pioche, Nev. Dunderberg is present in Snake Range, Nev., where Drewes and Palmer (1957) called it Corset Spring shale. Although they correlated it with Dunderberg shale of Eureka, Nev., and found basal Franconian fossils, they designated it as

Trempealeauan (Drews, 1958). Underlying Corset Spring shale is 228 feet of limestone designated by Drewes and Palmer the Johns Wash limestone, supposedly of upper Franconian and basal Trempealeauan age. Present writer [Bentley] does not agree with this dating or with nomenclature involved. Formation names used by Drewes and Palmer, at least those for Upper Cambrian, should be suppressed, and section renamed with either Eureka district or House Range terminology.

A. R. Palmer, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B289–B290. Unit that has been called "Dunderberg shale" by Bentley and by those who have studied it in western Utah is not equivalent to whole of Dunderberg shale exposed near Eureka and Cherry Creek, Nev. Evidence indicates that name "Dunderberg shale" should no longer be used for a thin unit of interbedded limestones and shales occurring in western Utah and containing *Elvinia* zone trilobites. This unit is better named Corset Spring shale. Bentley has pointed out correctly that the Corset Spring shale, which occurs in Snake Range just west of Nevada-Utah line, is equivalent to his "Dunderberg shale." Name Corset Spring extended into Deep Creek Range, where it occurs above Hicks formation and below Chokecherry dolomite.

Type section: Segment B of measured section (fig. 2), southern Snake Range, Nev. No suitable geographic name near this section but there is alternate section at elevation 10,500 above Corset Spring on northeast flank of peak 11,064, two miles east of Lincoln Peak, and shale is named for that spring.

Corsicana Marl (in Navarro Group)[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 342–343.

D. L. Frizzell, 1954, Texas Bur. Econ. Geology Rept. Inv. 22, p. 51–52, pls. Overlies Nacatoch sand; underlies Kemp clay. Foraminifera described.

Type locality: Pit Corsicana Brick Co., 2 miles south of courthouse at Corsicana, Navarro County.

Corson diabase[1]

Precambrian: Southeastern South Dakota(?) and northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; 1914, Science, new ser., v. 40, p. 144.

Probably named for Corson, Minnehaha County, S. Dak.

Corta Sandstone (in Joserita Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11. Hard-cross-bedded partly quartzitic and partly calcareous reddish-brown and in places whitish sandstone. Thickness 35 feet. Underlies Quimbo dolomite (new); overlies Espinal grit (new).

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Cortado Formation

Pennsylvanian (Des Moines): Northern New Mexico.

J. A. Young, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1247. Arkose, arkosic sandstone, arenaceous, carbonaceous, and calcareous shale, and a few thin beds of limestone. Thickness over 3,300 feet. Overlies Whiskey Canyon limestone.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 51. Presentation of better locality data (from unpub. thesis of Young).

First described from occurrence near mouth of Rio Grande del Rancho Canyon, northern Sangre de Cristo Mountains, Taos County.

Cortlandt Complex

Cortland Series[1]

Age undetermined: Eastern New York.

Original references: J. D. Dana, 1880, Am. Jour. Sci., 3d, v. 20, p. 194–220; 1881, Am. Jour. Sci., v. 22, p. 103–119.

G. P. Woollard, 1948, Am. Geophys. Union Trans., v.. 29, no. 3, p. 316. Referred to as Cortlandt complex, a norite intrusive.

N. C. Steenland and G. P. Woollard, 1952, Geol. Soc. America Bull., v. 63, no. 11, p. 1075–1104. Cortlandt complex is a body of igneous rocks, composed of norite, diorite, and pyroxenite. Outstanding features are: (1) unusual suite of basic rocks; (2) systematic zoning of rock types; (3) conspicuous banding in parts of complex; and (4) funnel shape for complex as a whole and similar shape for some of its constituent parts. Report is based on 185 gravity and magnetic stations established over complex and contiguous areas. Complex is in region of granitic rocks and lower Paleozoic sediments.

First described in township of Cortlandt, northwestern part of Westchester County, between Croton River on south and parallel of Peekskill on north. Covers area of about 24 square miles.

Corwin Formation[1] (in Nanushuk Group)

Lower and Upper Cretaceous: Northwestern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 244.

E. G. Sable, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2641–2643, fig. 3. Restricted in Utukok-Corwin area to the predominantly nonmarine facies of Nanushuk group which overlies and intertongues with Kukpowruk formation (new) and underlies Prince Creek formation of Colville group. Upper contact with Prince Creek formation not exposed but may represent an unconformity. Thickness at type section about 15,500 feet; thins northeastward to about 4,500 feet on lower Utukok River. Age redesignated at late Early and Late Cretaceous, not older than middle Albian. Type locality given.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 101–125, pls. Formation described in Utukok-Corwin region. Consists predominantly of nonmarine rocks (coastal facies with possibly some inland facies); intertongues with and overlies Kukpowruk formation. Shale, siltstone, claystone, sandstone, coal, conglomerate, ironstone, clay, and bentonitic clay are commonest rock types. Thins eastward in northern part of region and also thins northward from more than 15,400 feet near Corwin Bluff to about 4,500 feet along lower Utukok River.

Type locality: Corwin Bluff vicinity in sea cliffs from 0.6 mile west of Thetis Creek and west for 11 miles, thence 0.3 mile upstream along small creek which enters the ocean at this point; Cape Lisburne region.

Coso Formation

Pliocene, upper, or Pleistocene, lower: Eastern California.

J. R. Schultz, 1937, Carnegie Inst. Washington Pub. 487, p. 79. Alluvial gravels, tuffs, and lake beds that form a unit sharply differentiated from other rock types in region. Conformably overlain by basaltic lava; overlies granite. Thickness about 300 feet.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 415, 416, pl. 1. Thickness about 500 feet. Basal material consists of reddish arkose and buff gravel, sandstone, and shale; above is about 200 feet of well-stratified thin-bedded white and light-buff lake beds, with interbedded white rhyolite tuffs. Alluvial fan material below tuffs has yielded vertebrate fauna. Rests on erosion surface cut in granitic rocks; overlain without angular discordance by flows of basaltic lava.

Exposed on west, north, and east flanks of Coso Range, Inyo County.

Coso Granodiorite

Upper Mesozoic: Southern California.

V. C. Kelley, 1937, Econ. Geology, v. 32, no. 8, p. 993, 994 (fig. 2), 996 (fig. 4). Mentioned as lobe of Coso batholith. Intrusive into Pennsylvanian limestone.

V. C. Kelley, 1938, California Jour. Mines and Geology, v. 34, no. 4, p. 514, pl. 7. Megascopically a coarse-grained light-colored granitoid rock in which the principal minerals are quartz, feldspar, and green hornblende,

Occurs in Darwin silver-lead district in the Coso Range, Inyo County. Batholithic in extent and underlies most of plateau south and west of Darwin Hills.

Cosumnes Formation (in Amador Group)

Middle (?) and Upper Jurassic: East-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283. Basal formation of Amador group at its northern section. Basal beds consist of alternate sandstones and conglomerates 1,200 feet in thickness; these pass upward into sheared arkosic sandstones and dark clay-slate which, in turn, grade upward into thin-bedded tuffs and fine sediments; basic flows and red and green cherts locally present in upper part. Thickness 4,400 feet to east of Calaveras anticline; thicker on west owing to presence of rhyolite flows and agglomerates. Underlies Logtown Ridge agglomerates (new); unconformably overlies the Calaveras (Clipper Gap formation).

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 10–11, pls. 1, 2. Described in Angels Camp and Sonora quadrangles, Calaveras and Tuolumne Counties, where maximum thickness is about 1,500 feet, base not exposed. Consists of metavolcanics, chiefly thin-bedded tuff, with minor slate; dark-gray to black slate, quartzite, chert, and minor conglomerates. Unconformably underlies Logtown Ridge formation; unconformably overlies Calaveras formation. Age considered to be Middle or Late Jurassic. Perisphinctid ammonite collected from unit.

Type locality: At northern type section of Amador group on Cosumnes River, Eldorado and Amador Counties.

Cottage Grove Sandstone[1] Member (of Chanute Shale)

Pennsylvanian (Missouri Series): Southeastern Kansas and northeastern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 92, 97.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 61 (fig. 6), 63–64. Described in Washington County where it is 6 to 50 feet thick. Occurs above unit referred to as Thayer coal member and below unnamed carbonaceous shale member.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 84. Yellowish-brown or tan thin-bedded to massive sandstone; comprises upper one-third to one-half of Chanute shale in southeastern Kansas; occurs only locally in northeastern Kansas. Thickness featheredge to 60 feet.

Named for Cottage Grove Township in Allen County, Kans.

Cotter Dolomite[1]

Lower Ordovician: Northern Arkansas, southern Missouri, and Oklahoma.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

J. G. Grohskopf, E. L. Clark, and S. P. Ellison, 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., app. 4, p. 7–9. Underlies Fortune formation (new).

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 15, 32–39, pls. Predominantly cherty dolomite varying from gray to buff; fine-grained to coarse-grained; thin to massive bedded. Thickness 340 feet in vicinity of Cotter. Includes Crooked Creek chert bed (new) in lower part and Jenkins Branch chert bed (new) near middle. Underlies Powell dolomite; unconformably overlies Theodosia formation (new) of Jefferson City group. As used in this report, term Cotter is restricted to those beds which crop out in vicinity of type area. Type section designated. Lower half of what Weller and St. Clair (1928, Missouri Bur. Geology and Mines, v. 22, 2d ser.) called Cotter is here included in Theodosia formation.

G. G. Huffman, 1953, Oklahoma Geol. Survey Guide Book 1, p. 5, 7. Unconformably overlies Precambrian Spavinaw granite. Where exposed near Qualls, Cherokee County, is succeeded by Burgen sandstone.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23. In Mascot-Jefferson City zinc district, Tennessee, names Kingsport and Mascot (both new) replace terms Jefferson City formation and Cotter-Powell beds. There is no possibility that these formations can ever be traced into Appalachian Valley. Kingsport limestone corresponds to some part of Jefferson City formation of Ozark region, and Mascot dolomite corresponds to some part of the Cotter, but there is n evidence to indicate that Jefferson City-Cotter boundary is same as Kingsport-Mascot boundary.

Type section: Starting at valley bottom just upstream from west end of White River bridge at Cotter and extending to top of hill westward along U.S. Highway 62, Baxter County, Ark.

Cotton Formation (in Conneaut Group)

Upper Devonian: North-central Pennsylvania and central New York.

G. H. Chadwick, 1936, New York State Mus. Bull. 307, p. 78, 96. Name proposed for mass of continental strata. Briefly mentioned in discussion in which a number of beds loosely termed "Catskill" are reassigned.

G. A. Cooper and others, 1942. Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Geographically extended into New York.

Named from Cotton Creek in Bingham and Genesee Townships, Potter County, Pa.

†Cottondale Formation (in Tuscaloosa Group)

Upper Cretaceous: West-central Alabama.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37. Comprises the apparently nonmarine gravelly sand and carbonaceous clay which lie between the Paleozoic basement and the overlying marine Eoline formation (new). Sand and clay members vary in thickness though most outcrops show 25 to 50 feet of gravelly sand overlain by a few feet of carbonaceous clay. Sand is cross bedded, coarse to fine grained; gravel present in lower half, chiefly as thin stringers, but toward base is abundant enough to form beds; clay typically forms one or two layers at top, but locally occupies entire thickness of formation; upper part of clay locally lignitic. Thickness 30 to 100 feet; topographic irregularities on Paleozoic floor cause corresponding differences in thickness of formation. Upper contact of formation locally sharp but in some places appears to be gradational. Flora indicates Upper Cretaceous age.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull, v. 30, no. 2, p. 192–194. Commonly 25 to 75 feet of cross-bedded slightly micaceous sand, which is coarser or even gravelly at base and is overlain by 2 to 8 feet of carbonaceous or lignitic clay; at many places dark-gray and purple clays are interbedded with the sand; at some places, entire interval is represented by dark-gray to purple clay as much as 50 to 60 feet thick. Type locality designated.

C. W. Drennen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 528. Name abandoned. Sediments heretofore designated Cottondale are included in the Eoline, which is here reduced to member status in the Coker formation (revised).

Type locality: East of Cottondale in sec. 25, T. 21 S., R. 9 W., Tuscaloosa County. Named for Cottondale, about 6 miles east of Tuscaloosa, where several exposures are present along Southern Railway and nearby county roads.

Cotton Valley Formation or Group

Upper Jurassic: Subsurface in northern Louisiana, southern Arkansas, western Mississippi, and eastern Texas.

H. K. Shearer, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 6, p. 722, 723, 724–725. Dominantly marine beds, made up of various types of shale, sand, and limestone, underlying Travis Peak red beds; includes Schuler facies (or limestone). Thickness about 3,240 feet at Rodessa, La. Name approved by Shreveport Geological Society.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 966. Geographically extended into Arkansas where it overlies the Smackover limestone and Bucker anhydrite.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 25–27. Further desribed in Arkansas where it underlies Hosston formation (new). Jurassic age favored on basis of fossils.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 578 (table 1), 579–582. Rank raised to group. Includes rocks between base of Hosston formation (Travis Peak of East Texas petroleum geologists) and top of Buckner formation, or top of Smackover formation in areas where Buckner is not recognizable. Consists of Schuler formation above and Boosier formation below.

T. H. Philpott and R. T. Hazzard, 1949, *in* Shreveport Geol. Soc. Guidebook 17th Ann. Field Trip, fig. 5 (correlation chart); L. A. Goebel, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1978–1979. Proposed that Cotton Valley as a formation be restricted to the gray sands and shales above a major unconformity that exists within the formation and that Haynesville formation be used for the red sands, shales, and anhydrite below unconformity.

Type locality: Cotton Valley field, Webster Parish, La.

Cottonwood Beds[1]

Miocene: North-central Oregon.

Original reference: W. D. Matthew, 1900, Am. Mus. Nat. History Bull., v. 12, p. 23.

Rattlesnake Creek, near Cottonwood, John Day region.

Cottonwood Beds (in Horsetown Group)

Lower Cretaceous (Shasta Series): Northern California.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 32 (fig. 1), 38 (table 1), 63–67, table 2. Name applied to lower part of Horsetown group. Beds, which vary in thickness from 3,480 feet on North fork of Cottonwood River to 8,400 feet on Dry Creek, contain a succession of distinctive faunal zones. Consist of sandstone and conglomerate in lower part with shales in upper part. Underlie Hulen beds (new) though the boundary is more one of paleontological distinction; overlie Shasta group.

Type area: Along Cottonwood River [Shasta County]. Beds form a belt 2½ miles broad, crossing North and Middle forks of Cottonwood River; from the latter stream, belt extends in southwest course by Dry Creek, northern Tehama County, and thus across the delta area.

†Cottonwood Formation (in Council Grove Group)[1]

Permian: Eastern Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 37–41.

Named for Cottonwood Valley, Chase and Lyon Counties.

Cottonwood Limestone (in Council Grove Group)[1]

Cottonwood Limestone Member (of Beattie Limestone)

Permian: Eastern Kansas, southeastern Nebraska, and north-central Oklahoma.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 112–114.

G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1, p. 13. Beattie formation (new) comprises (descending) Morrill limestone, Florena shale, and Cottonwood limestone members.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47. Member of Beattie limestone. Underlies Florena shale member; overlies Eskridge shale. Thickness about 6 feet. Wolfcamp.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000) : U.S. Geol. Survey. Cottonwood limestone in Council Grove group mapped in Oklahoma.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 101–103. In Pawnee County, classed as limestone in Council Grove group. Overlies Eskridge shale and underlies Garrison shale. As currently classified in Nebraska, Kansas, and north-central Oklahoma, the Cottonwood is basal member of Beattie formation overlain in turn by Florena shale and Morrill limestone members. Members of Beattie can be identified in Pawnee County just south of Arkansas River in two northernmost outliers of Cottonwood limestone. Only Cottonwood member is traceable for any distance across county. Accordingly, Beattie formation has been ignored in subdividing Council Grove group for this report. Maximum development is along Arkansas River where Cottonwood occurs as single resistant bed of light-greenish-gray limestone 2.2 feet thick. Wolfcamp series.

Named for Cottonwood Falls, Chase County, Kans.

Cottonwood Quartzite

Precambrian: Northern Utah.

N. E. A. Hinds, 1938, Am. Jour. Sci., 5th, v. 35, no. 210, 445. Cottonwood quartzite over 10,000 feet thick, mentioned in discussion of Precambrian Arizonan revolution in western North America.

This may or may not be same unit referred to as Cottonwood schists and gneisses.

Present in Wasatch, Uinta, and other ranges of northern Utah.

Cottonwood Rhyolite[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 37.

Occurs about headwaters of Cottonwood Canyon, Oatman district.

Cottonwood Schists and Gneisses[1]

A name that has been rather loosely applied to the Precambrian schists and gneisses of Cottonwood Creek region, central Wasatch Mountains, Utah.

†Cottonwood Shales (in Council Grove Group)[1]

Permian: Eastern Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 38–39.

In Cottonwood Valley and at Manhattan and vicinity, Riley County.

Cottonwood white layer[1]

Eocene, middle: Wyoming.

Original reference: W. D. Matthew and W. Granger, 1909, Am. Mus. Nat. History Mem., v. 9, p. 295.

Bridger Basin.

Cottonwood Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 374, 382.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., [Guidebook] Spring Mtg., May 11–12, p. 72. Chiefly white friable sandstone, 300 feet thick. Underlies Hanna Valley bed; overlies Spring Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Cottonwood Creek, San Saba County.

Cottonwood Creek Formation

Miocene, middle to upper: Southern California.

Otto Hackel and K. F. Krammes, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 4, road log (p. 6), geol. map. Series of light-colored coarse sands and conglomerates. Unconformably overlies Round Mountain silt; unconformably underlies Kern River formation. Can be traced north and west into Mon Bluff formation (new).

Type locality: Near Round Mountain, Kern County.

Cottonwood Draw banded layers[1] (in Wind River Formation)

Eocene, lower: Wyoming.

Original reference: W. Granger, 1910, Am. Mus. Nat. History Bull., v 28, p. 244.

Along Cottonwood Creek, near Lost Cabin, northeast corner of Fremont County.

†Cottonwood Falls Limestone[1]

Permian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 112–114.

Named for Cottonwood Falls, Chase County.

Cottonwood Spring Basalt (in Buck Hill Volcanic Series)

Cottonwood Spring Basalt (in Green Valley Volcanic Series)

Oligocene and younger(?): Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Green Valley volcanic series is divided into (ascending) Pruett formation, Cottonwood Spring basalts, and Duff tuff. Consists of basaltic lava flows up to 325 feet thick.

S. S. Goldich and G. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Oct. 29–31, p. 14 (table 1), 17 (fig. 3), 20. Included in Buck Hill volcanic series. [Authors made no reference to previous use of Green Valley volcanic series.] Derivation of name given.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1156–1159, 1171 (fig. 6), 1179, (measured section 5, type section), pl. 1. Dense to vesicular and amygdaloidal flows; trachyandesite to olivine basalt. Flows vary in number and in thickness. Maximum thickness 325 feet in area west of Whirlwind Spring; in type section, flows aggregate 300 feet, and lowermost flow, 40 to 50 feet thick, rests on Pruett formation; on Potato Hill, total thickness of 166 feet includes six flows. On Crossen Mesa, Cottonwood Spring basalt rests on tuff deposited on weathered surface of Potato Hill andesite. Age Eocene(?).

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 550–551, pl. 1. Traced across Cathedral Mountain quadrangle, Cottonwood Spring basalt flows occupy position between Potato Hill andesite and Duff formation, a relationship which is maintained across the south-north length of Alpine quadrangle. Thickness 220 to 332 feet. Top of Eocene is placed at disconformity between Crossen trachyte and Sheep Canyon basalt; suggested that overlying lava and tuff layers are Oligocene and younger(?), and map bracket shows this age for Cottonwood Spring basalt.

Type section: In vicinity of elevation 4,054 feet, south of Cottonwood Spring, Buck Hill quadrangle, Brewster County.

Cotui Limestone

Cotui Limestone Member (of San Germán Formation)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 198. Massive rarely thick-bedded limestone near top of San Germán formation. Includes microcoquino and pellet limestone with some argillaceous limestone. Maximum thickness 75 meters. Stratigraphically above Cabo Rojo member. Maestrichtian.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 340, 341, 342, pl. 1. Cotui limestone is highest unit in San Germán except southeast of Cabo Rojo, where about 150 meters of andesitic volcanic rock, shale, and conglomerate overlie it. Mitchell (1922) used term San Germán to describe the massive limestone herein called Cotui limestone. Definition of San Germán has been expanded in present report.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico.: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 53, 67. Referred to as Cotui limestone. Outcrops occur along western margin of Peñuelas quadrangle, where unit crops out in low hills surrounded by alluvium. In Mayagüez area, Mattson includes this limestone as a member of his San Germán formation. Relationship of the Cotui to underlying Mayagüez group could not be discerned in area of present report.

Well exposed in quarries along south edge of Guanajibo Valley, Mayagüez area.

Couch Formation

Pliocene, lower: Western Texas.

G. L. Evans, 1949, West Texas Geol. Soc. Guidebook Field Trip 2, Nov. 6–9, p. 4 (table 1), 5–6. Compact well-sorted calcareous sand and gravel; typically pinkish gray. Thickness at type locality 125 feet; thickness varies markedly with relief of underlying bedrock; maximum

development in deeper pre-Cenozoic valleys; thins and wedges out against higher ridges and divides on bed rock surface. Underlies Bridwell formation (new); unconformably overlies Triassic and Cretaceous rocks.

D. C. Van Siclen, 1957, Jour. Geology, v. 65, no. 1, p. 49 (fig. 2), 51, 52. Thickness 200 feet. Stratigraphic section lists formation under Pliocene (Miocene?).

Type locality: About 7 miles east of Crosbyton, Crosby County. Named for Couch Ranch, in Blanco Canyon. Extends northward into Texas panhandle.

Coudersport Member (of Cattaraugus Formation)[1]

Upper Devonian: North-central Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 581.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 287–288. Green standstone 10 to 20 feet thick, about 100 feet below [above] base of Cattaraugus. Persists into Potter, Tioga, and probably McKean Counties and perhaps as far as Cameron, Clinton, Lycoming, and Sullivan Counties. Not to be confused with Oswayo which it closely resembles.

Named for Coudersport, Potter County, where it occurs in quarries along west side of town.

†Coulters Ferry Sands[1]

Upper Cretaceous: Northeastern Mississippi.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric. Rept., p. 66, 67, 73.

Named for exposures at Coulter's Ferry, on Old Town Creek, near its confluence with the Tombigbee, sec. 34, T. 10, R. 7 E., Monroe County.

Council Grove Group[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 709.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 45–49. As defined in Kansas, includes (ascending) Foraker limestone, Johnson shale, Red Eagle limestone, Roca shale, Grenola limestone, Eskridge shale, Beattie limestone, Stearns shale, Bader limestone, Easly Creek shale, Crouse limestone, Blue Rapids shale, Funston limestone, and Speiser shale. Thickness 310 to 330 feet. Overlies Admire group; underlies Chase group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes only Cottonwood limestone, Neva limestone, and Red Eagle limestone.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 73 (table 3), 77–105. As presently applied, group includes beds from base of Americus limestone upward to base of Wreford limestone. Lies with apparent conformity between underlying Admire group and overlying Chase group. Thickness increases from 321 feet in Kansas to about 480 feet in Pawnee County. In southwest part of T. 22 N., R. 4 E., Wreford limestone, base of which defines upper limit of group, loses its identity; farther south, therefore, Council Grove and overlying Chase groups cannot be differ-

entiated. They grade laterally into Konawa-Asher sequence of central Oklahoma. Group subdivided into limestone and shale-sandstone units of equal rank. Where applicable, names from Kansas section have been used, but rank of these names in Kansas classification has been discarded. In Pawnee County, includes (ascending) Foraker limestone with Americus limestone, Hughes Creek shale, and Long Creek limestone members, Johnson shale, Red Eagle limestone, Roca shale, Neva limestone, Eskridge shale, Cottonwood limestone, and Garrison shale. Wolfcamp series.

Named for Council Grove, Morris County, Kans.

Council Spring Limestone (in Veredas Group)

Pennsylvanian (Missouri series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 58 (fig. 6), 59, 62–63. Proposed for uppermost formation of Veredas group (new). Overlies Adobe formation and underlies Burrego formation (both new). Limestone is light gray to white, coarsely crystalline to fine grained, and massive to massively bedded. Thickness at type locality 18 feet.

Type locality: Northwest face of Oscura Mountains in eastern part of SE¼ sec. 36, T. 5 S., 5 E., Socorro, County. Name derived from Council Spring near top of Oscura Mountains, about 5 miles south of north end of mountains.

†Courtland Quartzite[1]

Precambrian (Huronian): Central southern Minnesota.

Original reference: C. W. Hall, 1899, U.S. Geol. Survey Bull. 157. p. 20–25.

Redstone, in Courtland Township, midway between towns of New Ulm and Courtland, Nicollet County.

Courtney Granite[1]

Mesozoic: Northern California.

Original reference: O. H. Hershey, 1900, Science, new ser., v. 11, p. 130–132.

Mount Courtney batholith, Trinity County.

†Coutchiching Series[1]

Precambrian: Northern Minnesota, and Ontario, Canada.

Original reference: A. C. Lawson, 1887, Am. Jour. Sci., 3d ser., v. 33, p. 473–480.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1020–1022. No Coutchiching recognized in Minnesota.

Rainy Lake region, Minnesota.

Covada Group[1]

Probably Devonian, Carboniferous, or Mesozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1913, Washington Geol. Survey Bull. 16, p. 20–30.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 75a), Correlation chart shows age Mississippian to Permian.

Washington [State] Division of Mines and Geology, 1960, Washington Div. Mines and Geology Rept. Inv. 20, p. 5. Intruded by Scatter Creek

rhyodacite (new). Has been mapped as greenstone and limestone. Greenstone includes greenstone, graywacke, graywacke conglomerate, quartzite, argillite, chert, and phyllite; limestone is lenticular; some is Permian in age and some Triassic.

Named for Covada, Ferry County.

†Cove Limestone[1]

Ordovician: Appalachian region.

Original reference: H. D. Rogers, 1836, Pennsylvania Geol. Survey 1st Ann. Rept., p. 12–22.

Name probably derived from Cove Mountain, Franklin County, Pa.

Cove Quartz Monzonite

Jurassic: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

†Cove Slate[1]

Ordovician: Appalachian region.

Original reference: H. D. Rogers, 1836, Pennsylvania Geol. Survey 1st Ann. Rept., p. 12–22.

Name probably derived from Cove Mountain, Franklin County, Pa.

†Cove Creek Limestone[1]

Mississippian: Southwestern Virginia.

Original reference: C. Butts, 1927, Virginia Geol. Survey Bull. 27, p. 16.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Abandoned on basis of this report. Replaced by Bluefield formation.

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1911. Butts (1927) ignored Reger's 1926 terminology and used names "Cove Creek" limestone and "Fido" sandstone for certain stages of the Mauch Chunk and assigned everything between the Gasper (Upper Union) and St. Louis (Hillsdale) to the Ste. Genevieve. This assignment of certain lower rocks to the Ste. Genevieve was merely an avoidance of Pickaway, Taggard, Patton, and Sinks Grove. Continued use of Butts' illogical Ste. Genevieve column has led to confusion. [See Denmar formation.]

Well exposed along Cove Creek, Scott County.

Cove Fort Quartzite

Upper Devonian(?): Southwestern Utah.

G. W. Crosby, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 3, p. 20–21, 52, pl. 11. Proposed for cream-colored vitreous quartzite formation unconformably overlying Guilmette formation. Consists of three units: lower, which is thickest, is white to cream, highly indurated, clean quartz sand; middle, gray limestone intraformational breccia with large amount of sand; upper, reddish-gray poorly sorted quartzite with calcareous cement. Thickness about 85 feet. Disconformably underlies Redwall limestone.

Occurs in south end of Pavant Mountains. Measured section is in sec. 16, T. 24 S., R. 6 W., [Millard County] at southeast corner of White Sage Flat. Exposed in overturned limb of asymmetrial syncline resting

in thrust relationship on Triassic beds. Cove Fort is in southeastern corner Millard County.

Covel Conglomerate Member (of Carbondale Formation)

Covel Conglomerate (in Carbondale Group)

Pennsylvanian: Northern Illinois.

H. B. Willman, 1939, Illinois Acad. Sci. Trans., v. 32, no. 2, p. 174–176. Proposed for a thin limestone conglomerate that occurs at top of Summum cyclothem a short distance below No. 5 coal in overlying St. David cyclothem. Notably lenticular so that it is discontinuous in almost every outcrop. Thickness varies from a trace to about 1 foot but is usually ½ to 2 inches thick. In upper Illinois Valley, underlain by a light-greenish-gray calcareous clay and overlain by 4 to 6 inches of dark-gray thin-bedded shale.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), pl. 1. Rank reduced to member status in Carbondale formation (redefined). Stratigraphically above Hanover limestone member and below Springfield (No. 5) coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼SW¼ sec. 26, T. 33 N., R. 3 E., La Salle County. Named for exposures along Covel Creek south of Ottawa.

Cove Mountain Formation

Tertiary: Eastern Nevada and southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 44, maps 1 and 2. Consists of four members (ascending) Willow Spring, Racer Canyon tuff, Pilot Creek basalt, and Cedar Spring. Thickness as much as 2,000 feet. Stratigraphically above Maple Ridge porphyry (new). Underlies Ox Valley tuff (new). Name credited to H. R. Blank (unpub. thesis).

Type locality and derivation of name not stated. Cove Mountain is in Bull Valley area, Washington County, Utah.

Cove Mountain Member (of Pocono Formation)

Lower Mississippian: Central Pennsylvania.

Bradford Willard, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 18. Name proposed for uppermost division of formation in south-central Pennsylvania. Consists of gray sandstone and pebble beds; lithologically similar to Second Mountain member at base of formation, but distinguished by presence of several coal beds. Conformably overlies Peters Mountain member; underlies Mauch Chunk red beds. Has been termed Burgoon, but question of precise correlation with that unit occurring in areas to the west warrants introduction of new name.

Type locality: In highway cuts at Cove Mountain, Perry County, south of Duncannon.

Coventry Conglomerate[1]

Lower Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1919, Vermont State Geologist 11th Rept., p. 47.

Located about 10 miles north of Craftsbury, and on main road from Newport to South Troy, and crosses northern part of Coventry Township, Orleans County.

Coventry Limestone[1]

Coventry phase (of Waits River Limestone)[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1908, Vermont State Geologist 6th Rept., p. 265–291.

Type locality: Coventry, Irasburg quadrangle, Orleans County.

†Covington Group[1]

Covington Subseries

Upper Ordovician (Cincinnatian Series): North-central Kentucky and southwestern Ohio.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 9.

R. H. Flower, 1946, Bulls. Am. Paleontology, v. 29, no. 116, p. 107–112. Referred to as Covington subseries of Cincinnatian series. Below Richmond subseries. Includes Eden and Maysville groups.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1032. Group comprises (ascending) Eden, Fairview, and McMillan formations. Cincinnatian series. Group contains standard sections of Eden and Maysville stages.

Named for Covington, Ky.

Cowaselon Clay[1]

Pleistocene: Southeastern New York.

Original reference: B. Smith, 1914, Am. Jour. Sci., 4th, v. 38, p. 463.

Named for Cowaselon Creek, Madison County.

Cow Bayou Formation (in Wilcox Group)

Cow Bayou Member (of Logansport Formation)

Paleocene: Northwestern Louisiana and northeastern Texas.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13, 14. Named in a stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Pertoleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 57. Consists of carbonaceous to lignitic shale of a cyclic pattern; typical facies best developed in and around type locality. Average thickness 75 to 100 feet. Underlies Lime Hill member; overlies Dolet Hills member; both upper and lower contacts are transitional, the transition taking place through 5 to 15 feet of section. Paleocene. Type locality designated.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 110–116, pl. 10. Consists of two facies Benson (lower) and Lulu. Geographically extended into Panola County, Tex.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 54–55. Formation, in Sabine Parish [this report], consists of interbedded silts, shales, and fine-grained sands. Present only in subsurface. Overlies Dolet Hills formation. Underlies Converse formation (new) which includes sand occupying valleys of Pleasant Hill oil field mapped by Murray (1948) as Cow Bayou member of Logansport. Term Logansport eliminated as members are given formational rank. Wilcox group.

Type locality: Along Cow Bayou in SE¼ sec. 9 and NW¼ sec. 16, T. 10 N., R. 14 W., De Soto Parish, La., approximately 3 miles southeast of Hunter on road to Converse.

Cow Creek Granodiorite

Jurassic–Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11, pl. 1. Leucocratic granodiorite; light gray and finer grained than rocks of Giant Forest pluton. Relation to other named plutonic rocks in area not determined.

Named from exposures along Cow Creek along west side of mapped area, Sequoia National Park.

Cow Creek Limestone Member (of Pearsall Formation)

Cow Creek Limestone Member (of Travis Peak Formation)

Cow Creek Beds (in Travis Peak Formation)[1]

Cow Creek Formation

Lower Cretaceous: Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Rept., pt. 7, p. 141–143.

R. H. Cuyler, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 632–633. Referred to as member of Travis Peak formation.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Middle member at type section of Pearsall formation (new) in subsurface. Thickness about 85 feet. Consists of black, gray, and light-brown hard dense to finely crystalline limestone. Overlies Pine Island member; underlies Hensell shale member. Occupies same stratigraphic position as Cow Creek limestone member of Travis Peak formation of outcrop and as James limestone of Arkansas-Louisiana-east Texas area.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 318, 319 [1946]. In outcrops, overlies Sycamore sand member and underlies Hensell sand member. Overlaps top of Honeycut formation and all of Carboniferous within map area of this report. A fossil coquina in which fossils are bonded into massive limestone bed.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5, 6–7 (fig. 1), 8. Upper member of Travis Peak formation (restricted). Thickness 10 to 30 feet. Underlies Hensell sand member reallocated to member status in Shingle Hills formation (new).

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 69, 70, figs. In subsurface and outcrop, formation overlies Hammett shale (new). Hammet was originally included in Hill's Cow Creek beds.

Named for Cow Creek, Burnet County.

Cowdren Anhydrite Member (of Salado Formation)

Permian (Ochoa): Subsurface in West Texas and southeastern New Mexico.

G. A. Kroenlein, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1689. Anhydrite bed at base of a 200-foot zone of alternating halite and anhydrite beds. Above a basal 150-foot halite zone. Name credited to Giesey and Fulk (unpub. ms.).

S. G. Giesey and F. F. Fulk, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 4, p. 603. Mainly white crystalline anhydrite in type locality well, whereas 70 miles to north bed is composed of brown earthy dolomitic anhydrite. Also becomes considerably dolomitic southward.

Thickness in type section 15 feet; in other localtities 10 to 50 feet. Lowermost anhydrite bed in Salado, occurring from 150 to 200 feet above base of formation. Type section designated.

Type locality well: Between depths of 2,590 and 2,605 feet in Southern Crude Oil Purchasing Co. J. M. Cowden No. 1, located 2,310 feet from north and 330 feet from west lines of sec. 26, Blk. 43, T. 1 N., T. & P., Ector County, Tex.

Cowesett Granite (in East Greenwich Group)

Mississippian(?): Central Rhode Island.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Gray to pink medium-grained granite which is subporphyritic, mostly massive, and foliated near the contacts. Underlies Pennsylvanian sedimentary rocks unconformably. Intrusive into Westboro(?) quartzite, Spencer Hill volcanics (new), an unnamed metadiorite, and Maskerchugg granite (new). Intruded by a dark fine-grained granite dike. Included in East Greenwich group.

Named for typical exposures along Cowesett Road one-half mile west of Hardig Road, Kent County.

Cowiche Gravel[1]

Pleistocene: Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 86.

Occurs in broad terrace in valley of Cowiche Creek, Ellensburg quadrangle.

Cow Island Beds[1]

Upper Cretaceous: Central northern Montana.

Original reference: C. H. Sternberg, 1914, Science, new ser., v. 40, p. 134–135.

At Dog Creek, east of Judith River and in Fergus County.

Cowles Member (of Tererro Formation)

Lower Mississippian: Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754–1756, 1760, 1763–1768, 1769, 1770–1771, 1772, 1773. Consists of lower unit of calcarenite and upper unit, present locally, of marly quartz siltstone and intercalated limestone beds. Thickness 26 to 50 feet. Overlies Manuelitas member (new); underlies Sandia formation. Because of its unconformable relation with Manuelitas member, the Cowles may be of Late Mississippian age.

Typical section: Abandoned quarry on road to Winsor Ranch, 0.2 mile above junction with State Highway 63, 1.4 miles south of Cowles, San Miguel County. East side of Pecos River Canyon.

Cowley Formation

Upper Mississippian: Kansas (subsurface).

Wallace Lee *in* G. E. Abernathy, R. P. Keroher, and Wallace Lee, 1940, Kansas Geol. Survey Bull. 31, p. 15. Consists of silty and cherty gray or dark-gray or buff to almost black dolomite or dark dolomitic silty shale; contains glauconite, particularly in a zone a few inches to 30 or

more feet thick, which forms a transgressive deposit at base of formation. Thickness as much as 300 feet. Conformably underlies Warsaw limestone; unconformably overlies rocks of Osage age.

Wallace Lee, 1940, Kansas Geol. Survey Bull. 33, p. 66–79, pl. 2. In different areas, base is in contact with Keokuk, Burlington, Reeds Spring, and St. Joe limestones of Osage age; in some areas, rests on Northview shale, Compton limestone, Chattanooga shale, and even on pre-Chattanooga rocks; at most places, unconformably overlain by Pennsylvanian rocks, but, in some places, conformably overlain by the Warsaw. Deriviation of name given.

Named for Cowley County, where in most wells, except in north-central part of county, there is a good development of the formation.

Cowley Canyon Member (of Wasatch Group)

Paleocene or Eocene, lower: Northern Utah.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1144–1145. Ooidal, stromatolitic ,pisolitic, or algal limestone at most outcrops with army-brown stromatolites in brownish-gray matrix of compact limestone. Locally stromatolites are missing, and rock is compact cream-colored limestone. Thickness 0 to 83 feet. Basal member of Wasatch group. Unconformably overlies Paleozoic rocks.

Good exposure on east side of Cowley Canyon in sec. 21, T. 12 N., R. 3 E., 0.9 mile above junction of Cowley Canyon and Right Fork Roads. Base of section at elevation 5,880 feet, about 100 feet above road, Logan quadrangle.

Cowlitz Formation[1]

Eocene, upper: Southwestern Washington and northwestern Oregon.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 90–97. At type section, consists of massive stratified medium- to coarse-grained brownish-gray marine sandstones, shaly sandstnoes, sandy shales, and clay shales, with estuarine and fresh-water members near middle and intercalated basaltic flows near base; extreme lower part not exposed. Thickness at type section 3,745 feet.

R. S. Beck, 1943, Jour. Paleontology, v. 17, no. 6, p. 584–614. Approximately 200 feet of Eocene beds are exposed 1½ miles east of Vader, Lewis County, Wash., along west bank of Cowlitz River in E½SE¼ sec. 28, T. 11 N., R. 2 W. Weaver (1912) proposed name Cowlitz formation for the beds containing molluscan fauna at this locality. Weaver (1937) expanded type Cowlitz to include strata exposed along Olequa Creek between towns of Winlock and Vader. This emendation is undesirable because Olequa Creek section was not included in original definition and the addition would necessitate two type localities for the Cowlitz. In this report, type Cowlitz is limited to beds exposed along Cowlitz River. Foraminifera described. [Report also refers to Cowlitz River beds.]

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 44, no. 5, p. 593, chart 11. Formation composed of about 8,000 feet of marine grayish-brown sandstone and sandy shale containing well-preserved molluscan fossils. Type section is in banks of Olequah Creek and not in banks

of Cowlitz River. Best known fauna does occur in about 200 feet of strata exposed in bluffs of Cowlitz River, 1½ miles east of Vader, and corresponds to strata in middle of type section on Olequah Creek.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 42. West of Willamette River, unconformably overlies Tillamook volcanic series (new); interfingers with basal part of Goble volcanic series (new).

W. C. Warren and Hans Norbisrath, 1946, Am Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 221–225. Described in upper Nehalem River basin where it is 950 feet thick, overlies Tillamook volcanic series, and underlies Keasey formation. Upper Eocene.

D. A. Henriksen, 1954, Dissert. Abs., v. 12, p. 2315–2316; 1956, Washington Div. Mines and Geology Bull. 43, p. 16 (fig. 5), 36–66, pl. 1.

Weaver's 1937 type section expanded to include strata along Stillwater Creek from its confluence with Olequa Creek westward to contact with uppermost basalt flows of Metchosin volcanic series 3 miles west of Ryderwood. Type Cowlitz, as redefined herein, consists of more than 8,000 feet of upper Eocene sediments and subordinate volcanic rocks exposed along Stillwater and Olequa Creeks as far south as Cowlitz River. Subdivided into (ascending) Stillwater Creek, Pe Ell volcanics, Olequa Creek (all new), and Goble volcanics members. Underlies undifferentiated Oligocene.

M. L. Steere, 1955, Geol. Soc. Oregon Country News Letter, v. 21, no. 10, p. 85. In Sunset Tunnel area, Columbia County, Oreg., underlies Nehalem formation (new).

M. H. Pease, Jr., and Linn Hoover, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–188. Underlies Hatchet Mountain formation (new).

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (table), 14–19, pl. 1. In Toledo-Castle Rock coal district, Washington, unconformably overlies Northcraft formation and underlies Hatchet Mountain formation. Thickness about 2,600 feet.

Type section (Weaver, 1937): In canyon of Olequa [also spelled Olequah] Creek between towns of Winlock and Olequa, Lewis and Cowlitz Counties, Wash. Well exposed between Winlock and junction of Olequa Creek and Cowlitz River, a distance of about 14 miles.

Cowlitz River Beds

See **Cowlitz Formation.**

Cow Run Sandstone (in Conemaugh Formation)[1]

Cow Run sandstone and shale member

Pennsylvanian (Conemaugh Series): Eastern Ohio and western West Virginia.

Original reference: J. J. Stevenson, 1906, Geol. Soc. America Bull., v. 17, p. 154.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 68. 70, table 1. Member of Barton cyclothem in report on Perry County. Includes about 30 feet of shale and sandstone lying between Portersville member of Anderson cyclothem and Ewing limestone member of Barton cyclothem. Dominantly interval contains brick-red or buff shale or interbedded sandstone and shale, but massive coarse-grained sandstone is locally present. Conemaugh series.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 42–45. Name Cow Run has been applied to almost any massive sandstone in middle part of Conemaugh series. Member, as defined by Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) and as adopted by Geological Survey of Ohio, includes an erratic sequence of sandstones and shales between the Portersville shale and limestone member below and Ewing limestone above; these latter units are not developed in many areas; hence, boundaries of Cow Run member usually are indefinite. Lithologically member varies from a massive sandstone to a series of sandstones and shales or to a sandy shale or clay shale section; facies changes are rapid. Thickness in Morgan County 30 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 124–127. Sandstone member of Upper Bakerstown cyclothem in report on Athens County. Name Cow Run was originally applied to an oil-bearing sandstone in shallow wells in Lawrence Township, Washington County, Ohio. Name has been used and misused for various Pennsylvanian sandstones, and today a First Cow Run sandstone (to which name was first given and one under consideration here), lying in interval between Ames and Cambridge limestone, and a deeper Second Cow Run sandstone (Lower Freeport), lying above Middle Kittanning coal, are recognized. Cow Run member under discussion here is commonly considered to be the local massive thick sandstone lying just above Anderson cyclothem and at some places cutting out and replacing members of that cycle. Here, Cow Run will be used not only for massive sandstone but also for bedded sandstone and shale lying between Portersville and Ewing members. Average thickness about 26 feet. Conemaugh series.

Named for stream in eastern Washington County, Ohio.

Cow Springs Sandstone

Upper Jurassic: Northeastern Arizona, southwestern Colorado, northwestern New Mexico, and southeastern Utah.

E. D. McKee *in* C. R. Longwell, 1949, Geol. Soc. America Mem. 39, p. 46 (fig. 6). Name appears on cross section of north side of Black Mesa, Ariz. Name credited to J. W. Harshbarger.

J. W. Harshbarger, C. A. Repenning, and R. L. Jackson, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 97–98. In Navajo country, Summerville formation, Bluff sandstone member, and Recapture shale member of Morrison grade laterally southwestward into district sand facies here named Cow Springs sandstone. Consists of greenish-gray to light-yellowish-gray fine-grained well-sorted cross-stratified well-cemented sandstone. Thickness at type locality 342 feet. Separated from overlying Dakota sandstone by erosional unconformity; thins southward to 112 feet at Coal Canyon and remains relatively thin eastward to Hopi Buttes area; 420 feet at Steamboat, Ariz.; 240 feet at Lupton, Ariz. Overlies Entrada sandstone.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 48–51. Because of its intertonguing relationships with Summerville formation and lower members of Morrison formation, Cow Springs cannot be considered either a formation in San Rafael group or a member of Morrison formation. Bluff sandstone is believed to be a tongue of Cow Springs, but, because of

its homogeneous and mappable character and its areal extent, it is considered a separate formation and assigned to San Rafael group.

Type locality: In cliff along north face of Black Mesa, Ariz., 4 miles east of Cow Springs along Reservation Highway 3. Section is 1¼ miles west of long 110°45′ W., and 6 miles south of lat 36°30′ N.

Cox Sandstone

Cox Sandstone (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 47.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1003. Described in northern Quitman Mountains where it is about 704 feet thick, overlies Bluff formation, and underlies Finlay formation.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 21–22. Described in Eagle Mountains, where it is 1,300 feet thick, underlies Finlay limestone, and overlies Bluff Mesa formation (name replaces preoccupied Bluff formation).

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 376–378. In Kent quadrangle, disconformably overlies Yearwood formation (new); underlies Finlay formation, here included in Sixshooter group (new). In eastern and northeastern parts of quadrangle, the Cox oversteps Permian Castile, Rustler, and Pierce Canyon formations. Thickness 130 feet.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 291. In northern Rim Rock country, underlies Tarantula gravel (new).

Named for Cox Mountain, El Paso County.

Coxcomb Granodiorite

Upper Jurassic(?): Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 64, pl. 3. Light gray; uniform in composition, structure, and texture. Cuts steeply dipping beds of McCoy Mountains formation (new).

Named for typical occurrence in middle part of Coxcomb Mountains, Riverside County, where it comprises an area of approximately 20 square miles.

Coxville Sandstone[1]

Coxville Sandstone Member (of Linton Formation)

Middle Pennsylvanian: Central western Indiana.

Original reference: G. H. Ashley, 1899, Indiana Dept. Geol. and Natl. Res. 23d Ann. Rept., p. 300–303, 385.

S. A. Friedman, 1960, Indiana Geol. Survey Prog. Rept. 23, p. 7, 23–28. Rank reduced to member status in Linton formation (Allegheny series). Thickness about 60 feet. Occurs at or near base of formation. Conformably overlain by (ascending) underclay, Coal IIIa, dark-gray and black shale, and thin limestone; underlain disconformably by shale above Coal III, by Coal III, or, where this coal has been completely eroded, by underclay or gray shale.

Named for outcrops north and east of Coxville, Parke County, approximately 15 miles north-northeast of Terre Haute.

Coyote Formation[1]

Eocene(?): Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Coyote Hills, near Plush, Lake County.

Coyote Sandstone Member (of Madera Limestone)[1]

Pennsylvanian: Central northern New Mexico.

Original references: C. L. Herrick, 1900, Jour. Geology, v. 8, p. 115; 1900, Am. Geologist, v. 25, p. 234–237; 1900, New Mexico Univ. Bull., v. 2, pt. 3, p. 1–14.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 21. Term poorly defined. Not possible to determine exact position of Coyote sandstone. Term should not be used.

Named for Coyote Springs, Sandia Mountains.

Coyote Butte Formation

Permian: Central Oregon.

C. W. Merriam, 1942, Jour. Paleontology, v. 16, no. 3, p. 372. Fusulinid-bearing limestones, sandy limestones, and sandstones, 900 feet thick. Unconformably underlies Triassic sandstones and conglomerates; unconformably overlies Pennsylvanian Spotted Ridge formation (new).

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 156–158. At type section, lower part of formation is light-olive-gray commonly crinoidal limestone, locally containing abundant fusulinids; higher in section, limestones become purer, finer grained, deep olive gray, and more distinctly bedded, and fusulinids become less common, brachiopods more abundant.

Type locality: Steeply dipping strata forming crest of Coyote Butte, near Paulina, Crook County.

†Coyote Mountain Clays (in Imperial Formation)[1]

Miocene, lower: Southern California.

Original reference: G. D. Hanna, 1926, California Acad. Sci. Proc., 4th ser., v. 14, no. 18, p. 435.

Type locality: In foothills bordering southeastern slopes of Coyote Mountains, Imperial County.

Coys Hill Granite[1]

Late Carboniferous or post-Carboniferous: Western central Massachusetts and southwestern New Hampshire.

Original reference: B. K. Emerson, 1898, U. S. Geol. Survey Mon. 29, p. 319–320, pl. 34, map.

Composes mass of Coys Hill, western central Massachusetts.

Cozy Dell Formation

Cozy Dell Shale Member[1] (of Tejon Formation)

Eocene, or Eocene, upper: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1928, Geol. Soc. America Bull., v. 39, p. 1090.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1931. Upper Eocene.

T. W. Dibblee, Jr., 1950, California Div. Mines. Bull. 150, p. 27–28, 38 (fig. 2), pls. 1–6. Formation described in Santa Ynez Mountains, Santa Barbara County, as well-bedded brown clay shale lying conformably on the Matilija sandstone and grading upward through a series of thin sandstone interbeds into the overlying Sacate sandstone. Thickness 700 to 2,000 feet.

Typically exposed in Cozy Dell Canyon, on east side of Ventura River, Ventura County.

Cozzette Member (of Price River Formation)

Upper Cretaceous (Montana): Central western Colorado.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 188, 191, fig. 2. In Neslen facies. Littoral marine sandstone and associated coal-bearing rocks which overlie Corcoran member (new) and are separated from it by tongue of Mancos shale which rests disconformably on coal-bearing rocks of Corcoran member. The basal sandstone grades downward into the Mancos tongue and is composed of two units with combined thickness of about 130 feet. This massive-bedded buff sandstone begins near Hunter Canyon and extends into Grand Mesa. Upper limit of member drawn at disconformity between coal-bearing rocks and overlying tongue of Mancos shale which, in turn, underlies Cameo member (new).

Named for exposures near old Cozzette mine north of Palisade, Mesa County. In Book Cliffs.

Crabbottom Sandstone

Silurian: Northwestern Virginia, western Maryland, and eastern West Virginia.

C. K. Swartz and F. M. Swartz, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2008. Proposed for a thick-bedded, whitish sandstone at base of Wills Creek formation. Overlies McKenzie formation near Driscol and Frost, W. Va. Widespread and apparently intertongues northward with Bloomsburg beds at base of Wills Creek in western Maryland.

Well exposed near Crabbottom, Va., 6½ miles northeast of Monterey, Highland County, along road leading from Strait Creek to Crabbottom.

Crab Creek Formation

Tertiary: North-central Utah.

R. E. Metter, 1955, Dissert. Abs., v. 15, no. 6, p. 1047. A piedmont deposit which may be lateral facies of Flagstaff and Colton formations. Younger than North Horn formation.

In area of southern Wasatch Mountains and northern Cedar Hills bounded by Spanish Fork Canyon, Utah Valley, Santaquin Canyon, Gardner Hollow, and Thistle Creek.

Crab Orchard cyclothem (in Carbondale Group)

Pennsyvalnian: Southern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 16, 17 (fig. 3). In list of cyclothems in southern Illinois, Crab Orchard occurs between Brereton above and St. David below. Includes coal No. 5A.

C. C. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 16 (fig. 2). Crab-orchard limestone shown on correlation chart below Herrin limestone and

above Absher limestone. Text states that "Craborchard" limestone is part of a cyclothem which includes the so-called No. 5A coal; name "Craborchard" is a field term which is not proposed as a permanent stratigraphic name.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 54 (table 3). Replaced by Briar Hill cyclothem (new).

Type locality and derivation of name not given.

Crab Orchard Formation

Crab Orchard Clay Shales

Crab Orchard Shale[1]

Lower and Middle Silurian: Central Kentucky and southwestern Ohio.

Original reference: W. M. Linney, 1882, Kentucky Geol. Survey Repts. on Garrard and Lincoln Counties.

J. K. Rogers, 1936, Ohio Geol. Survey, 4th ser., Bull. 38, p. 69–71, geol. map. Described in Highland County, Ohio, where it is from 30 to 95 feet thick, base not exposed. Occurs below Bisher and Lilley dolomites and above Brassfield and Dayton limestones.

Kentucky Geological Society, 1955, Kentucky Geol. Soc. Field Trip, p. 31 (fig. 11). Shown on generalized section of Serpent Mound region. Adams and Highland Counties, Ohio, as Crab Orchard clay shales; includes Estill member below and Ribolt member above. Thickness about 120 feet. Occurs below Bisher formation and above Dayton limestone.

U.S. Geological Survey currently classifies the Crab Orchard as a formation and designates the ages Lower and Middle Silurian on the basis of a study now in progress.

Named for Crab Orchard, Lincoln County, Ky.

Crab Orchard Sandstone

Pennsylvanian: Eastern Tennessee.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 36–37 An interval of evenly bedded hard sandstone younger than the Rockcastle. This sandstone, which has been extensively quarried near Crossville, is known commercially as Crab Orchard sandstone. It is proposed that it be called Crossville sandstone member of Duskin Creek formation since name Crab Orchard has been previously applied to a Silurian shale in Kentucky.

Occurs in syncline in Cumberland County west of Crab Orchard Mountains. Exposed on Pigeon Ridge Road, northwest of Byrd Creek, near Cumberland Homesteads CCC camp, about 6 miles south of Crossville.

Crab Orchard Mountains Formation

Crab Orchard Mountains Group

Lower Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], p. 1, 4, pls. 3, 4, 6. Includes all strata from top of Gizzard group to base of Crooked Fork group (new). At type section, approximately 640 feet thick; 300 feet in vicinity of Jamestown; 900 feet along eastern edge of Walden Ridge. Includes (ascending) Sewanee conglomerate,

Whitewell shale, Newton sandstone, Vandever formation, and Rockcastle conglomerate.

U.S. Geological Survey currently classifies the Crab Orchard Mountains as a formation on the basis of a study now in progress.

Type section: (Composite) along U.S. Highway 70N and the tracks of the Tennessee Central Railway Company where they cut across the Crab Orchard Mountains of Cumberland County.

Crack Canyon Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Listed as underlying Little Valley formation (new) and overlying Sulfur Creek formation (new). Comprises Grizzly Creek member above and Blue Ridge member (both new). The Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Craddock Clay Member (of Harpersville Formation)

Pennsylvanian (Cisco): North-central Texas.

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 21–23, pl. 3. Black or very dark gray hard compact joint clay weathering gray and in most places oxidizing upon exposure to pink, red, or maroon. Average thickness about 8 feet. Occurs as an under clay just below the Newcastle coal bed, which is below Belknap limestone. [Member of Harpersville formation.]

Named from the Craddock Farm and Craddock Lake, 1 mile northwest of Cisco, Eastland County.

Craftsbury Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for Craftsbury Township or one of villages of that name within that Township, in unnamed quadrangle in southern part of Orleans County.

Craggy Gneiss[1]

Triassic to Cretaceous: Southwestern Oregon.

Original reference: G. M. Butler and G. J. Mitchell, 1916, Min. Res. Oregon, v. 2, no. 2.

Hewitt Wilson and R. C. Treasher, 1938, Oregon Dept. Geology and Mineral Industries Bull. 6, p. 11 (fig. 3). Triassic to Cretaceous.

Composes West Craggy, Curry County.

†Craghead Creek Shale[1]

Upper Devonian: North-central Missouri.

Original reference: D. K. Greger, 1909, Am. Jour. Sci., 4th, v. 27, p. 375.

Named for Craghead Creek, 6 miles south of Fulton, Callaway County.

Crag Mountain Formation

Middle Paleozoic: North-central Massachusetts.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–92; Map GQ–93. Name proposed for formation consisting of four unnamed members.

Basal member is coarse-grained white or yellowish hard glassy quartzite; locally conglomeratic, containing abundant quartz pebbles and fragments of black cherty rocks and schist. The quartzite is irregularly distributed along the borders of the formation and is overlain by and locally interbedded with mica schist. Mica schist member is typically dark-gray, silvery, or black lustrous phyllitic schist; beds are isoclinally folded. Metagraywacke member overlying the mica schist is a succsesion of thick-bedded gray or greenish rocks; quartzose beds are separated by thin chloritic phyllite, fine-grained dark-green amphibolite, or by layers composed of quartz, garnet, epidote, hornblende and chlorite. Youngest member is a dark-green or greenish-gray well-foliated amphibolite; thin veins of quartz, albite, and epidote are common. Base of amphibolite member generally rests conformably on metagraywacke; locally, lenses of one occur in the other. This amphibolite occurring near village of Erving in the Millers Falls quadrangle was called Erving hornblende schist by Emerson (1917). Quartzite member overlies Poplar Mountain gneiss on west slopes of Brush and Crag Mountains.

Named for Crag Mountain in south-central part of Massachusetts part of the Northfield quadrangle, Massachusetts-New Hampshire-Vermont.

Craig Limestone Member (of Rogersville Shale)

Middle Cambrian: Eastern Tennessee.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim. Map. Named on map legend.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 10–11. Formally proposed for members near top of Rogersville. Thickness at Craig quarry 85 feet; here member is separated from overlying Maryville limestone by 17 feet of green shale; in general, member thins to west and northwest and thickens to east and southeast; a few miles east-northeast of Lee Valley section, overlying shale thins to disappearance, and the Craig merges with the lithologically similar Maryville. Name credited to Josiah Bridge.

Named from Craig quarry in southern part of village of Rutledge, Grainger County. Quarry is about 0.15 mile south of junction of U.S. Highway 11W and State Highway 92, near sharp turn of latter.

Craig Shale[1]

Pennsylvanian: North-central Oklahoma.

Original reference: G. C. Clark and C. L. Cooper, 1927, Oklahoma Geol. Survey Bull. 40H, fig. 3.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Approximates pre-Warner Pennsylvanian in Craig County.

Craigsville Limestone[1]

Lower Devonian: Central western Virginia.

Original reference: R. J. Holden, 1920, Geol. Soc. America Bull., v. 31, p. 137.

Probably named for Craigsville, Augusta County.

†Crainesville horizon (in Midway Group)[1]

Eocene, lower; Southwestern Tennessee and northeastern Mississippi.

Original reference: G. D. Harris, 1896, Bulls. Am. Paleontology, v. 1, no. 4, p. 18–25.

Exposed in vicinity of Crainesville, Hardeman County, Tenn., and also identified in northern Mississippi.

Cramer Limestone Member (of Modesto Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1), pl. 1. Proposed for unit formerly called Trivoli limestone. Name Turner limestone, informally used in northern Illinois, is discontinued because it is believed to be equivalent to the Cramer. Stratigraphically above Chapel (No. 8) coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: SW¼ sec. 3, T. 8 N., R. 5 E., Peoria County. Named for village of Cramer about 1⅓ miles southwest of type locality.

Cram Hill Formation

Middle Ordovician: Central Vermont.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1492, 1493–1496. Gray to black slate and phyllite grading downward into quartz-chlorite-sericite schist; thin to massive quartzite beds at bottom, herein named Harlow Bridge quartzite member. Siliceous volcanics at top; greenstone dikes locally abundant. Thickness from 1,500 to 2,600 feet. Underlies Shaw Mountain formation (new); overlies unnamed Ordovician(?) schists. Equivalent to upper part of "Missisquoi" schists of Richardson (1919).

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116. Lower Cambrian to Lower Ordovician.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Subdivision of the Missisquoi group of Richardson (1924, Vermont State Geologist Rept. 1923–1924).

Named for and well exposed on east slope of Cram Hill 3½ miles south-southeast of Roxbury, Barre quadrangle. Traced from Randolph about 27 miles north to point 2½ miles north of Montpelier.

Cranberry Gneiss

Cranberry Granite[1]

Cranberry Granite Gneiss

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 3.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 17–18; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. As mapped, Cranberry granite gneiss consists essentially of Cranberry granite as named by Keith (1903) and further described by him [see bibliography of this reference]. Keith considered the Cranberry granite as igneous in origin, Archean in age, and intrusive into older formations. As considered here, the unit, whatever its origin, is essentially gneiss which grades at places into schist. Near Linville Falls, McDowell

County, it is in contact with Henderson granite gneiss, and the two units are considered to be stratigraphically equivalent. Precambrian(?).

Named for development at Cranberry in Mitchell, now Avery County, N.C. In North Carolina, occurs as strips and patches in the mountain region along northwestern border of State from near Asheville to Virginia line.

Cranberry Island Series[1]

Cranberry Island volcanic facies (of Frenchmans Bay Series)

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1042–1047, 1059, 1061, and map.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Considered a facies of the Frenchmans Bay series (new). Interfingers with and is of same age as Bar Harbor detrital facies. Silurian.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 173. Volcanic facies consists of felsite (and porphyry) flows and ash beds with tuffs and amygdaloids. Developed extensively in the southern part of Mount Desert Island.

C. A. Chapman and P. S. Wingard, 1958, Geol. Soc. America Bull., v. 69, no. 9, p. 1194 (table 1). Middle or Upper Silurian.

Named for development in Great Cranberry and Little Cranberry Islands, south of Mount Desert Island, Hancock County.

Crandall Conglomerate

Eocene: Northwestern Wyoming.

W. G. Pierce, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 592–593 (fig. 1), 609–613. Stream-channel deposit of coarse conglomerate. At northwestern end of deposits the Crandall rests on Upper Cambrian; just south of Squaw Creek, conglomerate in middle part of channel rests on Pilgrim limestone, and toward sides of channel contact rises stratigraphically until conglomerate rests on Grove Creek formation. South of Squaw Creek, maximum thickness about 350 feet.

Type locality: South side of Squaw Creek about 2 miles above its junction with Clarks Fork, Park County. Fourteen areas of outcrop are spread over a linear distance of 20 miles.

Crane Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43 p. 153 (fig. 2), 154. Name proposed for the relatively fine-grained basal member of the formation. Type section extends from depths of 3,105 to 3,845 feet. Thickness 620 to 740 feet. Overlies a 245-foot arkosic zone above Precambrian granite; underlies Kenyon member (new).

Type well: Wyman No. 1 (well 7), in NE¼NE¼SE¼ sec. 35, T. 41 N., R. 5 E., DeKalb County. Name derived from Crane School, 4 miles south of type well.

Crane Creek Gravel

Pleistocene (Yarmouth): Northeastern Montana and northwestern North Dakota.

A. D. Howard, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 580–581. Characterized by distinctive brown water-worn pebbles. Contains many glacial pebbles of northeastern origin. Caps a broad strath terrace, the Crane terrace, within the major valleys.

A. D. Howard, 1960, U. S. Geol. Survey Prof. Paper 326, p. 19 (table 3), 20 (fig. 9), 21–23, pl. 1. Gravel and interbedded sand on Missouri Plateau peneplain. Thickness about 30 feet; average 10 to 15 feet. Similar to older and higher Flaxville and Cartwright gravels.

Named after Crane Creek, a tributary of the Yellowstone River near town of Crane in southern Richland County, Mont.

Cranesville Dolomite or Formation

Lower Ordovician (Upper Canadian): East-central New York.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 77, 92–93. Name proposed for thin- to thick-bedded grayish-brown dolomites alternating with sandy and silty dolomites and dolomitic siltstone. Thin seams of sandy shale rare. Basal stratum invariably a feldspathic sandstone (or subgraywacke). Lower part of formation coarse-grained blue-gray variegated silty dolomite. Upper part characterized by coarse light-tan dolomarenites and dolomitic siltstone. Maximum thickness 70 feet; thins rapidly eastward and westward. Unconformably overlies Chuctanunda Creek dolomite (new).

Type locality: Along Swartztown Creek 0.6 mile east of Cushing quarry which is just east of the Niagara-Mohawk power station at Cranesville, Montgomery County.

Cranktown Sandstone[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures at a small group of prospectors' cabins, locally called Cranktown, on Silver Creek about 1 mile below Mogollon, Catron County.

Cranston Beds[1]

Pennsylvanian: Eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 159–164.

Occur in southwestern part of Cranston Township, Providence County.

Crater Creek Basalt

Pleistocene or Recent: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 3, p. 25–26, pl. 3. Series of basalt flows with beds of tuff and tuff-breccia, the products of explosive eruptions, making up small part of unit. Most flows massive, but a few blocky and brecciated. Top and bottom of individual flows commonly flow breccias, 5 to 20 feet thick, consisting of red oxidized lava fragments. Individual basalt flows from 10 to 70 feet thick. Flow rocks are fine-grained basalt containing few or no phenocrysts. Youngest flows display well-developed flow structure. Tuff and tuff-breccia are medium gray on fresh surfaces and weather light reddish yellow. Maximum thickness 1,300 feet. Basalt thickens away from Okmok caldera in northern part of mapped area, indicating that many flows probably emitted from vents

well down the flanks of Mount Okmok. Overlies Tulik and Ashishik basalts (new); underlies Tanak volcanics (new). Mapped as Tertiary and Quaternary.

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 313–314, pl. 41. Youngest unit of precaldera age. Originally defined to include uppermost aphyric basalt flows on outer slopes of Okmok Volcano, but is herein restricted to sequence of basalt flows exposed in Crater Creek Gorge and in north wall of Okmok Caldera to west. Fault separates the Crater Creek in north wall from Ashishik basalt where north arcuate ridge intersects Okmok Caldera. Separated from Ashishik basalt by erosional surface. Consists of at least 15 separate flows with total exposed thickness of 500 feet. Older than Okmok volcanics. Latest Pleistocene or early Recent.

Crater Creek Gorge, on north wall of Okmok Caldera, Umnak Island.

Crater Lake dacites, lavas, flows, series.

General terms applied to rocks of Crater Lake region.

Crater Lake Pumice.

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 68–98, 115. Map shows distribution and thickness of Crater Lake pumice. The pumice is of two kinds, pumice flows and pumice fall. Main pumice fall was part of culminating activity of Mount Mazama. Finely divided dacite pumice which was projected high above summit of volcano drifted afar and was winnowed by winds. Earlier pumice fall was followed by explosions in which pumice escaped from crater in too large a volume and too rapidly to be thrown far into air but fell en masse on upper slopes of volcano and swept downward into the canyons and across surrounding flats as glowing avalanches. Some of these flows are: Annie Creek, Sun Creek, Sand Creek, Rogue River, and Castle Creek.

I. S. Allison, 1945, Geol. Soc. America Bull., v. 56, no. 8, p. 789–808. Discussion of pumice beds at Summer Lake, Oreg. Here, section shows six beds of pumice. Four of these appear to record eruptions of Mount Mazama. On basis of lacustrine sedimentation, the first layer of Mount Mazama pumice would be a little more than 14,000 years old, and age of main Crater Lake pumice layer about 500 years less than that. These are older than eruption of Newberry pumice.

H. P. Hansen, 1946, Am. Jour. Sci., v. 244, no. 10, p. 710–734. Discussion of postglacial succession and climate in Oregon Cascades. Figure 1 is map showing distribution of Mount Mazama pumice. [This is adapted from Williams' (1942) map (fig. 16) which shows distribution and thickness of Crater Lake pumice.]

Covers area around Crater Lake.

Crater Peak Basalt Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 33–34. Name applied to basalt flow on Crater Peak. [See Timber Crater Basalt Flow].

Crater Peak is south of Crater Lake.

Cravatt Formation (in Kite Group)

Cravatt Member (of Bois d'Arc Limestone)

Silurian and Devonian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 134. Defined as upper part of Kite group (new). Consists of hard cherty lithographic and argillaceous limestones and slates. Average thickness 60 to 75 feet. Conformably underlies Bois d'Arc limestone; conformably overlies Haragan formation.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 4 (fig. 3), 7, 41–45, fig. 4. Rank reduced to member of Bois d'Arc formation. Overlies Haragan formation; base of Cravatt arbitrarily placed at base of lowest cherty bed of any appreciable thickness. Underlies Fittstown member (new) of Bois d'Arc limestone. Silurian and Devonian. Type locality given.

Type locality: NE¼SW¼SW¼ sec. 2, T. 2 S., R. 7 E., Pontotoc County. Name taken from original allotment owner, Katy Cravatt.

Crawford Series[1] or Subseries[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 40–46.

†Crawford Shale[1]

Devonian(?) and Mississippian: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1879, Pennsylvania 2d Geol. Survey Rept. I_3 Atlas, pl. 11.

Named for occurrence in Crawford County.

Crazy Hollow Formation

Eocene, upper, or Oligocene, lower: Central Utah.

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 36–37, [pl. 1]. Red and orange sandstone, siltstone, and shale, white sandstone, and pepper-and-salt sandstone. Thickness about 600 feet in Crazy Hollow. Overlies Green River formation and underlies Gray Gulch formation (new) with disconformable contacts. Age not known, but probably Eocene and may be late Eocene.

W. N. Gilliland, 1952, American Assoc. Petroleum Geologists Bull., v. 36, no. 7, p. 1461, 1464. Of late Eocene or early Oligocene age.

C. T. Hardy, 1952, Utah Geol. and Mineralog. Survey Bull. 43, p. 41 (table 1). Eocene.

Type locality: In Crazy Hollow, where it forms lower walls of the gulch beginning a short distance above its mouth and is more completely exposed than anywhere else as far as known. Crazy Hollow gulch is on south side of Salina Canyon next west of mouth of Soldier Canyon, about 2½ miles from Salina [Sevier County].

Crazy Johnson Member (of Chadron Formation)

Oligocene, lower: Southwestern South Dakota.

John Clark, 1954, Carnegie Mus. Annals, v. 33, art. 11, p. 197. Designated as middle member of formation. Underlies Peanut Peak member (new); overlies Ahearn member (new). Author previously described unit as "Middle Member" of Chadron.

Type locality: At standard section of Chadron formation in Big Badlands on south fork of Indian Creek, Pennington County, from sec. 34, T. 3 S.,

R. 12 E., to sec. 10, T. 4 S., R. 12 E. Named from prominent butte in southern part of sec. 10, T. 4 S., R. 12 E.

†Crazy Mountain Beds[1]

Upper Cretaceous and Paleocene: Montana.

Original reference: G. H. Eldridge, 1886, U.S. Tenth Census, v. 15, maps 50 to 54.

In Crazy Mountains, Little Belt Mountains quadrangle.

Crazy Mountain Granite[1]

Eocene: Central southern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

Occurs over considerable area in Crazy Mountains, Little Belt Mountains quadrangle.

Creal Springs Limestone Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32–33, 45 (table 1), 65, pl. 1. Proposed for limestone previously correlated with Curlew limestone but now considered to be younger. Weathers reddish buff, dense, hard, fossiliferous; thins to north. Thickness about 1½ feet. Stratigraphically above Granger sandstone member (new) and below Mount Rorah coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼SE¼SE¼ sec. 25, T. 10 S., R. 3 E., Williamson County. Exposed just above top of sandstone quarried east of Creal Springs.

Creal Springs Sandstone (in Tradewater Group)

Pennsylvanian: Southern Illinois.

W. H. Smith, 1957, Illinois Geol. Survey Circ. 228, p. 8 (fig. 2), 9. Sandstone overlying Upper New Burnside coal and immediately underlying Curlew limestone. Name credited to P. E. Potter (1957, unpub. ms.).

Exposed in vicinity of Creal Springs, T. 10 S., R. 3 E., Johnson County.

Creede Formation[1]

Tertiary, middle or upper: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull 718.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 167–172, pl. 1. Comprises two members: lower, made up entirely of fragmental material, greater part of which was deposited by water; much of material is thinly laminated white shaly tuff, part is sandy and part is breccia and conglomerate; interbedded with tuff of lower member are beds of travertine; upper member coarser than lower member and made up mainly of well-bedded breccia. No satisfactory estimate of thickness made; structure is uncertain; top of formation nowhere preserved; and base exposed only on steep sides of basin. About 500 feet of lower member exposed on both sides of Willow Creek below Creede; neither top nor base shown; east of

Creede, where top of lower member is preserved, about 900 feet are present; about 1,000 feet of upper member exposed east of Windy Gulch. Cut by and underlies Fisher quartz latite. Overlies Potosi volcanic series (Piedra rhyolite). Upper Miocene.

U.S. Geological Survey tentatively considers the Creede formation to be middle or late Tertiary in age.

Named for development on slopes of both sides of Willow Creek about town of Creede, Mineral County.

Crekola Sandstone Member (of Boggy Shale)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 52–53. Bedded brownish sandstone, 4 to 10 feet thick. Lies about 10 feet below Inola limestone and about 6 feet above Secor or Upper Witteville coal.

Named for village of Crekola, in E½ sec. 10, T. 14 N., R. 17 E., Muskogee County.

Creola Member (of Yegua Formation)

Eocene (Claiborne): Central Louisiana, eastern Mississippi, and eastern Texas.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, pt. 2, p. 879 (fig. 133), 881. Name applied to beds of upper Yegua which contain unmistakable marine indicators, such as marine fossils, glauconite, limestone layers, or fucoids. This part of the Yegua has been referred to as a "transition zone" between the typical Yegua and typical Jackson. Thickness varies from 10 feet at Garland's Creek, Clarke County, Miss., to 40 feet at Pineland, Tex.; at type locality 32.4 feet. Bounded at top by a widespread clear-cut sharp disconformity on which the lower Jackson rests; at base, grades into typical nonmarine Yegua beds; west of Pineland, Creola outcrops become more and more nonmarine and fade into uppermost Yegua beds.

Type locality: Creole Bluff, near Montgomery, Grand Parish, La. Old town of Creola was built on the bluff in 1850.

Cresaptown Iron Sandstone[1] (in Rose Hill Formation)

Cresaptown Sandstone Member (of Clinton Shale)

Silurian (Niagaran): Western Maryland.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey, Silurian Volume, p. 28–31.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 73. Referred to as Cresaptown iron sandstone member of Clinton shale or formation.

Well exposed at Cresaptown 6 miles southwest of Cumberland, Allegany County.

Crescent Formation[1]

Eocene, lower(?) and middle: Northwestern Washington.

Original reference: R. Arnold, 1906, Geol. Soc. America Bull., v. 17, p. 451–468, map.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 25 (table), 40–45. At time of first investigation, the occurrence

of Metchosin volcanics on Vancouver Island was unknown, and stratigraphic and structural relationships of the lavas and tuff at Crescent Bay to those along north side of Lake Crescent were not understood; in original description, these basaltic lavas together with the water-laid tuff were considered as a single formation. Recent studies indicate that the marine tuffs, shales, and sandstones which rest stratigraphically upon strictly volcanic part of formation and beneath Lyre conglomerates (new) should be segregated. Contact between underlying lava flows referred to as Metchosin volcanics and overlying marine phase in which volcanic products are mainly represented by tuffs is sharp and clearly defined. It is proposed to include within Crescent formation these upper tuffs and sedimentary deposits. Thickness about 1,000 feet. Includes Boundary shale (new) in uppermost part. Unit confined to northern border of Olympic Peninsula where it is represented in northern and southern limbs of Clallam syncline.

R. D. Brown, Jr., H. D. Gower, and P. D. Snavely, Jr., 1960, U.S. Geol. Survey Oil and Gas Inv. Map OM–203. As used in this report [Port Angeles-Lake Crescent area], name Crescent formation is extended to include entire sequence of volcanic rocks of which Arnold's type locality is small but generally typical part. Volcanic rocks of formation form belt from 2 to 5 miles wide, trending about N. 80° W., that extends from near Mount Muller southeastward to Round Mountain and form high ridges along south limb of Clallam syncline. Thickness difficult to estimate; more than 10,000 feet near east end of Lake Crescent. Underlies and interfingers with Aldwell formation (new). Overlies and interfingers with argillite and graywacke. Middle and possibly early Eocene.

Named for occurrence in vicinity of Port Crescent.

Crescent City Beds[1]

Crescent City facies (of St. George Formation)[1]

Miocene and Pliocene: Northwestern California.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 31–35.

William Back, 1957, U.S. Geol. Survey Water-Supply Paper 1254, p. 21. Facies of St. George Formation. Outcrop of Crescent City beds no longer above sand and water level.

Occurs from Smith River to 3 miles south of Crescent City, Del Norte County.

Crescent Cliffs Flow, Lava, Dacite

Cenozoic: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 309–310, geol. map. Discussed under general heading pre-Lassen dacite flows which include Manzanita dacites, Loomis Peak flow, Black Butte flow, and other similar units.

Mapped in vicinity of Crescent Cliffs on western side of Mount Lassen.

Crescent Crater Dacites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 675. Cenozoic.

Occur in Lassen National Park.

Crescent Hill Basalt

Miocene and (or) Pliocene: Northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 17–19, 78 (table 9), pl. 4. Coarse olivine basalt. Much of the olivine has changed to serpentine, and much of the pyroxene to uralite. Varies from brown to gray, although some exposures are colored brilliant red or yellow by surface growths of minute plants. Rock is massive to platy Platy character due to closely spaced shear surfaces. Most fractures are healed with silica, which also forms regular and irregular nodules and geodes many of which contain well-developed quartz crystals. Black color of fresh surfaces and coarse texture are in contrast to color and texture of Geode Creek basalt (new). Maximum thickness of 60 to 80 feet.

Typically exposed on summit of Crescent Hill from which it takes its name; Yellowstone National Park.

Cresswell Limestone Member (of Winfield Limestone)

Cresswell Limestone (in Chase Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 51.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Consists of limestone and locally shale in upper and middle parts and massive fossiliferous limestone in lower part; upper part, which has been called "Luta limestone" is thinner bedded and more shaly. Throughout a considerable distance, the lower massive ledge is almost constantly 3 feet thick. Total thickness of member commonly about 17 feet. Overlies Grant shale member; underlies Odell shale. Wolfcamp series.

Type locality: East side of golf course, in NE¼ sec. 18, T. 34 S., R. 4 E., on north side of Arkansas City, Cowley County, Kans.

Crest Hill Granite

Precambrian: Northern Virginia.

L. R. Thiesmeyer, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1963. Four major Precambrian granitic bodies, representing extensive batholiths of the western Piedmont, have been delineated; in order of intrusion, these are Lovingston gneiss, hypersthene granodiorite, Crest Hill granite, and Marshall granite (redefined).

Occurs in western Piedmont in Fauquier County.

Creston Formation

Creston Quartzite[1]

Precambrian (Belt Series): Northwestern Montana and northern Idaho, and southeastern British Columbia, Canada.

Original references: R. A. Daly, 1905, Canada Geol. Survey Summ. Rept. 1904, p. 96–100; 1905, Am. Jour. Sci., 4th ser., v. 20, p. 186.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 6 (fig. 4). Formation shown on correlation chart for the Belt series in northern Idaho.

Named for station on Canadian Pacific Railway (in Kootenay Province, southeastern British Columbia). Occurs at international boundary, 49th parallel, in section from Port Hill, Idaho, to Gateway, Mont.

Creston [Formation]

Eocene, upper: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Creston Red Shale

Creston Shale (in Washington Formation)[1]

Permian (Dunkard Series): Western West Virginia and southeastern Ohio.

Original reference: R. V. Hennen, 1911, West Virginia Geol. Survey Rept. Wirt, Roane, and Calhoun Counties, p. 154.

J. B. McCue and others, 1948, West Virginia Geol. Survey [Rept.], v. 18, p. 9. Creston red shale, maximum thickness 60 feet, occurs between upper and lower Marietta sandstones, about 300 feet above base of Dunkard series. Commonly contains limestone nodules and locally interstratified with sandstone.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Creston shale, in Washington formation, listed in stratigraphic summary of Dunkard group in Harrison County. Thickness 30 to 65 feet. Above Middle Washington limestone and below Washington "A" coal and (or) fire clay and black carbonaceous shale.

Named for occurrence at Creston Flats, 1 mile east of Creston, Wirt County, W. Va.

Crestone Conglomerate Member (of Maroon Formation)

Crestone Conglomerate Member (of Sangre de Cristo Formation)

Crestone conglomerate phase[1] (of upper Sangre de Cristo Conglomerate)

Pennsylvanian or Permian: Southern central Colorado.

Original reference: F. A. Melton, 1925, Jour. Geology, v. 33, p. 812.

John Chronic, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 63. Proposed that name Sangre de Cristo be dropped and that prior name Maroon be applied to equivalent coarse redbeds, at least as far south as La Veta Pass. Conglomeratic unit in upper part of formation is about 6,000 feet thick in vicinity of Crestone, where it has been called Crestone conglomerate "phase," more appropriately member, of Sangre de Cristo formation (now Maroon formation). Very local in occurrence, disappearing both southward and northward within a distance of about 10 miles.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1923, 1924–1925, 1933. Referred to as member of Sangre de Cristo formation. Overlies lower unnamed member. Formation considered to be late Pennsylvanian(?) and probably Permian (Wolfcamp).

Well exposed near Crestone, Sangre de Cristo Range.

Creta Dolomite (in Blaine Formation)[1]

Permian: Southwestern Oklahoma.

Original reference: G. G. Suffel, 1930, Oklahoma Geol. Survey Bull. 49, p. 29–40, 42, 47, 48, 63.

Named for station of Creta, in western part of Jackson County.

Crete Formation

Crete Formation (in Sanborn Group)

Crete Member (of Sanborn Formation)

Pleistocene: Nebraska and Kansas.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1947, Nebraska Geol. Survey Bull. 15, p. 24–25 Name applied to unit which Lugn (1935) [1934] classified as "valley phase" of Loveland formation. A channel fill deposit which rests unconformably upon Upland formation or older Pleistocene deposits and is believed to be Illinois in age. Consists of sand, light-pinkish-brown in upper part, brownish-gray in middle, light-brownish-gray in lower part; grading from medium- to coarse-grained sand with fairly common fine to medium gravel in lower part, to fine to medium sand with rare fine gravel and fairly common silt in upper part; thin zone (1 to 2 inches) of red-brown iron-stained sand at base. Thickness 8 to 9½ feet. At type locality, underlies Loveland formation.

J. C. Frye and A. B. Leonard, 1949, Kansas Geol. Survey Bull. 81, p. 42–43; 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 110–115. Extended into Kansas where it is basal member of Sanborn formation. Underlies Loveland member.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 24–25. Overlies Sappa formation which name replaces Upland formation of Lugn.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, p. 55 (fig. 1). Formation at base of Sanborn group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as Crete formation. [Kansas does not use term Sanborn group.]

Type locality: In roadcuts along State Highway 33 about 1½ miles west of main intersection at Crete, Saline County, Nebr., in NE¼ sec. 32, T. 8 N., R. 4 E.

Crevasse Canyon Formation (in Mesaverde Group)

Upper Cretaceous: Northwestern New Mexico.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 91–92, pls. 1, 11. Name applied to sedimentary units which lie between top of Gallup sandstone and base of Point Lookout sandstone. Thickness 420 to 620 feet in northern sections; thickens to south of Crevasse Canyon, as it replaces rapidly thinning Point Lookout, to about 700 feet at type section. Includes three members: Dilco, Dalton sandstone (tongue), and lower Gibson.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2149, 2156–2157. In revised nomenclature of Mesaverde group in San Juan Basin, Crevasse Canyon formation is accepted for that part of group between Gallup and Point Lookout sandstones, with Gibson coal member (restricted) at its top; also includes Dilco coal, Dalton sandstone, and Bartlett barren members. For purposes of New Mexico State geologic map and other regional geologic maps now in preparation, contact between Crevasse Canyon and Menefee formations is arbitrarily shown at top of undivided Gibson and Cleary coal members in area of outcrop in which Point Lookout sandstone is missing.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 181, 188 (fig. 2), 191, 195. Winchester's (1920) Bell Mountain sandstone member at top of his Miguel formation in Alamosa Creek Valley area, Socorro and Catron Counties, is upfaulted duplication of his Gallego sandstone member, from which it had been supposed to be separated by nearly 1,000 feet of beds. Winchester's names Miguel formation, Chamiso formation, and Bell Mountain sandstone are abandoned and stratigraphic names in use in San Juan Basin are extended to units recognized in Alamosa Creek area. Winchester's Chamiso formation was properly defined and as it included only that part of the Mesaverde rocks above his Bell Mountain sandstone, it was not involved in duplication of section that requires abandonment of Miguel formation. Most of it, however, represents the Crevasse Canyon formation, including Dilco coal member at base and representatives or equivalents of Mulatto tongue of Mancos, overlying Dalton sandstone member, and Gibson coal member. Chamiso is abandoned in favor of Crevasse Canyon for Alamosa Creek area even though overlying Point Lookout sandstone or its equivalent has not been positively identified.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 7 (fig. 2), 18, 20, 22, 23, pl. 1. In Puertecito quadrangle, overlies La Cruz Peak formation (new) and underlies Baca formation.

Type locality: Exposures north of Catron Creek, about 3 miles southwest of mouth of Crevasse Canyon, Tohatchi quadrangle.

Crill terrane[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148, 150.

Named for old site of Crill mill, on Sioux River, Sioux City, Woodbury County.

Criner Formation[1]

Middle Ordovician: Central southern Oklahoma.

Original reference: E. O. Ulrich, 1930, U.S. Nat. Mus. Proc., v. 76, art. 21, p. 73.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Unit may be the Corbin Ranch formation of Harris (1957) and may include the Pooleville member of the Bromide formation (Cooper, 1956).

Named for exposures at south end of Criner Hills, south of Overbrook, Love County.

Crinerville Limestone (in Hoxbar Group)

Crinerville Limestone Member (of Hoxbar Formation)[1]

Pennsylvanian (Missouri Series): Southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p 15.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on chart as limestone in Hoxbar group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 41–42. Criner-

ville beds (or member) of Hoxbar group comprise a basal buff sandstone, a calcareous shale, and a limestone at top, each with maximum thickness of at least 30 feet. Crinerville beds are 400 to 500 feet above base of Hoxbar group and 400 to 500 feet below Anadarche beds or member. Confederate limestone is at base of Hoxbar.

Type locality: Near center of W½ sec. 28, T. 5 S., R. 1 E., near Crinerville Schoolhouse, Carter County.

†Cripple Creek Breccia[1]

Tertiary: Central Colorado.

Original reference: W. Cross, 1896, Colorado Sci. Soc. Proc., v. 5, p. 30.

Cripple Creek district, Teller County.

Cripple Creek Granite[1]

Precambrian: Eastern Colorado.

Original reference: E. B. Mathews, 1900, Jour. Geology, v. 8, p. 214–240.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 29. As used in this report, Cripple Creek granite of Pikes Peak quadrangle is included in Silver Plume granite.

Characteristically developed in area to west of line drawn from Lake George to town of Cripple Creek and thence in a somewhat sinuous line to waters of Oil Creek, Pikes Peak region.

Cripple Deer Sandstone Member (of Alsobrook Formation)[1]

Upper Mississippian: Northwestern Alabama and northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Included in Tanyard Branch member of Pride Mountain formation (both new). Alsobrook stratigraphically restricted above and reduced to member status in Pride Mountain formation.

Type locality: Along highway on north side of Cripple Deer Valley, Colbert County, Ala.

Crisfield Sandstone Member (of Salt Plain Formation)

Permian: Southern Kansas.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1788; R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 159. Sandstone about 29 feet thick occurring about 115 feet below top of formation. Name credited to G. L. Knight.

Outcrops in Harper and Barber Counties.

Cristobal limestone[1]

Ordovician: Southern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 6.

In Franklin, Caballos, Fra Cristobal, and Mimbres Ranges.

Critzer Limestone[1] (in Swope Limestone)

Critzer Limestone Member (of Hertha Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas and western Missouri.

Original references: J. M. Jewett, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 99, 100, 103; R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 90, 97.

J. M. Jewett, 1940, Kansas Geol. Survey Bull. 30, p. 9. Reallocated to member status in Hertha limestone.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. The Hertha differs from previous usage of Missouri Survey by inclusion of Critzer limestone and Mound City shale members.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 90. Consists of massive brownish-gray granular partly algal limestone and thin wavy-bedded gray limestone. Thickness ranges from featheredge to about 11 feet. Basal member of Hertha. Underlies Mound City shale member; overlies Pleasanton group.

Type locality: In sec. 17, T. 22 S., R. 23 E., south of Critzer, Linn County, Kans.

Croasdale Quartzite[1]

Silurian: Northeastern Pennsylvania.

Original reference: A. W. Grabau, 1913, Geol. Soc. America Bull., v. 24, p. 479.

Kittatinny Valley, Delaware Water Gap region.

Croatan Sand[1]

Croatan Formation

Pliocene, lower: Eastern North Carolina.

Original reference: W. H. Dall, 1892, Wagner Free Inst. Sci. Trans., v. 3, pt. 2, p. 209, 213–216.

F. S. MacNeil, 1938, U.S. Geol. Survey Prof. Paper 189–A, p. 19. Croatan sand of U.S. Geological Survey usage is of Pliocene age. Dall's original material from "Croatan beds" is mixture of Pliocene and Pleistocene and was probably collected along river for a distance of several miles. No Pliocene is exposed in bluffs of Neuse River nearest Croatan itself, so that type section for Croatan sand cannot be recognized there. Best section of Pliocene in region is exposed on property of Mr. Hastings on right bank of Neuse River, 2 miles below James City, Craven County, and this might be regarded as type section of Croatan sand.

R. F. Flint, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 543. In places along coast from the Carolinas to Florida are marine deposits of undoubted Pliocene date, with faunas that imply relatively warm water temperatures. These include the Croatan, Waccamaw, Charlton, and Caloosahatchie formations.

Type section (MacNeil): On property of Mr. Hastings on right bank of Neuse River, 2 miles below James City, Craven County. Named for exposures around Croatan. near Neuse River, Craven County.

Crockett Formation (in Claiborne group)

Crockett Member (of Claiborne Formation)[1]

Eocene: Eastern Texas and northwestern Louisiana.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 124–158 [1939]. Formation described in Leon County where it includes (ascending) Wheelock marl, Landrum shale, Spiller sand, and Mount Tabor members (all new). Overlies Stone City formation; underlies Yegua formation. Thickness about 385 feet. Middle Eocene.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ Geology Pub. 3945, p. 847–904. Yegua-Crockett boundary discussed.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1663. Crockett formation replaced by term Cook Mountain formation.

G. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 13–20. In Leon County, formation includes (ascending) Stone City, Wheelock, Two Mile (new), and [Mount] Tabor members.

Type locality: Vicinity of Crockett, Houston County, Tex.

Croghan Syenite Granite Complex[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1919, New York State Mus. Bull. 207, 208, p. 102–110, map.

Probably named for village of Croghan, Lewis County.

Croixan[1] or Croixian[1] Series

See **St. Croixan Series.**

Crook Formation

Upper Devonian: Central Arizona.

E. N. Harshman *in* M. N. Short and others, 1943, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 27. As originally described by Ransome, Martin limestone in Bisbee area contained a fauna similar to that of Hackberry shale of Iowa. Stoyanow noted that in Superior area a section of Upper Devonian limestone with interbedded clastic sediments is present below the true Martin limestone. These beds contain invertebrate fauna similar to that of Cedar Valley limestone. This lower part of Martin limestone section is here termed Crook formation.

Named after its locality in the Crook National Forest, Superior mining area.

Crooked Creek Chert Bed (in Cotter Dolomite)

Lower Ordovician: Northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 35, pls. 2, 9. Interbedded chert and dolomite; chert is very dark bluish gray, almost black, and occurs in three layers. Occurs near top of lower half of formation and stratigraphically below Jenkins Branch chert bed (new).

Well exposed on Arkansas State Highway 101 just above the north approach to the bridge at Crooked Creek, 2½ miles southwest of Cotter, Baxter County.

Crooked Creek Formation

Lower Cretaceous: Central southern Montana and central northern Wyoming.

R. M. Moberly, Jr., 1958, Dissert. Abs., v. 18, no. 1, p. 198. Sandstones and thinly interbedded rusty-brown-weathering siltstones, dark shales,

and ironstones. Disconformably overlies Lovell member (new) of Cloverly formation; gradationally underlies Thermopolis shale.

In Bighorn Basin.

Crooked Creek Formation (in Meade Group)

Pleistocene: Southwestern Kansas and northwestern Oklahoma.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 69 (fig. 1), 70–73. Proposed for sediments laid down during cycle of deposition which followed Meade formation; includes the following succession (ascending): (1) sands and gravels, (2) silt, (3) Pearlette ash, and (4) overlying deposits up to and including a well-developed caliche; as thus defined, includes Stump Arroyo member (new) at base. Type locality for the Crooked Creek is the same locality that was designated by Frye and Hibbard (1941) as type locality of Meade formation; it is now known that beds to which Cragin (1896) applied name Meade formation do not occur in this sequence of Pleistocene deposits but belong to an older series of Pleistocene beds.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 56, 57, 58. Top formation in Meade group. Comprises (ascending) Stump Arroyo member, Pearlette ash lentil, and Atwater member (new). Thickness as much as 60 feet. Overlies Ballard formation (new); underlies Kingsdown formation.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 57–58, pl. 2. Name Crooked Creek formation is applied in Harper County to gravels, sand, silt, and Pearlette volcanic ash lentils which unconformably overlie Ogalalla formation and Whitehorse group and are generally blanketed by post-Crooked Creek sand dune. Pearlette ash, which is only recognizable unit, forms a 13-foot lenticular bed in NW¼ sec. 10, T. 28 N., R. 26 W., but is absent elsewhere in county. Thickness 0 to 70 feet.

Type locality: S½ sec. 16, W½ sec. 15, and N½ sec. 21, T. 33 S., R. 28 W., on east side of Crooked Creek, Meade County, Kans.

Crooked Fork Group

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 6, pls. 3, 4, 6. Includes all strata between top of Crab Orchard Mountains group (new) and base of Slatestone group (new). Consists of alternating sequence of three sandstones and three shales. Northwest of type area, upper and lower sandstones converge so that in northern part of Barthell Southwest quadrangle group is essentially thick conglomerate overlying Rockcastle conglomerate. Thickness at type locality 360 feet; on Cumberland block 150 to 330 feet. Includes (ascending) Dorton shale (new), Crossville sandstone, Burnt Mill shale (new), Coalfield sandstone (new), Glenmary shale (new), and Wartburg sandstone. Rex coal present near base and Poplar Creek coal at top.

Type section: Southeastward from Wartburg and along Crooked Fork, Morgan County.

Crooked Lake Granite Pebble Conglomerates

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1615. Name applied to coarse granite pebble conglomerates that

were deposited on the arkosites and graywackes which rest directly on the Saganaga granite. Some 12-inch Saganaga granite boulders are common in the middle or top of the conglomerate as well as at the bottom. Conglomerates reach a thickness of nearly three-fourths of a mile, or one-half that much where isoclinally folded over their width in sec. 36, T. 66 N., R. 6 W. Conglomerate is limited by a fault on western margin. In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Crooked Lake conglomerate as unit 15 occurring above Ester Lake graywackes and below an unnamed lower slate pebble conglomerate.

Report covers a belt in eastern Vermilion district more or less parallel to international boundary.

Crooked River Formation[1]

Recent(?): Central northern Oregon.

Original reference: E. T. Hodge, 1927, Geol. Soc. America Bull., v. 38, p. 163.

Cascade Mountains.

Crooks Complex[1]

Precambrian: Central Arizona.

Original reference: T. A. Jaggard, Jr., and C. Palache, 1905, U.S. Geol. Survey Geol. Atlas, Folio 126.

Named for exposures in Crooks Canyon in northwestern part of Bradshaw Mountain quadrangle.

Cropsey Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 159–161. Largely till, locally both overlain and underlain by outwash deposits of gravel and sand. Maximum thickness about 50 feet; commonly less than 15 feet. Overlies Bloomington drift; underlies Farm Ridge drift. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Named for morainic ridge at Cropsey, McLean County.

Crosby Lentil (in Starkey Tongue of Sherburne Formation)

Crosby Sandstone[1] Member (of Standish Formation)

Upper Devonian: West-central New York.

Original reference: I. W. Fox, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 7, p. 677, 681, 687.

P. D. Torrey and others, 1932, Am. Petroleum Inst. Div. Production Paper 826–4A, figs. 6, 7. Crosby sandstone in Standish shale and flags below Bluff Point flagstone.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 67, pl. 1. Reallocated. Lentil lies at base of Starkey tongue of Sherburne formation. Further described as heavy-bedded crinoidal very fine calcareous sandstone.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2824–2825. In area between Gorham and Penn Yan, Genundewa limestone member of Genesee grades laterally into Crosby sandstone of Torrey. In vicinity of Keuka Lake and Keuka Lake Outlet, Torrey's Crosby sandstone forms basal part of eastward-

thickening wedge of Ithaca member of Genesee. East of Seneca Lake, Crosby sandstone of Torrey is in lower part of Ithaca. At Williams Brook, the Williams Brook coquinite of Caster (1933) is apparently at horizon of Crosby sandstone—the horizon of Genundewa limestone member. Interval between top of Geneseo shale member of Genesee and Torrey's Crosby is 170 feet near Keuka Lake, 200 feet at Seneca Lake, and 385 feet in vicinity of Ithaca.

Named from exposures at Crosby on east shore of Lake Keuka.

Crossen Trachyte (in Buck Hill Volcanic Series)

Crossen Trachyte (in Pruett Formation)

Eocene, upper: Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Lava flows intercalated in Pruett formation are (ascending) Crossen trachyte, Sheep Canyon basalts, and Potato Hill andesite.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1144 (fig. 3), 1151–1153, 1171 (fig. 6), 1178, pl. 1. Porphyritic flows, 115 to 150 feet thick. Rests on tuff and fresh-water limestone of the Pruett. In vicinity of Potato Hill underlies tuff beds which are succeeded by Potato Hill andesite. Near northern boundary of Buck Hill quadrangle, Sheep Canyon basalt overlies the trachyte. In Alpine quadrangle, trachyte was eroded by stream and channel subsequently filled by Sheep Canyon basalt; small erosional remnants of trachyte now appear as inliers in the Sheep Canyon.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 546–547, pl. 1. Described in Cathedral Mountain quadrangle. Rank raised to formation in Buck Hill volcanic series. Average thickness approximately 200 feet; maximum thickness 265 feet at Mount Ord. Top of Eocene is placed at prominent disconformity between Crossen trachyte and Sheep Canyon basalt.

Named for the fact that it caps Crossen Mesa in north-central part of Buck Hill quadrangle, Brewster County.

Cross Mountain Group

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 11, 19, pls. 2, 3, 4, 6, 8. Includes all strata between top of Frozen Head sandstone of Vowell Mountain group (new) and the top of Cross Mountain. Thickness at type section 554 feet. Includes (ascending) shale interval, Low Gap sandstone (new), shale interval, Tub Spring sandstone (new), and shale unit.

Type locality: Cross Mountain, Lake City quadrangle, Anderson County. Section is on road leading to top of Cross Mountain. Group includes youngest Pennsylvanian beds in Tennessee and is preserved only on the higher peaks and ridges in the Cumberland Mountains.

Cross Plains Sandstone[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Derivation of name not stated.

Crossville Sandstone (in Crooked Fork Group)

Crossville Sandstone Member (of Duskin Creek Formation)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 37, 44 (table 3), 139. Light-gray fine- to medium-grained even-bedded sandstone; iron-stained, giving bands of pink, yellow, brown, and gray both on and across the bedding. Thickness about 39 feet. Occurs at top of Duskin Creek formation about 75 feet above Rockcastle sandstone. Known commercially as Crab Orchard sandstone, but name Crab Orchard preoccupied; hence, Crossville proposed.

C. W. Wilson, Jr., J. W. Jewell and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Rank raised to formation in Crooked Fork group (new). Thickness as much as 130 feet. In Morgan County, unit varies from a single thin sandstone to a bipartite or tripartite sandstone; only lower bench believed to represent the Crossville of the type area. Underlies Burnt Mill shale (new); overlies Dorton shale (new).

Well exposed on Pigeon Ridge Road, northwest of Byrd Creek, near Cumberland Homesteads CCC Camp, about 6 miles south of Crossville, Cumberland County.

Crosswicks Clay[1] (in Matawan Group)

Upper Cretaceous: New Jersey, northern Delaware, and eastern Maryland.

Original reference: T. A. Conrad, 1869, Am. Jour. Sci., 2d, v. 47, p. 359–360.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 251–256. In banks of Chesapeake and Delaware Canal, conformably underlies Englishtown sand; unconformably overlies Magothy formation. Thickness about 50 feet.

R. A. Schmidt, 1948, Jour. Paleontology, v. 22, no. 4, p. 392 (table 1). Shown in Matawan group in northern Delaware.

Named for village of Crosswicks, on Crosswicks Creek, Burlington County, N.J.

Croton Gypsum[1]

Permian: Central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, pl. 9.

Mapped in Stonewall County. Derivation of name not stated.

Croton Limestone (in St. Louis Limestone)[1]

Mississippian: Southeastern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 231.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 813. About 30 feet of compact buff dolomitic limestone which grades into or is interbedded with dense gray nondolomitic limestone. Underlies Verdi member.

Named for exposures in vicinity of Croton, Lee County.

Croton Falls Diorite

Croton Falls Hornblendite[1]

Upper Ordovician(?): Southeastern New York.

Original reference: C. R. Fettke, 1914, New York Acad. Sci. Annals, v. 23, p. 228.

T. W. Fluhr, 1948, Rocks and Minerals Mag., v. 23, no. 8, p. 699. Referred to as diorite in map legend. Age shown as probably Upper Ordovician.

Occurs at Croton Falls and extends northeastward along east side of Croton River, Westchester County.

Crouse Limestone (in Council Grove Group)

Crouse Limestone Member (of Garrison Shale)[1]

Permian: Oklahoma, Kansas, and Nebraska.

Original reference: K. C. Heald, 1916, U.S. Geol. Survey Bull. 641–B, p. 21, 22.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12). In diagram showing comparison of old and revised classification of beds referred to lower part of Big Blue series of "Permian" age, Garrison shale is replaced by ascending) Beattie limestone (includes Florena and Morrill limestone members), Stearns shale, Bader limestone (includes Eiss limestone, Hooser shale, and Middleburg limestone members), Easly Creek shale, Bigelow limestone (includes Crouse limestone, Blue Rapids shale, and Funston limestone members), and Speiser shale.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 64–65. Condra (1935) employed term Bigelow limestone as comprising (ascending) Sabetha limestone (Crouse limestone), Blue Rapids shale, and Funston limestone. The Bigelow thus included strata between the Easly Creek shale and Speiser shale. To be consistent with classification applied to strata above and below them, these beds should be divided into formations. Proposed that Bigelow be dropped as stratigraphic term and that Crouse limestone, Blue Rapids shale, and Funston limestone be recognized as formations. In Council Grove group, Wolfcamp series.

Named for Crouse Hill, Foraker quadrangle, Osage County, Okla.

Croweburg Formation (in Cabaniss Group)

Croweburg Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Missouri, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group is divided into 15 cyclic formational units. The Croweburg, 12th in sequence (ascending), overlies the Coalvale and underlies the Ardmore. Average thickness 18 feet. Contains coal here referred to as Tebo. [For complete sequence see Cherokee group.]

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on midcontinent composite stratigraphic section as Croweburg formation in Cabaniss group. Underlies Verdigris formation; overlies Fleming formation.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as a coal cycle in Senora formation, Cabaniss group, in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 25, 34. Exposed in Vernon County, Mo., where it is about 6 feet thick. **Derivation of name given.**

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 68–72. Formation in Cabaniss subgroup of Cherokee. Includes beds above Fleming coal and extends to top of Croweburg coal. From base upward, succession includes massive dark lenticular limestone and dark-gray calcareous shale (cap-rock of Fleming coal), dark-gray to black shale containing clay-ironstone concretions, lenticular sandstone and underlimestone, underclay, and Croweburg coal. Each division, except Croweburg coal, is extremely variable in thickness, lithology, and distribution.

Named for association with Croweburg coal type locality of which is in strip pits about 1 mile east of Croweburg, Crawford County, Kans.

Crow Creek Member (of Pierre Shale)

Crow Creek zone (in Sully Member of Pierre Shale)

Upper Cretaceous: Central South Dakota.

J. P. Gries and E. P. Rothrock, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 14–18, pl. 1. Sand and marl zone at base of Sully member (new) of Pierre shale. Name replaces term Gregory marl of previous reports.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2343, 2346. Rank raised to member of Pierre shale. Defined to include sandstone and calcareous shale and marl beds lying between noncalcareous shales of Gregory member below and DeGrey member (new) above. Thickness ranges from a few feet to 15 feet. Type locality designated.

Type locality: At mouth of Crow Creek, Buffalo County.

Crow Hill Member (of Waits River Formation)

Silurian and (or) Devonian: Northeastern Vermont.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 21–23, 26, pl. 4. Series of interbedded quartzites, micaeous quartzites, gray quartz-mica schists, quartz-feldspar granulites, and minor calcareous rocks distinct from typical Waits River. Member closely resembles Gile Mountain formation and may be continuous with it, but continuity cannot be proved due to lack of outcrops.

Name derived from Crow Hill, southwest of village of St. Johnsbury, St. Johnsbury quadrangle.

Crowleyan series[1]

Tertiary, lower: Missouri and Illinois.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Derivation of name not stated.

Crow Mountain Sandstone Member (of Chugwater Formation)

Crow Mountain Formation (in Chugwater Group)

Triassic: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 12, 43, 44. Predominantly sandstone with minor amount of shale; nonfossiliferous. Thickness 202 feet. Overlies Red Peak member (new); underlies Popo Agie member. Not recognized in any localities to west or in Wind River Mountains.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 135. Referred to as Crow Mountain formation in

Chugwater group. In Wind River Mountains, overlies Alcova dolomite and underlies Popo Agie formation.

T. C. Woodward, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 231–232. In Deadman Butte area, Natrona County, restricted use of name Crow Mountain sandstone member is applied to Triassic Chugwater interval between the Alcova below and Popo Agie members. Thickness 165 to 185 feet. In area where Love defined the Crow Mountain, the Alcova is absent; he probably included as part of the Crow Mountain the 20 to 80 feet of sandstone at top of Red Peak member.

Name derived from Crow Mountain, near southeastern end of Washakie Range.

Crown Conglomerate[1]

Upper Cretaceous (Gulf Series) : Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 66–67.

Named for Crown Peak, Brewster County.

Crownian Stage

Ordovician (Chazyan) : North America.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 91, 94 (table 2). Chazy has long been divided into three lithologic and faunal zones (Brainerd and Seely, 1888, Am. Geologist, v. 2), which were given "substage" names Day Point, Crown Point, and Valcour (Cushing, 1905, New York State Mus. Bull. 95). As stages, these have been called Dayan, Crownian, and Valcourian by Oxley (unpub. ms.).

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 830, 838, 840. In Champlain Valley, Chazy series is separable into Dayan, Crownian, and Valcourian stages, distinguished by faunal criteria. Each stage has several lithologic facies. Reefs are prevalent. *Maclurites magnus* Lesueur considered guide to Crown Point limestone.

Crown Point Lava Member (of Troutdale Formation)

Pliocene, upper(?) : Northwestern Oregon.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 10. Name applied to 30-foot flow of Boring lava interbedded in Troutdale formation.

Occurs in vicinity of Crown Point, east of Portland.

Crown Point Limestone[1]

Middle Ordovician: Eastern New York and west-central Vermont.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524 (table), 548–550. Chazyan succession (Chazy group) in west-central Vermont comprises (ascending) Crown Point limestone, Beldens limestone with Weybridge member (both new), and Middlebury limestone (new). Crown Point limestone consists of lead-gray compact massive rock that weathers to gray surface. Thickness 0 to 150 feet. Overlies upper Beekmantown Bridport dolomite (new) at the meridian of Shoreham and west. Lies on Bascom formation (new) and is gradationally overlain by Beldens formation east of meridian of Cornwall.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Inasmuch as Crown Point limestone (Cady, 1945) is structurally sepa-

rated from Crown Point limestone of type locality and other outcrops in New York and is succeeded by Beldens formation rather than Valcour limestone, it is proposed here that "Crown Point" formation east of Champlain thrust in west-central Vermont be designated Burchards limestone.

Philip Oxley, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12 pt. 2, p. 1492. Discussion of Chazyan stratigraphy west of Champlain thrust, New York and Vermont. Lower Middle Ordovician sequence is Day Point (oldest), Crown Point and Valcour limestones. Day Point basal quartz sands and succeeding crosslaminated, locally reefy calcarenites and shallow water deposits of transgressing sea. Southward-lapping Crown Point limestones are preponderately deeper water argillicalcisiltites, but locally, and particularly toward top, are *Stromatocerium* reefs. Lower limestones of offlapping Valcour tend to match facies of underlying Crown Point. Upper Crown Point reefs are most widespread, forming roughly linear, discontinuous trend from near Isle La Motte, Vt., south of Essex, N.Y.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 820, 825 (fig. 4), 828 (fig. 6), 830–833, measured sections. Discussion of Ordovician Chazyan series of Champlain Valley, N.Y. and Vt. Series is divided into three stages: Dayan, Crownian, and Valcourian. Crown Point substage (Cushing, 1905) was division B of Brainerd and Seely (1888, Am. Geologist, v. 2) originally described southwest of Chazy, N.Y., from exposure of original Chazy limestone (Emmons, 1842). Sequence is 250 feet of dark-blue-gray massive argillicalcisiltites, gray-weathering, with buff silty crenulated laminae at intervals up to 4 inches; a 20-foot zone of lighter gray medium to coarse calcarenite lies about 50 feet above base. The Crown Point becomes more argillaceous and thinner bedded toward top. Calcarenites of Fleury member (new) of Day Point underlie with slight disconformity and succeeding is a 2-foot light-yellowish-gray fine-textured dolomite, the base of Hero member (new) of Valcour formation. Has normal or basinal facies and reef facies.

Probably named for exposures at or near Crown Point, Essex County, N.Y.

†Crow Ridge Series[1]

Jurassic and Cretaceous: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 399–455.

Named for southwest spur of Crow Peak, Elkhorn region.

Crows Mill Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1915, Illinois Geol. Survey Bull. 20, p. 99–107.

Sangamon County.

Crow Wing Formation[1]

Precambrian (Animikie): Central Minnesota.

Original reference: C. Zapffe, 1930, Lake Superior Min. Inst. Proc., v. 28, p. 101–106.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002. Listed in geologic succession of central Minnesota as presumably Animikie in age.

Apparently named for extensive outcrops in northern part of Crow Wing County.

Croydon Group

Middle Devonian(?): South-central New Hampshire.

C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Described as fine-grained white to gray weakly foliated quartz diorite and granodiorite. Composed of oligoclase, quartz, biotite, and microcline. Belongs to Oliverian magma series whose age is post-Lower Devonian and probably Upper Devonian.

C. A. Chapman, 1952, Geol. Soc. America Bull., v. 63, no. 4, p. 391–392, pl. 1. Middle Devonian(?). Outcrop area largely in Sunapee quadrangle.

Confined to Croydon dome immediately east of Croydon Mountain in Grantham and Croydon Townships, Sullivan County.

†Crusher Hill (alternating) Shales and Limestones (in Council Grove Group)[1]

Permian: Central Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas, p. 9.

Derivation of name not stated.

Crystal Gray Quartz Monzonite (in Stearns Magma Series)

Precambrian (middle Keweenawan): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1008–1009, pl. 1. Pinkish gray; granitoid; seriate; phenocrysts 1 to 2 centimeters, grains of ground mass 1 to 5 millimeters; appears to have been heavily contaminated by St. Cloud gray granodiorite (new) and then attacked by deuteric reactions.

Exposed in quarry in NE¼ sec. 27, T. 124 N., R. 29 W., Stearns County. Derivation of name not given.

†Crystal City Sandstone[1]

Lower Ordovician: Eastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 352, 358.

Named for exposures at Crystal City, Jefferson County.

Crystal Falls Formation[1]

Precambrian (Upper Huronian): Northern Michigan.

Original reference: J. Zinn, 1933, Michigan Acad. Sci., Arts., and Letters, v. 18, p. 446–448, 454.

Has been traced almost continuously to Iron River district to west and to Florence district to south, Crystal Falls district.

Crystal Falls Limestone Member (of Thrifty Formation)

Crystal Falls Limestone (in Thrifty Group)

Crystal Falls Limestone Member (of Harpersville Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 161–164; 1922, Jour. Geology, v. 30, p. 24, 31, 39.

Wallace Lee, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 64–65, 66–67. Member of Harpersville formation. Consists of lower limestone, gray, finely crystalline, 1 foot thick; shale, 1½ feet; and light-yellowish to buff limestone, 1 foot thick. Overlies shale and limestone in lower part of formation; separated by shale interval from limestone referred to by some writers as "Upper Crystal Falls limestone."

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 6–20, figs. pls. Lower Crystal Falls limestone overlies Quinn clay (new). Curry clay (new) occurs between the lower and upper Crystal Falls limestone layers, just above Quinn clay in areas where sandstone deposits of Park Mountain and its probable equivalent, the Cisco Lake sandstone, do not occur.

John Kay, 1956, *in* North Texas Geol. Soc. Field Guidebook May 25–26, p. [13], fig. 4. Shown on columnar section as limestone in Thrifty group.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 7 (fig. 2), 8 (fig. 3), 23–26, pls. 1, 3. Plummer and Moore (1921) stated that the Crystal Falls limestone "occurs 40 to 80 feet above the base of the Harpersville formation," which is top of Breckenridge limestone. The Crystal Falls was described as "yellow or gray limestone, weathering locally red or purple, with an average thickness of 2 or 3 feet." A section accompanying type description (idem, p. 163) was measured along Clear Fork of Brazos River west of Crystal Falls, Stephens County. However, this section does not include an unnamed limestone 23 feet above the Breckenridge designated "C1" by Bradish (1937, Geologic map of Stephens County, revised) and discussed by Lee (1938, Texas Univ. Bull. 3801). Crystal Falls limestone has been called "Lower Crystal Falls" by Bradish (1937) and some other writers. Plummer and others (1949, Texas Univ. Pub. 4915) showed sections of Crystal Falls type area. Difference in interpretation may be noted by comparing section by Plummer and others (fig. 18) at Crystal Falls type locality (fig. 6 of present report) and their sections 23, 24, and 25, with sections 9, 10, and 11, respectively, of present report. In general, present report agrees with Lee's stratigraphic description for section between the Breckenridge and "Upper Crystal Falls" limestones in northern Stephens County. Type section of Crystal Falls herein redescribed. Type Crystal Falls composed of an upper 1-foot limestone bed separated by about 1 foot of shale from a lower limestone bed that is 1 to 3½ feet thick. Limestone weathers from gray to yellowish orange; upper surface is ferruginous, commonly dark red or purple. Upper surface uneven and has wave or "moundlike" undulations with amplitudes up to 5 feet. Overlies Quinn clay member; underlies Curry clay member which in turn underlies unit termed "Upper Crystal Falls member." Area of report is northern Stephens County.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 72, 74, pl. 27. Bed here correlated with Breckenridge is shown on geologic map of Coleman County (Hudnall and Pirtle, 1929) as Lower Crystal Falls limestone. The generally persistent upper part of Chaffin limestone member of Thrifty formation has been variously called Breckenridge limestone (Plummer and Moore, 1921; Bullard and Cuyler, 1935, Texas Univ. Bull. 3501), Upper Crystal Falls limestone (Hudnall and Pirtle, 1929), Crystal Falls limestone (Cheney, 1950, Abilene Geol. Soc

Guidebook Nov. 2–4), and Chaffin limestone (Sellards, 1933, Texas Univ. Bull. 3232; Nickell, 1938; Cheney and Eargle, 1951, Geologic map of Brown County).

Type section (Brown): Measured from the shale beneath Breckenridge limestone to top of "Upper Crystal Falls" limestone. Beds 1–4 of section (fig. 6 and pl. 2, A) crop out on State land and beds 4–14 on property of Truman Robertson of Crystal Falls. Breckenridge limestone crops out in bed of Clear Fork of Brazos River from dam beneath bridge on Farm Road 578, down stream to first bend. Lower part of section (fig. 6, beds 1–7C) was measured southwestward from first bend below dam (pl. 2, A), across the dam and old bridge road to good exposure of bed 4 (pl. 1, bed c), and upward to exposure of the Crystal Falls in railroad cut no. 1; upper part of Quinn clay (bed 5) is well exposed at clay exposure no. 1. The interval from the top of Crystal Falls limestone to coal in Curry clay was described at clay exposure no. 2 (beds 7C–11), about 25 yards southwest of railroad cut no. 1; the offset is along bed 7C. Upper part of section (beds 11–14D) was described in railroad cut no. 2 to west; offset correlated with coal (bed 11). Named from Crystal Falls, Stephens County.

Crystal Mountain Sandstone[1]

Ordovician(?): Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557; 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 32.

August Goldstein, Jr., and T. A. Hendricks, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 424 (fig. 2). Shown on columnar section as massive light-gray calcareous to quartzitic sandstone; chert conglomerate at base in McCurtain County, Okla. Thickness 500 to 850 feet. Underlies Mazarn formation; unconformably overlies Collier formation. Cambrian-Ordovician.

H. D. Miser and others, 1954, Geologic Map of Oklahoma (1:500,000), U.S. Geol. Survey. Ordovician(?).

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 18–22. Outcrop area in Oklahoma small. Thickness estimated from 5 to 100 feet. Honess (1923, Oklahoma Geol. Survey Bull. 32) estimated 500 feet. Comprises a basal conglomerate and a massive sandstone member. Overlies Collier limestone; underlies Mazarn shale.

Named for Crystal Mountains, Montgomery County, Ark.

Crystal Pass Limestone Member (of Sultan Limestone)[1]

Middle and Upper Devonian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 15.

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881, 884 (fig. 3). Geographically extended into Nopah Range, Inyo County, Calif., where it is 140 feet thick, overlies Valentine limestone member of Sultan, and underlies Dawn limestone member of Monte Cristo limestone. Herein suggested that name Stewart Valley limestone be abandoned and that Devonian beds ascribed to it be assigned to Crystal Pass and Valentine members of Sultan. Middle Devonian.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 41. Because no fossils have been found in Crystal Pass limestone and there are no

unconformities under or over the limestone, its age must be open to debate. Age of Sultan limestone is considered to be Middle or early Late Devonian.

U.S. Geol. Survey currently considers the Sultan limestone and its members to be Middle and Upper Devonian in age.

Named for Crystal Pass, sec. 2, T. 25 S., R. 58 E., Clark County, Nev.

Crystal Peak Dolomite

Middle Ordovician: Western Utah and eastern Nevada.

G. W. Webb, 1956, Utah Geol. and Mineralog. Survey Bull. 57, p. 12–13, 42–43 (fig. 11). Name applied to dolomite separating Watson Ranch tongue (new) of Swan Peak quartzite from overlying Eureka quartzite. Dolomites are closely parted by reddish or yellow silt seams and are gray or black and fine or medium in grain. Thickness about 85 feet.

Named for occurrences at Crystal Peak, near Ibex, Millard County, Utah.

Crystal River Formation (in Ocala Group)

Eocene (Jackson): Northern and western Florida.

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2, p. 130. Proposed for the 108 feet of limestone exposed in Crystal River Rock quarry in Citrus County. Includes all calcareous sediments of upper Eocene age lying stratigraphically between the Williston formation and the overlying Oligocene limestones.

W. E. Moore, 1955, Florida Geol. Survey Bull. 37, p. 30–36. In this report, includes all limestones containing Jackson Eocene orbitoid and camerinid faunas that underlie the Marianna limestone or younger beds and overlie beds of Cook Mountain (lower middle Eocene) age with *Operculinoides sabinensis*. White to cream-colored soft granular permeable limestone. Thickness in Jackson County about 200 feet including Bumpnose member (new).

H. S. Puri, 1957, Florida Geol. Survey Bull. 38, p. 31–38. Moore (1955) erroneously included in the unit all upper Eocene beds overlying the *Operculinoides sabinensis* faunizones of the Lisbon formation (Claiborne). Bumpnose member is not considered a valid stratigraphic unit. Type locality stated.

Type locality: Crystal River Rock Co. quarry, NE¼SW¼ sec. 6, T. 19 S., R. 18 E, Citrus County.

Crystal Spring Formation

Precambrian (Pahrump Series): Southern California.

D. F. Hewett, 1940, Washington Acad. Sci. Jour., v. 30, no. 6, p. 240; 1956, U.S. Geol. Survey Prof. Paper 275, p. 26, 28, 29, pl. 1. Comprises about 2,000 feet of quartzite, arkose, shale, and limestone, intruded by sills of diorite and syenite, with beds of dolomite and chert at top and thick coarse conglomerate at base. Base of series; underlies Beck Spring dolomite (new); unconformably overlies Precambrian granite gneiss. Base of formation observed at only one locality, on west end of ridge 2 miles east of Horse Springs; here conglomeratic quartzite rests on Precambrian gneissic granite.

L. A. Wright, 1952, California Div. Mines Spec. Rept. 20, p. 7 (fig. 3), 9–12, 13. Described in Superior talc area, Death Valley region, where it consists of lower 800 feet of conglomerate, quartzite, and shale, middle 600 feet of dolomite, and upper 200 feet of alternating quartzite, shale, and dolomite layers; a diabase sill, 200 to 600 feet thick, lies

at or near the base of the massive dolomite; below sill is alternation zone which contains commercial talc deposit. Underlies Beck Spring dolomite; overlies Archean quartzite, gneiss, and schist.

Crops out in belt that extends for 5 miles around north slope of Kingston Range and in two areas on eastern slope of range, Ivanpah quadrangle. Name derived from Crystal Spring on north slope of Kingston Range.

Cuba Formation (in Canadaway Group)

Cuba Member (of Canadaway Formation)

Cuba Sandstone[1]

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1902, New York State Mus. Bull. 52, p. 524–528.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 14, 16–18, 23–27. Referred to as Cuba formation in Canadaway group. Thickness about 40 feet in Wellsville quadrangle. Overlies Machias formation; underlies Wellsville formation (new) of Conneaut group.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 12–14. Rank reduced to member status in Canadaway formation.

Well exposed in quarry east of Erie depot at Cuba, Allegany County.

Cuba Sandstone (in Carbondale Formation)[1]

Cuba Sandstone (in Carbondale Group)

Pennsylvanian: Western and central Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 107–108, 195, 196, 204, 206, 207. Light brownish gray and spotted with bright brown specks; commonly thin bedded and shaly in upper part, the beds thickening downward. Thickness 3 to more than 80 feet; through most of Glasford quadrangle and east of Cuba in Havana and Canton quadrangles, ranges from 30 to 80 feet and varies inversely with underlying St. David beds. Underlies Big Creek shale near base of Brereton cyclothem, Carbondale group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35. Replaced by Vermilionville sandstone member of Carbondale formation. Name Cuba preempted.

Named from exposures north of Cuba in sec. 8, T. 6 N., R. 3 E., Havana quadrangle, Fulton County.

Cubierto Shale (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structural section as underlying Hunter sandstone and conglomerate (new) and overlying Blanco shale (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Thin-bedded gray micaceous clay shale and fine- and medium-grained sandstone. Thickness 864 feet. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon in southeastern Puente Hills, between Chino and Santa Ana River, San Bernardino County.

Cub Mountain Formation

Eocene: Central New Mexico.

M. W. Bodine, Jr., 1956, New Mexico Bur. Mines Min. Res. Circ. 35, p. 1, 8–11, figs. 2, 3. Consists of beds of pale-yellow to gray coarse-grained quartzose sandstones, with lenses of quartzite and chert-pebble conglomerate. Color not at all reliable because it changes drastically, both vertically and horizontally. Thickness at least 500 feet. Underlies Tertiary rocks with unconformity and overlies Mesaverde group with apparent unconformity. May be as old as latest Cretaceous or as young as Miocene.

G. B. Griswold, 1959, New Mexico Bur. Mines Mineral Resources Bull. 67, p. 7 (table 2), 12, pl. 2. Thickness about 2,000 feet. Mapped as Eocene.

Named for isolated peak located 7 miles due south of Carrizozo and 18 miles due west of Capitan, Lincoln County. Exposed in southwest flank of the mountain.

Cucamonga Complex

Pre-Upper Cretaceous: Southern California.

R. M. Alf, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1104 (fig. 2), 1107–1108, pl. 6. Characterized by discontinuous bands of pale and graphitic limestone, complex gneiss, and quartz monzonite mylonite. Aggregate thickness of the two sections sampled 231 feet.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 259–274, geol. map. Name replaced by Cucamonga Canyon group.

Occurs in San Gabriel Mountains southeast of Los Angeles.

Cucamonga fan deposits

Recent: Southern California.

E. M. Mackevett, 1951, California Div. Mines Spec. Rept. 5, p. 11. Contains a wide assemblage of clastic materials; some of constituent boulders exceed 2 feet in diameter. Distributaries have cut as much as 40 feet into the fan.

Almost surrounds Jurupa Mountains, western San Bernardino and Riverside Counties.

Cucamonga Canyon Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 259–272, geol. map. Divided into two subgroups on basis of textural criteria: layered plutonics and cataclastic plutonics. Distinction between the two is in many places difficult because all gradations of textures from typically granoblastic to ultracataclastic are represented. Group forms an east-northeast-trending belt south of Aurela Ridge group (new); the two are separated by Cucamonga Canyon thrust. Alf (1948) described these rocks as "Cucamonga complex" and considered them a heterogeneous aggregation of rocks of different origins. Present study indicates that most Cucamonga Canyon rocks were derived from Aurela Ridge granulites under conditions represented by the amphibolite facies.

Exposed in lower Cucamonga Canyon, San Bernardino County.

Cucaracha Formation[1]

Miocene, lower: Panamá.

Original references: D. F. MacDonald, 1913, Canal Records, v. 6, p. 214; 1913, Geol. Soc. America Bull., v. 24, p. 709.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 240–241, 246 (fig. 2). Chiefly massive generally greenish-gray waxy highly slickensided bentonitic clay. Bed of agglomeratic andesitic tuff, 10 to 35 feet thick, occurs about 200 feet below top of formation. Maximum thickness about 625 feet. Overlies Culebra formation; underlies La Boca formation. Early Miocene.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 39, 51 (fig. 4), pl. 1. Underlies La Boca member of Panamá formation. Assigned to early Miocene because both underlying Culebra formation and overlying Panama formation are considered to be of that age.

Type region: Along Gaillard Cut south of Continental Divide where village of Cucaracha was located near site of Cucaracha slide.

Cuchara Formation[1]

Eocene: Southern Colorado and northern New Mexico.

Original reference: R. C. Hills, 1893?, Colorado Sci. Soc. Proc., v. 4, p. 9; paper read Feb. 2, 1891.

W. S. Burbank and E. N. Goddard, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 947. Overlies Poison Canyon beds, with marked unconformity at northern end of Huerfano Park, and entirely overlaps formation locally; because the Cuchara is, in turn, overlapped along western side of park by Huerfano beds, it is assigned questionably to lower Eocene (Wasatch).

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map. OM–146. Described in La Veta area, Huerfano County, where it unconformably overlies Poison Canyon formation; unconformably underlies Huerfano formation. Composed of thin to massive red, pink, and white sandstone beds and thin red and tan shale beds. Estimated thickness more than 5,000 feet in center of Raton Basin on northern flank of West Spanish Peak; probably not more than 2,500 feet present in La Veta area. Eocene.

Named for exposures along Cuchara River north and south of La Veta, Huerfano County, Colo.

Cuchillo Formation[1] (in Trinity Group)

Lower Cretaceous (Comanche Series): Southwestern Texas, and northern Mexico.

Original references: R. H. Burrows, 1909, Min. and Sci. Press, v. 99, p. 324; 1910, Soc. geol. Mexicana Bol., t. 7, p. 95.

Gayle Scott, 1939, Texas Univ. Bur. Econ. Geol. Pub. 3945, p. 969–1077. Overlies Las Vigas formation; underlies Glen Rose in Sierra Blanca-Quitman Mountain area. Ammonite zone of *Sonneratia trinitensis* and *Douvilleiceras mammillatum* of Trinity group.

Named from Conchos Valley section north of Kansas City, Mexico & Orient Railroad, a short distance north of Presidio, Presidio County, Tex. Fossil collection made near Aurora mine, 5 kilometers south of Cuchillo Parado.

Cuchillo Negro Formation (in Mud Springs Group)

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 37, 39. Name proposed for all strata between top of Mud Springs [Hot Springs] formation below and base of Des Moines series above. At type locality, formation is composed almost entirely of medium- to light-gray massive to nodular cherty limestone. Calcareous algae are abundant in some parts of formation and make up more than 50 percent of some strata. Two thin beds of greenish to brownish coarse-grained sandstones to granule conglomerates occur in lower part of formation in some areas of the Mud Springs Mountains; one of these sandstones occurs at the base and the other occurs about 15 feet above base of formation. Thickness at type locality about 28 feet.

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73 (fig. 8), 74. Overlies Fra Cristobal formation (new) which name replaces preoccupied Hot Springs formation.

Type locality: Near west end of Whiskey Canyon in northern part of Mud Springs Mountain, just west of westernmost box canyon, in southwestern part of sec. 1, T. 13 S., R. 5 W., Sierra County. Name derived from Cuchillo Negro Peak where formation is well exposed.

Cucuracha Formation

See **Cucaracha Formation,** correct spelling.

Cuerbio Basalt

Pleistocene(?): North-central New Mexico.

C. E. Stearns, 1943, Jour. Geology, v. 51, no. 5, fig. 2. Mapped in Galisteo-Tonque area. Pleistocene. Younger than Santa Fe formation.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 476, 477, pl. 1. Basalt flows interbedded with Tuerto gravel (new) are tentatively correlated with Cuerbio basalt.

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines Mineral Resources Bull. 48, p. 5 (table 1), 29–30, pl. 1. In this report [Cerrillos area], basalt flows that are interbedded with and overlie upper part of Ancha formation, together with an associated cinder cone, are placed in Cuerbio basalt. Two flows mapped; each about 20 feet thick. Pleistocene(?). Name credited to Kirk Bryan (unpub. ms.).

Type locality and derivation of name not stated.

Cuero Formation (in Fleming Group)

Miocene, upper: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists 26th Ann. Mtg. Program, p. 20. Name appears on a chart; occurs below Lapara member of Goliad formation and above Oakville formation.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1724–1726. Proposed for the predominantly red, pink, green, and gray section of clays and sandstones lying above the Oakville formation and below the Goliad formation. Thickness about 350 feet. In Bee, Karnes, and DeWitt Counties, formation is identical with the section assigned to the Lower Lagarto by Weeks (1933, Am. Assoc. Petroleum

Geologists Bull., v. 17, no. 5) and is part of section assigned to Lagarto (emended) by Plummer (1933, Texas Univ. Bull. 3232).

Name taken from a city in DeWitt County.

Cuesta Diabase[1]

Lower Cretaceous: Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey. Geol. Atlas, Folio 101.

Extends from near Cuesta Pass on south to northern edge of San Luis quadrangle. Named for exposures near Cuesta and Cuesta Pass, San Luis Obispo County.

Cueva Rhyolite[1]

Eocene: Southern New Mexico.

Original reference: K. C. Dunham, 1935, New Mexico School Mines Bull. 11, p. 53, 55.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14). Age shown on correlation chart as Eocene.

Type locality: La Cueva, west of mouth of Fillmore Canyon, Organ Mountains, Dona Ana County.

Cuivre Shale

Mississippian (Kinderhook): Northeastern Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 98–100. Proposed to designate stratigraphic unit between Hannibal shale and Louisiana limestone. Predominantly very dark gray to blue-black somewhat fissile clay shale; in some places massive and shows blocky weathering; sandy at base with lenses of hard gray sandstone with calcareous and pyritiferous cement. Thickness 12 feet at type locality. Unconformable below, resting on Louisiana or Bowling Green limestone; unconformable beneath the Hannibal.

Type locality: SE¼NE¼SE¼ sec. 35, T. 54 N., R. 3 W., Pike County, about 4½ miles north of Bowling Green. Here, in one of head branches of Grassy Creek, entire thickness of unit is exposed. Named from Cuivre Township, near northeastern corner of which the type locality is located.

Culberson series[1]

Permian: Western Texas.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 57, p. 350, 351, 354.

Occurs on Wiley Ridge, Wiley Mountains.

Culbert Breccia

Pleistocene(?): Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 39. Composed of angular to subangular blocks of monzonite porphyry, as much as 5 feet in diameter, in a poorly cemented matrix. Considerable differences in color and density. Of mudflow origin and cited also as mudflow fanglomerate. Of probable Pleistocene age according to text; shown as Pliocene(?) age on fig. 2a. Generalized section of formations in area shows breccia stratigraphically above Pine Valley latite (new).

Exposed in small patches on east side of Culbert Canyon and in the Comanche Creek drainage, Pine Valley Mountains, Washington and Iron Counties.

Culebra Dolomite Member (of Rustler Formation)

Permian: Southeastern New Mexico and western Texas.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1600 (fig. 2), 1614. Name applied to 35-foot dolomite in upper part of Rustler. Name suggested by W. B. Lang 1938, New Mexico State Engineer 12th and 13th Bienn. Rept.), who divided Rustler into 11 units; Culebra member is unit 6 (descending) in this classification. Member is also good marker in subsurface where it extends into western Texas.

Exposed east of Pecos River, central Eddy County, N. Mex.

Culebra Formation[1]

Culebra Clays or Beds

Miocene, lower: Panamá.

Original reference (Culebra clays): R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 192–195.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 239. Referred to as Culebra beds. Upper Oligocene.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 236–240, 246 (fig. 2). Formation includes Emperador limestone member. Estimated maximum thickness about 500 feet. Conformably overlies Las Cascadas agglomerate; underlies Cucaracha formation. Upper Oligocene and lower Miocene. First named Culebra clays by Hill (1898).

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 34–39, 51 (fig. 4), pl. 1. Lower Miocene.

Type region: Central Gaillard Cut area, where town of Culebra was located on west side of canal during construction.

Culebra Lake Clay

Late Cenozoic: North-central New Mexico.

V. C. Kelley, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p 111–112. Accumulated in waters impounded by lava flows to the south. Some of the lavas poured into the lake, and, with the clay, formed subaqueous pudding-stone and pillow structure. Deposited in late Santa Fe time.

In Rio Grande depression between Taos and Santa Fe.

Cullom Limestone[1]

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 11, 20, 35.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 57. Condra (1927, Nebraska Geol. Survey Bull. 1, 2d ser.) wrongly correlated Beil limestone as Cullom. At Cullom Station, the bed so named is part of Westerville limestone.

Named for Cullom Station, Cass County, Nebr.

Cultus Formation[1]

Triassic: Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 16 and 17.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 17. In extreme western part of Cascades just south of Canadian boundary are outcrops of dark-gray to black argillite, together with intercalated bands of greenish-gray sandstone, grit, and conglomerate which have been described as Cultus formation.

Mapped around south shore of Cultus Lake, British Columbia.

Culver Springs Shale Member (of Brodhead Formation)

Lower Mississippian: Northwestern Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 147. Basal member of Brodhead formation, Pilot Knob facies (new). Thickness 40 feet. Underlies Lebanon Junction siltstone member (new); overlies New Providence formation, Keith Knob facies (new).

Good exposure on slope along northern side of Belmont-Pitts Point Road, 2 miles west of Culver Springs School, 3½ miles west of Belmont, southwestern Bullitt County.

Cumberland facies (of Clinton Formation)

Silurian (Niagaran): Western Maryland and western Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 238, 242–244. Clinton formation in Virginia is composed almost entirely of shale and sandstone and varies geographically in character and proportions of its constituents. At northeast and southwest ends of Appalachian Valley (in Virginia), formation comprises a rather homogeneous body of shale and thin layers of sandstone. It is proposed to designate this lithologic expression of formation the Cumberland facies. Merges laterally into Iron Gate facies (new). Facies is well displayed at north end of Rose Hill, Cumberland, Md., where approximately 600 feet of section is exposed.

Type locality not stated.

†Cumberland Quartzite[1]

Precambrian: Northeastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 106–107.

Crops out on south side of Sneech Pond, along to main street southeastward for 1½ miles in village of Cumberland Hill, Providence County.

Cumberland Sandstone[1]

Upper Ordovician (Richmond): Southern Kentucky.

Original reference: N. S. Shaler, 1877, Kentucky Geol. Survey, 2d ser., v. 3, p. 152, 153, 155, 159–160. 387.

W. R. Jillson, 1951, Geology of the McFarland Creek oil pool; Frankfort, Ky., Roberts Printing Co., p. 13. In Monroe County, 40 to 50 feet of Cumberland sandstone (Richmond-Upper Ordovician) is exposed beneath Chattanooga shale.

Named for exposures along Cumberland River in Cumberland and adjoining counties.

Cumberland Gap Shale Member (of Chattanooga Shale)[1]

Devonian and (or) Mississippian: Southern Tennessee and southwestern Virginia.

Original reference: J. H. Swartz, 1927, Am. Jour. Sci., 5th, v. 14, p. 485–499.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on Devonian correlation chart as Devonian or Mississippian.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 167, chart 5 (columns 93, 94, 97). Shown on Mississippian correlation chart as Kinderhook. Age of Cumberland Gap shale has not been determined, but may include strata of early as well as middle New Albany age.

Well exposed along Lee Highway on north edge of town of Cumberland Gap, Tenn.

Cumberland Head Shale[1] or Formation

Middle Ordovician: Northwestern Vermont and eastern New York.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95, map forming pl. 13.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 274–275, pl. 2. Redescribed as formation including argillaceous limestones and limestone-bearing black shales overlying lowest Sherman Fall Shoreham limestone and underlying Stony Point black shale in type region. Thickness typically about 150 feet. Assigned to Trenton group. Geographically extended to Vermont. Type region mentioned.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 32–37, 74–75, 77–80, 82, pl. 1. Described on Isle la Motte and in several fault blocks on South Hero Island in Lake Champlain.

Type region: [South] Hero Island, Grand Isle County, Vt., 2 miles southeast of Cumberland Head. Named for Cumberland Head near Plattsburgh, Clinton County, N.Y.

Cumberland River Sandstone[1]

Upper Ordovician: Southern Kentucky.

Original reference: A. M. Miller, 1919, Kentucky Dept. Geol. and Forestry, ser. 5, Bull. 2.

Named for exposures along Cumberland River in Cumberland and adjoining counties.

Cummingsville Member (of Galena Formation)

Middle Ordovician: Southeastern Minnesota and northwestern Iowa.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 764–766; 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1036–1037. Proposed for interbedded limestones and shaly limestones at base of Galena formation that were formerly included in overlying Prosser member. Unit is an argillaceous limestone, yellowish-gray to pale-yellowish-brown, generally microgranular, and thin and crinkly bedded, with conspicuous to thick shaly partings. Thin beds are typically grouped into massive units that are separated by smoother more prominent shaly partings. Thickness at type locality 63 feet; essentially uniform throughout its extent. Overlies Decorah formation; base is the level at which the green shales of

the Decorah are succeeded by rock that is predominantly limestone, usually beds of lumpy or nodular limestone in a shale matrix.

Type section: One-half mile north of Cummingsville, on east edge of SE¼ sec. 21, T. 105 N., R. 12 W. Name derived from hamlet of Cummingsville, Olmsted County, Minn., on State Highway 30, 3½ miles west of Chatfield.

Cummins Station Shale Member (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 212–214. Shale, slightly silty, blue-gray to olive-gray, with thin siltstone ribs. Forms basal unit of Maretburg facies (new) of formation. Thickness 12 to 18 feet. Overlies Floyds Knob formation.

Type section: Along Louisville and Nashville Railroad and nearby hillsides midway between Maretburg and Brodhead, one-half mile west of Cummins Station, Rockcastle County. Named for station on railroad.

Cumnock Formation (in Newark Group)[1]

Upper Triassic: Central North Carolina.

Original reference: M. R. Campbell and K. K. Kimball, 1923, North Carolina Geol. and Econ. Survey Bull. 33, p. 20, 25–43.

J. A. Reinemund, 1955, U.S. Geol. Survey Prof. Paper 246, p. 31–35, pl. 1. Conformably overlies Pekin formation; conformably underlies Sanford formation; in Colon, cross structure grades laterally into conglomerate and sandstone beds that are indistinguishable from strata in the Pekin and Sanford. Includes two coal beds, the Cumnock and Gulf, 200 to 260 feet above base of formation. Strata below coal beds consist mainly of light-gray, medium-dark-gray, and dark-greenish-gray siltstone and fine-grained sandstone and contain small amounts of claystone and shale; strata above coal beds consist mainly of medium-light-gray to black shale and include small amounts of claystone, siltstone, and sandstone; shale is irregularly calcareous and carbonaceous. Thickness 750 to 800 feet in north-central part of Sanford basin, northwest of Deep River fault.

Named for section exposed in mine shaft at Cumnock, Lee County. Crops out in narrow belt along center and northwestern side of Sanford basin, is duplicated four times by longitudinal faulting in western part of basin, and is present locally at southern end of Durham basin.

Cundiff Limestone (in Caddo Creek Formation[1]

Pennsylvanian: Central northern Texas.

Original reference: J. M. Armstrong, 1929, Texas Bur. Econ. Geology, geol, map of Jack County.

Crops out near Cundiff in eastern part of Jack County. Named for village of Cundiff.

Cunningham Granite

Precambrian: Central western Georgia.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 30, pl. 1. Commonly massive coarse-grained rock dark in color in contrast to other igneous and metamorphic rocks of region. Boundaries locally cut across lamination of Woodland gneiss (new) and the Cunningham is believed to be intrusive into the Woodland.

Named for Cunningham Crossroads in Talbot County, southeast of Manchester, where central part of the largest mass of the rock is exposed; area is south of Towaliga fault.

Curdsville Limestone[1] (in Lexington Group)

Curdsville Limestone Member (of Hermitage Formation)

Middle Ordovician: Central Kentucky and central Tennessee.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 9, 18.

C. W. Wilson, Jr., 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1993; 1949, Tennessee Div. Geology Bull. 56, p. 84 (fig. 15), 85–88. member at base of Hermitage formation in Tennessee. Consists of thin beds of medium-grained to coarsely crystalline blue to gray limestone interbedded with partings of gray shale. Maximum thickness 15 feet. Overlies Carters limestone of Stones River group.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41. Basal formation in Lexington group in Kentucky. Consists of cherty coarsely crystalline gray-blue limestone, about 20 feet thick. Underlies Hermitage formation; overlies Tyrone limestone of Highbridge group.

Named for Curdsville Station, Mercer County, Ky.

Curecanti Quartz Monzonite

Curecanti Granite[1]

Precambrian: Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Exposed for 3½ miles along Black Canyon, from a point 1½ miles east of Curecanti Creek to Nelson Gulch, Gunnison River region.

†Curl Formation[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 26.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey.

Named for Curl Creek, Nowata County.

Curlew Limestone Member (of Spoon Formation)

Curlew Limestone Member (of Tradewater Formation)[1]

Curlew Limestone (in Macedonia Formation)

Curlew Limestone (in Tradewater Group)

Middle Pennsylvanian: Western Kentucky and southern Illinois.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, pl. showing section of Lower Coal Measures; 1857, Kentucky Geol. Survey, v. 3, p. 13, 23.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 40. Curlew limestone occurs in Macedonia formation about 20 or 30 feet above a more or less local sandstone that lies above the Murray Bluff sandstone. Light gray, compact, and generally 3 to 4 feet thick; contains chert; and locally weathers to a porous cherty residium.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, *in* C. O. Dunbar and L. G. Henbest, Illinois Geol. Survey Bull. 67, p. 15 (fig. 2), 18, 20–21

[1943]. Curlew limestone included in Tradewater group. Occurs in Macedonia cyclothem above Murray Bluff sandstone and below Curlew coal and Curlew sandstone in Stonefort cyclothem. Light-colored limestone, very siliceous and cherty, and locally grades into a bed of solid chert. Thickness variable, maximum 5 to 6 feet. Known from Williamson County, Ill., to Butler County, Ky.

W. H. Smith, 1957, Illinois Geol. Survey Circ. 228, p. 8 (fig. 2), 9. Overlies Creal Springs sandstone (new) in vicinity of Creal Springs.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45. Reallocated to member status in Spoon formation (new). Overlies New Burnside coal member; underlies O'Nan coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

U. S. Geological Survey has discontinued the use of the name Tradewater in Illinois.

Type locality: South side of Indian Hill, near Curlew, Shawneetown quadrangle, Union County, Ky.

Curlew Sandstone (in Stonefort Formation)

†Curlew Sandstone (in Tradewater Formation)[1]

Curlew Sandstone (in Tradewater Group)

Pennsylvanian: Western Kentucky and southern Illinois.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, pl. showing section of Lower Coal Measures; 1857, Kentucky Geol. Survey, v. 3, p. 13, 23.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 41. Basal sandstone in Stonefort formation. Massive micaceous crossbedded more or less friable member that unconformably overlies Macedonia formation (new).

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 15 (fig. 2) [1943]. Included in Stonefort cyclothem, Tradewater group. Occurs above Curlew coal and below Bald Knob coal which is below Stonefort limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32. Replaced by Granger sandstone member of Spoon formation (both new).

Apparently named for Curlew, Union County, Ky.

Curley bed

Curley limestone member (of Gardner Dolomite)

Mississippian: Central Utah.

T. S. Lovering and others, 1949, Econ. Geology Mon. 1, p. 6 (table 1). A 2-foot bed of light-gray fine-grained wavy-bedded limestone in Gardner dolomite. Underlain by 6 feet of pink lithographic dolomite; overlain by thin-bedded blue limestone.

P. D. Procter and D. L. Clark, 1956, Jour. Sed. Petrology, v. 26, no. 4, p. 313–321. Referred to as member of Gardner. An unusual biostrome. Described in detail and distribution noted.

Crops out over area of at least 600 square miles west of Provo. Type locality and derivation of name not stated.

Currant Tuff

Miocene, upper, or Pliocene, lower: Eastern Nevada.

G. T. Faust and Eugene Callaghan, 1948, Geol. Soc. America Bull., v. 59, no. 1, p. 33–40. Contains a wide variety of tuffs—crystal tuff, crystal-vitric tuff, vitric-crystal tuff, and vitric tuffs. Thickness ranges from a few feet to over 400 feet. Occurs between two groups of volcanic flows here referred to as lower volcanics and upper volcanics.

C. J. Vitaliano, 1951, U.S. Geol. Survey Bull. 978–A, p. 1, 7–9, pl. 2. Considered to be late Miocene or early Pliocene.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 140 (fig. 4). In Grant Range, overlies Stone Cabin tuff (new) and underlies Windous Butte tuff (new). Windous Butte tuff has K–A age of 34 million years.

Named for Currant Creek area, in White Pine and Nye Counties, 29 miles southwest of Ely. Tuff is the host rock for magnesite in district.

Currant Creek Formation

Currant Creek Formation (in Wasatch Group)

Upper Cretaceous(?): Northeastern Utah.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 117–120, pls. 1, 2, 3. Proposed for sequence of conglomerates, sandstones, and variegated shales, which, in western part of Uinta Basin, transect Mesaverde Niobraran beds and unconformably underlie Eocene strata of probable Uinta age. Thickness along Red Creek 4,550 feet. Tentatively referred to Upper Cretaceous but probably represents transitional strata deposited from late Upper Cretaceous to Eocene during early phases of Laramide folding.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 106–107. Possibilities of Cretaceous age for Currant Creek and of correlation with conglomerates of Price River formation (as mapped by Spieker) must be considered. In many parts of Wasatch Mountains, thick conglomerates presently and formerly considered as Wasatch unconformably overlie strata of varying ages. Until relationship between these conglomerates and those of Price River formation is understood, seems best to assign Currant Creek to Wasatch group (redefined); considered Paleocene-lower Eocene.

Exposed from Currant Creek to a few miles east of Duchesne River, Wasatch and Duchesne Counties.

Curry Clay Member (of Harpersville Formation)

Pennsylvanian (Cisco): North-central Texas.

F. B. Plummer *in* M. G. Cheney, 1948, Abilene Geol. soc. [Guidebook] Spring Field Trip, June 11–12, p. 8. Named in road log.

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 17–21, pl. 3. Purplish red and greenish red, grading in places into deep maroon. Thickness varies from a few feet to 32 feet depending upon thickness of sand in section above it. Occurs between upper and lower Crystal Falls limestone layers, just above Quinn clay in areas where thick sandstone deposits of Parks Mountain and its probable equivalent, Cisco Lake sandstone, do not occur. [Member of Harpersville formation].

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 7 (fig. 2), measured sections. Member of Harpersville formation in report on Stephens County. Thickness 1 to more than 15 feet. Overlies Crystal Falls limestone member; underlies unit referred to as "Upper Crystal Falls" limestone member.

Named for Curry Farm, 5 miles south and 2¼ miles west of Breckenridge, Stephens County.

Curry Iron-Bearing Member (of Vulcan Iron-Formation)[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Referred to as iron-bearing member of Vulcan iron-formation. Underlies Loretto slate member; overlies Brier slate member.

Named for exposures north of Curry mine, Menominee district, [Dickinson County].

Curry Mountain Shale (in Panoche Formation or Group)

Upper Cretaceous: Central western California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2), 993. Panoche group (or formation) is subdivided into 10 units. Curry Mountain shale is lowermost in sequence (ascending). Underlies Long Canyon sandstone (new). Curry Mountain shale is assigned to Delevanian stage (new). Name credited to J. Q. Anderson.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 15). Shown on correlation chart as member of Panoche formation. Overlies Center Peak conglomerate member (new).

Occurs in Alcalde Hills, Coalinga-Ortigalito area, San Joaquin Valley.

Curtin Limestone (in Black River Group)

Curtin Limestone (in Hunter Group)

Curtin limestone facies (of Oak Hall Member of Nealmont Limestone)

Middle Ordovician (Trentonian): Central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 194, 197–203. Named as upper unit in Black River group in central Pennsylvania. Consists of impure and relatively pure limestone. Contains five metabentonites, A–E. Subdivided to include Valley View member (new) below and redefined Valentine member above. Thickness about 143 feet at type locality. Thins from 100–150 feet along northwest side of Nittany Valley to extinction along line from Tyrone to north of Lemont, Oak Hall and Spring Mills and south of Millheim. Unconformably underlies Nealmont limestone; overlies Stover member of Benner limestone.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1199. Assigned to upper Bolarian (Hunterian) series.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. [1402], 1409. Uppermost unit in Hunter group and Hunter subseries (Bolarian series).

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 78, 95, 102. Described as a calcilutite facies of the Oak Hall member of Nealmont limestone. Age changed to Trentonian.

Type section: In quarry wall south of headframe of Bell mine of America Lime and Stone Co. at Bellefonte, Centre County. Named from Curtin Gap 3 miles northeast of Bellefonte.

Curtis Formation (in San Rafael Group)[1]

Upper Jurassic: Southeastern and central Utah and western Colorado.

Original reference: J. Gilluly and J. B. Reeside, Jr., 1926, U.S. Geol. Survey Press Bull. 6064, March 30.

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 78–79. In San Rafael Swell, an erosional unconformity displaying irregularities of as much as 50 feet in height occurs at top of Entrada sandstone (new). Resting on this channeled surface is Curtis formation. Consists of series of greenish-gray glauconitic conglomerates, sandstones, and shales, and contains Upper Jurassic fossils. Thickness 193 feet at type locality; 252 feet at Summerville Point, at north end of the Swell; 50 feet near mouth of San Rafael River. Underlies Summerville formation (new) with boundary gradational. San Rafael group.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1278–1279. Discussion of stratigraphy of Uinta Mountains, Utah. Name Stump is used in Weber River, Duchesne River, and Lake Fork areas so that southeastern Idaho Jurassic terminology is uniform in all western sections. East of Lake Fork, name Curtis is used and along eastern part of mountains, the lithologic character is somewhat different than that on west. In general, the Curtis is made up of basal medium-grained to coarse-grained crossbedded sandstone which rests with sharp contact on subjacent beds [Entrada]. Middle part of formation is greenish-gray shale with intercalated fossiliferous sandstones, limestones, and coquinal limestones. At Whiterocks Canyon and near Vernal and Manila, formation has conspicuous limestone member at top which is characterized by brachiopod genus *Kallirhynchia*. Twin Creek limestone of Sears' (1924, U.S. Geol. Survey Bull. 751–G) Vermilion Creek section is the Curtis.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 235; 1950, U.S. Geol. Survey Prof. Paper 220, p. 49 (fig. 25), 51 (table), 96, pl. 5. Described in Zion Park region where it is 40 to 50 feet thick; consists of gray roughly bedded limestone and thick gypsum; unconformably overlies Entrada sandstone and unconformably underlies Winsor formation (new).

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 599–600. In Strawberry Valley quadrangle, Utah, 725 feet thick; overlies Entrada sandstone, and underlies Morrison formation.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 72–73, strat. sections. Described in Henry Mountains region where it is as much as 175 feet thick and consists of evenly bedded gray sandstone and shaly sandstone, glauconitic(?), numerous siliceous geodes and concretions at some places; local thin basal conglomerate. Underlies Summerville formation, unconformably overlies Entrada sandstone.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 85–89, pls. 1, 2, 6. Described in Uinta River-Brush Creek area, Utah, where it is 144 to 270 feet thick. Unconformably overlies Entrada formation; underlies Morrison formation.

Named for exposures on Curtis Point, near head of Cottonwood Springs Wash, on northeastern side of San Rafael Swell, southeastern Utah.

Curzon Limestone Member (of Topeka Limestone)

Curzon Limestone (in Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Northwestern Missouri, southwestern Iowa, northeastern Kansas, and southeastern Nebraska.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 57.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 20, 46, 50–51. Reallocated to member status in Topeka limestone; underlies Jones Point shale member; overlies Iowa Point shale member. Iowa occurrences noted. Type locality designated. [Name spelled Curzen.]

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Member of Topeka formation. Overlies Iowa Point shale member; underlies Jones Point shale member. This is a classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16, fig. 5. Variable in texture; commonly divided into two or three units by thin shale partings. Near Thurman, Fremont County, a fine-grained sublithographic brecciated bed that contains soft green shale within the fractures is common near top of member; in Mills County, to the north, upper beds are thicker and contain dark-brown chert; near Howe, Adair County, to the northeast, it is made up of light-gray *Osagia*-bearing bed overlying fine-grained massive fossil-bearing limestone; west of Macedonia, Pottawattamie County, it is composed of alternating shales and limestones. Thins northeastward; thickness 9 feet near Thurman; 6 feet near Macedonia; about 3 feet near Howe. Member of Topeka limestone. Underlies Jones Point shale member; overlies Iowa Point shale member.

Type locality: East of Curzon Station, southeast of Forest City, Holt County, Mo. Reason for change in spelling of name of station since Gallaher's time not known.

Cushing Granodiorite[1]

Late Carboniferous(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, U.S. Geol. Survey Prof. Paper 108, p. 176.

Named for exposures on Cushing Island, in Casco Bay.

†Cushing Limestone Member (of Elmdale Formation)[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 80.

Exposed about one-half mile west of Cushing, Payne County.

Cusseta Sand

Cusseta Sand Member (of Ripley Formation)[1]

Upper Cretaceous: Western Georgia and eastern Alabama.

Original reference: J. O. Veatch, 1909, Georgia Geol. Survey Bull. 18, p. 86–89.

C. W. Cooke and A. C. Munyan, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 790–791. Rank raised to formation. In western

Georgia, overlaps Blufftown and Eutaw formations in Marion County and extends eastward on the Tuscaloosa as far as Peach County, where it is overlain by basal Eocene Clayton formation. Above the Cusseta is more than 100 feet of dark-gray micaceous sand representing the Ripley formation.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1643 (fig. 2), 1649–1650. Geographically extended into eastern Alabama where it merges into Selma chalk; merging takes place in an east-west stretch of 15 or 20 miles in region south of Montgomery; intertonguing consists of two main westward extending tongues of sand, one below and one above an eastward extending tongue of chalk. In its westward continuation through Alabama, the updip near-shore facies of Cusseta becomes a coarse sand with fine-gravel lenses in basal part. North-facing escarpment known as Chunnenuggee Ridge, which extends from Union Springs eastward toward Chattahoochee River, is physiographic expression of the Cusseta. Underlies Ripley formation; presence of unconformity separating the two not established.

D. H. Eargle, 1948, Southeastern Geol. Soc. 6th Field Trip [Guidebook]. p. 44, 45. In this report [Cretaceous of east-central Alabama], the Cusseta is considered a member of Ripley formation.

Named for exposures in vicinity of Cusseta, Chattahoochee County, Ga.

Cussewago Limestone[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 202.

Cussewago Sandstone[1]

Cussewago Stage

Mississippian: Northwestern Pennsylvania and eastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 91–98, 202, 203, 204, 205 (fig. 63).

W. M. Laird, 1941, Pennsylvania Geol. Survey Prog. Rept. 126, p. 12–16. Discussed as Cussewago stage in lower part of Oil Lake series. Includes interval between Berea stage above and Riceville stage below.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Discussion of relationship of Berea, Corry, and Cussewago sandstones in Ohio and Pennsylvania. Bedford shale has been traced eastward across Ohio into Pennsylvania where it lies below Berea and above the Cussewago sandstone. In Pennsylvania, name Cussewago was first applied to this shale by White, and later name Hayfield was substituted by Chadwick (1925, Geol. Soc. America Bull., v. 36, no. 3). Cussewago limestone of White, renamed Hayfield by Chadwick and redefined as Littles Corners by Caster (1934, Bulls. Am. Paleontology, v. 21, no. 71) is described as occurring in this shale in Bartholomew quarry (outcrops 55 of this report). Name Cussewago as originally applied by White included sandstone and shale below Berea in outcrop at Bartholomew quarry. Because of lack of formal description, name has been redefined by later workers and extended beyond areal limits of the sandstone. However, Cussewago sandstone forms a mappable lithologic unit and is best horizon marker in its outcrop area. Cussewago sandstone merits rank of formation and is here defined as the typical friable greenish-brown medium-grained quartz sandstone below Bedford shale at Bartholomew quarry. Here, top of Cussewago

lies 37 feet below graphic siltstone layer at base of Orangeville shale and 29 feet below top of Berea sandstone. This section is on a tributary of Cussewago Creek, which is type locality of Cussewago as cited by White. Cussewago sandstone has been designated by Caster (1934) as western facies of Cobham conglomerate of Warren, Pa., region. The two are separated horizontally by shales and cannot be traced into one another. Recognition of Cussewago as independent unit lying below Berea sandstone, and separated by Bedford shale from that sandstone, has not been general. Inclusion of Cussewago and Bedford in Berea in Ohio is largely responsible for introduction of hypothetical threefold Berea formation in Ohio. Mississippian.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1351 (fig. 3), 1353–1354, 1362. In Crawford County, Pa., underlies Shellhammer Hollow formation (new). Underlies Riceville shale.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Pocono group includes, in Appalachian Plateau, Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp formations.

Named for exposures in Cussewago Valley, Crawford County, Pa. Exposed in Bartholomew quarry, Hayfield Township.

†Cussewago Shales[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 94–96.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1356, 1366. In Bartholomew section, Hayfield Township, White reported 35 feet of Cussewago shale, including 2 feet of limestone near the top, between his Cussewago sandstone and his Corry sandstone. Bedford shale has been traced into this outcrop, where it lies between Cussewago sandstone and White's Corry. Bedford has priority; recommended that name Cussewago shale be dropped from literature.

Named for exposures in Cussewago Valley, Crawford County.

Cussewago Slate[1] or monothem[1]

Mississippian: Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 53, 103, table opposite p. 61.

Custards shale member[1] (of Meadville Stage)

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 137.

Well exposed at Peterson's Falls, on Rocky Creek, 2 miles west of Custards, Crawford County.

Custer Formation[1] or Group

Triassic, (?): Oklahoma, Kansas, and Texas.

Original reference: R. Roth, 1932, Jour. Geology, v. 40, no. 8, p. 688–725.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 421–474. Trace of unconformity at base of Custer mapped from Wheeler County southward to Coke County, Tex. Suggested that beds occupying interval between base of Dockum and the unconformity

mapped be given one formation name, Custer, and that names now in usage be confined to the facies which they represent. In Collingsworth and Wheeler Counties, contact between base of Custer and older beds is one of sandstone resting on shale or gypsum. In Collingsworth and Hall Counties, includes Dozier Mounds dolomite member. In Childress and Cottle Counties, Childress dolomite is 3 to 20 feet above base of Custer. In King and Stonewall Counties, base is sandstone or gypsum. In Fisher, Nolan, and Coke Counties, base is marked by sandstone or anhydrite and a fine quartz conglomerate. In these counties, Eskota dolomite is from a few feet to 20 feet above base. Sediments below are shale, sandstones, or gypsum, or the "Blaine of Texas." In Nolan and Coke Counties, pre-Custer erosion has removed most of "Blaine of Texas," and the Custer rests on upper sandstone facies of the San Angelo. Terms Cloud Chief, Quartermaster, and Whitehorse have been very loosely applied to sediments of Custer age in Texas.

Ira Cram, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 474. In Andarko basin, Oklahoma, Roth's Custer formation would include sediments between base of Marlow formation and the Tertiary. In this area, there are unconformities which separate Marlow formation from Rush Springs formation and the Rush Springs from higher sediments. These mechanical changes may or may not be recognizable in other areas, but their presence over several counties in Oklahoma satisfied requirements for dividing Custer unit into formations. Custer cannot be correctly termed a formation because it contains within its boundaries good formations. Term Custer is an Oklahoma term, and Oklahoma conditions are important. Custer unit is correctly classified as a group.

Robert Roth, N. D. Newell, and B. H. Burma, 1941, Jour. Paleontology, v. 15, no. 3, p. 313. Table shows Custer group comprises (ascending) Whitehorse formation, Day Creek dolomite, and Quartermaster formation.

Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412, 1413. Overlies Pease River group (new).

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Roth grouped the Whitehorse, Cloud Chief, and Quartermaster and considered them of Triassic age. Grouping is not recognized, and name is not used.

Named for Custer County, Okla., where almost whole formation is exposed.

Custer Granite Gneiss[1]

Jurassic(?): Southwestern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 15.

Forms Custer Ridge, British Columbia.

Custerian series[1]

Early Cretacic: South Dakota.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 43. p. 109, 125, 126.

Well exposed in Black Hills. Named for exposures in Custer County, S. Dak.

Cutalossa Member (of Stockton Formation)

[Upper Triassic]: East-central New Jersey.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 52–53 (table). Medium to coarse thick-bedded arkose with interbeds of red-brown fine sandstone. Thickness 232 feet. May or may not include overlying 787 feet of red and gray sandstone and red shale and underlying 373 feet of red and brown sandstone [see Stockton formation]. Older than Raven Rock member (new); younger than Prallsville member (new).

In area along Delaware River from Stockton northward to 3 miles west of Milford, Hunterdon County.

Cutbank Sand[1]

Cut Bank Sandstone

Jurassic or Lower Cretaceous: Northwestern Montana (subsurface and surface).

Compiler unable to locate original reference.

R. J. Weimer, 1959, Billings Geol. Soc. Guidebook 10th Ann. Field Conf., p. 88. Surface section of Cut Bank sandstone shows an intertonguing in the lower 10 feet of gray medium- to coarse-grained sandstone (Cut Bank) and laminated glauconitic sandstone and siltstone (Swift). Jurassic. Editors note states that Weimer's correlations of the Cretaceous Jurassic section differ radically from those in other articles of the guidebook.

Surface section measured in NE¼ sec. 34, T. 30 N., R. 11 W., in Cut Bank area.

Cutler cyclothem (in McLeansboro Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Shown on correlation chart as underlying Gimlet cyclothem and overlying Bankston cyclothem. Includes Cutler limestone and Cutler coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43. Strata of cycle now referred to Sparland cyclothem, but strata included in cycle in southern and southwestern Illinois do not include all strata included in Sparland. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: Secs. 2 and 3, T. 6 S., R. 4 W., Perry County.

Cutler Formation[1]

Cutler Group

Permian: Southwestern Colorado, northeastern Arizona, northwestern New Mexico, and southeastern Utah.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1423, 1425, 1436, 1444, 1445, 1446. Includes (ascending) Halgaito tongue, Cedar Mesa sandstone tongue (new), Organ Rock tongue (new), White Rim sandstone member (new), DeChelly sandstone member, and Hoskinnini tongue (new).

L. G. Henbest, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1330. On basis of fossil evidence, at least part of redbeds of Cutler at type locality are believed to be of Pennsylvanian age.

C. B. Hunt, Paul Averitt, and Ralph Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 39–45, pls. 1, 15. Formation includes all Permian rocks exposed in canyons east of Henry Mountains. Divided into three members (ascending): Cedar Mesa sandstone, Organ Rock tongue, and White River sandstone. In Monument Valley, southeastern Utah and northeastern Arizona, comprises (ascending) Halgaito tongue, Cedar Mesa sandstone member, Organ Rock tongue, DeChelly sandstone member, and Hoskinnini tongue.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2174. Includes Rico basal member. Overlies Hermosa formation. [See Hermosa formation for explanation of "R" datum.]

George Herman and S. L. Sharps, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 81. Rico should not be considered basal unit of Cutler.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2054, 2055 (fig. 3). Rank raised to group. Includes (ascending) Rico transition facies, Halgaito formation, and Cedar Mesa formation. Overlies Hermosa group.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1854–1856, 1857 (fig. 3). In most of southeastern Utah and southwestern Colorado, Cutler formation of Permian age overlies Rico formation of Pennsylvanian and Permian(?) age and underlies Moenkopi formation of Triassic(?) and Early and Middle(?) Triassic age. In salt anticline region, the Cutler is absent over crests of some anticlines and pinches out northeast along southwestern edge of Uncompahgre Plateau. In southwestern Utah, consists of reddish-brown horizontally bedded siltstone and sandstone redbed tongues with light-colored very fine- to fine-grained cross-stratified sandstone members. In Monument Valley, members, as recognized in this report, are (ascending) Halgaito tongue, about 400 feet thick; Cedar Mesa sandstone member, about 800 feet; Organ Rock tongue, about 500 feet; and DeChelly sandstone member, about 300 feet. Formation is stratigraphically restricted above to exclude Hoskinnini member which is reallocated to Moenkopi formation. Thickness about 2,000 feet in southern part of southeastern Utah; thins irregularly northward to about 700 feet in some parts of east-central Utah; zero to several thousand feet in salt anticline region; maximum thickness not known.

R. O. Lewis, Sr., and R. H. Campbell, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–194. Mapped in Elk Ridge 3 NE quadrangle, San Juan County, Utah. Includes Cedar Mesa sandstone member, Organ Rock tongue, and Hoskinnini tongue. Overlies Rico formation; underlies Moenkopi formation.

Named for exposures on Cutler Creek, which enters Uncompahgre River about 4 miles north of Ouray, Ouray County, Colo.

Cutler Limestone (in McLeansboro Group)

Cutler Limestone Member (of McLeansboro Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: A. H. Bell, C. Ball, and L. McCabe, 1931, Illinois Geol. Survey Press Bull. 19.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 17 (fig. 3), 25–26. Columnar section shows Cutler limestone in McLeansboro group. In St. Clair, Perry, and Randolph Counties, the Cutler is a light-gray bed about 5 feet thick which lies about 15 feet above Bankston Fork limestone. Included in Gimlet cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Correlation chart shows Cutler limestone in Cutler cyclothem (new) and in Sparland cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37. Replaced by Piasa limestone member of Modesto formation (new).

Type locality: Secs. 2 and 3, T. 6 S., R. 4 W., Perry County. Named for exposures in vicinity of Cutler.

Cutoff Shaly Member (of Bone Spring Limestone)

Permian (Leonard Series): Southern New Mexico and western Texas.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 569–570, pl. 2. Consists of several hundred feet of buff, dove-gray, or black thin-bedded limestones and siliceous shales at top of formation. Assigned to the Bone Spring because, 2 miles north of Bone Spring, the beds are truncated and overlain unconformably by Delaware Mountain group. At type locality, overlies Victorio Peak gray member. In some areas, lies between the Victorio Peak gray member and the sandstone tongue of the Cherry Canyon formation; in other areas, underlies Brushy Canyon formation.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 16, 18, 24, pl. 3 [1949]. Name Cutoff shaly member given to discontinuous sets of beds at top of Bone Spring limestone exposed in three general districts: area from which it is named; Shumard Canyon, where it is separable into two divisions; and along base of Delaware Mountains. Mapped in New Mexico.

Type exposure: On west face of Cutoff Mountain near Texas-New Mexico line.

Cutright Sandstone Member[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 118, 181, 182, 189, 212, 250.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Cutright sandstone, Weed Patch, and Mount Ebel sandstone members included in Allens Creek facies of Edwardsville. Lower Mississippian.

Named derived from Cutright Bridge across Salt Creek, center sec. 4, T. N., R. 1 E., from Cutright Ridge to the south, and from the Cutright community, Monroe County.

Cutter Member (of Montoya Formation)

Cutter Formation or Dolomite (in Montoya Group)

Upper Ordovician: Southern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs, in Geology 4, p. 57, 62–64, fig. 4. Thin sequence of light-gray-weathering generally unfossiliferous claystone, limestone, calcitic dolomite, and dolomite in

Caballo Mountains. Limestone is medium gray to dark gray on fresh surfaces and weathers blue gray. Dolomite is light gray to dark gray and along with the calcitic dolomite weathers light gray or light tan. Both limestone and dolomite are generally microgranular or sublithographic. Chert present as occasional bands parallel to bedding or as rounded nodules; it is dark gray to black on fresh exposure and weathers black. Thickness 121 to 162 feet in Mud Springs Mountains, from 50 to 115 feet from Palomas Gap south, and 130 feet at Granite Wash. Conformably overlies Aleman formation (new). Underlies Percha formation at north end of San Andres Mountains. Unit here named Cutter was called Fusselman(?) by Darton (1917, U.S. Geol. Survey Prof. Paper 108-C; 1928, U.S. Geol. Survey Bull. 794). Montoya group.

L. C. Pray, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1907 (footnote). Cutter formation (name pub. by Kelley and Silver after submission of ms. for present rept.) is probably correlative with Valmont dolomite (new) of Sacramento Mountains.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 1, 26. Term Cutter, as applied by Kelley and Silver (1952) to lower part of Richardson's (1909) Fusselman, has priority over Pray's (1953) term Valmont, but agewise should yield to Entwhistle's (1944) term Raven. Where not eroded by pre-Onate erosion, the Cutter is relatively uniform in thickness beneath Fusselman dolomite, being 168 feet in Ash Canyon and 182 feet in Hembrillo Canyon. In Rhodes Canyon, only lower beds are present, and thickness varies from 26 to 75 feet. Cutter, however, has been used more often in south central New Mexico. Overlies Aleman dolomite. Unconformably underlies Fusselman dolomite in Ash and Hembrillo Canyons, and Onate formation in Rhodes Canyon. Montoya group.

Dorothy Hill, 1959, New Mexico Bur. Mines Mineral Resources Bull. 64, p. 3. Cutter formation (uppermost Montoya) is Upper Ordovician or Lower or Middle Silurian. Determination based on study of corals.

Type locality: Cable Canyon section opposite Sierrite mine in NW¼ sec. 10, T. 16 S., R. 4 W., Caballo Mountains.

Cutting Dolomite

Cutting Dolomite (in Beekmantown Group)

Lower Ordovician: West-central Vermont.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 539–540, 541–542, 543. Sequence of dolomite beds averaging 1 or 2 feet in thickness. At base is thinly laminated sandstone that bears worm boring "*Scolithus*." Nodules of black chert occur in upper part of the dolomite. Thickness about 350 feet. Underlies Bascom formation (new); overlies Shelburne marble. Corresponds to Division C of the "Calciferous" of Brainerd and Seely (1890, Am. Mus. Nat. History Bull., v. 3). Beekmantown group (Beekmantownian).

Type locality: On eastern dip slope of Cutting Hill in southeastern Shoreham Township, Addison County.

Cuyahoga Group[1] or Formation[1]

Cuyahoga Formation (in Pocono Group)

Mississippian: Ohio and western Pennsylvania.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 21.

J. E. Hyde, 1915, Jour. Geology, v. 23, p. 655–682. Formation includes five facies: Toboso conglomerate, Hocking Valley conglomerate, Granville shale, Scioto Valley shale, and Vanceburg sandstone. Named members: Berne, Black Hand, Buena Vista, Churn Creek, Fairfield, Henley, Lithopolis, Raccoon, and Rarden.

H. P. Cushing, Frank Leverett, and F. R. Van Horn, 1931, U.S. Geol. Survey Bull. 818, p. 48–54, pl. 20. Cuyahoga, in its typical area, is elevated to rank of group. Comprises (ascending) Orangeville shale, Sharpsville sandstone, and Meadville shale. Thickness 165 to 425 feet. As generally recognized in Ohio, overlies Sunbury shale, a thin representative of which is present in basal part of Orangeville shale. Unconformable below Sharon conglomerate.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942 Jour. Geology, v. 50, no. 1, p. 34–67. Seven lithologic facies, each subdivided into a varying number of members and submembers are recognized in Cuyahoga formation: Tinkers Creek shale (new), River Styx conglomerate (new), Killbuck shale (new), Toboso conglomerate, Granville shale, Hocking Valley conglomerate, and Henley shale. Facies named in progressive order from northeastern Ohio to south-central Ohio. Cuyahoga directly underlies Logan formation. Named members: Meadville shale, Sharpsville sandstone, Orangeville, Black Hand conglomerate, Armstrong sandstone, Black Hand shale, Burbank, Pleasant Valley Black Hand siltstone, Raccoon shale, Fairfield sandstone, Lithopolis siltstone, and Henley shale. Sunbury shale not recognized as distinct formation in area of this report; all black shale immediately overlying Berea sandstone is included in Orangeville member of Cuyahoga.

P. A. Dickey, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–22, p. 5. Group, in Titusville quadrangle, is 130 to 150 feet thick. Not subdivided in this area. Overlies Corry sandstone; underlies Shenango group.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Formation, as shown on generalized section, comprises (ascending) Henley, Buena Vista, Portsmouth, Black Hand, and Berne members. Overlies Sunbury; underlies Logan.

P. A. Dickey, R. E. Sherrell, and L. S. Matteson, 1943, Pennsylvania Geol. Survey, 4th ser., Bull. M–25, p. 18–20, map. Cuyahoga group, in Oil City quadrangle, includes strata between basal member (A) of Shenango formation and Corry sandstone of Berea group. Thickness about 140 feet. Consists of alternating beds of shale and sandstone. Group not subdivided.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 10 (fig. 4), 13. Group comprises (ascending) Sunbury shale, Orangeville shale, Sharpsville sandstone, and Meadville shale. Overlies Berea sandstone.

J. F. Hall, 1958, Dissert. Abs., v. 18, no. 2, p. 559. Southern Hocking County, Ohio, contains strata ranging in age from Kinderhook-Osage series of Mississippian to Conemaugh series of Pennsylvanian. Oldest outcropping unit, the Cuyahoga shale member of Cuyahoga formation, consists of about 75 feet of interbedded shales and sandstones. Over-

lying and grading into shale member in a facies relationship is Black Hand member, composed of 175 feet of coarse-grained sandstone and lenses of conglomerate. Disconformably underlies Logan formation of Osage series.

E. J. Szmuc, 1958, Dissert, Abs., v. 18, no. 6, p. 2109. Cuyahoga rocks are marine clastic deposits, which include fine-grained shelf sediments and coarse-grained deltaic or bar sediments. Maximum thickness about 600 feet in northern Ohio. Formation comprises (ascending) Orangeville, Sharpsville, Strongsville (new), Meadville, Rittman, Armstrong, Wooster (new), and Black Hand. Cuyahoga-Shenango contact in northwestern Pennsylvania and northeastern Ohio is conformable. Cuyahoga-Logan contact in Wayne and Ashland Counties, Ohio, locally is surface of minor disconformity. In most of northern Ohio, a major unconformity separates Cuyahoga strata from Lower Pennsylvanian rocks.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in Pocono group.

Named for exposures along Cuyahoga River, between Akron and Cleveland, Ohio.

Cuyama Formation[1]

Cuyama Beds

Pliocene(?): Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

Chester Stock, 1947, Southern California Acad. Sci., v. 46, pt. 2, p. 84–85. New faunal evidence indicates Miocene age for Cuyama beds.

Crops out in Cuyama Valley, Ventura County.

Cuyamaca Gabbro

Cuyamaca basin intrusive[1]

Upper Cretaceous: Southern California.

Original reference: F. S. Hudson, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 6, 181, 192–207.

S. C. Creasey, 1946, California Jour. Mines and Geology, v. 42, no. 1, p. 18, 19–21, pl. 3. Described in Julian-Cuyamaca area as Cuyamaca gabbro. Youngest rock in area; intrusive into Julian schist and Stonewall quartz diorite.

Richard Merriam, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 234. Mapping in Ramona area has shown that Cuyamaca basic intrusive (Hudson, 1922) and San Marcos gabbro (Miller, 1937) are probably the same. In this area, name San Marcos gabbro is applied.

D. L. Everhart, 1951, California Div. Mines Bull., 159, p. 66–74, pls. 3, 4, 5. Described in Cuyamaca Peak quadrangle. Writer followed Creasey (1946) in referring to rocks as Cuyamaca gabbro, thereby retaining original locality name given by Hudson, but substituting more appropriate gabbro for term basic intrusive. Considered older than Green Valley tonalite.

Named for the three peaks of Cuyamaca Mountains, Ramona and Cuyamaca quadrangles, San Diego County.

Cuyuna Member (of Crow Wing Formation)[1]

Precambrian (Huronian): Central Minnesota.

Original reference: C. Zapffe, 1930, Lake Superior Min. Inst. Proc., v. 28, p. 101–106.

Cuyuna district, Crow Wing County.

†Cuyuna Series[1]

Cuyuna Slates

Precambrian (Huronian): Central Minnesota.

Original reference: C. K. Leith, 1907, Econ. Geology, v. 2, p. 145–152.

G. M. Schwartz, 1951, Geology of the Cuyuna Range: Minnesota Univ. Center for Continuation Study Mining [Geology] Symposium [No. 2], p. 3. For the most part, the Cuyuna slates have been considered to belong to the Virginia slate. This correlation has very little evidence to support it.

Occurs in Cuyuna Range, Crow Wing County.

Cygnian Substage

Pennsylvanian (Desmoinesian): Missouri, Iowa, Kansas, Nebraska, and Oklahoma.

W. V. Searight *in* W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Named on a stratigraphic column of Carroll and Livingston Counties, Mo. Comprises Cabaniss and Marmaton groups.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1), 2749. Shown on a northern midcontinent composite stratigraphic column. Cygnian substage together with underlying Venteran substage (new) make up the Desmoinesian stage.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 22. Type area stated.

Type area: Along Marais des Cygnes River (Little Osage) in Vernon County, Mo., and to west in Bourbon and Lynn Counties, Kans.

Cynthia Falls Sandstone (in Tuxedni Group)

Cynthia Falls Sandstone Member (of Tuxedni Formation)

Middle Jurassic: Central southern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1). Medium-grained gray sandstone grading horizontally into alternating sandstone and conglomerate. Thickness 800 feet.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Thick-bedded to massive, medium- to coarse-grained sandstone. Dark gray green; weathers light gray. Contains many lenticular layers of subrounded pebbles. Bed of arenaceous siltstone, from 50 to at least 100 feet thick, present near middle of member. Member 600 to 900 feet thick. Underlies Bowser member (new); overlies unnamed siltstone member. Derivation of name and geographic distribution given.

U.S. Geological Survey currently classifies the Cynthia Falls Sandstone as a formation in Tuxedni Group on the basis of a study now in progress.

Named for conspicuous waterfall on Hardy Creek. Forms hogback ridges along flanks of Tonnie syncline and Fitz Creek anticline and well exposed in nearly all creeks tributary to Fitz Creek from the west; in Iniskin Peninsula.

Cynthiana Formation[1]

Middle Ordovician: East-central Kentucky, southern Indiana, and southwestern Ohio.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10, 13, 14, 211–212.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 992–995. Several names have been applied to different members of the Cynthiana. There is confusion in the literature in regard to the relationships, due both to regional variation in lithology and fauna, and to overlap. Formation as defined herein comprises following members: Rogers Gap, Greendale, Millersburg, Nicholas limestone, Bromley, and Gratz; in southern and western Bluegrass are other pre-Greendale beds that are characterized by a fauna not known elsewhere in central Kentucky. Thickness 38 to 125 feet. Marked unconformity at base; formation rests at different places on all formations from top of Perryville (Cornishville) to Jessamine formation (in Lexington limestone). Underlies Eden.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky, Univ., p. 11 (footnote), 19–23. Name Sulphur Well member proposed for beds below Greendale member.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1641–1645. Lexington-Cynthiana-Eden is probably a conformable succession. Cynthiana consists of fossiliferous limestone and shale 40 to 100 feet thick varying in character in different parts of area. Following divisions discussed: Greendale, Millersburg, Nicholas limestone, Rogers Gap beds, Bromley shale, Gratz shale, and *Allonychia* zone. Facies of divisions change from place to place. Unit formerly termed Sulfur [Sulphur] Well member is herein considered facies of upper Lexington. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of Cynthiana. This would include as members the lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, p. 257–276. Rogers Gap [member of Cynthiana] formation, uppermost member of the Mohawkian, and overlying Fulton shale, lowermost member of the Cincinnatian, are faunally indistinguishable in area of this report [Ohio Valley around Cincinnati]. They appear to be lithologic facies of same time-rock unit. Evidence indicates advisability of extending Cincinnatian series downward to embrace Cynthiana formation, rather than including it in the Mohawkian as has been common practice.

F. R. Hall and W. N. Palmquist, Jr., 1960, U.S. Geol. Survey Hydrol. Inv. Atlas HA–25. Generalized columnar section of rocks in Carroll, Gallatin, Henry, Owen, and Trimble Counties, Ky., shows Cynthiana formation, 80 to 173 feet thick, above Benson limestone member of Lexington and below Eden formation. Includes Woodburn limestone member at base, and Devils Hollow facies above; upper part formation unnamed. Middle Ordovician.

Named for Cynthiana, Harrison County, Ky.

Cypress Sandstone[1]

Cypress Sandstone (in Homberg Group)

Upper Mississippian (Chester Series): Southern Illinois, northwestern Alabama, southern Indiana, western Kentucky, and Tennessee.

Original reference: H. Engelmann, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 189–190; paper read in 1862.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 830. Assigned to Homberg group (new). In standard Mississippian section, underlies Golconda formation and overlies Paint Creek formation.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 27, pl. 1. In Indiana, Cypress sandstone is 25 to at least 40 feet thick. Typically cream-white to light-tan fine-grained subangular well-sorted sandstone in which thinner beds are laminated locally; in some places, massive and crossbedded. Sandstone herein referred to as Cypress can be traced into the thick-bedded Big Clifty sandstone. Correlation of the Beech Creek limestone of Indiana with the Chester section of Illinois is uncertain at this date. If future investigations show that Beech Creek is equivalent to the lower part of Golconda formation of southern Illinois, beds herein termed Cypress should be designated Big Clifty.

S. W. Welch, 1958, U.S. Geol, Survey Oil and Gas Inv. Chart OC–58. In northwestern Alabama, Mynot sandstone member of Pride Mountain formation (both new) is equivalent to strata referred to by Butts (1926, Alabama Geol. Survey Spec. Rept. 14) as Cypress sandstone.

Named for exposures on Cypress Creek, southeastern Union County, Ill.

Cypress Creek Chert[1]

Lower Devonian: Southwestern Tennessee.

Original reference: C. O. Dunbar, 1917, Geol. Soc. America Bull., v. 28, p. 207.

Cyprian Sandstone Member (of Thermopolis Shale)

Lower Cretaceous: Northeastern Montana.

M. M. Knechtel, 1959, U.S. Geol. Survey Bull. 1072–N, p. 739–740, pls. 52, 53. Name applied to prominent sandy unit near middle of Thermopolis. Thickness about 25 feet. Unit has been referred to as Muddy sand.

Typically exposed in Cyprian Creek on southwest side of road that crosses NE¼NW¼ sec. 31, T. 25 N., R. 24 E., 2 miles southwest of Landusky, Phillips County, Little Rocky Mountains.

Cyrene Member (of Edgewood Limestone)[1]

Silurian (Albion Series): Northeastern Missouri and southwestern Illinois.

Original reference: T. E. Savage, 1913, Geol. Soc. America Bull., v. 24, p. 361, 376.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 16, 17, 18, 19. Described in Bowling Green quadrangle where it is typically a light-gray to dusky brown finely crystalline limestone. Includes Noix oolitic facies, which. at Clinton Springs, is about 7 feet 2 inches thick; maximum thickness of Cyrene 17 feet. Underlies Bowling Green member.

Named for exposures at Cyrene, Pike County, Mo.

†Cyril Gypsum Member[1] (of Greer Formation)

Permian: Central Oklahoma.

Original reference: F. G. Clapp, 1920, Mining and Metall., Am. Inst. Mining and Metall. Engineers, no. 158, sec. 27, Feb. 1920.

Named for exposures near Cyril, Caddo County.

Dadina Schist[1]

Mississippian: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 27, map.

Occurs along south side of a tributary of Dadina River that drains from flanks of Snider Peak.

Dagger Flat Sandstone[1]

Dagger Flat Formation

Upper Cambrian: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1064–1066.

J. L. Wilson, 1954, Jour. Paleontology, v. 28, no. 3, p. 251–252; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 12, p. 2465. Dagger Flat formation subdivided at type locality into Buttrill Ranch member (new) below and Roberts Ranch member (new) above.

Type locality: South side of Dagger Flat northeast of Buttrill Ranch, Brewster County. Exposed in long narrow belts in center of anticlines in both Marathon and Dagger Flat anticlinoria.

Dagmar Dolomite

Dagmar Limestone[1]

Middle Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 6–7. In East Tintic Mountains, consists of dense medium- to light-gray laminated dolomitic limestone that weathers creamy white. Thickness 75 to 100 feet. Underlies Herkimer limestone, contact sharp; overlies Teutonic limestone, contact commonly gradational through 10 feet or more, base placed at base of lowermost laminated bed. Type locality indicated.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 14 (fig. 3), 16–17. In Stansbury Mountains, commonly less than 20 feet thick and consists of light-medium-gray finely crystalline dolomite; distinctly laminated. Overlies Teutonic limestone; underlies Herkimer limestone.

Type locality: Near Dagmar mine, 1 mile west-northwest of Eureka, Juab County.

Dagmar Limestone Member (of Ute Formation)

Middle Cambrian: Southeastern Idaho and northern Utah.

G. B. Maxey, 1955, Dissert. Abs., v. 15, no. 4, p. 558. Incidental mention.

Dake Quartzite[1]

Precambrian: Central southern Wisconsin.

Original reference: A. Leith, 1935, Kansas Geol. Soc. Rept. 9th Ann. Field Conf., p. 329–330, fig. 216.

Well exposed on south bank of Baraboo River, near west Baraboo, and on a low ridge 2 miles east of Baraboo on north side of main highway from Baraboo to Portage, Sauk County.

Dakin Hill Member (of Littleton Formation)

Lower Devonian: Southwestern New Hampshire.

M. T. Heald, 1950, Geol. Soc. America Bull., v. 61, no. 1, p. 45 (fig. 2), 54–55, pl. 1. Uppermost part of Littleton formation in Lovewell Mountain quadrangle. Consists of porphyroblastic orthoclase gneiss, biotite-quartz gneiss, biotite-sillimanite gneiss and pyritiferous gneiss. Evidence of bedding rare and foliation poorly developed. Thickness undetermined, the breath of outcrop may mean that the thickness is of the order of 10,000 feet. Overlies May Pond member (new). Occupies a large area extending from southern boundary to northern boundary of quadrangle.

C. A. Chapman, 1952, Geol. Soc. America Bull., v. 63, no. 4, p. 387, 390–391, pl. 1. In Sunapee quadrangle where May Pond member is absent, Dakin Hill member overlies Hubbard Hill member and is separated from it by a mass of Kinsman quartz monzonite. Thickness from knife edge to 2,500 feet.

Dakin Hill is in Cheshire County.

Dakota Sandstone,[1] Formation, Quartzite, or Group

Dakota Stage

Lower and Upper Cretaceous: Nebraska, eastern Colorado, Kansas, Minnesota, southeastern Montana, northeastern New Mexico, North Dakota, western Oklahoma, and eastern Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 420.

N. H. Winchell, 1875, *in* William Ludlow, Report of a reconnaissance of the Black Hills of South Dakota, made in the summer of 1874, U.S. Engineer Dept., U.S. Army: Washington, U.S. Govt. Printing Office, p. 32, 60, 64. Report mentions the light-colored sandstones of the Dakota group of the Cretaceous. Thickness about 500 feet.

Henry Newton and W. P. Jenney, 1880, U.S. Geog. and Geol. Survey Rocky Mountain Region, p. 151–180. Group described in Black Hills region where it is prominently developed, forming capping rock to foothills that surround the Hills on all sides. Appears with its characteristic composition—coarse yellow or red sandstones with discontinuous variegated clays. At places, considerable thickness of very soft and fine white sandstone appears at base. Elsewhere considerable portions are hard dense quartzite. No animal fossils, but many remnants of plants—in no case more than mere coaly fragments. Lower Cretaceous. Thickness 250 to 400 feet.

G. H. Eldridge, 1896, U.S. Geol. Survey Mon. 27, p. 62–65. In Denver basin, formation is from 225 to 350 feet thick and commonly consists of two or three nearly equal benches of massive sandstone separated by narrow bands of shale which locally become fire clays. Characteristic conglomerate occurs at base of formation; at summit, a zone of hard white slaty shales, 10 to 30 feet thick, transitional to Benton shale of Colorado group. Fossil flora found throughout. Overlies Morrison formation (new).

W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 568–593. Newton's Dakota group of Black Hills is subdivided into five divisions 1 to 5, descending. Proposed names for the divisions, No. 5, Beulah clays, Upper Jurassic; No. 4, Hay Creek coal formation; No. 3, Barrett shales; No. 2, Oak Creek beds; and No. 1, Dakota sandstone. Dakota sandstone is Upper Cretaceous, the other units Lower Cretaceous. Dakota sandstone divided into two units, lower 30 to 45 feet thick and upper 35 to 45 feet. Unconformably underlies Fort Benton.

N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 489–599. In Black Hills, Dakota sandstone (formation), 35 to 150 feet thick, overlies Fuson formation. Underlies Graneros shale of Benton group.

G. W. Stose, 1912, U.S. Geol. Survey Geol. Atlas, Folio 186. Dakota sandstone described in Apishapa quadrangle, Colorado. Consists of massive gray sandstone, weathering rusty brown, generally in two ledges with variable thin dark shale parting. Thickness 63 to 83 feet. Overlies Purgatoire formation (new); underlies Graneros shale of Benton group. Purgatoire formation was formerly considered part of Dakota sandstone and is so mapped in Walsenburg and Pueblo folios. Upper Cretaceous.

G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203. Dakota sandstone (formation) consists of light-colored quartz sandstone having average thickness in Colorado Springs quadrangle of 100 feet. Unconformably overlies Glencairn member (new) of Purgatoire formation, although unconformity is probably not extensive. Commonly conformably overlain by Graneros shale of Benton age, but near north side of quadrangle intervening formations are overlapped by Dawson arkose, which there lies unconformably on the Dakota. Upper Cretaceous.

W. T. Lee, 1923, U.S. Geol. Survey Bull. 751–A, p. 1–22. Dakota group is divided into five informally named formations (ascending): Lower sandstone, Lower shale, Middle sandstone, Middle shale, and Upper sandstone. Group is well exposed about 2 miles north of Bellvue, Colo., and section measured here, about 325 feet thick, may be regarded as type section of group. Lower sandstone (40 feet at Bellvue) is a gray massive coarse-grained usually crossbedded and conglomeratic sandstone, variable in thickness but everywhere present and readily identified; unconformably overlies Morrison formation. Lower shale (40 feet at Bellvue) consists of variable beds of sandy shale and thin layers of hard sandstone; commonly, but not invariably, highly colored—red, purple, green, blue. In Wyoming, this shale has been called middle member of Cloverly. It may prove to be age equivalent of Fuson formation of Black Hills and is probably included in Kootenai of Montana. Middle sandstone (10 feet at Bellvue) is gray, hard, quartzose, evenly bedded, and strongly ripple marked at many localities; variable in thickness, and, where the variegated underlying shale is absent or not distinctive, it cannot be differentiated from the lower sandstone. This middle sandstone has been called upper Cloverly, true Dakota, and second Muddy and probably is included in Purgatoire formation by different workers. Middle shale (200 feet at Bellvue) is thickest formation of group. It is dark-colored bituminous marine shale. In many areas in northern Colorado between Morrison and Boulder, it contains fossil plants which Knowlton refers to the Dakota flora. North of Boulder it has yielded fossil invertebrates which Reeside tentatively places in Kiowa fauna of Kansas and Purgatoire

fauna of southeastern Colorado. Near Colorado Springs, this shale is called Glencairn member of Purgatoire formation. In southern Wyoming, it has been included in Graneros shale or lower part of the Benton. It is equivalent to upper part of Thermopolis shale of northern Wyoming. Upper sandstone (35 feet at Bellvue) is variable in character and thickness and in some places thins out entirely. Contains fossil plants, fragments of charcoal, streaks of coal and markings resembling fillings of worm borings. This sandstone is the upper Dakota of northern Colorado but is known in oil industry as Muddy sand. It is herein emphasized that there is no single definite persistent and easily recognized sandstone such as was formerly supposed to exist and was termed the Dakota sandstone. The group as a whole is interpreted as the result of accumulation of sediments near the strand line of the advancing Cretaceous sea, and as such it differs in age from place to place by length of time consumed by advance of strand line across the intervening distance. Whether this advance marks the beginning of Upper Cretaceous time remains to be determined. Area of report extends from Perry Park, Colo., about 35 miles south of Denver, northward along foothills east of Rocky Mountains to Douglas, Wyo., thence northwestward to Thermopolis, and includes section at Lander and Rawlins.

W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 57–65. Dakota sandstone, in Russell County, includes Rocktown channel sandstone member (new).

W. T. Lee, 1927, U.S. Geol. Survey Prof. Paper 149, p. 17–23. Name Dakota group, applied by writer [Lee] (1923) to beds as far west as Lander and as far north as Greybull, Wyo., is accepted by the U.S. Geological Survey only for section at Bellvue, Colo., with understanding that if rocks of Comanche age are proved to be present in Dakota group of that section, they are to be excluded from group. The rocks to which the writer thus applied term Dakota group are described in present report according to their position. They are (ascending) lower conglomeratic sandstone; a variable division of sand shale separable toward north into a highly colored lower shale and sandstone that becomes the middle sandstone of the group where three sandstones are present; upper shale, which was called middle shale in 1923 publication, but which in many sections is the higher of two shales and is therefore designated the upper shale of this group; an upper sandstone which is the upper Dakota of northern Colorado and the Muddy sand of many Wyoming localities and is probably equivalent to Newcastle sandstone of eastern Wyoming. Writer believes that group is well defined from Colorado Springs, Colo., northward nearly to southern boundary of Montana. According to this interpretation, it includes Cloverly formation of Wyoming and some rocks usually included in Benton shale.

W. L. Russell, 1928, Econ. Geology, v. 23, no. 2, p. 134–137. Term Fall River formation replaces Dakota sandstone in Black Hills region.

A. C. Tester, 1931, Iowa Geol. Survey, v. 35, p. 199–322. Discussion of Dakota stage of type locality. Meek and Hayden used term group. Other writers have used series, stage, formation, or sandstone. Lithology of the Dakota, distribution of the various zones, stratigraphic range and interpretations made in present study, all suggest that term stage be used to designate the sandstones, shales, and clays exposed

near Dakota City, Nebr., and described by Meek and Hayden as Dakota group. Dakota age is used for time. Best exposures are at Sioux City, Iowa, and its suburbs. This includes Prospect Hill section; exposures at Sioux City Brick Company pits, at Riverside; bluffs along Big Sioux River south of west entrance to Stone Park; Sergeant Bluff, south of Sioux City; Crill Mill section south of Westfield, Iowa; and several sections in vicinity of Homer, Nebr.

R. C. Moore and K. K. Landes, 1937, Geologic map of Kansas (1:500,000): Kansas Geol. Survey. Dakota group as mapped includes Solomon and Ellsworth formations of Late Cretaceous age, and Belvidere formation and Cheyenne sandstone of Early Cretaceous age. Comanche series.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 99–104. In southeastern Minnesota, Dakota formation includes Ostrander member (new). Geological column shows Dakota formation of Dakota series stratigraphically below Coleraine (Benton) formation of Colorado series and above Devonian Senecan series.

B. F. Latta, 1941, Kansas Geol. Survey Bull. 37, p. 68–79. Group includes all strata from base of Cheyenne sandstone to base of Graneros shale. All Cretaceous strata in Stanton County [this report] belong to Dakota group. They comprise (ascending) Cheyenne sandstone, Kiowa shale, and an upper sandstone (formerly called Dakota) that is here named Cockrum sandstone.

A. R. Edwards, 1941, Wyoming Geol. Survey Bull. 32, p. 10. Term Dakota group, in Platte and Laramie Counties, Wyo., includes sequence of sandstones and shales which rest disconformably upon Morrison formation. Consists of five members (ascending): dark-gray coarse-grained sandstone; dark shale; buff hard ripple-marked sandstone; dark carbonaceous shale; and massive hard sandstone. Thickness 250 to 375 feet. Underlies Benton group.

Norman Plummer and J. F. Romary, 1942, Kansas Geol. Survey Bull. 41, p. 315–348. Dakota formation of Kansas, as here defined, has been called variously "Dakota group," "Dakota formation," Ellsworth and Solomon formations, Rocktown channel sandstone member, and "Dakota sandstone." Dakota formation is here defined to include Cretaceous strata from top of Kiowa shale below to top of Graneros shale above. Subdivided into (ascending) Terra Cotta clay and Janssen clay (new) members.

Norval Ballard, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1562. Strata of Dakota group crop out as hogbacks completely surrounding the Black Hills and are present throughout the Dakotas in subsurface. Group comprises an upper unnamed sandstone member, middle or Fuson shale member, and lower or Lakota sandstone member. Maximum thickness 725 feet.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7), 18–20. Group was named by Meek and Hayden in 1862. Since that time it has been separated as three formations, the upper one of which is yet called Dakota sandstone, a usage conflicting with name of the group. Lee (1927) correlates the subdivisions of Dakota group at east side of Laramie Range in Wyoming, in a section near Greenacre ranch, as follows (ascending): Lakota sandstone, Fuson shale, Fall River sandstone, Skull Creek shale, and Newcastle sandstone. Studies reveal that Newcastle sandstone, Skull Creek shale, and Fall River

sandstone correlate collectively with the so-called Dakota sandstone or top formation of Dakota group in eastern Nebraska. Name Omadi sandstone proposed for the so-called Dakota formation, to include section lying between Fuson and Graneros shales. Dakota group then includes (ascending) Lakota, Fuson, and Omadi. Meek and Hayden did not locate a very definite type locality; hence, type locality is herein designated. Thickness at proposed type locality 392 feet.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153–154, 155 (fig. 3). Formation consists of clay, shale, siltstone, and sandstone, interbedded and lenticular; contains carbonaceous material, lignite, concretions of hematite and limonite, and locally quartzitic sandstone. Average thickness 215 feet. Contains stratigraphic units formerly called Rocktown channel sandstone, Ellsworth formation, Solomon formation, Reeder sandstone, Marquette sandstone, Spring Creek clay, and others. Comprises (ascending) Terra Cotta clay and Janssen clay members. Underlies Graneros shale; overlies Kiowa shale. Cockrum sandstone of southwestern Kansas is equivalent in age to part of Dakota formation. Gulfian series.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8. Generalized section of exposed sedimentary rocks in Henry Mountains structural basin shows that Dakota sandstone, 0 to 50 feet thick, overlies Morrison formation and underlies Tununk shale member of Mancos shale.

J. W. Huddle and F. T. McCann, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 75. Dakota sandstone, in Duchesne and Wasatch Counties, Utah, includes lower sandstone, 30 to 40 feet thick, a middle shale, 160 feet thick, and an upper sandstone, 5 to 26 feet thick. Lower sandstone and shale tentatively considered to be of Lower Cretaceous age, and upper sandstone to be of Upper Cretaceous age. Overlies Morrison; contact concealed. Underlies Mancos shale.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 93. Term Dakota sandstone, as used in this report [Egnar-Gypsum Valley area, San Miguel and Montrose Counties, Colo.], includes the impure coal, carbonaceous beds, and lenticular, yellow, fluvial sandstones above Burro Canyon formation (new) and below Mancos shale. Average thickness about 125 feet. Upper Cretaceous.

K. M. Waagé, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 375 (fig. 1). Discussion of clay deposits of Denver-Golden area. Generalized stratigraphic section shows Dakota sandstone, 80 feet thick, overlies Purgatoire formation and underlies Benton shale.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Dakota sandstone in Mora County, N. Mex., is about 180 feet thick; overlies Morrison formation and underlies Benton formation.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. Dakota sandstone in Colfax County, N. Mex., conformably overlies Purgatoire formation and conformably underlies Graneros shale.

K. M. Waagé, 1953, U.S. Geol. Survey Bull. 993, p. 6 (fig. 2), 11–26, pls. 1, 2, 4, 5. Throughout large part of southeastern Colorado, Dakota sandstone is prominent cliff-forming unit averaging about 100 feet in thickness and consisting largely of fine- and medium-grained cross-laminated sandstone. Consists of lower unnamed sandstone unit, Dry

Creek Canyon member (new), and upper sandstone unit. Overlies Glencairn shale member of Purgatoire formation; underlies Graneros shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Dakota sandstone mapped in northwestern Oklahoma.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 15–49. Discussion of Dakota group in northern Front Range foothills, Colorado. Area includes narrow belt of pre-Benton Cretaceous exposures extending from 2 miles south of Wyoming State line, in Larimer County, where beds emerge from under Cenozoic cover, to fault-terminated end of Dakota hogback just south of Indian Creek in Kassler quadrangle, Douglas County. Northern foothills area corresponds with area in which Lee (1923) applied name Dakota group to pre-Benton Cretaceous rocks of Colorado and divided it into five informal subdivisions. Terminology presented in this report is revision of Lee's (1923) Dakota group and is intended to apply only to northern foothills area. Name Lytle formation is applied to lower part of sequence and South Platte formation (new) to upper part of sequence. Overlies Morrison formation [see Morrison formation, this reference for discussion of Morrison-Lytle contact]; underlies Benton shale. First formal subdivision of Dakota formation was made by Stose (1912) in Apishapa quadrangle. He named lower sandstone and middle shale of the threefold sequence the Purgatoire formation and retained name Dakota sandstone for upper sandstone. Finlay (1916), in Colorado Springs quadrangle, named the sandstone and shale units in the Purgatoire the Lytle sandstone and Glencairn shale members, respectively. With exception of addition to Dakota sandstone of a local refractory shale unit, Dry Creek Canyon member (Waagé, 1953), the subdivision and nomenclature have remained as designated by Stose and Finlay. Names Dakota sandstone, in restricted sense, and Purgatoire formation have been used throughout southeastern and central Colorado and as far north along Front Range foothills as Perry Park in Castle Rock quadrangle. Lee's work in northern foothills led to fivefold rather than threefold subdivision of the Dakota in this area. Lee used his terminology throughout Front Range foothills and correlated his subunits with subdivisions of Stose and Finlay to the south and with Wyoming terminology to the north. No formal changes have been made in nomenclature or subdivision of Lee's Dakota group since it was proposed, and it has existed side by side with southern classification of Stose and Finlay. Terminologies other than that of Lee have been used in northern Front Range foothills presumably because Lee's Dakota group is too broad a unit for detailed work and because some of his subdivisions lack lateral continuity and are difficult to apply. Stose and Finlay's terminology was used in Denver-Golden area by Waagé (1952), but subsequent work leading to present report has shown that it was incorrectly applied and that it is equally as unsatisfactory as Lee's in providing a logical subdivision of pre-Benton Cretaceous strata. George (1927, Colorado Univ. Semicentennial Pub.) called Early Cretaceous rocks throughout eastern Colorado the Purgatoire and incorrectly used names Lakota and Fuson in northern foothills for members of the Purgatoire that he considered equivalent, respectively, for Finlay's Lytle and Glencairn members in Colorado Springs area. This usage, based on incorrect correlation with

Black Hills area, is still used in Colorado by some workers. Others have extended the Cloverly-Thermopolis-Muddy terminology southward from Wyoming, and some still use term Dakota formation in sense in which it was used in early reports of Geological Survey. Several sources of confusion in usage of pre-Benton Cretaceous terminology are apparent in the history of subdivision and nomenclature of the Dakota. First source is taxonomic change from use of terms formation and group as synonyms to their use as terms for separate ranks of rock units. More critical source was tendency to separate the Early Cretaceous from the Late Cretaceous parts of the pre-Benton Cretaceous sequence, a tendency that influenced, and is reflected in, Stose's formal subdivision of Dakota formation. Use of age as criterion for subdivision of rock units, a practice at the root of many nomenclatural problems, can lead only to confusion in correlation and to ambiguity in terminology when applied to complex transgressive deposits like the pre-Benton Cretaceous sequence. Much of the confusion associated with name Dakota stems from this cause. An unfortunate nomenclatural practice, that of retaining name Dakota for Late Cretaceous part of sequence in those areas where Early Cretaceous rocks can be identified and separated, has served to crystallize the confusion. This practice has been applied in Kansas and in Colorado, making it impossible to use name Dakota in a single sense for physical correlation between areas in which Early Cretaceous strata are separated from the Dakota and areas in which occurrence of Early Cretaceous rocks has not been sufficiently well established to permit their separation from the Dakota. Introduction of terminologies from other areas is a recent source of confusion in Colorado pre-Benton Cretaceous classification. Usage of Dakota in present report follows that of Meek and Hayden (1862) inasmuch as it includes all pre-Benton Cretaceous strata. In type area along Missouri River in Nebraska, the Dakota rests on Paleozoic rocks so its lower contact is unequivocal. The characteristic twofold lithogenetic division is present in type area where sharp break separates sandstone with variegated clay below from sandstone with dark-gray clay, carbonaceous clay, and lignite above. In light of previous attempts to make name Dakota reflect opinion on age of rock that it includes, it is emphasized that Dakota group, as used herein, is strictly a rock term, and whether or not the group contains both Lower and Upper Cretaceous rocks, is entirely Lower Cretaceous, or varies in age from region to region is irrelevant to this definition. Because of indefinite nature of Morrison-Lytle contact in parts of northern foothills, it may not be convenient in some places to use Dakota group as a unit for small-scale mapping; in such places, best map units would be Morrison and Lytle formations, undifferentiated, and South Platte formation.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 259–263. Dakota sandstone is basal Cretaceous formation of Black Mesa, Navajo, and Hopi Indian Reservations, Ariz. Consists of a lower sandstone member, middle carbonaceous member, and upper sandstone member. Average thickness about 80 feet; maximum thickness 119 feet. Underlies Mancos shale. Believed to be entirely of Late Cretaceous in this area, although presence of Lower Cretaceous beds at base cannot be ruled out.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1081–B, p. 13–26. A persistent disconformity separating continental deposits of varied facies from overlying marginal marine deposits and marine deposits was recognized in Dakota group of northern Colorado Front Range (Waagé, 1955), where this twofold lithogenetic pattern was used as basis for subdivision of the group. Earlier (Waagé, 1953) the same disconformity, whose regional significance was not recognized at the time, was used as contact between Lytle and Glencairn members of Purgatoire formation in south-central Colorado. Reconnaissance studies supplemental to those in Front Range and additional studies as yet unpublished reveal the disconformity and the two gross lithogenetic units it separates in the Purgatoire-Dakota sequence of southeastern Colorado and southwestern Kansas, in the Cloverly-Thermopolis-Muddy sequence of Bighorn Basin area and eastern Wyoming, in type area of original Dakota formation along the Missouri River in Iowa and Nebraska, and in Inyan Kara-Skull Creek-Newcastle sequence of Black Hills region. Within the broad twofold lithogenetic framework, the Dakota group and its equivalents vary considerably from place to place. Changes in type of rock, sequence of rocks, and thickness of individual subunits locally obscure basic pattern. Many environments of deposition represented in the two parts of sequence account for much of the variation. Deposits of lower sequence are, in general, typified by fine- to coarse-grained buff to white lenses of sandstone and conglomeratic sandstone, irregularly interbedded with variegated red, green, yellow, gray, and black claystones; shale is rare and commonly limited to local lacustrine deposits; most of the coarser material is chert, quartzite, and quartz, obviously many cycles removed from parent rock. In some areas, such as south-central and southeastern Colorado, lower part of sequence is dominantly sandy, and variegated claystones are rare; in other areas such as the Bighorn Basin, variegated claystone and argillaceous siltstone predominate. Fossils not common in lower part, but plant remains include coniferous wood, cycadeoids, charophytes, and other algae and foliage of ferns and cycods; animal remains include dinosaur bones, fresh-water mollusks, ostracodes, and branchiopods. Lower part of sequence is more closely related lithogenetically to underlying Morrison than to upper part of sequence. No obvious stratigraphic break marks contact with the Morrison, and at many places it is impossible to separate the two units except on some arbitrarily selected local feature. Upper part of Dakota sequence consists chiefly of fine-grained commonly thin-bedded laminated to tabular cross-laminated buff- to brown-weathering sandstone interbedded with gray to black shale and siltstone. Thin bedding and lamination characterize this part of sequence. In some areas, such as central Wyoming, that lay within central part of basin of deposition, nearly the entire sequence is shale and silty shale (Thermopolis) except for some sandy shale and local sandstone at top (Muddy) and base (Rusty beds). Fossils in marginal marine beds include dicotyledonous leaves, wood, false trunks of *Tempskya*, some fresh-water clams, linguloid brachiopods, and Foraminifera. Marine beds contain pelecypods, gastropods, linguloid brachiopods. Foraminifera, bones of fish, crocodiles, and plesiosaurs. Contact of the two parts of sequence is, in many places, a relatively plane surface of disconformity marking an abrupt lithic change. The gross twofold subdivision affords only consistent means of orientation within the varied local Dakota sequences. Whether or not this disconformity transgresses time, it is an excellent datum to

use in working out equivalency of lithogenetic units in Dakota sequence, and, if local terminologies can be adjusted to it, many of the Dakota nomenclatural problems will resolve themselves. Many problems of stratigraphy of Dakota and equivalent rocks have their roots in the nomenclature. Report gives historical summary of usage of term Dakota in Black Hills area and points out, among other things, the fact that Darton (1901) miscorrelated these beds with the Dakota of eastern Colorado. He became convinced that the Fort Benton of the Black Hills was the "precise equivalent" of Gilbert's (1896) Graneros shale in eastern Colorado and introduced name Graneros into Black Hills terminology. This miscorrelation has had lasting effect. Name Fuson is still misapplied by some geologists to black shale of Glencairn member of Purgatoire formation, the Skull Creek equivalent in southern part of Colorado Front Range. Name Graneros is still used locally by most geologists in spite of the fact that it is a hangover from miscorrelation by Darton and is misleading in regional correlation. It is used both as a formation and group to include beds between Fall River formation and Greenhorn limestone. Black Hills area is one of several that have followed similar pattern in development of the terminology applied to its pre-Benton (Dakota equivalents) Cretaceous beds. In much of the central and northern Great Plains and Rocky Mountains, these beds vary in stratigraphic detail from place to place, but their sequence is uniform in its major lithogenetic features. This uniformity is obscured by complex and conflicting terminology that has resulted largely from the unfortunate practice of distinguishing stratigraphic units on the basis of their supposed age. Soon after name Dakota was introduced, it came to be used synonymously with sandy basal Upper Cretaceous rocks. Subsequent discovery of Early Cretaceous fossils in these rocks resulted in their subdivision, generally with name Dakota for that part of sequence still considered Upper Cretaceous. Division between Lower and Upper Cretaceous rocks in northern part of interior region has been placed higher and higher in the sequence. In Black Hills, each shift of this time boundary has resulted in change in nomenclature. For Black Hills, where name Dakota has passed from nomenclature, the principal subunits, Lakota, Fuson, and Fall River formations, have not proved to be satisfactory mappable units. This is the problem with which present report is concerned. In Black Hills, the transgressive disconformity discussed above falls within Inyan Kara group. Subdivision and nomenclature of Inyan Kara group is adjusted to conform to this twofold lithogenetic division.

R. G. Young, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 154–194. Basal Cretaceous deposits of Colorado Plateau can be subdivided into two formations on basis of carbonaceous content. The lower noncarbonaceous unit, Cedar Mountain formation, consists of mudstones and persistent conglomeratic sandstones which were deposited in an inland floodplain environment. The upper carbonaceous unit, Naturita formation (new), consists of carbonaceous mudstone, coal, persistent conglomeratic sandstones, and beach sandstones deposited on or adjacent to shore of Mancos sea. Naturita deposits can be traced landward into Cedar Mountain deposits, indicating that they are facies of a larger unit, the Dakota group. Upper part of Naturita intertongues with and passes laterally into basal part of Mancos shale throughout much of Colorado Plateau. Group is unconformable above Morrison formation. Lower and Upper Cretaceous.

Type locality (Condra and Reed): In Missouri River bluffs of Dakota County, located 1 mile southeast of Homer, Nebr., in NE¼ sec. 13, T. 27 N., R. 4 E.

Type locality of group (Lee): About 2 miles north of Bellevue, Larimer County, Colo.

Dale quartzites[1]

Lower Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Dallas deposits[1]

Pleistocene: Central southern Iowa.

Original references: J. L. Tilton, 1913, Science, new ser., v. 38, p. 241; 1913, Iowa Acad. Sci. Proc., v. 20, p. 218.

Named for Dallas, Marion County.

†Dallas Limestone[1]

Upper Cretaceous (Gulf Series): Northern Texas.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d, v. 33, p. 298.

Named for occurrence at Dallas, Marion County.

Dallas Limestone Bed

Dallas Limestone Member (of Yamhill Formation)

Eocene, upper: Eastern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 2–5. Dallas limestone crops out as dark-gray massive rock, which weathers first to light-buff color and then to deeper shades of iron oxide. Thickness 50 to 75 feet. Occurs at base of marine series of Cowlitz age and above basalt believed to be equivalent of Tillamook volcanics. May occupy stratigraphic position similar to Buell limestone (new).

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Brothers, Inc., p. 13. Dallas limestone member of Yamhill formation. Present at base of formation. Composed of fragments of shells, Foraminifera, and calcareous algae intermixed with tuffaceous material derived from underlying volcanic rocks.

Crops out in northeast part of T. 8 S., R. 6 W., from 2 to 4 miles southwest of Dallas, Polk County, on western edge of Willamette Valley. Extensively quarried.

Dalles Formation[1]

Pliocene: Central northern Oregon and central southern Washington.

Original reference: E. D. Cope, 1880, Am. Philos. Soc. Proc., v. 19, p. 61; 1880, Am. Nat., v. 14, p. 458.

R. W. Chaney, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1945. Mammalian remains suggest an early Pliocene or late Miocene age. Plant fossils indicate an age not earlier than lower Pliocene. When these are compared with larger flora from Ellensburg formation in which mammalian remains are well represented, contemporaneity of Dalles is established, and age of both formations may be indicated as Pliocene.

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C. R. Warren, 1941, Am Jour. Sci., v. 239, no. 2, p. 106–126. Hood River conglomerate is of contemporaneous origin with the Dalles and Ellensburg formations, both of late Miocene or early Pliocene.

E. T. Hodge, 1942, Oregon State Coll. Studies in Geology Mon. 3, p. 23–26. Hodge (1928, Pan-Am. Geologist, v. 49, no. 5) gave name Madras formation to beds in vicinity of Madras. Present study has shown that the Dalles and Madras are one formation; hence the older name, Dalles, takes precedence. Consists of lava flows and water-spread materials. Lavas vary from 15 to 200 feet and average 75 feet in thickness. Unconformably overlies all older formations. Rhododendron formation extends eastward and becomes Dalles formation. To east and north of Kloan, the Dalles grades into Shutler formation.

R. W. Chaney, 1944, Carnegie Inst. Washington Pub. 553, p. 285–321, pls. Discussion of the Dalles flora. Age of Dalles formation, as indicated by fossil flora, is lower Pliocene.

Dalton Formation[1]

Lower Cambrian: Western Massachusetts and southwestern Vermont.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Dalton formation in southwestern part of State below Cheshire quartzite.

Best exposed at site of former Dalton clubhouse, on high hill south of Dalton Station, in open pasture farther south and on southeastward to lookout tower, Berkshire County, Mass.

Dalton Gneiss[1]

Precambrian: Northwestern Connecticut.

Original reference: W. M. Agar, 1932, Am. Jour. Sci., 5th, v. 23, p. 35.

Dalton Sandstone Member (of Crevasse Canyon Formation)

Dalton Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears 1934, U.S. Geol. Survey Bull. 860–A.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 90, 92–93, pl. 1. Reallocated to member status in Crevasse Canyon formation (new). Overlies Dilco member; underlies lower Gibson member. In area of this report [Fort Defiance-Tohatchi quadrangles], comprises two sandstone units from 20 to 45 feet thick, occupying an interval from 40 to 72 feet; lower unit disappears toward southern edge of mapped area, and upper unit thins markedly.

Named for exposures at Dalton Pass, Gallup region, McKinley County.

Dam Breccia

Tertiary: Northwestern Arizona and southeastern Nevada.

U.S. Bureau of Reclamation, 1950, U.S. Bur. Reclamation, Boulder Canyon Proj. Final Repts., pt. 3, Preparatory Exams., Geol. Inv., Bull. 1, p. 80 (fig. 28), 89–92, fig. 34 (geol. map). Dark-red cemented sedimentary breccia. Roughly and indefinitely bedded. No complete section exposed. Based on average dip of 30° and an exposure of 3,500 feet along canyon, estimated thickness is about 1,700 feet. Overlain by latite flow breccia. Older than Spillway breccia (new). In-

cluded in older volcanic series of area. Name credited to F. L. Ransome (unpub. rept.).

Named for occurrence at site of Hoover Dam in Black Canyon of Colorado River. Forms floor and lower part of walls of the canyon.

Damascus Red Shale[1]

Upper Devonian: Northeastern Pennsylvania and southern New York.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 584–585.

L. V. Rickard *in* W. H. Young, Jr., and W. L. Kreidler, 1957, New York State Geol. Assoc. Guidebook 29th Ann. Meeting, fig. 2, [p. 23]. Geographically extended to New York.

Well exposed near Damascus, Wayne County, Pa.

Dam Lake Quartzite[1]

Precambrian: Minnesota.

Original reference: H. B. Ayers, 1911, Science, new ser., v. 33, p. 465.

Dam Lake, Aitkin County.

Damnation Limestone[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 35.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1086–1087, 1089, 1090 (fig. 2). Redefined to include former Damnation and Nannie Basin limestones, and name Nannie Basin dropped. Thickness at type locality, herein stated, 149 feet; at Pentagon Mountain, 191 feet. Overlies Gordon shale; underlies Dearborn limestone.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 213 (table 1), 220. Described in southwest Saypo quadrangle where it is 150 feet thick, overlies Gordon shale, and underlies Dearborn limestone.

Type locality: At west end of Scapegoat basin in S½ sec. 6 SW¼ sec. 5, and N½ sec. 8, T. 18 N., R. 10 W. Named from Damnation Creek on west side of Pagoda Mountain, Flathead Range.

Dana Diorite[1]

Upper Carboniferous or post-Carboniferous: Central Massachusetts and southwestern New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 244–247, and map.

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–3]. Name based upon an erroneous interpretation by Emerson (1917). Part of unit is represented by Ammonoosuc volcanics in the Mount Grace quadrangle, Massachusetts.

Well developed in Dana and Ware, Mass.

Danbury Granite Gneiss or Augen Granite

Danbury Granodiorite Gneiss[1]

Pre-Triassic: Southwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 104, 108, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed

as a granite gneiss. Consists of gray to pink gneissic augen granite or augen gneiss. Pre-Triassic. Derivation of name stated.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Quad. Rept. 7, p. 12–15, geol. map. Porphyrite gneissic augen granite characterized by large microcline megacrysts. In this report [Danbury quadrangle], much of area mapped as Danbury granodiorite on State geological map of 1906, including Shelter Rock area, is assigned to Brookfield plutonic series. Name Danbury augen granite is retained for granites that crop out along western shore of Lake Candlewood in towns of Danbury and New Fairfield.

Named for town of Danbury, Fairfield County.

Danby Formation[1]

Lower Cambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 396.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 535–536. Stratigraphically extended to include overlying beds, formerly the Wallingford formation, as Wallingford member. Thickness 400 to 800 feet. Underlies Clarendon Springs dolomite.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 22–23. Described in Castleton area. Crops out in narrow belt extending from boundary of Castleton and Brandon quadranges through Florence and Procter to western slopes of Pine Hill. Southern exposures cover area extending from boundary of quadrangle southwest of Chippenhook northward to western slope of Boardman Hill. Includes Wallingford member in upper part. Overlies Winooski dolomite; underlies Clarendon Springs dolomite. Thickness about 700 feet. Upper Cambrian.

Named for town of Danby, Rutland County.

Dane Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 41, figs. 3, 10, 12, 16. Dolomite, thin- to thick-bedded, with weak argillaceous streaks and some shale films. Thickness varies from 3 to 14 feet. Shown on columnar section as underlying New Glarus member (new) and overlying Chana member (new).

Occurs in the Dixon-Oregon area.

Danforth Formation[1]

Pliocene: Southeastern Oregon.

A. M. Piper, 1936, Geol. Soc. Oregon County News Letter, v. 2, no. 8, p. 10. Unconformably overlies Steens basalt; unconformably underlies Harney formation (new). Thickness 20 to 800 feet. In southern part of area, consists of four facies: tuff-breccia and associated stratified rocks; basaltic breccia and associated siltstone, sandstone, conglomerate, and two intercalated sheets of basalt; stratified siltstone, sandstone, and ash; and spherulitic rhyolite. In northwestern part of area, formation comprises, in upper part, stratified siltstone, sandstone, tuff, and volcanic ash with intercalated layers of glassy perlitic rhyolite and one rhyolitic tuff-breccia layer; lower part massive rhyolite.

A. M. Piper, T. W. Robinson, and C. F. Park, Jr., 1939, U.S. Geol. Survey Water-Supply Paper 841, p. 43–49, pl. 2. Detailed description. [This is report cited in Wilmarth Lexicon as "in press."]

Name derived from Danforth Ranch in T. 22 S., R. 32½ E., where section is exposed along Cow Creek, Harney County.

Dangkulo Limestone

See Dankuro Limestone.

Daniels Conglomerate

Tertiary, middle(?) : Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 46–47, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 42–44, pl. 3 [1947]. Coarse stream gravel, partly cemented; includes a little interbedded quartz latite. Carries boulders 4 feet in diameter, but most of the pebbles are less than 3 inches through. As much as 250 feet thick in Chico Shunie Hills, but thinner elsewhere. Unconformably overlies Cornelia quartz monzonite (new), Cardigan gneiss (new), and Chico Shunie quartz monzonite in southern part of quadrangle and Sneed andesite (new) and Childs latite (new) in the Childs Mountain localities. Conglomerate seems more likely to be early Pliocene or even older rather than a correlative of the Gila conglomerate of southeast Arizona.

Poorly exposed in hills just north of Daniels Arroyo, from which it is named, Ajo quadrangle, Pima County. Principal exposure is in southwestern part of Chico Shunie Hills, just north of Daniels Arroyo, where it forms a belt about 1½ miles wide practically from west edge of T. 13 S., R. 6 W., to west boundary of the quadrangle northwest of Teepee Butte.

Dankuro (Dangkulo) Limestone

Recent (early Holocene) : Mariana Islands (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 58, table 4 [English translation in library of U.S. Geol. Survey, p. 69]. Named on correlation chart. Correlated with Tanapag limestone on Saipan, Mirikattan limestone on Rota, and Garukijokku limestone on Palau. A raised coral reef. Recent.

S. Hanzawa *in* Jacques Avias and others. 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 27. Dangkula limestone, a raised coral reef; younger than Sonson limestone. Early Holocene. Name credited to M. Kodaira (unpub. ms.).

Danley Ranch Tongue (of Abo Sandstone)

Lower Permian (Wolfcamp Series) : Central southern New Mexico.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 690 (fig. 1), 692–695, 698 (fig. 5). Predominantly soft red shale, reddish-brown cross-laminated shaly siltstone, and very fine grained sandstone; thin ledges of thin-bedded tannish-weathering light-olive-gray limestone, which probably represent minor tongues of Hueco limestone, present in most places; conglomerate of four types present in most localities in lower part of tongue. Maximum thickness about

200 feet; average thickness 100 feet; thickness varies widely as result of intertonguing with Hueco limestone and from marked relief of erosional surface on which Abo was deposited. In most areas, rests with sharp angular unconformity on limestone and shale beds of Pennsylvanian sequence; most commonly these rocks belong to upper unit of Magdalena group.

Type section: Exposed in SW¼ sec. 35, T. 19 S., R. 11 E., about 1 mile west of Danley Ranch headquarters, Otero County. Crops out in Sand Canyon area in narrow, discontinuous band from northeast edge of area to north fork of Culp Canyon.

†Dannemora Formation[1]

Precambrian: Northeastern New York.

Original reference: H. P. Cushing, 1901, New York State Mus. 53d Ann. Rept., pt. 1, p. r36–r69, map.

Well exposed all over Dannemora Mountain and throughout Dannemora Township, Clinton County.

†Dan River Series[1]

Upper Triassic: Central northern North Carolina.

Original reference: E. Emmons, 1856, Geological report of Midland Counties of North Carolina: North Carolina Geol. Survey.

Dan River region.

Dantzler Formation

Cretaceous (Comanche): Subsurface in Mississippi and Louisiana.

R. T. Hazzard, B. N. Blanpied, and W. C. Spooner, 1947, Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 477 (table), 478. Defined as the sand and gray and red-mottled shale section, with fossiliferous zones, which intervenes between base of lower Tuscaloosa and top of Washita limestone. Occurs between 8,905 and 9,910 feet in type well.

Type well: Humble Oil Co.'s B–1 Dantzler well, Jackson County, Miss. Recognized in wells in Forest, Jefferson Davis, Lamar, Lawrence, Marion, and Stone Counties, Miss., and in Washington Parish, La.

Danville Coal Member (of Carbondale Formation)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 36, 48 (table 1), 65, pl. 1. Uppermost member of Carbondale formation (redefined). In southern area, occurs above Galum limestone member; in western and northern areas, occurs above Copperas Creek sandstone member; in eastern area, occurs above Herrin (No. 6) coal member. Thickness about 1⅔ feet. Danville (No. 7) coal is extended to No. 7 coal throughout Illinois. In southern Illinois, replaces name Cutler (No. 7) coal; in northern and western areas, replaces name Sparland (No. 7) coal. Coal named by Bradley (1870, Geology and Paleontology, v. 4, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: E½ sec. 7, T. 19 N., R. 11 W., Vermilion County.

Danville Injection Gneiss

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss,

Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate gneiss (new), Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite-biotite schist.

Occurs in Lewiston area, Androscoggin County.

Danville Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Danville, Yell County, Ark.

Danville Landing Beds or Group[1]

Danville Landing Formation or Beds (in Jackson Group)

Eocene: Central Louisiana.

Original reference: M. A. Hanna, Donald Gravell, and James McGuirt, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip [Guidebook], p. 35–37, table opposite p. 30.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 106. Danville Landing beds present in Grant and La Salle Parishes as a 40-foot series of interbedded sands and clays. Grade vertically into underlying Verda member (new) of Yazoo formation and into overlying gypsiferous clays of Vicksburg group.

H. N. Fisk, 1944, U.S. Mississippi River Comm., p. 13 (table 2), 14, 15. Jackson group divided into three formations (ascending): Moodys Branch marl, Yazoo clay, and Danville Landing beds.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839. Danville Landing formation present above Yazoo clay in central Louisiana. In Jackson group.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 702 (fig. 1), 703, 704, 705. Formation (beds) underlies Mosley Hill formation (new).

Named for occurrence in vicinity of Danville Landing, reported to be on Ouachita River, Catahoula Parish.

Darby Formation[1]

Middle and Upper Devonian: Northwestern Wyoming.

Original reference: E. Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8, p. 420.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Upper Devonian.

W. W. Rubey, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–109. In Bedford quadrangle, formation consists of alternating thick beds of (1) dark-gray buff-weathering massive dolomitic limestone; and (2) black, yellow, and red sandy calcareous siltstone. Thickness 450 to 550 feet. Overlies Bighorn dolomite; underlies Madison and Brazer limestone (mapped together).

Named for canyon of Darby Creek, on western slope of Teton Range.

Dardanelle Flow or Latite

Miocene and Pliocene: Central California.

F. L. Ransome, 1898, U.S. Geol. Survey Bull. 89, p. 14, 46–52. Discussion of lava flows on western slope of the Sierra Nevada in region drained

by Stanislaus River. Latites belong to at least three distinct flows. The youngest, Dardanelle flow (or facies), consists of dark very compact augite-latite, with small scattered phenocrysts of labradorite and augite. Similar to oldest flow, herein named Table Mountain.

Named for occurrence on extreme summit of the West Dardanelle, Tuolumne County.

Darling Creek Glaciation

Pleistocene: East-central Alaska.

T. L. Péwé, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1289; T. L. Péwé *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 9, 13 (table 1). At least three major Quaternary glaciations recorded at north end of Delta River valley. Darling Creek, the earliest glacial advance, preceded Delta glaciation (new). Maximum extent of Darling Creek glaciers not known, but in immediate area of Big Delta they probably abutted against Yukon-Tanana upland and deflected down Tanana River valley perhaps as far as Richardson. Only isolated remnants of till occur on flat interfluves 2,000 to 3,000 feet above floor of Delta River valley.

Delta River valley in Big Delta area.

Darlington (plant) Bed (in Allegheny Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 308–316.

Beaver County.

Darlington Shale (in Allegheny Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 308–316.

Beaver County.

Darlington Underclay (in Allegheny Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 308–316.

Beaver County.

Darrough Felsite

Permian(?): South-central Nevada.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. Masses of fine-grained felsitic rocks largely intrusive into older rocks, chiefly the Pablo formation (new); also probably flows. The rocks are mostly rhyolitic in appearance and are fine grained and procelainlike in texture, commonly with well-defined flow banding. Contains abundant inclusions, particularly near contacts. Locally, in central parts of larger masses, the texture is coarser, resembling a fine-grained granitic rock.

Type locality: East front of Toyabe [Toiyabe] Range, west of Darrough's Hot Springs.

Darty Limestone

Mississippian (Kinderhookian): Illinois.

J. M. Weller, 1948, (abs.) Am. Jour. Sci., v. 246, no. 3, p. 150; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 153, chart 5. Name proposed for a thin glauconitic limestone occurring in one or two layers and formerly included in basal part of Springville shale of Union County, Ill. Underlies restricted Springville shale; overlies Mountain Glen shale.

Charles Collinson and A. J. Scott, 1958, Illinois Geol. Survey Circ. 254, p. 511. Limestone near base of Springville shale is accepted as Chouteau and name Darty is no longer needed.

Name derived from tributary of Caney Creek, west of Jonesboro, Union County.

Darwin Quartz Diorite

Upper Mesozoic: Southern California.

V. C. Kelley, 1937, Econ. Geology, v. 32, no. 8, p. 992, 996 (fig. 4). Typically a white or light-grayish-green rock; the average or normal phase of the Darwin stock.

V. C. Kelley, 1938, California Jour. Mines and Geology, v. 34, no. 4, p. 514–516, pl. 7. Formation name Darwin quartz diorite is applied to the elongated stock which occupies center of Darwin Hills. Mapped as Darwin quartz diorite.

Occurs in Darwin silver-lead district in Coso Range, Inyo County.

Darwin Sandstone Member (of Amsden Formation)[1]

Pennsylvanian: Northwestern Wyoming.

Original reference (Dorwin): E. Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8, p. 422.

C. A. Burk, 1954, Jour. Paleontology, v. 28, no. 1, p. 1–16. Discussion of faunas and age of Amsden. Faunal evidence confirms Pennsylvanian age of Amsden. [Hence Darwin sandstone is Pennsylvanian.] Fossils used in present report were collected by Biggs (unpub. thesis). Biggs revisited localities at Bull Lake Canyon and Cherry Creek where Branson and Greger (1918, Geol. Soc. America Bull., v. 29, no. 2) collected from what they believed to be Amsden formation. Biggs demonstrated that Branson's and Greger's collection from Bull Lake Canyon was taken from Mississippian Madison limestone but that it was possible that part of their collection from Cherry Creek was taken from the Amsden. This cannot be established because beds are poorly exposed, and Biggs points out that fossils could apparently be obtained only from slope wash. Because the Branson and Greger collections were the only ones figured, they became a standard reference for later geologists; on this basis, the apparent Mississippian age of Amsden was generally accepted by geologists.

J. D. Love, 1954, Tentative diagrammatic correlation of Tensleep, Amsden, Casper, and Hartville formations in Wyoming: Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf. Correlation chart shows Darwin sandstone member at base of Amsden formation. Stratigraphic, structural, and paleontologic data suggest that base of Darwin is contact between Pennsylvanian and Mississippian rocks. At Bull Lake, Darwin sandstone member overlies Sacajawea formation (this is, at type section of Sacajawea).

A. B. Shaw and W. G. Bell, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 3, p. 333–337. New fossil collections made from lower part of Amsden at Cherry Creek, Wind River Mountains. Mississippian-Pennsylvanian boundary placed more than 48 feet and less than 63 feet above Madison limestone. Lower faunas are Chesteran, and upper faunas tentatively dated Atokan. Presence of two sandstones in the Amsden, both of which have been called "Darwin" is inferred. Since basal sandstone of Amsden at Cherry Creek lies below Mississippian fauna, it cannot be same lithic unit as that identified as Darwin sandstone by Biggs, as quoted by Burk (1954) and Love (1954), elsewhere in Wind River Mountains. Thus there are two sandstones, both lying at base of red-bed sequence, that have been confused as one. Systemic boundary may lie below the upper sandstone, but it cannot lie below the lower sandstone. Love's correlations suggest that the upper sandstone is correlative of type Darwin. Use of name Sacajawea formation at Cherry Creek is not justified.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51–57. Discussion of Mississippian stratigraphy of western Wyoming and Mississippian-Pennsylvanian contact. Recommended that Darwin sandstone should mark base of Amsden formation and term Sacajawea be applied to all strata below Darwin and above Madison group. Darwin sandstone is not present in Cherry Creek section of Shaw and Bell (1955) but a Darwin zone, depicted by conglomerate between 68 and 73 feet above top of Madison, marks base of Amsden.

Name derived from Darwin Peak, in Gros Ventre Range.

Dashner Limestone[1] Member (of Topeka Limestone)

Pennsylvanian: Northeastern Kansas.

Original references: R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans., [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; 1936, Kansas Geol. Soc. Guidebook 10th Ann. Field Conf., Sept. 4–7, p. 41.

Derivation of name not stated.

Datil Formation[1]

Datil Volcanics

Tertiary: Southwestern New Mexico.

Original reference: D. E. Winchester, 1920, U.S. Geol. Survey Bull. 716–A.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. Restricted to exclude unit here named Baca formation, which as defined includes the lower 694 feet of Winchester's stratigraphic section. Restricted Datil in that area is 1,140 feet and consists of latite, rhyolites, and andesite flows, agglomerate, tuff, conglomerate, and sandstone. Thickness in area of this report [La Joya area, Los Pinos Mountains, and northern Chupadera Mesa] estimated about 2,000 feet. Truncates several formations; in Socorro Mountains, rests on Madera limestone, the Baca being absent. Age of formation in doubt; if Baca is Eocene, Datil may be Eocene or younger. Mapped as Miocene(?).

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 6 (table 1), 7 (fig. 2), 26–32, pl. 1. Referred to as Datil volcanics. Winchester failed to measure complete section of Datil in Bear Mountains because above his uppermost 120 feet of quartz rhyolite

there is at least 150 feet of vitric and welded rhyolitic tuff and a minimum of 1,200 feet of basalt and basaltic andesitic lava flows. He mapped about 500 feet of the Popotosa-Santa Fe unit as Datil, but did not include it in his measured section. In area of this report [Puertecito quadrangle], the Datil rests on strata of Cretaceous age as well as on Baca formation. Subdivided into (ascending) Spears, Hells Mesa, and La Jara Peak members. Thickness 2,740 to 2,990 feet. Underlies Santa Fe group. Upper Miocene(?).

M. E. Willard, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 95–98. Use of Datil formation in restricted sense by some authors and in very broad sense by others (as Tonking) has caused misunderstanding and confusion. On basis of reconnaissance study in Catron County, redefinition of Datil is suggested. Typically, a latite facies makes up lower parts of formation and is commonly gradational into an overlying rhyolite facies of tuff, welded tuff, and flows; rhyolite facies is overlain by, or interfingers with, an andesite facies consisting of flows, dikes, sills, and pyroclastics; conglomerate, sandstone, and siltstone from various sources may be present at any stratigraphic position but are only locally of sufficient thickness to warrant their being designated as facies. At only few places is whole assemblage of facies present; commonly one or two make up bulk of formation. Overlies nonvolcanic (Baca) sediments; underlies basalt and basaltic andesite.

Named for fact it is mountain-forming series of Datil Mountains. Winchester's section measured at north end of Bear Mountains in secs. 4, 5, 8, and 9, T. 1 N., R. 4 W., Socorro County.

Daube Limestone (in Hoxbar Group)

Daube Member (of Hoxbar Formation)[1]

Pennsylvanian (Missouri Series): Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 16.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6. Shown on chart as formation in the Hoxbar here considered a group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 42–43. Referred to as member of Hoxbar group. Thickness 10 feet. Lies about 400 feet above Anadarche member and about 500 feet below Zuckerman member. Missourian.

Named for occurrence at abandoned coal mine of Daube, Westheimer, Munzesheimer, and Zuckerman, in SE¼ sec. 8, T. 5 S., R. 2 E., Carter County.

Dauphin Shale (in Martinsburg Group)

Ordovician: South-central and east-central Pennsylvania and northwestern New Jersey.

Bradford Willard, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1069 (footnote), 1070, 1118. Name proposed for lower shaly part of group. Underlies Fairview sandstone or Shochary sandstone; overlies Chambersburg limestone or Jacksonburg limestone. Table 1 shows upper

part included in interval of Jonestown red beds in Susquehanna Valley and Lehigh and Berks Counties, Pa.

M. E. Johnson and Bradford Willard, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 129. Mostly black shale west of Delaware Valley and black slate in Delaware Valley. Thickness at least 3,500 feet. Geographically extended to New Jersey.

Named from good exposures in Dauphin County, Pa.

Davenport Beds[1]

Davenport Member (of Wapsipinicon Formation)

Middle Devonian: Eastern Iowa.

Original reference: W. H. Norton, 1894, Iowa Acad. Sci. Proc., v. 1, pt. 4, p. 24.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 38 (fig. 1), 42–43. Uppermost member of formation. Overlies Spring Grove member; underlies Cedar Valley formation. Typically gray sublithographic dense unfossiliferous pure limestone, which is commonly highly brecciated; a shaly zone just below the Cedar Valley is referred to as Vinton phase. Average thickness between 10 and 30 feet; may be more than 50 feet thick in Scott County where lower boundary cannot be delimited.

Named for occurrence in vicinity of Davenport, Scott County.

David Formation

Eocene, upper: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 131, 134 (correlation chart). Upper Eocene limestone. Below Majagua formation.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, Geol. Sci., p. 234 (chart), 236. David formation applied in broad sense to the younger upper Eocene rocks of Panamá, consisting generally of foraminiferal limestones in their entirety or of shale and sandstone formations in which the limestones may be entirely missing or restricted to reeflike masses. In vicinity of David and Brenon, occurs above Bucarú formation; in Veraguas and Los Santos area occurs below Tonosi limestones.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 334. Poorly defined name. Eocene.

In Chiriqui Province.

David City Formation[1]

Pleistocene (Nebraskan): Eastern Nebraska and northeastern Kansas.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 53–55. In Kansas, term David City formation is applied only to water-laid deposits occurring below and genetically related to Nebraska glacial till; its distribution, therefore, is restricted to Doniphan, Atchison, and Brown Counties. In NE¼SE¼ sec. 6, T. 2 S., R. 20 E., Doniphan County, measured section includes 10 feet of sand, gravel, and cobbles which rest directly on Pennsylvanian limestone (Deer Creek limestone and Calhoun shale) and are conformably overlain by Nebraska till.

Type area: David City, Butler County, Nebr.

Davidson Granodiorite

Davidson Diorite

Miocene(?): Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299. Davidson diorite is clearly intrusive but its precise place in geological events of area is undetermined.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 64–68. Described as medium-grained granular rock of light-gray color. Contains many andesite inclusions. Intruded the Alta andesites, probably about middle Miocene.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042-C, p. 52–54, pl. 3. Gianella's (1934) Davidson diorite renamed Davidson granodiorite. Intrudes Alta formation. May be contemporaneous with parts of Kate Peak formation; cannot be younger than all of Kate Peak because it is cut by a few dikes of andesite porphyry of Kate Peak formation. Miocene(?).

Makes up bulk of Mount Davidson, Virginia City quadrangle.

Davidson Granophyre[1]

Precambrian: Southwestern Oklahoma.

Original reference: M. G. Hoffman, 1930, Oklahoma Geol. Survey Bull. 52, p. 39–48.

Crops out in west half of Davidson Hill and northwest along Little Medicine Creek for about one-half mile.

†Davion rock[1]

Miocene: Southern Mississippi.

Original reference: B. L. C. Wailes, 1854, Mississippi Agric. and Geol. Rept., p. 214–216.

Davis Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern and southwestern Illinois and western Kentucky.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 33, 46 (table 1), 64, pl. 1. Assigned member status in Spoon formation (new). Occurs above Stonefort limestone member and below DeKoven coal member. Thickness about 3½ feet. Coal named by Lee (1916, Kentucky Geol. Survey, ser. 4, v. 4, pt. 2); reference of Owen (1856, Kentucky Geol. Survey Bull., v. 1, ser. 1) incorrect. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Davis mine. one-half mile east of DeKoven, Shawneetown quadrangle, Union County, Ky.

Davis cyclothem (in Tradewater Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 16 (fig. 2) [1943]. Shown on columnar section as Davis cyclothem. Occurs below DeKoven cyclothem and above Stonefort cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol, Survey Circ. 217, p. 5. Name Colbert cyclothem substituted for preempted name Davis.

Type locality of Davis cyclothem not given, but type locality of Colbert is one-half mile west of Colbert School in SE¼SW¼ sec. 23, T. 10 S., R. 7 E., Saline County.

Davis Formation (in Elvins Group)[1]

Davis Member (of Elvins Formation)

Upper Cambrian: Southeastern Missouri.

Original reference: E. R. Buckley, 1907, Missouri Bur. Geology and Mines, v. 10, 2d ser., separate.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Table shows Davis as basal formation of Elvins group. Underlies Derby dolomite; overlies Bonneterre dolomite.

V. E. Kurtz, 1960, Dissert. Abs., v. 21, no. 3, p. 595. Referred to as member of Elvins formation. Sharp lithologic change of wide areal extent divided member into a lower dominantly carbonate section and an upper dominantly shale unit. Underlies Derby member; disconformably overlies Bonneterre dolomite.

Named for outcrops on Davis Creek, St. Francois County.

Davis Formation (in Tradewater Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 39, 41. Uppermost formation in Tradewater group. Overlies Stonefort formation. Represents a single cycle of deposition. Basal sandstone, Davis, has maximum thickness of 30 feet or more but thins and pinches out to west; Davis coal is persistent seam about 3 feet thick.

Type locality and derivation of name not given.

Davis Creek Beds[1]

Miocene: Northwestern Nevada.

Original reference: R. W. Chaney, 1924, Geol. Soc. America Bull., v. 35, p. 162–163.

Washoe County.

Davis Creek Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Shown in list as underlying Brophy Canyon formation and overlying Little Valley formation (both new). Comprises Buck Island member above and Baldy Mountain member (both new). The Upper Jurassic and Cretaceous section, about 40,000 feet, consists of sequence of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Davistown Sandstone (in Washington Group)

Permian: Western Pennsylvania and West Virginia.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 151. Medium- to heavy-bedded, medium-grained brown shaly sandstone. Thickness 10 to 30 feet. Lies 320 feet above Waynesburg coal and a short distance between Jollytown coal. Probable that in parts of West Virginia where Middle Washington limestone is lacking, this sandstone may have been included in Upper Marietta, but from type section given by Hennen, the Upper Marietta is confined to

sandstone lying below a calcareous shale which is probable equivalent of Middle Washington limestone rather than bed so called in Hennen's (1909, West Virginia Geol. Survey County Rept. Marshall, Tyler, and Wetzel Counties) section. Therefore, in section where Middle Washington limestone is well developed, it seems prefrable that Upper Marietta be confined to sandstone strata below this limestone, and that sandstone above it be given another name.

A. T. Cross and M. P. Schemel, 1956, West Virgina Geol. Survey, v. 22, pt. 1, p. 53 (fig. 1–141). Columnar section of Lower Dunkard (Washington series) in Ohio River valley, West Virginia, shows Davistown sandstone above Upper Marietta sandstone and below Upper Washington limestone.

Named for quarry in the sandstone just north of National Pike at Davistown, Greene County, Pa.

Dawes Sandstone (in Clinton Group)

Middle Silurian: Central New York.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13, 99–100, 170. Name proposed for light-gray slightly calcareous sandstone. Very cross-bedded and unfossiliferous. Few thin layers of arenaceous shales in basal part. Upper part stained red. Thickness about 8 feet. Unconformably underlies Kirkland iron ore; unconformably overlies Willowvale shale.

Type locality: On small stream known locally as Dawes Quarry Creek flowing west into Oriskany Valley within limits of village of Clinton; section is east of main part of Clinton in town of Kirkland, Oneida County. Outcrop area bounded on west by College Hill Creek on west side of Oriskany Valley and on east by Dawes Quarry Creek.

Dawn Limestone Member (of Monte Cristo Limestone)[1]

Dawn Member (of Monte Cristo Dolomite)

Lower Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 17.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 880, 881, 883 (fig. 2). Geographically extended into Nopah Range, Inyo County, Calif., where it is predominantly limestone 350 feet thick, underlies Anchor limestone member and overlies Sultan limestone (Crystal Pass member). Name Stewart Valley is abandoned, and Mississippian beds previously ascribed to it are assigned to Dawn limestone.

Charles Deiss, 1952, U.S. Geol. Survey Bull. 973–C, p. 114–115, pl. 13. Member described in Sloan district, Nevada, where it is approximately 175 feet thick, and consists of two lithologic units. Lower, which comprises four-fifths of the formation, is dull chocolate gray, tan gray, light gray, or white and consists of a medium to coarsely crystalline, thick-bedded dolomite; upper unit consists of thinner bedded (2 to 18 inches) tan-buff medium crystalline dolomite. Underlies Anchor member; contact arbitrarily drawn at base of lowest bed containing chert.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42. Described in Ivanpah quadrangle (California-Nevada) where it is made largely up of beds of blue-gray to dark-gray limestone, 2 to 10 feet thick, but is widely altered to dolomite. Underlies Anchor limestone member.

Well exposed west of Dawn mine, SW¼ sec. 15, T. 23, S., R. 58 E., Goodsprings quadrangle, Nevada.

Dawson Arkose[1] or Formation

Upper Cretaceous and Paleocene: Eastern Colorado.

Original reference: G. B. Richardson, 1912, Geol. Soc. America Bull., v. 23, p. 267–276.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1309–1312, 1314–1315 (fig. 3), 1320–1328. More than 2,000 feet thick; consists of arkosic conglomerate and sands. Merges northward into Arapahoe and Denver formations along foothills of Front Range, where beds stand vertically or dip steeply eastward on west flank of Denver basin. Dawson and Arapahoe along this belt overlie, with erosional irregularity, Laramie formation. In plains region—on east side of basin—where beds dip gently westward into basin, upper part of Dawson is coarsely conglomeratic, but lower consists chiefly of arkosic sands and dark shales, contains beds of lignite, and is not much different than underlying Laramie upon which it rests with apparent conformity. Identifiable remains of *Triceratops* present in lower part, but upper part has not yielded fossils of diagnostic age. Underlies Castle Rock conglomerate.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 65–86. New fossil evidence places basal part of Dawson arkose and Denver formation in Upper Cretaceous sequence. Proposed that Dawson arkose be restricted to Tertiary strata and that lower part be included in redefined Laramie.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 107–111, pls. 1, 2. Arapahoe and Denver formations can be mapped throughout Denver basin, and these names should replace term "lower" Dawson of Dane and Pierce (1936). Dawson formation (type section at Dawson Butte) should designate only "upper" Dawson of Dane and Pierce. Name Green Mountain conglomerate should be abandoned because it is only partial representative of Dawson formation as here restricted.

Named for Dawson Butte, about 6 miles southwest of Castle Rock, Douglas County.

Dawson Bay Formation

Dawson Bay Formation (in Manitoba Group)

Middle Devonian: Surface and subsurface in Manitoba, Canada, and subsurface in northeastern Montana, western North Dakota, and northwestern South Dakota.

A. D. Baillie, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 444–452; 1953, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 52–5, p. 26–27. Term proposed for lowest sequence of strata of Manitoba group. Lower limit is taken at base of red and green argillaceous zone that overlies Elk Point group. Upper limit marked by top of widespread reefoid and stromatoporid zone. Thickness 100 to 200 feet. In outcrop overlies Winnipegosis formation. Underlies unnamed strata of group.

W. M. Laird, 1953, Interstate Oil Compact Quart. Bull., v. 12, no. 2, p. 74. Underlies Souris River formation (new). Included in Beaver Hill Lake group.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2302–2304 (fig. 4), 2307–2308, 2309 (fig. 5). Baillie placed Dawson Bay formation and overlying unnamed beds that are approximately equivalent to Souris River formation of present report in Manitoba group. This grouping is not recommended for United States part of Williston basin because Dawson Bay and Souris River formations are readily separable. In Birdbear well, Dunn County, N. Dak., formation lies between depths of 11,052 and 11,170 feet. Ranges in thickness from fraction of foot to 185 feet; thickest along international boundary and in north-central North Dakota. Underlies approximately same area as Elk Point group in Williston basin and northeastern Montana but extends slightly beyond limit of Winnipegosis formation. Overlies Prairie formation of Elk Point group; underlies Souris River formation. Does not outcrop in United States.

Named for exposures along shores of Dawson Bay at northern end of Lake Winnipegosis, Manitoba, Canada.

Dayan Stage

Ordovician (Chazyan): North America.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 91, 94 (table 2). Chazy has long been divided into three lithologic and faunal zones (Brainerd and Seely, 1888, Am. Geologist, v. 2) which were given "substage" names Day Point, Crown Point, and Valcour (Cushing, 1905, New York State Mus. Bull. 95). These stages have been called Dayan, Crownian, and Valcourian by Oxley (unpub. ms.).

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 820–829. In Champlain Valley Chazy series is separable into Dayan, Crownian, and Valcourian stages, distinguished by faunal criteria. Each stage has several lithologic facies. Reefs are prevalent.

Marshall Kay, 1960, Internat. Geol. Cong. 21st, Copenhagen, pt. 7, p. 28–33. Chazyan series has Whiterockian, Dayan, Crownian, and Valcourian stages.

Day Creek Dolomite

Day Creek Dolomite Member (of Cloud Chief Formation)

Day Creek Dolomite (in Cimarron Group or Woodward Group)[1]

Permian: Southern Kansas, eastern Colorado, and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 44.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 37. Fine-grained dense dolomite about 2 feet thick in Kansas. Crops out in western Clark County; seemingly absent between northern part of T. 33 S., R. 24 W., and a point in Oklahoma near center of T. 25 N., R. 25 W., (Indian meridian). Overlies Whitehorse sandstone; underlies Taloga formation of Quartermaster group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as member of Cloud Chief formation.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 81, 82 (fig. 23). Day Creek dolomite exposed in Baca County, Colo., where it underlies Taloga formation.

Named for Day Creek, Clark County, Kans.

Day Point Limestone[1]

Middle Ordovician: Eastern New York and western Vermont.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1402 (fig. 2). Shown on correlation chart as Chazyan. Below Crown Point formation.

Marshall Kay, 1950, (abs.) Geol. Soc. America Bull. 61, no. 12, pt. 2, p. 1476. Bridport dolomite underlies Chazy Day Point formation within and west of Lake Champlain in Vermont and New York.

R. E. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 11–20, 63, 65, pls. 1, 2. Described on South Hero Island and Isle La Motte, where it overlies Providence Island dolomite and underlies Crown Point limestone. Thickness about 233 feet on Isle La Motte; 237½ feet on South Hero Island.

Philip Oxley and Marshall Kay, 1959, Am. Asoc. Petroleum Geologists Bull., v. 43, no. 4, p. 820–829. Included in Dayan stage (new). Comprises (ascending) Head, Scott, Wait, and Fleury members (all new). Chazyan.

Well exposed at Day Point, Peru Township, Clinton County, N.Y.

Days Creek Formation (in Myrtle Group)

Lower Cretaceous: Southwestern Oregon.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2775 (fig. 2), 2777 (fig. 3), 2781 (table 1), 2782–2784. Name applied to early Cretaceous clastic sedimentary rocks that concordantly overlie Riddle formation (new). Consists of alternating units of greenish-gray, fine-grained, even-grained sandstone and medium-gray to greenish siltstone; divisible into two members of which lower is distinguished from upper by presence of limestone lenses, by its siltstone units being medium gray instead of greenish gray, by its sandstone units being less massive, and by containing pelecypod *Buchia crassicollis* (Keyserling). Thickness at type section 809 feet. Rests directly on Riddle formation at many places in Douglas County; appears to rest normally on Galice formation at bridge across Illinois River west of O'Brien, Josephine County, but actual plane of contact not visible; in Port Orford area, basal beds containing *Buchia crassicollis* (Keyserling) rest generally on the Riddle but locally overlap onto Colebrooke schist. Contact with Galice and Colebrooke interpreted as angular unconformity. Name Days Creek replaces Horsetown formation and Cretaceous part of Knoxville as used by Diller and Kay (1924, U.S. Geol. Survey Geol. Atlas, Folio 218) in southwestern Oregon.

Type section: Along South Umpqua River in NW¼ sec. 15, SW¼ sec. 47, and E½ sec. 9. T. 30 N., R. 4 W., Douglas County. Named for village of Days Creek.

Daysville Formation (in Ancell Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 21, figs. 3, 12. Dolomite, impure, greenish-gray, chalky, thin-bedded. Thickness about 4½ feet. Shown on columnar section as underlying Loughridge formation (new) and overlying Kingdom formation (new).

Occurs in Dixon-Oregon area.

Dayton Limestone[1]

Middle Silurian: Southwestern Ohio.

Original reference: E. Orton, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 143; 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 297, 299–301, 309, fig. 1 facing p. 310.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart below Estill clay and above Waco limestone. Niagaran series.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci. Sec. Geology Guidebook 35th Ann. Field Conf., p. 17, 21. Silurian section exposed in Yellow Springs region shows Dayton limestone, 5 to 8 feet thick, above Brassfield limestone and below Osgood shale. Clinton group.

Typically exposed in vicinity of Dayton, Montgomery County.

Dayville Member (of Coeymans Limestone)

Lower Devonian: Central New York.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. When traced westward from the Helderbergs, the Coeymans formation thickens to nearly 100 feet at Cherry Valley. Slightly further west, this greatly thickened Coeymans splits into three parts. Lower part, for which name Dayville limestone is proposed, grades laterally into Olney limestone of Syracuse area.

Type locality and derivation of name not stated.

D-Cross Tongue (of Mancos Shale)

Upper Cretaceous: Southwestern New Mexico.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187, 188 (fig. 2). A marine shale unit ranging from 90 to 191 feet in thickness and decreasing consistently in thickness from south to north. Underlies Gallego sandstone member of Gallup sandstone and overlies lower part of Gallup sandstone. Unit formerly correlated with Pescado tongue but now believed to be a distinct and higher tongue.

Named for exposures at D-Cross Mountains in secs. 17 and 18, T. 3 N., R. 8 W., Socorro County.

Dead Horse Conglomerate Member (of Manitou Formation)

Lower Ordovician: Central northwestern Colorado.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 893, 905–906. Consists largely of thin beds of gray flat-pebble limestone conglomerate. Thickness about 108 feet. Underlies Tie Gulch dolomite member (new); overlies Clinetop algal limestone member (new) of Dotsero formation.

Type section: Spur on north side of U.S. Highway 6, one-half mile northeast of bridge over French Creek. Named for exposures along Dead Horse Creek which enters Glenwood Canyon from northwest near NE cor. sec. 30, T. 5 S., R. 87 W., Garfield County.

Dead Horse Tuff

Eocene, upper: Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–690, Book 2, p. 304–305. Massive dull-green to reddish- and pinkish-gray biotite quartz latite welded tuff. Thickness about 5,000 feet. Grades upward into coarse conglomerate which is overlain by Jarbidge rhyolite (new). Rests on Paleozoic limestone.

U.S. Geological Survey currently considers the Dead Horse Tuff to be upper Eocene in age.

Present in Jarbidge quadrangle.

Deadman Limestone[1]

Upper Triassic: Southeastern Idaho and northwestern Wyoming.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1801 (table 1). Age shown on table as Upper(?) Triassic.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 34–35, pl. 1. Mapped in Ammon and Paradise Valley quadrangles. Type locality designated.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 180–181. Mansfield (1927, U.S. Geol. Survey Prof. Paper 152) recognized following sequence of beds between Thaynes and Nugget formations: Timothy sandstone, Higham grit, Deadman limestone, and Wood shale. These units are distinct lithologically and are equivalent to Ankareh formation of Wasatch and Uinta Mountains of western Wyoming. In present report, Timothy sandstone is considered uppermost member of Thaynes. Higham grit and Deadman limestone are recognized as independent formations and Wood shale is considered westward extending tongue of Ankareh formation. At type area, the Deadman is 150 feet thick and directly overlies Higham grit.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 46. Geographically extended into Snake River Range, Wyo.

Type locality: Deadman Creek in northeastern part of T. 4 S., R. 38 E., Paradise Valley quadrangle, Idaho, where formation is crossed by the creek and extends northwestward along the ridge parallel to and northeast of prominent band of Higham grit. Named from Deadman Creek.

Deadman Quartzite

Precambrian: Central Arizona.

E. D. Wilson, 1938, *in* Arizona Bur. Mines Bull. 145, Geol. Ser. 12, pl. 3; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118, 1123. Hard fine- to medium-grained thinly stratified crossbedded cliff-forming quartzite, together with some thin conglomerate and hematitic shale members and an irregular basal conglomerate. In general, upper third weathers grayish brown to white, in contrast to reddish-brown tint of lower part. Thickness ranges from 90 to 110 feet except in a thrust block

at the southeast where it is approximately 800 feet. Thins out northward; removed by erosion southward. Unconformably overlies Red Rock rhyolite; conformably underlies Maverick shale (new).

Named from typical occurrence on North Fork of Deadman Creek. Found only within northern half of Mazatzal Range.

Deadman Island Beds[1] (in San Pedro Formation)

Pleistocene: Southern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, chart opposite p. 217.

Deadman Island no longer exists. Was an island formerly located in San Pedro Harbor but has now been entirely removed by steam shovels.

Deadwood Formation[1]

Upper Cambrian and Lower Ordovician: Western South Dakota, southeastern Montana, and eastern Wyoming.

Original reference: N. H. Darton, 1901, U.S. Survey 21st Ann. Rept., pt. 4, p. 505.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 45 (chart), 47. In northern Black Hills, conformably underlies Aladdin sandstone (new).

M. R. McCoy, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 21. In Powder River Basin, term Deadwood is used to include a series of sandstone, shale, and limestone-dolomites which are Upper Cambrian and Lower Ordovician in age. At type section in Black Hills, Deadwood is 350 to 400 feet thick. Sandstone or conglomerate, often auriferous, marks base of formation; this unit, which rests on beveled schists or quartzites, is erratic in thickness, varying from 2 to 95 feet. Above basal sandstone is series of interbedded blue-gray shales, with 2 or 3 horizons, 10 to 70 feet thick. In upper part, a massive sandstone unit is commonly present, often dolomitic, and sometimes ferruginous. Deadwood thins southward to zero edge.

Type locality: Whitewood Canyon, just below Deadwood, Lawence County, S. Dak.

Deadwood Gulch Rhyolite Tuff[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures in upper part of Deadwood Gulch, Mogollon district.

Dean Formation (in Great Smoky Group)

Precambrian: Central northern Georgia.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 9, 40–45, pl. 1, map. Staurolite-mica schists, X-biotite schists, quartzites, metaconglomerates, and "pseudo-diorite" beds; interbedded lesser amounts of gray slate, phyllite, and sericite schist; shows marked horizontal variations, abrupt vertical variations, and many breaks in lithologic sequence. Thickness 2,500 to 3,500 feet. Overlies Hothouse formation (new), hybrid character of rocks between the two makes position of boundary largely interpretative; underlies Nantahala slate, formations appear to be gradational through a zone less than 20 feet thick, and concordant; staurolite schist and metaconglomerate formerly included in basal Nantahala are

here included in the Dean, and the Dean-Nantahala boundary is drawn at base of dark slate.

Crops out in a one-half-mile wide belt on each limb of Murphy syncline; western belt extends along west side of Dean Ridge, after which formation is named, through Windy Ridge, and along upper course of Sugar Creek; eastern belt lies to west of Lake Toccoa, Mineral Bluff quadrangle, Fannin County.

Dean Sandstone

Permian (Wolfcamp): Western Texas (subsurface).

Lamar McLennan, Jr., and H. W. Bradley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 4, p. 899, 903, 904, 908. Name was first applied by Seaboard geologists to a sandstone in Gulf Oil Corp.'s Dean No. 1, from 7,990 to 8,190 feet. Type section for Dean as used in this report occurs between depths of 7,550 to 7,660 feet in the Seaboard's Robison 6–A. In type locality, consists of approximately 120 feet of gray-white to brown fine sandstone with thin streaks of tan to brown dense limestone and black shale. Occurs below Spraberry sandstone.

Type well: Seaboard's Robison 6–A, a Spraberry field well in sec. 37, Black 34, T. 5 N., Texas and Pacific Railway Survey, Dawson County.

Deanefield Shale (in Pottsville Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: J. H. Gardner, 1927, Kentucky Geol. Survey, ser. 6, v. 26, p. 135, 137, 153.

Extends throughout territory from Butler to Daviess Counties and is well exposed around Deanefield and Fordsville, Hartford quadrangle.

Dean Lake Chert

Dean Lake Chert (in Hannan Limestone)

Dean Lake Chert Member[1] (of Madison Limestone)

Mississippian (Kinderhookian and Osagean): Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 47.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 38). Underlies Rooney chert and overlies Saypo limestone, all in Hannan limestone. Kinderhookian and Osagean.

J. M. Andrichuk, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 89. Hall (1952, unpub. thesis) proposed that Deiss' Dean Lake be recognized as a formation. Deiss gave thickness of 60 feet at type section. Hall redefined type section of 105-foot thickness to include about 45 feet of overlying similar beds separated by 11 feet of chert-free limestone. Kinderhook.

Type locality: Southeast side of Pentagon Mountain in SW¼ sec. 14 T. 25 N., R. 14 W. Named for small cirque lake lying at foot of cliffs that form upper part of east side of the mountain.

Deansboro Member (of Coeymans Limestone)

Lower Devonian: Central New York.

L. V. Rickard, 1955, New York Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9 (strat. column); 1956, Dissert Abs., v. 16, no. 1, p. 102. Coeymans limestone of central New York, overlying Jamesville member of the Manlius, is entirely younger than the Coeymans of eastern New York.

Name Deansboro is proposed for this part of the Coeymans. Consists of massive gray or blue coarse-grained limestone, 30 to 60 feet thick, characterized by *Gypidula coeymanensis, Brachyprion varistriata, Atrypa "reticularis", Camarothoechia semiplicata, Leptostrophia planulata,* and *Uncinulus mutabilis.* Contains at least four coral reefs. Underlies Onondaga. The "Bishop Brook" is merely a reappearance of the Deansboro at Manlius beneath the pre-Onondaga unconformity.

Type locality and derivation of name not stated.

Dearborn Limestone[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 36.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1075, 1081–1082, 1086, 1089, 1090 (fig. 2); 1939, Geol. Soc. America Spec. Paper 18, p. 26, 30, 33, 40, 54 (fig. 6). As herein defined, conformably overlies Damnation limestone (redefined) and conformably underlies Pagoda limestone. Steamboat limestone, as used in 1933 sequence, has proved to be part of massive upper Dearborn which was repeated in the Dearborn section by low angle overthrust. Steamboat as now used refers to limestone underlying Switchback limestone and overlying Pentagon shale. Thickness at type locality 354 feet. Consists of lower shaly interval and a much thicker upper limestone interval. Middle Cambrian.

Type locality: On north side of valley of North Fork of Dearborn River, in W½ sec. 6, T. 17 N., R. 7 W., south-central part of Lewis and Clark Range, Lewis and Clark County.

Death Canyon Member (of Gros Ventre Formation)[1]

Death Canyon Limestone (in Gros Ventre Group)

Cambrian: Western Wyoming.

Original reference: B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 119.

A. B. Shaw and P. O. McGraw, 1954, Wyoming Geol, Assoc. Guidebook 9th Ann. Field Conf., chart 2; A. B. Shaw and C. R. LeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 38, 39. Gros Ventre formation of earlier workers is raised to group status in western Wyoming where it contains three mappable formations: Wolsey shale, Death Canyon limestone, and Park shale.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 12, 13. In Gros Ventre, southern Teton, northern Hoback, and Snake River Ranges, considered middle member of formation; overlies Wolsey shale member; underlies Park shale member. Consists of massive dull-blue-gray limestone in two beds of unequal thickness with an intervening fossiliferous shale. Thickness 207 to 368 feet.

Type section: Along divide between Death and Teton Canyons in Teton Range.

Death Valley Formation[1]

Precambrian: Southeastern California.

Original reference: F. M. Murphy, 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 355, 378 (fig. 7). This study [Manly Peak quadrangle] has made pos-

sible the correlation of formations defined by Murphy (1930, Econ. Geology, v. 25; 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley. Death Valley formation is correlated with Stirling quartzite here assigned to Precambrian as defined in this report.

Mapped over a wide area to west of Death Valley, Panamint Mountains, Inyo County.

Deaton Formation,[1] Series,[1] or Iron-Ore Series[1]

Middle Ordovician: Northwestern Georgia.

Original reference: J. W. Spencer, 1893, Georgia Geol. Survey, Paleozoic group, p. 46, 83.

Named for exposures at Deaton mine, Polk County.

DeBeque Formation

Paleocene, upper, and Eocene, lower: Western Colorado.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 18, pl. 1. Late Paleocene and Wasatchian of western Colorado, to be named and described by Patterson.

J. A. Dorr, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2 facing p. 64. Correlation chart shows age to be Paleocene (Tiffanian and Clarkforkian) and early Eocene (Wasatchian).

D. B. Kitts, 1956, Am. Mus. Nat. History Bull., v. 110, p. 47, 49, 51. Includes Rifle member (new).

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 134 (fig. 1), 135. Comprises (ascending) Plateau Valley beds, Lysite equivalent, and Lost Cabin equivalents. Tiffanian, Clarkforkian, and Wasatchian.

Town of De Beque is in Mesa County.

Debris Dam Sandstone

Upper Cretaceous: Southern California.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1730 (fig. 2), 1734 (fig. 4), 1739–1743. Lower 750 feet of type section consists of sandstone members 60 to 330 feet thick alternating with shale members 50 to 150 feet thick; middle 850 feet is massive cliff-forming sandstone that is predominantly light gray; upper 600 feet is alternating shales and sandstones, members averaging about 150 feet in thickness. South of Santa Ynez fault, includes Romero conglomerate lentils (new). In type area, underlies Pendola shale (new); southwest of type section, Pendola is cut out and the Debris Dam is unconformably overlain by middle Eocene Juncal formation. Gradationally overlies unnamed Cretaceous shale unit; base of Debris Dam arbitrarily selected where sandstone first predominates over shale in the transitional sequence.

Type locality: Small canyon that drains westward to Agua Caliente Canyon about 1½ miles northeast of Pendola Guard Station and 1⅛ miles south of Big Caliente Debris Dam, Santa Barbara County. Base of section 6,200 feet S. 1° E. of Big Caliente Dam, and top is 6,700 feet S. of 23° E. of dam. Formation forms part of Auga Caliente anticline. To northwest of type section, beds extend past Big Caliente Debris Dam to northern limit of area; southwestward, they extend approxi-

mately 1 mile where they disappear beneath Juncal formation; seemingly they reappear south of Santa Ynez fault in an elongate east-west-trending belt; however, correlation here is uncertain because of lack of fossils and occurrence of Romero conglomerate lentils.

Decathon Dolomite

Silurian: Eastern Nevada and western Utah.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 23 (fig. 5), 25–26, 30–31 (fig. 6), 34–35 (fig. 7), 36–37 (fig. 8), 40–41 (fig. 9), 52–53 (fig. 11), 60. Proposed for light-gray coarsely crystalline, dense dolomite 350 feet thick lying above Roberts Mountain and below Kings Canyon dolomite (new) at Big Springs, Nev. Locally overlies Jack Valley dolomite (new).

Name taken from Decathon Canyon, one of principal drainage channels of southern part of Snake Range, Nev., west of Big Springs Ranch.

Decatur Limestone[1]

Decatur Limestone (in Brownsport Group)

Upper Silurian: Western and central Tennessee.

Original reference: W. F. Pate and R. S. Bassler, 1908, U.S. Natl. Mus. Proc., v. 34, p. 410–432.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Age shown on correlation chart as Niagaran [Middle Silurian].

T. W. Amsden, 1949, Yale Univ., Peabody Mus. Nat. History Bull. 5, p. 10–12, fig. 6. Conformably overlies Brownsport formation. A post- Decatur unconformity is present throughout area [western Tennessee]; Decatur may be overlain by beds ranging in age from Devonian to Cretaceous; as result of this post-Silurian erosion, thickness of Decatur varies greatly within short distances—as near Sewell's Spring, Clifton quadrangle, where thickness ranges from 18 to 70 feet; here, too, some Devonian may be present in upper part.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 266–269, fig. 2. Included in Brownsport group. Everywhere overlain unconformably by formations of the Devonian or by Chattanooga shale. Locally is an overlapping unit; transgresses westward across beveled Lobelville and Bob formations and part of Beech River formation. Believed to be Niagaran in age.

Type section: At Tuck's Mill, 1½ miles north of Decaturville. Named for Decatur Country.

†Decatur Sand (in Claiborne Group)[1]

Eocene, middle: Southeastern Mississippi.

Original reference: E. N. Lowe, 1919, Mississippi Geol. Survey Bull. 14, p. 78.

Crops out mainly near Enterprise, Wautubbee, and Decatur. Named for exposures near Decatur, Newton County.

Decaturville Chert[1]

Upper Ordovician (Richmond): Central Missouri.

Original reference: G. H. Scherer, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 2, p. 67.

Probably named for exposures at Decaturville, Camden County.

Decaturville Chert[1]

Decaturville Chert (in Linden Group)

Decaturville chert zone (in Ross Formation)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 744.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., 53, no. 12, pt. 1, chart 4. Shown on correlation chart as uppermost formation in Linden group. Occurs above Birdsong shale and below Quall limestone.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280, 290–292, 295–296, 301–302. Considered a zone conformably interbedded with beds of Ross limestone member, Bear Branch facies, and Birdsong shale member of Ross formation (new). Term Decaturville zone is applied to the porous fossiliferous gray chert that is developed by chertification of limestone zone that carries large specimens of brachiopods and overlies the Bryozoan zone.

Well exposed in vicinity of Decaturville, Decatur County.

†Decaturville Limestone[1]

Upper Cambrian: Central Missouri.

Original reference: E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 1, p. 42.

Named for exposures at Decaturville, Camden County.

Deception Rhyolite (in Ash Creek Group)

Deception Porphyry[1]

Precambrian (Yavapai Series): Central Arizona.

Original reference: L. E. Reber, Jr., 1922, Am. Inst. Mining and Metall. Engineers Trans., v. 66, p. 12.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308. p. 15–17, pl. 1. As exposed in Deception Gulch and in part of Mescal Gulch, unit is a hydrothermally altered facies of rhyolitic flows and fragmental rocks. Name therefore modified to Deception rhyolite to include all rhyolitic rocks older than Grapevine Gulch formation (new) and younger than Shea basalt, dacite of Burnt Canyon, Brindle Pup andesite (new), and Buzzard rhyolite (new). A jasper-bearing facies of rhyolite present at top of unit in drainage basin of Ash Creek and in Hull Canyon. A minor facies in Mescal Gulch area contains sericitized plagioclase phenocrysts in microcrystalline groundmass. Near Jerome, outcrops are reddish hue, changing to buff and cream in Mescal Gulch, and are pale colored near Ash Creek. Most complete section exposed between Ash Creek and Black Canyon, where rhyolite is about 3,000 feet thick.

Well exposed in drainage basins of Mescal Gulch and Deception Gulch, which is the name for the deep rugged part of Hull Canyon south of Jerome, Yavapai County. Also exposed south of Mingus Mountain between Ash Creek and Black Canyon.

Decew Dolomite

DeCew Limestone[1]

Middle Silurian: Ontario, Canada, and western New York.

Original reference: E. M. Kindle, 1914, Science, new ser., v. 39, p. 918.

D. W. Fisher, 1959, New York State Mus. Sci., Service Geol. Survey Map and Chart Ser. 1. There is variance of opinion as to whether time break exists between Lockport group and underlying Rochester shale. There seems to be physical break between Decew dolomite and Gasport in western New York, but no physical break can be seen from Rochester eastward. The Rochester grades imperceptibly upward into Decew. Decew dolomite is placed in Tonawandan stage (new) because it contains *Arctinurus boltoni* and *Trimerus delphinocephalus* which are unknown in Lockportian stage (new). Middle Silurian.

Well exposed at DeCew Falls, Ontario.

†Decewsville Formation[1]

Decewville Formation[1]

Middle Devonian: Southeastern Ontario, Canada, and western New York.

Original reference: E. O. Ulrich and C. Schuchert, 1902, New York State Mus. Bull. 52, p. 653, chart opposite p. 659.

Named for exposures near village of Decewsville, Ontario.

De Chelly Sandstone

De Chelly Sandstone Member (of Cutler Formation)[1]

Permian: Northeastern Arizona and southeastern Utah.

Original reference: H. E. Gregory, 1915, Am. Jour. Sci., 4th, v. 40, p. 102.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 90. Rank raised to formation. Eolian De Chelly grades into continental fluvial deposits overlying differentiated Cutler in southeastern Utah; along northeast margin of southern and western San Juan Basin, loses its identity as it grades into arkosic facies of Cutler. In Arizona, overlies Supai formation; in New Mexico, overlies Yeso formation along its lateral boundary with the Glorieta. Includes Hoskinnini as member.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1855 (fig. 2), 1857 (fig. 3), 1862. In and near Monument Valley, De Chelly member of Cutler underlies Hoskinnini (herein reallocated to member status in Moenkopi formation). Thickness about 300 feet.

Gregory (1916) mapped sandstone along Canyon de Chelly, Apache County, Ariz.

Decie Member (of Duff Formation)

Oligocene and younger(?): Southwestern Texas.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 553–554, pl. 1. Northern facies of Duff differs from southern facies in that the effusive rocks are predominantly rhyolite, trachyte, and trachyandesite, whereas flows in southern part are chiefly trachybasalts. A succession that appears to constitute more than half of the formation in Paisana Peak quadrangle is herein named Decie member. Southernmost tongue, a trachyte porphyry, is about 60 feet above base of the Duff and is 60 to 110 feet thick west of Haley Mountain and along west side of McIntyre Peak intrusive mass. A second rhyolite porphyry tongue crops out around east and north sides of McIntyre Peak. Base of the rhyolite is about 150 feet above base of the Duff and has maximum thickness of 237 feet.

Named for exposures on Decie Ranch near McIntyre Peak, Cathedral Mountain quadrangle.

Decker Limestone[1]

Upper Silurian: Northern New Jersey, southeastern New York, and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 76–77, 137–141.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart at base of Keyser group below Rondout limestone and above Bossardville limestone. Cayugan series.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Keyser formation passes into Manlius, Rondout, and Decker formations.

Well exposed near Decker's Ferry below Flatbrookville, Sussex County, N.J.

Decker Ferry Limestone[1] or Formation[1]

Silurian: Northern New Jersey, southeastern New York, and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 76–77, 137–141.

Named for exposures near Decker's Ferry below Flatbrookville, Sussex County, N.J.

Decker Ferry Sandstone[1]

Silurian: Northwestern New Jersey and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 77, 140–141.

Well exposed near Decker's Ferry below Flatbrookville, Sussex County, N.J.

Decker Ferry Shales[1]

Silurian: Northwestern New Jersey and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 77, 141.

Well exposed at Decker's Ferry, Sussex County, N.J.

Decorah Shale[1] **or Formation**

Decorah Shale Member (of Galena Formation)

Middle Ordovician: Northeastern Iowa, western Illinois, southern Minnesota, northern Missouri, and southwestern Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 84.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 72, 81, 82–86. Considered member of Galena formation in southeastern Minnesota. Underlies Prosser member; overlies Spechts Ferry member of Platteville formation. Includes Guttenberg and Ion submembers. Thickness 27 to 46 feet.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2064–2066. In southeastern Missouri, underlies Kimmswick limestone and overlies Macy formation (new) of Plattin group. Spechts Ferry member traced from type locality into Missouri where it is lower shale-bearing part of formation. Thicknesses: 25 feet in Lincoln County; 18 feet in St. Louis County; 15 feet in Jefferson County; and 20 feet in Perry County, Spechts Ferry member absent.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 759–763. Overlies Carimona member (new) of Platteville formation and underlies Cum-

mingsville member (new) of Galena formation. Thickens from about 20 feet at Iowa line to nearly 90 feet at Twin Cities. Spechts Ferry, Guttenberg, and Ion members not recognizable units in Minnesota.

A. F. Agnew, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 49–50. Carimona limestone reallocated to member status in Decorah formation in Minnesota for following reasons: lithology is similar to that of limestone bands in Spechts Ferry member; Carimona and Spechts Ferry members wedge out eastward, and Guttenberg member thins eastward, whereas Quimbys Mill member of Platteville wedges out to west and McGregor member of Platteville thins westward; there is disconformity in Platteville at top of Quimbys Mill member.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1029 (fig. 1), 1033–1036, pl. 1. Formation described in Fillmore County, Minn., where it is not differentiated into members. Here, and in adjacent exposures, formation is a shale, grayish yellow green to greenish gray, calcareous, generally fissile, but more massive and blocky where coquinoid layers are absent or sparse. Numerous limestone layers concentrated near base and top and subordinately near middle. A 1- to 2-inch bentonite present near base; this seam is the "putty layer" of Twin City section and is continuous with Spechts Ferry bentonite. Thickens northwestward across county from 22 to 46 feet. Underlies Galena formation, Cummingsville member; overlies Platteville formation, Carimona member. Most fossiliferous unit in Minnesota Ordovician.

A. V. Heyl, Jr., and others, 1959, U.S. Geol. Survey Prof. Paper 309, p. 8 (fig. 2), 11 (fig. 3), 14–17. Formation described in upper Mississippi Valley zinc-lead district (Wisconsin, Illinois, Iowa) where it is about 40 feet thick; includes three members: a basal green-shale member (Spechts Ferry) that thickens toward northwest, a thin-bedded pinkish-buff sublithographic limestone and interbedded carbonaceous brown-shale member (Guttenberg), and a medium-bedded gray dolomite or limestone member (Ion) that has thin greenish-shale partings. Disconformably overlies Platteville formation and grades upward into Galena dolomite.

First described in city and vicinity of Decorah, Winneshiek County, Iowa.

Decota Sandstone (in Kanawha Formation)[1]

Pennsylvanian: West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Rept. Kanawha County, p. 292.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 81. In lower Kanawha between Eagle (above) and little Eagle coals.

Named for Decota, Kanawha County.

Dederick Shale Member[1] (of Cherokee Formation)

Dederick Subgroup (of Cherokee Group)

Pennsylvanian (Des Moines Series): Western Missouri.

Original reference: F. C. Greene and W. F. Pond, 1926, Missouri Bur. Geology and Mines, v. 19, 2d ser., p. 38–44.

T. R. Beveridge, 1951, Missouri Geol. Survey and Water Resources, 2d ser., v. 32, p. 51–53, pl. 11. Rank raised to subgroup of Cherokee group; regional correlations are insufficient to determine the position of the Weaubleau area (this report) Dederick within the subgroup. In

Weaubleau quadrangle, unit is undifferentiated and consists of dark-colored shale, in some localities carbonaceous to coal bearing, in others micaceous and silty. Maximum exposed thickness 6 feet; base not exposed. Unconformable on deeply eroded Mississippian rocks [Burlington]; relations of contact with overlying Graydon formation not known.

Named for exposures along railroad in northern part of sec. 26, T. 36 N., R. 29 W., and NE¼SE¼ sec. 36, T. 36 N., R. 29 W., in vicinity of Dederick, Vernon County.

Dedham Granodiorite[1]

Devonian(?): Eastern Massachusetts and southeastern New Hampshire.

Original reference: W. O. Crosby, 1880, Boston Soc. Nat. History Occasional Papers 3, map.

N. E. Chute, 1940, Massachusetts Dept. Public Works Bull. 1, p. 4, 11, pls. 2–A, 2–B. Ordovician(?) or Silurian(?).

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad Map [GQ–5]. Three rock types described in Brockton quadrangle, Massachusetts. Usual Dedham is pale-pink massive fairly homogeneous medium- to coarse-grained rock. Other varieties are white or light-gray granodiorite and porphyritic granodiorite with pink feldspar phenocrysts. Few dikes of fine-grained albite granite intrude the pink and light-gray varieties. Intrudes Salem gabbro-diorite. Lower Paleozoic(?).

A. W. Quinn and G. H. Springer, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–42. Restricted from Bristol quadrangle and vicinity, Rhode Island-Massachusetts. Pre-Carboniferous rocks of area assigned to Metacom granite gneiss (new) and two unnamed units.

Named for typical exposures about Dedham, Mass.

Deep Canyon Fanglomerate[1]

Quaternary: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 384–385, map.

Named for Deep Canyon, Riverside County.

Deep Creek Andesite

Pliocene(?): Southwestern Washington.

R. V. Fisher, 1957, Dissert, Abs., v. 17, no. 9, p. 1981. Named and age given as Pliocene(?).

Exposed along Bumping River, Mount Aix quadrangle.

†Deep Creek Beds[1]

Miocene, middle: Central southern Montana.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 287.

East of Fort Ellis along Deep Creek, Little Belt Mountains region.

Deep Creek division[1]

Lower Ordovician: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. 302–306, pl. 3.

Named for Deep Creek, San Saba County.

Deepian series

Precambrian (Protozoic): Eastern California.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 307 (chart). Listed as a series consisting of 2,100 feet of shales. Unconformable below Campitoan series and above Reedian series.

Occurs in Death Valley region.

Deepkill Shale[1]

Lower and Middle Ordovician: Eastern New York and west-central Vermont, and Canada.

Original reference: R. Ruedemann, 1902, New York State Mus. Bull. 52, p. 546–575.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Deepkill shale in Taconic sequence above Schaghticoke shale and below Bald Mountain limestone. Lower Ordovician.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65. no. 3, chart 2 (columns 8, 14). Correlation chart shows Deepkill shale present in Taconic area, New York and Vermont. Canadian and Chazyan. Overlies Schaghticoke shale; underlies Normanskill shale. Also present in Gaspe and New Brunswick.

W. B. N. Berry, 1959, (abs.) Geol. Soc. America Bull., v. 70, no. 12, pt. 2, p. 1568–1569. Graptolite and zonal sequence in Deepkill shale worked out by Ruedemann nearly 60 years ago, and faunas that constitute the zones have been considered standard of comparison for all Early Ordovician graptolites in North America. Also, term "Deepkill" has acquired time-stratigraphic significance in some publications. Reinvestigation and reinterpretation of formation and its faunas reveal that four zones based on graptolite assemblages may be delimited within it. Three of the zones are in the continuous exposure (Ruedemann's beds 1 through 5) in lower part of Deepkill Gorge. The two older zones are latest Early Ordovician, and the third zone is earliest Middle Ordovician. Rocks of fourth zone, which comprise Ruedemann's beds 6 and 7, are in fault contact with Normanskill shale. This zone is Middle Ordovician. One zone is missing between it and next youngest zone in Deepkill shale. Missing zone, although widely represented in other parts of country, has not been found anywhere in New York.

Named from typical exposure in Rensselaer County, N.Y., along Deepkill River, a tributary of the Hudson from the east.

Deep Lake Argillite[1] (in Stevens Series)

Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 80, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 602 (table 4), 611. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Parker and Cannon (1943) for Metaline quadrangle. Part of Deep Lake argillite is considered correlative with Metaline limestone, part correlative with Maitlen phyllite.

Exposed along east shore of Deep Lake, Stevens County.

Deep Lake Metaquartzite[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference. E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 625.

J. J. Runner, 1928, Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included at base of Snowy Range series (new); overlies Centennial series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Crops out around Deep Lake, Medicine Bow Mountains.

Deep River Beds[1].

Miocene, middle: Central southern Montana.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 287.

W. T. Thom, Jr., 1957, Billings Geol. Soc. Guidebook 8th Ann Field Conf., p. 11 (table 1). Name appears on generalized stratigraphic section for Crazy Mountain Basin and nearby areas. Overlies Fort Logan beds and together the units dated as middle and upper Miocene.

Deposits occur east of Fort Ellis along Deep Creek (also called Deep River and Smith River); Little Belt Mountains region and Meagher County.

†Deep River Formation[1] or Series[1]

Upper Triassic: Central North Carolina.

Original reference: E. Emmons, 1856, North Carolina Geol. Survey Rept. of Midland Counties, p. 255, 273.

Named for exposures along Deep River.

Deep Run Formation

Deep Run Member (of Ludlowville Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 218, 226, 227.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 371–372, pl. 1. Member is 55 feet thick at type locality; thins rapidly westward until it wedges out in Batavia quadrangle. Corps out in eastern part of Batavia quadrangle, three-quarters mile southeast of Pavilion Center. Here is consists of 3.6 feet of calcareous shale and is overlain by Menteth limestone 0.6 foot thick.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455 (fig. 2). Referred to as Deep Run formation. Thickness 10 feet. Overlies Tichenor formation; underlies Menteth formation. Ostracodes discussed.

Type locality: Ravine, about 1 mile north of Cottage City, on east side of Canandaigua Lake, Ontario County.

Deep Spring Formation[1]

Precambrian(?): Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. R. Longwell, 1950, Geol. Soc. America Bull., v. 61, no. 5, pl. 1. Underlies Campito sandstone; overlies Reed dolomite.

U.S. Geological Survey currently designates the age of the Deep Spring Formation as Precambrian(?) on the basis of a study now in progress.

Named for exposures along west side of Deep Spring Valley in canyons north of Antelope Spring, Inyo Range.

Deer Diorite

Pre-Upper Cretaceous: Southern California.

R. M. Alf, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1104 (fig. 2), 1109–1110, pl. 6. Medium- to coarse-grained plutonic rock with small to large crystals of hornblende up to 1 inch or more in length. Occurs as a lenticular mass in what is termed Black Belt (nongeographic name) mylonites.

Well exposed in Deer Canyon, San Gabriel Mountains, southeast of Los Angeles.

Deer Creek Formation

Pennsylvanian: South-central Colorado.

D. W. Bolyard, 1956, Rocky Mountain Assoc. Geologists Guidebook to geology of the Raton Basin, Colorado, p. 52–53; 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1904–1910. Proposed for beds previously called Clastic member of Sandia formation by Brill (1952) from Huerfano River south to New Mexico border. Consists of grayish, reddish, and greenish sandstones, siltstone, conglomerates, and shales, interbedded in upper part with gray sandy to argillaceous limestones; crossbedding and cut-and-fill stratification common in sandstones and conglomerates. Thickness at type section 1,119 feet. Unconformably overlies Precambrian at Huerfano River and La Veta Pass; gradationally underlies Madera formation with contact placed at top of highest redbeds. Name Clastic member of Sandia refers to a basal transgressive suite of gray sandstone, shale, and conglomerate, with a few coal beds, underlying Madera formation in central New Mexico (Read and Andrews, 1944). Abandonment of this term in south-central Colorado proposed because in this area red beds included in member bear impress of a different depositional sequence; furthermore, red coloration provides lithologic basis for separating these beds from Madera, whereas, if Brill's nomenclature were followed, separation would be based on paleontology. Assigned to upper Atokan on basis of fusulinids.

Type section: Along Huerfano River, beginning at unconformable contact with Precambrian in E½ sec. 23, crossing Deer Creek and extending to SW¼ sec. 24, all in T. 27 S., R. 72 W., Sangre de Cristo Mountains, between La Veta Pass and Westcliffe.

Deer Creek Limestone (in Shawnee Group)

Deer Creek Limestone Member (of Pawhuska Formation)

Deer Creek Limestone Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Southwestern Iowa, eastern Kansas, northwestern Missouri, southeastern Nebraska, and central northern Oklahoma.

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Original reference: J. Bennett, 1896, Kansas Univ. Geol. Survey, v. 1, p. 117.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 142 (fig. 29), 156. Deer Creek formation, in Shawnee group, underlies Calhoun formation and overlies Tecumseh formation; includes (ascending) Ozawkie limestone, Oskaloosa shale, Rock Bluff limestone, Larsh shale, Haynies limestone, Burroak shale, and Ervine Creek limestone members. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. In Kansas, the shale between the Rock Bluff and Ervine Creek limestones is called the Larsh-Burroak because it seems to be exactly equivalent to the Larsh shale, Haynies limestone, and Burroak shale as described in Nebraska. The Deer Creek is a member of the Pawhuska formation as defined in Oklahoma.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17–18. In Missouri, the interval between the Rock Bluff limestone member and the uppermost limestone of the Deer Creek is occupied by shale; this shale has been treated by Missouri Geological Survey as occupying the Rock Bluff-Ervine Creek interval, with implication that intervening Haynies limestone is absent in Missouri. Missouri follows Kansas practice, and the shale is called Larsh-Burroak; the Missouri Survey recognizes the possibility that Burroak shale member may be absent in Missouri and that the uppermost limestone of the Deer Creek may include the Haynies and Ervine Creek limestone members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17–18, fig. 5. Comprises (ascending) Ozawkie limestone, Oskaloosa shale, Rock Bluff limestone Larsh shale, Haynies limestone, Burroak shale, and Ervine Creek limestone members. Lower two members not differentiated everywhere. Underlies Calhoun shale; overlies Tecumseh shale. Shawnee group.

Named for exposures on Deer Creek, east of Topeka, Shawnee County, Kans.

Deer Creek Quartzite[1]

Precambrian (Glenarm Series): Northern Maryland.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Rept., v. 1, p 130–132.

Occurs in center of Harford County, marking a sharp, narrow ridge 300 feet high, 4 miles long, and less than 1 mile wide.

Deerfield Diabase[1] (in Newark Group)

Upper Triassic: Central Massachusetts.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Revived and described in Mount Toby quadrangle as fine-grained black effusive diabase or trap rock, reddish-brown to nearly yellow on weathered surfaces. Generally massive in thicker parts; upper surface is somewhat vesicular. Locally a flow breccia. Maximum thickness 100 feet. Underlies Turners Falls sandstone (new); overlies Sugarloaf formation. No longer considered a unit of the Holyoke diabase because no direct con-

nection can be traced and source and age of the two may differ. Triassic. Outcrop area described.

Crops out in Greenfield and Mount Toby quadrangles on western and southern slopes of the Mount Toby highland and west of the Connecticut River in the Pocumtuck Range.

Deer Isle Granite

Lower Devonian: South-central Maine.

H. W. Fairbairn and P. M. Hurley, 1957, Am. Geophys. Union Trans., v. 38, no. 1, p. 104 (table 7), 106 (table 9). Incidental mention. Probably comagmatic with Vinalhaven granite.

Occurs on Deer Isle, Hancock County.

Deer Lake Argillite[1]

Paleozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 54, map.

Exposed along shores of Deer Lake, Stevens County.

†Deer Lake Conglomerates[1]

Precambrian (Keewatin): Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 490, 492, 496.

Exposed on Kitchi Hills, in vicinity of Deer Lake, Marquette district.

Deer Mountain Red Shale Member (of Hueco Limestone)[1]

Permian (Wolfcamp Series): Western Texa.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 925.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 695, 697. Lee Ranch tongue (new) of Abo sandstone is believed to be stratigraphically lower than Deer Mountain red shale member of type Hueco. The herein named Otero Mesa member of Yeso formation is believed to occupy an intermediate stratigraphic position between Lee Ranch tongue and Deer Mountain red shale.

Named from exposures on Deer Mountain, 4 miles southeast of Cerro Alto [Mountain], Hudspeth County.

Deerpark Stage or Group

Lower Devonian (Ulsterian): North America.

G. A. Cooper and others, 1952, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. The Devonian is subdivided into 10 stages of which the Deerpark is second in sequence (ascending). [For complete sequence see Helderberg stage, this reference.] Follows Helderberg stage and is succeeded by Onesquethaw stage (new). Includes Oriskany and its correlates.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv. Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 35 (table 1). Referred to as group in Mackinac Straits region, Michigan. Underlies Onesquethaw group; overlies Bass Island[s] group. Includes Garden Island formation (new).

Type section (stage): Southeastern Deerpark Township on west slope of Shawangunk Mountains facing Port Jervis, Sullivan County, N.Y.

Deer Plain Formation

Pleistocene (Wisconsin): Central western Illinois and eastern Missouri.

W. M. Rubey, 1952, U.S. Geol. Survey Prof. Paper 218, p. 12 (chart), 90–96, pl. 1. A variable series of gravel, sand, and clay; along Mississippi River and near mouth of Illinois River, consists largely of gravel; up valley of Illinois River, becomes finer grained and passes within only a few miles through sand into silt and clay; at all exposures, material becomes progressively finer grained upward. True maximum thickness unknown; near Deer Plain at least 50 feet; in many smaller remnants 5 to 20 feet. Stratigraphic and physiographic evidence shows that Deer Plain formation is younger than Brussels formation and loess; physiographic relations demonstrate that Deer Plain terrace is younger than Metz Creek terrace and the scattered pebbles of igneous and metamorphic rocks that lie upon it; also evidence shows that Deer Plain formation is too old to be included within the latest or Recent stage of earth history.

Named for exposures near village of Deer Plain, sec. 16, T. 13 S., R. 1 W., Calhoun County, Ill. Deposits occur as a wide terrace in lowlands west of Illinois River and as small terrace remnants along Illinois and Mississippi Rivers; some terrace and deposits are well developed in lowlands west of Mississippi River from Winfield to Old Monroe in Lincoln County, Mo.

Deer Rips Lime-Silicate Gneiss (in Androscoggin Series)

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss (new), Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate gneiss, Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite schist. Middle Silurian.

L. W. Fisher, 1938 (abs.) Geol. Soc. America Proc. 1937, p. 81. Deer Rips lime-silicate gneiss and Bates limestone included in Androscoggin series.

Occurs in Lewiston area, Androscoggin County.

Deer River Shale[1]

Middle Ordovician: Northern New York, and southern Ontario, Canada.

Original reference: Rudolf Ruedemann, 1921, New York State Mus. Bulls. 227, 228, p. 124–126, 130.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 284–285. Derivation of name. Middle Ordovician (Mohawkian).

Named for Deer River, northern Lewis County, N.Y.

Deer Trail Group

Deer Trail Argillite[1] (in Stevens Series)

Precambrian (Belt Series): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 59, map.

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 7–8. Referred to as a group including Stensgar dolomite.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Described as a group consisting of

a series of metasediments, probably of Beltian age, composed dominantly of fine-grained clastics with minor amounts of quartzite and dolomite. Thickness 5,000 feet. Includes (ascending) Togo formation, Edna dolomite, McHale slate (all new), Stensgar dolomite, and Buffalo Hump formation (new). Unconformably underlies Huckleberry group (new).

Present in Stevens County.

Deerwood Iron-Formation Member (of Virginia Slate)[1]

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 212–215.

G. M. Schwartz, 1951, Geology of the Cuyuna Range: Minnesota Univ. Center for Continuation Study, Mining [Geology] Symposium [No. 2], p. 3. For most part, Deerwood iron-formation and Cuyuna slates have been considered to belong to the Virginia slate. This correlation has very little evidence to support it. General stratigraphy of Deerwood suggests a fourfold subdivision somewhat analogous to subdivisions of Biwabik formation.

Named for development at and near Deerwood, Crow Wing County.

Deese Formation[1]

Deese Group

Pennsylvanian (Des Moines Series): Central southern Oklahoma.

Original reference: W. L. Goldston, Jr., 1922, Am. Assoc. Petroleum Geologists Bull., v. 6, no. 1.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2040–2044. The four principal conglomerates in the Arbuckle Mountains region are divisible into two general groups, an older consisting of "Franks" and Deese and a younger consisting of Collings Ranch (new) and Vanoss. All but Vanoss (youngest) are preserved in synclinal grabens and are moderately to strongly folded and faulted. In vicinity of Mill Creek, sec. 7, T. 2 S., R. 5 E., the Deese is about 1,950 feet thick (top eroded) and consists of pebble-cobble limestone conglomerates interstratified with red and gray shales and a few thin limestones. Conglomerate sequence rests disconformably on Atoka formation. In Buckhorn area south of Sulphur, sec. 26, T. 1 S., R. 3 E., the Deese rests disconformably on Springer shale (Lower Pennsylvanian) and underlies Vanoss conglomerate. In Lake Classen area, conglomeratic Deese rocks rest disconformably on Caney shale (Mississippian); they are steeply dipping to locally overturned and structurally conformable with older folded rocks of Arbuckle anticline.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. p. 697, chart 6 (column 37). Shown on correlation chart as Deese group. Occurs below Hoxbar group and above Dornick Hills group. Includes (ascending) Devils Kitchen, Arnold limestone, Rocky Point conglomerate, and Confederate limestone. Base of Hoxbar group is here drawn above Confederate limestone, rather than below it, inasmuch as boundary between Desmoinesian and Missourian deposits preferably should correspond with Deese-Hoxbar contact.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 28–36. Group

constitutes bulk of Desmoinesian section in Ardmore basin. Top of series was placed by Moore and others (1944) at top of Confederate limestone, basal member of overlying Hoxbar group, but base of Confederate is probably to be preferred in light of reclassification by Thompson and others, (1956, Jour. Paleontology, v. 30, no. 4) of abundant fusulinid in that limestone as *Wedekindellina ardmorensis*. Includes named units (ascending) Devils Kitchen sandstone and conglomerate, Arnold limestone, Rocky Point conglomerate and associated beds, Camp Ground member, Warren Ranch conglomerate facies (new), Williams member, and Natsy member. Overlies Pumpkin Creek limestone member of Big Branch formation of Dornick Hills group.

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 213 (fig. 3), 200–221. Term Deese group is used in this report [Cement Pool area] for a succession of rocks comparable in lithologic character and fauna with rocks in Ardmore area. Melton zone formerly assigned to basal Hoxbar is designated to mark top of Deese and is included in West Arm formation (new). Tussy zone, with its Tussy limestone, is well developed at Cement Pool. It is given formational status in this report. Overlies Dornick Hills group.

Type locality: Sec. 33, T. 3. S., R. 1 E., adjoining village of Deese, Carter County.

Degonia Sandstone[1]

Degonia Sandstone (in Elvira Group)

Upper Mississippian (Chester Series): Western Illinois and western Kentucky.

Original references: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 281–290; no. 5, p. 395–416; 1920, Illinois Geol. Survey Bull. 41.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131. 136, 137; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 839. Included in Elvira group (new). Underlies Kinkaid limestone; overlies Clore limestone. Thickness as much as 100 feet; thickest at type locality; thins progressively eastward; in Kentucky, maximum thickness about 18 feet. In southwestern Indiana, probably represented by Mount Pleasant sandstone.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Name Degonia sandstone extended into southern Indiana where it replaces term Mount Pleasant sandstone. Local Indiana names of upper Chester are dropped and formations given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 2. Shown on stratigraphic column of upper Chester in Indiana as hard massive sandstone that weathers blocky. Thickness 10 to 35 feet. Term Elvira not used in Indiana.

Named for Degonia Township, Jackson County, Ill. Forms conspicuous cliffs in bluffs of the Mississippi and sides of the tributary valleys.

DeGraff Coal Member (of Modesto Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 48 (table 1), pl. 1. Name applied to coal member in lower part of

formation. Stratigraphically above Piasa limestone member and below Pond Creek coal member (new). Has been referred to as "1st Cutler Rider coal." Name credited to Cady (unpub. ms.). Piasa limestone and DeGraff, Pond Creek, and Lake coals may be included in the complex West Franklin member in eastern part of area. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE cor. NE¼SW¼ sec. 21, T. 5 S., R. 4 E., Perry County. Name derived from DeGraff School about 1 mile northeast of exposure.

DeGrey Member (of Pierre Shale)

Upper Cretaceous: Central South Dakota.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2341, 2343, 2345–2346. Defined to include Agency-Oacoma zones of previous reports. Consists of clay, shale, and bentonite beds. Underlies Verendrye member (new); overlies Crow Creek member (new); contacts gradational. Thickness at type locality about 82 feet; thickness increases toward Pierre to about 160 feet and decreases toward Chamberlain to about 40 feet.

Type locality: West edge of NW¼ sec. 8, T. 109 N., R. 75 W., Hughes County. Named for DeGrey post office and store. Type section is 2 miles southeast of DeGrey in cut-bank of Missouri River.

DeKalb Granite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing, 1916, New York State Mus. Bull. 191, p. 13, 17, 19, 23.

Occurs in DeKalb, St. Lawrence County.

DeKalb Limestone Member (of Kansas City Formation)[1]

Pennsylvanian: Iowa, eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: H. F. Bain, 1898, Am. Jour. Sci., 4th, v. 5, p. 437–439. Named for DeKalb, Decatur County, Iowa.

Dekkas Andesite[1]

Dekkas Formation (in Bollibokka Group)

Permian: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

H. E. Wheeler, 1939, 6th Pacific Sci. Cong. Proc., p. 369–376. Assigned to late Anthrocolithic (Permian) on basis of regional correlation.

J. P. Albers and J. F. Robertson, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1319. Age designated as Permian on basis of paleontological evidence and data obtained from geologic mapping. Dekkas andesite, composed chiefly of andesitic tuffs, andesitic flows, and mudstone lenses, is at least 3,500 feet thick. Underlies Bully Hill rhyolite; substructural divergence suggests unconformable relationship.

A. H. Coogan, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1821. Formation, at type locality of Nosoni along Nosoni Creek, is restricted to the 3,840 feet of green massive tuff breccia, tuffaceous conglomerate and sandstone, minor basic flows, black cherty shale, and

chert conformably overlying Nosoni formation. Basal contact drawn at top of highest black shale below a thick sequence of massive green tuff breccia. Conformably underlies Pit shale. As originally mapped much of type Dekkas at Dekkas Creek is lateral equivalent of type Nosoni. Fossils show formation to be early Guadalupian age.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Described in Bollibokka area. Included in Bollibokka group (new). Name changed to formation because unit is of varied character. Consists of massive green andesite tuff breccia, green tuffaceous sedimentary rocks, lithic lapilli tuff, gray to purple chloritized basalt and olivine basalt, and scattered beds of red chert, medium-bedded black shale, light-gray cherty shale, red mudstone, and tuffaceous calcareous shale. Formation is herein restricted to the green tuff breccia, tuffaceous sedimentary rocks, and basic flows overlying topmost black shale unit of Member Four of type Nosoni formation. Formation redefined to resolve confusion which resulted from definition of unit on basis of fusulinids. At Dekkas Creek, type locality of Dekkas, Members Three and Four of Nosoni underlie the basalt green tuff breccia of the Dekkas as it is exposed in Nosoni Creek. Diller (1906) mapped all these rocks as Dekkas andesite although more than half are lateral equivalents of type Nosoni. Thickness about 3,840 feet at Nosoni Creek. Underlies Pit shale. No fossils found in Dekkas along Nosoni, Chatterdown, or Dekkas Creeks. Fossils were collected from a tuffaceous limy shale bed on ridge at elevation of 2,700 feet between Horse and Town Mountains in sec. 8, T. 24 N., R. 3 W., Bollibokka Mountain quadrangle. Bed contains *Parafusulina* of type described by Diller as characteristic of Nosoni formation and dates fossiliferous horizon as early Guadalupian. Diller (1906) believed that the Dekkas and Nosoni were separated by an unconformity. He referred the Dekkas to the Triassic because of its conformable relationship with the overlying Pitt and supposed unconformity separating it from overlying Nosoni.

Named for exposures along Dekkas Creek, Redding quadrangle.

DeKoven Coal Member (of Spoon Formation)

Pennsylvanian: Western Kentucky and southwestern and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 33, 46 (table 1), 63, pl. 1. Assigned member status in Spoon formation (new). In southeastern area, occurs below Palzo sandstone member and above Davis coal member; in southwestern area, occurs below Cheltenham clay member and above Davis coal member. Thickness about 3 feet. Coal named by Lee (1916, Kentucky Geol. Survey, ser. 4, v. 4, pt. 2). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Near DeKoven Station, Shawneetown quadrangle, Union County, Ky.

DeKoven cyclothem (in Spoon Formation)

DeKoven cyclothem (in Tradewater Group.)

Pennsylvanian: Northern Kentucky and southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). In list of cyclothems in southern Illinois, the DeKoven occurs at top of Tradewater group and overlies Davis cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 5, 10, pl. 1. Includes DeKoven coal. Stratigraphically below Liverpool cyclothem; overlies Colbert cyclothem (formerly termed Davis). Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 54 (table 3). Included in Spoon formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclothemic classification retained but is independent of rock-stratigraphic classification.

Type locality: Near DeKoven Station, Union County, Ky.

DeKoven Formation[1]

Pennsylvanian (Allegheny): Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 27.

Probably named for DeKoven, Union County.

Delaney Gravel

[Quaternary]: Central Texas.

R. W. Mathis, 1944, Jour. Sed. Petrology, v. 14, no. 2, p. 87–88. Scattered gravel deposit consisting of flint, chert, quartz, and some feldspar pebbles. Lower than Uvalde formation.

A. W. Weeks, 1945, Am. Assoc. Petrolem Geologists Bull., v. 29, no. 12, p. 1705. Mathis described Delaney gravel, located west of Austin and occupying a level between the Uvalde and Asylum deposits. Since abundant limestone material is present in Uvalde and younger deposits, Mathis' omission of limestone pebbles in discussion of the Delaney suggests that either he failed to see them or that the Delaney came down from higher levels as erosion progressed and therefore is not in place.

Tops a hill 245 feet above Colorado River level on Delaney Ranch, along Bee Caves Road, 3 miles east of Austin, Travis County. Also occurs along ridge between Barton Creek and Fredericksburg Road and southeast of mouth of Bull Creek.

Delaneys Creek facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 169–172.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 2. Mississippian facies nomenclature discussed. Correlation chart lists Delaneys Creek facies of Carwood formation.

Name derived from Delaneys Creek which flows north across east-central T. 3 N., R. 4 E., Washington County.

Delano Peak Latite Member (of Bullion Canyon Volcanics)

Miocene(?): Southwest-central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 442, 443, 445. Brownish red with abundant phenocrysts of oligoclase, hornblende, and biotite, and minor quartz and magnetite in glassy base with fluidal structure. Forms lenticular mass in Bullion Canyon volcanics. Thickness over 800 feet in center of lens; no separate flows distinguished, although upper part has appearance of flow-breccia. Early Tertiary.

U.S. Geological Survey currently considers the Delano Peak Latite to be Miocene(?) in age. This designation is made on the basis of a restudy of Bullion Canyon Volcanics, now considered to be Miocene(?).

Named for occurrence in vicinity of Delano Peak, Marysvale region.

Delassus formation

Cambrian (Cambric): Southeastern Missouri.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 75, no. 3, p. 239. Proposed as a substitute for Buckley's Doe Run dolomite.

Name taken from railroad station near Doe Run, St. Francois County.

Delaware Flags[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 73, 76, 77, 80.

†Delaware Limestone[1]

Silurian (Niagaran): Central eastern Iowa.

Original references: S. Calvin, 1885, Iowa Univ. State Lab. Nat. Sci. Bull., v. 3, p. 183–189; 1896, Iowa Geol. Survey, v. 5, p. 49–50.

Named for development in Delaware County.

Delaware Limestone[1]

Middle Devonian: Central and northern Ohio.

Original reference: N. H. Winchell, 1874, Ohio Geol. Survey, v. 2, p. 290–302.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1754, chart 4. At type section, several zones can be recognized, one of the most important, the *Hadrophyllum d'orbignyi* zone, near top. Chart shows the Delaware limestone below Plum Brook shale.

G. A. Stewart, 1955, Ohio Jour. Sci., v. 55, no. 3, p. 147–180. Upper of the two Middle Devonian limestones of central and north-central Ohio. Average thickness about 36 feet in central Ohio; maximum thickness in type area about 45 feet. Overlies Columbus limestone; underlies Olentangy shale. Review of terminology.

Named for exposures at Delaware, Delaware County.

Delaware Creek Member (of Caney Shale)

Mississippian (Meramecian and Chesterian): South-central Oklahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 62–65, 69–71. Gray to dark-gray noncalcareous to slightly calcareous, finely laminated to flaky, partly bituminous shale, locally rotten (shattered), with large amount of finely crystalline gypsum along bedding planes; gray to light-gray to light-buff limestone concretions common, some as much as 12 feet in diameter. Thickness at type locality about 270 feet, dip of beds N. 18° E. 25°. Overlies Ahloso member (new), boundary taken as first or lowest occurrence of softer shale above harder calcareous shale of Ahloso and almost immediate occurrence in it of concretions 3 to 12 feet across; underlies Sand Branch member (new), and boundary is lithologic change from medium-soft-gray shale to dark-gray or nearly black shale of the Sand Branch.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 7, 17–18. Type section redesignated. Thickness 164.8 feet.

Type section: Beds 38 to 97, measured section C, sec. 14, T. 2 S., R. 7 E., Johnston County. Name derived from Delaware Creek which flows eastward in Bromide-Wapanucka area.

Delaware Mountain Group

Delaware Mountain Formation[1]

Permian (Guadalupe Series): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 38.

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 8. Rank raised to group. Subdivisions heretofore referred to as lower, middle, and upper are designated by formational names, Brushy Canyon, Cherry Canyon, and Bell Canyon respectively. New names credited to P. B. King.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 576–592, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 27–28, pl. 3, strat. sections. Group is about 2,700 feet thick and consists largely of sandstone. Separable into (ascending) Brushy Canyon, Cherry Canyon, and Bell Canyon formations. Northwestward away from basin, lower formation overlaps older rocks along Bone Spring flexure and is absent beyond. Lower part of Cherry Canyon formation persists northwestward as thin sandstone tongue, but upper part changes into Goat Seep limestone. Upper formation changes northwestward into Capitan limestone. Overlies Bone Spring formation; underlies Castile formation.

P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112. Bell Canyon formation of group mapped in Carlsbad Caverns West quadrangle, New Mexico.

Named for exposures in Delaware Mountains, El Paso County, Tex.

Delaware River Flags[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 94, 99–101.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Assigned to Catskill facies group.

Type region: Along Delaware River north of Hawks Nest, N.Y.

†Delaware River Gravels and Clays[1]

Pleistocene: Northern Delaware and southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. C_6.

Named for development along west side of Delaware River in northern Delaware.

Del Cuerto Formation (in Keller Group)

Pennsylvanian (Virgil Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 70 (fig. 7), 71–72. Term proposed for rocks of lower part of Keller group (new) between top of Story formation (new) and base of Moya formation (new). At type locality, formation is 81 feet thick and composed of irregularly bedded to nodular limestone, highly arkosic sandstone, limestone conglomerate, and gray

and red shale. In other areas, formation generally is more highly clastic and thicker.

Type locality: Northeast side of Oscura Mountains in NE¼ sec. 31, T. 5 S., R. 6 E., and west-central part of sec 32, Socorro County. Name derived from Del Cuerto Spring on east slope of Oscura Mountains.

De Leon Formation (in Big Saline Group)

Pennsylvanian (Lampasas Series): North-central Texas (subsurface).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 84 (fig. 5), 85. Sequence of limestone and shale. Lies at a depth of 3,870–4,130 feet in type well. Underlies Sipe Springs formation (new); overlies Comyn formation (new).

Type well: Roxana Petroleum Co. Seaman No. 1, northwest Palo Pinto County. Name derived from town in northern Comanche County.

Delevanian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 993–994, 1006. Lowermost of six stages, based on foraminiferal assemblages, in Upper Cretaceous column between top of Moreno and base of Panoche, as defined by Anderson and Pack (1915).

Stage embraces lower part of Yolo and whole thickness of Venado formations of Kirby (1943) and the lowest 14,000 feet of the Moreno surface section. Occurs below Cachenian stage (new).

Occurs in Great Valley in both surface and subsurface. Named after town of Delevan near Funks Creek, sec. 23, T. 17 N., R. 3 W., Colusa County.

Delhi Formation[1]

Mississippian: Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on correlation chart above Cape Horn slate and below Clipper Gap formation.

Typical exposures near Delhi mine, Nevada County.

Delhi Limestone[1] Member (of Columbus Limestone)

Middle Devonian: Central Ohio.

Original reference: N. H. Winchell, 1874, Ohio Geol. Survey, v. 2, p. 296–301.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 121 (fig. 3). Chart shows Delhi (Klondike) as uppermost member of Columbus.

R. C. Moore, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 309 (fig. 2). Shown on columnar section as uppermost member of Columbus formation; overlies Bellepoint member; underlies Delaware formation.

Named for exposures at Delhi, the old name for Radnor, Delaware County.

Delight Sand (in Trinity Group)

Lower Cretaceous (Comanche Series): Southwestern Arkansas.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Proposed for sand lying between the Pike gravel and the Dierks limestone in Sevier, Howard, and Pike Counties. Sand is gray, generally

fine grained and crossbedded, thick bedded, and interbedded with some clay and locally impregnated with asphalt. Attains thickness of at least 200 feet in area between Delight and Pike and thins westward.

Type locality: Asphalt quarry just west of Wolf Creek and about 3¾ miles northwest of Delight, Pike County.

Delleker Formation

Miocene, middle(?): Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Welded rhyolite tuff with gravel at base. About 350 feet thick; thickens to east and is probably equivalent to identical tuffs of early Miocene age, west of Pyramid Lake, Nev. Unconformable below Bonta formation (new); rests unconformably on Clover formation (new) and all older rocks; unconformities marked by faulting.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 170–172. Consists mostly of biotite sanidine rhyolite tuff, but contains some gravel, mostly near base. Thickness 350 feet. Overlies Ingalls formation (new); in some areas, rests on both Ingalls and Lovejoy formations; underlies Bonta formation. Probably lower or middle Miocene; chart shows middle Miocene(?).

Named for recently abandoned sawmill community of Delleker which is partly on Blairsden and partly on Portola quadrangles; name appears only on the latter, edition of 1950. Most representative section is in Blairsden quadrangle in sec. 32, T. 23 N., R. 13 E., 2½ miles west of Delleker on east side of Willow Creek.

Dellet Sand Member (of Moodys Branch Marl)

Eocene (Jackson): Southwestern Alabama.

H. B. Stenzel, 1952, Mississippi Geol. Soc. [Guidebook] 9th Field Trip, p. 41, 58 (fig. 1), 59. Friable and slightly tough, light-greenish-gray when wet and fresh, for most part weathered to light grayish rust-brown, massive, argillaceous, glauconitic, fossiliferous, fine-grained sand at base of the Jackson. Thickness 2.2 feet. Disconformably overlies Gosport formation.

Name derived from Dellet mansion, a well-known landmark in old town of Claiborne, Monroe County.

Dellvale Ash Bed (in Ash Hollow Member of Ogallala Formation)

Pliocene: Northwestern Kansas.

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 254. Name applied to volcanic ash bed. Thickness at type locality 9½ feet; occurs within silts and sandy silts which overlie a thick fossiliferous sand and gravel bed. Lies stratigraphically above Fort Wallace ash bed (new) and below Reager ash bed.

Named from exposures in NW¼NW¼ sec. 2, T. 4 S., R. 24 W., southeast of Dellvale, Norton County.

Dellville Sandstone,[1] Shale, or Beds

Upper Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F–2, p. 77–78, 394.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 33. Del[l]ville beds are a marine unit intercalated with Catskill continental facies in Perry County.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 17 (table 5). Dellville shale and Kings Mill sandstone included in Damascus red beds of Catskill facies group.

Exposed at Dellville, Perry County.

Delmar Sand[1]

Delmar Sand Member (of La Jolla Formation)

Eocene or Eocene, middle: Southern California.

Original reference: M. A. Hanna, 1926, California Univ. Pub., Geol. Sci. Bull., v. 16, no. 7, p. 187–246.

L. G. Hertlein and U. S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 65. Lowest member of La Jolla. Underlies Torrey sand member. Maximum thickness about 100 feet, base not exposed.

M. A. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Listed on chart as member of La Jolla. Middle Eocene.

G. B. Oakeshott, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 254 (table). Table lists Delmar sand (formation); underlies Torrey sand.

Named for exposures in sea cliff at town of Delmar, San Diego County.

Delmontian Stage[1]

Miocene, upper: California.

Original reference: R. M. Kleinpell, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 3, p. 376–378.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 131–135, figs. 4, 14 (correlation chart). Superjacent to Mohnian stage. Subjacent to "Lower Pliocene" stage. Contains *Bolivina obliqua* zone in lower part. Systematic catalogue.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. Subjacent to Pliocene Repettian stage (new).

Type locality: At head of Canyon Segundo, south of Del Monte, Monterey County.

Delmore Formation

Pliocene, middle: Central Kansas.

C. C. Williams and S. W. Lohman, 1949, Kansas Geol. Survey Bull. 79, p. 56–59, pl. 1. Proposed for Pliocene sediments underlying area north and northwest of Canton and Galva, Delmore Township, McPherson County; beds were originally assigned to Emma Creek formation, type beds of which were considered to be Pliocene; on the basis of present study, beds at type locality of Emma Creek are assigned to Pleistocene and Emma Creek abandoned; the Delmore does not extend into type area selected for Emma Creek. Formation consists of calcareous gray to buff silt and clay, fine- to coarse-grained sand, and some gravel; locally the calcium carbonate has been concentrated and forms irregularly shaped nodules and thin layers within the silt. Maximum thickness about 75 feet as shown by test drilling. Underlies McPherson formation.

Type area: Secs. 24, 25, and 26, T. 18 S., R. 2 W., and along ravines in sec. 31, T. 18 S., R. 1 W., McPherson County.

DeLong Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Name applied to thin unit formerly designated as Upper DeLong coal. Stratigraphically above Brush coal member (new), formerly designated as Middle DeLong coal, and below Seahorne limestone member. Presentation of new rock-stratigraphic classification of Pensylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Brush Creek in secs. 6 and 8, T. 9 N., R. 2 E., Knox County. Named for village of DeLong about 1½ miles northeast of type outcrop.

DeLong cyclothem (in Spoon Formation)

DeLong cyclothems (in Tradewater Group)

Pennsylvanian: Northern, western, and southwestern Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 188, 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63, 73–76, 191, 192, 198, 199, 200, 201, 202, 203, 204, 205. Occupies interval between Seville cyclothem below and Seahorne cyclothem above. Sequence includes three rudimentary cyclothems referred to as Lower, Middle, and Upper Delong cyclothems. Consists principally of underclay, with soft shale and from one to four coaly streaks or thin coals; locally one or two thin sandstones are present but no limestone. Type exposure and derivation of name.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 52 (table 2), pl. 1. Name applied to cyclothem formerly called Upper DeLong. Above Brush cyclothem (new) and below Seahorne cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type exposure: Along Brush Creek in secs. 5 and 8, T. 9 N., R. 2 E., Galesburg quadrangle, Knox County. Named for town of DeLong which is about 2½ miles northeast of type exposure.

†Delphi Black Shale[1]

Upper Devonian: Northern central Indiana.

Original reference: R. T. Brown, 1883, Indiana Dept. Geology and Nat. History 12th Ann. Rept., p. 84.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1754, chart 4. Assigned to the Naples and Chemung because of presence of three species of *Manticoceras*.

Named for Delphi, Carroll County.

†Delphi Dolomite[1]

Permian: Southwestern Oklahoma and northern Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d. Bienn. Rept., p. 42, 56.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Gould spelled his member name Delphi although he named it for village of Delhi, Beckham County. Name Delphi is preoccupied. If corrected to correspond with name of town, Delhi is also preoccupied. The unit is the Mangum dolomite.

Named for Delhi, Beckham County, Okla.

†Delphi Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 219.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Name abandoned. Replaced by Delphi Station member.

Type section: Knights Falls, 1 mile east of Delphi.

Delphi Station Member (of Skaneateles Formation)

Middle Devonian: Central New York.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Proposed to replace Delphi shale of Cooper, 1930 (not Brown, 1883, or Gould, 1902).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows Delphi Station shale and sandstone below Pompey shale and sandstone and above Mottville sandstone and limestone. Middle Devonian.

[G. A. Cooper], 1955, *in* New York State Geol. Assoc. [Guidebook] 27th Ann. Mtg., p. 10, 11. Basal member of formation. Dark shale grading upward into sandy mudstone and calcareous sandstone. Thickness 80 feet.

Type section: Knights Falls. Name is derived from Delphi Station, Cazenovia quadrangle, which is about 1½ miles northwest of Knights Falls.

†Del Rio Clay (in Washita Group)[1]

Upper Cretaceous (Comanche Series): Southern Texas.

Original references: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey Geol. Atlas, Folio 42, p. 2; 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 236–237.

W. S. Adkins, 1933 [1932], Texas Univ. Bull. 3232, p. 387. Considered synonym of Grayson formation.

L. W. Stephenson, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 10, p. 1538–1541. Discussion of fossils from limestone of Buda age in Denton County. If it is admitted that this limestone is a facies of Buda age in upper part of Grayson marl, then the Grayson is not exact equivalent of Del Rio but includes equivalents of both Del Rio and Buda.

A. P. Noyes, Jr., and Keith Young, 1960, Texas Jour. Sci., v. 12, nos. 1–2, p. 74 (fig. 5), 89–90. Described in Purgatory Creek area where it is as much as 30 feet thick, overlies Georgetown limestone and underlies Buda limestone. Upper Cretaceous.

Type locality: Low conical butte, Loma de la Cruz, and surrounding clay lowlands, 2 miles south of Del Rio, Valverde County.

Delta Glaciation

Pleistocene: East-central Alaska.

T. L. Péwé, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1289; T. L. Péwé *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 9, 13 (table 1). At least three major Quaternary glaciations recorded at north end of Delta River valley. Delta succeeded Darling Creek glaciation (new); preceded Donnelly glaciation (new). Trunk glacier in Delta Valley coalesced with smaller northward-flowing glaciers to form piedmont lobe spreading about 30 miles beyond front of Alaska Range. Moraines dissected and considerably subdued.

Named from Delta River, along the valley of which the glacier coursed; Big Delta area.

Del Valle Formation

Upper Cretaceous: Northern California.

C. A. Hall, Jr., 1956, Dissert. Abs., v. 16, no. 12, p. 2426. Incidental mention as overlying Niles Canyon formation (new).

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 11–14, fig. 2, geol map. Proposed by Funkhouser (1948, unpub. thesis) for Upper Cretaceous rocks in Arroyo del Valle-Rocky Ridge area of northeastern part of La Costa Valley quadrangle, Alameda County. Name Del Valle formation is applied in this report to rocks along Sunol Ridge in northern part of Niles quadrangle and along western edge of Dublin quadrangle. Rocks along Sunol Ridge cannot be traced into type locality of formation, but they are similar to type section in lithology and age. Thickness along Sunol Ridge, where beds are commonly overturned, may be 3,500 feet; formation thins to the south along ridge. Characteristic lithology is a brown massive soft to hard occasionally concretionary sandstone interbedded with thinly bedded brown siltstone or shale; conglomerate along Sunol Ridge resembles conglomerate of type locality but occurs at top instead of middle of formation. At type locality, brown to reddish-brown hard concretions occur within the sandstone, and crossbedding and flow structures are common; individual sandstone beds at some localities are massive, whereas elsewhere they are 1 to 10 feet thick, interbedded with 1-inch to 4-foot layers of gray, greenish-gray, or brown shale; lenticular conglomerate near middle of formation is approximately 700 feet thick, thinning to the east. Conglomerate along west side of Sunol Ridge is approximately 600 feet thick; thickness is divided into 50- and 100-foot beds of alternating conglomerate and sandstone; this conglomerate unit was traced into Hayward quadrangle where it occurs below Upper Cretaceous rocks. Conformably overlies Niles Canyon formation; underlies Tolman formation. At type area, where maximum thickness is approximately 9,000 feet, formation is faulted against Franciscan group and Cierbo sandstone and is overlapped by Cierbo sandstone and Livermore gravels. Huey (1948) mapped rocks between Rocky Ridge and Arroyo del Valle as Panoche formation. Funkhouser renamed rocks Del Valle because type locality of Panoche is in Panoche Hills of Fresno County, nearly 100 miles from Arroyo del Valle; also Panoche is not a well-defined unit at its type locality.

Type locality: Arroyo del Valle-Rocky Ridge area of northeastern La Costa Valley quadrangle, Alameda County, where it covers approximately 4 square miles; extends into Tesla quadrangle.

Delwood Coal Member (of Abbott Formation)

Pennsylvanian: Southern Ilinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), 62, pl. 1. Assigned to member status in Abbott formation (new). Occurs below Murray Bluff sandstone member and above Finnie sandstone member. Thickness 3 feet in type section of formation. Term Finnie sandstone is applied to unit formerly termed Delwood sandstone in order to retain name Delwood for the coal. Name Delwood coal credited to J. M. Weller (1940, Illinois Geol. Survey Rept. Inv. 71). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NW¼NW¼ sec. 3, T. 11 S., R. 6 E., Pope County.

Delwood cyclothem (in Abbott Formation)

Delwood cyclothem (in Tradewater Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Underlies Macedonia cyclothem and overlies Grindstaff cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 9. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 54 (table 3). In Abbott formation (new).

Type locality: Sec. 5, T. 11 S., R. 6 E., Pope County. Name derived from a crossroads village in northern part of county.

Delwood Formation or Sandstone (in Tradewater Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 16 (table), 39, 40, 41. Formation contains only one important sandstone and one coal and is considered to represent a single cycle of deposition. Basal sandstone is about 50 feet thick, generally massive and crossbedded and conspicuously micaceous; above the coal, formation consists of a succession of sandy shales and shaly to thin-bedded sandstones with a probable maximum thickness of 50 feet. Underlies Macedonia formation; overlies Grindstaff formation.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 9. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31. Replaced by Finnie sandstone.

Type locality: Sec. 5, T. 11 S., R. 6 E., Pope County. Name derived from a crossroads village in northern part of county.

Dement Member (of Grand Detour Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone, dolomitic, medium bedded, and nonshaly. Thickness about 7 feet. Shown on columnar

section as underlying Walgreen member (new) of Grand Detour formation and overlying Briton member (new) of Mifflin formation.

Occurs in Dixon-Oregon area.

Demingian Series or Stage

Ordovician (Canadian): North America.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 18. Divisions within Canadian system favor natural division into four major units: Gasconadian, Demingian, Jeffersonian, and Cassinian. Demingian (Middle Canadian) beds in east are restricted and confined largely to *Lecanospira fauna*. In the west, a definite succession is known comprising the first endoceroid zone, first piloceroid zone, the oolite and succeeding gastropod beds of El Paso section in New Mexico, and F and lower G of Garden City sections.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–32. Canadian series includes Gasconadian, Demingian, Jeffersonian, and Cassinian stages.

Interval well developed in Cooks Range, Florida Mountains, N. Mex. Name derived from city of Deming, N. Mex.

†Demopolis (broad sense)[1]

Upper Cretaceous: Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, geographic map of Alabama.

Probably named for exposures at Demopolis, Marengo County.

Demopolis Chalk or **Formation** (in Selma Group)

Demopolis Chalk Member (of Selma Chalk)

†Demopolis division (narrow sense)[1]

Upper Cretaceous: Western Alabama and eastern Mississippi.

Original reference: E. A. Smith, 1903, 58th Cong., 1st sess., S. Ex. Doc. 19, p. 12–20, map.

W. H. Monroe, 1941, Alabama Geol. Survey Bull. 48, p. 64–73. Smith (1903) divided Selma chalk into three divisions: upper, or Portland; middle, or Demopolis; and lower, or Selma. Later workers did not follow Smith in his threefold division of Selma, but recent works show that subdivision of Selma is not only practicable but desirable. In present paper, Smith's Selma division is represented almost exactly by the unnamed lower marly member of Selma chalk, but because name Selma chalk has long been established for formation as a whole, its additional use to designate member of same formation would be confusing. Smith's Demopolis division is represented by Arcola limestone member and lower part of Demopolis member. Smith's Portland division is represented in western Alabama by upper part of Demopolis member, Ripley formation, and Prairie Bluff chalk, and in central Alabama by upper part of Demopolis member and lower part of Ripley formation. Specifically, in this report, Demopolis member of Selma chalk includes all chalky and marly beds between diastem above Arcola limestone member below and Ripley formation above. Estimated thickness about 490 feet (estimates from wells). In Montgomery County, member is split into two eastward-extending tongues by westward-extending tongue of Cusseta sand. Type locality stated.

H. R. Bergquist, 1943, Mississippi Geol. Survey Bull. 53, p. 15 (table), 26–31. Demopolis chalk member geographically extended into Mississippi. Thickness is about 410 feet in Clay County. Overlies Arcola member; underlies Ripley formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Rank raised to formation in Selma group.

W. H. Monroe and D. H. Eargle, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 50. In southwestern part of Eutaw quadrangle, Alabama, overlies Arcola limestone member of Mooreville chalk.

W. H. Monroe, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2740–2742. Subdivided to include Bluffport marl member (new).

R. H. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 46–59, pls. 1, 5, 6, 10. Demopolis chalk described in Kemper County where it includes Bluffport marl member at top. Thickness about 260 feet. Underlies Ripley formation; oldest deposit exposed in county. In east-central Mississippi, the Demopolis lies between Ripley formation above and Mooreville chalk below; in northern part of state, overlain by Owl Creek tongue of Ripley and underlain by Tupelo tongue of Coffee sand.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 26 (fig. 4), 52–61, pl. 4. In this report [Prentiss County], Demopolis formation refers to those chalk beds between Coffee sand below and transitional clay of Ripley formation above. Thickness 230 to 235 feet.

Type locality: Bluff of chalk on Tombigbee River at Webb and Sons cotton warehouse in Demopolis, Marengo County, Ala.

Dempsey Marble[1] (in Talladega Series)

Pennsylvanian: Northeastern Alabama.

Original reference: G. I. Adams, 1933, Jour. Geology, v. 41, no. 2, p. 163.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 20. Present in upper part of Talladega series. Pennsylvanian.

Present in Clay County.

DeNay Limestone Member (of Francis Formation)[1]

DeNay Limestone Member (of Coffeyville Formation)

Pennsylvanian (Missouri Series): Central southern Oklahoma.

Original references: G. D. Morgan, 1922, Oklahoma Geol. Survey Circ. 12, p. 9, 10; 1924, [Oklahoma] Bur. Geology Bull. 2, p. 110–115.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as basal member of formation.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 62, 63, 64. Reallocated to member status in Coffeyville formation. Interval designated by Morgan (1924) as Francis formation is herein described under headings Coffeyville and Nellie Bly.

Named for typical development on side of an eastward-facing bluff in sec. 5, T. 4 N., R. 7 E., about one-fourth mile west of DeNay School, in Stonewall quadrangle, Pontotoc County.

†Denison Formation (in Washita Group)[1]

Lower Cretaceous (Comanche Series): Northeastern Texas and southern Oklahoma.

Original reference: R. T. Hill, 1889, Am. Jour. Sci., 3d, v. 37, p. 290.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 29–41, pl. 1. Formation described in Fort Worth-Weatherford area, Texas, where it comprises (ascending) Denton marl, Weno marly limestone, Pawpaw shale, Main Street limestone, and Grayson marl members. Thickness about 245 feet. Overlies Fort Worth limestone; underlies Buda limestone. Washita group.

U.S. Geological Survey has abandoned the term Denison Formation and raised the members to formational status.

Named for exposures at Denison, Grayson County, Tex.

Denmar Formation

Middle Mississippian (Meramecian): Southwestern West Virginia.

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 902–918. Proposed for sequence of gray slightly cherty calcarenite and calcilutite beds that are younger than top of Hillsdale in its type section and older than the Taggard in its type section; this stratigraphic and lithologic unit includes beds defined by Reger (1926) as Sinks Grove and Patton limestones. Thickness at type section 214 feet. Conformably overlies Hillsdale limestone from southern Mercer County to northern end of Pocahontas County; across remaining distance of latter county and for approximately 5½ miles into Randolph County, near Monterville, unconformably overlies thinning Maccrady; 1½ miles south of Monterville, the Maccrady disappears and the Denmar rests on the Pocono; throughout area investigated the Denmar underlies Reger's (1926) Taggard formation [shale]. Middle Mississippian (Meramecian series).

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1910–1912. The Patton and Sinks Grove do not represent a single stratigraphic and lithologic unit; in Monroe County, where they were named, they are separated by 10 to 20 feet of plant bearing shale [Patton shale]; use of term Denmar for these two formations is without merit.

Type locality: On eastern slope of Droop Mountain along County Road 20 in Locust Creek valley, 0.7 mile south of junction with U.S. Highway 219, Little Levels district, Pocahontas County. Named for village of Denmar about 2½ miles southeast on Greenbrier River.

Denmark Formation

Denmark Member (of Sherman Fall Formation)

Middle Ordovician (Mohawkian): Central and northern New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 267–268, pl. 4. Named as a member and defined as alternating shaly and coarse-textured limestones constituting larger part of the formation. Calcareous fucoidal claystones present in higher part. Thickness about 170 feet. Base tends to be more resistant than more shaly Shoreham member (new) below, but contact is indistinct; contact with overlying Cobourg formation poorly defined lithologically.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599, 605. Rank raised to formation. Subdivided to include three new members in West Canada Creek area, in ascending order: Rathbun limestone, Poland limestone, and Russia limestone. Contains several metabentonites. Grades into Canajoharie black shale southeastward. Underlies Rust

limestone member (new) of Cobourg formation; disconformably overlies Shoreham limestone.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 527–530. Stratigraphically restricted by reallocation of basal Rathbun member to underlying Shoreham formation. In northwestern New York, lower part is subdivided to include Camp member below and Glendale member above. In Black River valley, consists primarily of coarse-textured fossiliferous calcarenites, few intercalated finer grained calcisiltites, and calcilutites of the Glendale member. Poland and Russia members not recognizable in sections north of Trenton Falls.

Named for Denmark Township, Lewis County. Well displayed in Trenton Falls Gorge.

Denmarkian (Denmark) Stage or Substage

Middle Ordovician: Eastern North America.

Referred to as Denmark time. G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 603.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1414–1415. Middle Trentonian includes rocks equivalent to Shoreham and Denmark limestones of New York, or undivided Sherman Fall limestone. Denmarkian commonly has abundance of *Sinuites cancellatus* (Hall), but upper limit has been established only in New York and Ontario, where succeeded by late Trentonian Cobourg limestone; in central Pennsylvania, the Salona is overlain by Coburn limestone, the contact approximating top of Denmarkian. The Denmarkian has limestones west of Adirondack line, which have been shown to change through a succession of facies into Canajoharie black shale as they thicken and approach Adirondack line in New York.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30. Suggested that term Shermanian stage be applied to Shorehamian and Denmarkian substages.

Name derived from Denmark Township, Lewis County, N.Y., for which Denmark formation was named.

Dennis Limestone[1] (in Kansas City Group)

Dennis Limestone (in Bronson Group)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 36.

M. C. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 723–724. Abandoned in Oklahoma in favor of Hogshooter limestone.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 191–192. Included in Bronson group. Comprises (ascending) Canville limestone, Stark shale, and Winterset limestone members. Overlies Galesburg shale; underlies Fontana shale.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Formation included in Bronson subgroup of Kansas City group. Comprises Canville limestone, Stark shale, and Winterset limestone members. Overlies Galesburg formation; underlies Cherryvale formation.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11–12. Formation redefined for Missouri to include Canville, Stark, and Winterset members.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 421. Thickness of formation in Madison County, Iowa, about 23 feet. Includes Canville, Stark, and Winterset members. Overlies Galesburg shale; underlies Cherryvale formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Comprises (ascending) Canville limestone, Stark shale, and Winterset limestone members. Canville usually missing in Iowa sections. Underlies Cherryvale shale; overlies Galesburg shale. Kansas City group.

Named for exposures at railroad station at Dennis, Labette County, Kans.

Dennis Bridge Limestone Bed (in Hill Creek Member of Lazy Bend Formation)

Dennis Bridge Limestone Member (of Lazy Bend Formation)

Dennis Bridge Limestone (in Millsap Lake Formation)[1]

Dennis Bridge Limestone (in Rayville Formation)

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to member of Lazy Bend formation. Occurs between Brannon Bridge limestone member (above) and Kickapoo Falls member (below).

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 210. Reallocated to Rayville formation (new).

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 14, fig. 3. Rank reduced to bed in Hill Creek member of Lazy Bend formation. Occurs at base of member. At type locality, overlain by 3 feet of shale; along strike, bed is covered by alluvium and Cretaceous rocks. Type locality established.

Type locality: Outcrops at end of bridge over Brazos River at Dennis in southwestern part of Parker County. Exposure extends westward along the Brazos for one-fourth mile to valley of tributary; basal 3 feet is exposed in small outcrop in stream bank one-half mile east of south end of bridge at Dennis; these are the only surface occurrences of the limestone.

Denny Formation

Pre-Tertiary: Central Washington.

R. J. Foster, 1957, Dissert. Abs., v. 17, no. 9, p. 1982; 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 111, pl. 1. At type locality, consists of medium- to coarse-crystalline marbles interbedded with fine-grained hornfels. Thickness not estimated; deformation and metamorphism that accompanied emplacement of Snoqualmie granodiorite has obscured structure. Rocks were included in Guye formation by Smith and Calkins (1906). Field relationships show Denny to be pre-Snoqualmie granodiorite and probably in fault contact with other rocks. Probably pre-Tertiary.

Type locality: Snoqualmie Mountain saddle, central Cascades Mountains. Confined to two small areas on Denny and Snoqualmie Mountains with total extent of less than 2 square miles.

Dennys Formation[1]

Silurian: Southeastern Maine.

Original references: E. S. Bastin and H. S. Williams, 1913, Maine Water Storage Comm. 3d Ann. Rept., p. 168; 1913, Geol. Soc. America Bull., v. 24, p. 378, 379.

C. K. Swartz and others, 1942. Geol. Soc. America Bull., v. 53, no. 4, chart 3. Assigned to Niagaran series [Middle Silurian].

Named for exposures near Dennysville, Washington County.

Densinyama Formation

Densinyama Beds

Eocene, upper: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island. Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 53–56]. Beds comprise four units (ascending): conglomerate containing felsite and limestone blocks with intercalated clays; conglomerate consisting largely of felsite pebbles with minor amounts of medium-sized limestone, liparite, andesite, and quartz pebbles; fine-grained conglomerate of felsite pebbles, sandstone, and tuff with two thin beds of yellow and pink clay (fuller's earth); well-stratified arenaceous limestone or calcareous sandstone. Thickness varies, about 60 to 100 meters at Densinyama; thins southward. Commonly in contact with Hagman andesite, with no intermediate Mantansya beds. Oligocene.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 8–9. Referred to as formation. Miocene (Aquitanian).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 51–56, pl. 2, chart 2. Formation, as herein described, comprises three facies (ascending): breccia, conglomerate-sandstone, and limestone-conglomerate. The conglomerate sandstone is subdivided into quartz-rich and quartz-poor facies. Thickness varies; aggregate at type section 730 feet; may exceed 800 feet in places; thins to disappearance. Upper Eocene. Type section designated. Difficult to distinguish some parts of Densinyama from Machegit conglomerate member (new) of Tagpochau limestone and from parts of Hagman formation.

Type section: Succession exposed along Talofofo Road that runs west and east from crest of Talofofo Ridge in north-central Saipan. Tayama gave as type locality ridge called Densinyama (radio hill) by Japanese, correct geographic name of which is Ogso Talofofo, or Talofofo Ridge.

Denton Clay (in Washita Group)

Denton Clay Member (of Denison Formation)[1]

Denton Formation (in Washita Group)

Denton Marl Member (of Denison Formation)

Denton Shale Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Central and northeastern Texas and central southern Oklahoma.

Original reference: J. A. Taff, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 272.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Chart shows Denton clay in Washita group. Occurs below Weno limestone and above Fort Worth limestone. [Term Denison abandoned.] Lower Cretaceous.

D. L. Frizzell, 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 27, table 4. Foraminifera of Denton formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Trip, p. 88, 91. In central Texas, referred to as shale member of Georgetown limestone. Overlies Fort Worth limestone member; underlies Weno limestone. Thickness 3 to 5 feet. Predominantly marly shales containing two thin coquinoid limestone beds which are separated by about 1 foot of shelly marl.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 30–32, 33 (fig. 13). In this report [Fort Worth-Weatherford area], Denton marl is used in sense intended by Taff; that is, member of Denison formation. In Tarrant County, consists of about 35 feet of gray marly limestone, gray marl, and weakly consolidated shell beds near top of member. Underlies Weno marly limestone member; overlies Fort Worth limestone.

Named for Denton Creek, Denton County, Tex.

Denver Formation[1]

Upper Cretaceous and Paleocene: Eastern Colorado.

Original reference: W. Cross, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 119–133.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1310 (fig. 2). Underlies Castle Rock conglomerate; overlies Arapahoe formation; southward merges into Dawson arkose.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 71, 78 (table 2), 84. Denver formation has yielded invertebrates found only in Laramie formation in Denver basin. Proposed that Laramie be redefined to include Arapahoe formation as a member, basal part of Denver formation, and basal part of Dawson arkose. Paleocene.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7), 57–61, 62, pl. 1. Described in South Park area where it consists of gravel, conglomerate, sandstone, and sandy shale with interbedded agglomerate and tuff. Thickness as much as 8,000 feet, but it is possible that the formation or a part of it may have been repeated by step faulting, now hidden, or small-scale faulting. Unconformably overlies Laramie formation; underlies Balfour formation, but relation to Balfour nowhere exposed; hence, Balfour, as here defined, may prove to be topmost part of Denver; in southern part of the area, overlies Fox Hills formation, and along eastern side of Trout Creek valley, overlies Pierre shale; locally overlies Precambrian and Permian deposits. Eocene.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 2, 40, 41, 42. Upper Cretaceous and Paleocene.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 107–112, pl. 1. Proposed that Arapahoe-Denver contact be placed at widespread erosional disconformity at base of lowest, thickest, and most prominent basalt-andesite pebble conglomerate bed in Denver area instead of at first appearance of andesitic debris as proposed by Emmons, Cross, and Eldridge (1896, U.S. Geol. Survey Mon. 27); also proposed that Denver formation be extended throughout Denver basin to include all dark clastic sediments derived from erosion of basic lavas as indicated by their mineral content. Denver formation (and Arapahoe herein also extended) would replace the "lower" Dawson of Dane and Pierce. Paleocene.

Named for exposures about city of Denver.

Denver Basin Group

See Basin Ridge Group.

Denzer Diorite[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 137.

Occurs in secs. 9 and 10, T. 10 N., R. 5 E., north and northwest of Denzer, Baraboo district.

Denzer Tuff[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 132.

Exposed in a ledge nearly 200 feet long and 5 to 10 feet wide on north bank of a small stream in SE¼ sec. 11, T. 10 N., R. 5 E., about 1½ miles northeast of Denzer, Honey Creek Township, Baraboo district.

Depass Formation[1]

Middle Cambrian: Western Wyoming.

Original reference: B. M. Miller, 1935, Geol. Soc. America Proc. 1934, p. 352.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1096–1101, 1102–1104. Redefined to include all beds in type locality between Cambrian-Precambrian contact and base of Upper Cambrian Boysen formation (new). Middle-Upper Cambrian boundary cannot be drawn upon evidence of fossils. Top of Depass is arbitrarily placed at top of two thick beds of intraformational conglomerate, which lie upon a 14-inch shale zone containing new genera of Middle Cambrian trilobites, and 12 feet below lowest horizon containing *Arapahoia?* sp. and *Dicellomus?* sp. On basis of lithology, divided into basal Flathead sandstone member and upper Gros Ventre member. Thickness emended section 580 feet.

Type section: Wind River Canyon at eastern end of Owl Creek Range. Name is taken from "D" Pass (now spelled Depass) near eastern end of Bridger Range.

†Depauville (Depeauville) Waterlime[1]

Lower Ordovician: Central New York.

Original reference: E. Emmons, 1840, New York Geol. Survey, 4th Rept., p. 324.

The village name is spelled Depauville, Jefferson County.

Deputy Formation (in Hamilton Group)

Middle Devonian: Southeastern Indiana.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1060–1061. Blue to gray limestone weathering light gray; in fresh material difficult to distinguish from the Speeds formation except by fossils; has been included with the Speeds as a part of the Jeffersonville or Sellersburg. Underlies Silver Creek formation; overlies Speeds formation; at type section occurs between Speeds and Swanville formations.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 9, p. 42, pl. 1. Deputy and Swanville "formations" appear to be only faunal facies of units previously recognized and names, or combinations of such units; they might better be called "zones" or "faunal facies" of Sellersburg (North Vernon) limestone.

Type section: On secondary road one-half mile east of its intersection with Highway 3, three-quarters mile south of Deputy, Jefferson County.

De Queen Limestone (in Trinity Group)

De Queen Limestone Member (of Trinity Formation)[1]

Lower Cretaceous (Comanche Series): Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690, p. 19, 22.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Rank raised to formation in Trinity group. Table shows unit as cropping out in Arkansas below the Paluxy sand and above the Holly Creek formation. Subsurface equivalents discussed.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16 (table 5), 22–26, pl. 1. Crops out in McCurtain County just south of Holly Creek formation in narrow band ranging in width from several feet to more than half a mile. Outcrop extends from sec. 1, T. 6 S., R. 23 E., eastward to Arkansas State line. Thickness 38 feet in eastern part of outcrop; less than 1 foot in western extremity. Downdip attains maximum thickness of 190 feet at southeastern edge of county. Conformable to overlying Paluxy sand and to underlying Holly Creek formation. Unconformable to underlying Paleozoic rocks where Holly Creek is absent. Trinity group; Comanche series. Early Cretaceous.

Named for occurrence at De Queen, Sevier County, Ark.

Derby Dolomite (in Elvins Group)[1]

Derby Dolomite Member (of Elvins Formation)

Upper Cambrian: Eastern Missouri.

Original references: E. R. Buckley, 1907, Missouri Bur. Geology and Mines, v. 10, 2d ser., separate; H. A. Buehler, 1907, Missouri Bur. Geology and Mines, v. 6, 2d ser., p. 231.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Middle formation in Elvins group. Overlies Davis formation; underlies Doe Run dolomite. Upper Cambrian.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 27–30. Missouri Geological Survey uses compound term, Derby-Doe Run. Because Doe

Run was used as formation named by Frazer (1883) [for unit in Pennsylvania], it seems good usage to discontinue it as compound term. Term Derby formation is used in this report. Dominantly dolomite noncherty, gray to buff. Exposures of entire formation nowhere identified. Thicknesses of 75 feet near Potosi and 110 feet near St. Joe Lead Company mine are maximums that have been identified. Overlies Davis formation; underlies Potosi formation. Term Elvins group not recognized as valid in this report.

V. E. Kurtz, 1960, Dissert. Abs., v. 21, no. 3, p. 595. Referred to as member of Elvins formation. Overlies Davis member; underlies Doerun member. Derby and Doerun members become indistinguishable a short distance from their type localities.

Named for Derby mine (now Federal mine) near Elvins, St. Francois County.

Derry Series

Pennsylvanian: Central and southern New Mexico and western Texas.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 26–31. Term proposed for all rocks in the central to the extreme south-central areas of New Mexico between base of Pennsylvanian system and the basal part of Des Moines series. Composed largely of marine limestones, shales, conglomerates, and coarse sandstones; locally contains, especially in lower part, dark shales, sandstones, and thin coal beds. About 130 feet thick at type locality; thickens southward to slightly more than 600 feet in the Hueco Mountains of western Texas where it is composed almost entirely of marine limestones. Subdivided into two groups, Green Canyon below and Mud Springs (both new). At type locality, unconformably overlies Devonian Percha shale; elsewhere unconformably overlies rocks of Mississippian, Devonian, Cambrian(?), or Precambrian age. Overlain by Des Moines sediments referred to Armendaris group (new).

Type locality: West slope of hill about three-fourths mile east of center of Derry, near center of sec. 32, T. 17 S., R. 4 W. Named for village of Derry in Sierra County, N. Mex.

Descanso Granodiorite[1]

Late Mesozoic: Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 115–141, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 486, 487, table 4. Discussed under Late Mesozoic plutonics. Shown on table as older than La Posta quartz diorite and younger than Harbison quartz diorite.

Type occurrence in general vicinity of Descanso, southern Peninsular Range, San Diego and Imperial Counties.

†Deschutes Formation[1]

Pliocene, lower to middle: Central northern Oregon.

Original reference: I. C. Russell, 1905, U.S. Geol. Survey Bull. 252, p. 90–91.

R. W. Chaney, 1938, Carnegie Inst. Washington Pub. 476, p. 187–216. Flora and fauna indicate a lower to middle Pliocene age.

U.S. Geological Survey has abandoned the term Deschutes Formation.

Well exposed in wall of Deschutes River for at least 25 miles up stream from Crooked River.

Desecheo Stage[1]

Recent: Puerto Rico and Desecheo Island.

Original reference: B. Hubbard, 1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 97.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 324–325. Hubbard introduced term for post-Pleistocene beach sands and gravels in northern Puerto Rico and Desecheo Island. He recognized an Upper and Lower Desecheo stage in terms of elevation above sea level.

Deseret Limestone[1]

Lower and Upper Mississippian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 15 (fig. 4), 18–19. Described in East Tintic Mountains where it replaces Pine Canyon limestone of Loughlin (1919). Consists of three members: basal phosphatic shale, lower limestone member, and an upper limestone member. Total thickness 900 to 1,200 feet. Overlies Madison limestone; underlies Humbug formation.

A. E. Disbrow, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–131. Mapped in Fivemile Pass quadrangle where it is predominantly medium-gray cherty limestone interbedded with buff to brown sandy or shaly limestone and dolomite; beds of black carbonaceous phosphatic shale at base. Thickness about 700 feet. Overlies Madison limestone equivalents; underlies Humbug formation.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 49–52, pl. 1. Gilluly (1932) assigned 650 feet of limestone to Deseret limestone. In this report [southern Oquirrh Mountains], the upper 350 feet of Gilluly's section are referred to the Deseret, and lower strata are included in Pine Canyon formation, largely the upper member. Restricted Deseret is mapped in Ophir Canyon and on crest of Ophir anticline where it crosses Mercur Canyon. Conformably underlies Humbug formation.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 63, 65–66, 69 (fig. 3), 70–71. Conformably overlies Gardison limestone (new) in Cottonwood, Provo, and Oquirrh Mountains areas.

Named for exposures at Deseret mine, Dry Canyon, Stockton quadrangle.

Desert Member (of Blackhawk Formation)

Upper Cretaceous (Montana): Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 186, figs. 2, 3, pl. 3. Comprises a sandstone tongue and the overlying coal-bearing rocks which separate it from the Castlegate member of the Price River formation above. Basal unit of member is medium-grained buff sandstone with maximum thickness of about 70 feet; massive near top but grades downward into thinner beds and finally into Mancos shale which in turn disconformably overlies Grassy member (new) of Blackhawk formation; disappears eastward into Mancos shale at Saleratus Canyon.

About 50 feet of coal-bearing rocks is present at Desert, and it thins rapidly to southeast and is absent at Green River, where basal sandstone of the Castlegate rests directly on basal sandstone of Desert member.

Named for exposures in nearly vertical cliffs of Mount Elliot east of Desert, a siding of the D. & R. G. W. Railroad, Emery County.

Desert Cone Basalt Flow

Pliocene to Pleistocene, lower: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 32. Name applied to basalt flow on Desert Cone. [See Timber Crater Basalt Flow.]

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 27. Here considered to be pre-Mazama.

Desert Cone is in northwestern part of Crater Lake National Park.

Desert Peak Formation

Pliocene, lower: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci. v. 33, p. 97–99, 139–141, figs. 5, 6, 8. Consists of two unnamed members: Lower member described as thick yellow-brown to tan shales, yellow-green basalt tuffs, thin basalt flows, and dense olive-gray basalt; thickness 850 feet; upper member described as white, creamy thin siliceous shales, chiefly opalized diatomite, some horizons breaking into conchoidal chips; higher parts grade northeastward to diatomite locally; basalt tuffs locally interbedded in section; thickness from 1,600 to 2,200 feet. Higher parts of formation grade upward into Truckee formation. Conformably overlies Chloropagus formation (new).

Type region at northern end of Hot Springs Range surrounding Desert Peak. Occurs also on far side of Carson Sink Basin in hills southwest of Fallon, as well as in Stillwater Range southeast of Stillwater.

De Smet Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Min. Journal-Press, v. 115, p. 793, 799, 836–843, maps.

J. A. Noble and J. O. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 945. Does not maintain constant position; may be absent or occur at one or several positions. Name De Smet dropped as separate formation; unit included in Poorman formation.

Named for exposures around north end of main opencut southwest of De Smet shaft, Lead district, Lawrence County.

†De Smet Formation[1]

Upper Cretaceous to Eocene, lower(?): Northern Wyoming.

Original reference: N. H. Darton, 1906, U.S. Geol. Survey Prof. Paper 51, p. 13, 62–67.

R. L. Nace, 1936, Wyoming Geol. Survey Bull. 26, p. 26. Originally defined as formation. Has since been shown to be terrane and subdivided into more natural divisions.

Typically exposed at Lake De Smet, Fort McKinney quadrangle.

Des Moines Series

Des Moines Group[1]

Middle Pennsylvanian: Iowa, Arkansas, Kansas, Missouri, Nebraska, and Oklahoma.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 86–114.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 19 (table 1). Group, in Muskogee-Porum district, comprises (ascending) Atoka formation, Hartshorne sandstone, McAlester shale, Savannah formation, and Boggy formation. Overlies Morrow group.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 657–706, chart 6. In upward order, Midcontinent time-rock divisions of the Pennsylvanian are designated as Morrowan, Lampasan, Desmoinesian, Missourian, and Virgilian.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2). Chart shows classification and correlation of type Pennsylvanian section of eastern and western Pennsylvania with costandard sections of Appalachian and Midcontinent regions. Midcontinent region section comprises (ascending) Springer, Morrow, Lampasas, Des Moines, Missouri, and Virgil series. Des Moines series is equivalent to Allegheny series in Appalachian region and Allegheny River valley, western Pennsylvania. Costandard section shown as east-central Oklahoma and reference section as south Ardmore basin, Oklahoma.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v .30, no. 2, p. 185. Atoka formation is elevated to Atoka series and defined to include all beds from top of Wapanucka limestone, Morrow series, to base of Hartshorne sandstone, Des Moines series. Term Atoka series replaces term Lampasas series.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66, p. 50. In present classification of Pennsylvanian rocks of Oklahoma, all strata between top of Morrow series and base of Missouri series are referred to Des Moines series. This classification places Atoka formation in Des Moines series.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2020, 2021 (fig. 1). In some parts of northern Midcontinent states, Desmoinesian deposits are separable from underlying pre-Desmoinesian Pennsylvanian rocks, but in large areas, especially in subsurface of northern Oklahoma and Kansas along Nemaha Ridge and bordering central Kansas uplift, Desmoinesian beds rest on pre-Pennsylvanian formations with angular unconformity. Upper boundary of series is defined by disconformity which is inconspicuous in most places but, on basis of paleontological changes, is judged to be division line of first-rank intra-systemic magnitude. Series designated paleontologically as zone of *Fusulina*. Comprises Cherokee and Marmaton groups. Spans interval between Atokan series and Missourian series. Oklahoma uses Des Moines series as extending downward to top of Morrowan beds.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 286. Oklan series (new) comprises rocks assigned to Atokan and Desmoinesian stages.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1526. Lower and middle part of Des Moines series in Oklahoma includes Krebs and Cabaniss groups (both new). These groups to-

gether are nearly but not quite the same, stratigraphically, as Cherokee rocks of southeastern Kansas.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2747–2749. In classification adopted in northern Midcontinent, Desmoinesian stage is subdivided into Venteran substage below and Cygnian substage above. Desmoinesian comprises Krebs, Cabaniss, and Marmaton groups. Middle Pennsylvanian. Iowa does not fully concur in this classification.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 20–21, 22 (fig. 5). Term Cherokee revived for basal group of Des Moines. Terms Krebs and Cabaniss reduced to rank of subgroups within the Cherokee.

W. H. Bradley, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2284–2285. In Midcontinent region (including Arkansas, Iowa, Kansas, Nebraska, and Oklahoma), U.S. Geological Survey uses following series subdivision of the Pennsylvanian: Morrow, Atoka, Des Moines, Missouri, and Virgil. The Des Moines is Middle Pennsylvanian.

Named for exposures on Des Moines River, Iowa.

Desmoinesian Series or Stage

See **Des Moines Series.**

†De Soto Beds[1]

Pliocene, lower: Southern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 126, 133, 141, 157, 158, 324.

Dessau Formation

Upper Cretaceous: South-central Texas.

C. L. Durham, Jr., 1955, Corpus Christi Geol. Soc. [Guidebook] Ann. Field Trip, Mar. 11–12, [p. 57], pl. 16. Consists of a basal glauconitic calcarenite which grades upward into a white calcilutite sequence. Approximately 70 to 90 feet thick in Travis County. Includes Pilot Knob tuff (new). Underlies Burditt marl (chalk); overlies disconformity at top of undifferentiated Austin. Name credited to Durham and Roux (unpub. ms.).

Type locality: On branch of Big Walnut Creek 7.6 miles north-northeast of State Capitol, Austin, Travis County.

Detonti Sand (in Wilcox Group)

Eocene: Central Arkansas.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 4), 55–58, plates. Homogeneous sand unit containing some interbedded gray clay lenses and a prominent lignite bed at base. Best known from drill holes; as interpreted from logs thickness ranges from 207 to 412 feet. Unconformably overlies Saline formation (new); covered at many localities by deposits of gravel of late Tertiary age.

Type section: On east bank of first prominent gully west of Detonti on Detonti-Tull Road near center of NW¼NW¼NW¼ sec. 4, T. 3 S., R. 14 W., Saline County. Named for settlement of Detonti. Crops out in irregular northwestward-trending belt up to 3 miles wide and is probably continuous across bauxite region. Cut off at northeast by overlap of sediments higher in section and by Quaternary alluvial sediments of Arkansas River flood plain.

Detroit Glacial Stage

Detroit Till

Pleistocene: Northwestern Oregon.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 20, 23–24. Stage defined as time during which Detroit till was deposited. All exposures of till are small.

Till crops out in North Santiam River just above bridge and on Quartzville Trail, in a roadcut one-half mile southwest of Berry, where highway crosses Breitenbush River southwest of Detroit, Marion County.

Detroit River Group

Detroit River Dolomite[1]

Middle Devonian: Southeastern Michigan and northern Ohio, and western Ontario, Canada.

Original reference: A. C. Lane and others, 1909, Geol. Soc. America Bull., v. 19, p. 555.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1754–1755, chart 4. Group, as now understood, includes Sylvania sandstone at base. Maximum thickness 1,000 feet in wells in central part of Southern Peninsula of Michigan; outcrop thickness commonly less than 200 feet. Wherever base of Sylvania is exposed, its contact with underlying rock is disconformable, and disconformity widens on leaving Michigan basin. In western Lake Erie region, the Sylvania lies on Bass Island[s] (Upper Silurian) beds, but unconformity includes at least part of Lower Devonian as indicated by Lower Devonian ostracoderms in pre-Sylvania stream deposit. If this disconformity is followed to farthest limits of Michigan basin province, the base of the "Sylvania" basal sand will rise in the column. This far-out "Sylvania" sand is probably to be found in Pendleton of Indiana, Hillsboro sandstone of southern Ohio, and Springvale sandstone in region around Cayuga, Ont. In first two cases, unconformity is so wide that it rests upon Niagaran limestones. Beds covering Detroit River vary in age from place to place, indicating disconformity at top, but not as great as one at base. Overlying rock at Sibley, Mich., northwestern Ohio, and Amherstburg, Ont., are of Dundee age; in Bruce and Huron Counties, Ont., overlying rock is lower Onondaga; on Mill Creek, Cheboygan County, Mich., group is said to contain a Schoharie fauna and is overlain by *Amphigenia*-bearing Mackinac breccia.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 127–128. Group, in Ohio, comprises Amherstburg and Lucas formations. Underlies Columbus formation; overlies Oriskany.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 35 (table 1), 109–120. Discussion of geology of Mackinac Straits region. Detroit River strata are regarded as a group but not differentiated into formations. In southeastern Michigan, southwestern Ohio, and northwestern Ohio, Detroit River dolomites and Sylvania sandstone are underlain by Middle Devonian Dundee limestone. In Mackinac Straits area, the group is underlain by Bois Blanc formation (new). In Rogers City area and apparently elsewhere in northern part of South-

ern Peninsula, the group is overlain by Dundee limestone. Most of the rocks of the group in northern part of Southern Peninsula are covered with Pleistocene gravel several hundreds of feet thick. Thickness of group difficult to determine. Well records indicate thickness of about 700 feet in northern part of Southern Peninsula.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1456. Succession of Detroit River formations above Sylvania sandstone as given by Lane and others (1909) has been doubtful matter in mind of several geologists for many years. No evidence has been obtained to prove that Lane and his associates were incorrect in believing that the Sylvania is succeeded respectively by Flat Rock dolomite, Anderdon limestone, Amherstburg dolomite, and Lucas dolomite. Present studies indicate that oldest unit of the group, the Sylvania sandstone, is succeeded respectively by Amherstburg dolomite, Lucas dolomite, and Anderdon limestone. Flat Rock dolomite cannot be distinguished in outcrop or in well borings as distinct formation. Strata of this dolomite are part of Amherstburg dolomite. Term Flat Rock should be dropped from stratigraphic nomenclature. Middle Devonian.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 1–23. Correlation of outcropping rocks in type locality of Detroit River group with thick sequence of rocks in subsurface Michigan Basin. Surface nomenclature as revised by Ehlers (1950) is suggested for subsurface section in place of heterogeneous collection of names now used. Sylvania sandstone is placed in Detroit River group and reduced to member status in Amherstburg formation. Group comprises Amherstburg formation below and Lucas formation above. In subsurface, the group is overlain by Dundee formation except in southwestern Michigan where Dundee is absent. Overlies Bois Blanc formation except in western and southern Michigan where it overlies rocks of Silurian age. Anderdon limestone not identified in subsurface.

Named from exposures along Detroit River, Mich.

Devils Flow

Devils Hill Obsidian Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 56, 60 (fig. 44). Discussion of Mount Multnomah ancient ancestor of the Three Sisters. Name Devils flow applied to flow that extends eastward from Devils Hill and covers about one-fourth square mile.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 58. Referred to as Devils Hill obsidian flow in report on volcanoes of Three Sisters region. May be among youngest rocks of region.

Devils Hill is south of South Sister Mountain and between Le Conte and Cayuse Craters.

Devils Canyon Member (of Modin Formation)

Upper Triassic: Northern California.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert, v. 27, p. 436. Middle member of formation. Underlies Kosk member (new); overlies Hawkins Creek member (new).

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 10–11, pl. 1. Formal proposal of name. Composed principally of massive dark-gray tuffaceous limestone, calcareous tuff, fine- to medium-grained cal-

careous sandstone, and nearly pure limestone lenses. Thickness 430 to about 1,000 feet. Overlies Hawkins Creek member; underlies Kosk member.

Type section: Devils Canyon, Big Bend quadrangle, Shasta County. Upper contact about one-half mile west of confluence of Devils Canyon and Alder Creek; lower contact three-quarters mile west.

Devils Den Limestone (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. Böse, 1918, Texas Univ. Bull. 1758, p. 17. Covers west side of Jim Ned Mountains, Wise County. Probably named for occurrence in Devils Den.

Devils Den Sandstone[1]

Upper Devonian or Mississippian: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 332, 333 (footnote), 335, 336, 339.

Type locality not stated.

Devils Gate Limestone

Middle and Upper Devonian: Eastern Nevada.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 16–17. Name applied to upper 2,065 feet of Devonian strata exposed at Devils Gate and Modoc Ridge east of Yahoo Canyon. Overlies Nevada formation (restricted and redefined); underlies unit referred to as Diamond Peak series (includes Diamond Peak quartzite and White Pine shale).

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 48–52. Described in vicinity of Eureka where it consists largely of thick-bedded gray to blue-gray limestone that is cliff forming in most places. Thickness ranges from about 675 feet east of Phillipsburg mine in Diamond Mountains to 2,065 feet in combined sections at Devils Gate and Modoc Peak. On Newark Mountains and in southern end of Diamond Mountains, two members distinguished: Meister limestone below and Hayes Canyon limestone above. Overlies Nevada formation (Bay State member, new); underlies Pilot shale. In original description, formation was defined almost wholly on basis of faunas, lower boundary placed at top of zone containing *Stringocephalus*, and upper one marked by disappearance of *Crytospirifer* ("*Spirifer disjunctus*") fauna. Results of present study indicate there is adequate lithologic basis for establishing limestone as separate stratigraphic unit consistent with paleontologic definition. Middle and Late Devonian, time boundary apparently lies in upper half of Hayes Canyon limestone member.

Donald Carlisle and others, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2181 (fig. 3), 2184. In Sulphur Springs and Pinyon Ranges, overlies Telegraph Canyon member (new) of Nevada formation.

Type section: At Devils Gate, 8 miles northwest of Eureka, Eureka County.

Devils Glen Dolomite[1]

Upper Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 40.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 30, 46–47, 54 (fig. 6). Top of Middle Cambrian in area. Conformably overlies and

is transitional into Switchback shale; underlies White Ridge limestone. Thickness at type locality 565 feet.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1131 (table 1), 1133–1134. In Sawtooth Range, consists of white-gray to pale-buff-gray, finely crystalline thick- and some thin-bedded dolomite; mottled salmon pink and coarser grained in upper part. Thickness 200 to 250 feet. Overlies Switchback shale. Unconformable below unnamed Devonian formations. Upper Cambrian.

Type locality: Northern spur of Monitor Mountain, south of North Fork of Dearborn River, in SW¼ sec. 6, NW¼ sec. 7, T. 17 N., R. 7 W., Lewis and Clark Range. Named from narrow and partly boulder filled section of North Fork of Dearborn River known as Devils Glen.

Devils Grave Sandstone (in Mancos Shale)

Upper Cretaceous: Northwestern Colorado.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Field Conf., Symposium, p. 41, 43, figs. 3, 4. Sequence of alternating yellowish-brown fine-grained sandstone and dark-brown sandy shale. Zone is 50 feet thick and lies 1,350 feet below top of Mancos shale.

Forms Devil's Grave, a conspicuous escarpment and mesa 3½ miles northwest of Yampa.

Devils Gulch Beds[1]

Miocene and Pliocene: Northwestern Nebraska.

Original reference: E. H. Barbour and H. J. Cook, 1917, Nebraska Geol. Survey, v. 7, pt. 19, p. 173.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 18, 35. Although this term has been less used, it precedes Valentine and was adequately defined, stratigraphically, from the first, in terms of what was then known; if redefined, it is available to replace Valentine formation, if the latter be considered preoccupied or unduly ambiguous.

Present in Brown County.

Devils Hill Pumice

Pleistocene to Recent: Southwestern Oregon.

B. N. Moore, 1934, Jour. Geology, v. 42, no. 4, p. 360 (fig. 1). Devil Hill pumice shown on map showing distribution of pumice sheets of Crater Lake region.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 70 (fig. 16). Devils Hill pumice shown on map showing distribution and thickness of Crater Lake pumice.

Devils Hill is north of Crater Lake.

Devils Hole Dolomite

Middle Silurian (Lockportian): Western New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Eastwardly thinning wedge of dolomite carrying Guelph fauna. Underlies Oakfield limestone (new); overlies Eramosa dolomite. Replaces preoccupied Lower Shelby of Clarke (1903).

Type section: Devils Hole State Park, in Niagara Gorge.

Devils Hole Formation

Miocene(?): Southeastern Colorado.

E. H. Baltz, Jr., 1955, U.S. Atomic Energy Comm. Trace Elements Mem. Rept. TEM–929, p. 31. Incidental mention.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 719, fig. 2. Sequence of water-laid volcanic rocks; mainly of beds of light-gray conglomeratic tuff. Matrix is tuffaceous. Coarse material is poorly sorted mixture of pebbles and cobbles of pumice, perlite, gneiss, and schist. Beds generally lenticular and cross stratified. May be thin to massive bedded. Thickness ranges from 25 to 1,300 feet. Intertongues westward with red conglomeratic sandstone. Unconformably overlaps Farisita conglomerate (new) and older rocks of Cenozoic, Mesozoic, and Paleozoic age.

Named from exposures in Devil's Hole in north-central part of Huerfano Park. No type section described because of scarcity of and discontinuity of outcrops.

Devils Hollow Member (of Cynthiana Formation)

Devils Hollow division of (Lexington Limestone)

Devils Hollow facies (of Cynthiana Formation)

Middle Ordovician: North-central Kentucky.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1640. Name proposed for the post-Woodburn "Perryville" of the upper Lexington limestone in the Frankfort-Versailles area. Term Perryville formerly applied to these beds is now considered a synonym of Benson. The 25 feet at type section includes 15 feet of the "Faulconer" rock and 10 feet of the "Salvisa." Regarded as a facies of the upper Woodburn and probably also lowermost Cynthiana.

F. H. Hall and W. N. Palmquist, Jr., 1960, U.S. Geol. Survey Hydrol. Inv. Atlas HA–23. Referred to as Devils Hollow facies of Cynthiana formation.

U.S. Geological Survey currently classifies the Devils Hollow as a member of Cynthiana Formation on basis of a study now in progress.

Type locality: Devils Hollow Road, a few miles west of Frankfort, Franklin County.

Devils Island Sandstone (in Bayfield Group)[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 38.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 147. Thwaites' Chequamegon is considered to be Port Wing brownstone member of Orienta repeated by faulting. Contact of Chequamegon formation with supposedly underlying Devils Island formation is reported by Thwaites only from type locality, Devils Island. Beds here that Thwaites considered to be basal Chequamegon are believed to be part of the Devils Island.

Named for exposures on Devils Island, Ashland County.

Devils Kitchen Member (of Deese Formation[1] or Group)

Pennsylvanian (Desmoinesian) : Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40–Z, p. 14–15.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum Geology of southern Oklahoma—a symposium, v. 2: Tulsa, Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 31. Devils Kitchen member of Deese group, is about 500 feet thick. At base is medium-grained buff sandstone about 100 feet thick, locally split into two members separated by shale. Above this is shale interval from 100 to 200 feet thick, containing toward top 10 feet or more of fossiliferous impure limestone and calcareous shale. Above this is 200-foot sandstone which, near Ardmore, contains chert grains, and southeastward from Ardmore develops into a coarse conglomerate of angular to subangular chert pebbles. Overlies unnamed sandstone and shale below Arnold limestone. Desmoinesian.

Named for glen in sec. 10, T. 6 S., R. 2 E., Carter County.

Devils Lake Sandstone[1]

Upper Cambrian: Central southern Wisconsin.

Original reference: E. O. Ulrich, 1920, Washington Acad. Sci. Jour., v. 10, p. 74, 75.

F. T. Thwaites, 1943, Michigan Acad. Sci., Arts, and Letters, Papers, v. 28, p. 487. Reaffirms abandonment of name by Wanenmacher, Twenhofel, and Raasch (1934).

First described in vicinity of Devils Lake, Sauk County.

Devils Pocket Formation (in Big Snowy Group)

Pennnsylvanian: Central Montana.

H. D. Hadley and P. J. Lewis, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 143. Dolomite and limestone, partly sandy to siliceous, commonly red stained. Thickness ranges from 0 to 150 feet. Overlies Alaska Bench formation. Name credited to L. S. Gardner.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 332 (fig. 2), 334 (fig. 3), 336 (fig. 4), 347–348. Included in Big Snowy group. Conformably succeeds Alaska Bench limestone; overlain with probable unconformity by rocks of unknown late Paleozoic or post-Paleozoic age. Formation was removed by pre-Ellis erosion nearly everywhere in central Montana, and has been recognized in outcrop only by vicinity of Stonehouse Ranch, sec. 32, T. 11 N., R. 21 E., where entire formation, 143 feet thick, is exposed, and at Durfee Creek dome where lower 71 feet remain. Type section designated.

Type section: In Road Canyon, sec. 31, T. 11 N., R. 21 E., about one-half mile west of Stonehouse Ranch. Name derived from Devils Pocket, an anticlinal valley on a long anticlinal nose breached by erosion in southeastern Big Snowy Mountains (T. 10 N., R. 21 E.), where formation is 141 feet thick.

Devils River Limestone[1]

Lower Cretaceous (Comanche Series): Southwestern Texas.

Original reference: J. A. Udden, 1907, Augustana Lib. Pub. 6, p. 56.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol Survey Prof. Paper 312, p. 8–9, pl. 1. Oldest rock exposed in Terlingua district. Consists of

sequence of medium- to thick-bedded fine-grained limestone, light to dark gray on fresh surface and gray on weathered surface. Thickness more than 1,500 feet in cliffs of Mesa de Anguila, base not exposed. Conformably underlies Grayson formation. In rim of the Solitario where base is exposed, conformably overlies impure limestone containing Glen Rose fossils.

Named for exposures along entire length of Devil's River, Valverde County, from Camp Hudson down to the Rio Grande.

Devils Slide Syenite

Mississippian(?): Northern New Hampshire.

H. W. Jaffe, H. T. Evans, Jr., and R. W. Chapman, 1956, Am. Mineralogist, v. 41, no. 5–6, p. 474, 475–476, 485. Described as typically coarse-grained syenite. Includes a medium-grained subporphyritic greenish-gray to bluish-gray fayalite-quartz syenite. One of the major components of the Devil's Slide ring dike. Belongs to the White Mountain plutonic volcanic series.

Occurs northwest of the village of Stark, Percy quadrangle.

Devilwater Silt Member (of Monterey Formation)

Miocene, middle: Central California (subsurface and surface).

W. C. Bailey, 1939, California Oil Fields, v. 24, no. 3, p. 67. Devilwater silt shown on composite columnar section of Wasco oil field. Overlies Gould shale; underlies McDonald shale.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1611 (fig. 2), 1616. Monterey shale in southern part of Temblor can be subdivided into three lithologic and faunal units, lowest of which is Devilwater-Gould member. At type area of Temblor formation, in vicinity of Chico Martinez Creek, the Devilwater silt, Gould shale, and "Buttonbed" sandstone lens are distinct faunal and lithologic units characterized, respectively, by the *Valvulineria californica*, *Valvulineria robusta*, and *"Scutella" merriami* faunal zones. In Recruit Pass area [this report], an interval of 1,850 feet of well-bedded siliceous light-brown shale, with minor amount of interbedded tan silt and lentils of massive buff limestone, comprise a single lithologic unit from which have been collected faunules common to both Gould shale and Devilwater silt as they are defined on Chico-Martinez Creek. This unit is referred to as Devilwater-Gould member of Monterey. Underlies McDonald shale; overlies Temblor-Vaqueros.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, Road log, topog. profile, chart, map. Devilwater silt member underlies McDonald shale member and overlies Gould shale member in Chico Martinez Creek area. Thickness about 1,180 feet.

Shown on stratigraphic column of Wasco oil field, Kern County, at depths of 11,300 to 11,500 feet.

Dewdney Formation[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Survey Mines Mem. 38, map 7.

Named for Dewdney Trail, British Columbia.

Dewdney Creek Formation or Group

Dewdney Creek Series[1]

Jurassic and Cretaceous: Southern British Columbia, Canada, and northeastern Washington.

Original reference: C. E. Cairnes, 1923, Canada Geol. Survey Summ. Rept. 1922, pt. A, p. 97, 111.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map 1–175, p. 5 (table 2). Termed a formation; geographically extended into northeastern Washington.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull. 71, no. 10, p. 1534, chart 10e (column 58). Formation was listed by McKee and others (1956) as partly of Jurassic age. In Princeton area of British Columbia (Rice, 1947, Canada Geol. Survey Mem. 243), the upper 7,200 feet of Dewdney Creek group contains fossils definitely of Early Cretaceous age.

First described in British Columbia.

Dewey Limestone[1] (in Skiatook Group)

Dewey Limestone Member (of Drum Limestone)

Pennsylvanian (Missouri Series): Northeastern, central, and central northern Oklahoma and eastern Kansas.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 30, 37.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 51–56; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 720 (table 1), 725. Included in Skiatook group. Underlies Chanute formation; overlies Nellie Bly formation.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030. Northward tracing proves that Dewey member of Drum is the same as limestone called Cement City in Kansas City area. Dewey has priority over Cement City and is recognized as a formational unit in Oklahoma. Kansas Geological Survey proposes to use Dewey in place of Cement City for lower member of the Drum. Other State surveys will continue Cement City until question of stratigraphic identity of the type of this unit (near Kansas City) and the Dewey is removed.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 68–72. Described in Okfuskee County where it consists of a lower limestone or arenaceous limestone member and an overlying shale. Base is about 40 feet above uppermost Nellie Bly sandstone. Type locality stated.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 25–28. In a study of gas and oil fields of Indian Territory, the Drum limestone was traversed by G. I. Adams from outcrop west of Coffeyville to Bartlesville. It occurs on divide between the Verdigris and Caney, extending southward to Hogshooter Creek, thence northwestward to Bartlesville (Adams, Girty, and White, 1903, U.S. Geol. Survey Bull. 211). It is evident from text and map that Adams was following Hogshooter limestone from Kansas-Oklahoma line to SE cor. T. 26 N., R. 13 E., where he stepped up to the Dewey and followed it to Bartlesville. Sandstone and limestone conglomerate were erroneously shown on geologic map of Oklahoma (1926) as Dewey limestone from sec. 13, T. 28 N., R. 14 E., northeastward to Kansas-Oklahoma line across an area in which the Dewey was removed by pre-Chanute erosion. Thickness 20 to 50 feet

in Creek County. Overlies Nellie Bly formation; underlies Chanute limestone. Skiatook group.

Type locality: In old quarry of Dewey Portland Cement Co., sec. 26, T. 27 N., R. 13 E., near Dewey, Washington County, Okla.

Dewey Bridge Dolomite

Upper Cambrian: East-central New York.

John Rodgers *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., 1952, Geol. Soc. America Guidebook for Field Trips in New England, p. 35 (table 2), 53 (road log). Dark-gray crystalline and sandy dolomite; cryptozoon layers in upper part and thin sandstone at top. Thickness 200 feet. Underlies Whitehall formation; overlies Potsdam sandstone. Refers to R. H. Flower (unpub. ms.).

Occurs in Fort Ann quadrangle.

Dewey Lake Redbeds

Dewey Lake Formation

Permian: Subsurface and surface in western Texas and southeastern New Mexico.

L. R. Page, 1938, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1709. Incidental mention as Dewey Lake redbeds.

L. R. Page and J. E. Adams, 1940, Am. Asoc. Petroleum Geologists Bull., v. 24, no. 1, p. 62–63. Formation consists of orange-red sandstones and silts. Overlies Rustler formation; underlies Tecovas silts. Occurs between depths of 1,155 feet and 1,407 feet in type well. No complete section found in outcrops hence named from subsurface. Triassic-Permian boundary occurs at top of formation.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 91–92, 101 (fig. 12). Referred to as Dewey Lake red beds. Ochoa series.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 23. In Eddy County, redbeds and sandstones correlated with Dewey Lake redbeds overlie Rustler formation.

Type section: In Penn's Habenstreit No. 1 well, near center sec. 47, Block 36, T. 3 S., Texas and Pacific Railroad Survey, Glasscock County, Tex. Name derived from Dewey Lake.

Dewitt Formation[1]

Miocene and Pliocene: Eastern Texas.

Original reference: A. Deussen, 1914, U.S. Geol. Survey Water-Supply Paper 335, p. 28, 74–76.

Named for Dewitt County.

Dexter Member (of Woodbine Formation)

Dexter Member (of Euless Formation)

Dexter Sand Member (of Woodbine Sand)[1]

Upper Cretaceous: Northeastern Texas.

Original reference: J. A. Taff, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 285–298.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 475, 476, 477. Dexter sand is basal member of newly defined Euless formation.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Termed Dexter member of Woodbine formation. In Cooke, Grayson, and Fannin Counties, stratigraphically restricted above to exclude 60 to 70 feet of sandstone and shale herein named Red Branch member. As restricted and redefined, Dexter member consists of 100 to 130 or 140 feet of nonmarine beds of white to ferruginous and siliceous sandstone with silty clay lenses, some carbonaceous clays at base, some scattered leaf and wood prints, and at top a persistent bed of varicolored clay. Overlies Grayson marl.

Named for exposures at Dexter, Cooke County.

Dexterville Shale Member[1] (of Chadakoin Formation)

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 63–66, table opp. p. 61.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 14. Gray sandstones and siltstones that underlie Ellicott member of Chadakoin and overlie Northeast shale member of Canadaway formation. Thickness in Cherry Creek quadrangle about 150 feet. Volusia shale, described by Chadwick (1923), bearing *Pugnoides duplicatus* is here included in the Dexterville. Lillibridge sandstone (Caster, 1934)member of Chadakoin is not a distinct lithologic unit and is abandoned.

Named for brick quarries, south of Chadakoin River in East Jamestown, a district formerly known as Dexterville, Chautaqua County, N.Y.

Deza Formation

Tertiary: Northwestern New Mexico and northeastern Arizona.

H. E. Wright, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1830, 1831–1833, figs. 1, 2. Consists largely of sands with some layers of shale and clay and marked by a basal conglomerate. Color mostly white to buff and light green with a few beds of chocolate red clay. Appears to be largely an alluvial deposit. Thickness 250 feet in type area. Overlies Mesaverde group with angular unconformity and underlies Chuska sandstone.

Named for exposures 3 miles north of Tohatchi on south-facing scarp (Deza Bluffs) which lead up to the landslide-covered east foot-slope of Chuska Mountains, N. Mex.

Diablo Formation

Permian: Southwestern Nevada.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of the Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]; 1954, U.S. Geol. Survey Geol. Quad. Map. 45. Dolomite with varying amounts of basal conglomerate and locally fanglomerate. Along western border, largely dolomite, but conglomerate and grit form isolated hill southeast of Redlich; in Monte Cristo Range, basal conglomerate overlain by interbedded dolomite, grit, and conglomerate. To west, in Mina quadrangle, dolomite grades into sandstone and grit. Thickness in Monte Cristo Range probably about 500 feet. Elsewhere not over 300 feet; missing in places: unconformable contacts with Palmetto formation below and Candelaria formation above.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. Described and mapped in Round Mountain quadrangle where it is more than 3,000 feet thick in Toyabe Range. Underlies Pablo formation (new).

B. M. Page, 1959, Nevada Bur. Mines Bull. 56, p. 18–21, pl. 1. In Candelaria mining district, Mineral County, a thin grit bed, the Diablo formation, unconformably overlies Palmetto formation, angular unconformity ranging from 5° to 90°. Underlies Candelaria formation. Thickness as much as 30 feet.

Type locality: For sandstone, crest and west slope of Mount Diablo, 1 mile west of Candelaria, Mina quadrangle; for dolomite facies, 1 mile north of Columbus, Mina quadrangle.

Diablo Formation

Pliocene, lower: Northern California.

B. L. Clark, 1944, *in* C. E. Weaver and others, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. Consists of coarse arkosic sandstones; a heavy conglomerate at base composed mostly of andesitic boulders with lenses of conglomerate higher up; also thin layers of shale carrying abundant leaf impressions. Thickness about 1,000 feet. Shown on chart as underlying Green Valley formation and overlying Neroly formation. Replaces name Alamo formation.

D. I. Axelrod, 1944, Carnegie Inst. Washington Pub. 553, p. 213. Derivation of name given.

Name derived from Diablo post office, Mount Diablo region.

†Diabolo Sandstone[1]

Precambrian: Western Texas.

Original reference: W. H. Von Streeruwitz, 1891, Texas Geol. Survey, v. 2, p. 682, 683.

Occurs along foot of southern cliffs of Sierra Diabolo, Sierra Diablo region.

Diamond Formation[1]

Pleistocene, upper, or Recent: Southeastern Oregon.

Original reference. W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed at Diamond Craters, Harney County.

Diamond Creek Sandstone

Permian: Northeastern Utah.

A. A. Baker and J. S. Williams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 623 (fig. 4), 625. Gray or buff to red, fine- to coarse-grained cross-bedded sandstone, in large part lime-cemented and friable but locally silica-cemented. Thickness 600 to 1,000 feet. Conformably underlies Park City formation; conformably overlies Kirkman limestone (new).

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 589. Described in Strawberry Valley quadrangle. Traced as almost continuous outcrop from southern Wasatch Mountains northward where it passes beneath Tertiary sediments in Strawberry Ridge; reappears in North Strawberry Valley as thin outcrop band and extends almost due northeast of and overlying Kirkman limestone from Willow Creek

Canyon to point near mouth of Right Fork of Strawberry River. From known maximum thickness of 1,140 feet in Spanish Fork Canyon near Castilla, thins northward to 165 feet in North Strawberry Valley.

Named for outcrops in sec. 22, T. 8 S., R. 4 E., near head of Little Diamond Creek, Utah County.

Diamond Head Black Ash

Recent: Oahu Island, Hawaii.

C. K. Wentworth, 1937, Jour. Sed. Petrology, v. 7, no. 3, p. 91–103. Black sandy vitric ash, pisolitic. Typical mantle bedding; very small proportion of bedding of clear, wind-produced or dune characteristics.

H. T. Stearns, 1940, Hawaii Div. Hydrog. Bull. 5, p. 53. Five distinct eruptions occurred along Kaimuki-Diamond Head rift, namely Mauumae basalt, Diamond Head ash, Kaimuki basalt, Black Point basalt, and Black Point ash. Eruption must have taken place in Recent time while sea was practically at its present level.

Type locality: On slopes and near base of Diamond Head. Crops out only in small area at southeast foot of Diamond Head tuff cone and on Black Point.

Diamond Head Talus Breccia[1]

Recent: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 40, 43.

G. A. Macdonald and D. A. Davis, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6 Océanie, fasc. 2, p. 80. Talus breccia composed of angular fragments of Diamond Head tuff cemented by calcareous cement into a porous fairly compact mass. Thickness commonly 5 to 25 feet, exceptionally up to 50 feet. Rests against and on Diamond Head tuff. No fossils. Some of it is older than Diamond Head black ash, but some of it is still forming.

Named for occurrence on slopes of Diamond Head.

Diamond Head Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 40, 42.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 80–81. Palagonitized subaerial brown tuff containing many accessory and accidental ejecta including many fragments of reef limestone and some of Koolau basalt. Magma is nepheline basalt. Thickness about 900 feet. Rests on reef limestone believed to have been formed during plus 95-foot (Kaena) stand of sea; overlain locally by beach limestone of plus 25-foot (Waimanalo) stand. Overlain by Kaimuki and Black Point basalts.

Type locality: Diamond Head. Covers about 1.3 square miles on south coast of Oahu about 10 miles west of Makapuu Head.

Diamond Hill Felsite[1]

Carboniferous: Northeastern Rhode Island.

Original reference: C. H. Warren and S. Powers, 1914, Geol. Soc. America Bull., v. 25, p. 461.

Diamond Island Slate (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour. v. 7, p. 198.

Named for exposures on Great Diamond Island and Little Diamond Island in Casco Bay.

Diamond King Member (of Esmeralda Formation)[1]

Miocene, upper, and Pliocene, lower: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Prominent on Diamond King Hill, Manhattan district.

Diamond Peak Formation

Diamond Peak Quartzite[1]

Diamond Peak Series or Beds

Upper Mississippian: Northern Nevada and eastern California.

Original reference: Arnold Hague, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 28; 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 268.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 43–46. Diamond Peak series used to apply to post-Devils Gate sedimentary rocks in Roberts Mountains region. Used in preference to extending Hague's White Pine shale and Diamond Peak quartzite into area. Further work in post-Devils Gate deposits may lead to redefinition of Diamond Peak formation and necessitate revised terminology for beds in Devils Gate area.

C. W. Merriam and C. A. Anderson, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1690–1691. Term Diamond Peak beds used to include not only original Diamond Peak quartzite of Diamond Peak (Eureka district) but also underlying black shales and sandy interbeds referred by Hague (1892, U.S. Geol. Survey Mon. 20) to White Pine shale. "Diamond Peak quartzite" included large percentage of conglomerate at Diamond Peak; hence, lithologic term is misleading. Because stratigraphic relations of true White Pine formation in White Pine district are not well understood, it appears undesirable to use this term for dark shale in Eureka and Roberts Mountains area.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 57, 60–61. Proposed to use term Diamond Peak formation, in Eureka district, for the coarse clastic part of upper Mississippian sequence where it can be satisfactorily separated from underlying black shales and to adopt Spencer's name of Chainman shale for lower unit where it can be mapped separately. Hague characterized Diamond Peak as quartzite, but even at this type locality, unit contains large proportion of shale, conglomerate, and limestone; hence, term formation seems more appropriate. Formation mapped separately only south of Eureka, elsewhere equivalent beds are included in Chainman and Diamond Peak undifferentiated sequence. Thickness as much as 420 feet. Underlies Ely limestone. Discussion of problems of nomenclature and correlation of upper Mississippian sedimentary rocks in area.

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists 11th Ann. Field Conf., p. 84. Discussion of aspects of Chainman stratigraphy. The Chainman is recognized as valid stratigraphic unit. Diamond

Peak and Scotty Wash are referred to as facies within the Chainman. Term Illipah suppressed as synonymous with the Diamond Peak.

Named for exposures on flanks of Diamond Peak, Eureka district, Nevada.

Diamond Rock Quartzite[1]

Diamond Rock Quartzite Member (of Schodack Formation)

Lower Cambrian: Eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 64. Schodack formation, in Troy and Cohoes quadrangles, includes as members (ascending) Bomoseen grit, Diamond Rock quartzite, Troy shale and limestone, and Schodack shale and limestone.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 331. Dale's (1904, U.S. Geol. Survey Bull. 242) division G in Rensselaer County, was named by Ruedemann (1914) from type locality at Diamond Rock overlooking North Troy. Ruedemann states that formation occurs only at this locality, but Dale (1904) reported it farther east and west. In type area, the Diamond Rock is variable: hard quartzite with infrequent quartzite pebbles, lenses of a breccia of quartz pebbles in dark-gray matrix, rare thin beds of dolomite, a reddish- to orange-weathering sandstone with well-rounded frosted quartz grains in calcic or dolomite cement, and a yellow-stained calcareous sandstone with poorly preserved fauna tentatively identified as *Hyolithes*, *Paterina*, *Rustella*, *Microdiscus*, and olenellid fragments. Possibly beds are repeated due to faulting and (or) folding, so true thickness in indeterminable; probably no more than 50 feet. Whether Diamond Rock is correlate of Eddy Hill grit is conjecture.

Named for exposures at the "Diamond Rock," Lansingburgh (North Troy, N.Y.).

Diamond Valley Complex

Paleozoic and (or) Mesozoic: Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 477–479. Series of strongly metamorphosed sediments, with associated metatuffs, commonly injected lit-par-lit with granitic material. In type area, dips are steep, and strike is northwesterly over ridge; exposed thickness not accurately known, but is some thousands of feet.

Type area: Ridge 4 miles in length east and southeast of Winchester, Riverside County. Named for exposures on north side of Diamond Valley.

Diana Complex

Diana Syenite Complex[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1919, New York State Mus. Bull. 207, 208, p. 102–110, map.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 73–109. Diana quartz syenitic complex consists of eight facies. In this report, they are discussed in detail in order of their occurrence from northwest to southeast, and which, on their interpretation as parts of a stratiform sheet, would be from bottom to top. Pitcairn gneiss (new) and Gren-

ville limestone border main complex on northeast. Pyroxene quartz syenite outcropping in southeast part of Lowville quadrangle, and for an unknown distance to southeast, is mapped as part of the Diana, though it may belong with Santa Clara complex or may be a separate sheet.

Named from Diana Township, Lake Bonaparte quadrangle, within which the central part of the complex lies. Forms northwest border of Adirondack highlands, from Carthage to South Edwards.

Diana Formation

Silurian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in report on Paleozoic continental margin of central Nevada. Underlies Masket formation (new); overlies Antelope Valley formation.

Toquima Range, Nye County.

Diana Granite (in Cerbat Complex)

Precambrian: Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 666, fig. 2. Coarsely porphyritic granite which occupies core of a distinctive anticline preserved in schists of Cerbat complex (new).

B. E. Thomas, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 400–401, pl. 1. Rock is medium gray on fresh fracture and weathers light to moderate brown. Many outcrops show weak foliation, and some exposures are highly gneissic or mylonitic. Porphyritic texture with medium-grained groundmass. Body is roughly circular, with diameter of about 1¾ miles.

Named from Diana (Arizona Magma) mine, which is approximately in center of the exposure, in western half of Chloride district, Cerbat Mountains, Mohave County.

Diboll Member[1] (of Jackson Formation)

Eocene: Southeastern Texas.

Original reference: I. R. Sheldon, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 7, p. 819, 820, 822.

In Driscoll pool, Duval County.

Dick Rhyolite

Precambrian: West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 12, pl. 3. Porphyritic rock containing quartz phenocrysts in microcrystalline groundmass. Forms intrusive masses. Locally is foliated, becoming a quartz-sericite schist. Distinguished from King Peak rhyolite (new) by presence of phenocrysts in Dick rhyolite. Probably younger than King Peak rhyolite. Intrudes Bridle formation and Butte Falls tuff (both new). Pattern of outcrops indicates that it also intrudes King Peak rhyolite.

Large mass is exposed on Dick Peak, for which the rock has been named, in south-central part of Bagdad area, Yavapai County. This mass, more than 2,000 feet wide, has been mapped for distance of 1 mile. and extends southward beyond the mapped area.

Dickerson Formation (in Millsap Lake Group)

Dickerson Member (of Millsap Lake Formation)[1]

Pennsylvanian (Strawn Series): North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation. Basal formation of group. Underlies Kickapoo Falls member of Lazy Bend formation; overlies unnamed subsurface units.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 45 ,no. 2, p. 163. Kickapoo Falls limestone may well be classified as top member of Dickerson formation in harmony with common practice in this region [Texas] of placing an important limestone at top of formation.

Exposed in Brazos River valley.

Dickinson Group

Precambrian: Northern Michigan.

R. W. Bailey, 1956, Dissert, Abs., v. 16, no. 8, p. 1426. Name used in discussion of lower Precambrian rocks of Lake Mary quadrangle, Iron County. Composed chiefly of metavolcanic schist. Underlies core area of Holmes Lake anticline, which is flanked by steeply dipping Middle Precambrian (Huronian) formations. Major unconformity separates Dickinson group from overlying Middle Precambrian rocks.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 27 (table 1), 31. Name applied to a sequence of lower Precambrian rocks—Archean of older reports—consisting of metamorphosed sedimentary and volcanic rocks. Strata unconformably overlie older granite gneiss and have been invaded by granitic rocks of batholithic dimensions. In central Dickinson County, group is divided into three formations: East Branch arkose (oldest), Solberg schist, and Six-Mile Lake amphibolite. Rocks are steeply dipping or vertical and sequence is believed to be conformable. Separated by covered interval from strata of group is newly defined Hardwood gneiss, which may be in part or wholly equivalent in group.

Named for Dickinson County where group occurs in an easterly trending belt about 4 miles wide in central part of T. 42 N., R. 28, 29, and 30 W.

Dicksburg Hills Sandstone

Upper Pennsylvanian: Southwestern Indiana.

C. A. Malott, 1939, (abs.) Indiana Acad. Sci. Proc., v. 48, p. 114. Overlies Hazleton Bridge formation (new).

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 131, 133 (fig. 2), 134 [1948]. Massive coarse-grained micaceous friable crossbedded sandstone. Thickness at type locality 50 feet. Unconformably overlies Hazelton Bridge formation; underlies Parkers formation. To the south, the sandstone was mapped as a part of Fuller's Inglefield formation (Ditney and Patoka folios of U.S. Geological Survey). Type locality designated.

Type locality: In "The Rock Bluffs," SW¼ sec. 18, T. 1 N., R. 10 W., in northeastern part of the western hill of the Dicksburg Hills, Knox County.

Dicks River facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 117–119. Predominantly shale with a middle zone of massive cliff-forming siltstone, Gum Sulphur siltstone member (new), up to 40 or more feet thick. Average thickness of facies about 125 feet. Merges with Junction City facies (new) on west and with Boone Gap facies (new) on east. Underlies Brodhead formation (new) [Irvine facies]; overlies New Albany black shale.

Typical section: Along steep slope at north side of Dicks River valley, immediately west of confluence with East Fork, half a mile north of Brodhead, Rockcastle County. Named for Dicks River in northwestern part of county.

Dierks Limestone (in Trinity Group)

Dierks Limestone Lentil (of Trinity Formation)[1]

Lower Cretaceous (Comanche): Southwestern Arkansas.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690–B.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Rank raised to formation in Trinity group. Underlies Holly Creek formation; overlies Delight sand (new). Subsurface equivalents discussed.

Named for exposures near Dierks, Howard County.

Difficulty Creek Latite[1]

Miocene or Pliocene: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1907, U.S. Geol. Survey Geol. Atlas, Folio 153.

Cut by wild canyon of Difficulty Creek, Ouray region.

Dighton Conglomerate[1]

Pennsylvanian or Permian(?): Southeastern Massachusetts and Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 184–187, pl. 17.

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–5]. Permian(?).

Named for occurrence in Dighton, Mass.

Dike Lake Slate

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1034, 1038 (fig. 4). Finely banded and laminated slate containing numerous beds of graywacke and lenses of black cherty slate. Thickness about 1,000 feet. Overlies Saddlebag Lake conglomerate [table and map show Moose Lake conglomerate at this horizon]; unconformable below rocks of Ogishke group.

Occurs in vicinity of Dike Lake, Kekequabic-Ogishkemuncie area.

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Dilco Coal Member (of Crevasse Canyon Formation)

Dilco Coal Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1925, U.S. Geol. Survey Bull. 767.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 90, 92, pl. 1. Reallocated to member status in Crevasse Canyon formation (new). Underlies Dalton sandstone member. Overlies Gallup sandstone. In area of this report [Fort Defiance-Tohatchi quadrangle], consists of 240 feet of silty shale, laminated siltstone, thin coal, and thin- to medium-bedded fine-grained sandstone, the latter being more abundant toward top. Thins toward south to about 81 feet.

Named for Dilco, McKinley County.

Dillard Limestone Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 133. Defined as uppermost unit of Chimneyhill. Consists of two lithologic units, a basal shale, 1 to 2 feet thick, and an upper limestone unit 15 to 18 feet thick. Overlies Cochrane limestone member (new); underlies Henryhouse formation.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 19. Replaced by Clarita member; name Dillard preoccupied. States Maxwell's type locality for Dillard.

Type locality: E½W½SW¼ sec. 8, T. 1 S., R. 8 E. [Coal County.].

†Dillard Series[1] or Formation

Jurassic: Southwestern Oregon.

Original reference: G. D. Louderback, 1905, Jour. Geology, v. 13, p. 522–555.

N. L. Taliaferro, 1941, Geol. Soc. America Bull., v. 52, no. 12, p. 1957. Dillard, as originally defined, includes Knoxville (Upper Jurassic) sediments and possibly infolded Lower Cretaceous, but most of unit is to be correlated with Franciscan.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 71–112. Generally accepted correlations of Jurassic of southwestern Oregon and California are: Galice and Mariposa, Dothan and Franciscan, Myrtle and Shasta. Dothan is stated to be younger than Galice. Has been stated that the Dillard, the lower part of the original Myrtle, is the equivalent of the Franciscan. Since the Dillard unconformably overlies the Dothan and Galice, it is clear that one or other of these correlations must be erroneous. Evidence is presented in present report to show that the Dothan is older than the Galice and cannot be same age as the Franciscan. Dillard, as originally defined, includes Knoxville (Upper Jurassic) sediments and possibly infolded Lower Cretaceous, but bulk of Dillard is to be correlated with Franciscan. It would be unsafe to state that the beds in vicinity of Dillard, Oreg., were Lower Cretaceous on basis of *Aucella "crassicollis."* Lower Cretaceous beds may be present in area covered by Louderback's (1905) Dillard group, but unquestionably the great bulk of Dillard series and that part of Diller's (1907, Am. Jour. Sci., 4th, v. 23) Myrtle in this locality are lithologically identical with Franciscan of Coast Ranges of

California. Discovery of fossils, nearly all species of *Aucella* formerly regarded as indicative of Lower Cretaceous, is not sufficient justification for including beds in vicinity of Dillard, Oreg., (Louderback's Dillard series) in the Myrtle and regarding them as Lower Cretaceous. The Myrtle as mapped and defined, includes beds of both Upper Jurassic and Lower Cretaceous and at least one important unconformity; the Myrtle either should be redefined and restricted or the name abandoned.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, chart 8C (column 97). Shown on correlation chart as Upper Jurassic.

Named for village of Dillard in Roseburg quadrangle.

Dillon Granite Gneiss

Precambrian (pre-Beltian): Southwestern Montana.

E. W. Heinrich, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1432. A number of post-Cherry Creek intrusives, all of which show varying degrees of metamorphism, include, among others, the Dillion granite gneiss, widespread in Beaverhead and Madison Counties.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 351–352, pl. 1. Introduced by Heinrich (1953) to replace term Blacktail previously used for same unit (Heinrich, 1950) because latter term is preoccupied. A plutonic complex of granite gneisses, pegmatites, aplites, quartz masses, and hybrid gneisses. Most common rock type is a reddish-brown feldspar-quartz gneiss in which bands of pink feldspar and quartz alternate with dark bands of mafic minerals. Complex is most widespread of the pre-Beltian metamorphic rocks. Intrudes rocks of both Pony and Cherry Creek groups.

Crops out over large areas of Blacktail and Tendoy Ranges and of the mountain north of Armstead, Beaverhead, and Madison Counties.

Dilworth Sandstone Member (of McElroy Formation)

Dilworth Sand[1]

Eocene, upper: Southeastern Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1311.

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 166–171. In Grimes and Manning Counties, unit termed Dilworth by Renick (1936, Texas Univ. Bull. 3619) on assumption that it was equivalent to Dilworth of Gonzales County, is here named Tuttle sandstone member of Manning formation.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2626 (table 1), 2630–2631. Termed sandstone and reallocated to member status in McElroy formation (redefined). Overlies Manning clay member; underlies Conquista clay member (new).

Named for exposures about 1 mile east of Dilworth, Gonzales County.

Dime Box Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

H. D. McCallum, 1947, South Texas [Geol. Soc. Guidebook] 14th Ann. Mtg. Field Trip, p. 4. Consists of red sand. Basal member of formation; underlies Cistern member (new).

Named after Dime Box, a small settlement in Lee County.

Dimple Limestone

Pennsylvanian: Southwestern Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 46.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 289 (fig. 1). Included in Morrowan stage of Ardian series (new).

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 23. Here included in Bend (Atoka) series.

Named for exposures in and near Dimple Hills, Pecos County.

Dingess Limestone (in Kanawha Formation[1] or group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 165.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). Shown on correlation chart in Kanawha group.

Named for Dingess, Mingo County.

Dingess Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. D. Teets, Jr., 1919, West Virginia Geol. Survey Rept. Fayette County, p. 926–928.

At Dingess, Mingo County.

Dingess Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia and Kentucky.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties.

Occurs in Kanawha, Fayette, Nicholas, Boone, Logan, and Mingo Counties, W. Va., and in Kentucky.

Dingus Limestone (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Kentucky.

Original reference: L. C. Robinson, 1927, Kentucky Geol. Survey, ser. 6, v. 26, p. 239.

Probably named for Dingus, Morgan County.

Dinosaur Canyon Sandstone Member (of Moenave Formation)

Dinosaur Canyon Sandstone

Upper Triassic(?): Northeastern Arizona and southern Utah.

E. H. Colbert and C. C. Mook, 1951, Am. Mus. Nat. History Bull., v. 97, art. 3, p. 151–153. Proposed for the orange-red sandstone, about 200 feet thick, that overlies the Chinle and underlies about 140 feet of the so-called Wingate below the Kayenta. Contains *Protosuchus*.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2517, 2519. Rank reduced to member status in Moenave formation. Basal member of formation; underlies Springdale sandstone member. Geographically extended into southern Utah.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 13–16, 63. At type locality, consists of sequence of lenticular units predominantly of fluvial origin but which

also include large amount of eolian sandstone. Thickness at type locality 202 feet; 307 feet at Moenave; 321 feet at Kachina Point; thins northeast from type locality to 110 feet at Navajo Creek, 28 feet at Piute Canyon, and 47 feet at Steamboat Canyon. At type locality, unconformably overlies Chinle formation; in Navajo Creek area, Arizona, overlies Lukachukai member of Wingate sandstone.

Type locality: Dinosaur Canyon, which joins valley of Little Colorado to east of Cameron, Ariz. Completely exposed in cliffs of Kachina Point, 40 miles northwest of Winslow, Navajo County, Ariz.

†Dinsmore Limestone Bed (in Monongahela Formation)[1]

Pennsylvanian: Southwestern Pennsylvania and southeastern Ohio.

Original reference: W. T. Griswold and M. J. Munn, 1907, U.S. Geol. Survey Bull. 318, p. 69–70.

Named for town of Dinsmore, Washington County, Pa.

Dinwoody Formation[1]

Dinwoody Formation (in Chugwater Group)

Lower Triassic: Western Wyoming, southeastern Idaho, southwestern Montana, and northeastern Utah.

Original reference: D. D. Condit, 1916, U.S. Geol. Survey Prof. Paper 98, p. 263.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 134. Lowermost formation in Chugwater group. Underlies Red Peak formation.

N. D. Newell and Bernhard Kummel, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 940–945, pl. 1, strat. sections. As originally defined [authors refer to Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8], formation comprised 200 feet of gray and olive-gray shaly siltstones and shales, with thin brown limestones near base. Limits of formation were defined by Phosphoria limestone below and bright red shales and siltstones of Chugwater formation above. Present study reveals that change from gray to red beds does not follow stratigraphic plane but varies in position from place to place, even within a few hundred yards in Dinwoody Canyon. Since color boundary between Dinwoody and Chugwater is not useful or natural boundary, it is proposed to restrict Dinwoody at type locality to include only dominantly silty strata between Phosphoria and top of resistant siltstones about half way toward summit of original Dinwoody. Restricted Dinwoody is 90 feet thick at type locality. Thickness: less than 40 feet southwest of Lander to 120 feet at northwest end of Wind River Mountains; 650 to 700 feet in deeper parts of geosyncline near Afton and Cokeville, Wyo., and Montpelier, Idaho. Three major divisions recognized: basal siltstone; *Lingula* zone, characterized by thin dense limestone and dark-olive shales; and *Claria* zone, characterized by calcareous olive-buff siltstones, with some interbedded hard gray limestones. Successively higher divisions of Dinwoody are progressively more extensive toward north and east across southwestern Wyoming. If upper part of *Claria* zone corresponds to Thomas' (1934) Little Medicine tongue, equivalents of *Claria* zone can be recognized as far to east as southeastern Wyoming. Dinwoody is probably time equivalent of lower part of red-beds section in type area of the Woodside. In much of western Wyoming, Dinwoody is overlain by several hundred feet of red shaly siltstones and sandstone,

variously called lower Chugwater, Red Peak, and red Woodside; these red beds belong to same facies as type Woodside but apparently correspond stratigraphically only to about upper half of typical Woodside as defined in Park City area. These red beds between the Dinwoody and Thaynes are regarded as northeastern tongue of Woodside.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 241. Beaverhead formation (new) unconformably overlies Cretaceous Kootenai, Triassic Dinwoody, and Permian Phosphoria.

H. A. Tourtelot, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–124. In Badwater area, is 10 to 80 feet thick; overlies Phosphoria formation; underlies Chugwater formation. Little Medicine tongue extends eastward into Big Horn Mountains.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 18), 167–170. Discussion of Triassic stratigraphy of southeastern Idaho and adjacent areas. In southeastern Idaho, Dinwoody is 700 to 2,400 feet thick and includes beds both older and younger than those at type locality. In southeastern Idaho, southwestern Montana, and western Wyoming, Dinwoody is bounded below by Phosphoria and above by Woodside or Thaynes. Relationship of Dinwoody and Woodside to Phosphoria not completely understood. Areas discussed in detail.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2836–2837 (fig. 4). Chart shows Dinwoody overlies Ervay member of Park City formation, and Retort phosphatic shale and Tosi members (both new) of Phosphoria formation. Column 15 shows Dinwoody in Crawford Mountains, Utah.

Named for Dinwoody Canyon in Wind River Mountains near Dubois, Wyo.

Dip Creek Formation

Paleocene: West-central California.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 450, 512–517. Name proposed for Paleocene beds in central and south Santa Lucia Range. Consists of coarse cobble and boulder conglomerates and coarse to fine-grained arkose sandstones, commonly filled with carbonized plant remains. Thickness about 1,320 feet. Unconformably underlies pre-Vaqueros landlaid redbeds and marine Vaqueros sandstones; overlies Asuncion formation [group].

Type locality: In west part of sec. 30, T. 25 S., R. 10 E., Adelaida quadrangle, Santa Lucia Range.

Dipping Vat Formation

Eocene: Central Utah.

D. P. McGookey, 1959, Dissert, Abs., v. 19, no. 12, p. 3278; 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 5, p. 591, 592–593 (fig. 2), 594, 607, 608–610. Proposed for light-gray to white coarse tuffaceous sandstone that rests conformably on, and is possibly gradational with, beds of Bald Knoll formation and is overlain disconformably by Bullion Canyon volcanics. Thickness about 208 feet.

Type section: Upper 208 feet of section measured along line starting in cutbank on west side of Lost Creek in sec. 1, T. 23 S., R. 1 W., and ending in NE¼ sec. 11, T. 23 S., R. 1 W., Sevier County. Named from exposures in canyon of Dipping Vat Creek just above confluence with Little Lost Creek in sec. 30, T. 23 S., R. 1 E.

Dirty Creek Sandstone Member (of Atoka Formation)[1]

Middle Pennsylvanian: Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 29–30. Thickness 5 to 20 feet in type area. Separated by unnamed shale intervals from overlying Webbers Falls sandstone member and underlying Georges Fork sandstone member.

Named for exposures west of Dirty Creek in secs. 11 and 14, T. 12 N., R. 19 E., Muskogee County.

Disappointment Mountain Greenstone Conglomerate

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1592. Name applied to a conglomerate consisting mostly of fragments of greenstone with a few fragments of jasper. Average thickness at Disappointment Mountain about 1,200 feet; south of Moose Lake, only a few feet to 300 feet thick and grades into graywacke and slate. Overlies or surrounds Ely greenstone. In this report, the Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Disappointment Mountain and Moose Lake greenstone as unit 3 occurring above unnamed flinty slates and below Jasper Lake greenstone conglomerate or agglomerate.

Report covers a belt in eastern part of Vermilion district more or less parallel to international boundary.

Dismal Conglomerate Lentil (in Dismal Formation)[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Named for exposures on Dismal Creek, Buchanan County, Va.

Dismal Formation[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio, 44.

Named for exposures on Dismal Creek, Buchanan County, Va.

†Dismal Swamp Formation[1]

Pleistocene: North Carolina and Virginia.

Original reference: C. K. Wentworth, 1930, Virginia Geol. Survey Bull. 32, p. 691.

Dismal Swamp area.

Ditney Formation[1]

Upper Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84.

C. A. Malott, 1948, Indiana Acad. Sci. Proc., v. 57, p. 126 (fig. 1), 128–129, Ditney formation (restored) underlies Merom sandstone and overlies West Franklin limestone.

Caps Big Ditney and Little Ditney Hills, Warren County.

Divide Andesite[1]

Miocene, upper(?): Southwestern Nevada.

Original reference: A. Knopf, 1921, U.S. Geol. Survey Bull. 715, p. 151, 155.

Occurs southeast of Tonopah Divide mine. Forms main bulk of largest and highest mountainous area in district and is well exposed at highest point on Tonopah-Goldfield Road, Divide district.

Divide cyclothem

Pennsylvanian: Southern Illinois.

J. R. Ball, 1943, Illinois Acad. Sci. Trans., v. 36, no. 2, p. 147, 150. Named in list of cyclothems in the late Pennsylvanian (McLeansboro) rocks in Carlinville quadrangle. Approximate thickness 9 feet. Occurs above Livingston cyclothem. Text (p. 150) refers to the Divide(?) cyclothem and states that this is probably a channel sandstone because it includes only sandstone and shale.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by E. S. Ekblaw in south-central Illinois led to tentative recognition of six cyclothems, of which the Divide is second in sequence (ascending). Occurs above the LaSalle and below the Effingham (new). If the Greenup and Omega limestones are not equivalent, a single standard reference section would include 14 cyclothems; the Divide would be seventh in sequence (ascending) and would occur below the Effingham and above the Cohn.

Present in Carlinville quadrangle, northeast corner of which is about one-half mile east of Virden and 20 miles south of Springfield.

Divide Peak Andesite[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, p. 71 (map).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 676. Cenozoic.

Occurs in Mount Lassen region.

Divine Limestone[1]

Upper Ordovician: Northeastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1931, Illinois Geol. Survey Rept. Inv. 23, passim.

E. P. Du Bois, 1945, Illinois Geol. Survey Rept. Inv. 105, p. 7. Specific names, such as Fernvale limestone, Divine limestone, and Thebes sandstone, have been applied locally to parts of the Maquoketa formation, but it appears that none of these, except possibly the Divine limestone, are consistent stratigraphic units.

Named for exposures in vicinity of Divine Station, on Elgin, Joliet & Eastern Railroad, Grundy County.

Dixie shale[1]

Lower Cretaceous: Southeastern Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 129, 138, 139.

Named for Dixie Canyon, near Bisbee, Cochise County.

Dixie Valley Formation

Lower Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Conglomerate grading locally to fanglomerate, sandstone and shaly limestones and dolomites. Forms massive steplike ledges, prevailingly yellowish to brownish red or maroon. Maximum thickness about 600 feet; 280 to 300 feet at south end of Tobin Range. Underlies Favret formation (new), contact gradational; overlies Tobin formation (new).

Type locality: Northwest part of Augusta Mountain, north end of Dixie Valley.

†Dixon chalk or limestone[1]

Upper Cretaceous: Nebraska and western Iowa.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 147–149.

Dixon Earthy Limestone Member (of Wayne Formation)[1]

Dixon Formation (in Wayne Group)

Middle Silurian: West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 566, 578–582, 681, 694.

H. D. Miser, 1921, Tennessee Div. Geology Bull. 26, p. 20. Referred to as Dixon earthy limestone member of Wayne formation.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 244, 253–256, figs. 2, 76, 80. Dixon formation included in Wayne group. Consists of an alternation of several lithologic types, all of which are argillaceous; these include beds of calcareous shale as much as 5 feet thick, massive calcareous mudstone averaging about 5 feet in thickness but being locally as much as 10 or 15 feet thick, earthy limestone, and uniformly bedded, argillaceous limestone containing disseminated silt; this latter type is ordinarily concentrated near base of formation and represents the gradation between the Lego and Dixon. Western part of formation (fig. 76) is usually brick red; the eastern part is usually gray, commonly greenish gray; color change is commonly quite rapid and may locally occur with distance of 1 mile. Thickness varies owing to gradation into underlying Lego; average thickness about 38 feet where overlain by Beech River formation. Locally overlain unconformably by Pegram formation or Chattanooga shale.

T. W. Amsden, 1949, Yale Univ. Peabody Mus. Nat. History Bull. 5, p. 10. Discussed as Dixon formation underlying Brownsport formation.

Named for Dixon Spring, Decatur County.

†Dixon Formation[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 81. Highest Pennsylvanian formation in western Kentucky. Includes beds younger than Lisman formation. Consists of (descending) Mount Gilead sand-

stone, Mount Gilead shale, Vanderburg sandstone, Bald Hill shale, and Dixon sandstone.

Named for exposures east of Dixon, Webster County.

Dixon Granite

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 24–25, 45, pl. 2. Typically is fairly coarse grained but varies a good deal in both texture and composition from place to place. In gorge of Rio Pueblo, it is mainly even-grained pink and gray biotite granite. Intrudes all older Proterozoic rocks in area. Intruded during Pueblo revolution.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 37. Preoccupied name Dixon replaced by term Embudo granite.

Conspicuous in hills to west and south of Harding mine and exposed along Rio Pueblo from Dixon almost to Picuris. Also occurs in belt extending from foot of mountain slope northeast of Picuris nearly to Talpa and other smaller outcrops in Picuris area, Rio Arriba County.

Dixon Sandstone

Ordovician: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 100. Abandoned by Oklahoma Geological Survey. Eldridge (1901, U.S. Geol. Survey 22d Ann. Rept., pt. 1, p. 227) states that he named unit for the Indian upon whose allotment the rock occurs. Sandstone is probably in Oil Creek formation. If restored, name would invalidate well known Dixon limestone, Silurian, of Tennessee, named in 1903. Name has also been used for a Kentucky Pennsylvanian sandstone, a schist in New York, and an Upper Cretaceous chalk in Nebraska.

†Dixon Sandstone (in Henshaw Formation)[1]

Dixon Sandstone Member (of Dixon Formation)

Pennsylvanian: Western Kentucky.

L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26. Fine-grained sandstone of variable character, 10 to 25 feet thick; locally 50 to 60 feet; forms basal member of Dixon formation.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 81. Basal member of Dixon formation.

Named for exposures near Dixon, Webster County.

Dixon Schist[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. N. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs above Hague gneiss and below Faxon limestone.

Type locality: Dixon mine, Hague Township, Warren County.

Dixon Mountain Member (of Wilhite Formation)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962. Dominantly siltstone, mostly micaceous and sandy, con-

taining much carbonate that is mainly concentrated along certain laminae; some interbedded sandstone. About 1,500 feet thick. Underlies Yellow Breeches member (new).

Named for Dixon Mountain west of Jones Cove, Sevier County.

†Dixons Group[1]

Upper Cretaceous: Eastern Nebraska and western Iowa.

Original reference: I. N. Nicollet, 1843, Rept. intended to illustrate map of hydrographical basin of Upper Mississippi River: 26th Cong., 2d sess., S. Ex. Doc. 237, p. 35, 37.

Named for the fact that divisions A, B, and C compose Dixon's bluff, in Dixon County, Nebr., about 12 miles above Sioux City, Iowa.

Dobbs Valley Sandstone (in Millsap Lake Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 163.

Crops out north of Dobbs Valley, Brazos River region.

Dock Street Clay Member (of Four Mile Dam Formation)

Dock Street Clay[1]

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabow, 1902, Rept. Michigan State Board of Geol. Survey for 1901, p. 178, 192.

A. S. Warthin and G. A. Cooper, 1942, *in* G. A. Cooper and others, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1744. Above Alpena (restricted) are 8 feet of blue clay shale, the Dock Street clay of Grabau, a lens confined to east side of Alpena, and classified with the Alpena limestone.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 588. Considered member of Four Mile Dam. At type section of Four Mile Dam, consists of bluish-gray calcareous mudstone about 7½ feet thick; near base of formation. Contains well-preserved echinoderms.

First described from test well on Dock Street, Alpena. Well exposed at type section of Four Mile Dam, Thunder Bay quarries, SE¼ sec. 14, T. 31 N., R. 8 E., Alpena County.

Dockum Group[1] or Formation

Upper Triassic: Western Texas, Colorado, Kansas, Oklahoma, and New Mexico.

Original reference: W. F. Cummings, 1890, Texas Geol. Survey 1st Ann. Rept., p. 189.

J. W. Stovall and D. E. Savage, 1939, Jour. Geology, v. 47, no. 7, p. 759–766. Skull of phytosaur *Machaeroprosopus* discovered in Sloan Canyon formation, confirms Triassic age of rocks lying beneath Exeter (Jurassic) in valley of dry Cimarron River in Union County, N. Mex., and Cimarron County, Okla. Underlying red beds, the Sloan Canyon formation, and Sheep Pen Canyon formation form continuous and conformable succession of strata. These three units should be included in Dockum group.

R. E. King and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 556. Upper Triassic red shales and sandstones of terrestrial origin overlie

Permian throughout much of South Permian basin. They are placed in Dockum group and divided into (ascending) Tecovas shale, Santa Rosa sandstone, and Chinle shale.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 23–24. Group, in Eddy County, overlies Rustler formation. Consists of redbeds and sandstones. Lower part of these beds has been considered Permian and correlated with Dewey Lake redbeds by some geologists. Total thickness of group east of Artesia is about 1,000 feet. Formations exposed are Pierce Canyon redbeds, Santa Rose sandstone, and redbeds that possibly represent the Chinle formation. Triassic.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 463 (fig. 2), 467. Glorieta sandstone, in Galisteo-Tonque area, New Mexico, is overlain by about 800 feet of red and variegated sandstone and shale. These beds are generally correlated with Dockum group of eastern New Mexico.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 34–42, pl. 1d. Group, as used in this report, includes all beds of Triassic age exposed in Union County. With only one or two exceptions, exposures of the Dockum are restricted to drainage area of Dry Cimarron, where group is divided into four formations (ascending): Baldy Hill (new), Travesser (new), Sloan Canyon, and Sheep Pen. Unconformably underlies Exeter sandstone. Thickness about 900 feet.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Dockum group shown on chart with statement that some part of Triassic section is believed to crop out in small area in Morton County.

Named for Dockum, Dickens County, Tex.

Dodds Creek Sandstone Member (of Coffeyville Shale)

Dodds Creek Sandstone[1] Member (of Galesburg Shale)

Pennsylvanian (Missouri Series): Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 97.

R. C. Moore and others, 1937, Kansas Geol. Soc. 11th Ann. Field Conf. Guidebook, p. 40 (table), 42. Included in Coffeyville shale (restricted) in northeastern Oklahoma.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 83, 87. Massive to thin-bedded sandstone, seemingly of deltaic origin; thickness as much as 40 feet.

Occurs in Galesburg shale in southern Kansas.

Named for Dodds Creek, Labette County, Kans.

Dodge gypsum[1]

Upper Cretaceous or Miocene(?): Iowa.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 219, pls. 25, 26, fig. 3.

Fort Dodge, Webster County.

Dodge shale[1]

Upper Cretaceous or Miocene(?): Western Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148, 154.

Probably named for Fort Dodge, Webster County.

Dodson Member (of Cook Mountain Formation)

Eocene (Claiborne): Central Louisiana.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 87–91, 92, pl. 3. Term proposed for the basal fossiliferous glauconitic, clayey sands which underlie the Milams member and overlie the Sparta sands. As defined, the Dodson includes the lower 17 feet of the Milams member as defined by Ellisor (1929). Thickness 4 to 25 feet.

Name derived from town of Dodson in sec. 27, T. 13 N., R. 3 W., north-central Winn Parish. This is nearest geographical name to any of the typical localities described.

Doe Creek Sandstone Member (of Marlow Formation)

Permian: Northwestern Oklahoma.

O. F. Evans, 1954, Oklahoma Acad. Sci. Proc., v. 33, p. 196–197. Name applied to a sandstone, 6 to 36 feet thick, exposed in a line of disconnected hills that extend southwest from about 15 miles west of Alva, to near Woodward, a distance of about 40 miles. Sandstone is hard, highly cemented, fossiliferous. Considered younger than Verden sandstone although some workers have suggested that it is an extension of the Verden; both units are included in the Whitehorse [group].

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as sandstone member of Marlow formation.

C. C. Branson, 1955, Hopper, v. 15, no. 12, p. 137. Doe Creek lies within the Marlow formation at a higher level than the Verden sandstone. The original Whitehorse sandstone of the Whitehorse Springs locality is the Doe Creek; name Whitehorse has been applied to the group consisting of the Marlow formation and Rush Springs sandstone. Derivation of name given.

Named for Doe Creek in T. 25 N., R. 18 W., Woodward County. Type section not designated; perhaps in Doe Creek mounds, which are buttes along valley of Doe Creek. Occurs in Cleveland Hills, Whitehorse mounds, Wildcat mounds, Woods County; Doe Creek mounds and vicinity of Woodward, Woodward County.

Doe Run Dolomite (in Elvins Group)[1]

Doe Run Member (of Elvins Formation)

Upper Cambrian: Eastern Missouri.

Original references: E. R. Buckley, 1907, Missouri Bur. Geology and Mines, v. 10, 2d ser., separate; H. A. Buehler, 1907, Missouri Bur. Mines, v. 6, 2d ser., p. 231.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1). Uppermost formation in Elvins group. Overlies Derby dolomite; underlies Potosi dolomite. Upper Cambrian.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 27–30. Missouri Geological Survey uses compound term Derby-Doe Run. Because

Doe Run was used as formation name by Frazer (1883) [for unit in Pennsylvania], is seems good usage to discontinue it as compound term with Derby. Term Derby formation is used in this report. Term Elvins not recognized as valid in this report.

V. E. Kurtz, 1960, Dissert. Abs., v. 21, no. 3, p. 595. Doerun referred to as member of Elvins formation.

Named for Doe Run Lead Co., which owns land in St. Francois County, upon which type section occurs.

Doe Run Limestone[1]

Precambrian: Southeastern Pennsylvania.

Original reference: P. Frazer, 1883, Pennsylvania 2d Geol. Survey Rept. C_4, p. 70, 304, 307.

Extends more than 1 mile in southwest direction parallel to valley of Doe Run, from near Doe Run village to vicinity of Passmore's mill, Chester County.

Dog Bend Limestone (in Mineral Wells Formation)[1]

Dog Bend Limestone Bed (in Salesville Formation)

Dog Bend Limestone Member (of Salesville Formation)

Pennsylvanian (Canyon): Central northern Texas.

Original reference: F. B. Plummer, 1929, Texas Bur. Econ. Geology, geol. map of Palo Pinto County.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Salesville is raised to formation rank and expanded below to base of Lake Pinto sandstone. Chart shows Dog Bend limestone member above Lake Pinto member; underlies unnamed sandstones and limestone below Turkey Creek sandstone member of Keechi Creek formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 24, pl. 1. Referred to as limestone bed in Salesville formation. As used in this report [Parker County], it is lower part of unnamed shale member that overlies Lake Pinto sandstone member. Bed is continuous with bed mapped and named Dog Bend in Palo Pinto County.

Probably named from exposures in the Dog Bend of Brazos River 5 miles west of Mineral Wells, Palo Pinto County.

†Dog Canyon Limestone[1]

Permian: Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 588 (footnote). Abandoned in favor of Goat Seep limestone (new).

Exposed on western flank of Guadalupe Mountains, in Dog Canyon.

Dog Creek Shale (in Nippewalla, El Reno, or Pease River Group)

Dog Creek Shale (in Cimarron Group)[1]

Dog Creek Shale (in Double Mountain Group)

Permian: Central southern Kansas, western Oklahoma, and western Texas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 39.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1469. In central and west-central Oklahoma, in areas where Blaine formation can be identified, Dog Creek shale lies between it and Marlow formation. Thickness about 150 feet at Mountain View; more than 200 feet in Canadian County where it contains several continuous thin dolomites in basal 50 feet.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Mapped in Double Mountain group in northwestern Texas. Includes Childress dolomite member at top.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 98. Top formation of El Reno group on east side of Permian basin. Overlies Blaine gypsum; underlies Whitehorse group. El Reno appears to be better term than recently suggested San Andres group. Leonard series.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 685–699. Includes (ascending) unnamed shales, Guthrie member, unnamed shales, Aspermont member, unnamed shales and gypsums, and Childress member. Overlies Blaine; underlies Whitehorse. Faunas discussed.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Included in El Reno group. Double Mountain group abandoned.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 158, 161 (fig. 4). Uppermost formation in Nippewalla group. Consists of maroon shale, sandstone, thin layers of dolomite, dolomitic sandstone, and gypsum. Thickness 14 to 53 feet; average 35 feet. Overlies Blaine formation. Underlies Whitehorse sandstone. In Kiowa County overlapped by Cretaceous sandstone (Cheyenne).

Robert Roth, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 893–907. Pease River group includes San Angelo, Flowerpot, Blaine, and Dog Creek formations as exposed in Texas. Chart shows Pease River group as Guadalupe.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 19 (fig. 4), 28–30, pl. 1. As classified in this report [Carter area], Dog Creek overlies Van Vacter gypsum member (new) of Blaine formation and underlies Marlow formation of Whitehorse group. Thickness 80 feet. In El Reno group.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 24 (fig. 6), 34–36, pl. 1. Described in Harper County where it conformably overlies Blaine formation and is unconformable below Whitehorse formation. Consists of reddish-buff gypsiferous shale with thin beds of red sandstone and gypsum. Thickness 25 to 50 feet. Uppermost formation of El Reno group; Guadalupian. [Page 36 refers to El Reno group, Leonardian series.]

Named for Dog Creek, Barber County, Kans.

Dog Gulch Formation[1]

Tertiary: Southwestern New Mexico.
Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.
Named for exposures in upper part of Dog Gulch, Mogollon district.

Dogs Head Andesites

Quaternary: Southwestern Washington.

Jean Verhoogen, 1937, California Univ. Dept. Geol. Sci. Bull., v. 24, no. 9, p. 286. Dark reddish tough andesite which carries abundant gabbroic inclusions. Overlain by succession of thin sheets of basalt separated by clinkery layers of cinders and thin beds of ash.

Occurs in vicinity of Mount St. Helens on western slope of Cascade Range, 40 miles north of Columbia River. Dogs Head is prominent escarpment that rises over east end of Forsythe glacier.

Dolet Hills Formation (in Wilcox Group)

Dolet Hills Member (of Logansport Formation)

Paleocene: Northwestern Louisiana.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Named in a stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 57. In type area, consists of about 100 feet of rather massive sand; lithologically cannot be differentiated from other sands in Midway-Wilcox complex. Interfingers along strike with overlying and partially equivalent Cow Bayou member and is gradational from underlying Naborton formation.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 105–110. Overlies Chemard Lake lignite lentil of Naborton formaton. Midway group.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 53–54. Rank raised to formation in report on Sabine Parish. Term Logansport discontinued. Overlies Naborton formation; underlies Cow Bayou formation. Wilcox group. Subsurface.

Type area: Dolet Hills south of Naborton, especially exposures along road from Grove Hill Church and Cemetery to Naborton and adjacent ravines in sec. 6, T. 11 N., R. 11 W., in sec. 1, T. 11 N., R. 12 W., and sec. 36, T. 12 N., R. 12 W., De Soto Parish.

Dolgeville Shale[1]

Dolgeville facies (of Denmark Formation)

Dolgeville facies (of Sherman Fall Formation)

Middle Ordovician: Eastern New York.

Original reference: H. P. Cushing, 1909, New York State Mus. Bull. 126, p. 20.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 271. Facies of Sherman Fall formation.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 57. Name Dolgeville was proposed for interbedded rather than barren limestones and dark shales that lie between fossiliferous Trenton limestones and black shales near Dolgeville. In type locality, these overlie Shoreham limestone and underlie uppermost Canajoharie (Fort Plain zone of Fairfield member). Rocks of this lithology grade into Poland member of Denmark formation along lower West Canada Creek, and in southeastern exposures at Stony Creek there is limited representation of typical Poland lithology. Thus, it is certain that lower part of type Dolgeville corresponds to Poland limestone. Rocks having stratigraphic position of Russia member of Denmark in vicinity of Middleville are wholly of

Dolgeville facies and are succeeded by black shales bearing same fauna as type Dolgeville. It is probable that the higher type Dolgeville is equivalent to most of the Russia. Thus, typical Dolgeville is equivalent to near the whole of the Denmark.

Well exposed in banks of East Canada Creek, just below Dolgeville, Herkimer County.

Dolls Run Sandstone (in Washington Formation)[1]

Permian: Northern West Virginia.

Original reference: E. L. Core, 1929, West Virginia Acad. Sci. Proc., v. 3, p. 204.

Occurs in region near Core, Monongalia County.

Dolores Formation[1]

Upper Triassic: Southwestern Colorado.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

A. L. Bush, C. S. Bromfield, and C. T. Pierson, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-96. Mapped as Upper Triassic. In Placerville quadrangle, consists of red siltstone, sandstone, shale, and a few thin limestone-pebble conglomerate layers; quartz-pebble conglomerate or grit at base; locally includes thin Wingate sandstone equivalent of Triassic age at top. Unconformable above Cutler formation and below Entrada sandstone.

Named for typical exposures in valley of Dolores River.

†Doloresian series[1]

Upper Triassic: Colorado, Arizona, New Mexico, and Utah.

Original reference: C. R. Keyes, 1924, Pan-Am, Geologist, v. 41.

Dome Limestone

Dome Formation[1]

Dome Limestone (in Ophir Group)

Middle Cambrian: Western Utah and southeastern Nevada.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 11.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1134–1135, 1141 (fig. 5), 1145. At emended section formation is 310 feet thick and consists of black and dark-gray thick- and thin-bedded fine-grained limestone which contains drab-tan and maroon clay flakes, laminae, and nodules in lower two-thirds and dull-gray argillaceous pure limestone in upper third. Conformably overlies Howell limestone (emended); underlies Swasey limestone (emended). Forms part of continuous emended Cambrian section for region.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 38–39, fig. 5. Geographically extended into Nevada where it is same as units D-E of Highland Peak limestone as described by Wheeler and Lemmon (1939). Unconformably overlies Burnt Canyon limestone (new); unconformably underlies Condor member (new) of Swasey limestone.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 35, 45–46, pl. 1, measured sections. Included in Ophir group in Sheeprock

Mountains, where it overlies Burnt Canyon limestone and underlies Condor formation. Thickness 37 to 81 feet.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 49, 50 (fig. 4), 51. Wheeler's terminology in House Range revised. Term Burnt Canyon replaced by Chisholm formation, and Condor member of Swasey limestone replaced by Whirlwind formation (new). Hence, Dome overlies the Chisholm and underlies the Whirlwind. In Wah Wah Range, the Dome lies between the Chisholm and the Whirlwind.

Type locality: Head of Dome Canyon, House Range, Millard County, Utah. Emended section measured on north side of Marjum Canyon, House Range.

Dome Canyon Limestone[1]

Middle Cambrian: Western Utah.

Original reference: C. D. Walcott, 1912, U.S. Geol. Survey Mon. 51, p. 157.

U.S. Geological Survey has abandoned the term Dome Canyon limestone in favor of Dome limestone, the more widely used term.

Type locality: Dome Canyon, House Range, Utah.

Domengine Formation[1] or Sandstone

Domengine Stage

Eocene, middle: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 3, p. 167–168.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 861–863. West Coast Eocene comprises (ascending) Martinez, Meganos, Capay, Domengine, Transition, and Tejon stages. For the Martinez, Capay, and Domengine, there is fairly good faunal evidence for general correlation.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. Domengine formation in Tumey Hills overlies Lodo formation (new).

H. E. Vokes, 1939, New York Acad. Sci. Annals. v. 38, p. 13 (table 1), 15–16. Name Domengine was first used (as Domijean) by Anderson (1905) to designate a sandstone member in Eocene north of Coalinga, the upper part of which included Domengine formation as recognized in this report but lower part of which included the white sandstones of Arroyo Hondo formation (new). Formation is described in areas designated as follows: type section of Domengine, including region from Oil City north to Cantua Creek; Vallecitos section, including Vallecitos syncline; Coal Mines section between the overlaps north of Alcade Creek and south of Los Gatos Creek; and Reef Ridge section, including area from Garza Creek to point about 2 miles south of Big Tar Canyon. Domengine (restricted) occurs as almost continuous line of outcrop throughout entire area included in this report. Only interruptions of any extent occur between north end of Reef Ridge section near Zapato Creek and southern part of Coal Mine section and southern part of type section in vicinity of Los Gatos Creek. In both areas, the Domengine is overlapped by Etchegoin formation. Thickness about 140 feet in type area. In some areas, overlies Cantua sandstone member of Arroyo Hondo formation; underlies Kreyenhagen formation. Domengine stage is younger than Capay stage.

Boris Laiming, 1940, 6th Pacific Sci. Cong., v. 2, p. 535–568. Discussion of character and distribution of smaller foraminifera in marine Eocene

deposits of California and correlation of foraminiferal zones with faunal "stages" already established by paleontologists on basis of mollusca. Correlation chart shows 12 foraminiferal zones in Eocene as compared to 6 stages on basis of mollusca. Foraminiferal zones (ascending) B–1 and B–1A correlate with Domengine stage of Clark and Vokes (1936).

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1747–1750. Domengine sandstone, as redefined by Clark (1926, California Univ. Pub. Bull. Geol. Sci., v. 16, no. 5), is well-defined mappable unit, and north of Coalinga overlies Yokut sandstone (new); underlies Kreyenhagen shale.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 209–210. In San Benito quadrangle, Domengine sandstone occurs on both sides of Butts Ranch syncline, from eastern edge of quadrangle to Salt Creek, where it is overlapped by Etchegoin group and San Benito gravels. Thickness about 200 feet. On south side of syncline, rests on Yokut sandstone; on north side of syncline, rests alternately upon Butts Ranch shale and Call sandstone member (both new) of Panoche group. Middle Eocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 56–59, pls. Domengine sandstone widely distributed in all quadrangles mapped in this report [Coast Ranges immediately north of San Francisco Bay region] except Point Reyes, Petaluma, and Santa Rosa. Exposed in eight areas and attains maximum thickness of 2,200 feet; average thickness less than 200. Overlies Capay shale; underlies Markley sandstone.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Overlies Hawkhill formation (new).

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 4), 12 (fig. 6), 13, 15, 16 (fig. 9). Formation is defined in this paper [area of type Moreno] as beds stratigraphically below glauconite at base of Kreyenhagen shale and above Lodo formation. Includes gray foraminiferal shale and underlying gray sands down to base of Panoche bed which rests unconformably on Lodo formation in southeastern part of Panoche Hills. This is sequence of sediments except for the restricted area where Chaney Ranch sandstone (new) is found in outcrop and another area just north of Cantua Creek where basal Kreyenhagen glauconitic sand lies directly on Yokut sand. Comprises (ascending) Nonada sand and Capita shale members (both new). In some areas, overlies Laguna Seca formation (new). Name Domengine is undesirable in time stratigraphic sense.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. As used in this report [Panoche Hills, Fresno County], Domengine sandstone includes fossiliferous sandstone that directly overlies Lodo formaiton or White's Yokut sandstone, where it is present, and underlies Kreyenhagen shale. Crops out discontinuously from Tumey Gulch northward until it is overlapped by Tulare(?) formation in NW¼ sec. 5, T. 15 S., R. 12 E., at north edge of area. Thickness 125 to 250 feet.

G. B. Oakeshott, 1958, California Div. Mines Bull, 172, p. 22 (fig. 2), 58–59, pl. 1. In current usage, Domengine is stage name applied to rocks of middle Eocene age. It is also commonly used in many parts of California for mappable units in which middle Eocene microfauna or megafauna has been recognized. Formation crops out in San Fernando

quadrangle south of San Gabriel fault and covers area of about 0.1 square mile in Elsmere Canyon. Exposed thickness about 650 feet, but beds are cut off by Whitney fault. Unconformable below Elsmere sandstone member of Repetto.

Named for exposures in vicinity of Domijean or Domengine Ranch, in NE¼ sec. 17, north of Coalinga, Fresno County.

Domenigoni Granodiorite

See **Domenigoni Valley Granodiorite.**

Domenigoni Valley Granodiorite

Cretaceous: Southern California.

E. S. Larsen, Jr., and N. B. Keevil, 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 488. Named Domenigoni granodiorite in a report on a study of the batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 69, pl. 1. Described as several bodies of rock that range from tonalite to granodiorite. Crops out as light-colored boulders of disintegration. Derivation of name given.

Well exposed on both sides of Domenigoni Valley, southeastern part Elsinore quadrangle.

†Domijean Sands[1]

Eocene, middle: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 3, p. 167–168.

Named for development in vicinity of Domijean or Domengine Ranch, in NE¼ sec. 17, north of Coalinga, Fresno County.

Don Limestone[1]

A name applied by geologists of mining companies, in their company reports, to upper 260 feet of Syrena Formation (Pennsylvanian) of Santa Rita district, New Mexico.

See Humboldt Formation, New Mexico.

Dona Ana Member (of Lake Valley Formation)

Mississippian (Osage): Central southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1941 (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73–75; 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 935; no. 12, p. 2116, 2136–2138, fig. 8. Thin- to massive-bedded gray to brown coarsely crystalline very cherty crinoidal limestone. Normally interbedded with dark crinoidal marl beds. Normal even bedding complicated by local small bioherm masses. Basal part contains more soft marly material than central part. Upper part filled with large masses of light-colored chert. In some sections, uppermost 10 feet of member made up almost entirely of chert. Thickness of 60 feet in type section; thins northward and is missing entirely in northern part of Sacramento Mountains. Maximum thickness of 175 feet in San Andreas Canyon; thins abruptly to south and is absent in southern part of range. Thickness dependent to great extent on amount of pre-Pennsylvanian erosion in area where section is being measured. Upper member of formation. Conformably overlies Arcente member (new); unconformably underlies widely varying members of Pennsylvanian formations.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11 (fig. 4), 15. Geographic distribution given.

Type section: At head of Deadman Canyon, Sacramento Mountains, in south center sec. 3, T. 17 S., R. 10 E., Otero County. Named from Dona Ana County. Occurs only in Sacramento Mountains and in central part of San Andres Mountains.

Donaher sandstones[1]

Precambrian (Belt Series): Central western Montana.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 215.

Mission Range.

Donald quartzites[1]

Precambian: Montana.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 217.

Derivation of name not stated.

Donegal Limestone (in Sumner Group)[1]

Permian: Northeastern Kansas.

Original reference: R. C. Moore, 1936, Jour. Geology, v. 44, no. 1, p. 5–9.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 30. Term Wellington is used for the section between top of Herington limestone and base of Ninnescah formation. Of the 10 subdivisions listed, the Strickler limestone and Newbern shale members of the Donegal limestone (Moore, 1936) are not very persistent; name Donegal limestone is not well founded.

Type locality and derivation of name not stated.

Doneley Limestone Member (of Savanna Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma and southeastern Kansas.

C. C. Branson, 1954, Oklahoma Acad. Sci. Proc., v. 33, p. 192, 193 (table 1); C. C. Branson, 1955, *in* E. W. Reed, S. L. Schoff, and C. C. Branson, Oklahoma Geol. Survey Bull. 72, p. 67–68. Defined as the uppermost of three persistent "brown limes" of Savanna formation. At type section, calcareous clay ironstone 3 inches thick, lying 8 inches above a thin coal and its underclay. Lies 70 feet below base of Bluejacket sandstone; overlies Rowe coal, which is above Sam Creek limestone. Name credited to L. P. Chrisman (unpub. thesis).

Type section: One mile north of school building in NW¼ sec. 16, T. 26 N., R. 20 E., Craig County, Okla., in south bank of creek which crosses north-south section line road. Exposure is about 100 feet east of road. Name derived from Doneley School, which is shown on U.S. Geological Survey topographic map of Vinita quadrangle in NW¼ sec. 27, T. 26 N., R. 20 E. This school has been replaced by Pleasant Hill School which is at same location.

Doniphan Shale Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 44, 47.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22),

153. Doniphan shale member of Lecompton formation; underlies Big Springs limestone member; overlies Spring Branch limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24. Thickness 4 to 5 feet in Iowa and Nebraska and 5 to 10 feet in Kansas. Type locality stated.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 66. Notes thickness in Kansas as 5 to 34 feet. Contains some red shale and prominent sandstone beds in southern Kansas.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20, fig. 5. Dark-gray to buff, calcareous shale with beds of fossiliferous nodular limestone. Thickness 3 to 6 feet. Underlies Big Springs limestone member; overlies Spring Branch limestone member.

Type locality: In Missouri River bluffs, northeastern Doniphan County, Kans.

Donkey Fanglomerate

Pliocene(?): Southern central Idaho.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1095, 1122–1123, pl. 1. Defined to include partially cemented material of alluvial character which is older than the alluvium of the modern valleys. Composed almost exclusively of rounded to subangular poorly sorted gravel in an abundant cemented matrix composed largely of angular pebbles, sand, and dirt held in a mixture of quartz and calcite. Locally porous calcareous material so predominates in cement that material resembles caliche. Forms hills and spurs in and on sides of valleys, and recent alluvium laps up against it. Attains thicknesses upward of 1,000 feet. Rests on and contains pebbles of Challis volcanics.

Named for Donkey Hills where it is exceptionally well displayed. Principal exposure is west of Donkey Creek in western part of T. 11 N., R. 24 E., Borah Peak quadrangle.

Donkey Creek Glaciation or **Drift**

Pleistocene, upper: South-central Utah.

R. F. Flint and C. S. Denny, 1958, U.S. Geol. Survey Bull. 1061–D, p. 117 (fig. 25), 125, pl. 6. Southern part of Fish Creek-Grover drift lobe composed of drift assigned to Donkey Creek and Blind Lake (new) glaciations. Near Hickman Pasture, Donkey Creek drift narrows to width of less than 1,200 feet, probably because of massive slumping on eastern side of valley. Eastern lateral moraine of the drift is cut by an earthflow near Hickman Pasture. Pinedale(?) stage.

Mapped on flanks of Boulder Mountain, including the course of Donkey Creek on north flank of Boulder Mountain; Wayne and Garfield Counties.

Donley Limestone Member (of Greene Formation)[1]

Permian: Southwestern Pennsylvania and eastern Ohio.

Original reference: W. T. Griswold and M. J. Munn, 1907, U.S. Geol. Survey Bull. 318, p. 77.

Exposed in vicinity of Donley, Donegal Township, Washington County, Pa.

Donnay (Donny)

See **Donni Sandstone Member** (of Tagpochau Limestone).

Donnelly Glaciation

Pleistocene: East-central Alaska.

T. L. Péwé, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1289; T. L. Péwé *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 9, 13 (table 1) At least three major Quaternary glaciations recorded at north end of Delta River valley. Donnelly succeeded Delta glaciation (new). Extended about 15 miles north of Alaska Range. Distinct terminal bulbs spread northward onto plain from Little Delta River, Delta Creek, Granite Creek, Gerstle River, and Johnson River. Well-preserved end moraines with many lakes and fresh knob-and-kettle topography at base of range. Glacier split into major and minor lobe near Donnelly Dome and partially surrounded the dome.

Named after Donnelly Dome, a prominent rock knob 25 miles south of Big Delta.

Donnelly iron ore[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Donni Sandstone Member (of Tagpochau Limestone)

Donni Tuff

Miocene, lower: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 61–63]. Donny beds include alternating tuff, sandstone, and shale beds. Lower part consists of alternating fine-grained conglomerate, sandstone, shale, and tuff with limestone blocks and lenses; middle part, alternating sandstone, sandy shale, and shale; upper, alternating shale, arenaceous shale, and marl. Well stratified. Thickness appropriate 100 to 200 meters at Donny and Tarohoho; 30 centimeters on sea-cliff of Naftan Peninsula. On north wall of valley east of Saipan Institute, exposed in thin calcareous seam between Laulau limestone and Tappocho limestone.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 10–11. Donni tuff is brilliantly colored and well-stratified formation consisting of beds of conglomerate, tuff, sandstone, and shale. Rests unconformably on Sankakuyama rhyolite, Hagman andesite, and tuffs of Densinyama formation, and grades laterally into Laulau and Tagpochau limestones; disconformably overlain by Naftan and Mariana limestones. Miocene (Aquitanian).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 68–71, pl. 2, chart 2. Reduced to member status in Tagpochau limestone. Comprises thinly bedded and well-bedded, soft, tuffaceous, marine sandstone, siltstone, marl and shaly beds, and pebble and granule conglomerates. Average thickness 100 feet; may be as much as 200 feet. Although at any given place the Donni may lie relatively above, below, or within the local Tagpochau succession, its

general distribution pattern suggests that it properly occupies a position near middle of formation. Type section designated.

Type section: Between I Hasngot Ravine and I Pitot Ravine. Its base is west of junction of Cross-Island Connecting Highway and East Coast Highway and its top along East Coast Highway about 800 feet east-southeast of junction.

Donny Sandy Tuff

See **Donni Sandstone Member** (of Tagpochau Limestone).

Donovan Formation

Lower Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229–235. Consists principally of hard green and gray noncalcareous sandstone, sandy shale, red sandstone, and yellowish calcareous sandstone. Thickness 2,241 to 2,500 feet. Underlies Mowich group; appears to be oldest Jurassic formation in central Oregon; Jurassic sequence lies with high-angle discordance upon a basement of highly folded strata which are in part of Mississippian and Upper Triassic age.

Exposures occupy less than one-half square mile in secs. 5, 6, 7, and 8, T. 20 S., R. 30 E., 19 miles north of Burns and 10 miles west of Crow Flat Ranger Station. Named for Tim Donovan Ranch, in sec. 7, T. 20 S., R. 30 E., Crook County.

Dooley Rhyolite Breccia[1]

Miocene(?): Northeastern Oregon.

Original reference: J. Gilluly, 1937, U.S. Geol. Survey Bull. 879.

Named for exposures on Dooley Mountain and in Stices Gulch and Mill Creek, Baker quadrangle.

Dora Dolomite Member (of Bluebell Formation)

Silurian: Central Utah.

Paul Billingsley, 1933, *in* J. M. Boutwell, Internat. Geol. Cong. 16th, [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Name appears on stratigraphic column of Tintic district. Overlies Beecher member (new); underlies Noah member (new).

T. S. Lovering and others, 1949, Econ. Geology Mon 1, p. 7 (table 1). Upper 10 feet gray wavy thin-bedded ("Curley") dolomite; remainder of unit dominantly fine-grained blue-gray dolomite containing a few light-gray nearly lithographic dolomite beds. Thickness 212 feet.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 144. Dora dolomite (in part at least) should be termed Sevy.

Type locality and derivation of name not stated.

Dorado Basalt (in Hinsdale Series)

Pliocene: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 51, 53, pl. 1. Flows of olivine basalt, basalt, and quartz basalt. Appears partly to wholly crystalline, fine grained, and porphyritic in thin section. Thickness from at least 40 to about 100 feet. Younger than Cisneros basalt (new); unconformably overlies Cordito member (new) of Los Pinos formation. Name credited to Butler (unpub. dissert.).

Name applied to basalt that caps Petaca Mesas. Particularly well exposed in Dorado Canyon, northeast of Petaca.

Dorans Cove Sandstone[1]

Mississippian: Northeastern Alabama.

Original reference: J. J. Stevenson, 1903, Geol. Soc. America Bull., v. 14, p. 76.

Well exposed in Madison, just west from Jackson. Named for Dorans Cove, Jackson County.

Dorcheat Member (of Schuler Formation)

Upper Jurassic: Subsurface in Arkansas, northern Louisiana, and eastern Texas.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 578 (table 1), 597, 602–609. Upper member of formation. Defined as including the nearshore pastel, varicolored shales, and sandstones, and the equivalent offshore dark-gray fossiliferous shales, sandstone, and limestones between the base of the Hosston formation and the top of the red-green shales, sandstones (nearshore facies), and marine rocks (offshore facies) of the Shongaloo member (new). Locally, dark-gray, glauconitic, fossiliferous shale, herein named the Wesson tongue, occurs near the top of the nearshore facies of the member. Occurs between depths of 6,420 to 7,510 feet in type well. Attains its greatest thickness of 1,200 feet or more near Arkansas-Louisiana State line and on the Monroe uplift, in Morehouse Parish, La., south of which it thins gradually. In most areas, the Dorcheat is overlain with regional conformity by the Hosston formation; in central part of Monroe uplift, overlain by late Upper Cretaceous chalk; in East Texas basin, the contact is unconformable; generally the Dorcheat conformably overlies the Shongaloo; in Nevada County, Ark., it overlaps the Shongaloo and rests directly on the Smackover limestone; in Bowie County, Tex., it overlaps the Shongaloo and rests on Paleozoic sandstone.

Type section: Atlantic Refining Co.'s Pinewoods Lumber Company No. 1, C., NE¼NE¼ sec. 16, T. 18 S., R. 22 W., Columbia County, Ark:; Dorcheat Field discovery well.

Dorchester Slate Member (of Roxbury Conglomerate)[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. W. Dodge, 1881 and 1882, Boston Soc. Nat. History Proc., v. 21, p. 208–210.

Named for Dorchester district of Boston, where it is exposed at several places.

Dorena Welded Tuff

Tertiary: Western Oregon.

D. M. Hausen, [1954], Mississippi Acad., Sci. Jour., v. 5, p. 212–216. Consists, locally, of five mappable units ascending): crystal and vitric tuff, pumice tuff, dacite tuff, pumice tuff, and crystal and vitric tuffs. Overlies and underlies pumice tuff units.

Type locality: Near Dorena, Lane County.

Dornick Hills Formation[1]

Dornick Hills Group

Pennsylvanian: Central southern Oklahoma.

Original reference: J. A. Waters, 1927, Jour. Paleontology, v. 1, p. 129.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Dornick Hills group comprises (ascending) Jolliff, Otterville, Bostwick, Lester, and Frensley limestones, and Pumpkin Creek beds. Overlies Springer group; underlies Deese group. Morrow-Lampasas series.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 138–143. Group redefined and subdivided into three formations (ascending): Golf Course (new), Lake Murray (new), and Big Branch. Golf Course formation includes the Primrose at base and the Otterville at top. Primrose sandstone and shale between the Primrose and Otterville are transferred from Springer group to Dornick Hills. Overlies Springer group; underlies Deese group. Pennsylvanian (Morrow, Atoka, Des Moines).

Named for Dornick Hills north of Ardmore, Carter County.

Dorothy Limestone and Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original references: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Raleigh and western Mercer and Summers Counties, p. 353.

Exposed at Dorothy, Raleigh County.

Dorr Run Shale Member (of Allegheny Formation)

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and W. M. Merrill, 1949, Ohio Jour. Sci., v. 49, no. 1, p. 1–11. Proposed for fossiliferous shale overlying the Lower Freeport coal in an exposure on southwest side of Dorr Run valley 1.6 miles northwest of junction of road along Dorr Run with Logan-Nelsonville road. Typically gray to dark-gray or even black argillaceous carbonaceous fossiliferous marine shale; in vicinity of Downhour School in Ward Township, member is light gray and argillaceous. Average thickness 17 inches.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 83–84. Member of Lower Freeport cyclothem in report on Athens County. Allegheny series.

Type section: In abandoned strip mine in SW¼NW¼ sec. 31, Ward Township, Hocking County; entire section includes strata exposed along side road in SE¼NW¼ sec. 31.

Dorset Limestone[1]

Cambrian and Ordovician: Southwestern Vermont.

Original reference: C. H. Hitchcock, 1860, Boston Soc. Nat. History Proc., v. 7, p. 237.

Dorset Mountain, Rutland and Bennington Counties.

Dorton Shale (in Crooked Fork Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4–6, pls. 2, 3. Name applied to shale between top of Rockcastle conglomerate and base of Crossville sandstone. Thickness commonly 50 to 80 feet; at type locality approximately 35 feet; in Crooked Fork section 42 feet; maximum thickness 115 feet occurs on Cumberland block. Contains Rex coal near base and thin Potters Falls coal near top. Name Duskin Creek was previously used for beds presumably overlying the Rockcastle, and including Dorton shale of this report. Type section of Duskin Creek consists of beds of the Vandever formation that actually underlie the Rockcastle. This error is believed due to failure to identify the Rockcastle because of its local shaly character.

Named from exposure near Dorton, Dorton quadrangle, Cumberland County.

Dorwin Sandstone Member (of Amsden Formation)[1]

See **Darwin Sandstone Member** (of Amsden Formation), correct spelling.

Dosados Sand and Shale Member (of Moreno Formation)

Upper Cretaceous: Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1954; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 4), 9, 22, pls. 2, 3. Thickness about 200 feet. Underlies Tierra Loma shale member (new); unconformably overlies Panoche formation. On basis of this mapping it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch.

Type locality: Escarpado Canyon, Panoche Hills, Fresno County. Name is contraction of Spanish dos a dos. Escarpado Canyon is 6 miles south of Moreno Gulch and 2 miles north of Panoche Creek.

†Dos Alamos Gypsum Member (of Delaware Mountain Formation)[1]

Permian: Western Texas.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 922, 925.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 570 (footnote). Term Dos Alamos gypsum abandoned because the gypsum layers are included in the newly defined Cutoff shaly member of Bone Spring limestone.

Named for exposures near Dos Alamos, or Cottonwood Wells, due west of Guadalupe Point, on west side of Salt Flat, Hudspeth County.

Dos Palmas Rhyolite

Miocene(?): Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 24, 25 (fig. 3), pl. 2. Thickness as much as 400 feet. Rests directly on much older crystalline rocks. Southeast of Box Canyon, underlies Canebrake conglomerate (new).

Crops out in Mecca Hills, Imperial County, 8 miles S. 30° E. of Mecca.

Dos Palos Shale Member (of Moreno Formation)

Upper Cretaceous and Paleocene(?): Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1953; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 4), 9, 22, pls. 2, 3, 4, 5. Consists principally of brown shale. Thickness 900 to 1,045 feet; includes the 60-foot Cima sandstone lens (new) 185 feet below its top. Discomformably underlies Paleocene glauconitic sandstone; overlies Marca shale (new). On basis of this mapping, it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortegalita Creek some 1,800 feet stratigraphically lower than in their type Moreno in Moreno Gulch.

Type locality: Escarpado Canyon, secs. 7 and 8, T. 15 S., R. 12 E., Panoche Hills, Fresno County. Named for town of Dos Palos. Escarpado Canyon is 6 miles south of Moreno Gulch and 2 miles north of Panoche Creek.

Dos Picachos Gravels

Pleistocene and Recent: West-central California.

N. L. Taliaferro, [1946?], Geologic map of the Hollister quadrangle, California (1:62,500): California Div. Mines Bull. 143, pl. 1 [preprint?]. Shown on map legend as coarse cemented gravels.

Exposed along Dos Picachos Creek, northeast Hollister.

Dot Limestone, Dolomite, or Formation

Middle Ordovician: Southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Dolomitic limestone weathering yellow or red and with characteristic rounded surfaces in lower part; tan dense fine-grained limestone in upper part; normally contains no zones of chert nodules, but locally one or more zones of chert nodules are present near top; prominent conglomeratic zone of chert and dolomite pebbles at base. Thickness 120 to 193 feet. Unconformably underlies Poteet limestone (new); unconformably overlies Mascot dolomite. Dot limestone and Poteet limestone shown as Murfreesboro limestone (after Butts) on U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 76.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–37, 93, 96, 100–102, pl. 1. Further described and type section given. Dot seems to correlate with zones 1 and 2 of Blackford formation as used by Cooper (1944) in Burkes Garden quadrangle. Summary of conflicts in nomenclature of Middle Ordovician formations in Lee County.

Type section: In cut of Louisville and Nashville Railroad spur at Hagan, Lee County. Name derived from settlement of Dot, which is at junction of U. S. No. 58 and State Route 66 in eastern part of Jonesville district. Limestone crops out in two continuous belts on opposite sides of main anticlinal axis of Jonesville district.

Dothan Formation[1]

Upper Jurassic: Southwestern Oregon and northern California.

Original reference: J. S. Diller, 1907, Am. Jour. Sci., 4th, v. 23, p. 401–421.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 81–83. Diller (1907) concluded that the Dothan was younger than the Galice and believed that the entire section, Galice, volcanics, and Dothan, was

overturned. Present study indicates that Dothan sediments in type section are not overturned, except locally on drag folds; Dothan is older than the Galice and, at type section at least, is separated from it by volcanics which grade downward into the former and upward into the latter.

F. G. Wells and G. W. Walker, 1953, Geology of the Galice quadrangle, Oregon: U.S. Geol. Survey Geol. Quad. Map [GQ–25]. Consists largely of sandstone, siltstone, and shale, with a few chert lenses, lenticular beds of conglomerate, and layers of volcanic rocks. Crops out in western part of quadrangle; distance across strike is 12 miles, 7 within and 5 without the quadrangle. Thickness difficult to determine due to thickening by folding and repetition of beds; stratigraphic thickness may be 10,000 to 18,000 feet. Present study shows Dothan is right side up and stratigraphically below volcanic rocks of Rogue formation (new). Dothan is assumed to be older than Galice.

F. W. Cater, Jr., and F. G. Wells, 1953, U.S. Geol. Survey Bull. 995–C, p. 84–86, pl. 11. Geographically extended into Gasquet quadrangle, California, where it consists of about 15,000 feet of graywacke, sandstone, shale, chert, and conglomerate. In northwest corner of quadrangle, Dothan rocks plunge southward under, and are generally conformable with, the peridotite sheet of Josephine Mountains; to the south, on Middle Fork of Smith River, the peridotite in turn underlies southward-plunging metavolcanic rocks of Galice formation that are known to be in normal position; hence, it is assumed Dothan underlies Galice, and although older than Galice, is still probably no older than Late Jurassic.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2778. Myrtle formation in southwestern Oregon is herein rank raised to group and subdivided into Riddle and Days Creek formations. Some of Myrtle formation as mapped by Diller is excluded from Myrtle group and reassigned to Dothan formation. Riddle formation rests on Rogue formation near Days Creek and in valley of Myrtle Creek, Douglas County; on Dothan formation in Dutchman Butte quadrangle and in southwestern part of Roseburg quadrangle in Douglas County; on Dothan formation in Dutchman Foggy Creek area of Bone Mountain quadrangle in Coos County. Contact with these underlying formation is angular unconformity.

Named for Dothan post office on Cow Creek, Douglas County, Oreg.

†Dothan Limestone (in Moran Formation)[1]

Dothan Limestone (in Moran Group)

Permian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Moran herein raised to group status. Underlies Horse Creek formation; overlies Camp Colorado formation in Pueblo group.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 5. Replaced by Ibex limestone (new). Term Dothan preoccupied.

Crops out near Dothan, Callahan County.

Dotsero Formation

Dotsero Dolomite

Upper Cambrian: Central northwestern Colorado.

C. F. Bassett, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1855–1858. Dotsero dolomite consists of beds of gray dolomite and limestone with partings and thin beds of shale. Some beds intraformational conglomerates and breccias. In some beds, the included pebbles are gray, whereas in others they are red. Dolomites and limestones are of shallow-water origin as indicated by presence of ripple marks, rain prints, and other markings. Thickness in a bluff along road, 2.35 miles west of Garfield-Eagle County line, is 269 feet. Overlies Sawatch quartzite and underlies Parting quartzite member of Chaffee formation.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 896–904. Redefined as formation, which includes only the lower part (Late Cambrian) of the former Dotsero dolomite. Comprises the sequence of beds, 96 to 106 feet thick, directly above Sawatch quartzite. Contains considerable amounts of glauconite in many beds. Subdivided into two new members (ascending): Glenwood Canyon and Clinetop algal limestone. Underlies Dead Horse conglomerate member (new) of Manitou formation.

Named for good exposures in northeastern end of Glenwood Canyon near Dotsero, about 100 miles west of Denver.

Dotson Black (sheety) Shale[1]

Mississippian: Northwestern Arkansas.

Original reference: D. D. Owen, 1858, First Rept. Geol. Reconn. northern counties of Arkansas, p. 101–102.

Exposed on Wharton Creek at Dotson's Farm, Madison County.

Dotson Sandstone[1]

Dotson Sandstone (in Kanawha Group)

Pennsylvanian (Pottsville Series): Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 215, 221, 222. In Greenbrier County, Dotson sandstone (Campbell, 1897) is 20 to 65 feet thick. Underlies Gilbert coal; overlies Douglas coals. Lower Dotson sandstone (Hennen, 1919) is 10 to 25 feet thick. Overlies Douglas shale; separated from overlying Dotson sandstone by Douglas coals. Both sandstones included in Kanawha group, Pottsville series.

Named for occurrence at Dotson, McDowell County, W. Va.

Double Crater Volcanics

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Agglomerate and interbedded lava flows. Name appears only on geologic map legend.

Mapped on summit of Double Crater in vicinity of Pavlof Volcano, Alaska Peninsula.

Doublehorn Shale Member (of Houy Formation)

Upper Devonian and Lower Mississippian(?) : Central Texas.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 807, 810, 811, pl. 3 (fig. 1). A black fissile radioactive spore-bearing shale from which, at places, large silicified pieces of wood of *Callixyon* have weathered free. Maximum thickness 15 feet; thins to disappearance. Principal unit of the Houy; overlies Ives breccia member; underlies unnamed phosphoritic member, or locally, Chappell limestone. Remnants of Doublehorn are found only along eastern side of Llano region.

Type section: Along Burnam Branch where it enters Doublehorn Creek and on Rubin Houy Ranch along Doublehorn Creek just down stream from Houy Branch, Burnet County.

Double Horseshoe cyclothem (in Carbondale Group)

Pennsylvanian: Eastern Illinois and western Indiana.

J. W. Alexander, 1943, Illinois Acad. Sci. Trans., v. 36, no. 2, p. 141–143. Composed of two limestones, both of which are thin and discontinuous. Upper is limestone conglomerate which has light-gray limestone matrix and contains black pebbles; maximum thickness 6 inches. Lower is light-gray lithographic slightly septarian limestone; maximum thickness 14 inches. Occurs below St. David limestone and above Summum cyclothem.

Well exposed in "Double Horseshoe" region on Little Vermilion River at Illinois-Indiana border.

†Double Mountain Formation[1] or Group

Permian: Central northern and central Texas.

Original reference: E. T. Dumble and W. F. Cummins, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxx, 187, 188, pl. 3.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 668. Name Double Mountain group abandoned; part of former unit now classed under Whitehorse group.

Named for Double Mountains, Stonewall County.

Double Point Dacite

Quaternary, middle: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 177–180, pl. 23. Flows of light- to dark-gray glassy to lithoidal rocks containing many small plagioclase phenocrysts ordinarily visible in hand specimen. Rocks commonly irregularly vesicular, the vesicles commonly being lined with sugary-textured altered glass, tridymite, or both. Although classified as high-silica dacite, composition ranges into rhyodacite. Contains many round inclusions of miarolitic andesite. Flows form volcanic pile 3,000 feet high. Younger than Williwaw Cove (new), Sitkin Point (new), and East Point (new) formations. Underlies Patterson Point formation (new).

Named for exposures north of Double Point in southwest coast of Little Sitkin Island, in Rat Islands group of Aleutian Islands. Largest outcrop area extends from Double Point northeastward to drainage of Williwaw Cove stream and includes present caldera scarp.

Doublian series[1]

Permian: Texas.

Original reference: C. R. Keyes, 1929, Pan-Am. Geologist, v. 57, p. 337, 350–356.

Dough Hills Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 158–161, geol. map. Consists primarily of a thick group of silty clays with calcareous beds near the center; lower beds are yellow silty clays carrying localized opaline nodules. Thickness 85 to 135 feet. Contact with underlying Carnahan Bayou member (new) arbitrarily taken as a tuffaceous clay bed which outcrops near center of NW¼ sec. 12, T. 4 N., R. 5 W.; contact with overlying Williamson Creek member (new) arbitrarily drawn on the appearance of numerous sand lentils in the clayey-silt sequence overlying the calcareous clay beds.

Crops out in Dough Hills, centrally located in T. 4 N., Rs. 4 and 5 W., Rapides Parish.

Doughnut Formation

Upper Mississippian: Central northern Utah.

M. D. Crittenden, Jr., B. J. Sharp, and F. C. Calkins, 1952, Utah Geol. Soc. Guidebook 8, p. 10–11, pl. 1. Includes parts of Morgan formation as defined by Calkins (1943, U.S. Geol. Survey Prof. Paper 201). Formation consists of dark rocks that are relatively unresistant. Lowest beds which are well exposed at south end of Doughnut Cliffs, are resistant, more or less sandy and siliceous, tawny-weathering rocks, in sharp contrast to the blue limestones of upper part of Humbug formation. Next 50 to 100 feet is black shale. Upper part consists of about 200 feet of thin-bedded limestone, blue black on fresh fractures but gray to buff on weathered surfaces. Underlies Morgan(?) formation.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 69–70, 71–72, 73. Overlies Humbug formation. Underlies Round Valley limestone (called Morgan? by Calkins and Butler, 1943, U.S. Geol. Survey Prof. Paper 201). Thickness at type locality 400 feet. This unit [Doughnut] can be traced over much of Cottonwood area, from near Neff Canyon near Salt Lake, south to Charleston Thrust, and east to Park City. East of there, bedrocks are covered by volcanics and younger sediments, but they reappear about 2½ miles east of Kamas where this unit consists largely of black shale. It has been called Manning Canyon shale by Sadlick (1955, Wyoming Geol. Assoc. Guidebook 10th Field Conf.; 1956, Intermountain Assoc. Petroleum Geologists Guidebook 7th Ann. Field Conf.) but fauna is virtually identical with Doughnut formation. Proposed that black shale unit of western Uinta Mountains be called Doughnut formation.

Type sections: In Cliffs east of Doughnut Falls, in Mill D South Fork, a tributary of Big Cottonwood Canyon, in Wasatch Mountains, east of Salt Lake.

Douglas Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, pl. 18.

Named for occurrence in Douglas mine, Houghton County.

Douglas Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Douglas Group[1]

Douglas Formation[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 93, 94.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2034, 2035 (fig. 5). As now recognized, group comprises strata, almost exclusively clastic occurring between disconformity at base of Virgilian series and base of Oread formation. Overlies Pedee group; underlies Shawnee group. Includes Stranger formation below and Lawrence formation above.

Named for Douglas County, Kans.

Douglas Shale (in Kanawha Formation[1] or Group)

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 183.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 215, 222. Underlies Lower Dotson sandstone; overlies Upper Nuttall sandstone. Thickness about 25 feet. Included in Kanawha group, Pottsville series.

Named for exposures at Douglas Railroad Station, McDowell County.

Douglas Canyon Formation[1]

Miocene, upper: Central Washington.

Original reference: A. D. Hoffman, 1932, Jour. Geology, v. 40, no. 8, p. 735–738.

Exposed in Douglas Canyon, one of side canyons of Moses Coulee, above and below waterfalls about one-half mile from canyon mouth, NW¼SW¼ sec. 30, T. 23 N., R. 24 E., Douglas County.

Douglas County traps[1]

Precambrian (Keweenawan): Northwestern Wisconsin.

Original reference: R. D. Irving, 1874, Am. Jour. Sci., 3d, v. 8, p. 46–56.

Douglas and Bayfield Counties.

Douglas Creek Member (of Green River Formation)[1]

Eocene: Northwestern Colorado and northeastern Utah.

Original reference: W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168.

D. C. Duncan and N. M. Denson, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 94. Described in Garfield County, Colo., where it is essentially brown sandstone and gray shale with a few thin beds of oolites and algae. Thickness 430 to 470 feet. Underlies Garden Gulch members; overlies Wasatch formation. Douglas Creek, Garden Gulch,

and Parachute Creek members interfinger with a unit referred to as lower sandy member of Green River. Eocene.

F. M. Swain, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 128, 130. In this report, the shales, sandstones, and oolitic limestones which Bradley placed in Douglas Creek member are referred to the Colton-Green River transition beds.

C. W. Cline, 1957, Brigham Young Univ. Research Studies, Geology Ser., v. 4, no. 3, p. 1–46. Discussed in detail in Piceance Creek basin, Colorado. Age of Green River given as upper middle Eocene.

Well exposed at head of Douglas Creek in E½ of T. 5 S., R. 102 W., Garfield County, Colo.

Douglas Hills member (of Fleming Formation)

A lapsus for Dough Hills.

Douglas Island Volcanic Group[1]

Jurassic(?) to Lower Cretaceous(?): Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 255–256, chart opposite p. 247, p. 270.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Age shown on chart as Jurassic.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. On northeast limb of Shelter syncline. Thickness estimated to be at least 5,000 feet and probably 10,000 feet in Juneau (B–3) quadrangle. Jurassic(?) to Early Cretaceous(?).

Forms main mountain mass of Douglas Island, Juneau region.

Douglas Lake Member (of Lenoir Limestone)

Middle Ordovician: Eastern Tennessee.

Josiah Bridge, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 727–729. Proposed for beds overlying Mascot dolomite and underlying typical nodular member of the Lenoir in Douglas Lake area. Member is composed of several rock types including rubble conglomerate. chert conglomerate, and black dolomite; the chert conglomerate overlies the rubble conglomerate (that occurs in depressions or sinks on upper surface of the Mascot) and at other places forms the lower part of the member; the black fine-grained thick-bedded dolomite, as much as 30 feet thick at the two large sinks, grades upward almost imperceptibly into typical Lenoir limestone; the Douglas Lake, therefore, is regarded as a discontinuous member of the formation.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 147. In Tellico-Sevier belt, eastern Tennessee, the Douglas Lake is basal member of the Lenoir. Underlies Mosheim member.

Type locality: On north shore of Douglas Lake, 1½ miles northeast of Douglas Dam, Jefferson County.

Douglass[1] (shales)

Lower Cretaceous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not given.

†Douty Gravel[1]

Pleistocene (pre-Wisconsin?): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 395. According to Willis (1898), deposits of Vashon age include Vashon drift, Osceola till, Osceola clays, and Douty gravels. Osceola till of Willis is now known to be a postglacial mudflow deposit from Mount Rainier. Osceola clays and Douty gravels of Willis are glacial drift of Vashon age, and the two names are thereby abandoned.

Named for Douty Station, in canyon near Carbonado, Pierce County.

Dover Limestone Member (of Stotler Limestone)

Dover Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 31.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15. Consists of thin fossiliferous limestone and some shale. Thickness 2 to 4 feet in Nebraska, southeastern Iowa, and northwestern Missouri; thicker in southern Kansas. Underlies Dry formation; overlies Langdon formation.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Stotler limestone (new). Underlies Dry shale member; overlies Pillsbury shale (new).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12, fig. 5. Consists of two limestone beds separated by thin bed of gray shale. Upper limestone is dense, gray, unfossiliferous, and weathers buff; lower limestone is dark gray to black, weathering to nodular form with many white fragments of *Derbyia*, *Chonetes*, and *Crurithyris*. Thickness about 3 feet. Underlies Dry shale; overlies Table Creek shale. Wabaunsee group.

Named for exposures near Dover, Shawnee County, Kans.

Dover Shale and Sandstone (in Wabaunsee Group)[1]

Pennsylvanian: Northeastern Kansas.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 31.

Named for Dover, Shawnee County.

Dowell Hill facies[1] (of New Providence Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 95, 102–103.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Correction chart lists Dowell Hill as facies of New Providence formation.

Described in Brown and Bartholomew Counties. Name derived from Dowell Hill in NE¼ sec. 25, T. 9 N., R. 4 E., 5½ miles west of Columbus, Bartholomew County.

Dowelltown Member (of Chattanooga Shale)

Dowelltown Formation (in Chattanooga Shale)

Upper Devonian: Central Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 883–884, 885. In type area and adjacent territory, consists of lower and upper member, each with a lower bed of fissile black shale and an upper bed with interbedded layers of gray and black shale; near crest of Nashville Dome, formation is a poorly fissile soft dull-black shale that shows a blending of the black and gray shale elements into a shale intermediate in character; lower member pinches out and is represented at Nashville only by a foot of sandstone. A layer of sandstone which is correlated with the Hardin sandstone occurs at base of Dowelltown at Celina. Thickness varies; 22 to 29 feet in type area; 8 to 12 feet in Macon and Clay Counties; 15 to 19 feet in Sumner County. Lies between Trousdale formation below and Gassaway shales (new) above and is basal part of the Chattanooga in most of central Tennessee. Devonian.

S. G. Conrad, R. T. Elmore, Jr., and S. W. Maher, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1358. Termed Dowelltown member of Chattanooga shale. Within Flynn Creek structure, Jackson County, maximum thickness of Dowelltown is 166.4 feet.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 12 (table 1), 16–20. In this report, considered a member of the Chattanooga shale. Underlies Gassaway member and in some areas overlies Hardin sandstone member. Where well developed, it is between 10 and 17½ feet thick and consists of two persistent units; lower one, which is predominantly black shale, and upper, which is primarily a grayish mudstone near the top of which is a bentonite bed about 0.1 foot thick. On west flank of Cincinnati anticline, Dowelltown is commonly a sandy black shale as much as 17 feet thick. Wedges out in Sequatchie Valley of eastern Tennessee and has not been recognized in south-central Tennessee or north-central Alabama.

Type sction: Outcrop 1½ miles east of Dowelltown, DeKalb County. Hass did not find Campbell's type section at designated distance but considered an exposure 3.1 miles east of Dowelltown on an abandoned part of Tennessee Highway 26 as Campbell's type locality.

Downeys Bluff Member (of Renault Formation)

Mississippian (Chester Series): Southern Illinois and northern Kentucky.

Elwood Atherton, 1947, Illinois Acad. Sci. Trans., v. 40, p. 129, 130 (fig. 7), 131 (fig. 8). Frank Tippie (unpub. ms.) correlated upper part of the Renault with the basal Paint Creek of western Illinois and proposed name Downeys Bluff for this member of the Paint Creek; remainder of the Renault is referred to as Shetlerville member. Thickness about 40 feet. At type locality, underlies Bethel sandstone.

J. M. Weller and others, 1952, Illinois Geol. Survey Bull. 76, p. 62–63. In fluorspar district, consists predominantly of limestone with small amounts of shale occurring as partings; limestones are commonly gray or bluish gray and crystalline to more or less fine grained. Thickness about 30 feet. Overlies Shetlerville member; at Downeys Bluff, contact is unconformable and at most places separation of the two units is difficult, especially where shale is not abundant in Shetlerville; underlies Bethel sandstone.

Type locality: Downeys Bluff, NW¼SE¼ sec. 5, T. 13 S., R. 8 E., Hardin County, Ill.

†Downs Limestone (in Greenhorn Limestone)[1]

Upper Cretaceous: North-central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 50.

Quarried near Downs, Osborne County.

Dox Sandstone (in Unkar Group)[1]

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (table), 110. Top formation in Grand Canyon series. Thickness over 3,000 feet in Unkar Valley. Underlies Cardenas lava series (new).

Named for Dox Castle, in Shinumo quadrangle, underneath which a typical section is found below Tonto group, which makes the castle.

Doxey Member (of Quartermaster Formation)[1]

Permian: Western Oklahoma.

Original reference: H. L. Griley, 1933, Pan-Am. Geologist, v. 59, no. 3, p. 234.

D. A. Greene, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1473, 1474. Doxey shale is 160- to 200 feet thick in Washita and Beckman Counties; near middle of unit are several bench-forming beds of siltstone. Underlies Elk City member, contact irregular; overlies Cloud Chief member.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Quartermaster formation includes Doxey and Elk City members. Cloud Chief mapped as formation.

Quartermaster formation is noted as occurring in Beckham, Caddo, Custer, Grady, and Washita Counties.

Doyle Shale (in Chase Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 715.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 80. Restored to formal nomenclature and considered as consisting of (ascending) Holmesville shale, Towanda limestone, and Gage shale members, which had heretofore been given formational rank. Overlies Barneston limestone; underlies Winfield limestone.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 115–116. Subdivided into (ascending) Holmesville shale, Towanda limestone, and Gage shale members. Members recognized in Kansas, southeastern Nebraska, and northern Oklahoma where they have been identified in Kay and Osage Counties. Members cannot be differentiated in Pawnee County. Thickness 103 to 118 feet in Kay County; 125 to 135 feet in Osage County. Thickness difficult to determine in Pawnee County; electric logs show about 150 feet. Overlies Fort Riley limestone; underlies Winfield limestone. Wolfcamp series.

Named for exposures on Doyle Creek, southwest of Florence, Marion County, Kans.

Doylesburg Member (of Shippensburg Formation)

Middle Ordovician (Bolarian): South-central Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 727–731. Name proposed for uppermost member of formation. Described at type locality as massive-bedded white-weathering dove calcilutite with dark-gray fine-grained platy limestone at top. In western belts of outcrop, two locally intertonguing lithofacies recognized: calcilutite facies and platy limestone facies with heavy interbeds of medium-gray to dove limestone conglomerate. Facies variations distributed in northeast-trending belts. Thickness 6 to 40 feet. Conformably overlies Fannettsburg member (new); disconformably underlies Mercersburg formation.

Type section: Exposure on south side of U.S. Route 30, 1 mile southwest of St. Thomas, Franklin County. Named for exposure at Binkley and Ober quarry at Dry Run, 4 miles southwest of Doylesburg in Path Valley.

Dozier Sandstone Member (of Rush Springs Formation)

Dozier Sandstone Member (of Peacock Formation)[1]

Permian: Western Texas.

Original reference: J. W. Beede, 1907, Kansas Univ. Sci. Bull., v. 4, no. 3, p. 142.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Reallocated to member status in Rush Springs formation.

U.S. Geological Survey has abandoned the term Peacock Formation.

First described on western side of "Dozier Mountains," east of Mr. Caperton's place (then Dozier post office), 15 miles south or southwest of Shamrock, Collingsworth County.

Dozier Mounds Dolomite

Dozier Mounds Dolomite Member (of Custer Formation)

Triassic: Texas.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 422, 438, 439, 450–457. Referred to as Dozier Mounds dolomite and Dozier Mounds dolomite member of Custer formation. When Custer was originally defined (Roth, 1932), base of Dozier Mounds dolomite was chosen as base of Custer because Dozier Mounds dolomite [Roth did not use formal name Dozier Mounds in his 1932 report] and Verden channel dolomite of Oklahoma were considered the same. Present study shows that Dozier Mounds dolomite is not always at base of Custer. Interval between Dozier Mounds dolomite and base of Custer increases as section is traced southwestward from Collingsworth County. First description of unit credited to Gould (1906, U.S. Geol. Survey Water-Supply Paper 154), who described unit near middle of Quartermaster as ledge of rather hard red or pinkish more or less oolitic sandstone, which on weathering gives rise to a number of flat-topped buttes and ridges. One of most typical [buttes] is Dozier Mounds, near Dozier post office. [On plate 8, Gould showed a hill in Rocking Chair Mountains capped by Dozier sandstone.]

Type locality: NE¼NE¼NE¼ sec. 28, Blk. 16, H. and G. N. Survey, Collingsworth County. Named for Dozier Mounds.

Dracut Diorite[1]

Upper Carboniferous or post-Carboniferous: Northeastern Massachusetts and southeastern New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 221–223, map.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 66. Not mapped by name in New Hampshire.

Named for occurrence at Dracut, north of Lowell, Middlesex County, Mass.

Dracut Norite[1]

Post-Cambrian and pre-Carboniferous: Northeastern Massachusetts.

Original reference: E. E. Fairbanks, 1927, Boston Soc. Nat. History, v. 38, p. 397–407.

W. H. Dennen, 1943, Econ. Geology, v. 38, no. 1, p. 27, 29, 32–34, 35–41. Contains many inclusions of Merrimack quartzite which it intrudes. Typical texture is holocrystalline. Cut by Andover granite and a few diabase dikes. Post-Cambrian and pre-Carboniferous.

Occurs at Dracut, Middlesex County.

Dragonian Age

Paleocene: North America:

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 9. pl. 1. Provincial time term, based on Dragon local fauna in North Horn formation, Dragon Canyon, Emery County, Utah, principally from western half of sec. 8, T. 19 S., R. 6 E. Covers interval between Paleocene Puercan (older) and Torrejonian ages. Definition of 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

†Dragoon Quartzite[1]

Middle Cambrian: Southeastern Arizona.

Original reference: E. T. Dumble, 1902, Am. Inst. Mining Engineers Trans., v. 31, p. 696–715.

Dragoon Mountains.

Dragoonan series[1]

Cambrian: Arizona and New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico. Des Moines, Robert Henderson, State Printer, p. 4, 6.

Named for Dragoon Mountains, southeastern Arizona.

Draney Limestone (in Gannett Group)[1]

Lower Cretaceous: Southeastern Idaho and western Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98–G, p. 76, 83.

R. E. Peck, 1941, Jour. Paleontology, v. 15, no. 3, p. 285–286. Considered Lower Cretaceous on basis of faunal studies.

L. S. Gardner, 1944, U.S. Geol. Survey Bull. 944–A, p. 7. In Irvine quadrangle, Idaho, 245 feet thick; overlies Bechler shale and underlies Bear River formation.

A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 65 (table 1), 67 (fig. 2), 68. In Gannett Hills area, western Wyoming, overlies Bechler formation (shale or conglomerate); underlies a discontinuous unnamed red bed unit below Bear River formation. Tygee sandstone is here included in Bear River formation.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 56, pl. 21. Referred to as member of Gannett group in Jackson Hole area. Consists of about 55 feet of limestone. Underlies Tygee sandstone member; overlies Bechler conglomerate member.

Named for exposure on top of ridge about 1¼ miles east of Draney Ranch, on Tygee Creek, sec. 10, T. 8 S., R. 46 E., Boise meridian, Idaho.

Draper Dolomite Member (of Nittany Formation)

Lower Ordovician (Canadian): Western Virginia.

B. N. Cooper, 1939, Jour. Geology, v. 47, no. 5, p. 511 (footnote). Name applied to upper member of formation; overlies Oglesby member (new). Thickness approximately 350 feet.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 19–20, pls. 1, 3. Formally proposed as Draper dolomite member. Composed of medium-bedded light-gray dolomitic limestone and dolomite; most beds are siliceous and slightly argillaceous; bedding is uniform in lower part of member but irregular in upper part. Thickness as much as 475 feet. Conformably underlies Bellefonte formation. Type locality stated.

Type locality: In Draper Mountain area, south of Lee Highway about three-fourths mile southwest of Draper School, near Draper, Pulaski County.

Draytonville Conglomerate Member (of Kings Mountain Quartzite)[1]

Ordovician to Mississippian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith and D. B. Sterrett, 1931, U.S. Geol. Survey Geol. Atlas, Folio 222.

U.S. Geological Survey currently designates the age of Draytonville as Ordovician to Mississippian on the basis of a study now in progress.

Named for exposures on Draytonville Mountain, Cherokee County, S.C.

Dresbach Group

Dresbach Sandstone[1] or Formation

Upper Cambrian: Southern Minnesota, northwestern Illinois, northeastern Iowa, and western Wisconsin.

Original reference: N. H. Winchell, 1886, Minnesota Geol. Nat. History Survey 14th Ann. Rept. p. 334–337.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 28 (table 4), 29–35. Formation described in southeastern Minnesota where it includes (ascending) Mount Simon, Eau Claire, and Galesville members. Underlies Franconia formation. At type section, includes Galesville member, 24 feet, and Eau Claire member about 128 feet. St. Croixian series.

H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 54. Classified as group consisting of Mount Simon, Eau Claire, and Galesville formations.

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 555. Underlies Woodhill member of Franconia formation.

R. R. Berg, C. A. Nelson, and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 6–8. No exhaustive study of Dresbach formation has been published, and distribution of its members and faunas is poorly known. Internally, Dresbach contains three distinguishable but genetically and gradationally related rock types: (1) medium- to coarse-grained quartzose sandstone that characterizes near-shore transgressive (Mount Simon member) and regressive (Galesville member) phases of cycle, (2) shaly sandstone and very fine grained quartzose sandstone that characterizes offshore (Eau Claire member) phase, and (3) red shale phase of Eau Claire identified in wells. Dresbach is topped by disconformity. At type section, uppermost 35 feet of Eau Claire member is composed of thin-bedded very fine grained sandstone, siltstone, and shale. Overlying 93 feet of Galesville member is massive- to crossbedded fine- to medium-grained sandstone. This subdivision of type section differs from previous descriptions in which most of Galesville sandstone was included in Eau Claire member.

U.S. Geological Survey currently classifies the Dresbach as a group on the basis of a study now in progress.

Named from town of Dresbach in Winona County, Minn.

†Dresbach Shale[1]

Upper Cambrian: Southeastern Minnesota.

Original reference: N. H. Winchell, 1888, Minnesota Geol. Nat. History Survey Final Rept., v. 2, p. 364.

At Dresbach, Winona County.

Dresbachian Stage

Upper Cambrian: North America.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Upper Cambrian comprises three stages (ascending): Dresbachian, Franconian, and Trempealeauan. The Dresbachian includes three faunal zones: *Cedaria*, *Crepicephalus*, and *Aphelaspis*.

C. A. Nelson, 1956, Internat. Geol. Cong. 20th Mexico, Cambrian symposium, pt. 2, p. 421–425. Dresbachian stage consists, by definition, of *Cedaria*, *Crepicephalus*, and *Aphelaspis* zones, which in turn occur within middle Eau Claire member of Dresbach formation. Hence, it is likely that Dresbach formation and Dresbachian stage will maintain nomenclatorially coincident boundaries in upper Mississippian Valley. However, *Cedaria* and *Aphelaspis* zones have their minimum expression in type Dresbachian area because of hiatuses associated with unconformities that bound Dresbach formation. Consequently, concept of Dresbachian will have to be expanded in area where sedimentary record is more complete and where its faunas mingle with earlier and later ones.

Named from town of Dresbach in Winona County, Minn.

Dresden Amphibolite[1]

Precambrian: Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

Type locality: Dresden Township, Washington County.

Dresden Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5, p. 919, 920, 991.

Probably named for Dresden, Muskingum County.

Drews Lake Granite[1]

Carboniferous(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 106–107, 148–149.

Named for exposures near Drews Lake, west of Houlton, Aroostook County.

Drinkard Sandy Member (of Yeso Formation)

Permian: Southeastern New Mexico (subsurface).

R. E. King, 1945, New Mexico Bur. Mines Mineral Resources Bull. 23, p. 13–15, fig. 1. Name applied to widespread clastic zone in middle or lower part of Yeso formation. In eastern Lea County, member is 90 to 110 feet thick, and consists of very fine grained calcareous and argillaceous gray and brown sandstone and sandy shale, in part pyritic, interbedded with brown sandy dolomite. In type well, occurs between depths of 6,100 and 6,210 feet.

Type section: Penetrated in Texas Co. Blinebry 1, 660 feet from south line and 1,980 feet from east line sec. 19, T. 22 S., R. 38 E., Drinkard area, Lea County.

Drinker Creek sandstone member (of Lanesboro formational suite)

Upper Devonian (Chautauquan): Northeastern Pennsylvania.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 46, 47–49. Name proposed for member at base of formational suite. Described as micaceous, quartzose, usually gray or olive-greenish sandstone; varies from fine sand to thin layers of flat vein-quartz pebbles up to 1 inch in diameter. Whole unit more or less lenticular and locally broken into flags and shales. Thickness 25 feet. Basal unit of upper sandstone sequence of White's (1881) New Milford group.

Type locality: Old quarry pits near forks of Drinker Creek about 1½ miles south of Susquehanna, Susquehanna County.

Dripping Spring Quartzite (in Apache Group)[1]

Precambrian: Southeastern Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

M. N. Short and others, 1943, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 12, 21–22. Completely uninterrupted section crops out on east side of Potts Canyon just west of Prudential mine. Here thickness is 820 feet, which is average total thickness of formation in Superior area.

J. R. Cooper, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 31, 32 (fig. 13). Unconformably underlies Bolsa quartzite in Johnson Camp area, Little Dragoon Mountains, Cochise County.

H. C. Granger and R. B. Raup, 1959, U.S. Geol. Survey Bull. 1046–P, p. 422–424, pls. 46–48. An upper and a lower member recognizable throughout Gila County. Lower member typically feldspar-rich cross-stratified well-indurated sandstone; upper member mostly of thinly stratified are-

naceous siltstone. Thickness ranges from 450 to 700 feet and averages about 600 feet in Sierra Ancha region and about 450 to 540 feet in Mescal Mountains. Overlies Barnes conglomerate; underlies Mescal limestone.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. Three members recognized in Haunted Canyon quadrangle. Lower, 100 to 200 feet thick, medium- to coarse-grained quartzite, grayish yellow, light gray, white; middle, 10 to 15 feet, nearly pure white medium-grained quartzite; upper, 200 to 300 feet, fine-grained quartzite interbedded with layers of shale. Overlies Barnes conglomerate; underlies Mescal limestone.

U.S. Geological Survey currently classifies the Barnes Conglomerate as a member of the Dripping Spring Quartzite on the basis of a study now in progress.

Named for Dripping Spring Mountains, Globe quadrangle.

Dripping Springs Formation

Pleistocene: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 3, 9, 14–15, pl. 1. Defined as the fanglomerates, in Temecula region, deposited with reference to a base level not greatly above present base level, as opposed to Pauba fanglomerates which were deposited at a much higher base level. Thickness about 30 feet. Unconformably underlies Recent terrace gravels; unconformably overlies Pauba formation (new).

Occurs in Elsinore fault zone in western Riverside and northern San Diego Counties. Well exposed in Dripping Springs alcove, Riverside County, especially in roadcuts along Highway 71.

Driscoll-Sevier Sand

Oligocene: Southern Texas (subsurface).

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1630 (fig. 5), 1631 (fig. 6), 1632–1633, 1634. Name suggested for sand unit north and west of marine shale wedge [Old Ocean sand] and representing merged western representatives of both underlying [Van Vleck] and overlying [Pierce Estate or Flour Bluff] sand.

Typically developed in well No. 27 (Santa Clara, Driscoll-Sevier No. A–1), Nueces County.

Droop Sandstone (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 415.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 225, 264. In Greenbrier County is grayish brown, massive, medium grained, and hard, commonly crossbedded, and ripple marked with carbonized plant remains. Thickness 50 to 100 feet. Underlies unnamed shale sections; overlies yellow, olive sandy shale above Reynolds limestone. Mauch Chunk series.

Type locality: On Droop Mountain, Pocahontas County, W. Va., in vicinity of Spice, Mt. Zion Church and West Droop School.

†Drum Group[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 73–74.

Drum Limestone (in Kansas City Group)[1]

Drum Limestone (in Skiatook Group)

Drum Limestone Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 37, 63, 66.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table), 42. Included in Skiatook group. Overlies Cherryvale shale; underlies Chanute shale of Ochelata group. Near Kansas-Oklahoma State line, the Drum is absent owing to erosion. Reappears a few miles south of State line and in Oklahoma has been known as Dewey limestone.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030–2032. Drum limestone, in type area, comprises two units classed as members. Upper unit, Corbin City, locally 40 feet or more in thickness, is not persistent. Corbin City disconformably overlies lower member which consists of fine-grained bluish limestone; this is identified unquestionably as Dewey limestone of northeastern Oklahoma. Northeastward tracing proves that Dewey member is same as limestone called Cement City in Kansas City area. Inasmuch as Dewey has priority over Cement City and has been widely used, it is recognized by Oklahoma Geological Survey as formational unit which is classed as uppermost division of Skiatook group. Kansas has used Cement City for lower member of Drum limestone, and Cement City was recognized by interstate conference. Kansas proposes to deviate from interstate classification by adopting Dewey, instead of Cement City.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 36–37. Formation comprises (ascending) Corbin City limestone (missing in Nebraska), Cement City limestone, Richfield Quarry shale (new), and P. W. A. Quarry limestone (new) members. Thicknesses: 12½ feet southwestern Iowa; 14 feet, Sarpy County, Nebr.; 3 to 18 feet, Kansas City, Mo.; 2 to 60 feet in Kansas. Underlies Chanute formation; overlies Quivera formation. Note on type locality.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness of formation 2 feet in Madison and Adair Counties; no members differentiated. Overlies Cherryvale formation; underlies Chanute formation. Kansas City group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. As shown on chart, Drum Limestone comprises (ascending) Cement City Limestone and Corbin City Limestone Members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Formation in Iowa is single conglomeratic, oolitic limestone bed characterized by tiny *Triticites*. Thickness 6 feet, Madison County; 14 feet, Pottawattamie County. Overlies Quivera shale; underlies Chanute shale. Kansas City group.

Type locality: Along highway east of Independence, Kans., and at cement plant in NW sec. 4, T. 33 S., R. 16 E. Named for Drum Creek, Montgomery County, Kans.

Drumheller Silts

Quaternary (post-Wisconsin): Central Washington.

[G. F. Beck], 1937, Central Washington Coll. Education Bull., v. 2, no. 7. Proposed for most recent valley fills occurring generally over Columbia Basin. Channel fills are 6 to 12 feet in depth. Bones showing relationship to modern buffalo are abundant in silts.

Well exposed in Drumheller section of Lower Crab Creek, Grant County.

Drumlummon Porphyry[1]

Tertiary, upper(?): Western central Montana.

Original reference: J. Barrell, 1907, U.S. Geol. Survey Prof. Paper 57.

Mapped on Drumlummon Hill, just south of Marysville, Lewis and Clark County.

Drummond[1] (clays)

Tertiary: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Drury Shale Member (of Caseyville Formation)

Drury Shale Member (of Battery Rock Formation)

Drury Shale and Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: J. E. Lamar, 1925, Illinois Geol. Survey Bull. 48, p. 23, 91–95, map.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 37, 38. Reallocated to member status in Battery Rock formation. Principally sandy shale and shaly sandstone 50 to 100 feet thick. Upper part of formation; overlies Battery Rock sandstone in lower part of formation.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29–30, 44 (table 1), 61, pl. 1. Reallocated to member status in Caseyville formation (redefined). Includes all strata between Battery Rock sandstone member below and Pounds sandstone member. Dominantly shale but includes some sandstone and two or more discontinuous coals. Thickness at type section of Caseyville, 98 feet. Name Drury not used in southeastern Illinois where Gentry coal and Sellers limestone are differentiated in this interval. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois.

Type locality: Along Drury Creek, secs. 33 and 34, T. 10 S., R. 1 W., Jackson County. Named for exposures along Drury Creek, in bluffs south of Makanda, Jackson County.

Dry Shale Member (of Stotler Limestone)

Dry Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 22, 236.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15. Consists of clay-shale, sandy shale, and fossiliferous limeseams. Thickness 14 feet in clay pits at Nebraska City. Areal extent noted.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Stotler limestone (new). Underlies Grandhaven limestone member; overlies Dover limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12, fig. 5. Bluish-gray silty shale with thin interbedded gray limestone and siltstone; ferruginous concretions common in siltstone. Thickness about 20 feet. Underlies Grandhaven limestone; overlies Dover limestone. Wabaunsee group.

Type locality: Dry Creek, in sec. 5, T. 20 S., R. 11 E., southwest of Emporia, Lyon County, Kans.

Dry Camp Breccia

Tertiary: Northwestern Arizona.

U.S. Bureau of Reclamation, 1950, U.S. Bur. Reclamation, Boulder Canyon Proj. Final Repts., pt. 3, Preparatory Exams., Geol. Inv., Bull. 1, p. 99, fig. 34 (geol. map). An intervolcanic sedimentary breccia. Resembles Dam breccia (new) but more definitely bedded. Maximum thickness about 400 feet. Part of younger volcanic series of area. Underlain and overlain by basalt. Name credited to F. L. Ransome (unpub. rept.).

Occurs only on east side of Black Canyon, Hoover Dam area.

Dry Cimarron Flow (in Capulin Basalts)

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1031. Black fine-grained vesicular olivine basalt with 4-mm olivine phenocrysts.

One long flow north and east 21 miles down Dry Cimarron Canyon, from Folsom, Union County.

Dry Creek Formation[1]

Eocene: Northern California.

Original reference: V. T. Allen, 1929, California Univ. Pub., Bull. Dept. Geol. Sci., v. 18, no. 14, p. 367–369, 400, 401, 403.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Used in quotational sense as a sandstone member of Ione formation. Name Dry Creek is preoccupied by Dry Creek shale of Montana.

Exposed in steep-walled valley formed by a tributary of Dry Creek, Chico quadrangle.

Dry Creek Glaciation

Pleistocene: Central southern Alaska.

Clyde Wahrhaftig 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 7, 13 (table 1); Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 17, 28–30, pls. 2, 3, 5.

Lake deposit at Dry Creek, 5 miles west of Healy; and drift between McKinley Park Railroad Station, 10 miles south of Healy, and Windy 20 miles further to the south, Nenana River valley area.

Dry Creek Sandstone Member[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Geol. Pub. 98, p. 76, 238, 243, 246.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Dry Creek sandstone and Brownstown Hills sandstone members included in Medora Knob facies of formation.

Named for prominence along Dry Creek, both east and west of Jackson-Lawrence County line.

Dry Creek Shale[1]

Dry Creek Shale Member (of Open Door Limestone)

Dry Creek Shale Member (of Red Lion Formation)

Dry Creek Shale Member (of Sage Limestone)

Dry Creek Shale Member (of Snowy Range Formation)

Upper Cambrian: Western Montana and northwestern Wyoming.

Original references: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110; 1896, U.S. Geol. Survey Geol. Atlas, Folio 24; W. H. Weed, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1284, 1335–1337, strat. sections. Weed's (1900) definition of Dry Creek shale emended. Dry Creek rests on Pilgrim limestone (emended) and is youngest Cambrian formation in any of measured sections. Underlies Devonian limestones; term Yogo limestone discarded. Characteristically bright-maroon and yellow-buff dolomitic sandy calcareous mudstones, interbedded with red and green shales and thin limestones. Average thickness 68 feet, exclusive of Checkerboard and Helena sections; from maximum thickness of 99 feet, on Belt Creek, formation thins eastward to 32 feet in Big Snowy Mountains, and westward to extinction in Beaver Creek area in Big Belt Mountains; thickness 50 feet at emended type section, herein designated Weed (1900) defined Dry Creek shale as lying "between the beds of the massive Pilgrim limestone and the dark chocolate-colored beds of the Jefferson formation." The statement gives exactly the actual conditions observable wherever these rocks are exposed and is concise in placing Cambrian-Devonian boundary at top of Dry Creek shale. Consequently, Yogo limestone or any other Cambrian rocks could not be present in Little Belt Mountains above Dry Creek. That Weed did not find Cambrian rocks in these mountains is implied in his statement. If Weed's statement had not been confused by the definition of the fictitious Yogo limestone, much confusion would have been avoided, and a more correct picture of Cambrian stratigraphy in central Montana would have resulted. Weed (1900) did not specify type section for Dry Creek shale, name of which he obviously took from Peale's (1893) Three Forks section, instead of from Little Belt Mountains. Type of Dry Creek shale (formation) must be in Little Belt Mountains province, or serious confusion will result. In section on north side of Dry Wolf Creek, Dry Creek shale is sharply defined at its top by *Spirifer* bed which marks base of Devonian. However, Dry Creek shale is better exposed in Yogo Gulch, and lower 13 feet contain only identifiable Dry Creek fossils in Montana known to writer. [See Flathead quartzite.]

Erling Dorf and Christina Lochman, 1940, Geol. Soc. America Bull., v. 5, no. 4, p. 551. Unit termed Dry Creek shale by Deiss (1936) apparently represents lower part of Snowy Range formation (new).

Christina Lochman and Donald Duncan, 1944, Geol. Soc. America Spec. Paper 54, p. 2–3, 4 (fig. 1), 6–12. Dry Creek shale is partly emended

by restricting all limestone pebble conglomerates and gray-green shales to Pilgrim formation. This revision gives lithologic unity to both Dry Creek and Pilgrim in all sections and restricts fossil horizons to Pilgrim. As thus emended, contact between the two formations differs in most sections from that designated by Deiss (1936). Dry Creek-Jefferson boundary discussed.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1405–1406, 1407–1409, 1413, 1415. In central Montana, shales, mudstones, and argillaceous dolomites assigned to Devonian are apparently transitional with beds lithologically like Upper Cambrian Dry Creek shale. Weed (1900) and Deiss (1936) assigned all shales to Cambrian, although Deiss recognized difficulty of separating them from Devonian. It is believed that a variable proportion of the shale previously placed in Cambrian is Devonian in age. In Three Forks area, basal Devonian rocks are predominantly red shales, mudstones, and argillaceous dolomites. These beds are in apparent transition with underlying Cambrian strata and were formerly grouped with them in Dry Creek shale. For purposes of this report, the glauconitic, micaceous, and sandy shales associated with flat-pebble conglomerates, bearing trilobite fragments and phosphatic brachiopods, are assigned to the Cambrian Dry Creek shale; the nonmicaceous and less fissile shales and mudstones interbedded with rocks of Devonian type are placed in Devonian. At Logan, the Dry Creek is 45 feet thick; 34 feet, Yogo Creek section, Judith Basin County.

Christina Lochman, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2200–2222. Name Dry Creek shale was originally proposed by Peale for small nonfossiliferous unit in Gallatin formation in Upper Cambrian sequence in vicinity of Three Forks, Mont. Weed (1899, U.S. Geol. Survey Geol. Atlas, Folio 55) used same name for formation of brick-red shales and dolomites, a unit entirely different in age, lithology, and stratigraphic position from that of Peale. Subsequent usage of term, with or without definition, has been regarded by authors as implying that they were referring to beds which were wholly or in part the equivalent of original Dry Creek shale member of Peale. With exception of Knopf (1913, U.S. Geol. Survey Bull. 527), no author using Dry Creek shale as formational unit in Montana sections referred to beds which were lithologic or time equivalent of Peale's Dry Creek shales. Names should be used as originally defined by Peale, but strata involved do not constitute a mappable lithic unit by present mapping standards. Peale's Dry Creek shales constitute lower member of Snowy Range formation; name Sage pebble conglomerate is proposed for upper member of this formation. Weed's (1899) formation of brick-red shales and dolomites is mappable lithic unit of Devonian age; it is basal Devonian unit (unit C) of Sloss and Laird (1947) should be called Maywood formation, the name proposed by Emmons and Calkins (1913) for same lithologic unit in Philipsburg quadrangle.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull. v. 35, no. 10, p. 2146. Term Red Lion is favored for beds formerly assigned to Dry Creek in southwestern Montana.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 12, 18, pl. 5. Lochman restricted term Dry Creek to Peale's original usage, and, as thus defined, the Dry Creek shale becomes lower shale member of Red Lion formation in southwestern Montana. Overlies Sage

pebble conglomerate member. Thickness commonly 20 feet; locally absent.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Lochman (1950) revised and redescribed Dry Creek shale and named what, in Wyoming, is called "upper Gallatin limestone" the Sage pebble conglomerates. This name seems applicable in Wyoming, but because of lithic changes it is better called Sage limestone. Dry Creek shale is thin and rarely mappable and most commonly should be regarded as member of Sage limestone. Gallatin is herein raised to rank of group with Sage limestone as upper member.

A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 38, 39 (fig. 1), 40 (fig. 2), 41. Rank reduced to member status in Open Door limestone (new) in southwestern Wyoming. Forms basal part of formation; overlies Du Noir limestone.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 400–401. Snowy Range formation is used in this report [area east and southeast of Livingston] because of inconsistencies in use of Dry Creek shale. Formation in this area apparently includes beds in stratigraphic position of Peale's Dry Creek shales and pebbly limestones and still younger beds.

Type locality (emended): North side of Yogo Gulch, on northeastern side of Little Belt Mountains, Judith Basin County, Mont. Section measured approximately one-eighth mile west of mouth of Bear Creek, in SE¼ sec. 1, T. 13 N., R. 10 E. Peale (1893) did not designate type locality but stated unit was best exposed on Dry Creek, northeast corner Three Forks quadrangle, Gallatin County.

Dry Creek Canyon Member (of Dakota Sandstone)

Lower Cretaceous: South-central Colorado.

K. M. Waagé, 1953, U.S. Geol. Survey Bull. 993, p. 12, 13–17, fig. 2, pls. 2, 4, 5. Consists of three lithologic zones (ascending): even-bedded white sandstone with some interbedded shale with average thickness in type area of about 6 feet; a middle zone composed commonly of upper bed of blue-gray to black plastic clay and lower bed of flint clay and sandy flint clay, thickness up to 18 feet; and roof-rock zone of fine-grained thin- to thick-bedded soft-white to hard-green sandstone, with intercalated sandy gray clay shale and blue-gray plastic clay, up to 27 feet thick. Member underlies upper sandstone unit of Dakota sandstone with local unconformity and overlies lower sandstone unit of Dakota.

Type area: Along Dry Creek Canyon in S½NW¼SE¼ sec. 26, T. 18 S., R. 67 W., Pueblo County.

Dryden Formation

Middle Ordovician (Mohawkian): Western Virginia and eastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 58, chart 1 (facing p. 130). Name used for combined Benbolt and Wardell formations when these two are not separated by Gratton formation. Consists mostly of limestone, but may contain conspicuous amounts of shale as at Rye Cove and Lone Mountain. Usually easy to identify Benbolt or Wardell parts of sequence in upper and lower parts, respectively, but boundary between two more difficult to find. Thickness 300 to 500

feet. Underlies Witten formation; overlies Surgener formation (new) in Tennessee sections and undivided Peery-Ward Cove sequence in Virginia. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: In fields on both sides of highway about 1 mile east of Dryden and less than 1,000 feet west of Stallard Ford Bridge across Powell River, Keokee (TVA 178–SW) quadrangle, Lee County, Va.

Dry Hill Granite Gneiss

Middle Paleozoic: North-central Massachusetts.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Described in Mount Toby quadrangle. Name credited to Robert Balk. Pre-Triassic.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–93. Described in its type area as medium-grained well-foliated granitoid gneiss with uniform pinkish or light-gray color. Layers and lenses of quartz and feldspar are separated by thin black films of biotite; large ellipsoidal crystalloblasts of microcline common. Includes border facies consisting of closely related finer grained siliceous gneiss which lacks feldspar crystalloblasts, has more evenly distributed biotite flakes, and has chalky-appearing feldspars. Both facies occur as sheets 2,500 feet or more in thickness; numerous thinner sheets penetrate Poplar Mountain gneiss. Represents igneous facies of domelike gneissic complex which Emerson (1917) termed Pelham granite. Border facies is stratigraphic equivalent of Joshua schist of Greenfield quadrangle. Middle Paleozoic.

Named for exposures on Dry Hill, 3 miles southeast of Millers Falls, Millers Falls quadrangle.

Dry Hollow Formation

Dry Hollow Latite

Pliocene(?): Southwest-central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 449. Individual latite flows are more than 200 feet thick in many places and aggregate thickness probably about 1,000 feet. Rests on earlier volcanic rocks and upon Mount Belknap rhyolite; interbedded with Joe Lott tuff (new); overlain by younger rocks including Sevier River formation and basalt flows. Tertiary.

U.S. Geological Survey has approved the name Dry Hollow formation for this unit. Age considered to be Pliocene(?). This designation is made on the basis of a restudy of units in this area.

Occurs in Marysvale region. Derivation of name not stated.

Dry Hollow Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 1), 140, 141, 143 (fig. 2), 145 (fig. 3). Consists of basal conglomerate, a lower shaly interval 880 feet thick, 90 feet of carbonaceous coal-bearing rocks, and prominent white cliff-forming sandstone 200 feet thick. Aggregate thickness 1,000 to 1,220 feet. Underlies Grass Creek member (new); unconformably overlies rocks of early Carlile age [Oyster Ridge sandstone member.] Name credited to D. W. Trexler (unpub. thesis).

Typically exposed in Dry Hollow, a strike valley, 1½ miles northeast of Coalville, Summit County.

Drywood Formation (in Cherokee Group)

Drywood Formation or coal cycle (in Krebs Group)

Pennsylvanian (Des Moines Series): Southwestern Missouri, southeastern Kansas, and northeastern Oklahoma.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Dry Wood (Drywood) formation. Includes Dry Wood coal at top. Underlies Bluejacket sandstone; overlies Rowe formation (new). Included in Krebs group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 6. Referred to as Dry Wood coal cycle in Savannah formation, Krebs group.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 14 (fig. 5), 18 (fig. 7), 20 (fig. 9), 35. At type section, Drywood (Dry Wood) consists of basal black shale, underclay, lenticular sandy shale, and thin coal horizon. Thickness about 5 feet. Overlies Rowe formation; underlies Bluejacket formation. Krebs group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 38–39. A formation in Krebs subgroup of Cherokee group. In southeastern Kansas, includes (ascending) basal dark shale containing lenticular limestone, thin irregular silty limestone and clay ironstone, underclay, and Dry Wood coal. Thickens from 6 to 8 feet in Crawford County to maximum of somewhat more than 15 feet in Cherokee County. Overlies Rowe formation; underlies Bluejacket formation.

Type locality: Below spillway of the artificial lake on a tributary of Dry Wood Creek in SE¼NE¼ sec. 4, T. 32 N., R. 33 W., 1½ miles west of Liberal, Barton, County, Mo.

Duarte Conglomerate

Pliocene(?): Southern California.

J. S. Shelton, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 63. Coarse unsorted sandy poorly consolidated conglomerate; conspicuously gray and light colored. Maximum exposed thickness at least 1,500 feet, due north of Duarte, where it either overlies or is faulted against sandstone of Topanga(?) formation, and is overlain by Quaternary deposits.

Exposed in steeply dipping, isolated outcrops, in foothills between Maddock and Sawpit Canyons, north and northwest of town of Duarte, east of Monrovia, Los Angeles County.

Dublin Blue Shale[1]

Middle Devonian: Central Ohio.

Original reference: E. Claypole, 1903, Am. Geologist, v. 32, p. 19, 20, 34, 35.

Named for exposures along Scioto River near Dublin, Franklin County.

Dubois Greenstone[1]

Precambrian (Gunnison River Series): Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Extends from Lake Fork of Gunnison River on west to beyond South Beaver Creek on east. Named for exposures at old mining camp of Dubois, on Goose Creek, Gunnison River region.

Du Bois Limestone[1] Member (of Topeka Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 42, 52, 53.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 164; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Du Bois limestone member of Topeka formation; underlies Holt shale member; overlies Turner Creek shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21. Type locality stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 15–16, fig. 5. Commonly single bluish-gray bed; locally divided into two limestone beds separated by shale; fossiliferous. Thickness seldom more than 1 foot; lenses out in some localities. Underlies Holt shale member; overlies Turner Creek shale member.

Type locality: About 4 miles southeast of Du Bois, Pawnee County, Nebr. Not definitely identified south of Topeka, Kans.

Dubose Member (of Whitsett Formation)

Dubose Sands and Clays[1]

Eocene, upper: South-central Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1314.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2632–2633. Here considered member of Whitsett; overlies Stones Switch member. Near Czestochowa, Karnes County, about 85 feet of Dubose is exposed; it is underlain by Stones Switch member and unconformably overlain by Catahoula tuff. Lower 100 feet of member exposed in Tordilla Hill in western Karnes County, hill is capped by sandstone locally called Tordilla sandstone bed; upper part of member is exposed in type section of Whitsett. In southeastern Atascosa County and southwest, Dubose is conformably overlain by Calliham sandstone member; northeast of Fashing, the Calliham is not traceable and Dubose, Calliham sandstone, and Fashing clay member become indistinguishable; northeast of Fashing, this part of section is truncated and overlapped by Catahoula; about 100 feet of Dubose is overlapped in vicinity of Fashing, and about 200 feet is overlapped in northern Karnes County.

Named for exposures in valley wall south of Sandies Creek near former Dubose Ranch, 2.5 miles by county road north-northeast of Sample in southern part of Gonzales County. Sample is on U.S. Highway 87, 7.8 miles south of Smiley.

Dubuque Formation[1]

Dubuque Shaly Member (of Galena Dolomite)

Dubuque Formation (in Galena Group)

Dubuque Member (of Maquoketa Formation)

Middle Ordovician: Eastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: F. W. Sardeson, 1907, Geol. Soc. America Bull., v. 18, p. 193.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 90–92. Considered member of Maquoketa formation in Minnesota. Thickness about 30 feet. Underlies Wykoff member; overlies Stewartville member of Galena limestone.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. In Dixon-Oregon area, Illinois, considered uppermost formation in Galena group. Thickness about 30 feet. Overlies Wise Lake formation (new).

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 26, 297–299; A. V. Heyl, Jr., and others, 1959, U.S. Geol. Survey Prof. Paper 309, p. 17–18. Referred to as shaly member of Galena dolomite; overlies Stewartville massive member. In mining district member is light-gray to buff fine-grained sugary and silty dolomitic limestone that weathers to yellowish buff; medium to thin bedded and contains interbeds of platy dolomitic shale. Thickness 35 to 45 feet. Age of Galena, Middle Ordovician.

M. P. Weiss, 1957, Geol. Soc. America Bull., 68, no. 8, p. 1029 (fig. 1), 1040–1042, pl. 1. This report [Fillmore County, Minn.] follows Kay's (1935, Jour. Geology, v. 43, no. 5) concept of type section. At type section, interval of transition from Stewartville rock to Dubuque rock is thicker than it commonly is in Minnesota. The Dubuque is unit of interbedded limestone and shale and contains two feldspathized shale beds. Control on thickness of Dubuque in southeastern Minnesota and adjacent Iowa is meager, but it is about 34 feet thick at two outcrops; in Fillmore County, outcrops are close to eroded edge of formation. Overlies Stewartville member of Galena formation; underlies Maquoketa formation.

Named for Dubuque, Dubuque County, Iowa.

Dubuque terrane[1]

Quaternary: Iowa.

Original reference: C. R. Keyes, 1914, Iowa Acid. Sci. Proc., v. 21, p. 186.

Probably named for Dubuque or Dubuque County.

Duchesne Formation[1]

Oligocene: Northeastern Utah.

Original reference: O. A. Peterson, 1932, Carnegie Mus. Annals, v. 21, no. 2, p. 61–63, pl. 1.

Duchesne River, in Duchesne County, traverses these beds.

Duchesne limestone[1]

Upper Jurassic: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 300.

Derivation of name not stated.

Duchesnean Age

Eocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 10, pl .1. Provincial time term, based on Duchesne River formation of northeastern Utah. Covers interval between Uintan (Eocene) and Chadronian (Oligocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Duchesne River Formation[1]

Eocene or Oligocene: Northeastern Utah and northwestern Colorado.

Original reference: J. L. Kay, 1934, Carnegie Mus. Annals, v. 23, p. 357–359, pls. 45, 46, map.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 97 (table 1), 99 (table 2), 122–123. Consists of buff and gray sandstone, red and pink sandy shale, and conglomerate; fluviatile. Thickness western part Uinta basin 1,500 feet; eastern part of basin, 1,372 feet. Unconformably underlies Bishop conglomerate; unconformably overlies Uinta and Uinta(?) formation. Oligocene.

W. B. Cashion and J. H. Brown, Jr., 1956, U.S. Geol. Survey Oil and Gas Inv. Map OM–153. Mapped in oil shale area, Uintah County, Utah, and Rio Blanco County, Colo. Only basal 50 feet of formation exposed. Along Raven Ridge, unconformably overlies both Uinta formation and Green River formation; near axis of basin, unconformably overlies Uinta formation. Eocene or Oligocene.

First described along Duchesne River, Duchesne County, Utah.

Duck Creek Formation[1] or **Limestone** (in Washita Group)

Duck Creek Limestone Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Central and northwestern Texas and south-central Oklahoma.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 516.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 25–26, table 4. Foraminifera of formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Conf., p. 88, 90–91. In central Texas, considered member of Georgetown limestone. Overlies Kiamichi clay member; underlies Fort Worth limestone member. Thickness 120 feet at type section, thinning to 30 feet in McLennan County. Locally Kiamichi is missing, and Duck Creek rests on Edwards limestone.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 24–27, pl. 2. Formation described in Tarrant and Parker Counties, Tex., where it consists of lower thickly bedded fucoidal limestone and an upper marl with interbedded thin marly limestone. Thickness 50 to 60 feet. Overlies Kiamichi formation with possible unconformity; conformably underlies Fort Worth limestone. Washita group.

Named for Duck Creek, north of Denison, Grayson County, Tex.

†**Duck Creek limestone,**[1] **marl,**[1] **or limy marl**[1]

Lower Cretaceous (Comanche Series): Eastern Texas, southwestern Arkansas, and central southern and southeastern Oklahoma.

Original reference: W. M. Winton and W. S. Adkins, 1919, Texas Univ. Bull. 1931.

Duck Lake Formation

Pleistocene: South-central Louisiana (subsurface).

J. A. Doering, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 782–783. Name applied to interval between base of Lissie and top of Citronelle equivalent that occurs in type well between 880 feet and 1,470 feet.

Type well: Hunt Oil Co. State Lease 1392 No. 1, sec. 2, T. 15 S., R. 11 E., Duck Lake field, St. Martin Parish.

Duck Lake Stage

Miocene: Southeastern Louisiana (subsurface).

C. M. McLean, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 241, 242 (fig. 1), 243. Stage name, based on faunal assemblages occurring in sediments commonly referred to as "Middle" Miocene in subsurface of southeastern Louisiana. Clovelly and Napoleonville stages are proposed as replacements for "Lower" and "Upper" Miocene respectively. Names were selected arbitrarily only because denoted fields demonstrate representative sections for each; nothing in way of principal producing members is implied.

†Dudley Limestone[1] or Series[1]

Ordovician: New York.

Original reference: T. A. Conrad, 1839, New York Geol. Survey 3d Rept., p. 58–59.

Exposed at Dudley.

†Dudley Shale (in Pleasanton Group[1]

†Dudley Shale Member (of Pleasanton Formation)[1]

Pennsylvanian: Eastern Kansas, Missouri, and southeastern Nebraska.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 34.

Named for Dudley, Neosho County, Kans.

Duff Formation or Tuff (in Buck Hills Volcanic Series)

Duff Tuff (in Green Valley Volcanic Series)

Oligocene and younger: Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Name applied to upper 1,000 feet of Green Valley volcanic series (new). Overlies Cottonwood Spring basalts (new). Underlies Mitchell Mesa rhyolite (new).

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Oct. 29–31, p. 14 (table 1), 17 (fig. 3), 20–21; S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1159–1161, pl. 1. Formation included in Buck Hill volcanic series (new). [Authors make no reference to use of term Green Valley volcanic series.] Chiefly rhyolitic tuff with minor breccia and conglomerate. Thickness at type section 1,015 feet. Overlies Cottonwood Spring basalt. Oligocene(?). Derivation of name stated.

R. L. Erickson, 1953, Geol. Soc. America Bull., v. 64, no. 12, pt. 1, p. 1362–1364. Formation described in Tascatol Mesa quadrangle where it is

about 764 feet thick. Underlies Mitchell Mesa tuff flow; overlies Pruett formation.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 551–554. Includes Decie member (new) in Cathedral Mountain quadrangle. Northward across quadrangle, formation changes from dominantly rhyolite tuff to lava tuff, and conglomerate (Decie member). Thickness 1,400 to 1,500 feet. Overlies Cottonwood Spring basalt; underlies Mitchell Mesa welded tuff.

Named for Duff Spring in northwestern part of Buck Hill quadrangle, Brewster County.

Duffin Limestone[1]

Duffin limestone or dolomite facies (of Portwood Formation)

Middle Devonian: East-central Kentucky.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145.

G. A. Cooper and others, 1942, Geol. Soc. America Bull. v. 53, no. 12, pt. 1, chart 4. Middle Devonian.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 860 (fig. 4), 861, 862–863. Portwood formation (new) contains three coeval facies: Duffin limestone or dolomite, Harg shale (new), and Ravenna shale (new). Duffin layer is mottled gray to brownish dolomite which commonly presents brecciated appearance. Typically represented in Boyle, Lincoln, and Casey Counties, where it ranges from 3 to 8 feet thick, and eastward to Berea, thins to 1 foot at Crab Orchard. Harg replaces Duffin dolomite in area where former appears and is transitional between Duffin and Ravenna.

A. C. McFarlan and W. H. White, 1952, Kentucky Geol. Survey, ser. 9, Bull. 10, p. 5–16. Discussion of Boyle-Duffin-Ohio shale relationships.

Named for Duffin cut three-fourths mile north of Junction City, Boyle County.

Duffin Sandstone and Shale (in Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 36–37, pl. 2. Medium- to coarse-grained brick-red sandstones with interbedded purple shales. Crossbedding locally prominent. Near California, Barbee and Walker, and Thompson mines, a clay pebble conglomerate as much as 1 foot thick lies just above upper contact of Tecumseh sandstone (new). West of McNally mine, unit includes thin white lenticular sandstone 50 feet above lower contact. Total thickness 427 feet. Underlies Quaternary alluvium; overlies Silver Reef sandstone with local unconformities.

Section measured 500 feet south of Duffin mine, Silver Reef (Harrisburg) Mining District, Washington County.

Dufrene Slate (in Amador Group)

Middle or Upper Jurassic: East-central California.

G. R. Heyl and J. H. Eric, 1948, California Div. Mines Bull. 144, pt. 1, p. 51, 52, 53, pl. 7. A series of schists and greenstone in Newton mine area (near Jackson, Amador County), tentatively correlated with Jurassic Amador group described by Taliaferro (1942), is subdivided into four formations (descending): Mountain Spring volcanics, Dufrene slate,

Newton Mine volcanics, and Sunnybrook volcanics. Dufrene consists of sequence of dark-blue-gray slates and fine-grained gray sandstone; some green chloritic feldspathic schist near base. Approximate thickness 745 feet. In absence of fossil evidence, wider regional studies will be necessary to determine definitely whether Dufrene slate and Mountain Spring volcanics should be considered uppermost Amador or part of Mariposa slate. Measured section, along Mountain Spring Creek from Mariposa slate eastward, dips steeply to east; relation of beds to Mariposa slate suggests section is overturned and is on west limb of overturned anticline or its faulted equivalent.

Name derived from Dufrene Ranch west of Newton mine, Amador County.

Dugger Formation

Middle Pennsylvanian: Southeastern Indiana.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1. Consists of (ascending) 55 feet of sandstone and shale locally containing two thin coal beds and massive conglomeratic limestone in places; Coal VI, which may be absent or as much as 6 feet thick; 40 to 50 feet of sandstone and shale containing thin limestone in places; Coal VII, which is generally 2½ feet thick; and 20 feet of gray shale in places. Overlies Alum Cave member of St. Petersburg formation; unconformably underlies sandstone of Shelburn formation.

C. E. Wier, 1951, U.S. Geol. Survey Coal Inv. Map C–9. Includes Universal limestone member (new) between Coal VI and Coal VII.

Named for exposures in secs, 31 and 32, T. 8 N., R. 7 W., and secs. 5 and 6, T. 7 N., R. 7 W., 2 miles northeast of Dugger, Sullivan County.

Dugout Beds[1]

Pennsylvanian: Texas.

Original reference: C. L. Baker and W. F. Bowman, 1917, Texas Univ. Bull. 1753, p. 104–105.

Exposed in vicinity of Dugout Creek at Payne's Ranch, Marathon Basin.

Dugout Clay and Gravel[1]

Miocene and Pliocene: Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 68.

Named for Dugout wells, near Boquillas, Brewster County.

Dukes Boulder Bed[1]

Pleistocene: Southeastern Massachusetts and southern Rhode Island.

Original reference: J. B. Woodworth and Edward Wigglesworth, 1934, Harvard Coll. Mus. Comp. Zool. Mem., v. 52, p. 163.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1715, chart 12. Pleistocene (Kansan).

Named for occurrence in Dukes County, Mass.

Duluth Gabbro[1]

Duluth Gabbro or Gabbro Complex (in Keweenawan Group)

Precambrian: Northeastern Minnesota, northern Michigan, and northern Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 124, 134.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1054–1057. Included in middle part of Keweenawan group, late Precambrian. Upper part of middle division of group is made up of acidic and basic intrusives: Logan intrusives, Beaver Bay complex, Duluth gabbro, and scattered granites. Detailed description of Duluth gabbro and its relation to other units.

F. F. Grout, R. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 13, 40–50. Described as Duluth gabbro complex in Cook County.

Named for development near Duluth, Minn.

†Duluth Group[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 134, 142–146, 185, pl. 14.

Exposed along north side of St. Louis River up to Duluth, St. Louis County.

Dun Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: Robert Hay, 1887, Kansas Acad. Sci. Trans., v. 10, p. 7.

Named for Dun, Wilson County.

Duncan Chert[1]

Mississippian: Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66, p. 2.

Extends from Duncan Peak across North Fork of American River to vicinity of Monumental Hill, Colfax quadrangle.

Duncan Group

Miocene, upper: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Lithology shown questionably as clay. Older than San Pedro group; younger than Sonoita group (new).

Duncan Sandstone[1] (in El Reno Group)

Permian: Central southern and southwestern Oklahoma.

Original reference: C. N. Gould, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 324–341, map.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). Included in El Reno group. Overlies Hennessey formation; underlies Chickasha formation.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 13–14, pl. 1. Described in Carter area where it is base of El Reno group. Underlies Flowerpot shale; overlies Hennessey shale. Thickness about 40 feet. Maximum thickness about 250 feet to southeast in Stephens County. Note on type locality.

Type locality: Duncan, county seat of Stephens County.

Dunchee Hill Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 124–126, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts is known but stratigraphic position of Dunchee Hill, Purvine Mesa, Sierra Grande, and Gaylord Mountain is not known.

Dunchee Hill, a low hill, 1 mile north of Des Moines, Union County, is eroded remnant of volcano.

Dundee Limestone[1] **or Formation**

Middle Devonian: Southern Michigan and northern Ohio, and Ontario, Canada.

Original references: A. C. Lane, as reported by M. C. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66; A. C. Lane, 1895, Michigan Geol. Survey, v. 5, pt. 2.

G. M. Ehlers and R. E. Radabaugh, 1937, Michigan Acad. Sci., Arts, and Letters Sec. Geology and Mineralogy [Guidebook] 7th Ann. Field Excursion, [p. 8–9]; 1938, Michigan Acad. Sci. Arts, and Letters, Papers, v. 23, p. 441–445. Dundee limestone restricted to lower unit, about 140 feet thick at Rogers City, which contains characteristic Dundee limestone fauna. Upper unit with distinct fauna is herein named Rogers City limestone.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1756, chart 4. Bassett (1935, Geol. Soc. America Bull., v. 46, no. 3) shows that type Dundee exposed in Sibley quarry, southeastern Michigan, contains *Spirifer lucasensis* and is underlain by Anderdon limestone. He correlates this section with "Upper Columbus" of the Silica and Whitehouse quarries in northwestern Ohio where the Dundee overlies Lucas dolomite and underlies "Blue bed" of Silica shale. Thus, the Dundee lies between Onondaga dolomite and Hamilton shale. In Presque Isle County, Mich., the Dundee overlies Mackinac breccia of lower Onondaga (Schoharie) age and underlies Rogers City limestone which carries *Stringocephalus* fauna.

K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 35 (table 1), 52, 101, 111, 115, 118. Dundee limestone in northwestern Ohio is erroneously designated Columbus limestone. Columbus limestone contains upper Onondaga fauna and is older than Dundee limestone. Dundee limestone of so-called Anderdon quarry near Amherstburg, Ont., owned by Bruner Mond Canada Limited, is incorrectly called Onondaga limestone. Examination of several reports of Devonian of southwestern Ontario leads to belief that Dundee limestone underlies large areas of southwestern Ontario where it is incorrectly designated Onondaga. In Mackinac Straits area, Detroit River group is underlain by Bois Blanc formation (new), most if not all of which is correlative of typical Onondaga limestone of southwestern Ontario. In Rogers City area and apparently elsewhere in northern part of Southern Peninsula, Detroit River group is overlain by Dundee limestone. Table of rocks of Straits of Mackinac region shows Dundee limestone overlies Mackinac breccia. In northwestern Ohio, the Dundee disconformably overlies Lucas dolomite of Detroit River group; in southeastern Michigan and at Amherstburg Ont., unconformably overlies Anderdon limestone of Detroit River group.

G. M. Ehlers, E. C. Stumm, R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northeastern Ohio: Ann Arbor, Mich., Edwards Brothers, Inc., p. 17–18. Dundee limestone ("Columbus limestone" of Ohio geologists) is 61½ feet thick at Silica, Lucas County, Ohio. Underlies Silica formation.

Named for exposures at Dundee, Monroe County, Mich.

Dundee sandstone member

Pennsylvanian (Pottsville series): Northeastern Ohio.

R. E. Lamborn, 1956, Ohio Geol. Survey Bull. 55, p. 26–29, geol. map. Gray to yellowish brown, medium to coarse, heavy bedded to massive, bedding planes rare. Thickness 5 to 75 feet. Base occurs either below drainage or is obscured by alluvial deposits. Top of sandstone in massive development occurs about 10 feet below Lower Mercer limestone on north side of Walnut Creek in sec. 13, Walnut Township; rises stratigraphically down valley to northeast; where Lower Mercer limestone is absent, top of Dundee is about 20 feet below Upper Mercer limestone; where both Upper and Lower Mercer are absent, the sandstone is about 15 feet below Tionesta coal. Only upper half of Pottsville series occurs above drainage in area of this report.

Named for exposure at Dundee, Tuscarawas County. Forms prominent cliffs along valleys of Walnut Creek and South Fork.

Dunderberg Shale[1] or Formation

Upper Cambrian: Eastern Nevada and western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1812, p. 184.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 18–19. Dunderberg shale was originally defined by Hague (1883) as Hamburg shale. In order to avoid use of name Hamburg for two formations in same district, Walcott (1908) proposed name Dunderberg for shale unit. Latter name is used in this report [vicinity of Eureka, Nev.]. It is not certain whether top of unit as mapped by Hague is exactly equal to one currently used. Hague writes of the shale as having, near the top, persistent layers of chert and sand. It is probable that these layers have been included within overlying Windfall formation (new), although all beds of flaky shale of any appreciable thickness have been included within Dunderberg of this report. Thickness 265 feet on ridge in Windfall Canyon. Overlies Hamburg formation. Underlies Catlin member (new) of Windfall formation. Late early Late Cambrian and early middle Late Cambrian, that is, late Dresbach and early Franconia age in standard Late Cambrian time scale.

R. H. Olson, 1956, Utah Geol. Soc. Guidebook 11, p. 47–48. Geographically extended into Promontory Range, Utah, where it is exposed along crest of Black Mountain and on both sides of North Fork of Little Valley. Thickness at least 378 feet. Overlies Marjum limestone; separated from Garden City formation by thick sequence of dolomites, limestones, and interbedded shales.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 340, 342–343. In Nye and Clark Counties, Nev., Dunderberg shale, about 195 feet thick; overlies Yucca Flat formation (new). Under-

lies unnamed limestone and dolomite interval provisionally referred to as Upper Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 24–25, 28 (fig. 4), geol. map. Described in Stansbury Mountains where it is 30 to 200 feet thick; overlies Opex formation and underlies Ajax limestone.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 21–24, 39–40, 44, 48, 53, 58, 61, 62–63. Described in western Utah where it is 4 to 137 feet thick; overlies Orr formation (restricted) or Hicks formation (restricted); underlies Notch Peak formation. Dunderberg is basal Franconian and is equivalent to a sandstone, shale, and limestone unit about 600 feet above base of Mendha limestone at Pioche, Nev. Dunderberg shale is present in Snake Range, Nev., where Drewes and Palmer (1957) called it Corset Spring shale. Although they correlated it [Corset Spring] with Dunderberg shale at Eureka, Nev., and found basal Franconian fossils, they designated it as Trempealeauan (Drewes, 1958). Underlying Corset Spring shale is limestone which they designate Johns Wash limestone, supposedly of Upper Franconian and basal Trempealeauan age. Author [Bentley] does not agree with their dating nor with nomenclature employed and believes that their formation names, at least those for Upper Cambrian, should be suppressed and section renamed with either Eureka district or House Range terminology. Olson (1956) designated 378 feet of argillaceous siltstone and limestone in Promontory Range as Dunderberg. Formation as used by Olson is not equivalent to Dunderberg shale of Eureka and may not even by Upper Cambrian. Olson states that overlying his Dunderberg is 3,800 feet of Upper Cambrian (undifferentiated) dolomites and limestones, 1,160 feet below top of which is Worm Creek quartzite member [of St. Charles formation]. Haynie (1957, unpub. thesis) affirmed Olson's Worm Creek designation. Since Worm Creek is same age as Dunderberg shale of Eureka, Olson's Dunderberg shale is misnomer and should not be used.

A. R. Palmer, 1960, U.S. Geol. Survey Prof. Paper 334–C, p. 53–109, pls. Report describes trilobites of Dunderberg shale. Five local lithic units, designated by letters (ascending) A–E, are recognized. All but upper unit (E) contain thin fossiliferous limestones bearing generally distinctive trilobite assemblages. Fauna of units A–C belong to upper half of *Dunderbergia* zone of late Dresbach age. Fauna of unit D correlates with basal part of *Elvinia* zone of early Franconia age.

A. R. Palmer, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B289–B290. Previous to 1958, the Dunderberg shale or supposedly equivalent unit had been identified at many places in eastern half of Great Basin. Bentley (1958) described what he called "Dunderberg shale" as occurring at many localities in western Utah and has shown that it is shaly westward extension of Worm Creek quartzite member of St. Charles formation of northern Wasatch Range. Bentley has also shown that trilobite fauna of "Dunderberg shale" in western Utah is that of *Elvinia* zone. Recent studies of Dunderberg at its type locality reveal that trilobites of *Elvinia* zone are confined to upper 50 feet of formation. Bentley's "Dunderberg shale" is younger than almost all of Dunderberg shale at its type locality. In Eureka district, contact of Dunderberg with underlying Hamburg dolomite is zone of shearing. Until recently, only a few feet of beds were believed to be missing.

New evidence indicates that as much as 200 to 300 feet of lower part of Dunderberg may be faulted out at Eureka. Practically unfaulted exposure of Dunderberg, 600 feet thick, has now been recognized at Cherry Creek about 65 miles northeast of Eureka. In this section, upper 350 feet of beds contain trilobites of both *Elvinia* and *Dunderbergia* zones similar to those at Eureka. Lower 250 feet contains trilobites belonging to *Aphelaspis* zone. Below these beds, and above another shaly unit containing *Eldoradia*, there is about 1,000 feet of thick-bedded limestone which has not been named. As *Eldoradia* is found in upper beds of Secret Canyon shale, which underlies Hamburg dolomite at Eureka, unnamed limestone near Cherry Creek should probably be correlated with Hamburg dolomite. Hence, there is no indication of significant stratigraphic thinning of Dunderberg between Cherry Creek and Eureka. A 30-foot unit of interbedded limestone and shale at top of Hicks formation in Deep Creek Range, Utah, contains trilobites of *Elvinia* zone. This unit was identified by Bentley as "Dunderberg shale" and separated from underlying Hicks. Shaly unit in middle of Hicks formation, separated from Bentley's "Dunderberg shale" by 120 feet of dolomite, contains trilobites of *Dunderbergia* zone in its upper part and trilobites of the *Aphelaspis* zone in its lower part. This unit correlates with lower part of Dunderberg shale as exposed near Cherry Creek. Therefore, unit that has been called "Dunderberg shale" by Bentley and by those who have studied it at many localities in western Utah is not equivalent to whole of Dunderberg shale exposed near Eureka and Cherry Creek, Nev. Evidence indicates that name "Dunderberg shale" should no longer be used for thin unit of interbedded limestones and shales occurring in western Utah and containing *Elvinia* zone trilobites. This unit is better named Corset Spring shale.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field. Conf., p. 160. In Shell Creek Range, Nev., name Dunderberg formation is applied to sequence of shales and limestones which forms characteristic ledge above Raiff limestone (new) and below Windfall formation. Thickness about 600 feet.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 10 (fig. 3), 14–15, pl. 1. Described in White Pine district. Average thickness about 350 feet. Overlies Secret Canyon shale, and although they appear to form continuous depositional sequence, they are apparently separated by disconformity. Underlies Goodwin formation of Mount Hamilton group (new). [Editor's note states that reexamination of Humphrey's collections from Secret Canyon and re-collection of trilobites in 1959 show that all known trilobites of Secret Canyon in Hamilton district are Upper Cambrian. Revision of age of Secret Canyon removes need for an unconformity between it and the Dunderberg. As far as can be determined, Cambrian section on west face of Mount Hamilton is without significant stratigraphic breaks.]

Named for exposures opposite Dunderberg mine, Eureka district, Nevada.

Dunderbergian series[1]

Upper Cambrian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 78.

Dun Glen Formation

Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad Map [GQ–11]. Dark-gray to black massive dolomite, in part crossbedded, standing in bold relief; interbedded with limestone and shale in lower 100 feet. In Stillwater Range, principally nodular limestone with some quartzite near base. Thickness generally 500 to 600 feet but reaches 1,150 feet in northwestern part of Sonoma Range. Underlies Winnemucca formation with local unconformity; overlies Grass Valley formation.

Type locality: Dun Glen Peak, East Range, Winnemucca quadrangle.

Dunham Dolomite[1]

Lower Cambrian: Southern Quebec, Canada, and northwestern and west-central Vermont.

Original reference: T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 6, 10.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 146–147. Dark gray, sometimes black, rock weathering brown. Crystalline throughout; stratification obscure. Thickness 30 to 120 feet. Underlies Oak Hill slate; overlies Gilman quartzite conformably. Type locality cited.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 528–530. Extended into Vermont where it includes Mallett member in upper part. Thickness 1,700 to 2,000 feet. Overlies Cheshire quartzite; underlies Monkton quartzite.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 525–528, 532 (fig. 5), pl. 1. Described in St. Albans area, where it consists of sandy facies (Mallett member of Cady) and carbonate facies. Thickness 2,800 feet east of Highgate Springs; about 1,500 feet at southern boundary of area; 25 feet at international boundary. Overlies Gilman quartzite; underlies Parker slate. Lower Cambrian (Georgian series).

Type locality: At Oak Hill, Sutton quadrangle, Quebec. Named for nearby town of Dunham.

Dunkard Group[1]

Dunkard Series or Division

Pennsylvanian and Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio. and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 88. Permian strata in Ohio are grouped under term Dunkard which has been given rank of group by U.S. Geological Survey, and of series in earlier publications of Ohio Geological Survey. Washington and Greene subdivisions of Dunkard have been classified as formations. Latter are herein raised to series rank, thus making main subdivisions of strata in Permian the same stratigraphic rank as those in Pennsylvanian. Dunkard becomes a sort of superseries and is superfluous. Term in Ohio is synonymous

with term Permian. In this report, term Dunkard division is used in order to keep term under consideration until decision is made as to its validity in current stratigraphic usage.

H. L. Berryhill *in* C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, p. 1789–1790. West Virginia, Pennsylvania, and Ohio Geological Surveys and U.S. Geological Survey agreed (November, 1959) to designate age of Washington formation as Pennsylvanian-Permian and age of Greene formation as Early Permian. [Thus age of Dunkard group is Pennsylvanian and Permian.]

First described on Dunkard Creek, Greene County, Pa.

†Dunkard Creek Series[1]

Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22.

On Dunkard Creek, Greene County, Pa.

Dunkirk Shale Member (of Perrysburg Formation)

Dunkirk Formation (in Canadaway Group)

Dunkirk Shale Member (of Canadaway Formation)

Dunkirk Shale or Sandstone[1]

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 24, chart.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 17. In area of this report, Dunkirk sandstone is used in preference to Canaseraga sandstone.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 397. In Batavia quadrangle, considered a formation in Canadaway group. Youngest formation present in area of this report.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Rank reduced to member status in Perrysburg formation (new). Dunkirk shale member of this report is restricted to 19 feet of black and 20 feet of olive-black and brownish-black shale resting on Hanover shale in exposures on Walnut Creek south of town of Silver Creek, Chautauqua County. In some areas, overlies Wiscoy sandstone. Grades upward into South Wales member (new) through transition zone between very dark-gray and brown shales and gray shales containing some platy siltstones. Thickens eastward from 40 feet on Walnut Creek to maximum of about 120 feet in area between Big Indian Creek and Irish Gulf; thins to featheredge in Woodhull quadrangle and has not been identified to south in Pennsylvania. Name Canaseraga sandstone is reapplied to unit termed Dunkirk sandstone by Bradley and Pepper (1938).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 14. Basal member of Canadaway formation. Underlies South Wales member; overlies Hanover or Wiscoy member of Chemung formation.

Named for Dunkirk, Chautauqua County.

Dunlap Formation[1]

Lower and Middle Jurassic: Southwestern Nevada.

Original reference: S. W. Muller and H. G. Ferguson, 1936, Geol. Soc. America Bull., v. 47, p. 241–252.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–45. Described in Mina quadrangle where five units are mapped. Formation deposited during folding and thrusting; consequently lithology varies from range to range. Usual sequence not everywhere complete. Upper part: conglomerate, with interbedded sandstone, pebbles derived from Luning formation; includes "thrust conglomerate" derived from upper plates of surface thrusts and overridden by same thrusts; greenstone and greenstone breccia with variable amounts of conglomerate and sandstone. Lower part: basal conglomerate overlain by interbedded sandstone and conglomerate in variable proportions; sandstones commonly reddish and crossbedded, locally interbedded shale; pebbles in conglomerates almost exclusively derived from Excelsior formation. In eastern Excelsior Mountains, basal unit is coarse breccia (fossil talus) of felsite fragments. Locally thin beds of moraine limestone and dolomite. Variable thickness, maximum about 5,000 feet in Pilot Mountains. Though locally conformable on Sunrise over most of area, it is unconformable on Luning and Excelsior formations.

N. J. Silberling, 1959, U.S. Geol. Survey Prof. Paper 322, p. 24 (fig. 3), 29–31, pls. 10, 11. Described in Union district, Shoshone Mountains, where it conformably overlies undifferentiated Gabbs and Sunrise formations. Consists mainly of noncalcareous, possibly nonmarine, sandstone including two relatively thin dolomitic carbonate units near top. Structure is for most part a syncline, which is partly overturned to west and divided into three dislocated segments of unequal size by two westerly trending high-angle faults; east limb of this syncline in middle one of its three faulted segments approaches anticlinal axis adjacent to Third Canyon thrust. On east, formation is bounded by thrust [Third Canyon] which has carried undifferentiated Gabbs and Sunrise formations to west over Dunlap. Southern limit of formation is intrusive contact with Tertiary volcanic rocks. Thickness about 800 feet. Unfossiliferous; might be assigned, at least in lower part, to lower Middle Jurassic.

Type locality: In ridge west of upper part of Dunlap Canyon, Pilot Mountains, Mina quadrangle.

†**Dunlap Limestone**[1]

Pennsylvanian: Eastern Kansas.

Original reference: M. Z. Kirk, 1896, Kansas Univ. Geol. Survey, v. 1, p. 81, 82.

Named for Dunlap, Morris County.

Dunlap Sandstone (in Greene Group)

Permian (Dunkard Series): Southwestern Pennsylvania.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 152–153. Thin-bedded brown micaceous sandstone, with little crossbedding. Mica especially conspicuous along bedding planes. Individual beds ½ to 1 inch thick. Total thickness 10 to 35

feet, average about 20 feet. Overlying strata commonly obscured. Base of sandstone lies 5 to 15 feet (average 10 feet) above top of Upper Washington limestone of Washington group. Was noted by Stevenson (1876) in his Greene group section for Washington County but not named.

Named from Dunlap Creek just north of which it is well exposed on hill, 2 miles east of Republic, Fayette County.

Dunlap Sandstone Member (of Catahoula Formation)

See Dunlap Quarry Sandstone Member (of Catahoula Formation)

Dunlap Quarry Sandstone Member[1] (of Catahoula Formation)

Miocene, lower(?): Southeastern Texas.

Original reference: B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 64, table facing p. 17.

W. L. Russell, 1957, Gulf Coast Assoc., Geol. Soc. Trans., v. 7, p. 68. Formation, in Grimes, Brazos, and Burleson Counties, includes Chita, Dunlap, and Corough (new) members.

Well exposed in large quarry on G. W. Dunlap 165-acre tract, in southeastern part of E. M. Millican survey, 2.4 miles S. 17° E. of Millican, Brazos County.

Dunleith Formation (in Galena Group)

Middle Ordovician; Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 23–24, figs. 3, 9. Dolomite, pure and argillaceous in alternating units, cherty, medium crystalline, medium- to thick-bedded; green shale partings. Thickness up to 125 feet. Differentiated into 10 members (ascending) Buckhorn, St. James, Beecher, Eagle Point, Fairplay, Mortimer, Rivoli, Sherwood, Wall, and Wyota. Underlies Wise Lake formation (new); overlies Guttenberg formation.

In copy of guidebook used by compiler, in figures 3 and 9, name Buckhorn had been crossed out and name Red Oak written in.

Type area is extreme northwestern Illinois.

Dunn Creek Slate (in Paint River Group)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 37–38. Basal formation of group. Consists of sequence of siltstones and slates; in type area contains one or more layers of slaty sideritic iron-formation; in uppermost part includes newly defined Wauseca pyritic member. Probable maximum thickness about 800 feet; probable minimum thickness about 400 feet. Underlies Riverton formation (new); overlies Badwater greenstone (new).

Type area: Eastern Iron County. Name derived from Dunn Creek, south of Crystal Falls.

†Dunnellon Formation[1]

Pliocene, lower: Northern Florida.

Original reference: E. H. Sellards, 1910, Florida Geol. Survey 3d Ann. Rept., p. 22–35.

Named for exposures at Dunnellon, Marion County.

Dunns Peak Sandstone

Eocene: Northern California.

Boris Laiming, 1940, 6th Pacific Sci. Cong. Proc., v. 2, p. 562 (fig. 8). Shown on stratigraphic column as sandstone 350 feet thick. Underlies Markley sandstone; overlies Capay formation ("Vacaville shales"). Occurs in Vaca Valley north of San Francisco.

Du Noir Limestone (in Gallatin Group)

Du Noir Member (of Gallatin Formation)[1]

Upper Cambrian: Western Wyoming.

Original reference: B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 124–127.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1104. Original nomenclature and definitions of formations in Wind River Canyon section is herein revised. Name Gallatin formation is replaced by Boysen formation (new). Because Upper-Middle Cambrian boundary is nearly 100 feet below base of Miller's Du Noir, member would have to be redefined to include many beds which Miller assigned to Middle Cambrian; hence, Du Noir member is not recognizable in Wind River Canyon, and lower member of Boysen is called Maurice member.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Rank raised to formation in Gallatin group. Underlies Dry Creek shale; overlies Park shale. In Wind River basin, overlies Buck Spring formation (new).

Type section: Along Warm Springs Creek, 2 miles west of Du Noir, in nothwestern part of Wind River Mountains.

Du Page Limestone[1]

Upper Ordovician (Richmond): Northeastern Illinois.

Original reference: J. R. C. Evans, 1926, Chicago Univ., Abs. Theses, Sci. ser., v. 2, p. 199–200.

Type locality not stated.

Duperow Formation (in Jefferson Group)

Upper Devonian: Subsurface in North Dakota, northeastern Montana, and northwestern South Dakota, and Manitoba and Saskatchewan, Canada.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2302–2304 (fig. 4), 2309 (fig. 5), 2315–2318, 2319 (fig. 6). Named by Powley (1951, unpub. thesis). He designated type subsurface section as interval between depths of 3,310 and 4,150 feet in Tidewater Oil Co.'s Duperow Crown Well 1 in southwestern Saskatchewan and considered the Duperow to be equivalent to all but basal section of Beaverhill Lake formation of Late Devonian age in Alberta. Through misunderstanding of Powley's definition, the Duperow came to be considered as an equivalent of Woodbend formation of Late Devonian age which overlies Beaverhill Lake formation in Alberta. In February 1953, Williston Basin Nomenclature Committee of American Association of Petroleum Geologists abandoned use of Duperow formation in sense in which Powley had originally intended and applied name to overlying lithologic unit. The Duperow as defined by the committee has been used widely in geologic literature and by geologists working in Williston basin. Standard subsurface section herein designated. Consists of medium- to brownish-gray dense to

microcrystalline limestone, yellowish- to light-brownish-gray fine-grained argillaceous limestone and dolomitic limestone, brownish-gray finely crystalline dolomite, and white to brownish-gray anhydrite, interbedded with thinner beds of greenish-gray dolomitic shale, very fine-grained siltstone, and sandy argillaceous dolomite. Formation ranges in thickness from fraction of a foot to approximately 600 feet in north-central and northeastern Montana along international boundary. Overlies Souris River formation; underlies Birdbear formation (new). In Jefferson group.

Standard section: Interval between depths of 10,400 to 10,743 feet in Mobil Producing Co.'s Birdbear Well 1, center sec. 22, T. 149 N., R. 91 W., Dunn County, N. Dak.

Duplin Marl[1]

Miocene, upper: Eastern North Carolina, Florida, eastern Georgia, and eastern South Carolina.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 388; published in 1897, as 55th Cong., 2d sess. H. Doc. 5.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 180–195. Geographically extended into Florida where it includes *Ecphora* and *Cancellaria* zones formerly included in Choctawhatchee marl (abandoned). *Ecphora* zone, which lies near base of Duplin, is believed to be equivalent to deposit in South Carolina named Raysor marl (Cooke, 1936); recommended that use of Raysor marl be discontinued. Thickness at Alum Bluff 46 feet; in Georgia 5 to 16 feet; maximum thickness South Carolina 41 feet; North Carolina 100 feet. From North Carolina to Florida, unconformably overlies older beds—in Carolinas, underlying formations range in age from Upper Cretaceous Black Creek to middle Miocene Hawthorn; in Georgia and Florida east of the Apalachicola, underlying formation is Hawthorn; west of the Apalachicola, Chipola and Shoal River formations. Everywhere unconformably underlies Pliocene or Pleistocene deposits.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in Coastal Plain of North Carolina, Oct. 8–9, p. 11. In this report, the Duplin and Yorktown are considered one formation, the Yorktown.

H. E. Malde, 1959, U.S. Geol. Survey Bull. 1079, p. 28–34. Term Duplin marl, defined as the rocks deposited in this region [Carolinas and Georgia] during late Miocene time, denotes a stage, in time-stratigraphic sense. The Duplin has distinctive marine fauna but little lithologic uniformity; Duplin outcrops would be difficult to identify if adequate fossils were lacking. Many other time-stratigraphic units in Atlantic and Gulf Coastal Plain are similarly named, but with progress in detailed mapping, formations will be defined as rock units, not on basis of age. Term Duplin marl might then be abandoned. Base of Duplin is an unconformity. Along Pee Dee River, the Duplin rests on Cretaceous rocks (Peedee formation). Farther south, rests on Eocene rocks (probably Black Mingo formation), and in Charleston area [this report] on Oligocene rocks (Cooper marl). Along Savannah River, rests on middle Eocene (Hawthorn formation). Fossils indicate that the Duplin near present coast is younger than Duplin marl farther inland. Upper Miocene.

Named for exposures in Duplin County, N.C., especially in Natural Well, southwest of Magnolia.

Duquesne cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 141 (map 17), 143–147. Embraces interval between Gaysport cyclothem (new) below and Elk Lick cyclothem above. Includes (ascending) Lower Grafton shale and sandstone, Duquesne redbed, Duquesne limestone, Duquesne underclay, Duquesne coal, Skelley shale and sandstone, and Skelley limestone members. Except for Skelley marine limestone, members of cyclothem are inconspicuous and not well known in eastern Ohio; in Athens County it is rather thick with all members at least present but with several not well developed. Average thickness between 35 and 40 feet.

Most outcrops are in Alexander, Ames, Athens, Canaan, and Dover Townships, Athens County. Named for Duquesne coal. Name is taken from Duquesne, a locality in metropolitan district of Pittsburgh, Pa.

Duquesne Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Topog. and Geol. Survey Atlas 27, p. 31, 60, 61.

Well exposed in bluff on north side of Allegheny River which faces Herrs Island. Probably named for Duquesne, Allegheny County.

Durango Glaciation or Till

Durango Glacial Stage[1] or Till[1]

Pleistocene (pre-Wisconsin): Southwestern Colorado and northwestern New Mexico.

Original references: W. W. Atwood and K. F. Mather, 1915, U.S. Geol. Survey Prof. Paper 95, p. 14, map; 1924, Geol. Soc. America Bull., v. 35, p. 122; 1932, U.S. Geol. Survey Prof. Paper 166.

V. C. Kelley, 1949, New Mexico Univ. Pubs. in Geology 2, fig. 2, facing p. 2. Durango gravels shown on correlation chart of New Mexico formations as present in San Juan County.

Named for Durango, southwestern Colorado.

Durango Sand Member (of Taylor Marl)[1]

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: C. H. Dane and L. W. Stephenson, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 51.

Occurs 1.2 miles south of Chilton, Falls County, and extends southwest through Durango to Theo, on Bell-Falls County line.

Durbin Formation[1]

Durbin Group

Middle Silurian: Southwestern Ohio.

Original reference: A. F. Foerste, 1917, Ohio Jour. Sci., v. 17, p. 187.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown no correlation chart as group including (ascending) Euphemia dolomite, Springfield dolomite, and Cedarville dolomite. Underlies Peebles dolomite; overlies Lilley formation.

Named for exposures at Mills quarries, about 1 mile east of Durbin and 1 mile southwest of Springfield, Clark County.

Durgin Brook Member (of Littleton Formation)

Lower Devonian: Northern New Hampshire.

M. T. Heald, 1955, The geology of the Gilmanton quadrangle, New Hampshire: New Hampshire State Plan. Devel. Comm., p. 8, 9, 10 (table 1), geol. map. Uppermost part of Littleton formation in Gilmanton quadrangle. Composed of well-bedded schists, chiefly sillimanite schist, pseudosillimanite schist and mica schist. Overlies Jenness Pond member (new).

Good exposures near village of Belmont.

Durham Quartz Diorite[1]

Devonian(?): Southeastern New Hampshire.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 149.

Extends from 2 miles southwest of Exeter to within one-quarter mile of Rollingsford. Named for exposures through Durham Township, Strafford County.

Durkee Hill Greenstones

Upper Devonian or post-Devonian: East-central Vermont.

C. G. Doll, 1945, Vermont State Geologist 24th Rept., p. 16, 20. A complex of gray to green to black basic and ultrabasic intrusives and volcanics. Massive and schistose, fine grained to coarse grained. Chlorite schist prominent. Light-gray feldspathic gneiss occurs irregularly among the greenstones. Some volcanics may be of Middle Ordovician age.

Exposed in area between Monroe and Ammonoosuc faults, Strafford quadrangle. Named for good exposures on Durkee Hill.

Durst Group

Pennsylvanian-Permian: Northeastern Utah.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 62 (fig. 1), 70–76 Name proposed to include type Morgan and type Weber formations; group should also include Hells Canyon formation of eastern Uinta Mountains because this formation is facies of Morgan. Unconformable above Round Valley formation. Term probably can be applied within at least the following localities: North Rich County, where names Wells formation and Weber sandstone have been used; southward to just north of Charleston thrust; and eastward along flanks of Uinta Mountains to Juniper Mountain in eastern Moffatt County, Colo.

Walter Sadlick, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 83 (table 1), 84–85, 86–87. Includes Permian (mainly Wolfcamp) fusulinids in upper 150 to 180 feet.

Named after Durst Mountain, a prominent peak about 7 miles north of Morgan, Morgan County.

Durst Silts

Pleistocene (Wisconsin?): West-central Texas.

M. M. Leighton, 1936, Medallion Papers 24, p. 16, 39 (fig. 5). Compact pebbly silts unconformably underlying Elm Creek silts (new). Show evidence of human occupation.

Well exposed on the P. Durst Survey near Abilene, Taylor County.

Dushkin Basalt

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 2, p. 13–14, pl. 2; 1955, U.S. Geol. Survey Bull. 1028–A, p. 9–10, pl. 3. Youngest of three extensive lava-flow units filling old canyons and gullies carved in Belkofski tuff (new) and intrusive diorite stocks. Overlies Arch Point basalt (new). Locally, a single flow more than 200 feet thick makes up unit; elsewhere unit comprises many superimposed flows, each a few tens of feet thick, which in places aggregate several thousand feet, as in the cliffs south of "Emmons" Lake.

Well displayed on north margin of Dushkin Lagoon, vicinity of Pavlof Volcano, Alaska Peninsula.

Duskin Creek Formation[1] (in Lee Group)

Pennsylvanian: Eastern Tennessee and southern Kentucky.

Original reference: W. A. Nelson, 1925, Tennessee Dept. Ed., Div. Geol. Bull. 33A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 37, 44 (table 3), 139. Extended to include strata between Rockcastle and Corbin sandstones in northern Tennessee and southern Kentucky. Includes Crossville sandstone member (new).

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], p. 4–5. Duskin Creek formation was used for beds presumably overlying Rockcastle, and including Dorton shale (new) of this report. Type section of Duskin Creek, which is along this tributary of Piney River, however, consists of beds of Vandever formation that actually underlie the Rockcastle. This error is believed to have been due to failure to identify the Rockcastle because of its local shaly character. For this reason, the name Duskin Creek is no longer used.

Well exposed on Duskin Creek, a tributary of Piney Creek, which flows by Spring City, Rhea County, Tenn.

Dutch Creek Sandstone[1]

Middle Devonian: Southwestern Illinois and eastern Missouri.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 170–171, 175.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 15–16; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 24–25, 26. Further described in southwestern Illinois where it is included in Ulsterian group. Comparatively thin and highly characteristic formation. It is only restricted zone in Devonian succession that can be invariably recognized, but actual outcrops in places are not abundant. Massive sandstone 10 to 30 feet thick, composed almost exclusively of rounded grains of St. Peter type. Probably overlies Clear Creek chert with slight unconformity; grades upward into Grand Tower limestone through a few inches or feet of calcareous sandstone and sandy limestone. Strata intervening between Grand Tower limestone (or the Dutch Creek sandstone where Grand Tower is absent) and Mountain Glen shale (or Springville shale where Mountain Glen is absent) have been referred by Savage (1920) to Misenheimer shale

and Lingle and Alto limestones. Restudy of the area suggests that recognition of these three formations may be neither stratigraphically logical nor practically feasible.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Lower or Middle Devonian.

Named for exposures along Dutch Creek, southwestern part Union County, Ill.

Dutchmans Conglomerate Lens[1] (in Amity Shale)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61, 84.

I. H. Tesmer, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1651. Mentioned in proposed stratigraphic sequence of Cattaraugus formation.

Named for exposures along Dutchman's Run, a tributary of Allegany River in Mead Township, Warren County.

Dutch Peak Tillite (in Sheeprock Series)

Precambrian: Western Utah.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 19–25, 28, 131–133, 135, pl. 1. Proposed for tillite in Sheeprock series(new). Typically dark-green conglomeratic rock having a slate of quartzite matrix. Thickness 4,044 feet on Dutch Peak; 2,555 feet in Pole Canyon. Occurs in middle part of series.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 37. Gradational character of upper and lower contacts and interfingering of tillite with quartzites and phyllites of Sheeprock series indicates that Dutch Peak is conformably included between strata represented by hiatuses above and below Mineral Fork tillite of Wasatch Range.

Type section: Dutch Peak, Tooele County. Crops out from head of South Oak Brush Canyon along crest of Sheeprock Mountains to Dutch Peak where it leaves divide and forms dip slope along north-facing slopes to Little Valley Creek. Present north of principal mining area in West Tintic mining district.

Dutchtown Formation

Middle Ordovician: Southeastern Missouri and northern Arkansas.

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 1, p. 12–25. Name applied to rocks which intervene between St. Peter and Everton sandstones below and Joachim dolomite above. Lower member is light to dark, smoky-gray, dense to fine-grained, argillaceous limestone and dark-gray shale; middle member, referred to as Geiser Quarry member, consists of dark-brown to black, argillaceous limestone, calcareous, hard, platy and fissile shale, and calcareous siltstone; upper member contains dark-brown to black, dense, and occasionally very finely crystalline limestone, and calcareous shales and siltstones of same color. Thickness 5 to 170 feet (determined from wells). Lower Ordovician.

J. S. Cullison, 1938, Jour. Paleontology, v. 12, no. 3, p. 219–228. Formation belongs in Buffalo River group. Fauna described.

E. B. Branson and M. G. Mehl, 1943, Jour Paleontology, v. 17, no. 4, p. 375. Whether Dutchtown is Lower or Middle Ordovician depends on where line between two series is drawn. In this report boundary is placed below St. Peter sandstone; hence, Dutchtown is lower Middle Ordovician in age.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 52, 53). Correlation chart shows Dutchtown limestone as Chazyan. In Missouri and Arkansas.

Name derived from village of Dutchtown, SE¼ sec. 24, T. 30 N., R. 12 E., Cape Girardeau County, Mo.

Duzel Formation

Upper Ordovician(?): Northern California.

F. G. Wells, G. W. Walker, and C. W. Merriam, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 645–646, 647 (fig. 1), pl. 1. Proposed for sequence of pale-gray-green phyllitic graywackes. Crumpled structure is most distinctive feature. The graywacke is thinly layered and fissile; in general, it is layered at 1- to 2-mm intervals, although occasional beds up to 3 inches occur, and some a foot to 18 inches thick crop out at stratigraphic intervals of 1 to several hundred feet. Such beds are hard in contrast to the fragile thin layers. Limestone and associated chert beds occur within the phyllite. Many are less than 2 feet thick, but others as much as 200 feet in outcrop width are conspicuous in Horseshoe Gulch and to northeast along the ridge. The largest is more than a mile long and several hundred feet thick. Attitudes of beds indicate that the Duzel is involved in northward-plunging synclinorium, the east limb of which has been thrust over beds of younger Gazelle formation (new). In southern part of area, the syncline has been cut off by steeply dipping northward-trending fault which has dropped beds of the Duzel against peridotite and quartz-mica schist. Because top of Duzel is not exposed and base is uncertain, total thickness cannot be determined; below Duzel Rock, 1,250 feet of crinkled phyllite and phyllitic graywacke is exposed, but structure of the formation indicates its total thickness must be many times this figure. Contains coral and brachiopod fauna and is oldest fossil-bearing formation in Klamath Mountains.

Occurs in two valleys south of Yreka, Siskiyou County. Crops out in drainage basin of Moffett Creek. Name is derived from Duzel Creek, a tributary of Moffett Creek, which is just east of Duzel Rock, conspicuous mass of white marble that caps highest peak in area.

Dwale Shale[1]

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 42, 43, 82. In lower part of Breathitt formation, forming roof of Prestonburg coal. Exposed at Dwale, Floyd County.

Dyberry Glomerate[1] (in Cherry Ridge Red Beds)

Dyeberry Conglomerate

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 578.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 279 (table 30), 284–285. Upper Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Listed as Dyeberry conglomerate.

Named from Dyberry Creek and Township, Wayne County.

Dyer Dolomite Member (of Chaffee Formation)[1]

Upper Devonian: Central Colorado.

Original reference: C. H. Behre, Jr., 1932, Colorado Sci. Soc. Proc., v. 13, no. 3, p. 60.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 174–177. Described in Pando area where it is 73 to 80 feet thick; overlies Parting quartzite member and uncomformably underlies Gilman sandstone member (new) of Leadville dolomite.

Typically exposed on West Dyer and Dyer Mountains, 5 miles east of Leadville.

Dyer Bay Dolomite Lentille (of Cabot Head Shale Member[1] of Cataract Formation)

Dyer Formation

Middle Silurian: Ontario, Canada, and Michigan.

Original reference: M. Y. Williams, 1919, Canada Geol. Survey Mem. 111, no. 191, geol. ser., p. 35, chart opposite p. 18.

T. E. Bolton, 1953, Canada Geol. Survey Paper 53–23, p. 3, 11. Rank raised to formation and geographically extended into northern Michigan. Formation is considered northern facies of Lower Clinton, rather than local phase of Cabot Head as postulated by Williams (1919). Overlies Cabot Head shales.

Type locality: Dyer Bay, Ontario, Canada.

Dyer Hill member (of Madrid Formation)

Age not stated: West-central Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Composed of chloritoid-bearing black slates. Grades downward into quartzites of formation.

In Anson quadrangle.

†Dyestone Group[1]

Silurian: Tennessee.

Original reference: J. M. Safford, 1856, Geol. Reconn. Tenn., 1st Rept., p. 149, 156–158, map.

Dynneson Sand

Lower Cretaceous: Eastern Montana and western North Dakota.

G. R. Wulf, 1959, Dissert. Abs., v. 20, no. 5, p. 1747. Blanket-type sand much of which came from land areas to the east. Upper part deposited as series of northeasterly trending features resembling offshore bars. Underlies highly siliceous clays. Previously called Newcastle sand.

Type locality and derivation of name not given.

Dyson Hollow Limestone Member or zone (of Stoner Member of Stanton Formation)

Pennsylvanian (Missouri Series): Eastern Nebraska.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. Zone or member within Stoner limestone. Thickness 1½ to 2 feet. Underlies Kiewitz shale zone; overlies Eudora shale.

Type locality: Below upper water fall in Dyson Hollow, located about 1⅝ miles west of La Platte, Sarpy County.

Eager Formation

Upper Cretaceous-Paleocene: Northeastern Arizona.

G. K. Sirrine, 1959, Dissert. Abs., v. 19, no. 8, p. 2064. Incidental mention.

Springerville-St. Johns area, Apache County.

Eagle Bed[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 733, 735.

Probably named for Eagle Spring, at northeast end of Eagle Mountain, El Paso County.

Eagle Dolomite Member (of Bluebell Formation)

Upper Ordovician: Central Utah.

Paul Billingsley *in* J. M. Boutwell, 1933, Internat. Geol. Cong., 16th, [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Name appears on stratigraphic column of Tintic district. Basal member of formation. Underlies Beecher member (new); overlies Opohonga formation.

T. S. Lovering and others, 1949, Econ. Geology Mon. 1, p. 7 (table 1). Light-gray fine-grained dolomite with dark-gray cherty bed at top, and 15-foot bed of dark-blue-gray fine-grained thin-bedded flaky dolomite at base. Thickness 180 feet.

T. S. Lovering and others, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1506. Entire lower part of Bluebell, known locally as Eagle dolomite, is Upper Ordovician. Thickness about 200 feet on Pinyon Peak.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 137, 139. What has been termed Eagle dolomite in Tintic district should be called Fish Haven dolomite.

Type locality and derivation of name not stated.

Eagle Greenschist (in Easton Group)

Paleocene or older: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Contains blue-amphibole schist intercalations.

Between central and eastern part of Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Eagle Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southwestern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 140, 141, 177.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 82. Marine limestone in lower part of Kanawha group about 100 feet below Eagle coal, between Cedar above and Little Cedar coals, in Eagle shale.

Named for exposures in cuts of Chesapeake and Ohio Railroad at mining village of Eagle, Fayette County.

Eagle Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 202.

Named for association with underlying Eagle coal.

Eagle Sandstone (in Montana Group)[1]

Upper Cretaceous: Montana and central northern Wyoming.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

R. M. Lindvall, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-29. Exposed along Missouri River and along several faults in Eagleton quadrangle. Includes Virgelle sandstone member in lower 80 to 100 feet. Middle and upper members consist of 125 to 150 feet of alternating beds of gray to buff medium-grained sandstone, containing sandy limonitic concretions. Conformably underlies Claggett shale; overlies Colorado shale with contact transitional through series of alternating beds of sandstone and shale.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 114–115. On east side of Sweetgrass arch, the Eagle sandstone includes all strata between Telegraph Creek formation and Claggett shale. Divided into lower Virgelle sandstone member and upper unnamed member of mudstone, shale, siltstone, and sandstone.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 15, 16. Discussion of marine Cretaceous formations of Hardin district, Montana and Wyoming. Local nomenclature revised. Names Frontier and Eagle which appear on maps published by Thom and others (1935, U.S. Geol. Survey Bull. 856), Richards and Rogers (1951, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 111), and Knechtel and Patterson (1952, U.S. Geol. Survey Circ. 150) have been dropped from nomenclature adopted for this report. Rocks formerly called Eagle sandstone are assigned to unnamed sandy shale member in upper part of the Cody; they represent a shaly facies of strata that elsewhere in central Montana includes thick massive sandstone beds that are typical of Eagle sandstone.

Type exposures: Along Missouri River about mouth of Eagle Creek, 40 miles below Fort Benton, Chouteau County, Mont.

Eagle Shale (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 211–215.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 82. Widespread dark-gray to black marine shale including Eagle limestone; in lower part of Kanawha group.

Derivation of name not given but may be same as Eagle limestone.

Eagle Bridge Quartzite[1]

Lower Cambrian: Eastern New York.

Original reference: L. M. Prindle and E. B. Knopf, 1932, Am. Jour. Sci., 5th, v. 24, p. 277–278.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 65 [1946]. Mentioned in discussion of correlation of Schodack formation in geology of Catskill quadrangle.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 330–331. Named and originally described by Prindle and Knopf, the Eagle Bridge was assigned to Lower Cambrian. Basis for this age assignment appears unsound. Nomenclators state that its stratigraphic position below slate that carries Beekmantown graptolites and above Lower Cambrian limestone indicates that it is probably Lower Cambrian. It is equally as logical to assume Lower Ordovician age by virtue of such reasoning. Type locality restudied for present report. Here, bluish-gray slightly feldspathic calcitic and dolomitic orthoquartzite grades upward through alternating thin beds of argillaceous sandstone and sandy and silty shale into graptolite-bearing shales carrying *Dicellograptus*, *Dicranograptus*, and *Nemagraptus*. Thus, Eagle Bridge is transitionally overlain by Middle Ordovician Normanskill formation. At the base, Eagle Bridge is set off sharply but conformably from platy black pyritiferous, somewhat siliceous, shales with no fossils. They may be Lower Cambrian Schodack shales or Lower Ordovician Deepkill shales. Whatever the age of underlying unit, Eagle Bridge is intimately associated with the overlying unit, which is proved Middle Ordovician. Eagle Bridge is removed from Lower Cambrian and assigned to Ordovician.

Well exposed in vicinity of Eagle Bridge, on Hoosick River, Washington County.

Eagle City Beds[1] or Limestone

Eagle City Member (of Hampton Formation)

Mississippian (Kinderhook): Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52, 92–94.

L. A. Thomas, 1960, Tri-State Geol. Soc. Guidebook 24th Ann. Field Conf., p. [3, 17–19]. Stratigraphic reconstruction of Lower Mississippian rocks across Iowa Falls area, when adjusted to orthodox system of classification, presents anomalous situation that is irreconcilable with stratigraphic relationships observed elsewhere in the State. Believed that this stems from miscorrelations resulting from misunderstanding of relationships of Gilmore City to Iowa Falls dolomite. Van Tuyl (1925) considered Eagle City limestone to be nearly 80 feet thick and to consist of two limestones separated by a thick dolomite and to be unconformable beneath Iowa Falls dolomite. Present evidence suggests that formation is essentially limestone, about 20 feet thick, and conformable with Iowa Falls and Maynes Creek dolomites. May be facies of Gilmore City.

Named for exposures in banks of Iowa River at Eagle City, Hardin County.

Eagle Cliff Porphyrite[1]

Permian and Cretaceous: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. in Geology, v. 2, p. 142, 146–148.

W. R. Danner, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2056. Volcanic rocks originally described as intrusive dikes of Eagle Cliff porphyrite appear to be composed largely of submarine pillow lavas of Permian and Cretaceous age.

Named for Eagle Cliff on north end of Cypress Island, San Juan Islands.

†Eagle Creek Formation[1]

Upper Triassic: Northeastern Oregon.

Original reference: W. D. Smith and E. L. Packard, 1919, Oregon Univ. Bull., v. 16, no. 7, p. 88, 105, 108.

Wallowa Mountains region.

Eagle Creek Formation[1]

Miocene: Central northern Oregon and southwestern Washington.

Original reference: I. A. Williams, 1916, Oregon Bur. Mines and Geol. Res. Oregon, v. 2, no. 3, p. 95–96.

W. M. Felts, 1939, Ohio Jour. Sci., v. 39, no. 6, p. 300–301, 304, 315 (fig. 4). Described in Skamania County, Wash., where it underlies Skamania andesites (new) and is intruded by Silver Star granodiorite (new).

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 7. Mehama volcanics are comparable in age to Warrendale or Eagle Creek formation in Columbia River Gorge. Oligocene.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 5. In Columbia River Gorge, Columbia River basalt lies on erosional surface cut in sediments of Eagle Creek formation. Chaney (1944, Carnegie Inst. Washington Pub. 553) assigned fossil flora of Eagle Creek formation to lower Miocene.

Exposed along Columbia River Gorge from Warrendale to Viento, on Oregon side, with corresponding distribution on north side of river.

Eagle Flats Formation

Quaternary or later: Western Texas.

R. T. Hill, 1890, (abs.) Am. Assoc. Adv. Sci. Proc., p. 242. Largest part of area west of Pecos River consists of extensive flats which are shown to be almost recent lakes, drained of their waters, except in rare instances where salt lakes still occupy limited parts of basin. Quaternary or later sediments of these former lakes are described as Eagle Flats formation.

Eagle Ford Shale,[1] **Clay,**[1] **or Formation**

Eagle Ford Formation (in Woodbine Group)

Eagle Ford Group

Upper Cretaceous (Gulf Series): Texas, western Louisiana, and southeastern Oklahoma.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d, v. 33, p. 298.

W. S. Adkins, 1932, Texas Univ. Bur. Econ. Geology Pub. 3232, p. 425–426. Group divided into (ascending) Tarrant, Britton, and Arcadia Park formations. Names credited to W. L. Moreman.

C. C. Albritton, Jr., and others, 1941, Field and Lab., v. 10, no. 1, p. 17–42, pls. 1, 3. Referred to as formation. Moreman's subdivisions not recognized in area of this report [Dallas County]. Underlies Austin formation. Chiefly clay-shale. Average thickness 475 feet.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart as Eagle Ford shale. Overlies Woodbine sand; underlies Austin chalk.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 472, 473, 474, 475, 477, 480 (correlation chart). Formation in Woodbine group (surface and subsurface). Includes Tarrant member. Overlies Lewisville formation with unconformity; underlies Ector chalk of Austin group with unconformity.

L. W. Stephenson, 1953, U.S. Geol. Survey Prof. Paper 243–E, p. 58. Eagle Ford shale unconformably overlies Pepper shale member of Woodbine formation at type section of Pepper shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Eagle Ford shale.

Named for exposures at Eagle Ford, Dallas County, Tex.

Eagle Gulch Latite[1]

Tertiary: Southwestern Colorado.

Original reference: H. B. Patton, 1916, Colorado Geol. Survey Bull. 9, p. 21–63.

Forms county rock on both sides of Eagle Gulch, Bonanza district, Saguache County.

Eagle Hill Rhyolite[1]

Eocene(?): Central northern Utah.

Original refernece: J. E. Spurr, 1895, U.S. Geol. Survey 16th Ann. Rept., p. 377.

P. D. Procter, 1959, Utah Geol. Soc. Guidebook 14, p. 183–187. Discussed in report on igneous rocks of Mercur-Ophir area. Table lists Eagle Hill under heading probable late Eocene or early Oligocene(?).

Named for exposures in vicinity of Eagle Hill, just south of Mercur, Mercur district.

Eagle Mills Formation

Permian(?): Subsurface in Arkansas, Louisiana, Mississippi, and Texas.

H. K. Shearer, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 6, p. 724. Consists chiefly of red shale and sand that overlies Pennsylvanian and Mississippian beds and underlies Smackover limestone and also underlies, and evidently in part contemporaneous with, mass of rock salt. Age of salt and associated red beds unknown, but best estimate is early Mesozoic, probably Triassic or Jurassic, because Eagle Mills beds seem to be more nearly conformable and related to overlying Cretaceous than to underlying Paleozoic. Name approved by Shreveport Geological Society.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 958–959 (fig. 2), 960 (fig. 3), 962–964. Thickness 1,190 feet in type well, herein designated. Underlies Smackover limestone; overlies Pennsylvanian and possibly Mississippian. Permian(?).

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 8–15, pl. 12. Southward from type locality, red beds pass abruptly into thick rock salt that contains minor amounts of anhydrite. Salt is bounded at top and bottom, in most sections in Arkansas, by red beds and associated anhydrite which constitute southward spreading tongues from main mass of red beds. Upper red beds are herein defined as Norphlet tongue

and lower red beds, Louann tongue. Overlies Morehouse formation (new), apparently conformable and gradational; underlies Smackover, apparently conformable. Formation has been tentatively assigned by various authors to periods as removed as Permian, Upper Jurassic, and Lower Cretaceous. Herein considered Jurassic.

R. W. Imlay, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 11, p. 1422–1440. Described in Gulf Coast region. Upper Jurassic.

R. T. Hazzard, W. C. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 483, 484–486, cross sections. As used in this report, Eagle Mills is older than Morehouse formation. Term Louann tongue is synonymous with Werner formation (new); term Louann salt is proposed for formation overlying the Werner; term Norphlet tongue, as formerly used, is replaced by Norphlet formation. Thickness 500 to 4,500 feet; maximum thickness unknown. Permian.

F. M. Swain, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1207–1212. Formation, as used in this report [Upper Jurassic of northeastern Texas], includes (ascending) Werner formation, Louann salt, and Norphlet formation of Hazzard, Spooner, and Blanpied who believe that type Eagle Mills is older than their Werner formation. Upper Jurassic.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. If Louann and Werner formations are of Jurassic age, then Eagle Mills of this report is youngest pre-Jurassic formation in middle part of Gulf Coast region. Late Paleozoic age assigned to unfossiliferous Eagle Mills (restricted) is questionable. Validity of paleogeologic map in Gulf Coast region, as well as summary isopach and Interval B maps herein presented, depends on solution of these stratigraphic problems. Neither relation of Morehouse to overlying and underlying formations nor its position relative to Eagle Mills formation is clear. Three interpretations suggested: Eagle Mills older than Morehouse; Morehouse older than Eagle Mills; or unit separated by fault of unknown dip and displacement. Second interpretation followed in this report. Permian.

Type well: Amerada Petroleum Co. et al. No. 1 Eagle Mills Lumber Co. well in sec. 11, T. 12 S., R. 16 W., Ouachita County, Ark.

Eagle Mountain Quartzite[1]

Paleozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 56, map.

Named for occurrence on Eagle Mountain, 5 miles northeast of Chewelah, Stevens County.

Eagle Mountains Sandstone Member (of Grayson Formation)

Eagle Mountains Sandstone

Upper Cretaceous: Southwestern Texas.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 11 (table 1), 27, 28, 31, pls. 1, 8, 16. Uppermost member of Grayson. About 70 feet of interbedded brown sandstones (some of which are quartzitic), brown shales, siltstones, and sandy limestones; dominantly brown; contrasts strongly with dominant blue gray of other formations of late Comanche age. Overlies 60-foot middle member informally referred to as reef-limestone. Conformably underlies Buda limestone.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Rank raised to formation. In Van Horn Mountains, overlies Loma Plata limestone, upper member of which is approximately correlative with San Martine member of Boracho limestone (Brand and De Ford, 1958); underlies Buda limestone.

Type locality: Carpenter Canyon at point about 1 mile above Carpenter Wells, Hudspeth County. Named for exposures on east side of Eagle Mountains.

Eagle Nest Formation

Pliocene(?): Central northern New Mexico.

L. L. Ray and J. F. Smith, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 190–191, pl. 1. Reddish clay and white tuffs interbedded with coarse white to buff sand and gravel. Cobbles up to 8 inches in diameter not uncommon. In general, cobbles are smooth but subangular. A few small channel deposits of sand in thicker beds of clay. Thickness unknown since neither top nor base has been seen, but total thickness must have been over 1,000 feet. Probably represents great coalescing stream fans. Tentatively assigned to Pliocene and perhaps early Pleistocene.

Along U.S. Highway 64, north of Eagle Nest Lake, in Moreno Valley, Colfax County.

Eagle Pass Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: C. A. White, 1891, U.S. Geol. Survey Bull. 82, p. 116, 117, 124, 126, 127, 130, 138, 139.

Named for Eagle Pass, Maverick County.

Eagle Peak Syenite

Tertiary: Southwestern Texas.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 38, pl. 1. Proposed for brownish-gray medium-grained rock with large phenocrysts of feldspar, chiefly orthoclase, which occurs in central and highest part of Eagle Mountains and is exposed on Eagle Peak. Much of rock has been altered to "soda syenite". Crops out as roughly elliptical-shaped body, with, in the main, almost vertical contacts with surrounding rhyolite.

Altered syenite is well exposed on summit of Eagle Peak; unaltered syenite is well exposed on flanks of Eagle Peak and in Wind Canyon 1½ miles southeast of Eagle Peak, Hudspeth County.

Eagle Point Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 33, fig. 3. Shown on columnar section as underlying Fairplay member (new) and overlying Beecher member (new).

Occurs in Dixon-Oregon area.

Eagle River Group[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 690.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Name Portage Lake lava series (new) pro-

posed to include Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports; these subdivisions are quite arbitrary and depend on continuity of individual flows or conglomerate beds for validity. They are not useful for purpose of this report.

Named for exposures on Eagle River, Keweenaw County.

Eagle River Porphyry[1]

Tertiary, lower: Central Colorado.

Original reference: S. F. Emmons and W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 80, 188, 193, 330, 591.

Ogden Tweto, 1951, Geol. Soc. America Bull., v. 62, no. 5, p. 510, 511, 512. Term Eagle River porphyry is used here for a quartz monzonite porphyry that is younger than Lincoln porphyry. Originally (Emmons and Cross, 1886) term included both this and later porphyry and Lincoln porphyry. Emmons and Cross used term only in Leadville monograph and made no mention of it in their later work on Tenmile district (U.S. Geol. Survey Geol. Atlas, Folio 48). Eagle River porphyry is similar to Johnson Gulch porphyry of Gray porphyry group at Leadville, and mapping now in progress may prove it to be equivalent. In this area [near Pando], four varieties of early Tertiary quartz monzonite and quartz latite porphyries: Elk Mountain, Lincoln, Eagle River, and Pando (new) form numerous sills in Pennsylvanian and Permian(?) clastic rocks of southern part of Gore Range.

Odgen Tweto, 1953, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–12. Mapped in Pando area, Summit and Eagle Counties, where early Tertiary sequence of porphyries includes (ascending) Pando, Elk Mountain, Quail, Lincoln, and Eagle River.

Named for occurrence at headwaters of Eagle River, Tenmile region, Eagle County.

Eagle Rock Flow or Basalt

Pliocene, lower(?): Southeastern Idaho.

H. T. Stearns and Andrei Isotoff, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 24, 30, 33–34, pl. 1. Basalt has red vesicular base and dense olive-black middle phase which grades into red scoriaceous basalt at top. Locally lenses of pyroclastic material intercalated between flow units. Basal part carries inclusions of basaltic cinders and quartz grains. Lower Pliocene(?).

Exposed on crest of Eagle Rock, a prominent hill on northwest bank of Snake River, 7½ miles downstream from American Falls, and on both sides of river in secs. 28 and 29, T. 8 S., R. 30 E., Power County.

Eagle Rock Tuff[1]

(?)Pliocene, lower: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 32 (table), 44–46, pls. 4–6. Thickness about 35 feet. Shown on stratigraphic column above Neeley lake beds and below Massacre volcanics. Type locality designated.

H. T. Stearns and Andrei Isotoff, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 23. Renamed Walcott welded tuff to avoid confusion with basaltic tuff that originated at locality of Eagle Rock.

Type locality: North bank of Snake River at America Falls, Power County.

†Eangua Limestone[1]

Upper Cambrian and Lower Ordovician(?): Central Missouri.

Original reference: H. King, 1844, Am. Jour. Sci., 1st, v. 47, p. 129.

In vicinity of Eangua River.

†Earlham Limestone (in Kansas City Formation)[1]

Pennsylvanian: Western Iowa, eastern Kansas, and Missouri.

Original reference: H. F. Bain, 1897, Iowa Geol. Survey, v. 7, p. 511–517.

Well exposed at Earlham, in sec. 22, Lincoln Township, Madison County, Iowa.

†Earlton Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 51, 103.

Well developed to west and northwest of Earlton, Neosho County.

Earp Formation (in Naco Group)

Upper Pennsylvanian and Permian: Southeastern Arizona and southwestern New Mexico.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 18–23. Base of formation arbitrarily taken where thin shaly limestones and reddish shales become dominant over more massive limestones characteristic of Horquilla formation (new). Much shale, a little sandstone, and a few beds of limestone and shale conglomerate occur somewhat higher in section and in turn give way upward to more massive limestone with a few conspicuous beds of dolomite, 1 to 5 or 6 feet thick, that weather to brilliant orange or red. Dolomites commonly crossbedded and somewhat cherty, and associated with a few thin sandstones. Topmost dolomite bed taken as top of formation. Underlies Colina limestone (new). Broken sequences exposed west of Dragoon Camp (Pearce quadrangle) suggest thickness of 600 feet. Formation may thicken abruptly toward north. Late Pennsylvanian and possibly Permian.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 35–38, tables 1 and 2, pl. 1. In Peloncillo Mountains, southwestern New Mexico, formation comprises lower dominantly clastic unit and upper dominantly carbonate section. As exposed near Silver Hill mine, lower unit of alternating beds of sandstone, siltstone, or shale and medium-grained gray limestone—399 feet thick; upper unit wholly of medium- to thick-bedded medium-grained gray limestone—432 feet thick. In Peloncillo Mountains, formation includes beds of Permian [Wolfcamp] age only.

Type section: Extends from saddle south of Earp Hill up to conspicuous mottled, pink and gray limestone, and then (to avoid faulting at this locality) is completed by exposed section above this mottled bed about

one-half mile to east on the same slope. Named from Earp Hill in sec. 5, T. 21 S., R. 23 E., on whose slope lower part of formation is well exposed, central Cochise County. There is no continuous, unfaulted section of entire formation in area of northern Mule Mountains, Tombstone Hills, or Dragoon Mountains, included in Pearce and Benson quadrangles, Arizona.

Easley Group

Mississippian (Kinderhookian): Missouri, Illinois, Indiana, Iowa, and Kentucky.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, chart 5; J. M. Weller, 1948, (abs.) Am. Jour. Sci. v. 246, no. 3, p. 150. Proposed for Upper Kinderhook strata which are generally conceded to be of Mississippian age. In type area, in Mississippi Valley, group consists of Hannibal shale and Chouteau limestone and related formations or members. At least locally, these are separated by unconformities from underlying Fabius group (new) and overlying Osage series.

M. G. Mehl, 1960, Denison Univ. Jour. Lab., v. 45, art. 5, p. 94. Weller and others (1948) proposed that the Kinderhook be considered a series and divided into two groups, the Easley and Fabius. The Easley was to include all Kinderhookian strata which are almost universally recognized to be of Mississippian age, and the Fabius to include all those Kinderhookian strata which are believed by some to be Mississippian and by others to be Devonian. Position of the committee in establishing two Kinderhook groups based on above distinction does not appear tenable. Recommended that terms Easley and Fabius groups be dropped from list of stratigraphic designations in Missouri.

Name derived from Easley, Boone County, Mo., where Chouteau limestone and Sylamore sandstone are well exposed.

Easly Creek Shale (in Council Grove Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 229–237.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Consists of red, green, and gray shale, partly calcareous and containing local limestone beds; upper part is light colored and calcareous; lower part largely red shale; locally contains gypsum bed near base. Thickness approximately 15 to 20 feet. Underlies Crouse limestone; overlies Bader limestone.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 81–82. Easly Creek shale was named by Condra (1927) who described it as member of Garrison shale and defined it as beds from top of Eiss limestone to base of Crouse limestone. Condra and Upp (1931, Nebraska Geol. Survey Bull 6, 2d ser.) redefined Easly Creek to include beds between Middleburg limestone [member of Bader limestone] and Crouse limestone. This is classification followed in present report [Wabaunsee County, Kans.]. Thickness 10 to 18 feet.

Type locality: On Easly Creek, in NE¼ sec. 35, T. 1 N., R. 13 E., about 10 miles south and 1¼ miles east of Humboldt, Richardson County, Nebr.

East Berlin Formation (in Newark Group)

Upper Triassic: Central Connecticut.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 7, 8 (table 1), 14–24, pl. 1. Proposed for sedimentary rocks that conformably overlie Holyoke basalt and conformably underlie Hampden basalt. This unit was designated as upper sedimentary division of Meriden formation by Krynine (1950). Principally fine-grained clastics—shale and mudstone—predominantly grayish red. On basis of calculations along three cross sections in three different fault blocks, thickness found to vary between 550 and 600 feet.

Type section: On Connecticut Highway 72, just northeast of town of Berlin and west of village of East Berlin, in northwest corner of Middletown quadrangle.

East Bluff Member (of Windrow Formation)

Cretaceous: Southwestern Wisconsin, northwestern Iowa, and southwestern Minnesota.

G. W. Andrews, 1958, Jour. Geology, v. 66, no. 6, p. 599, 606 (fig. 2), 607–610. Proposed to include coarser clastic deposits of formation which commonly rest conformably on older ferruginous deposits here named Iron Hill member. Term Ostrander member of Dakota formation has been applied to these deposits in southeastern Minnesota by Stauffer and Thiel (1941). Thwaites and Twenhofel (1921) refer these deposits to Windrow. Section in Fillmore County, Minn., consists of 20 feet of lensing units of gray clay, sand, and sandy clay, with beds of iron oxide near base; channel fillings of small well-sorted quartz and chert pebbles, granules, grit, and sand common; channel deposits occasionally show cross-lamination. Underlies Kansan drift.

Named for exposures on the East Bluff in Devil's Lake State Park, Sauk County, Wis.

East Branch Arkose (in Dickinson Group)

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 31–32. Basal formation of group. Strata comprise arkose, arkosic conglomerate, and interbedded metamorphosed basalt flows and basic tuffs; beds are steeply dipping or vertical. Thickness in type area about 1,000 feet. Underlies Solberg schist (new); actual contact with older granitic gneiss not observed, though in some places the two rock units are exposed but a few feet apart. Strata have been referred to Sturgeon quartzite by earlier workers who assumed it to underlie Randville dolomite that is exposed a short distance to the north.

Well exposed in broad glacially polished outcrops in secs. 17 and 18, T. 42 N., R. 28 W., along East Branch of Sturgeon River, Dickinson County.

East Buffalo Creek Limestone Member (of Tyler Formation)

Carboniferous: Central Montana.

G. H. Norton, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 62, 63 (fig. 7). Limestone unit very much like Amsden in lithology; overlain by basal Amsden conglomerate.

Named from exposures on East Buffalo Creek, secs. 11 and 12, T. 12 N., R. 16 E.

East Cape Volcanics

Quaternary: Southwestern Alaska.

R. R. Coats, 1953, U.S. Geol. Survey Bull. 989–A, p. 8–9, 14–16, fig. 2. Rocks of East Cape Volcano include hypersthene-bearing hornblende basalts and basaltic andesites. All are dense medium-gray rocks, with 80 to 90 percent of plagioclase. Dome on flank of volcano also of pale-gray hypersthene-bearing hornblende basalt.

Associated with East Cape Volcano consisting of older and higher cone to the north and smaller volcanic dome on southeastern flank, which contributed largely to construction of northeastern part of Buldir Island, in western Aleutian Islands.

East Caroline Beds or Formation

Miocene. East Caroline Islands.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 69–70, table 5 [English translation in library of U.S. Geol. Survey, p. 84; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 29. Consist of agglomerate, tuff, conglomerate, and breccia; intruded by basalt dikes. Rest unconformably on base rocks of islands. Getsuyoto [Getuyoto] beds of Truk, Matalanim [Mataranium] formation of Ponape, and Maremu [Marem (Malam)] formation of Kusaie are included in this formation.

Type locality: East Caroline Islands.

Eastern Basalts[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 230–235, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 676. Cenozoic. Overlie Juniper lavas.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta, v. 8, p. 78 (table 3). Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Occurs in Lassen Volcanic National Park, near Butte Lake.

Easterwood Shales (in Yegua Group)

Eocene (Claiborne): East-central Texas.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 3–4, geol. map. Name applied to dominantly shaly section of group; underlies Cockfield formation and overlies Byram sandstone.

Name derived from Easterwood Airport located on campus of A & M College of Texas, Brazos County.

Eastford Granite Gneiss[1]

Pre-Triassic: Northeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 127, and map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 51. Mapped as Monson orthogneiss.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as a granitic gneiss.

Good exposure in southeastern corner of Eastford [Township], Windham County.

East Fork Formation[1]

Precambrian(?): Central Idaho.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10–17.

C. P. Ross and J. D. Forrester, 1947, Geologic map of the State of Idaho (1:500,000): U.S. Geol. Survey. Mapped as Precambrian(?).

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 3. Precambrian(?) rocks in Pioneer Mountains include Hyndman formation, about 6,600 feet, and East Fork formation, at least 1,560 feet. East Fork consists largely of metamorphosed limestone but includes conspicuous interbedded quartzite masses. The two formations crop out over an area of about 20 square miles along southwestern border of a granite body. They are cut by many faults and separated from all other sedimentary rocks in vicinity by faults. Assumption that the Hyndman and East Fork are Precambrian is far from proved.

Forms a belt on west side of area of metamorphosed rocks as far south as divide between Hyndman Creek and East Fork of Big Wood River. Best exposed on east side of headwaters area of Hyndman Creek, Hailey quadrangle.

†East Gallatin Group[1]

Precambrian: Central southern Montana.

Original reference: F. V. Hayden, 1885, U.S. Geol. Survey 6th Ann, Rept., p. 50.

Exposed near mouth of East Gallatin River, Threeforks quadrangle.

East Greenwich Group[1]

Mississippian(?): Central Rhode Island.

Original reference: B. K. Emerson and J. K. Perry, 1907, U.S. Geol. Survey Bull. 311, p. 58–65, map.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. May [GQ–17]. Revived as a group because intrusive and extrusive rocks in vicinity of East Greenwich form a natural group closely related in composition and age. Subdivided to include (ascending) Spencer Hill volcanics (new), unnamed metadiorite, Maskerchugg granite (new), unnamed granite porphyry, Cowesett granite (new), and unnamed dark fine-grained granite. Younger than Blackstone series and Esmond granite; older than Pennsylvanian rocks of the Narragansett Basin. Mississippian(?). Derivation of name.

Occurs in and west of village of East Greenwich, East Greenwich quadrangle.

East Haven Granite[1]

Precambrian: Central Connecticut.

Original reference: E. Hitchcock, 1823, Am. Jour. Sci., 1st, v. 6, p. 3–86.

In East Haven and Branford, New Haven County.

†East Iowan Formation[1]

Pleistocene: Iowa.

Original reference: T. C. Chamberlin, 1894, Great ice age, by James Geikie, 3d ed., p. 724–775.

†East Iowan stage of glaciation[1]

Pleistocene: Iowa.

Original references: James Geikie, 1894, Great ice age, 3d ed., p. 724–775; 1895, Jour. Geology, v. 3, p. 270–277.

East Kane shale member[1] (of Knapp formational suite)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 61, 112, table opposite p. 61.

Well exposed in brick shale quarries at East Kane, McKean County.

Eastland Formation

Eastland Member (of Lee Formation)

†Eastland Shale Lentil (of Bon Air Sandstone)[1]

Lower Pennsylvanian: Central Tennessee.

Original reference: Charles Butts and W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–D, p. 4–12, pl. 4.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 17). Correlation chart shows Eastland formation underlying Newton sandstone and overlying Herbert sandstone.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4. Conglomeratic phase of Newton sandstone in southern Cumberland and northern Bledsoe Counties was type "Herbert conglomerate" erroneously considered by Nelson (1925) to be older than Newton. The shale thought to be between the sandstones and named "Eastland shale" by Nelson is actually Whitwell shale. Names "Herbert" and "Eastland" are here discarded.

Named for occurrence at mining town of Eastland, 1 mile west of Clifty, White County.

†Eastland Formation (in Canyon Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologist Bull., v. 3, p. 133–145.

Named for Eastland, Eastland County.

†Eastland Limestone Member (of Caddo Creek Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Well exposed in creek bed one-half mile east of Caddo and in Caddo oil field. Named for Eastland, Eastland County.

Eastland Sandstone (in Graham Formation)[1]

Pennsylvanian: Central Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 62.

Well exposed in railroad cut 1 mile northwest of Eastland, Eastland County.

Eastland Lake Formation (in Smithwick Group)

Pennsylvanian (Lampasas): North-central Texas (subsurface).

M. G. Cheney, 1940, Am. Asoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 84 (fig. 5), 86. Basal formation of group. Consists of sandstones in lower part and gray limestones in upper part. Occurs between depths of 3,960 and 4,225 feet in type well. Underlies Caddo Pool formation (new); overlies Sipe Springs formation (new).

Some reports place Eastland Lake in Kickapoo Group, Strawn Series.

Type well: Anzac Oil Corp. et al. E. S. Graham No. 1, in Allen Hines Survey, Abstract 135, central Young County. Named from Eastland Lake district of northwest Eastland County.

†East Lee Gneiss[1]

Precambrian: Western Massachusetts.

Original reference: B. K. Emerson, 1892, U.S. Geol. Survey Hawley sheet, that is, proof sheets of geologic maps and text intended for a geologic folio, but never completed and published in that form, although cited in U.S. Geol. Survey Bull. 191, 1902.

Named for exposures in hill overlooking East Lee on northeast.

†East Lee Limestone[1]

Precambrian: Massachusetts.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159, p. 50–51.

Exposed at East Lee, Berkshire County.

East Liberty Bone Bed (in Columbus Formation)

Middle Devonian: West-central Ohio.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 280–282. Name applied to bone bed near top of formation. Consists of dolomitic sandstone containing phosphatic nodules, many of which are internal molds of small mollusks and other fossils; some fish remains also present. Thickness of bone bed commonly less than 1 foot but arenaceous character of bed extends downward for 10 feet or more, and lower boundary of bone is gradational in places. Disconformably overlain by Ohio black shale.

Well exposed in quarry of East Liberty Stone Co., 1 mile west of East Liberty, Logan County. Area is known as Bellefontaine Devonian outlier.

East Lynn Sandstone

East Lynn Sandstones (in Allegheny Formation)[1]

Pennsylvanian (Allegheny Series): Southern West Virginia and Eastern Kentucky.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1913, West Virginia Geol. Survey Rept. Cabell, Wayne, and Lincoln Counties, p. 183.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 45, 48, 82. In lower Allegheny between Middle Kittanning above and No. 5 Block (Lower Kittanning) coals.

Named for occurrences at East Lynn, Wayne County, W. Va., where it forms massive cliffs 40 to 60 feet high.

East Molokai Volcanic Series

Pliocene(?): Molokai Island, Hawaii.

H. T. Stearns 1946, Hawaii Div. Hydrography Bull. 8, p. 69 (table), 71–72; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 11, p. 16–23; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 81–82. Consists of caldera complex member, lower (basalt) member, and upper (andesite) member. Exposed thickness 4,900 feet; probably extends 12,000 feet or more to ocean floor. Separated from underlying West Molokai volcanic series (new) by erosional unconformity; separated from overlying Kalaupapa basalt (new) by erosional unconformity.

Type locality: Cliff south of Kalaupapa Peninsula. Covers area 26 miles long and 8 miles wide, comprising almost all of East Molokai.

East Mountain Schist[1]

Precambrian(?): Southwestern Vermont.

Original reference: E. J. Foyles, 1931, Vermont State Geologist 17th Rept., p. 249.

East Mountain, Mendon Township, Rutland County.

East Mountain Shale Member (of Mineral Wells Formation)[1]

East Mountain Formation (in Lone Camp Group)

Middle Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 25, 31; Texas Univ. Bull. 2132, p. 77, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87, 88, 92. Rank raised to formation in Lone Camp group (new). Includes (ascending) Hog Mountain sandstone, Capps limestone (upper part), and Village Bend limestone members. Overlies Garner formation; underlies Salesville formation of Whitt group (new). Name Mineral Wells dropped in this report.

R. J. Cordell and others, 1954, Abilene Geol. Soc. Guidebook Nov. 19–20, fig. 2 (strat. chart). Formation revised to include (ascending) Brazos River sandstone (in part) and conglomerate, Hog Mountain sandstone, conglomerate sandstone in East Mountain shale, Capps limestone, and Village Bend limestone. Revision based on faunal break in Brazos River sandstone.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 22–23, fig. 3, pl. 1. Formation in Parker County consists of shale, one sandstone body (Hog Mountain sandstone bed), and one conglomeratic sandstone. Thickness 330 feet in traverse located east of Lake Mineral Wells. Upper 35 to 40 feet exposed in scarp that crosses Wolters Military Base; beds are poorly laminated clay-shale; interval includes stratigraphic position of Village Bend limestone mapped in Palo Pinto County (Plummer and Hornberger, 1935 [1936]), but limestone cannot be traced into Parker County. Underlies Salesville formation; overlies Garner formation. Group terminology not used in this report.

Type locality: Extensive exposures on south end of East Mountain in Mineral Wells, Palo Pinto County.

Easton Schist[1]

Easton Group

Pre-Ordovician(?) or Carboniferous(?): Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Prof. Paper 19.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4 p. 775. Easton group, in Skykomish area, subdivided into Eagle greenschist and Tonga formation (both new).

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 102, pl. 1. Easton schist forms pre-Tertiary basement west of Cle Elum Valley. In area of this report [northern parts of Mount Stuart and Snoqualmie folios], consists of blue amphibole schists and apparently interbedded greenschist and phyllite. Is apparently southern end of extensive but discontinuous unit that has been traced from near Canadian border to just north of Snoqualmie quadrangle. Schist is pre-Swauk and therefore pre-Tertiary. W. S. Smith (1915, Columbia Univ. School of Mines Quart., v. 36; 1916, Jour. Geology, v. 26, no. 6) reported Ordovician fossils north of Snoqualmie quadrangle in less metamorphosed rocks and used these to date Easton as pre-Ordovician. Recent workers have not found Ordovician fossils and original Ordovician collection has been lost.

Named for occurrence near Easton, Kittitas County. Exposed in cores of two anticlines between Kachess and Cle Elum Lakes.

East Point Formation

Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 177, pl. 23. Uninterrupted sequence of andesitic lava flows, over 500 feet thick. Two dozen separate flow units distinguished in 700-foot sea cliff on southeast side of East Point. Lavas are light- to dark-gray andesite and basalt locally containing plagioclase, pyroxene, and olivine phenocrysts. Probably younger than Sitkin Point formation (new).: conformably underlies Double Point dacite (new).

Named for exposures, at sea level, on either side of East Point, Little Sitkin Island, in Rat Islands group of Aleutian Islands.

Eastport Formation[1]

Upper Silurian: Southeastern Maine.

Original references: E. S. Bastin and H. S. Williams, 1913, Maine Water Storage Comm. 3d Ann. Rept., p. 168; 1913, Geol. Soc. America Bull., v. 24, p. 378, 379.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart above Pembroke formation. Underlies Devonian. Cayugan series.

Named for exposures at Eastport on Moose Island, Washington County.

East Ridge Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 278–283, geol. map. Dominantly ultramylonites with some layered plutonics interlayered. Occurs in an apparently homoclinal sequence. Separated from Aurela Ridge and West Ridge rocks (both new) by Marjo Canyon thrust. Contact relations with Sarac Ridge mylonite (new) not certain.

Exposed on East Ridge, San Bernardino County.

East Tioga Clay (in Golden Valley Formation)

Eocene: Western North Dakota.

Great Northern Railway Co. Mineral Research and Development Department, 1958, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 5, p. 8, 22, map. A 10-foot bed of clean, buff-colored clay. White Earth, South Ross, and Lakeside clays occur in same general area.

On Great Northern mainline in center sec. 33, T. 157 N., R. 94 W., Mountrail County.

East Verde limestone

[Upper Devonian] (Jeromian): Arizona.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228. Upper part of Jeromian series (new). Thickness 350 feet. Older than Island Mesa limestone. Overlies Sycamore sandstone. Upper part of Jerome formation (of Stoyanow).

[In Jerome region.]

East Waterford Red Sandstone Member (of Juniata Formation)

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geol. Contr. 3, 58p. Consists of red graywacke-type sandstones with interbeds of shale and siltstone. Basal member of Juniata from Tyrone Gap to Susquehanna Gap. Underlies Plummer Hollow red mudstone and sandstone member (new) of Juniata from Tyrone Gap eastward to about vicinity of Lost Creek Gap. Overlies Spring Mount sandstone member (new) of Bald Eagle sandstone; eastward overlies Lost Run conglomerate. [Swartz refers to his 1955 report *in* Pennsylvania Geologists Guidebook 21st Ann. Field Conf. Compiler was unable to locate a copy of this report.]

Type locality: East Waterford Narrows in Tucsarora Mountain, Juniata County.

East Waynesboro Formation

[Lower Cambrian]: Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 139. Lower part of Unicoi up to top of 300-foot acid lava flow is named Swannanoa formation, and upper part of Unicoi is named East Waynesboro formation.

Report discusses structure and stratigraphy of Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is overturned anticline, with axial plane dipping 28° SE., and thrust fault bordering it on its western edge.

†East Wisconsin Formation[1]

Pleistocene: Wisconsin.

Original reference: T. C. Chamberlin, 1895, Jour. Geology, v. 3, p. 270–277.

Named for thick development of drift in eastern Wisconsin.

†East Wisconsin stage of glaciation[1]

Pleistocene: Wisconsin.

Original reference: T. C. Chamberlain, 1894, Great ice age, by James Geikie, 3d ed., p. 724–775.

Named for thick development of drift in eastern Wisconsin.

Eaton Beds[1]

Middle Silurian: Ohio.

Original reference: A. F. Foerste, 1888, Denison Univ. Sci. Lab. Bull., v. 3, p. 8.

Eaton Greensand Lentil (in Claiborne Group)[1]

Eocene, middle: Eastern central Texas.

Original reference: B. C. Renick and H. G. Stenzel, 1931, Texas Univ. Bull. 3101, p. 78, 90–91.

Occurs south of Eaton, in vicinity of Shiloh School, in southern Robertson County.

Eaton Sandstone Member (of Saginaw Formation)

Eaton Sandstone (in Grand River Group or Formation)

Pennsylvanian: Southern Michigan.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 207, 211–214. Eaton sandstone (in newly defined Grand River group) proposed for uppermost sandstones forming bluffs or ledges along valley of Grand River and its tributaries in vicinity of Grand Ledge in northern part of Eaton County. Beds are post-Saginaw in age, but true stratigraphic relations to Woodville sandstone, Ionia sandstone, or other strata of Grand River group cannot be determined. Overlies Saginaw at type locality of that group. Thickness 50 feet in vicinity of Grand Ledge.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan; Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28–29. Herein considered member of Grand River formation. Occupies channels cut into shale and sandstone of Saginaw formation. It is probable that future study will show that the Eaton is brown-weathering facies of the Ionia as exact stratigraphic position of Eaton and Ionia members in the Grand River is not known.

Name derived from Eaton County.

Eau Claire Grit[1]

Upper Cambrian: Southwestern Wisconsin.

Original reference: L. C. Wooster, 1878, Wisconsin Geol. Survey Ann. Rept. 1877, p. 37.

Exposed at mouth of Eau Claire River, Eau Claire County.

Eau Claire Sandstone[1] (in Dresbach Group)

Eau Claire Member (of Dresbach Formation)

Upper Cambrian: Western Wisconsin and southeastern Minnesota.

Original reference: C. D. Walcott, 1914, Smithsonian Misc. Colln., v. 57, p. 354.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 32, 33, measured sections. Middle member of Dresbach formation. Commonly medium- to fine-grained gray to buff sandstone with beds and partings of gray shale; may include conglomerates, and over large areas its shales may be red. Thickness about 128 feet at type section of Dresbach. Overlies Mount Simon member; underlies Galesville member.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 255 (fig. 32), 371. Referred to as Eau Claire sandstone. Overlies Mount Simon sandstone; underlies Dresbach sandstone. Thickness 70 to 330 feet.

U.S. Geological Survey currently includes the Eau Claire Sandstone in the Dresbach Group.

Named for exposures at mouth of Eau Claire River, Eau Claire County, Wis.

Ebbetts Pass Granodiorite

Pre-Tertiary: Central eastern California.

H. G. Wilshire, 1957, California Univ. Dept. Geol. Sci. Bull., v. 32, no. 4, fig. 1. Named on map legend of Ebbetts Pass region.

Ebbetts Pass is in Alpine County.

†Ebensburg Sandstone Member (of Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: C. Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133.

Crops out in river bluff to east of Summerhill, and also on top of knoll just northwest of Summerhill. Probably named for town of Ebensburg, Cambria County.

Echo Granite[1]

Precambrian(?): Southern California.

Original reference: W. J. Miller, 1930, Geol. Soc. America Bull., v. 41, p. 149–150.

Comprises several square miles, extending from Millard Canyon to Eaton Canyon, including part of Echo Mountain, San Gabriel Mountains.

Echo limestone or formation (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Consists of three chief ledges of limestone separated by shales. Principal limestone formation of entire Protozoic section. Thickness 150 feet. Underlies Walhalla formation (new); overlies Carbon Butte shales (new).

Name derived from Echo Cliffs, at edge of Kaibab Plateau, on latitude of mouth of Little Colorado River; Grand Canyon region.

Echo Canyon Conglomerate

Upper Cretaceous: Northeastern Utah.

N. C. Williams and J. H. Madsen, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10, p. 123, 125. Proposed for sequence of red conglomerates, sandstones, and shaly sandstones exposed in Echo Canyon and adjacent areas. Thickness 3,100 feet. Overlies Wanship formation; unconformably underlies Knight formation. Fossils near base are considered to be late(?) Niobrara; upper part of unit may be Montanan in age. Relationship of Echo Canyon conglomerate to Hilliard formation, which contains Coloradoan-Montanan boundary in southwestern Wyoming not presently known.

Eardley (1944, Geol. Soc. America Bull., v. 55, no. 7) mentioned, but did not define, an Echo Canyon conglomerate which he stated (p. 844) occurred below Fowkes(?) formation. Table 1, p. 824, shows his newly defined middle Paleocene(?) Saw Mill conglomerate underlying upper Paleocene(?) Fowkes formation.

L. A. Hale, 1960, Wyoming Geol. Assoc' Guidebook 15th Ann. Field Conf., p. 142. Refers to Echo Canyon (formerly Pulpit) conglomerate.

Exposed in Echo Canyon and vicinity of Echo Junction, Coalville area, Summit County.

Echo Falls Shale

Eocene, upper: Southern California.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1920 (fig. 3). Shown on structure section as underlying Matilija sandstone and overlying Topatopa sandstone.

Section is 2 miles east of Santa Paula, Ventura County.

Echooka River Glaciation

Pleistocene: Central northern Alaska.

R. L. Detterman, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 12, 13 (table 1). Four Quaternary glacial advances recognized in Sagavanirktok-Anaktuvuk district. Echooka, the last recognizable advance, succeeded Itkillik glaciation (new). Relatively minor, covering less than 50 square miles. At its maximum extent, ice did not reach front of range and formed independent valley glaciers. Well-developed end moraines and kame terraces along valley wall. Knob and kettle topography of moraine relatively fresh. Till sheet 30 to 50 feet thick.

Named after Echooka River, major eastern tributary of Sagavanirktok River. Confined to major valleys of Sagavanirktok River drainage area.

Echo Pond Granitic Complex

Age not stated: Northeastern Vermont.

B. K. Goodwin, 1959, Dissert, Abs., v. 20, no. 5, p. 1740. Granitic rocks occupy about two-thirds of map area. Three major granitic bodies are present: Averill granite, Nulhegan quartz monzonite (new), and Echo Pond granitic complex. Rocks of Echo Pond range from granite to gabbro.

Report discusses geology of Island Pond area, located between Green Mountain anticlinorium and Connecticut River.

Eckman Sandstone (in Pottsville Group)[1]

Eckman Sandstone (in Pocahontas Group)

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 221.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 217, 245. Included in Pocahontas group, Pottsville series. In Greenbrier County is lenticular brown to gray sandstone. Thickness 20 to 40 feet. Underlies No. 6 Pocahontas coal and overlies No. 5 Pocahontas coal.

Named for exposures at Eckman, McDowell County.

Economy Formation or Shale (in Eden Group)

Economy Member (of Eden Formation)

Economy Member (of Latonia Shale)[1]

Upper Ordovician: North-central Kentucky, southeastern Indiana, and southwestern Ohio.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 9.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on correlation chart as basal

formation in Eden group in Indiana. Underlies Southgate formation; overlies Cynthiana formation in Trenton group. Consists of shale 50 to 80 feet thick.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 66, no. 3, chart 2 (column 45). Shown on correlation chart as Economy shale in Eden group. Underlies Southgate shale; overlies Fulton shale.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030–1031. Basal member of Eden formation. Economy member (designated "Fulton-Economy" in this rept.) is 20 to 80 feet thick. Gradationally underlies Southgate member.

Economy was old name of village now known as West Covington, Kenton County, Ky.

Ector Tongue (of Austin Chalk)[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: L. W. Stephenson, 1918, U.S. Geol. Survey Prof. Paper 120–H, p. 149.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart as underlying Bonham marl and overlying Eagle Ford shale.

Exposed near Ector, Fannin County.

Eddy sandstone[1]

Permian: Southern New Mexico.

Original reference: C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

Derivation of name not stated, but probably named for Eddy, Lincoln County [now Eddy County].

Eddy Hill Grit[1]

Eddy Hill Grit Member (of Schodack Formation)

Eddy Hill lithofacies

Lower Cambrian: Southwestern Vermont and eastern New York.

Original reference: Rudolf Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 64. Rank reduced to member of revised Schodack formation.

Christina Lochman, 1956, Geol. Soc. America Bull., v. 67, no. 10, p. 1335, 1336, 1339, pl. 9. Referred to as a lithofacies of third phase of Lower Cambrian sedimentation in Cambridge and Hoosick quadrangles, New York. Not considered time-stratigraphic unit. Contemporaneous with Mettawee and Schodack lithofacies.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 332. Dale's "Black patch grit" (1898, U.S. Geol. Survey Ann. Rept., v. 19, pt. 3B) was named the Eddy Hill grit by Ruedemann (1914) from type exposure at Eddy Hill, Vt., where unit is 40 feet thick. The Eddy Hill is dark-gray calcareous quartz grit with black shaly patches and calcareous sandstone nodules. Another variant is feldspathic sandstone or subgraywacke with calcareous and sericitic cement. Formation may be mistaken for Middle Ordovician Normanskill graywacke but lacks kaolinized inclusions and more pronounced bedding. Southward exten-

sion of Eddy Hill into Rensselaer County is unproved, and its correlation with Diamond Rock quartzite is speculative.

Named for exposures at Eddy Hill near Fairhaven, Vt.

Eden Beds[1]

Pliocene, lower: Southern California.

Original reference: C. Frick, 1921, California Univ. Pub., Dept. Geol. Bull., v. 12, p. 283–288.

Occur in Eden region, San Jacinto quadrangle, Riverside County.

Eden Group[1] or Formation

Eden Formation (in Covington Group)

Eden (Edenian) Stage

Upper Ordovician: Southwestern Ohio, southern Indiana, central northern Kentucky, central Tennessee, and West Virginia.

Original reference: J. S. Newberry, 1873, Ohio Geol. Survey, v. 1, table facing p. 89.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 175–179. Eden group geographically extended into central Tennessee. An intercalation of beds carrying an Eden fauna and lithologically different from Leipers and Catheys occurs low on southeastern flank of Nashville dome. This zone is here named Inman formation.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Generalized stratigraphic column of Ordovician rocks exposed in Jefferson and Switzerland Counties, Ind., shows Eden group comprising (ascending) Economy formation, 50 to 80 feet, Southgate formation, 70 to 120 feet, and McMicken, 60 to 80 feet. Underlies Maysville group; overlies Trenton group.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2; Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Cincinnatian series comprises (ascending) Edenian, Maysvillian, Richmondian, and Gamachian stages.

W. C. Sweet and others, 1959, Jour. Palentology, v. 33, no. 6, p. 1029–1030. Basal formation in Covington group. Underlies Fairview formation; above Point Pleasant (Cynthiana) beds. Formation divided into three members (ascending); Economy (including basal Fulton beds), Southgate, and McMicken. Eden formation may be considered reference standard for early Cincinnatian Eden stage.

Named for Eden Park, Cincinnati, Ohio.

Edgecliff Member (of Onondaga Limestone)

Middle Devonian: New York.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 626–627, 631 (fig. 2), 635–636, 641–642, pl. 1. Lowest member of Onondaga. Massive light-gray (in some places pink) very coarsely crystalline limestone characterized, in type area of Onondaga, by profusion of tabulates, large rugose corals, and crinoidal columnals. This is true coral biostrome and is Hall's (1879, New York Geol. Survey, Palentology, v. 5, pt. 2) "great coral bearing limestone" and the "Onondaga limestone" of early reports. Biostrome ranges in thickness from 8 feet at Split Rock

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to 25 feet at Chittenango Falls. Base of this unit is very sandy in most places; sandy zone (Springvale horizon) ranges in thickness from fraction of an inch with only widely scattered sand grains to 4 feet with high enough sand concentration at its lower limit to make it a sandstone; carries Onondaga fauna and is easily distinguished from true Oriskany sandstone. Whitish-gray chert nodules are characteristic of upper half of limestone but may occur in lower part also. Recognizable as far west as Buffalo; main changes are in thickness and amount of chert; near Buffalo contains large biohermal "reef" structure 35 feet thick and several hundred feet in diameter. Thickens eastward; 20 feet thick at Springfield Four Corners, where biostrome extends to top of member; 39 feet in Berne and Albany quadrangles, where biostrome occupies only lower 16 feet. Underlies Nedrow member (new). Onondaga in New York is generally considered lower Middle Devonian (Onesquethaw stage).

Named from exposures at Edgecliff Park, southwest of Syracuse and 1 mile northeast of Howlet Hill, Camillus quadrangle, Onondaga County. Member is most accessible at Split Rock, but this name is preoccupied.

†Edgehill Quartzite[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. C_6, p. 14–47, map.

Probably named for Edge Hill, Montgomery County.

Edgewood Limestone[1] or Dolomite

Lower Silurian: Northeastern Missouri, western Illinois, and northeastern Iowa.

Original reference: T. E. Savage, 1909, Am. Jour. Sci., 4th, v. 28, p. 517–518.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 16–22, pl. 1. Formation described in Bowling Green quadrangle where it is 0 to 40 feet thick and includes Cyrene limestone member below and Bowling Green dolomite member above. Unconformably overlies Maquoketa formation of upper Ordovician age; unconformably underlies Grassy Creek formation of Mississippian or Devonian age. Reference section designated. Albion series.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 34–40, pls. 1, 3. Geographically extended into Dubuque South quadrangle, Iowa-Illinois, where it consists chiefly of dolomite. Thickness 9 to 116 feet. Separable into (ascending) Mosalem and Tete des Morts members (both new). Unconformably overlies Neda member of Maquoketa shale; underlies Kankakee formation.

Reference section: On Higginbotham Farm in NW¼NE¼ sec. 28, T. 53 N., R. 1 W., Bowling Green quadrangle, about 1 mile north of Calumet, Pike County, Mo. Named for exposures 3 miles north of Edgewood, Pike County, Mo.

Edie School Rhyolites

Pliocene: East-central Idaho and southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4. p. 376–377, pl. 1. Named for slightly porous pale-lavender rhyolitic rocks that weather in shades of brown. Attain greatest thickness, estimated at 200 to 250 feet, in southeast corner of

area and wedge out where they overlap on flanks of adjoining ranges. Overlie mid-Tertiary sediments of South Medicine Lodge Basin and are overlapped by Snake River basalts in southeast corner of region.

Described in Lima region, Clark County, Idaho, and Beaverhead County, Mont.

Edinburg Formation

Middle Ordovician: Western Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 78–86. Proposed for stratigraphic interval above Lincolnshire limestone and below *Reuschella "edsoni"* zone which characterizes Oranda formation (new). In Shenandoah Valley, underlies Collierstown limestone (new). Embraces two equivalent facies: one of cobbly to nodular buff-weathering limestone, Lantz Mills (new), and other of black limestone and shale, Liberty Hall facies (new). Thickness as much as 1,348 feet; at type locality 455 feet. Includes Botetourt limestone member (new) at base and St. Luke member (new) near top. Corresponds to substantial part of Chambersburg formation of Pennsylvania.

Type section: One and one-half miles N. 61° E., of Edinburg, Shenandoah County.

Edison Gneiss[3]

Precambrian: Northern New Jersey.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 439.

D. R. Baker, 1957, Dissert. Abs., v. 17, no. 3, p. 597–598. Edison gneiss, a major lithologic unit in Edison area, is divided into four unnamed subunits. Detailed petrographic description given.

Edison area is in New Jersey highlands 3 miles south of Franklin, Sussex County.

Edisto Marl[1]

Miocene, lower: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources in South Carolina, p. 12, 18, 19.

Extends from mouth of Wando River by Charleston, Church Flats, Port Royal, Parachucla, Givhams Ferry, Bacon's Bridge and thence back to head of Wando River, Colleton County.

Edmunds Formation[1]

Silurian: Southeastern Maine.

Original references: E. S. Bastin and H. S. Williams, 1913, Maine Water Storage Comm. 3d Ann. Rept., p. 168; 1913, Geol. Soc. America Bull., v. 24, p. 378, 379.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Assigned to Niagaran and Cayugan series [Middle and Upper Silurian].

Named for exposures near Edmunds, Washington County.

Edmunds Hill Andesite[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1899, Am. Jour. Sci., 4th, v. 8, p. 359–360.

Forms entire top of Edmund's Hill, Chapman Township, Aroostook County.

Edna Dolomite (in Deer Trail Group)

Precambrian (Belt Series): Northeastern Washington.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as the second of five formations in group. Younger than Togo formation; older than McHale slate.

Report of discusses magnesite belt of Stevens County.

Edna Mountain Formation

Upper Permian: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]. Gray to buff calcareous sandstone and shale with interbedded chert-pebble conglomerate and thin limestone beds. Thickness about 100 feet. Unconformably overlies Antler Peak limestone.

H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Thickness about 250 feet in Edna Mountain, about 100 feet in Battle Mountain.

Type locality: West slope of Edna Mountain, Golconda quadrangle.

Edray Sandstone (in Bluefield Formation)[1]

Edray Sandstone (in Lillydale Shale)

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 443.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 265. Lenticular sandstone that may correspond to Edray sandstone of Reger (1926) is present in Lillydale shale. It is a thin poorly defined stratum.

Type locality: In Pocahontas County, W. Va., on mountain road 1.2 miles north of Edray.

Edson Beds (in Ash Hollow Formation)

Edson Beds (in Ogallala Formation)[1]

Pliocene, lower: Western Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7, p. 161–162.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 144. Included in Ash Hollow formation (Ogallala group). Consist of unconsolidated sands topographically a few tens of feet below Rhinoceros Hill beds. Contain vertebrate fauna.

Form an isolated outcrop near Edson, Sherman County.

Edwards Limestone (in Fredericksburg Group)[1]

Lower Cretaceous (Comanche Series): Southern Texas.

Original references: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey Geol. Atlas, Folio 42, p. 2; U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 227–235.

W. S. Adkins, 1932, Texas Univ. Bur. Econ. Geology Pub. 3232, p. 338–348.

Name Edwards replaced terms Caprina limestone (paleontological term) and Barton Creek limestone of Hill. From Fort Worth to south of Waco, Edwards gradually thickens, and is overlain, apparently unconformably by Kiamichi clay. South of Waco, Kiamichi is absent, and Edwards is overlain by Duck Creek limestone. Type locality stated.

F. E. Lozo and others, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, 235 p. Symposium on Edwards limestone. Based on outcrop sections, a southern complex of Edwards, Comanche Peak, and Walnut formations is indicated to pass northward into a complex composed of Goodland, Walnut, and Paluxy formations.

A. P. Noyes, Jr., and Keith Young, 1960, Texas Jour. Sci., v. 12, nos. 1, 2, p. 78–85, 99–104. Described in Purgatory Creek area where it is about 250 feet thick, overlies Walnut clay and underlies Georgetown limestone of Washita group.

Type locality (Adkins): Barton Creek, near Austin. Named for Edwards Plateau, Nueces and Uvalde quadrangles, southwestern Texas, of which it is chief component of scarps and mesas.

Edwardsville Formation (in Borden Group)[1]

Lower Mississippian: Southeastern Indiana.

Original reference: P. B. Stockdale, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 170.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 76, 220–300. Includes following facies: Stewarts Landing, Springler Knob, Medora Knob, Allens Creek, Bear Wallow, and Riverside sandstone. Named members (not in sequence): Dry Creek sandstone, Brownstown Hills, Cutright sandstone, Weed Patch, and Mount Ebel sandstone.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74, 78. Indiana units, Locust Point, Carwood, Floyds Knob, and Edwardsville were proposed by writer [Stockdale] in 1931. In present report, the Floyds Knob is carried into the Kentucky classification; the Edwardsville and "Lower Harrodsburg" are combined in Muldraugh formation (new); the Locust Point and Carwood together make Brodhead formation (new) in Kentucky.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 799. Includes Floyds Knob member (rank reduced).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Shown on correlation chart in Borden group. Osage series; underlies Harrodsburg limestone; overlies Floyds Knob formation.

Named for village of Edwardsville, near center NE¼ sec. 1, T. 3 S., R. 5 E., 4½ miles west of New Albany, Floyd County.

Eel River Formation (in Wildcat Group)

Pliocene, lower: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 28–31, 105–107, pls. 1, 2. Massive dark gray-black siltstone and glauconitic sandstone 600 to 2,000 feet thick. Unconformably underlies Rio Dell formation (new); unconformably overlies Pullen formation (new).

Type section: West bank of Eel River near Scotia, Humboldt County. In southern part of area, unit forms northward-dipping belt of varying thickness which extends from coast southeastward to Eel River and beyond.

Effingham cyclothem

Pennsylvanian: Southeastern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by Ekblaw led to tentative recognition of six cyclothems of which Effingham is third in sequence (ascending). Succeeds Divide cyclothem and is followed by Omega cyclothem. If Greenup and Omega limestones are not equivalent, a single standard reference section would include 14 cyclothems of which the Effingham would be eighth in sequence (ascending).

Type locality and derivation of name not given. However, type locality of Effingham beds is in sec. 33, T. 8 N., R. 6 E., on tributary to Salt Creek one-half mile south of Effingham, Effingham County.

Effingham Limestone Member (of Mattoon Formation)

Effingham Beds (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12. Referred to as Effingham beds in McLeansboro group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), pl. 1. Effingham limestone member of Mattoon formation (new) proposed. Occurs above Shumway limestone member and below Bogota limestone member. Thickness about 11 feet at type outcrop. Name Effingham beds discontinued.

Type locality: In sec. 33, T. 8 N., R. 6 E. on Tributary to Salt Creek one-half mile south of Effingham, Effingham County.

Effingham terrane[1]

Pennsylvanian: Illinois.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 39, no. 4, p. 320.

Probably named for Effingham, Effingham County.

Effna Limestone (in Cliffield Group)

Middle Ordovician (Mohawkian): Southwestern Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 59–64, pl. 8. Proposed for beds overlying Lincolnshire limestone and underlying Whitesburg limestone along northwest base of Walker Mountain. Consists mainly of white to light-gray coarse-grained shell limestone, some beds of which are pinkish; pyrite occurs as nests and stringers in 15-foot zone about 70 feet above base of formation. Thickness at type section 221 feet; decreases to about 60 feet south of Ceres.

C. E. Prouty, 1946,, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 5, p. 1152. Effna limestone is below Whitesburg, Athens, and Peery limestones in sequence southeast of Saltville thrust and is thought to be partly equivalent to Thompson Valley limestone (new), but relationships of succeeding Whitesburg to the Thompson Valley and Ward Cove are uncertain; because of this indefinite relationship, use of both Effna and Thompson Valley appears advisable.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 60–61, chart 1 (facing p. 130). Underlies Rich Valley formation (new). At Porterfield quarry, rests on thin tongue [Fetzer (new)] of Arline formation (new). Older than Red Knobs formation (new).

Type section: In and near McNutt quarry, about 1½ miles southeast of Sharon Springs, Bland County, Va. Name derived from settlement on State Highway 42, about 2 miles east of Sharon Springs.

Egan limestone[1]

Lower Ordovician: Eastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 78.

Named for Egan Range, Ely region.

Eggleston Limestone[1] or Formation

Middle Ordovician: Southwestern Virginia and eastern Tennessee.

Original reference: A. A. L. Mathews, 1934, Virginia Geol. Survey Bull. 40, p. 7, 11, 30.

R. R. Rosenkrans, 1936, Virginia Geol. Survey Bull. 46–I, p. 100. Not a valid formation name. Considered a facies of Black River age transitional between red Moccasin facies and overlying Trenton facies of the Martinsburg. Generally overlies red Moccasin facies but also replaces uppermost part of red Moccasin in more westerly belts.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (two sheets); 1954, Virginia Geol. Survey Bull. 71, p. 108 (table 6), 109–116. Overlies Hardy Creek member (new) of Moccasin limestone in Rose Hill Oil Field, Lee County. Underlies Trenton limestone. Consists of buff-weathering earthy calcareous siltstone at base and near top; rest of formation is thin-bedded fine-grained moderately fossiliferous limestone; two thick and several thin bentonite beds in upper part. Thickness 135 to 165 feet.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 61–66, 110–111, pl. 1. Mathews (1934) did not give type section, but sections at Narrows in Giles County that include beds assigned to Eggleston limestone have been published by Rosenkrans (1936) and Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1). Section along highway at Narrows has slumped and is less well exposed than when studied by Rosenkrans and Butts, but several bentonite beds listed in their sections are still visible. Base of Eggleston, as defined by Mathews, was clearly intended to begin with drab-green mudstones that overlie red mudstones typical of the Moccasin. Butts draws base of his Eggleston at this horizon. Top of Eggleston is less readily seen in this section, because the critical zone in which the contact was placed by Butts is now largely covered. Now lowest exposed beds of typical Trenton lithology and containing *Dalmanella* and *Sowerbyella* are 25 feet above place where Butts draws top of Eggleston. Drawing contact close below the lowest exposed *Dalmanella-Sowerbyella* beds would keep the two thick bentonites that should occur in this 25-foot covered interval within the the Eggleston, where they seem to belong according to evidence from other parts of southwest Virginia. However, it must be assumed that Butts' placing of the contact is correct unless the covered beds in the critical zone are reexcavated. Throughout Lee County and in adjacent Tennessee, the Eggleston is divisible into three unnamed members. Thickness 126 to 181 feet. Conformably overlies Hardy Creek limestone; underlies Trenton limestone; in both contacts, lithologic and faunal changes are abrupt and without evidence of erosion.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 61. Formation appears in western belts of southwestern Virginia and eastern Ten-

nessee on northwest slope of Wallen Ridge from Tennessee nearly to Big Stone Gap, and throughout Russell and Giles Counties, Va.

Type locality: Along State Highway 8, 1 mile north of Narrows, Giles County, Va. Also well exposed 1.1 miles south of Eggleston.

Eggners Ferry Chert

Mississippian: Western Kentucky.

E. M. Luttrell and Ann Livesay, 1952, Kentucky Geol. Survey, ser. 9, Bull. 11, p. 5, 11–12. Dark-blue to black chert that weathers white and gray. Contains *Productus* and *Spiriferina*. Occurs above New Albany shale and below Warsaw chert and, therefore, of Fort Payne age. Near Eggners Ferry, beds are from a few inches to 1 foot thick. Chert has been mapped as undifferentiated Meramec, St. Louis member of Meramec, Fort Payne, Camden chert, or Clear Creek chert by various workers [see bibliography this report].

Exposed along and near Kentucky Lake in vicinity of Eggner's Ferry, near Aurora, Marshall County.

Egremont Limestone[1]

Cambrian and Ordovician: Southwestern Massachusetts and northwestern Connecticut.

Original reference: W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Named for its wide extent in Egremont Valley, Berkshire County, Mass.

Egypt sand[1]

Upper Cretaceous: Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252. Derivation of name not stated.

Eidson Member (of Lincolnshire Formation)

Middle Ordovician (Mohawkian): Northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 61–62, chart 1 (facing p. 130). Name proposed for thinned part of Lincolnshire formation underlying Hogskin shale (new) in belts where that member is present. Consists of dark limestone containing black chert. Name credited to B. N. Cooper and G. A. Cooper.

Type section: Just north of Eidson, Kyles Ford (TVA 170–SE) quadrangle, Hawkins County. Present in Clinch, Hogskin, and Beaver Valleys.

Eighteenmile Creek Member (of Ludlowville Formation)

Middle Devonian: Western New York.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 366. Described as shale. Overlies Spring Brook shale member in Lake Erie sections. Name used by G. A. Cooper (unpub. thesis, 1929) who has since modified the stratigraphy by combining this unit and Spring Brook member to form Wanakah shale member.

Eight Mile Dacite

Pleistocene(?): Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 69. Consists of lower massive hard cliff-forming pale-brown dacite 50 to 100 feet thick, principally composed of glass tabulae; and upper denser, heavier porphyritic lithoidal dacite at least 200 feet thick. Of

probable Pleistocene age according to text; shown as Pliocene(?) age on figure 2a. Generalized section shows dacite stratigraphically above Pine Valley latite (new).

Filled a valley which descended to south from Eight Mile Spring, northeast of present village of Central, Washington County.

Eileen Sandstone (in Oronto Group)[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. W. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 50, 54.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474–1479. Thwaites assumed that Eileen sandstone lay below Amnicon sandstone on basis of distribution of outcrops and strikes and dips. Eileen at type locality is not in contact with any other formation of Oronto series but is separated by unexposed interval of almost 1½ miles from Amnicon formation. Therefore, relation of the Eileen to the Amnicon is not definitely known at type locality, and sequence postulated by Thwaites is only one of several possible explanations of relation of these two sandstones. Lithological and heavy mineral evidence suggests that the Eileen belongs above the Amnicon and includes beds on Middle River and Fish Creek sections which Thwaites classes as lower Orienta (in Bayfield group). Eileen sandstone is probably basal Orienta, and Amnicon arkose is upper Freda. Thickness of the Amnicon as given by Thwaites—5,000 feet—is included in his estimate of thickness of Freda, and the 2,000 feet assigned to the Eileen is the Orienta. Hence, Oronto group is revised to exclude Eileen and Amnicon.

Type locality: South fork of Fish Creek in sec. 20 and 21, T. 47 N., R. 5 W., in town of Eileen, Bayfield County.

Einstine (Einstein) Sandstone[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow and F. Hawn, 1865, Kansas Geol. Survey Rept. on Miami County, p. 7.

At McFaddin's and Ward's mill, Miami County. Derivation of name not stated.

Eiss Limestone Member (of Bader Limestone)

Eiss Limestone (in Council Grove Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 229, 233, 234, 235, 237.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 61, 62. Rank reduced to member status in Bader limestone. Underlies Hooser shale member; overlies Stearns shale.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 78–79, pls. Thickness about 10.9 feet in Wabaunsee County, Kans. Generally, consists of two beds of limestone and thin bed of shale. Underlies Hooser shale member; overlies Stearns shale.

Type exposure: In SE¼ sec. 3, T. 1 N., R. 13 E., on Eiss Farm, 8 miles south of Humboldt, Richardson County, Nebr.

Ekker Formation (in Sheeprock Group)

Precambrian: West-central Utah.

DeVerle Harris, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 1, p. 6, 16–23, pl. 1. Includes phyllitic quartzites, quartzites, graywackes, feldspathic quartzites, and tillites which comprise autochthon of Sheeprock thrust. Total measured thickness 4,159 feet. Underlies Quaternary alluvium; overlies Auts Canyon formation (new).

The only location where complete succession of beds can be seen fairly well exposed and in their proper relation is on ridges east and west of Hard-To-Beat Canyon. In vicinity of Dutch Peak and Rick Ekker Ranch, Sheeprock Range, Tooele County.

Eklutna Glaciation

Pleistocene: Alaska.

T. N. V. Karlstrom, 1957, Science, v. 125, no. 3237, p. 74 (fig. 1). Named on correlation chart of glacial events. Recognized in Cook inlet area. Older than Knik glaciation.

R. D. Miller and Ernest Dobrovolny, 1959, U.S. Geol. Survey Bull. 1093, p. 11–12, 13 (fig. 2), pl. 3. Represented by till, outwash, and silt. Locally truncated surface of till is overlain by till and outwash of Knik glacier. Oldest pre-Wisconsin deposits in Anchorage area.

Exposed north of Eagle River Flats along bluff of Knik Arm, Anchorage area.

Elbert Formation[1]

Upper Devonian: Southwestern Colorado.

Original reference: W. Cross, 1904, Am. Jour. Sci., 4th, v. 18, p. 245–252.

Harley Barnes, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1780–1791. Heretofore, Ignacio quartzite has been thought to be Late Cambrian in age, disconformably overlain by Elbert formation of Late Devonian. Recent fieldwork suggests that Ignacio quartzite is Devonian in age and that it forms essentially continuous depositional sequence with overlying Elbert formation and Ouray limestone.

R. L. Knight and J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1], p. 56, 57. In subsurface in Four Corners area, overlies Aneth formation (new) and subdivided to include McCracken sandstone member at base.

F. H. T. Rhodes and J. H. Fisher, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2508–2518. Major unconformity exists between Ignacio quartzite and Elbert formation. This is contrary to conclusions of Barnes (1954). No explanation is offered for parallelism of bedding of Ignacio and Elbert, nor for seeming transition is lithology between the two units.

Named for exposures on Elbert Creek, a western tributary of Animas River, entering it just above Rockwood.

Elberton Granite

[Cambrian-Ordovician]: Western Georgia.

Felix Chayes, 1952, Am. Jour. Sci., v. 250, no. 4, p. 284–286. Fine-grained massive granite. Extensively quarried.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 31. Intrudes Little River series in Wilkes County.

Marc Grunenfelder and L. T. Silver, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1574. Age determinations by isotope-dilution methods on zircon concentrates from Elberton granite yielded ages of 375 to 490 million years. These data are in contrast with K/A and Rb/Sr ages of 250 to 290 million years reported from same rocks by previous workers. Older ages indicate a late Cambrian(?) plutonic episode which has not been recognized in region previously.

Occurs in vicinity of Elberton and crops out over wide area in Elbert and Oglethorpe Counties.

Elbow Ridge Sandstone Member (of Coeymans Limestone)

Devonian: Southern Pennsylvania.

F. M. Swartz, 1939, Pennsylvania Geol. Survey Bull. G–19, p. 86. Thick-bedded quartzitic sandstone, some crinoid stems. Thickness about 11 feet.

Section is on south side of Licking Creek where it bends southward across Maryland line, and across northeastern end of Elbow Ridge. It is several hundred feet west of bridge crossing creek about 1 mile east of Warren Point and 1½ miles southwest of Yeakle Mill, Franklin County.

Elbrook Limestone,[1] Dolomite, or Formation (in Conasauga Group)

Middle and Upper Cambrian: Central southern Pennsylvania, western Maryland, northwestern Virginia, and northeastern West Virginia.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 209.

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 155–169. Geographically extended into Jefferson and Berkeley Counties, W. Va., where it occurs in two separated belts of outcrop. Estimated thickness in Jefferson County 2,200 to 2,400 feet; in Berkeley County, 2,000 to 2,200 feet. Overlies Waynesboro formation, but contact poorly exposed, may be unconformable; conformably underlies Conococheague dolomite with sharp contact.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 32–33, pl. 1. Described in Elkton, Va., area where it consists mostly of thin-bedded light-gray fine-grained dolomite that contains laminae and partings a few inches apart; some blue-gray limestone is interbedded with the dolomite, especially in upper part: some dolomitic buff or pink shale forms partings between dolomite or limestone beds. In most outcrops, dips are varied and formation is crossed by many small faults. In Crooked River Valley, belt of outcrop is about 3,500 feet wide and beds stand nearly vertical, except for local folds near top. Estimated thickness about 3,000 feet. Overlies Waynesboro formation; underlies Conococheague.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 54, pl. 1. Conasauga group is interfingering complex of shale, limestone, and dolomite, of which Elbrook dolomite, Honaker dolomite and Nolichucky shale are representatives in northeasternmost Tennessee [this report]. Within this region, group is exposed in two areas—one to north, along southeast edge of Appalachian Valley, and other to southwest near Elizabethton, in trough of Stony Creek syncline. In northern occurrence, interval is all Elbrook dolomite, but to southwest, Nolichucky shale is at top and underlying dolomite is Honaker. Thick-

ness of Elbrook about 2,000 feet in Denton Valley area, upper contact uncertain.

Named for outcrops near Elbrook, Franklin County, Pa.

El Capitan Granite[1]

Cretaceous: West-central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 121–122, map.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2122, 2123 (fig. 1). Discussed in paper dealing with potassium-argon dating of igneous rocks. Age given as 92.2 millions of years. Younger than Gateway granodiorite and older than Sentinel granodiorite.

E. S. Larsen, Jr., and others, 1958, U.S. Geol. Survey Bull. 1070–B, p. 52 (table 9). Lead-alpha age 94 millions of years.

Named for fact that it forms greater part of El Capitan, Yosemite National Park.

Elco Gravel[1]

Mississippian: Southwestern Illinois.

Original reference: L. C. Glenn, 1906, U.S. Geol. Survey Water-Supply Paper 164, p. 22, 150–152.

Quarried near Elco, Alexander County.

Elden limestones[1]

Carbonic: Northern central Arizona.

Original reference: C. [R.] Keyes, 1922, Pan-Am. Geologist, v. 38, p. 243, 251, 336.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart). In Mississippian series. Overlies Truxton limestones; unconformably underlies Pierce shales. Of Carbonic age.

Name derived from Elden Mountain near Flagstaff.

Eldena Member (of Nachusa Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15 C. Shown on columnar section as underlying Elm member (new) of Nachusa formation and overlying Forreston member (new) of Grand Detour formation. Thickness varies from 2 to 6 feet.

Occurs in Dixon-Oregon area.

Elder Sandstone

Age not stated: Northeastern Nevada.

James Gilluly, 1955, *in* Pacific Petroleum Geologist, v. 9, no. 8, p. 1. Thickness 3,000 to 5,000 feet. Arkosic sandstone dominant with beds of tan, pale, or buff chert. Overlies Ordovician Valmy formation; underlies Middle Devonian Slaven chert (new).

Occurs in Roberts Mountains area, Eureka district.

Elder Creek Group

Upper Jurassic (Knoxville): Northern California.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint 1941]. Shown as lowermost group of Knoxville series. Underlies Grindstone group (new).

F. M. Anderson, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 924, 925–926. Basal beds, as exposed near Redbank Creek, consist of dark-reddish-brown greatly indurated shale or thin-bedded cherty strata standing at a high angle and in part slightly overturned. In Bennett Creek area, a thick succession of alternating thin-bedded shales and calcareous sandstone layers constitute major part of group. Maximum thickness 6,600 feet. To the north, group is overlapped by early Shasta (Paskenta) beds; farther south, it is overlapped by conglomerates of Grindstone group. Lowest exposed beds rest upon or against pre-Knoxville metaandesite of Klamath complex.

Traceable northwest from Redbank Creek for a short distance and toward the south for more than 40 miles to latitude of Elder Creek village, Tehama County.

Eldora Sandstone[1]

Pennsylvanian: Central northern Iowa.

Original reference: S. W. Beyer, 1900, Iowa Geol. Survey, v. 10, p. 254.

Named for Eldora, Hardin County.

Eldoradan series[1]

Middle Cambrian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 78.

Eldorado Dolomite

Eldorado Limestone[1]

Middle Cambrian: Eastern Nevada.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1812, p. 184, footnote.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 18–20, fig. 3. Referred to as dolomite. Consists of thick-bedded dolomite, dolomitic limestone, and limestone. Thickness 2,000 feet south of Prospect Peak. Overlies Prospect Mountain quartzite; underlies Geddes limestone (new). In absence of fossils, dolomite is questionably assigned to Lower and Middle(?) Cambrian.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 9–11, pl. 2. Detailed description of Eldorado dolomite. Wheeler and Lemmon's (1939) definition accepted in this report. Restricted in outcrop area—confined to Prospect Ridge and southerly extension of the Ridge in Secret Canyon. North of Secret Canyon divide, exposures are discontinuous as result of two minor thrust zones, the Eldorado occurring in each of the three thrust blocks. Lowest of blocks includes type locality. In middle plate, Eldorado lies concordantly above and to east of main mass of Prospect Mountain quartzite and in several places overrides belts of Secret Canyon shale. In third and highest block, dolomite commonly overlies Prospect Mountain with thrust contact, but in a few places it appears to dip westward and rest in relative conformity on Pioche shale. Cannot be dated by enclosed fossils, but time range is limited by upper Lower Cambrian Pioche

shale below and medial Middle Cambrian Geddes limestone above. Wheeler and Lemmon assign unit to Lower and Middle(?) Cambrian; in view of occurrence of Middle Cambrian fauna in Pioche shale at Pioche, assignment to early Middle Cambrian is probably more suitable.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 159, 160. Eldorado limestone is as much as 3,171 feet thick in north-central Schell Creek Range. Overlies Pioche formation; underlies Monte Neva formation (new).

Type locality: Eldorado Tunnel, which is near north end of Prospect Ridge and about 2,000 feet north of east from portal of Prospect Mountain Tunnel. Beds exposed here are near top of formation as it is now defined. Named for Eldorado mine, Eureka district.

El Dorado Ridge Gneissose Quartz Diorite

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 298–300, geol. map. Medium-grained gneissose biotite-hornblende quartz diorite. Occurs in east-northeast-trending El Dorado Ridge—Stoddard Canyon pluton and south of Rainbow Flat metamorphics (new).

Named from exposures on El Dorado Ridge in San Bernardino County. Also present in Los Angeles County.

Eldoran Epoch[1] or Series[1]

Quaternary (Wisconsin and Recent): Iowa and Illinois.

Original reference: G. F. Kay, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 449–452.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38. In Iowa and Illinois, Pleistocene is classed as a Period (System) and four Epochs (Series) are used to include a glacial-interglacial pair each. These are Grandian (Nebraskan and Aftonian), Ottumwan (Kansas and Yarmouthian), Centralian (Illinoian and Sangamonian), and Eldoran (Wisconsinan and Recent). Of these units, each of first three essentially coincides with a glacial cycle; present data indicate that the youngest (Eldoran) includes two distinct cycles, each of which is complex within itself. These terms have not been adopted for official use in Kansas partly because of this inconsistency and partly because the retention of Quaternary as the System-Period with Pleistocene as its contained Series-Epoch would necessitate erection of new category of names to include these terms and thus produce further complication of classification system.

Named for Eldora, Hardin County, Iowa.

Eleana Formation

Mississippian to Lower Pennsylvanian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 357–360, pls. 32, 33. Lithologically most diverse unit in area. Generally consists of a conglomerate, quartzite, and shale facies in northern part of area. Southward, these grade into finer grained sediments. On Quartzite Ridge, where incomplete measured section is 2,810 feet thick, the Eleana is subdivided into three units. Lower unit consists of 1,000 feet or more of dark-brown to buff hard poorly bedded slope-forming argillite and shale. Middle is composed of about 1,050 feet of interbedded quartzite, conglomerate. Upper consists of about 760 feet

of varicolored argillite. These three units traceable southward into Eleana Range where they grade laterally into finer grained sediments. Most noticeable facies change is in middle unit which is split by shale tongue which thickens southward where it also contains interbedded limestone beds and occupies about a third of middle unit. Remainder is conglomerate and quartzite. Similar changes occur in upper unit. In southern part of Eleana, upper unit consists of interbedded sequence of argillite and limestone. South of Eleana Range and in Mine Mountains, middle and upper units not recognizable as such owing to abrupt lithologic changes. In these areas, formation consists of interbedded conglomerate, quartzite, shale, and some limestone. Lower contact of formation not exposed in area. Underlies Tippipah limestone (new). Upper contact on margins of Syncline Ridge, placed at lithic break between interbedded quartzite, argillite, and overlying limestone and appears to be conformable.

Named for exposures in Eleana Range, Atomic Energy Commission Nevada proving grounds area, Nye County.

†Electric Intrusives[1]

Miocene: Yellowstone National Park.

Original reference: A. Hague and others, 1899, U.S. Geol. Survey Mon. 32, pt. 2, pl. 10.

Probably named for Electric Peak.

Electric Peak Intrusives[1]

Miocene: Yellowstone National Park.

Original reference: A. Hague and others, 1904, U.S. Geol. Survey Mon. 32, Atlas, Gallatin sheet.

Intrude sedimentary rocks of Electric Peak in Gallatin quadrangle, Yellowstone National Park.

Elephant Limestone[1]

Pennsylvanian: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 703, chart 6 (column 53a). Mainly Pennsylvanian but may be Permian in part.

Named for Elephant Canyon, southeast of Frisco district.

Elephant Butte Formation (in Armendaris Group)

Pennsylvanian (Des Moines Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 44 (fig. 3), 47–49. Term proposed for all rocks between top of Derry series (new) and base of Whiskey Canyon limestone (new). Formation is essentially limestone, with one thin bed of conglomeratic sandstone about 22 feet above base and several beds of calcareous gray silty and micaceous shale near middle. Includes Warmington limestone member (new) at base. Thickness at type locality about 82 feet. Overlies Cuchillo Negro formation (new).

Type locality: Western end of Whiskey Canyon, in norther part of Mud Springs Mountains in southwest part of sec. 1, T. 13 S., R. 5 W., Sierra County. Name derived from Elephant Butte in Rio Grande Valley at Elephant Butte Dam.

Elephant Hill Breccia (in Glendora Volcanics)

Miocene, middle or older: Southern California.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 56, pl 1. Breccia member of Glendora volcanics. Composed of angular fragments of laminated gray spherulitic glass in tuffaceous matrix. Most of the blocks are 1 inch or less across, but the largest are at least 2 feet long.

Occurs in steep-walled semicircular valley head 500 feet in diameter that penetrates east flank of Elephant Hill, in Spadra area near Pomona, Los Angeles County.

Elephant Mountain Flow

Miocene and Pliocene: South-central Washington.

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 673, pl. 1. Name applied to basalt flow interstratified in Ellensburg formation. Occurs at higher stratigraphic level than Selah Butte flow (new). Average thickness about 35 feet in area mapped; thickens eastward into widespread lava sheet in Black Rock Spring quadrangle. Map bracket shows Ellensburg and associated basalt flows as Miocene and Pliocene. Text states that much or all of the Ellensburg and its associated intercalated basalt flows are regarded as Pliocene.

Flow crops out on Elephant Mountain, eastern continuation of Rattlesnake Ridge, Yakima East quadrangle.

Eleventh Street Limestone

Pennsylvanian (Des Moines Series): Northern Oklahoma.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 102. Limestone in upper part Des Moines subseries; occurs at or near horizon of Lenapah limestone.

R. H. Dott, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 8, p. 1593. Abandoned in favor of Lenapah limestone. Credits name to F. E. Greene. Gives area and derivation of name.

Crops out on East Eleventh Street (U.S. Highway 66), about one-half mile east of intersection of East Eleventh Street and Sheridan Road, NE¼ sec. 11, T. 19 N., R. 13 E., Tulsa, Tulsa County.

†Elgin Limestone (in Maquoketa Group)[1]

Elgin Shaly Limestone Member (of Maquoketa Formation)

Upper Ordovician: Northeastern Iowa and western Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 98.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as shaly limestone member of Maquoketa formation. Underlies Clermont shale member; overlies Dubuque dolomite.

Named for exposures near Elgin, Fayette County, Iowa.

Elgin Sandstone Member (of Vamoosa Formation)

Elgin Sandstone[1]

Pennsylvanian (Virgil Series): Southern Kansas and central northern and central Oklahoma.

Original reference: Erasmus Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 64.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 67. In southern Kansas, much of the interval between the Lecompton and Oread formations is occupied by sandstone, sandy shale, and red shale collectively called Elgin sandstone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as sandstone member of Vamoosa formation.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 32–34. Elgin in Pawnee County consists of four sandstone beds and numerous sandstone lenses within Kanwaka shale member of Vamoosa.

Well exposed near Elgin, Chautauqua County, Kans.

Eliot Formation (in Merrimack Group)

Eliot Slate[1]

Probably Ordovician and Silurian: Southwestern Maine and southeastern New Hampshire.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Jacob Freedman, 1950 Geol. Soc. America Bull., v. 61, no. 5, p. 450, 453 (fig. 2), 454–456, 488. Termed formation since slate not abundant in Mount Pawtuckaway quadrangle, New Hampshire. Includes light- and dark-gray phyllite, green phyllite, quartzite, and quartz-sericite schist. Calef member at top. Silurian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in Merrimack group in New Hampshire. Age designated as probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 40–41. Age tentatively considered Silurian, probably Middle Silurian.

Named for developmnet at Eliot, York County, Maine.

Elizabeth Gabbros[1]

Precambrian: Eastern New York.

Original reference: G. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, p. 82.

Named for development around Elizabethtown, Essex County.

Elizabeth Furnace Conglomerate Member (of Gettysburg Shale)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: A. I. Jonas and G. W. Stose, 1930, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 168.

M. E. Kauffman, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., Oct. 22 and 23, p. 23. Basal member of Gettysburg shale. Pebbly sandstone and conglomerate up to 2,500 feet thick. Underlies unnamed shale member.

Forms prominent ridge, Elizabeth Furnace Hill, northeast of Mount Hope, Lancaster County.

Elizabethtown Gabbro[1]

Precambrian: Northeastern New York.

Original reference: G. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, p. 82.

Occurs around Elizabethtown, Essex County.

Elizaville Shales

Upper Cambrian and Lower Ordovician(?): Southeastern New York.

J. D. Weaver, 1957, Geol. Soc. America Bull., v. 68, no. 6, p. 739–743, pl. 1. Mainly light gray but ranges from light greenish gray to dark gray approaching black. Coarse shaly or fine silty texture with all variations from fine phyllitic shale to coarse siltstone. Upper part contains horizon with many bands of brown quartzite ranging from 3 inches to 12 inches in thickness, at intervals of 2 or 3 feet. Also contains banding consisting of thin layers of ferruginous and dolomitic material an inch or so apart, and characterized by fine irregular crumpling, with crenulations of amplitude about one-half inch; this crumpling is somewhat similar to that in Pine Plains dolomites. Thickness about 90 feet.

Named from village of Elizaville, southeast corner of Catskill quadrangle. Described in Copake quadrangle.

Elk Fire Clay (in Conemaugh Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Rept. Kanawha County, p. 179.

Named for Elk River, near Charleston, Kanawha County.

Elk Basin Sandstone Member (of Telegraph Creek Formation)[1]

Upper Cretaceous: Southern Montana and central northern Wyoming.

Original reference: C. J. Hares, 1917, Washington Acad. Sci. Jour., v. 7, p. 430.

Forms rims from Park City to Elk Basin and Shoshone River, Yellowstone and Bighorn Counties.

Elk Butte Member (of Pierre Shale)

Upper Cretaceous: Central South Dakota and northeastern Nebraska.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 50–55, pls. 2, 3. Includes all beds in South Dakota between top of Mobridge member (new) and base of Fox Hills formation. Essentially medium-gray flaky shale with small ferruginous concretions. Thickness 70 to 290 feet.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2, p. 20, 26. Overlies Interior member, used in this report in preference to Mobridge member.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 16. Geographically extended into northeastern Nebraska.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2 (revised), p. 20, 25. Overlies Mobridge member, which name is now accepted in place of Interior.

Type locality: Along U.S. Highway 12, near Elk Butte, Corson County, S. Dak. Section begins a little less than 1½ miles west and continues to 5 miles west of Wakpala.

Elk City Member (of Quartermaster Formation)

Elk City Sandstone Member (of Quartermaster Formation)[1]

Permian: Western Oklahoma.

Original reference: H. L. Griley, 1933, Pan-Am. Geologist, v. 59, no. 3, p. 234.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in western Oklahoma as Elk City member of formation; upper member of formation; overlies Doxey member.

Well exposed in SE¼ sec. 3, T. 11 N., R. 19 W., [Washita County].

Elk Creek Basalt

Miocene and (or) Pliocene: Northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 33–36, 78 (table 9), pl. 4. Highly porphyritic basalt; the phenocrysts of feldspar are tabular, and average about one-quarter inch in size. Normally blue black. Intensely altered locally. Color of altered phases is lighter and in some places is almost white. Younger than Crescent Hill basalt (new) and older than Lost Creek trachyte (new).

Well exposed at southeast base of Crescent Hill ,near mouth of Elk Creek where it forms a bench, Yellowstone National Park.

†Elk Creek Beds (in Cheyenne Sandstone)[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 366.

Named for Elk Creek, Kiowa County.

Elk Creek Gabbro

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11, pl. 1. Distinguished by extreme dark color, prominent hornblende, and marked variation in grain size; most striking feature is local development of poikilitic brown hornblende crystals as large as 6 inches across. Relation to other named plutonic rocks in area not determined.

Crops out in four small masses about a square mile in area along and near Elk Creek, an intermittent stream northwest of Ash Mountain Park headquarters, Sequoia National Park.

Elk Falls Limestone[1]

Pennsylvanian: Southern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 65–66, 105.

Named for Elk Falls, Elk County.

†Elkgarden Formation[1]

Pennsylvanian: Northeastern West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Well exposed on Elkgarden Plateau, Mineral County, W. Va.

Elk Hill Complex[1]

Precambrian: Southeastern Virginia.

Original reference: S. Taber, 1913, Virginia Geol. Survey Bull. 7, p. 57.

C. B. Brown, 1937, Virginia Geol. Survey Bull. 48, p. 15, pl. 2. Precambrian.

Complex is from 1 to 1½ miles wide where it crosses James River at Elk Hill; well exposed in bluffs three-quarters mile below Elk Hill, Goochland County.

Elkhorn Basalt

Tertiary: Southwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1054, 1060, pl. 1. Oldest of three basalts in area—that is, older than Cataract basalt (new) and Sheepeaters basalt (new). Not included in Gardiner River rhyolite-basalt complex (new). Porphyritic rock, slightly reddish in some phases and locally carrying numerous amygdules of zeolite; dense in lower part; grades upward into scoriaceous and cindery basalt near contact with overlying Cataract basalt. Relationships indicate Elkhorn is intermediate in age between Castle rhyolite (new) and Cataract basalt.

Present near Sevenmile Bridge on Gardiner River, Yellowstone Park.

Elkhorn Formation (in Richmond Group)[1]

Elkhorn Limestone (in Richmond Group)

Elkhorn Shale (in Medina Group)

Upper Ordovician: Southern and eastern Indiana and western Ohio.

Original reference: E. R. Cumings, 1908, Indiana Dept. Geology and Nat. Resources 32d Ann. Rept., p. 678.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 31, 32, table facing p. 46. Medina group as used here includes two members: Elkhorn shale and Clinton sandstone, which are correlatives respectively with Queenstown shale and Whirlpool sandstone of New York section.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 45). Correlation chart shows Elkhorn limestone at top of Richmond group above Whitewater-Saluda formations.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define Richmond stage of Cincinnatian series.

Type locality: About 3½ miles southeast of Richmond, Wayne County, Ind.

Elkhorn Limestone

See **Milligen Formation.**

Elkhorn Shale[1] or Hornstone[1]

Upper Cambrian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Report., pt. 2, p. 434, 437, map.

Well exposed in a hanging-wall crosscut of Elkhorn mine, Elkhorn mining district.

Elkhorn Volcanics

See **Elkhorn Mountains Volcanics.**

Elkhorn Mountains Volcanics

Upper Cretaceous: Southwestern Montana.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 26 (table), 31–41, pls. 1, 2, 3. Sequence of volcanic rocks that differs from place to place. In region east of Boulder batholith, volcanic rocks divisible into three unnamed members of which only lower and middle are present in area of this report [southern Elkhorn Mountains, Jefferson and Broadwater Counties]: lower member that consists mainly of andesitic fragmental rocks with

a few andesitic and basaltic flows and a few thin welded ash flow tuffs of andesitic to calcic quartz latitic composition, thickness probably more than 3,000 feet; a middle member that consists essentially of units of welded tuff alternating with units of ash-fall crystal tuff and water-laid volcanic ejectamenta, thickness at least 2,500 feet; and third member that consists largely of water-laid andesitic volcanic sediments that is missing in mapped area. Total thickness of volcanics in excess of 10,000 feet. In area mapped, more than 5,000 feet. Overlie Slim Sam formation. Where Slim Sam formation is absent, Elkhorn Mountains volcanics rest with angular unconformity on beds as old as the Morrison. In lower parts of area, Elkhorn Mountains volcanics are overlain with strong angular unconformity by poorly consolidated sedimentary rocks of lower Oligocene or Quaternary age. Maximum original thickness probably nowhere preserved. Billingsley (1921, Geol. Soc. America Bull., v. 32, p. 465, fig. 7) considered volcanic rocks in and adjacent to mapped area a separate volcanic field and used name Elkhorn volcanics. Usage has not been followed by others and is not recommended here because name Elkhorn is preempted as formation name. Alexander (1951, unpub. thesis) extended name Livingston into Whitehall area and included in the formation more than 9,600 feet of andesitic flows and tuffs that are continuous with Elkhorn Mountains volcanics. These, he stated, are unconformable on folded and truncated Madison formation. These volcanic rocks in Whitehall area are assigned to Elkhorn Mountains volcanics. Adel Mountain volcanics (Lyons, 1944) are younger than Elkhorn Mountains volcanics. Although volcanic rocks of Elkhorn Mountains are partial age equivalents of and compositionally similar to Livingston formation of type area, their modes of origin are distinctly different, and separate formation names are needed.

No single section has been designated as type section. Widely distributed in and around Elkhorn Mountains in plateaulike accumulation, Broadwater and Jefferson Counties.

Elkhorn Ridge Argillite[1]

Lower Permian: Northeastern Oregon.

Original reference: James Gilluly, 1937, U.S. Geol. Survey Bull. 879.

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull. 54, no. 2, p. 162. Elkhorn Ridge argillite contains "Fusulina" and is apparently at least in part Pennsylvanian. May be comparable in age to Spotted Ridge formation of central Oregon.

A. J. Eardley, 1947, Jour. Geology, v. 55, no. 4, p. 322. Overlies Burnt River schist and underlies Clover Creek greenstone. Thickness about 5,000 feet. Pennsylvanian on basis of fusulinid fossils.

W. H. Taubeneck, 1955, Northwest Sci., v. 29, no. 3. p. 97–100. Age determination of fusilinids, in conjunction with regional Pacific Coast stratigraphic relations, are considered sufficient evidence to assign Permian age to all strata included by Gilluly (1937) in Elkhorn Ridge argillite. Permian age is somewhat less certain for part of formation that underlies the fossiliferous limestone. However, base of argillite has not been found nor have the strata been observed in contact with older formations. In areas bordering Pacific Coast of North America, Pennsylvanian marine formations are characteristically lacking, hence, Pennsylvanian age is improbable for any part of Elkhorn Ridge argillite stratigraphically below fusulinid limestone.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 195. Cut by Black Bear quartz gabbro (new) in area of Bald Mountain batholith.

Named for exposures on Elkhorn Ridge, Sumpter quadrangle, Baker County. Argillite can be traced almost continuously for 70 miles from vicinity of Lookout Mountain westward to Greenhorn Mountains.

Elkins Sandstone[1]

Upper Devonian: Eastern West Virginia.

Original reference: D. B. Reger, 1928, Am. Jour. Sci., 5th, v. 15, p. 50–57.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart below Valley Head sandstone and above "Portage" formation.

Well exposed on State road 3 miles northwest of Elkins, Randolph County.

Elkins Fork Shale[1] (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 297.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 82. Marine shale in Breathitt formation. Probably equivalent to marine Seth limestone, West Virginia.

Named for exposures opposite Elkins Fork School in northern Pike County.

Elkland parvafacies[1]

Devonian or Carboniferous: Northern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 31.

Probably named for Elkland, Tioga County.

Elk Lick Clay[1] (in Conemaugh Formation)

Elk Lick underclay member

Pennsylvanian: Pennsylvania, Ohio, and West Virginia.

[Original reference]: R. E. Lamborn, 1930, Ohio Geol. Survey, 4th ser. Bull. 35, p. 157–158.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 150. Member of Elk Lick cyclothem in report on Athens County. Average thickness about 2 feet. Conemaugh series.

Named from its overlying coal. Type area of coal is near Elk Lick, Somerset County, Pa.

Elk Lick cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958. Ohio Geol. Survey Bull. 57, p. 94 (table 11), 147–150. Embraces interval between Duquesne cyclothem (new) below and Little Clarksburg cyclothem (new) above. Includes (ascending) Birmingham redbed, Upper Grafton shale and sandstone, Elk Lick limestone, Elk Lick underclay, and Elk Lick coal members. Consists essentially of redbed and shale and sandstone members, the Elk Lick members being poorly represented. Intricate facies relationship exists between Birmingham redbed and Upper Grafton shale and sandstone, and their thicknesses may be represented largely or entirely by redbed, by bedded shale and sandstone, by massive sandstone, or by variable combination

of redbed and bedded shale and sandstone. Thickness about 53 feet. In area of this report, Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Outcrops of members of cycle occur in Alexander, Ames, Athens, Canaan, and Dover Townships, Athens County.

Elk Lick Limestone Member (of Conemaugh Formation)[1]

Elk Lick limestone member

Upper Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 60.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 33. Recognized only in Jefferson County. Where present on outcrop, maximum thickness does not exceed 2 feet and average is much less. Lies about 25 feet above Skelly limestone and 48 feet below Clarksburg coal. Conemaugh series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 148–150. Member of Elk Lick cyclothem in report on Athens County. Poorly exposed. Conemaugh series.

Named for relations to Elk Lick coal, which was named for Elk Lick, Somerset County, Pa.

Elkmont Sandstone (in Great Smoky Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 958, 959 (fig. 4). Fine-grained feldspathic sandstone. First formation above Greenbrier fault, base not visible; variable thickness present under Thunderhead sandstone—a few thousand feet on east, about 5,000 feet near Elkmont, and as much as 9,000 feet south of Cades Cove. Intertongues laterally with Thunderhead so that its top in eastern exposures lies at least several thousand feet higher than in western; much of western section differs only slightly from overlying Thunderhead. In southeastern part of mountains where stratigraphic base of Great Smoky group emerges, the Elkmont has not been identified, and it is uncertain to what part of this sequence it is related.

Type locality: Along Little River from Tennessee Highway 73 southward past Elkmont to base of Thunderhead sandstone. Named for community of Elkmont, 5 miles southwest of Gatlinburg, Sevier County. Crops out on lower and northern spurs of Great Smoky Mountains, from Greenbrier Pinnacle on east to beyond Cades Cove on west.

Elk Mountain Porphyry[1]

Tertiary, lower: Central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Tenmile Spec. Folio 48.

Ogden Tweto, 1951, Geol. Soc. America Bull., v. 62, no. 5, p. 509, 510–511. Sills of Pando area comprise four types of quartz monzonitic porphyries (ascending): Pando (new), Elk Mountain, Lincoln, and Eagle River, all of early Tertiary age.

Ogden Tweto, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–34. Mapped as early Tertiary in Tennessee Pass area where se-

quence of porphyries is (ascending) Pando, Elk Mountain, Sacramento, Lincoln, and Eagle River.

Named for Elk Mountain.

Elk Mountain Sandstone[1] Member (of Catskill Formation)

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 57, no. 4, p. 561, 574–577.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 283. Summary discussion. Included in Upper Devonian Catskill facies group.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Pennsylvania Geological Survey currently limits use of term Catskill to thick brownish- and grayish-red units which characterize middle and upper parts of Middle and Upper Devonian red-bed sequence. Light-colored sandstones, such as Honesdale and Elk Mountain members, known only in east, are included in Catskill only in those areas where they are underlain by thick all-red unit.

Named for Elk Mountains, Susquehanna County.

Elk Mountain transition group[1]

Upper Devonian or Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 235.

Crops out around slopes of North and South Knobs of Elk Mountains, southeastern Susquehanna County.

Elko Shale[1] or Group[1]

Eocene: Northeastern Nevada.

Original reference: S. F. Emmons, 1877, U.S. Geol. Expl. 40th Par., v. 2, p. 551–564.

Elko Prince Rhyolite[1]

Tertiary: Central northern Nevada.

Original reference: E. H. Rott, Jr., 1931, Nevada Univ. Bull., v. 25, no. 5.

Occurs in both east and west walls of Elko Prince vein in Gold Circle or Midas mining district, western Elko County.

Elk Peak Leucocratic Quartz Monzonite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 210–211, 235. Uniform-grained slightly pinkish rock. Intrudes Bald Mountain tonalite-Anthony Lake granodiorite transition zone.

Present on summit and southeast slopes of Elk Peak, in Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Elk Point Group

Elk Point Formation

Middle Devonian: Subsurface in Alberta and Saskatchewan, and surface and subsurface in Manitoba, Canada, and subsurface in northeastern Montana, northwestern North Dakota, and northwestern South Dakota.

J. R. McGehee, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 4, p. 603–613. Study based on sample determinations of 12 wells, one of

which is in Saskatchewan and 11 in plains of Alberta, shows sequence of strata of questionable age that is herein referred to as Elk Point formation. Consists of two conspicuous red shales, anhydritic dolomites, and thin slightly fossiliferous argillaceous silty limestones, in addition to three salt members. Maximum thickness about 1,557 feet. Underlies Upper Devonian Waterways formation. Overlies Ordovician, Cambrian, or Precambrian rocks. Considered to be Silurian although upper part may be Middle Devonian.

J. R. McGehee, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 64. Geographically extended into Manitoba. Tentative Silurian age abandoned in favor of Middle Devonian.

H. R. Belyea, 1952, Canada Geol. Survey Paper 52–27, p. 7–12. Rank raised to group but subdivisions not named.

A. D. Baillie, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 444–452; 1953, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 52–5, p. 10–13, 18–21. Term Elk Point group is applied to basal major Devonian unit in Williston basin. Group is approximately equivalent to Elk Point formation in Alberta. In Williston basin, includes (ascending) Ashern, Elm Point, and Winnipegosis formations of outcrop area and their subsurface equivalents and also main Middle Devonian salt and anhydrite section for which name Prairie evaporite is proposed. Upper limit is top of evaporite section or top of Winnipegosis formation where the evaporites are not present. Underlies Manitoba group. Middle Devonian.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2302–2303 (fig. 4), 2304–2307. In the U.S. part of the Williston basin and adjacent areas, Elk Point group consists of Winnipegosis formation and overlying Prairie formation. Underlies Dawson Bay formation.

First described from wells in Elk Point area, near North Saskatchewan River, Alberta, Canada.

Elk Ridge Limestone Member (of Minturn Formation)

Elk Ridge Limestone

Pennsylvanian: Northwestern Colorado.

A. H. Koschmann and F. G. Wells, 1946, Colorado Sci. Soc. Proc., v. 15, no. 2, p. 62 (table 1), 67. In Kokomo mining district, includes two limestone beds, separated by 200 to 225 feet of thin-bedded red sandstone and conglomerate; upper limestone is 5 to 7 feet thick, dark bluish gray, and overlain by 10 to 12 feet of black micaceous shale; lower limestone is 12 to 15 feet thick, upper 7 to 8 feet crystalline and light gray, lower 6 to 7 feet mottled dark bluish gray. Underlies unnamed sandstone 250 to 400 feet thick; overlies unnamed sandstone and shale 300 to 500 feet thick.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 202–203. Limestone, which in Pando area lies 275 feet above Robinson member of Minturn formation, or about 4,800 feet above Belden shale, is known as Elk Ridge limestone at Kokomo and is here designated Elk Ridge limestone member of Minturn formation. In Pando area, member is single limestone bed 7½ feet thick; where thickest, on Radio Ridge, consists of 3 feet of dark fine-grained thin-bedded dolomite, overlain by 10 feet of mottled gray and pink slightly sandy locally

oolitic limestone. Lies 150 to 200 feet below White Quail limestone member.

Forms conspicuous outcrops on crest of Elk Ridge, near Kokomo, Summit County.

Elk River Beds[1]

Pleistocene, upper: Southwestern Oregon.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 30–31.

E. M. Baldwin, 1945, Jour. Geology, v. 53, no. 1, p. 35, 42–43. Elk River beds of Cape Blanco region, as currently used, include deposits of late- to post-Pleistocene age and beds of middle Pliocene age which unconformably underly them. Name Elk River beds is restricted to terrace deposits in accordance with Diller's original definition. Name Port Orford formation is proposed for beds of middle Pliocene age; name Coquille formation is proposed for estuarine deposits that unconformably underlie Elk River beds (restricted) just north of mouth of Coquille River.

Named for occurrences at mouth of Elk River, near Cape Blanco, Curry County.

†Elk River Series[1]

Pennsylvanian: West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 70–98.

Ellenburger Group

Ellenburger Limestone[1]

Lower Ordovician: Central Texas.

Original reference: S. Paige, 1911, U.S. Geol. Survey Bull. 450, p. 24.

V. E. Barnes and P. E. Cloud, Jr., 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 1–2. Ellenburger group subdivided into (ascending) Tanyard, Gorman, and Honeycut formations.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 133, 139–148, 151–153, 156–159, pls. 5, 6 [1945]. Group of this report is derived by revision of Ellenburger limestone (Paige, 1911) which by subsequent usage had come to include not only all Lower Ordovician dolomites and limestones in Llano region and adjacent subsurface but the immediately subjacent carbonate rocks of Upper Cambrian as well. Term Ellenburger is here restricted to beds of Lower Ordovician age. Cambrian dolomites formerly included in Ellenburger are here named Pedernales dolomite member of Wilberns formation. Maximum thickness approximately 1,820 feet in vicinity of Johnson City, southeastern part of uplift; thins north and west by truncation of upper beds to 970 feet in Mason County and about 800 feet in McCulloch County; truncation was essentially pre-Middle Devonian and probably pre-Devonian. Overlapped by Devonian, Mississippian, and Cretaceous.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 473, plates [1946]. Type section, standard section, and local stratigraphy, including underlying Cambrian formations, described in detail.

Type section: Composite Tanyard-Gorman section adjoining the Ellenburger Hills. This section is relatively inaccessible. Combined Moore

Hollow and Warren Springs sections south of Llano, Llano County, are designated as standard section. Named for Ellenburger Hills, Burnet County.

Ellensburg Formation[1]

Pliocene, lower: Central Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

J. H. Mackin, 1947, (abs.) Northwest Sci., v. 21, no. 1, p. 33. Includes Selah tuff member (new) which underlies Wenas basalt member.

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 671, 673–675, pl. 1. Described and mapped in Yakima East quadrangle where it interfingers with underlying Yakima basalt. Includes interstratified basalt flows (ascending) Wenas basalt, Selah Butte flow (new), and Elephant Mountain flow (new). Present mapping indicates that contact between any one basalt flow and an overlying sedimentary bed cannot serve as workable horizon for defining top of Yakima basalt and the base of Ellensburg; in some areas, exact position of contact is matter of arbitrary choice; at one locality, Ellensburg pinches out and Wenas basalt rests directly on Yakima. In a broad sense, entire lower part of Ellensburg can be considered marginal sedimentary facies of Yakima basalt flows. Much or all of Ellensburg and its associated intercalated basalt flows is regarded as Pliocene. Map bracket shows Miocene and Pliocene.

D. R. Mullineaux, L. M. Gard, and D. R. Crandell, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 3, pt. 1, p. 694–695. Formation is alluvial deposit of volcanic detritus at least 1,600 feet thick that was transported eastward into central Washington from position of present Cascades. Formation was first assigned late Miocene age by Smith (1903, U.S. Geol. Survey Geol. Atlas, Folio 86) on basis of fossil leaves and *Hipparion* remains. Waters (1955) considered formation to be lower Pliocene on basis of new finds of vertebrate fossils and freshwater gastropods, and suggested that base of Ellensburg is probably placed at different stratigraphic positions in different areas. Problem of age is further complicated by fact that paleobotanists and other paleontologists are not agreed upon placement of Miocene-Pliocene boundary. Hence, exact age of Ellensburg is uncertain but formation likely contains both upper Miocene and lower Pliocene strata.

Forms floor of Kittitas Valley, Kittitas County, in which town of Ellensbur is situated.

Ellerslie Fire Clay (in Allegheny Formation)[1]

Pennsylvanian: Western Maryland.

Original references: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 572.

Georges Creek Basin.

Ellerslie Sandstone (in Allegheny Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1918, Geol Soc. America Bull., v. 30, p. 572.

At Ellerslie, Allegany County.

Ellett Formation

Middle Ordovician (Mohawkian): Western Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 62, chart 1 (facing p. 130). Name proposed for dark-gray limestones between Knox [group] and Botetourt formation (above) in belt east of Roanoke Valley. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: In fields west of County Road 615, about 899 feet north of Virginian Railway, near Ellett Station, Blacksburg (15′) quadrangle, Montgomery County.

Ellicott Shale Member[1] (of Chadakoin Formation)

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 66–70, table opp. p. 61.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 15. Lies above Dexterville member; underlies Panama conglomerate member of Cattaraugus formation. Thickness in Cherry Creek quadrangle about 270 feet.

Type occurrence: In roadside cuts along Hunt Road, between Ashville and Jamestown, N.Y. This is in town of Ellicott, Chautauqua County.

Ellicott City Granite[1]

Upper Devonian(?): Northeastern Maryland.

Original reference: E. B. Knopf and A. I. Jonas, 1929, Maryland Geol. Survey Baltimore County Rept., p. 134–135.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 42 (table 7), 63. At least three periods of granite formation are recognized in Maryland rocks. The oldest granites are the probable migmatites associated with Baltimore gneiss. Those of second period cut Glenarm series. Rocks of third period are represented by Woodstock, Ellicott City, and at least part of Sykesville granite. The Ellicott City is a biotite-quartz monzonite.

Named for exposures at Ellicott City, Baltimore County. Crops out in a narrow mass extending southwestward from Ellicott City to Orange Grove, Howard County.

Ellicottville Conglomerate[1]

Pennsylvanian: New York.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 89, 96.

Occurs at Ellicottville, Cattaraugus County.

Elliott Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference; N .F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 376.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 73 Largely bluish-gray clays. Thickness 100 feet. Overlies Burnt Branch bed; underlies Shadrick Mills sandstone. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units

of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to base of Drake's Ricker bed.

Named for Elliott Creek, Lampasas County.

Ellis Formation[1] or Group

Middle and Upper Jurassic: Montana and northwestern Wyoming.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 100, map.

W. A. Cobban, R. W. Imlay, and J. B. Reeside, Jr., 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 4, p. 451–453. Thickness 297 feet at type section herein designated. Underlies Morrison formation; overlies Tensleep(?).

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1262–1303. Rank raised to group and subdivided into (ascending) Sawtooth, Rierdon, and Swift formations (all new). Name is restricted to marine Jurassic beds. In Sweetgrass arch area, north-central Montana, unconformably overlies marine Mississippian beds and underlies Upper Jurassic continental deposits (Morrison) or Lower Cretaceous continental deposits (Kootenai). Middle and Upper Jurassic (Bathonian-Argovian).

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart. 32. Group, in south-central Montana, comprises (ascending) Piper (new), Rierdon, and Swift formations.

J. D. Weir, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 4, p. 547–563. Three-fold division of Ellis group into Swift, Rierdon, and Sawtooth formations recognizable and applicable in Alberta. Known only in subsurface in southern Alberta Plains [area of this rept.].

J. D. Vine and W. J. Hall, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 108. Group, in Hobson area, central Montana, consists of (ascending) Piper, Rierdon, and Swift formations. Entire group less than 100 feet thick, and commonly only Swift formation represented. Overlies Amsden formation; underlies Morrison formation.

C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1802–1810. Marine Jurassic rocks of southwestern Montana have heretofore been mapped as Ellis formation, but study of these beds indicates that subdivisions recognized by Cobban (1945) in Sweetgrass arch region are present in area considered in this report. Proposed that Ellis of this region be raised to group rank and that formation names of Sweetgrass arch region be used in southwestern Montana. Thickness 236 feet, Little Water Creek section, Beaverhead County. Overlies Lower Triassic Thaynes formation.

R. W. Edmund, 1951, Augustana Libr. Pub. 23, p. 8 (fig. 5). Stratigraphic section of northern end of Teton Range, Wyo., shows that Ellis formation, 400 feet thick, comprises (ascending) Nugget sandstone, Twin Creek limestone, and (?) Stump sandstone members. Overlies Chugwater formation; underlies Lower Cretaceous sandstones, shales, and siltstones.

J. A. Mann, 1954, Yellowstone-Bighorn Research Proj. Contr. 190, p. 25–30. Ellis, in Gravelly Range, is thin, 13 to 41 feet, and is not dif-

ferentiated into formations. Underlies Morrison formation; overlies Thaynes(?).

Type section: On north side U.S. Highway 10 on north side of Rocky Creek Canyon about 3.7 miles southeast of site of Fort Ellis, or 7 miles southeast of Bozeman Court House, in sec. 19, T. 2 S., R. 7 E., Gallatin County, Mont.

Ellison Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Min. Jour. Press, v. 115, p. 793–799, 836–843, maps.

J. A. Noble and J. A. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944, 947–948, 951. In Lead district, consists of phyllites, schists, and large amount of dark quartzites; thickness 3,000 to 5,000 feet. Overlies Homestake formation; underlies Northwestern formation. In Rochford district, where Northwestern formation is missing, underlies Flag Rock formation.

Named for exposures on road to Homestake mine office and Ellison shaft, Lead district, Lawrence County.

†Ellisville phase[1]

Oligocene(?) and Miocene: Southern Mississippi and southern Louisiana.

Original reference: L. C. Johnson, 1893, Science, v. 21, p. 90–91.

Named for Ellisville, Jones County, Miss.

Ellsworth Formation (in Dakota Group)

Cretaceous (Comanche Series): Central Kansas.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Yellow-brown sandstone and reddish or varicolored shale mostly non-marine. Thickness 25 to 200 feet. Includes Rocktown sandstone above and Terra Cotta shale below. Unconformable below Solomon formation (new) and above Belvidere formation.

R. C. Moore and K. K. Landes, 1937, Geologic map of Kansas (1:500,000): Kansas Geol. Survey. Mapped with Dakota group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Dakota formation, as herein defined, contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Probably named for occurrences in vicinity of Ellsworth, Ellsworth County.

Ellsworth Schist[1]

Precambrian or Cambrian: South-central and southeastern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 1–2.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172. Name abandoned; it was incorrectly applied to unit earlier named Bartletts Island.

W. T. Forsyth, 1953, Maine State Geologist Rept. 1951–1952, p. 34–37, 41–46. Includes massive pyritiferous quartzite not previously reported. No direct evidence of age known.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. In Hancock and Penobscot Counties, Knox gneiss and Copeland formation (new) appear to be older than surrounding formations but not necessarily equivalent to Ellsworth.

P. S. Wingard, 1958, Kansas Acad. Sci. Trans., v. 61, no. 3, p. 330–333. Ellsworth formation, previously designated as Precambrian (Smith, 1907) should now be considered pre-Middle Silurian. Underlies Castine formation.

Named for exposures near Ellsworth, Hancock County.

Ellsworth Shale[1]

Upper Devonian and Lower Mississippian: Central western Michigan.

Original reference: R. B. Newcomb, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 2, p. 159.

G. V. Cohee, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Because upper part of Antrim shale is known to grade laterally westward into lower part of Ellsworth and upper part of Antrim shale is considered to be of lower Mississippian age (Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5), the Upper Devonian and Mississippian time boundary appears to be within Ellsworth shale in western Michigan and within Antrim in eastern Michigan.

Type section: Petoskey Portland Cement Co. quarry, NE¼NE¼ sec. 26, T. 32 N., R. 8 W., about 1½ miles south of Ellsworth, Banks Township, Antrim County.

El Luis Ridge Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 296–298, geol. map. Includes metasedimentary rocks that are enclosed in El Dorado Ridge gneissose quartz diorite (new). On El Luis Ridge and in Stoddard Canyon, rocks are predominantly calc-silicate and quartzitic; a thin layer of metamorphosed argillaceous rock is intercalated. In San Antonio Canyon, rocks are predominantly feldspathic and migmatitic. Relations of group to Aurela Ridge granulite (new) are not certain.

Exposed in Los Angeles and San Bernardino Counties.

Elm Member (of Nachusa Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15B, 15C. Shown on columnar section as underlying Everett member (new) and overlying Eldena member (new). Thickness as much as 3 feet.

Occurs in Dixon-Oregon area.

Elm Branch Shale[1]

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85, 90, 97.

Derivation of name not stated.

Elm Creek Limestone (in Canyon Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. Böse, 1918, Texas Univ. Bull. 1758, p. 18.

Occurs in middle part of Elm Creek, Wise County.

Elm Creek Limestone (in Cherokee Shale)[1]

Pennsylvanian: Northeastern Oklahoma and southeastern Kansas.

Original reference: S. Weidman, 1932, Oklahoma Geol. Survey Bull. 56, p. 25–26.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey. Name preoccupied. Weidman's name has not been replaced.

Named from occurrences along Elm Creek, south of road, in NW¼SE¼ sec. 10, T. 29, N., R. 22 E., Ottawa County, Okla. Also occurs a few miles north of Kansas State line.

Elm Creek Limestone Member (of Belle Plains Formation)

Elm Creek Limestone (in Belle Plains Group)

Elm Creek Limestone Member (of Admiral Formation)[1]

Lower Permian (Leonard Series): Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 424.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 96. Rank raised to formation in Belle Plains group. Overlies Jim Ned shale (new); underlies Jagger Bend limestone. Leonard series.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Described in Colorado River valley where it is classified as member of Belle Plains formation. Overlies Jim Ned shale member; underlies Voss shale member (new). Consists of closely spaced beds of gray medium-grained partly foraminiferal limestone, that weather light brown. Beds range in thickness from 1 to 5 feet, and except locally, are noncherty. Thickness about 45 feet at Colorado River. Note on type exposure.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 273, pl. 11. Member of Belle Plains formation. Thickness 55 to 95 feet in Brazos River valley. Overlies Jim Ned shale member; underlies Voss shale member.

Type exposures: On lower Elm Creek near its confluence with Colorado River, south of Leaday, Coleman County. Forms prominent escarpment in western Coleman County. Named for Elm Creek, Brown County.

Elm Creek Silts

Pleistocene (Illinois? or Sangamon?): West-central Texas.

M. M. Leighton, 1936, Medallion Papers 24, p. 8–11, 39 (fig. 5). Consists of series or regularly thick-bedded and nearly uniformly textured silts and sandy silts with minor amounts of sand and gravel. Unconformably overlie Durst silts (new). Show evidence of human occupation.

Extensively exposed along Elm Creek, which flows into Clear Fork of Brazos River and heads into Edwards Plateau about 12 miles southwest of Abilene, Taylor County.

†Elmdale Formation or Shale (in Wabaunsee Group)[1]

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and central northern and central Oklahoma.

Original reference: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 178.

U.S. Geological Survey has abandoned the terms Elmdale Shale and Formation.

Named for exposures east of Elmdale, Chase County, Kans.

Elm Grove cyclothem

Permian (Washington Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 204, 205 (map 26). Lowest recognized cyclothem in Washington series. Occurs below Waynesburg "A" cyclothem (new). Thickness 15½ feet. Normal sequence includes (ascending) shale and sandstone, redbed, Elm Grove limestone, underclay, Elm Grove coal, and Elm Grove roof shale, but in Athens County cycle is poorly developed. In area of this report, Washington series is discussed on a cyclothemic basis; the following cyclothems are named (ascending): Elm Grove, Waynesburg "A," Little Washington, and Washington.

Recognized in two measured sections in Troy and Carthage Townships, Athens County.

Elm Grove Limestone Member (of Washington Formation)[1]

Elm Grove Limestone (in Washington Group)

Elm Grove limestone member

Pennsylvanian: Northern West Virginia, southeastern Ohio, and southwestern Pennsylvania.

Original reference: G. P. Grimsley, 1907, West Virginia Geol. Survey Rept. Ohio, Brooke and Hancock Counties, p. 68.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135–145. Elm Grove limestone occurs 13 feet above base of Washington group. Overlies Cassville shale; underlies Waynesburg sandstone. Thickness as much as 5 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 90–91, geol. map. In Morgan County, Elm Grove limestone member of Washington series overlies Cassville shale member and underlies Waynesburg sandstone and shale member. Thickness about 4 feet.

Named from exposures in vicinity of Elm Grove, Ohio County, W. Va.

Elmo Limestone Member (in Sumner Group)[1]

Permian: Central Kansas.

Original reference: C. O. Dunbar, 1924, Am. Jour. Sci., 5th, v. 7, p. 176, 178–208.

Named for occurrence about 3 miles south and one-half mile east of village of Elmo, Dickinson County, where it caps Insect Hill.

El Modeno Volcanics

Miocene: Southern California.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. A series of volcanic rocks. Subdivided into three members: the oldest, an olivine basalt flow; the second, a palagonitic tuff and tuff breccia; and the upper, a calcic andesite flow and flow breccia. Locally one or more of members may be missing. Thickness ranges from about 100 feet to 750 feet; average thickness about 300 feet. Unconformably underlie La Vida member (new) of Puente formation;

overlie Topanga formation. Volcanics probably straddle boundary between middle and late Miocene.

R. F. Yerkes, 1957, U.S. Geol. Survey Prof. Paper 274–L, p. 313–324, pl. 46. Detailed description of unit. Maximum outcrop thickness 850 feet. Middle to early late Miocene. Tentatively correlated with Glendora volcanics 25 miles to northwest.

Exposed in hills just east of El Modeno, Orange County. Cover an area of approximately 4 square miles.

Elmont Limestone Member (of Emporia Limestone)

Elmont Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 30.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 17. Areai extent of formation noted.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. Rank reduced to member status in Emporia limestone here recognizde and used as originally defined. Overlies Harveyville shale member; underlies Willard shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 58–60. Described in Pawnee County. As currently defined (Moore, 1949, Kansas Geol. Survey Bull. 83), the Elmont overlies Harveyville shale and underlies Willard shale. In Pawnee County, overlying shale is the Gano. Thickness 20 to 34 feet. Traced across Pawnee County into Payne County, but southern extent not known.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12–13, fig. 5. Formation in Wabaunsee group. Underlies Willard shale; overlies Harveyville shale. Consists of two limestone beds separated by fossiliferous gray shale. Upper bed nodular and argillaceous; lower bed, dark blue gray, sublithographic. Thickness about 2 feet.

First described from occurrence on hills near Elmont, Shawnee County, Kans. [Condra refers to this as type locality.]

Elmwood Member (of Manlius Limestone)

Elmwood Beds[1] (in Manlius Group)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 271, p. 26, 27–31.

G. H. Davis 3d, 1953, New York State Mus. and Sci. Ser. Circ. 35, p. 10. Discussion of contact between Manlius limestone and Coeymans limestone in upper New York State. In section measured at Perrysville, Madison County, members of Manlius proposed by Smith (1929) are distinguished (ascending): Olney, Elmwood, Clark Reservation, Jamesville, and Pools Brook limestone. Top of quarry lies stratigraphically in Onondaga limestone which rests on Coeymans, the Oriskany sandstone being absent.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Manlius formation subdivided into (ascending) Thacher (new), Olney, Elmwood, Clark Reservation, and Jamseville. Thacher is only member present in eastern New York. Higher limestone mem-

bers, all named by Smith (1929), pass laterally into Coeymans limestone of eastern New York and, hence, are undoubtedly Devonian in age.

L. V. Rickard, 1956, Dissert, Abs., v. 16, no. 1, p. 102. West of Cherry Valley, Coeymans formation splits into three parts. Lower part, for which name Dayville is proposed, grades laterally into Olney limestone of Syracuse area. Middle part grades into Elmwood, Clark Reservation, and Jamesville members of Manlius.

Type section: At Sweet's quarry, about one-half mile northeast of Onondaga Hill and in belt between St. Agnes Cemetery and Elmwood Park, Onondaga County.

Elmwoods Limestone Member (of Manlius Limestone)

See Elmwood Limestone Member (of Manlius Limestone).

El Pasan series[1]

Ordovician: Southern New Mexico and western Texas.

Original reference: C. R. Keyes.

El Paso Limestone[1] or Formation

El Paso Group

Lower Ordovician: Western Texas, Arizona, and southern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 29.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. in Geology 4, p. 31 (table), 40–56. Rank raised to group. Comprises (ascending) Sierrite limestone and Bat Cave formation (both new). Overlies Bliss formation (sandstone); underlies Montoya group.

F. E. Kottlowski, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 7 (table 2), 16–23. Acceptance of group status for El Paso not predicated on discriminating Sierrite and Bat Cave subdivisions of Kelley and Silver (1952) but on succession of faunas and lithic units as outlined by Flower (1955, New Mexico Geol. Soc. Guidebook 6th Field Conf.). Group in New Mexico can be subdivided into three lithic units of probable formational rank which correspond closely with faunal zones. Thickness as much as 760 feet. Ordovician (Canadian).

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 472–475. Formation geographically extended into southeastern Arizona where it conformably overlies Bolsa quartzite and underlies Portal formation (new); contact is disconformity representing time interval from Middle Ordovician through Middle Devonian; no angular discordance at contact. Thickness 340 to 715 feet. Term formation used because in this area [Chiricahua-Dos Cabezas Mountains] El Paso beds are predominantly dolomite rather than limestone. Upper Cambrian-Lower Ordovician:

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 21–24, table 1. Limestone described in central Peloncillo Mountains where it is about 550 feet thick; overlies Bolsa quartzite and underlies Montoya limestone. Age of limestone in this area, based on fossils collected and correlation with Chiricahua section, is late Cambrian and early Ordovician; thus, it contains beds which are older than any heretofore included in the El Paso in New Mexico.

Named for exposures in Franklin and Hueco Mountains, El Paso quadrangle, Tex.

El Portal Glaciation

El Portal Stage[1]

Pleistocene: Eastern California.

Original reference: F. E. Matthes, 1929, Science, new ser., v. 70, p. 75–76.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243A, table 2. Correlated with Sherwin glaciation.

Change of name from stage to glaciation made in accordance with adoption of Stratigraphic Code, June 1961.

Named for occurrence in vicinity of El Portal, entrance to Yosemite Park.

El Rayo Formation

El Rayo Volcanics (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200. In Yauco area, a complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limstones, mudstones, tuffs, and sedimentary rocks derived from the volcanic rocks, is divided into eight formations: Sabana Grande (new), El Rayo (new), Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). El Rayo and Sabana Grande formations unconformably underlie Ensenada and Río Yauco formations. Complex ranges in age from Senonian to late Paleocene, possibly Eocene.

P. H. Mattson, 1958, Dissert, Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 339–340, pl. 1. El Rayo volcanic rocks were defined by Slodowski as feldspathic olivine basalt porphyry (90 percent) with interbedded lenses (about 10 percent) of volcanic conglomerate and dark massive limestone. In Mayagüez area, the dark massive limestone has been named Melones limestone, and the El Rayo volcanic rocks are considered within the Mayagüez group. The El Rayo rocks include about 1,000 meters of basalt lava, andesite breccia, and lava, and minor conglomerate and wacke. Conformable with underlying Yauco mudstone. Within area of outcrop of El Rayo volcanics and bordering it on the west are volcanic rock and limestone of San Germán formation believed to unconformably overlie the El Rayo. Campanian to Maestrichtian.

Forms part of north limb of Tea syncline, Mayagüez area.

El Reno Group

El Reno Formation[1]

Permian: Western Oklahoma.

Original reference: C. M. Becker, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 955.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). El Reno group used to include Duncan-Chickasha sequence from top of Hennessey formation to base of Whitehorse group. Duncan-Chickasha sequence grades laterally into Flower Pot shale, Blaine gypsum, and Dog Creek shale.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 97–98. Shown on correlation chart of north-central Texas as El Reno (San Andres) group. Includes (ascending) San Angelo sandstone, Flower Pot shale, Blaine gypsum, and Dog Creek shale. On east side of Permian basin, name El Reno group appears to have prior-

ity and to be more appropriate on a facies basis than recently proposed San Andres group for beds of Leonard age from base of San Angelo sandstone to top of Dog Creek shale.

F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 80, 81, 83, 84. El Reno group extends across Red River and can be traced southward across Texas 250 miles before it is lost under Cretaceous rocks. Unconformably overlies Clear Fork group. Considered Guadalupe in age; boundary between Guadalupe and Leonard should be drawn at base of San Andres-El Reno groups.

Robert Roth, 1945, Geol. Soc. America Bull., v. 56. no. 10, p. 893–894. Pease River group includes San Angelo, Flowerpot, Blaine, and Dog Creek formations as exposed in Texas. Formations form natural group bounded by disconformities. However, formations change facies so rapidly that any group name becomes a facies name. Examples: Pease River group, evaporite facies; El Reno, clastic facies; San Andres of Sacramento Mountains, dolomite facies; and Cherry Canyon formation, clastic and limestone facies. All these appear to be variants of the Word.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 12–13, pl. 1. Group comprises (ascending) Duncan sandstone, Flowerpot shale, Blaine formation (redefined), and Dog Creek shale. Overlies Hennessy shale; underlies Whitehorse group. In Oklahoma, El Reno outcrop forms "V-shaped" pattern; one limb of group passes along north side of Wichita Mountains, including Carter area (this report), and the other limb swings northwestward through west-central Oklahoma into Kansas. This outcrop pattern results from synclinal folding of Anadarko basin. Within southeastern margin of basin is a pronounced facies change that has led to recognition of numerous stratigraphic problems [see bibliography this report]. It is now generally believed that the Chickasha-Duncan complex is near-shore coarse-clastic equivalent of the shale-gypsum-anhydrite-dolomite strata comprising the El Reno on both sides of the basin to the north and west. The fact that the two evaporite areas are separated by nonevaporite sediments has resulted in establishment of dual nomenclature, one set being applied to members of the Blaine, and another set in the Carter area and elsewhere in southwestern Oklahoma. This report follows classification used by Schweer (1937) and older stratigraphic concept of the Blaine is revised. [For outcrop pattern see Geologic map of Oklahoma (Miser, 1954).]

C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, chart 6 (columns 75, 76, 77). Correlation chart uses Pease River group in Texas in preference to El Reno group. Group in Oklahoma comprises in southwestern part of State—Duncan sandstone and Chickasha formation; in west-central part—Flowerpot shale, Blaine formation, and Dog Creek shale; in north-central part—Cedar Hill sandstone, Flowerpot shale, Blaine formation, and Dog Creek shale. Overlies Hennessey shale; underlies Marlow formation of Whitehorse group.

Probably named for El Reno, Canadian County, Okla.

El Rito Formation

Tertiary (Eocene ?): North-central New Mexico.

H. T. U. Smith, 1938, Jour. Geology, v. 46, no. 7, p. 937 (fig. 4), 940–944, 958. Composed of sandstone, conglomerate, and breccia—all have a

characteristic brick-red color. Well consolidated; commonly stands in steep cliffs. Maximum thickness about 200 feet. Underlies Abiquiu tuff. Rests on Precambrian to Jurassic rocks with angular unconformity.

A. J. Budding, C. W. Pitrat, and C. T. Smith, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 82–84. Described in southern part of Chama Basin. Estimated that at least a 400-foot thickness of formation is present east of Madera Canyon. Overlies older formations (Cutler, Agua Zarca, Chinle, Entrada, and Mancos shale) with angular unconformity. Underlies Abiquiu tuff member of Santa Fe formation. Age uncertain; likely early Tertiary, possibly Eocene.

Principal localities: Ortega Mountains along both branches of El Rito Creek; badland west of the Cerro de las Minas; north bank of the Chama about 5 miles west of Abiquiu.

Elsinore Metamorphic Series[1]

Triassic: Southern California.

Original reference: P. H. Dudley, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 223.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 480–481, table 4. Described as including metasediments and metavolcanics. Most of metasediments are dark-gray slates and phyllites, gray quartzites which lie mostly above the slates, and some chert, all representing generally uniform low-grade metamorphism. May be younger than Diamond Valley complex (new).

René Engel, 1959, California Div. Mines Bull. 146, p. 24. Proposed that name Santa Ana formation be continued to designate Upper(?) Triassic metasedimentary rocks in preference to name "Elsinore formation" as proposed by Dudley (1935, California Div. Mines Rept. 31).

Occurs in Riverside-Elsinore-Coahuila area, Riverside County.

Elsmere Member (of Repetto Formation)

Pliocene, lower: Southern California.

U. S. Grant, 4th and L. G. Hertlein, 1943, California Div. Mines Bull. 118, pt. 2, p. 202 (fig. 85) [preprint 1941]. Shown on correlation chart as lying within Pico and Repetto formations in Ventura basin.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 51 (table 1), 54 (fig. 2), 55. Consists of coarse marine sandstone, conglomerate, siltstone, and mudstone. The Elsmere dips off crystalline basement rocks on which it lies unconformably; overlaps on Modelo and Mint Canyon formations; underlies siltstone member of Repetto and may be in part contemporaneous with it. Maximum thickness about 100 feet. Type locality designated.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2). 75, 77, 79, pl. 1. Member reaches its maximum thickness of 1,400 feet, from its contact on pre-Tertiary crystalline rocks to overlying base of Pico formation, in upper Elsmere Canyon. Thins rapidly northward and is overlapped by Pico before reaching Whitney Canyon. Southeastward becomes folded and faulted in complexities of Santa Susana fault zone and is overlapped by Pacoima formation near Olive View. Unconformably overlies Domengine sandstone. Present only south of San Gabriel fault. "Towsley formation" (Winterer and Durham) includes "Elsmere member."

Type locality: Elsmere Canyon, Los Angeles County. Occurs to south and east around western border of San Gabriel Mountains.

†Elstone Formation[1]

Eocene: Southern Texas.

Original reference: R. A. Liddle, 1921, Texas Univ. Bull. 1860, p. 75, map, columnar section.

Typically exposed near Elstone, Media County.

Elves Chasm Tongue (of Mauv Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 87–88. Snuff-brown massive crystalline dolomite which passes down into beds of buff fine-grained crossbedded glauconitic sandstone in vicinity of Bass trail. Thickness at Bass Canyon 12 feet; at Fossil Rapids 35 feet; and at Gateway Canyon 50 feet. Older than Garnet Canyon tongue (new); younger than Meriwitica tongue (new).

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 513, 515 (fig. 2). Cited as tongue of Mauv formation.

Excellent horizon marker throughout most of east-central Grand Canyon. Can be traced eastward from Bass Canyon to and beyond Hermit Canyon. Named for canyon of same designation.

Elvins Group[1]

Elvins Formation

Upper Cambrian: Southeastern Missouri.

Original references: E. O. Ulrich and H. F. Bain, 1905, U.S. Geol. Survey Bull. 260, p. 234; Bull. 267, p. 12, 17, 23–26.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–I, p. 234 (table 1). Rank raised to group. Includes (ascending) Davis formation, Derby dolomite, and Doe Run dolomite. Underlies Potosi dolomite; overlies Bonneterre dolomite.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 30. Term Elvins as introduced by Ulrich is not recognized as valid in this report. As a group it would include the Davis and Derby and probably part of the Potosi.

V. E. Kurtz, 1960, Dissert, Abs., v. 21, no. 3, p. 595. Referred to as Elvins formation comprising (ascending) Davis, Derby, and Doerun members. Separated from underlying Bonneterre dolomite by disconformity; shows facies relationships with underlying Potosi formation. Contains four faunal zones. Upper Cambrian.

Named for exposures at Elvins, St. Francois County.

Elvira Group

Mississippian (Chester Series): Southern Illinois and western Kentucky.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 835, 841. Includes eight alternating sandstone and limestone-shale formations of upper Chester series (descending): Kinkaid limestone, Degonia sandstone, Clore limestone, Palestine sandstone, Menard limestone, Waltersburg sandstone, Vienna limestone, and Tar Springs sandstone. Latter three are considered equivalent to Baldwin formation in some areas.

Name derived from Elvira township, Johnson County, Ill., where all formations of standard Mississippian section are well developed.

Elway Limestone

Elway Limestone Member (of Lurich Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 42–43, 45 (fig. 8), pls. 9, 18, 23. Consists of dove-gray to dark-bluish-gray fine-grained argillaceous limestones containing chert which weathers into characteristic blocks. Average thickness 35 to 40 feet. Underlies Five Oaks limestone; overlies Blackford formation which is herein restricted to exclude zone of blocky chert here named Elway.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 61, 72. Rank reduced to member status in Lurich formation (new).

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad, Map GQ–111. As described in Duffield quadrangle, includes about 15 feet of limestone that may be equivalent to Five Oaks limestone as used by Cooper (1945) in Scott County. This uppermost unit is a medium-light-gray lutite textured limestone with interbedded medium light-gray calcareous shale and dark-gray lutite-textured limestone.

Type section: Along State Highway 80, near Blackford, Russell County. Name derived from settlement along U.S. Route 19 near Lebanon.

Elwren Formation (in West Baden Group)

Elwren Sandstone (in Chester Group)[1]

Elwren Sandstone Member (of Paint Creek Formation)

Mississippian (Chester Series): Southwestern Indiana and northern and central Kentucky.

Original reference: C. A. Malott, 1919, Indiana Univ. Studies, v. 6, no. 40, p. 7–20.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig. 1), 269, 270 (fig. 2), 274 (fig. 3), 276. Paint Creek is used here to include group of formations above Sample sandstone and below Cypress sandstone between Ohio River and southern end of Hardin and Breckinridge Counties, Ky. The three formations of the Paint Creek are correlative of three formations of Indiana (ascending); Reelsville limestone, Elwren sandstone and shale, and Beech Creek limestone. Names Reelsville and Elwren are here proposed for the two lower members of Kentucky formation; term *Productus inflatus* zone is used for upper member. Elwren is 40 feet thick near Seree, Breckinridge County, and 3 feet thick at Girkin.

J. M. Weller and A. H. Sutton, 1940 Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 828; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Considered member of Paint Creek formation in Indiana.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7, 14. Paint Creek of standard Chester column has triple expression in southern Indiana (ascending): Reelsville limestone, Elwren sandstone, and Beech Creek limestone. Each of these is a distinct stratigraphic unit in parity with other formations of Chester and deserves a name in its own right. Elwren sandstones present through outcrop of lower Chester beneath Beech Creek limestone; continues northward

as far as Reelsville, Putnam County, but locally is cut out in part or in entirety and overlapped by the Pennsylvanian northward from Lawrence County. Locally, cuts below level of Reelsville limestone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 25, pl. 1. Elwren sandstone in Indiana ranges from 20 to 50 feet in thickness. Lower part of formation is typically light-gray to light-brown commonly rust-spotted thick-bedded to massive locally crossbedded sandstone; drab-gray soft shale is commonly more abundant than sandstone in upper part of formation. In many localities, Elwren beds immediately below Beech Creek limestone are characteristically green-gray thin-bedded soft shale, which contains thin discontinuous beds of brick-red shale. Field identification of Elwren normally is based upon its stratigraphic position between distinctive Reelsville and Beech Creek limestone. Type locality indicated.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 45, pl. 1. Uppermost formation in West Baden group (redefined). Thickness 37 to 52 feet. Overlies Reelsville limestone; underlies Beech Creek limestone of Stephensport group (redefined).

Type locality: Vicinity of Elwren, Monroe County, Ind., where exposures occur in cuts along Illinois Central Railroad within 1 mile of boundary between Greene and Monroe Counties.

Ely Greenstone[1]

Precambrian (Keewatin): Northeastern Minnesota, and Ontario, Canada.

Original reference: C. R. Van Hise and J. M. Clements, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 401–409, map.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1025–1027. Formation is not uniform, and various areas are not necessarily of same age. Some rocks are effusive, others intrusive, and others fragmental; nearly all are altered and green because of abundant secondary chlorite; ellipsoids common and are safest criterion for recognition of the greenstone. Thickness cannot be estimated unless some underlying formation is clearly recognized. Considered base of earlier division of Precambrian; there is a possibility of a formation below Ely in Canada, but in Minnesota base has not been observed. At many places lower contact is with intrusive granites and gabbro. Soudan iron-formation lies near top and partly within greenstone. Overlain at places by Ogishke conglomerate; Animikie (Gunflint or Biwabik) iron-formation lies directly on Ely east of sec. 27, T. 65 N., R. 4 W. Intruded by Saganaga granite, Duluth gabbro, and Algoman granites.

G. M. Schwartz and I. L. Reid, 1955, Mining Eng., v. 7, no. 3, p. 298. Soudan beds should be considered member of Ely greenstone.

F. F. Grout, R. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 12–15. Occurs only in northwestern part of Cook County as narrow belt across T. 65 N., Rs. 4 and 5 W. This is south of Alpine and Sea Gull Lakes and along north side of Gunflint iron-bearing district. Width of belt ranges from thin lens at east end in sec. 22, T. 65 N., R. 4 W. to maximum of 1¼ miles in secs. 19 and 30. Greenstone is bounded on north throughout most of its length by Saganaga granite which intruded and metamorphosed the greenstone.

Typical exposures are under and adjacent to town of Ely, St. Louis County, Minn. Principal exposures follow Vermilion iron-bearing dis-

trict from Tower to Gunflint Lake; largest, including type locality, extends 40 miles from Vermilion Lake to Moose Lake; another extends northeast into Hunter's Island, Canada.

Ely Limestone[1]

Ely Group

Upper Mississippian and Lower and Middle Pennsylvanian: Eastern Nevada and western Utah.

Original references: A. C. Lawson, 1906, California Univ. Pub. Bull., Dept. Geol., v. 4, no. 4, p. 295; A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 26, 27.

E. N. Pennebaker, 1932, Mining and Metallurgy, v. 13, no. 304, p. 164. Ely limestone, in Robinson mining district, is lowermost Pennsylvanian formation. It is practically free from sandy admixture and carries abundant chert as bands, lenses, and nodules. Estimated thickness 1,500 to 3,200 feet. Overlain by series of sandstone and sandy limestone herein designated Rib Hill formation. Most of Rib Hill was formerly included in Ely.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2219 (fig. 2), 2234–2248. Rank raised to group in Elko area. Includes Moleen formation below and Tomera formation above (both new). Overlies Tonka formation (new); underlies Strathearn formation (new). Thickness about 3,200 feet. Lower and Middle Pennsylvanian.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 61–63. Described in vicinity of Eureka where it is as much as 1,500 feet thick; overlies Diamond Peak formation and underlies Carbon Ridge formation (new). As exposed in this area, belongs to lower half of Pennsylvanian.

W. M. Winfrey, Jr., 1958, Am. Assoc. Petroleum Geologists, Rocky Mountain Sec., 8th Ann. Mtg., p. 77, 79 (fig. 2). In Egan Range, Nev., unconformably underlies Eocene Sheep Pass formation (new).

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2170–2174. Geographically extended into Confusion Range, Utah, where it replaces term Bird Spring formation. Consists of 1,850 to 2,000 feet of alternating resistant thick-bedded limestone and slabby slope-forming limestone. Upper 100 to 350 feet contain early Permian fauna and is commonly more massive and less cherty than remainder of formation, which contains fauna characteristic of lower half of Pennsylvanian and locally Late Mississippian. Overlies Chainman shale; underlies Arcturus limestone.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Gold Hill district and Confusion Range, Utah, and Moorman Ranch area, Nevada, overlies Illipah formation.

J. S. Berge, April 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 9–18, pl. 4. Ely limestone, in Ferguson Mountain area, unconformably overlies Chainman shale and underlies Ferguson Mountain formation (new). Thickness 1,411.4 feet, of this, basal 111.8 feet is Morrowan age, followed by 262.2 feet of Derryan, 120.4 feet of Desmoinesian, 745.6 feet of upper Missourian, and 171.4 feet of Virgilian. In White River valley overlies Butte formation (new). Overlies Ferguson Springs formation (new) at Ferguson Springs.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists 11th Ann. Field Conf., p. 93 (chart 1), 99–100, 101. Pennebaker (1932) redefined Ely by placing upper contact at base of yellow and tan sand sequence, formerly assigned to Arcturus limestone, which he named Rib Hill formation; lower contact remained at top of Chainman. Ely is herein restricted to those limestones lying stratigraphically above Chainman shale or Scotty Wash quartzite, whichever is present, and below regional Pennsylvanian unconformity—that is, to those limestones described by Pennebaker as having abundant bedded and nodular chert. Because of nature of unconformity, overlying unit may be South Ridge sandstone (new), or that part of the Ely taken away from the unit as restricted in this paper. Upper 300 feet of massive coralline limestones without chert above the unconformity, and removed from Ely, is here named Riepe Spring limestone. Thickness of Ely (restricted) varies from 2,500 feet at type area to less than 500 feet at north end of Pequop Range. At reference section, herein designated, Ely overlies Scotty Wash quartzite (Illipah sandstone) and underlies Riepe Spring limestone. Disconformably underlies Ferguson Springs formation (new) at type locality of that unit. On basis of fusulinids dated as Pennsylvanian (Morrowan-middle Desmoinesian). Name Rib Hill abandoned.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 160, 163–164. Underlies Kinsey Canyon formation (new).

Type area: Ely district, Ely quadrangle. Reference section: Along U.S. Highway 50, between Illipah Creek and Moorman Ranch, secs. 7 and 8, T. 17 N., R. 59 E., White Pine County, Nev. This is 30 miles west of type area.

Ely Springs Dolomite[1]

Middle and Upper Ordovician: Eastern Nevada and southeastern California.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 14 (fig. 6), 13–15, pls. 1, 2, 3. Described in Quartz Spring area, northern Panamint Range, Calif., where it conformably underlies Hidden Springs dolomite (new) and overlies Eureka quartzite. Thickness 740 to 940 feet. Upper Ordovician.

H. R. Wanless, 1960, Jour. Paleontology, v. 34, no. 5, p. 862. In Independence quadrangle, California, overlies Middle Ordovician Johnson Spring formation (new) of Eureka group.

U.S. Geological Survey currently designates the age of the Ely Springs as Middle and Upper Ordovician on the basis of a study now in progress.

Named for exposures in Ely Springs Range, Pioche region, Nevada.

†Embar Formation[1] or Group[1]

Permian and Triassic(?): Western and central Wyoming.

Original reference: N. H. Darton, June 1906, Geology Owl Creek Mountains, Wyoming: 59th Cong. 1st Sess., S. Doc. 219, p. 17.

P. T. Walton, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1441–1442. Embar limestone, in subsurface in Oregon basin field, Park County, Wyo., underlies Dinwoody formation and overlies Tensleep sandstone. Name Embar was given by Darton (1906) to all beds

between base of Chugwater and top of Tensleep sandstone, which interval is now recognized as consisting of both Triassic and Permian strata. Herein suggested that term Embar is too well established to consider abolishing it when it is applied in its present usage, that is, when used to denote only characteristic limestone section usually correlated with Phosphoria formation of Idaho. Permian.

W. G. Pierce, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 77. Formation mapped in Basin-Greybull area, Big Horn County, Wyo., where it overlies Pennsylvanian Tensleep and underlies Triassic Chugwater formation.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 32–34, pl. 1. Embar and Chugwater formations mapped separately only in southwestern part of area [Bighorn Canyon-Hardin area, Montana and Wyoming] where Embar consists of 100 feet of dolomite, limestone, red siltstone, and sandstone. Elsewhere, a zone of redbeds, gypsum, and thin beds of limestone is seemingly the Embar equivalent. Overlies Tensleep sandstone.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, 2833, 2835. Name Embar, introduced for beds between Tensleep and Chugwater, has been used for redbeds of Permian and Triassic age in central Wyoming (Lee, 1927, U.S. Geol. Survey Prof. Paper 149). Embar has also been used for Permian rocks only (Andrews and others, 1945, U.S. Geol. Survey Prelim. Map 25; Richards, 1955), and in that sense is synonym for the Phosphoria as used by others in same area. In new nomenclature herein proposed, Darton's Embar formation is considered obsolete.

Named for Embar post office, Big Horn County, on Owl Creek, a short distance south of which formation is extensively developed.

Embarrass Granite[1]

Precambrian (post-Keweenawan): Northeastern Minnesota.

Original reference: C. K. Leith, 1903, U.S. Geol. Survey Mon. 43, p. 186.

Forms core of extreme east end of Giants Range. Named for its lithologic similarity to granite exposed at Embarrass Station on Duluth & Iron Range Railroad just north of Mesabi Range, Mesabi district.

Embudo Granite

Precambrian: Central northern New Mexico.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 37–46, pl. 1. Name introduced to replace Dixon granite of Just (1937); name Dixon preoccupied. Three main granite types distinguished: coarse-grained partly porphyritic biotite granite, light-colored partly porphyritic gneissic granite, and flesh-colored coarse-grained to pegmatitic leucogranite. Has invaded all rocks of Ortega and Vadito (new) formations, and thus is of more recent age.

Borders the Picuris Range on south and on east, Taos County. Name taken from town of Embudo, located 2 miles west of Dixon and 4 miles west of extensive outcrops of the granite.

Emerald Dolomite Member (of Ajax Dolomite)[1]

Upper Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 9. Massive bed of medium-grained creamy- or grayish-white dolomite marked or mottled by irregular zones of coarse-grained gray to white dolomite. Thickness about 30 feet. Overlies lower member 90 to 180 feet thick, and underlies upper member that averages about 450 feet in thickness. Ajax has yielded fossils of Late Cambrian age.

Named for Emerald mine, Tintic district. Continuously exposed from Mammoth to Eureka.

†Emerald Limestone[1]

Middle or Upper Cambrian: Southeastern Arizona.

Original reference: J. A. Church, 1903, Am. Inst. Mining Engrs. Trans., v. 33, p. 3–37.

Tombstone district.

†Emerald Series[1]

Middle or Upper Cambrian: Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

Ajax Mountain, Tombstone district.

Emerson Formation

Middle and Upper Cambrian and Lower Ordovician(?): Central Montana.

M. M. Knechtel, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1994–1995. Name applied to sequence of shale, thin beds of limestone, and intraformational conglomerate overlying Flathead sandstone and underlying Bighorn dolomite. Thickness at type locality estimated not less than 950 feet and not more than 1,100 feet. Approximately lower half is Middle Cambrian in age. Upper part includes 538 feet of strata of Late Cambrian and probably Early Ordovician age.

Type locality: At and near mouth of Emerson Gulch, on Lodgepole Creek, in SW¼ sec. 20, T. 36 N., R. 25 E., Phillips County, and about 4½ miles south-southwest of Lodgepole Subagency of Fort Belknap Indian Reservation.

Emery Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, p. 439.

J. G. Bartram, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7, p. 908. Suggests that name Emery be abandoned and unit included in proposed Eagle group.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8 (table). Generalized section of sedimentary rocks exposed in Henry Mountains shows Emery sandstone member above Blue Gate shale member and below Masuk shale member. Thickness 200 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Paper 228, p. 36 (table), 84–85, pls. In southern part of Castle Valley (type area), the Emery is about 800 feet thick, at north end of valley thins to 100 feet and grades eastward into marine shale. In Henry Mountains structural basin, Emery is about 250 feet thick. Here it underlies Masuk member and overlies Blue Gate shale member. Between type locality and Henry Mountains region, the sandstone has been removed by erosion and cannot be traced into this region, but name as used in this report is applied to beds in same stratigraphic position, which are

lithologically like type Emery and which overlie shale beds containing marine fauna equivalent to fauna in beds beneath type Emery. Name Bluegate sandstone was used by Gilbert (1877). Probably never extended very far east of Henry Mountains.

Named for exposures southwest of Emery, Emery County.

Emery Peak Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. H. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 115–118, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt area are named and mapped. Stratigraphic position of six of these basalts has been determined. Emery Peak is oldest in known sequence; followed by Big Hill basalt.

Emery Peak is in northwestern Union County.

Emigrant Formation[1]

Middle and Upper Cambrian: Southwestern Nevada.

Original reference: H. W. Turner, 1902, Am. Geologist, v. 29, p. 261–272.

U.S. Geological Survey currently designates the age of the Emigrant Formation as Middle and Late Cambrian on the basis of a study now in progress.

Well developed to south of Emigrant Pass, in northern part of Silver Peak Range, Esmeralda County.

Emigration Formation[1]

Middle Triassic: Central northern Utah.

Original reference: A. A. L. Mathews, 1931, Oberlin Coll. Lab. Bull., new ser., no. 1.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 28. Mathews separated the Thaynes, on the basis of fossil evidence, into two units to which he applied names Pinecrest and Emigration formations. He assigned the Emigration to Middle Triassic.

Bernhard Kummel, Jr., 1943, Am. Jour. Sci., v. 241, no. 5, p. 325. Fauna from Emigration formation has never been described or illustrated, therefore Mathews' age determination cannot be checked from the literature.

Named for Emigration Creek east of Salt Lake City.

Emily Member (of Crow Wing Formation)[1]

Precambrian: Central Minnesota.

Original reference: C. Zapffe, 1930, Lake Superior Min. Inst. Proc., v. 28, p. 101–106.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3). Table shows sequence (ascending) Ogishke, Agawa, Emily, and (Carlton). Units are marked with asterisk(*) which, according to footnote, means uncertain as to place.

Named for occurrence at village of Emily, Crow Wing County.

Eminence Dolomite[1]

Upper Cambrian: Southeastern Missouri.

Original reference: E. R. Buckley, 1908, Am. Min. Cong. Rept. Proc. 10th Ann. Sess., p. 286.

Josiah Bridge, 1930, Missouri Geol. Survey and Water Resources, 2d ser., v. 24, p. 75–97, table 2, geol. map. Described in Eminence and Cardareva quadrangles. Maximum thickness 250 feet; average about 200. Overlies Potosi dolomite or overlaps Potosi and rests on Precambrian; unconformably underlies Gunter sandstone member of Van Buren formation. Fauna described.

O. R. Grawe, 1945, Missouri Geol. Survey and Water Resources, 2d ser., v. 30, p. 53–55. Overlies Potosi, dolomite; underlies Gasconade formation. In this report, Gasconade is used in its earlier unrestricted sense to include all strata between the Eminence and the Roubidoux.

R. D. Knight, 1954, Missouri Geol. Survey and Water Resources Rept. Inv. 17, p. 57. Reprinted from Kansas Geol. Soc. Guidebook 17th Ann Field Conf., 1954. Underlies Gunter member of Gasconade formation.

Named for exposures at Eminence, Shannon County.

†Emma Creek Formation

Pliocene, middle and upper: Central Kansas.

S. W. Lohman and J. C. Frye, 1939, (abs.) Econ. Geology, v. 34, no. 8, p. 943. Sands, gravel, clays, and silts of middle and upper Pliocene age. Underlies McPherson formation (redefined). Deposits formerly referred to the McPherson formation.

S. W. Lohman and J. C. Frye, 1940, Econ. Geology, v. 35, no. 7, p. 849–851. Brown, buff, and gray channel sand and gravel, and floodplain sandy silt and clay. Thickness 10 to 180 feet. Interfingers with Ogallala formation to southwest. Derivation of name stated.

C. C. Williams and S. W. Lohman, 1949, Kansas Geol. Survey Bull. 79, p. 56. Name abandoned. Beds at type locality are Pleistocene. Some beds assigned to Emma Creek have proved to be of Pliocene age and are here designated Delmore formation.

Named from exposures along Emma Creek, southeastern McPherson County.

Emmett Formation[1]

Pleistocene: Southwestern Idaho.

Original reference: V. R. D. Kirkham, 1928, Idaho Bur. Mines and Geol. Pamph. 29, p. 1.

Probably named for town of Emmett, Gem County.

Emmitsburg facies[1]

Upper Triassic: Western Maryland.

Original reference: G. E. Dorsey, 1919, Geol. Soc. America Bull., v. 30, p. 155–156.

Probably named for occurrence at or near Emmitsburg or Emmitsburg Junction, Frederick County.

Emmons Peak Quartzite[1]

Precambrian: Northeastern Utah and northwestern Colorado.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, p. 244.

Probably named from Emmons Peak, Uinta Mountains, Utah.

†Emory Sandstone[1]

Pennsylvanian: Southeastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 153.

Forms top stratum of Tracy City Measures in water gaps of Big Emory River at Harriman, Roane County.

Emperador Limestone[1] Member (of La Boca Formation)

Emperador Limestone Member (of Culebra Formation)

Miocene, lower: Panamá.

Original reference: D. F. MacDonald, 1913, (abs.) Geol. Soc. America Bull., v. 24, p. 709.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 237, 238, 246 (fig. 2). Member of Culebra formation. Massive cream-colored limestone. Limestone is rare along the Panamá Canal and is so conspicuous in the predominantly tuffaceous rocks that such beds in different regions were formerly correlated with the Emperador. As a result of these correlations, limestones in Caimito and La Boca formations, and even in Gatuncillo formation in Madden basin, were designated Emperador limestone. Even when limestones in other formations are eliminated there remains residue of limestones in the Culebra, the relative stratigraphic position of which is uncertain. Early Miocene. Formerly exposed in shallow quarries at Empire. Unit was termed Empire limestone by Hill (1898).

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 34, 36–37, 39, 51. Limestone agreeing with descriptions of the Emperador is still exposed along canal. These beds of relatively pure coralliferous limestone probably are at different horizons in upper part of Culebra formation and probably grade southeastward into calcareous sandstone. Should it be demonstrated that the name is being used for limestone at different horizons, the name should be abandoned, except for limestone at type locality.

U.S. Geological Survey currently classifies the Emperador Limestone as a member of La Boca Formation on the basis of a study now in progress.

Type region: Quarries at Empire, now unrecognizable.

Empire Formation[1]

Pliocene(?): Southwestern Oregon.

Original reference: J. S. Diller, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 475.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 195–197. Consists of approximately 1,050 feet of brownish-gray massive concretionary medium- to coarse-grained moderately indurated sandstones which are involved in a northerly plunging synclinal fold situated on south side of Coos Bay. Sandstones rest with marked angular unconformity on Tunnel Point sandstones. Cannot be distinguished on faunal basis from Coos conglomerate. Pliocene.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 109–110. Empire fauna is more probably Pliocene than Miocene.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 590, chart 11. Coos conglomerate is lens in Empire.

J. W. Durham, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1504–1505. Examination of section of marine fossiliferous strata along

south side of Cape Blanco, referred to Empire formation (Pliocene) by Diller (1903) and other workers, revealed unconformity dividing formation into two parts. The unconformity, marked by moderately coarse conglomerate, is exposed in sea cliff about one-half mile south of the Cape and a short distance stratigraphically above 25-foot tuff member noted by Diller. *Securella* [*Chione*] *securis-Anadara trilineata* fauna is restricted to beds above the conglomerate. Name Empire should be applied only to these upper beds.

Well exposed on beach 3 miles southwest of Empire City, between Pigeon Point and Fossil Point.

Empire Formation (in Missoula Group)

Empire Member (of Spokane Formation)

Empire Shale[1] or Formation (in Piegan Group)

Precambrian (Belt Series): West-central Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1898. Member of Spokane formation which is included in Meagher facies (new) of Belt series. Member consists of argillites, thickly bedded, siliceous, greenish-gray, with some sandstones and limestones. Thickness about 600 feet. Overlies Prickly Pear member (new).

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 835–837. Marysville stock is surrounded by Precambrian rocks of Belt series (ascending): Empire formation, Helena limestone (renamed dolomite), Marsh formation, and Greenhorn Mountain quartzite (new). Area contains type section of Empire "shale." Empire formation, or "shale" as Walcott (1899) called it, was named for exposure west of Empire mine, at head of Lost Horse Gulch in western part of Marysville district. Lowermost beds exposed here are intruded by granodiorite of Marysville stock. All rocks in type section are hornfelsed, dark weathering, and are crackle breccias ramified with tremolite veinlets and quartz veins. They are well within contact-metamorphic aureole of Marysville stock and are overlain conformably by white diopsidic hornfels of Helena dolomite. Walcott mentioned occurrence of Empire shale on Drumlummon Hill, in eastern part of district, but rock there is a superb scapolite-diopside hornfels. Barrell (1907, U.S. Geol. Survey Prof. Paper 57) in his account of Marysville district, ignored type section of Empire and described formation as exposed on Long Creek in north-central part of Marysville area, outside of contact aureole, where it consists of finely laminated, soft limy shale, grayish-green or buff-colored with a few reddish bands. As observed in present study, the Empire there consists of pale-green hard argillite alternating with mud-cracked rose or lavender argillites. Top of Empire is light colored and weathers pale buff and yellowish. Section at this locality is bottomed by fault; Barrell measured 520 feet of Empire and accepted Walcott's figure of 600 feet at total thickness. However, base of Walcott's section is an intrusive contact. In present work formation was found to be best exposed in section that extends east-west through U.S.G.S. bench mark 4450 in Scratchgravel Hills, northwest of Helena where it consists of pale-green argillite, deep-red argillites, and fine-grained light-green and white quartzite. Thickness about 1,000 feet. Conform-

able contacts with Spokane shale below, where first appearance of quartzite in section is taken to mark base of Empire. Transition to overlying Helena is abrupt, taking place within stratigraphic thickness of 20 feet.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Provisionally included in Piegan group.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 6, pls. 1, 2. Empire shale intertongues with and grades downward into Spokane shale and underlies Flathead quartzite in southern Elkhorn Mountains, Jefferson and Broadwater Counties. Thickness about 600 feet.

U.S. Geological Survey currently classifies the Empire as a formation in the Missoula Group on the basis of a study now in progress.

Type localities: On ridge north of Empire, between Lost Horse Gulch, and in canyon walls just below Marysville, Lewis and Clark County.

Empire Limestone[1]

Miocene: Panamá.

Original reference: R. T. Hill, 1898, Mus. Comp. Zool. Harvard College Bull., v. 28, no. 5, p. 195–196.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 335. Limestone in Gaillard Cut area now referred to lower Miocene. MacDonald (1913, Isthmian Canal Comm., Ann. Rept., app. S. p. 564–582) renamed unit Emperador limestone. Credits name to R. T. Hill.

Named for Empire, now abandoned, a village on original line of Panama Railroad near Culebra and about one-half mile west of Gaillard Cut.

Empire Gulch Rhyolite[1]

Tertiary: Colorado.

Original reference: W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 351.

Named for occurrence on south side of Empire Gulch, south of Leadville, Lake County.

†Emporia Blue Limestone[1]

Pennsylvanian: Northeastern Kansas.

Original reference: A. J. Smith, 1903, Kansas Acad. Sci. Trans., v. 18, p. 100.

Named for Emporia, Lyon County.

Emporia Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: M. Z. Kirk, 1896, Kansas Univ. Geol. Survey, v. 1, p. 72–85.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. As originally defined and now again recognized, the Emporia comprises beds between Willard shale above and Auburn shale below. Thickness ranges from 7 to 40 feet. Includes (ascending) Reading limestone, Harveyville shale, and Elmont limestone members. Kirk did not define type section or locality; reference section given.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 55–60. Emporia limestone of Kansas comprises (ascending) Reading limestone, Harveyville shale, and Elmont limestone members. Moore (1949, Kansas Geol. Survey Bull. 83) correlated the Reading, Harveyville, and Elmont of Kansas with lower, middle, and upper units of Stonebreaker formation in Osage County, Okla. Name Stonebreaker has been discarded as formation name in north-central Oklahoma in favor of name Emporia. Kansas subdivisions of Emporia are recognizable in Pawnee County; southern extent is not known. Average thickness 90 feet in Pawnee County. Overlies Auburn shale; underlies Gano shale.

Reference section exposed in roadcut on Kansas Highway 10 in NW¼ sec. 31, T. 11 S., R. 14 E., Shawnee County, Kans.

†Emporia (reservoir) Shales[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905. The Carboniferous rock system of eastern Kansas.

Probably named for Emporia, Lyon County.

Endeavor Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Endee shale[1]

Triassic(?): Northeastern New Mexico.

Original reference: C. R. Keyes, 1905, Am. Jour. Sci., 4th, v. 20, p. 424.

Derivation of name not stated.

Endicott Diorite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1899–1901, pl. 1. Holocrystalline dark-colored fine- to coarse-textured pegmatitic diorite. Shown on map as diorite breccia. Brecciated and intruded by Conway granite and Cobble Hill phase of Belknap syenite. Older than Conway granite and Belknap syenite at Cobble Hill; younger than Gilford gabbro. Assigned to White Mountain magma series.

Typical exposures on Endicott Hill in Belknap Mountains.

Enebro Sandstone Lens (in Johnson Peak Formation)

See Johnson Peak Formation.

Enfield facies subgroup[1]

Upper Devonian: Southern central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 201.

Ithaca region.

Enfield Formation

†Enfield Shale Member (of Portage Formation)[1]

Upper Devonian: South-central New York.

Original reference: H. S. Williams, 1906, Science, new ser., v. 24, p. 365–372.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1758, chart 4. As represented on correlation chart, Enfield formation lies between the Ithaca below and the Chemung above and, according to Chadwick (1935, Am. Midland Nat., v. 16), is eastern representative of Rhinestreet-Hatch sequence. This correlation differs from that published by Caster (1933, Geol. Soc. America Bull., v. 44, pt. 1), which showed that Enfield of Ithaca region consisted of Van Etten and Hatch.

R. E. Stevenson, 1948, New York State Sci. Rept. Inv. 1, p. 2 (chart). Shown on chart as upper member of Naples formation. Overlies Ithaca formation.

J. W. Wells, 1952, Jour. Paleontology, v. 26, no. 1, p. 120–122. Referred to as formation. Starfish *Ptilonaster* collected from middle of formation about 400 feet below base of Chemung and about same distance above top of Ithaca formation.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2826. In area south of Cayuga Lake, the Sonyea formation occupies upper four-fifths of rock sequence that was designated Enfield shale member of Portage formation by Williams and others (1909, U.S. Geol. Survey Geol. Atlas, Folio 169).

Typically exposed at town of Enfield, west of Ithaca, Tompkins County.

Engadine Dolomite[1]

Middle Silurian (Niagara Series): Northern Michigan.

Original reference: R. A. Smith, 1916, Michigan Geol. Survey Pub. 21, p. 151.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37,, p. 35, 36. In Straits of Mackinac region, underlies Pointe aux Chenes formation (new).

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Field Excursion, p. 2 (table), 23, 29. Youngest unit of Middle Silurian in Northern Peninsula. Thickness 200 to 250 feet. Overlies Cordell dolomite with contact sharply defined in some area; underlies Pointe aux Chenes shale with contact not exposed.

Named for exposures at and around Engadine, Mackinac County.

Engle coal group (in Vermejo Formation)[1]

Upper Cretaceous: Eastern Colorado.

Original reference: R. C. Hill, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58.

Elmoro region.

Englevale Channel Sandstone[1]

Englevale Sandstone Member (of Labette Shale)

Pennsylvanian (Des Moines Series): Southeastern Kansas and western Missouri.

Original reference: W. G. Pierce and W. H. Courtier, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 1061–1064.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 197. Englevale sandstone member of Labette shale is one of several bodies of sandstone, collectively referred to as Warrensburg sandstone. Lies in middle and lower part of Labette shale.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6. Geographically extended into southwestern Missouri, Bates County and probably elsewhere.

Well exposed in vicinity of Englevale, Crawford County, Kans., along north-south road on east side of town and along east-west road one-half mile north of town.

Englewood Formation

Englewood Limestone[1]

Devonian and Mississippian: Western South Dakota and northeastern Wyoming.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 509.

E. P. Rothrock, 1955, North Dakota Geol. Soc. Guidebook Black Hills Field Conf., p. 76–77. Mississippian system is represented in South Dakota by formations of Madison group, called Englewood and Pahasapa, where they outcrop and Bakken, Lodgepole, Mission Canyon, and Charles where encountered in wells.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in northeastern Wyoming.

U.S. Geological Survey currently classifies the Englewood as a formation and designates the age as Devonian and Mississippian on the basis of a study now in progress.

Name derived from Englewood, Lawrence County, S. Dak.

English River Formation (in Hannibal Group)

English River Sandstone Member (of Hannibal Shale)[1]

English River Siltstone Member (of Hannibal Formation)

Lower Mississippian (Kinderhook): Western Illinois and southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 322.

L. A. Thomas, 1949, Geol. Soc. America Bull., v. 60, no. 3, p. 408–409. Referred to as siltstone member. In southeastern Iowa, overlies Maple Mill shale with apparent conformity; at Burlington, underlies McCraney (McKerney) limestone with boundary indicated by leached yellow part at top of English River; in western Louisa County, underlies Wassonville limestone, which overlies Maple Mill near Kalona, northern Washington County. Conodont assemblage indicates Lower Mississippian.

M. A. Stainbrook, 1950, Am. Jour. Sci., v. 248, no. 3, p. 209, 212. English River siltstone is not member of Hannibal formation. Kinderhook succession in upper Mississippi valley seems to be (ascending) Maple Mill shale, English River siltstone, Louisiana limestone, Hannibal shale and siltstone, and Chouteau limestone.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 27–28. Top formation in Hannibal group in Illinois. Conformably overlies Maple Mill shale; conformably underlies and is gradational into McCraney (McKerney) limestone. Present in western Illinois in north-south belt about 25 miles wide extending from Henderson to Pike Counties. Thickness 30 to 43 feet along middle of belt; less than 10 feet along western border of state; wedges out eastward.

Named for exposures along English River, Washington County, Iowa.

Englishtown Formation (in Matawan Group)

Englishtown Member (of Matawan Formation)

Englishtown Sand (in Matawan Group)[1]

Upper Cretaceous: New Jersey and Delaware.

Original reference: H. B. Kummel, 1907, New Jersey Geol. Survey Paleontology, v. 4, p. 17, footnote.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, pt. 6, p. 243 (fig. 22), 256–258. Geographically extended into Delaware where it is present along Chesapeake and Delaware Canal. Underlies Marshalltown formation; overlies Crosswicks clay.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8, (fig. 4), 24, 28–30. Member of the Matawan which is here reduced to formational rank. Conformably overlies Woodbury member; conformably underlies Marshalltown member. It is believed that Carter's interpretation of stratigraphy in Chesapeake and Delaware Canal is in error and that beds referred to Englishtown by him are Wenonah.

M. E. Johnson and H. G. Richards, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2150–2160. Here considered of formational rank. Report is a discussion of paper by Spangler and Peterson (1950).

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Formation in Matawan group. Overlies Woodbury clay; underlies Marshalltown formation. Average dip SE 38 feet per mile. Thickness 20 to 140 feet; thickens northeast in outcrop.

Named for development in vicinity of Englishtown, Monmouth County, N.J.

†Enid Formation[1]

Permian: Western Oklahoma, western Kansas, and western Texas.

Original reference: C. N. Gould, 1905, U.S. Geol. Survey Water-Supply Paper 148, p. 39–44, map.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 99. Listed with names abandoned by Oklahoma Geological Survey.

Named for Enid, Garfield County, Okla.

†Enochkin Formation[1]

Middle and Upper Jurassic: Southwestern Alaska.

Original reference: T. W. Stanton and G. C. Martin, 1905, Geol. Soc. America Bull., v. 16, p. 397.

Typically exposed on eastern shore of Enochkin [Iniskin] Bay.

Ensenada Shale[1] or Formation

Upper Cretaceous: Puerto Rico.

Original reference: G. J. Mitchell, 1922, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 3, p. 252.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 325. Limy shale about 650 feet thick. Contains fragments of *Radiolites* and foraminifera. Stratigraphical relations not known. Upper Cretaceous.

T. R. Slodowski, 1958, Dissert, Abs., v. 18, no. 1, p. 200–201. In Yauco area, the younger complex, more than 9,000 meters thick, has been di-

vided into eight formations: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara. Ensenada is considered to have been deposited in a southern basin penecontemporaneously with deposition of Río Yauco and Río Blanco formations in a northern basin. Ensenada and Río Yauco formations overlie Sebana Grande and El Rayo formations unconformably and are separated from overlying San Germán and Jicara formations, at least locally, by unconformities.

Named for exposures at Ensenada, on Guanica Bay.

Ensign Lake Green Slates, Tuffs, and Graywackes

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1605–1606. Name applied to green slates and tuffs that form a large part of Ensign Lake Basin and extend eastward to [Duluth] gabbro. Beds commonly only a fraction of an inch thick; bands are light and dark green and gray with some pink. Locally formation is injected by granite and pegmatite dikes. Quartz veins from paper thin to 10 feet in width permeate rock in places. Isoclinally folded. Thickness may be 4,000 feet or more. In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Ensign Lake green slates as unit 10 occurring above Amoeba Lake graywackes and below Kekekabic Lake tuffs, agglomerates, slates, and andesite porphyry.

Report covers a belt in eastern part of Vermilion district more or less parallel to international boundry.

Ensign-Snowbank Lake Agglomerate

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1593. Dark greenish gray on fresh surface and light gray on weathered surface; not uniform in texture and structure; appears homogeneous on fresh surface; when weathered may appear massive, fragmental, or banded; contains a number of "blow-outs" and dikes of feldspar porphyry; bedding indistinct; gradational bedding rare. Thickness variable; probably 4,000 feet maximum. In practically all occurrences, overlies slates and graywackes. In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Ensign-Snowbank Lake agglomerate as unit 12 occurring above Kekebabic Lake tuffs, agglomerates, slates, and andesite porphyry and below unnamed feldspar porphyry intrusions.

Occurs in vicinity of Snowbank and Ensign Lakes, Lake County.

†Enterprise Green Marl (in Claiborne Group)[1]

Eocene, middle: Southeastern Mississippi.

Original reference: O. Meyer, 1885, Am. Jour. Sci., 3d, v. 30, p. 435.

Wythe Cook, 1925, U.S. Geol. Survey Prof. Paper 141–E, p. 135. Because name Enterprise is preoccupied, Winona sand is here redefined to include typical "Winona sand" of Montgomery County and typical "Enterprise marl" of Clarke County, but to exclude sands at base of Tallahatta formation in Lauderdale County.

Named for exposures at town of Enterprise, Clarke County.

†Enterprise Sandstone (in Boggy Shale)[1]

Pennsylvanian: Central eastern Oklahoma.

Original reference: S. W. Lowman, 1932, Summaries and abstracts of technical papers presented before Tulsa Geological Society 1932, unpaged.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey. Name of the Haskell County village was given to unit now known as Bluejacket sandstone. Name preoccupied.

†Enterprise Shale (in Sumner Group)[1]

Permian: Central Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: J. W. Beede, 1909, Kansas Acad. Sci. Trans., v. 21, pt. 2, p. 253.

Name not used on Geologic map of Oklahoma (1954). The Enterprise or its equivalents transferred to Chase Group.

Named for Enterprise, Dickinson County, Kans.

Entrada Sandstone (in San Rafael Group)[1]

Upper Jurassic: Southern, southeastern, and northeastern Utah, northeastern Arizona, western, central, and southeastern Colorado, and northwestern New Mexico.

Original reference: J. Gilluly and J. B. Reeside, Jr., 1926, U.S. Geol. Survey Press Bull. 6064, March 30.

A. A. Baker and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 8, p. 787, 799, 804, 805. In Moab region, Utah, includes Moab tongue (new).

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 76–78. A thick series of earthy sandstones and subordinate shales. Thickness 312 feet at type locality; 844 feet at Muddy River on west flank of San Rafael Swell; 405 feet at Black Dragon Canyon; 498 feet at mouth of San Rafael River. Overlies Carmel formation; underlies Curtis formation. Extends into Colorado.

A. A. Baker, 1933, U.S. Geol. Survey Bull. 841, p. 49–50, pls. In Moab region, the Entrada consists of massive crossbedded medium-grained sandstone. Moab tongue is white; remainder of formation is banded orange and white with rows of solution cavities parallel to normal bedding. Thickness 360 to 405 feet. Underlies Summerville formation; overlies Carmel formation.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 7–8, pls. Summary of results of recent fieldwork in eastern Utah and adjacent parts of Arizona, New Mexico, and Colorado and revision of interpretations and correlations of Jurassic formations of area. The Entrada extends eastward from type area into, and in the north, across Rocky Mountain province in Colorado and a relatively short distance southward into New Mexico and Arizona. A sandy zone above the Carmel in southwestern Utah has position and lithology of the Entrada and is here correlated with it. The Entrada in San Rafael Swell is deep-red fine-grained earthy sandstone that weathers into small bosses, "stone babies," and other rounded forms and at many localities is not much more resistant than shale. This facies occurs also in southwestern Utah. Eastward from San Rafael Swell, this earthy facies passes into less earthy irregularly bedded sand-

stone. This, in turn, passes eastward into sandstone composed of clean fine- to medium-sized lime-cemented quartz grains, red, orange-red, or gray, banded at many places with zones of color in sharp distinction to uniform coloring of the Navajo and Wingate. Moab sandstone tongue present at top of Entrada in vicinity of Moab, Utah. Maximum thickness about 1,000 feet near Circle Cliffs, Utah; thins southward. Rests on Carmel formation as far east as Bush Canyon in Colorado. Farther east rests successively upon Navajo sandstone, Kayenta formation, and Wingate sandstone and upon Dolores formation where Wingate sandstone is not recognized. Lower boundary arbitrary where Carmel formation is present; elsewhere it is sharp. Contact with overlying Curtis formation in San Rafael Swell is erosional unconformity, but elsewhere upper boundary is only moderately sharp and probably not an unconformity. Lower member of La Plata sandstone of Cross (1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3) at many localities in southwestern Colorado is Entrada, and so also is entire La Plata of north-central Colorado. San Rafael group. Upper Jurassic.

R. L. Heaton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 8, p. 1153–1177. Results of this study show that basal sandstone of the "Jurassic" of northern Colorado is probably partly Entrada and partly Upper Triassic, that the latter grades into redbeds southward and the former continues into New Mexico where it is identical with the so-called Wingate; and that it does not extend westward to the Arizona line but can be correlated with lower La Plata of San Juan Mountains in Colorado. Further, the so-called Nugget of northwestern Colorado is Nugget and Entrada separated by thin remnant of Carmel formation.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1277–1278. In Uinta Mountains, Preuss red beds grade into crossbedded Entrada sandstone.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1664–1668. Report is revised correlation of Jurassic formations of parts of Utah, Arizona, New Mexico, and Colorado. Entrada sandstone, with more or less typical lithologic character and in normal sequence with underlying Carmel formation, and Navajo, Kayenta, and Wingate formations of Glen Canyon group are recognized at Navajo Mountain, Utah, Kayenta and Rough Rock, Ariz., Boundary Butte, Utah, and Beclabito dome, New Mexico. Overlying Todilto limestone is not recognized at Navajo Mountain, is absent at Boundary Butte, but crops out at Kayenta, Red Rock, Ariz., and Beclabito dome. Southward from Red Rock, the Todilto is present at Toadlena and at its type locality at Todilto Park. Underlying Entrada thickens southward from Red Rock to Toadlena and to Todilto Park, where it is the thick cliff-forming sandstone which all previous workers, including authors of present report, have correlated with Wingate sandstone of Fort Wingate region. This cliff-forming sandstone which crops out along Arizona-New Mexico State line at Todilto Park, Window Rock, Hunters Point, and Lupton and in cliffs north of Fort Wingate, N. Mex., is thus equivalent to sandstone called Entrada over most of Utah and Colorado. Evidence shows that the sandstone extends northward to Chama Basin and is same sandstone that crops out at Mesa Alta, Navajo Canyon, El Rito, and Rio Canones in Chama Basin. These new conclusions as to correlation pose problem of stratigraphic nomenclature. Strict application of principles of priority would require that

name Wingate sandstone now be applied to unit heretofore called Entrada and would require a new name to be applied to Wingate sandstone of Utah and adjacent regions. However, it is believed that abandonment of this nomenclature through application of principles of priority would be confusing. Hence, name Entrada is extended to include sandstone at type locality of the Wingate, and name Wingate is retained for the sandstone forming lower part of Glen Canyon group, with the understanding that original type locality of the Wingate has been abandoned.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 93. Entrada sandstone mapped in Egnar-Gypsum Valley area, San Miguel and Montrose Counties, Colo.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 94–96, pls., strat. sections. In Zion Park region, light-red white-banded fine even-grained thin-bedded gypsiferous friable sandstone 70 to 220 feet thick. At type section, consists chiefly of thick-bedded red sandstones, among them several massive crossbedded sandstones 13 to 30 feet thick; no gypsum beds included; thickness 312 to 844 feet. Overlies Carmel formation; unconformably underlies Curtis formation.

W. B. Hoover, 1950, New Mexico Geol. Soc. Guidebook 1st Field Conf., p. 77–80. Entrada and its members may be considered as representing the whole of San Rafael group where the Carmel is absent. Entrada, at type locality, is overlain by Curtis and Summerville. The Curtis apparently grades into Summerville, and the Summerville, in part, grades into Moab tongue of Entrada. Farther south, the Entrada divides again into a lower bed, the Entrada proper, and Bluff sandstone member. Term Red Mesa is here introduced for sandstone beds, 100 feet thick, between Entrada proper and Bluff member. Crinkly beds of the Red Mesa are similar in appearance to the Carmel at Moab which led Stokes (1944) to conclude that the Bluff and Entrada were one and same bed.

H. E. Wright, Jr., and R. M. Becker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 3, p. 610 (fig. 2). Discussion of correlation of Jurassic formations along Defiance monocline, Arizona-New Mexico. Cross section shows Entrada overlying Carmel formation and underlying Summerville formation and Todilto limestone.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 70–72, pls., strat. sections. Described in Henry Mountains region where it overlies Carmel formation and unconformably underlies Curtis formation. Thick-bedded and crossbedded sandstone; thinner bedded earthy sandstone to north. Thickness 300 to 700 feet.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 88–92, pls. 1, 2. Extended into Baca County, southeastern Colorado. Disconformably overlies Dockum group; underlies Morrison. These beds have been referred to as Exeter sandstone. Thickness 0 to 380 feet.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–64. Mapped in Horse Range Mesa quadrangle, Colorado.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 35–38, strat. sections. In most of Navajo country comprises three members which represent two distinct depositional facies. Lower sandy member is a sandy crossbedded facies, in part eolian, present only in northwestern part of area;

medial silty member approximates lithology of type section and is present in central and eastern parts of area; upper sandy member, a cross-bedded facies, is present in eastern part of area. A thin (50-foot) eastward extension of medial silty member and a thick (253-foot) sequence of upper sandy member constitute upper half of original type section of Wingate sandstone. In southwestern area, it is difficult to differentiate from underlying Carmel formation. In some areas, underlies Cow Springs sandstone, in others Summerville formation or Todilto limestone. Thickness as much as 303 feet.

R. B. Johnson, 1959, U.S. Geol. Survey Bull. 1071–D, p. 94–95, pls. 4, 5, 6. Described in Huerfano and Custer Counties, Colo., where it is 70 to 100 feet thick; disconformably overlies Sangre de Cristo formation and disconformably underlies Morrison. In this area and adjacent parts of New Mexico, replaces names Exeter and Ocate sandstones.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Map MF–221. Mapped in Moqui SE quadrangle where it consists of two units: upper sandstone 70 to 80 feet thick, pale brown and light pink at top grading to white and finally to orange in lower part; and lower argillaceous fine-grained brick-red sandstone 25 to 35 feet thick. Underlies Summerville formation; overlies Navajo formation.

R. B. Johnson and E. H. Baltz, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1895, 1897, 1898 (fig. 2). In Sangre de Cristo Mountains, Colo., unconformably overlies Johnson Gap formation (new), Lykins(?), or Sangre de Cristo formations.

Named for exposures on Entrada Point, in northern part of San Rafael Swell, Utah.

Enumclaw Volcanic Series[1]

Miocene, upper: Western Washington.

Original reference: C. E. Weaver, 1916, Washington Geol. Survey Bull. 13, p. 84.

Well exposed from Enumclaw to Cedar Lake, in southwestern part of King County.

†Eolian Limestone[1]

Cambrian and Ordovician: Southwestern Vermont.

Original reference: E. Hitchcock, 1861, Vermont Geologist Rept., v. 1, p. 396–419.

Named for Mount Eolus (Dorset Mountain) in Pawlet quadrangle.

Eolian Limestone Member (of Pueblo Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 24, 31, 171–173, pl. 2, table 2.

Named for exposures near Eolian, Stephens County.

Eoline Member (of Coker Formation)

Eoline Formation (in Tuscaloosa Group)

Upper Cretaceous: West-central Alabama.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37; W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 194–197. Forma-

tion includes the marine beds which lie between the apparently nonmarine Cottondale formation (new) and the Coker formation (new). Consists of glauconitic fine- to medium-grained sand and laminated gray clay; sand and clay beds are lenticular and of doubtful persistence, but upper part is commonly more clayey and lower part more sandy; *Halymenites* borings locally present, chiefly in upper half; weathered exposures commonly bright rusty red; updip exposures in Cottondale quadrangle chiefly purple and red sand with little or no glauconite and no *Halymenites*. Thickness 50 to 150 feet. In many places, upper contact is abrupt locally showing as much as 40 feet of channeling and in such places commonly overlain by nonglauconitic sand; at other places, contact is more obscure and laminated clay of Eoline is overlain by massive clay of Coker; at such places, contact is undulating surface having about 10 feet of relief. Lignitized logs and macerated plant remains near top have been determined as Upper Cretaceous.

C. W. Drennan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 528, 529. Rank reduced to member status in Coker formation (revised). Sediments heretofore designated Cottondale are included in Eoline member.

Named for exposures in cuts along Alabama Highway 6, about 30 miles southeast of Tuscaloosa, and 1½ miles east of community of Eoline, Bibb County.

Eolus Granite[1] (in Front Range Granite Group)

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe. 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

Composes Mount Eolus, Needle Mountain quadrangle.

Ephraim Conglomerate (in Gannett Group)[1]

Lower Cretaceous: Southeastern Idaho and western Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98–G, p. 76, 82.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 40–42, pl. 1. In Paradise Valley quadrangle, Idaho, is sole representative of group. Contained in small slice of rocks in zone between middle and east branches of Bannock overthrust. Thickness 1,025 feet. Overlies Stump sandstone. Upper Jurassic and Lower Cretaceous.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 55–56, pl. 21. Referred to as conglomerate member of Gannett group in Jackson Hole area. Underlies Peterson limestone member; overlies Stump formation. Lower Cretaceous.

W. W. Rubey, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–109. Described in Bedford quadrangle, Wyoming, where it is a conspicuous unit composed of sandy siltstone and shale; contains crossbedded coarse-grained sandstone and prominent conglomerate lentils. Thickness, where least disturbed by faulting or other deformation, 350 to 500 feet. Overlies Stump sandstone; underlies unit referred to as Draney-Peterson limestone. Lower Cretaceous.

Named for Ephraim Valley, sec. 36, T. 10 S., R. 45 E., Boise meridian, Crow Creek quadrangle, Idaho.

Epitaph Dolomite (in Naco Group)

Lower Permian: Southeastern Arizona.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 25–27, 41; James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 44–46, pl. 5. Lowest member of formation consists of about 200 feet of dolomite which ranges from medium to light gray on fresh fracture and weathers to various shades of gray—light to very dark. Characterized by presence of knots of silica, which are suggestive of being silicified fossils—weather to brown or tan. Toward the top of this part of formation, partings of red shale occur in dolomite; overlying beds generally poorly exposed sandy limestone or limy sandstone with higher porportion of maroon shale and much less dolomite. Uppermost part of formation is assemblage of dolomite, limestone, red shale, and thin sandy layers. Thickness at type locality 783 feet. Unconformably underlies Glance conglomerate or other rocks of Comanche age; overlies Colina limestone (new) with gradational contact.

Type locality: On dip slope of Colina Ridge, west of Epitaph Gulch (from which dolomite takes its name), 1 mile south of Horquilla Peak, central Cochise County.

Epler Formation (in Beekmantown Group)

Lower Ordovician: Southeastern Pennsylvania.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2716 (fig. 3), 2718, 2719–2720, 2721. Proposed for interbedded limestone and dolomite overlying Rickenbach formation (new) and underlying dolomite beds here termed Ontelaunee formation. Divided into two unnamed members: upper characterized by large proportion of calcarenite with bioclastics and limestone pebbles, and lower in which calcilutite is common; both members contain interbedded dolomite with much larger percentage in lower member. Thickness 800 feet in type section. Contact with underlying Rickenbach transitional, and boundary set at base of first limestone above solid dolomite body of the Rickenbach; contact with overlying Ontelaunee is placed at top of first limestone bed beneath lowest chert bed of Ontelaunee, and in Berks County this contact is 100 feet below lowest chert bed; contact zone gradational.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of the Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Described in Lebanon County where it is approximately 1,000 feet thick.

Type section: Continuous with type section of upper member of Rickenbach formation, east of Epler School, near Reading, Berks County.

Epworth Gravel Member (of San Pedro Formation)

Pleistocene, lower: Southern California.

California State Water Resources Board, 1953 (revised 1956), California State Water Resources Board Bull. 12, v. 2, p. B–103, pls. B–1C, B–2. Consists of up to 300 feet of gravel, gravelly clay, and silt, grading westward and southward into silt and clay. Gravels occur near top of formation and have been folded and partly eroded.

Occurs in a limited area around Moorpark, Ventura County.

†Equity Quartz Latite (in Alboroto Group)

†Equity Quartz Latite (in Potosi Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 93 (table 18). Alboroto rhyolite described in San Juan district. Upper part is biotite-hornblende latitic rhyolite; includes Equity and Phoenix Park quartz latites [both part of Alboroto group] of Creede district.

U.S. Geological Survey has abandoned the term Equity Quartz Latite on the basis of a study now in progress.

Named for development near Equity mine, Creede district.

Eramosa Member[1] (of Lockport Dolomite)

Middle Silurian: Ontario, Canada and western New York.

Original reference: M. Y. Williams, 1915, Canada Geol. Survey Mus. Bull. 20, Geol. Ser. 29, p. 1–4.

E. R. Cummings, 1939, Geologie der Erde, North America, v. 1, p. 596 (fig. 7), 597. Uppermost member of Lockport dolomite. Thickness 15 feet. Overlies Suspension Bridge member (new). Underlies Guelph dolomite. Forms crest of Niagara Falls.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Member of Lockport formation. Underlies Oak Orchard member (new); overlies Goat Island member (new). Term Goat Island replaces preoccupied name Suspension Bridge.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Formation in Lockport group. Overlies Goat Island limestone; underlies Devils Hole dolomite (new). Lockportian stage. Middle Silurian.

Well exposed along banks of Eramosa River between Rockwood and Guelph, Ontario.

Erath Member (of Anahuac Formation)

Oligocene, upper, or Miocene, lower: Southern Louisiana (subsurface).

H. C. Goheen, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 91–97. Term proposed for so-called deep water facies of down-dip Anahuac formation, which is regarded as upper Oligocene or lower Miocene. Predominantly shale unit containing some sandstone. Characterized by two foraminiferal zones, *Planulina palmerae* and Abbieville. These biostratigraphic zones serve to define Erath member, the same way *Marginulina* and *Discorbis* zones are used to limit type Anahuac. No single well log at present satisfactorily includes entire member. Reference log designated.

Reference log: Texas Co. Erath Unit 3S, No. 7, Erath field, Vermilion Parish. Near Erath townsite.

Ericson Sandstone[1] or **Formation** (in Mesaverde Group)

Upper Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: J. D. Sears, 1926, U.S. Geol. Survey Bull. 781, p. 20, pl. 5.

W. R. Hansen and M. G. Bonilla, 1954, Colorado Sci. Soc. Proc., v. 17, no. 1, p. 4 (fig. 1), 9, 10. Geographically extended into Daggett County, Utah, where it is 290 feet thick in Flaming Gorge area, overlies Rock Springs formation and unconformably underlies Fort Union(?) formation; 800 feet thick in Clay Basin.

W. R. Hansen, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–101. Described as formation in Clay Basin quadrangle, where it is about 800 feet thick, and consists of three massive gray sandstone beds separated by earthy punky dark-gray shale; locally basal beds are shale. Underlies Fort Union formation.

Named for exposures near old Ericson Ranch, on Salt Wells Creek, sec. 31, T. 16 N., R. 102 W., Sweetwater County, Wyo.

Erie Clay[1]

Pleistocene: New York and Ohio, and Ontario, Canada.

Original reference: W. E. Logan, 1863, Canada Geol. Survey Repts. 1843–1863, p. 887, 896–907.

Occurs along north shore of Lake Erie from Long Point westward to Detroit River, and appears to underlie whole country between this part of lake and main body of Lake Huron. Also occurs at Owen Sound and along Nottawasaga River, along shores of Lake Ontario and east far as Brockville.

Erie Group[1]

Erie Series[1] or Erian Series

Middle Devonian. New York and West Virginia.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geol. 2d dist., p. 100, 429.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 253, 254, 308–311. Erie group (Erian) of West Virginia contains two members, Marcellus black shale below and Hamilton formation above. Name, which is currently in use by New York State Museum but not by U.S. Geological Survey, is here adopted to resolve a difficulty which otherwise would call for erection of a new term or transfer of another term not yet known to be wholly appropriate. To serve as the name of the Marcellus-Hamilton group of this report (that is, the Hamilton group of Pennsylvania) recourse is had to Erie, or Erian, early used by Emmons (1842) and redefined by Clarke and Schuchert (1899 Science, new ser., v. 10) expressly for this service—namely, for the rocks between the Onondaga and Tully limestone.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1729–1794, chart 4. Erian series, Middle Devonian. Comprises (ascending) Cazenovia, Tioughnioga, and Taghanic (Taughannock) stages. Follows Ulsterian series and precedes Senecan series.

Named for Lake Erie.

†Erie Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 108, 118.

Named for Erie, Neosho County.

†Erie Shale[1]

Upper Devonian: Northern Ohio.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 20.

Named for exposures on shores of Lake Erie from mouth of the Vermillion to Dunkirk.

Erin Shale[1]

Erin Slate Member (of Talledega Series)

Carboniferous (probably Early Pennsylvanian): Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Special Rept. 14, p. 217.

R. H. Griffin, 1951, Alabama Geol. Survey Bull. 63, p. 28, 31. Described in Hillabee area where Talladega series is divided into Cheaha quartzite, Erin slate, and group of quartzites, phyllites, and slates lying below, between, and above the two members. Thickness at type locality 2,800 feet; true thickness cannot be measured since upper limit is determined by Whitestone fault.

Type locality: Vicinity of Erin, Clay County.

Ermont Formation[1]

Upper Devonian: Southwestern Montana.

Original reference: P. J. Shenon, 1931, Montana Bur. Mines and Geology Bull. 6.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1742. Upper Devonian.

In vicinity of Ermont mine, Argenta district, Beaverhead County.

Erna Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

F. B. Plummer, [1942], Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 22, p. 1, 2, map. Medium- to coarse-grained well-sorted well-rounded friable poorly cemented sand, 10- to 25-feet thick, near middle part of formation. Due to complicated system of normal faults which occurs in region, outcrop is repeated three times so that three narrow belts of the sand can be traced across Cambrian area.

Best exposures are on middle belt along east bluff of Leon Creek, 2 miles southeast of Erna, Mason County.

Ervay Carbonate Rock Member or **Tongue** (of Park City Formation)

Ervay Member (of Goose Egg Formation)

Ervay Tongue or **Member** (of Phosphoria Formation)[1]

Upper Permian: Northwestern Wyoming.

Original reference: H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1664, 1666.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2832 (fig. 3), 2844; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 3 (fig. 1), 19–20, pls. 2, 3. In this report, beds that Thomas (1934) called Phosphoria in Wind River Mountains are designated Park City formation; hence, Ervay is considered member of Park City. Extends to northern Wind River Mountains where it is 30

to 40 feet thick; north and west of this, grades into upper member of Shedhorn sandstone; west of Big Piney, grades into Tosi chert member of Phosphoria. Mostly limestone in its western area and dolomite in its eastern area. Underlies Dinwoody formation. [Members of Phosphoria, Park City, and Shedhorn formations are referred to as tongues in areas where they occur singly or are subordinate parts of the interval.]

U.S. Geological Survey also classifies the Ervay as a member of the Goose Egg Formation on the basis of a study now in progress.

Type section: Casper Creek, Natrona County. Crops out a few hundred feet west of Evray, a post office in Natrona County, near north end of Rattlesnake Hills.

Ervine Creek Limestone[1] Member (of Deer Creek Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 49, 50.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Uppermost member of Deer Creek; overlies Burroak shale member; underlies Calhoun formation. Virgilian series. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 22. Member persists from Adair County, Iowa, to Oklahoma. Thickness 14 to 18 feet. Type exposures noted.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17–19, fig. 3. In Missouri, interval between Rock Bluff limestone member and uppermost limestone of the Deer Creek is occupied by shale. This shale has been treated by Missouri Geological Survey as occupying the Rock Bluff-Ervine Creek interval, with implication that intervening Haynies limestone is absent in Missouri. This shale interval is here termed Larsh-Burroak. Missouri Geological Survey recognizes the possibility that Burroak shale member may be absent in Missouri and that uppermost limestone of Deer Creek formation may include both Haynies and Ervine Creek limestone members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17, fig. 5. Massive- to wavy-bedded fossiliferous light-gray limestone, often chert bearing; algal and oolitic beds near top. Thickness 10 to 14 feet. Overlies Burroak shale member; underlies Calhoun shale.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 46, pl. 1. Member, in Douglas County, is 13 to 17 feet thick. Overlies Larsh-Burroak shale member; underlies Calhoun shale.

Type exposures: On Ervine Creek about 5 miles northeast of Union, Cass County, Nebr.

Erving Hornblende Schist[1]

Pre-Triassic: Central Massachusetts.

Original reference: B. K. Emerson, 1917. U.S. Geol. Survey Bull. 597, p. 60, 72–74, map.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Described in Mount Toby quadrangle as fine-grained hornblende schist with interbedded feldspathic quartzite. Thinly layered amphibolite grades into overlying Joshua schist through narrow zone of quartzitic mica schist which contains small widely separated layers of amphibolite. Overlies Poplar Mountain gneiss with gradational contact. Pre-Triassic.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–93. Restricted. Unit mapped as Erving by Emerson (1917) in Millers Falls quadrangle is considered amphibolite member at top of Crag Mountain formation. Relation of Erving to amphibolite lenses in Poplar Mountain gneiss not known.

Named for occurrence at Erving, Millers Falls quadrangle.

Erwin Quartzite[1] or Formation[1] (in Chilhowee Group)

Lower Cambrian(?): Eastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 5.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 7–22. In Great Valley of Virginia, Erwin quartzite underlies Shady dolomite. In vicinity of Austinville, Lower Cambrian dolomite overlies Erwin. Proposed to extend Pennsylvania names Vintage dolomite, Kinzers formation, and Ledger dolomite to this fossil-bearing series of beds, which although equivalent to Shady dolomite of Great Valley, is different sedimentary facies deposited to southeast of main Appalachian geosyncline, and has been carried northwestward by thrust faulting to rest on typical Shady dolomite.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 29–35. Formation in northeastern Tennessee consists of interbedded layers of white vitreous quartzite, ferruginous quartzite, siltstone, and shale. Formation extends from overlying Shady dolomite to base of widely traceable white quartzite bed that contains *Scolithus* in many places. As thus defined, it has rather uniform thickness of 1,200 to 1,400 feet throughout region. Includes Helenmode member (new) in Iron and Holston Mountains. The Helenmode consists of the so-called "transition beds" of earlier reports. Overlies Hampton formation; underlies Shady dolomite.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 14–16. Formation, as mapped in this report [Hot Springs Window], includes upper part of Murray slate and Hesse quartzite as mapped by Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116). Base of formation is placed beneath resistant ledge-forming white quartzite series of beds that overlie upper shale member of Hampton formation. *Scolithus* tubes not noted except at one locality. Except for Helenmode member at top, Erwin beds are not subdivided in this area. Overlies Hampton formation; underlies Shady dolomite. Two sets of formation names for Lower Cambrian clastic rocks are in current use in eastern Tennessee and western North Carolina. Northeast Tennessee names Unicoi, Hampton, and Erwin are used here for same rocks which Keith (1904) and Stose and Stose (1947, Am. Jour. Sci., v. 245, no. 10) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28, 32, 41–45, pls. 1, 19. Uppermost unit of Chilhowee group. Consists of interbedded layers of white vitreous quartzite, dark ferruginous quartzite, siltstone, and shale. Thickness 1,220 feet at type locality; between 1,200 and 1,500 feet on Holston Mountain and Iron Mountain; 1,000 feet in Stone Mountains; about 600 feet on Nowhere Ridge. Includes (ascending) Nebo quartzite, Murray shale, Hesse quartzite, and Helenmode members. Overlies Hampton formation; underlies Shady dolomite. Lower Cambrian.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 19–20, pl. 1. In this report [Rockingham County], term Erwin quartzite is used in preference to Antietam sandstone. Consists almost entirely of thick beds of clean well-sorted grains of white quartz sand which are cemented with silicia. Thickness 800 to 1,000 feet. Overlies Hampton (Harpers) formation; underlies Shady (Tomstown) dolomite.

Type locality: On Nolichucky River, southeast of Unaka Springs. Named for exposures near Erwin, Unicoi County, Tenn.

Escabrosa Limestone[1]

Lower and Upper(?) Mississippian: Southeastern Arizona and southwestern New Mexico.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 2–13. Crops out in northwestern Mule Mountains, Tombstone Hills, in many fault blocks in southeastern end of Dragoon Mountains, and along main ridge of Dragoon Mountains and in parts of Little Dragoon Mountains, Gunnison Hills, and Johnny Lyon Hills. Overlies Martin limestone or Abrigo limestone; underlies Horquilla limestone (new), or Black Prince limestone. Thickness 585 to 755 feet. Lower Mississippian.

F. F. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 476 (fig. 6), 480–481. Described in Chiricahua and Dos Cabezas Mountains where it consists of cherty crinoidal limestone 630 to 730 feet thick. Overlies Upper Devonian Portal formation (new); underlies Upper Mississippian Paradise formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 28–29, table 1. In central Peloncillo Mountains, about 460 feet thick; overlies Percha shale and underlies Paradise formation. Unit resembles Escabrosa of Bisbee area much more closely than it does Lake Valley limestone; hence, term Escabrosa is used here even though it is at variance with nomenclature used throughout rest of New Mexico. Kinderhookian-Meramecian.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. Thickness about 300 feet in Haunted Canyon quadrangle, Arizona. Overlies Martin limestone; underlies Naco limestone.

U.S. Geological Survey currently designates the age of Escabrosa Limestone as Lower and Upper(?) Mississippian.

Named for exposures on Escabrosa Ridge, Bisbee quadrangle, Ariz.

Escacado Limestone

Upper Devonian (Rockfordian): Southeastern Arizona.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 227, 228 (table). Name applied to lower 100 feet of Martin limestone of Ransome (1904).

Characterized by occurrence of Iowa Rockford fauna. Younger than Berenda formation; underlies Patagonia limestone (new).

In Bisbee region.

Escanaba Limestone[1]

Middle Ordovician: Michigan.

Original reference: A. C. Lane, 1909, Michigan Geol. Survey Rept. 1908, p. 47.

Escanaba and St. Mary's Rivers.

Escanaba River Group

Middle Ordovician: Northwestern Michigan.

R. C. Hussey, 1950, Michigan Geol. Soc. [Guidebook 14th] Ann. Geol. Excursion, introd. Proposed for Middle Ordovician rocks of Michigan.

Middle Ordovician rocks are well exposed along Escanaba River from hydroelectric power station at Bony Falls almost to mouth of stream, Upper Peninsula.

Escobar Sandstone

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 44–48, pls. 4A, 4B, 4C. Proposed for massive thick-bedded grayish and yellowish-brown medium-grained sandstones with subordinate amounts of interstratified brown silty shales which overlie Muir sandstone (new) and underlie Alhambra formation (new). Thickness at type section approximately 1,200 feet.

Type section: In west limb of Pacheco syncline in cut along Industrial Highway, east of Alhambra Valley, and in cuts along Santa Fe Railway, Contra Costa County. Forms crest of ridge in west limb from Martinez southward nearly to town of Walnut Creek. Also exposed in east limb of syncline.

Escondido Formation (in Navarro Group)[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 227–229, 230.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 137. In Medina County, Escondido formation (marl facies), 34 feet thick, unconformably overlies Anacacho limestone.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull. v. 53, no. 3, chart 9. Shown on correlation chart above Olmos formation in longitude of Eagle Pass and above Anacacho limestone in longitude of Anacacho Mountain and D'Hanis, and above Corsicana marl in latitude of Castroville. Navarro group.

Named for exposures on Escondido River below Eagle Pass, Maverick County.

†Escondido Series[1]

Miocene, middle: Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, pl. 1, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 518, table 4. Succession of volcanic rocks and continental sediments, the former being

mainly basaltic and andesitic lava flows with considerable associated agglomerate. Middle Miocene.

Type section: Tick Canyon, Los Angeles County.

Escondido Creek Leucogranodiorite

Cretaceous: Southern California.

E. S. Larsen, Jr., and N. B. Keevil, 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 489. Named in report on study of batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 87–89, pl. 1. Fine-grained light-colored rock that ranges in composition from leucogranodiorite to leucotonalite and averages granodiorite. Along most of its contact, it intrudes Santiago Peak volcanics but in some places intrudes both Green Valley tonalite and San Marcos gabbro. Derivation of name given.

Named from its excellent and characteristic development in canyon of Escondido Creek, San Diego County. Largest exposed mass of this rock occupies area about 7 square miles mostly in drainage of Escondido Creek.

Escudo Sandstone

Miocene, middle (Relizian): Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Poorly sorted buff calcareous fossiliferous sandstone. Maximum thickness 150 feet. Underlies Alferitz formation (new); unconformably overlies Hannah formation (new).

Occurs in Devils Den oil field district, northwestern Kern County, adjacent to Kings County line, about 40 miles east of Paso Robles and about 60 miles northeast of Bakersfield.

Eshamy Granite[1]

Mesozoic(?): Southeastern Alaska.

Original reference: U.S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 34–35, 46.

Practically surrounds Granite Bay and occupies nearly all of neck land between Granite and Eshamy Bays, Prince William Sound region.

Eshe Porphyry

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 81–83, pl. 1. Comprises stocks, dikes, and sill-like sheets of quartz monzonite porphyry and quartz diorite porphyry. Quartz monzonite near Eshe Ranch is light cream to grayish brown. Rock has finely granular goundmass and phenocrysts of feldspar, biotite, hornblende, and quartz.

Prominent around Eshe Ranch, after which rocks are named, in sec. 33, T. 8 S., R. 76 W. Underlies series of ridges and hills in northern and northwestern parts of South Park, Park County.

†Eska Conglomerate[1]

Miocene(?): Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 500, p. 15, 52–54.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 1, 13. Eska conglomerate found to be divisible, at least in Wishbone Hill

district, into two formations, Wishbone (new) below and Tsadaka (new) above.

Extends west from valley of Eska Creek, for which it is named, Cook Inlet region.

Eskota Beds[1]

Permian: Central northern Texas.

Original reference: J. W. Beede and W. P. Bentley, 1921, Texas Univ. Bull. 1850, p. 16, 22, 29, 51, 53.

Probably named for Eskota, Fisher County.

Eskota Dolomite[1] or Gypsum[1]

Eskota Dolomite (in Custer Formation)

Permian: Central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 953, pl. 10.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 422. In Fisher, Nolan, and Coke Counties, Eskota dolomite occurs from a few feet to 20 feet above base of Custer formation.

Probably named for Eskota, Fisher County.

Eskridge Shale[1] (in Council Grove Group)

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 181.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47. Shale and minor amount of limestone and locally thin coal beds; red and green shale predominant in most exposures; in central Kansas, a seemingly persistent limestone, as much as 2 feet thick, overlain locally by coaly material and underlain by green shale, occurs a few feet from base. Thickness 20 to 40 feet. Underlies Cottonwood limestone member of Beattie limestone; overlies Neva limestone member of Grenola limestone (redefined). Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 99–100. Formerly considered top unit of Wabaunsee group. Reclassification of section by Moore (1936, Kansas Geol. Survey Bull. 22) and others has since placed Eskridge in Council Grove group. Overlies Neva limestone; underlies Cottonwood limestone. Identification of Cottonwood in Pawnee County is uncertain and recognition of upper limit of Eskridge is accordingly doubtful. Thickness 80 to 90 feet, increasing southward.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 69–71, pls. Thickness 32½ to 38 feet in Wabaunsee County, Kans. Overlies Grenola limestone; underlies Beattie limestone. Note on type locality and probable type section.

Type locality: Vicinity of Eskridge, Wabaunsee County, Kans. Probable type section: About 1⅛ miles south of Eskridge in SW¼NW¼NW¼ sec. 17, T. 14 S., R. 12 E., where upper half of shale is exposed.

Esmeralda Formation[1]

Miocene, upper, and Pliocene, lower: Southwestern Nevada and central eastern California.

Original references: H. W. Turner, 1900, Am. Geologist, v. 25, p. 168–170; 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 197–208.

H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723, p. 43–50. In Manhattan district, subdivided into (ascending) Hedwig breccia, Round Rock, Diamond King, and Bald Mountain lake beds members.

D. I. Axelrod, 1940, Washington Acad. Sci. Jour., v. 30, no. 4, p. 163–170. Lower Pliocene.

H. G. Ferguson, S. W. Muller, and S. M. Cathcart, 1953, Geology of the Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Roughly divisible into two lithologic units: upper, dominantly sedimentary but containing some volcanic material; lower, in which pyroclastic material grading from fine-grained tuff and pumice to coarse rhyolite breccia exceeds the bedded material. Sedimentary rocks include fanglomerate, conglomerate, and coarse sandstone at normal contact with older rocks grading outward into fine-grained sandstone, calcareous and sandy shales, marls, and impure hard limestones. Estimated thickness 1,000 feet in Stewart Valley, probably thicker to south, but estimate of 14,800 feet at type locality is probably excessive. Older than Oddie rhyolite. Upper Miocene and lower Pliocene.

Type locality: Big Smoky Valley, Silver Peak quadrangle, Nevada. Named for development in Esmeralda County, Nev. [before county was subdivided].

Esmond Granite

Mississippian(?) or older: Northeastern Rhode Island.

Alonzo Quinn, R. G. Ray, and W. L. Seymour *in* Alonzo Quinn and others, 1948, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p 13, 15, geol. map (bedrock). Light-gray, pink, and fresh-colored medium- to coarse-grained slightly gneissic granite. Much of rock may be termed alaskite. Formerly included in Milford granite. Cuts Blackstone series discordantly.

Exposed in western part of Pawtucket quadrangle. Named for village of Esmond located just beyond southwest corner of quadrangle.

Esmont slate facies (of Candler Formation)

Lower Paleozoic(?): South-central Virginia.

W. R. Brown and H. C. Sunderman, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1356. Facies of Candler formation in James River synclinorium. Age not stated.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2). Age of Candler formation is shown on columnar section as Lower Paleozoic(?).

Type locality of Candler formation is Candler Mountain, 2 miles south of Lynchburg, Campbell County.

Esopus Grit, Shale, or Siltstone

Esopus Grit or Shale (in Oriskany Group)[1]

Esopus Shale (in Onondaga Group)

Esopus Shale Member (of Onondaga Formation)

Lower or Middle Devonian: Eastern New York, northern New Jersey, and northeastern Pennsylvania.

Original reference: L. Vanuxem, 1842, Geology of New York, pt. 3, p. 127–130.

Bradford Willard, 1938, Pennsylvania Geol. Survey, 4th ser. Bull. G–11, p. 5, 6 (fig. 3), 14–16. Included in Onondaga group in Pennsylvania. Esopus shale (Caudi-galli grit of early writers) consists of not less than 250 feet of gray brown-weathering sandy shale. Overlies Oriskany. Grades upward into Buttermilk Falls limestone (new).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1758–1759, chart 4. In Onesquethaw stage (new). Lower or Middle Devonian.

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 677–678, 679, 689–690, 694. Formation restricted, beds formerly classed as upper Esopus are separated into Sharon Springs formation (new).

Winifred Goldring and R. H. Flower, 1944, Am. Jour. Sci., v. 242, no. 6, p. 340. Name Carlisle Center formation proposed for preoccupied name Sharon Springs.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW–22, p. 10 (table 2), 17–18. In Schoharie County, Esopus consists of about 80 feet of brownish-gray siltstone. Underlies Carlisle Center formation; overlies Oriskany sandstone. Lower or Middle Devonian.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 731 (fig. 2), 732–734. At Highland Mills, N.Y., formation comprises (ascending) Highland Mills member (new), middle member, and Woodbury Creek member (new). Overlies Connelly conglomerate; underlies Kanouse sandstone. Thickness about 200 feet. Lower Devonian. Esopus stage recognized.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation as mapped includes Esopus shale in easternmost part of state.

Named from Esopus settlement and Esopus Creek, Ulster County, N.Y.

†Esopus Millstones[1]

Silurian: Eastern New York.

Original reference: W. W. Mather, 1840, New York Geol. Survey 4th Rept., p. 246–250.

Extends north from Shawangunk Mountain nearly to Kingston. Present village of Esopus is about 10 miles south of Kingston, Ulster County.

Esopus Slate[1]

Lower Devonian: Eastern New York, northern New Jersey, and northeastern Pennsylvania.

Original reference: N. H. Darton, 1894, New York State Geologist 13th Ann. Rept., p. 209–210, 244–245, 302.

Named for Esopus settlement and Esopus Creek, Ulster County, N.Y.

Esopus Stage

Lower Devonian: Eastern North America.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 737–739. Proposed for eastern North America. Has been customary to conclude that Esopus formation is either upper Deerpark (Oriskany) or lower Onesquethaw (Schoharie) age. Discovery of Highland Mills and Wood-

bury Creek member faunas makes it clear that Esopus time is of same order as either Deerpark or Onesquethaw. In eastern New York and Pennsylvania, stage will be represented by relatively unfossiliferous Esopus formation. Elsewhere in eastern United States, strata of this age are absent owing to disconformity between strata of Oriskany and Onondaga age.

Espada Formation

Upper Jurassic and Lower Cretaceous: Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 22–23, pls. 1, 2. A series of dark-greenish-brown thin-bedded silty shales and a lesser amount of thin interbeds of hard fine-grained sandstone; locally thin lenses of conglomerate with well-rounded chert pebbles. No complete section exposed at any one locality. At type locality where base is exposed, consists of 1 to 5 feet of dark-brown conglomeratic sandstone resting unconformably on highly sheared clay shale of Honda formation (new); conglomerate is overlain by about 4,000 feet of dark-greenish-brown shale and thin hard sandstone which is unconformably overlain by lower Miocene beds. In San Lucas and Wons Canyons, a maximum thickness of 6,800 feet is exposed; base is in fault or intrusive contact with serpentine; top is unconformably overlain by Eocene beds. Relationship of Espada to Upper Cretaceous Jalama formation (new) not definitely known; but these are believed to be in contact at head of Salsipuedes Canyon, where relationship appears to be an unconformity, and at Nojoqui Canyon, where shales of Espada are in conformable contact with sandstones and shales believed to be the Jalama.

Type locality: South side of Canada Honda about 3 miles east of Point Pedernales, Santa Barbara County. Other exposures: Salsipuedes and El Jaro Canyons, Nojoqui and Alisal Canyons, San Lucas and Wons Canyons.

Esperance Sand Member (of Vashon Drift)

Pleistocene: Northwestern Washington.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 19–25, pl. 1. Largely an advance outwash deposit consisting of sand and gravel up to 400 or 500 feet thick; discontinuous silt beds common. Overlies Admiralty clay (new).

Exposed in scattered areas in western part of Snohomish County.

Esperanza Trachyte[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 30, map.

Named for Esperanza Canyon, Oatman district.

Espey Creek Limestone Member (of Chappel Formation)

Mississippian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 22, 26, 28. Commonly made up of several layers of hard crystalline crinoidal limestone, each layer having a thickness of from 3 to 8 or 10 inches; in many areas where member is not more than 1 foot thick, it consists of a single layer containing crinoidal debris or coquina somewhat loosely cemented and sparsely fossiliferous. Thickness ranges from 6 inches to 4 feet. Most persistent member of formation and is

present almost everywhere along Barnett-Ellenburger contact. Chappel comprises [ascending] King Creek marl (new), Ives conglomerate, Espey Creek limestone, and Whites Crossing coquina (new) members.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 810 (footnote). Plummer's Espey Creek limestone member of Chappel formation is same as Chappel limestone of Sellards (1933) and Cloud and Barnes (1948), excluding basal 15 inches referred by him to the Chappel at Espey Creek.

Name derived from exposures along Espey Creek southeast of Hallenbeck ranchhouse, Lampasas County.

Espina Breccia[1]

Miocene, upper(?): Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 69.

Forms Espina Hill, Goldfield district.

Espinal formation

[Upper Devonian] (Tombstonian): Southeastern Arizona.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 227, 228 (table).

Name applied to upper 150 feet of Martin limestone of Ransome (1904). Older than Vecol formation (new); overlies Patagonia limestone (new).

Name taken from great intermont plain which washes its outcrops; Bisbee region.

Espinal Grit (in Joserita Member of Lowell Formation)

Lower Cretaceous: Southeastern Ariznoa.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11–12. Coarse partly conglomeratic grit with imperfectly rounded and subangular pebbles of limestone, quartzite, chert, arkose, and sandstone. Large inclusions of underlying yellow dolomite. Southward grades into sandstone, arenaceous shale, and limestone. Thickness 4 feet. Underlies Corta sandstone (new); overlies unnamed dolomite.

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Espinaso Formation or Volcanics

Tertiary: Northwestern New Mexico.

C. E. Stearns, 1943, Jour. Geology, v. 41, no. 5, p. 304 (fig. 2), 309–310. Includes water-laid breccia, conglomerate, and tuff, with massive flows and explosive material in subordinate amounts. Thickness more than 1,000 feet. Overlies Galisteo formation with contact transitional; unconformably underlies Santa Fe formation. Name credited to Kirk Bryan and J. E. Upson (unpub. ms.).

C. E. Stearns, 1953, Am. Jour. Sci., v. 251, no. 6, p. 415–452. Comprises detrital beds deposited by mud flows and streams radiating from centers of contemporaneous eruption in Ortiz Mountains and Cerrillos Hills, with a few interbedded lava flows. Overlies Galisteo formation without stratigraphic break; hence, assigned to Duchesnean (latest Eocene). Thickness as much as 1,450 feet. Underlies Abiquiu(?) formation.

Older than Cieneguilla limburgite (new) and separated from it by time interval during which a small body of augite quartz latite was intruded, solidified, and exposed by subsequent erosion. Type locality stated.

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines and Mineral Resources Bull. 48, p. 5 (table 1), 11–24, pl. 1. Described in detail in Cerrillos area in connection with four major periods of igneous activity that occurred during Espinaso time. Thickness more than 2,000 feet. Extrusion of Espinaso volcanics may span Oligocene and early Miocene time. Mapped as Oligocene(?).

Ming-Shan Sun and Brewster Baldwin, 1958, New Mexico Bur. Mines and Mineral Resources Bull. 54, p. 22. In this report [discussion of volcanic rocks of Cienega area], age of Espinaso volcanics is considered to be some or all of time between and including late Eocene and middle Miocene.

Type locality: Espinaso Ridge along Arroyo Pinovetito. Espinaso de Clotero Montoya (also known as Pinovetito Ridge) is hogback 5 miles long, 11 miles southeast of Cerrillos, Santa Fe County.

Espiritu Santo Formation

Devonian(?): Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1752–1759, 1766 (fig. 12), 1770, 1771–1772. Name applied to sequence of sandstone, arenaceous limestone, calcarenite, and crystalline dolomitic limestone overlying crystalline rocks of Precambrian age near confluence of Holy Ghost Creek (formerly called Espiritu Santo Creek) and Pecos River at Tererro. Thickness at type locality more than 30 feet; consists of basal sandstone more than 11 feet thick, overlain by interbedded thin sandstone, calcarenite, and sandy limestone 5 feet thick; thin-bedded dolomitic limestone 11 feet thick; at top, sandy limestone, shale, and limestone pebble conglomerate 3½ feet thick. Unconformably underlies Tererro formation (new). Correlated with Devonian rocks on the basis of lithology and stratigraphy only; therefore classed as Devonian(?). Further studies must precede correlation, firm age assignments, and adjustments in terminology of Espiritu Santo, Tererro, and Arroyo Penasco formations.

Type locality: In quarry west of Pecos River about 75 yards north of Holy Ghost Creek at Tererro, San Miguel County.

Esplanade Sandstone Member (of Supai Formation)[1]

Permian: Northern Arizona.

Original reference: D. White, 1929, Carnegie Inst. Washington Pub. 405, p. 11.

Grand Canyon.

Espy Formation (in Washita Group)

Lower Cretaceous: Western Texas.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1004–1007, pl. 1. Consists of three unnamed members: lowest, 679½ feet thick, is primarily light- to dark-gray and bluish limestone, slightly arenaceous, with small lentils and thin intercalated layers of shale and sandy shale; middle, 340½ feet thick, consists of platy white thin-bedded to laminated arenaceous to argillaceous limestone; upper, about

266½ feet thick, is principally buff and olive-brown sandstone. At type locality, where exposed thickness is 1,021 feet, it is chiefly thin beds of almost pure dense gray limestone, with buff marly limestone, brown sandstone, and a few interbedded shale layers. In northern Quitman Mountain area, base is not exposed, and consequently relationships to underlying formations of Fredericksburg group are not certainly known; in adjacent areas, relations appear conformable; in northern Quitman Mountain area, conformably underlies Etholen formation with sharp contact; in Devil Ridge area, conformably underlies group of shales designated as Eagle Ford.

Type locality: Low hills upheld by Washita strata east of Love Hogback and southeastern part of Devil Ridge, northern Quitman Mountains, Hudspeth County. Name derived from Espy Ranch about 10 miles east of Love Hogback.

Esquibel Member (of Los Pinos Formation)

Miocene(?) or Pliocene(?): Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 45–46. Arkosic sandstone, sandy conglomerate, some thin beds of tuff or tuffaceous siltstone, and felsitic tuff. Thickness 600 feet. Underlies Cordito member (new): overlies Biscara member (new). Name credited to Butler (unpub. dissert.). Biscara and Esquibel members as differentiated by Butler, mapped here as single unit, Biscara-Esquibel member (new).

Exposed westward from near divide on Tusas-Tres Piedras Road.

Essex Limestone[1] Member (of Edgewood Limestone)

Lower Silurian (Albion Series): Northeastern Illinois.

Original reference: T. E. Savage, 1912, Illinois Acad. Sci. Trans., v. 4, p. 100.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53; no. 4, chart 3. Member of Edgewood limestone. Albion series.

Named for Essex, Kankakee County.

Essex Series

Precambrian: Southern California.

J. C. Hazzard and E. F. Dosch, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 308–309. Composed of basal quartz-feldspar-biotite gneiss 1.500 feet thick, 500- to 600-foot marble, quartzite, and schist unit, designated Chubbock marble member, and upper unit of quartz-feldspar-biotite gneiss at least 5,000 feet thick. Overlain by Lower Cambrian(?) quartzite. Older than Fenner granite gneiss (new).

Well exposed in southern Piute Mountains, north of Barrel Spring, in northern Old Woman Mountains, and at Chubbuck on Santa Fe Railroad, San Bernardino County.

Establishment Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 15A, 16. Limestone, thick-bedded; dolomite, moderately argillaceous and shaly, thin-bedded. Thickness 2 to 7 feet. Shown on columnar section as underlying Hazelwood member (new) and overlying Boarman member (new).

In copy of guidebook used by compiler, a handwritten note states that Brickeys Member overlies Boarman Member. Thus, the sequence would be (descending) Hazelwood, Establishment, and Brickeys. Compiler had no way of determining what change, if any, had been made in other copies of the guidebook.

Occurs in Dixon-Oregon area.

Estelle Tonalite

Estelle Quartz Diorite[1]

Cretaceous: Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 502, map.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 70, 138, pl. 1. Described as Estelle tonalite, a light-gray rock with grains up to a few millimeters in length. Intrudes Temescal Wash quartz latite porphyry which surrounds it on all sides.

Occurs in first valley east of Estelle Mountain, Riverside County.

Ester Ash Bed

Pleistocene: East-central Alsaka.

T. L. Péwé, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 713. Gritty 6-inch-thick gray to white pure glass volcanic-ash layer near base of Ester "Island" section. Has sharp contacts with upland silt both above and below.

In "Island" section [sec. 8], T. 1 S., R. 2 W., about 8 miles west of Fairbanks. Named from adjacent Ester Creek.

Ester Lakes Graywackes, Slates, and Tuffs

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1611–1613. Name applied to thick series of graywackes, slates, and tuffs above Kekekabic [Lake] tuffs and agglomerates in Knife Lake synclinorium. Conglomerate lenses and agglomerates present. Slates are thin bedded; dark gray on fresh fracture. Graywackes grade into grit on one side and slate on the other; usually weather whitish to dirty brown. Thin bands of red jasper may be found between the tuffs and graywacke layers. They are the only red jasper beds observed in Knife Lake series. Estimated thickness of Ester Lake graywackes several thousand feet. In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Ester Lake graywackes as unit 14 occurring above feldspar porphyry intrusives and below Crooked Lake pebble conglomerate.

Report discusses a belt in western Vermilion district more or less parallel to international boundary.

Estes System[1]

Precambrian: Southwestern South Dakota.

Original reference: J. J. Runner, 1934, Am. Jour. Sci., 5th, v. 28, p. 354–372.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 3–4, geol. map. There are three systems of Precambrian sedimentary rocks in Black Hills. According to Runner (1934), these are (ascending) Nemo, Estes, and Lead.

Well exposed along Estes Creek, Black Hills.

Estes Park Beds

Precambrian: Eastern Colorado.

M. F. Boos, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1372. Estes Park beds of Big Thompson series of metasedimentary formations and Longs Peak (Silver Plume) and Mount Olympus granitic rocks constitute bedrock of Estes Park Valley.

Estes Park Valley east of Rocky Mountain National Park, Larimer County.

Esther Granite[1]

Paleozoic(?): Southeastern Alaska.

Original reference: U. S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 39–41, 46.

Occupies greater part of Esther Island, at southern end of Port Wells, Prince William Sound region.

Estill Clay[1]

Estill Member (of Crab Orchard Clay Shales)

Silurian (Niagaran): East-central Kentucky and southwestern Ohio.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 59.

A. C. McFarlan and D. J. Jones, 1952, Kentucky Geol. Survey, ser. 9, Bull. 10, p. 10, 13, 14. In much of outcrop along eastern flank of Cincinnati arch, Ohio shale rests on Estill clay; elsewhere Boyle limestone intervenes.

R. N. Thomas, chm., 1955, Kentucky Geol. Soc. Field Trip, p. 31 (fig. 11). Shown on generalized section of Serpent Mound region, Adams and Highland Counties, Ohio, as Estill member of Crab Orchard clay shales. Thickness 70 feet. Underlies Ribolt member; overlies Dayton limestone.

Type exposure: Northeast of Estill Springs, Estill County, Ky.

Etchegoin facies (of San Ardo Group)

Pliocene: Western California.

T. A. Baldwin, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1986 (fig. 6), 1988. Ocher-brown dirty and pebbly fossiliferous sands; intermediate unit of three overlapping facies. Paso Robles gravels grade laterally to fossiliferous Etchegoin sands, which in turn finger out in diatomaceous Pancho Rico shale.

Exposed on slopes of Pancho Rico Canyon and nearby gulches which drain westward to Salinas River near San Ardo, Monterey County.

Etchegoin Formation[1]

Etchegoin Beds, Group, or Stage

Pliocene, middle: Southern California.

Original reference (Etchegoin beds, including Etchegoin sands and San Joaquin clays): F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 178–192.

W. F. Barbat and John Galloway, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 4, p. 477 (table 1), 482–483. Formation restricted to exclude San Joaquin clay. Highest member of Etchegoin sand has been described as "upper *Mulinia*" zone, and top of upper zone is chosen as base of San Joaquin clay as this zone marks important lithologic

and faunal change. Etchegoin sand rests with marked unconformity on Reef Ridge shale on Reef Ridge, southwest of Kettleman Hills.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 26–27, 55–75, pl. 3. There is no general agreement in classification and nomenclature of Pliocene strata underlying Tulare formation. Anderson (1905) originally divided them into two units, San Joaquin clays and Etchegoin sands, but he also used name Etchegoin in group sense (Etchegoin beds) for both. Arnold and Anderson (1910, U.S. Geol. Survey Bull. 398) divided this part of section into two formations, Etchegoin formation and Jacalitos formation, the latter embracing original part of Coalinga beds of Anderson (1905). Mapping in Kettleman Hills has shown desirability of recognizing as a separate unit the upper part of Etchegoin formation of Arnold and Anderson (1910, U.S. Geol. Survey Bull. 398). Because this unit corresponds to F. M. Anderson's San Joaquin clay, that name has recently been revived (Barbat and Galloway, 1934). Nomland (1917, California Univ. Dept. Geology Bull., v. 10, no. 14), Gester and Galloway (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 10), and Barbat and Galloway (1934) extended name to embrace Jacalitos formation—that is, they adopted Anderson's (1908, California Acad. Sci. Proc., 4th ser., v. 3) revised nomenclature with the exception that Etchegoin was not used in group sense. Reed (1933, Geology of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists) raised Etchegoin to group rank and extended name Jacalitos to include Arnold and Anderson's Etchegoin minus the San Joaquin. In view of conflicting opinions and undesirable features of other schemes, a compromise involving restriction of name of Etchegoin to Arnold and Anderson's Etchegoin minus the San Joaquin is adopted in this report. This solution was reached independently by Goudkoff (1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 4). Exposed part of formation has thickness of about 700 feet in North dome and estimated exposed thickness of about 600 feet in Middle dome. With exception of freshwater beds near top of formation in North dome, formation consists of marine deposits, principally sandstone and conglomerate, and silt. Faunal zones mapped.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 225 (fig. 4), 240–246. Discussion of geology of San Benito quadrangle. Term Etchegoin is herein used as group as Nomland (1917) used it to include the Jacalitos, Etchegoin, and possibly San Joaquin formations of Coalinga district, which cannot be distinguished lithologically in field in this region. One cartographic division is separated, a series of red beds 400 to 600 feet thick on nonmarine origin at base, which is quite different character from rest of group. Group lies chiefly in narrow belt, 2 miles wide, between San Andreas and San Benito fault zones. Here it reaches maximum thickness of 3,500 feet. In Sulphur Creek area, the Etchegoin extends 2 miles farther east, overlapping sediments of Butts Ranch syncline, but with reduced thickness of only 750 feet. Main belt, along San Benito River, continues northwest of quadrangle beneath San Benito gravels and reappears in Lomerias Muertos, northwest of Hollister. To the southeast, belt extends through Priest Valley and Waltham Canyon (where it has thickness of 8,000 feet) into Coalinga district. Basal red beds of main Etchegoin belt rest disconformably upon Santa Margarita formation southwest of San Benito

River. Eastern belt rests with as much as 90° angular discordance upon upper Cretaceous, middle Eocene, and middle Miocene sediments of Butts Ranch syncline. In some areas, in fault contact with Franciscan.

Umberto Young, 1943, California Div. Mines Bull. 118, pt. 3, p. 523, 524, (fig. 224). Unconformably overlies Belridge diatomite in Midway-Sunset area.

J. W. Durham, R. H. Jahns, and D. E. Savage, 1954, California Div. Mines Bull. 170, chap. 3, p. 60 (fig. 2). Chart shows Etchegoin megafaunal "stage" equivalent to Venturian microfaunal stage.

Name derived from Etchegoin Ranch, about 20 miles northeast of Coalinga, where formation is characteristically developed.

†Etchegoin Formation (broad sense)[1]

Pliocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 178–192.

Occurs on summit and flanks of Anticline Ridge and on southeast end of Joaquin Ridge. Named for exposures in vicinity of Etchegoin Ranch, 20 miles northeast of Coalinga, in NW¼ sec. 1, T. 19 S., R. 15 E., Fresno County.

Etchegoin Sands[1]

Pliocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 178–192.

Named for exposures in vicinity of Etchegoin Ranch, 20 miles northeast of Coalinga, in NW¼ sec. 1, T. 19 S., R. 15 E., Fresno County.

Etholen Conglomerate[1]

Etholen Formation (in Washita Group)

Lower Cretaceous: Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 723, 736.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1007–1009, pl. 1. Described as Etholen formation in northern Quitman Mountains. Consists of gray to black limestone conglomerate, with thin lentils and beds of arenaceous shale, buff to olive-brown sandstone, gray limestone, and red nodular limestone. Greatest thickness, about 500 feet, occurs on Etholen Hill, away from which formation becomes thinner. Conformably overlies Espy formation (new), contact sharp; upper contact of formation not exposed.

R. M. Huffington, 1947, Harvard Univ. Summ. of Theses, 1943–45, p. 196–197. Overlies Lasca formation (new).

Type locality: Etholen Knobs, northwest of Etholen section house, and in nearby small hills south of railway, in Quitman Mountains, Hudspeth County. Formation appears to occupy large syncline upon which central dome of Etholen Hill has been superimposed.

Etna Quartz Monzonite Porphyry[1]

Post-Carboniferous: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 80.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 30. Name changed to Mount Aetna quartz monzonite porphyry be-

cause name Etna had previously been used elsewhere in United States for a rock unit. Spelling of Etna changed to Aetna to conform to that used on topographic base map of Garfield quadrangle.

Exposed on Mount Aetna (Etna), Garfield quadrangle, Chaffee County.

Etna Sandstone[1]

Pennsylvanian: Central Tennessee and West Virginia.

Original reference: J. J. Stevenson, 1904, Geol. Soc. America Bull., v. 15, p. 125, 201.

Extends on west side of basin north to middle Tennessee and on east side to probably 50 miles north from New River in West Virginia.

†Euchee phase[1]

Miocene, upper(?): Northwestern Florida.

Original reference: L. C. Johnson, 1893, Science, v. 21, p. 90–91.

Named for development at Eucheeanna, Walton County.

Euclid Siltstone Member (of Bedford Shale)

Euclid Sandstone Lentil (in Bedford Shale)[1]

Mississippian: Northern Ohio.

Original reference: W. F. Morse and A. F. Foerste, 1909, Jour. Geology, v. 17, p. 166.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1356. Termed Euclid siltstone member; unit is of unknown areal extent and composed predominantly of massive light-bluish-gray coarse-grained siltstone and some very fine grained sandstones in beds from 3 to 18 inches thick. Maximum thickness about 20 feet. In lower part of the Bedford below Sagamore siltstone member; separated from underlying Cleveland member of Ohio shale by a few feet of dark-gray and black shale and some thin siltstones.

Named for Euclid Creek east of Cleveland, Cuyahoga County. Exposed from Independence Township Cuyahoga County, northeastward to Willoughby Township, Lake County.

Eudora Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: J. Bennett, 1896, Kansas Univ. Geol. Survey, v. 1. p. 113.

Eudora Shale[1] Member (of Stanton Limestone)

Pennsylvanian (Missouri Series): Northeastern Kansas, south-central Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 12, 26, 27, 31, 34.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 118. Overlies Captain Creek limestone member; underlies Stoner limestone member (this is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947). Lower part consists of black fissile shale or in some places of dark clay shale containing thin carbonaceous layer; upper part is greenish to bluish gray and is soft and clayey. Thickness ranges from only 1 foot

in some northern outcrops to 50 feet in part of Montgomery County, Kans.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. In Nebraska, underlies Dyson Hollow limestone zone or member (new) of Stoner limestone. Persistent in Kansas, Missouri, southeastern Nebraska, and south-central Iowa. Type locality stated.

Type locality: West of north-south side road where it joins the east-west Highway about 2 miles east of Eudora, Douglas County, Kans.

†Eufaula sands[1]

Upper Cretaceous: Southwestern Alabama and northeastern Mississippi.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888 geographic map of Alabama.

Probably named for exposures at Eufaula, Barbour County, Ala.

Eugene Formation[1]

Oligocene, lower and middle: Northwestern Oregon.

Original reference: W. D. Smith, 1924, Econ. Geology, v. 19, no. 5, p. 462.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Meyers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. As interpreted here, name is extended to include all marine Oligocene sands exposed in hills along southern margin of Willamette Valley. Also a few exposures on hills projecting above alluvium of valley floor, a belt of exposures along western margin of Coburg Hills, and a long tongue extending from area east of Spencer Butte southeastward to vicinity of Dorena Dam. Beds exposed in these outcrops form well-defined unit consisting primarily of coarse- to fine-grained highly arkosic, micaceous sandstones weathering to a yellow to orange-brown color. Thickness about 8,000 feet in hills along southern border of Willamette Valley. Beds have prevailing north-northwest strike and a northeast dip that averages between 10° and 15°. At all exposures mapped Eugene rests on tuffs of Fisher formation; contact is marked by soft friable, arkosic and quartzose sandstone that contains fossil wood. Evidence indicates Eugene and Fisher formations are contemporaneous.

R. E. Corcoran and F. W. Libbey, 1956, Oregon Dept. Geology and Mineral Industries Bull. 46, p. 7, pl. 1. Geographically extended into Salem Hills area where exposed thickness is about 2,200 to 2,500 feet. Unconformably overlain by Salem lavas (new).

I. S. Allison and W. M. Felts, 1956, Geology of the Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Thickness 400 to at least 2,000 feet in Lebanon quadrangle. Cut out by basic intrusives and unconformably overlain by Stayton lavas in northwestern part of quadrangle. Overlies Mehama volcanics. Oligocene.

U.S. Geological Survey currently considers the Eugene Formation to be lower and middle Oligocene.

Typically exposed in city of Eugene, Lane County.

Euless Member (of Woodbine Formation)

Euless Formation (in Woodbine Group)

Upper Cretaceous (Gulf Series): Northeastern Texas.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 475, 476, 477, 480. Defined as surface

unit which intervenes between basal Pine Bluff member of the Lewisville and base of the Dexter sands. Upper part of formation is gray and dark fossiliferous shales and sandstones. In subsurface, unconformably overlies South Tyler formation. Designation of base of the Euless (base of Dexter sand member), both in surface and in subsurface, is a matter of opinion; in certain areas, base of the Dexter is considered base of the Gulf Cretaceous.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 10. Rank reduced to member status and restricted to a shale unit, in part carbonaceous, with interbedded sandstone lenses, that forms upper part of the Euless as originally defined. Estimated thickness 45 or 50 feet.

Type locality: Town of Euless, Tarrant County.

Eulie Shale (in Chattanooga Shale)

Lower Mississippian: Central Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 885, pl. 1. Soft argillaceous shale in three gray, yellowish, or greenish layers, with top layer of nodules at Bransford; it is single layer of greenish shale with nodules at base at Westmoreland. Thickness 6 to 9 inches. Overlies Gassaway shale (new); underlies Westmoreland shale (new). The Eulie and Westmoreland are complementary in their stratigraphic relations; the absence of either would make determination of the status of the other way difficult.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 11. Eulie shale is gray to greenish-gray mudstone that contains phosphatic nodules. Campbell held that this shale was of early Mississippian age, but present writer [Hass] classifies this shale as very late Devonian. Name Eulie shale is not used in present report [Chattanooga shale and Maury formation]; beds so named by Campbell are placed in Maury formation and not named.

Identified only at Bransford, Westmoreland, and Eulie, Sumner County.

Eunice Formation

Pleistocene: Southwestern Louisiana.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1831. Name used for formation covering Lake Charles-Ville Platte-Opelousas-Lafayette area. Younger than newly defined Oberlin formation. Unit has been referred to as upper Beaumont.

Town of Eunice, St. Landry Parish, lies approximately in the center of the area.

Euphemia Dolomite[1] (in Durbin Group)

Middle Silurian: Southwestern Ohio.

Original reference: A. F. Foerste, 1917, Ohio Jour. Sci., v. 17, p. 187, 201, 202.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as basal formation of group. Stratigraphically above Lilley formation.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci. Geology Sec. Guidebook 35th Ann. Field Conf., p. 13, 17–18, 21. Silurian section in Yellow Springs region shows Euphemia dolomite, 7 to 15 feet thick, above Massie shale and below Springfield dolomite. Niagaran.

Type locality: At quarry described as Lewisburg stone quarry, 1 mile northwest of Lewisburg, Preble County. Euphemia is one-half mile northwest of Lewisburg.

†Eureka Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Probably named for Eureka, Greenwood County.

†Eureka Limestone[1]

Lower, Middle, and Upper Cambrian and Lower Ordovician: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 622.

Tintic district.

†Eureka Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 67, 73.

Named for Eureka, Greenwood County.

Eureka Quartzite[1]

Eureka Group

Middle to Upper(?) Ordovician: Northern Nevada, eastern California, and western Utah.

Original reference: A Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 262.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 10–11. Underlies Hanson Creek formation (new) and overlies Pogonip limestone in Roberts Mountains region, Nevada.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 20, 21 (fig. 4). Underlies Fish Haven dolomite in Millard County, Utah. Thickness about 850 feet.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 29–32, pl. 2. Described in Eureka district where it is 300 to 350 feet thick, underlies Hanson Creek formation and overlies Pogonip group, but in some areas overlies Goodwin limestone and in others Antelope Valley limestone (new). Kirk (1933, Am Jour. Sci., 5th, v. 26) recognized inadequacy of outcrops in Eureka district proper and proposed that section along west base of Lone Mountain be chosen as new type locality. This redesignation has been accepted by U.S. Geological Survey and Lone Mountain section is commonly regarded as an appropriate standard section for comparative purposes.

R. L. Langenheim, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2086 (fig. 2), 2087 (fig. 3), 2092–2095. In Independence quadrangle, California, Eureka group includes Barrel Spring formation, about 150 feet thick, in lower part and an undifferentiated part, about 200 feet, above. Overlies Pogonip group; underlies Ely Springs formation. Mohawkian.

J. F. McAllister, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–95. In Ubehebe Peak quadrangle, California, overlies Pogonip limestone and underlies Ely Springs dolomite. Thickness, 2½ miles north of quadrangle, 400 feet.

G. W. Webb, 1956, Utah Geol. and Mineralog. Survey Bull. 57, p. 13–14; 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2340–2342, 2343–2359. In Lone Mountain area, Eureka quartzite is restricted to the higher 181 feet of Kirk's (1933) section; lowermost 40 feet of post-Pogonip beds are placed in Copenhagen formation. Restricted Eureka is divided into three members which differ from Kirk's subdivision. Lower 35 feet is designated lower discolored quartzite member; middle 95 feet, white quartzite member; upper, gray quartzite member. Normally overlain by dark dolomites generally considered to be Cincinnatian. Correlations discussed.

H. R. Pestana, 1960, Jour. Paleontology, v. 34, no. 5, p. 109–112. Group includes Johnson Spring formation (new) which is name proposed for undifferentiated upper part of Eureka group of Langenheim and others (1956). Middle Ordovician.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 10 (fig. 3), 23–24, pl. 1. In White Pine district, overlies Pogonip formation of Mount Hamilton group (new); underlies Hanson Creek dolomite. Thickness 250 to 400 feet. Age of formation probably Middle Ordovician but may be Upper Ordovician in upper part.

U.S. Geological Survey currently considers the Eureka quartzite as Middle to Upper(?) Ordovician.

Standard section: Kirk's Lone Mountain section which is along west base of Lone Mountain, about 15 miles airline northwest of Eureka, Eureka County. Named for exposures at Eureka, Nev.

†Eureka Shale[1]

Devonian(?): Northern Arkansas.

Original reference: J. C. Branner and F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xiii, 26–27.

Named for Eureka Springs, Carroll County.

Eureka Tuff (in Silverton Volcanic Group)

Eureka Rhyolite (in Silverton Volcanic Series)[1]

Tertiary, middle and upper: Southwestern Colorado.

Original reference: Whitman Cross and Ernest Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 77–78. Mainly in flows or welded tuffs. Maximum observed thickness near Eureka Gulch of 2,000 feet, thins out to west, north, and east. Typical exposure and geographical extent cited.

U.S. Geological Survey currently classifies the Eureka Tuff as a formation in the Silverton Volcanic Group and designates the age as middle and late Tertiary on the basis of a study now in progress.

Greatest and most typical exposure in steep walls of Animas Valley at and above Eureka Gulch. Widely distributed in Silverton quadrangle and extends eastward down Henson Creek as far as Lake City and for a few miles into San Cristobal quadrangle.

Eutaw Formation[1]

Eutaw Formation (in Selma Group)

Upper Cretaceous: Alabama, western Georgia, eastern and northern Mississippi, and western Tennessee.

Original reference: E. W. Hilgard, 1860, Miss. Geol. and Agric. Rept., p. 3, 61–68.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1642 (fig. 2), 1648–1649. Formation includes Tombigbee sand member at top. Underlies (west to east) Coffee sand, Mooreville tongue of Selma chalk, and Blufftown formation. Blufftown formation, as defined here, includes additional beds below Blufftown marl (as originally defined) that were correlated with upper part of Eutaw by Veatch (1909, Georgia Geol. Survey Bull. 18) and with "typical beds of Eutaw" by Stephenson (1911).

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 13–17. As herein described, formation in Georgia is restricted to beds that Stephenson (1911, Georgia Geol. Survey Bull. 26) thought lay below Tombigbee sand member but has since discovered that they are equivalent to it. Beds that Stephenson called Tombigbee sand member are herein called Blufftown formation. Eutaw is more than 100 feet thick. Base of formation is littoral deposit of coarse gray or iron-stained crossbedded sand; remainder consists chiefly of platy sandy clay and clayey sand. Unconformably overlies Tuscaloosa formation; uncomformably underlies Blufftown formation.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37. Restricted at base to exclude glauconitic crossbedded sand, gravelly sand, and laminated clay beds herein named McShan formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. As mapped in Mississippi, includes Tombigbee sand member; overlies Tuscaloosa formation, undifferentiated.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 188 (fig. 1), 207–210. Unconformably overlies McShan formation and apparently overlaps it toward north. Underlies Mooreville chalk. Includes Tombigbee sand member at top. Thickness about 175 feet.

D. H. Eargle, 1955, U.S. Geol. Survey Bull. 1014, p. 23–32. In Georgia, formation in Chattahoochee River valley consists of basal bed containing coarse grains of quartz sand and other detrital materials as well as borings of *Halymenites major*. Basal sand is overlain by dark-gray soft shale interbedded with fine white sand. Toward the east formation apparently becomes nonmarine and consists of pale-tinted sands containing a few thin beds of clay. Thickness about 125 feet in Chattahoochee Valley; thins toward the east, possibly owing in part to overlap, to about 77 feet in Marion County. East of Flint River, cannot be differentiated from overlying Blufftown formation. Overlies Tuscaloosa formation. Crops out along narrow belt from Chattahoochee River to Flint River; east of Flint River, forms base of sequence of rocks so similar lithologically that Eutaw and overlying rocks up to base of Ripley formation cannot be differentiated.

H. L. Reade, Jr., and J. C. Scott, [1948], Profile showing geology along U.S. Highway 331, Montgomery County, Alabama (1:16,000): Alabama Geol. Survey. Map legend shows Eutaw formation in Selma group.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 30–40, pl. 3. Eutaw, in this report [Prentiss County], refers to strata between McShan formation below and Coffee formation above and in-

cludes two distinct units: the lower typical Eutaw beds, and Tombigbee sand member. Thickness 185 to 225 feet.

Named for Eutaw, Greene County, Ala.

Evacuation Creek Member (of Green River Formation)[1]

Eocene: Northeastern Utah and northwestern Colorado.

Original reference: W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168.

D. C. Duncan and Carl Belser, 1950, U.S. Geol. Survey Oil and Gas Inv. Map OM–119. Described in Piceance Creek basin, Colorado. Forms upper part of formation and contains alternating brown-weathering siltstone, sandstone, and gray marlstone near base but grades upward to predominantly sandstone and minor marlstone. In some reports, upper part of sequence in central part of basin has been tentatively assigned to Bridger formation. These upper beds are equivalent to upper part of Evacuation Creek member as identified near Parachute Creek. Because no convenient horizon was found to subdivide upper part of sequence penetrated by drilling, it is included in Evacuation Creek member. Thickness about 1,000 feet as recognized in well cuttings and surface sections. Overlies Parachute Creek member.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 413–416. Described in Duschesne, Uintah, and Wasatch Counties, Utah, where it is 600 to 865 feet thick and consists chiefly of bedded shale, mudstone, marlstone, siltstone, and sandstone. Includes Horse Bench sandstone bed. Overlies Parachute Creek member. Transitional and intertonguing relationships with overlying Uinta formation. Top of member rises toward central part of Uinta Basin as indicated by correlation of tuff beds. Contact selected arbitrarily and defined by reference to correlatable tuff beds here included in Evacuation Creek.

Named for exposures on Evacuation Creek, Utah.

Evans Granite[1]

Precambrian(?): Central northern Colorado.

Original references: J. Underhill, 1906, Colorado Univ. Studies, v. 3, no. 4, p. 272; 1906, Colorado Sci. Soc. Proc., v. 8, p. 103–122.

Probably named for Mount Evans, Clear Creek County.

Evans Creek coal series[1]

Eocene: Western central Washington.

Original reference: B. Willis, 1886, U.S. 10th Census, v. 15, pls. 81, 84.

Puget Sound region.

Evans Gulch Porphyry[1] (in Gray Porphyry Group)

Upper Cretaceous(?) or early Tertiary: Northern central Colorado.

Original reference: S. F. Emmons, J. D. Irving, and G. F. Loughlin, 1927, U.S. Geol. Survey Prof. Paper 148.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 52–53, 57, pl. 1. Closely resembles Mount Zion porphyry. Probably no Mount Zion porphyry occurs in area here described [west slope of Mosquito Range], but possibly some highly altered rock on south slope of Prospect Mountain, here mapped as Evans Gulch porphyry, should be grouped with Emmons' Mount Zion porphyry. In igneous sequence, intrusion of quartz diorite porphyry was followed by intrusions of Evans Gulch and Sacramento porphyries and typical Lincoln porphyry; relative

ages of these porphyries not determinable. Older than Iowa Gulch porphyry. Igneous rocks that are younger than Precambrian in area of this report are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene in age.

Named for exposures in Evans Gluch, east of Leadville, Rake County.

Evans Landing facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 167–169.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 2. Mississippian facies nomenclature discussed. Correlation chart lists Evans Landing as facies of Carwood formation.

Type section: Along steep ravine and cascade, cut into Ohio Valley bluff, north of road, center SE¼ sec. 4, T. 6 S., R. 5 E., 1½ miles north of Evans Landing, Harrison County.

†Evanston coal series[1]

Upper Cretaceous or Eocene: Southwestern Wyoming.

Original reference: C. A. White, 1870, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 240–241.

Exposed north of Evanston, Uinta County.

Evanston Formation[1]

Upper Cretaceous and Paleocene: Southwestern Wyoming.

Original reference: L. Lesquereux, 1876, U.S. Geol. and Geog. Survey Terr. Bull. 5, 2d ser., p. 244–248.

H. E. Wood 2d, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 19, pl. 1. Tentatively called Paleocene (Puercan); underlies Almy formation.

J. I. Tracey, Jr., and S. S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 126–128. Veatch (1907 U.S. Geol. Survey Prof. Paper 56) showed formation limited to three small areas near Evanston. Present mapping shows fairly wide distribution of rocks lithologically and temporally equivalent to the Evanston within Fossil Basin. On east side of basin, unit may be traced for great distances where boulder beds dip 25° to 30° to west and form hogbacks. Along this belt, mapped as Almy formation by Veatch, the Evanston conformably overlies Adaville formation, but north of Kemmerer the boulder beds truncate large syncline in the Adaville. Thickness ranges widely due to lack of uniformity in deposition and to subsequent erosion; 1,200 feet near southern boundary of Kemmerer quadrangle, uppermost several hundred feet not present. Contact with overlying Wasatch formation poorly exposed; apparently gradational at type locality, but angular unconformity present at many places. Latest Cretaceous and Paleocene. Formation is significant because of its relation to structural framework of basin; it indicates that principal period of formation of basin extended from latest Cretaceous (Lance) through Paleocene; also dates at least part of orogeny in thrust belt as Late Cretaceous.

Well exposed north of Evanston, Uinta County.

†Evanstonian series[1]

Paleocene: Wyoming.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36. 65–66.

Evansville Sandstone Bed (in Wellington Formation)[1]

Permian: Central northern Oklahoma.

Original reference: J. M. Patterson, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 3, p. 243, 251.

Exposed three-fourths mile east of Evansville.

Everett Member (of Nachusa Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15B. Shown on columnar section as uppermost member of Nachusa formation; overlies Elm member (new); underlies Hazel Green member (new) of Quimbys Mill formation. Thickness 2 to 6 feet.

Occurs in the Dixon-Oregon area.

†Everett Schist[1]

Ordovician: Southwestern Massachusetts and northwestern Connecticut.

Original reference: W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Named for fact it has its maximum thickness within area of Mount Everett, Mass.

†Everglades Limestone[1]

Pleistocene: Southeastern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 101, 154, 157, 325.

Probably named for the Everglades.

Evergreen Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Occurs in Evergreen mine, north of Evergreen Bluff, Ontonagon County.

Evergreen Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Occurs in Evergreen mine, north of Evergreen Bluff, Ontonagon County.

Everona Limestone[1]

Lower Ordovician: Northeastern Virginia.

Original reference: A. I. Jonas, 1927, Geol. Soc. America Bull., v. 38, p. 842.

Exposed from Mitchells Ford, on Rapidan River, to southwest of Rivanna River near Charlottesville, Albemarle County. Named for Everona, Orange County.

Eversole Chert[1] Member (of Columbus Formation)

Middle Devonian: Central Ohio.

Original reference: C. R. Stauffer, 1909, Ohio Geol. Survey Bull. 10, p. 72–74.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 276 (fig. 1). Shown on generalized section as chert member of Columbus formation.

Wilber Stout and R. A. Schoenlaub, 1945, Ohio Geol. Survey, 4th ser., Bull. 46, p. 21. In Delaware County, underlies Klondike member; overlies Bellepoint member. Thickness 10 feet.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 121 (fig. 3). Shown on chart as underlying Delhi (Klondike) member and overying Bellepoint member.

Named for Eversole Run, Delaware County.

Everton Formation

Everton Formation (in Buffalo River Group)

Everton Limestone[1]

Middle Ordovician: Northern Arkansas and southern Missouri.

Original reference: A. H. Purdue, 1907, Geol. Soc. America Bull., v. 18, p. 251–256.

G. C. Branner, 1929, Arkansas Geol. Survey Geol. Map of Arkansas. Includes Calico Rock sandstone member (new).

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. I, p. 6, 9. Everton formation (sandstone and dolomite) included in Buffalo River Group.

J. A. Straczek and D. M. Kinney, 1950, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–1. Mapped in Batesville manganese district. Unconformably underlines St. Peter sandstone. Middle Ordovician.

E. B. Brewster and N. F. Williams, 1951, Guidebook to the Paleozoic rocks of northwest Arkansas: Arkansas Resources Devel. Comm., Div. Geology, p. 12, columnar section. Formation includes Kings River member in lower part and Newton sandstone member in upper part. Thickness about 400 feet. Overlies Powell dolomite; underlies Jasper limestone. Lower Ordovician.

E. E. Glick and S. E. Frezon, 1953, U.S. Geol. Survey Circ. 249, p. 4–6, measured sections. Formation described in Newton County, Ark., where it overlies Powell dolomite and underlies St. Peter sandstone. Thickness about 405 feet. Composed of four lithologic units (ascending): sequence of dolomite and sandstone, 245 feet exposed, base covered; Newton sandstone member, 8 feet thick; sequence of dolomite and sandstone, 80 feet thick; and Jasper member, 55 feet thick. Middle Ordovician.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 117. Basal formation in Buffalo River group. Underlies Jasper formation.

Named from Everton, Boone County, Ark.

Evington Group

Paleozoic(?): South-central Virginia.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 93. Includes (ascending) Candler formation (new), Joshua schist (new), Arch marble (new), Pelier schist (new), Mount Athos formation, and Slippery Creek greenstone (new). Overlies Precambrian. Paleozoic(?).

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 14, 15 (table 1), pl. 1. Comprises (ascending) Candler formation, Archer Creek formation (new), Mount Athos formation, and unnamed greenstone.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 28–30, pl. 1. Age shown on columnar section as Lower Paleozoic(?).

Type locality: In vicinity of Evington, 11 miles southwest of Lynchburg, Campbell County. Lynchburg quadrangle.

Ewing Limestone Member (of Conemaugh Formation)[1]

Ewing Limestone (in Conemaugh Group)

Ewing limestone member

Upper Pennsylvanian: Southeastern Ohio, western Pennsylvania, and northern West Virginia.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889, 890, 897, pls. facing p. 889, 900, 912.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 78, 95, 96, fig. 21. Ewing limestone in Conemaugh group. Overlies Pittsburgh red beds; separated from overlying Ames limestone by Harlem coal. Thickness in Fayette County, 5 to 10 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 45–46, geol. map. In Morgan County, Ewing limestone member (Conemaugh series) is nonpersistent; stratigraphically overlies Cow Run sandstone and shale member; occurs from 6 to 11 feet below Barton coal and from 30 to 40 feet below Ames limestone. Thickness 6 inches to 4¾ feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 127–129. Member of Upper Bakerstown cyclothem in report on Athens County. Throughout outcrop area, the Ewing is represented by three lithologic varieties. First is single nodular layer 2 to 12 inches thick of light-gray to gray dense brecciated or sandy micaceous limestone. Second type includes layers but more commonly nodules and veins of limestone distributed in thicknesses of up to 15 feet of sandy shale and shaly sandstone. Third type comprises small nodules of limestone embedded in clay shale. Limestone in any of these types may be ferruginous. In Dover Township, a 6-inch layer of ironstone represents Ewing member. Overlies Cow Run sandstone member. Conemaugh series.

Named for Ewing Site, in Sunday Creek valley, Hocking or Perry County, Ohio.

Excello Formation (in Cabaniss Group)

Excello Formation (in Cherokee Group)

Excello Shale Member (of Senora Formation)

Pennsylvanian (Des Moines Series): Western and northern Missouri, southeastern Kansas, and northeastern Oklahoma.

W. V. Searight *in* W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Shown on stratigraphic column as uppermost formation in Cabaniss group. Underlies Blackjack Creek limestone member of Fort Scott formation; overlies Lagonda formation. Exposed in Carroll and Livingston Counties.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite

stratigraphic section as formation in Cabaniss group. Underlies Fort Scott formation of Marmaton group; overlies Mulky formation.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 3, 5, 14 (fig. 4). Geographically extended into Oklahoma where it is at top of Senora formation. Overlies Breezy Hill limestone. Cabaniss group.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 31 (fig. 20), 35. Formation composed largely of black fissile shale which contains abundant flattened, phosphatic concretions and large biscuit-shaped concretions which measure a few feet in diameter. Thickness at type section about 4 feet. Underlies Blackjack Creek limestone member of Fort Scott; overlies Mulky formation. Type section designated.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 88–89. Geographically extended into Kansas. Thickness 2 to 5 feet. Uppermost division of Cabaniss subgroup of Cherokee group.

Type section: NW¼ sec. 30, T. 56 N., R. 14 W., 2.6 miles west of U.S. Highway 63, west of Excello, Macon County, Mo., in highwall of coal strip pit.

Excelsior Formation[1]

Middle Triassic(?): Southwestern Nevada.

Original reference: S. W. Muller and H. G. Ferguson, 1936, Geol. Soc. America Bull., v. 47, p. 241–252.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of the Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ-23]. Described in Coaldale quadrangle. Dominantly volcanic. Estimated thickness 12,000 feet, but no complete section present. Nowhere in contact with Lower Triassic Candelaria formation, and it is presumed that two are present on different plates of major thrust. In hills near Readlich, greenstone breccia with pillow lavas unconformably overlies Diablo formation and appears to mark base of Excelsior. On southern flank and crest of Pilot Mountains, formation is unconformably overlain by Jurassic Dunlap formation and in adjacent Mina quadrangle is unconformably overlain by Upper Triassic Luning formation. Tentative assignment of formation to Middle Triassic is based on fossils from interbedded limestone lens in volcanic rocks of Gillis Range, about 50 miles northwest, but lack of contact with Candelaria and presence of volcanic rocks of probable Permian age in Toyabe Range, 60 miles northeast, make assignment to Middle Triassic uncertain.

D. I. Axelrod and W. S. Ting, 1960, California Univ. Pub. Geol. Sci., v. 39, no. 1, p. 3. In fault contact with upper Pliocene Wichman formation (new).

Named for Excelsior Mountains, where formation is well exposed in Gold Range mining district, about 6 miles southwest of Mina, Mineral County.

Exeter Diorite[1]

Upper Devonian(?): Southeastern New Hampshire.

Original reference: C. H. Hitchcock, 1870, 2d Ann. Rept. Geol. New Hampshire, map and p. 32.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Probably belongs to New Hampshire plutonic series of Upper Devonian(?) age.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. and Devel. Comm., p. 66, 187. Has average composition of granodiorite, though still termed diorite. Included in newly named Hillsboro plutonic series which is younger than Lower Devonian(?) and older than Mississippian(?).

Named for occurrence in Exeter Township, Rockingham County.

Exeter Sandstone[1]

Upper Jurassic: Western Oklahoma.

Original reference: W. T. Lee, 1902, Jour. Geology, v. 10, p. 45–46.

R. B. Johnson, 1959, U.S. Geol. Survey Bull. 1071–D, p. 94–95. Entrada sandstone can be traced from Huerfano Park area by surface exposures and subsurface data to type locality of Exeter sandstone in northwestern New Mexico. In view of wide usage of name Entrada sandstone, and general acceptance of correlation of Entrada sandstone with Ocate and Exeter sandstones, names Exeter and Ocate sandstones are herein abandoned for usage in southeastern Colorado and northeastern New Mexico and name Entrada sandstone used.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County, Okla. Jurassic.

Named for exposures near Exeter post office [now called Johnson], Union County, N. Mex.

Exline cyclothem (in McLeansboro Group)

Pennsylvanian: Illinois and Iowa.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, p. 145. Cyclothem in McLeansboro group. In sequence above Gimlet cyclothem and below Trivoli cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 119–121. Cyclothem includes Exline limestone and shale. Strata here referred to Exline cyclothem were formerly included in upper part of Gimlet cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 54 (table 3). Term discontinued.

Named for Exline, Appanoose County, Iowa.

Exline Limestone (in Appanoose Group)

Exline Limestone (in Henrietta Group)

Exline Limestone (in Pleasanton Group)

Exline Limestone Member (of Modesto Formation)

Pennsylvanian (Missouri Series): Southern Iowa, northern and western Illinois, and northern Missouri.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 62, 65–66. Limestone at top of Henrietta group. Upper 3 inches laminated lower 1 foot massive; dark blue gray, earthy, medium grained; well jointed, weathers brown and slabby; fossiliferous with *Chonetes* and white crinoid stems which contrast strongly with weathered yellow-brown matrix. Separated from underlying Cooper Creek limestone (new) by underclay, coal, and shale. Traced into northern Missouri.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 31). Shown on chart at top of Appanoose group in Iowa.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 10. In Pleasanton group, Missouri series.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1). Member of Modesto formation (new). In northern western Illinois, overlies Lonsdale limestone member and underlies Trivoli sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: About 1½ miles south of southwest corner of Exline, Appanoose County, Iowa. Well exposed in west-flowing tributary ravine of North Shoal Creek, SE¼ sec. 6, T. 67 N., R. 17 W.

Extension Breccia (intrusive)[1]

Tertiary: Central Nevada.

Original reference: T. B. Nolan, 1930, Nevada Univ. Bull., v. 24, no. 4, p. 17.

Well exposed in Tonopah Extension mine, Tonopah district.

Eyer Formation (in Hatter Group)

Eyer Member (of Hatter Formation)

Middle Ordovician (Bolarian): South-central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 193. Lowermost member of formation. Dark impure limestone, partly calcarenite. Thickness 6 feet in type section. Underlies Grazier member (new); overlies Clover member of Loysburg formation.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 7–10. Relationship to Grazier member not definitely known. Unit is either truncated by the Grazier or represents an offlapping unit subsequently overlapped by that member. Thus, beds may be stratigraphically more closely related to Loysburg formation than to the Hatter, but are included in the Hatter because of strong lithologic similarity to Grazier member. Maximum thickness 37 feet. Derivation of name stated.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8 p. [1402], 1407. Rank raised to formation in Hatter group or Hatterian subseries (Bolarian series).

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 82, 102. Discussed as a member.

Type section: On two sides of Pennsylvania Railroad cut north of Union Furnace, Huntingdon County. Named for Eyer, north of Union Furnace.

Fabius Group

Devonian or Mississippian: Missouri, Illinois, Indiana, Iowa, and Kentucky.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, chart 5; J. M. Weller, 1948, (abs.) Am. Jour. Sci., v. 246, no. 3, p. 150. Proposed for those lower Kinderhookian strata which are variously referred to either Mississippian or Devonian system. In type area, in Mississippi Valley, group consists of (ascending) Grassy Creek shale, Saverton shale, and Louisiana limestone. Unconformably overlies strata ranging from Ordovician to Devonian age and, locally at least, is overlain unconformably by strata of Easley group (new).

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 14. Replaced by Champ Clark group (new).

M. G. Mehl, 1960, Denison Univ. Sci. Lab. Jour., v. 45, art. 5, p. 94. Weller and others (1948) proposed that the Kinderhook be considered a series and divided into two groups, the Easley and Fabius. The Easley was to include all Kinderhookian strata which are almost universally recognized to be of Mississippian age and the Fabius to include those Kinderhookian strata which are believed by some to be Mississippian but by others to be Devonian. Position of the committee in establishing two Kinderhook groups based on above distinction does not appear tenable. It is here recommended that terms Fabius and Easley groups be dropped from list of stratigraphic designations in Missouri.

Name derived from South Fabius River which flows from Knox through northern Marion County, Mo., where above formations are well exposed.

Fagasa Gabbro

Pliocene(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 113–115. Elliptical body of gabbro with diameters of 100 to 200 meters. Cuts across older series of basalts.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1296. Appears to be dike in Pago volcanic series (new), considered to be Pliocene or early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 162. Pliocene(?).

Occurs on divide about 300 meters south of Pago Pago-Fagasa trail.

Fagundas Conglomerate[1]

Pennsylvanian: Pensylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38–40.

Occurs in hill tops at Fagundas, Warren County.

Fairbank Formation or Tongue (of Fountain Formation)

Pennsylvanian: Eastern Wyoming and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3, 32, 35, 44; R. L. Bates, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 10, p. 1990–1991. Consists of red sandstone or quartzite which is locally calcareous. Basal tongue of Fountain formation. Comprises Division VI of Hartville "formation" (Condra and Reed, 1935). Thickness 30 to 100 feet. Underlies Reclamation group (new); overlies Pahasapa limestone.

Type locality: North Platte River bluffs immediately north and northwest of site of abandoned village known as Fairbank, in sec. 27, T. 27 N., R. 66 W., Platte County, Wyo.

Fairbanks Loess

Quaternary: Central eastern Alaska.

T. L. Péwé, 1958, U.S. Geol. Survey Geol. Quad. Map. GQ–110. Massive, homogeneous, unconsolidated eolian silt. Buff to tan-gray when dry, brown when wet. Contains three white volcanic ash beds ½ inch to 6 inches thick. Thickness ranges from 3 feet on upper hill slopes to maximum of 200 feet on middle slopes and low hill tops.

Named from city of Fairbanks. Widespread on upper slopes and hilltops in northern one-half of Fairbanks (D–2) quadrangle. Excellent exposures in placer excavations in quadrangle, especially on Gold Hill, 8 miles west of Fairbanks, and in center sec. 8, T. 1 S., R. 2 W., 9 miles west of Fairbanks.

Fairbury Trachyte (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Includes varied sequences of extrusive members in vicinity of Fairbury Draw on Bell ranch. Consists of four members: basal breccia about 140 feet thick; plagioclase trachyte member which varies in thickness from 190 to 390 feet; anorthoclase trachyte member about 100 feet thick; and tuff member (thickness not given). Overlies Pantera trachyte (new); underlies Means trachyte (new).

Composite type section: East face of Garren Mountain for basal breccia; north face of Buck Mountain for plagioclase trachyte member; southeast bank near mouth of Fairbury Draw for anorthoclase trachyte member; east face of Blanquito Hill and west slope of hill east-northeast of Bell's ashpit for tuff member, Culberson County.

Fairfax[1] (coalbearing rocks)

Eocene: Western Washington.

Original reference: W. F. Jones, 1914, Geol. Soc. America Bull., v. 25, p. 122.

Probably named for town of Fairfax, Pierce County.

Fairfax Formation[1]

Pennsylvanian (Conemaugh): Northern West Virginia and western Maryland.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Exposed around Fairfax, Grant County, W. Va.

Fairfax Limestone[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1923, West Virginia Geol. Survey Rept. Tucker County, p. 130, 149, 156.

Visible near summit of Fairfax Knob, Grant County.

Fairfax Schist

Precambrian(?): Northern Vermont.

E. C. Jacobs, 1935, (abs.) Geol. Soc. America Proc. 1934, p. 85. Fine-grained schist. Outcrop belt several miles wide. At eastern margin is in undertermined contact with Mount Mansfield series of schist and gneisses.

Present in Green Mountain area.

†Fairfield coal group (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: E. T. Hancock and J. B. Eby, 1930, U.S. Geol. Survey Bull. 812C, p. 206, 208–230.

In Meeker, Axial, and Monument Butte quadrangles. Named for Fairfield mine, Meeker quadrangle.

Fairfield Member (of Canajoharie Formation)

Fairfield Slate[1]

Middle Ordovician (Mohawkian) : East-central New York.

Original reference: Lardner Vanuxem, 1842, Geology New York, pt. 3, p. 56–60.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 270–271, pl. 4. Redefined as shale member at top of Canajoharie formation. Includes upper three graptolite zones of the formation; uppermost is Fort Plain zone. At type locality of the Canajoharie, member contains conspicuous set of five metabentonites in lower part. Higher up, beds become interbedded black shales and gray-weathering silty shales; include metabentonites. Composed of silty and sandy beds in Minaville section where upper limit is uncertain. Maximum thickness at least 450 feet. Overlies Minaville member (new) of Canajoharie formation; underlies Utica formation. Extends westward as gradationally overlapping tongue of the formation passing through the Dolgeville interbedded facies into upper Denmark member (new) of Sherman Fall formation. Derivation of name.

Named for Fairfield Township, Herkimer County.

Fairfield Member (of Cuyahoga Formation)[1]

Mississippian (Kinderhook) : South-central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 671.

F. T. Holden, 1942, Jour. Geology, v. 50, p. 45. Included in Hocking Valley conglomerate facies. Consists of thick coarse- and medium-grained sandstones alternating with shale layers commonly of equal thickness with the sandstones. Thickness of each sandstone may be as much as 65 feet. Overlies Lithopolis sandstone member; underlies Black Hand conglomerate member.

Named from development in Fairfield County.

Fairhaven Diatomaceous Earth Member (of Calvert Formation)

Fairhaven Member (of Calvert Formation)[1]

Miocene, middle: Eastern Maryland.

Original reference: G. B. Shattuck, 1904, Maryland Geol. Survey, Miocene Volume, p. lxxii.

Lincoln Dryden and R. M. Overbeck, 1948, Maryland Dept. Geology, Mines and Water Resources [Repts.] Charles County, p. 53–56. Described in Charles County where it is about 75 feet thick at Popes Creek. Of this total, only one bed, 17 feet thick, contains more than an insignificant proportion of diatoms; it is suggested that term Fairhaven member be used for lower part of Calvert formation and "diatomaceous earth" or "diatomite" be reserved for the one bed containing a high percentage of diatoms.

Named for Fairhaven, Anne Arundel County.

Fairlee Quartz Monzonite

Fairlee Granite Gneiss[1]

Ordovician: East-central Vermont and west-central New Hampshire.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table facing p. 288.

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M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 499. Belongs to Highlandcroft magma series.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 22. Described as coarse-grained greenish-gray quartz monzonite with local pink tinges. Generally appears more or less crushed and foliated; converted to phyllonite on margins of the body. Age designated probably Upper Ordovician. Extends into New Hampshire. Type locality given.

Type locality: Strikingly exposed on cliffs known as the Palisades in Fairlee, Orange County, Vt.. Forms several prominent hills in Mount Cube quadrangle in Bradford, Vt., and Piermont, N.H.

Fairmont Shale Member (of Hennessey Shale)[1]

Permian: Central northeastern Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 786–799.

Named for exposures near Fairmont, Garfield County.

†Fairmount Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1887, Pennsylvania 2d Geol. Survey Ann. Rept. 1886, p. 1601–1603.

Forms hill at Fairmount, in vicinity of Philadelphia.

Fairmount Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central eastern Ilinois.

Original reference: E. F. Lines, 1912, Illinois Geol. Survey Bull. 17, p. 59, 75.

Crops out over area of less than 2 square miles near Fairmount, Vermilion County.

Fairmount Limestone Member (of Fairview Formation)[1]

Fairmount Formation (in Maysville Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and northern Kentucky.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 78.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Fairmount formation, in Maysville group, shown on generalized stratigraphic column of Ordovician and Silurian rocks exposed in Jefferson and Switzerland Counties. Limestone, blue, thick bedded at top; contains minor amounts of shale. Thickness 30 to 60 feet. Occurs above Mount Hope formation and below Bellevue formation. Cincinnatian.

Named for Fairmount, a part of Cincinnati, Ohio.

†Fairmount Slate[1]

Upper Cambrian: Northwestern Georgia.

Original reference: H. K. Shearer, 1918, Georgia Geol. Survey Bull. 34, map opposite p. 43.

Named for development about Fairmount, Gordon County.

Fairplay Glacial Substage

Pleistocene (Wisconsin): Central Colorado.

Q. D. Singewald, 1950, U.S. Geol. Survey Bull. 955–D, p. 103, 123, 125, 128, pl. 9 [1951]. The times of maximum ice advance and of the two prin-

cipal ice stands during retreat are called Fairplay, Briscoe, and Alma substages, respectively of Wisconsin stage of glaciation.

In northwestern Park County.

Fairplay Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 33, fig. 3. Shown on columnar section as underlying Mortimer member (new) and overlying Eagle Point member (new).

Occurs in Dixon-Oregon area.

Fairport Chalky Shale Member (of Carlile Shale)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 40.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 24. Thickness 85 feet in Russell County to 147 feet in Hamilton County. Underlies Blue Hills shale member; overlies Greenhorn limestone.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 121. In Baca County, Colo., consists of alternating beds of chalky limestone and tan platy to fissile chalky shale.

Named for exposures a few miles south and west of Fairport, Russell County, Kans.

Fairview Diorite[1]

Tertiary: Central southern Colorado.

Original reference: W. Cross, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 291.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, the volcanics, in order of decreasing age, consist of Rosita fragmental andesite, Bunker massive andesite, Fairview diorite in dikes cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Named for Mount Fairview, Silver Cliff-Rosita Hills region.

Fairview Formation (in Maysville Group)[1]

Fairview Formation (in Covington Group)

Fairview Member (of Martinsburg Formation)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, north-central Kentucky, and Pennsylvania.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 10.

R. S. Bassler, 1919, The Cambrian and Ordovician deposits of Maryland: Maryland Geol. Survey, p. 157, 173. Martinsburg shale in southern Pennsylvania and Maryland include a lower Maysville division (Fairview) consisting of fossiliferous gray sandstone with *Orthorhynchula linneyi* beds at top. Thickness 300 feet. Overlies Eden division; underlies upper Maysville division (Oswego sandstone).

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p 1175, 1176, 1177, 1183. Upper member of Martinsburg formation in Pennsylvania. Thickness 135 to 246 feet. Overlies beds of Eden and older in lower part of formation. Underlies Bald Eagle member of

Juniata formation, transitional. Massive sandstone at top of Martinsburg in Schuylkill Gap area is herein named Shochary sandstone member. Lithologically, stratigraphically, and faunally, it appears to be correlate of Bassler's Fairview sandstone in south-central section but it is not traceable through.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized column of Ohio as overlying Latonia formation of Eden group. Thickness 115 feet. Includes (ascending) Mount Hope and Fairmount members.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1030. Middle formation of Covington group. Overlies Eden formation; underlies McMillan formation. Fairview and McMillan formations constitute standard for median Cincinnatian Maysville stage.

R. R. Pulse and W. C. Sweet, 1960, Jour. Paleontology, v. 34, no. 2, p. 237–264. Fairview formation (Bassler, 1906) has been divided into two members (ascending) Mount Hope and Fairmount (Nickles, 1902). These units were originally distinguished by their contained bryozoan faunas, the Mount Hope being the "*Amplesopora septosa beds*" and the Fairmount the "*Dekayia aspera* beds." Formation consists of 100 to 120 feet of thin alternating beds of bluish-gray fossiliferous limestone and greenish-gray shale. Individual beds are both laterally and vertically gradational, and a number of different structural types of both limestone and shale occur within formation. In general, shale beds are thicker and limestone beds correspondingly thinner in lower 50 to 60 feet than in upper 60 to 70 feet. As a result, formation can be crudely subdivided into two members of about same thickness, which correspond roughly, at least in type section, to Nickles' (1902) Mount Hope and Fairmount divisions. In present study, more calcareous upper Fairview has been assigned to the Fairmount, and shalier lower Fairview has been regarded as Mount Hope. In sections where this interval is well exposed, the level of first appearance of *Strophomena planoconvexa* was considered to mark boundary between the two members. Overlies Eden formation; underlies McMillan formation. Conodonts described.

Named for Fairview Heights, Cincinnati, Ohio.

†Fairview Shale[1]

Lower Devonian: Colorado.

Original reference: J. M. Hill, 1909, U.S. Geol. Survey Bull. 380, p. 24, 35–36.

J. W. Gabelman, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 8, p. 1584. Term Fairview facies could be applied to lower part of Parting quartzite member of Chaffee formation in northern Sangre de Cristo Range. This part of Parting has been termed Elbert facies but name Fairview facies is more applicable as Lower Devonian Fairview shale is geographically nearer to region discussed.

Named for fact that shale forms hanging wall in Fairview mine located 7½ miles northwest of Pitkin, Gunnison County. Crops out in Quartz Creek district.

Fairview Valley Formation

Permian: Southern California.

O. E. Bowen, Jr., *in* L. A. Wright and others, 1953, California Jour. Mines and Geology, v. 49, pl. 2. Shown on columnar section as unconformably

underlying Sidewinder volcanic series (new) and unconformably overlying Oro Grande series. Thickness about 6,075 feet.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 36–42, pls. 1, 3, 7. Described as tightly folded series of clastic and limy sediments including dark-gray limestone conglomerate, gray-green hornfelsed, silty and sandy limestones, and dense black limestone in thin lenses. Intruded and overlapped by volcanic rocks of Triassic(?) Sidewinder volcanic series (new).

Type section: Fairview Valley, Barstow quadrangle, San Bernardino County. Crops out over area of approximately 3 square miles north and northwest of Southwestern Portland Cement Co.'s Reserve quarry and west of Sidewinder gold mine.

Fais Limestone

Pleistocene or Quaternary (early Holocene): Caroline Islands (Fais).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 347. (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 68, table 5 [English translation in library of U.S. Geol. Survey, p. 82–83]. Named on correlation chart. Elevated coral reef limestone. Younger than Caroline limestone. Principally coral limestone; lesser amount of *Halimeda* limestone. Pleistocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 31. Early Holocene.

Fais (Feys) Island. Constitutes second, third, and fourth terraces on island.

Fajardo Formation

Fajardo Shales[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

C. A. Kaye, 1959, U.S. Geol. Survey Paper 317–A, p. 7 (table 2), 10 (fig. 4), 27–29, pl. 2. Termed Fajardo formation in San Juan area because shale is not prevalent lithology. Consists of light-colored ashy siltstone, siliceous siltstone, and chert, interfingering graywacke, conglomerate, and impure limestone. A little south of Río Guaynabo section, massive to stratified purplish-gray tuff, interbedded in upper part of section, that may be equivalent of Meyerhoff's and Smith's San Diego formation, are included in the Fajardo because it seems that the typical ashy siltstone is only a facies and that formation consists of wide range of rock types forming an interfingering sequence. Maximum thickness, Trujillo Alto Road, estimated 3,000 feet; northwest of Guaynabo, 1,885 feet. Overlies Figuera volcanics; contact conformable in some places, but in others angularity exists. No fossils found. Believed to be Paleocene or Eocene.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover, 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 141–143. Fajardo formation of this report includes both Fajardo shales of Berkey and underlying volcanic sandstones that Meyerhoff (1931, New York Acad. Sci., v. 1, pt. 3) apparently called Luquillo formation of Cretaceous age. Formation crops out in northeastern corner of island across nose and along north-

western limb of dissected northeast-trending anticline underlying Luquillo Range and adjacent areas. Base is obscured by faulting, and contact relation with underlying volcanic complex not known. Rocks tentatively correlated with Fajardo formation crop out in central Puerto Rico in faulted blocks that lie across main axis of Puerto Rico anticlinorium. Basal contact with volcanic complex in central Puerto Rico appears to be unconformable. Between these two areas, rocks equivalent to Fajardo appear to have been removed by faulting and subsequent erosion. Thickness of formation and equivalent strata ranges from about 8,000 feet in eastern part of island and 6,500 feet in central Puerto Rico to only a few feet in southernmost outcrops in south-central part of island. Includes Aguas Buenas limestone member at base in central Puerto Rico. Upper Creataceous.

Named for outcrops in vicinity of Fajardo, in northeastern part of island.

Falcon Granite Gneiss

Precambrian: Central northern Colorado.

M. F. Boos, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1179. Invaded Idaho Springs and younger Precambrian formations, preceding Mt. Evans quartz monzonite.

Denver Mountain Park Area.

Falcon Limestone Member (of Lykins Formation)

Falcon Tongue (of Minnekahta Limestone in Lykins Formation)

Permian: North-central Colorado and southern Wyoming.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31, 33. fig. 7. Impure limestone containing numerous thin, irregular, varvelike laminae of red silt ranging in thickness from paper thin to one-tenth inch. Locally several 2-inch seams of vuggy limestone contain black brittle bituminous material. Unit represented at Ralston Creek by unindurated irregularly interlaminated red and gray calcareous silt. Thickness ranges from 2 to 3½ feet. At type locality, unit lies 46 feet stratigraphically below base of Glennon limestone (new) and 58 feet above Lyons formation. Underlies Bergen shale member (new); overlies Harriman shale member (new).

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Designated tongue of Minnekahta limestone in Lykins formation. Underlies Glendo shale member of Lykins. Falcon tongue extends at least from Horse Creek, Wyo., southward to Red Creek Canyon, which is between Colorado Springs and Canyon City, Colo.

Type locality: In west fork of Glennon Canyon, Golden-Morrison area, Jefferson County, Colo. Named from Mount Falcon in southwest part of Morrison quadrangle, sec. 9, T. 5 S., R. 70 W., about 2½ miles southwest of town of Morrison.

Falcon Sandstone Member (of Cook Mountain Formation)

Eocene (Claiborne): Western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 263. Proposed for upper 500 feet, approximately, of Cook Mountain formation. Characterized by massive crossbedded fossiliferous marine sandstone beds. Underlies La Perla shale member (new) of Yegua formation; overlies Veleno member (new) of Cook Mountain formation.

Named for town of Falcon, on American bank of Rio Grande, 2 miles north of Starr-Zapata County line.

Falkirk Dolomite[1] (in Bertie Group)

Falkirk Member (of Bertie Formation)

Upper Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Member of Bertie formation. Continues eastward into Fiddlers Green dolomite member.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Formation in Bertie group. Overlies Oatka shale; underlies Scajaquada shale. Field work has not demonstrated lateral continuity of Falkirk and Fiddlers Green as shown on present chart. Thick glacial deposits conceal these units in area where they may merge (north of Seneca Lake). Possibility of facies change should not be overlooked. At present time, distinct names are retained for western and central New York.

Derivation of name not stated. Falkirk is in Erie County.

Fall Creek Conglomerate Lentil (of Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania and central southern New York.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 74–79, 82, 98, 100, 236.

Bradford Willard, 1939, Pennsylvania Geol. Survey Bull. G–19, p. 300. White (1881) thought that Cascade sandstone, which he recognized in lower Chemung in Susquehanna County, might be equal to Fall Creek conglomerate previously described by Sherwood (1878, Pennsylvania 2d Geol. Survey, v. G) from northern Bradford and Tioga Counties. Because Fall Creek is now considered to be at top of Chemung, this correlation seems unlikely, nor is either the Fall Creek or the Cascade to be correlated with Cuba sandstone, because the Cuba is still higher, at base of Conneaut group. White placed Fall Creek below New Milford formation by 200 to 325 feet, an obvious error if the Fall Creek of White was the same as that of Sherwood. Present study would place Fall Creek below the Luthers Mills by about 50 feet. Hence, it should be very near contact between beds of highest Chemung and lowest Canadaway.

Type locality: Falls Creek, Bradford County, Pa.

Falling Run Member (of Sanderson Formation)

Mississippian (Kinderhookian): Southeastern Indiana and northern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 848–849, 857–858. Consists of phosphatic nodules and is final phase of Sanderson; represents near-shore facies resulting from retreat of sea around Cincinnati dome. Thickness commonly less than 1 foot. Stratigraphic position is beneath Underwood formation (new), but in most of southern Indiana the Underwood is absent, and Falling Run is overlain by Henryville formation (new). Overlain by New Providence shale in Kentucky.

Type section: On Falling Run Creek, at end of Market Street, New Albany, Floyd County, Ind. Traced from Ohio River north to Uniontown, Jackson County, Ind., and south and east through Kentucky to Irvine, Estill County.

Falling Springs Sandstone Member (of New Scotland Formation)

Lower Devonian: Central Pennsylvania.

F. M. Swartz, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1923; 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 57, 67, 83. Medium-bedded solid calcareous sandstone. Thickness 23 feet at type locality. Underlies Mandata shale and chert (new). Derivation of name given.

Named for Falling Springs, Perry County, where best exposed.

Fallis Sandstone Member (of Wellington Formation)[1]

Permian: Northeastern Oklahoma.

Original reference: J. M. Patterson, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 3, p. 243, 248.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1522 (fig. 2). Included in Minco division of Permian.

H. D. Miser and others, 1954, Geologic Map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Fallis sandstone member of Wellington formation.

Named for town of Fallis, sec. 29, T. 15 N., R. 2 E., Lincoln County.

Fall River Formation (in Inyan Kara Group)

Fall River Sandstone Member (of Colorado Shale)

Fall River Formation (in Dakota Group)

Fall River Sandstone (in Inyan Kara Group)[1]

Lower Cretaceous: Western South Dakota and northeastern Wyoming.

Original references: W. L. Russell, 1927, Am. Jour. Sci., 5th, v. 14, p. 402; 1928, Econ. Geology, v. 23, no. 2, p. 135–137.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Shown on columnar section as basal member of Omadi sandstone (new). Underlies Skull Creek member; overlies Fuson shale.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2170, 2173–2175, 2197 (fig. 2). Formations in Black Hills that are equivalent to Colorado shale are Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Fall River sandstone and equivalent rocks discussed in northern Black Hills, central and northwestern Montana.

K. M. Waagé, 1958, Wyoming Geol. Assoc. Gundebook 13th Ann. Field Conf., p. 71–76. Discussion of regional aspects of Inyan Kara stratigraphy. Fall River sandstone overlies Fuson-Lakota sequence and underlies Skull Creek sandstone.

R. E. Davis and G. A. Izett, 1958, Am. Assoc. Petroleum Geologists Bull. v. 42, no. 11, p. 2745–2756. Formation in northern Black Hills consists of about 120 to 140 feet of well-bedded siltstone, silty claystone, and very fine- to fine-grained sandstone. Subdivided into three and locally four units. Includes Keyhole sandstone member (new) in upper part.

Underlies Skull Creek shale; overlies sequence of lensing and interfingering continental deposits of claystone, siltstone, and sandstone that seem genetically related to underlying Morrison formation and which have been referred to variously as Lakota and Fuson formations undifferentiated, or Lakota formation. Separated from underlying rocks by nearly planar surface of transgressive disconformity.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1081–B, p. 58–64, 79–81. Fall River formation (Dakota sandstone of Darton) is redefined so that its basal contact conforms to the transgressive disconformity [see Dakota group] and formation becomes upper part of twofold division of Inyan Kara group as herein redefined. In terms of Russell's (1928) definition of Fall River and Darton's interpretation of the Dakota in Fall River area, the redefinition consists of shift downward in basal contact. In terms of remainder of the Inyan Kara outcrop, redefined Fall River would include, locally, a variable thickness of shale and thin-bedded sandstone, which Darton included in the Fuson. Russell's (1928) definition included "the sandstone and interbedded shales of post-Fuson age lying below the base of the Graneros shales." Russell included Quarry sandstone (Ward, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2) in these beds. That is, he followed Darton's restriction of the latter's Dakota formation in Fall River Canyon inasmuch as base of Quarry sandstone marked Fuson contact in both classifications. Russell gave type locality "at Evan's Quarry." Actually there are two Evan's quarries both abandoned. The newer quarry shows only face of the massive sandstone and a few of beds above, whereas original Evan's quarry shows the massive sandstone and, in a gully leading from it, all beds beneath it to basal contact of Fall River formation. Good exposures of formation above Quarry sandstone are present a short distance downstream on northeast side of river below falls formed by Quarry sandstone. This general area in vicinity of the falls and the two quarries is here included as part of type locality. Thickness at type locality 158 feet where it overlies Lakota formation and underlies Skull Creek shale. Throughout Black Hills, formation maintains thickness of 110 to 160 feet. Basal contact sharply delimited by transgressive disconformity. Upper contact commonly an abrupt change from sandstone to gray sandy shale, which grades within 5 to 15 feet to black clay shale typical of Skull Creek. Contact, even where relatively sharp is conformable. In southern and eastern Black Hills, formation has threefold subdivision because of tongue of continental beds similar to Lakota formation.

W. A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc., v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

U.S. Geological Survey currently classifies the Fall River as a member of the Colorado Shale in Montana on the basis of a study now in progress.

Type locality: Exposures in bluffs of Fall River in area of the falls and Evan's quarries which lie on opposite sides of river just above the falls. All exposures are in N½ sec. 33, T. 7 S., R. 6 E., Hot Springs quadrangle, Fall River County, S. Dak.

Fall River Sandstone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: Robert Hay, 1887, Kansas Acad. Sci. Trans., v. 10, p. 7, cross section.

Named for Fall River, Greenwood County.

Falls Formation[1]

Lower Ordovician: Central southern Oklahoma.

Original references: E. O. Ulrich, 1928, Manuscript chart exhibited at New York Meeting of Geol. Soc. America; 1930, U.S. Natl. Museum Proc., v. 76, art. 21, p. 73.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey.

Named for exposures on Falls Creek, sec. 33, T. 1 S., R. 2 E., Murray County.

Falls City Limestone (in Admire Group)

Falls City Limestone (in Admire Shale)[1]

Falls City Limestone Member (of Chicago Mound Formation)

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 9, 17, 30.

G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 9. Rank raised to formation in Admire group. Includes (ascending) Miles limestone, Reserve shale, and Lehmer limestone member.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 37. Rank reduced to member status in Chicago Mound formation (new). Includes Miles limestone, Reserve shale, and Lehmer limestone as beds. Thickness about 9 feet.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 52. Underlies West Branch shale; overlies Hawxby shale.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Falls City limestone underlies West Branch shale member of Janesville shale (new); overlies Hawxby shale member of Onaga shale (new). Wolfcamp series.

Type locality: In Lehmer quarry, sec. 32, 2½ miles south and 1½ miles west of Falls City, Richardson County, Nebr.

Falls City Shale[1]

Eocene (Jackson): Southeastern Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1314.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2631. Replaced by Conquista clay member (new) of McElroy formation. Name Falls City preempted.

Type locality: West of Falls City, in bed of San Antonio River, forming falls of the river, Karnes County.

†Falls Creek Formation[1]

Lower Ordovician (Chazy): Central southern Oklahoma.

Original reference: C. E. Decker and C. A. Merritt, 1931, Oklahoma Geol. Survey Bull. 55, p. 12, 98.

Arbuckle and Wichita Mountains.

Falls Mills Limestone (in Hinton Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 295, 338.

Type locality: Along Bluestone River slightly northwest of Falls Mills, Tazewell County, Va. Also observed in Summers County, W. Va.

Falls Mills Sandstone (in Hinton Formation[1] or Group)

Falls Mills Sandstone (in Pennington Formation)

Mississippian (Chester): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 295, 335.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5, pl. 2, columns 97–99. Shown on correlation chart as sandstone in Pennington formation in southwest Virginia; occurs below Princeton sandstone and above Avis limestone.

Type locality: In edge of Tazewell County, Va., just west of Falls Mills Station; makes falls across Bluestone River.

Falls Mills Shale (in Hinton Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 295, 336.

Type locality: Along Bluestone River slightly northwest of Falls Mills, Tazewell County, Va. Also observed in Mercer and Summers Counties, W. Va.

Falor Formation

Pliocene: Northwestern California.

G. A. Manning and B. A. Ogle, 1950, California Div. Mines Bull. 148, p. 7, 14 (fig. 2), 22–25, pls. 1, 2. Poorly consolidated marine sandstones, clays, silts, and conglomerates. Thickness 750 to 2,000 feet; upper 200 feet are red beds. In fault contact with Franciscan. Beds strike approximately N. 40° W., and dip homoclinally about 20° NE. Name replaces term Boulder formation as used by authors in unpublished theses.

Type locality: Along Maple Creek near Falor Ranch, Blue Lake quadrangle, Humboldt County.

Fan Mountain Glaciation

Recent: Northern Alaska.

R. L. Detterman, A. L. Bowsher, and J. T. Dutro, Jr., 1958, Arctic, v. 11, no. 1, p. 45, 57, 60 (table 1), figs. 3, 10. Six glacial advances recognized in northern Brooks Range and on Arctic Slope. Fan Mountain represents most recent glacial advance recorded in region. Preceded by Alapah Mountain glaciation (new). Moraines are fresh, bare of tundra, and generally restricted to cirque areas. Kettle lakes present behind a few of the moraines. Small glaciers confined to higher, larger, and mainly north-facing cirques characterized the glaciation.

Named for glacial deposits at thresholds of cirques in vicinity of Fan Mountain, 13 miles south of Shainin Lake. Moraines appear to be present in many cirques in higher parts of Brooks Range, generally above altitude of 4,600 feet in vicinity of Alapah Mountain.

Fannettsburg Member (of Shippensburg Formation)

Middle Ordovician (Bolarian): South-central Pennsylvania and western Maryland.

L. C. Craig, 1959, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 722–727. Name proposed for middle member of formation. Described at type locality as light- to dark-gray medium-grained to coarsely crystalline limestone in platy to massive beds. Shows two intertonguing facies; dark and fine grained in eastern belts of outcrop, and lighter medium to coarsely crystalline in western belts. Crude vertical zoning also present in western belts; lower part typically medium gray, rather thick-bedded coarse calcarenite with layers of *Solenopora* conglomerate, and upper part dark-gray cross-laminated fine calcarenite in platy beds. Contains four metabentonite beds in eastern outcrops. Maximum thickness 263 feet; 39 feet at type locality. Conformably overlies Pinesburg member (new); conformably underlies Doylesburg member (new) in type section and disconformably underlies Mercersburg formation in eastern belts.

Type section: Exposure on south side of U.S. Route 30, 1 mile southwest of St. Thomas, Franklin County, Pa. Named for the exposure east of Pennsylvania Route 75, 2.6 miles southwest of Fannettsburg in Path Valley.

Fanney Rhyolite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for prominent outcrops in vicinity of Fanney mine, on Fanney Hill, Mogollon district.

Fant Meta-Andesite[1] or **Andesite**

Lower Jurassic: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map. I–175, p. 5 (table 2). Fant andesite overlies Hardgrove sandstone; underlies Thompson limestone. Lower Jurassic.

Named for an unidentified locality near Taylorsville, Plumas County.

Fant Tuff Member (of Catahoula Tuff)[1]

Oligocene or Miocene, lower: Southwestern Texas.

Original reference: T. L. Bailey, 1926, Texas Univ. Bull. 2645, p. 46, 65, 66–80, 178–179.

H. H. Cooper, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 11, p. 1432. Principally volcanic tuff. Thickness 100 feet. Underlies Soledad member; overlies Frio formation.

Named for exposures near Fant City, northern Live Oak County.

Fantastic Lava Beds

Cenozoic: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, geol. map. Named on geologic map.

Mapped in Lassen County, northeastern part of Lassen Volcanic National Park.

Farallon Quartz Diorite

[Upper Cretaceous]: Western California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Name applied to quartz diorite exposed on Farallon Islands. These outcrops have been regarded by geologists as the ancient core of a mountain range which once extended along coast of California and which supplied sediments for Franciscan formation and for many of Cretaceous formations. Age determination by potassium-argon method 89.5 million years.

Farallon Islands are off the coast of California near San Francisco Bay.

Faraway Ranch Formation

Faraway Ranch Series

Cenozoic: Southeastern Arizona.

H. E. Enlows, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 106 (fig. 1). Series comprises (ascending) buff pahoehoe biotite dacite—thickness 400 feet; basalt breccia—175 feet; lapilli tuff—200 feet; soft white rhyolite tuff —10 feet; and hard pink rhyolite tuff—10 feet in Rhyolite Canyon section, Chiricahua National Monument. Uncomformably underlies Rhyolite Canyon series (new).

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1217, 1221 (table 2). Formation overlies Bonita Park formation (new) in Hands Pass region just east of Chiricahua National Monument. Most of rhyolite deposits of Cenozoic age in Monument, heretofore termed flows, are more correctly classified as welded rhyolite tuff or ignimbrite, the result of many eruptions of nuées ardentes. Thickness at least 800 feet. Underlies Rhyolite Canyon formation. Probably correlative with Blacktail formation (new). Derivation of name given.

F. F. Sabins, 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1325–1327, pl. 1. In Cochise Head and Vanar quadrangles, all but minor part of formation consists of volcanic flows and agglomerate. Lenses of lacustrine deposits and stream-deposited tuff constitute minor part. Lacustrine deposits comprise a red clastic sequence and a light-colored sequence containing fresh-water limestone. In southeast part of the area, formation overlies Nipper formation (new), but to the north and west it unconformably overlies Bisbee group. Late Cretaceous to late Tertiary.

Named from outcrops near Faraway Ranch on lower Bonita Canyon, a short distance west of Chiricahua National Monument, Cochise County.

Farewell Glaciation

Pleistocene: Central southern Alaska.

A. T. Fernald *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 6–7, 13 (table 1); A. T. Fernald, 1960, U.S. Geol. Survey Bull. 1071–G, p. 222, 225–233. Two major glaciations of western part of Alaska Range recognized in Upper Kuskokwim region. The younger, Farewell, succeeded Selatna glaciation (new). Represented along South Fork of Kuskokwim River by prominent moraines; along Middle Fork by two moraines; and along West Fork by single V-shaped moraine which lies in broad open valley within mountainous area. Twofold division of Farewell glaciation, which is well displayed on piedmont slope along South and Middle Forks, may represent two distinct glaciations.

Along South Fork of Kuskokwim River near Farewell; also along Middle and West Forks. In Upper Kuskokwim region. Named after settlement of Farewell on Sheep Creek, just outside moraines of South Fork.

Fargo Limestone[1]

Pennsylvanian: Southeastern Nebraska and southwestern Iowa.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 15, 26, 27.

Type locality: Prominent cliff in valley side near Fargo, Richardson County, Nebr. Exposed between Weeping Water Valley and Walnut Creek, from 4 miles northwest of Fargo to near Rulo, and in spur south of Rulo, Richardson County, Nebr.

Fargo Canyon Diorite

Upper Jurassic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 44, 45, 59–60. Massive to moderately foliated. Cut by granite and pegmatitic granite dikes which are offshoots of White Tank and San Jacinto batholiths. Probably a correlative of Bradley granodiorite (new). In Little San Bernardino Mountains, the Fargo Canyon cuts Chuckwalla complex (new).

Named for exposures in Fargo Canyon, Little San Bernardino Mountains, northeast of Indio, Riverside County.

Farisita Conglomerate

Oligocene(?): Southeastern Colorado.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 718. Consists of buff conglomeratic sandstone and siltstone beds. Individually beds are lenticular and highly cross-laminated and show limonite stains on bedding surfaces. Conglomeratic fragments range in size from pebbles to 8-foot boulders and are subangular to rounded and very poorly sorted. Rocks generally poorly cemented. Ranges in thickness from thin edge to about 1,200 feet. Unconformably overlies Huerfano formation and older rocks of Cenozoic, Mesozoic, and Precambrian age. Unconformably underlies Devils Hole formation.

Robert Berner and L. I. Briggs, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1533. Detailed mapping demonstrated that accurately dated Huerfano formation interfingers with Farisita formation in central part of basin. This dates Farisita as late early Eocene (Wasatchian), middle Eocene (Bridgerian), and probably late Eocene. Uppermost beds of formation may be still younger.

Named from exposures along Turkey Creek north of town of Farisita. No more specific type section reported or described owing to nature of outcrops, which are very scarce and discontinuous. Occurs entirely within Huerfano Park.

Farland[1] (limestone)

Lower Cretaceous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Farley Limestone Member (of Wyandotte Limestone)

Farley Limestone Bed (in Lansing? Formation)[1]

Farley Limestone Member (of Lane Shale)

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: H. Hinds and F. C. Greene, 1915, Missouri Bur. Geology and Mines, v. 13, 2d ser., p. 29, 155.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. Shown on chart as member of Lane shale. Thickness 2 to 10 feet. Underlies Bonner Springs shale member; overlies Island Creek shale member.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 14. According to interstate agreement, Farley limestone is classified as uppermost member of Wyandotte limestone. Overlies Island Creek shale member; underlies Bonner Springs shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25, fig. 5. Uppermost member of Wyandotte limestone. Comprises two or three gray argillaceous limestone beds separated by thin shales and varies considerably in thickness. Thickness about 2 feet in Madison County; more than 7 feet in Union County. Overlies Island Creek shale; underlies Bonner Spring shale.

Named for exposures near Farley, Platte County, Mo.

Farm Creek Intraglacial Substage

Pleistocene (Wisconsin): North-central United States.

M. M. Leighton, 1960, Jour. Geology, v. 68 no. 5, p. 549, 550. Name applied to Farmdale-Iowan intraglacial substage. Represented by black soil, wood, and peat that overlie Farmdale silt and underlie Iowan and Tazewell (Peorian) loess. This report also gives consideration to other classifications of the Wisconsin including one proposed by Frye and Willman (1960).

Named for Farm Creek, Tazewell County, Ill.

Farmdale Stade, Loess

Farmdale Drift, Till, Silt

Farmdale Substage, Subage, Glaciation

Farmdalian Substage

Pleistocene (Wisconsin): Mississippi Valley.

M. M. Leighton, 1947, *in* Itinerary State Geologists Conf. on loess deposits-Illinois portion, p. [8]. Names Farmdale(?) and Farmdale loess(?) listed on correlation chart.

M. M. Leighton and H. B. Willman 1950, Jour. Geology, v. 58, no. 6, p. 602–603. Silt deposit which lies on weathered zone and erosional slopes of Illinoian drift and which has very youthful profile of weathering beneath Peorian loess was described by Leighton (1926, Jour. Geology, v. 34) as late Sangamon loess. This is unit named Farmdale (Leighton, 1948, *in* H. L. Wascher, R. P. Humbert, and J. C. Cady, Soil Sci. Soc. America Proc., v. 12, p. 390). Farmdale substage and loess are pro-Wisconsin. Farmdale is older than Iowan. Loess has definite valley relationships to Illinois River valley (ancestral Mississippi), present Mississippi Valley below mouth of Illinois River and Wabash and lower Ohio Valleys. Such a relationship suggests a valley-train source. This, in turn, implies an extension of an ice sheet during Farmdale into drainage basin of ancestral Mississippi prior to Iowan substage but not yet

recognized in series of drift sheets because it fell short of subsequent ice lobes.

J. C. Michelson, 1950, Iowa Acad. Sci. Proc., v. 57, p. 268–269. Loess, exposed in sec. 31, Magnolia Township, Harrison County, Iowa, believed to be equivalent to Farmdale loess of Illinois as defined by Leighton. Thickness 4 feet. Overlies Loveland loess; underlies Iowan loess. A section which shows similar succession of loesses is exposed near St. Charles, Mo. These loesses are called Loveland, Farmdale, and Peorian.

P. R. Shaffer, 1954, Science, v. 119, no. 3098, p. 693–694; 1956, Illinois Geol. Survey Rept. Inv. 198, p. 13–24. Part of glacial drift in northern Illinois formerly mapped as Illinoian is Farmdale in age, the earliest substage of Wisconsin stage. Drift sheet consists of till and widespread deposits of water-laid materials in form of kames, eskers, and kame terraces. So far as known, this is first reported occurrence of glacial drift of Farmdale age. This drift is uppermost drift in northern half of Boone County, in all but small areas in southeastern and northwestern Winnebago County, southeastern Stephenson County, northern Ogle County, and small areas in eastern Carroll and northern Whiteside Counties. The loess (Peorian) cover which varies from a few inches to about 5 feet is usually leached. Farmdale drift passes beneath Shelbyville drift.

G. E. Ekblaw and H. B. Willman, 1955, Illinois Acad. Sci. Trans., v. 47, p. 129–138. Farmdale drift described in vicinity of Danville.

R. V. Ruhe, Meyer Rubin, and W. H. Scholtes, 1957, Am. Jour. Sci., v. 255, no. 10, p. 671–689. New radiocarbon dates in Iowa permit grouping of age values and raise new problems in stratigraphic correlation of late Pleistocene deposits in Iowa and adjacent regions. Older group of ages greater than 29,000 years dates Iowan substage and pre-Iowan deposits. Old group of ages of 22,900 to 25,100 years dates the Farmdale substage. Intermediate group of ages ranges 14,000 to 17,000. A possible interpretation of radiocarbon dates from Iowa places Iowan substage in older position than Farmdale, rather than younger, as hitherto believed. Farmdale is dated in Iowa at 24,500 years B. P.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 174. Discussion of Wisconsin glaciation in Illinois River valley. Farmdale (sub-age, glaciation) is oldest of five advances. Pinkish-colored Farmdale loess was leached to depth of 7 feet before deposition of overlying Peorian loess in those few places where its thickness was that great. Farmdale subage was followed by Iowan subage.

L. R. Ray, 1957, Jour. Geology, v. 65, no. 5, p. 542–544. Farmdale loess recognized in section at Medora, Ky. Thickness about 5 feet. Overlies Loveland loess; underlies Tazewell loess.

J. C. Frye and H. B. Willman, 1960. Illinois Geol. Survey Circ. 285, p. 1, 2, 3, 6, 11–12. Presentation of revised time-stratigraphic classification of Wisconsinan stage of Lake Michigan lobe. Wisconsinan consists of (ascending) Altonian (new), Farmdalian, Woodfordian (new), Twocreekan, and Valderan substages. Farmdalian substage is based on Farmdale slit exposed in Farm Creek area, Tazewell County. Deposits in this stratigraphic position have been known since the last century and for many years were assigned to late Sangamon. Rock-stratigraphic unit, Farmdale silt, consists of massive silt, noncalcareous, light-brown to pale-purple, that commonly contains wood fragments and is locally replaced by peat. Although some Farmdale silt probably was initially deposited as loess during Farmdalian time, it is believed that much of

it was derived by water transport and colluvial action from older Roxana loess (new). Radiocarbon dates from Farmdale silt and peat range from 26,150±600 (W–381) to 22,900±900 (W–68). On the basis of these dates, their positions within Farmdale deposits, and dates from both younger and older deposits, it is herein suggested that the range of radiocarbon years for Farmdalian substage is 28,000 to 22,000. Although till in several areas (Shaffer, 1956; Ekblaw and Willman, 1957 [1955]) has been referred to the Farmdale, present data indicate absence of till of Farmdalian age. It is here concluded that the Farmdalian is the major interval of glacial withdrawal within Wisconsinan as developed in Lake Michigan lobe rather than an episode of glacial advance.

W. D. Thornbury, 1958, Am. Jour. Sci., v. 256, no. 7, p. 457. Possibility exists that some of till that has been considered Tazewell in age in upper Wabash Valley may be Farmdale or Iowan.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–540. Presentation of classification of Wisconsin glacial stage of north-central United States. Farmdale glacial substage, oldest in sequence, is separated from Iowan glacial substage by Farm Creek intraglacial substage (new). Author [Leighton] does not agree with classification presented by Frye and Willman (1960); among the reasons cited one (1) C–14 dates of large pulmate land snails in Roxana silts of Frye and Willman are in question; (2) C–14 dates of wood from black soil, peat, and muck, heretofore referred to as Farmdale substage, belong to boreal Farmdale-Iowan intraglacial substage, the overlying loess being Iowan; (3) no deposit of Wisconsin age intervenes between Farmdale materials Sangamon weathered zone; (4) only humus forest bed, peat, and related materials separate Farmdale loess and drift from deposits below from Iowan loess and Iowan drift above; and (5) Iowan substage is not datable by spurious fragments of wood found in its base but is shown by stratigraphic and other geologic evidence to be younger than Farmdale.

Name amended to Farmdale Stade to comply with Stratigraphic Code adopted 1961.

Named from exposure in Farm Creek section near Farmdale, Tazewell County, Ill.

Farmers Siltstone Member (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 125–126, 128, 129, 130. Even-bedded uniform-grained siltstones generally 25 to 35 feet thick. Included in Bluestone facies (new) of the formation. In type area, underlies 15-foot unnamed shale and siltstone unit and overlies Henley shale member of New Providence formation.

Well exposed at quarry of Rowan County Freestone Co. and adjacent hillside, at village of Farmers, about 6 miles southwest of Morehead, Rowan County. Named for village of Farmers.

Farmington Complex

See Farmington Canyon Complex.

Farmington Sandstone Member (of Kirtland Shale)[1]

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: C. M. Bauer, 1916, U.S. Geol. Survey Prof. Paper 98–K.

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Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Described in Red Mesa area, La Plata and Montezuma Countries, Colo. Middle member of Kirtland; overlain and underlain by unnamed shale members. Consists of thin- to massive-bedded lenses of sandstone separated by shale and sandy silty shale. Thickness about 345 feet.

Well exposed near Farmington, San Juan County, N. Mex.

Farmington Shale Member (of Modesto Formation)

Farmington Shale (in McLeansboro Formation)[1]

Farmington Shale (in McLeansboro Group)

Pennsylvanian: Western and northern Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 309.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 116, 189, 190, 191, 193, 194, 195. Shale is gray to olive green; commonly contains gray ironstone concretions as much as 2 inches thick by 1 foot in maximum diameter. Maximum thickness 50 feet. Locally, in Glasford quadrangle, entirely cut out by Gimlet sandstone. Included in Sparland cyclothem. Overlies Sparland (No. 7) coal, which in turn overlies Copperas Creek sandstone. In McLeansboro group. Derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1), pl. 1. Reallocated to member status in Modesto formation (new). Underlies Gimlet sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois.

Type locality: Outcrops in Farmington Township, T. 8 N., R. 4 E., Fulton County.

Farmington Canyon Complex

Precambrian: North-central Utah.

A. J. Eardley, 1939, Geol. Soc. America Bull. v. 50, no. 8, p. 1282, pl. 1, Rocks of Farmington Canyon complex crop out in mouth of Little Cottonwood Canyon.

A. J. Eardley and R. A. Hatch, 1940, Jour. Geology, v. 48, no. 1, p. 59 (fig. 3), 61–72. Name given to large group of crystalline rocks in north-central Utah area. Rocks are distinctly stratified throughout region. Contains metamorphosed mafic rocks, injection gneisses, silicic igneous rocks, and metamorphosed sedimentary rocks. Type locality stated.

A. J. Eardley and R. A. Hatch, 1940, Geol. Soc. America Bull., v. 51, no. 6, p. 810 (fig. 3), 815. In Willard Canyon [between Ogden and Brigham City] underlies Tintic quartzite.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 823, 827. Thickness about 10,000 feet. Underlies an ancient sequence which is probably Upper Proterozoic and in part Lower Cambrian.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 34–36, 37 (fig. 2). Precambrian rocks of western Uinta Mountains and central and northern Wasatch Mountains are divisible into two main groups. Older group is divisible into two sequences: older, Farmington Canyon complex, and younger, Little Willow series. Most of the description of Farmington Canyon is based on an unpublished thesis by Larsen (1957).

Type locality: Farmington Canyon and Bountiful Peak, Davis County.

Farm Ridge Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 161–162. Largely till but includes sand and gravel as lenses in the till, in kames, in one large esker, in subglacial channels, and as outwash deposits in front of the moraine and overlying the ground moraine; till is medium to light gray, yellowish, or brownish, silty, clayey. Thickness in Farm Ridge moraine commonly 30 to 40 feet, although in some of higher hills as much as 60 feet; in ground moraine commonly 5 to 15 feet. Overlies Bloomington till. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Named for Farm Ridge post office at one time located on prominent part of moraine about 5 miles west of Grand Ridge in Farm Ridge Township, Streater quadrangle, La Salle County.

Farragut Limestone

Middle Ordovician: Northeastern Tennessee.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1156–1157. Proposed for coarsely crystalline variegated limestone, or marble (of Knoxville and surrounding area) which overlies Lenoir limestone (restricted) and underlies Tellico sandstone. Thickness 115 feet. Zone has been referred to stratigraphically as "Holston" marble in this area and represents principal zone quarried for commercial "Tennessee marble"; just east of Knoxville along Holston River, Keith (1895) assigned name "Holston" to lentils of variegated marble occurring within Chickamauga limestone; since term was originally assigned to type of lithology occurring at different horizons, term "Holston" is of no significance as definite formational unit.

Type section: Appalachian Marble Co. quarry, 1.4 miles due east of Lowes Ferry. Named for site of Admiral Farragut homestead at Lowes Ferry on Tennessee River 9.5 miles southwest of Knoxville.

Farrer Formation

Farrer Member or facies (of Price River Formation)

Farrer Noncoal-Bearing Member (of Price River Formation)[1]

Upper Cretaceous: Central eastern Utah and central western Colorado.

Original reference: D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

Teng-Chien Yen, 1954, U.S. Geol. Survey Prof. Paper 254–B, p. 59, 60, 62. Listed in fossil collection locality data both as formation and as member of Price formation.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187, 191–192, figs. 2, 3, pl. 3. Beds of coarse to fine sandstone, shale, and sandy shale. Do not contain appreciable coal although a few thin beds found at various horizons. Lenslike sandstones constitute bulk of rocks and are somewhat darker than sandstones in Neslen facies. Shales mostly gray but in places olive green. Castlegate member included in base of Farrer facies west of Woodside and in top of Neslen facies eastward. Rocks thicken from about 1,200 feet in Price River Canyon, Utah, to about 1,500 feet near Palisade, Colo. Facies comprises whole of formation at Price River Canyon but only upper part of formation near Palisade. Upper boundary coincides with that of formation and underlies North Horn formation with transitional contact in Price River Canyon and

disconformably underlies Tuscher formation east of Green River. Montana age.

Named for local mine in Coal Canyon, Utah. In Book Cliffs.

Farrington Sand Member (of Raritan Formation)

Upper Cretaceous: East-central New Jersey.

H. C. Barksdale and others, 1943, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 104–140. Medium- to fine-grained sand (No. 1 sand of previous reports) in lower part of Raritan between Woodbridge clay above and Raritan fire clay below. Separated from Sayreville sand member (new) by Woodbridge clay. Lower part, 10 to 20 feet thick, is coarse, arkosic, light-gray, or light-yellow sand commonly containing sprinkling of small pebbles. Arkosic material, as seen in outcrop, is partly kaolinized, the white kernels of the partly decomposed feldspar standing out in contrast to the gray and yellow sand and gravel; occasionally the gravelly beds contain numerous small chunks of red and white clay. Lenses of clay, commonly only a few feet thick, are present, and thin clay seams are fairly common within limits of member. Thickness 80 feet. Most of the discussion deals with relation of unit to ground-water supply. In this report, Woodbridge and Raritan clays are considered informal economic names.

Crops out in band nearly 1 mile wide along southeast edge of Farrington Lake, Middlesex County.

Far Rockaway Gravels[1]

Tertiary: Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, pl. 1, map.

In Oyster Bay and Hempstead quadrangles, Long Island.

Fashing Clay Member (of Whitsett Formation)

Fashing Clays[1]

Eocene, upper: South-central Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1315.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2633–2634. Termed member of Whitsett. At designated type locality, thin fossiliferous sandstone, less than 1 foot thick and containing *Corbula*-type pelecypods, overlies olive-gray bentonitic clay containing coquinas of *Corbula*, *Ostrea*, and other pelecypods, and septarian calcareous concretions. This section, about 20 feet thick, is exposed on western valley wall of small branch on Hierholzer Ranch. Elsewhere banks of oyster shells are found. Overlies Calliham sandstone member; overlain by Olmos sand of Ellisor (1933).

Type locality: About 1.8 miles south of Fashing School, and one-quarter mile south of sharp curve on Farm Road 99 where highway from Fashing to Whitsett bends from a southerly to southwesterly direction. Named for exposures around town of Fashing, Atascosa County.

Faulconer Formation

Faulconer Limestone Member (of Perryville Formation)[1]

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste. 1912, Denison Univ. Sci. Lab. Bull. 17, p. 23, 32, 131, 132.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 992. Exposure in northern Jessamine County seems to indicate that the Faulconer and Salvisa are not entirely distinct stratigraphic units but are lithologic facies, in part contemporary.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1640. Term Perryville is synonym of Benson; name Devils Hollow division of upper Lexington is proposed for post-Woodburn "Perryville" of Frankfort-Versailles area. At its type section, the Devils Hollow includes 15 feet of "Faulconer" rock and 10 feet of the "Salvisa".

J. A. Stokley and F. H. Walker, 1953, Kentucky Geol. Survey, ser. 9, Rept. Inv. 8, p. 44, 45. At Harrodsburg, Mercer County, Faulconer formation is 18½ feet thick; underlies Salvisa formation.

Named for Faulconer, Boyle County.

Fauquier Formation

Precambrian: North-central Virginia.

A. S. Furcron, 1939, Virginia Geol. Survey Bull. 54, p. 1, 37–41, pl. 1. Series of marbles, graphitic slates and graphitic schists, mica schists, and biotite-garnet gneisses. In vicinity of Fauquier White Sulphur Springs and west of Piney Mountain, it is extensively intruded by dikes of greenstone, amphibolite, or metagabbro of Catoctin age. Oldest rocks of sedimentary origin in area [Warrenton quadrangle]. Underlies Precambrian Catoctin volcanic series and locally Warrenton agglomerate member (new) of Catoctin. Rocks of Fauquier were formerly classified with Loudoun formation of Cambrian age.

Named for exposures in vicinity of Fauquier White Sulphur Springs, Fauquier County. Formation enters quadrangle from north where it follows west side of Watery Mountain and extends southwestward through quadrangle.

Favret Formation

Middle Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Thin-bedded black bituminous limestone and interbedded black shale, generally underlain by massive dark-gray to brown dolomite. Thickness at type locality 800 feet; locally much thinner. Conformably underlies Augusta formation (new); overlies Dixie Valley formation (new), contact gradational.

Type locality: Favret Canyon, west slope of Augusta Mountain.

Faxon Limestone[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. M. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs above Dixon schist and below Swede Pond quartzite.

Type locality: Faxon Pond, Warren County.

Fayette Breccia[1]

Middle Devonian: Northeastern Iowa.

Original reference: W. J. McGee, 1884, 10th Census, v. 10, Rept. on Building stones, p. 262–263.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 69. It may be interpolated that term "Fayette breccia" as used by Calvin (1898 Iowa Geol. Survey, N. 8) included basal Cedar Valley beds and that, in all cases where "Fayette breccia" lies above Independence shale, it is basal Cedar Valley and not the lithographic Davenport ("Lower Davenport of Norton").

Occurs at Fayette, Fayette County, Quasqueton, Buchanan County, and elsewhere.

Fayette facies (of Flagstaff Formation)

Paleocene, upper: Central Utah.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 29, pl. 11. Consists of light-gray to buff extremely dense massive locally fossiliferous limestone. Thickness of nearly 500 feet on north side of Mellor Canyon. Unconformably overlies Price River formation. Exact correlation of Fayette facies with Flagstaff of other areas not known; believed to be roughly correlative with unit B of Valley Mountain facies (new).

Particularly well exposed on north side of Mellor Canyon about 2 miles north-northeast of village of Fayette, Gunnison quadrangle.

†Fayette Sandstone[1]

Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 497.

Named for Fayette Station, Fayette County, W. Va.

†Fayette Sandstone[1] or Formation

Eocene (Jackson): Northwestern Louisiana and eastern and southern Texas.

Original reference: E. T. Dumble and R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. xxxiii, 17, 47, 57, 58, 63.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 266–270. Fayette formation described in area between Laredo and Rio Grande City, Tex. Classification followed is that of Kane and Gierhart (1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9) in which names Fayette and Jackson are used synonymously; it is understood that Fayette has been restricted so that some of beds of lower Jackson are not now included in Fayette. Thickness in Starr County about 1,500 feet. Contains three prominent marine sandstone tongues separated by shaly beds of marginal to nonmarine facies. Named units include (ascending) Salineno sandstone tongue, Resendez shale member (new), Roma sandstone tongue. Gorgora shale member (new), Sanchez sandstone tongue, Agua Verde shale member (new), and Villa Nueva sandstone member. Overlies Yegua formation; underlies units termed uppermost Jackson.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2625–2626. History of usage summarized. On the basis of recent fieldwork, it is believed that the Jackson of west Gulf Coastal Plain should be classified as a group and that name Fayette, of varied usage in the past, be abandoned.

Named for Fayette County, Tex. Section exposed at Lipan Hills, Atascosa County, as described by Dumble (1924) has been regarded as type section.

Fayetteville Shale[1]

Fayetteville Formation

Upper Mississippian: Northern Arkansas, southern Missouri, northeastern, central, and eastern Oklahoma.

Original reference: F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. 26, 42–49.

R. A. Brant, 1941, *in* Tulsa Geol. Soc. [Guidebook] Field Trip, Oct. 18. strat. sections. In Tulsa-Choteau-Grand River area, overlies Grand River limestone (new) and underlies Pitkin limestone or rocks of Morrow age.

W. H. Easton, 1942, Arkansas Geol. Survey Bull. 8, p. 17 (table), 19–20; K. C. Jackson, 1959, Fort Smith Geol. Soc. Guidebook 1st Field Conf., p. 56. In Arkansas, includes Mayes limestone member near base.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 267–268. Geographically extended into Missouri where it occurs in outliers of Boston Mountains, Reed Mountain, Lennox Mountain, and Oakleigh Mountain. Consists of black fissile carbonaceous shale and thin lenticular beds of dark-gray limestone; contains discus-shaped concretions of earthy limestone. Overlies Batesville sandstone; underlies Pennsylvanian Hale sandstone.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 66–71. Described on flanks of Ozark uplift in northeastern Oklahoma. Formation is typically developed on Bragg Mountain escarpment where it is 110 feet thick. Lower 95 feet is largely black fissile shale with thin interbeds of blue-black lithographic limestone; upper part consists of interbedded limestone and shale; grades upward into overlying Pitkin through 6½-foot zone of rubbly nodular-weathering black to gray lithographic limestone; in eastern Adair County 165 feet thick; lower 100 feet consists of black fissile shale with black lithographic septarian concretions; overlying Wedington sandstone member is as much as 25 feet thick. Unconformably overlies Hindsville limestone; where Hindsville is absent, the Fayetteville rests upon "Boone" chert knobs; where the Pitkin is missing Hale formation rests upon the Fayetteville; in northernmost exposures in Craig County, succeeded unconformably by sandstones and shales of Middle Pennsylvanian age.

K. C. Jackson, 1959, Fort Smith Geol. Soc. Guidebook 1st Field Conf., p. 55–56. Fayetteville, in area of this report [southwestern Washington County, Ark.], is divided into four units. Major part of formation is lower black shale member; near base of this unit is a locally developed limestone known as Mayes limestone member. Lower shale member is overlain by Wedington shale member. Upper member is light-colored silty shale. Thickness 100 to 247 feet. Underlies Pitkin formation. Chesterian.

Named for Fayetteville, in valley of West Fork of White River, Washington County, Ark.

Faywood Rhyolite

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 37, pl. 1. Described as two domelike plugs of cream-colored fine-grained flow-layered rhyolite. Also minor flows. Both plugs intrude Rubio Peak flows and Sugarlump tuffs.

One plug forms Mimbres Mountain in secs. 17, 18, 19, 26, T. 20 S., R. 10 W.; other plug located near Faywood Hot Springs, in secs. 15, 16, 21, 22, T. 20 S., R. 11 W., Dwyer quadrangle.

Fearn Springs Sand Member (of Nanafalia Formation or Wilcox Formation)

Fearn Springs Formation

Eocene, lower: Mississippi and Alabama.

F. F. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 33–37. In this report [Winston County] four divisions of Wilcox series are recognized: Fearn Springs (new), Ackerman, Holly Springs, and Hatchetigbee. In complete section, Fearn Springs formation lies disconformably on lignite of Betheden formation (new) and is disconformably overlain by grit-bearing arkosic(?) sand of Ackerman formation. Contains ball-type clays, stoneware clays, silty clays, silt, sand, lignite, and siderite. Thickness 0 to more than 50 feet. Fearn Springs is possibly equivalent to Ackerman formation as limited in Alabama by Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2) or to Coal Bluff series of Langdon (1895). At time of Cooke's correlation, the Ackerman was defined as all the Wilcox below Holly Springs formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Mapped as sand member of Wilcox formation.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 47 (fig. 1). Correlation chart shows Fearn Springs (sand) member at base of Wilcox group (undifferentiated) in Mississippi.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 18–19. Redefined as member of Wilcox formation in Mississippi and member of Nanafalia formation in Alabama. Unit is more of a channel sand in Alabama than in Mississippi. Thickens and thins greatly along strike. Maximum thickness in Alabama 80 feet, in western Butler County. In area of type locality, in addition to fine-grained sands and clay originally assigned to unit by Mellen, it also includes coarse sand (originally considered to be colluvium) exposed farther downhill from type locality but actually forming main part of member. In Mississippi, member varies both in thickness and texture, but in general thickest sections carry coarsest material. Greatest thickness, about 100 feet, and very coarse throughout, is in northern Lauderdale and southern Kemper Countries. Fine-grained sands and clays which commonly mark top of member are lenticular; some lenses pinch out completely within single exposure. Member thins northward, becomes finer textured, and, in northern Mississippi, is indistinguishable from overlying Wilcox.

F. F. Mellen, 1950, Mississippi Geol. Survey Bull. 69, p. 7–20. Discussion of confusion existing in use of term Fearn Springs. Proposed that section of Fearn Springs clays at Flat Rock Church be regarded as alternate locality of formation. At this locality, basal Ackerman gritty sand which caps ridge overlies stoneware clays of Fearn Springs, at top of which is fossil leaf-bearing ironstone. About 300 yards to the west, Betheden kaolin is exposed in stream channel.

F. S. MacNeil, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1062–1073. Report is reply to Mellen's (1950) article. Evidence is presented to show that Mellen's interpretation of type locality was erroneous. From section compiled at Fearn Springs, based in part on auger hole, it is shown that upper part of Fearn Springs member (of Wilcox

formation) consists of about 28 feet of laminated to slightly crossbedded fine sandy or silty micaceous clay. Above this lies coarse red sand that Mellen called basal Ackerman sand, Below silty clay is concealed interval of 19 feet, and below this is exposed 27½ feet of coarse crossbedded sand some fine gravel and clay balls. Much of the disagreement between Mellen and writer [MacNeil] hinges on this lower unit of coarse sand, found to have total thickness of 34½ feet. This same sand in nearby exposures can be seen to be the sand Mellen included in most other sections as his basal Ackerman sand. Probably this accounts for Mellen's failure to map the Fearn Springs and Ackerman separately in Winston County. This 34½-foot unit of coarse sand is in turn underlain by 12½-foot interval composed of tough silty clay, coarse sand, clay balls, and sand containing lignitized logs that probably represents Betheden formation as defined by Mellen. There are, therefore, two coarse sands: one below the silty clay phase of the Fearn Springs and another above it. Mellen believes that only one sand exists. This erroneous interpretation led to the following misapplication of names: (1) sand in lower part of type exposure of Fearn Springs, which Mellen believed to be colluvium, is in reality in place; in other exposures, Mellen has termed unit basal Ackrman sand: (2) name Fearn Springs was applied to part of Naheola formation at surface in Lauderdale and Kemper Counties, Miss., (Foster, 1940, Mississippi Geol. Survey Bull. 41) and to entire Naheola formation in subsurface in both Alabama and Mississippi (Mellen, 1950): and (3) Naheola, as used by Mellen (1950) in his subsurface diagrams, includes mainly Matthews Landing marl bed of Smith and Johnson (1887), a zone of fossiliferous greensand and clay that was once regarded as basal part of Naheola formation, but is now designated Matthews Landing marl member of Porters Creek clay. Also suggested that name Fearn Springs be made to include Betheden unit and name Betheden be abandoned.

J. S. Attaya, 1951, Mississippi Geol. Survey Bull. 71. p. 8–10. Fearn Springs formation overlies Porters Creek formation in Lafayette County. Most data from drill holes.

T. W. Luck, 1956, Mississippi Geol. Survey Bull. 80, p. 18–25. Formation described in Benton County where greatest exposed thickness is about 103 feet at Hickory Flat, lower contact not exposed. Underlies Ackerman formation; overlies Betheden formation.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 143–165. Described in Kemper County where it is treated as basal member of Nanafalia formation.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 98. Sand beds included in Gravel Creek member (new) of Nanafalia have been called Fearn Springs sand member. However, name Fearn Springs is not used in this report for lower member of Nanafalia in Alabama because boundary positions at Fearn Springs type locality are in dispute and stratigraphic relationships with section in Alabama are uncertain.

Type locality: SE¼NE¼ sec. 3, T. 13 N., R. 14 E., one-fourth mile west of Fearn Springs, Winston County, Miss. Alternate locality: At Flat Rock Church (old Hurley School) near center sec. 9, T. 5 S., R. 2 E., Benton County, about one-half mile west of Tippah County line.

Federal Hill Beds (in Patapsco Formation)[1]

Lower Cretaceous: Northeastern Maryland.

Original reference: L. F. Ward, 1905, U.S. Geol. Survey Mon. 48, p. 566–569, 598.

At Federal Hill, in Baltimore.

Felch Formation (in Menominee Group)

Felch Schist[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 303, 307.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Name Felch formation used in preference to lithologic term schist. In type locality, designated strata occur between Randville dolomite and Vulcan iron-formation; in Menominee district, term Felch formation is applied to distinctive sericitic slate-quartzite sequence which similarly lies above Randville dolomite and below the Vulcan iron-formation and which has been referred to as "Traders quartzite" and "Footwall slate." Forms basal unit of group.

Named for typical development at Felch Mountain, Dickinson County.

†Felch Mountain Iron-Bearing Series[1]

Precambrian (Huronian): Michigan.

Original references: C. R. Van Hise, 1892, U.S. Geol. Survey Bull. 86, p. 195; 1892, U.S. Geol. Survey Mon. 19, p. 473.

Felch Mountain district.

Feldt Ranch Beds (in Ash Hollow Formation)

Pliocene: Southwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 141. Name applied to 15 feet of beds of loose crossbedded sand and gravel, cemented grit, and porous limestone that occur in lower part of Ash Hollow formation in type section of the Ogallala.

Type locality: On north side of South Platte Valley, 2 to 2½ miles east and northeast of Ogallala, Keith County. (Also type locality of Ogallala.)

Feliz Granodiorite

Pre-Cretaceous(?): Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 7 (table 1), 12–14, pl. 1. Name applied to fine- to medium-grained granodiorite that occurs in Feliz pluton. Except for microbreccia in western end of Riverside fault block, Feliz granodiorite is confined to Mount Hollywood fault block where it is in intrusive-fault contact with older quartz diorite and with metamorphosed basic igneous rocks. Suggested sequence of intrusion in area is Vermont quartz diorite (new), Lar quartz diorite (new), and Feliz granodiorite.

Exposed in Griffith Park and for short distance south of Los Feliz Blvd., city of Los Angeles.

Fena Beds

Eocene: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 51, table 4 [English translation in library of U.S.

Geol. Survey, p. 61, 62; S. Hanzawa in Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 31–32. Conglomerate with very little liparitic material; pebbles are chiefly andesite and greenish shale, and considered to have originated from underlying Santa Rosa beds. Unconformably underlies Asan limestone. Correlated with Densinyama formation of Saipan.

Type locality: Fena, Guam.

Fence Lake Gravel

Tertiary-Quaternary: Central western New Mexico.

R. J. Marr. 1960, (abs.) Arizona Geol. Soc. Digest, v. 3, p. 181. Incidental mention.

Present on Lynch Ranches, 23 miles east of St. Johns, Ariz. Town of Fence Lake is in Valencia County.

Fencepost limestone[1]

Fencepost limestone bed (in Pfeifer Shale Member of Greenhorn limestone)

Upper Cretaceous: North-central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 50.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 111. Bed at top of Pfeifer shale member. Blue gray, weathers to light tan.

Extensively quarried for fence posts near Downs, Osborn County.

Fence River Formation (in Baraga Group)

Precambrian (Animikie Series): Northern Michigan.

J. E. Gair and K. L. Wier, 1956, U.S. Geol. Survey Bull. 1044, p. 14 (table 2), 57–58, pl. 1. Name applied to magnetic rock exposed at Sholdeis exploration where it consists of (ascending) (1) magnetite-specularite-quartz rock, (2) thinly banded rock rich in quartz, magnetite, hornblende, and epidote, and (3) massive garnet-grunerite schist. Estimated thickness probably as much as 250 feet. Conformably overlies eastward-dipping Hemlock formation; underlies biotite-quartz schist that resembles schists of Hemlock formation. If this schist were considered to be part of the Hemlock, the Fence River would be an upper member of the Hemlock; if the schist is considered a basal member of Michigamme slate, the Fence River is a distinct formation between the Hemlock and Michigamme; the latter view is adopted in this report.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Assigned to newly defined Baraga group of Animikie series.

Only known exposure is in SE¼NE¼ sec. 21, T. 45 N., R. 31 W., Baraga County. Formation is represented by strong linear north-trending magnetic anomaly crossing northeastern part of area, on east flank of the Amasa oval, extending northward beyond Kiernan quadrangle to the exposure at Sholdeis exploration. Named for Fence River, which crosses magnetic belt 1,100 feet south of the exploration.

Fenner Granite Gneiss

Precambrian: Southern California.

J. C. Hazzard and E. F. Dosch, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 309. Granite gneiss, in part augen. Considered younger than Essex series (new) and older than Kilbeck granite gneiss (new).

Well exposed at Mountain Springs in Piute Mountains, in northern Old Woman Mountains and at Chubbuck, San Bernardino County.

Fentress Formation

Fentress shale division (of Lee Formation)[1]

Pennsylvanian (Pottsville Series): Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Div. Geology Bull. 33–B, p. 276, 384, 385.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 4. Glenn used name Fentress shale to include all strata of Pennsylvanian age beneath Rockcastle conglomerate in Fentress County and vicinity, where these beds are primarily shale and where Sewanee conglomerate is too thin to be mapped. Name is here changed to formation because of local occurrences of sandstone. Definition, however, remains the same. Formation includes beds equivalent to parts of two groups: the entire Gizzard group and all of Crab Orchard Mountains group (new) below Rockcastle conglomerate; hence, it is equivalent to Raccoon Mountain formation (new). Warren Point sandstone, Signal Point shale (new), Sewanee conglomerate, Whitwell shale, Newton sandstone, and Vandever formation. In localized areas, some of the constituent formations are recognizable. Name, Fentress formation, is used only where Sewanee conglomerate is not mappable.

Probably named for development in Fentress County.

Ferdig Shale Member (of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2794–2795; 1959 Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1). Inconspicuous disconformities divide member into three units (ascending): dark-gray shale containing maroon-weathering layers of dark-gray syngenetic ferruginous dolostone and few thin beds of bentonite; micromicaceous silty bentonitic shale characterized by abundant surface litter of small thin flakes of rusty iron-stained shale, which contain gray and yellow-weathering concretionary limestone beds, secondary gypseous concretions, sandy shale, and thin persistent layers of sandstone; and dark-gray shale or sandy siltstone with thin layers of gray limestone concretions. Thin layer of pebbly sandstone present at top of middle unit and persists from type section southward for more than 100 miles. Total thickness of member at type section about 225 feet. Disconformably underlies Kevin shale member (new); overlies Cone calcareous member (new):

Type section: Composite from exposures 3 to 5 miles northwest of Ferdig and from outcrops 8 miles southeast. Name derived from post office of Ferdig at SE cor. sec. 30, T. 35 N., R. 1 W., Sunburst quadrangle, Toole County, which is located over the subcrop of member on east flank of Kevin-Sunburst dome.

Ferdinand Limestone (in Mansfield Group)

Pennsylvanian (Pottsville): Southwestern Indiana.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 87 (fig. 1), 88, 89. Consists of black shiny opaque chert with casts of productids and dark-blue gray argillaceous dull limestone. Thickness about 2 feet.

Lies about 20 feet below top of group; separated from underlying Fulda limestone (new) by about 15 feet of shale, underclay and coal.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2), 19. Included in Ti Valley series (new).

Well exposed northeast of Ferdinand in T. 3 S., R. 4 W., and west of Ferdinand State Forest, Dubois County.

Ferguson Gypsum Member (of Blaine Gypsum)[1]

Permian: Western Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 47.

Named for Ferguson, Blaine County.

Ferguson Mountain Formation

Permian (Wolfcampian-Leonardian): Eastern Nevada.

J. S. Berge, Apr. 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 10 (fig. 2), 18–24, pl. 4, chart (strat. section). (Footnote on chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., 1960, p. 91, 106–107. Road logs in guidebook dated Sept. 8–10.). Ferguson Mountain formation is named for thick carbonate sequence overlying Ely limestone at Ferguson Mountain. Steele (1959, unpub. thesis) termed part of this the Ferguson Spring[s] formation, but name and type locality he selected are ill chosen. Therefore Ferguson Spring[s] formation is herein redefined and name Ferguson Mountain formation proposed. This proposal is based on applicability of name to topographic sheet (Elko NK 11–12) of area. The area on topographic sheet is referred to as Ferguson Mountain, not Ferguson Springs Mountains. Type section is in secs. 21 and 22, T. 30 N., R. 69 E., Elko County. Measured section obtained on east side of Ferguson Mountain on spur directly north of principal east-trending canyon on this part of mountain. In adjacent areas surrounding spring area, southeastern side of Ferguson Mountains near U.S. Highway 50, no Ferguson Mountain formation is present. Geology there consists instead, of Guilmette limestone, Ely limestone, Tertiary volcanics, and Quaternary and Recent alluvium. Area is complexly folded, and is fractured by faulting. [c] Seventeen hundred feet to the west in the southern part of the mountain, fault block of Ferguson Mountain formation is juxtaposed against various rock types but cannot be considered type section. Steele (1959) dates this section Upper Lower Missourian to Upper Upper Wolfcampian with total thickness of 3,085 feet, of which 1,111 feet is Pennsylvanian and remaining 1,974 feet is assigned to Lower Permian. He [Steele] also extends lower part of his formation to Mid-Pennsylvanian disconformity with upper limit in contact with Pequop formation of Leonardian age. Ferguson Mountain formation consists predominantly of dark-gray to light-gray limestones. Thickness 1,985½ feet, of which 1,717½ feet is assigned a Wolfcampian age and 268 feet lower Leonardian. Underlies Pequop formation; overlies Ely limestone. On chart (stratigraphic section) Ferguson Mountain is shown above Strathearn formation and below Pequop formation.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart), 1428 (fig. 3). Name appears on chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian

strata. Underlies Pequop formation; stratigraphically above Strathearn(?).

Type section: Secs. 21 and 22, T. 30 N., R. 69 E., Elko County. Measured section on east side of Ferguson Mountain.

Ferguson Springs Formation

Pennsylvanian-Permian: Northeastern Nevada and western Utah.

J. S. Berge, Apr. 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 11 (fig. 3), 18. (Footnote on stratigraphic chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf.) Steele (1959, unpub. thesis) named Ferguson Spring[s] formation. His name and type locality were ill chosen and Ferguson Spring[s] formation is herein redefined and renamed Ferguson Mountain formation. Correlation chart (in column credited to Steele) Ferguson Springs formation unconformably overlies Ely limestone and underlies Pequop formation. Pennsylvanian (Missouri-Virgil) and Permian (Wolfcamp).

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart), 101, 104 (pl. 5, fig. 3). (Road logs dated Sept. 8–10). Name applied to those limestones occurring above the middle Pennsylvanian regional unconformity and stratigraphically below Pequop formation of Leonardian age. Light- to medium-gray, crypto- to fine-crystalline, bioclastic, silty, limestone sequence with thin interbeds of bituminous shale. Thickness 3,185 feet at type section. Lower 1,101 feet dated upper Pennsylvanian in age, with lower 592 feet assigned to Missourian, and remaining 519 feet to Virgilian. Upper 1,984 feet dated Wolfcampian. At nearly all known localities, including type area, formation rests disconformably on Ely limestone.

Type section: Sec. 16, T. 30 N., R. 69 E., Elko County, Nev. Named for Ferguson Springs, 1½ miles south of measured section.

†Fernandan system[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lvi, 267–276.

Named for San Fernando Creek, Llano County.

Fernando Formation

Fernando Group[1]

Pliocene and Pleistocene: Southern California.

Original reference: G. H. Eldridge and R. Arnold, 1907, U.S. Geol. Survey Bull. 309.

D. L. Durham and R. F Yerkes, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. Group includes Repetto formation below and unnamed conglomeratic and siltstone sequence above. Overlies Sycamore Canyon member of Puente formation; underlies La Habra formation. Pliocene.

U.S. Geological Survey currently classifies the Fernando as a formation and designates its age as Pliocene and Pleistocene on the basis of a study now in progress.

Named for exposures in San Fernando Valley, Los Angeles County.

Fern Creek Formation (in Chocolay Group)

Precambrian (Animikie Series): Northern Michigan.

F. J. Pettijohn and F. A. Hildebrand, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1927. Named Fern Creek conglomerate; in unfaulted contact with reddish granite gneiss and pegmatite; contains large subrounded boulders derived from subjacent pre-Huronian and truncates, at an angle of 30° or more, the foliation of these basement rocks. Underlies Sturgeon quartzite.

F. J. Pettijohn, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1289. Formation includes at top a 100-foot thick tillite member, containing 2 to 5 percent of siltstones as much as 6 feet in diameter scattered in fine-grained nonbedded graywacke matrix; tillite is underlain by thinly laminated member characterized by scattered rafted cobbles; this bed grades down into pebbly arkoses and coarse granite-bearing conglomerates which lie unconformably on a granite gneiss basement. Tillite cannot be, by any correlation currently accepted, the correlative of Canadian Cobalt (Gowganda) tillite.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 35. Formation is basal unit in newly defined Chocolay group.

Occurs near Fern Creek, Dickinson County.

Ferndale Sandstone

Pliocene, upper: Northwestern California.

H. D. MacGinitie, 1943, California Div. Mines Bull. 118, pt. 3, p. 633. Fine-grained gray sandstone with thin interbed of clay shale. Thickness about 2,500 feet. Underlies Wildcat formation; overlies Pico formation.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 33. Name Ferndale sandstone abandoned. Unit redefined as Scotit Bluffs sandstone.

Occurs in central and southern Humboldt County.

Fern Glen Limestone

Fern Glen Limestone (in Osage Group)[1]

Fern Glen Member (of Chouteau Formation)

Lower Mississippian (Osage Series): Eastern Missouri and southwestern Illinois.

Original reference: S. Weller, 1906, St. Louis Acad. Trans., v. 16, p. 438.

J. M. Weller, 1939, *in* Stuart Weller and J. M. Weller, Illinois Geol. Survey Rept. Inv. 59, p. 8, pl. 1. Formation crops out only on Valmeyer anticline, and exposures occur from Dennis Hollow northward to SW¼ sec. 35, T. 2 S., R. 11 W. Consists chiefly of deep red more or less argillaceous limestone with interbedded shale. Thickness about 50 feet. Underlies Burlington-Keokuk limestone.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 198–199. Interpreted as member of Chouteau formation.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 20. In certain parts of Ozark border area in western St. Clair and Monroe Counties, and possibly in northwestern Jackson County, Fern Glen limestone, of early Osage age, directly overlies Moccasin Springs formation (new) of the Niagaran.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook Field Trip St. Louis Mtg., p. 24 (fig. 3), 50 (fig. 9), 51. Chautauqua, Jersey County, Ill., is northernmost outcrop at which Fern Glen is both characteristically and well exposed. Here it has lost its distinctive red color. Shale grades upward into crinoidal limestone of Burlington; the contact is placed at point where chert nodules lose their greenish color; and the limestone becomes relatively pure. In some areas, consists of light-greenish-gray crinoidal limestone containing greenish-gray chert bands. In vicinity of Jerseyville, the Fern Glen cannot be differentiated from lower Burlington, thus indicating that it is actually a shaly facies of the Burlington. Overlies Sedalia dolomite. Valmeyer series [which includes Osage group]. Thickness about 20 feet.

Named for occurrence near Fern Glen Station, 20 miles west of St. Louis, St. Louis County, Mo.

Fernow Gneiss

Pre-Ordovician(?): North-central Washington.

E. A. Youngberg and T. L. Wilson, 1952, Econ. Geology, v. 47, no. 1, p. 2–4, 12. Name applied to series of quartz-amphibole gneisses, thickness of which is unknown because they extend outside mapped area. Age sequence not clear; it would appear that Fernow units is older than less metamorphosed Buckskin and Martin Ridge schists (both new); this would require that beds be overturned because Fernow gneisses lie stratigraphically above schists.

Named for occurrence in vicinity of Mount Fernow, near Holden, Chelan County.

Fernow Quartz Latite

Fernow Rhyolite[1]

Eocene, middle: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, pl. 74.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 30–32. Referred to as quartz latite.

U.S. Geological Survey currently considers the Fernow Quartz Latite to be middle Eocene in age.

Named for Fernow Canyon in southern part of Tintic district.

Fern Ridge Tuffs[1]

Miocene or Pliocene, lower and middle: Northwestern Oregon.

Original reference: T. P. Thayer, 1933, Pan-Am. Geologist, v. 59, no. 4, p. 317.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 8, fig. 1. Consist of conglomerates, tuffs, and breccia; lower beds are mainly tuffs, sandstones, and fine pebble beds; upper part comprises coarse andesitic conglomerates which contain boulders as much as 18 inches in diameter in tuffaceous matrix. Maximum thickness about 1,500 feet, northeast of Mehama. Conformably overlies Stayton lavas and are probably part of same general sequence. Mehama volcanics (new), Stayton lavas, and Fern Ridge tuffs are traceable as distinct formations to crest of Mehama anticline. Miocene.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 15–16, pl. 2. Overlie Columbia River basalt and underlie lava of Pliocene or younger age. Tuffs can be traced northward into Molalla River drainage where they have been referred to correlative Molalla formation. Age shown on chart as lower and middle Pliocene.

Type locality: Fern Ridge, about 5 miles northeast of Stayton, Marion County.

Fernvale Limestone or **Formation** (in Richmond Group)[1]

Fernvale Formation (in Patterson Ranch Group)

Upper Ordovician: Western Tennessee, northwestern Alabama, northern Arkansas, southwestern Illinois, southeastern Missouri, and central eastern, and northeastern Oklahoma.

Original reference: C. W. Hayes and E. O. Ulrich, 1903, U.S. Geol. Survey Geol. Atlas, Folio 95, p. 2.

W. H. Shideler, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 367–368. The "Fernvale" extending from Glen Park, Mo., and Valmeyer, Ill., to south side of Arbuckles in Oklahoma, is a massive uniformly crystalline limestone with varied fauna of ostracods and trilobites; this differs from typical Fernvale. Name Ada is proposed for the crystalline limestone.

J. M. Weller, 1939, *in* Stuart Weller and J. M. Weller, Illinois Geol. Survey Rept. Inv. 59, p. 7. Exposed in limited area in Kimmswick quadrangle where Ordovician rocks are brought to surface in Mississippi River bluff at crest of Valmeyer anticline. Consists of brownish coarsely crystalline limestone with many fossils. Thickness 6 to 14 inches. Overlies Kimmswick limestone; underlies Maquoketa shale.

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 153, 154 (table 1). Formation included in Patterson Ranch group (new). Overlies Viola; underlies Sylvan.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 92–93. Chiefly limestone with considerable amount of impurities, in some places highly siliceous. Commonly light gray but ranges from nearly white to brown or reddish tints. Lies on various members of Kimmswick; unconformable below Maquoketa formation. Thickness about 4 feet. Lowest Upper Ordovician in Missouri; correlates with part of Arnheim of Kentucky; continuous with Fernvale of Arkansas and Illinois.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 524. Templeton and Willman (1953, unpub. ms.) reported name Ada limestone preempted and proposed name Cape limestone for the Missouri "Fernvale".

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 26–27, pls. 3, 4. Limestone described on south and west flanks of Ozark uplift in northeastern Oklahoma. Massive coarsely crystalline fossiliferous crinoidal limestone. Light gray to pink and weathers lead gray. Maximum thickness 18 feet; average thickness 14 feet. Unconformably overlies Fite limestone and conformably underlies Sylvan shale south and east of Tahlequah; northeast of Tahlequah unconformably underlies Chattanooga black shale. Upper Ordovician, Richmondian.

G. B. Martin, 1960, Gulf Coast Assoc. Geol. Sci. Trans., v. 10, p. 201–205. In Alabama, Fernvale formation consists mainly of gray to blue crystalline

thin-bedded fossiliferous limestone. Thickness 12 to 20 feet. Unconformably underlain by Leiper formation or by Hermitage formation. Recommended that in this area name Chickamauga be avoided in favor of more specific Leipers and Fernvale formations.

Named for Fernvale, Williamson County, Tenn.

†Ferriferous Limestone[1]

Ferriferous ironstone member

Pennsylvanian (Allegheny Series): Pennsylvania, Ohio, and West Virginia.

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania: Philadelhia, J. P. Lippincott & Co., v. 2, pt. 1, p. 491.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 45–46, table 1. Ferriferous ironstone member of Scrubgrass cyclothem in report on Perry County. Name Ferriferous was first applied to limestone which, in present usage, is known as Vanport. In this report, term Ferriferous is restricted to ironstone directly overlying Vanport member. Thickness 6 inches to 1 foot. Underlies Lower Kittanning clay of Lower Kittanning cyclothem. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 60. Term Ferriferous is one of few descriptive names still used as name for rock units in Pennsylvanian rocks. A useful bed for correlation in a series of beds lacking distinguishable members in Athens County [this report], and without its positive identification, recognition of any members of Scrubgrass cyclothem within county would have been uncertain or impossible.

Ferris Formation[1]

Upper Cretaceous and Paleocene: Central southern Wyoming.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Prof. Paper 108, p. 228, 230.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 81–82. Supposed unconformity between the Medicine Bow and Ferris is now regarded as nonexistent or as marked by a transitional zone indicating erosional irregularity. Basal 1,000 feet of Ferris is a coal-barren conglomeratic zone whose matrix and pebbles are similar to those of Medicine Bow. This zone yields remains of *Triceratops* and a Cretaceous flora not materially different from the lower Medicine Bow and Lance. Typical Paleocene flora has been found in lowest coal-bearing strata just above the latest dinosaur remains of the Ferris, indicating that the Cretaceous-Tertiary boundary is at or near that level. Concluded that Medicine Bow formation encompasses basal dinosaur-bearing part of the Ferris and that the remainder of the Ferris, about 5,500 feet, is Paleocene.

Well exposed on old Ferris Ranch, on North Platte River, Carbon County.

Ferron Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Central and southeastern Utah.

Original reference: C. T. Lupton, 1914, U.S. Geol. Survey Bull. 541, p. 128.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 438, 440 (fig. 2). In Wasatch Plateau, Ferron sandstone member overlies unnamed lower shale member that is equivalent to "Tununk shale" of Gilbert's (1877) section in Henry Mountains and

underlies unnamed shale member below Emery sandstone member (new).

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8 (table). Generalized section of exposed sedimentary rocks in Henry Mountains structural basin shows that Ferron sandstone member of Mancos overlies Tununk shale member and underlies Blue Gate shale member. Thickness 150 to 250 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 36, 37 (table), 80–83, pl. 1. Underlies Blue Gate shale member; overlies Tununk shale member. Thickness about 800 feet in southern Castle Valley; thins to about 75 feet at northeast end of valley and thinned part becomes increasingly shaly eastward; at Green River represented only by very thin sandy beds. In Henry Mountain region, almost 300 feet thick but thins eastward to about 150 feet; probably did not extend far east of Henry Mountains. In most parts of the region, consists of three lithologic units each having about same thickness: at base is sequence of interbedded sandstone and shale; overlying is massive sandstone; and at top is lenticular carbonaceous and coal-bearing shale and sandstone. Data on type locality. Gilbert (1877) applied name Tununk sandstone to this member.

Type locality: In Castle Valley near town of Ferron, Emery County.

Ferron Point Formation[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 581–582, 583. Described in Thunder Bay region where it underlies Genshaw formation (redefined) and overlies Rockport Quarry limestone. Thickness at type section about 18½ feet. Included in Traverse group.

Type section: West wall of Rockport quarry at Rockport, sec. 6, T. 32 N., R. 9 E., Alpena County.

Ferry Lake Anhydrite (in Trinity Group)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, Mississippi, and Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 4, 35–36, cross sections. Consists of about 250 feet of white to gray finely crystalline anhydrite which contains minor amounts of interbedded gray to black shale, dense limestone, and dolomite. Lies conformably between Rodessa below and Mooringsport formation (new) above. Name replaces Glen Rose massive anhydrite. Type section will be described in paper by Shreveport Geological Society.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2354–2355. Redefined as formation which occupies stratigraphic interval between base of Rusk formation (new) and top of Rodessa formation as they are recognized in Caddo Lake (Ferry Lake) area of western Caddo Parish, La. Formation thins as anhydrite grades into shale and limestone northward into southern Arkansas where it is represented in outcrop by interval of gypsum within DeQueen limestone. Ferry Lake is regional wedge thickening basinward

from southern Arkansas into northern Louisiana and reaching thickness of about 250 feet in type area; extends into Texas where it grades rather abruptly into porous fossiliferous and oolitic limestones; thins to featheredge in central Mississippi. Type well designated.

Type well: Gulf Refining Co.'s Caddo Levee Board "O" Gas Unit Well No. 1, Jeems Bayou field, sec. 10, T. 20 N., R. 16 W., Caddo Parish, La. Top of unit placed at 3,823 and base at 4,072 feet.

Fetzer Tongue (of Arline Formation)

Middle Ordovician (Mohawkian): Eastern Tennessee, northern Georgia, and southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 64, chart 1 (facing p. 130). In type section, consists of 6 to 8 feet of nodular crumbly limestone with thin granular interbeds. Has general lithology of Arline formation. Generally more argillaceous than underlying beds of Lenoir limestone; overlies Paperville formation (new). Virtually the same unit as Botetourt limestone member of Edinburg formation of Shenandoah Valley of Virginia. Page 83 mentions Fetzer formation. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along U.S. Route 64 about 3 miles southwest of Benton Station, Benton (TVA 126–NW) quadrangle, Polk County, Tenn. Named from Fetzer Creek not far from type section along Ocoee River. Recognized in southeastern belts of Southern Appalachian region from Wytheville, Va., to Georgia.

Fibron Limestone[1]

Fibron Limestone Member (of Hendricks Dolomite)

Middle Silurian (Niagaran): Northern Michigan.

Original reference: R. A. Smith, 1916, Michigan Geol. Survey Pub. 21, p. 153.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 15. Member occupies position near top of formation. Thickness at type section about 30 feet; maximum thickness about 50 feet; thickness in type section of Hendricks 18 feet. Member is thickest high calcium layer in formation.

Type section: Abandoned Fibron quarry, about 3 miles east and 3 miles north of Rexton, Mackinac County.

†Fickett Series[7]

Silurian(?), Devonian, and Mississippian: Northern central Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 242.

Named for river called Fickett River in early reports but now known as John River.

Fidalgo Formation[1]

Triassic(?): Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. Geol., 2, p. 142–146.

Occurs on Fidalgo Head and at several localities in southeastern part of Fidalgo Island. Composes Burrows, Young, Allan, Saddlebag, Dot, and Hat Islands, and Williamson Rocks, and major part of Cypress Island.

Fiddlers Green Dolomite (in Bertie Group)

Fiddlers Green Dolomite Member (of Bertie Formation)

†Fiddlers Green Limestone[1]

Upper Silurian: Central and western New York.

Original reference: T. C. Hopkins, 1914, New York State Mus. Bull. 171, p. 12.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 9, fig. 1. Rank reduced to member status at base of Bertie formation. Underlies unnamed middle member. Overlies Camillus. Grades into Brayman shale (redefined).

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9. In central New York, dolomite is considered member at base of Bertie formation. Underlies Forge Hollow member (new). Thickness 25 to 30 feet. Not restricted to Syracuse region; may be traced east and west for considerable distances. Continues westward into Falkirk member of Bertie; therefore should not be referred to Camillus shale of Salina group. Upper Silurian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Basal formation in Bertie group in central New York. Underlies Forge Hollow shale. Fieldwork has not demonstrated lateral continuity of the Falkirk and Fiddlers Green as indicated on present chart. Thick glacial deposits conceal these units in area where they may merge. Possibility of facies changes should not be overlooked. At present, distinct names are used in western and central New York.

First described in Syracuse quadrangle.

†Fido Sandstone[1]

Upper Mississippian: Southwestern Virginia.

Original reference: Charles Butts, 1927, Virginia Geol. Survey Bull. 27.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Abandoned on basis of this report. Equivalent to top beds of Greenbrier and basal beds of Bluefield.

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1911. Butts (1927) ignored Reger's 1926 terminology, used names "Cove Creek" limestone and "Fido" sandstone for certain stages of the Mauch Chunk, and assigned everything between the Gasper (Upper Union) and St. Louis ((Hillsdale) to the Ste. Genevieve. This assignment of certain lower rocks to the Ste. Genevieve was merely an avoidance of Pickaway, Taggard, Patton, and Sinks Grove. Continued use of Butts' illogical Ste. Genevieve column has led to confusion. [See Denmar formation.]

Named for exposures in vicinity of Fido, Scott County.

†Fierro Limestone[1]

Mississippian, Pennsylvanian, and Permian: Southwestern New Mexico.

Original reference: S. Paige, 1916, U.S. Geol. Survey Geol. Atlas, Folio 199.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 7. Formation names were assigned to Carboniferous rocks in Silver City, Santa Rita and Fierro mining districts without regard to their stratigraphic relations to previously named formations in other districts of State. Consequently, several synonymous formational names

were proposed for Mississippian rocks of this area. Paige (1916) introduced name Fierro for limestone beds resting on Devonian Percha shale and unconformably overlain by Cretaceous Beartooth quartzite. Lower part of the Fierro has been correlated with Lake Valley formation.

Named for Fierro mine in northeastern part Silver City quadrangle.

Fifes Peak Formation

Fifes Peak Andesite

Oligocene or Miocene: South-central Washington.

W. C. Warren, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2035. Name applied to a unit consisting of basic andesite flows and pyroclastics forming upper part of Keechelus andesitic series in Mount Aix quadrangle. Unconformable on lower part of Keechelus series. Overlapped by marginal flows of Yakima basalt.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 800–802. Described as a group of flows, agglomerates, and tuffs. Proportion of flows to agglomerates and tuffs varies from place to place; on the whole, the pyroclastic materials have the greater volume. Flows are black on fresh exposures; they are dense to vitreous, porphyritic, with clear phenocrysts of plagioclase. On weathered surfaces, rock is brownish with chalky phenocrysts. Tuffs are yellow to buff. Agglomerates are variable in color with grays, reds, and purples predominating. Underlies Yakima basalt. Presumably not younger than middle Miocene.

Occurs in Mount Aix quadrangle in vicinity of Fifes Peak, Yakima County.

Figuera Volcanics

Figuera Formation[1]

Paleocene, upper, or Eocene, lower: Pureto Rico.

Original reference: H. A. Meyerhoff and I. F. Smith, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 284.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7), 71. Thickness 500 feet. Underlies Fajardo shale; overlies Trujillo Alto limestone. Upper Cretaceous.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 3), 22–27, pl. 2. Figuera volcanics in San Juan area consist of pyroclastic rocks of variable thickness with lenticular calcareous beds and included blocks of older limestone (Trujillo Alto? limestone) in basal part. Characteristically hornblende andesite of mauve to greenish color. Greatest thickness, about 3,000 feet, south and east of Guaynabo; about 600 feet on Trujillo Alto Road. Meyerhoff and Smith placed the Figuera stratigraphically between Trujillo Alto limestone and Fajardo shales, but noted that no outcrop of Trujillo Alto was seen in vicinity of the Figuera. The absence of common contact with Trujillo Alto at type locality and uncertainty that Fajardo shales of Meyerhoff and Smith at Fajardo and those in San Juan area are stratigraphically identical raise an element of uncertainty as to identity of the two volcanic sequences. Near Pueblo Seco and La Muda, Figuera volcanics conformably overlie Trujillo Alto limestone; between Guaynabo and Rio Piedras, apparently separated from underlying rocks by angular

unconformity because north of Guaynabo the Figuera overlies Monacillo limestone (new) whereas to the south it overlies Frailes formation (new). Underlies Fajardo formation. No diagnostic fossils found above Trujillo Alto, but it is proposed that Figuera volcanics correlate with late Paleocene or early Eocene deposits of Loiza, to east, and Corozal, to west.

Two parallel bands occur near Ceiba, one at east coast of Punta Figuera, from which formation has been named; the other extends from Puerto Medio Mundo into interior for undetermined distance.

Filer Sandstone Lentil (of Amherstburg Formation)

Middle Devonian: Michigan (subsurface).

K. K. Landes. 1951, U.S. Geol. Survey Circ. 133, p. 2 (fig. 2), 7, 9, 12. Lies within carbonate rock sequence above Sylvania sandstone member of Amherstburg formation and below Lucas formation. Thickness exceeds 50 feet in Bay and western Manistee Counties, and as much as 100 feet in western Michigan.

Type section: Ruggles and Rademacher well 24, sec. 12, T. 21 N., R. 17 W., Filer Township, Manistee County. Confined for most part to western flank of Michigan Basin.

Fillmore Limestone (in Pogonip Group)

Lower Ordovician (Canadian): West-central Utah and eastern Nevada.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 9 (fig. 2), 13–16, 29 (fig. 4), 37–38, 39–40, 41–43, 45–50. Characteristically a complex of thin-bedded interbeds of intraformational conglomerate, limy siltstone, muddy limestone, and limy shales, with occasional layers of calcilutite; individual beds thin and lens out, or grade into other beds, within short distances. Thickness, composite section, about 1,500 feet; entire thickness not exposed in any one section. Thins eastward from Ibex, Utah; westward in Nevada, thickness changes little, but lithology changes considerably—intraformational conglomerates become less prominent, and quartz detritus less conspicuous in limestone, chert becomes more prominent, and several thick-bedded resistant beds appear. Overlies House limestone (new); underlies Wahwah limestone (new). Pogonip group redefined in this report.

Type localities: Ibex sections D, G, and H, are designated as type localities of various portions as listed in section descriptions. These are, respectively, approximately 2 miles south-southeast of Government Well 108 which is located in sec. 1, T. 22 S., R. 14 W.; NW¼ sec. 8, T. 23 S., R. 14 W.; east slope of lava capped butte approximately at ¼ cor. sec. 5, sec. 6, T. 23 S., R. 14 W. Name derived from Fillmore, Millard County, Utah.

Final shales (in Chuaran series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Brown more or less sandy shales. Some thin limestone layers included. Thickness 600 feet. Underlies Oveja formation (new) unconformably; overlies Marble limestone.

Exposed in Chuar Valley under Cape Final, a long tongue reaching down from Kaibab Plateau; Grand Canyon region.

Fina-sisu Formation

Oligocene, upper: Mariana Islands (Saipan).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 60–62, chart 1, pls. 1, 2. Calcareous marine tuffs and interbedded andesite flow rocks, with distinctive planktonic smaller Foraminifera in some of tuffs. Flows commonly less than 20 feet thick but one is 80 to 100 feet. Maximum exposed thickness about 400 feet in type section; base of formation nowhere exposed. Overlapped by Tagpochau limestone.

Type section: Fina-sisu hills or ridge, south of As Lito village. Section extends eastward from fault at west side of Fina-sisu hills up ravine 300 to 400 feet south of structure section C–C' (pls. 1, 2), and south of As Lito village, to unconformably overlapping *Acropora*-rich facies of Mariana limestone.

Finger Bay Volcanics

Tertiary(?): Southwestern Alaska.

R. R. Coats, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 5, p. 75–76, pls. 6; pt. 7, p. 101, pl. 8. Sequence of volcanic rocks on Adak Island consisting of black, dark-gray, purplish-gray, greenish-gray and grayish yellow-green basaltic tuff, basalt flows, tuff-breccia, agglomerate, and dikes with a few small rhyolitic flows and dikes. Some rocks conspicuously porphyritic. In general, rocks are intensely altered and locally recrystallized. Thickness at least 2,000 feet and possibly as much as 15,000 feet. Intruded by Zeto Point basalt porphyry (new). Tentatively assigned to the Mesozoic.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 57, 60–61, pls. 4, 5. Oldest rocks exposed on Great Sitkin Island. Predominantly andesitic and basaltic greenstone, and include coarse- to fine-grained porphyritic flows, amygdaloidal flows, coarse flow-breccia, pillow lava, and dense fine-grained rocks that are probably flows, and also coarse- to fine-grained tuff. Unconformably underlies Sand Bay volcanics (new). Chain of islands between Great Sitkin and Adak seem to be composed largely if not entirely of Finger Bay volcanics. Source of volcanics not known.

F. S. Simons and D. E. Mathewson, 1955, U.S. Geol. Survey Bull. 1028–B, p. 27–28, pl. 5. Age not definitely known but believed to be late Paleozoic. Mapped as Pennsylvanian(?) or Permian(?).

R. R. Coats, 1956, U.S. Geol. Survey Bull. 1028–C, p. 48–49. Described on northern Adak Island. Leaf impressions, identified as *Annularia stellata* (Schlotheim) Wood, of Pennsylvanian or Permian age, have been collected from sandstone in northernmost outcrops, isolation of sequence in which fossil was found from type area about Finger Bay and Sweeper Cove introduces the possibility that rocks of more than one age are included in the mapped unit. At present, Finger Bay volcanics are regarded as Paleozoic(?).

G. D. Fraser and G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–M, p. 377–384. Coats (1956) included a body of fossiliferous yellow sandstone of volcanic composition, basaltic flows, and sills that crop out between Clam Lagoon and Andrew Lake in northern Adak Island in his Finger Bay volcanics as mapped. The rocks are Pennsylvanian or Permian as indicated by impressions of fossil leaves. Relations of these fossiliferous

rocks to rocks of Finger Bay volcanics, which are continuous with those mapped as Finger Bay volcanics in southern Adak Island (and identical with those of Kagalaska Island) are uncertain. Volcanic sandstone beds of northern Adak Island are doubtless terrestrial beds, whereas Finger Bay volcanics of this report is interpreted as marine Tertiary(?) age believed more probable than Paleozoic(?) for Finger Bay volcanics.

Underlies southern part of northern Adak Island; well exposed in Finger Bay from which it takes its name. Also on chain of islands extending eastward to Great Sitkin Island and beyond; in central part of Aleutian Islands.

Finger Lakes Group

Finger Lakes Stages

Upper Devonian (Senecan): North America.

G. A. Cooper and others, 1942. Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1734, chart 4. Devonian is subdivided into 10 stages of which the Finger Lakes is seventh in sequence (ascending). [For complete sequence see Helderberg stage this reference.] Preceded by Taghanic stage (new). Includes strata from top of Geneseo shale to base of Chemung stage (Cayuta shale and sandstone and Grimes sandstone). Sequence includes Genesee and Naples groups.

A. T. Cross and J. H. Hoskins, 1951, Jour. Paleontology, v. 25, no. 6, p. 718 (fig. 3). Shown on composite stratigraphic column of western New York and northwestern Pennsylvania as Finger Lakes group. Includes Portage and Catskill formations. Overlies Taughannock group; underlies Chemung group.

Type section (stage): In Finger Lakes country of New York where these rocks are exposed on all the larger lakes.

Finis Formation (in Caddo Creek Group)

Finis Shale Member (of Graham Formation)[1]

Pennsylvanian (Canyon Series): Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31; Texas Univ. Bull. 2132, p. 127–128.

B. F. Howell, Wagner Free Inst. Sci., v. 28, no. 1, p. 4. Referred to as Finis formation in Caddo Creek group, Canyon series.

Named for Finis, Jack County.

Finlay Limestone

Finlay Limestone (in Fredericksburg Group)[1]

Finlay Limestone (in Sixshooter Group)

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 47.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1004. In vicinity of northern Quitman Mountains, overlies Cox sandstone; underlies Kiamichi formation. Thickness about 100 feet. Basal formation of Fredericksburg group.

R. M. Huffington, 1947, Harvard Univ. Summ. of Theses, 1943–1945, p. 196. In Quitman Mountains, overlies Cox formation; underlies Tarantula formation (new).

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 22–24, pls. 1, 10. Described in Eagle Mountains, Hudspeth County. Thickness 198½ feet. Overlies Cox sandstone; underlies Kiamichi formation. Map bracket shows the Finlay as basal formation in Fredericksburg group.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Described in Wylie Mountains and vicinity where it is basal formation of Sixshooter group (new). Underlies Boracho formation (new); overlies Cox sandstone. Thickness 110 to 170 feet.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 378–379. Described in Kent quadrangle. Basal member of Sixshooter group. Underlies Levinson limestone member (new) of Boracho limestone. Unconformably overlies Cox sandstone. Thickness 40 feet.

Named for Finlay Mountains, El Paso County.

†Finley Limestone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 42.

Finley Creek, Christian County.

Finley Knob Shale Member (of Carwood Formation)[1]

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 100, 111, 116, 148, 151, 152, 154, 158, 162–163.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 75. Finley Knob shale member included in Bennettsville facies of Carwood.

Name derived from Finley Knob, on Knobstone Escarpment, NW¼ sec. 5, T. 2 N., R. 6 E., 6 miles west of Vienna, Scott County.

Finney Greenschist

Age not stated: Northern Washington.

R. W. Jones, 1959, Dissert, Abs., v. 20, no. 3, p. 994. Consists of actinolite-, tremolite-, glaucophane-, and crossite schists with interlayered quartz-albite schists. Forms core of synclinorium. Gold Mountain phyllite (new) forms adjacent anticlinorium.

Report discusses geology of Finney Peak area, northern Cascades.

Finnie Sandstone Member (of Abbott Formation)

Finnie Sandstone (in Tradewater Formation)[1]

Pennsylvanian: Western Kentucky, southern Illinois, and southern Indiana.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Bull. 17, p. 13, 14, 23, 24.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 34, 83. Massive sandstone in lower part of Tradewater formation between Ice House above and Bell coals; locally attains maximum thickness of 60 to 80 feet. Recognized in Indiana.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), 62. Reallocated to member status in Abbott formation (new). Replaces name Delwood sandstone so that term Delwood may be retained for the coal. Overlies Willis coal member (new); underlies Delwood coal member (new). Thickness about 60 feet at

type section of Abbott. Type locality stated. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along road for less than 2 miles north of Mulfordtown [Milfordtown], near Caseyville, Union County, Ky. Named for Finnie Bluff, on road north of Milfordtown.

Fire Clay Hill Bentonitic Shale (in Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 19–22, pl. 2. Fluffy soil indicative of bentonite with gentle to steep scarps, characterizes weathered outcrop of these gray to purplish beds. Towards the base, calcareous concretions and geodes as much as 6 inches in diameter occur sporadically and in places are associated with concretions of iron-oxide and copper-bearing concretions. Agate beds banded with red, orange, green, yellow, and white occurs at base of shales, ranges in thickness from fraction of an inch to almost a foot, and is remarkably persistent total. Thickness changes a little from East Reef to West Reefs; average is 10–13 feet. Underlies Trail Hill sandstone (new); overlies Hartley shale and sandstone (new).

Best exposures of shales on East Reef 1,000 feet north of Duffin mine. Best exposures of agate bed at base of Fire Clay Hill south of old town of Silver Reef, Silver Reef (Harrisburg) Mining District, Washington County.

Fire Creek Underclay (in New River Group)

Pennsylvanian (Pottsville): Eastern West Virginia.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 18. Medium gray clay, about 4 feet thick, in lower part of New River group; about 900 feet below base of Kanawha group. Commonly occurs immediately below Fire Creek coal, but locally is separated from it by a foot of carbonaceous shale.

Present in Webster County.

Firemoon Limestone Member (of Piper Formation)

Middle Jurassic: Central and eastern Montana (subsurface and surface) and western North Dakota (subsurface).

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 97, 101–102. Consists of 69 feet of buff to brown, dense to earthy limestone in type section, which is typical of member throughout much of northern and eastern Montana. Locally becomes sandy and oolitic. In some wells, member is dolomitic and cherty, especially on east flank of Sweetgrass arch. In south-central Montana, unit is thinly bedded with much varicolored claystone and locally some gypsum. Pebbly oolitic and coquinoid limestones common. Very uniform in thickness. In outcrop sections, member appears transitional with underlying Tampico shale member (new) and overlying Bowes member (new), but in subsurface of northern Montana stratigraphic boundaries generally sharp. West and south of Bearpaw Mountains, it overlaps Tampico member and unconformably rests on Madison limestone. Occasionally in contact with Amsden formation on Big Snowy platform. Unit is correlative to middle limestone member of Piper as described by Imlay and others (1948).

Type section: Interval from 4,618 to 4,687 feet in Murphy Corp. No. 1 Firemoon well, center SE¼SE¼ sec. 12, T. 30 N., R. 41 E., Valley County, Mont.

First Street terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941 (abs.) Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg., p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703 (fig. 8), 1710, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name First Street proposed for terrace deposit that is younger than and lies about 18 feet below Beaumont (Sixth Street) terrace. Composed of dark weathering silt overlying limestone gravel.

Named for occurrence at corner of First and Chicon Streets, Austin, Travis County. Extends much of length of First Street east of Congress Avenue.

Fish Creek Argillite[1]

Paleozoic(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 80, map.

Occurs along Fish Creek, Stevens County.

†Fish Creek Beds[1]

Upper Cretaceous: Central southern Montana.

Original reference: E. Douglass, 1902, Am. Philos. Soc. Proc., v. 41, p. 207–221.

In area east of Crazy Mountains and south of Big Snowy Mountains, in basin of Musselshell River. Well exposed between Fish and Mud Creeks, a few miles from where the latter empties into Musselshell River Sweetgrass County.

Fish Creek Gypsum

Miocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22, pl. 2. Playa deposit of white bedded gypsum and anhydrite. Ranges in thickness from knife edge to about 100 feet. Rests on Split Mountain conglomerate and is overlain by Imperial formation in western Fish Creek Mountains.

Occurs in Fish Creek Mountains in southwestern Imperial Valley.

Fish Creek Sandstone Member (of Greene Formation)[1]

Permian: Southwestern Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 42.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17. Fish Creek sandstone listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness about 30 feet. Occurs above Fish Creek coal and below unnamed shale below Hostetter coal and (or) fire clay.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Fish Creek sandstone listed in Greene series. Occurs above Fish Creek coal and below Hostetter coal.

Named for exposures on Fish Creek, southwestern Greene County, Pa.

Fish Creek Shale (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 183.

Named for association with Fish Creek coal.

†Fish Creek shale (in Medinan Group)

Lower Silurian: Western New York, and southern Ontario, Canada.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1987–1988. Name proposed for medium-dark-gray argillaceous rock with minor amounts of angular quartz silt, secondary silicia, and secondary calcite. Thin beds of calcareous sandstone occur near base. Includes Rumsy Ridge sandstone member (new) 6 feet above base in Niagara Gorge. Maximum thickness 24 feet. Underlies Manitoulin dolomite; overlies Whirlpool sandstone with transitional contact. Unit corresponds to lower part of Power Glen formation of Ontario, and abandonment of latter name suggested.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Name preoccupied; replaced by Rumsy Ridge shale herein given formational status.

Type locality: In Niagara Gorge. Best sections include those near old tunnel for abandoned New York Central Railroad, 0.9 mile south of center of village of Lewiston and 0.2 mile south of American end of Lewiston suspension bridge, Niagara County, N.Y. Also well exposed where Fish Creek cascades down east wall of Niagara Gorge, 500 feet south of Lewiston Bridge.

Fisher Formation[1]

Eocene, upper, and Oligocene: Northwestern Oregon.

Original reference: H. G. Schenck, 1927, California Univ. Pub. Dept. Geol. Sci. Bull., v. 16, no. 12, p. 451, 459.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Myers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Continental Fisher formation consists of approximately 7,000 feet of clastic material, largely andesitic lapilli tuffs and breccias, but includes also large amounts of basaltic and some rhyolitic fragmental debris; in lower part of formation are lenses of coarse water-laid conglomerate that may be as much as 50 feet thick and contain boulders predominantly of andesitic composition, as much as 4 feet in diameter. At all exposures mapped, Eugene formation rests on tuffs of the Fisher, the contact being marked by soft friable arkosic and quartzose sandstone that contains much fossil wood. Evidence indicates Fisher and Eugene formations are contemporaneous. Overlies Spencer formation (redefined). Upper Eocene and Oligocene.

Typically exposed in vicinity of Coyote Creek sec. 12, T. 18 S., R. 5 W., about 8 miles west of Eugene, and near Fisher Butte, one-quarter mile west of Oak Hill, Lane County.

Fisher Quartz Latite

Fisher Latite-Andesite[1]

Tertiary, middle or upper: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 23–33.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 172–185, pl. 1. Termed Fisher quartz latite. Characteristically a chaotic aggregate of flows and breccias. Outcrops are mostly light gray to brownish and somewhat darker than those of rhyolites of Potosi volcanic series. Maximum thickness about 1,000 feet. Overlies different formations of Potosi volcanic series from Conejos quartz latite to Piedra rhyolite; also locally overlies older rocks and Creede formation. In most places, not overlain by younger formations but locally overlain by Hinsdale formation.

T. A. Steven and J. C. Ratté, 1960, U.S. Geol. Survey Prof. Paper 343, p. 13–28, pls. 1, 2. Fisher quartz latite, in Summitville district, differentiated into two members separated by an unconformity. Lower member consists of rhyo-dacite and quartz latitic flows, volcanic domes, and pyroclastic rocks (tuff and volcanic breccia) that were erupted onto irregular surface cut across earlier volcanic rocks of San Juan Mountains. Resulting pile of volcanic rocks was faulted, locally altered by hydrothermal activity, and deeply eroded before renewed eruptions poured out quartz latitic lava flows to form upper member of formation. Unconformable above Conejos formation. Middle or upper Tertiary.

Named for exposures in vicinity of Fisher Mountain, Creede quadrangle.

Fish Haven Dolomite[1]

Upper Ordovician: Southern Idaho and northeastern and western Utah.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 409.

L. L. Sloss, 1954, Geol. Soc. America Bull., v. 65, no. 4, p. 365, 366, 367 (fig. 1). In Lemhi arch, Idaho, overlies Kinnikinic quartzite and underlies Laketown and(or) Jefferson dolomite. Thickness 41 to 700 feet.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 16 (fig. 4), 18–19, measured sections. In western Millard County, Utah, is predominantly dolomite with chert; subdivided into five unnamed members. Thickness 505 to 590 feet. Conformably underlies Roberts Mountain[s] formation; overlies Eureka quartzite.

P. D. Proctor and others, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–45. Mapped in Allens Ranch quadrangle where it is 280 feet thick. Overlies Opohonga limestone and underlies unit referred to as Bluebell and Fish Haven undifferentiated.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 10, 11 (fig. 3). In East Tintic Mountains, underlies Bluebell dolomite and overlies Opohonga limestone. Thickness 275 to 350 feet. As used in this area, includes lower third of Bluebell dolomite of Loughlin (1919); thus, it includes Eagle dolomite plus lower half or so of Beecher dolomite.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 28 (fig. 4), 31–33. In Stansbury Mountains is as much as 260 feet thick, underlies Laketown dolomite and overlies Kanosh shale. In northern areas, where Kanosh is missing, overlies Garden City formation.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 137–140. In Fivemile Pass-North Boulter Mountain area consists essentially of dark-gray and medium gray-blue aphanitic to coarse-crystalline dolomite in thin- to massive-bedded layers, with some gray chert. Thickens gradually through Boulter Mountains to about 70 feet in Rattlesnake spur area. Disconformably underlies Laketown dolomite; overlies Opohonga limestone.

M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 17–21, pl. 1. Described in Thomas Range, Juab County, Utah, where it is 280 to 303 feet thick; overlies Swan Peak formation and underlies Floride dolomite (new).

Named for exposures on Fish Haven Creek, Bear Lake County, Idaho.

†Fish House Beds[1]

Pleistocene: Southern New Jersey.

Original reference: L. Woolman, 1897, New Jersey Geol. Survey Ann. Rept. State Geologist 1896, p. 201.

At Fish House, on Delaware River, about 5 miles north of Camden, Camden County.

Fish House Clay[1]

Pleistocene: Southern New Jersey.

Original reference: R. D. Salisbury, 1895, New Jersey Geol. Survey Ann. Rept. State Geologist 1894.

At Fish House, on Delaware River, about 5 miles north of Camden, Camden County.

Fishkill Limestone[1]

Cambrian and Ordovician: Southeastern New York.

Original reference: J. M. Clarke, 1909, New York State Mus. Bull. 133, p. 12–18.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329, 343. Name rejected. Stockbridge has priority.

Crops out in town of Fishkill, northwest of road from Fishkill Village to Matteawan, Dutchess County.

Fishpot cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 168 (map 21), 170–172. Embraces interval between Redstone cyclothem (new) below and Lower Sewickley cyclothem (new) above. Normal sequence includes six members (ascending): Pomeroy sandstone, Fishpot redbed, Fishpot limestone, Fishpot underclay, Fishpot coal, and Fishpot roof shale. Thickness varies from 15 to 50 feet; average 44 feet; variability is attributed to thickening and thinning of Pomeroy sandstone. In area of this report, Monongahela series is discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County.

Fishpot Limestone Member (of Monongahela Formation)[1]

Fishpot Limestone (in Monongahela Group)

Fishpot limestone and shale member

Upper Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Shown on columnar section below Sewickley sandstone and above Redstone coal in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 71–72, geol. map. Fishpot limestone and shale member (Monongahela series) occupies interval between Pomeroy sandstone (below) and Fishpot clay members. In Morgan County, consists of an alternation of limestone and calcareous shale layers which vary rapidly in thickness and lateral extent. Thickness 15 to 33 feet. Basal contact is uncertain where the sandstone and shale development extends upward in thick section; summit boundary indefinite where Fishpot coal and clay members are absent and where overlying Lower Sewickley sandstone is shaly; locally the Fishpot extends to or near base of Meigs Creek (No. 9) coal. In three localities; Pomeroy sandstone occupies entire interval of Fishpot limestone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 171. Member of Fishpot cyclothem in report on Athens County. Thickness as much as 34 feet. Monongahela series.

Probably named for occurrence at mouth of Fishpot Run in southern Washington County, Pa.

Fishpot roof shale member

See Fishpot cyclothem.

Fishpot Sandstone (in Monongahela Formation)[1]

Upper Pennsylvanian: Eastern Ohio.

Original reference: R. E. Lamborn, 1930, Ohio Geol. Survey, 4th ser., Bull. 35, p. 29, 32, 181, 234, 235–236.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 71. Term Fishpot sandstone, as defined by Lamborn (1930), was applied to a sandstone occurring between the Fishpot and Sewickley (Meigs Creek) coals. Probable correlation with Lower Sewickley sandstone of West Virginia was recognized by Lamborn; thus, the term Fishpot as applied by Lamborn is stratigraphically higher than the Pomeroy sandstone of Lovejoy. On "Generalized Section of Rocks of Ohio," published by Ohio Geological Survey (Stout, 1939 and 1947), the sandstone above the Redstone (Pomeroy) (No. 8–A) coal is designated as the Fishpot or Pomeroy sandstone. However, the Ohio Geological Survey no longer considers the Fishpot sandstone correlative with the Pomeroy sandstone, and term Fishpot is abandoned.

Type locality and derivation of name not stated.

Fishpot underclay member

See Fishpot cyclothem.

Fisk Formation (in Admiral Group)

Permian (Wolfcamp Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, p. 66 (fig. 1), 95–96. Proposed for the limestones and underlying shales and sandstones ("Indian Creek bed" of Drake, 1893 [Indian Creek shale member of Admiral formation]) that occur above the Hords Creek formation

(redefined) and below the disconformity at the base of the newly defined Jim Ned shale.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip June 11–12, p. 15. Wildcat Creek shale and Overall limestone members of Admiral formation are names being introduced by R. C. Moore to replace "Indian Creek" shale and "Coleman" limestone of earlier reports. These two members are equivalent to the Fisk formation.

Name derived from village of Fisk about 12 miles southwest of Coleman, Coleman County. Fisk is located on upper part of the formation.

Fiske Creek Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

Klaus Küpper, 1956, Cushman Foundation Foram Research Contr., v. 7, pt. 2, no. 152, p. 40–47. Description of Upper Cretaceous pelagic Foraminifera from "Antelope shale" of Taliaferro (1954). Kirby (1943, California Div. Mines Bull. 118) referred to these strata as Horsetown formation of Shasta group. J. Lawton (unpub. thesis) has proposed term Fiske Creeke formation for this unit. In present report, term "Antelope shale" is used as most suitable published name, although it is a junior homonym of "Antelope formation" (Miocene) subsurface, Kern County, Calif., described by Noble (1940, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3).

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Uppermost of six formations in area studied. Overlies Brophy Canyon formation (new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Fiss Fanglomerate (in Tropico Group)

Miocene(?): Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138, 141. Composed of ill-sorted cobbles and boulders of pinkish-brown rhyolitic volcanic and granitic rocks; crudely bedded; nonfossiliferous. Thickness at type section about 500 feet; 1 mile northwest 900 feet; at Antelope Buttes about 1,700 feet. Overlies Gem Hill formation (new), in places unconformably; top is eroded, and, north of Rosamond, fanglomerate is unconformably overlain by gravel of probable Pleistocene age.

Type locality: Fiss Hill, in west-central part sec. 1, T. 9 N., R. 13 W., San Bernardino base and meridian, 1½ miles north-northeast of Tropico mine, 4½ miles northwest of Rosamond, Rosamond quadrangle, Kern County. Crops out discontinuously about 8 miles along southwestern margin of Rosamond Hills from the west end 6 miles northwest of Rosamond to Red Hill.

Fitch Formation[1]

Middle Silurian: West-central New Hampshire.

Original references: M. P. Billings and A. B. Cleaves, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 196; 1933, Am. Jour. Sci., 5th ser., v. 25, no. 146, p. 149.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 24–27. Formation

is in chlorite metamorphic zone northwest of the Ammonoosuc River. Interbedded rocks in that area include bluish-gray limestone, white marble, buff dolomite slate, gray calcareous slate and gray slate; less common are white calcareous sandstone, gray arenaceous limestone, white arkose and light-gray quartz conglomerate. In other areas, formation is represented in staurolite metamorphic zone by white to buff marble, greenish-gray diopside-actinolite granulite, greenish-gray actinolite marble, purplish-brown actinolite-biotite schist, purplish-brown biotite-calcite schist, light-gray arenaceous marble, white quartzite, and light-gray mica schist. Also includes amphibolites in area west of Newport. Overlies Clough formation; underlies Littleton formation. Distribution discontinuous; hence, not everywhere present between Clough and Littleton formations.

Named for [G. E.] Fitch Farm, 2 miles northwest of Littleton, Grafton County.

Fitchburg Granite[1]

Upper Carboniferous or post-Carboniferous: Central Massachusetts and south-central New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 231–233, map.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 67. Represented mostly by granodiorite in the Fitchburg pluton in New Hampshire. Granodiorite was mapped with the granite by Emerson (1917).

Outcrop area extends through Fitchburg, Mass.

Fitch Hill Arkose[1]

Silurian (Niagaran): Northwestern New Hampshire.

Original reference: F. H. Lahee, 1913, Am. Jour. Sci., 4th, v. 36, p. 231–250.

Forms Fitch Hill, northwest of town of Lisbon, Grafton County.

Fitch Hill Granite Gneiss[1]

Silurian(?): Northwestern New Hampshire.

Original reference: F. H. Lahee, 1913, Am. Jour. Sci., 4th, v. 36, p. 231–250, map.

Probably named for proximity to Fitch Hill, northwest of town of Lisbon, Grafton County.

Fitchville Formation

Lower Mississippian: Central Utah.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 63, 65, 69 (fig. 3). Basal beds in Provo area are characterized by yellowish-weathering unit ranging from 1 to 10 feet thick and varying in composition from limy siltstone to well-cemented quartzite; bulk of formation is dolomite, commonly with two distinct and roughly equal units—a lower one of light-gray medium-grained dolomite and an upper one of coarser grained dark-gray dolomite —separated by a few feet of yellowish limy siltstone much like that at base. Thickness 170 to 265 feet. In some places overlies limestone member of Ophir shale, and in others overlies about 200 feet of Maxfield limestone; underlies Gardison limestone (new). Unit formerly presumed to be Devonian and called Jefferson(?) dolomite (Calkins and Butler,

1943, U.S. Geol. Survey Prof. Paper 201). Name credited to Morris and Lovering.

Named for exposures on Fitchville Ridge, East Tintic Mountains.

Fite Limestone[1]

Ordovician: Central eastern Oklahoma.

Original reference: I. H. Cramm, 1930, Oklahoma Geol. Survey Bull. 40–QQ, p. 20–22.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 24–26, pls. 3, 4. Described on southwestern flank of Ozark uplift as a predominantly light-gray dense lithographic limestone characterized by specks and streaks of clear calcite; near base is a 3-foot bed of buff sandy dolomite underlain by 2 feet of gray lithographic limestone; upper beds are massive when fresh but weather into layers 4 to 20 inches thick. Thickness about 8 feet. Unconformably underlies Fernvale limestone; believed to conformably overlie Tyner formation; alternating ledges of Tyner and Fite lithologies in basal parts are thought to represent transition from dominantly dolomite facies of Tyner to lithographic limestone of Fite.

Named from exposures on estate of Dr. Fite in sec. 11, T. 17 N., R. 22 E., northeast of Tahlequah, Cherokee County.

Fittstown Member (of Bois d'Arc Formation)

Silurian and Devonian: South-central Oklahoma.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 45–47, fig. 4. Name proposed for upper member of formation. Described as fossiliferous calcarenite with relatively low silt-clay content; beds 6 or 8 inches thick; locally contains nodules and lenses of chert. Thickness difficult to determine due to gradational nature of lower boundary; maximum thickness 75 feet (on Haragan Creek); on Lawrence uplift, thickness ranges from 25 to 60 feet. Overlies Cravatt member; underlies Frisco formation.

Type locality: Along Chimneyhill Creek, SE¼ and NE¼ sec. 4, T. 2 N., R. 6 E., Pontotoc County. Named from town of Fittstown.

Fitzwilliam Granite[1]

Upper Carboniferous or post-Carboniferous: Southwestern New Hampshire and central northern Massachusetts.

Original reference: C. H. Hitchcock, 1873, Am. Assoc. Adv. Sci. Proc., v 21, p. 134–135.

Named from Fitzwilliam, Cheshire County, N.H.

Fivemile Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 295–296, 338–340.

Type locality: Fivemile Creek, along Princeton-Narrows Road, 4.5 miles southeast of Princeton, Mercer County, W. Va.

Five Oaks Limestone (in Cliffield Group)

Five Oaks Limestone (in Lurich Formation or Group)

Five Oaks Limestone Member (of Cliffield Formation)

Middle Ordovician: Northeastern Tennessee and southwestern Virginia.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 826, 863, 884 (fig. 3). In Tazewell County, the strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into 29 zones (ascending). Name Five Oaks limestone member of Cliffield formation is applied to zone 4, described as the first calcilutite, the lowest of four zones of fine-grained high-calcium limestone. Thickness at type locality 50 feet; average thickness about 25 feet. Overlies Blackford member (new); underlies Ward Cove member (new). Five Oaks member is Butts' Mosheim in Burkes Garden, Thompson Valley, and in median and northwestern belts west of Tazewell but does not correspond to the Mosheim of the Yellow Branch section in Lee County.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 57–58. In area between Brushy and Walker Mountains, the Five Oaks is considered a formation in Cliffield group.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 17 (fig. 3), 44–46. Overlies Elway limestone (new).

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1148–1150. Widely distributed and represented in all belts in southwestern Virginia and northeastern Tennessee. In local absence of the Blackford, the Five Oaks rests directly on Beekmantown dolomites. Thickness at Rye Cove, Va., 90 feet.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 33–34, 41–43. Probably correlates with Rob Camp limestone of Jonesville district. Discussion of problems of correlation and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 69, 72. Included in Lurich formation or group (new).

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Quad. Map GQ–111. In Duffield quadrangle, the upper 15 feet of the Elway may be equivalent to the Five Oaks limestone as used by Cooper (1945) in Scott County.

Type locality: In lime quarry at Five Oaks village, about 4 miles northeast of Tazewell, Tazewell County, Va.

Five Point Limestone Member (of Janesville Shale)

Five Point Limestone (in Admire Shale)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: R. C. Moore and G. E. Condra, Oct. 1932, Revised classification chart of Pennsylvanian rocks of Kansas and Nebraska.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Reallocated to member status in Janesville shale (new). Underlies Hamlin shale member; overlies West Branch shale member. Wolfcamp series.

Type locality: Five Point Creek, near Five Point School, sec. 25, T. 1 N., R. 15 E., 2 miles south and 4½ miles west of Falls City, Richardson County, Nebr.

Fizzle Flat Lentil (in Terlingua Formation)

Cretaceous (Gulf Series): Western Texas.

C. G. Moon, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 151, 159 (fig. 2), 160, 164. Name applied to a 50-foot rock unit that occurs about the middle of the Bouquillas-Terlingua sequence and is considered as the base of the Boquillas-Terlingua unit. The lentil, termed a transition zone, is predominantly a creamy-yellow platy impure limestone.

Occurs in Agua Fria quadrangle, in southwestern part of Brewster County, in Big Bend region.

Flades Clay[1]

Silurian (Niagaran) : East-central Kentucky.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Bull. 7, p. 10, 18, 60.

Named for Flades Creek, east of Crab Orchard, Lincoln County.

Flag Pond Granite Group

Precambrian: North Carolina and Tennessee.

Ebraham Shekarchi, 1959, Dissert. Abs., v. 20, no. 4, p. 1323. Crystalline complex is divided into two groups, Flag Pond granite and unakite granite. Both groups contain mylonite, pegmatite, diorite bodies, basic dikes, and various types of granite. Flag Pond granite group is a medium- to fine-grained granite with units of sheared biotite granite.

Report discusses geology of Flag Pond quadrangle, Tennessee-North Carolina.

Flag Rock Formation

Precambrian: Southwestern South Dakota.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563. Graphitic, sandy, or pyritic schists: some quartzite. Thickness 5,000 feet. Unconformably overlies Northwestern formation; underlies Grizzly formation (new).

J. A. Noble and J. O. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944, 949–952, pl. 1. Heterogeneous. Most abundant material is light-gray sericitic phyllite or schist. Special feature of formation is the Iron Dike that forms conspicuous outcrops on hilltop to east and northeast of Lead. This consists of dense siliceous jaspery material, for the most part without visible bedding. Thickness 5,000 feet, but there may be some duplication by faulting. Overlies Northwestern formation; underlies Grizzly formation.

In Lead district.

Flag Spring Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889–890.

Named for well-known locality in Walnut Township, Gallia County.

Flag Spring Trachyte[1]

Tertiary, middle or upper: Northwestern Arizona.

Original reference: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743.

Well exposed in cliffs along Cottonwood Canyon. Named for Flag Spring, in the canyon, Oatman district.

Flagstaff Limestone[1]

Flagstaff Formation

Paleocene, upper, and Eocene, lower(?) : Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, p. 150–151, 488.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 135–136. Limestone, gray shale, gray sandstone, some oil shale. Thickness 300 to 1,500 feet. Overlies North Horn formation with local unconformity; underlies Colton formation. Age uncertain, more likely Paleocene than lower Eocene.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., No. 8, p. 25–33, pl. 2. Formation described in Gunnison quadrangle; term limestone considered inappropriate in area west of Sevier Valley where unit contains large amounts of sandstone and conglomerate. Four more or less distinct facies in area: Valley Mountain, yellow, gray, and red dense massive limestone with some shale; red limestone, arenaceous, in part, interbedded with considerable amounts of sandstone and conglomerate; Fayette facies, massive gray dense limestone; and Willow Creek, conglomerate and limestone. Throughout extent, lacustrine Flagstaff strata are gradational with fluviatile sediments of underlying North Horn formation and overlying Colton formation. Fauna indicates early Tertiary no younger than Eocene, and, in view of other date, late Paleocene age seems acceptable.

S. L. Schoff, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 622 (table 2), 631–632. Described in Cedar Hills area where it is 750 feet thick; overlies North Horn formation and underlies Colton formation. Upper Paleocene and lower Eocene.

Aurèle La Rocque, 1960, Geol. Soc. America Mem. 78, 100 p. Formation divided into three units: lowest, Paleocene; middle, Paleocene or Eocene; and upper, Eocene. This determination made on basis of study of molluscan faunas. Unconformably overlies North Horn formation; underlies and interfingers with Colton formation; where Colton is absent, underlies Green River formation. Type section noted.

U.S. Geological Survey currently designates the age of the Flagstaff Limestone as upper late Paleocene and lower Eocene(?) on basis of a study now in progress.

Type section: On slopes of Flagstaff Peak, T. 20 S., R. 5 E., San Pete County.

Flambeau Quartzite[1]

Precambrian (Huronian): Northwestern Wisconsin.

Original reference: W. O. Hotchkiss and others, 1915, Wisconsin Geol. Nat. History Survey Bull. 44, econ. ser. 19, p. 50.

Probably named for exposures at Flambeau or on Flambeau River, Rusk County.

†Flaming Gorge Group[1]

Upper Jurassic: Northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 51, 146, 151.

Named for Flaming Gorge, on south side of Green River, at mouth of Henrys Fork, Uintah County, Utah.

†Flanagan Limestone[1]

Middle Ordovician: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 2.

Term Flanagan Limestone abandoned. Woodburn and Brannon Limestones, formerly classified as members of the Flanagan are now classified as members of Cynthiana Formation.

Named for exposures at Flanagan Station, Clark County.

Flannigan Coal Member (of Bond Formation)

Pennsylvanian: Southeastern and eastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Assigned member status in Bond formation (new). Occurs above Mount Carmel sandstone member and below Reel limestone member. Coal named by Newton and Weller (1937, Illinois Geol. Survey Rept. Inv. 45). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Flannigan Township, T. 6 S., R. 5 E., Hamilton County.

Flannigan cyclothem (in Bond Formation)

Flannigan cyclothem (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 10; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). In sequence, occurs below Macoupin cyclothem and above Shoal Creek cyclothem. Thickness about 26 feet.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Bond Formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Named from exposures in Flannigan Township, Hamilton County.

Flat Creek Coal Member (of Bond Formation)

Pennsylvanian: Central and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 72, pl. 1. Name applied to coal member stratigraphically above Bunje limestone member (new) and below Witt coal member (new). Thickness about 1 foot. Name credited to J. A. Simon (unpub. ms.). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼SE¼ sec. 24, T. 6 N., R. 5 W., Bond County. Named for exposures along Flat Creek.

Flat Creek cyclothem (in Bond Formation)

Flat Creek cyclothem (in McLeansboro Group)

Pennsylvanian: South-central Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Name appears in list of cyclothems in McLeansboro group. Occurs below an unnamed cyclothem below the Millersville cyclothem and above Bunje cyclothem (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 6, 7, 11, pl. 1. Simon (1946, unpub. thesis) worked out sequence above Shoal Creek limestone in Bond County and proposed terms (ascending)

Sorento, Bunje, and Flat Creek for cyclothemic units in lower half of interval. A persistent cyclic succession intervenes between the Flat Creek and Millersville; term Reel limestone has been used for the limestone in this succession. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 52 (table 2), pl. 1. In Bond formation (new). Below Witt cyclothem (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Center E½ sec. 24, T. 6 N., R. 5 W., Bond County.

Flat Gap Limestone Member (of Olive Hill Formation)[1]

Flat Gap Formation

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 738.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 302–306, figs. 2, 88. Rank raised to formation. Overlies various units of Ross formation (new)—Ross limestone member, Bear Branch facies, Birdsong shale member; unconformably underlies Harriman formation which truncates it northward. Maximum thickness 55 feet at type exposure herein stated.

Type exposure: On Flat Gap Creek, northeast of Olivehill, Hardin County.

†Flathead Formation[1] or Shales[1]

Middle Cambrian: Montana and northwestern Wyoming.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

Named for exposures in Flathead Pass, in northeast corner of Threeforks quadrangle, Montana.

Flathead Quartzite[1] or Sandstone

Flathead Sandstone Member (of DePass Formation)

Middle Cambrian: Montana and northwestern Wyoming.

Original references: A. C. Peale (Flathead formation with Flathead quartzite, 125 feet at base, and Flathead shales, 290 feet above), 1893, U.S. Geol. Survey Bull. 110, p. 20–22, pl. 4; W. H. Weed, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 285–286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1271–1272, 1288, 1289 (fig. 5), 1317 (fig. 9), 1326–1328. Presentation of revision of type Cambrian formations and sections of Montana and Yellowstone National Park. Publications dealing with problem of Cambrian nomenclature in area are discussed. Peale's original Flathead and Gallatin formations are not valid because latter included both Middle and Upper Cambrian rocks. Although Weed and others used Peale's names, the Flathead and Gallatin formations, meanings of these names were never redefined and given official status. Because of error by Walcott, formational name Gallatin was dropped, but name Flathead was retained to include only strata equivalent to Flathead quartzite member of Peale's Flathead formation. In present report, names given by Weed (1900) for Little Belt Mountains are retained to designate type Cambrian formations of central and southern Montana and Yellowstone National Park. These names, Flathead, Wolsey, Meagher, Park, Pilgrim, and Dry Creek, are chosen for types because they were correctly used by Weed (1900); they have been widely used by later writers, and they are taken from carefully measured and located sections. These formational names were

correctly taken from geographic features. However, the location of these geographic features were not and are not the type localities or sections of either the original or emended formations. This fact must be clearly understood by future workers. Weed's (1900) definition of Flathead sandstone quoted. Flathead sandstone (herein emended) is basal formation of Cambrian system and everywhere in Montana and Yellowstone Park rests upon Precambrian rocks. Underlies Wolsey shale (emended). Within region, maximum thickness of Flathead is 276 feet in Beaver Creek area; least thickness, 93 feet on Crowfoot Ridge; 243 feet at emended type section; thins northward to average of 90 feet in northwestern Montana. Consists of crossbedded, thin- and thick-bedded sandstones, which have been indurated locally into quartzites. Most diagnostic characteristic is presence of tan and white pure quartz pebbles, which range from less than one-fourth inch to more than 3 inches in diameter, are well rounded, and are largely concentrated into thin lenses. Most exposures exhibit purple-maroon and buff banding, particularly in lower half of formation; upper half commonly thinner bedded, more sandy, and contains intercalated, micaceous, sandy, thin beds of shale. Oolitic hematite or hematitic sandstone, as much as 2 feet thick, commonly marks top of formation. Emended type section is on Belt Creek; formation is better exposed, more complete, and less metamorphosed on Crowfoot Ridge in Yellowstone National Park, Checkerboard Creek in Castle Mountains, and on Beaver Creek in northern part of Big Belt Mountains. Weed took name Flathead for his formation in Little Belt Mountains from Peale's (1893) Three Forks section. By using name Flathead, Weed created confusion in nomenclature, but not in the stratigraphy, because he neither stated nor implied that type section of Peale's Flathead quartzite member was type of Flathead sandstone (formation) in Little Belt Mountains. Weed gave his Belt Creek section as part of his definition of the formation and thereby indicated it as type of his Flathead sandstone. Comparison of the original and emended Belt Creek section shows a sill at top instead of near bottom of latter section and a thickness of 243 feet instead of 168 feet (sills excluded in both cases). In this section, Flathead sandstone is incompletely exposed, and contact with Wolsey shale is covered. It is however, the best known section of basal Cambrian formation in Little Belt Mountains. Because Weed indicated Belt Creek section as the type, the emended one is retained in that capacity for Flathead sandstone.

B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 118–119. Formation described in northwestern Wyoming where it averages about 175 feet in thickness and consists of quartz sandstones and quartzites which unconformably overlie Precambrian rocks and conformably underlie Gros Ventre formation.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1083, 1088–1089, 1098–1100, 1101 (fig. 3), 1103. Deiss (1933, Montana Bur. Mines and Geology Mem. 6) divided Cambrian rocks in northwestern Montana into 11 formations—Flathead quartzite at base overlain by Wolsey shale. Sequence is herein revised—Flathead sandstone is overlain by Gordon shale. In Wind River Canyon area, Wyoming, Flathead sandstone is considered member of DePass formation. Underlies Gros Ventre member; overlies pre-Beltian granite. Thickness in type section of Depass 280 feet.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 34, 35–37. In Dearborn River-Monitor Mountain section, Lewis and Clark Range, Mont., Flathead sandstone is 102 feet thick and conformably overlies Miller Peak formation.

E. N. Goddard, 1940, U.S. Geol. Survey Bull. 922–G, p. 163, 165 (table). In Phillipsburg area, Montana, Flathead quartzite is 135 feet thick, underlies Silver Hill formation; overlies Spokane formation.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 213 (table 1), 219. In Saypo quadrangle, Montana, Flathead sandstone is 50 to 100 feet thick; underlies Gordon shale and unconformably overlies Precambrian Ahorn quartzite (new).

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 839. On Greenhorn Mountain, overlies Greenhorn Mountain quartzite (new). In extant geologic maps, Greenhorn Mountain quartzite has been included with "undifferentiated Devonian and Cambrian" strata, with the result that the Flathead, which averages 100 feet in thickness with little deviation from this thickness over scores of miles, is implied to have thickness of several thousand feet on Greenhorn Mountain.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 20, 27, 29, 34. Unconformably overlies two major rock types. North of line connecting Melrose, Whitehall, Three Forks, and Livingston, overlies Belt series; south of this line, overlies Precambrian metamorphics including Cherry Creek series, Pony series, and other unnamed units.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. In Wind River basin, underlies Buck Spring formation (new).

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 44. In Johnson County, Wyo., Flathead sandstone unconformably overlies Precambrian granite and underlies Gallatin limestone and Gros Ventre formation, undivided. Consists of about 260 feet of tan to light-brown medium- to coarse-grained quartz sandstone.

M. M. Knechtel, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1994–1995. In Little Rocky Mountains, Mont., underlies Emerson formation (new).

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 7–8, pls. 1, 2, 3. Five lowest natural map units of Cambrian in southern Elkhorn Mountains, Mont., are lithologically similar to Flathead sandstone, Wolsey shale, Meagher limestone, Park shale, and Pilgrim dolomite of nearby areas, as redefined by Deiss (1936), and these formational names have been adopted. Flathead quartzite is 100 to 119 feet thick; overlies Belt series (Spokane shale) and underlies Wolsey shale.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 10, 11. Flathead sandstone is oldest sedimentary formation in Buffalo-Lake De Smet area. Together with overlying undifferentiated Gros Ventre and Gallatin formations, it crops out in narrow belt marked by valleys and saddles between Precambrian granite and metamorphic rocks to the west and high ridges of Bighorn dolomite to the east. Thickness 344 feet at Johnson Creek where it consists mainly of yellowish-gray fine- to coarse-grained crossbedded sandstone with some interbedded green micaceous siltstone and shale. Middle Cambrian.

Type section (emended): On Belt Creek, Little Belt Mountains, Cascade County. Incomplete section of Flathead measured from Archean contact, 40 to 50 feet above railroad track on spur one-half mile north of mouth of Hoover Creek and 5¼ miles S. 35° E. of Monarch, in Belt Creek valley in NE¼ sec. 14, SW¼ sec. 13, N½ sec. 24, and SE¼ sec. 25, T. 15 N., R. 7 E., near north edge of Little Belt Mountains. Weed gave locality of his Monarch (Belt Creek) section as "Section of beds exposed north of Belt Creek, 8 miles south of Monarch." Only Archean rocks, as indicated correctly on Weed's geological map, are present from 5½ to 8 miles south of Monarch along Belt Creek. Named for exposures in Flathead Pass, northeastern corner Three Forks quadrangle, Montana.

Flatiron Andesites[1]

Cenozoic: Northern California.

Original reference: H. Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 214–367, map.

Cenozoic: O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 676.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2), 80 (table 4). Listed on tables and mentioned in text in report on uranium geochemistry of Lassen volcanic rocks.

Flatiron Ridge is in Shasta County in southern part of Lassen Volcanic National Park.

Flatiron Coquinite Member (of Riceville Formation)

Upper Devonian: Northwestern Pennsylvania.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 14 (footnote), 278 (footnote). Caster (1934) credited with renaming Roystone coquinite as Flatiron; Roystone here considered to be in good standing. Footnote (with initials of G. H. Ashley) states that "bed here named 'Flat-iron' (Roystone) coquinite is same as Marvin Creek limestone of Ashburner" (1880).

Occurs in McKean and western Potter Counties. Probably named for Flat Iron Station near Olean, Rock City, Cattaraugus County, N.Y.

Flat Lick Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: W. R. Jillson and J. M. Hodge, 1919, Kentucky Dept. Geology and Forestry, ser. 5, Bull. 3, p. 1, 2, 3, 9–10, 34.

Well exposed in cliffs along river near Artemus and forms base of Flat Lick Plateau. Named because it is well exposed by the doming at Flat Lick, Knox County.

Flat Ridge Formation (in Mount Rogers Volcanic Group)

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 48, 49–52, pls. 1, 60. Volcanic agglomerate and conglomerate, arkose, tuffaceous slate, and basalt. Cornett basalt member (new) generally at base of formation. Volcanic agglomerate, flow breccia, and thin basalt flows near base form Cinnamon Ridge member (new). In Mount Rogers volcanic series. Main part of formation composed of purplish-red feldspathic tuff, purplish-red shale, and purple arkose. In

places, tuffaceous layers conglomeratic; at some localities, thin layers of tuff replaced by apple-green pinite; in others, tuff is buff sericitic slate. Purple-banded quartzite, with layers of red jasper and interbedded purplish-red shale in many places. Conglomerate of granite boulders as much as 10 inches in diameter and of smaller fragments in dark-colored arkosic matrix forms base of formation just west of Cinnamon Ridge. Estimated thickness on hill 1 mile north of Union Church 150 feet. On Comers Rock Branch, north of Comers Rock village, thickness estimated to be 250 feet. Overlies older Precambrian rocks in vicinity of Comers Rock village.

Named from village of Flat Ridge located in Grayson County 5 miles west of Gossan Lead district (as mapped). Mapped in the district.

Flat Rock Dolomite Member (of Lucas Formation)

Flat Rock Dolomite Member (of Detroit River Dolomite)[1]

Middle Devonian: Southeastern Michigan, and western Ontario, Canada.

Original reference: W. H. Sherzer and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 541.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1456. Detroit River group revised. Flat Rock dolomite of Sherzer and Grabau cannot be distinguished in outcrop or in well borings as distinct formation. There is little doubt that strata of this dolomite are part of Amherstburg dolomite. Name Flat Rock should be dropped from nomenclature.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 1. Term Flat Rock does not merit formation status. At type locality in town of Flat Rock, a bed of carbonate rock 2 or 3 feet thick is poorly exposed in channel of Huron River. This section has not been identified with certainty anywhere else. It is the opinion of the writer [Landes] that these strata actually belong in Lucas formation.

Named for exposures at Flat Rock, Wayne County.

Flat Rock Formation

Precambrian: Southwestern South Dakota.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563. Name appears on list of Precambrian rocks of area. Consists of sandy or pyritic schists about 5,000 feet thick.

J. A. Noble and J. A. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944 (fig. 1), 949–952. Examples of varied lithology: abundant light-gray sericitic phyllite or schist; soft sooty black phyllite or schists with pyrite; quartzites in bands that range in thickness from about 2 feet to about 20 feet; features known as Iron Dike, a dense siliceous jaspery material without visible bedding. Unconformable above Northwestern formation. Underlies Grizzly formation; unconformably overlies Northwestern formation.

Occurs at Homestake mine in vicinity of Lead, Lawrence County.

Flat Rock Creek Granite

Age not stated: Central southern Virginia.

J. P. Meador, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 137. Varies in texture from medium grained to coarse grained and in structure from granulose to gneissose. Lies between Virgilina greenstone and the injected gneisses.

Area discussed is in eastern half of Lunenburg County. Granite covers approximately one-fourth of mapped area.

Flat Top Granite

Precambrian: Southwestern Oklahoma.

C. A. Merritt, 1958, Oklahoma Geol. Survey Bull. 76, p. 33–34. Named by Thomas Polk (1948, unpub. thesis). In present study, name Flat Top granite is not used because in many areas the Flat Top could not be distinguished from the Reformatory granite.

Named for occurrence on Flat Top Mountain, Altus Lake area.

Flat-top limestone[1]

Devonian or Mississippian(?): Western Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 292.

Named for Flat-top Mountain, north of Glenwood Springs, Garfield County.

Flat-top Sandstone[1]

Pennsylvanian: Southeastern Oklahoma.

Original reference: H. M. Chance, 1890, Am. Inst. Min. Engrs. Trans., v. 18, p. 653–661.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Name preoccupied.

Flattop Schist[1]

Precambrian: Western North Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 4.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 30; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Occurs in association with Linville metadiabase, Montezuma schist, and metarhyolite.

Named for Flattop Mountain, Cranberry quadrangle, Watauga County.

Flat Top Mountain Sandstone (in Pottsville Group)[1]

Pennsylvanian: Northeastern Kentucky.

Original reference: J. B. Hoeing, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 81.

Upper Big Sandy Valley and headwaters of North Fork of Kentucky River.

Flattop Mountain Sandstone Member (of Pocahontas Formation)

Flattop Mountain Sandstone (in Lee Formation)

Flattop Mountain Sandstone (in Pocahontas Group)

Flattop Mountain Sandstone (in Pottsville Group)[1]

Lower Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2A, p. 13.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey, Greenbrier County, p. 242–243. At top of Pocahontas group in southern West Virginia. Generally hard, medium grained, micaceous, and bluish gray

to brown. Thickness 10 to 40 feet. In vicinity of Duo, apparently coalesces with Pierpont sandstone, cutting out beds that normally occcur between the two sandstones.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 19). Shown on correlation chart as sandstone in Lee formation in Virginia.

U.S. Geological Survey currently classifies the Flattop Mountain Sandstone as a member of Pocahontas Formation on the basis of a study now in progress.

Named for Flattop Mountain, 2 miles northwest of Pocahontas, Va.

Flattop Mountain suite

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 39, 43 (map 2). Complex of flows and small intrusive masses that represent a period of eruptive activity in a restricted center. Rocks range from highly siliceous rhyolite to rhyodacite. Colors range from white through bluish purple to almost black. Strong flow layering present in some units and is locally distorted. Thickness exceeds 1,000 feet. Name credited to H. R. Blank (unpub. thesis).

Occurs in vicinity of Flattop Mountain, Washington County.

†Flatwoods Clay[1]

Eocene, lower: Southwestern Alabama, northeastern Mississippi, and western Tennessee.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agr. Rept., p. 110–111, 275.

Named for low, flat land covering several counties in northeast Mississippi, resembling broad river and generally known as the "Flatwoods country."

†Flatwoods Group[1]

Eocene: Western Tennessee.

Original reference: J. B. Killebrew and J. M. Safford, 1874, Resources of Tennessee, p. 44.

Occurs on Porter's Creek.

†Flatwoods Shale[1]

Middle and Upper Cambrian: Eastern Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal fields, p. 148, map, and structure sec. opposite p. 162.

Named for level, badly drained lands in valley region of eastern Alabama, which are generally known as "Flatwoods."

Flaxman Formation[1]

Pleistocene (Wisconsin): Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 142, map.

Well exposed on Flaxman Island, Canning River region.

Flaxville Formation

Flaxville Gravel[1]

Miocene, upper, or Pliocene: Northern Montana and western North Dakota, and Alberta and Saskatchewan, Canada.

Original reference: A. J. Collier, 1917, Washington Acad. Sci. Jour., v. 7, p. 194–195.

R. B. Colton, 1955, U.S. Geol. Survey Geol. Quad. Map [GQ–67]. Flaxville gravel described in Wolf Point quadrangle, Montana. Unconformably overlies Fort Union strata and is unconformably overlain by glacial deposits. In some areas, underlies preglacial Wiota gravels (new). Average thickness about 40 feet. Very late Miocene or early Pliocene.

E. G. Meldahl, 1956, North Dakota Geol. Survey Rept. Inv. 26. Mapped in Grassy Butte area, McKenzie County. Stratigraphically above Golden Valley formation.

I. J. Witkind, 1959, U.S. Geol. Survey Bull. 1073, p. 10 (table), 13, pl. 1. Discussion of Smoke Creek-Medicine Lake-Grenora area, Montana and North Dakota. Flaxville gravel above Fort Union formation, crops out along west edge of area. Thickness 10 to 20 feet. Miocene or Pliocene.

A. D. Howard, 1960, U.S. Geol. Survey Prof. Paper 326, p. 16 (table 2), 17, pl. 1. Average thickness 30 feet. In eastern Montana, stratigraphically above Rimroad gravel. One probable occurrence reported in North Dakota. Miocene or Pliocene.

Named for Flaxville, Daniels County, Mont.

Fleanor Formation

Middle Ordovician (Mohawkian): Northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 65, chart 1 (facing p. 130). Name proposed for about 200 feet of maroon and red shale, thin gray limestones, siltstone, and calcarenite. Underlies Rockdell formation; overlies Elway formation. Name attributed to B. N. Cooper and G. A. Cooper.

Named from exposures on a farm lane along Foster Branch near Fleanor Mill, 2 miles northeast of Heiskell, Powell Station (T.V.A. 137–SE) quadrangle.

Fleener facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 184–186.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Correlation chart lists Fleener facies of Carwood formation.

Named for exposures in vicinity of old village and post office of Fleener, NE¼SW¼ sec. 22, T. 10 N., R. 1 E., Monroe County.

†Fleming Clay[1] or Group[1]

Fleming Formation (in Grand Gulf Group)

Miocene: Eastern Texas and Western Louisiana.

Original reference: W. Kennedy, 1892, Texas Geol Survey 3d Ann. Rept., p. 45, 62.

H. N. Fisk, 1940, Louisiana Geol. Survey Bull. 18, p. 150–173. Formation, in surface exposures in Rapides Parish, divided into (ascending) Lena, Carnahan Bayou, Dough Hills, Williamson Creek, Castor Creek, and Blounts Creek members (all new). Overlies Catahoula formation; underlies Pleistocene. Grand Gulf group.

H. B. Stenzel, F. E. Turner, and C. J. Hesse. 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 7, p. 977–1011. In light of new age determinations, it is believed that term Fleming formation is applicable to clay beds near Burkeville, Tex., and that term Lagarto, formerly used, is not.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, p. 1721–1726. In this report, Fleming is considered a group name including both Oakville and Cuero (new) formations. Unconformably overlies Catahoula formation; unconformably underlies Goliad formation.

J. J. Quinn, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 14, p. 5–6. New faunal evidence leads to conclusion that the Fleming is middle Miocene in age.

P. H. Jones, 1954, Louisiana Geol. Survey Bull. 30, p. 52 (table 2), 55–56. Formation in subsurface in southwestern Louisiana, underlies Foley formation (new).

Named for Fleming, Tyler County, Tex.

Fleming Formation (in Cabaniss Group)

Fleming Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Missouri, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group is divided into 15 cyclic formational units. The Fleming, 10th in the sequence (ascending), overlies the Mineral and underlies the Coalvale. Average thickness 24 feet. Contains coal bed ranging from 12 to 20 inches in thickness. [For complete sequence see Cherokee group.]

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Fleming formation in Cabaniss group. Underlies Croweburg formation; overlies Robinson Branch formation (new).

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as a coal cycle in Senora formation, Cabaniss group, in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 25 (fig. 14). Fleming, as exposed in highwall of Ellis mine in SW¼SW¼ sec. 18, T. 34 N., R. 32 W., Vernon County, Mo., underlies Croweburg formation and overlies Mineral formation. Consists of (ascending) limestone, black shale, sandstone, underclay, and coal. Thickness more than 15 feet. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 62–63, 66–68. Formation in Cabaniss subgroup of Cherokee group. Where complete succession is present, formation includes (ascending) calcareous shale and thin beds of limestone, dark shale, sandstone, underclay, and Fleming coal. Over most of outcrop in Kansas consists of Fleming coal and its underclay, lying on underclay or dark shale properly included in Robinson Branch formation.

Type locality and derivation of name not given.

Fletcher Anhydrite Member (of Salado Formation)

Permian (Ochoa): Southeastern New Mexico (subsurface).

W. B. Lang, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 63, 69, 75–78. Massive dense fine crystalline to granular crystalline anhydrite of pale-maltese-gray, clear, or pale-bluish color. Contains minor amounts of gray dolomitic silt. Practically free from insoluble grit. Thickness ranges from 50 to 100 feet or more; 69 feet in Fletcher No. 1 well. Unconformably overlies Carlsbad limestone.

Name taken from Fletcher No. 1 well, in lot 4, sec. 1, T. 21 S., R. 28 E., Eddy County, in which this core test was made.

Fleury Member (of Day Point Formation)

Middle Ordovician (Chazyan): Northwestern Vermont and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 824 (fig. 3), 825 (fig. 4), 826 (fig. 5), 827–829, geol. sections. [At type section] consists of 115 feet of light-gray fossiliferous calcarenite in medium to heavy cross-laminated beds. Biohermal masses, principally of *Lamottia heroensis* Raymond, are in a zone 44 to 51 feet from base, and similar structures of *Stromatocerium* and bryozoans are about 20 feet from top. Reef masses not present in northern Champlain Valley. On Valcour Island, thickness reaches 220 feet, the upper 65 feet being calcisiltite distinguished poorly from that of succeeding Crown Point limestone, and 35 feet is similarly transitional near South Hero. Overlies Wait member (new).

Type section: The Head, southern Isle La Motte, Vt. Name derived from Fleury Bay.

†Flint Creek Beds[1]

Miocene, upper: Central western Montana.

Original reference: E. Douglass, 1906, Carnegie Mus. Annals, v. 2, p. 153–154.

P. E. Vanzolini, 1952, Jour. Paleontology, v. 26, no. 3, p. 453. Beds assigned to upper Miocene.

Typically exposed in a line of bluffs, 100 to 150 or more feet, high on west side of valley of Flint Creek, beginning about 1 mile north of village of New Chicago and extending southward several miles; Philipsburg region.

Flint Hill Sandstone (in Little Osage Member of Fort Scott Formation)

Pennsylvanian (Des Moines Series): Central Missouri.

F. C. Greene, and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6, fig. 1. Channel type sandstone and siltstone that occurs above Blackwater Creek shale in Little Osage member and below Higginsville limestone member. Name credited to A. G. Unklesbay.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources [Rept.] 2d ser., v. 33, p. 96, 97. At type section, consists of gray to yellowish-brown fine- to medium-grained massive resistant friable calcareous sandstone; locally contains brownish-red and purple streaks. Thickness 5⅔ feet.

Type section: W½SW¼ sec. 11, T. 50 N., R. 13 W., Boone County. Name derived from Flint Hill near Flint Hill School. [1949 reference states type section as NW¼SE¼ sec. 11.]

†Flint Hills division[1]

Permian: Central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 6–9.

Named for Flint Hills, Cowley and Butler Counties.

Flint Ridge Clay (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Southern Ohio.

[Original reference]: Wilber Stout, 1927, Ohio Geol. Survey Bull. 31, p. 108–112.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 31, table 1. Included in Flint Ridge cyclothem. Dominantly gray and plastic, locally gray and very sandy; contains siderite nodules. Thickness 6 inches to 8 feet. Overlies Flint Ridge shale and (or) sandstone; underlies Flint Ridge coal.

Extends across State from Mahoning County to Scioto County. Underlies Flint Ridge coal which was named for occurrence on Flint Ridge in Licking County.

Flint Ridge cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 31–32, 137, table 1, geol. map. Includes (ascending) Flint Ridge shale and (or) sandstone, 13 feet; Flint Ridge clay, 4 to 8 feet; Flint Ridge coal. Occurs below Middle Mercer cyclothem and above Lower Mercer cyclothem. In area of this report, the Pottsville series is described on a cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Exposed in western and northern Perry County.

Flint Ridge Flint[1]

Flint Ridge Flint (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 305.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 22). Shown on correlation chart as occurring in upper part of Breathitt formation.

Exposed below top of Flint Ridge at head of Leatherwood Branch of South Quicksand Creek, Troublesome quadrangle, Breathitt County.

Flint Ridge Flint (in Allegheny Formation)[1]

Pennsylvanian: Central Ohio.

Original reference: E. B. Andrews, 1871, Ohio Geol. Survey Rept. Prog. 1870, pl. opposite p. 242.

Named for Flint Ridge, 2½ miles southeast of Newark, Licking County.

Flint Ridge Limestone (in Allegheny? Formation)[1]

Pennsylvanian: Central Ohio.

Original references: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 86, 91–93; 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 89, 94–95.

Named for Flint Ridge, Licking County.

Flint Ridge Shale (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Central and southeastern Ohio.

Original reference: C. L. Herrick, 1887, Denison Univ. Sci. Lab., v. 2, pt. 1, p. 10–12.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 31, table 1. Flint Ridge shale and or sandstone included in Flint Ridge cyclothem in Perry County. Thickness about 13 feet thick; underlies Flint Ridge clay; overlies Boggs member of the Pottsville.

Named for Flint Ridge, Licking County.

Flint River Formation

Flint River Formation (in Vicksburg Group)[1]

Oligocene, upper: Southern Georgia, southeastern Alabama, northwestern Florida, and southwestern South Carolina.

Original reference: C. W. Cooke, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1170–1171.

C. W. Cooke and A. C. Munyan, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 792. Flint River formation, formerly supposed to be facies of Glendon limestone, has proved to be somewhat younger. Tentatively correlated with Chickasawhay member of Byram of Mississippi. Formation overlaps Eocene formations as far as the Clayton. East of Oconee River, it is overlapped by Hawthorn formation but reappears in Savannah drainage basin. Report is about the coast plain of Georgia.

F. S. MacNeil, 1944, Southeastern Geol. Soc. [Guidebook] 2d Field Trip, p. 35–37. Recent mapping in southwestern Alabama has shown that Flint River is not a single unit of deposition but a mixture of argillaceous and siliceous residuum of Oligocene limestones and disarranged beds of Miocene formations. It appears, therefore, that except at its northward extremity, where Tampa and Hawthorn beds have been eroded away or were never deposited, the Flint River contains materials of Oligocene, if the residuum of the Ocala is excluded from it, Miocene, and possibly of more recent age. If the formation is to be dated from time that it assumed its present form, it is probably largely Pleistocene or Recent.

F. S. MacNeil, 1946, Southeastern Geol. Soc. [Guidebook] 4th Field Trip, p. 64. Suggested that name Flint River be abandoned and that the heterogeneous beds to which name was applied be designated as residuum of Jackson, Oligocene, and Miocene, undifferentiated.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1). In discussion of Cenozoic echinoids, age of Flint River formation (Georgia) is given as late Oligocene.

Named from exposures on Flint River between Red Bluff, 7 miles above Bainbridge, to Hales Landing, 7 miles below Bainbridge, Decatur County, Ga.

Flood Member (of Blackleaf Formation)

Lower Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2787–2790, 2792 (fig. 3); 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90. At type section, consists of three parts having combined thickness of 138 feet; lower part is light-brown ledge-making sandstone; middle is poorly exposed dark-gray fissile shale with thin interbeds of flaggy sandstone and concretions of dark-brown ironstone or iron-stained limestone; upper part is massive light-brown cliff-forming sandstone that contains large dark-brown-weathering concretions of calcareous sandstone. Basal member of formation; underlies Taft Hill glauconitic member (new).

Type section: On south side of Sun River valley 4½ miles west of city of Great Falls, in SW¼NW¼ and NE¼ sec. 7, T. 20 N., R. 3 E., Cascade County, about 5 miles northwest of Flood Siding. Named for exposures along bluffs on west side of Missouri River in vicinity of Flood Siding on Great Northern Railway in NW¼ sec. 34, T. 20 N., R. 3 E.

Florena Shale Member (of Beattie Limestone)

Florena Shale Member (of Garrison Shale)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 712.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47. Middle member of Beattie limestone. Underlies Morrill limestone member; overlies Cottonwood limestone member. Consists of highly fossiliferous gray shale containing thin limestone beds in southern Kansas. Thickness 3 to 18 feet. Wolfcamp series.

Named for exposures in quarries near Florena, Marshall County, Kans.

Florence Dolomite

Cambrian: West-central Vermont.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. [Guidebook] 34th Ann. Field Mtg., p. 8. Described as mainly well-bedded buff-weathering sandy dolomite with some graywacke and micaceous slate. Characterized by ripple marks, corrasion channels, solifluction structures, and interformational breccias. Thickness 1,000 feet. Underlies Pittsford Valley dolomite (new); overlies Clarendon dolomite (new).

Occurrence: Central Vermont marble belt, Rutland County.

Florence Gravel[1]

Pleistocene: Northwestern Illinois.

Original reference: O. H. Hershey, 1895, Am. Geologist, v. 15, p. 7–12.

Typically exposed in banks of Yellow and Crane's Creeks, a few miles west and south of Freeport. Named for Florence Township, Stephenson County.

†Florence Limestone (in Chase Group)[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 771–786, 798.

Named for Florence, Marion County.

Florence Limestone Member (of Barneston Formation)

Florence Flint (in Chase Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 771–786, 798.

G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 41. Florence flint member of Barneston formation (new).

R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12. Florence limestone member of Barneston limestone.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 45. Limestone, an abundance of flint, and a minor amount of shale; limestone is commonly lighter in color than the included nodules and layers of gray flint; shale partings common locally. Thickness between 35 and 45 feet. Underlies Oketo shale member; overlies Blue Springs shale member of Matfield shale. Wolfcamp series.

Named for exposures near Florence, Marion County, Kans. Because of large amount of flint or chert it contains, the limestone has been known generally as the Florence flint.

Florencia Formation[1]

Pleistocene: Northwestern Illinois.

Original reference: O. H. Hershey, 1897, Am. Jour. Sci., 4th, v. 4, p. 90–98.

Name derived from Florence Township, Stephenson County.

Flores Limestone

Upper Cretaceous: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 63–67. Dark- to light-gray pure limestone occurring in beds 5 to 10 feet thick. Present as allochthonous blocks in Ildefonso formation (new) emplaced by faulting or possibly by sliding.

Type locality: Quarry about 0.25 kilometer to northeast of intersection of Routes 154 and 153, Coamo quadrangle. Named from village of Las Flores.

Florida Gravel[1]

Pleistocene: Southwestern Colorado and northwestern New Mexico.

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

V. C. Kelley, 1949, New Mexico Univ. Pubs. in Geology 2, chart facing p. 22. Shown on correlation chart of New Mexico formations as present in San Juan County.

Named for fact it caps Florida Mesa in southwestern Colorado.

Floride Dolomite

Upper Ordovician or Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–330, p. 105; M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 21–22, pl. 1. Predominantly fine grained and light to medium gray. Thickness 100 to 135 feet. Overlies Fish Haven dolomite; underlies Bell Hill dolomite (new). Formation may be wholly Ordovician, wholly Silurian, or both.

Type section: Half a mile north of Floride mine in NE¼NE¼ sec. 3, T. 13 S., R. 12 W., Juab County. Named for occurrence at Floride mine. Crops out chiefly along east side of Spor Mountain in southern half of range.

†Floridian Group[1] or Series[1]

Pliocene, lower: Southwestern Florida.

Original reference: A. Heilprin, 1887, Wagner Free Inst. Sci. Trans., v. 1, p. 28–32, 64A–64B, May, 1887.

Named for development on west coast of Florida.

Florissant Lake Beds[1]

Oligocene: Central Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

H. E. Woods 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 19–20. Oligocene, probably Orellan. Paleontological evidence as to age is both uncertain and conflicting. Only mammal, *Peratherium*, is known only from the Oligocene and the John Day. Paleobotanical evidence has usually been interpreted in favor of a much more recent age. Comprise determination as Oligocene and perhaps Orellan represents return to opinions of Cope, Lesquereux, and Scudder.

Named for Florissant, Teller County.

Flour Bluff Sand

Oligocene: Southern Texas (subsurface)

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1630 (fig. 5), 1631 (fig. 6), 1632, 1634. Name suggested for the thick body of sand above an Oligocene marine shale wedge [Old Ocean sand] and below the Fleming, or zone of reworked Cretaceous foraminifera, now loosely designated as the *Discorbis*. Name Pierce Estate also suggested for this unit.

Named for well No. 38 (Hurlburt and Still, Phillips No. 1), in west section of Nueces County.

Flour Sack Member (of Bright Angel Shale)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 82–83. Facies changes within member are striking. At Diamond Creek, Quartermaster Canyon, and Columbine Falls, consists almost entirely of thin fissile micaceous green and purple shale. West of these localities, at Rampart Cave and Diamond Bar Ranch, thin platy limestone replaces much of shale. Farther west, at mouth of Grand Canyon, shale forms only lower 30 feet of section. Thickness averages about 100 feet. Underlies Rampart Cave member (new) of Muav formation; overlies Meriwitica tongue (new).

Named from former rapids of that name 8 miles east of Grand Wash Cliffs, western Grand Canyon.

Floweree Member (of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2793–2794; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 91. Chiefly dark-

gray noncalcareous shale, medium-gray siltstone, and lentils of sandy siltstone and fine sandstone that locally contains scattered granules of dark-gray chert. Limestone concretions present on east side of Sweetgrass arch and on Kevin-Sunburst dome. A few marine fossils present. About 63 feet thick at type section; regionally shows seemingly unsystematic variation in thickness from 13 to 150 feet. Basal member of Marias River shale (new) underlies Cone calcareous member (new); overlies Bootlegger member (new) of Blackleaf formation.

Type section: Two miles northeast of Floweree on north side of Black Coulee in S½NE¼ sec. 17, and SW¼NW¼ sec. 16, T. 23 N., R. 6 E., Chouteau County. Named for station of Floweree on Great Northern Railway in E½SE¼ sec. 24, T. 23 N., R. 5 E, and contiguous part of sec. 19, T. 23 N., R. 6 E., Chouteau County.

Flowerpot Shale (in El Reno, Nippewalla, or Peace River Group)

Flower-pot Shale (in Cimarron Group)[1]

Permian: Central southern Kansas, western Oklahoma, and Texas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 24–27.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782, 1791–1792. Included in Nippewalla group (new).

H. C. Fountain, 1939, *in* Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 764; Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412. Included in Pease River group (new).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as formation in El Reno (San Andres) group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 158; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 39. Red soft gypsiferous shale. Average thickness 180 feet. In Nippewalla group below Blaine formation and above Cedar Hills sandstone. Leonardian.

Robert Roth, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 902–904. At type locality of Pease River group, underlies Blaine formation and overlies San Angelo formation. Thickness 274 feet. Includes Chaney gypsum and anhydrite and Kiser gypsum and anhydrite.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 11 (fig. 2), 15–16 (fig. 3), pl. 1. Described in Carter area, Oklahoma, where it conformably overlies Duncan sandstone and conformably underlies Blaine formation. Includes Chaney gypsum and Kiser gypsum members. Thickness 165 feet. El Reno group, Guadalupe series.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart in Nippewalla group. Guadalupian.

Named for Flowerpot [Flower-pot] Mound, Barber County, Kans.

Floyd Limestone[1]

Upper Devonian: Central northern Iowa.

Original reference: A. O. Thomas, 1912, Science, new ser., v. 36, p. 569–570.

In Floyd County.

Floyd Shale[1]

Upper Mississippian: Northwestern Georgia, northern central Alabama, and southern Tennessee.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 90). Age shown on correlation chart as Chesterian.

Charles Butts, 1948, Georgia Geol. Survey Bull. 54, p. 49–52. In northwestern Georgia, predominantly gray to black fissile shale but includes beds of limestone like those of the "Bangor" and, at one place, a thick bed of sandstone; some beds of limestone have been mapped as "Bangor," but in such places the amount of limestone falls far short of the real "Bangor," and these beds are regarded as part of the Floyd in this report. Estimated thickness at least 1,500 feet. Occurs above Pennington shale. Distribution noted.

Named for development in Floyd County, Ga. Occurs only east of White Oak Mountain and Taylor Ridge where it occupies several large and more or less detached areas.

Floyds Knob Formation (in Borden Group)[1]

Floyds Knob Member (of Edwardsville Formation)

Lower Mississippian: Southeastern Indiana and northern Kentucky.

Original reference: P. B. Stockdale. 1929, Ohio Jour. Sci., v. 29, no. 4, p. 170.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 76, 193–200. Includes the following facies: Goss Mill limestone, Fordyce Knob sandstone, and Cisco Branch.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 192–200, 228. Geographically extended into northern Kentucky where it extends across the Kentucky outcrop belt to Ohio boundary. Thickness seldom over 5 feet; commonly only 1 or 2. Overlies Brodhead formation (new); underlies Muldraugh formation (new).

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 799. Rank reduced to member of Edwardsville formation.

Named for Floyds Knob three-fourths mile east of post office of same name, 3 miles northwest of New Albany, Clark County, Ind.

Fly Sandstone

Pennsylvanian (Monongahela Series): Eastern Ohio.

A. T. Cross, W. H. Smith, and Thomas Arkle, Jr., 1950, Field guide for the special conference on the stratigraphy, sedimentation, and nomenclature of the Upper Pennsylvanian and Lower Permian strata (Monongahela, Washington, and Greene series) in the northern portion of the Dunkard Basin of Ohio, West Virginia, and Pennsylvania: West Virginia Geol. and Econ. Survey, Sec. 26 (upper part). Fly sandstone shown on profile of strata from upper part of Benwood limestone to about the Washington coal horizon along Pennsylvania Highway 88. Description reads: upper Benwood sandstone (Fly sandstone of Ohio, Arnoldsburg of some reports).

Fly Creek Limestone[1]

Upper Cretaceous: Central southern Montana.

Original reference: J. F. Kemp and P. Billingsly, 1921, Geol. Soc. America Bull., v. 32, p. 474 (chart).

Flying W Formation

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1500–1501. pl. 1. Volcanic members of formation are: green, amygdaloidal basaltic pillow lavas containing sparse iron ore; a 150-foot-thick black, porphyritic keratophyre which extends 3½ miles from Colcord to Houden Mesa; and a conglomerate composed of well-rounded gravel, cobbles, and boulders of volcanic rock. Thickness 375–3,200 feet. Unconformably underlies Houden formation (new); overlies Alder formation on south slope of Colcord Mesa with gradational contact, but elsewhere basal member of Flying W formation is either a conformable cobble conglomerate or a pillow lava.

Type section: On lowest tributary to Walnut Creek; base of section approximately 4,450 feet elevation 1 mile north-northwest of Flying W ranchhouse. Good exposures also occur west of Spring Creek three-quarters mile northwest of ranchhouse. Named from Flying W Ranch on Spring Creek, 12 miles west of Young, Ariz., Diamond Butte quadrangle.

Fodderstack Sandstone (in Redoak Mountain Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19, pls. 2, 3, 4. Thickness at least 12 feet in Cross Mountain section; about 5 feet in Petros section. Separated from underlying Caryville sandstone (new) by shale interval that ranges in thickness from 50 to 150 feet and contains the Sharp coal; separated from overlying Silvey Gap sandstone (new) by shale interval that ranges from 45 to 110 feet in thickness and contains the Red Ash and Walnut Mountain coal.

Named from Little Fodderstack Mountain, Petros quadrangle, where it forms a bench on which a trail encircles the mountain.

Foley Formation

Pliocene: Southwestern Louisiana (subsurface).

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 56–61. Sequence of fine- to medium-grained sands interbedded with soft to moderately hard gray-green to brown laminated clays penetrated by a number of water wells in vicinity of Oakdale. Thickness at Oakdale about 1,500 feet; at Mamou, 18 miles down dip, thickness is about 2,500 feet. Includes Mamou member above and Steep Gully member (both new). Underlies Williana formation; overlies Fleming formation.

Named for town of Foley, central Allen Parish. Name Oakdale has been used for other deposits.

†Folley Limestone[1]

Lower Ordovician (Chazy): Central eastern Missouri.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 61.

Named for Foley, Lincoln County.

Folsom Vent Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 127, 155 (fig. 28). Name applied to basalt that issued from Folsom Vent. Folsolm Vent basalt rests on 5 feet of alluvial sands and gravels, which in turn rest directly on sediments of Cretaceous Niobrara group.

Folsom Vents, two cinder cones and associated basalt, cover less than one-half square mile near mouth of Hereford Park, 1 mile west of Union County line on New Mexico State Highway 72.

Fonda Limestone Member (of Tribes Hill Formation)

Lower Ordovician (lower Canadian): East-central New York.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 89–90. Name proposed for youngest most fossiliferous member of formation in Mohawk Valley. Silty, sandy phosphatic calcarenites and dolomitic calcilutite predominate; rest of unit consists of pebble conglomerates, calcitic dolomite, steel-gray dolomisiltite and oolitic dolomitic limestone. Contains ripple marks, cross-laminations, and mud cracks filled with glauconite. Maximum thickness 22 feet; has variable thickness and spotty distribution. Overlies Wolf Hollow member (new); unconformably underlies Chuctanunda Creek dolomite (new).

Type locality: Abandoned quarry 0.5 mile east of Stone Ridge, Montgomery County.

Fond du Lac Beds

Fond du Lac Sandstone[1] (in Lake Superior Series or Keweenawan Group)

Precambrian: Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4, p. 567.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 10, 12–15. Fond du Lac beds are lower formation in Lake Superior series. Occur below Hinckley sandstone. Contact with Hinckley not exposed in east-central part of southeastern Minnesota. Thickness 235 feet at Fond du Lac. Base not exposed.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1058–1061. Included in upper part of Keweenawan group. Thickness several hundred to more than 2,000 feet.

Named for exposures on both banks of St. Louis River from Fond du Lac, Carlton County, westward.

Fontana Shale[1] Member (of Cherryvale Formation)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85, 91, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Member of Cherryvale formation; underlies Block limestone member; overlies Winterset limestone member of Dennis formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 38. Considered formation in Nebraska; overlies Dennis formation; underlies Sarpy for-

mation (new). Thickness 15 feet at type locality; 5 feet at Kansas City, 2 to 7 feet in Missouri; 6½ feet in Sarpy County, Nebr., and near Wimberton, Iowa.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Lowermost member of Cherryvale. Consists of gray calcareous silty micaceous shale. Thickness 10 feet. Underlies Block limestone member; overlies Winterset member of Dennis limestone.

Type exposures: In roadcuts at NE cor. sec. 11, T. 18 S., R. 23 E., and at middle of west side of NW¼ sec. 36, T. 18 S., R. 23 E., near Fontana, Miami County, Kans.

Fontenelle Tongue (of Green River Formation)

Fontenelle Member (of Green River Formation)

Eocene: Southwestern Wyoming.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 60, 62, 63–64. Proposed to designate sequence of alternating buff-brown sandstones and green and gray mudstones, which conformably overlie Knight member of Wasatch; underlies marginal facies of Laney shale member of Green River. Thickness as much as 300 feet. East of Big Piney, interfingers laterally with New Fork tongue (new) of Wasatch. Middle Eocene.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1072. Rank reduced to tongue of Green River. This change is based on inference that unit merges with rest of Green River formation some distance downdip below outcrop belt. Eocene.

Type locality: Sec. 13, T. 24 N., R. 114[115] W., about one-half mile south of Fontenelle Creek, Lincoln County.

Fool Creek Conglomerate

Oligocene(?): West-central Utah.

F. W. Christiansen, 1951, Utah Geol. Soc. Guidebook 6, p. 9, (fig. 2), 10–11; 1952, Geol. Soc. America Bull., v. 63, no. 7, p. 727–728, pl. 1. Thickness 0 to 1,800 feet. Unconformably overlies North Horn(?) formation; unconformably underlies Bonneville and pre-Bonneville sediments.

Well exposed in Dry Fork of Fool Creek and in long spur projecting westward from Canyon Range in area immediately south of small farming community of Fool Creek.

Foraker Limestone (in Council Grove Group)

Foraker Limestone (in Wabaunsee Group)[1]

Foraker Limestone Member (of Sand Creek Formation)

Permian: Central northern and central Oklahoma, southern Kansas, northwestern Missouri, and southeastern Nebraska.

Original refence: K. C. Heald, 1916, U.S. Geol. Survey Bull. 641, p. 21, 25.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273. Overlies Janesville shale (new) of Admire group.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 78–85, pl. 1. Described in Pawnee County, Okla., where it is between 60 and 70 feet thick. Includes (ascending) Americus limestone, Hughes Creek shale, and Long Creek limestone members. Members are traceable southward

from Nebraska across Kansas and into Lincoln County, Okla. Basal formation of Council Grove group; underlies Johnson shale; overlies Admire formation. Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 53–58. Described in Wabaunsee County, Kans., where it averages about 47 feet in thickness. Comprises (ascending) Americus limestone, Hughes Creek shale, and Long Creek limestone members. Underlies Johnson shale; overlies Hamlin shale member of Janesville shale.

Named for Foraker, Osage County, Okla.

Forbes Formation

Upper Cretaceous (Chico Series): Northern California.

Listed as uppermost formation in Chico series; overlies Guinda formation (new). J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282–283, 291, 293. Described as chiefly shale and siltstone with minor thin sandstones. Thickness 1,875 to 3,000 feet. Underlies upper Pliocene Tehama gravels; conformably overlies Guinda formation. Type locality designated.

Type locality: On crest and east flank of Rumsey Hills, Tps. 12 and 13 N., R. 3 W., Yolo County.

†Forbes limestone (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri, southwestern Iowa, and southeastern Nebraska.

Original reference: C. R. Keyes, June, 1898, Am. Geologist, v. 21, p. 349.

Exposed in top of bluffs of Missouri and Nodaway Rivers, near town of Forbes, Holt County, Mo.

Forbush Creek facies (of New Providence Formation)

Lower Mississippian: Southern Kentucky.

H. J. Klepser, 1937, Ohio State Univ. Abs. Doctors' Dissert. 24, p. 182–183. Name applied to unit that represents featheredge of New Providence formation.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77. Includes Beaver Creek member of New Providence formation.

Occurrences are in Clinton, Cumberland, Monroe, Pulaski, Russell, and Wayne Counties.

Ford Sandstone[1]

Pennsylvanian: Central southern Iowa.

Original reference: H. Hinds, 1909, Iowa Geol. Survey, v. 19, p. 99, 131, 178.

Probably named for Ford, Warren County.

Fordham Gneiss[1]

Fordham Gneiss (in New York City Group)

Precambrian: Southeastern New York and western Connecticut.

Original reference: F. J. H. Merrill, 1890, Am. Jour. Sci., 3d, v. 39, p. 388–389.

D. M. Scotford, 1956, Geol. Soc. America Bull., v. 67, no. 9, p. 1158, 1159 (table 1), 1170–1173, pl. 1. Assigned to New York City group (new).

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, p. 672–684. Basal formation of New York City group. Conformable to overlying Inwood marble, and Manhattan formation. Traced almost continuously from New York City northeast and east to vicinity of Danbury, Conn. Cannot be considered equivalent of Precambrian gneiss of Hudson Highlands. Interlayering of Fordham, Inwood, and Manhattan type lithologies within formation belts reflects original alternation in type of sediments laid down. Such alternation in lithologic types is most pronounced near the contacts between principal formation belts. So-called Lowerre quartzite, formerly considered basal member of New York City group, is no valid formation but a highly sheared phase of Fordham gneiss. Nonexistence of "Lowerre quartzite" invalidates any correlation based upon presumed similarities in stratigraphic sequences between New York City group and Cambro-Ordovician series north of Hudson Highlands. New York City group may be lower Paleozoic.

T. W. Fluhr, 1957, Geol. Soc. America Eng. Geology Case Histories 1, p. 2, 6 (fig. 1). Fordham is a series of metamorphosed sediments and forms base of Fordham-Inwood-Manhattan group. There is disagreement as to age of formations; some geologists believe they are Precambrian; they are here considered to be early Paleozoic.

J. W. Clark, 1958, Connecticut Geol. and Nat. History Survey Quad. Rept. 7, p. 15–18, geol. map. Mapped in Danbury quadrangle. Stratigraphically below Inwood marble. In Bethel quadrangle to the south, the Inwood is absent and the Fordham lies against Manhattan formation.

Named for fact it forms anticlinal ridge of Fordham Heights, which borders eastern shore of Harlem River, N.Y.

Ford River Granite

Precambrian (Huronian): Michigan.

R. M. Dickey, 1938, Jour. Geology, v. 46, no. 3, p. 321–335. Granite porphyry which comprises most of the southern complex of the Upper Peninsula of Michigan. It has been considered post-Huronian and named Republic granite by Lamey (1933, Jour. Geology, v. 41).

Type locality and derivation of name not given. Ford River is in Delta County.

Fordyce Knob sandstone facies[1] (of Floyds Knob Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 208–210.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Correlation chart lists Fordyce Knob sandstone as facies of Floyds Knob formation.

Name derived from Fordyce Knob, SE¼NE¼ sec. 9, T. 1 S., R. 5 E., 2 miles southwest of Borden, Clark County.

Forelle Limestone[1]

Forelle Limestone Member (of Goose Egg Formation)

Forelle Limestone (in Phosphoria Group)

Forelle Limestone Member (of Lykins Formation)

Permian: Southeastern Wyoming and northeastern Colorado.

Original reference: N. H. Darton, 1908, Geol. Soc. America Bull., v. 19, p. 430.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1950, Nebraska Geol. Survey Bull. 13–A, p. 2 (fig. 2), 6, 9. Formation in Phosphoria group. Overlies Glendo shale (new); underlies Freezeout shale.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Reallocated to member status in Lykins formation. Underlies Livermore shale member (new); overlies Glendo shale member.

U.S. Geological Survey classifies the Forelle Limestone as a member of the Goose Egg Formation on the basis of study now in progress.

Named for railroad station a few miles south of Laramie, Wyo.

Foreman Argillite[1]

Upper Jurassic: Northern California.

Original references: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81; no. 5, p. 895.

Occurs at Taylor's Diggins, in south fork of Forman [Foreman] Ravine, Mount Jura.

Foreman Formation[1]

Upper Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175, table 2. Shown on paleotectonic map as underlying Combe sandstone and overlying Hinchman sandstone.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California, Westwood sheet (1:250,000): California Div. Mines. Mapped with Triassic and (or) Jurassic metavolcanic rocks.

Named for exposures at Foreman and in Foreman's Ravine, northeast of Taylorsville, Plumas County.

Forest Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in old Forest mine, Ontonagon County.

Forest Conglomerate[1] (in Bohemian Range Group)

Precambrian: Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on mining interest and details of geology of Ontonagon County; pamph. of 24 pages and map, Philadelphia, 1863, map, p. 19.

Exposed 500 feet north of old Forest mine, Ontonagon County.

Forest Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Forest City Limestone (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 55, 57.

Named for Forest City, Holt County.

Forest City sand rock (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 55, 57.

Named for Forest City, Holt County.

Forestdale Marble[1]

Forestdale Member (of Mendon Formation)

Precambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 362, 394.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 21 (table 1), 28, 30, 33, 35, geol. map. Rank reduced to middle member of Mendon formation. This is unit termed "pebbly, crystalline limestone" member of Mendon series (Whittle, 1894). Member is buff to rusty-weathering; white to gray dolomite marble. Thickness featheredge to 115 feet. Occurs about 600 feet above base of formation; absent in some areas. Lower Cambrian.

P. H. Osberg, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 45, 46. In Coxe Mountain area, Vermont, Forestdale dolomite overlies Pinnacle formation. Precambrian(?). Names Mendon and Nickwacket have been used for rocks included in Pinnacle of this report.

Excellent section at Forestdale, Rutland County.

Forest Grove Formation[1]

Mississippian (Chester): Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Upper shale of Green Hill member of Pride Mountain formation (both new) is equivalent to lower part of Morse's Forest Grove formation.

Named for school located on formation near old Mingo village and Southward Bridge, Tishomingo County.

Forest Hill Sand[1]

Forest Hill Formation (in Vicksburg Group)

Forest Hill Member (of Jackson Formation)

Oligocene, lower: Southern Mississippi and southwestern Alabama.

Original reference: C. W. Cooke, 1918, Washington Acad. Sci. Jour., v. 8, p. 187, 191–193.

F. E. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 23. Reallocated to member status in Jackson formation. In Yazoo County, consists of argillaceous lignitic silt, thin argillaceous allocthonous lignite; lignitic leaf-bearing montmorillonitic clays; and fine-grained crossbedded

sand. Thickness 60 to 80 feet. Overlies Yazoo member; underlies Mint Springs facies of Glendon member of Vicksburg formation. Eocene.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1314 (fig. 1), 1318–1324. Cooke originally regarded Forest Hill sand as contemporaneous with Red Bluff clay but later accepted view of group of Gulf Coast geologists that the Red Bluff comes in from the east as a wedge between Yazoo clay and Forest Hill sand. Concept derived from present study is that Forest Hill is deltaic equivalent of Red Bluff, as Cooke originally believed. Vicksburg group is restricted below to exclude Forest Hill sand and Red Bluff clay. Chart shows Forest Hill overlies Yazoo clay of Jackson group and underlies Mint Spring marl member of Marianna limestone. Oligocene.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. Forest Hill sand and Red Bluff clay mapped together in Choctaw County, Ala.

H. N. Fisk, 1944, [U.S.] Mississippi River Comm., p. 13 (table 2), 15. Table shows Forest Hill formation at base of Vicksburg group. Oligocene.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839 (footnote). Forest Hill sand overlies Shubuta (clay) member (new) of Yazoo formation.

W. J. Hendy, 1948, Mississippi Geol. Soc. [Guidebook] 6th Field Trip, p. 27–28. As used in this report, formation includes Red Bluff member.

W. H. Monroe, 1954, U.S. Geol. Survey Bull. 986, p. 62–74, pls. 2, 3. Forest Hill sand crops out in belt across Mississippi from Yazoo County on the west through Hinds, Rankin, Scott, and Smith Counties, in which area it is interposed between belts of outcrops of Yazoo clay and Mint Spring marl member of Marianna limestone; from eastern Smith County to Alabama line through Jasper, Clarke, and Wayne Counties, it is underlain by and may interfinger with Red Bluff clay. Thickness 68½ feet at type locality (herein stated); thickness generally 100 feet.

Type locality: On Jackson-Raymond Road, one-half mile northeast of Forest Hill School in NE¼ sec. 22, and NW¼ sec. 23, T. 5 N., R. 1 W., Hinds County, Miss.

Forestville Member (of Canadaway Formation)

Upper Devonian (Senecan): Southwestern New York.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2317, 2318. Name given to unit formerly known as Gowanda member of Canadaway formation. Underlies Laona member; overlies South Wales member. Different type locality designated.

[Probably named for Forestville, Chautauqua County.]

Forestville Shale[1]

Mississippian: Michigan.

Original reference: C. H. Gordon, 1900, Michigan Geol. Survey, v. 7, pt. 3, p. 23.

Probably named for exposures at Forestville, Sanilac County.

Forge Hollow Dolomite (in Bertie Group)

Forge Hollow Member (of Bertie Formation)

Upper Silurian: Central New York.

L. V. Rickard, 1955, New York Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7,

9 (strat. column). Gypsiferous shales, 25 to 40 feet thick. Overlies Fiddlers Green member; underlies Williamsville member.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Rank raised to formation in Bertie group. Overlies Fiddlers Green dolomite; underlies Oxbow dolomite (new). Fieldwork has not demonstrated lateral continuity of Forge Hollow and Scajaquada as indicated on present chart. Thick glacial deposits conceal these units in area where they may merge. Possibility of facies changes—for example, Falkirk to Forge Hollow—should not be overlooked. For the present, distinct names are retained for western and central New York.

Occurs in Clockville and Munnsville areas.

Forked Deer Limestone[1]

Lower Ordovician: Northeastern Tennessee.

Original reference: G. M. Hall and H. C. Amick, 1934, Tennessee Acad. Sci. Jour., v. 9, no. 2, p. 158–161.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 49. Kingsport limestone (new) replaces Jefferson City formation (Oder, 1934) and Forked Deer formation (Hall and Amick, 1934).

Named for Forked Deer Creek in valley in which U.S. Highway 25 is located, Morristown quadrangle, Hamblen County.

†Fork Mountain Slate[1]

Pennsylvanian: Southwestern Arkansas.

Original references: A. H. Purdue, 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 40; 1914, U.S. Geol. Survey Bull. 586.

Named for Fork Mountain, Polk County.

Fork Ridge Sandstone Member (of Mingo Formation)[1]

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 39, 40.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 82, 83, 89, 140. In Mingo formation about 40 feet below Mingo coal.

Named for Fork Ridge, Bell County, Ky.

Forlorn Hope Shale

Lower Cambrian: Southeastern Nevada.

J. F. Mason *in* A. W. Grabau, 1936, Paleozoic formations in the light of the pulsation theory, v. 1, Lower and Middle Cambrian pulsation: 2d ed., Peiping, China, University Press, Natl. Univ. Peking, p. 275–276. Green argillaceous shale with *Olenopsis*. Thickness 115 feet. Overlies Pioche formation (restricted); underlies Comet shale (new). Pioche shale of Walcott (1908), and Westgate and Knopf (1927) includes Comet shale, Forlorn Hope shale, and Pioche shale as used here. Lower to Middle Cambrian boundary was placed at top of Forlorn Hope shale in order to cause *Olenopsis* to fall at summit of Lower Cambrian.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1149, 1159. Mason (1936) did not define term Forlorn Hope and did not indicate type locality. Term Forlorn Hope not used in this report [Highland Range area, Nevada].

Type locality and derivation of name not given.

†Forman Volcanics

Miocene, upper: Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299. Interbedded with Sutro tuffs (new); older than Mount Kate volcanics (new).

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 53. Similar name is used for a formation in California; therefore, renamed Alta andesite series.

Forms hanging wall of the Comstock lode throughout most of its length and entirely encloses the Silver City system of veins, Silver City district.

Forrest Shale[1]

Lower Cretaceous: Southeastern Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 129, 138, 139.

Named for Forrest Ranch, a few miles east of Bisbee.

Forreston Member (of Grand Detour Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15A, 15C. Shown on columnar section as underlying Eldena member (new) of Nachusa formation (new) and overlying Victory member (new) of Grand Detour formation (new). Thickness 4 to 17 feet.

Occurs in Dixon-Oregon area.

Fort Adams Member (of Pascagoula Formation)

Miocene: Southwestern Mississippi.

G. F. Brown and W. F. Guyton, 1943, Mississippi Geol. Survey Bull. 56, p. 22, 23 (table), 47–50, pl. 3. Calcareous green clay, indurated blue claystone, compact sand, and light coarse sand. Overlies Homochitto member (new). Thickness 135 to 235 feet (data based on test well). Derivation of name given.

This may or may not be unit referred to as Fort Adams or Ellisville phase of Grand Gulf Group.

Named for exposures along bluff above Fort Adams, southwestern Wilkinson County. Supposedly can be followed in northeasterly direction from Fort Adams across Wilkinson County into Franklin County.

†Fort Adams[1] or Ellisville phase[1]

Oligocene(?) or Miocene: Southern Mississippi and southern Louisiana.

Original reference: L. C. Johnson, 1893, Science, v. 21, p. 90–91.

Named for Fort Adams, Wilkinson County, Miss., and Ellisville, Jones County, Miss.

Fort Ancient division (in Richmond Group)[1]

Fort Ancient Member (of Waynesville Formation)

Upper Ordovician: Southwestern Ohio.

Original reference: A. F. Foerste, 1909, Denison Univ. Sci. Lab. Bull. 14, p. 292.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of

Ohio as basal member of Waynesville formation. Underlies Clarksville member; overlies Oregonia member of Arnheim formation.

Named for Fort Ancient, Warren County.

Fort Ann Limestone (in Great Meadows Formation)

Fort Ann Limestone Member (of Tribes Hill Formation)

Lower Ordovician: East-central New York.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Named as member of Tribes Hill formation.

R. R. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518, 522. Limestone is middle member of Tribes Hill in Champlain and Hudson Valleys. Underlies Benson dolomite member; overlies Norton member. Represents division C 3 of Brainerd's and Seely's "Calciferous" (1890, Geol. Soc. America Bull., v. 1, p. 501–516).

John Rodgers, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, p. 35 (table 2). Described as persistent limestone layer at top of Great Meadows formation (new). Refers to R. H. Flower (unpub. ms.).

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 74. Subdivisions of Tribes Hill of Champlain Valley are poorly defined and can not be used in Mohawk Valley.

Probably named for occurrence at Fort Ann, Washington County.

Fort Apache Limestone Member (of Supai Formation)[1]

Permian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 533–536.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 86, 88, fig. 2. Underlies Corduroy member (new); overlies Big "A" sand facies.

Described in Fort Apache Indian Reservation.

Fort Atkinson Limestone Member (of Maquoketa Shale)

Fort Atkinson Limestone (in Maquoketa Group)[1]

Upper Ordovician: Northeastern Iowa and western Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 98.

W. H. Twenhofel, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as limestone member of Maquoketa formation. Underlies Brainard limestone member; overlies Clermont shale member.

Named for exposures in quarry west of old fort at town of Fort Atkinson, Winneshiek County, Iowa.

†Fort Benton Group[1]

Upper Cretaceous: Southeastern Montana, Colorado, Kansas, southern Minnesota, Nebraska, northern New Mexico, South Dakota, and eastern Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 421.

Occurs along Missouri River from 10 miles above James River to Big Sioux River, along eastern slope of Rocky Mountains, and at Black Hills. Named for Fort Benton, on Missouri River, about 40 miles below Great Falls, Mont.

Fort Buchanan Formation (in Sonoita Group)

Upper Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 59. Consists of a basal conglomerate about 400 feet thick overlain by a series of alternating hard gray sandstones and soft maroon shales approximately 1,500 feet thick. The lower division of Sonoita group; underlies Fort Crittenden formation (new). Rests on andesitic flows.

In Casa Blanca Canyon, Patagonia Mountains. Name adopted from the nearby ruins of an old fort.

Fort Cassin Formation[1]

Lower Ordovician: Northwestern Vermont and eastern New York.

Original reference: R. P. Whitfield, 1890, Am. Mus. Nat. History Bull., v. 3, p. 25–28.

John Rodgers, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, Nov. 10–12, p. 35 (table 2). Described in Fort Ann 15-minute quadrangle, New York, as consisting of interbedded limestone and dolomite with a basal sandstone. Thickness 150 feet. Underlies Providence Island dolomite; overlies Smith Basin formation.

Named for Fort Cassin, Addison County, Vt.

Fort Covington Glaciation

Fort Covington Till

Pleistocene: Northwestern New York.

Paul MacClintock, 1958, Glacial geology of the St. Lawrence seaway and power project: New York State Mus. and Sci. Service, p. 6–25. Younger of two episodes of glaciation in area. Advance followed Malone glaciation (new) and came from the northwest. Till forms morainal ridges, mantles the northeast-southwest drift hills, and lies on varved sediments in St. Lawrence seaway excavations.

Named for Fort Covington, Franklin County, in vicinity of which till forms strong morainal ridges.

Fort Crittenden Formation (in Sonoita Group)

Upper Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 27 (table). Named on table. Soft red and yellow clay and sandstone. Early Tertiary.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 59. Consists of (ascending) alternating yellow thin-bedded shales and hard sandstones, 600 feet thick; yellow, red, and black shale alternating with hard yellow and pink sandstone, 200 feet thick; light-colored conglomerate, 350 feet thick; thin-bedded sandstone, 80 feet thick; soft light-colored shale and gray and buff sandstone and shale; conglomerate composed of large boulders, probably over 1,000 feet thick; and south of the Greaterville fault, terminates in a thick series of scarlet-red strata. Upper division of Sonoita group; overlies Fort Buchanan formation (new). Geographical area given. Late Cretaceous.

In Casa Blanca Canyon, Patagonia Mountains. Name adopted from the nearby ruins of an old fort.

Fort Denaud Member (of Caloosahatchee Marl)

Pleistocene: Southern Florida.

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 192, (table 1). Table shows Fort Denaud as lowermost member of Caloosahatchee. Underlies Bee Branch limestone member (new); overlies Tamiami formation.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136, (fig. 4), 139–143. Typically strata are light colored, with cream, white, and light gray predominating, although some units are mottled yellow brown. Composed of sandy and silty marls, soft and relatively unconsolidated; near Ortona Locks in Hendry County, a thin hard calcareous sandstone almost barren of fossils forms slight ledge at or below water level. Several units (faunizones) and numerous facies are recognized; includes (ascending) *Cyrtopleura costata* faunizone, basal oyster biostrome, and a brackish-water bed characterized by *Rangia nasuta*. Exposed thickness rarely exceeds 5 feet and commonly is less, although locally may be as much as 8 feet. Base of lower beds observed only where Caloosahatchee marl laps onto erosional remnants of Tamiami formation. Underlies Bee Branch member; where erosion has been intense, member is unconformable below Fort Thompson or Pamlico formation.

Named for exposures along stretch of Caloosahatchee River extending between point ½ mile and 3½ miles upstream from Fort Denaud in Hendry County.

Fort Dodge Gypsum[1]

Permian(?): Central northern Iowa.

Original reference: W. J. McGee, 1884, Rept. 10th Census, v. 10, Rept. on building stones, p. 257, 258.

Occurs in vicinity of Fort Dodge, Webster County.

Fort Ellis Beds[1]

Pliocene(?): Central southern Montana.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 287.

In vicinity of Fort Ellis, near Bozeman, Threeforks quadrangle.

†Fort Gaines[1]

Eocene, lower: Western Georgia and southern Alabama.

Original reference: E. A. Smith, 1888, Geographic map of Alabama: Alabama Geol. Survey Rept. Prog. 1884–1888.

Probably named for Fort Gaines, Clay County, Ga.

Fort Hall Formation (in Thaynes Group)[1]

Lower Triassic: Southeastern Idaho.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 31, pl. 1. Mapped in Ammon and Paradise Valley quadrangles where thickness is about 1,000 feet.

Bernard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 172. Mansfield (1916, Washington Acad. Sci. Jour., v. 6) raised Thaynes to rank of group and subdivided it into (ascending) Ross Fork limestone (called Ross limestone in Mansfield's 1916 paper), Fort Hall formation, and Portneuf limestone. In area between Fort Hall Indian Reservation and Gray's Range, these three divisions of Thaynes are distinctive. Eastward toward Salt River Range and southward toward Bear Lake Valley, the Ross Fork and Fort Hall formations lose their identity. The Portneuf is a much more distinctive unit, and parts of it can be traced from Fort Hall, Idaho, to Cumberland, Wyo. Name Portneuf is retained, but in present paper names Ross Fork and Fort Hall are not used.

Named for old Fort Hall, the site of which is in valley of Lincoln Creek, which appears on some maps as Fort Hall Creek. Formation occupies a prominent ridge along north side of valley.

†Fort Hays division or Group[1]

Upper Cretaceous: Western Kansas.

Original reference: B. F. Mudge, 1876, U.S. Geol. and Geog. Survey Terr. Bull. 2, p. 218–221.

Named for old Fort Hays, Ellis County.

Fort Hays Limestone Member (of Niobrara Formation)[1]

Upper Cretaceous: Western Kansas, eastern Colorado, northeastern New Mexico, and southeastern South Dakota.

Original reference: S. W. Williston, 1893, Kansas Acad. Sci. Trans., v. 13, p. 108–109.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 30–31. Described in Colfax County, N. Mex., where it underlies Smoky Hill marl member and overlies Carlile shale. Consists of seven or eight limestone beds that are separated by beds of calcareous shale. Thickness 15 to 20 feet. Believed to be equivalent to part of Timpas limestone of previous usage.

E. J. Bolin, 1952, South Dakota Acad. Sci. Proc., v. 31, p. 190. Geographically extended into southeastern South Dakota. It is difficult to distinguish Fort Hays and Smoky Hill members on lithologic basis, but, this investigation demonstrated that they could be distinguished on basis of microfossils. Thickness of Fort Hays varies from 50 to 80 feet.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Described in La Veta area, Huerfano County, Colo., where it crops out as prominent hogback on flanks of Greenhorn anticline. Consists of thick beds of light-gray chalky limestone alternating with thin interbeds of gray calcareous shale. Average thickness 60 feet. Underlies Smoky Hill marl member; overlies Codell sandstone member of Carlile shale.

M. A. Jenkens, Jr., 1957. Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks basin, Colorado, p. 53, pl. 1. Described in Red Dirt area, Grand County, Colo., where it is about 14 feet thick; underlies Smoky Hill member; overlies Codell sandstone here included in the Benton because Graneros, Greenhorn, and Carlile cannot be distinguished in this area. Believed that names Fort Hays and Smoky Hill have priority over terms Timpas and Apishapa; use of the former terms would help standardize Niobrara terminology in west-central Colorado.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as Fort Hays limestone member of Niobrara chalk. Underlies Smoky Hill chalk member; overlies Codell sandstone.

Named for old Fort Hays, well-known landmark in western Kansas.

Fort Hunter Sandstone Member (of Mahantango Formation)

Middle Devonian: Central Pennsylvania.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 138, 139, 164, 165 (fig. 38), 180–182. Thin, very hard dark-gray rusty-weathering sandstone. At type locality, unit is interbedded in more shaly lower part of Montebello sandstone facies of the Mahantango. Occurs near base of Skaneatels facies of Mahantango from Perry County east of the Schuylkill River. Thickness about 5 feet. Was called Rockville by Willard and Cleaves (1938), but that name is preoccupied.

Type locality: Southernmost quarry at Rockville, Dauphin County. Named for Fort Hunter, 4 miles north of Harrisburg.

Fort Johnson Member (of Tribes Hill Formation)

Lower Ordovician (Lower Canadian): East-central New York.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 84–85. Name proposed for basal member of formation in Mohawk Valley. Breccia of dolomite cobbles or a sandstone stratum commonly forms base. Lower part is predominantly dolomite (dolomisiltite and dolomarenite). Above is a transition zone of calcite dolomite and dolomitic limestone. Upper part is primarily thick-bedded white-weathering blue-black dolomitic calcilutite in which irregular buff-weathering dolomite patches stand out in relief. Thickness 28 feet at type locality where base is concealed. Thickened extension of lower half of unit reaches 90 feet in northeastern part of Amsterdam quadrangle; this interval, when traced into Saratoga Springs area, is coextensive with Gailor dolomite. Underlies Palatine Bridge member (new) and is overlapped by it northward; contact gradational west of Cranesville and unconformable to the east. Overlies an unnamed dolomite, usually conformably.

Type locality: Abandoned quarry and West Shore Railroad cut 2 miles east of Fort Hunter, Montgomery County. Named for village of Fort Johnson on north side of Mohawk River northeast of Fort Hunter.

Fort Kent Shale

Lower Devonian: Northern Maine, and northwestern New Brunswick, Canada.

O. O. Nylander, 1940, Geological formations of the St. John River valley, northern Maine and New Brunswick; Caribou, Maine, privately printed, p. 3–4. Name proposed for distorted, folded beds of shale. Overlies unnamed sandstone.

Crops out in vicinity of hill in southern part of town of Fort Kent about 1¼ miles northwest of Daigle post office, Aroostook County, Maine. Well-exposed in village of Edmunston and along road to St. Basil, New Brunswick, Canada.

†Fort Knox Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: J. Collett, 1874, Indiana Geol. Survey 5th Rept., p. 323.

Named for Fort Knox, Knox County.

Fort Littleton Formation (in Portage Group)[1]

Upper Devonian: Eastern and central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1199, 1218.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G 19, p. 210–218. Summary discussion. Underlies Chemung group or Catskill facies group; overlies Rush formation. Since there is a definite line of separation between Burket member of the Rush and Harrell member of the Fort Littleton, use of terms Fort Littleton and Rush in sense of formations is convenient.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Stratigraphically restricted; Parkhead sandstone is shown as distinct unit overlying Fort Littleton formation, not a member of the latter.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Fort Littleton contains Trimmers Rock sandstone, Brallier shale, and Harrell shale members.

Named for Fort Littleton, a village in northeastern part of Fulton County.

Fort Logan Beds[1]

Miocene, lower: Western central Montana.

Original reference: E. Douglas, 1903, Carnegie Mus. Annals, v. 2, p. 150–151.

W. T. Thom, Jr., 1957, Billings Geol. Soc. Guidebook, 8th Ann. Field Conf., p. 11 (table 1). Name appears on generalized stratigraphic section for Crazy Mountain Basin and nearby areas. Underlies Deep River beds, together the two units are dated as middle and upper Miocene.

Named for military post in Meagher County near which beds are best exposed.

Fort Mountain Gneiss

Precambrian: Northwestern Georgia.

A. S. Furcron, K. H. Teague, and J. L. Calver, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1195. Thrust faults supplementary to the mapped overthrust, which separates the eastern crystalline block from known Paleozoic sediments of the Great Valley, bring up a Precambrian biotite augen gneiss, Fort Mountain gneiss, intruded by granite, upon which Ocoee rocks are unconformable. Talc deposits and associated schists, Cohutta schist, occur in upthrust block of Fort Mountain gneiss but not in the Ocoee series.

A. S. Furcron and K. H. Teague, 1947, Georgia Geol. Survey Bull. 53, p. 9–11, pl. 1. Fort Mountain gneiss, as mapped, is a complex of igneous and metamorphic rocks which contains numerous bodies of Corbin granite and Cohutta schist. Intruded by Corbin granite. Derivation of name given.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 277–278. Fort Mountain (granite) gneiss forms narrow belt 4 to 5 miles long on west slope of Fort and Cohutta Mountains and lies south of Holly Creek embayment of Cartersville thrust block. Hayes (U.S. Geol, Survey Dalton folio, unpub.) states that the gneiss is overlain by basal arkosic conglomerate, black slate, graywacke, and conglomerate. Lower part of sedimentary series that overlies the granite gneiss should

be Hurricane graywacke (new). Fort Mountain gneiss considered a hybrid rock and regarded as part of injection complex below Ocoee series.

Named from Fort Mountain, Murray County. Crops out in two distinct belts in the Fort and Cohutta Mountain district, east of Chatsworth.

Fort Niobrara Formation[1]

Pliocene: Nebraska, Colorado, and Wyoming.

Original reference: H. F. Osborn, 1909. U.S. Geol. Survey Bull. 361, p. 115.

F. W. Johnson, 1936, Am. Jour. Sci., 5th, v. 31, p. 469. Name Valentine has priority over Fort Niobrara formation.

F. W. Walker, 1938, Am. Jour. Sci., 5th, v. 36, no. 213, p. 215, 219. Proposed to consider terms Fort Niobrara and Niobrara River as obsolete and incompatible to good geologic nomenclature. Name Valentine beds should be retained and applied to lower 175 to 225 feet of unconsolidated sands of Ogallala formation in Valentine area.

Type locality: On Niobrara River, near Fort Niobrara, Cherry County, Nebr.

Fort Payne Chert[1] or Formation

Lower Mississippian: Northern and eastern Alabama, northwestern Georgia, Kentucky, northeastern Mississippi, and Tennessee.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept on Cahaba coal field, p. 155–156, sec. opposite p. 152, map.

H. J. Klepser, 1937, Ohio State Univ. Abs. Doctors' Dissert. 24, p. 182. Formation, in Eastern Highland Rim area, includes a northern facies, Greasy Creek, and a southern facies, Short Mountain (both new).

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 52–54. Referred to as formation. Term Fort Payne has been used in many ways since its original definition by Smith (1890). As presently used in Tennessee, restricted to the characteristically cherty strata between Chattanooga shale (or Maury or New Providence, if present) and the so-called Warsaw formation. Age of top and bottom of unit varies with locality; main mass of unit is primarily of Keokuk age. Maximum thickness in Tennessee about 275 feet. Includes Greasy Creek facies and Short Mountain facies.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 86–88, 90, 92–94). Shown on correlation chart as Osagean.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 106–108, pt. 1, pls. Grainger formation is recognized in belts southeast of Whiteoak Mountain and Wallen Valley faults, and Fort Payne chert in those northwest, except that belt along Cumberland escarpment northeast of Jacksboro fault is shown as grading from Fort Payne chert near La Follette to Grainger formation near Cumberland Gap. Thickness 100 to 200 feet.

A. T. Allen and J. G. Lester, 1953, Georgia Geol. Survey Bull. 60, p. 192, 193. Columnar section at Little Sand Mountain, Ga., shows Fort Payne chert, 390 feet thick, overlies Chattanooga shale and underlies St. Louis limestone.

G. T Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 16 (table 3), 34–39. Chert crops out in northwestern Madison County over area of about 50 square miles. Thickness (determined from well logs) 95 to 160 feet. Unconformably overlies Chattanooga shale; conformably underlies Tuscumbia limestone. Osage.

Named for development at Fort Payne, De Kalb County, Ala.

Fort Pena Formation[1]

Middle Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066, 1070.

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 7–8. Age given as Middle Ordovician.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 20–23. In the Solitario and old Jones Ranch areas, Alsate shale is not present between characteristic limestones of Marathon limestone and Fort Pena formation; in its place is white to buff quartzose sandstone 20 to 50 feet thick herein named Rodriquez Tank sandstone. Underlies Woods Hollow shale. Graptolite fauna discussed.

Type locality: On ridge directly north of old Fort Pena Colorada, Brewster County.

Fort Plain[1]

Fort Plain Shale Member (of Canajoharie Shale)

Fort Plain zone (of Fairfield Member of Canajoharie Formation)

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 119. Referred to as Fort Plain shale member of Canajoharie. Underlies Chuctenunda shale member.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 57–58. Uppermost zone of Fairfield member. Composed of silty shale at Canajoharie, but of black shale along West Canada Creek. Underlies Utica shale; overlies rocks of Dolgeville facies in Little Falls and southeastern Utica quadrangles. Thin metabentonite occurs just above contact with Dolgeville in stream south of County Home, Utica quadrangle; thickness of zone here at least 50 feet.

Type locality and derivation of name not given but may have been named for Fort Plain, Montgomery County.

Fortress Mountain Formation

Lower Cretaceous: Northern Alaska.

W. W. Patton, Jr., 1956, *in* George Gryc and others, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 219–221, figs. 2, 5. Consists of shale and large percentage of coarse graywacke sandstone and conglomerate. Conglomerate and sandstone typically green to gray and composed chiefly of chert, feldspar, and mafic igneous fragments in mudstone matrix. Beds of coarse clastics several feet to more than 1,000 feet thick, and intercalated with dark gray soft clay and silt shale and gray to green siltstone. Thickness at type section, the thickest known section, approximately 10,000 feet; over most of foothills, less than 5,000 feet and generally less than 3,000 feet. Locally overlies Okpikruak formation and older rocks with angular discordance; overlies Tiglukpuk formation at type locality. Succeeded stratigraphically possibly by part of Torok formation and by Nanushuk group.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 69–73, pls. 8, 9, 18. Described in Utukok-Corwin region where it is more than 4,400 feet thick and consists mostly of marine shale, siltstone,

graywacke-type sandstone, and some conglomerate. No distinct contact with overlying Torok formation exposed in mapped area. Early Cretaceous.

Type section: A composite of several partial sections exposed along Kiruktagiak River and on Castle Mountain. Named from exposures on Fortress Mountain (lat 68°34'30" N., long 152°58' W.), where typically exposed. Mapped over wide area in southern half of Arctic Foothills province from Sagavanirktok River west beyond Kukpowruk River.

Fort Ridgely Granite (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482, 1483. Pinkish-gray porphyritic granite with aligned phenocrysts 2 inches or more in length that stand out prominently on slightly weathered surfaces. Dark inclusions locally abundant, and where these are present the rock resembles Morton gneiss but lacks typical contorted structure of the Morton. May be a less contaminated and more massive facies of the Morton.

Exposed in vicinity of Fort Ridgely State Park, Nicollet County.

Fort Riley Limestone (in Chase Group)[1]

Fort Riley Limestone Member (of Barneston Limestone)

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 14.

G. E. Condra and J. E. Upp. 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 41. Uppermost member of Barneston formation (new).

R. C. Moore, 1936, Kansas Geol. Soc. Guidebook 10th Ann. Field Conf., p. 12 (fig. 4), 69 (fig. 45). Overlies Oketo shale member (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44–45. Limestone, light-gray and tan, massive and thin-bedded, with minor amount of gray shale. Basal part contains thin, more or less shaly beds that are overlain by massive "rim rock," which contains fossil algae; thin shaly beds and locally clay shale deposits occur in middle part; upper strata rather massive but less so than the "rim rock." Thickness 30 to 45 feet. Underlies Holmesville shale member of Doyle shale. Wolfcamp series.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Fort Riley limestone in Chase group.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 80, p. 111–114. Currently considered to be top member of Barneston formation. Underlain in turn by Oketo shale member and Florence limestone (Florence flint) member. These subdivisions of Barneston have been traced across Kay County, Okla. Between Kay and Pawnee Counties, Florence limestone member disappears and only a noncherty limestone, here considered to be Fort Riley member, extends southward as far as Pawnee County. In Kay County, consists of about 31 feet of soft light-gray to buff limestone with massive algal bed more than 10 feet thick occurring locally in lower part. Overlies Matfield shale; underlies Doyle shale.

Named for Fort Riley, Geary County, Kans.

†Fort Scott coal series[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 25–26.

Probably named for exposures at Fort Scott, Bourbon County.

Fort Scott Limestone[1] (in Marmaton Group)

Fort Scott Limestone (in Henrietta Group)

Fort Scott Limestone Member (of Henrietta Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Kansas, western Missouri, southwestern Iowa, and northeastern Oklahoma.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 25.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 25–26 (fig. 2), 36–37, measured sections. Basal formation in Henrietta group. From Missouri River northward, formation includes parts of three cyclothems. At type section, southeastern Kansas, formation is predominantly limestone, but, northeastward in Missouri, shale becomes increasingly prominent, and, in latitude of Missouri River, shale is predominating rock type; if formation has been correctly traced, there are three limestone members which persist into Iowa. In ascending order, these limestones are called by Missouri Survey the lower Fort Scott ("Mulky cap rock"), the "Rhomboidal," and upper Fort Scott "Lexington bottom-rock"). These limestones are herein named (ascending) Blackjack Creek, Houx, and Higginsville. Underlies Labette shale; overlies Cherokee shale (group).

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 302–309. Cline (1941) named lower member the Blackjack Creek, the upper, the Higginsville, and a thin limestone that occurs between them, the Houx. Name Little Osage shale is here proposed for beds between Blackjack Creek and Higginsville limestones, and Houx limestone is considered bed in Little Osage shale. Bennett (1896, Kansas Univ. Geol. Survey, v. 1) probably regarded exposure in cut a short distance east of Missouri Pacific Railway station in Fort Scott as type exposure; a better type exposure is herein designated. Thickness at this exposure 27¾ feet. Overlies Cherokee shale; underlies Labette shale.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 93–96, measured sections, pl. 7. Fort Scott, in east-central Missouri, consists of alternating beds of shale and limestone below which there is section of shale, base of which is marked by a sandstone, the Squirrel. Although the Squirrel is usually placed in upper part of Cherokee, it is believed that more detailed work will show that it belongs at base of Henrietta group. Unconformably overlies Lagonda shale of Cherokee group. Thickness in Callaway County about 54 feet.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, shows formation includes (ascending) Blackjack Creek limestone, Houx limestone, Backwater [Blackwater] Creek shale (new), and Higginsville limestone members. Overlies Lagonda sands and shales; underlies Labette shale. Henrietta group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 5–6 Name Henrietta group sup-

pressed. Fort Scott reallocated to Marmaton group Missouri. Includes (ascending) Blackjack Creek limestone, Little Osage, and Higginsville limestone members. Little Osage member includes (ascending) Houx limestone, Blackwater Creek shale, and Flint Hill sandstone (new). Underlies Labette formation.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2093. Breezy Hill limestone member of Cherokee formation seems rather consistently to have been identified as lower Fort Scott in northern Oklahoma, whereas the true lower Fort Scott limestone (Blackjack Creek) of type area is actually the next limestone unit above the Breezy Hill. Lithologically, the Breezy Hill in northern Oklahoma is very much like lower Fort Scott limestone of type region, and the true lower Fort Scott (Blackjack Creek) has developed a somewhat different lithology.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 20–25, pl. 1. Described in Tulsa County. According to present usage, term Fort Scott is applied to two limestones and an intervening shale at type locality where aggregate thickness is about 30 feet. Formation maintains its tripartite character southward into Oklahoma, but upper limestone member does not extend south of T. 25 N., R. 16 E., southeastern Nowata County. Lower limestone member extends southward beyond Tulsa County and is overlain, at least locally by middle shale member. These two members are not more than 10 feet thick in most exposures south of Arkansas River. Conformably overlies Senora formation; conformably underlies Labette shale.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Fort Scott formation, Marmaton group, shown on northern midcontinent composite stratigraphic section above Excello formation, Cabaniss group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 33, fig. 5. Fort Scott has not been completely differentiated in Iowa, but the following members have been identified (ascending): Blackjack Creek limestone, Summit coal, Houx limestone, and Higginsville limestone. Shale section underlies Higginsville; this interval is about 15 feet thick in Appanoose County and about 7 feet in Madison County. Underlies Labette shale; overlies Cherokee shale. Marmaton group. Classification of Marmaton group used in this report is that agreed upon by State Geological Surveys in northern midcontinent region (Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11). Although Iowa Survey is not entirely in agreement on this classification, it is used here for convenience of those who may be familiar with grouping as used in other states of region.

Type exposure: Cement plant quarry NE¼ sec. 19, T. 25 S., R. 25 E., northeast of Fort Scott, Bourbon County, Kans.

†Fort Scott Marble (in Cherokee Shale)[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim, Rept., p. 26.

Probably named for exposures at Fort Scott, Bourbon County.

†Fort Scott marble series (in Cherokee Shale)[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 26.

Probably named for exposures at Fort Scott, Bourbon County.

Fort Shafter (Schafter) Gravel[1]

Pleistocene(?): Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 62, 64, 65–71.

G. A. Macdonald and D. A. Davis, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 82–83. Fort Schafter gravel included by Stearns (1935, Hawaii Div. Hydrog. Bull. 1) in older alluvium. Underlies lowest tuff of Honolulu volcanic series in area northeast of Pearl Harbor. Pleistocene(?). Type locality.

Type locality: Bluff on edge of Fort Shafter Terrace overlooking Moanalau Gardens and lower gorge of Moanalau Stream. South side of Koolau Range about 17 miles west of Makapuu Head.

Fort Sill Limestone
Fort Sill Formation[1] } (in Arbuckle Group)

Upper Cambrian: Southern Oklahoma.

Original reference: E. O. Ulrich, 1932, Geol. Soc. America Bull. v. 43, no. 3, p. 742–747.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 20–21, measured sections. Basal formation of Arbuckle group. Consists chiefly of thin beds of limestone; thick beds occur at intervals. Thicknesses: 120 to 283 feet in Arbuckle Mountains; 224 to 369 feet in Wichita Mountains. At type section, underlain by 44 feet of Honey Creek limestone and overlain by conglomerates of Signal Mountain formation. In Wichita Mountains, Fort Sill and Signal Mountain formations are separated by about 200 feet of Royer dolomite; in Arbuckle Mountains, separated by 675 to 771 feet of Royer.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Fort Sill limestone.

Type section: On west end of McKenzie Hill, in secs. 7 and 8, T. 2 N., R. 12 W., Comanche County. Named for Fort Sill military post where part of formation is exposed in quarry near south edge of post.

†Fort Sill Series[1]

Tertiary(?): Southwestern Oklahoma.

Original reference: T. B. Comstock, 1890, Texas Geol. Survey 1st Ann. Rept., p. 322, 324, 328.

Named for Fort Sill, Comanche County.

†Fort Smith Formation[1]

Pennsylvanian (Allegheny): Western Arkansas.

Original reference: A. J. Collier, 1907, U.S. Geol. Survey Bull. 326, p. 12, 18–20, map.

Named for Fort Smith, Sebastian County.

Fort Stanton Shale[1]

Upper Cretaceous: Southern central New Mexico.

Original reference: G. H. Hansen, 1931, George Washington Univ. Bull., Summ. Theses 1925–1928, p. 84.

Near Fort Stanton Reservation, Sierra Blanca region.

Fort Thompson Formation[1]

Pleistocene: Southern Florida.

Original reference: E. H. Sellards, 1919, Florida Geol. Survey 12th Ann. Rept., p. 71–72, 75, 76, 118.

J. R. DuBar, 1957, Illinois Acad. Sci., Trans., v. 50, p. 192 (table 1); 1958, Gulf Coast Assoc., Geol. Soc. Trans., v. 8, p. 133, 135, 144–147. Includes Coffee Mill Hammock marl member above and Okaldakoochee marl member (new). Overlies Caloosahatchee marl and where that unit is absent rests on Tamiami formation. Underlies Pamlico formation or Lake Flirt marl.

J. R. DuBar, 1958, Florida Geol. Survey Bull. 40, p. 38, 64–71, 82–83, 85, 122–136, 142–144. Represented along Caloosahatchee River by thin succession of alternating fresh-water and marine marls that bear unconformable relationship to underlying Caloosahatchee. Downstream from Fort Denaud where Caloosahatchee is absent, Fort Thompson beds rests on Tamiami formation. Overlying beds are unconformable and belong either to Pamlico formation or Lake Flirt marl. Maximum thickness about 8 feet. Marine sediments are subdivided into *Chalmys* bed and Coffee Mill Hammock marl. Fresh-water deposits are interbedded with marine sediments. Wisconsinan.

Typically exposed at Fort Thompson, just below Goodno's Landing.

ɔrtune Formation

Devonian: Southwestern Missouri.

J. G. Grohskopf, E. L. Clark, and S. P. Ellison, Jr., 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., app. 4, p. 9–15. Name applied to the sequence of sandstone, chert, and limestone which intervenes between Cotter dolomite below and Sylamore sandstone above. Thickness at type section 6 feet. Locally, the Compton or Chattanooga may lie on the Fortune.

Type section: NE¼SW¼SW¼ sec. 4, T. 23 N., R. 26 W., Barry County. Name derived from Fortune Branch. Formation restricted in its outcrops to eastern one-fourth of Cassville quadrangle and western one-fourth of Shell Knob quadrangle, an area of approximately 100 square miles.

Fortune Lakes Slate (in Paint River Group)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 39. Uppermost formation in group. Consists mostly of slate and minor graywacke, with characteristic thin beds (10 feet or less) of course massive graywacke about 300 feet above the base; sideritic slate is present in some areas between Crystal Falls and Alpha; one exposure near Fortune Lakes contains oxidized chert-sideritic rock (iron formation). Aggregate thickness probably at least 4,000 feet. Overlies Stambaugh formation (new).

Main areas of exposure are between Crystal Falls and Fortune Lakes, and in the area between Alpha and Brule, Iron County. Name derived from Fortune Lakes.

Fort Union Formation[1]

Fort Union Group or Series

Upper Cretaceous and Paleocene: North Dakota, northwestern Colorado, Montana, South Dakota, and Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 433.

W. G. Pierce, 1936, U.S. Geol. Survey Bull. 847–B, p. 57–64. Formation, in Rosebud coal field, Montana, comprises Lebo shale member below and Tongue River member above. Overlies Lance formation. Eocene.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, 287 p. Fort Union group in Crazy Mountain field, Montana, comprises Lebo formation below and Melville formation (new) above. Thickness about 6,350 feet. Overlies Bear formation (new). Paleocene. Mammalian faunas described.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 11–12, pls. 1, 3. Formation is about 1,000 feet thick in McCone County, Mont. Comprises Lebo shale member below and Tongue River member above. Overlies Lance formation. Eocene.

G. L. Jepsen, 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 231–238. Term Polecat Bench formation proposed to replace term "Fort Union" in vicinity of Polecat Bench, Park County, Wyo.

Erling Dorf., 1940, Geol. Soc. America Bull., v. 51, no. 2, p. 213–236. Discussion of relationship between floras of type Lance and Fort Union formations. Paleobotanical evidence supports known vertebrate evidence in placing boundary between true Lance and the "Fort Union" at base of nondinosaur-bearing Tullock, Ludlow, or Bear formations or their equivalents; that is, at top of *Triceratops*-bearing Hell Creek or Lance formations as originally defined. Table of proposed revision shows Fort Union group comprises Tullock formation (equivalent to Ludlow formation and Cannonball marine member) in lower part, and several formations (not discussed) in upper part. Overlies Lance formation (equivalent to Hell Creek formation). Paleocene.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 20, pl. 1. Referred to as Fort Union series or group. Paleocene.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 16–23, measured sections. Group, in southern Morton County, comprises Ludlow, Cannonball, and Tongue River formations. Overlies Hell Creek formation. Paleocene.

W. E. Benson and W. W. Laird, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1166–1167. Formation in North Dakota; underlies Golden Valley formation (new).

R. W. Brown, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1265–1274. Recent paleontologic and stratigraphic evidence points toward retention of Sentinel Butte shale within Fort Union formation of Paleocene series. Unit has been considered by some geologists to be of Wasatch (Eocene) age.

W. D. Johnson, Jr., and R. P. Kunkel, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–148. Formation in Oliver and Mercer Counties, N. Dak., is about 500 feet thick, underlies Golden Valley formation and overlies Cannonball formation.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Formation, as mapped, includes Tongue River, Lebo shale, and Tullock members.

P. R. May, 1954, U.S. Geol. Survey Bull. 995–G, p. 267–268. Described in Wibaux area, Montana and North Dakota, where it comprises Ludlow,

Tongue River, and Sentinel Butte members. Conformably overlies Upper Cretaceous Hell Creek formation.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 60–62, pls. Formation, in Buffalo-Lake De Smet area, Wyoming, consists of nonmarine sandstone, shale, and conglomerate which overlies Lance formation and underlies Kingsbury conglomerate member of Wasatch formation. In west-central part of area, formation is divided into two members by an angular unconformity, beneath which as much as 2,600 feet of strata in middle and lower parts of formation may locally have been removed by erosion. Thickness about 3,900 feet south of Buffalo.

Named for exposures at old Fort Union, near mouth of Yellowstone River, later called Fort Buford and now town of Buford, McKenzie County, N. Dak.

Fort Wallace Ash Bed (in Ash Hollow Member of Ogallala Formation)

Pliocene: Northwestern Kansas.

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 253–254. Name applied to volcanic ash bed. At type locality 1½ feet thick. Occurs 29 feet above Ogallala-Pierre shale contact and 65½ feet below top of the "algal limestone." Lies stratigraphically above Rawlins ash bed (new) and below Fort Wallace ash bed (new).

Named for exposures south of old Fort Wallace in tributary canyons along south side of Smoky Hill River valley in west line of SW¼ sec. 7, T. 14 S., R. 38 W., Wallace County.

Fort Washington[1]

Eocene: Southern Maryland.

Original reference: T. A. Conrad, 1830, Acad. Nat. Sci. Philadelphia Jour., v. 6, p. 205–217.

Fort Washington and vicinity, Prince Georges County.

Fort Washington Gneiss[1]

Precambrian: New York.

Original reference: R. P. Stevens, 1867, New York Lyc., Nat. History Annals, v. 8, p. 116–120.

Occurs in and around Fort Washington Park.

Fort Worth Limestone[1] } (in Washita Group)
Fort Worth Formation }

Fort Worth Limestone Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Central and eastern Texas, southwestern Arkansas, and central southern and southeastern Oklahoma.

Original reference: R. T. Hill, 1889, Texas Geol. Survey Bull. 4, p. xiv, xxi, xxii.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Correlation chart shows Fort Worth limestone above Duck Creek formation and below Denton clay member of Denison formation.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Correlation chart shows Fort Worth limestone above Duck Creek limestone and below Denton clay. [Denison formation abandoned and mem-

bers raised to formation rank.] Washita group, Comanche series, Lower Cretaceous.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 26–27, table 4. Foraminifera of formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Conf., p. 88, 91. In central Texas, considered member of Georgetown limestone. Overlies Duck Creek limestone member and underlies Denton shale member.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 27–29, pl. 2. Limestone described in Tarrant County, Tex., where it is about 32 feet thick and consists of regularly alternating dense gray limestone beds, 6 to 12 inches thick, and gray marls, 2 feet or less in thickness. Apparently conformable with underlying Duck Creek formation and overlying Denton marl member of Denison formation. Washita group.

Named for exposures at Fort Worth, Tarrant County, Tex.

Fortymile Granite[1]

[Precambrian]: Eastern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 135, 137.

Fortymile district.

†Fortymile Group[1]

†Fortymile Series[1]

Precambrian and Paleozoic: Central eastern Alaska.

Original reference: J. C. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 145–155.

Named for exposures along canyonlike valley of Fortymile Creek.

Fossil Creek Volcanics[1]

Middle Ordovician: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1936, U.S. Geol. Survey Bull. 872.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Typically exposed in White Mountains, about 50 miles north of Fairbanks, where they crop out just north of Fossil Creek, in belt about 40 miles long, Yukon-Tanana region.

Fossil Lake Formation[1]

Pleistocene: Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Fossil Lake, northern part of Lake County.

Fountain Formation[1]

Pennsylvanian and Permian: Eastern Colorado and southeastern Wyoming.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

A. K. Miller and H. D. Thomas, 1936, Jour. Paleontology, v. 10, no. 8, p. 723–724. Results of this study indicate that Fountain sandstone of Colorado thins northward by continental overlap and that the Fountain of Laramie Basin, which near Laramie interfingers with marine

beds of the Casper, represents only upper part of type Fountain in Colorado. The arkosic beds disappear north of Laramie and are replaced by marine beds of different lithology.

R. H. Beckwith, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1451–1453. Formation in Elk Mountain district, Carbon County, Wyo., is 150 feet thick; consists of red sandstone, shaly sandstones, white limestones, and pink arkosic grits; partly marine. Overlies Madison limestone; underlies Tensleep sandstone. Unit here called Fountain lies between Madison and Tensleep in same position as beds of comparable lithology and thickness called Amsden in Rollins uplift (Dobbin and others, 1928, U.S. Geol. Survey Bull. 796). Pennsylvanian.

G. E. Condra, E. E. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 35, 44. Includes Fairbank tongue.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 14 (fig. 3), 15 (table 1), 16–24. Described in Golden-Morrison area, where it is 760 to 1,130 feet thick and consists typically of red, arkosic sandstones, conglomerates, and minor beds of red, arenaceous mudstones. Rests nonconformably on Precambrian gneisses and schists; underlies Lyons formation. Upper Pennsylvanian.

K. P. McLaughlin, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1937–1968. Described in Colorado Springs quadrangle where it consists of thick series of red irregularly bedded coarse-grained arkosic sandstones and conglomerates sparsely interbedded with thin shales and locally fossiliferous. Greatest known thickness is at type locality where nearly 4,400 feet of red sandstones and conglomerates are exposed in valley of Fountain Creek between Manitou and West Colorado Springs. Paleozoic exposures are cut out for distance of about 10 miles along mountain front by overthrusting along Cheyenne Mountain thrust. As result, Fountain exposures in Manitou embayment are separated from those in southwestern part of quadrangle. In latter area, thickest surface exposures are of order of 1,500 feet. Rests on Glen Eyrie formation in most of Manitou embayment. In southwestern part of quadrangle, Fountain overlies older Paleozoic formations with angular unconformity or rests directly on eroded Precambrian rocks. Along Little Bear Creek is in contact with Ordovician Manitou dolomite and Harding sandstone and Mississippian Madison limestone; south of Little Bear Creek rests on Pikes Peak granite. Underlies Lyons sandstone.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 33–34. Lower part of Pennsylvanian along eastern side of Front Range is Fountain formation. Maximum thickness about 4,500 feet near Colorado Springs where it includes Glen Eyrie shale member at base. In northern part of Colorado, underlies Ingleside formation; underlies Lyons sandstone south of Loveland.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. In Pueblo County, Colo., overlies Beulah limestone.

S. L. Pederson, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 18–21, 23. Boundary between Permian and Pennsylvanian systems has been determined on paleontological evidence in Gilmore Canyon section, Albany County, Wyo., (Thomas and Thompson, 1953, Wyoming Geol. Survey Bull. 46) and if projected into the other section it seems possible that upper part of Fountain formation may be Permian in age.

Typically developed on Fountain Creek below Manitou Springs in Colorado Springs quadrangle, and at head of same stream in northeastern corner of Pikes Peak quadrangle.

Fountain Peak Rhyolite

Miocene(?): Southern California.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 33, pl. 2. Includes at least two intrusive facies and an unknown amount of pyroclastic material having general composition of rhyolite vitric tuff.

Occurs in northern Providence Mountains, San Bernardino County. Forms main intrusive mass around Fountain Peak, as well as dike system that extends therefrom.

Fourmile Limestone (in Wreford Limestone)[1]

Permian: Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 31.

Type locality: Head of a branch of Fourmile Creek, near Kansas-Nebraska line, about 10½ mile south and one-half mile east of Humboldt, Nebr. Named for Fourmile Creek, in southwestern part of Richardson County, Nebr.

†Fourmile Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–D, p. 17–20.

U.S. Geological Survey has abandoned both the Nelagoney Formation and the Fourmile Sandstone. The Fourmile is equal to Cochahee Sandstone member of Vamoosa Formation.

Named for exposures on the point south of Fourmile Creek in SW¼ sec. 30, T. 24 N., R. 10 E., Osage County.

Four Mile Dam Formation (in Traverse Group)

Middle Devonian: Northeastern Michigan.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Fossiliferous limestone, which at its type section is a part of a reef of uncertain thickness overlain unconformably by Norway Point formation.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 587–589. Overlies Alpena limestone. Includes Dock Street clay member at base. Thickness at type section 8 feet; thickness where Dock Street clay member is present about 16 feet. Included in Traverse group.

Type section: At Four Mile Dam on Thunder Bay River, Alpena County.

Fowkes Formation

Fowkes Formation (in Wasatch Group)[1]

Eocene, upper: Southwestern Wyoming and eastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 20, pl. 1. Tentatively assigned to late Paleocene (Tiffanian and Clarkforkian).

J. L. Tracey, Jr., and Steven S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 128 (table 1), 129, 130. Formation, as defined by Veatch, and its lithologic equivalents to the north in Fossil Basin are of late Eocene age and are youngest of early Tertiary rocks yet found in basin. Formation appears to be valid formation despite Veatch's misconception regarding its stratigraphic position (between Almy and Knight formations) and its erroneous inclusion in Wasatch group. His lithologies are accurate, and unit is distinctive, recognizable, and mappable. Unit is cut by faults limited in distribution. Formation is here removed from Wasatch group. Separated from underlying Green River formation by unnamed unit consisting of pink and green to red mudstone, sandstone, conglomerate, and interbedded limestone.

A. J. Eardley, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 167. Fowkes formation was presumed by Veatch to lie between Almy and Knight formations. He pointed out hills on west side of Bear River valley northwest of Evanston as locality where this relation could best be seen and recognized that in other places the Fowkes is absent. Norwood tuff of early Oligocene age (Eardley, 1944) had been traced from area east of Coalville anticline nearly to Evanston, Wyo., into tuffaceous outcrops labeled Fowkes by Veatch. Reexamination of geologic map of Evanston area showed Fowkes outcrops to be compatible with a post-Knight age, except those on west side of Bear River. This area was revisited, and the conclusion was reached that the contact is due to normal faulting. These relations are deceptive because a red unit exists in tuffs adjacent to fault, a gray unit exists on other side of fault in the red Knight, and it appears from most ground positions that the Fowkes extends under the Knight. Concluded that the Fowkes is Norwood and of early Oligocene age. Name Fowkes has priority and is applied to all Norwood outcrops.

Named for exposures at Fowkes Ranch, about 9 miles from Evanston, Uinta County, Wyo.

Fowler Limestone[1]

Upper Ordovician: Southern Kentucky.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 434.

Named for Fowlers Landing, Cumberland County.

Fox Member (of Santa Rosa Island Formation)

Pleistocene, upper: Santa Rosa Island, California.

P. C. Orr, 1950, Geol. Soc. America Bull., v. 71, no. 7, p. 1113, 1115–1116. Consists of basal marine facies and overlying of calcareous clays, sand, and eolianite. Sands have been dated at more than 33,000 years B. P. Thickness about 10 feet. Overlies Garanon member (new); underlies Tecolote member (new). Fox platform cuts both Garanon terrestrial alluvium and Rincon shale.

Deposits occur in Caranon Canyon, Gasoline Alley (present head of Fox Gulch), Skull Gulch, Tecolokito Canyon, Tecolote Canyon, and Deer Gulch.

Fox Canyon Member (of San Pedro Formation)

Pleistocene, lower: Southern California.

California State Water Resources Board, 1953 (revised 1956), California State Water Resources Board Bull. 12, v. 2, p. B–80, B–103, pls. B–1C, B–2. Basal member of formation. Consists of sand and gravel with some clay and silt lenses; generally white or gray; irregularly bedded. Thickness 100 to 400 feet. Overlies Grimes Canyon member (new) of Santa Barbara formation.

T. L. Bailey, 1954, *in* Pacific Petroleum Geologist, v. 8, no. 9, p. 1. Mostly gravel and coarse sand, the lower 200 to 500 feet of the formation.

R. G. Thomas and others, 1954, California Div. Mines Bull. 170, chap. 6, p. 20, pls. 2, 6, 7. About 300 feet thick. Lies at or near base of formation.

Named from exposures in Fox Canyon, about 1 mile west of Bradley Road, Ventura County.

Foxen Mudstone

Foxen Formation[1]

Pliocene, middle(?) and upper: Southern California.

C. F. Tolman, 1927, Econ. Geology, v. 22, no. 5, p. 459. Named on stratigraphic column. Described as fine sandstone and diatomite 750 feet thick. Underlies the lower Fernando; overlies Harris formation. Pliocene.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1336 (fig. 1), 1340 (table 1), 1353–1355. Consists chiefly of mudstone and siltstone but includes fine-grained silty sandstone and fine-grained volcanic ash. Maximum exposed thickness 800 feet (at type locality). In complete sections, such as type region, gradationally overlies diatomaceous strata of Sisquoc and grades upward into Cebada fine-grained member of Careaga sandstone. Type region designated.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. 222, p. 10 (table), 36–42. History of name given. Term mudstone used as a more appropriate lithologic designation. As defined here, formation is not represented along Foxen Canyon, which furnished the name and was presumably intended by proposers as the type region. Diatomaceous strata along and near Foxen Canyon are now referred to the Monterey shale and the upper part of Sisquoc. In most sections where the Foxen is thick, typical diatomaceous strata of the Sisquoc formation are separated from typical Foxen strata by a transition zone as much as 100 feet thick. Middle(?) and late Pliocene.

Type region. North slope of western Purisima Hills, Santa Maria district, Santa Barbara County.

Fox Ford Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 378.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 76. Sandstone about 500 feet thick. Underlies Horse Creek clays and shales; overlies bed No. 8. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Fox Hills Sandstone (in Montana Group)[1]

Fox Hills Formation

Upper Cretaceous: South Dakota, eastern Colorado, Montana, North Dakota, and Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 427.

J. Henderson, 1920, Colorado Geol. Survey Bull. 19. Fox Hills sandstone, in northeastern Colorado, includes Milliken sandstone member.

W. T. Thom, Jr., and C. E. Dobbin, 1924, Geol. Soc. America Bull., v. 35, no. 3, p. 484–495. Includes Colgate member.

W. V. Searight, 1934, South Dakota Geol. Survey Rept., Inv. 22, p. 4–15. In South Dakota, Fox Hills sandstone includes all beds between uppermost transition beds of the Pierre and gumbo clays and gumbo sands of lower Hell Creek member of Lance. In Stoneville coal area, Meade County, formation is divided into four members, which consist of basal member of alternating beds of shale and sandstone, sandstone member with thin beds of shale, Stoneville member (new), and sandstone member composed of thin interbedded shale. Thickness 435 to 465 feet.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1312–1313. Fox Hills sandstone described in Denver basin, Colorado, where it is 200 to 300 feet thick; overlies Pierre shale and underlies Laramie formation. Consists, in lower part, of buff or brown sandstone and sandy shale containing large gray to brown hard sandy concretions and, in upper part, chiefly of soft, poorly consolidated white sandstone.

Erling Dorf, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 275; 1942, Carnegie Inst. Washington Pub. 508, p. 1–78, pls. [preprint 1938]. Medicine Bow formation of southern Wyoming and the so-called "Laramie" formation of northwestern Colorado occupy similar stratigraphic positions above a marine sandstone which carries a distinctive Fox Hills fauna, including the diagnostic *Sphenodiscus lenticularis*. This marine sandstone, hitherto included in Medicine Bow or underlying Lewis shale, is separated as distinct unit and referred to Fox Hills formation. Thickness of Fox Hills 375 to 400 feet in Hanna basin, Wyoming; about 475 feet in northwestern Colorado.

R. E. Morgan and B. C. Petsch, 1945, South Dakota Geol. Survey Rept. Inv. 49. p. 11–18. fig. 4. Described as formation in Dewey and Corson Counties. Contains two identifiable units of almost pure sandstone but two others that, over considerable part of area, are much less sandy in character. Sandstone members are herein named Trail City (below) and Timber Lake. Thickness 120 to 250 feet. Overlies Pierre formation; underlies Hell Creek formation.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 10–16. Most extensive of formations outcropping in Emmons County. Trail City and

Timber Lake members recognized. These members pinch out eastward and disappear between southwestern corner and center of county. Upper 160 to 230 feet of formation is series of gray to brown sands with thin gray shales. It lies above *Halymenites* bench of Timber Lake member and is capped by sandstone bed. Overlies Pierre formation; underlies Hell Creek formation.

R. E. Stevenson, 1957, Areal geology of McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Formation includes (ascending) Trail City member, 65 feet thick; Timber Lake member, 20 to 25 feet; Bullhead member (new), and Colgate member, 15 feet. Underlies Hell Creek formation.

Named for exposures in Fox Ridge, northwestern Armstrong and southwestern Dewey County, S. Dak.

Foys Limestone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. xxii, 320.

Foy's Knob, Wayne Township, Lawrence County.

Fra Cristobal Formation (in Mud Springs Group)

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73. Name proposed to replace Hot Springs formation proposed by Thompson (1942). Term Hot Springs preoccupied. Overlies Apodaca formation; underlies Cuchillo Negro formation.

Type locality: West end of Whiskey Canyon, just west of westernmost box canyon, near north end of Mud Springs Mountains, Sierra County. Name derived from Fra Cristobal Range on east side of the Rio Grande.

Fraction Breccia[1] (of Esmeralda Formation)

Miocene, upper: Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 39, map.

Named for occurrences around Fraction No. 1 and No. 2 mine, Tonopah district.

Frailes Formation

Upper Cretaceous: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (chart), 9 (fig. 3), 10 (fig. 4), 16–19, pl. 2. Marine accumulation of shale, siltstone, and graywacke, with lenticular limestone in lower part, La Muda limestone member, massive lapilli tuff in middle, and well-bedded tuffaceous limestones, Leprocomio limestone member (new), in upper part. Thickness 2,300 feet. Underlies Monacillo formation (new); overlies Tortugas andesite (new) and locally Hato Puerco tuff; in some areas, La Muda member rests on what seems to be Guaynabo formation; in at least one locality, overlies an unnamed andesite porphyry sill. Variable nature of lower contact is taken in part to result from lenticular nature of La Muda member and in part from discordant and overlapping nature of Frailes onto eroded surface of older rocks. Faunal evidence, particularly the ammonites, shows formation to be Late Cretaceous.

Named after Barrio Frailes, east of Guaynabo, in which formation is well developed. Typical section (described in detail) is exposed in roadcuts

on Highway 175 along left bank of Río Grande de Loíza west and north of Trujillo Alto.

Fraileys Shale

Mississippian (Chester Series): Southeastern Illinois, southwestern Indiana, and northeastern Kentucky.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 18, 19–20. New name is needed for the "Golconda" as recognized east of Todd County, Ky., and north into Indiana. Fraileys shale is proposed for the middle "Golconda," that is, the interval between Haney limestone (new) and Beech Creek limestones wherever sandstone [Big Clifty] is insignificant or lacking. Consists largely of shale with minor amounts of limestone and mudstone. Typically 70 to 90 feet thick in Illinois with extremes of about 45 to 140 feet; at type locality 94 feet.

Type locality: Easternmost exposure of the Golconda in Illinois, on the south slope of hill along west edge of NE¼SE¼ sec. 9, T. 12 S., R. 10 E., Cave in Rock quadrangle, Hardin County, Ill. Named for an abandoned village 1 mile to northeast, known variously as Fraileys, Fraileys Landing, or Fraileys Store.

Frame Shale Member[1] (of Mahantango Formation)

Middle Devonian: South-central Pennsylvania.

Original references: Bradford Willard, 1935, Geol. Soc. America Proc. 1934, p. 361; 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1279, 1283.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart at top of Mahantango formation, above Chaneysville sandstone member.

Named for Frame School about 6 miles north of Chaneysville, Bedford County.

Francis Formation[1]

Pennsylvanian (Missouri Series): Central and central southern Oklahoma.

Original reference: G. D. Morgan, 1924 [Oklahoma] Bur. Geology Bull. 2, p. 113–119.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as extending northward from Pontotoc County across Seminole County; north of Seminole County, name Francis is dropped and other terminology (Coffeyville, Nellie Bly) is used.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 62, pl. 1. In this report [Seminole County], northern names are carried south to Canadian River; interval designated by Morgan as "Francis" is herein described under headings "Coffeyville" and "Nellie Bly." Type locality stated.

Type locality: Town of Francis, northeastern Pontotoc County, and "all that portion of the outcrop which extends for distance of 3 miles north, and for a similar distance south of Canadian River" (Morgan, 1924).

Franciscan Formation[1]

Franciscan Group

Jurassic and Cretaceous: Western California.

Original references: A. C. Lawson, 1895, Am. Geologist, v. 15, p. 347; 1895, U.S. Geol. Survey 15th Ann. Rept., p. 415.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, p. 123–125 [preprint 1941]. In Oregon, the Franciscan overlies the Galice unconformably, and the Galice, both faunally and lithologically, is equivalent to the Mariposa, the age of which has been well established as Kimmeridgian and slightly older (Portlandian). In northern California, the Galice has been converted into slate, whereas the Franciscan is unmetamorphosed. In northern California, unmetamorphosed Franciscan occurs in proximity to Mariposa-Galice slates. Franciscan is therefore younger than Kimmeridgian. It is believed that the Franciscan does not extend below Portlandian or, at the lowest, the upper Kimmeridgian. Field evidence does not support theory of unconformity between Franciscan and "Knoxville."

N. L. Taliaferro, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 2, p. 109–219. Franciscan-Knoxville problem discussed. The unconformity between Franciscan and Knoxville, reported by many writers, is unsupported by field evidence. The Knoxville is herein regarded as upper phase of Franciscan. Since these names have become fixed in the literature, it is here suggested that name Franciscan-Knoxville group be used for entire sequence.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 195–198, 225 (fig. 4), 226 (fig. 5). In San Benito quadrangle, Franciscan group is in fault contact with Santa Lucia granite, believed to be pre-Franciscan. Thickness difficult to determine because of strong folding and lack of exposures of base and top. Thickness of 10,000 feet measured across section on north limb of syncline exposed along Las Aguilas Creek. Most of the contacts with younger rocks are faults, except for many of those with San Benito gravels which are depositional.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 15–23, pls. 1, 2, 3. Franciscan formation and related intrusive rocks comprise most of southern half of Tesla quadrangle and extend into adjacent quadrangles. Base of formation not exposed, and top cannot be distinguished. Thickness of sediments as obtained graphically from cross-sections E-E' and H-H' about 12,000 feet. Tolman (1915) reported section of 15,000 feet in this area and divided section into three members: Corral Hollow shales, dense bluish-gray arkosic sandstone, as lower part; folded and crumpled cherts as middle member; and Oak Ridge [Oakridge] sandstone as upper member. Because Oak Ridge is a divide in northwest corner of Mount Hamilton quadrangle, Tolman probably extended his section into this area adjoining on the south. In Tesla area, sandstone is predominant rock type throughout Franciscan section; likewise shales and cherts occur throughout section as interbeds in the sandstone; hence, Tolman's divisions are not recognized in this report, and section of Franciscan rocks is left undivided. In fault contact with Lower Cretaceous Horsetown formation; Plio-Pleistocene Livermore gravels is only younger formation which is in depositional contact with Franciscan.

J. A. Cushman and Ruth Todd, 1948, Cushman Lab. Foram. Research Contr., v. 24, pt. 4, no. 322, p. 90–98. Paper records foraminiferal fauna from New Almaden quicksilver district, Santa Clara County, in rocks ascribed to Franciscan group. Limestone in which the foraminifera occur has been traced to that mapped as Calera limestone member in Santa Cruz quadrangle to west. Foraminifera seem to indicate that beds are younger than Jurassic.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 22. Honda formation (new) may be equivalent to type Knoxville, but its highly sheared condition and unconformable relationship with Espada formation (new) suggests that it may be shale member of Franciscan.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 15–26. Formation crops out or is present beneath alluvium in almost two-thirds of San Jose-Mount Hamilton area. Comprises sandstone and shale, conglomerate, chert, and contemporaneous volcanics, and schists. Thickest continuous section is just east of Calaveras fault, where at least 6,000 feet of beds are exposed. In fault contact with Knoxville.

C. C. Church, 1952, Cushman Foundation Foram. Research Contr., v. 3, pt. 2, p. 68–70. Discussion of Cretaceous foraminifera from Calera limestone member of Cahil sandstone of the Franciscan. Evidence indicates that the Calera is somewhere near middle Cretaceous or basal Upper Cretaceous. It now seems to be general conclusion that Franciscan-type rocks cover wide range in age from Upper Jurassic to middle or even basal Upper Cretaceous. More detailed work is necessary to narrow the age limits of various members.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 12–16, pl. 1. In Eel River valley area, Humboldt County, Franciscan formation is about 10,000 feet thick. In fault contact with Yager formation (new); unconformably overlain by Wildcat group (undifferentiated).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 11–20, pls. 1, 3. In Ortigalita Park quadrangle, the Franciscan (group, formation) is exposed in eastern limb of asymmetrical anticline, overturned adjacent to Ortigalita thrust. Total thickness difficult to estimate because faults are difficult to trace in homogeneous graywacke sediments, but erratic attitudes and some development of phyllonites indicate a zone of dislocation southwest of Sugarloaf. The layered sequence above this zone is 8,000 to 10,000 feet in thickness, and if repetition is absent or minor, the thickness (measured on section E-E' through Ortigalita Peak) is at least 20,000 feet. Neither top nor bottom of group is represented. In fault contact with Lower Cretaceous Wisenor formation (new). Map bracket shows age Jurassic(?).

Julius Schlocker, M. G. Bonilla, and R. W. Imlay, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2372–2381. *Douvilleiceras* sp., an ammonite of Early Cretaceous age, has been found in graywacke-type sandstone that is part of narrow band of exposures in cliffs along southern shore of inlet to San Francisco Bay—an area regarded as in type locality of Franciscan group. Thus, age of part of group is Early Cretaceous, Albian. Because Franciscan rocks in other localities are overlain by beds containing Upper Jurassic fossils, it is proposed that Franciscan group be assigned to both the Cretaceous and Jurassic(?) periods pending subdivision and more precise age designations within the group.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Group, in Hayward quadrangle, comprises greenstone volcanic rocks, mainly lava with thin pyroclastic and sedimentary interbeds; chert with shale partings; sandstone; and muscovite-rich graywacke with interbedded arenaceous shale, conglomerate, chert, and greenstone. Relative ages of these units not known. Aggregate exposed thickness 2,000 to 3,000 feet. Unconformably overlain by Upper Jurassic Knoxville. Unconform-

ity may be local and does not necessarily conflict with generalization (Taliaferro, 1941) that Franciscan and Knoxville are regionally conformable and gradational, nor is it incompatible with his conclusion that Franciscan was deposited in a brief part of Late Jurassic time. However, fossils found in recent years in western part of Franciscan make it difficult to accept so limited an age for entire formation. Presence of these fossils has been explained by appealing to elaborate faulting mechanism, but it is here suggested that Franciscan eugeosynclinal sedimentation continued in peninsular area long after it gave way to miogeosynclinal sedimentation of Shasta series type farther east. In Hayward quadrangle, Franciscan rocks seem to be no younger than Late Jurassic.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Franciscan group is assemblage of detrital and chemical sedimentary and volcanic rocks that crop out discontinuously in a structurally complex, northwesterly trending belt along Coast Ranges. On the east, along west side of Sacramento Valley, a thick section of detrital sedimentary rocks has been subdivided into Knoxville, Paskenta, and Horsetown formations, of Late Jurassic and Early Cretaceous age, and several units of Late Cretaceous age. Franciscan group is widely held to be restricted to Late Jurassic age, the Knoxville formation to be a shaly phase of Franciscan group, and the two overlain unconformably by detrital strata of Cretaceous age. Paleontologic evidence indicates this view to be incorrect. The Franciscan group seems to have been deposited contemporaneously with the Knoxville, Paskenta, Horsetown, and lower Upper Cretaceous strata, because fossils ranging from Late Jurassic to early Late Cretaceous in age have been found in the group. The Franciscan group and strata of Sacramento Valley section may represent two facies of same stratigraphic section.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 3–6, fig. 2, geol. map. Discussion of geology of Pleasanton area, Alameda and Contra Costa Counties. Questionable Jurassic rocks mentioned in this paper have been referred to as Franciscan group; this does not imply that any of the formations mapped by Lawson are included or mapped in Pleasanton area. In adjoining areas, Crittenden (1951) and Huey (1948) called questionable Jurassic rocks Franciscan "formation." This term is considered inappropriate for a complex group of various lithologic types which here includes, metamorphic rocks, sandstone and interbedded shale, basalt, chert, and serpentine. Thickness of about 6,000 feet estimated from Indian Creek northeast to large chert outcrop shown near eastern edge of geologic map; top and base not recognized in area. In Arroyo del Valle region, Franciscan rocks are in fault contact with Upper Cretaceous Del Valle formation (new) and are unconformably overlain by Pliocene Livermore gravels. In Indian Creek area, group is unconformably overlain by Ciebo sandstone. Briones serpentine-arenite overlies Franciscan basalt unconformably near south fork of Apperson Creek; in southern part of La Costa Valley quadrangle, Franciscan rocks are in fault contact with Tertiary rocks or locally unconformably overlain by Oursan sandstone.

C. G. Higgins, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 3, p. 203–205, geol. map. In northwestern Sonoma County, formation unconformably underlies Ohlson Ranch formation (new).

Named for exposures at San Francisco, San Francisco County.

Francis Creek Shale (in Carbondale Group)

Francis Creek Shale and Limestone (in Carbondale Formation)[1]

Francis Creek Shale Member (of Carbondale Formation)

Pennsylvanian: Western and central Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 309.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 88–89, 203. In Carbondale, group thickness 40 to 45 feet near Lewistown and near type locality; 55 feet near Colchester. Shale is wholly or partially truncated in areas of Pleasantview sandstone channels; replaced by Jake Creek sandstone (new) in southern part of Vermont quadrangle. Included in Liverpool cyclothem where it occurs below the Jake Creek sandstone and above Colchester (No. 2) coal. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 46 (table 1), pl. 1. Termed Francis Creek shale member of Carbondale formation (redefined). Occurs about Colchester (No. 2) coal member and below Jake Creek sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois.

Type locality: Roadcut on west side of Francis Creek, NE¼SW¼ sec. 22, T. 5 N., R. 1 E., Vermont quadrangle, Fulton County.

Francoisian series[1]

Precambrian: Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 253.

Derivation of name not stated.

Franconia Breccia[1]

Upper Devonian or Upper Carboniferous: West-central New Hampshire.

Original reference: New Hampshire Geol. Survey 4th Ann. Rept. 1872, as interpreted by J. D. Whitney and M. E. Wadsworth *in* Harvard Coll. Mus. Comp. Zoology Bull., v. 7, (geol. ser. I), opposite p. 396.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Formed by injection of numerous binary granite dikes into the Kinsman quartz monzonite. Mapped as part of the latter.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 63–64. Abandoned as a formation name in New Hampshire although it has priority over the Franconia of the upper Mississippi Valley.

Occurs in Franconia and Lincoln [Townships], Grafton County.

†Franconia Gravel[1]

Pleistocene: Eastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 326–330, 339.

Well exposed at gravel pits of Alexandria & Fredericksburg Railroad at Franconia Station, 6 miles southwest of Alexandria.

Franconia Sandstone[1]

Franconia Formation

Upper Cambrian: Southeastern Minnesota, northern Illinois, and southwestern Wisconsin.

Original reference: C. P. Berkey, 1897, Am. Geologist, v. 20, p. 345–383.

A. C. Trowbridge and others, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 81, 92, 134, 140, 159, 431, 446, 449, 455. Comprises (ascending) Ironton sandstone, Goodenough (new), Hudson (new), and Bad Axe (new) members.

C. R. Stauffer, G. M. Schwartz, and G. H. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902. In suggested classification of Minnesota Upper Cambrian, the Franconia includes (ascending) Ironton member, Taylors Falls (new) or Goodenough member, Minnesika (new) or Hudson member, and Bad Axe member. Underlies Judson member (new) of St. Lawrence formation.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1228 (table 1), 1236–1239. Minnesota classification shows Franconia formation subdivided into (ascending) Ironton, Taylors Falls, Hudson, and Bad Axe members. Underlies Nicollet Creek member (new) of St. Lawrence formation. Overlies Galesville member of Dresbach formation. St. Croixian series.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 35–41, measured sections. Formation described in detail in southeastern Minnesota where it comprises (ascending) Ironton, Taylors Falls, Hudson, and Bad Axe members. Overlies Dresbach formation; underlies St. Lawrence formation, St. Croixian series.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. 1–3. Twenhofel, Raasch, and Thwaites (1935) proposed faunal zonation of the Franconia and applied geographic member names to the zones. Present study has resulted in discrimination of units of uniform lithic character, properly called member. Previously proposed names are rejected. Formation consists of (ascending) Woodhill, Birkmose, Tomah, and Reno members. Mazomanie sandstone member represents a nonglauconitic facies that interfingers with and replaces glauconitic sandstones to north and east. Distribution of faunal zones of Franconia stage is largely independent of lithic units of Franconia formation.

H. B. Willman and J. S. Templeton, 1951, Illinois Acad. Sci. Trans., v. 44, p. 109–113. Oldest formation exposed in northern Illinois. About 30 feet exposed in quarry in or near Oregon, Ogle County. Underlies Trempealeau formation.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 147. Bad Axe member of Franconia underlies Arcadia member (new) of Trempealeau formation.

R. R. Berg, 1954, Geol., Soc. America Bull., v. 65, no. 9, p. 857–882. Redefined Franconia formation described in detail. Redefinition of formation based on rock types results in different interpretation of lower and upper contacts and adds as much as 30 feet to its total thickness. Formation consists of quartzose sandstones that range from 150 to 210 feet thick within outcrop area. Member names—Ironton, Goodenough, Hudson, and Bad Axe which were in reality faunal zones—are rejected, and names Woodhill, Birkmose, Tomah, and Reno are applied to members. Mazomanie member interfingers with and replaces Reno member. Overlies Galesville member of Dresbach; underlies St. Lawrence formation.

Named for exposures in vicinity of Franconia, Chisago County, Minn.

Franconian Stage

Upper Cambrian: North America.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Upper Cambrian comprises three stages (ascending): Dresbachian, Franconian, and Trempealeauan. The Franconian consists of six faunal zones: *Elvinia*, *Ptychoplewrites*, *Comaspis*, *Prosaukia-Ptychaspis*, *Briscola*, and *Dikelocephalus postrectus*.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 857–882. Limits of Franconian stage were defined to coincide with Franconia formation, and this has resulted in artificial faunal boundaries. Greatest faunal change takes place between *Ptychaspis* and *Prosaukia* subzones. Saukinid trilobites first appear in *Prosaukia* subzone, and together with species of *Dikelocephalus* they form dominant group in overlying Trempealeauan stage. Redefinition of stage boundaries would place the contact at the faunal change within the Reno and Mazomanie members.

W. C. Bell, R. R. Berg, and C. A. Nelson, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 425–436. Franconian stage originated with Correlation Chart (Howell and others, 1944) and was defined by faunal criteria as a time-stratigraphic unit conincident with Franconia formation. When lithostratigraphic nomenclature is separated from biostratigraphic nomenclature, upper boundary of Franconia formation cannot be made to coincide with a biostratigraphic, and therefore stage, boundary. Recommended that boundary between Franconian and Trempealeauan stages be placed at top of *Ptychaspis-Prosaukia* zone. This produces nomenclatorial paradox; the upper part of Franconia formation in places belongs in Trempealeauan rather than Franconian stage. It is not likely that geologists in upper Mississippi Valley will abandon use of Franconia formation, though there are reasons for doing so. Type section of formation included only lower Mazomanie member, and nowhere in St. Croix Valley is exposed above river level a complete section of the formation as it is now defined. Might be more satisfactory to propose a new stage name.

Name derived from Franconia, Chisago County, Minn.

Frankford Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc., pt. 1, p. 279.

Exposed at Frankford, Philadelphia County.

Frankfort Shale[1]

Upper Ordovician: Central and east-central New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 372–373.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 601 (fig. 3). Stratigraphic diagram shows Harter shale member (new) of Frankfort formation.

G. M. Kay, 1953, New York State Mus. Bull. 347, p. 59 (fig. 42), 64–67. Formation described in Utica quadrangle where it comprises (ascending) Harter shale, Hasenclever sandstone (new), and Moyer (new) members. Thickness about 540 feet. Overlies Utica shale; underlies Silurian Oneida conglomerate. Eden group, Cincinnatian series.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 13, fig. 1. At Sharon Springs, unconformably underlies Brayman shale (redefined).

Typical exposure: Along Moyer Creek, southwest of Frankfort, Herkimer County.

Franklin Formation
Franklin Series[1] } (in Puget Group)

Eocene: Western Washington.

Original reference: G. W. Evans, 1912, Washington Geol. Survey Bull. 3, p. 42–49.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 26 (table), 55–62. Described in Green River area as Franklin formation in Puget group. Consists of a series of interbedded sandy and argillaceous and carbonaceous shales together with thick beds of massive brown sandstone; basal part of formation includes a 210-foot basal sandstone, the Franklin. Thickness about 3,600 feet. Underlies Kummer formation; overlies Bayne formation.

Probably named for town in King County.

Franklin Limestone[1]

Franklin Formation

Precambrian: Western New Jersey, Delaware, and eastern Pennsylvania.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 431–456.

D. M. Fraser *in* B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 162–170, 172, pl. 1. In Northampton County, associated graphitic quartz schist has been included with limestone to comprise Franklin formation. May also include clastic sediments of somewhat more argillaceous type; most extensive member is the coarse-grained graphite-bearing limestone. There is little evidence to indicate relative age of Franklin and Moravian Heights (new) formations and Pochuck gneiss, but this is the assumed sequence. In Chestnut Hill area, Franklin limestone occurs adjacent to Moravian Heights formation; no contact is observable; both formations have been injected and altered by invasions of Byram granitic material.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 1–12, 19–46, pl. 5. Described in Delaware Water Gap and Easton quadrangles, Pennsylvania, where it is dominant formation. Associated with it are sedimentary schists, slaty rocks, and gneisses (here mapped as Pickering gneiss) and generally believed to be older. Relationship to Hardyston quartzite not observable in area of report.

Named for occurrence at Franklin Furnace, Sussex County, N.J.

Franklin Limestone (in Washington Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 97, 102.

Franklin and Amwell Townships, Greene County.

Franklin Sandstone[1]

Eocene: Western Washington.

Original reference: G. W. Evans, 1912, Washington Geol. Survey Bull. 3, p. 42–49.

Probably named for town in King County.

Franklindale Limestone Lentil (of Chemung Formation)[1]

Upper Devonian: Central northern Pennsylvania.

Original reference: H. S. Williams and E. M. Kindle, 1905, U.S. Geol. Survey Bull. 244.

Exposed in Gulf Brook section, west of Franklindale, Bradford County.

†**Franks Conglomerate**[1]

Pennsylvanian (Desmoinesian and Missourian): Central southern Oklahoma.

Original reference: J. A. Taff, 1903, U.S. Geol. Survey Geol. Atlas, Folio 98.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2040–2044. The four principal conglomerates in the Arbuckle Mountains region are divisible into two general groups, an older consisting of "Franks" and Deese, and a younger consisting of Collings Ranch (new) and Vanoss. All but the Vanoss (youngest) are preserved in synclinal grabens and are moderately to strongly folded and faulted. The "Franks," which contains rocks chiefly from Hunton through Arbuckle, has maximum thickness of 1,500 feet and consists of conglomerate interbedded with and grading into fossiliferous shales, limestone, and sandstones. The "Franks" is considered an orogenic product of the first great period of uplift in the Arbuckle Mountains, which began as broad domal folding of the Hunton anticline in early Desmoinesian time; the conglomerates were closely folded, locally overturned, and faulted in late Pennsylvanian (middle Missourian) time.

Named from exposures in vicinity of Franks, Pontotoc County.

Franson Member or **Tongue** (of Park City Formation)

Permian: Eastern Utah, northwestern Colorado, eastern Idaho, southwestern Montana, and western Wyoming.

T. M. Cheney *in* V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologist Bull., v. 40, no. 12, p. 2842–2843; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 15–19, 31, 37, pls. 2, 3. Proposed for light-gray and grayish-brown carbonate rock, cherty or sandy carbonate rock, and calcareous sandstone that overlie Meade Peak tongue (new) of Phosphoria formation and underlie Woodside formation. In Montana, Wyoming, and Idaho, has been considered upper part of Rex chert member or the C member of Phosphoria formation (Klepper, 1951, U.S. Geol. Survey Bull. 969–C). At type locality, about 235 feet thick and consists of a lower unit, about 65 feet thick, of dominantly light-gray and grayish-brown carbonate rock; middle unit, about 85 feet thick, dominantly light-gray and brownish-gray carbonatic sandstone containing chert as beds and nodules; and upper unit, about 85 feet thick, dominantly white and light-gray carbonate rock; some beds of the upper unit, are reddish brown and are probably laterally continuous with Mackentire tongue of Woodside formation. Lower contact gradational but placed at top of gray and greenish-gray cherty phosphatic carbonate rock of upper part of Meade Peak tongue. Thickness 830 feet in southern Wasatch Mountains, but over most of its extent ranges from 50 to 200 feet in thickness. In most of Utah, western Wyoming, and parts of Montana, underlain by tongue of Phosphoria, either Meade Peak or Rex; in eastern Utah and northwestern Colorado, underlain by

Weber sandstone; in parts of Montana and Wyoming where Meade Peak and Rex are absent, Franson is difficult to separate from lower (unnamed) member of Park City; in northernmost Utah, eastern Idaho, western Wyoming, and southwestern Montana, interfingers basinward with the Rex, Tosi, and Meade Peak members of Phosphoria, and in Utah intertongues shoreward with red and greenish gray shales of Woodside formation; in western Wyoming, Montana, and northeastern Idaho, Franson tongue is overlain by Retort phosphatic shale member (new) of Phosphoria.

Named from exposures on north side of Franson Canyon near the mouth in S½SE¼ sec. 15, and N½NE¼ sec. 22, T. 1 S., R. 6 E., Summit County, Utah.

Frazier Well Gravel

Pre-Pleistocene: Northwestern Arizona.

Donaldson Koons, 1948, Science, v. 107, no. 2784, p. 475. Consists of well-rounded pebbles and boulders of vein quartz, granite, gneiss, schist, red and white quartzite, and sandstone. Deposits vary in thickness from thin veneer to more than 200 feet. Found at elevations ranging from 5,660 feet, 12 miles southwest of Frazier Well, to 7,150 feet, 5 miles northwest of the Well.

Best exposed near Frazier Well, Hualpai Reservation, after which the gravels are named.

Freda Sandstone (in Oronto Group)[1]

Precambrian: Northern Michigan and northern Wisconsin.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 692.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474–1479. Oronto group revised to exclude Eileen sandstone and Amnicon formation. Thickness of Amnicon given by Thwaites (1912) —5,000 feet—is included in his estimate of the Freda, and the 2,000 feet assigned to the Eileen is included in the Orienta (in Bayfield group). Thickness of Freda 12,000 feet. Overlies Nonesuch shale; underlies Orienta sandstone.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27 In Ahmeek quadrangle, Michigan, Freda consists of red fine- to medium-grained sandstone with prominent white streaks and blotches; contains minor amounts of red shale and conglomerate. Lowermost 700 feet of formation exposed here consists of light-gray fine- to medium-grained sandstone with purple streaks. Total thickness of formation where more fully exposed about 5,000 feet. Contact with underlying Nonesuch shale transitional.

Named for exposures at new stamp mills at Freda, Houghton County, Mich., and along adjacent shore.

Frederick Limestone[1]

Upper Cambrian: Central northern Maryland.

Original reference: C. R. Keyes, 1890, Johns Hopkins Univ. Circ. 84, v. 10, p. 32.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept.] Carroll and Frederick Counties, p. 43–47. Thickness in Frederick Valley 480 feet. Underlies Ordovician Grove

limestone in center of Frederick Valley syncline and in several narrow areas northwest of Frederick. In eastern part of valley, unconformably overlaps Lower Cambrian Antietam quartzite; here Lower Cambrian Tomstown dolomite, which overlies the Antietam in normal sequence in foothills west of Triassic border, is not present.

Probably named for occurrence in vicinity of Frederick.

Fredericksburg Gneiss[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Well exposed in quarries northwest of Fredericksburg, Spotsylvania County.

Fredericksburg Granite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Well exposed along Rappahannock River in Stafford and Spotsylvania Counties.

Fredericksburg Group[1]

Lower Cretaceous (Comanche Series): Texas and southern Oklahoma.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d, v. 33, p. 296–299.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, pl. 1. As mapped in Eagle Mountains, Hudspeth County, Tex., comprises Finlay limestone and Kiamichi formation. Overlies Cox sandstone of Trinity group; underlies Georgetown limestone of Washita group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes Goodland limestone and Walnut clay. Kiamichi mapped with Washita group.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 20–22. As used in this report [Cretaceous Foraminifera of Texas] group includes (ascending) Walnut clay, Goodland limestone, Edwards limestone, and Kiamichi formation. Overlies Paluxy formation of Trinity group; underlies Duck Creek formation of Washita group.

P. E. Lozo, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, p. 3 (fig. 2), 28 (fig. 13), measured sections. In this report [Symposium on Edwards limestone], Fredericksburg group comprises (ascending) Paluxy sand, Walnut formation, Comanche Peak limestone, Edwards limestone, and Kiamichi formation. Overlies Glen Rose limestone of Trinity group; underlies Georgetown limestone of Washita group or Kiamichi shale where Kiamichi is considered part of Washita group. A southern complex of the Edwards, Comanche Peak, and Walnut formations is indicated to pass northward into a complex composed of the Goodland, Walnut, and Paluxy formations. Classification of included stratigraphic intervals as Fredericksburg division follows Hill's early nomenclature and concept of an integrated subseries representing a major and distinct cycle of sedimentation.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 11–21, pls. 1, 2. In Fort Worth area, group comprises (ascending) Walnut marl and Goodland formation. Overlies Paluxy sandstone of Trinity group; underlies Kiamichi formation of Washita group.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16 (table 5), 31–34. In McCurtain County, only Goodland limestone is included in Fredericks-

burg group. No mappable stratigraphic boundary present between Kiamichi formation and Goodland limestone, and Kiamichi is mapped with Washita group. Unconformably overlies Paluxy sand of Trinity groups.

Named for Fredericksburg, Gillespie County, Tex.

†Fredericksburg Sandstone[1]

Lower Cretaceous: Virginia.

Original reference: W. B. Rogers, 1842, Philadelphia Acad. Nat. Sci. Proc., v. 1, p. 142.

Fredericksburg, Spotsylvania County.

†Fredericktown dolomite[1]

Upper Cambrian: Southeastern Missouri.

Original reference: C. R. Keyes, 1895, Missouri Geol. Survey Sheet Rept. 4, v. 9, p. 18, 19, 48.

Named for exposures at Fredericktown, Madison County.

Fredonia Limestone or **Oolite Member** (of Ste. Genevieve Formation)[1]

Fredonia Member (of Ste. Genevieve Limestone)

Upper Mississippian: Western Kentucky, southern Illinois, southern Indiana, southeastern Missouri, and western Tennessee.

Original reference: E. O. Ulrich and W. S. T. Smith, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24, 40.

F. E. Tippee, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 11, p. 1655–1656. Fredonia member is divisible into three units: upper limestone, middle sandstone, and lower limestone. Name Spar Mountain sandstone is here proposed for the middle sandstone member, heretofore known as a "sub-Rosiclare sandstone."

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 19–20, pl. 1. Termed Fredonia member by Indiana Geological Survey. Unit does not contain a higher proportion of oolite than do other members of formation. Thickness 30 to 115 feet. Base of member is 10 to 20 feet below Lost River chert (Elrod, 1899). Lowest member of formation; underlies Rosiclare member.

Named for exposures at Fredonia, Caldwell County, Ky.

Freedhem Tonalite

Precambrian (late Algoman): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1009, 1010, pl. 1. Metatonalite to granodiorite, tonalite most common; black to light gray, fine to medium granitoid, weak primary foliation. One of five major intrusives in late Algoman; these cannot be shown to be members of a single magma series; age relations of the named intrusives, St. Cloud gray granodiorite, Hillman tonalite, Freedhem tonalite, and Warman quartz monzonite are indeterminate because no contacts are exposed.

Name applied because most of its outcrops are around town of Freedhem, Morrison County.

Freedom Dolomite[1]

Precambrian: Central southern Wisconsin.

Original reference: S. Weidman, 1904, Wisconsin Geol. Nat. History Survey Bull. 13, p. 51.

Named for occurrence southwest of North Freedom, Sauk County.

Freeman-Jewett Shale

Miocene: Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 38, pls. 1, 2, 3. Light-grayish-brown thin-bedded, somewhat punky semisiliceous or diatomaceous shale; commonly contains thin laminae of fine silty sand. Thickness about 500 feet. Conformably underlies Bena gravels; conformably overlies Walker formation. Equivalent of lower Miocene Freeman-Jewett silt of the east side of San Joaquin Valley oil fields.

Crops out in Cottonwood Canyon, Kern County.

Freeport Clay[1]

See Upper Freeport Clay and Lower Freeport Clay.

Freeport coal group (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original references: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 474–492; J. P. Lesley, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. xxiii.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 78. Rogers (1858) used Freeport as a group name for strata between Lower Freeport and Lower Mahoning sandstones. Strata in above interval are now recognized as including three cyclothems (ascending) Lower Freeport, Bolivar, and Upper Freeport.

Name taken from town of Freeport, Armstrong County, Pa.

Freeport Formation[1] (in Allegheny Group)

Pennsylvanian: Pennsylvania.

G. H. Ashley, 1923, Eng. and Mining Jour.-Press, v. 115, no. 25, p. 1108; 1926, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 65, p. 28, pl. 4. Allegheny group, of Pittsburgh series, subdivided into (ascending) Clarion, Kittanning, and Freeport formations. Freeport comprises (ascending) Freeport sandstone, Freeport lower limestone, Freeport lower clay, Freeport lower or D coal, Butler sandstone, Bolivar flint clay, Freeport upper limestone, Freeport upper clay, Freeport Upper or E coal. Underlies Mahoning formation.

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 51–65. Allegheny group subdivided into (ascending) Clarion, Kittanning, and Freeport formations. The Freeport includes all rocks between top of Upper Freeport coal and top of Upper Kittanning coal. Comprises (ascending) Freeport and Kittanning sandstones, Lower Freeport clay and limestone, Lower Freeport coal, Butler sandstone, Bolivar fire clay, Upper Freeport limestone, and Upper Freeport coal and clay.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Field Trip Pittsburgh Mtg., p. 70 (fig. 5), 71. Allegheny group subdivided into three formations (ascending): Clarion, Kittanning, and Freeport.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). Formation includes (ascending) Lower Freeport sandstone, Lower Freeport coal, Butler sandstone, and Upper Freeport coal. Overlies Kittanning formation which contains Upper Kittanning coal at top. Allegheny group.

Name taken from town of Freeport, Armstrong County, Pa.

Freeport Gravel[1]

Pleistocene: Northwestern Illinois.

Original reference: O. H. Hershey, 1897, Am. Geologist, v. 19, p. 207–209.

Occurs 2 miles east of Freeport, Stephenson County.

†Freeport Limestone Member (of Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 492.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 27. Discussion of limestones of eastern Ohio. From 3 to 12 feet below base of Upper Freeport coal, there is an irregular bed of limestone which Rogers (1858) called Freeport limestone in northwestern Pennsylvania and which Newberry (1878, Ohio Geol. Survey, v. 3) apparently described as the White limestone in Mahoning County. In his report on Lawrence County, Pa., White (1879, Pennsylvania 2d Geol. Survey Rept. Q_2), at the suggestion of Lesley, renamed Butler limestone, which underlies Lower Freeport coal and which was not recognized by Rogers, the Lower Freeport and called the Freeport limestone of Rogers, the Upper Freeport. This terminology has been accepted in reports dealing with geology of coal measures in Pennsylvania, West Virginia, and Ohio.

Name taken from town of Freeport, Armstrong County, Pa.

Freeport Sandstone Member (of Allegheny Formation)[1]

Freeport Sandstone (in Allegheny Group)

Freeport Sandstone (in Freeport Formation)

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477.

G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, p. 28, pl. 4. Freeport sandstone included in Freeport formation.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C26, p. 60, 74–75. Formation in Allegheny group. Lies below Lower Freeport coal and fire clay and above Upper Kittanning coal. Consists of thin- to medium-bedded brown medium-grained micaceous sandstone, locally crossbedded. Thickness as much as 15 feet exposed in roadcut 1 mile southwest of Indian Head. Two miles southwest of Markleysburg along State line, a massive sandstone bed crops out which appears to be about 80 to 100 feet below Upper Freeport coal. Area of report, Fayette County.

Name taken from town of Freeport, Armstrong County, Pa.

†Freezeout Limestone[1]

Triassic(?): Central Wyoming.

Original reference: F. B. Peck, 1904, Wyoming Hist. and Geol. Soc. Proc. and Coll., v. 8, p. 28–41.

Freezeout Mountains.

Freezeout Shale (in Phosphoria Group)

Freezeout Tongue (of Chugwater Formation)[1]

Permian: Southeastern Wyoming.

Original reference: H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1664, 1670.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2; 1950, Nebraska Geol. Survey Bull. 13–A, p. 2 (fig. 2), 3. Chugwater, as used in Wyoming, is synonymous with Spearfish redefined. Freezeout tongue of Chugwater is here designated as a member or a formation. Chart shows Freezeout shale in Phosphoria group.

N. C. Privrasky, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 50, 52. Term Freezeout shale should be abandoned in Powder River Basin and unit referred to as unnamed shale member of Goose Egg formation.

Present in Freezeout Hills.

Fremont Limestone[1] or Dolomite

Fremont Formation

Middle and Upper Ordovician: Eastern and central Colorado.

Original reference: C. D. Walcott, 1892, Geol. Soc. America Bull., v. 3, p. 154–167.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Described along Front Range where it consists of limestone as much as 50 feet thick. Overlies Harding sandstone; underlies Williams Canyon limestone.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 32. At type section, limestone is 190 feet thick; maximum thickness 290 feet a few miles north of Priest Canyon.

J. W. Gabelman, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 8, p. 1582 (fig. 3), 1583. In Sangre de Cristo Mountains, Fremont consists of fairly uniform dark-gray to black crystalline dolomite. Overlies Harding quartzite; underlies Parting member of Chaffee formation. Thickness as much as 400 feet.

W. C. Sweet, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 294–300. Referred to as formation. Thickness 283½ feet. Lower 208 feet is massive dolomite; upper 75 feet is shale and dolomite and is here named Priest Canyon member. Overlies Harding formation; underlies Williams Canyon formation.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 13. In Garfield quadrangle, Fremont is dolomite. Thickness 15 to 135 feet. Uncomformably overlies Harding quartzite; uncomformably underlies Parting member of Chaffee formation.

Type section: Harding Quarry at Canon City. Named for exposures in Fremont County.

French Slate[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 622, 645, 649.

J. J. Runner, 1928, Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included at top of Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite,

Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Named for French Creek in Medicine Bow Mountains.

Frenchburg Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 180, 182, 183–184, pl. 17. Included in Morehead facies (new), Brodhead formation. Occurs in massive beds up to 6 feet thick. Thickness of member 10 to 17 feet. Underlies Haldeman siltstone member (new); overlies Christy Creek siltstone member (new).

Type section: Quarry one-half mile west of Frenchburg, Menifee County.

French Creek limestone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 135–136.

Type section: Ravine at "Glendale" Cemetery, in Meadville City, Crawford County.

French Creek Shale Member (of Root Shale)

French Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: R. C. Moore, May 1935, Kansas Geol. Survey Bull. 20, table opposite p. 14.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Root shale (new). Overlies Jim Creek limestone member; underlies Nebraska City limestone member of Wood Siding formation (redefined).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 11, fig. 5. Geographically extended into southwestern Iowa where it is uppermost unit in Wabaunsee group. Overlies Jim Creek limestone.

Type locality: French Creek, northeastern part of Pottawatomie County, Kans.

French Flat Sandstone

Pliocene, middle: Southern California.

D. I. Axelrod, 1950, Carnegie Inst. Washington Pub. 590, pl. 1. Shown on plate 1 as stratigraphically below Piru Gorge sandstone (new). [Text refers to a thick sand unit near French Flat. French Flat sandstone may be basal formation of Ridge Basin group.]

Occurs in Ridge Basin area along U.S. Highway 99 between Los Angeles and Bakersfield, in the region from 5 miles north of Castaic to the vicinity of Gorman.

French Lick Coal Member (of Mansfield Formation)

Pennsylvanian: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 26, 27, pl. 1. Important stratigraphic marker or

key bed about 50 feet below top of lower unit of Mansfield. Average thickness about 1 foot. Coal named by D. W. Franklin (1939, unpub. thesis). Franklin's type section for coal, in SW¼NW¼ sec. 4, T. 2 N., (sic) R. 2 W., not located. Another locality noted which may be one to which Franklin referred.

Type locality: Quarry and mine in NE¼NE¼ sec. 5, T. 1 N., R. 2 W., approximately 1 mile west of town of French Lick, Orange County.

French Lick Stone (in Chester Group)[1]

Mississippian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 81.

Named for French Lick Springs, Orange County.

Frenchmans Bay Series

Silurian: Southeastern Maine.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Named to include Bar Harbor detrital facies and Cranberry Island volcanic facies. Replaces four series of Shaler (1889), Schooner Head, Suttons Island, Cranberry Island, and Bar Harbor. Presumably Silurian.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172–173, 176–177. Includes all sedimentary rocks overlying Bartletts Island schist; these form a seemingly indivisible succession exhibiting two contrasting and interfingering facies, Bar Harbor and Cranberry Island facies.

Occurs on Mount Desert Island, Hancock County, which is bordered on the east by Frenchman Bay.

French Pond Granite[1] (in New Hampshire Plutonic Series)

Upper Devonian(?): West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, Moosilauke map, p. 28, 36.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in New Hampshire plutonic series of Upper Devonian(?) age.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, p. 61. Heterogeneous rock composed of five phases. In New Hampshire plutonic series.

Confined to circular stock 3 miles in diameter 3 miles southeast of Woodsville. Named from French Pond, 4½ miles southeast of Woodsville, Moosilauke quadrangle.

Frenchtown Diorite[1]

Age(?): Northeastern Maryland.

Original reference: G. P. Grimsley, 1894, Cincinnati Soc. Nat. History Jour., v. 17.

Near Frenchtown, Cecil County.

Frenck Shale[1]

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 94, 96.

Derivation of name not given.

Frensley Limestone (in Dornick Hills Group)

Frensley Limestone Member (of Lake Murray Formation)

Pennsylvanian: Eastern Oklahoma.

Jerome Westheimer, 1936, Correlation of the Pennsylvanian formations of the Ardmore basin and the Franks graben, Oklahoma: Ardmore Geol. Soc., last 3 pages of mimeographed program of a conference on correlation of the Pennsylvanian System of the Ardmore basin, held May 5, 1936. At base of the Pumpkin Creek south of Ardmore, nodular white dense limestone varying in thickness from 1 to 10 feet or more. Limestone contains an undescribed species of Fusulina which also occurs 50 feet below top of the Atoka in the so-called Red Oak member. Name Frensley is here proposed for this limestone and the shale overlying it and beneath the overlying prominent sandstone. Frensley marks top of the Atoka or Red Oak of eastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1). Shown on correlation chart of area south of Arbuckles. Pennsylvanian (Des Moines).

R. M. Jeffords, 1942, Kansas Geol. Survey Bull. 41, pt. 5, p. 250. Corals collected from Frensley limestone, Lampasas age, southeast of Ardmore, Okla.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on chart as Frensley limestone, in Dornick Hills group; Lampasas series.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 139, 140 (fig. 3). Rank reduced to member status in Lake Murray formation (new). Overlies Griffin sandstone (equivalent to Lester) member; underlies Big Branch formation. Atoka series.

Well exposed on Frensley Farm in SE¼ sec. 30, T. 3 S., R. 2 E., Carter County.

Fresnal Group

Pennsylvanian (Virgil Series): Central and southwestern New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 73–79. Term proposed for all sedimentary rocks that are definitely referable to the Virgil series between top of the Keller group (new) and base of the Permian Wolfcamp (above). Thickness at type locality 530 feet; in San Andres Mountains apparently more than 1,000 feet thick. At type locality, composed of argillaceous to essentially pure limestone, arkosic sandstone, conglomerates, and gray to red shale; more than 50 percent of rocks are clastics, but most of them are of marine origin. In central part of State, group is composed largely of red shale, with interbedded thin nodular to irregularly bedded fossiliferous limestone and arkosic sandstone. Many faunal as well as lithologic units recognized in type section of group, but formational names not applied at this time; includes Bruton formation (new) in lower part in area of Oscura Mountains. In Fresnal Canyon in north end of Sacramento Mountains, upper Virgil strata of Fresnal group are overlain unconformably by 250 feet of strata of undetermined age. These strata are composed largely of clastic red shale, gray shale, sandstone, and conglomerates. In some areas, the Abo formation rests directly on the Bruton.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 18, 19. Holder formation includes the Fresnal and Keller groups in classification of Thompson (1942). Thompson's detailed section of Fresnal group forms upper 530 feet of Pray's (1952, unpub. thesis) Holder formation and is overlain by Laborcita formation (new).

Type locality: Fresnal Canyon along State Highway 83, east of La Luz, in north end of the Sacramento Mountains. Section is mainly in NW¼ sec. 30, T. 15 S., R. 11 E., Otero County.

†Fresnian Stage

Eocene, late: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903; 1954, Pacific Petroleum Geologist, v. 8, no. 11, p. 1. One of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Includes interval between Oligocene Refugian stage above and Narizian stage. Also spelled Fresnoian.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 18. Term discontinued. Fresnian incorporated in redefined Narizian stage.

Fresnoian Stage

See Fresnian Stage.

Friant Formation

Miocene or Pleistocene(?): Southern California.

G. H. Jones, 1940, Am. Geophys. Union Trans., v. 21, pt. 1, p. 62 (fig. 2), 66. Composed of cemented sandy, tuffaceous lake-laid sediments; overlies granite.

G. A. Macdonald, 1941, California Univ. Pub., Dept. Geol. Sci. Bull., v. 26, no. 2, p. 262–265, map 1. Thickness varies; along northwestern side of Table Mountain about 250 feet; thickens to southwest; near lower end of Little Dry Creek, minimum exposed thickness 320 feet; entire series dips southwestward from 2° to 4°. Unconformably overlaps Ione formation near Little Table Mountain; on eastern side of San Joaquin Valley, lies on granitic rocks and crystalline schists; in some areas, capped by basaltic lava flows.

F. D. Trauger, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1531. Probably Pleistocene.

Typically exposed both east and west of San Joaquin River in vicinity of Friant, Fresno County.

Friedrich Shale Member (of Root Shale)

Friedrich Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: R. C. Moore, 1935, Kansas Geol. Survey Bull. 20, table opposite p. 14.

G. E. Condra and E. C. Reed, 1938, Nebraska Geol. Survey Paper 12, p. 9. In Nebraska, formation includes (ascending) Minersville shale, Palmyra limestone, and Otoe shale members (all new).

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in

Root shale (new). Underlies Jim Creek limestone member; overlies Grandhaven limestone member of Stotler limestone (new).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 11, fig. 5. Geographically extended into southwestern Iowa. Bluish gray to light gray, micaceous, and silty in upper part. Thickness 10 feet. Underlies Jim Creek limestone. Overlies Grandhaven limestone. Wabaunsee group. Interval from lower part of Friedrich shale through Grandhaven limestone is exposed along bluffs of Missouri River and major tributaries in Fremont County extending from NW¼ sec. 1 to NW¼ sec. 13, T. 69 N., R. 43 W. Condra and Reed suggest that their Otoe shale, Palmyra limestone, and Minersville shale may occupy horizon of Friedrich shale.

Type locality: Friedrich Creek, sec. 6, T. 22 S., R. 11 E., Greenwood County, Kans.

Friendsville Black Shale (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 574.

Probably named for occurrence at Friendsville, Garrett County.

Friendsville Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), pl. 1. Assigned member status in Mattoon formation (new). Occurs at base of formation about 50 feet below McClearys Bluff coal member. Coal named by Fuller and Clapp (1904, U.S. Geol. Survey Geol. Atlas, Folio 105). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Secs. 13 and 24, T. 1 N., R. 13 W., Wabash County.

Friendsville Formation[1]

Pennsylvanian: Southwestern Indiana.

Original reference: Marshall Harrell, 1935, Indiana Div. Geology Pub. 133, p. 73 (chart).

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 84. Division of post-Alleghenian in western Indiana between McClearys Bluff above and St. Wendells formations, which is supposed to include Friendsville coal, Wabash County, Ill.; correlations between Friendsville and southwestern Indiana may have been erroneous, and Friendsville coal may be higher than its supposed equivalent in Indiana.

Type locality and derivation of name not given.

†Frijole Limestone Member (of Delaware Mountain Formation)[1]

Permian: Western Texas.

Original reference: W. G. Blanchard, Jr., and M. J. Davis, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 973, 987.

Named for exposures at Frijole post office, Culberson County.

Frijole Shale[1]

Permian: Western Texas.

Original reference: J. E. Adams, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 6. p. 785.

Occurs in wells at top of Delaware Mountain section Loving County.

Frio Clay[1]

Oligocene(?): Eastern Texas.

Original reference: E. T. Dumble, 1894, Jour. Geology, v. 2, p. 554.

M. C. Israelsky, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 2, p. 376–382. Annotated bibliography of pertinent papers dealing with term Frio; also shows various uses of term as interpreted by the reviewer.

A. C. Ellisor, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1344–1375. Anahuac formation (new) lies between basal sands of Fleming above and subsurface Frio below.

A. D. Warren, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 221–227. Plummer (1932, Texas Univ. Bull. 3232) and Ellisor (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11) used Frio as term for subsurface strata thought to be equivalent to surface beds of same name as restricted and defined by Plummer. However, it has been determined that surface Frio of Texas is outcrop equivalent of subsurface Vicksburg. Suggested that term Frio could be suppressed in case of the surface Vicksburgian equivalent in Texas and another name applied to that unit.

D. H. Eargle and J. L. Snider, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 30, p. 11 (fig. 2), 14. Frio clay discussed in report on uranium-bearing rocks, Karnes County area. Believed to be present in subsurface beneath Catahoula tuff in central and southern Karnes County. Formation consists of light-greenish-gray clay that is bentonitic and slightly calcareous and which weathers to a characteristic brown silty or clayey soil. Although its strike is apparently same as that of underlying beds, the Frio is believed to rest unconformably on sands of Jackson formation. Downdip from outcrop, lower part of Frio of subsurface contains fauna characteristic of Vicksburg of east Gulf Coastal Plain and formation is therefore classed as Oligocene(?) in age. Thickness about 200 feet (well data in Karnes County).

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2634. Discussion of Jackson group of south-central Texas. Southwest from point in northern Live Oak County, near community of Esseville, Frio clay, of Oligocene(?) age, extends to the Rio Grande. This usage of Frio is in the sense that Bailey (1926, Texas Univ. Bull. 2645) described the formation, restricting it to clays that lie conformably on the Jackson and that are overlain unconformably by Catahoula tuff (the Gueydan formation of Bailey).

Named for exposures at and near mouth of Frio River, Live Oak County.

Frio Formation

Frio Stage

Oligocene: Subsurface in Louisiana and Texas.

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1616–1620, 1634. Inaccurate correlation of so-called subsurface Frio with surface Frio formation noted. Name Van Vleck sands suggested to replace "Frio" in subsurface.

M. C. Israelsky, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 2, p. 376–382. An annotated bibliography of pertinent papers dealing with term Frio; also shows various uses of term as interpreted by reviewer.

A. D. Warren, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 221–227. History of usage of term Frio in subsurface and proposal of formal type

section for Frio Formation and Stage. Plummer (1932, Texas Univ. Bull. 3232) and Ellisor (1933, Am. Assoc. Petroleum Geologists Bull. 17, no. 11) used Frio as term for subsurface strata thought to be equivalent to surface beds of same name as restricted and defined by Plummer. It has been determined, however, that surface Frio of Texas is outcrop equivalent of subsurface Vicksburg. Between 1933 and 1940, workers, unaware of equivalency of subsurface Vicksburg to surface Frio, adopted term Frio for subsurface strata between middle Oligocene (Anahuac) and Vicksburg. This usage is firmly entrenched in the literature. Suggested that term Frio could be suppressed in case of the surface Vicksburgian equivalent in Texas and another name applied to that unit. Frio Stage is that part of subsurface stratigraphic section between base of Anahuac sediments and top of Vicksburg Stage. In type well, Frio Formation is present from 7,663 feet to 9,725 feet, whereas the stage continues down to 9,961 feet. Formation consists of dark to very dark, varicolored shales and silty shales and massive to thin-bedded strata of sand and silty sand. Top of formation is top of first sand below *Marginulina* zone of the Anahuacian, and base of lowest sand above Vicksburg Stage is considered base of Frio Formation. Stage in subsurface of Louisiana extends across southern half of State from Sabine River to Pearl River and is situated between base of Anahuacian *Marginulina* zone and top of Vicksburgian. Threefold division of Frio into upper, middle, and lower units is facilitated on basis of lithology and paleontology.

Type locality and well (formation and stage): China gas-distillate field in northeast Jefferson Davis Parish, La.; field is 6 miles southwest of Elton, La. Type well: Continental Oil-Union Sulphur, H. J. Shoesmith No. 1. Well is located 330 feet south and 330 feet east of NW cor. sec. 1, T. 8 S., R. 4 W.

Frisbie Limestone[1] Member (of Wyandotte Limestone)

Frisbie Limestone Member (of Iola Limestone)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 92, 97.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Shown on columnar section of Jackson and Cass Counties, Mo., as limestone member of Iola formation; underlies Quindaro shale member; overlies Liberty Memorial shale member (new) of Chanute shale.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032, 2033; 1949, Kansas Geol. Survey Bull. 83, p. 103. Settlement of the "Iola problem" has led to a number of changes in the Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Frisbie limestone, Quindaro shale, and Argentine limestone, which were indicated as members of Iola limestone in western Missouri, are classified with overlying Island Creek shale and Farley limestone as members of the Wyandotte.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 35. Thickness 1 to 3 feet in Kansas, ⅔ foot in Cass County, Nebr., and a few inches on Middle River, southwest of Winterset, Iowa.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25, fig. 5. In Madison County, the Frisbie is a blue dense, locally fossiliferous limestone. Thickness one-half foot. Basal member of Wyandotte; underlies Quindaro shale member; overlies Lane shale.

Named for Frisbie, Johnson County, Kans. Well exposed at middle of north side of sec. 17, T. 12 S., R. 23 E.

Frisco Limestone[1] (in Hunton Group)

Lower Devonian: Northeastern and south-central Oklahoma.

Original reference: C. A. Reeds, 1926, Am. Mus. Nat. History Jour., v. 26, p. 470–473.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7, 47–49. In south-central Oklahoma, formation is a fossiliferous calcarenite with almost no argillaceous calcilutite. Maximum thickness about 41½ feet. Overlies Fittstown member (new) of Bois d'Arc limestone. Underlies Woodford formation. Reeds did not designate type section but mentioned that best exposures were along Bois d'Arc Creek; these exposures can be used as type section.

G. G. Huffman, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 33–35, pl. 4. Described on flanks of Ozark uplift, northeastern Oklahoma. Light- to dark-gray, fine- to medium-crystalline, thick bedded, coquinoid fossiliferous limestone. Locally, sandy, cherty, and dolomitic beds may be present. Thickness 0 to 7 feet. Unconformably overlies St. Clair limestone; separated from overlying Sallisaw or Sylamore by unconformity, and locally, small cavities in Frisco are filled with Sylamore sandstone. Early Devonian.

Type section: Along Bois d'Arc Creek and near Coal Creek, NE¼ sec. 11, T. 2 N., R. 6 E., 7 miles south of Frisco, Pontotoc County.

Frog Mountain Sandstone[1]

Lower or Middle Devonian: Northern and central Alabama and northwestern Georgia.

Original reference: C. W. Hayes, 1894, Geol. Soc. America Bull., v. 5, p. 470.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Lower or Middle Devonian.

H. E. Rothrock, 1949, Alabama Geol. Survey Bull. 61, pt. 1, p. 11–12, fig. 2. Described in Coosa coal field, St. Clair County, Ala., where it is 80 feet thick and unconformably underlies Chattanooga(?) shale. Lower or Middle Devonian.

W. H. Robinson, J. B. Ivey, and G. A. Billingsley, 1953, U.S. Geol. Survey Circ. 254, p. 50. In Birmingham area, crops out along Red Mountain above Red Mountain formation.

Type locality: Frog Mountain, Cherokee County, Ala.

Frondosa limestone[1]

Ordovician: Southern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 7.

Derivation of name not stated.

Frontier Formation (in Colorado Group)[1]

Frontier Sandstone Member (of Mancos Shale)

Frontier Formation (in Mancos Group)

Upper Cretaceous: Western Wyoming, Colorado, Idaho, southern Montana, and Utah.

Original reference: W. C. Knight, 1902, Eng. Mining Jour., v. 73, p. 721, in a paper on Uinta County, Wyo.

C. T. Lupton, 1916, U.S. Geol, Survey Bull. 621, p. 167, 169, 171. In Basin oil field, includes (ascending) Peay and Torchlight sandstone members. Thickness about 565 feet. Overlies Mowry shale; underlies Cody shale.

J. D. Sears, 1926, U.S. Geol. Survey Bull. 781–B, p. 16 (table), 18, 19. In Rock Springs uplift, Sweetwater County, Wyo., Frontier formation is 70 to 160 feet thick; overlies Aspen shale and underlies Baxter shale.

W. T. Thom, Jr., 1935, U.S. Geol. Survey Bull. 856, p. 49. Thickness of formation about 410 feet in Soap Creek field. Consists chiefly of dark shale and beds of bentonite lithologically similar to lower part of overlying Carlile shale. Division between the two formations arbitrarily placed at top of thick bentonite bed exposed east of Soap Creek dome, which lies a short distance above several thin layers of coarse sandstone containing small chert pebbles and shark teeth. These layers are confined to top 100 feet of formation at Soap Creek but apparently become thicker toward northwest. Overlies Mowry shale. Colorado group.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 101, 102, 103. Member of Mancos shale in Uinta basin, Utah. Thickness 156 feet at Red Creek; 157 feet at Rim Rock; 163 feet at Colorado border. Overlies Middle shale member; underlies Upper shale member. Stratigraphically above Aspen shale member.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 839–840. In north-central Wasatch Mountains, underlies Henefer formation (new) and overlies Aspen formation. Consists of coal-bearing series of hogback-making gray sandstones separated by dark shales and friable sandstones; coarse conglomerate in middle of section. Thickness about 10,000 feet.

D. M. Kinney and J. F. Rominger, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 82; D. M. Kinney, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–123. Member of Mancos shale in Whiterocks River-Ashley Creek area, Uintah County, Utah, where it is 80 to 90 feet thick; overlies Mowry member and underlies unnamed member. Member, in Duchesne and Uintah Counties, Utah, is 210 to 250 feet thick; overlies Mowry member and underlies unnamed member.

H. L. Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1538 (table), 1577–1584. Frontier formation in this area [Teton County, Wyo.] is characterized by tan sandstones with some interbedded sandstones, a few thin nodular limestones, many fossiliferous beds. Thickness about 2,750 feet. Overlies Mowry shale; contact placed at base of typical Frontier-type sandstone, above which no bentonite or porcellanite beds were observed. Conformably underlies Cody shale.

J. D. Love, 1948, Wyoming Geol. Assoc. Guidebook 3d Ann. Field Conf., p. 108–109. Frontier, as defined in central Wyoming, consists of sandstone and shale sequence overlying Mowry and underlying Cody shale. Frontier, as defined in type area and other parts of western Wyoming, comprises quite different set of beds. Correlation from southwest corner of Wind River basin southwestward through Bison basin, Rock Springs

uplift, and Church Buttes to type area indicates that Cody shale and probably at least part of Mesaverde formation of central Wyoming are age equivalent of type Frontier and that part of Frontier formation of central Wyoming is age equivalent of Aspen shale of western Wyoming. Name Frontier is applied in this report [Wind River basin] to the sandstone and shale above the Mowry shale and below the Cody shale, in conformity with long-accepted usage, but not with the implication that formation is the same age as at type area. Thickness 650 to 1,030 feet.

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p 688–689 (table 1) Shown on generalized columnar section as formation in Mancos group in Green River and Yampa River Canyons. Thickness 200 feet. Overlies Mowry formation; underlies an upper Mancos shale.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111, sheet 2. In Hardin area, Montana and Wyoming, includes Soap Creek bentonite bed (new).

Keith Young, 1951, Jour, Paleontology, v. 25, no. 1, p. 35–68. Formation in southern Montana is divided into seven stratigraphic units (unnamed). Faunas obtained from units of formation of southern Montana are compared with faunas from Frontier formation and Carlile shale of other areas. Suggested that term Carlile shale be discontinued as rock name in southern Montana and that Frontier be redefined to include all rocks between top of Mowry shale and base of Niobrara formation. Frontier section (Thom and others, 1935) east of Soap Creek oil field was used as section of reference.

T. H. Kiilsgaard, 1951, Idaho Bur. Mines and Geology Pamph. 92, p. 14–17. Extent and thickness of Frontier formation in Horseshoe area has long been subject of conjecture. Schultz (1918, U.S. Geol. Survey Bull. 543) mentioned its occurrence and noted that it contained producing coals in Lincoln County. Kirkham (1922, Idaho Bur. Mines Bull. 4) and Stalder (1928, unpub. rept., Teton County) mentioned that formation covers large parts of the district. In present report [Horseshoe Creek], term Frontier is restricted to those Upper Cretaceous sediments, essentially gray to buff sandstones, shales, and beds of coal, which overlie basal conglomerate separating Aspen and Frontier formations. Thickness 3,905 feet. Formation occupies most of Horseshoe Creek basin. It is bounded on west by Jackson fault and is underlain to south and east by Aspen formation. Northward, it passes beneath Tertiary volcanics.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 15, pl. 2. In Wasatch Mountains, east of Salt Lake City, overlies Kelvin formation and underlies Cretaceous(?) conglomerate. Thickness at least 8,000 feet. Tuffaceous beds similar to porcellanites of Aspen formation crop out near base.

W. A. Cobban and J. B. Reeside, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 1913–1961. Formation in its type area, consists of about 2,000 feet of sandstone, coal, bentonite, and porcellanite. At Cumberland Gap. Wyo., 15 miles south of Frontier, lower half of formation consists of nonmarine sandstone, siltstone, mudstone, and water-laid volcanic rocks with some coal, carbonaceous shale, and limestone. Upper half consists of sandstone, mudstone, and some coal. Underlain by marine Aspen shale of Early Cretaceous age; overlain by 6,000 feet of marine Hilliard shale of middle Late Cretaceous age, which in turn is

overlain by 4,000 feet of largely nonmarine Adaville formation. Nonmarine lower half cannot be precisely dated, but is probably Cenomanian. Marine beds in upper half are dated as of late Greenhorn (Turonian), early Carlile (Turonian), and early Niobrara (Coniacian) ages. Nonmarine unit near top believed to be of late Carlile age (Turonian). Northward from type area, formation does not appear to change greatly as far as Fontenelle basin, but upper half of overlying Hilliard shale changes to sandstone and shales of Adaville aspect. Farther north in Snider basin, a thin equivalent of typical Frontier can be identified, but it is overlain by great thickness of sandstone and shale that is not greatly different from the Frontier. Surface measurements suggest as much as 13,000 feet, but there may be duplication of beds not readily seen on surface. Uppermost part has not yielded fossils, but main part of these beds contains Niobrara fossils, and the entire sequence above the Aspen has been called Frontier by some authors. Formation passes eastward into dominantly marine rocks with fewer and thinner beds of resistant sandstone. Inasmuch as the sandstone beds that locally form top of Frontier pass eastward into shale, the upper limit of formation changes in age. Ordinarily one of three large units of sandstone forms top of formation. Youngest sandstone unit, of early Niobrara age, is tongue shaped, extending from southwest and northwest corners of Wyoming into central part of State. Sandstone beds of about middle Carlile age form top of formation for some distance eastward in Wyoming, northeastern Utah, and northwestern Colorado, beyond the eastern limits of the sandstone beds of early Niobrara age. In much smaller area in north-central Wyoming and south-central Montana, sandstone beds of pre-Carlile age form top of the Frontier. In Cumberland Gap section, formation contains Oyster Ridge sandstone member. Detailed discussion of specific areas. Correlation chart.

C. C. O'Boyle, 1955, Intermountain Assoc. Petroleum Geologists Guidebook 6th Ann. Field Conf., p. 33 (columnar section), 34. In northwestern Colorado (western part), overlies the Mowry and underlies Mancos formation; in eastern part, occurs above Dakota formation and below Niobrara equivalent.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 15. Nomenclature revised in Hardin district, Montana and Wyoming. Names Frontier and Eagle, which appear on maps published by Thom and others (1935), Richards and Rogers (1951), and Knechtel and Patterson (1952, U.S. Geol. Survey Circ. 150; 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–36), have been eliminated from nomenclature in present report. Strata that were designated Frontier formation are assigned to Belle Fourche member of Cody shale.

J. D. Haun, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 84–89. In Powder River Basin, top of Frontier is placed at top of Wall Creek sandstone member. Base of Frontier placed at base of Clay Spur bentonite. Overlies Mowry shale; underlies Carlile shale except in Buffalo-Crazy Woman Creek area where it underlies Cody shale. Thickness varies from almost 1,000 feet in southwest part of basin to 600 feet in subsurface northeast of Kaycee and to 800 feet in southeastern part of basin. Use of name Frontier, with Wall Creek sandstone member at top, can be extended to east and northeast to region where Greenhorn limestone becomes distinct. If Greenhorn limestone is distinctly present, Black Hills nomenclature should be used.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 43–46, pls. 1, 3. In Buffalo-Lake De Smet area, formation is 500 feet thick and consists of interbedded light-gray sandstone and dark-gray shale with a few beds of bentonite and conglomerate. Overlies Mowry shale; underlies Cody shale.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 34, 36–37. Frontier sandstone member of Mancos overlies Mowry shale member and underlies main body of Mancos in Daggett County. Average thickness about 200 feet.

N. C. Williams and J. H. Madsen, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 122–123. In Coalville area, Utah, beds previously assigned to Frontier formation contain a heretofore unnoted major tectonic interruption; hence, the Frontier formation should be divided in recognition of this unconformity. Name Frontier is retained for beds below the angular unconformity, and name Wanship is applied to immediately overlying beds. Thickness of restricted Frontier 2,132 feet.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136–146. Formation revised is Coalville area. Comprises (ascending) Longwell sandstone, Spring Canyon, Chalk Creek, Coalville, Allan Hollow, Oyster Ridge, Dry Hollow, Grass Creek, Judd shale, and Upton sandstone members. All member names except Oyster Ridge are new. Overlies rocks tentatively assigned to Aspen shale; underlies Henefer formation. Intraformational unconformity recognized, but formation is not divided on basis of this hiatus; hence, Williams and Madsen's (1959) Wanship not used in present report. On correlation chart, column credited to Trexler (1955, unpub. thesis) shows Frontier formation comprises (ascending) Aspen zone, Skunk Point sandstone, Chalk Creek, Grass Valley shale, Oyster Ridge, Coalville conglomerate, Dry Hollow sandstone, Meadow Creek sandstone, Judd shale, and Upton shale members. Between Skunk Point sandstone and Chalk Creek member are about 2,800 feet of sandstone, shale, and conglomeratic sandstone not recognized as Frontier. Most of this interval is Chalk Creek member of present report.

Type area: Southwestern Wyoming. Named for exposures near Frontier, 2 miles north of Kemmerer, Lincoln County, Wyo. Characteristically exposed at Cumberland Gap, 15 miles south of Frontier.

Front Range Granite Group[1]

Precambrian: Colorado.

Original reference: T. S. Lovering and others, 1935, Geologic map of Colorado.

Includes following named units: Cripple Creek Granite, Curecanti Quartz Monzonite, Eolus Granite, Mount Rosa Granite, Pikes Peak Granite, Powderhorn Granite, Sherman Granite, Silver Plume Granite, Tenmile Granite, Trimble Granite, Twilight Granite, Vernal Mesa Quartz Monzonite, and Whitehead Granite.

Named for development in Front Range.

†Frostburg Formation[1]

Permian: Western Maryland.

Original reference: P. T. Tyson, 1837, Maryland Acad. Sci. Trans., v. 1, p. 92–98.

Named for Frostburg, Allegany County.

Frozen Head Sandstone (in Vowell Mountain Group)

Frozenhead Grit (in Anderson Sandstone)[1]

Pennsylvanian (Pottsville Series): Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 324–328.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19, pls. 2, 4. Reallocated to Vowell Mountain group (new) and referred to as Frozen Head sandstone. In type locality 35 feet thick; in Cross Mountain section 60 feet thick; maximum thickness 100 feet. Occurs near top of group; overlies an unnamed shale unit; underlies shale interval below Low Gap sandstone (new) of Cross Mountain group (new).

Exposed on Frozen Head Mountain, Petros quadrangle, Morgan County. [Board on Geographic Names gives Frozen Head as correct spelling.]

Fruitland Formation[1]

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: C. M. Bauer, 1916, U.S. Geol. Survey Prof. Paper 98–P.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Described in Red Mesa area, La Plata and Montezuma Counties, Colo., where it is 510 to 520 feet thick and consists of a sequence of sandstone, shale, and coal beds. Underlies Kirtland shale; overlies Pictured Cliffs sandstone.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144. Discussed in Baker-Dome-Fruitland area, New Mexico, where it underlies Kirtland shale and intertongues with underlying Pictured Cliffs sandstone.

Named for small settlement on San Juan River, San Juan County, N. Mex.

Frye Mesa Beds (in Gila Conglomerate)

Pleistocene: Southeastern Arizona.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. Consist of conglomerate containing large boulders set in brown silty matrix. Maximum thickness adjoining Graham Mountains about 700 feet. Unit thins rapidly toward center of Safford Valley. Conformably overlie Solomonsville beds. Name credited to W. L. Van Horn and L. A. Heindl (unpub. theses).

In Stafford Valley, [Graham County].

Fulda Limestone (in Mansfield Group)

Pennsylvanian (Pottsville): Southwestern Indiana.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 87 (fig. 1), 88–89. Dark-blue-gray dense pure brittle, sparsely fossiliferous limestone. Thickness 2½ feet. Occurs near top of group about 15 feet below Ferdinand limestone (new).

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2), 19. Included in Ti Valley series (new).

Named for exposures along road between Fulda and New Boston, eastern Spencer County. Well exposed in S½SW¼ sec. 33, T. 4 S., R. 4 W.

Fulda Sandstone[1]

Permian: Central northern Texas.

Original reference: E. C. Case, 1907, Am. Mus. Nat. History Bull. 23, p. 660-662.

Named for prominent development near station of Fulda, Baylor County.

Fullerton Formation[1]

Fullerton Member (of Blanco Formation)

Fullerton Member (of Chase Channel Formation)

Pleistocene (Aftonian): Southern, central, and northern Nebraska and western Kansas.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

O. S. Fent, 1950, Kansas Geol. Survey Bull. 85, p. 64–65. Top member of Chase Channel formation (new), a subsurface unit in western Kansas. Maximum thickness 30 feet. Gray silty clay containing much sand. Gradationally overlies Holdrege member; underlies Meade formation.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 12 (fig. 6), 16. Formation is composed of silt and calcareous clay grading locally into fine sand. Occurs between Holdrege and Grand Island formations in Loess Plains area. Thickness varies between a few feet and 50 feet or more; average 20 to 30 feet. Grades westward into "Aftonian formation" which was developed generally on the Holdrege sand and gravel plain where subdrainage was not active.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 59–60, 61, 64. Considered upper member of Blanco formation in Kansas. Where exposed in Sedgwick County, consists of 8 feet of gray to greenish-gray silt and sand and overlies Permian shale; underlies red sandy silts and silty sands tentatively classed as Crete-Loveland.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Chart of revised classification of Kansas Pleistocene shows Fullerton as member of unnamed formation in Meade group. Overlies Holdrege member; and occurs below Afton soil.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown as formation in Kansas. Nebraskan-Aftonian.

Named for exposures in vicinity of Fullerton, Nance County, Nebr.

Fullington Shale[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 379.

Named for Fullington Ranch, at Belvidere, Kiowa County.

Fulton Shale (in Eden Group)[1]

Fulton Beds (in Economy Member of Latonia or Eden Formation)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

Original reference: A. F. Foerste, 1905, Science, new ser., v. 22, p. 150.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Chart shows Fulton formation in

Utica group. Occurs below Latonia formation of Eden group and above Point Pleasant formation of Trenton group.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 257–276. Report is based on reexamination of stratigraphy of sub-Eden beds of Ordovician age along Ohio River at its crossing of Cincinnati arch. Review of the literature reveals several sources of confusion in nomenclature and correlation. Study of detailed section at West Covington and Carntown, Ky., and Point Pleasant, Ohio. Rogers Gap [member of Cynthiana] formation, uppermost member of the Mohawkian, and overlying Fulton shale, lowermost member of the Cincinnatian, are faunally indistinguishable in this area. They appear to be lithologic facies of same time-rock unit. Faunal and lithologic evidence indicates advisability of extending the Cincinnatian series downward to embrace the Cynthiana formation, rather than including this formation in the Mohawkian.

K. E. Caster, E. A. Dalve, and J. K. Pope, 1955, Elementary guide to the fossils and strata of the Ordovician in the vicinity of Cincinnati, Ohio: Cincinnati Mus. Nat. History, p. 12 (fig. 3). Chart shows Fulton beds at base of Economy member of Latonia formation.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030–1031. In this report [Eden conodonts from Cincinnati region], Eden formation is classified as lowermost formation in Covington group and divided into (ascending) Economy (including basal Fulton beds), Southgate, and McMicken member. Economy member is also referred to as "Fulton-Economy" member.

Named for Fulton, formerly a suburb of Cincinnati, Ohio.

Fulton Shale Member (of Monongahela Formation)[1]

Fulton shale and sandstone member

Upper Pennsylvanian: West Virginia, eastern Ohio, and western Pennsylvania.

Original reference: G. P. Grimsley, 1907, West Virginia Geol. Survey Rept. Ohio, Brooke, and Hancock Counties, p. 92.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 36, 37. Thin shale member which in eastern Ohio occurs about midway between the Sewickley and Uniontown coals. In Jefferson County, Ohio, and northwestern West Virginia, underlies Arnoldsburg limestone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 178, 180. Shale and sandstone member of Arnoldsburg cyclothem in report on Athens County. In Athens County, olive-green shaly sandstone that occurs above Benwood coal bed has been identified as the Fulton "green" shale. Here, the Fulton shale is separated from Benwood coal by bedded sequence of silty shale or fine-grained sandstone that averages nearly 10 feet in thickness. Fulton shale, itself, is an olive-green massive calcareous and micaceous unit that contains shaly partings and averages 4½ feet in thickness. Monongahela series.

Exposed at Fulton, Ohio County, W. Va.

Fults Member (of Salem Limestone)

Mississippian (Valmeyer Series): Southwestern Illinois.

J. W. Baxter, 1959, Dissert. Abs., v. 19, no. 11, p. 2910. Salem limestone is subdivided into four members [sequence not indicated] to which the names Kidd, Fults, Chalfin, and Rocher are assigned. Fults member

consists of alternating beds of fine-grained dolomitic limestone and beds which contain admixtures of skeletal debris and microcrystalline non-skeletal grains.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2–3, 7, 22–24, pl. 1. Three general rock types predominate; very fine grained argillaceous silty earthy, mostly dolomitic limestone; mostly fine-grained dolomitic limestone with less detrital clay and silt; and medium-grained bioclastic limestone. Maximum thickness 34 feet. Conformably overlies Kidd member; contact with Chalfin member is at base of semilithographic bed.

Type section: In SE¼NE¼ sec. 20, T. 4 S., R. 10 W., near village of Fults, southern Monroe County.

Funeral conglomerate[1]

Tertiary: Southeastern California and southwestern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78.

Well developed on flanks of Funeral Range, northeast of Death Valley in southeastern California.

Funeral Formation

Funeral Fanglomerate

Pliocene and Pleistocene(?): Southeastern California and southwestern Nevada.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 956–957. In addition to fanglomerate and other arid-basin deposits, unit contains interbedded flows of basalt. Lies unconformably on all other formations; in Amargosa Valley, unconformably overlain by a series of flat-lying beds that contain Pleistocene fossils. Thickness 3,000 feet. Deposited later than Amargosa thrusting. Name credited to T. P. Thayer.

Typically exposed between base of Funeral Range and Ryan, in Death Valley, southeastern California.

Funks Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Listed as underlying Guinda formation and overlying Sites Formation (both new).

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282, 284, 291, 293. Described as consisting mainly of greenish-gray clay shale and siltstone. Thickness 620 to 2,500 feet. Typical exposures noted.

Typical exposures in vicinity of Stone Corral Creek in W½ sec. 27, T. 17 N., R. 4 W., and along Funks Creek in W½ sec. 10, T. 17 N., R. 4 W., Colusa County.

Funk Valley Formation (in Indianola Group)

Upper Cretaceous: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 128, 133 (fig. 17). Thick unit of marine sandstone and shale of Niobrara age overlying Allen Valley shale (new). At type locality, formation consists of three clearly separable members: (1) basal series of sandstones with interbedded shale, about 900 feet thick; (2) middle unit of gray marine shale, 650 feet thick; and (3) upper sandstone 700 feet thick. Underlies Sixmile Canyon formation (new).

Type locality: Ridges bordering Funk Valley in secs. 34 and 35, T. 18 S., R. 2 E., Salt Lake Meridian, 3 to 4 miles southwest of Manti. Formation also forms marginal foothills of Wasatch Plateau for more than 4 miles south of Crystal Spring. In Salina Canyon, basal 600 feet of formation is exposed.

Funston Limestone (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 23.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 64–65. Condra (1935) employed term Bigelow limestone to comprise three units (ascending): Sabetha limestone (Crouse limestone), Blue Rapids shale, and Funston limestone, It is here proposed that Bigelow be dropped as stratigraphic term and that Crouse limestone, Blue Rapids shale, and Funston limestone be recognized as formations.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 84–86, pls. Described in Wabaunsee County, Kans., where it commonly consists of three thin beds of moderately hard massive limestone separated by gray beds of shale. Contains biostrome that extends into parts of four counties in east-central Kansas. Thickness 8 to about 26 feet. Overlies Blue Rapids shale; underlies Speiser shale. Council Grove group.

Type locality: In bluffs of Kansas River valley south of Funston, Kans. Named for Camp Funston, Riley County.

Furnace Limestone[1]

Furnace Formation

Paleozoic: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 352–365, map.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5, 10–12, pl. 1. Consists of three members, gray, white, and black. Stratigraphic position of only basal gray member is known. It crops out beneath Chicopee formation (new) in overturned and faulted limb of anticline southwest of Cactus Flat. White and black members are separated from the gray by granitic intrusions and faults, and their relative age is not known with certainty. Thickness about 6,000 feet. Intruded by Cactus quartz monzonite. Considered Mississippian-Pennsylvanian(?).

J. F. Richmond, 1960, California Div. Mines Spec. Rept. 65, p. 15–25, pl. 1. About one-third of total area of formation mapped by Vaughan is exposed in area of this report [south of type area]. Consists chiefly of calcite and dolomitic marbles which may be as much as 5,000 feet thick. Conformably overlies Chicopee Canyon formation which name replaces preoccupied Chicopee formation of Guillou (1953). Probably at least 1,000 feet of Furnace formation is Mississippian and remainder may be in part Pennsylvanian.

U.S. Geological Survey currently designates the age of the Furnace Limestone as Paleozoic on the basis of a study now in progress.

Named for Furnace Canyon, San Bernardino Mountains, San Bernardino County.

Furnacean series[1]

Miocene: California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 78. Crops out in Furnace Canyon, east of Death Valley, Inyo County.

Furnace Creek Formation

Miocene or Pliocene: Southern California.

H. D. Curry *in* D. I. Axelrod, 1940, Jour. Geology, v. 48, no. 5, p. 527, 528, 531. Consists of several thousand feet of lavas, pyroclastics and terrestrial sediments. Lower part of formation primarily highly colored volcanics and pyroclastics with some fanglomerates, all presumably in unconformable contact with earlier Tertiary rocks. Pyroclastics grade laterally and vertically into tuffaceous lake and playa sediments. Unconformably underlies Ryan formation (new). Beds strongly folded into an asymmetrical syncline striking northwest.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 955–966. Unconformably underlies Greenwater volcanics (new); unconformably overlies Artist Drive formation (new). Thickness 2,500 feet.

Exposed in area drained by Furnace Creek Wash in central Death Valley region.

Furnace Creek Quartz Diorite Gneiss

Precambrian: Southeastern Pennsylvania.

T. V. Buckwalter, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 115, 118. Name proposed for dark-greenish-gray medium-grained, usually homogeneous rock. Considered a recrystallized migmatic resulting from assimilation of hornblende gneiss and gabbro by Byram gneiss. Does not have obvious gneissic structure. Contains diffuse bands and clots of hornblende. Everywhere grades into Byram gneiss, Pochuck gneiss, or more common mechanically assimilated migmatites of these units.

Type locality: In South Mountain near headwaters of Furnace Creek and very near the Blainsport-Newmanstown Road. Area is near the point where Berks, Lancaster, and Lebanon Counties meet.

Furnace Ridge Conglomerate (in Gettysburg Sandstone lithofacies)

Triassic: Southeastern Pennsylvania.

D. B. McLaughlin and R. C. Gerhard, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 136, 137. Coarse quartz-pebble conglomerate with interbedded red quartzose sandstone; occurs in lower part of lithofacies. Thickness 3,000 feet. Disappears rapidly westward near Mount Hope, Lancaster County, by interfingering with sandstones. Remains prominent to east beyond northeastern Lancaster County.

Maximum development along Hammer Creek, Lancaster County. May be named for Furnace Ridge in Lancaster quadrangle.

Furnaceville iron ore[1]

Silurian: Central and western New York.

Original reference: J. M. Clarke, 1906, New York State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12.

Tracy Gillette, 1947, New York State Mus. Bull. 351, p. 38–46. In Genessee Gorge, the Furnaceville is underlain by 3 feet of rather typical basal Reynales and overlain by the *Pentamerus* part of the same formation.

This condition holds for only a short distance to the east where the hematitic limestone appears to gradually fade into a true limestone. A few miles farther east, the Furnaceville is present again but occupies a position at base of the Reynales. Furnaceville constitutes a lithologic unit easily recognized and mappable; it can be traced for a long distance and with more assurance than most Clinton formations. Hence, it seems preferable to use it as a formational name to designate the lowermost hematitic limestone of Clinton group. Genesee Gorge lentil is considered a part of Furnaceville iron ore.

H. L. Alling, 1947, Geol. Soc. America Bull., v. 58, no. 11, p. 996, 998 (fig. 2), 1000. Furnaceville is herein defined as the ore that occurs at or near the base of the Reynales limestone.

Typically developed in vicinity of Furnaceville, Wayne County.

Furnaceville Shale[1]

Silurian: Central and western New York, and Ontario, Canada.

Original reference: M. Y. Williams, 1919, Canada Geol. Survey Mem. 11, p. 47.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 35. Now included in Neahga shale.

Fuson Member (of Lakota Formation)

Fuson Shale (in Dakota Group)

Fuson Shale (in Inyan Kara Group)[1]

Lower Cretaceous: Western South Dakota, northwestern Nebraska, and eastern Wyoming.

Original reference: N. H. Darton, 1901, U. S. Geol. Survey 21st Ann. Rept., pt. 4, p. 530.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Middle formation in Dakota group. Overlies Lakota formation; underlies Omadi sandstone (new).

K. M. Waagé, 1959, U. S. Geol. Survey Bull. 1081–B, p. 33, 84. History of stratigraphic nomenclature in Black Hills area and revision of nomenclature of Inyan Kara group. Darton's Fuson is key to difficulties that have arisen in attempts to map his threefold subdivision (Lakota, Fuson, and Dakota) in different parts of Black Hills. In southeastern corner of Black Hills where Minnewaste limestone is present and lower part of the Fall River is generally a massive sandstone affording a clearcut base, upper and lower contacts of Darton's Fuson are sharp and unmistakable. Minnewaste limestone is limited to small fraction of total outcrop of Inyan Kara group and basal part of Fall River formation is commonly shaly outside of limited area in southern Black Hills where they were first used. In subsequent work outside of southeastern Black Hills, Darton's interpretation of Fuson varied from one exposure to next [examples cited]. Consequently, both Darton's contact of Fuson and Dakota (Fall River) formations and his contact of the Lakota and Fuson formations wander up and down in the section with lateral changes in ratio of sand to clay-rock in beds above and below the persistent transgressive disconformity [see Dakota group]. Darton's measurement of type Fuson (Darton, 1901) and a revision (Darton and Paige, 1925, U.S. Geol. Survey Geol. Atlas, Folio 219) corresponds closely to section 10 (of present report), and his base of the Dakota (Fall River) is precisely at the

transgressive disconformity. Fuson shale is reduced to member status in redefined Lakota formation. Name Fuson has been widely misapplied outside of Black Hills to beds equivalent to Skull Creek shale, as a result of Darton's miscorrelation with the Dakota equivalents of Colorado Front Range. Use of name Fuson as member of Lakota in limited area of southern Black Hills, where Minnewaste is present, may be helpful but should not be used beyond limits of Minnewaste. If this procedure is followed, Fuson member should be given new type locality. At Darton's type section, herein stated, is 92 feet thick; consists of siltstone, claystone, and sandstone; separated from overlying Fall River formation by transgressive disconformity.

W. A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc., v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

Type section: At apex of sharp north bend in Dry Creek, Fuson Canyon, SW¼SE¼NE¼SW¼ sec. 36, T. 5 S., R. 6 E., Custer County, S. Dak.

Fusselman Dolomite

Fusselman Limestone[1]

Middle Silurian: Western Texas and southern New Mexico.

Original reference: G. B. Richardson, 1908, Am. Jour. Sci., 4th, v. 25, p. 476, 479–480.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 164, 170. In Franklin Mountains, Tex., underlies Canutillo formation (new).

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 13, (table 2), 19–20, pl. 2. Referred to as dolomite. In Silver City, N. Mex., area, disconformably overlies Raven member (new) of Montoya dolomite; unconformably underlies Percha shale. Thickness 75 feet.

F. R. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 220 (fig. 2), 223 (fig. 3), 225 (fig. 5), 226 (fig. 6). In Sacramento and San Andres Mountains, N. Mex., underlies Onate formation (new). Onate replaces term Canutillo in this area.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. in Geology 4, p. 62, 66–68. In Caballo Mountains, thin sequence of light-gray-weathering, generally unfossiliferous claystone, limestone, calcitic dolomite, and dolomite referred to by Darton (1917, U.S. Geol. Survey Prof. Paper 108–C) as Fusselman(?) is here named Cutter formation and assigned to Montoya group. Fusselman dolomite poorly exposed in area of this report.

L. C. Pray and A. L. Bowsher, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1342. In Sacramento Mountains and other ranges farther west in south-central New Mexico, Darton identified the Upper Ordovician Montoya limestone, as well as two members of Fusselman limestone for which a Middle Silurian (Niagaran) age has been generally accepted. Recent study indicates that major erosional break within Montoya-Fusselman sequence occurs between the two members of Fusselman limestone in Sacramento Mountains. Fossils from lower member appear to be Upper Ordovician, and those of upper member appear to be Lower Silurian. Lower member of Fusselman is lithologically distinctive, widespread, and easily mappable in south-central New Mexico. In Sacramento

Mountains, it consists of 150 to 225 feet of medium to very light gray sublithographic dolomite that contains little chert; upper contact interpreted as disconformity. Upper member consists of resistant gray to brown cherty dolomite as much as 100 feet thick.

L. C. Pray, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1906–1917. Overlying cherty upper member of Montoya formation in Sacramento Mountains, and in many other ranges of south-central New Mexico, is lithologically distinctive unit that was termed lower member of Fusselman limestone by Darton (1917, U.S. Geol. Survey Prof. Paper 108–C). This lower member of Fusselman is herein designated as independent formation and named Valmont dolomite. The Valmont underlies unit termed "upper member of Fusselman limestone" by Darton (1928, U.S. Geol. Survey Bull. 794). Rock unit in Sacramento Mountains termed upper member of Fusselman limestone by Darton (1917; 1928) may be correlative with part of Fusselman limestone at type section designated by Richardson (1908) near El Paso. Correlation is open to question, and unit is herein referred to as Fusselman (?) formation.

L. C. Pray, 1958, West Texas Geol. Soc. Guidebook Franklin and Hueco Mountains, Tex., p. 30–43. Formation in Franklin Mountains is 608 feet thick, and consists largely of dolomite; divided into three lithologic units designated as lower, middle, and upper. Overlies Cutter dolomite of Montoya group. Type section suggested.

Type section (Pray): Northern Franklin Mountains, 6 miles north of Fusselman Canyon. Named for exposures in Fusselman Canyon, north of El Paso, Tex.

Fusselmannian series

Middle Siluric: Arizona and New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 107; no. 4, p. 253. Appears only on charts of geologic formations.

Fuyk Sandstone Member (of Rondout Waterlime)

Upper Silurian: Southeastern New York.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. Sandstone included in Rondout waterlime.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 45, 46, 51, 55, 146 [1946]. Member of Rondout waterlime. Lower beds locally shaly and consist of reworked Normanskill arkose. Maximum thickness 20 feet. Underlies Manlius limestone. Has been called "Binnewater;" younger than that unit and not connected with it. Type locality designated.

Type locality: Ledge on west ridge of the Fuyk, west of Catskill.

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Gabbs Formation[1]

Upper Triassic: Southwestern Nevada.

Original reference: S. W. Muller and H. G. Ferguson, 1936, Geol. Soc. America Bull., v. 47, p. 241–252.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey (geol.) Quad. Map GQ–45. Described in Mina quadrangle where it consists of sandy shale and limestone in upper part, brown shaly limestone in middle, and black carbonaceous shale with a few beds of black impure limestone, weathering purple, in lower part. Thickness at type locality 420 feet. Overlies Luning formation; underlies Sunrise formation.

Named for Gabbs Valley Range, where it is well exposed in New York area.

Gabilan Limestone[1]

Pre-Franciscan: Western California.

Original reference: G. F. Becker, 1888, U.S. Geol. Survey Mon. 13, p. 128, 181.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 193, 224 (fig. 3). Described as a white to bluish-gray, thoroughly recrystallized marble, commonly exhibiting faint banding. Occurs as isolated roof pendants in Santa Lucia granite and as fault breccia along San Andreas fault zone.

Occurs in San Francisco Bay region.

Gabilan Mesa Quartz Diorite

[Cretaceous]: Central western California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Discussed in paper dealing with potassium-argon age determinations. Age given as 83.8 million years.

Occurs in Gabilan Mesa, which covers an area of approximately 250 square miles east of Salinas Valley. Oldest sedimentary rock resting in depositional contact on flanks of mesa is Miocene in age. Dated specimen collected in sec. 29, T. 17 S., R. 7 E., on road to Pinnacles National Monument, 3.2 miles east of its junction with Metz Road.

Gaddes Basalt (in Ash Creek Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 10–11, pl. 1. Forms black to dark-green outcrops. On unweathered surfaces basalt is dark green. Chiefly pillow lavas; local intercalated rhyolitic flows. Pyroclastic rocks of highly vesicular or amygdaloidal, irregular-shaped basaltic fragments resembling lapilli and small bombs appear in bodies of small size east of Mingus Mountain. Pillow structures range from 1 to 5 feet in length and average 1½ to 2 feet. Estimated thickness in Black Canyon, 2,000 to 2,500 feet. Underlies Buzzard rhyolite (new).

Good exposures in Gaddes Canyon, south of Mingus Mountain, and in Black Canyon, Jerome area, Yavapai County.

Gadsden Limestone (in Ocala Group)

Eocene, upper: Northwestern Florida (subsurface).

W. E. Moore, 1955, Florida Geol. Survey Bull. 37, p. 21 (table 1), 30, 42–44. Introduced for some limestones of Jackson age that occur in subsurface sections of southeastern Jackson County. Consists of those limestones that have no, or few, specimens of the larger Foraminifera such as *Lepidocyclina*, *Asterocyclina*, or *Operculinoides*. Underlain in Jackson County by Marianna limestone. Stratigraphic equivalent of Crystal River formation which includes the Bumpnose member. Grades laterally into Crystal River formation, and youngest Gadsden beds extend farthest to northwest. Depending upon where the Gadsden is encountered, it is underlain by the Crystal River formation or by older Eocene formations. Overlies Tallahassee limestone in well W–4 in Gadsden County. Thickness 0 to 180 feet in Jackson County. Gadsden is confined to area southeast of Cypress fault, and from fault it thickens to southeast at expense of Crystal River.

H. S. Puri, 1957, Florida Geol. Survey Bull. 38, p. 34–35. Appears to be a faunal facies of the Crystal River. Suggested that name be abandoned.

Named for occurrence in City of Quincy water well W–4, Gadsden County.

Gaffney Marble[1]

Gaffney Formation

Mississippian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith and D. B. Sterrett, 1921, Limestones and marls of North Carolina, by G. F. Loughlin and others: North Carolina Geol. and Econ. Survey Bull. 28, p. 28, 72–75.

T. L. Kessler, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 756, 764, 776, 780. The quartzite, carbonate-silicate rocks, and crystalline limestone have been mapped as Cambrian (the Kings Mountain, Blacksburg, and Gaffney formations). Near Kings Mountain, mica schist and gneisses previously mapped as Carolina gneiss, and hornblende gneisses previously mapped as Roan gneiss actually constitute the metamorphosed upper part of the Gaffney; names Carolina and Roan, therefore, have lithologic but not stratigraphic significance.

U.S. Geological Survey currently designates the age of the Gaffney Marble as Mississippian on the basis of a study now in progress.

Named for exposures at Gaffney, Cherokee County, S.C.

Gage Shale Member (of Doyle Shale)

Gage Shale (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 45.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. As currently defined, consists mostly of clayey shale with calcareous fossiliferous shale and a minor amount of limestone in upper part; lower and middle parts are chiefly varicolored noncalcareous shale consisting of red, green, purple, and chocolate-colored zones interbedded with gray and yellow layers. Thickness approximately 45 feet. Overlies Towanda limestone member; underlies Stovall limestone member of Winfield limestone.

Type locality: Between 1 and 2 miles south of west side of Wymore, Gage County, Nebr.

Gaikema Sandstone (in Tuxedni Group)

Gaikema Sandstone Member (of Kialagvik Formation)

Gaikema Sandstone Member (of Tuxedni Formation)

Middle Jurassic: Central southern Alaska.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Member of Kialagvik formation. Predominantly of resistant cliff-forming sandstone beds 1 to 10 feet thick; usually separated by thin laminae of siltstone. Pebble lenses common and several conglomerate beds present. Thickest conglomerate bed approximately 50 feet. Rocks are dark green in fresh exposure and dark brown in weathered exposures. Thickness ranges from 500 feet in southern part of outcrop area to about 970 feet in northern part. Overlies unnamed siltstone member; underlies Tuxedni formation. Lower Jurassic. Name credited to Kellum and Wedow (rept. in preparation).

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, table 5 facing p. 60. Assigned to Tuxedni formation. Lies between two unnamed siltstone members. Middle Jurassic.

U.S. Geological Survey currently classifies the Gaikema Sandstone as a formation in Tuxedni Group on the basis of a study now in progress.

Well exposed on Gaikema Creek, in northern part of Iniskin Peninsula.

Gailor Dolomite

Lower Ordovician: East-central New York.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 797, 803 (fig. 3), 807–808, 811–812, 813. Because *Ophileta*, *Helicotoma*(?) *uniangulata*, and *Ectenoceras* are exclusive Canadian index fossils, the latter two indicative of the Lower Canadian, the age of the cherty dolomite above Mosherville sandstone (new) is established as lowermost Ordovician. Name Little Falls dolomite for these beds is in error, and name Skene dolomite (Wheeler, 1942) is not applicable because it was defined as Upper Cambrian. Hence, name Gailor dolomite is proposed for these beds. Thickness varies from about 80 feet in northern part of Amsterdam quadrangle to about 150 feet in Saratoga region. West of Petrified Sea Gardens, formation is capped by massive 6-foot gray chert bed which locally contains *Cryptozoon*. Underlies Tribes Hill limestone in western part of area and Amsterdam limestone in eastern part of area. Section at Rock City Falls shows 12 feet of Gailor dolomite below thin Lowville limestone. Mosherville sandstone also referred to as basal member of Gailor.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 85. Traced into Fort Johnson member (new) of Tribes Hill formation in Mohawk Valley. Debatable whether some of dolomite beneath the Fort Johnson in that area should be assigned to the Gailor.

Type locality: Gailor quarry at northern edge of city of Saratoga Springs, one-eighth mile west of U.S. Highway 9, Saratoga County.

Gaines Group

Gaines Stage

Upper Cretaceous (Chico): Northern California.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Group in lower part of Chico series; embraces late Albian to Turonian. Thickness 5,300 feet. Underlies Panoche group.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 185 (fig. 69) [preprint 1941]. Shown as a stage, based on a faunal assemblage, in Pioneer group.

Group present in western Shasta County.

†Gainesville[1]

Lower Cretaceous (Comanche Series): Northeastern Texas and southwestern Arkansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 384–385.

Named for Gainesville, Cooke County, Tex.

Gainesville Sandstone Bed (in Blackjack Knob Member of Theodosia Formation)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 31, pl. 2. Fossiliferous sandstone at least 8 feet thick that occurs near the base of the Blackjack Knob.

Well exposed on Missouri Highway 80 just east of county seat [Gainesville] of Ozark County, Mo.

Gakona Formation[1]

Eocene, upper: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 52, map.

Occurs east of Gakona Glacier, central Copper River district.

Galap Sub-Member (of Ngarsul Member of Aimeliik Formation)

Eocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 44, pl. 8. Andesitic-basaltic tuff intercalated with tuff breccia in lower part of Ngarsul member (new).

Occurs only in north part of Babelthuap Island on Arekalong Peninsula. Well exposed along coast north of village of Galap.

Galata Ash

[Recent]: Northwestern Montana, and Alberta, Canada.

Leland Horberg and R. A. Robie, 1955, Geol. Soc. America Bull., v. 66, p. 949–955. Volcanic ash layer that occurs in postglacial alluvium and colluvium at several localities. Stratigraphic relations and physical properties indicate a single episode of volcanic activity and possible correlation with an ash layer in southeastern Glacier Park assigned on basis of pollen analyses to postglacial Xerothermic period. If correlation with postglacial ash from Glacier Peak, Wash., is established by later studies, this name should be dropped and term Glacier Peak ash adopted.

Galatia Sandstone (in McLeansboro Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: G. H. Cady, 1926, Illinois State Acad. Sci. Trans., v. 19, p. 256–258.

Crops out about one-half mile north of Galatia, Saline County.

Galdog Beds

See Ngardok (Galdog) Beds.

Various spellings—Galdock, Goldock, Goldog, Garudokku.

Gale Sand[1]

Pleistocene (Wisconsin) : Western Washington.

Original reference: B. Willis and G. O. Smith, 1899, U.S. Geol. Survey, Geol. Atlas, Folio 54.

Named for creek in Tacoma quadrangle, which flows across part of area covered by Gale sands, Puget Sound region.

Galena Dolomite[1]

Galena Group or Formation

Middle Ordovician: Northern Illinois, eastern Iowa, southern Minnesota, and southwestern Wisconsin.

Original reference: J. Hall, 1851, Rept. on geology of Lake Superior land district, by J. W. Foster and J. D. Whitney, pt. 2, p. 146–148.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 81, 82–90, measured sections. Formation, in southeastern Minnesota, comprises (ascending) Decorah shale, with Guttenberg and Ion submembers, Prosser, and Stewartville members. Overlies Spechts Ferry member of Platteville formation; underlies Dubuque member of Maquoketa formation. Mohawkian.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6. fig. 3. Group, in Dixon-Oregon area, Illinois, comprises (ascending) Spechts Ferry (missing in some places), Guttenberg, Dunleith (new), Wise Lake (new), and Dubuque formations. Overlies Platteville group.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 763–766. Formation, in southeastern Minnesota, comprises carbonate rocks that overlie Decorah shales and underlie limestones and shales of Dubuque formation. Thickness about 93 feet. Includes (ascending) Cummingsville (new), Prosser, and Stewartville members.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 255, 257, 259, 261–269, 296–300. In zinc-lead district, Galena dolomite is commonly coarsely crystalline massive vuggy dolomite or limestone divisible regionally into two units: a cherty lower unit 105 feet thick and a noncherty upper unit 120 feet thick. Cherty unit is divisible into four zones based primarily upon relative chert content and presence of *Receptaculites*. Noncherty unity unit is divided on basis of thinness of bedding and amount of interbedded shale into Dubuque, at top, and the more massive, less shaly Stewartville and zone P of the Prosser below; latter is divided less precisely on basis of *Receptaculites* which are abundant in the Stewartville but not in zone P below. Name Dubuque is applied much as it has been in past; name Stewartville is applied more or less as it has been in past; name Prosser includes the cherty unit and probably all of zone P overlying noncherty unit. Because of paleontologic deficiencies and because of distinct lithologic difference, the Galena in this report is subdivided into cherty and noncherty units rather than into Prosser, Stewartville, and Dubuque members of common, although not precise, usage. Overlies Decorah formation; underlies Maquoketa shale.

Named for exposures in bluffs of Mississippi River in vicinity of Galena, Jo Daviess County, Ill.

†Galena Series[1]

Middle Ordovician: Upper Mississippi Valley region.

Original reference: F. W. Sardeson, 1896, Am. Geologist, v. 18, p. 356–368.

Galesburg Shale (in Kansas City Group)[1]

Original reference: G. I. Adams, 1903. U.S. Geol. Survey, Bull. 211, p. 36.

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11–12. Redefined to exclude Canville limestone and Stark shale formerly included in it by Missouri Geological Survey.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 87. Thickness 3 to 75 feet. In southern Kansas, includes Dodds Creek sandstone member. Overlies Swope limestone; underlies Dennis limestone. Southward from point where Swope limestone disappears, a few miles north of Oklahoma line, Galesburg is not separable as a unit and forms upper part of Coffeyville formation. In Bronson subgroup of Kansas City group.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 65, p. 421. Thickness about 8 feet in Madison County, Iowa. Separates Swope formation below from Dennis formation above. Kansas City group.

Named for Galesburg, Neosho County, Kans.

Galesville Sandstone (in Dresbach Group)

Galesville Member[1] (of Dresbach Formation)

Upper Cambrian: Wisconsin, Iowa, and southern Minnesota.

Original reference: A. C. Trowbridge and G. I. Atwater, 1934, Geol. Soc. America Bull., v. 45, p. 45, 79.

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935, Geol. Soc. America Bull., v. 46, no. 11, p. 1696–1697. Uppermost member of Dresbach formation; overlies Eau Claire member; underlies Ironton member of Franconia formation.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 861–862. Underlies Woodhill member of Franconia formation. Name Woodhill replaces term Ironton. Measured sections show thickness 13 to 60 feet.

U.S. Geological Survey currently classifies the Galesville as a formation in Dresbach Group on the basis of a study now in progress.

Named for exposures on bluff of Beaver Creek at mill dam at Galesville, Trempealeau County, Wis.

Galice Formation[1]

Upper urassic: Southwestern Oregon and northern California.

Original reference: J. S. Diller, 1907, Am. Jour. Sci., 4th, v. 23, p. 401–421.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 74, 81–83. Diller (1907) concluded that the Dothan was younger than the Galice and believed entire section, Galice, volcanics, and Dothan, was overturned. Present study indicates that Dothan sediments in type section are not overturned, except locally on drag folds; Dothan is older than Galice and, at type section at least, is separated from it by volcanics which grade downward into former and upward into latter; Dillard series lies unconformably on and overlaps Dothan and Galice.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 4–9. Described in Kerby quadrangle. Galice, as defined by Diller, included only slates and sandstones in type area; present mapping shows that volcanic rocks are intercalated with slates and sandstones and form part of a continuous cycle of deposition; they are here included in the formation. Consists of volcanic member and

sedimentary member. Estimated thickness of sedimentary member 15,000 feet; volcanic member 10,000 feet. Unconformably overlies gneiss in northeastern part of quadrangle; in fault contact with similar gneiss in southwestern part of quadrangle; not in contact with Dothan.

F. G. Wells and F. W. Cater, Jr., 1950, California Div. Mines Bull. 134, pt. 1, chap. 2, p. 81. Geographically extended into northern California.

F. G. Wells and G. W. Walker, 1953, Geology of the Galice quadrangle, Oregon; U.S. Geol. Survey Geol. Quad. Map [GQ–25]. In Galice quadrangle, lies to east of Rogue formation (new).

F. W. Cater, Jr., and F. G. Wells, 1953, U.S. Geol. Survey Bull. 995–C, p. 79, 84 (chart), 86–92, pl. 11. Geographically extended into Gasquet quadrangle, California, where it includes a lower metavolcanic rock unit at least 7,000 feet thick, consisting of andesitic flows, breccias, and tuffs, and an upper sedimentary unit consisting of not less than 3,000 feet of slate and phyllite with interbedded tuffaceous sandstone. Contacts between Dothan and Galice have been destroyed by plutonic intrusions.

Well exposed at Galice, on Rogue River, and on Galice Creek, Josephine County, Oreg.

Galisteo Formation

Galisteo Sandstone[1]

Eocene-Oligocene(?): Central northern New Mexico.

Original reference: F. V. Hayden, 1869, U.S. Geol. and Geog. Survey Terr. 3d Ann. Rept., p. 40, 67, 90.

C. E. Stearns, 1943, Jour. Geology, v. 51, no. 5, p. 301–319. Referred to as formation. Consists of from 900 to at least 4,000 feet of sandstone, sand, and clay, variegated in color, together with minor amounts of conglomerate, fresh-water limestone, and water-laid tuff. Succeeded without interruption by deposition of Espinaso volcanics (new). Unconformably overlies Upper Cretaceous Mancos or Mesaverde. Fossil evidence indicates Duchesnean (late Eocene or early Oligocene).

Peter Robinson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 757. Molar of *Coryphodon*, collected from red mudstone bed approximately 700 feet above base of formation in Santa Fe County, indicates lower Eocene (Wasatchian) age for lower part of formation.

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines Mineral Resources Bull. 48, p. 5 (table 1), 10–11, pl. 1. Formation described in Cerrillos area where it is 1,200 to 3,000 feet thick and consists of sandstone, clay, conglomerate, with silicified wood. Includes strata lying between erosion surface that cuts Upper Cretaceous and top of first massive sandstone beneath Espinaso volcanics. Fossil evidence indicates deposition of Galisteo terminated in late Eocene or possibly early Oligocene.

Named for occurrence in valley of Galisteo Creek.

Galiuro Limestone[1]

Pennsylvanian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 517–521.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 facing p. 706 (column 52b). Galiuro formation used on Pennsylvanian correlation chart.

Type section: In Galiuro Mountains at junction of Gila and San Pedro Rivers, about 45 miles northeast of Tucson and 6 miles east of Winkelman, south of Deer Creek coal field and Ash Creek, and at foot of Saddle Mountain, Gila Basin.

Galiuro Rhyolite[1]

Tertiary: Southeastern Arizona.

Original reference: W. P. Blake, 1902, Eng. and Mining Jour., v. 73, p. 546.

Galiuro Mountains.

Galkyoku Limestone

See Ngarekeukl Limestone.

Gallatin Limestone[1] or Formation

Gallatin Group

Upper Cambrian: Southern Montana and northwestern Wyoming.

Original references: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110; 1896, U.S. Geol. Survey Geol. Atlas, Folio 24.

B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 124–127. In Wind River Mountains and Owl Creek-Bridger uplift, formation is subdivided to include Du Noir member (new).

Erling Dorf and Christina Lochman, 1938, Geol. Soc. America Proc. 1937, p. 275–276; 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 541–555. Term Gallatin eliminated; its use in any sense other than original definition of Peale is invalid and confusing. Replaced by (ascending) Maurice, Snowy Range, and Grove Creek formations (all new).

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1091–1105. Terms Du Noir and Gallatin not applicable to Wind River Canyon section which is herein divided into Depass formation and Boysen formation (new).

H. A. Tourtelot and R. M. Thompson, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 91. Formation, in Boysen area, Wyoming, consists of 455 feet of limestone and limestone-pebble conglomerate with lesser amounts of limy siltstone and shale. Contact between Gallatin and overlying Gros Ventre is placed at base of prominent cliff-forming limestone about 87 feet thick; the contact thus placed is approximately at base of Gallatin as used by Miller (1936) and is about 60 feet above contact between DePass and Boysen formations of Deiss (1938). Underlies Bighorn dolomite. In southern Big Horn Mountains, Gallatin underlies Madison formation.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Rank raised to group. Includes (ascending) Du Noir limestone, Dry Creek shale, and Sage limestone. It should be noted that Dry Creek shale in most exposures is thin and rarely mappable and should be most commonly regarded as member of Sage limestone.

C. R. DeLand, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1374. Formation comprises three subdivisions (ascending): Du Noir limestone, Dry Creek shale, and Sage limestone:

A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 38, 39 (fig. 1), 40 (fig. 2), 41. Group in southwestern Wyoming, comprises (ascending) Du Noir limestone and Open Door limestone (new).

Named for typical occurrence in Gallatin Range, the southern extension of which is in northwestern corner of Yellowstone Park.

Gallatinian series[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Gallaway Beds or Formation

Miocene: Northern California.

C. E. Weaver, 1943, California Div. Mines Bull., 118, p. 630–632. Alternating units of dark-gray and brown argillaceous shale, mudstones, and medium-grained sandstone interstratified with thick units of massive and bedded brownish-gray sandy shales. Beds strongly folded. Thickness 2,075 feet. Underlies Point Arena beds (new); overlies Skooner Gulch basalt (new).

C. E. Weaver, 1944, Washington [State] Univ. Pubs. in Geology, v. 6, no. 1, p. 4, 19, 20, 21, pl. 2. Described as a formation; overlies Skooner Gulch formation (redescribed); type section designated.

Type section: In sea cliffs from north side of Skooner Gulch northward to Abalone Cove for a distance of about 3,800 feet. Point Arena-Fort Ross area, Mendocino County.

Gallego Sandstone Member (of Gallup Sandstone)

Gallego Sandstone Member (of Miguel Formation)[1]

Upper Cretaceous: Southwestern New Mexico.

Original reference: D. E. Winchester, 1920, U.S. Geol. Survey Bull. 716–A.

C. A. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187, 188 (fig. 2). Cretaceous section in Alamosa Creek valley area, Catron and Socorro Counties, reinterpreted and stratigraphic names used in San Juan basin extended into valley. Name Gallego sandstone member retained but applied to upper sandstone member of Gallup standstone, and name Miguel formation abandoned. Underlies Dilco coal member of Crevasse Canyon formation; overlies D–Cross tongue (new) of Mancos shale.

Named for Gallego Creek, Socorro County.

Gallegos sandstone[1]

Pennsylvanian(?): Central northern New Mexico.

Original references; C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 7.

Sandia Mountains.

Gallinas shale[1]

Cretaceous: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 7.

Well developed on Gallinas Creek, near Las Vegas, San Miguel County.

Gallitzin Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1880, Pennsylvania 2d Geol. Survey Rept. H_5, p. 312.

Armstrong County.

Gallup Sandstone (in Mesaverde Group)

Gallup Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1925, U.S. Geol. Survey Bull. 767.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 9, 39–35. Pescado tongue (new) of Mancos shale splits Gallup member of Mesaverde into upper and lower parts.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 91. Rank raised to formation in Mesaverde group. In Fort Defiance-Tohatchi quadrangles, basal unit of group; underlies Crevasse Canyon formation (new).

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156. Nomenclature of Mesaverde, in San Juan basin, revised. Gallup sandstone as a formation replaces Gallup sandstone member, and also, in its northward extension, replaces in its entirety Tocito sandstone lentil of Mancos shale.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187, 188 (fig. 2), 190, 191. Cretaceous section in Alamosa Creek valley area, Catron and Socorro Counties, reinterpreted, and stratigraphic names used in San Juan basin extended into valley. Gallup sandstone is split into upper and lower units by D–Cross tongue (new) of Mancos shale. Name Gallego sandstone retained but applied to upper sandstone member of Gallup rather than to member of Miguel formation which is herein abandoned. Overlies Mancos shale; underlies Crevasse Canyon formation (Dilco coal member). Gallup as identified, correlated, and described in this report, corresponds with only the upper part of La Cruz Peak formation of Tonking (1955) which includes also the underlying part of the Mancos down to a sandstone identified by him as Tres Hermanos(?) sandstone member of Mancos.

Named for town of Gallup.

Galton facies (of Belt Series)

Precambrian: Northwestern Montana, and southern British Columbia, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Galton facies is a transitional stage between Glacier Park and Purcell facies. Distinguished from former by more clastics in the Siyeh and Helena; from the latter by finer clastics below Siyeh and presence of Altyn siliceous dolomites.

In MacDonald-Galton Ranges.

Galton Series[1]

Precambrian: Northwestern Montana, and southeastern British Columbia, Canada.

Original reference: R. A. Daly, 1913, Canada Dept. Int., Rept. Chief Asst. 1910, v. 2, p. 97, pl. opposite p. 178.

Gallatin Range, Montana-British Columbia.

Galum Limestone Member (of Carbondale Formation)

Galum Limestone (in McLeansboro Group)

Galum Limestone Member (of McLeansboro Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: A. H. Bell, C. Ball, and L. McCabe, 1931, Illinois Geol. Survey Press Bull. 19.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as Galum limestone in McLeansboro group. Underlies Cutler limestone; overlies Bankston Fork limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Correlation chart shows Galum limestone in Sparland cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 48 (table 1), pl. 1. Reallocated to member status in Carbondale formation (redefined). Occurs above Allenby coal member (new) and below Danville (No. 7) coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian stata in Illinois.

Type locality: North center sec. 13, T. 6 S., R. 4 W., Perry County. Well exposed along Galum Creek near Pinckneyville.

Galveston Sand

Recent: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 132, pls. 63, 64. Vertical cliff expóses four layers (or horizons) which show progressively decreasing consolidation upward; each lies unconformably on the preceding. Maximum thickness of exposure a little more than 9 feet. Galveston sand is a thin top stratum representing recent wind deposited sand from adjacent strand. Overlies Pine sand (new).

Exposure between Kure's Beach fishing pier and Ethyl Dow Bromine Plant on lower Cape Fear Peninsula.

Galway Formation[1]

Upper Cambrian: East-central New York.

Original reference: J. M. Clarke, 1910, New York State Mus. Bull. 140, p. 11–12, map.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 802, 803 (fig. 2), 810. Name Galway formation substituted for beds previously termed "Theresa" in Saratoga Springs area. Formation redefined to comprise sandy dolomites, dolomitic sandstones, and calcareous sandstones lying below the Hoyt limestone and above the Potsdam sandstone. Formation has total thickness of 125 feet in area, and top lies 12 feet below *Cryptozoon proliferum* reef of Hoyt limestone; strata formerly classed as lower Hoyt are now included in the Galway. Embraces beds of lower Franconia through Trempealeau age. In area of Mosherville, unconformably underlies Mosherville sandstone (new). Type locality designated.

Type locality: Two railroad cuts and roadcut along New York State Highway 9–K, 3 miles northwest of Saratoga Springs. Named for Galway, Saratoga County.

Gamboa Formation

Oligocene(?): Panamá.

Karl Sapper, 1905, Petermanns Mitt. Erganzungsbd. 32, no. 151, p. 38, 39. Terms Gesteine von Gamboa, Gamboa formation, and Gamboagesteinen used in text discussion.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 335–336. Name has not been used in recent literature but is available as a name to include Bas Obispo formation and Las Cascadas agglomerate.

Game Lodge Granite

Precambrian: Western South Dakota.

G. L. Taylor, 1935, Am. Jour. Sci., 5th ser., v. 29, no. 171, p. 281–282. Fine-grained gray biotite-granite which consists essentially of quartz, feldspars, and biotite. More compact and darker than most of Harney Peak granite which intrudes it. Occurs as intrusive masses into Precambrian sediments. Field evidence did not indicate relative ages of Game Lodge to Little Elk gneissoid granite (new), Harney Peak granite, or igneous amphibolites.

Exposed west of Game Lodge Hotel, which is in valley of Galena Creek, vicinity of Custer, Black Hills.

Gamerco Formation

Recent: Northwestern New Mexico.

L. B. Leopold and C. T. Snyder, 1951, U.S. Geol. Survey Water-Supply Paper 1110–A, p. 6–9. At type locality, consists of (ascending) 1 to 2 feet of fine gravel partly cemented with caliche; about 2 feet of brown compact silty sand with white mottling of caliche; 2 feet of reddish- to reddish-brown silty fine compact sand containing hard calcareous concretions. Disconformably underlies Nakaibito formation (new); disconformably overlies shale and sandstone of Gibson coal member of Mesaverde.

Type locality: In outskirts of Gallup about 300 yards east of El Rancho Hotel. Crops out in gully wall of Puerco River. Name derived from Gamerco, a suburb of Gallup, McKinley County. Most exposures occur where bedrock, the Mesaverde formation, crops out in gully channel.

Game Refuge Formation (in Jackfork Group)

Mississippian (Chesterian): Southeastern Oklahoma.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 131 (fig. 1), 135–136. Replaces name Union Valley sandstone extended into this area (Harlton, 1938). Consists of approximately 250 to 350 feet of gray to dark-gray shale and intercalated massive and thin-bedded fine to medium subangular sandstone. Intercalations of fine to medium-coarse fossiliferous limonitic sandstones with abundance of crinoid columnals and plant remains present in upper half of formation. Overlies Wesley shale; underlies unit referred to as Johns Valley shale of published reports. Included in Pushmataha series considered to be of Carboniferous age.

L. M. Cline and O. B. Shelburne, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 179 (table 1), 190 (table 2), 192–193. Referred to as Game Refuge sandstone. Approximately 350 to 400 feet thick in western Ouachitas; thins northward in frontal Ouachitas and disappears north of Ti Valley fault. Underlies Johns Valley shale. Mississippian (Chesterian).

Name derived from State Game Refuge at Jerusalem Hollow in western Kiamichi Range in secs. 28 and 29, T. 1 S., R. 18 E., about 6 to 7 miles southwest of Clayton, Pushmataha County. [Referred to as type locality by Cline and Shelburne.] Best exposures are in Round Prairie syncline in sec. 2, T. 2 S., R. 12 E., along Campbell Creek, but name Campbell Creek is preoccupied.

Gammon Ferruginous Member (of Pierre Shale)[1]

Upper Cretaceous: Northeastern Wyoming, southeastern Montana, and northwestern South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

W. A. Cobban, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 87. Well exposed in common corner of Montana, Wyoming, and South Dakota, where it is about 800 feet thick and divisible into three units. Lower consists of 600 feet of gray mudstone that is slightly calcareous in basal 150 feet; middle unit is Groat sandstone bed, about 50 feet thick; and upper is 150 feet of gray mudstone with ferruginous and calcareous concretions. Underlies Mitten black shale member.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 104–107, measured sections. Traced across northern end of Black Hills and along western side as far south as Beaver Creek, which is a few miles southeast of Osage, Weston County, Wyo. Pedro bentonite beds crops out at base of member near Osage. Groat sandstone bed present about 150 feet below top of member. Thickness 700 to 800 feet in vicinity of Osage. Underlies Mitten black shale member; overlies Niobrara formation.

Named for exposures along Gammon Creek, T. 57 N., Rs. 67 and 68 W., Crook County, Wyo.

Gamsetu (Gamusetsu) Agglomerate

Eocene: Caroline Islands (Babelthuap)

Risaburo Tayama, 1939, Brief report on the geology and ore resources of Babelthuap Island (Palau Island proper): Tropical Industry Inst., Palau, South Sea Islands Bull. 3 [English translation in library of U.S. Geol. Survey, p. 15, 18]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 64, table 4 [English translation in library of U.S. Geol. Survey, p. 75–76]. Group of rocks resembling quartz trachyte. Lower member greenish breccia; upper member a liparite agglomerate. Underlies Babelthuap agglomerate.

Typically developed at Gamusetsu on north shore of Ngatpang (Gasupan) Bay.

Ganado Series[1]

Tertiary or Pleistocene: Northeastern Arizona.

Original reference: A. B. Reagan, 1932, Kansas Acad. Sci. Trans., v. 35, p. 253–258.

Caps an irregularly shaped mesa north of Ganado, Apache County.

Gander Run Shale Member[1] (of Mahantango Formation)

Middle Devonian: South-central Pennsylvania.

Original references: Bradford Willard, 1935, Geol. Soc. America Proc. 1934, p. 361; 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1279, 1282.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Gander Run shale listed on correlation chart at base of Mahantango formation, and below Chaneysville sandstone, and above Marcellus shale. Middle Devonian.

Named for stream occupying valley underlain by these strata 6 to 8 miles north of Chaneysville, Bedford County.

Gannett Group[1]

Lower Cretaceous: Southeastern Idaho and southwestern Wyoming.

Original reference; G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98–G, p. 76, 82, 83.

L. S. Gardner, 1944, U.S. Geol. Survey. Bull. 944–A, p. 7. In Irwin quadrangle, where Draney limestone is top of group, underlies Bear River formation. Overlies Stump sandstone. Thickness 940 feet.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 39, 43, pl. 1. In Paradise Valley quadrangle, Idaho, Ephraim conglomerate is only representative of group. In Ammon quadrangle, group comprises Ephraim conglomerate, Peterson limestone, and Bechler conglomerate. Underlies Wayan formation.

C. A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 63–68. Restricted to exclude Tygee sandstone which is here included in overlying Bear River formation. Uppermost unit of group is unnamed discontinuous redbed unit above Draney limestone. Lower Cretaceous.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 53–57. Described in Jackson Hole area where all formations —(ascending) Ephraim conglomerate, Peterson limestone, Bechler conglomerate, Draney limestone, and Tygee sandstone—are recognized. Here group is much thinner than in type area, nearly 100 miles southwest, and cannot be divided into separate formations as conveniently. Lower Cretaceous.

Named for Gannett Hills, in Bannock County, Idaho, and Lincoln County, Wyo., in eastern part of Wayan quadrangle, where all of its formations are well exposed.

Gannett Peak Stage

Gannett Peak Stage

Recent: Rocky Mountain region.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, correlation chart. In proposed time-stratigraphic standard for Rocky Mountains, the Recent epoch includes (ascending) Castle Valley, Temple Lake, Spanish Valley, and Gannett Peak stages.

G. M. Richmond, 1957, Internat. Assoc. for Quaternary Research, 5th Cong., Madrid, p. 157. Two stages of Recent glaciation recognized in Rocky Mountain region, an early Recent stage, Temple Lake, and a late Recent stage, Gannett Peak. Unweathered moraines of the Gannett Peak occur in front of existing glaciers or in recently evacuated cirques.

Gano Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

C. C. Branson, 1956, Oklahoma Geology Notes, v. 16, no. 11, p. 122–123, 124–126. Name applied to shale, limestone, and sandstone sequence between top of Emporia limestone and base of Wood Siding formation; base of Wood Siding is at base of Nebraska City limestone member in Osage County, at base of Grayhorse limestone member southward to T. 15 N., and at base of Brownville limestone member in southern Lincoln County. Thickness about 62 feet.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 61–62. First recognizable keybed above Elmont limestone in Pawnee County is "Grayhorse"

limestone. Between the Elmont and "Grayhorse" is shale-sandstone sequence which in Kansas is subdivided into more than a dozen stratigraphic units on basis of persistent limestones which occur in section there. All of these limestones pinch out north of Pawnee County; consequently there is no basis for subdivision of Pawnee County section. Branson (1956) applied name Gano shale to this shale-sandstone sequence. Upper limit is lowermost recognizable key bed in Wood Siding formation. As result of southward pinchout of progressively higher key beds in lower part of Wood Siding, the Gano-Wood Siding boundary migrates upward in the section toward south. In Pawnee County, this boundary is base of "Grayhorse" limestone. Thickness 35 to 50 feet in Pawnee County.

Type section: Exposed in hills northeast of Gano, a refinery village northeast of Cushing, Wayne County.

Gansevoort[1]

Gansevoort Shale Member (of Canajoharie Shale)

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 118. Referred to as Gansevoort shale member of Canajoharie. Overlies Chuctenunda shale member; underlies Sprakers shale member.

Type locality and derivation of name not given, but may have been named for Gansevoort, Saratoga County.

†Gant Bed[1]

†Gant Limestone[1]

Silurian (Niagaran): West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 576, 582–583.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 262. Foerste named Gant limestone and Gant bed from exposures in Wayne County. Gant limestone included 30 feet of limestone and is equivalent to Bob limestone as recognized by Miser, Jewell, Wilson, and Pate and Bassler at some localities. If name Bob had not become so well established, it would be recommended here that Bob limestone be dropped in preference to Gant.

Named for A. B. Gant homestead, about 1 mile northeast of Martin's Mill, Wayne County.

†Gap Latite[1]

Miocene: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13.

Platoro-Summitville region.

Gap Sandstone Member (of Tallant Formation)

Gap Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: M. I. Goldman, 1920, U.S. Geol. Survey Bull. 686–W, p. 330, 333.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 38. Reallocated to Tallant formation. Goldman (1920) correlated this lenticular member

with the Revard sandstone; present study indicates that unit is northward continuation of Bigheart sandstone, except south of Caney River, where it falls at top of or above the Revard sandstone member.

Named for occurrence at top of Gap Ridge, in SW cor. T. 29 N., R. 13 E., in northwest corner of Washington County.

Gap Ridge Sandstone Member (of Stanley Shale)

Pennsylvanian: Southwestern Arkansas.

N. H. Stearn *in* J. M. Hansell and J. C. Reed, 1935, Am. Inst. Mining Metall. Engineers Trans., v. 115, p. 245. Consists of (ascending) a 300-foot sandy zone, a 200-foot shaly zone, and a 100-foot sandy zone. Occurs about 1,000 feet below top of Stanley shale and about 700 feet above the Parker Hill sandstone member (new).

J. C. Reed and F. G. Wells, 1938, U.S. Geol. Survey Bull. 886–C, p. 25, pls. 2, 3. Stratigraphically restricted to the lower 300-foot sandstone.

Named from Gap Ridge mine, an important mining development in that horizon. Mine is in sec. 11, T. 7 S., R. 26 W., Pike County.

Gaps Flow or Tongue (of Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 112, 133, 134, 143 (fig. 20). East of type locality, Clayton basalt consists of many long tongues. For purpose of this report, these tongues have been named, from south to north, the Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that gave rise to these basalts are unknown.

Well exposed along east side of Sand Gap, eastern Union County.

Gaptank Formation[1]

Pennsylvanian: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 47.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 73–92. Gaptank, as originally defined, evidently included strata now known as Wolfcamp formation. Later the Gaptank was restricted to exclude *Uddenites* zone which Böse believed to be of Permian age. Further knowledge of fossils near Pennsylvanian-Permian boundary obtained in recent years has led to conclusion that *Uddenites* zone is of Pennsylvanian age, and top of Gaptank is now placed above this zone. West of Marathon are exposures of strata, here considered to be part of Gaptank formation, which were variously placed in Tesnus (Baker and Bowman, 1917, Texas Univ. Bull. 1753), Haymond (Böse, 1917, Texas Univ. Bull. 1762) and Gaptank by Baker, Böse, and Udden. Term Dugout beds (Baker, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 11) has also been proposed for them. Gaptank formation crops out only in northern part of Marathon basin [this report]. Type area of Gaptank lies north of region of this report, but problematic strata exposed on Dugout Creek and here considered to be part of Gaptank formation crop out over wide area in northwestern part of Monument Spring quadrangle. Thickness at type locality about 1,800 feet; overlies Haymond formation; underlies Wolfcamp formation. In most places the Gaptank is separated from Wolfcamp by strong angular unconformity.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 289 (fig. 1). Desmoinesian, Oklan series.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 49, no. 9, p. 299, 300 (fig. 1). Discussion of Wolfcamp series (Permian) and new species of fusulinids, Glass Mountains, Tex. Nealranch formation (new) overlies Gaptank formation, which, according to chart, contains "grey limestone" included in Wolfcamp formation by King (1937) and *Uddenites* shales. Boundary between Pennsylvanian and Permian is taken at unconformity at top of "grey limestone."

Occurs at Gaptank, 24 miles northeast of Marathon, Brewster County. Named for tank, sometimes locally called Gap Tank, located in a gap locally called Stockton Gap and Marathon Gap.

Garanon Member (of Santa Rosa Island Formation)

Pleistocene, upper: Santa Rosa Island, California.

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1113, 1115. Consists of a basal marine facies and upper terrestrial facies. Thickness about 25 feet. Marine facies is commonly a light-gray calcareous clay containing fossil bones of whale, sea lion, sea otter, shore birds, and occasional dwarf mammoth as well as organic remains and quantities of "rotted" asphalt. Thickness at least 2 feet except for a few erosional channels.

Garanon platform and member exposed along sea cliffs between Jaw Gulch on west and Tecolote Canyon on east. Present locally between Survey Point and Arlington Canyon.

Garber Sandstone[1]

Permian: Northwestern, central, and south-central Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 786–799.

C. C. Branson, 1954, Shale Shaker, v. 4, no. 6, p. 7, 12. Thick sequence of deep-pink sandstones and intervening red shales. Overlies Wellington formation; underlies Hennessey shale. Leonardian.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in northwestern, central, and south-central parts of State.

Named for exposures at Garber, Garfield County.

Garceno Sandstone Member (of Cook Mountain Formation)

Eocene (Claiborne): Western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 261–262. Name applied to basal sandstone member of formation. With exception of a 50-foot dark-colored marine shale about 150 feet above the base, member is composed of glauconitic marine sandstone beds that are highly fossiliferous. Thickness approximately 500 feet. Underlies Veleno member (new); overlies Mount Selman formation.

Name is taken from Garceno ranchhouse, located on an outcrop of the sandstone, 9 miles northwest of Zapata, Mexico. Ranchhouse is on American side of Rio Grande.

Garcia Formation (in Armendaris Group)

Pennsylvanian (Des Moines Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 42–43 (fig. 4), 50–51. Name introduced for all sediments

between top of Whiskey Canyon limestone (new) below and base of Bolander group (new). Type section is composed of about 213 feet of rocks, including essentially pure highly fossiliferous limestone, argillaceous to slightly arenaceous and cherty limestones, several thin gray to red shales, and a 50-foot bed of highly conglomeratic sandstone at its base. Formation is wide spread and varies considerably lithologically.

Type locality: East of westernmost box canyon of Whiskey Canyon in northern part of Mud Springs Mountains, sec. 1, T. 13 S., R. 5 W., Sierra County. Name derived from Garcia Road, 4 or 5 miles west of Mud Springs Mountain.

Gardeau Shale Member (of West Falls Formation)

Gardeau Shale Member (of Portage Formation)[1]

Gardeau Shale or Formation

Upper Devonian: Western and west-central New York.

Original reference: J. Hall, 1840, New York Geol. Survey 4th Rept., p. 390–392, 452–455.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 37. Gardeau shale and overlying Nunda sandstone make up sedimentary cycle which begins as series of silty gray shales containing a few thin siltstones and grades upward through flaggy siltstones and a few silty shales into massive siltstone and shale at top. The Gardeau is predominantly shale, silty shale, and various amounts of intercalated siltstones. Locally some massive siltstones occur in the Gardeau, and member or formation names have been given to them, for example, Table Rock sandstone (Chadwick, 1933). Naming of such beds serves little purpose because they cannot be positively identified beyond their type exposure.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 393–394. Formation, in Batavia quadrangle, overlies Grimes sandstone and underlies Nunda sandstone. Table Rock sandstone not present in this area. Thickness 200 to 550 feet, thinning is westward.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Hall proposed name Gardeau for sequence of rocks between top of Cashaqua shale and base of his Portage group, later called Nunda group, which crops out along gorge of Genesee River in area that is now Letchworth Park. Gardeau is herein designated shale member of West Falls formation (new). In this report, Gardeau shale along gorge of Genesee River in Letchworth Park area includes rocks between top of Rhinestreet shale member and base of West Hill member. In Naples-Hammondsport area, overlies Grimes siltstone member. In westernmost outcrops, Gardeau intertonques with Angola shale member, and base is not sharply marked. Thickness 12 feet in western Wyoming County; 525 feet in vicinity of Letchworth Park; 350 feet at Naples.

Extensively exposed along Gardeau Reservation, Livingston and Wyoming Counties.

Gardena Intraglacial Substage

Pleistocene (Wisconsin): North-central United States.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 549. Name applied to Iowan-Tazewell intraglacial substage. Radiocarbon dates show deposition

of Iowan loess was completed about 1,700 years before advent of Tazewell glacier.

Name derived from village of Gardena, Tazewell County, Ill.

Garden City Formation

Garden City Limestone[1]

Lower and Middle Ordovician : Northern Utah and southeastern Idaho.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 408.

G. B. Richardson, 1941, U.S. Geol. Survey Bull., 923, p. 13, 14, 16. As originally defined, included succession of thick and thin beds of gray limestone approximately 1,000 feet thick lying between St. Charles limestone and Swan Peak quartzite. St. Charles is restricted to lower 400 feet (approximately) as defined by Walcott, and upper 900 feet (approximately) is included in Garden City limestone. Thickness of expanded Garden City 1,900 feet.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1135–1136. Thickness in Green Canyon, northeast of Logan, Utah, 1,400 feet. Deiss (1938) erred in attempt to redefine St. Charles formation in Blacksmith Fork section; the 258 feet of limestones and intercalated and intraformational conglomerates which he included at top of St. Charles is basal Garden City and contains Ordovician fossils.

R. J. Ross, Jr., 1949, Am. Jour. Sci., v. 247, no. 7, p. 472–491. Formation divided into two members: lower comprising approximately two-thirds of formation is composed of numerous alternations of interbedded and interlensed intraformational conglomerates, and crystalline, aphanitic and muddy limestones; and upper characterized by high content of chert nodules, stringers, and interbeds occurring for the most part in irregularly laminated limestone and dolomitic limestone. Thickness 1,200 feet on east to 1,800 feet on northwest of Logan quadrangle.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 26–30. Term extended into Stansbury Mountains where it is used for sequence of argillaceous limestones and dolomites that occur above Ajax limestone and below Fish Haven and Kanosh formations. Four units recognized (ascending): interbedded series of cherty limestone and dolomite; well-bedded medium-gray argillaceous limestone; interbedded, evenly bedded argillaceous limestone and shale or shaly limestone; and very cherty and sandy limestone. Thickness 1,100 to 1,300 feet.

U.S. Geological Survey currently designates the age of the Garden City Formation as Lower and Middle Ordovician.

Named for exposures in Garden City Canyon, Rich County, Utah.

Garden Creek Phyllite[1]

Cambrian(?) : Southern central Idaho.

Original reference: C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth).

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 11, 12, pl. 1. Composed exclusively of dark-gray or nearly black phyllite with silvery sericite on cleavage surfaces. Thickness several hundred feet; base not exposed. Underlies Bayhorse dolomite.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2140 (fig. 5). Middle Cambrian age shown on chart.

Named for Garden Creek on which Challis is located.

Garden Gulch Member (of Green River Formation)[1]

Eocene: Northwestern Colorado and northeastern Utah.

Original reference: W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168.

D. C. Duncan and N. M. Denson, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 94. Described in Garfield County, Colo., where it is essentially gray marlstone with some gray and brown shale and a few thin shales. Thickness 630 to 720 feet. Underlies Parachute Creek member; overlies Douglas Creek member. Parachute Creek, Garden Gulch, and Douglas Creek members interfinger with unit referred to as lower sandy member of Green River.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 102, 107–108. In this report, the Green River is considered to be middle Eocene in age.

F. M. Swain, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 130. Garden Gulch, where it is developed in Piceance Creek and eastern Unita Basin, is herein considered to represent lower part of Green River; Douglas Creek member is referred to unit termed Colton-Green River transition beds.

Named for exposures in buffs near mouth of Garden Gulch a tributary of Parachute Creek, in secs. 7 and 8, T. 6 S., R. 96 W., Garfield County, Colo.

Garden Island Formation

Lower Devonian: Northeastern Michigan.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv. Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 34, 35 (table 1), 73–80. Proposed for a dolomite and dolomitic limestone which occupies a position between Upper Silurian St. Ignace formation (new) and Middle Devonian Bois Blanc formation (new). Thickness at type locality probably not more than 3 feet; maximum thickness probably not more than 25 feet, and average thickness not more than 15 feet. Included in Deerpark group.

Type locality: On Garden Island, which is north of Beaver Island, in Lake Michigan. Underlies narrow belt of land having east-northeast trend across the island.

Garden Valley Formation

Permian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 67–68. Consists of four unnamed members: (1) a basal limestone; (2) one made up of conglomerate, sandstone, and shale; (3) a resistant siliceous conglomerate; and (4) a sequence of purple and red shales and conglomerates. Maximum thickness is about 3,000 feet. Overlies Vinini formation with angular unconformity. Permian(?).

U. S. Geological Survey currently considers this unit to be of Permian age.

Described from occurrence along east side of Garden Valley on western slope of Sulphur Spring Range, vicinity of Eureka, Eureka County.

Gardiner River Rhyolite-Basalt Complex

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1047–1052, pls. 2, 3. Term applied to complex that is part of the lava filling of a valley eroded in main mass of Yellowstone Plateau rhyolites. Includes Lodgepole rhyolite and Cataract basalt (both new). Younger than Meadow rhyolitic tuff (new); older than Elkhorn basalt and Sheepeaters basalt (both new).

Main body of complex lies 5 miles south of Mammoth Hot Springs and three-quarters mile down stream from Sevenmile Bridge at point where Gardiner River begins to descend its canyon on north side of plateau, Yellowstone Park.

Gardiners Clay[1]

Pleistocene: Southeastern New York (Long, Gardiners, and Fishers Islands) and islands of southern New England (Block, Nantucket, Marthas Vineyard, No Mans Land, and probably Cape Cod).

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

K. E. Lohman, 1939, U.S. Geol. Survey Prof. Paper 189–H, p. 229–235. Discussion of Pleistocene diatoms from Long Island. Because all species, with one exception, are represented in living floras in about the same latitude, an age no older than some interglacial stage of Pleistocene is indicated. Similarity of floras suggests contemporaneous deposition, and tentative correlation of Gardiners clay with Cape May formation of New Jersey is proposed.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 143–163. Gardiners clay in eastern Long Island is variable in thickness, lithology and fossil content. Foraminferal assemblage in clay is indicative of shallow water, probably brackish-water deposition and suggests a depositional environment similar to bays that fringe southern shore of Long Island today. Most abundant Foraminifera—those which might possibly be used as guide fossils—are *Elphidium clavatum* and *E. florentinae*. Clay, in western part of Long Island, overlies Jameco gravel; in eastern part, lies directly above Upper Cretaceous deposits (Magothy?). Described as bluish clay in central part of Long Island and as red and green clay near eastern end of island. At type locality, a succession of black, green, and red clays, 28 feet thick, merging upward into Jacob sand. Gardiners clay underlying Brookhaven area is a green-gray silty clay 10 to 20 feet thick. In general, zones of true clay are fossiliferous, and sand and gravel are not. Samples from wells of Riverhead Water District, about 10 miles northeast of Brookhaven Laboratory, reveal 11 feet of greenish fossiliferous Gardiners clay lying beneath 7 feet of fossiliferous sand and gravel and above 10 feet of fossiliferous sand and gravel. Microfaunal assemblage of the clay is almost identical with that of the two zones of sand. Surface of this predominantly coarse-grained fossiliferous zone in Riverhead is 70 feet below sea level. It is overlain by about 45 feet of unfossiliferous gray and brown clay which is overlain by about 50 feet of typical glacial sand. Many sections of the clay contain gravel, and some contain sand lenses. Fuller (1914, U.S. Geol. Survey Prof. Paper 82) reported outcrops of Gardiners clay beneath Jacob sand on north shore of Long Island at Roanoke Point and Jacobs Hill, 3 miles north of Riverhead.

Recent evidence indicates that Gardiners clay is 70 feet below sea level 3 miles south of Roanoke Point and Jacobs Hill. Because Gardiners clay seems to thin toward north and to grade into a shoreline sand and gravel facies, it is believed that clays described by Fuller are not part of Gardiners clay but are equivalent to 45-foot section of unfossiliferous clay that overlies the Gardiners in Riverhead area. Most recent work on Gardiners Island shows that beds called the interglacial Gardiners clay actually consist of two clays of entirely different origin. The upper part (probably red clay referred to by Fuller) is reddish-brown varved glacial clay, and lower part is predominantly green fossiliferous interglacial clay. The reddish-brown varved clay on Gardiners Island and the gray-brown clays at Roanoke Point and Jacobs Hill both grade upward into Jacob sand; perhaps these clays are correlative, as Fuller suggested. They are not part of the interglacial Gardiners clay but a younger glacial deposit.

Named for Gardiners Island, at east end of Long Island.

Gardison Limestone

Lower Mississippian: Central Utah.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 63, 65, 69 (fig. 3). Basal beds, which are conformable with underlying Fitchville formation (new), consist of 20 to 50 feet of coarse-grained, crossbedded black clastic dolomite; these are overlain by 200 to 250 feet of banded rock consisting of blue-gray fine-grained fossiliferous limestone in beds 2 to 4 inches thick with ¼ to ½ inch partings of tan to brownish-gray-weathering silty dolomite; upper part of unit consists of massive cliff forming beds of dolomite and limestone containing pods and lenses of white chert increasing in abundance upwards. Conformably underlies Deseret limestone; contact drawn at base of a black carbonaceous shale. Name credited to Morris and Lovering who applied name in East Tintic Mountains to body of dark limestone, most of which was originally included in Gardner dolomite and which in Wasatch Mountains has commonly been called Madison.

In Provo area, formation is well exposed in American Fork Canyon at several places along road between Timpanogos Cave National Monument and mouth of South Fork. Type locality and derivation of name not stated.

†Gardner Dolomite[1]

Lower Mississippian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

T. S. Lovering and others, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1506. Restricted to exclude beds now known to contain an Upper Devonian fauna. These beds are included in underlying Pinyon Peak limestone. The restricted Gardner is about 535 feet thick and contains lower Mississippian fossils in its basal bed.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 14. Name Madison limestone is preferred to name Gardner dolomite for rocks of Lower Mississippian age in East Tintic Mountains inasmuch as Gardner dolomite, as originally defined by Loughlin (1919), erroneously included some beds of Late Devonian age, and name was essentially restricted in its usage to East Tintic Mountains. Term Madison will be used as group name to include two new formations in report currently being prepared.

Names have not been officially adopted by U.S. Geological Survey, and, hence, are not used in present report.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 40–43. Described in Stansbury Mountains, Tooele County, where it consists of a lower member 200 to 650 feet thick and an upper member 475 to 1,110 feet thick. Underlies Pine Canyon formation; overlies Pinyon Peak limestone. Report states that U.S. Geological Survey has revised Mississippian nomenclature in Tintic district, but because names have not been officially proposed term Gardner is used in essentially same sense as applied by Lovering and others (1949, Econ. Geology Mon. 1). Gardner, as used in present report, includes all the Madison group of Morris (1957) except the upper cherty beds, which are mapped separately as basal unit of Pine Canyon formation.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 38–43, 46 (fig. 10), 155–157, pl. 1. Described in southern Oquirrh Mountains where it is about 812 feet thick and consists of two members: lower, 344 feet thick, chiefly dolomite; and upper, 468 feet, chiefly limestone with some chert at top. Lower member includes Gilluly's (1932, U.S. Geol. Survey Prof. Paper 173) Jefferson(?) dolomite; upper member includes approximately lower half of Gilluly's (1932) Madison. Disconformably overlies Opex formatiom (upper part of Lynch of Gilluly); stratigraphically above Stansbury formation; underlies Pine Canyon limestone which here includes some of upper strata of what Gilluly mapped as Madison. Described and mapped in Fivemile Pass and North Boulter Mountains quadrangles where it consists of lower and upper member. Name is used in preference to Madison.

First described in Tintic district where fossils were collected on spur west of Gardner Canyon.

Garfield Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Mining Jour.-Press, v. 115, p. 793–799, 836–843, maps.

R. J. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 6, 14, geol. map. Discussion of Galena-Roubaix district. In north and northwest parts of district, rocks which are described and mapped as Garfield and Northwestern formations, strike northwestward toward outcrops of Garfield and Northwestern formations in Lead district. They cannot be traced directly into Lead district because of Cambrian and Tertiary igneous cover. Formation characterized by graphitic slates. Overlies Northwestern formation; underlies Pluma formation. In Lead system.

Occurs in Lead district, Lawrence County.

Garfield Formation[1]

Pennsylvanian: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 66.

R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 559. Crawford's (1913) Garfield formation includes Belden, Gothic, and possibly some Maroon, and is defined in an area of rather intense metamorphism. These factors make its interpretation uncertain and its usage undesirable.

Named for Garfield, Chaffee County.

Garfield Member (of Muldoon Formation)

Upper Mississippian: Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Underlies Iron Mine member (new); overlies Copper Creek member (new).

Deposited in Muldoon trough, aligned N. 30° W.

Garfield Sandstone (in Chester Group)[1]

Mississippian: Western central Kentucky.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908 and 1909, p. 79, 84.

Named for Garfield, Breckinridge County.

Garim Limestone

Pleistocene: Caroline Islands (Garim, island off Yap)

Risaburo Tayama, 1935, Topography, geology, and coral reefs of the Yap Islands: Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 19, p. 27–29 [English translation in library of U.S. Geol. Survey, p. 24–25]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 63, table 4 [English translation in library of U.S. Geol. Survey, p. 74]. Hard white limestone that resembles Mariana limestone. Primarily coral limestone and secondarily *Halimeda* limestone. Believed to overlap Tomil agglomerate nonconformably, though contact not observed.

Constitutes Garim Island and Irikku Island at southern extremity of Yap proper.

†Garland Conglomerate (in Pottsville Formation)[1]

Pennsylvanian: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38, 45–46.

At Garland quarries, about 1 mile northwest of Garland, Warren County.

Garland Peak Syenite

Carboniferous(?): East-central New Hampshire.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 377, 389, 400. A small pluglike body of light- to dark-gray, yellow-weathering syenite. Contains many needlelike grains of amphibole, increasing in quantity toward margin causing darker appearance. Irregular texture. Belongs to White Mountain magma series.

Best exposed on Garland Peak, a hill on east side of Red Hill, Carroll County. Also crops out in area southwest of the peak.

Garley Canyon Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 438.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (column 38). As shown on correlation chart, occurs near middle of formation stratigraphically above Ferron sandstone member and below Emery sandstone member.

Named for exposures in Garley Canyon, Carbon County.

Garlock Series

Permian: Southern California.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1), 15–19, pls. 1, 2, 3. Thick series of slightly metamorphosed Paleozoic sediments and volcanics, in part if not all of Permian age. About 22,000 feet of section exposed; possibility of repetition by isoclinal folding within the section, or even by strike faulting, should not be overlooked. Occurs as a large inclusion within a granitic batholith. Shown on columnar section as underlying unnamed quartzite conglomerate and hornfels below newly defined Goler formation and overlying newly named Mesquite schist.

Crops out in northeastern part of El Paso Mountains, Saltdale quadrangle, Kern County. Exposed continuously from Mesquite Canyon northeastward, striking about N. 20° W., across mountains and dipping steeply to the northwest.

Garnavillo Member (of Guttenberg Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9. Shown on columnar section as basal member of Guttenberg formation. Underlies Glenhaven member (new); overlies Spechts Ferry formation or where Spechts Ferry is absent, the Strawbridge member (new) of Quimbys Mill formation.

In copy of guidebook used by compiler, in fig. 3, the name Glenhaven had been crossed out and the name Garnet written in. However, in figure 9, the name Garnet had been used to replace the name Garnavillo. Since compiler had no way to determine what changes, if any, had been made in other copies of the guidebook, it was impossible to be certain which names should be retained.

Occurs in Dixon-Oregon area.

Garner Formation (in Strawn Group)[1]

Garner Formation (in Lone Camp Group)

Middle Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 108.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to Lone Camp group (new).

R. J. Cordell and others, 1954, Abilene Geol. Soc. Guidebook, Field Trip Nov. 19–20, p. 6 (fig. 2). Suggested revision on basis of faunal break in Brazos River sandstone member; upper part of Brazos River sandstone reallocated to base of East Mountain shale.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 20, fig. 3, pl. 1. Underlies East Mountain formation; overlies Grindstone Creek formation. Type section established; section is chosen where the best and most nearly continuous exposure occurs; approximately basal 45 feet of formation not exposed at type section, and section does not exhibit a thin coal seam or lensing limestones present in other localities. Rank designations suggested by Cheney (1940) are accepted in this paper.

Type section: Along the Millsap to Mineral Wells Highway as it ascends scarp 2½ miles west of Millsap, Parker County. Name derived from town of Garner.

Garnet Member (of Guttenberg Formation)

See Glenhaven Member and Garnavillo Member of Guttenberg Formation.

Garner Mountain Andesite

Pliocene: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 261–262. Dark-colored fine-grained porphyry in which glassy plagioclase phenocrysts are only easily determined component.

Occurs on Garner Mountain in Modoc Lava-Bed quadrangle.

Garnet Canyon Tongue (of Sanup Plateau Member of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 92. Rusty-brown or snuff-colored dolomite unit. Grades laterally into limestone to the west and into clastic sediments toward the east. Thickness averages about 12 feet. Older than Lava Falls tongue (new); younger than Elves Chasm tongue (new).

Upper of two very conspicuous dolomite units which form low but persistent cliffs from Garnet Canyon to Hermit Creek in eastern Grand Canyon.

Garnet Mountain Andesite

Probably lapsus for Garner Mountain Andesite.

Garnet Range Formation[1] } (in Missoula Group)
Garnet Range Quartzite }

Precambrian (Belt Series): Central western Montana.

Original reference: C. H. Clapp and C. F. Deiss, 1921, Geol. Soc. America Bull., v. 42, p. 681, figs. 2, 3.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 25, Sheet 1, Formation underlies Sheep Mountain quartzite and overlies McNamara formation, all in Missoula group.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. In Bonner quadrangle Montana, Garnet Range quartzite overlies McNamara argillite and underlies Pilcher quartzite (new).

Type locality: On north side of Blackfoot Canyon from Johnson Gulch 2 miles east of Bonner eastward to 1 mile from mouth of West Twin Creek. Blackfoot Canyon forms northwest boundary of Garnet Range, the western part of which is composed largely of rocks of Garnet Range formation, Missoula to Helena region.

Garnett Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 110, 120–121.

Named for Garnett, Anderson County.

Garnuan series[1]

Precambrian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 7.

Garo Sandstone

Jurassic(?) : Central Colorado.

D. B. Gould and others, 1947, Rocky Mountain Assoc. Geologists Guidebook Field Conf., June 16–19, p. 39 (road log). Name applied to yellow sandstone that underlies Morrison; has been mapped as Dakota sandstone by some workers.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 47–48, 160, pl. 1. Except for basal beds, which are coarse and in a few localities conglomeratic, consists of medium- to fine-grained sandstone. Color varies from red, pink, white, cream, gray, to brownish gray; generally red to the north and lighter to the south. Beds massive; crossbedding on large scale is especially characteristic. Thickness varies: 409 feet at Badger Spring near type locality; 132 feet at Red Hill; 85 feet west of Hartsel; 10 to 12 feet southeast of Hartsel. Unconformably overlies Maroon formation but locally overlaps on Precambrian; separated by unconformity from Morrison, generally regarded as Upper Jurassic. Nonfossiliferous.

Named from exposures in sec. 36, T. 11 S., R. 76 W., near town of Garo, Park County. Also present in fault block north of Hartsel.

Garrard Sandstone (in Eden Group)[1]

Garrard Sandstone Member (of Eden Formation)

Garrard Siltstone Member (of Maysville Formation)

Upper Ordovician : Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 2.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 17. Garrard sandstone member present in upper part of Eden formation in southern Fayette and Jessamine Counties.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Referred to as Garrard siltstone member of Maysville formation.

W. H. Twenhofel and others, 1954, Geol. Soc America Bull., v. 65, no. 3, chart 2 (column 44). Shown on correlation chart as Garrard siltstone.

Named for Garrard County.

Garren Group

Tertiary : Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Term proposed to embrace Tertiary extrusive rocks of the area (Wylie Mountains and vicinity) which consist of up to 2,500 feet of lava rock and tuff. Consists of seven formations (ascending) : Hogeye tuff, Pantera trachyte porphyry, Moon trachyte, Fairbury trachyte, Means trachyte, Zopilote breccia, and Bell Valley andesite (all new). Lies with marked angular unconformity upon unevenly eroded Cretaceous and Permiun strata; overlain by bolson deposits.

Group constitutes eroded northwest portion of Davis Mountains volcanic field in Wylie Mountains, Culberson and Jeff Davis Counties. Name taken from Guy Garren Ranch, on which all but the youngest formation are exposed.

Garrett conglomerate[1]

Lower Cretaceous (Comanche Series) : Northeastern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 7.

Derivation of name not stated.

Garrett Mill Sandstone Member (of Warsaw Formation)[1]

Upper Mississippian : North-central Tennessee and southeastern Kentucky.

Original reference: C. Butts, 1922, Kentucky Geol. Survey, ser. 6, v. 7, p. 89, 107, 122.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 15, 16, 212, 227, pl. 6. Throughout Kentucky belt, Butts (1922) identified three members of the Warsaw (ascending) : Wildie sandstone, Somerset shale, and Garrett Mill sandstone. Wildie sandstone of Butts is included in Wildie siltstone member of Muldraugh formation (new); Somerset shale is member of Salem formation; Garrett Mill sandstone of Butts is in upper part of Salem.

Named for exposures at Garrett Mill, on Eagle Creek, 3 miles north-northeast of Livingston, Overton County, Tenn.

Garrett Ranch Volcanic Group

Oligocene(?) : East-central Nevada.

W. M. Winfrey, Jr., 1958, Am. Assoc. Petroleum Geologists Rocky Mountain Sec., Geol. Rec., p. 77–78, 79 (fig. 2). Unconformably overlies Eocene Sheep Pass formation (new). Consists of basal conglomerate followed by volcanics (welded tuff and flows).

Egan Range, White Pine County.

†Garrison Shale (in Council Grove Group)[1]

Permian : Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 712.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12). In diagram showing comparison of old and revised classification of beds referred to lower part of Big Blue series of "Permian" age, Garrison shale is replaced by (ascending) Beattie limestone (includes Florena and Morrill limestone members), Stearns shale, Bader limestone (includes Eiss limestone, Hooser shale, and Middleburg limestone members), Easly Creek shale, Bigelow limestone (includes Crouse limestone, Blue Rapids shale, and Funston limestone members), and Speiser shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 103–105. As used in this report, Garrison shale is top unit of Council Grove group. Includes beds upward from top of Cottonwood limestone to base of Wreford limestone. Name was discarded by Moore (1936) who raised various members of Garrison formation to formation rank. Formations constituting Garrison section in Kansas cannot be identified in Pawnee County, and general term Garrison shale has been retained. Interval consists of poorly exposed heterogeneous sequence of red shales and red to tan lenticular sandstones. Thickness difficult to determine. About 140 feet in subsurface, slightly west of outcrop.

Named for exposures at Garrison, Pottawatomie County, Kans.

Gartra Grit Member (of Ankareh Formation)

Gartra Grit Member (of Stanaker Formation)

Upper Triassic: Northeastern Utah and northwestern Colorado.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1260 (fig. 2), 1271–1274. Name applied to basal conglomerate of Stanaker formation (new). Along south flank of Uinta Mountains, from Weber River to Skull Creek, and at Vermillion Creek, member is gray, poorly sorted coarse-grained felspathic quartz grit with sporadic quartz pebbles as large as 1 inch in diameter. At Manila, on north flank of mountains, consists of lenses of purplish-red crossbedded sandstone. Thickness 18 to 88 feet. At type locality, overlies Woodside shale.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 8), 180. Reallocated to member status in Ankareh formation. Overlies Mahogany member (new); underlies Stanaker member.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 101–104. Discussion of Triassic sequence in Wasatch and Uinta Mountains. Names Gartra and Stanaker considered unnecessary. Terms Shinarump(?) and Chinle preferred.

S. S. Oriel and L. C. Craig, 1960, Guide to the geology of Colorado: Rocky Mountain Assoc. Geologists, p. 43, 48. Because Shinarump member of Chinle formation is now known to be of far more limited extent than formerly believed, name is not applied to rocks in northwestern Colorado. Name Gartra grit seems more suitable. Not determined whether name should be given member or formation status because status of name Ankareh in northwestern Colorado is not yet settled.

Type section: At point where Vernal-Manila Highway crosses Brush Creek, about 10 miles north of Vernal, in north part of sec. 5, T. 3 S., R. 22 E., Uintah County, Utah. Name derived from Gartra Spring, sec. 11, T. 2 S., R. 21 E.

Garukiyoku Limestone

See Ngarekeukl Limestone.

Garzas Beds, Sandstone, or Formation (in Orestimba Group)

Upper Cretaceous: California.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Moreno group is faunally and lithologically divisible into Moreno beds below and Garas [Garzas] beds above. Chico series.

A. S. Huey, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 335. Cretaceous in Tesla quadrangle consists of Upper Horsetown, Chico, Panoche, Moreno, and Garzas. The Garzas formation is fossiliferous sandstone differentiated from top of Moreno.

F. M. Anderson, 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 395 [1939]. Orestimba group begins with stratigraphic unit of unique character as described by Anderson and Pack (1915) who termed it "Moreno formation." Its sediments are largely organic. This shaly unit has thickness of 2,000 feet, which in district of Orestimba Creek is overlain by 3,000 feet or more of sandy formation, termed Garzas from next important stream south of the Orestimba.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 185 (fig. 69), 186 [preprint 1941]. Moreno group, highest division of Chico series, is 5,000 feet or more thick on west side of San Joaquin Valley, and includes

three stages, Moreno, Quinto, and Garzas. Garzas member, highest part of Moreno group, is near top of Cretaceous succession.

L. I. Briggs, Jr., 1953, California Univ. Pub. Geol. Sci., v. 29, no. 8, p. 421. In eastern part of Diablo Range, the Upper Cretaceous sequence (Chico series) has been subdivided into two formations: Panoche at base and Moreno shale at top. North of Pacheco Pass, a third unit, Garzas sandstone, overlies the Moreno, and this formation can be traced for some 20 miles.

Named for exposures on Garzas Creek, Stanislaus and Merced Counties.

Gasconade Dolomite[1]

Lower Ordovician: Eastern and central Missouri.

Original reference: F. L. Nason, 1892, Missouri Geol. Survey, v. 2, p. vii, 12, 93, 114–115, pl. 3.

O. R. Grawe, 1954, Missouri Geol. Survey and Water Resources, 2d ser., v. 30, p. 52 (fig. 2), 55–57. Basal part of formation contains pebbles of chert and sometimes of Precambrian igneous rocks derived from older formation, but commonly it is marked by sandstone or sandy dolomite, 15 to 25 feet thick. This basal zone is known as Gunter. It is overlain by 80 to 125 feet of thin- to medium-bedded cherty dolomite which in some Missouri Survey reports is referred to as Van Buren formation, and this in turn is overlain by massively bedded cherty dolomite, 141 to 200 feet thick. In those reports in which term Van Buren formation is used, term Gasconade is restricted to this upper cherty dolomite. In present report, term Gasconade is used in its earlier unrestricted sense to include all strata between the Eminence and the Roubidoux.

R. D. Knight, 1954, Missouri Geol. Survey and Water Resources Rept. Inv. 17, p. 57. Includes Gunter member at base. Term Van Buren not used. Lower Ordovician.

Named for exposures on Gasconade River, central Missouri.

Gasconadian Series or Stage

Ordovician (Canadian): North America.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 18. Divisions within Canadian system favor natural division into four major units: Gasconadian, Demingian, Jeffersonian, and Cassinian. Gasconadian includes equivalents of the Van Buren and Gasconade of Ozark region, and their equivalents. Recognizable in general are: (1) an initial phase, often restricted geographically, with rather local faunas: (2) widespread beds of Gasconade in restricted sense; (3) late beds comprising *Kainella* zone, known as yet only from Cordilleran region. This division is late Ozarkian of Ulrich, with reservation that the Gasconade and Tribes Hill are equivalents and not successive intervals of deposition. Classification based principally on cephalopod distribution.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–32. Canadian series includes Gasconadian, Demingian, Jeffersonian, and Cassinian stages.

†Gasper Formation or Oolite (in Chester Group)[1]

Upper Mississippian: Kentucky, northern Alabama, northwestern Georgia, and southwestern Virginia.

Original reference: C. Butts, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, pt. 1, p. 64–84.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 374–381. In Virginia, the Gasper limestone lies between Ste. Genevieve limestone be-

low and Glen Dean limestone or Bluefield shale above, as along northwest belt of Appalachian Valley, or between Ste. Genevieve limestone and Fido limestone, as in Greendale syncline. Thickness 1,025 feet northwest of Greendale, Washington County; 515 feet northeast of Bluefield, W. Va.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 828. From Todd County to Grayson County, Ky., Bethel sandstone is absent, and Renault and Paint Creek formations together form limestone unit that cannot be easily subdivided. Name Gasper has been used for this limestone, but persistent miscorrelation has resulted in such confusion that name is no longer useful. These beds are now known as Girkin limestone.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 164–169. Butts (1917) named Gasper limestone from exposures in Warren County, Ky. Sutton and Weller stated that Gasper is unsuitable formation name because it was never adequately defined nor was its type locality clearly indicated. In this report [Burkes Garden quadrangle], name Gasper is used in tentative sense for limestones above the "Ste. Genevieve" and below Bluefield shale. Average thickness 425 feet. Chester series.

Charles Butts, 1948, Georgia Geol. Survey Bull. 54, p. 42, 46–47. Geographically extended into northwestern Georgia where, at north end of Lookout Mountain, it is about 100 feet thick and consists of a thick-bedded gray, rather coarsely crystalline limestone. Overlies Ste. Genevieve limestone; underlies Golconda limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 163, chart 5. Type Gasper appears to consist of both Renault and Paint Creek strata; type Ohara consists of the Levias member of the Ste. Genevieve and the Renault formation; thus the two names overlap.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Wagnon member of Pride Mountain formation (both new) includes the lower part of the strata referred to by Butts (1926, Alabama Geol. Survey Spec. Rept. 14) as Gasper formation.

Named for exposures in bluffs along Gasper River, Warren County, Ky.

Gasport Limestone Member (of Lockport Dolomite)[1]

Gasport Limestone (in Lockport Group)

Middle Silurian: Western New York, and Ontario, Canada.

Original reference: E. M. Kindle, 1913, U.S. Geol. Survey Geol. Atlas, Folio 190.

E. R. Cumings, 1939, Geologie der Erde, North America, v. 1, p. 596 (fig. 7), 597. Basal member of Lockport. Underlies Suspension Bridge member (new); overlies Decew. Thickness 15 feet.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Member of Lockport formation. Overlies DeCew waterlime member; underlies Goat Island member (replaces preoccupied name Suspension Bridge).

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Basal formation in Lockport group. Underlies Goat Island limestone; overlies Decew dolomite. Lockportian stage. Middle Silurian.

Named for exposures at Gasport, Niagara County, N.Y.

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Gasport shaly channel[1] (in Lockport Limestone)

Silurian: Western New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 265, p. 5–14.

Gassaway Member (of Chattanooga Shale)

Gassaway Formation (in Chattanooga Shale)

Upper Devonian: Northern Tennessee, north-central Alabama, and central southern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 881, 884, 886, pl. 2. Hard slaty fissile black shale with conspicuous joints, abundant *Lingula melie*, conodonts, and small fish scales; contains conspicuous phosphatic nodules at different levels. Thickness varies from 9 to 13½ feet north and east of the basin, except in Macon County where it is 5 feet; here total thickness of Chattanooga is only 13 feet. Includes Bransford sandstone member (new) at base. Underlies Eulie shale (new); overlies Dowelltown formation (new); at type section underlies Maury shale which in this area is about 8 inches thick. Mississippian.

S. W. Maher, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1363. Referred to as upper member of Chattanooga shale. Contains numerous sandstone beds and a series of thinly laminated siltstones.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 20–23. Member is chiefly a thin-bedded grayish-black shale, though along part of Eastern Highland Rim it can be subdivided into two black shale units and an intervening thin zone consisting of gray mudstone and black shale. Thickness between 12 to 21 feet along Eastern Highland Rim; thinner in south-central Tennessee and north-central Alabama; about 46 feet in Pulaski, Ky. Overlies Dowelltown member. Contains two distinct conodont faunas. Upper Devonian.

Type locality: On Highway 63, 5 miles south of Gassaway, Cannon County, Tenn.

Gassetts Schist[1]

Upper Cambrian(?): Southeastern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 210, 225.

Crops out at Gassetts, Ludlow quadrangle, in northern part of Chester Township, Windsor County.

Gastineau Volcanic Group[1]

Upper Triassic: Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 92, 247, chart opposite p. 120.

Named for Gastineau Peak, Juneau region.

Gatecliff Formation

Silurian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in report on Paleozoic continental margin in central Nevada. Overlies Perkins Canyon formation (new), Pogonip formation, or Caesar Canyon formation (new); underlies Masket formation (new).

Toquima Range, Nye County.

Gates Limestone[1]

Silurian: Western New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 335, 356, 358, 359, 360, 361, 364.

H. L. Alling, 1946, Rochester Acad. Sci. Proc., v. 9, no. 1, p. 52–53. Term Gates, in sense proposed by Chadwick, is a formation, for he says it is separated from the Rochester [restricted] below. Gates is a rock facies, and the retention of the name as a formation or a member of the Rochester is deemed inadvisable.

Named for town in Monroe County.

Gatesburg Formation[1]

Upper Cambrian: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 527, 534, 537.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 281–303. Stratigraphically expanded upward to include Mines dolomite (Butts, 1918) as uppermost member. As thus expanded, includes (ascending) Stacy dolomite member, lower sandy member, Ore Hill dolomite member, upper sandy member, and Mines dolomite member. Thickness about 1,700 to 1,800 feet. Overlies Warrior limestone; relation to overlying beds is obscure because upper contact of Mines member is not exposed but probably unconformably underlies Ordovician Larke dolomite or its limestone facies, the Stonehenge formation. Gatesburg rock types grade southeastward into the Conococheague-type limestone over a distance of about 40 miles; younger sediments cover the transition beds except in a small area along axis of a reverse-faulted anticline in Fulton County.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 8. Thick-bedded bluish, coarsely crystalline dolomite, with interbedded quartzite layers up to 10 feet thick. Includes Stacy dolomite member at base and Ore Hill limestone member near middle. Underlies Mines formation. Overlies Warrior formation.

Named for Gatesburg Ridge, Centre County.

Gatesville Formation (in Fredericksburg Group)[1]

Lower Cretaceous (Comanche Series): North-central Texas.

Original reference: S. A. Thompson, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 10, p. 1508, 1530, 1531–1533, 1536.

F. E. Lozo and others, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, p. 3 (fig. 2), 5–6. Formation mentioned in symposium on Edwards limestone in central Texas.

Type locality: Near State Training School for Boys, north of Gatesville, Coryell County.

Gateway Formation[1]

Precambrian (Belt Series): Northwestern Montana, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 2, 3, 4.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1899. Discussion of Belt series in Glacier Park region. In MacDonald and Galton Ranges of British Columbia, Daly describes 2,025 feet of Gateway (equivalent to Sheppard) strata, which the writers [Fenton and

Fenton] group into two members as follows: sandstone, 125 feet; and siliceous thin-bedded light-gray to greenish-gray argillite, 1,850 feet.

Named for exposures on heights east of Gateway, Mont.

Gateway Granodiorite

[Cretaceous]: Eastern California.

J. F. Everden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2123 (fig. 2). Shown on map in paper dealing with potassium-argon dating of igneous rocks. Age shown on map legend as 92.9 millions of years. Younger than Arch Rock granite; older than El Capitan granite. [Calkins (1930, U.S. Geol. Survey Prof. Paper 160) referred to granodiorite at the Gateway. Compiler was unable to locate reference to Gateway granodiorite.]

Occurs in Yosemite National Park.

Gateway Canyon Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 105–109. At type locality, consists of thin beds of mottled, aphanitic limestone separated by parting planes of yellow-brown siltstone. Thickness 137 feet. Base determined by weak zone which everywhere forms bench at top of Kanab Canyon member. Upper limit indicated by flat-pebble conglomerate zone at bottom of overlying cliff. Westward from type locality to and beyond Granite Park, member fairly constant in character; beds become thicker, and silt partings less numerous, but total thickness remains about the same. From Diamond Creek westward, however, marker beds at base are absent, and member cannot be differentiated from lithologically similar underlying units. Eastward from Gateway Canyon, member is progressively less massive, contains more clastic materials, and is thinner bedded. Older than Havasu member (new); younger than Kanab Canyon member (new).

Type locality: At mouth of Gateway Canyon in east-central Grand Canyon.

Gatún Formation[1]

Miocene, middle and upper: Panamá.

Original reference: E. Howe, 1907, Isthmian Canal Comm. Rept., app. E., p. 113–114.

H. N. Coryell and Suzanna Fields, 1937, Am. Mus. Novitates no. 956, p. 1. At Cativa, includes Cativa marl (new) in lower part.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 42–47, 51 (fig. 4), pl. 1. Chiefly massive medium to very fine grained sandstone and siltstone. Estimated thickness at least 500 meters. On faunal basis, divided into lower, middle, and upper parts; lower part not represented at type region; middle part includes best known strata. Overlies Caimito formation with contact covered by waters of Gatún Lake; farther east, overlaps Caimito and lies directly on Cretaceous(?) basement; underlies Chagres sandstone. Lower and middle Miocene. Gatún formation was named by Howe (1907). Hill (1898, Harvard Coll. Mus. Comp. Zool. Bull., v. 28, no. 5) had used names Monkey Hill formation and Mindi Hill beds. Howe used both Gatún formation and Monkey Hill formation in structure section, and in later publication (1908, Am. Jour. Sci., 4th ser., v. 26, p. 228) used only Monkey Hill formation. MacDonald's usage (1913,

Isthmian Canal Comm. Ann. Rept., 1913, app. S., p. 530) apparently established preference of Howe's name. Howe (1907) excluded oldest strata near Garun from Gatún formation and grouped them into Bohió formation. It is now known that oldest outcropping part of formation is not represented in type region.

Type area: From Gatún to Mount Hope (Monkey Hill of Howe's time), C.Z.

Gatuna Formation

Pleistocene: Southeastern New Mexico.

W. B. Lang, 1938, *in* T. W. Robinson and W. B. Lang, New Mexico State Engineer 12th–13th Bienn. Rept., p. 84–85 [1939]. Name given to an assemblage of rocks of various kinds that were laid down in Pecos Valley in post-High Plains time and apparently after completion of maximum cycle of erosion. Terrestrial; fine red sand dominant; conglomerates, stream gravels, gypsum, limestone also present; gray, purplish, and red. Mantles many places to depth of only a few feet; more than 100 feet in Pierce Canyon; may exceed 300 feet at head of Cedar Canyon. Overlies Rustler formation.

Name derived from Gatuna Canyon, northeastern Eddy County, N. Mex.

Gatuncillo Formation

Gatuncillo Shale

Eocene, middle and upper: Panamá.

T. F. Thompson, 1944, Geological explorations in the vicinity of Rio Quebrancha for the Panamá Cement Company: Panamá Spec. Eng. Div., p. 12–13. Gatuncillo shale consists of thick sequence of soft, finely bedded, uniformly fine, and even grained yellowish-gray or buff-colored shales and impure bentonite beds with occasional thin siltstone layers. Overlies basement complex. Older than Quebrancha limestone (new). Many forms of microfossils are related to those identified from the so-called Tranquilla shales of upper Eocene age, which formerly cropped out within Madden Reservoir basin now inundated.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 227–228, 246 (fig. 2). Gatuncillo formation, in type region, consists chiefly of mudstone, siltstone, impure bentonite, and thin lenses of limestone. Unless it is duplicated by faults, which would be difficult to detect, its thickness is as much as 3,000 feet. Unconformably overlies basement complex; underlies Bohío formation. Upper Eocene. Name Tranquilla shale was proposed for late Eocene strata in Madden basin (Coryell and Embich, 1937). That name was inadequately defined and specified type locality is now flooded by Madden Lake.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 13–22, 51, 56, 148. Middle and upper Eocene.

Type region: Quebrancha syncline.

Gavilan Peak Gabbro

Jurassic(?): Southern California.

E. F. Osborn, 1939, Geol. Soc. America Bull., v. 50, no. 6, p. 1925–1926. Dark, massive, medium to coarse grained, and hypidiomorphic. Intrudes schist believed to be Triassic.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. Listed as oldest of late Mesozoic plutonics in Riverside-Elsinore-Coahuila area. Older than Virginia quartz norite.

Occurs in Perris fault block, Riverside County.

Gaviota Formation[1]

Gaviota Stage

Eocene or Oligocene: Southern California.

Original reference: W. L. Effinger, 1935, Pan-Am. Geologist, v. 65, no. 1, p. 75.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 868–871. Defined as a stage based on faunal assemblages. Covers an interval at top of marine Eocene sequence above Tejon stage.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, fig. 14. Gaviota formation shown in Refugian stage (Oligocene).

F. R. Kelley, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 1, p. 3 (fig. 2), 6. In Canada de Santa Anita area, Santa Ynez Mountains, overlies Sacate formation (new).

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 29–30, 38 (fig. 2), pls. 1–6. Type Gaviota formation (west of Las Cruces) is about 1,600 feet thick and consists of three members, each about 500 feet thick. Lower member is a massive soft gray siltstone; middle member is light-buff thick-bedded well-sorted fine- to medium-grained concretionary sandstone; upper member a gray sandy siltstone with some interbedded fine-grained sandstone. Conformably underlies Sacate formation; conformably overlies Alegria formation (new). Oligocene.

Type locality: Canada de Santa Anita west of Gaviota Pass, Santa Barbara County.

Gay Hill terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg., p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Gay Hill is proposed for a terrace and terrace deposit of siliceous gravel at elevation of 372 feet in Fayette County. Younger than the Willis (herein considered to be Pleistocene); older than Bastrop Park (new) terrace deposit.

Named from Gay Hill cemetery. Exposed north of Colorado River, 6 miles northeast of Colorado County line, and along La Grange-Columbus Highway.

Gaylord Mountain Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 126, pl. 1–b, 11. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined, but stratigraphic position of Gaylord Mountain, Sierra Grande, Purvine Mesa, and Dunchee Hill is not known. Gaylord Mountain is younger than Purvine Mesa.

Gaylord Mountain (also known as Carr Mountain) is an irregularly eroded cone, 4 miles east of Folsom, Union County.

Gaysport cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 140–143. Embraces interval between Ames cyclothem (new) below and Duquesne cyclothem (new) above. An incomplete cyclothem. Includes (ascending) Gaysport shale and (or) sandstone and Gaysport limestone members. Thickness about 13 feet. In area of this report, the Conemaugh series is discussed on a cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Athens County.

Gaysport Member (of Conemaugh Formation)[1]

Gaysport limestone member

Pennsylvanian: Southeastern Ohio.

Original reference: W. Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 258.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 29, 32. In this report, the Conemaugh is considered a series, and the Gaysport is referred to both as a limestone and a member.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 55–56. Gaysport is a thin sandy limestone which is discontinuous in Morgan County [this report]. Average thickness about 4 inches. Occurs from 16 to 23 feet above Ames limestone and about 10 to 15 feet below Skelley limestone. Interval between Gaysport and Skelley is the position of Duquesne shale, clay, and coal member of geologic column of Ohio. Conemaugh series.

M. T. Sturgeon and others, 1958. Ohio Geol. Survey Bull. 57, p. 94 (table 11), 142–143, 144. Gaysport limestone included in Gaysport cyclothem (new). Separated from underlying Ames limestone by unit referred to as Gaysport shale and (or) sandstone member of cyclothem. Gaysport limestone as used in this report [Athens County] may be a split from Ames limestone. Conemaugh series.

Well developed in vicinity of Gaysport, Bluerock Township, Muskingum County.

Gazelle Formation

Silurian and Lower Devonian: Northern California.

F. G. Wells, G. W. Walker, and C. W. Merriam, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 646–649. Name applied to a sequence of clastic rocks with included limestone reefs. Consists essentially of hard fine-grained siliceous graywacke, dark-gray to black siltstone and mudstone, and siliceous and feldspathic grit; also contains appreciable quantities of chert, conglomerate, limestone, and limestone conglomerate. Five members have been distinguished (ascending): dark-gray to black siliceous mudstone—600 feet; graywacke—1,000 feet; black siliceous mudstone and green shale—300 feet; limestone lenses in chert conglomerate—500 feet; and siltstone, sandstone, and volcanic debris—200 feet. In most places in continuous exposures, one or more of these members is lacking or poorly exposed, and all vary markedly in thickness. Total thickness exceeds 2,400 feet. Formation is in fault contact with older Duzel formation (new) on the north, south, and west sides; on the east side, locally overlain by Devonian sedimentary and volcanic rocks and has been intruded by diorite and peridotite.

Michael Churkin, Jr., and R L. Langenheim, Jr., 1960, Am. Jour. Sci., v. 258, no. 4, p. 259 (fig. 1), 260–266. Described in Yreka quadrangle, Siskiyou County, where it is 85 to 713 feet thick and subdivided to include Payton Ranch limestone member at top. Member is 75 to 188 feet thick. Some outcrops of formation west of Payton Ranch limestone exposures are possibly younger than the member. Formation is interbedded sequence of shale, sandstone, bedded chert, conglomerate, limestone, and tuff; shale and sandstone predominate, but lateral gradation from one lithologic type to another is widespread; bedded chert, conglomerate, and limestone occur abundantly as discontinuous lenses and layers; one outcrop of andesitic lapilli tuff is only evidence of volcanic rock noted in formation in area. Base unexposed; folded thrust fault brings metamorphic rocks into contact with Gazelle. Contains trilobite and brachiopod fauna. Formation crops out in central part of area and forms east-west trending ridge between North and Middle Branches of Willow Creek.

U.S. Geological Survey designates the age of the Gazelle Formation as Silurian and Lower Devonian on the basis of a study now in progress.

Crops out in Siskiyou County in valley of East Fork of Scott River, across the Gazelle Mountain, and throughout northern part of valley of Willow Creek, and area of about 60 square miles.

Gazley Creek Sands and Clays[1]

Eocene: Southern central Texas.

Original reference: W. A. Price and K. V. W. Palmer, 1928, Jour. Paleontology, v. 2, p. 22.

Occurs on south bank of Colorado River at mouth of Gazley Creek, in western edge of Smithville, Bastrop County.

†Gebo Formation[1]

Upper Cretaceous: Northwestern Wyoming.

Original reference: D. F. Hewett, 1914, U.S. Geol. Survey Bull. 541, p. 91, 100.

Named for Gebo, near Thermopolis, Park County.

Geddes Limestone

Middle Cambrian: Eastern Nevada.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining ser., no. 31, p. 13, 20–23, fig. 3. Proposed for flaggy limestone beds between Eldorado dolomite and overlying paper shale of Secret Canyon formation; both contacts sharp. Bluish gray, moderately fine grained. Where unweathered, rock is black owing to carbonaceous impurities. Beds vary from ½ inch to 12 inches in thickness, most being 2 to 6 inches. Thickness about 335 feet. Unit complicated by faulting. Tentatively assigned to early Middle Cambrian.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 11–12, pl. 2. Described in stratigraphic section in vicinity of Eureka. Contact with Eldorado dolomite appears to be gradational, although in places this may result from folding or faulting rather than interlayering. On northwest nose of Prospect Ridge, the two formations interfinger; here a bed of massive limestone 10 or more feet thick and resembling beds of Eldorado can be mapped within Geddes near its base. Upper contact not well exposed, but appears to be sharp. Wheeler and Lemmon (1939) section referred to as type locality.

Type locality: Geddes and Bertrand mine, in Secret Canyon. Exposed as band of variable width east of outcrop of Eldorado dolomite, from south end of Secret Canyon, north along east side of Prospect Ridge as far as Diamond Tunnel of Diamond mine; occurs in two bands on either side of Mineral Hill from Eureka Tunnel at head of Goodwin Canyon nearly to Ruby Hill.

Geers Corners Gabbro

Precambrian: Northeastern New York.

A. F. Buddington, 1936, 16th Internat. Geol. Cong. Rept., v. 1, p. 348; 1939, Geol. Soc. America Mem. 7, p. 57, 59, 61. Banded gabbro that varies from place to place in composition and texture. Locally, there are repeated composite bands about 1 inch thick consisting successively, from bottom to top, of pyroxenite, gabbro, and anorthosite. The banding, as well as the foliation of surrounding country rock, indicate the nose of a syncline pitching west and having steep limbs.

Occurs at Geers Corners, 2½ miles north-northwest of Harrisville, Lake Bonaparte quadrangle, Lewis County.

Geertson Formation

Oligocene, upper, or Miocene, lower: Eastern central Idaho.

A. L. Anderson, 1957, Idaho Bur. Mines and Geology Pamph. 112, p. 13, 14, 17–18, pl. 1. Consists of light-colored shaly beds with some intercalated bentonite, sandy shales, sandstones, and pebble conglomerate and locally thin beds of impure lignite. Beds of pebble conglomerate are thin, discontinuous, but rather numerous and widespread in formation northeast of Lemhi River. No such pebble beds observed southwest of river. Thickness is some hundreds of feet. Rests unconformably on each of the other Tertiary formations described in Baker quadrangle and is overlain unconformably by Carmen formation.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 26–27. Thickness about 800 feet in North Fork quadrangle, Lemhi County. In area of this report, formation is almost entirely conglomerate with minor thin partings of sandy shale. Formation passes unconformably under Kirtley formation (new name to replace preoccupied Carmen) and spreads unconformably over eroded surface of Kriley (new) and Kenney formations and Challis volcanics. Late Oligocene or early Miocene.

Named for Geertson Creek along which more or less typical exposures are to be found. Confined to Lemhi Valley, Lemhi County.

Geiser Quarry Member (of Dutchtown Formation)

Lower Ordovician: Southeastern Missouri.

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 1, p. 18–19. Name applied to middle member of formation; lower and upper members unnamed. Consists of dark-brown to black argillaceous limestone; calcareous hard platy and fissile shale; calcareous siltstone; locally contains light-colored finely crystalline limestone with fine but distinct granular texture. Thickness about 10 feet.

Well exposed in abandoned quarry on Arnold Geiser Farm in southeast portion of U.S. Survey 214, approximately SW cor. NW¼NW¼ sec. 20, T. 30 N., R. 13 E., Cape Girardeau County.

Gem Hill Formation (in Tropico Group)

Miocene(?) : Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 138 (fig. 2), 140. Name applied to lower unit of group in Rosamond district. Consists mainly of stratified light-colored rhyolitic lithic tuff, tuff-breccia, tuffaceous sandstone, volcanic agglomerate, and some conglomerates of both volcanic and granitic clasts; locally, thin basalt flows at or near the top. Thickness at Gem Hill 1,250 feet; at Antelope Buttes about 1,200 feet; thinner elsewhere. Overlies quartz monzonite; underlies Fiss fanglomerate (new), contact gradational at Gem Hill and sharp, locally unconformable contact elsewhere. In Soledad Mountains, includes Bobtail quartz latite member (new) at base.

Type locality: Gem Hill, in S½ sec. 25, SE¼ sec. 26, and NE¼ sec. 35, T. 10 N., R. 13 W., San Bernardino Base and Meridan, 5½ miles northwest of Rosamond, Rosamond quadrangle, Kern County. Exposed nearly continuously from Gem Hill southeastward 7 miles to Red Hill; other exposures at Little Buttes, Middle Buttes, Soledad Mountain, and ridge north of Bissell.

Gemini Limestone[1]

Ordovician : Central northern Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

Probably named for Gemini mine, Tintic district.

Gemuk Group

Carboniferous(?) to Lower Cretaceous : Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 27–34, pl. 1. Chiefly dense dark massive siltstone, with which are interbedded smaller amounts of chert and volcanic rock, and thin interbeds of limestone, graywacke, and breccia. Siltstone and breccia beds made up of fragments unsorted as to size. Volcanic rocks chiefly of andesitic lava. Exposed part estimated to be 15,000 to 25.000 feet thick. A good section favorable for determinations of thickness occurs along Cinnabar Creek, comprises chiefly massive siltstone, 10,000 to 15,000 feet thick above and between 5,000 to 10,000 feet of thinly bedded siltstone below. Conformably underlies Kuskokwim group (new). Carboniferous(?), Permian(?), Triassic, and Lower Cretaceous.

J. M. Hoare and W. L. Coonrad, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–285. Rocks of Gemuk group in lower Kuskokwim region have yielded sparse fossil collections ranging in age from Mississippian(?) to Early Cretaceous. Thickness 15,000 to 25,000 feet. Map bracket shows age Carboniferous(?) to Cretaceous.

Type locality and also most favorable exposures lie north of lower middle course of Gemuk River. Rocks crop out in several irregular areas near axis of Kuskokwim Mountains southwest of Kuskokwim River. Largest mapped area of group extends northward about 15 miles from northwest side of Gemuk River valley into drainage basins of Atsaksovluk and Chikululnuk Creeks, and thence northeastward about 15 miles into headwater area of main fork of Holokuk River.

Gene Autry Shale

Pennsylvanian (Morrow Series) : South-central Oklahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum Geology of Southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2), 99–101. Uniformly soft clayey shale, gray to light gray; yellow-brown to red and maroon ferruginous concretions along bedding planes; contains one fossiliferous concretionary lentil, 2 or 3 feet thick, about 105 feet below what is considered top of formation. Thickness at type locality about 700 feet; dip almost vertical. Overlies Primrose sandstone; top is taken as base of concretionary fossiliferous lentil which is correlated with Jolliff formation.

Type section: North and west of center of NW¼ sec. 34, T. 3 S., R. 4 E., Carter County. Exposed in a series of ravines on both sides of Santa Fe Railroad track, about 2 miles north of town of Gene Autry.

Genesee Formation

Genesee Group[1]

Genesee Member (of Jennings Formation)

Middle and Upper Devonian: New York, Maryland, Pennsylvania, and West Virginia.

Original reference: L. Vanuxem, 1842, Geology of New York, pt. 3, p. 168–169.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, pl. 3. Columnar section shows Genesee group comprises (ascending) Geneseo shale with Genundewa limestone lentil, Standish flagstone, and West River shale. Overlies Tully limestone of Hamilton group; underlies Middlesex shale.

R. L. Bates, 1939, Virginia Geol. Survey Bull. 51–B. p. 41 (table 1), 62–63, pl. 6. In Lee County, entire Genesee formation consists of fissile coal black shale. Thickness about 200 feet. Overlies Helderberg formation; underlies Portage formation.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 385, 390. Genesee group not now recognized in outcrop area. Unit previously called "Genesee black shale" appears to be southwestern extension of Harrell shale of central Pennsylvania, and this term is considered appropriate for outcrops in West Virginia.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 41–76. Group, traced westward from Lake Erie, changes facies in central Finger Lakes region. In western New York, Geneseo and West River shales form lower and upper units. Sherburne-type rocks penetrate the West River of Finger Lakes region, and intertonguing units are named Penn Yan and Milo tongues of West River and Starkey tongue of the Sherburne. Term Genundewa is abandoned. Name Sherburne includes rocks between top of Penn Yan tongue and base of Middle Middlesex remnant in Cayuga Valley. Term Genesee group is used to include interval from base of Geneseo shale to base of Middlesex shale from Lake Erie to Cayuga Lake. To the east, the formational divisions do not correspond to those of western New York, and for all practical purposes Genesee group ends at Cayuga Lake. Overlies Tully limestone. Group is in Senecan series. An attempt to apply Caster's (1934, Bulls. Am. Paleontology, v. 21, no. 71) system of facies classification to Genesee rocks was not wholly successful.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 90, 99 (table 4). Member of Jennings formation. Consists of black fissile argillaceous shale. Thickness 90 to 100 feet, west of Wills Mountain near Cumberland; thins eastward and disappears before it reaches Washington County. Underlies Woodmont member; overlies Romney formation.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 381–386, pl. 1. In Batavia quadrangle, Genesee group comprises Geneseo formation and West River shale. Overlies Leicester marcasite member (new) of Moscow formation; underlies Middlesex black shale of Naples group.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2810–2828. Genesee group of Chadwick (1935) is here called Genesee formation. Includes all rocks between top of Tully limestone—or top of Moscow shale of Hamilton group where the Tully is absent—and base of Middlesex member of Sonyea formation in western half of New York. Formation is composed of seven intertonguing facies which are designated as members. In vicinity of Canandaigua Lake and Genesee River valley, formation consists of (ascending) Geneseo shale, Penn Yan shale, Genundewa limestone, and West River shale members. At Cayuga Lake, 30 miles east, comprises (ascending) Geneseo shale, Penn Yan shale, Sherburne flagstone, Renwick shale, Ithaca, and West River shale members. Top of formation is about 600 feet higher stratigraphically than top of Genesee group of previous workers. Thickness at reference section (herein designated) 125 feet; 850 to 940 feet near Ithaca; 595 feet near Sheldrake Creek on west side Cayuga Lake.

W. H. Hass, 1959, (abs.) Geol. Soc. America Bull., v. 70, no. 12, pt. 2, p. 1615. Discussion of conodont faunas from Devonian of New York and Pennsylvania. Parts of Geneseo shale [member of Genesee] placed in Middle Devonian. Leicester marcasite regarded as transgressive basal bed of Genesee formation; Leicester oldest east of Canandaigua where de Witt, Colton, and writer [Hass] found it above Tully limestone and youngest in western New York, where on Eighteen Mile Creek, Erie County, it includes Hinde's (1879, [Geol. Soc. London Quart. Jour., v. 35]) "Conondont bed"; its fauna there is mixture of high Middle and low Upper Devonian (pre-Genundewa and Genundewa) conodonts.

Reference section: At Beards Creek, near Leicester, western Livingston County. Named for exposures along Genesee River and valley, New York, especially in gorge of Genesee River below Portage.

Genesee Valley Limestone and Shales[1]

Triassic: Northern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, chart opposite p. 220.

Name probably derived from occurrence in Genesee Valley, east of Genesee, Plumas County.

Geneseo Shale Member (of Genesee Formation)

Geneseo Shale (in Genesee Group)[1]

Middle and Upper Devonian: New York.

Original reference: G. H. Chadwick, 1920, Geol. Soc. America Bull., v. 31, p. 118.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 47 (fig. 2), 54–59. Basal formation of Genesee group. Extends from Lake Erie to

Cayuga Lake, beyond which its black shale facies is recognized as far as Chenango Valley. East of Cayuga Lake, upper part of the Geneseo grades laterally into the coarser facies characterizing the higher beds; the black shale facies thins and disappears a short distance east of Chenango Valley. Formation thickens from a 2-inch sliver at Lake Erie to 125 feet at Cayuga Lake; thins eastward from this meridian to 40 feet at Cayuga Lake. Underlies Penn Yan tongue (new) of West River shale. Overlies Tully limestone.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Asso. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2816–2818, 2820. The 44 feet of black shale that overlies Moscow shale of Hamilton group in Menteth Gully, on west side of Canandaigua Lake 14 miles north of Naples, comprises Geneseo shale member of Genesee formation as defined in this paper. At reference section, herein designated, consists of homogeneous black shale and brownish-black shale containing a few layers of argillaceous limestone concretions 7 inches to 3 feet in diameter. Name Geneseo shale was proposed by Chadwick for exposures of about 82 feet of very dark gray calcareous mudrock and irregularly fissile shale containing some beds of black shale, many limestone concretions, and layers of nodular limestone in vicinity of Fall Brook. The Geneseo member is herein restricted at Fall Brook locality to a 5-foot tongue of black shale at the base and a 5-foot tongue of black shale 26 to 31 feet above the base of the 82-foot sequence. The lighter colored and less fissile rocks, which were originally included in the Geneseo by Chadwick, are herein placed in lower part of Penn Yan shale between and above tongues of the Geneseo shale member. The two tongues of black shale that comprise the Geneseo member at Fall Brook thicken eastward and coalesce near Hemlock Lake about 10 miles east of Geneseo. Member thins westward from about 45 feet at Canandaigua Lake to feather-edge in eastern Erie County. Thickness 113 to 135 feet at Cayuga Lake. Overlies Tully limestone.

W. H. Hass, 1959, (abs.) Geol. Soc. America Bull., v. 70, no. 12, pt. 2, p. 1615. Discussion of conodont faunas from Devonian of New York and part of Geneseo shale [member of Genesee formation] placed in Middle Devonian. Determination made on basis of conodont faunas.

Reference section: In Menteth Gully, on west side of Canandaigua Lake 14 miles north of Naples, Ontario County. Named for exposures at Fall Brook, 1½ miles south of Geneseo, Livingston County.

Geneva Limestone[1] **or Dolomite**

Middle Devonian: Central and southeastern Indiana.

Original reference: J. Collette, 1882, Indiana Dept. Geology and Nat. History 11th Ann. Rept., p. 63, 81, 82.

D. G. Sutton and A. H. Sutton, 1937, Jour. Geology, v. 45, no. 3, p. 331. Geneva is northward facies of Jeffersonville formation of Onondaga age as shown by Onondaga faunules of Jeffersonville which continue into Geneva at same horizons and by lateral transition from dolomitic Geneva to purer Jeffersonville limestone. Term Jeffersonville is synonym of Geneva, and by custom of priority latter name should be applied to all Indiana rocks of Onondaga age.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Lower or Middle Devonian.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 37–38, pl. 1. Indiana Geological Survey uses name Geneva dolomite. Consists of buff to chocolate-brown granular thin-bedded to massive dolomite and contains white crystalline calcite masses that range from a fraction of an inch to more than 1 foot in cross section; carbonaceous material present in bands and partings. From Shelby, Rush, and Bartholomew Counties, where maximum thickness is 35 feet, Geneva thins regularly southward to its pinchout in northern Clark County. In most places, overlies Louisville limestone but locally overlies Waldron shale or Laurel limestone; throughout southern Indiana, outcrop underlies Jeffersonville limestone; relationship to lower Jeffersonville not clear from Jennings County northward, but recent data prove that middle and upper Jeffersonville maintain their characteristics throughout this area and overlie the Geneva.

Named for Geneva, Shelby County.

†Geneva Quartzite[1]

Lower Ordovician: Northeastern Utah.

Original reference: E. Blackwelder, 1910, Geol. Soc. America Bull., v. 21, p. 519, 526–527, 542.

Well exposed in northern part of Wasatch Range.

†Geneva Sands[1]

Pleistocene: Southeastern Alabama and Georgia.

Original reference: E. A. Smith, 1894, Alabama Geol. Survey geol. map of Alabama, explanatory chart.

Probably named for Geneva or Geneva County, southeastern Alabama.

†Genevieve Group[1]

Mississippian: Missouri.

Original reference: H. S. Williams, 1891, U.S. Geol. Survey Bull. 80, p. 169.

Named for exposures in Ste. Genevieve County.

Gennet Creek Formation (in Chester Group)[1]

Mississippian: Southwestern Indiana.

Original reference: M. A. Harrell, 1935, Indiana Dept. Conserv. Pub. no. 133, p. 78.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 839. In Indiana, the Clore limestone is known as Gennet Creek formation and consists of 10 to 35 feet of predominantly shaly beds.

C. A. Malott, 1952, Stratigraphy of Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Name Clore limestone extended into Indiana and applied to shale and limestone interval underlying Degonia sandstone and overlying Palestine sandstone. [This appears to be interval to which name Gennet Creek was applied].

Type locality and derivation of name not given.

Genoa Member (of Oneota Formation)

Lower Ordovician: Southwestern Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 88–90, 91–92. Comprises two divisions, the lower of which is light buff, or buffy mottled

dolomite commonly in beds 2 to 3 feet thick. Beds are dull in lustre, compact, homogeneous, and generally finely crystalline. Many of the strata studded with globose, nut-size cavities, horizontal burrows conspicuous in many beds, and chert nodules, in rows parallel to bedding at a few localities. Ripple marks at one locality. Thickness ranges from 8 feet in north to 29 feet in south. Upper division of white, dull, homogeneous, and finely crystalline dolomite, which readily breaks to flagstone slabs 2 to 6 inches thick. Nut-sized cavities generally present. Thickness ranges from 3 feet in north to more than 8 feet in south. Thickness of member ranges from 11 feet in northeast to 46 feet in southwest part of quadrangle. Underlies Stoddard member (new) with transitional contact; overlies Mount Ridge member (new).

Type section: Quarry and Mississippi bluff in NE¼SE¼ sec. 32, T. 13 N., R. 7 W., Stoddard quadrangle, 1 mile south of Genoa, Vernon County.

Genshaw Formation[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci., Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin and G. A. Cooper *in* G. A. Cooper and others. 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1762, chart 4. Originally proposed for thin limestones and shales between Ferron Point formation and Killians limestone. Recent work has shown that black limestone of Killians facies appears in the Genshaw. Therefore, Genshaw is redefined to include the Killians and lower 15 feet of Alpena limestone which contains many Genshaw species.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 582–584. Redefined Genshaw described in Thunder Bay region where composite section shows thickness of 116 feet. Killians limestone is excellent horizon marker in region and is here considered a named member of the Genshaw. Underlies Newton Creek limestone; overlies Ferron Point formation. Included in Traverse group.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists, Bull., v. 31, no. 3, p. 448 (fig. 1), 451–453. Described in Afton-Onaway area where top is represented by Killians black limestone member. Separated from overlying Koehler limestone (new) by an interval which includes a buff limestone referable, possibly to the Newton Creek. Six faunal zones recognized in formation in area. Overlies Ferron Point formation.

Type locality: NE¼ T. 32 N., R. 8 E., Alpena County. Name derived from Genshaw School in SE¼ sec. 13.

Gent facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 178–184.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 2. Mississippian facies nomenclature discussed. Correlation chart lists Gent facies of Carwood formation. Includes Lampkins sandstone member of Carwood.

Named from an old inland post office, Gent, located on a now abandoned part of Bloomington-Brownstown Road at middle of east line of NE¼ sec. 27, T. 8 N., R. 1 E., 9 miles east of Bloomington, Monroe County.

Gentile Valley Group[1]

Tertiary, upper, or Pleistocene: Southwestern Idaho.

Original reference: A. C. Peale, 1879, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 612, 642, map.

In Portneuf Canyon, on east side of Cache Valley, and in Gentile Valley.

Gentry Coal Member (of Caseyville Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 44 (table 1), 61, pl. 1. Name applied to member of Caseyville (redefined). Overlies Sellers limestone member; underlies Pounds sandstone member. Thickness 2 feet in type section of Caseyville. Owen (1856) termed this Battery Rock coal, but Battery Rock has been more widely used for the sandstone and is so restricted in this report. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Sec. 26, T. 11 S., R. 10 E., southwestern Hardin County.

Genundewa Limestone Member (of Genesee Formation)

Genundewa Limestone Lentil (of Geneseo Shale)[1]

Genundewa Limestone Member (of Geneseo Formation)

Upper Devonian: Western and west-central New York.

Original reference; J. M. Clarke, 1897, New York State Geologist 15th Ann. Rept.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 9, 10, pl. 3. Limestone lentil at top of Geneseo shale. Underlies West River shale. A bed of black, very dark gray limestone, in most places less than 1 foot thick. At Firtree Point, on west shore of Seneca Lake, abnormally thick.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 45. Term Genundewa abandoned because beds to which it refers are not considered a formation but rather a discontinuous shell limestone facies of the West River. These lenses are referred to as the *Styliolina* or pteropod facies of the West River. Impure limestone layers overlying the Geneseo in Seneca-Cayuga Lake region have been called Genundewa. They differ in lithology from the *Styliolina* beds to west and are discussed as limy facies of Penn Yan tongue (new) of West River.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 384. Referred to as limestone member of Geneseo formation.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815 2816, 2817 (fig. 4), 2818–2819, 2827. Redefined as member of Genesee formation. In type area, composed of about 12 feet of nodular layers of dark-gray fossiliferous limestone 1 to 10 inches thick interbedded with dark-gray calcareous shale. A few thin beds of black shale present. Thins toward west and locally absent near Lake Erie; thins toward east and grades laterally into Crosby sandstone in southeastern Ontario County. Overlies Penn

Yan shale member and underlies West River shale member at reference section of Genesee; thickness 3 feet. The Genundewa at Canandaigua Lake is lateral equivalent of Crosby sandstone of Torrey and others (1932) at Keuka Lake and is tentatively correlated with Williams Brook coquinite of Caster (1933) at Williams Brook near south end of Cayuga Lake.

Typically exposed at Genundewa Point, locally spelled Genundewah, on east side of Canandaigua Lake, about 9 miles north of Naples.

Geode Creek Basalt

Miocene and (or) Pliocene: Northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 19–21, 78 (table 9), pl. 4. Olivine basalt, with labradorite and augite. Characteristically massive, but locally may be highly vesicular. Weathers into stubby plates, up to 1 foot in length. Contains no secondary silica. Gray color and fine texture in contrast to color and texture of Crescent Hill basalt (new). Northern exposure about 60 feet high. Lies unconformably on unnamed breccia.

Exposed in two small patches, one east of Geode Creek and other about 1 mile northwest of Crescent Hill, Yellowstone National Park. The southern patch, the higher of the two, reaches elevation between 7,300 and 7,400 feet.

Georges Fork Sandstone Member (of Atoka Formation)[1]

Middle Pennsylvanian: Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 29. Composed of thin to massively bedded sandstone. Thickness 35 feet at type locality. Separated by unnamed shale intervals from underlying Pope Chapel member and overlying Dirty Creek member.

Named for exposure east of Georges Fork, in secs. 24 and 25, T. 22 N., R. 19 E., Muskogee County.

Georgetown Limestone (in Washita Group)[1]

Georgetown Group or Subgroup

Lower Cretaceous (Comanche Series): Central and southern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Geol. Atlas, Folio 64.

T. L. Bailey, F. G. Evans, and W. S. Adkins, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 172–173. Washita group in Tyler basin is divided into eight stratigraphic units which can be traced in the subsurface. Except for Maness shale, which is not known at outcrop, and the Buda, which has been found at surface only as far north as southern Denton County, outcrop belts of each of the units in northeast Texas are readily mappable. Each unit is given formational rank, following Adkins and others (1933, Texas Univ. Bull. 3232). Lower five units are lumped into the Georgetown, which is here recognized as a subgroup. In central Texas where it is only 60 to 100 feet thick and where most of marls that separate the interval into mappable units are missing, it becomes an undifferentiated subgroup or formation and is called Georgetown limestone. Subgroup comprises (ascending) Duck Creek formation, Fort

Worth limestone, Denton shale, Weno formation, Pawpaw formation, and Main Street limestone.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 11 (table 1), 25–26, 27. In Eagle Mountains area, formation consists of interbedded blue-gray shales and black limestone at least 800 feet thick. Overlies Kiamichi formation; underlies Carpenter limestone member (new) of Grayson formation.

F. E. Lozo and others, 1959, Texas Univ. Bur. Econ. Geology Pub. 5909, p. 3–4, 15–18, 122–130. Discussed in symposium on Edwards limestone. Formation includes (ascending) Duck Creek, Fort Worth, Denton, Weno, Pawpaw, and Main Street members. Overlies Kiamichi formation; underlies Grayson formation.

Named for Georgetown, Williamson County.

Georgia Slate[1]

Lower Ordovician: Northwestern Vermont.

Original reference: Edward Hitchcock, 1861, Vermont Geologist Rept., v. 1, p. 357-386.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1014, 1021, 1025, 1045, 1052. Overlies Rockledge breccia (new). Upper Cambrian.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 550. In previous publications, names Georgia slate, Corliss breccia, Grandge slate, and upper Gorge formation have been used for Ordovician rocks in St. Albans area. In present report, name Georgia slate is abandoned because Walcott's name for Lower and Upper Cambrian rocks should not be extended to lower Ordovician.

Named for town of Georgia, Franklin County.

†Georgian Series[1] or Epoch[1]

Lower Cambrian: North America.

Original reference: C. D. Walcott, 1891, U.S. Geol. Survey Bull. 81, p. 360.

A. B. Shaw, 1954, Geol. Soc. America Bull., v. 65, no. 11, p. 1046. Walcott (1891, U.S. Geol. Survey 10th Ann. Rept., pt. 1) used name *Olenellus* zone essentially in sense of series term after he had established correct relative positions of *Olenellus* and *Paradoxides* faunas. Later, he (1891) applied name Georgian series to Lower Cambrian, referring to standard section described by him (1886, U.S. Geol. Survey Bull. 30) west of Georgia Center, Vt. Name Georgian was replaced by Waucoban series (Walcott, 1912) because Georgian was at that time also used for a formation, Georgia slate. Section at Waucoba has been studied recently. Believed that, in view of present state of knowledge, the Waucoba section is not a satisfactory standard. Term Georgian should be reinstated for the following reasons: (1) Georgia section, as opposed to that at Waucoba Springs, is well known, and its contained fossils are properly located stratigraphically. (2) Fauna of Georgia section, and especially of Parker slate, is varied and abundant. Fossils are not common and do not seem to be so varied in most of Waucoba section. (3) Name Georgian is no longer used for any other stratigraphic unit. [Georgia slate abandoned in this report.]

Named for section at west of Georgia Center, Vt.

Gering Formation[1] **or Sandstone** (in Arikaree Group)

Gering facies (of Monroe Creek Formation)

Miocene: Western Nebraska and southeastern Wyoming.

Original reference: N. H. Darton, 1898, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 735, 747–755.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, no. 210, p. 441–444. Arikaree group redefined to include Gering formation as basal unit. Underlies Monroe Creek formation.

C. B. Schultz and T. M. Stout, 1941, Guide for a field conference on the Tertiary and Pleistocene of Nebraska: Nebraska Univ. State Mus. Spec. Pub., p. 28. In most places, formation is disconformable on upper Oligocene Whitney member of Brule formation, and change in lithology from massive clay to gray or grayish-blue sand is commonly quite pronounced.

L. K. Wenzel, R. C. Cady, and H. A. Waite, 1946, U.S. Geol. Survey Water-Supply Paper 943, p. 70–72, pl. 2. Formation described in Scotts Bluff County where it is primarily a fine soft gray sandstone, strongly laminated and locally crossbedded. Occupies channel cut in upper surface of Brule formation. Maximum thickness about 200 feet, 6 miles south-southwest of Gering; thins toward the south and southwest and toward the north and northeast. Overlying Monroe Creek and Harrison formations cannot be distinguished in this area.

R. C. Cady and O. J. Scherer, 1946, U.S. Geol. Survey Water-Supply Paper 969, p. 20. Referred to as Gering sandstone.

P. O. McGrew, 1953, Wyoming Geol. Soc. Assoc. Guidebook 8th Ann. Field Conf., p. 62 (chart), 63. Geographically extended into southeastern Wyoming.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 46, fig. 10. Bayard paleosol complex caps top of Whitney member of Brule formation and extends into Gering formation in Castle Rock section near Bayard.

S. G. Collins, 1960, Geology of the Patricia quadrangle (1:62,500): South Dakota Geol. Survey. Monroe Creek formation includes two mappable facies tentatively correlated with Gering channel sand and Mellette limestone.

Well developed southwest of Gering, Scotts Bluff County, Nebr.

†Gerlane Formation[1]

Pleistocene: South-central Kansas.

Original reference: G. L. Knight, 1934, Geol. Soc. America Proc. 1933, p. 91.

J. C. Frye, 1945, Jour. Geology, v. 53, no. 2, p. 91–92. Term Gerlane formation has been applied to Pleistocene beds only in Barber County. These deposits underlie floor of lowland surface that extends westward as far as eastern Meade County: topographically below Tertiary-capped upland to north. Deposits similar to the Gerlane occur in Clark County and eastern Meade County, Kans., and in Beaver and Harper Counties, Okla. These deposits, loosely referred to as Ashland-Englewood terrace beds, are shown by their physiographic relations and fauna to be late Pleistocene in age, but their exact correlation with named formations in Meade Basin and elsewhere in central and western Kansas is unknown. Age and stratigraphic relations of Gerlane formation and associated beds are problems for further study.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Name appears in list of units that consist in part or entirely of deposits known to be of Illinoian or younger age and that are properly classed, at least in part, as Sanborn formation.

Type locality: Near Gerlane, Barber County.

Germania Formation (in Chadakoin Group)

Germania Formation (in Conneaut Group)

Germania Member (of Chadakoin Formation)

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 1), 47–50. Uppermost formation in Conneaut group. Overlies Whitesville formation (new); underlies Wolf Creek member of Cattaraugus formation. Thickness about 70 feet. Consists of thin green sandstones interbedded with red shales, with the "Catskill" crossbedded sandstone and conglomerate beds at different horizons, varying with the locality. Base of formation is recognized by the red color of the soil marking the earliest appearance of the real reds of the "Catskill."

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 15. Upper member of Chadakoin formation. Overlies Whitesville member; underlies basal Wolf Creek (Panama) member of Cattaraugus formation.

L. V. Rickard, 1957, New York State Geol. Assoc. [Guidebook] 29th Ann, Mtg., p. 17 (table 2), 19. Uppermost formation in Chadakoin group. Inasmuch as Upper Devonian strata are still not thoroughly understood, a more or less permanent classification satisfactory to a majority of workers may not be obtained for some time.

Type outcrop: On south flank of Marshfield anticline, near Germania, Potter County, Pa. Can be traced over most of Wellsville quadrangle, Allegany County, N.Y.

Germer Tuffaceous Member (of Challis Volcanics)[1]

Oligocene, upper, or Miocene, lower: Southern central Idaho.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

A. L. Anderson [1949], Idaho Bur. Mines and Geology Pamph. 83, p. 9. In most places, Germer member is interbedded with and overlies the flows of the basal latite-andesite member, but in Yankee Fork district it is in part stratigraphically equivalent to the flows and in part older.

Named for Germer Basin, on south side of Salmon River, nearly opposite mouth of Bayhorse Creek, Custer County.

Gerome Andesite[1]

Oligocene: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 98, map.

U.S. Geological Survey currently considers the Gerome Andesite to be Oligocene in age.

Named for exposures near town of Gerome, Stevens County.

†Geronimo Series[1]

Pennsylvanian(?): Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 140–141.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Named for Apache chief and thus not a geographic name.

Sequence occurs in Wichita Mountain region.

Gerster Formation[1] **or Limestone** (in Park City Group)

Permian: Western Utah.

Original references: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432; 1935, U.S. Geol. Survey Prof. Paper 177, p. 39–41.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2183 (fig. 5), 2184–2185. Termed Gerster limestone. Assigned to Park City group in Confusion Range where it is highest Permian unit. Overlies Plympton formation (new); underlies Thaynes formation. Consists almost entirely of resistant ledge-forming light-brownish-gray limestone interbedded with slope-forming yellowish-gray or rusty-brown argillaceous limestone; most limestone beds bioclastic. Aggregate thickness about 1,100 feet.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 91–113. Nolan (1935) placed lower contact of the Gerster at top of "Oquirrh formation," and upper contact at base of overlying Triassic limestone and shales. As determined in present study, lower 170 feet of Nolan's Gerster formation is lithologically equivalent to Kaibab formation. Would seem appropriate to restrict the Gerster to those limestones above gray cherty carbonates of the Kaibab. The Gerster appears to grade laterally into shales and cherts of the Phosphoria as the unit is traced north and northwest to Leach Mountains and Burnt Canyon Range. At several localities west of Gold Hill, upper contact of the Gerster is placed at base of a chert pebble conglomerate sequence believed to correlate with third member of Nolan's Garden Valley formation. Upper Guadalupian.

Named for exposures in Gerster Gulch, in northwestern corner Gold Hill quadrangle, Tooele County.

Gerty Sand[1]

Pleistocene: Southeastern Oklahoma.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 439.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Pleistocene.

O. D. Weaver, Jr., 1954, Oklahoma Geol. Survey Bull. 70, p. 85–88. Averages 35 feet thick across Hughes County. Typically reaches maximum of 40 feet in central parts of its outcrop. Overlies Pennsylvanian sandstones and shales.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 115. Validity of the Gerty, as anything more than a terrace level in Seminole County, questioned. Farther to southeast, geomorphic evidence lends support to Gerty concept.

Named for Gerty (formerly spelled Guertie), Hughes County.

Getaway Limestone Member (of Cherry Canyon Formation)

Permian (Guadalupe Series): Western Texas.

P. B. King *in* A. K. Miller and W. M. Furnish, 1940, Geol. Soc. America Spec. Paper 26, p. 9. Incidental mention.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 580, 585 (fig. 7), pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 35–36, pl. 3 [1949]. Consists of black or dark-gray limestone, with some lighter gray granular very fossiliferous limestone and some sandstone partings. Locally 200 feet thick; in some areas, feathers out. Lies 100 to 200 feet above base of formation: lies below South Wells limestone member which in turn lies about 600 feet above base of formation.

Type locality: Getaway Gap, 6 miles southeast of Guadalupe Peak and 6 miles southeast of El Capitan, Culberson County.

Getmuna Rhyolite Group

Paleocene(?) to Miocene(?): Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 50–53, pl. 1. Tuff comprises major part of formation though some lava crops out in small tract of about 3 square miles at southwest end of area in which group is exposed. Tuff beds and lava flows are rhyolitic. Lava is light purplish brown; weathered surface is buff colored. Tuff is mottled with contrasting light and dark shades of the fragmental materials; weathered surface is more uniform buff color. At least 500 feet thick. Maximum thickness estimated to be about 1,500 feet. Believed to cover folded and dissected Kuskokwim group (new) and to postdate Iditarod basalt (new). Probably older and extends beneath Holokuk basalt (new) exposed nearby.

Named for Getmuna Creek in central Kuskokwim region. Occupies elongate area, about 15 square miles north of Horn Mountains, that trends northeast across middle course of Getmuna Creek, a southwestern tributary of Crooked Creek.

Getsuyoto Beds or Formation

See Getuyoto Beds or Formation.

Gettysburg Shale (in Newark Group)[1]

Gettysburg sandstone lithofacies

Upper Triassic: Southern Pennsylvania and central Maryland.

Original reference: A. I. Jonas, 1926, Pennsylvania Geol. Survey Topog. and Geol. Atlas 178, p. 17, New Holland sheet.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. C–67, p. 115–120. Gettysburg shale, upper formation of Newark group, consists of red shale and red sandstone, with lenticular zone near base containing thick beds of conglomerate herein named Conewago conglomerate member, a series of hard gray sandstone near middle, called Heidlersburg member, and beds of limestone and conglomerate and quartzose fanglomerate at top. Thickness 15,500 to 18,100 feet. Overlies New Oxford formation.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties Rept. Geographically extended to Maryland.

D. B. McLaughlin and R. C. Gerhard, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 136, 137. Termed sandstone lithofacies in Lebanon and Lancaster Counties, southeastern Pennsylvania. Includes Furnace Ridge conglomerate (new) in lower part, sandstone units at bottom, middle, and top, and a second conglomerate unit below the top sandstone. Conspicuous changes

in lithology along strike. Interfingers with New Oxford subarkosic lithofacies and is the northern and generally overlying unit; transition marked by extensive interbedding of feldspathic and nonfeldspathic sandstones.

M. E. Kauffman, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., Oct. 22–23, p. 23. Formation comprises Elizabeth Furnace conglomerate member at base and shale member at top. Upper Triassic.

Named for exposures at Gettysburg, Adams County, Pa.

Getuyoto Beds or Formation

Miocene: Caroline Islands (Truk).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 69, table 5 [English translation in library of U.S. Geol. Survey, p. 84]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 29. Getuyoto (Getsuyoto) beds (formation) of Truk are included in East Caroline beds (formation).

†Geuda salt measures (in Sumner Group)[1]

Permian: Eastern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 1–48.

Named for town of Geuda Springs, Sumner County.

Geuda Springs Shale Member (of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5, 12–14. Thick sequence of drab and bluish-grey shales and clays and anhydrite. Not well exposed; only a few feet at any one place. Thickness 230 feet (based on core sample). Includes three claystone layers which occasionally become limestones and can be traced for some distance along the strike; these are here named Prairie Creek, Sanitorium, and Udall limestone lentils. Underlies Annelly gypsum member (new); overlies Hollenberg limestone member (new).

Type locality: At sanitorium half a mile east of Geuda Springs, sec. 7, T. 34 S., R. 3 E.

Geyser Bentonite Bed (in Colorado Formation)

Cretaceous: Southwestern Montana.

Great Northern Railway Co. Mineral Research and Development Department, 1960, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 12, pt. 2, p. 33–38, 41. Bed divided into two parts: lower bentonite member 3 to 16 feet thick, displaying "popcorn" bloom, overlying hard black shale; and upper hard siliceous shale member, 10 to 30 feet thick, weathering to a white outcrop. About 500 feet above base of Colorado formation; about 250 feet below Greenhorn bentonite bed (new).

Thirty miles of outcrop traced within distance of about 45 miles between Geyser and Windham, Judith Basin County.

Giannonatti facies

See **Cannonball Member** and **Ludlow Member** (of Fort Union Formation).

Giants Range Granite[1]

Precambrian: Northeastern Minnesota.

Original reference: J. E. Spurr, 1894, Minnesota Geol. Nat. Hist. Survey 22d Ann. Rept., p. 119–124.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1039, 1042. Giants Range granite is a batholith about 100 miles long and as much as 15 miles wide. Has several facies. Intrudes Knife Lake group. In some areas lies beneath Pokegama quartzite.

Forms core of Giants Range, Vermilion and Mesabi districts.

Gibbons Conglomerate Lentil (in Marble Falls Formation)

Gibbons Conglomerate Member (of Big Saline Formation)

Lower Pennsylvanian (Bend Series): Central Texas.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 65–66. A basal conglomerate that marks the contact of the Marble Falls and the Barnett formation in some places. Consists of a dark-gray coarse fossiliferous glauconitic sand containing numerous subrounded cobbles from a fraction of an inch up to 10 inches in diameter; conglomerate grades upward into a coarse sandstone layer about 1 foot thick. Lentil is about 30 feet long east and west, 1 foot thick at each end and about 4 feet in the middle.

F. B. Plummer, 1947. Jour. Geology. v. 55, no. 3, pt. 2, p.196 (table 2), 197. Rank raised to member status in Big Saline formation. East of Ridge Cavern, underlies Aylor member; west of Ridge Cavern, underlies Brook Ranch member.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 61–62, 63. At type section, the Gibbons is thin pebble conglomerate 6 to 12 inches thick.

Type section: One-fourth mile north of San Saba-Brady Road on the Gibbons Ranch 2½ miles south of Hall, San Saba County.

Gibson Coal Member (of Crevasse Canyon Formation)

Gibson Coal Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1925, U.S. Geol. Survey Bull. 767.

L. B. Leopold and C. T. Snyder, 1951, U.S. Geol. Survey Water-Supply Paper 1110–A, p. 6–9. Disconformably underlies Gramerco formation (new).

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 90, 92, 93, p. 1. Lower Gibson reallocated to member status in Crevasse Canyon formation (new). Overlies Dalton sandstone member; underlies Hosta tongue of Point Lookout sandstone.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2157. Coal-bearing zone, originally named Gibson, is split into lower and upper part northeast of Gallup by wedging in of Point Lookout (formerly Hosta) sandstone. By newly adjusted terminology of Measaverde, lower and upper parts become respectively uppermost member of Crevasse Canyon and, in San Juan basin, lowest member of Menefee formation. Name Gibson coal member is restricted to lower split zone, and upper zone is here named Cleary coal member of Menefee formation. Southwest of point where Point Lookout (formerly

Hosta) sandstone wedges out, Cleary coal member and restricted Gibson coal member of Crevasse Canyon are in direct contact.

Named for village of Gibson, McKinley County.

Gibson Limestone Member (of Grindstone Creek Formation)

Pennsylvanian (Strawn): North-central Texas.

H. T. Mann *in* R. J. Cordell, H. J. Fitzgeorge, and J. B. Sparks, 1954, Abilene Geol. Soc. Guidebook Nov. 19–20, p. 22, 25 (fig. 16). Name applied to member of Grindstone Creek. Lies below Goen limestone member and above Santo limestone member. Unit had been mapped as Santo by Plummer and Hornberger (1936, Texas Univ. Bull. 3534) and as Goen by Nickell (1939, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 26).

Named for exposures along Gibson Creek, Erath County.

Gila Conglomerate[1] or **Group**

Tertiary, middle(?) to Pleistocene: Southeastern Arizona and southwestern New Mexico.

Original reference: C. K. Gilbert, 1875, U.S. Geog. and Geol. Survey 100th Mer., v. 3, p. 540–541.

L. A. Heindl, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1262. Reexamination of type section areas shows that term Gila conglomerate is unsatisfactory because it includes large proportion of deposits other than conglomerates; it suggests that deposits in separate basins are identical; its use masks sequences of alluvial deposits within individual basins; and it oversimplifies a complex Cenozoic history. Suggested that these deposits be separated into two major divisions wherever possible: an upper division consisting of conformable units and a lower division of older Cenozoic alluvial deposits. Upper division Pliocene to Pleistocene; lower division Oligocene(?) to Miocene(?).

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8–9 (table), 118–120, pl. 5. Described in central Cochise County, Ariz., where it is essentially conglomerate, sandstone, silt, and clay several hundred feet thick; in southern Dragoon Mountains unconformable above S O volcanics (new) and in Sulphur Spring Valley unconformable above Pearce volcanics (new). Pliocene.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. Three units distinguished in Gila conglomerate in Safford Valley area, Arizona. Bonita beds (lowest), Solomonsville beds, and Frye Mesa beds. Pliocene and Pleistocene.

U.S. Geological Survey currently designates the age of the Gila Conglomerate or Group as middle(?) Tertiary to Pleistocene.

Well exposed along gorges of upper Gila River and its tributaries.

Gila cyclothem (in McLeansboro Group)

Gila cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 27–28; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). Lies below the Woodbury cyclothem (new) and above the Greenup cyclothem (new). Thickness at type locality about 20 feet; thins northeastward. Includes Gila limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 55 (table 3), pl. 1. In Mattoon formation (new). Above Greenup cyclothem and below Woodbury cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Mint Creek in sec. 31, southeast of Gila, Jasper County.

Gila Limestone Member (of Mattoon Formation)

Gila Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 28. Dense fine-grained brittle limestone that contains small fragments of carbonaceous material; medium-gray, weathers nearly white. Thickness 1 to 4 inches. Included in Gila cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Correlation chart shows Gila limestone in McLeansboro group below Woodbury limestone and above Greenup limestone. Gives type locality same as Gila cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), pl. 1. Reallocated to member status in Mattoon formation (new). Occurs above Greenup limestone member and below Woodbury limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois.

Type locality Mint Creek, NE¼SW¼ sec. 31, T. 8 N., R. 9 E., Jasper County.

Gilbert Andesite

Pliocene: Southwestern Nevada.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of the Coaldale quadrangle. Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Flows and agglomerates, dominantly andesitic but also containing basalt, cover crest of Monte Cristo Range. Typically dark porphyritic lava. Few flows of hornblende andesite and hypersthene and olivine basalt. Locally sandstone, conglomerate, and fanglomerate between flows; andesite agglomerates widespread in adjacent Mina quadrangle. Also small intrusive masses of hornblende andesite. Between 500 and 1,000 feet thick in Monte Cristo Range.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. In Round Mountain quadrangle, underlies Toyabe quartz latite (new).

Type locality: Southern part of Gilbert district, Monte Cristo Range.

Gilbert Limestone (in McMillan Formation[1] or Group)

Upper Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1912, Denison Univ. Sci. Lab. Bull. 17, p. 18, 23.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 26, 27. In southern Blue Grass region, McMillan group includes (ascending) Tate formation, Gilbert limestone, and Mount Auburn formation. Gilbert is a zone of dove to grey fine-grained to dense hard lime-

stone that grades into Mount Auburn; fossiliferous. Thickness 0 to 20 feet.

Probably named for Gilbert, Lincoln County.

Gilbert Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian (Pottsville Series) : Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 217–219.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 215, 221. Lower Gilbert sandstone of Hennen and Reger (1914) is massive, grayish-white, coarse grained, and 30 to 80 feet thick. Overlies Gilbert shale. New River group, Pottsville series. Upper Gilbert sandstone not present in county.

Named for Gilbert, Mingo County.

Gilbert Shale[1]

Pennsylvanian(?) : Northeastern Arkansas.

Original reference: D. D. Owen, 1858, First report geol. reconn. northern counties of Arkansas, p. 68–69.

Exposed 3 miles northwest of Searcy, White County, at "bald point," in vicinity of Widow Gilbert's Farm.

Gilbert Shale (in Kanawha Formation[1] or Group)

Pennsylvanian (Pottsville Series) : Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 168.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 221. Shale in Kanawha group, Pottsville series.

First described in connection with Gilbert A coal in Wyoming County.

Gilboa Formation[1]

Upper Devonian: East-central New York.

Original reference: G. A. Cooper, 1934, Am. Jour. Sci., 5th ser., v. 27, p. 1–12.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW–22, p. 10, 19. Further described as gray medium- to fine-grained sandstone, thin-bedded siltstone, and dark-gray shale in Schoharie County.

Type section: In west face of Reed Hill, Schoharie Valley. Best section at Intake Building and along road from this building which connects with road to Hardenburg Falls and Grand Gorge [near southern end of Schoharie-Delaware County line]. [Probably named for Gilboa, Schoharie County, or Gilboa Reservoir.]

Gilboy Sandstone Member (of Monongahela Formation)[1]

Gilboy Sandstone (in Monongahela Group)

Gilboy sandstone and shale member

Upper Pennsylvanian: Northern West Virginia, eastern Ohio, and southwestern Pennsylvania.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 150.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 124 (fig. 29), 126. Lies below Waynesburg coal, which is considered top of Monongahela group; separated from underlying Waynesburg limestone by Little Waynesburg coal. Thickness as much as 20 feet in Fayette County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 86, geol. map. In Morgan County, Gilboy sandstone and shale member (Monongahela series) consists of 13 to 20 feet of sandstone and sandy shales, with some gray to red shales. Where overlying Waynesburg (No. 11) coal is not present, sandstone section extends upward so that demarcation of Pennsylvanian-Permian contact is not possible.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 188. Lowest member of Waynesburg cyclothem in report on Athens County. In many sections, member is in part a gray massive medium-grained sandstone very resistant to weathering. These zones give way laterally and vertically to less resistant lithologies, as fine- to medium-grained, thin- to medium-bedded sandstone or shaly sandstone interbedded with sandy platy shale. Average interval from top of Gilboy to Waynesburg coal bed is 9 feet, but this is variable because upper part grades laterally into redbeds; this results in thickening and thinning of both Gilboy sandstone member and redbed member (Waynesburg redbed member). Thickness of Gilboy 8 to 40 feet; average 11. In some areas, thick sandstone sequence begins at stratigraphic position of Gilboy and is continuous vertically to Waynesburg sandstone, with which member it is coalesced. When coalesced, the two sandstones cannot be separated or distinguished.

Named for exposure in Gilboy cut on Baltimore & Ohio Railroad east of Mannington, Marion County, W. Va.

Gilchrist Shale (in Carbondale Formation)

Gilchrist Shale (in Pottsville Formation)[1]

Pennsylvanian: Northwestern Illinois.

Original reference: H. R. Wanless, 1929, Illinois Geol. Survey Bull. 57, p. 49, 73, 83, 88, 122, 142.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 84. In Carbondale formation, a little below Colchester (No. 2) coal.

Exposed in shale pits north of Gilchrist, Mercer County.

Gile Mountain Formation

Gile Mountain Schists

Devonian: East-central Vermont and northwestern and west-central New Hampshire.

C. G. Doll, [1944]. Vermont State Geologist 24th Rept. 1943–1944, p. 18–19, pl. 3, 4. Light- to dark-gray chiefly quartz-mica schists. Less abundant are thin beds of massive and sheared quartzite, occasional coarse feldspathic schists, calcareous beds, and some graphic layers. Becomes more highly metamorphosed toward western part of outcrop belt where predominantly coarse amphibolites are prevalent. Thickness (excluding Meetinghouse slates) estimated about 6,500 feet. Meetinghouse slates, which are gradational westward into the schists, are the upper member of unit. Lower Devonian.

W. S. White and M. P. Billings, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 654–656, 662, pl. 1. Formation restricted to exclude rocks exposed in southeast corner of Strafford quadrangle, east of Ammonoosuc thrust, which Doll mapped as Gile Mountain schist[s]. Tentatively assigned to Middle Ordovician.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Geographically extended to New Hampshire. Middle Ordovician(?).

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 19–22, pl. 1. Discussion of gradational relationship with underlying Waits River formation. Included in St. Francis group. Lower to Middle Devonian.

M. P. Billings, 1956, The geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 10–11, 94–98, geol. map. Correlation chart shows Gile Mountain formation stratigraphically above Standing Pond volcanics and below Meetinghouse slate. Waits River, Standing Pond, Gile Mountain, and Meetinghouse formations are probably Middle Ordovician; may possibly be Silurian and (or) Devonian. Map bracket shows Gile Mountain as Middle Ordovician(?).

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 276–287. If structural interpretation given in present paper is correct, the calcareous rocks in East Barre quadrangle, here termed "Waits River formation" are youngest in Vermont sequence. Westmore and Gile Mountain formations, in all probability, are one and the same, being repeated on limbs of a syncline.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 28–34, 36–40. Formation described in St. Johnsbury quadrangle where it consists mainly of 5,000 feet of interbedded quartz-mica schist, micaceous quartzite, and minor amounts of feldspathic granulite and calc-silicate rock. Overlies Waits River formation; underlies Meetinghouse slate. Most workers agree age is Silurian and (or) Devonian. Discussion of age relations of rocks in Vermont sequence. According to one theory, Waits River and Gile Mountain could be equivalent in age, but, according to another theory, the Gile Mountain could be older than Waits River.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 576, pl. 3. Formation of northeast Vermont is believed to be in section stratigraphically above Ammonoosuc volcanic rocks in west limb of Boundary Mountain anticlinorium. Billings (1956) suggests that Gile Mountain may be in higher stratigraphic position than the Ammonoosuc, although in an earlier interpretation (1955, map) he had tentatively placed the Gile Mountain in a stratigraphic position well beneath the Ammonoosuc. In northernmost Vermont, the Gile Mountain is continuous westward in Connecticut Valley-Gaspe synclinorium with identical slate, graywacke, and quartzite referred to Westmore formation (Doll, 1951), although farther south in Vermont belts of silty limestone are included in such terrane. Where this occurs, the belts of limestone are variously referred to as Waits River formation (Dennis, 1956; White and Jahns, 1950), or Barton River formation (Doll, 1951), or both (Murthy, 1957, Vermont Geol. Survey Bull. 10). Similar rocks with limestone interbeds crop out east of Gile Mountain formation in northern New Hampshire, where they have been referred to Waits River formation (Billings, 1955; 1956). Devonian.

Named for exposures on Gile Mountain in southern part of Strafford quadrangle, Vermont.

Giles Formation[1]

Silurian and Lower Devonian: Southwestern Virginia and southeastern West Virginia.

Original references: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 177, pl. 4; 1896, U.S. Geol. Survey Geol. Atlas, Folio 26, p. 2.

Named for Giles County, Va.

Gilford Gabbro[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1895, 1898–1899, pl. 1. Dark gabbro with an unusual texture. Groundmass is a diabasic intergrowth of feldspar and greenish augite; in this are set large black clotlike hornblende spheroids each of which is a single crystal but poikilitically encloses numerous feldspar crystals similar to those in the matrix. Hornblende stands out in relief on weathered surfaces. Older than Endicott diorite; younger than Moat volcanics. Contacts not exposed. Assigned to White Mountain magma series.

Crops out one-fourth mile east of Gilford Station in northwestern corner of Belknap Mountains area. Best exposures found at 600-foot elevation on small bench which forms westernmost spur of Locke's Hill.

Gill Breccia (in Vieja Group)

Tertiary: Southwestern Texas.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 14–17. Name proposed for a series of flow breccias consisting of three rock types: medium gray fragments in a grayish-red matrix; mottled fragments (pink, green, yellow, gray, and brown) in a dark-greenish-gray to orange-pink matrix; brecciated to massive light-olive-green to greenish-gray fine-grained rock. Contains blocks of massive Lower Cretaceous limestone, some of them as large as a three-story building. Maximum thickness 300 feet in type section. In most exposures, Gill breccia is concordant with underlying Jeff conglomerate; where Jeff conglomerate is absent or difficult to detect, the Gill forms the basal unit of the group; upper surface of Gill appears to form buried hills under the Colmena tuff (new).

Type section: Colmena Canyon (Gill Canyon) in the Rim Rock country, Presidio County.

†Gillespie Formation (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Central Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 221.

V. E. Barnes, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1955. Used in a quote sense and described as red beds occurring locally within Travis Peak formation. They are derived from red Cambrian sandstones and are at different stratigraphic levels, depending upon location of sandstone from which they were derived.

Probably named for Gillespie County.

Gilliam Limestone

Gilliam Thin-Bedded Member (of Capitan Limestone)[1]

Permian (Guadalupe Series) : Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 52.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 654–656, pl. 2. All beds of upper Guadalupe age have been placed in Capitan limestone, a chronologic unit that included Altuda, Vidrio, and Gilliam members. Capitan is herein restricted to that part of former Vidrio member, or reef facies, that is upper Guadalupe (post-Word) in age; both Altuda and Gilliam are given formational rank. Altuda, in western part of Glass Mountains, consists of siliceous shales and thin limestones that were laid down near margins of Delaware Basin; Capitan, in central part of mountains, is reef deposit, and Gilliam, in eastern part, a back-reef (shelf) deposit. Each formation grades into the other, and all are approximately of same age.

Exposed in Gilliam Canyon, Glass Mountains, Marathon region, Brewster County.

Gilman Quartzite[1]

Lower Cambrian : Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 6, 10.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 144–146. Light-gray or buff quartzite which weathers to a lighter color. At base is a coarse grit; beds of conglomerate occur near top. Thickness 3,000 feet. Underlies Dunham dolomite conformably; overlies West Sutton slate. Type locality cited.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1148–1149. Geographic extension into northwestern Vermont.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523–525, 532 (fig. 5), pl. 1. Thickness about 500 feet in St. Albans area, Vermont. Base not exposed. Underlies Dunham dolomite. Lower Cambrian (Georgian series). Unit has been called Brigham Hill graywacke by Jacobs (1935), but this name has not been generally adopted.

Type locality: Oak Hill, Sutton quadrangle, Quebec. Named for Gilman, 3 miles east of Sweetsburg.

Gilman Sandstone Member (of Leadville Dolomite)

Lower Mississippian : West-central Colorado.

Ogden Tweto and T. S. Lovering, 1947, Colorado Mineral Resource [Bull], p. 380, (chart). Gray sandstone, black cherty dolomite, and breccia containing much black clay. Thickness 20 to 50 feet.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 177–184. Reproposed for sandstone and associated breccia at base of Leadville limestone (or dolomite). Consists of lenticular beds of sandstone, dolomitic sandstone, or local quartzite, at base, overlain by sandy and locally cherty dolomite which at most places is interbedded with and overlain by breccia of dolomite and chert; sandstone is yellow, buff, or light gray, medium to coarse grained, and slightly arkosic; individual sandstone beds 2 to 24 inches thick; sandy dolomite is dense, dark, and

weathers light; typically brecciated and contains chert in fragments, nodules, and lenticles. Thickness commonly 10 to 20 feet; range from 5 to 50 feet observed. Underlies massive gray dolomite member; in most places, contact is a few feet of fine-grained structureless soft dark-brownish-gray dolomite; separated from underlying Chaffee formation (Dyer dolomite member); by unconformity.

L. R. Litsey, 1958, Geol. Soc. America Bull., v. 69, no. 9, p. 1157. Noted at Wellsville and Calcite, Fremont County.

Named for exposures on cliffs of Eagle Canyon at Gilman, Pando area, Eagle County.

Gilmanton Monzodiorite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1902–1903, pl. 1. Monzodiorite with striking differences in texture and composition of ferromagnesian minerals. Most characteristic type is equigranular to subporphyritic, yellow to pinkish. Feldspar is main constituent. Darker colored and medium grained with an even granular texture on Piper Mountain; biotite is chief dark mineral. Light colored and distinctly subporphyritic on Goat Pasture Hill; oblong phenocrysts of white feldspar are set in matrix of anhedral finer grained feldspar, and augite and hornblende are often concentrated along phenocryst borders. Intrudes older schists of the area. Older than Albany quartz syenite and Belknap syenite. Assigned to White Mountain magma series.

Named from township of Gilmanton, Belknap County. Occupies broad band along southwestern edge of Belknap complex extending from Piper Mountain on the northwest to Goat Pasture Hill on southeast.

Gilmer Schist

See Hurricane Graywacke.

Gilmore Limestone

Gilmore Limestone (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 173.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Table of classification and nomenclature lists Gilmore in Greene series above Upper Rockport limestone and below Gilmore coal.

Probably named for association with Gilmore coal.

Gilmore Sandstone Member (of Greene Formation)[1]

Permian: Southwestern Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 38–39.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Table of classification and nomenclature lists Gilmore sandstone in Greene series above Gilmore coal and below Windy Gap coal.

Named for exposures in Gilmore Township, Greene County, Pa.

Gilmore City Limestone[1]

Gilmore City Limestone (in Easley Group)

Mississippian (Kinderhook Series) : North-central Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 113–114.

J. M. Weller, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, 146, 150, chart 5. Shown on standard Mississippian stratigraphic section as uppermost formation in Easley group (new) underlying Fern Glen formation and overlying Sedalia formation. In Iowa overlies Iowa Falls dolomite. Also termed Alden formation.

L. A. Thomas, 1960, Tri-State Geol. Soc. Guidebook 24th Ann. Field Conf., p. [3–5, 17–18]. Van Tuyl (1925) considered that there was an erosional surface of about 75 feet of relief upon Iowa Falls dolomite and that Gilmore City limestone was decidedly younger than Iowa Falls dolomite. Present study suggests that Iowa Falls dolomite is in part a dolomitized lateral equivalent of Gilmore City limestone.

Exposed in Gilmore Portland Cement Co.'s quarry, 1½ miles northwest of Gilmore City, Pocahontas County.

Gilmore Gulch Formation[1]

Miocene, pre-upper (?) : Central Nevada.

Original reference: H. G. Ferguson, 1933, Nevada Univ. Bull., v. 27, no. 3, p. 21.

Named for exposures in Gilmore Gulch, Tybo district, Nye County.

Gimlet cyclothem[1] (in McLeansboro Group)

Gimlet cyclothem (in Modesto Formation)

Pennsylvanian : Northern, western, and southern Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 182, 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 60, 116–117, 193, 194, pls. 2, 5. Thickness of cyclothem 15 to 85 feet. Includes (ascending) Gimlet sandstone, Gimlet coal, and Lonsdale limestone. Gimlet sandstone has maximum thickness of 50 to 60 feet but is locally absent in some localities where higher Gimlet beds rest on Farmington shale; sandstone fills channels that cut from 50 feet above coal No. 7 to about 5 feet above Brereton limestone. Cyclothem is separated by erosional unconformities from Sparland cyclothem below and Trivoli and Exline cyclothems above. Derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 55 (table 3). In Modesto formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Named for exposure on Gimlet Creek in SE¼ sec. 16, T. 12 N., R. 9 E., Marshall County.

Gimlet Limestone[1] (in McLeansboro Formation)

Pennsylvanian : Central western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

Derivation of name not stated.

Gimlet Sandstone Member (of Modesto Formation)

Gimlet Sandstone (in McLeansboro Group)

Pennsylvanian: Western northern Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 60, 116–117. Gimlet sandstone has maximum thickness of 50 to 60 feet but is locally absent. Fills channels that cut from 50 feet above coal No. 7 to about 5 feet above Brereton limestone. Unconformable on Farmington shale. In Gimlet cyclothem, McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1). Included in Modesto formation (new). Occurs above Farmington shale member and below Lonsdale limestone member. Type locality stated. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: On Gimlet Creek in SE¼ sec. 16 T. 12 N., R. 9 E., Marshall county.

Ginseng Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 151–152. Lower member of Brodhead formation, Athertonville facies (new). Massive slightly calcareous buff drab siltstone 35 feet thick. In type area, underlies Rolling Fork limestone member (new), Athertonville facies (new), and overlies New Providence formation, Junction City facies (new).

Type section: Along road leading up hill west of old Ginseng post office, southeastern LaRue County.

Girard Shale Member (of Chemung Formation)[1]

Girard Formation (in Conneaut Group)

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 118–119, 251.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Generalized succession for marine Upper Devonian of northwestern Pennsylvania and southwestern New York listed. Girard formation (I. C. White's Girard shale) is shown in Conneaut group. Includes Cuba sandstone.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 17. Girard shale is here included in Northeast shale member of Canadaway formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Conneaut group includes "pink rock" of drillers and "Chemung" and "Girard" formations of northwestern Pennsylvania.

Well exposed along Elk Creek above Girard, Erie County, Pa.

Girardeau Limestone[1]

Lower Silurian: Southeastern Missouri and southwestern Illinois

Original reference: G. C. Swallow, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 1, p. 109.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 56. Girardeau limestone normally overlies Orchard Creek shale, which is

considered to be southward continuation of some part of Maquoketa shale generally conceded to be Upper Ordovician in age. There is no sharp break between the Girardeau and Orchard Creek. It it possible that Girardeau limestone should also be referred to Ordovician.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Alexandrian group, Albion series. Underlies Edgewood limestone.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, p. 260, chart 2. Shown on correlation chart as Ordovician, Cincinnatian. Age of Thebes sandstone, Orchard Creek shale, and Girardeau limestone is still under study. They may belong at base of Silurian.

Named for outcrops 1½ to 2 miles above Cape Girardeau, Cape Girardeau County, Mo.

Gird[1] (shales)

Lower Cretaceous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Girkin Formation[1]

Girkin Limestone

Upper Mississippian: Western Kentucky and northern Alabama.

Original reference: A. H. Sutton and J. M. Weller, 1932, Jour. Geology, v. 40, no. 5, p. 430, 440, 441.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 828. From Todd County to Grayson County, Ky., the Bethel sandstone is absent and Renault and Paint Creek formations together form a limestone that cannot be easily subdivided. Name Gasper has been used for this limestone, but persistent miscorrelation has resulted in such confusion that name is no longer useful. Hence, beds are now known as Girkin limestone. The Girkin consists almost entirely of massive light-gray limestone which cannot be distinguished from underlying Ste. Genevieve except by fossil content. Chester series.

Well exposed in hills that nearly surround village of Girkin, Warren County, Ky.

Gizzard Formation (in Lee Group)[1]

Gizzard Member (of Lookout Sandstone)

Gizzard Group

Gizzard Member (of Lee Formation)

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 369–370.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, p. 1941. Listed as member of Lee formation.

V. H. Johnson, 1946, Coal deposits on Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map. Geographically extended into northern Georgia where it is reduced to member status in Lookout sandstone. Consists of gray shales and fine-grained

sandstone; on Lookout Mountains, shale is minor part of member; in Cole City area, a silty saccharoidal carbonaceous sandstone as much as 150 feet thick occurs 30 to 50 feet below Sewanee member.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 4, 19, pls. 2, 3, 4. Rank raised to group. Includes all strata between top of Mississippian and base of Sewanee conglomerate. Thickness as much as 700 feet; at type locality 224 feet. Includes (ascending) Raccoon Mountain formation (new), Warren Point sandstone, and Signal Point shale (new); group is so subdivided on basis of wide distribution of Warren Point sandstone. Pottsville series. Type locality stated.

Type section: In gorge of Big Fiery Gizzard Creek (Gizzard Cove), about 2 miles south of Tracy City, Grundy County, Tenn.; geographic names used here are those on White City quadrangle, rather than "Little Fiery Gizzard" of Stafford.

Glacier Park facies (of Belt Series)

Precambrian: Western Montana, and southern Alberta and southern British Columbia, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence. thickness, recorded conditions of deposition, fauna, and flora. Glacier Park facies is the development of the series in Glacier National Park, Mont., Waterton Lakes National Park, Alberta, and westward to the Flathead trough. Grades into the dominantly clastic Purcell facies.

In Glacier-Waterton Parks.

Glacier Peak Volcanics[1]

Quaternary: Washington.

Original reference: H. C. Culver, 1936, Washington Div. Geology Bull. 32, p. 21.

Glacier Peak, Snohomish County.

Glacier Point Glaciation

Glacier Point glacial stage[1]

Pleistocene: Eastern California.

Original reference: F. E. Matthes, 1929, Science, new ser., v. 70, p. 75–76.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243A, table 2. Correlated with McGee glaciation.

Change of name from stage to glaciation made in accordance with adoption of stratigraphic code, June 1961.

Named for occurrence of erratic boulders above Glacier Point, Yosemite National Park.

Glacier Ridge Agglomerate

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Name appears on geologic map legend.

Mapped on south flank of Pavlof Volcano, Alaska Peninsula.

Glacier Ridge Andesite

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Name appears on geologic map legend.

Mapped on south flank of Pavlof Volcano, Alaska Peninsula.

†Glade Sandstone[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 202.

Gladeville Sandstone

Gladeville Sandstone (in Pottsville Group)[1]

Middle Pennsylvanian: Southwestern Virginia and southeastern Kentucky.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 33.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 141. Sandstone between the Wise (above) and Norton formations.

U.S. Geological Survey does not use the term Pottsville Group in Kentucky.

Named for Gladeville (now called Wise), Wise County, Va.

Glady Fork Sandstone[1] (in Bluestone Group)

Glady Fork Sandstone Member (of Bluestone Formation)

Mississippian (Chesterian): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 321.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 182–183, p. 15. Geographically extended into Virginia and redefined as member of Bluestone formation. Overlies Pipestem shale member; underlies Mud Fork member. Thickness 25 to 40 feet. In Chester series.

Type locality: In end of ridge between Brush Creek and Glady Fork, southeast of Princeton, Mercer County, W. Va.

Glance Conglomerate[1] (in Bisbee Group)

Lower Cretaceous (Comanche Series): Southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 56, 57.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 71, pl. 5. Described in central Cochise County. Thickness varies rapidly in short distances owing to irregularities in surface of unconformity beneath. Thickness of several thousand feet reported at Bisbee. Unconformable above older rocks; locally overlies Pinal schist; underlies Morita formation.

Named for Glance, on El Paso and SW Railroad near Glance mine, Bisbee quadrangle.

Glasco Limestone

Glasco Limestone Lentil (of Rondout Waterlime)

Upper Silurian: Southeastern New York.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 44, 46, 47, 51 [1946]. Name proposed for limestone lentil near top of Rondout. Maximum thickness 10 feet.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Glasco and Cobleskill limestones appear to be youngest fossil-bearing Silurian in New York. Name Glasco is preferred to that of Le Fever because the latter has never been adequately described. Chart shows Glasco above Rosendale waterlime and below Whiteport waterlime.

Type exposure on West Wood Farm, Route 9–W, west of Glasco, Ulster County.

Glassboro Gravel[1]

Glassboro phase (of Bridgeton Formation)

Pleistocene: New Jersey and southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 296–309.

J. C. Martens, 1956, Rutgers Univ. Bur. Mineral Research Bull. 6, p. 72–74. Glassboro phase of Bridgeton (Salisbury and Knapp, 1917, New Jersey Geol. Survey, v. 8) occurs south and west of line drawn from Berlin down Mullica River to Atlantic Coast. Phase includes greater part of formation and consists of fine sand and gravel with a few boulders and some clay.

Probably named for occurrence at Glassboro, Gloucester County, N.J.

Glass Buttes Series[1]

Miocene: Central southern Oregon.

Original reference: A. Waters, 1927, Jour. Geology, v. 35, p. 442–452.

Forms main part of Glass Butte Range, Lake County.

†Glass Mountain Formation (in Cimarron Group)[1]

Permian: Southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 353, 355.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. An indefinite Permian unit.

Exposed in Glass Mountains of Major County, Okla.

Glass Mountain Lava

Recent: Northern California.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 374, 375–376. Name applied to lava of recent eruptions at Glass Mountain. Material is mostly rhyolite pumice and obsidian. Flows mark close of volcanic history in area.

Occurs in Medicine Lake Highland, approximately in center of Modoc Lava Bed quadrangle.

†Glass Mountains Formation[1]

Permian: Western Texas.

Original reference: P. B. King, 1933, Historical Geology, by R. C. Moore, p. 325.

Glass Mountains.

Glastonbury Formation

Glastonbury Granite Gneiss[1]

Paleozoic (pre-Pennsylvanian? or Ordovician?) Central Connecticut and southern Massachusetts.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 115, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 51. Mapped as Monson orthogneiss.

G. E. Collins, 1954, Connecticut Geol. Nat. History Survey Quad. Rept. 4, p. 9–14, 26. Gneiss recognized in Ellington quadrangle as a unit separate from the belt of Monson gneiss which occurs east of Bolton formation exposures. Follows nomenclature of Gregory (1906). Eastern part of unit, here discussed, is light gray; western part is darker. Grades eastward into Bolton garnet-muscovite schist, and westward into a hornblende schist. Pre-Mississippian.

Norman Herz, 1955, Connecticut Geol. Nat. History Survey Quad. Rept. 5, p. 8–16. Areal variation in relative amounts of constituent minerals and degree of foliation and lineation. Four facies described in Glastonbury quadrangle: schistose, porphyroblastic, flaser gneiss, and highly felsic eastern border. Aplite dikes and pegmatites common. Devonian(?).

J. M. Aitken, 1955, Connecticut Geol. Nat. History Survey Quad. Rept. 6, p. 5–6, 15–16. Termed a formation.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic. Derivation of name given.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619, 627–630, pl. 56. Pegmatites of Middletown area cut metasediments of Bolton schist of pre-Mississippian (?) age and, in ascending order of sequence, mafic gneisses, Glastonbury granite gneiss, Maromas granite gneiss, and Monson gneiss. Position of these formations in stratigraphic column cannot be determined with accuracy; their maximum age is indicated by their relation to the pegmatities, which have been dated by uranium- and thorium-lead ratios as about 260 million years old, presumably Mississippian.

John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 19, 21, fig. 3. Unconformably underlies Collins Hill formation (new). Ordovician(?).

Named for town of Glastonbury, Hartford County, Conn. An elongate body of biotite gneiss, 4½ miles in maximum width; extends from Great Hill, Middletown area, Connecticut, northward into Massachusetts.

Gleeson Quartz Monzonite

Triassic or Jurassic: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 55–59, pl. 5. Consists of three principal facies. The first two facies—collectively called main facies—differ chiefly in the obvious alteration that has affected one and not the other and are mapped together. Main facies is coarse-grained light-gray rock that ranges to greenish gray where highly chloritized and to pink where it contains sufficient pink microcline; weathered surfaces commonly rusty brown. Practically all stages of alteration of main facies of the quartz monzonite recognized, from nearly unaltered normal igneous rocks to recrystallized gneissic rocks, though most of the forma-

tion is crystalloblastic-cataclastic in texture and some parts practically entirely cataclastic and grade into true mylonites. Third facies—alaskite facies—differs from other two in being practially devoid of dark minerals. Rock ranges from practically white through pale to pinkish gray. Rock ranges from fine aplitic-appearing material to fairly coarse in texture. Nearly all contacts of Gleeson quartz monzonite are with alluvium or are faults; overlapped by some of the S O volcanics (new) locally; cuts Pinal schist near South Pass.

Crops out over an area of nearly 30 square miles, in Tps. 18 and 20 S., Rs. 24 and 25 E., in southern part of Dragoon Mountains, and in pediment to south and east of it, central Cochise County. Town of Gleeson is at eastern side of the mass, and the Gleeson-Tombstone Road crosses it near its center.

Glenarm Series[1]

Lower Paleozoic(?): Maryland, New Jersey, Pennsylvania, and Virginia.

Original reference: E. B. Knopf and A. I. Jonas, 1922, Geol. Soc. America Bull., v. 33, p. 110.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346–347. In Frederick County, Md., includes Wakefield marble, Silver Run limestone, Ijamsville phyllite, Urbana phyllite, and Marburg schist (all new).

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 95–96, 103, 106. Peach Bottom slate and Cardiff conglomerate considered Ordovician(?); hence, they are removed from Glenarm series.

Ernst Cloos and Anna Hietanen, 1941, Geol. Soc. America Spec. Paper 35, p. 207. Detailed discussion in connection with geology of Martic overthrust in Pennsylvania and Maryland. It is not possible to determine age of the Glenarm definitely; it certainly is not Precambrian. Further detailed work will be necessary to furnish data on basis of which more definite conclusions can be based.

F. M. Swartz, 1948, Am. Assoc, Petroleum Geologists Bull., v. 32, no. 8, p. 1506–1512. In present review, there is much evidence favoring opinion that Glenarm series, as developed south of Chester Valley, is Cambro-Ordovician in age and less reason for supposition of Precambrian age.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 980. Includes (ascending) Setters quartzite, Cockeysville marble, Wissahickon schist, Peters Creek schist, Cardiff conglomerate, and Peach Bottom slate. Age probably early Paleozoic.

G. J. Wasserburg, F. J. Pettijohn, and J. Lipson, 1957, Science, v. 126, no. 3269, p. 355–357. Report discusses A^{40}/K^{40} ages of micas and feldspars from Glenarm series near Baltimore. Concluded that both the age and the metamorphism of Glenarm series and the time of pegmatite injection was about 350 million years ago corresponding to the end of the Ordovician period on the Holmes time scale. The absolute age is thus seen to coincide with ages of pegmatites in New England and North Carolina. This evidence supports view that whole eastern Appalachian region was "simultaneously" subject to igneous and metamorphic activity about 350 ± 20 million years ago. Thesis that Glenarm series is Precambrian because of its degree of metamorphism is untenable on basis of date presented here. These A^{40}/K^{40} dates do not, however, preclude the possibility that series was originally deposited during Precambrian time.

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1029 (table 1). Series comprises (ascending) Setters, Cockeysville, Wissahickon, and Peters Creek formations. Pre-Silurian.

Named for typical development near Glenarm, 13 miles northeast of Baltimore, Md.

Glencairn Shale Member (of Purgatoire Formation)[1]

Lower Cretaceous: Eastern Colorado.

Original reference: G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203.

K. M. Waagé, 1953, U.S. Geol. Survey Bull. 993, p. 6 (fig. 2), 7, 9–11, pls. 1, 2, 4, 5. Name extended to include subdivisions of Purgatoire in Fremont, Pueblo, and Huerfano Counties. Finlay's description is not sufficiently detailed to indicate certainly that his unit corresponds exactly to Glencairn as used in this report, but the discrepancy, if any, is not great. Consists of alternating units of olive-brown thin-bedded sandstone and gray and black shale totaling between 70 and 100 feet in thickness. Common sequence is three units of shale alternating with three units of sandstone. Pattern of six alternating units of shale and sandstone within the Glencairn is typical of member in Canon City embayment area, although pattern is obliterated locally by thickening of sandstone units at expense of shale units. At base of lower sandstone, and commonly separated from it by thin bed of silty shale, is a bed of conglomeratic sandstone from 2 to 18 inches thick; this conglomeratic bed rests on planed surface that truncates cross lamination in underlying Lytle sandstone member. Disconformably underlies Dakota sandstone.

Named for a tract of land a few miles north of Lytle, Colorado Springs region.

Glen Canyon Group[1]

Triassic and Jurassic: Southern and eastern Utah, northern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: A. A. Baker and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 8, p. 787 (table 1).

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 68–73. Includes (ascending) Wingate sandstone, Todilto(?) formation, and Navajo sandstone. Underlies San Rafael group; overlies Chinle formation. Jurassic(?).

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 4–6, pls. Includes (ascending) Wingate sandstone, Kayenta formation (previously designated "Todilto" and "Todilto?" formation), and Navajo sandstone.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1667–1668. Includes (ascending) Wingate sandstone, Kayenta formation, and Navajo sandstone. New conclusions as to correlation of units pose problem in stratigraphic nomenclature. Strict application of principles of priority would require that name Wingate be applied to unit heretofore called Entrada and would require that new name be applied to Wingate sandstone of Utah and adjacent regions. In current usage for Colorado Plateau and surrounding areas, these names apply to distinctive and widespread formations, and names are firmly entrenched in literature. Abandonment of this nomenclature through

principles of priority would be confusing. Name Entrada is extended to include sandstone at type locality of Wingate sandstone, and name Wingate is retained for sandstone forming lower part of group, with understanding that original type locality of Wingate has been abandoned. Name Glen Canyon group extended to include undivided equivalents of Navajo, Kayenta, and Wingate that crop out below Entrada sandstone and Chinle formation in parts of New Mexico and Arizona.

F. W. Cater, Jr., 1954, Geology of the Bull Canyon quadrangle, Colorado: U.S. Geol. Survey Geol. Quad. Map [GQ–33]. In southwestern Colorado, includes Wingate sandstone, Kayenta formation, and Navajo sandstone. Overlies Chinle formation; underlies San Rafael group.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2515–2535. Includes Moenave formation (new).

L. C. Craig and D. D. Dickey, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 93–97; J. C. Wright and D. D. Dickey, 1958, Intermountain Assoc. Petroleum Geologists Guidebook 9th Ann. Field Conf., p. 172–173. In southeastern Utah, includes (ascending) Wingate sandstone, Kayenta formation, and Navajo sandstone.

J. E. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 5–53, pl. 2. Described in Navajo country. Overlies Chinle formation; contact lies between Gregory's (1917, U.S. Geol. Survey Prof. Paper 93) "A" and "B" divisions of the Chinle. This reassignment of the Chinle "A" is based upon intertonguing between Wingate sandstone and Chinle "A" in several areas. Underlies various units of San Rafael group—Entrada sandstone, Carmel formation, or Entrada and Carmel undifferentiated. In Kachina Point and Navajo Creek areas, Arizona, includes (ascending) Wingate sandstone, Moenave formation, Kayenta formation, and Navajo sandstone; in Fort Wingate area, New Mexico, includes only Wingate sandstone (Lukachukai member).

R. G. Petersen, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–215. In Emmett Wash NE quadrangle, Coconino County, Ariz., group comprises (ascending) Moenave formation, Kayenta formation, and Navajo sandstone. Overlies Chinle formation. Upper Triassic(?) Lower Jurassic(?).

Named for exposures in Glen Canyon of Colorado River, Kane County, Utah.

Glendale Beds[1]

Eocene (Jackson): Eastern Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1316.

Crops out at Glendale, Trinity, and south of Groveton, Trinity County.

Glendale Granite[1]

Precambrian(?): Central northern Colorado.

Original reference: R. D. Crawford, 1909, Colorado Univ. Studies, v. 6, p. 97–131.

Occurs on both sides of Lefthand Canyon in vicinity of Glendale and Rowena, Boulder County.

Glendale Member (of Denmark Formation)

Middle Ordovician (Trentonian) : Northwestern New York.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 530–535. Even-bedded hard blue-gray calcilutites, calcareous shales, and coquinal calcarenites. Distinctive calcilutites rapidly disappear northward. Thickness 35 feet. Underlies upper unnamed member; overlies Camp member (new). Upper limit of unit arbitrarily placed above last zone of abundant calcilutites.

Named for Glendale, Lewis County.

†Glendale Shale[1]

Lower Mississippian : Southeastern Tennessee.

Original reference : J. H. Swartz, 1924, Am. Jour. Sci., 5th, v. 7, p. 24–26.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 13. Swartz (1924) named the upper gray-shale unit of Hayes' "Chattanooga black shale" the Glendale shale. Swartz was of the opinion that beds he identified as Glendale were, prior to his work, a part of Fort Payne chert. Name "Glendale shale" is not used herein; beds so named by Swartz are called Maury formation.

Named for exposures at Glendale Station, just outside Chattanooga, on electric road to Signal Mountain.

Glen Dean Limestone[1] or Formation

Glen Dean Limestone (in Homberg Group)

Glen Dean Limestone (in Stephensport Group)

Upper Mississippian (Chester Series) : Kentucky, southern Illinois, southern Indiana, Tennessee, and southwestern Virginia.

Original reference: C. Butts, 1917, Mississippian formations of western Kentucky : Kentucky Geol. Survey, p. 97.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 832–833. Uppermost formation in Homberg group (new). Underlies Tar Springs sandstone; overlies Hardinsburg sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 90–101, pl. 1. Described in Indiana where it attains thickness of 27 to 60 feet. Consists of gray or tan massive crystalline limestone in oolitic fossiliferous limestone in lower part; dark-gray shale and thin beds of impure limestone. Overlies Hardinsburg sandstone; underlies Tar Springs sandstone. Term Homberg group not applied in Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 38–39, pl. 1. Uppermost formation in Stephensport group (redefined). Formation has been defined as including a lower or main limestone member and an upper interbedded shale and limestone. Proposed here to restrict name Glen Dean to the more persistent main limestone member. In Huron area, only main limestone is present; in other areas, this restriction will reduce the Glen Dean to about one-half its former thickness. The interbedded shale and limestone should be placed in overlying Tar Springs formation. Thickness about 30 feet in Huron area [this report]. Conformably overlies Hardinsburg formation; unconformably underlies Mansfield formation. Chester series.

Named for exposures along railroad on both sides of Glen Dean, Breckenridge County, Ky.

Glendo Shale (in Phosphoria Group)

Glendo Shale Member (of Lykins Formation)

Permian: Eastern Wyoming, northeastern Colorado, and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, 6, 10, 19 (fig. 6), 36, 45. Consists of red shale, partly sandy. Comprises the interval between the Forelle and Minnekahta limestones. Thickness 43 to 56 feet.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Member of Lykins formation in eastern Colorado. Underlies Forelle limestone; overlies Falcon tongue of Minnekahta limestone.

Type locality: In Spring Creek valley, 1 mile south and 2 miles west of Glendo, Wyo.

Glendon Limestone Member (of Byram Formation)

Glendon Limestone (in Vicksburg Group)[1]

Glendon Member (of Vicksburg Formation)

Oligocene: Alabama, Florida, and Mississippi.

Original reference: O. B. Hopkins, 1917, U.S. Geol. Survey Bull. 661–H, p. 298, 300.

F. F. Mellen, 1939, Mississippi Acad. Sci. Jour., v. 1, p. 18, 19. Member of Vicksburg formation. Includes Mint Spring facies at base. Overlies Forest Hill member; underlies Byram member.

H. V. Howe, 1942, Jour. Paleontology, v. 16, no. 2, p. 264–271. Discusses fauna at type locality of Glendon formation.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1316, 1329–1332. Rank reduced to member status in Byram formation. Underlies unnamed marl member; overlies sandy facies of Marianna limestone. At type section, lower 12 feet consists of coarsely porous, crumbly to hard, crystalline, orbitoidal limestone with well developed but unevenly cemented ledges and interbedded less resistant zones; hard ledges characteristically weather to "horsebone," and locally entire interval is more evenly indurated and so weathered; above the coarse limestone, and constituting remainder of type section, are at least three hard smooth yellowish-brown limestone ledges interbedded with soft fossiliferous argillaceous marl. Evidence indicates that the hard crystalline limestone and open-spaced coquinas of type section pass westward into thicker, more uniform section of buff to cream hard to soft argillaceous marlstone and tough limestone. Sharper faunal break exists between Marianna and Glendon in Alabama than around Vicksburg. Eastward from type locality, member becomes more uniformly indurated and difficult to differentiate from Marianna. In vicinity of Marianna, Fla., largely altered to dolomite; thickness at Marianna about 18 feet.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. In stratigraphic investigation of Vicksburgian deposits in Mississippi, Alabama, and western Florida, two sedimentary cycles were identified. Lowermost cycle extends from disconformity at base of Mint Springs-Marianna formation to similar break at top of Byram (in this report excludes Bucatunna marl).

Name Glendon redefined and applied to alternating crystalline limes and marls located, in part, stratigraphically above type section. Typical "horsebone" lithology is extremely variable weathering phenomenon which may develop on any limestone bed immediately beneath lower Bucatunna disconformity. Reference section designated.

Type locality: Glendon, a flag station on Southern Railway between Jackson and Walker Springs, in southern part of sec. 31, T. 7 N., R. 3 E., Clarke County, Ala. Reference section: St. Stephens Quarry, St. Stephens, Ala.

Glendora Volcanics

Miocene: Southern California.

J. S. Shelton, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 63. Series of flows, chiefly andesitic, breccias, tuffs, and related intrusives.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 45–89, pl. 1. Includes undisturbed tuffs, tuff breccias, massive flows, autobrecciated flows, dikes, probable vent fillings of various kinds, volcanic conglomerates, and possibly local fumarolic alteration products; in the field, 22 mappable varieties or members recognized. Thickness varies from a few hundred to over 3,000 feet. Includes Spadra felsophyre, Elephant Hill breccia, and Johnstone Peak tuff breccia (all new). Overlies pre-Upper Cretaceous crystalline rocks of the basement complex which here includes Mountain Meadows dacite. In some areas, upper part of volcanics is interbedded with upper Miocene Topanga formation; more commonly unconformably underlie some part of upper Miocene Puente formation.

Exposed in foothills of San Gabriel Mountains in vicinity of Glendora, in South Hills, and at northeast end of San Jose Hills, Los Angeles County.

Glen Ellen Formation

Pliocene(?) and Pleistocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 98–99, pl. 6. Fluviatile gravel, sand, clay, and boulder deposits composed of materials derived from andesite and tuffs. Largest area of exposure, north and northwest of Glen Ellen, consists of stratified gravels and sands alternating with thick layers and lenses of conglomerates composed of andesite cobbles averaging 3 to 6 inches in diameter; at least 300 feet thick. Deposits may have been formed in part contemporaneously with gravels and sands of Huichica formation (new). Because formation rests upon folded Sonoma volcanics, it is believed to be Pleistocene but cannot be dated more definitely.

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 26 (table 6), 47–54. As used in this report [Santa Rosa and Petaluma Valleys], formation consists of thick sequence (0 to about 3,000 feet) of deformed continental deposits that discontinuously overlie and locally interfinger with Sonoma volcanics and interfinger with Merced formation. The Glen Ellen includes the Glen Ellen of Weaver, the upper part of the Sonoma group of Gealey (1950 [1951]), and the older Quaternary alluvium of Travis (1952, California Div. Mines Bull. 162). Pliocene(?) and Pleistocene.

Named from Glen Ellen in eastern part of Santa Rosa quadrangle, Sonoma County. Exposed intermittently in a northwest-southeast direction for a distance of more than 13 miles; lies within old structural valley of which Kenwood and Sonoma Valleys are now a part.

Glenerie Limestone (in Oriskany Group)[1]

Lower Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1908, Science, new ser., v. 28, p. 346–348.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. [83], 85–88 [1946]. Mapped as Glenerie limestone and chert. Composition ranges from limestone to solid chert beds, soft shale, and conglomerate. Beds are very blue to nearly black in fresh exposures; characteristically weather buff brown. Thickens greatly into limestone southward; northward in the Helderberg, grades into thin sandstone. Thickness about 30 feet in type exposure, which is described. Overlies Port Ewen beds in map area, the Catskill and Kaaterskill quadrangles; farther south overlies Connelly conglomerate. Derivation of name stated.

Type exposure at old quarry on east side of Route 9–W, ¼ mile north of Glenerie Mills, 4 miles below Saugerties, Ulster County. Named from old Glenerie white-lead mills on Esopus Creek at Glenerie Falls.

Glen Eyrie Shale Member (of Fountain Formation)[1]

Glen Eyrie Formation

Pennsylvanian: Eastern Colorado.

Original reference: G. I. Finlay, 1907, Jour. Geology, v. 15, p. 586–589.

K. P. McLaughlin, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1939 (fig. 2), 1942–1947. As used in this report [Colorado Springs quadrangle], Glen Eyrie is considered formation (this follows Finlay's original usage). Most completely developed and best exposed section, approximately 360 feet thick, is in and near Black Canyon at north edge of Manitou embayment and approximately three-fourths mile southwest of Finlay's probable type locality. Most of exposures are in cuts along Rampart Range Road and Black Canyon loop, both constructed in recent years. Overlies Madison limestone; gradationally underlies Fountain formation.

Well exposed on Glen Eyrie Creek, El Paso County. Glen Eyrie Creek now known as Queens Canyon.

Glenham Gneiss[1]

Precambrian; Southeastern New York.

Original reference: C. E. Gordon, 1911, New York State Mus. Bull. 148, p. 11, 18, 25–27, 33, 34, 78, 79, 85, 104.

Exposed between Fishkill Landing and New Beacon Mountain, Poughkeepsie quadrangle.

Glenhaven Member (of Guttenberg Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9. Dolomite, about 3 feet thick. Shown on columnar section as underlying Buckhorn member (new) of Dunleith formation (new) and overlying Garnavillo member (new) of Guttenberg formation.

In copy of guidebook used by compiler, in figure 3, name Glenhaven had been crossed out and name Garnet inserted. However, in figure 9, the name Garnet had been used to replace the name Garnavillo. Since the compiler had no way to determine what changes, if any, had been made

in other copies of guidebook, it was impossible to be certain which names should be retained.

Occurs in Dixon-Oregon area.

Glenkirk Limestone[1]

Silurian (Niagaran) : West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 566, 578–582, 692.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 251. Foerste used name Glenkirk to include lithologically indistinguishable Laurel and Lego limestones where the Waldron shale cannot be recognized. This report does not consider name Glenkirk necessary.

Named for Glenkirk Landing, Wayne County.

Glenmary Shale (in Crooked Fork Group)

Pennsylvanian (Pottsville Series) : Eastern Tennessee.

C. W. Wilson Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes beds between top of Coalfield sandstone (new) and base of Wartburg sandstone. Thickness usually 40 to 80 feet; at type locality 50 feet; 64 feet in Crooked Fork section; in southeast corner of Barthell Southwest quadrangle 20 feet; disappears in northern part of this quadrangle as it is overlapped by Wartburg sandstone.

Named from Glenmary, Robbins quadrangle, Scott County.

†Glenn Formation[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. A. Taff, 1903, U.S. Geol. Survey Geol. Atlas, Folio 98.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Unit is a lumping of four series; name applies to all rocks below the Pontotoc and above the Caney shale.

Named for Glenn, Carter County.

Glenn Creek Shale Member (of Jefferson Limestone)[1]

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 42.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4 (facing p. 1788). Correlation chart shows age as Upper Devonian.

Type locality: On south side of southwestern peak of White Ridge. Named for Glenn Creek, whose middle branch heads at eastern base of White Ridge. On Saypo topographic sheet the names Glenn Creek and Moose Creek have been interchanged.

Glennon Limestone Member (of Lykins Formation)

Permian: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31, 36–40, fig. 8. Divided into number of distinct lithic units, several of which are persistent throughout the area. They are (ascending) hard brittle pinkish laminated limestone that ranges in thickness from 2 inches to 2½ feet; gray to white fine-crystalline limestone with frequent vugs and laminated

chert concretions; pink to gray irregularly laminated limestone; silty, impure laminated limestone; gray and pink limestone with distorted laminae; pink to gray regularly laminated limestone; and gray to pink coarsely crystalline vuggy imperfectly laminated limestone. Thickness at type locality 14 feet. Underlies Strain shale member (new); overlies Bergen shale member (new). Has been referred to commonly by various workers as "crinkled limestone."

Type locality: In quarry on south side of Turkey Creek, about 800 feet west of Glennon-Turkey Creek confluence, Golden-Morrison area, Jefferson County. Named from Mount Glennon, between Bear Creek and Turkey Creek and southeast of town of Morrison.

Glen Park Formation[1]

Glen Park Limestone Member (of Sulphur Springs Formation)

Glen Park Formation (in Hannibal Group)

Mississippian: Central eastern Missouri and southwestern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, 2d ser., v. 2, p. 110.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 20–23. In this report, name Hannibal is used for formations that lie above the Louisiana limestone and beneath the Chouteau. Glen Park, at base of group, unconformably overlies Louisiana limestone and conformably underlies Maple Mill formation.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, no. 5, p. 76–78. Ulrich proposed name Glen Park for oolitic limestone, the middle member of three constituting Sulphur Springs formation. Term Sulphur Springs abandoned in this report. Ulrich did not designate type locality, but it is evident that he had in mind the vicinity of Glen Park, a small community on Mississippi River in Jefferson County, Mo. Outcrops near there are designated as type locality. Thickness varies from a few inches to more than 20 feet. At type locality, probably no more than 30 inches should be assigned to formation. Separated from underlying strata by unconformity involving Kimmswick, Maquoketa, Chattanooga, and Plattin. Underlies Bushberg formation and in some areas Massie Creek sandstone (new). Upper Devonian. Outcrops form northwest-southeast trending band roughly paralleling Mississippi River through Ste. Genevieve, Jefferson, Franklin, St. Louis, St. Charles, and Warren Counties.

Type locality (Mehl, 1960): In SE cor. SE¼ NE¼ sec. 5, T. 41 N., R. 6 E., in old quarry face along river bluff above Missouri Pacific Railroad, south of Glen Park, Jefferson County, Mo.

Glenray Limestone (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 432.

P. H. Price and E. T. Heck, 1938, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 255, 264. Glenray limestone of Reger (1926) is represented in Greenbrier County by 10 to 60 feet of more or less impure limestone. Commonly a bluish-gray siliceous thick-bedded very fossiliferous limestone, belonging 100 to 150 feet above base of Mauch Chunk series. Above Lillydale shale and below Webster Springs sandstone. Bluefield group.

Type locality: On northwestern side of Greenbrier River, opposite Glenray, Summers County, W. Va.

Glenrock Limestone[1] Member (of Red Eagle Limestone)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Consists of gray and brown limestone, impure in northern part of outcrop area, purer in central and northern part; fusulines common. Thickness in northern part of Kansas 1 to 2 feet; in central Kansas as much as 19 feet. Underlies Bennett shale member; overlies Johnson shale. Wolfcamp series.

Named for exposures high in valley side just northwest of Glenrock, Nemaha County, Nebr.

Glen Rose Limestone[1] or Formation (in Trinity Group)

Glen Rose Limestone Member (of Shingle Hills Formation)

Lower Cretaceous: Texas.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 507.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 155–165. Glen Rose subgroup of Trinity group consists of Lower Glen Rose formation, Glen Rose anhydrite, and Upper Glen Rose formation. Lower Glen Rose includes Pine Island member below and Rodessa member above. Overlies "Travis Peak" formation; underlies Paluxy formation. Subsurface data.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5, 8. Rank reduced to member status in Shingle Hills formation (new). Overlies Hensell sand member.

F. E. Lozo and F. L. Stricklin, 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 67–78. At generalized reference section of Trinity division, Glen Rose limestone consists of lower unit and an upper unit. Lower subdivision, that is interval below *Corbula* bed, is predominantly massive medium- to thick-bedded limestone with local moundlike concentrations of corals and caprinids in basal and upper parts. The lower Glen Rose above the massive limestone is largely shale alternating with thin-bedded limestones and is highly fossiliferous with several levels of *Orbitulina*, the large Foraminifera used as a subsurface Glen Rose marker. Trinity section above *Corbula* bed consists predominantly of buff-colored shales and fine-grained dolomites in lower and upper parts with darker shales and more resistant fossiliferous limestone in middle. The alternating relation of these lithic types resulted in early designation of "Alternating Beds" for the Glen Rose strata. Formal name was proposed by Hill (1891) from exposures near Glen Rose, Somervell County. Upper limit of Glen Rose in this area is placed at concordant contact of uppermost dolomitic section with overlying limestones similar to those higher in Fredericksburg division. Glen Rose is completely exposed from Hamilton Pool eastward to the Shingle Hills and has local thickness of 525 feet. Overlies Hensell sand. Lower Glen Rose contains basal coral reef at narrows of Blanco River.

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J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2328–2363. Terms Glen Rose, Glen Rose undifferentiated, and Glen Rose subgroup, as used in this report [stratigraphy of Comanchean Cretaceous Trinity group], all refer to those rocks below top of Glen Rose as defined in Austin area and above top of either Pearsall formation or its equivalent. These terms are used in areas where the Ferry Lake is not recognizable. Undifferentiated Glen Rose time-stratigraphic unit is defined to include those rocks below isochronous surface contemporaneous with top of Glen Rose as defined in Austin area and above isochronous surface contemporaneous with base of Rodessa formation as defined in type area. Rusk formation (new) occupies stratigraphic interval formerly termed upper Glen Rose formation and Paluxy formation. Top of Trinity group, as term is used in present report, is defined as top of Glen Rose formation of the Austin area and its equivalents. Subsurface data.

Named for Glen Rose, Somervell County.

Glens Falls Limestone (in Trenton Group)[1]

Middle Ordovician: Eastern New York and northwestern Vermont.

Original reference: R. Ruedemann, 1912, New York State Mus. Bull. 162.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 260 (table 3), 262–263, 265 (fig. 10), 266 (table 4). Discussed under formations of Hull age of Trenton group. Includes Larrabee and Shoreham members (both new). In some areas, overlies Isle la Motte formation and in others Amsterdam formation; underlies Canajoharie formation. In some areas, Shoreham is member of Sherman Fall formation.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524 (table), 557–558. In west-central Vermont, overlies Orwell limestone (new) and underlies Hortonville shale. Consists of thin-bedded dark blue-gray rather coarsely granular limestone. Thickness about 115 feet. Kay's (1937) Larrabee and Shoreham members not readily distinguished in strongly folded beds east of Champlain thrust.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 31, 34. Trenton units recognized by Cady in west-central Vermont continue southward into Castleton quadrangle, although the Glens Falls is not certainly identified. A blue marble that may be Shoreham member is called Whipple marble in this report. Larrabee member may be present along Taconic overthrust in Ira, but name Whipple is used until correlation with Glens Falls is certain.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 30–32, 61–62. Formation described on Isle la Motte and South Hero Island, Vt., where both Larrabee and Shoreham limestone members are present. Overlies Lowville and Isle la Motte limestones; underlies Cumberland Head formation.

Named for exposures at Glens Falls, Warren County, N.Y.

Glenwood Shale or **Formation**

Glenwood Shale Member (of Platteville Formation)[1]

Glenwood Subgroup (of Ancell Group)

Middle Ordovician: Northeastern Iowa, western Illinois, southern Minnesota, and southern Wisconsin.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 61, 75.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 11 (fig. 3). Shown on columnar section as Glenwood subgroup of Ancell group (new). Includes (ascending) Kingdom, Daysville, Loughridge, and Harmony Hill formations (all new).

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 57, 58 (table 1); M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1030. Referred to as a formation overlying the St. Peter sandstone and underlying Platteville formation.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 275–277. Further described as shale member of Platteville. Type locality stated.

Type locality: Sec. 6, T. 98 N., R. 7 W., Winneshiek County, Iowa.

Glenwood Tongue (of Weber Sandstone)

Pennsylvanian-Permian: Western Colorado.

D. W. Vanderwilt, 1953, Rocky Mountain Assoc. Geologists Guidebook Field Conf., May 14–16, p. 15, fig. facing p. 12. Shown on columnar section below South Canyon Creek dolomite member of Maroon formation. Gray sandstone 200 feet thick.

Glenwood Springs area.

Glenwood Tuff

Pleistocene: Hawaii Island, Hawaii.

J. B. Stone, 1926, Bernice P. Bishop Mus. Bull. 33, p. 26, 27. Red clayey material about 10 feet thick; unstratified except for thin carbonaceous streaks. Correlated with Pahala ash.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 55–56. Maximum thickness about 12 feet. Underlies Olaa agglomerate (new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 83. Considered to be part of Pahala ash. Pleistocene.

Occurs on east slope of Mauna Loa near Glenwood, Ferndale, and Olaa.

Glenwood Canyon Member (of Dotsero Formation)

Upper Cambrian: Central northwestern Colorado.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 893–894, 897–899. Proposed to apply to all beds in Dotsero lying below a ledge-forming algal limestone herein named Clinetop algal limestone member. Lower half of member consists of thin beds of light-gray to tannish-gray dolomite, and a few thin beds of flat-pebble dolomite conglomerate, interbedded with thin beds of light greenish-gray very dolomitic shale; upper half consists of thin beds of flat-pebble limestone conglomerate and interbedded light greenish-gray very limy shale. Thickness about 91 feet. Overlies Sawatch quartzite.

Type locality: In Glenwood Canyon in SE¼ sec. 16, T. 5 S., R. 87 W., Garfield County.

†Globe Limestone[1]

Devonian and Carboniferous: Southeastern Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

Named for development at and around Globe, Gila County.

Glorieta Sandstone[1]

Glorieta Sandstone Member (of San Andres Formation)

Permian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257, 262; Conspectus of geologic formations of New Mexico, p. 2, 7.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1662–1664. Because of its wide distribution, persistence of lithology, bold topographic expression, and stratigraphic importance, Glorieta is considered to be formation. Overlies Yeso formation; underlies San Andres formation. Maximum thickness 278 feet in Zuni Mountains. Type locality designated.

C. B. Read and D. A. Andrews, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 8. Shown on columnar section as basal member of San Andres formation. Thickness 100 to 250 feet. Underlies unnamed limestone member; overlies Yeso formation.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Member described in northwestern Mora County where it is about 266 feet thick near Ocate. Underlies Bernal formation; overlies Yeso formation in extreme southwestern part of mapped area and elsewhere Sangre de Cristo formation.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 7 (fig. 2), 10, 11, pl. 1. Member described in Puertecito quadrangle where it is about 230 feet thick. Underlies unnamed middle evaporite member. Gradationally overlies Los Vallos member of Yeso formation; contact placed above uppermost siltstone bed, so that basal part of Glorieta consists entirely of sandstone, which is pinkish at base.

C. H. Dane and G. O. Bachman, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–224. Considered of formational rank.

Type section: Glorieta Mesa 1 mile west of village of Rowe, San Miguel County. Section lies in south-central part T. 15 N., R. 12 E.

Gloucesterian (Gloucester) Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Collingwood and Gloucester are stages in latest Trenton.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30–31. Trenton group was divided by Raymond (1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56) into succession of faunal zones that he thought time-stratigraphic but which he called formations. In time these became stages: Rocklandian, Kirkfieldian, Shorehamian, Denmarkian, Cobourgian, Collingwoodian, and Gloucesterian of Kay (1937; 1943; 1948). The Cobourg-Collingwood-Gloucester seems to be time-equivalent to Utica group, but name Utica is strongly associated with black shale facies. Hence, term Pictorian stage is applied to uppermost Trentonian.

Name derived from Gloucester Township, Carleton County, Ontario, Canada, for which Gloucester shale is named.

Goathaunt Member (of Siyeh Formation or Limestone)[1]

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1895. Limestones, dolomites, and subordinate oolites, dolomitic sandstones, and argillites, thickly bedded; prevailingly dark gray. Mud breccias, abundant in northern exposures. Mud cracks common in carbonaceous layers. Thickness 2,000 to 3,200 feet. Overlies a *Collenia symmetrica* zone; separated from overlying Granite Park member by *C. frequens* zone. Type locality designated.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 137, 138. Discussion of stromatolites of Belt series. Goathaunt member of Fenton and Fenton is represented in *Collenia symmetrica* zone 1.

Type locality: South wall of cirque between Mount Goathaunt and Mount Cleveland, Glacier National Park. Well exposed in high peaks of Waterton-Glacier Parks.

Goat Island Member (of Lockport Formation)

Middle Silurian (upper Niagaran): Western New York, and southern Ontario, Canada.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Name proposed to replace preoccupied name, Suspension Bridge, first used for a lower Ordovician formation in New Brunswick. Underlies Eramosa member; overlies Gasport limestone member.

T. E. Bolton and B. A. Liberty *in* A. J. Mozola, chm., 1955, Michigan Geol. Soc. [Guidebook] Ann. Field Trip [no. 19], p. 29. Described in Niagara Escarpment of Ontario as a thick sequence of dolomites. Essentially thick-bedded gray to buff dolomite. Abundant chert nodules and lenses occur at base. Upper limit arbitrarily drawn at first occurrence of bituminous material characteristic of Eramosa member. Maximum thickness 80 feet in Hamilton region.

Named for Goat Island at brink of Niagara Falls, N.Y.

Goat Rock pyroclastic deposits.

Quaternary: Southwestern Washington.

Jean Verhoogen, 1937, California Univ. Dept. Geol. Sci. Bull., v. 24, no. 9, p. 274–277. Name applied to pyroclastic deposit consisting of angular blocks, some of them weighing several tons, scattered in a loose fine muddy matrix. Deposit is characterized by occurrence of "bread-crusted" bombs. Deposit is narrow; greatest width nowhere exceeds five-eights of a mile.

Occurs in an area between the northeast corner and the outlet of the small glacier which hangs between Goat Rock and "The Lizzard", on north side of Mount St. Helens.

Goat Seep Limestone or Dolomite

Permian (Guadalupe Series): Western Texas and eastern New Mexico.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 588–589, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 38–41, pls. 2, 3. Along west side of Guadalupe Mountains north of Bone Spring, Getaway, and South Wells, limestone members of Cherry Canyon formation thicken northward, and intervening sandstones disappear. On projecting point of escarpment, 1½ miles north of the spring, upslope from top of Bone Spring flexure, the limestones coalesce into solid mass, here termed Goat Seep limestone. Thickens rapidly from 700 feet at southernmost exposure to Bartlett Peak, 1 mile north, where it is 1,200 feet thick. On

Bartlett Peak, consists of gray dolomitic limestone, which forms thick beds in lower half of formation; upper half is single mass with few traces of bedding. The thick-bedded and massive limestones are probably reef deposits. Interfingers with Manzanita limestone member of Cherry Canyon formation; overlies sandstone tongue of Cherry Canyon; underlies Carlsbad limestone; interfingers with Queen sandstone member of Chalk Bluff formation. Unit was described by Crandall (1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 933) who called it Chupadera limestone, and by Lang (1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7) who called it Dog Canyon limestone; this latter name now abandoned.

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 42–43. It has been determined that Queen formation is equivalent to much, if not all, of shelf phase of King's Goat Seep dolomite. Because of confusion introduced by applying name Goat Seep to shelf, reef, and forereef facies, it is proposed to restrict name Goat Seep to reef and forereef talus facies, a nomenclatural device that has served well with Capitan formation.

Name is taken from Goat Seep, on western slope of Guadalupe Mountains, 1½ miles northwest of Guadalupe Peak, Culbertson County, Tex.

Gobbler Formation (in Magdalena Group)

Pennsylvanian (Morrowan?-Missourian): Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Consists of limestone, sandstone, and shale. Coarse quartz sandstone in lower part. Includes massive gray cherty Bug Scuffle limestone member which grades laterally into sandstone and shale. Thickness as much as 1,600 feet. Underlies newly named Beeman formation and overlies Helms formation.

In Sacramento Mountains, Otero County.

Gober Tongue (of Austin Chalk)[1]

Upper Cretaceous: Northeastern Texas.

Original reference: L. W. Stephenson, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, p. 8–12, pl. 1.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 133–146. Mentioned in discussion of stratigraphic relations of Austin, Taylor, and equivalent formations.

Named for occurrence at village of Gober, Fannin County.

Goble Volcanic Series

Goble Volcanics Member (of Cowlitz Formation)

Eocene, upper: Northwestern Oregon and southwestern Washington.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 42. Name applied to a section of widespread basic flows and pyroclastic rocks with some associated sediments. Basal part of series interfingered with tuffaceous sediments which contain a Cowlitz (upper Eocene) fauna. Thickness 5,000 feet or more, measured along U.S. Highway 99 between Woodland and Kelso, Wash.

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 16 (fig. 5), 59–62, 65. Described in lower Cowlitz River-eastern Willapa Hills area, southwestern Washington. Here Goble volcanics are represent-

ed by basaltic flows and flow breccia interbedded with both marine and coal-bearing Cowlitz sediments. Aggregate thickness of intercalated rocks less than 1,000 feet. In this area, name Goble volcanics member of Cowlitz formation is used for rocks which constitute a much thicker unit of formational rank elsewhere. Volcanics interfinger with sediments of underlying Olequa Creek member (new) and thin and wedge out toward northwest of mapped area.

Named for exposures in vicinity of Goble, Columbia County, Oreg. Series crops out along both the Oregon and Washington sides of Columbia River.

Goddard Shale Member (of Springer Formation)

Goddard Formation or Shale (in Springer Group)

Pennsylvanian: Oklahoma.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 143. Proposed to replace term "Pennsylvanian Caney." Consists of uniform dark shales with some thin concretionary layers between top of Mississippian rocks (commonly the Caney shale of Meramec age according to Ulrich, 1927, Oklahoma Geol. Survey Bull. 45) and base of Rod Club sandstone. Thickness at least 2,000 feet in type area. Springer series. Name credited to J. M. Westheimer.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as member at base of Springer. Pennsylvanian.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2), 74–89. In southern Arbuckle Mountains, includes Redoak Hollow sandstone member (new) in middle part. Mississippian (Chester).

J. M. Westheimer, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 392–396. Name was proposed for pre-Springer "Pennsylvanian" sediments. Because Goddard shales are indistinguishable from shales above the Rod Club sandstone, it had been proposed that base of Springer group be extended downward to top of the Caney. In view of new faunal evidence, the Goddard should not be included in the Springer and Mississippian-Pennsylvanian boundary should be drawn at base of Rod Club.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 8–10. Formation comprises lower half (Chesterian part) of Springer group as defined here.

C. W. Tomlinson, 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 323. Includes Grindstone Creek member (new) in upper part. Mississippian (precise systemic boundary open to question).

C. W. Tomlinson and Allan Bennison, 1960, Oklahoma Geology Notes, v. 20, no. 5, p. 123–124. Tiff member proposed to replace preoccupied name Grindstone Creek member of Tomlinson, 1959.

Type locality: Along Oil Creek, secs. 19 and 20, T. 3 S., R. 4 E., on Goddard Ranch about 7 miles east of Gene Autry (Berwin on older maps), John-

ston County. Section starts on west side of Oil Creek in SE¼ sec. 18 where contact between Caney and Goddard shales is well exposed, and extends in southwesterly direction to base of Rod Club sandstone.

Godfrey Shales (in Asuncion Group)

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 132 [preprint]. Underlies Cantinas sandstones (new); overlies Piedras Altas formation (new).

Santa Lucia Range is mountainous area, between Salinas Valley and the coast, which extends from Monterey Bay to central part of San Luis Obispo County.

Godfrey Flat Shale

See Godfrey Shales (in Asuncion Group).

†Godiva Limestone[1]

Ordovician to Mississippian: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 624.

Tintic district.

Godiva[1] or Goldiva limestone[1]

Eocene: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 279, 308.

Tintic district.

Gods Pocket Dacite

Pliocene(?): Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI-690, Book 2, p. 306. Sequence of dacite flow material about 700 feet thick. Disconformably overlies Jarbidge rhyolite (new) and locally separated from it by 30 to 50 feet of pale-gray vitric tuff.

U.S. Geological Survey currently considers the Gods Pocket Dacite to be Pliocene(?) in age.

In northeastern quarter of Jarbidge quadrangle.

Goen Limestone (in Millsap Lake Formation)[1]

Goen Limestone Member (of Grindstone Formation)

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1929, Geologic map of Pinto County: Texas Bur. Econ. Geology.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Grindstone Creek formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 19–20, fig. 3. In Parker County, limestone is 1 to 2 feet thick and is gray to yellowish gray. Limestone either lenses out to east, or its eroded edge is covered by debris from dissected dip slope of underlying sandstone. Occurs at top of formation. Overlies unnamed sandstones above the Santo limestone member; underlies Mingus member of Garner formation. Report follows classification of Cheney (1940) [but also refers to this unit as a limestone bed].

Well exposed on north side of Millsap-Brazos Road one-half mile northeast of Goen Cemetery entrance, Palo Pinto County.

†Goff coal group (in Williams Fork Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: E. T. Hancock and J. B. Eby, 1930, U.S. Geol. Survey Bull. 812, p. 206.

Meeker quadrangle.

†Gogebic Series[1]

Precambrian: Michigan.

Original reference: C. R. Van Hise and C. K. Leith, 1909, U.S. Geol. Survey Bull. 360, p. 137, 308–309.

Gogebic district, Lake Superior region.

Golconda Formation[1]

Golconda Formation (in Homberg Group)

Golconda Limestone (in Stephensport Group)

Upper Mississippian (Chester Series): Southern Illinois, northwestern Alabama, northwestern Georgia, southern Indiana, western Kentucky, southeastern Missouri, and western Tennessee.

Original references: A. D. Brokaw, 1916, Illinois Geol. Survey Extr. from Bull. 35; 1917, Illinois Geol. Survey Bull. 35, p. 19–29.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 830–831. Assigned to Homberg group (new). In standard Mississippian section, underlies Hardinsburg sandstone and overlies Cypress sandstone. Attains maximum thickness of more than 100 feet. Youngest formation present in Perry and Ste. Genevieve Counties, Mo., where it is gray crystalline limestone; in Perry County, overlaps the Ruma and rests unconformably on Paint Creek formation. In Indiana, overlies Indian Springs shale.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 42, 47–48. Geographically extended into Georgia where it occurs on Lookout Mountain. Underlies Hartselle sandstone; overlies Gasper limestone.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 5–25. Golconda section is (ascending) Beech Creek (lower Golconda) limestone, Fraileys (middle Golconda) shale (new) or Big Clifty, and Haney (upper Golconda) limestone (new). Section overlies Cypress sandstone and underlies Hardinsburg sandstone.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 3. Shown on chart of evolution of stratigraphic nomenclature in Chester series of Indiana as Golconda formation; underlies Hardinsburg formation and overlies Big Clifty formation, here used to replace Cypress sandstone. As shown on chart, Golconda includes unit formerly termed Indian Springs shale. Thickness 40 to 50 feet. Term Homberg group not used in Indiana.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. In northwestern Alabama, strata referred to by Butts (1926, Alabama Geol. Survey Spec. Rept. 14) as Golconda formation are included in Green Hill member of Pride Mountain formation (both new).

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 39–40, pl. 1. Included in Stephensport group (redefined). In Indiana, as recently as 1957 rocks considered to belong to Golconda formation have included an upper limestone member and a lower shale member. The shale appears to be more closely related to underlying Big Clifty formation, and it is here proposed to restrict name Golconda to the limestone and refer to unit as Golconda limestone. Thickness in Huron area [this report] 19 to 32 feet. Conformably overlies Big Clifty formation: underlies Hardinsburg formation with contact transitional.

Named for Golconda, Pope County, Ill.

Gold Basin Formation

Recent: Southeastern Utah.

G. M. Richmond, 1956, Dissert. Abs., v. 16, no. 6, p. 1128. Consists of two members comprising 10 lithofacies. Tills form two sets of small cirque moraines or rock glaciers. Weakly developed Spanish Valley soil is developed on lower member. No soil, or only a faint humus, is formed on upper member. Younger than Beaver Basin formation (new).

Located in La Sal Mountains area.

Gold Butte Granite

Precambrian: Southeastern Nevada and northwestern Arizona.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, p. 1405–1406. Pinkish gray, coarse-grained, and distinctly porphyritic granite. Unconformably underlies Cambrian rocks.

Prominent in Gold Butte, Nev., from which it takes its name. Distributed widely in southern Virgin Mountain block. Exposed at head of Virgin Canyon.

Gold Creek Quartzite[1]

Middle(?) Cambrian: Northern Idaho.

Original reference: E. Sampson, 1928, Idaho Bur. Mines and Geology Pamph. 31, p. 9.

C. E. Resser, 1938, Smithsonian Misc. Colln., v. 97, no. 3, p. 2. Estimated average thickness 400 feet. Distinguished from underlying Beltian strata by coarser grain. Underlies Rennie shale. Middle Cambrian.

Named for exposures on North and South Gold Creeks near Lakeview. Conspicuous outcrops on summit of ridge above cement rocks plant at Port Rock.

†Golden Formation or Group[1]

[Upper Cretaceous]: Central Colorado.

Original reference: A. C. Veatch, 1907, Jour. Geology, v. 15, p. 548.

Probably named for Golden, Jefferson County.

Golden Member (of Arapahoe-Denver Formation)

Tertiary: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 100 (fig. 23), 103, 104. Light-tan to light-brown silts, clays, silty shales, clayey sands, and some medium-grained sandstones. Thickness ranges from 60 feet on South Table Mountain to 76 feet on north side of North Table

Mountain. Overlies Pleasant View member (new); immediately underlies capping basalt flow of North and South Table Mountains.

Type section: On eastern extremity of South Table Mountain; NW¼ sec. 31, T. 3 S., R. 69 W., Morrison quadrangle, Jefferson County. Recognized only on slopes of Table Mountains.

Golden Eagle Limestone[1]

Pennsylvanian: Southwestern Illinois.

Original reference: H. E. Culver, 1925, Illinois Geol. Survey Coop. Min. ser., Bull. 29, p. 20.

Probably named for exposures at or near Golden Eagle, Calhoun County.

†Golden Gate Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Listed as basal formation in Chico series; underlies Mills formation (new).

J. M. Kirby, 1943, California Div. Mines Bull. 118, pt. 3, p. 606. Described as a sandstone varying in thickness from 3,000 to 3,500 feet. Derivation of name given.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282 (footnote). Name preoccupied; replaced by Venado formation.

Name derived from prominent gap in the sandstone rimrock in W½ sec. 9, T. 17 N., R. 4 W., through which Funks Creek flows, Colusa County.

†Golden Gate Series[1]

Jurassic(?): Western California.

Original reference: H. W. Fairbanks, 1895, Jour. Geology, v. 3, p. 416–426.

Named for development on north and south shore of Golden Gate, San Francisco County.

Golden Gate Hill Andesite

Neocene: Central California.

F. L. Ransome, 1899, U.S. Geol. Survey Geol. Atlas, Folio 63, p. 6. Consists in main of andesitic-breccia and conglomerate capped by thick mass of hornblende-andesite similar to Jackson Butte andesite (new).

Forms Golden Gate Hill, Calaveras County, Mother Lode district.

Golden Horn Granodiorite

Post-Lower Cretaceous: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 17–18. Later than Lower Cretaceous sediments and their folding. Intrudes Black Peak granodiorite and quartz diorite (new).

Golden Horn Peak is in Okanogan County. Composes a number of peaks including Methow Pinnacles and Mount Hardy, Golden Horn, the Needles, and Tower Mountain, Cutthroat Peak, Liberty Bell, and Silver Star.

Golden Ray Limestone[1]

Middle Cambrian: Central northern Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

Probably named for Golden Ray mine, Tintic district.

Goldens Ranch Formation

Eocene: Central Utah.

Siegfried Muessig, 1951, Science, v. 114, no. 2957, p. 234. Series of tuffs, bentonites, and volcanic boulder conglomerates; includes Sage Valley member (new) 820 feet above base. Conformably overlies Green River limestone. Volcanic conglomerates grade laterally into volcanic breccias that are part of latite series in northern part of area and in Tintic district.

Well exposed in roadcuts along U.S. Highway 91, in Long Ridge area, southwest of Levan, Juab County. Derivation of name not stated.

Golden Valley Formation

Eocene: Southwestern North Dakota.

W. E. Benson and W. M. Laird, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1166–1167. Consists of fine-grained micaceous sands with minor amounts of light-colored clays and shales; these sands and shales overlie a basal sequence of hard white to dark-gray clays, and locally, lignites; middle part of basal sequence is characteristically mottled reddish yellow on weathered surfaces and forms good marker bed. Formation includes beds bearing fossil fern *Salvinia preauriculata*. Unit has been referred to as unnamed formation of Wasatch group. Overlies Sentinel Butte shale member of Fort Union; unconformably underlies Oligocene White River group.

W. E. Benson, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1873–1874. Conformably overlies Tongue River member of Fort Union.

E. G. Meldahl, 1956, North Dakota Geol. Survey Rept. Inv. 26. Overlies Sentinel Butte shale herein considered member of Tongue River formation.

Great Northern Railway Co. Mineral Research and Devel. Dept., 1958, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 5, p. 5–23. In area of Mountrail County, includes White Earth, South Ross, Lakeside, and East Tioga clay beds.

Type exposure: Near town of Golden Valley, Mercer County.

†Golden Wall Sandstone (in Blair Formation)[1]

Upper Cretaceous (Montana): Southwestern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 48, 155.

Forms main scarp surrounding Baxter Basin, Sweetwater County. This scarp is commonly referred to as the "golden wall."

Gold Hill Conglomerate[1]

Triassic(?): Southwestern Colorado.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

Gold Hill, Ouray district.

Gold Hill Formation[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. No fossils were found in formation of Manhattan district, Toquima Range, but trilobite of Early Cambrian age (*Olenellus gilberti* Meek) was found in rocks of same lithology and stratigraphic position in

Toyabe Range near Jett Canyon. Therefore, established formation name is extended to Cambrian of both ranges. Consists chiefly of quartzite, quartz mica schist with some slate, and beds of crystalline dolomitic limestone, with locally some oolitic limestone in its upper part. Base not exposed; estimated exposed thickness at least 3,000 feet in Toyabe Range north of Summit Creek. Conformably underlies Ordovician Palmetto formation. Probably equivalent to Silver Peak group (Turner, 1902).

Type locality: Gold Hill in Manhattan district, Toquima Range.

Gold Hill Phyllite

Age(?): Northwestern Washington.

J. A. Vance, 1957, Dissert. Abs., v. 17, no. 9, p. 1984. A low grade metamorphic rock.

Occurs in Sauk River area in northern Cascades.

†Gold Hill Porphyry[1]

Eocene: Western central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Geol. Atlas, Spec. Folio 48.

On Gold Hill, Tenmile district.

Gold Mountain Phyllite

Age not stated: Northern Washington.

R. W. Jones, 1959, Dissert. Abs., v. 20, no. 3, p. 994. Much of eastern part of map area is underlain by broad belt of Gold Mountain phyllite which is flanked on west by belt of Finney greenschist (new). In fault contact with Sutter Mountain unit (new). Occurs in anticlinorium.

Report discusses geology of Finney Peak area, northern Cascades.

Gold Park Gabbro-Diorite

Precambrian: Southern California.

W. J. Miller, 1938, Geol. Soc. America Bull., v. 49, no. 3, p. 419–420. Consists of a variety of rather basic igneous rocks, but average mineral composition is about that of gabbro-diorite. Includes a massive facies and a "salt and pepper" facies. Considered older than Palms granite (new). Cut by White Tank monzonite (new).

Named from an occurrence in Gold Park Canyon, near Twenty-nine Palms, Riverside County.

Gold Road Latite[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 34, map.

Named for settlement and mine, both of which are called Gold Road, Oatman district.

Goler Formation

Eocene to Miocene, lower: Southern California.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1), 19–25, pls. 1, 2, 3. Consists of some 6,500 feet of terrestrial conglomerate, sandstone, and clay. Comprises two unnamed members. Unconformably underlies Ricardo formation; unconformably overlies basement rocks; southwest from type section the Goler is overlapped by the Ricardo. Age shown on columnar section as Eocene-Oligocene-Miocene.

M. C. McKenna, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 4, p. 512–515. Paleontological evidence indicates that most and probably all of formation is at least as old as early Tertiary.

Type section: Exposed in drainage area of Goler Gulch and northwestward to east slope of Black Hills, Saltdale quadrangle, Kern County.

Golf Course Formation (in Dornick Hills Group)

Pennsylvanian (Morrow Series): Southern Oklahoma.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 138–139. Includes Primrose sandstone member at base and Otterville member at top. Primrose sandstone, and shale between it and the Otterville, are transferred from the Springer group to the Dornick Hills. Thickness at type locality 1,400 to 1,500 feet. Entire sequence, which carries large and varied Morrow fauna, includes all rocks generally recognized as of Morrow age in Ardmore basin. South of Ardmore, Jolliff conglomerate is lowest unit so recognized. In Harrisburg trough, formation is divided into (ascending) Rowland (new), Limestone Gap, and Otterville members. Unconformably underlies Lake Murray formation (new); unconformably overlies rocks of Springer group.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 18. Morrowan series, in Ardmore basin, includes maximum of about 2,000 feet of strata from base of Primrose sandstone to a horizon above Otterville limestone and below Bostwick conglomerates. This is sequence of strata which Harlton (1956) has designated Golf Course formation.

Type locality: Along a creek in SW¼SW¼ sec. 7, T. 4 S., R. 2 E., Carter County. Name derived from golf course of Dornick Hills Country Club, type locality of Dornick Hills group.

Goliad Sand[1]

Goliad Formation

Pliocene: Southern Texas.

Original reference: J. T. Lonsdale and J. R. Day, 1933, Ground-water resources of Webb County, Texas: U.S. Geol. Survey Press Bull. 68861.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1726–1732. Termed formation. Includes Lagarto and Lapara formations of Dumble as members. Unconformably underlies Willis or younger Pleistocene. Composed of limestone, gray and black chert, and fossil wood, all commonly interbedded with sand or intermixed with clay balls. Dips coastward about 25 feet per mile; near downdip edge of outcrop, probably reaches average thickness of about 500 feet.

J. H. Quinn, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1292. On basis of fauna, considered late-upper Miocene.

Named for exposures along San Antonio River at Goliad, Goliad County.

Gonic Formation[1]

Pennsylvanian(?): Southeastern New Hampshire and southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 199.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 460. Katz (1917) assigned to Gonic formation schists, in Dover quadrangle to the east, that are continuous with Littleton formation in Mount Pawtuckaway quadrangle [this report].

Named for exposures near Gonic, Strafford County, N.H.

Gonzales Limestone Member (of Graham Formation)[1]

Gonzales Formation (in Graham Group)

Gonzales Shale (in Caddo Creek Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: C. S. Ross, 1921, U.S. Geol. Survey Bull. 726–G, p. 307.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 18–19. Member of Graham formation. Well exposed on high westward-facing bluff in southside of Brazos River and southeast of Salem Bend, where it is 18 feet thick. This is only place where complete unweathered section was noted in area of this report [Brazos River valley]. Separated from underlying Salem School member (new) by unnamed interval of shale and sandstone; underlies sandstone interval below Bunger limestone member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as formation in Graham group. Includes Salem School limestone member. Occurs below North Leon formation and above Home Creek limestone in Caddo Creek group. Cisco raised to series rank in this report.

C. E. Davis, 1956, *in* North Texas Geol. Soc. Field Guidebook, May 25–26, p. [6], fig. 2. Shown on correlation chart as Gonzales shale in Caddo Creek group.

Named for Gonzales Creek, Stephens County.

†Gonzales Shale[1]

Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer, 1929, Geologic map of Palo Pinto County: Texas Bur. Econ. Geology; O. F. Hedrick, E. Owens, and P. A. Myers, 1929, Geologic map of Shackelford County: Texas Bur. Econ. Geology.

Palo Pinto, Shackelford, and Stephens Counties.

Gonzales Creek Shale Member (of Graham Formation)[1]

Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31; 1922, Texas Univ. Bull. 2132, p. 127–134.

Named for Gonzales Creek in Eastland County.

Goodbread Sandstone Member (of Manning Formation)

Eocene (Jackson): East-central Texas.

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 166–171. Name applied to a sandstone in the Manning formation about 100 to 150 feet above the top of the Carlos sandstone. Thickness near type locality 5 to 30 feet; in Brazos County 40 to 50 feet. Separated from overlying Tuttle sandstone [member] (new) by a 75-foot interval that contains shales, shaly sandstone, lignitic beds, and ash beds. Unit had been mapped as part of Carlos sandstone by Renick (1936).

Type locality: On Lake Creek 1 mile west of Carlos, Grimes County.

Goodenough Member (of Franconia Sandstone)[1]

Upper Cambrian: Southwestern Wisconsin.

Original reference: A. C. Trowbridge and others, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 81, 92, 134, 140, 159, 446, 449, 455.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1239. Name Taylor Falls member (new) used in Minnesota in preference to extending term Goodenough member.

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 864. Name abandoned. Franconia member names used by Twenhofel, Raasch, and Thwaites (1935) are geographic names applied to faunal zones. New member names are proposed to designate rock types, because distribution of faunal zones in formation is largely independent of natural rock units. Goodenough member is *Conaspis* zone. This fauna occurs most abundantly in Tomah member and less abundantly in underlying Birkmose and overlying Reno members.

Type locality: Goodenough Hill, between Elroy and Mauston, Juneau County.

†Good Hope Formation[1]

Pliocene(?): District of Columbia and southern Maryland.

Original reference: W. B. Clark, 1890, Johns Hopkins Univ. Circ., v. 9, no. 81, p. 69–70.

Named for Good Hope Hill, D.C.

Goodland Limestone (in Fredericksburg Group)[1]

Goodland Formation (in Fredericksburg Group)

Lower Cretaceous (Comanche Series): Southwestern Arkansas, central southern and southeastern Oklahoma, and northeastern Texas.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 514.

B. F. Perkins, 1957, Dissert. Abs., v. 17, no. 6, p. 1310; 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 15–21, pl. 2. Formation described in Fort Worth-Weatherford area, Texas, where it is subdivided into Marys Creek marl member below and Benbrook limestone member above (both new). Thickness about 120 feet. Conformably and gradationally overlies Walnut marl; conformably underlies Kiamichi formation.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16–17, 31–34, pl. 1. Described in McCurtain County, Okla., where it is 25 to 50 feet thick, conformably overlies Paluxy sand and conformably underlies Kiamichi formation. Walnut clay, which underlies Goodland in other parts of Oklahoma and Texas, not identified in McCurtain County.

F. E. Lozo and others, 1960, Texas Bur. Econ. Geology Pub. 5905, p. 4. East of type locality, formation thickens to as much as 75 feet of more massive and purer limestone with rudists common in upper part and is in part same facies developed in Edwards limestone of Brazos River valley, Texas. Along outcrop south of Red River, formation thickens to about 125 feet west of Fort Worth. Near Tarrant-Johnson County line upper part is marked by massive beds containing rudists, lower part becomes argillaceous, and formation passes by transition into the Edwards, Comanche Peak, and upper Walnut of Brazos Valley section.

In northeastern Texas only, formation includes Walnut Shaly Member. Elsewhere the Walnut is considered formation in Fredericksburg Group.

Named for Goodland, Choctaw County, Okla. Old settlement of Goodland is present site of Good Switch on St. Louis and San Francisco Railroad, 3 miles south of Hugo, not present-day Goodland, 3 miles southwest of Hugo.

Goodnight Formation[1]

Pliocene: Northwestern Texas.

Original reference: W. F. Cummins, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 201–203.

Named for Goodnight, Armstrong County.

Goodrich Quartzite[1] (in Baraga Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 591.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Lowermost formation of newly defined Baraga group. Underlies Hemlock formation; overlies Vulcan iron-formation.

Named for exposures at Goodrich mine in Marquette Range, Iron County.

†Goodridge Formation[1]

Goodridge Limestone

Pennsylvanian: Southern Utah.

Original reference: E. G. Woodruff, 1912, U.S. Geol. Survey Bull. 471, p. 80.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 146 (fig. 2). Appears on correlation chart as Goodridge limestone. Pennsylvanian.

Named for town of Goodridge, now known as Mexican Hat.

Goodsprings Dolomite[1]

Upper Cambrian to Devonian(?): Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 11.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 375, p. 38–40, pl. 1. Described in Ivanpah quadrangle (California-Nevada), where it is mapped in San Bernardino County, Calif. Underlies Sultan limestone; overlies Bright Angel shale or Pioche shale. Upper Cambrian to Devonian. Hazzard and Mason, working in Providence and Marble Mountains, and Hazzard, working in Nopah Range, have made fossil collections, and, with other workers, have attempted to correlate faunal zones found in beds equivalent to the Goodsprings dolomite; as a result they have given formation names to following units: Cadiz formation, about 700 feet thick, probably Middle Cambrian; Bonanza King formation, about 1,500 feet thick, Middle Cambrian; Cornfield Springs, about 3,000 feet thick, Middle Cambrian; and Nopah formation, Upper Cambrian. Hazzard also recognizes units equivalent to Pogonip limestone (Lower Ordovician), Eureka quartzite (Middle Ordovician), Ely Springs dolomite (Upper Ordovician), and an unnamed unit of Silurian age. Validity and significance of faunal zones and correlations not discussed in this report.

Named for exposures near town of Goodsprings, Goodsprings quadrangle, Clark County, Nev.

Goodwin Limestone (in Pogonip Group)

Goodwin Formation[1]

Goodwin Formation (in Mount Hamilton Group)

Lower Ordovician: Central Nevada.

Original reference: C. D. Walcott, 1923, Smithsonian Misc. Colln., v. 67, no. 8, p. 466–467, 475.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 25–27. Goodwin limestone lowest formation in Pogonip group (redefined), stratigraphically restricted to exclude beds now assigned to Windfall formation (new) which originally were included in Goodwin formation (of Walcott). Composed dominantly of well-bedded fairly massive light-gray limestone. Platy limestones occur locally. Light-gray to white chert common in lower 350 feet of unit; decreases in amount in higher beds. Much of limestone very fine grained or aphanitic. Thickness ranges from 900 to 1,100 feet in Eureka area, and about 1,650 feet in Antelope region. Underlies Ninemile formation (new); overlies Windfall formation.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 17–19, pl. 1. Reallocated to Mount Hamilton group (new). Comprises two members: lower, platy yellow and blue limestone about 800 feet thick; and upper, dolomite, about 700 feet thick. Basal formation of group; underlies Pogonip formation; overlies Dunderberg shale. Upper Cambrian. In White Pine district, forms peak of Mount Hamilton and extends along ridge from Seligman thrust south to Ophir fault; makes up greater part of upper plate of Monte Cristo thrust. [Editor's note states that since completion of Humphrey's ms., unit here called Goodwin has been named Windfall formation at Eureka by Nolan, Merriam, and Williams (1956) and Goodwin has been used by them for basal formation of their Pogonip group.]

Type locality: On either side of Goodwin Canyon just east of Hill 7708 of Eureka mining district quadrangle, where limestone is well exposed. Also recognized in Antelope Valley area. Named for Goodwin Canyon.

Goodwinian series[1]

Lower Ordovician: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 78.

Goodwyn Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 358.

Type locality: Along Princeton-Narrows Road on Fivemile Creek, at Goodwyn Chapel, Mercer County.

Goodwyn Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 359–360.

Type locality: Along Princeton-Narrows Road on Fivemile Creek, at Goodwyn Chapel, Mercer County.

Goose Creek Granite[1]

Precambrian: Central southern Montana.

Original reference: T. S. Lovering, 1929, U.S. Geol. Survey Bull. 811A, p. 16.

Occurs in Cooke district, southeastern corner of Park County. Goose Creek flows over it for practically its entire length.

†Goose Creek Marl[1] or phase[1]

Pliocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, 19.

Named for exposures at Yeaman's Hall, on Goose Creek, north of Charleston, Berkeley County.

Goose Egg Formation

Permian and Lower Triassic: Eastern Wyoming and central northern Colorado.

C. A. Burk and H. D. Thomas, 1956, Wyoming Geol. Survey Rept. Inv. 6, p. 3–10. Sequence of interbedded red to ocher shales and siltstone, thin limestones, gypsums, and limestone breccias. Unconformably overlies Tensleep, Casper, Hartville, or Minnelusa formations; conformably underlies Chugwater or Spearfish formations. At typical exposure, unit is 380 feet thick; overlies Casper formation and underlies Chugwater formation. Measured section at Goose Egg post office shows that formation comprises (ascending) shale and siltstone, 70 feet, represents Opeche shale of central and eastern Wyoming; gray fossiliferous limestone, 10 feet, represents Minnekahta tongue of Phosphoria; shale and siltstone, 58 feet, represents Glendo shale of central and eastern Wyoming: gray to purple limestone, 22 feet, represents Forelle tongue of Phosphoria; unnamed shale and siltstone, 40 feet; gypsum with interbedded limestone, 98 feet; purple to gray limestone, 6 feet, Ervay member; shale and siltstone, 48 feet; limestone and sandstone, 18 feet, Little Medicine member; and shale and siltstone, 10 feet, known to be facies of Dinwoody and Phosphoria formations of western Wyoming. Middle Permian and Lower Triassic.

N. C. Privrasky and others, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 48–55. Formation divided into several mappable units all of which had been assigned names prior to definition of formation. Comprises (ascending) Opeche shale, Minnekahta limestone, Glendo shale, Forelle limestone, lower unnamed shale member, Ervay limestone, upper unnamed shale, and Little Medicine members. Top of formation can be mapped on surface when Little Medicine member can be identified, but, where Little Medicine grades into gypsum anhydrite sequence in Powder River Basin, it is generally difficult to determine top of formation; the top, however, can be picked accurately in subsurface. Permian-Triassic.

J. C. Stewart, 1958, Geology of the Dryhead-Garvin Basin, Bighorn and Carbon Counties, Montana (1:63,360): Montana Bur. Mines and Geology. Maximum thickness 60 feet. Composed of two members: basal red shale and upper carbonate member. Where upper carbonates are not present, it is impossible to distinguish redbeds of Goose Egg from those of Chugwa-

ter formation. Overlies Tensleep formation. In this area, rocks of Goose Egg are of Permian age only.

S. S. Oriel and L. C. Craig, 1960, *in* Guide to the geology of Colorado: Rocky Mountain Assoc. Geologists, p. 43, 45. Red beds and interbedded evaporites, including anhydrite, dolomite, and limestone, formerly included in basal part of Chugwater, are now assigned to Goose Egg formation in central and eastern Wyoming and in northern part of central northern Colorado.

Typically exposed near Goose Egg post office, NW¼ sec. 12, T. 32 N., R. 81 W., Natrona County, Wyo.

Goose Lake Clay

Pennsylvanian: Northeastern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 25–26, 84, pl. 5. Composite of two or more underclays of lower Carbondale and upper Pottsville age. Occurs below Colchester coal. Approximately equivalent to Cheltenham fire clay of Missouri.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33. Goose Lake clay is trade name and not recognized as part of Illinois stratigraphic nomenclature.

Named for occurrence near Goose Lake, east Grundy County. Used as a refractory clay.

Goosenest Flows

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 49, pls. 1, 2. Name applied to flows from Goosenest Volcano. Lithologically flows are extremely uniform. All are true block lavas; that is, they have crusts composed of smooth-faced blocks, as much as several yards across, that pass downward through a shattered layer into massive, unbroken lava.

Goosenest is conspicuous landmark in Macdoel quadrangle, Siskiyou County.

†Goose Pond Limestone[1]

Precambrian: Massachusetts.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159, p. 51–52.

Exposed north and east of Goose Pond, eastern Berkshire County.

Gorbut Member (of Gravel Point Formation)

Middle Devonian: Northern Michigan.

W. A. Kelly and G. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 448 (fig. 1), 449, 457. Sequence of dark-colored to black limestone and black shale that occurs near middle part of formation. Thickness 10 feet.

Well exposed in LeGrand quarry northeast of Gorbut School, Cheboygan County.

Gordo Formation (in Tuscaloosa Group)

Upper Cretaceous: West-central Alabama and east-central Mississippi.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37. Overlies Coker formation. Provisionally defined as the interbedded series of nonmarine gravel, sand, and clay beds between the

horizon [top of Coker formation] at which gravel first appears consistently and abundantly and the base of the McShan formation (new). Base of unit is marked by abrupt appearance of abundant chert gravel and gravelly sand, the gravel gradually decreasing in abundance upward. Consists of two unnamed members: the lower consists of 130 feet of gravel and sand, and the upper chiefly of clay and nongravelly sand and ranges in thickness from a little less than 200 feet west of Warrior River to about 60 feet east of river.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 200–204. Designated type section is an exposure of middle third of formation showing typical gravelly sand and mottled clay; thickness 92 feet. Geographically extended into Tishomingo County, Miss., where it is overlapped by Eutaw formation.

C. W. Drennen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 537. Recent study reveals evidences of a marine origin of at least part of formation.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 23–26. In present report [Prentiss County], name Gordo refers to those sediments overlying Paleozoic basement and underlying McShan formation. Thickness 87 feet. Basal contact not exposed in area of report. Gulf series.

Type locality: South-facing slope of Little Bear Valley, sec. 20, T. 20 S., R. 13 W., 2 miles southeast of Gordo, Pickens County, Ala.

Gordon Sandstone (in Strawn Formation)[1]

Pennsylvanian: Central northern Texas.

Original references: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxv, pl. 3; F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

Probably named for Gordon, Palo Pinto County.

Gordon Shale[1]

Middle Cambrian: Northwestern Montana.

Original references: C. D. Walcott, 1917, Smithsonian Misc. Colln., v. 67, no. 1, pub. 2444, p. 7–8; no. 2, pub. 2445, p. 16–19.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1076, 1082, 1087–1088, 1089–1090. Deiss (1933, Montana Bur. Mines and Geology Mem. 6) divided Cambrian of northwestern Montana into 11 formations (ascending): Flathead quartzite, Wolsey shale, Damnation limestone, Nannie Basin limestone, Dearborn limestone, Steamboat limestone, Pagoda oolite, Pentagon shale, Gordon Mountain limestone, Switchback limestone and Devils Glen dolomite. This sequence is revised as follows: Flathead sandstone, Gordon shale (instead of Wolsey), Damnation limestone (redefined to include Nannie Basin), Dearborn limestone. Pagoda limestone, Pentagon shale, Steamboat limestone (replaces Gordon Mountain limestone), Switchback shale, and Devils Glen dolomite. All appear to be Middle Cambrian. Thickness Gordon shale 140 to 274 feet.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 219–220. Described in Saypo quadrangle where it is approximately 220 feet thick; overlies Flathead sandstone and underlies Damnation limestone.

Type locality: On Gordon Creek, 6 miles from South Fork of Flathead River, Ovando quadrangle, Powell County.

Gordon Creek Shale Member (of Cook Mountain Formation)

Gordon Creek Shale Member (of Wautubbee Formation)

Eocene: Eastern Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 54, 57–59, profile B. Defined as uppermost member of Wautubbee formation in eastern Mississippi. Carbonaceous shale to blocky clay, chocolate-brown to light-yellowish-gray to red; basal 2 feet sandy and glauconitic and heterogeneous; typical feature of member is a thin ledge of white, sparingly glauconitic, siliceous siltstone that occurs 2 feet above base. Thickness 15 to 25 feet. Overlies Potterchitto member (new) with contact conformable and sharply defined; overlies Cockfield formation.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Considered uppermost member of Cook Mountain formation.

Type section: Along U.S. Highway 11 from Basic City to Pachuta, Clark, and Lauderdale Counties. Name taken from Gordon Creek which flows through Wautubbee Station and which is crossed by U.S. Highway 11 a short distance south of the station.

†Gordon Mountain Limestone[1]

Middle or Upper Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geol. Mem. 6, p. 39.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1089; 1939, Geol. Soc. America Spec. Paper 18, p. 35, 100. Name dropped from sequence of Cambrian formations recognized in northwestern Montana. Steamboat limestone, as used in 1933 sequence, has proved to be part of massive upper Dearborn limestone which was repeated in the Dearborn section by low-angle overthrust. Therefore, rocks to which name Steamboat was applied do not exist, and this name is freed for use and here applied to limestone and shale formerly designated Gordon Mountain limestone, which lies between the Pagoda or Pentagon and overlying Switchback formation.

Type locality: Middle part of cliffs which form lower part of east side of a peak, 8,300 feet elevation, the top of which is just 1 mile S. 48° E. of top of Pentagon Mountain. Forms top of central and principal peak of Gordon Mountain.

Gore Limestone (in Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889, 898, 903, pls. facing p. 889, 900, 912, 921.

Can be traced from Hocking Valley to Ohio River. Probably named for occurrence at Gore, Hocking County.

Gore Mountain Gabbro

Precambrian (Algoman): Northeastern New York.

M. H. Krieger, 1937, New York State Mus. Bull. 308, p. 28–32, 36. Chiefly medium-grained massive hypersthene-olivine gabbro or norite; speckled appearance on weathered surface. Bounded on the north and east by body of gabbroic and Whiteface-type anorthosite, on the south by a horn-

blende-garnet deposit, and on the west by Marcy-type and gabbroic anorthosite. Nowhere in contact with syenite, although syenite occurs within 100 to 300 feet of the gabbro on south side of garnet deposit. North of gabbro and between it and the anorthosite is a narrow zone of garnet gneiss. Considered younger than Grenville series.

Occurs in vicinity of Gore Mountain, Thirteenth Lake quadrangle.

Gorge Formation[1]

Upper Cambrian: Northwestern Vermont.

Original reference: Charles Schuchert, 1933, Am. Jour. Sci., 5th ser., v. 25, p. 359, 367, 368, 375–377.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1052–1057. Lithogically separable into two parts: upper Gorge consists of 145 feet of thin-bedded dolomite and limestone, black dolomitic slate, at least eight intraformational flat-pebble breccia beds, and thick beds of sandstone; lower Gorge, about 75 feet thick, is massive dolomite, more or less replete with thick-bedded black dolomite inclusions, making whole series conglomeratic. Separated from overlying Highgate by thrust plane; overlies Hungerford slates (new). Keith (1924) called upper series of beds Missisquoi, but term was preoccupied.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 548–549, pl. 1. In this report [St. Albans area, Vermont], all rocks below Highgate thrust are assigned to Gorge formation. North of type section only, the lower dolomite is generally exposed. This dolomite is 550 feet near Highgate Center; 60 to 75 feet at international boundary overlying shale-limestone-shale sequence present only at type locality where it is more than 400 feet thick. Overlies Hungerford slate; underlies Highgate formation. Most contacts with Highgate are faults.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 572, pl. 3 (correlation chart). Crops out in west limb of St. Albans synclinorium in Quebec, notably at Rosenberg, where it plunges north, at axis of minor anticline beneath Highgate formation. Cut out to west at Champlain overthrust. Gorge is uppermost formation in terrane that Clark (1934, Geol. Soc. America Bull., v. 45, no. 1) referred to "Milton dolomite."

Type locality: Highgate Gorge at Highgate, St. Albans quadrangle.

Gorgora Shale Member (of Fayette Formation)

Eocene (Jackson): Western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 268–269. Name applied to a thick, predominantly shaly group of beds lying between Sanchez sandstone tongue above and Roma sandstone tongue below. Basal 30 feet are marine or lagoonal gray shales with some lignite beds; middle part made up of blue and green and red bentonitic shales, thin sandstones, and oyster beds usually less than 1 foot thick; upper 30 feet is persistently marine or brackish-water shale. Electric logs show member about 500 feet thick; in Zapata County, it increases to 900 feet, for the most part at expense of Roma sandstone.

Named from Gorgora Hill, located 1 mile northeast of Roma, Roma quadrangle. Beds make a north-south valley across Starr County and south half of Zapata County.

Gorman Formation (in Ellenberger Group)

Lower Ordovician: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 1, 8–19. Limestone and dolomite. Thickness 426 feet. Overlies Tanyard formation (new); underlies Honeycut formation (new). Cherokee Creek section, San Saba County described.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 144–146, pls. 4, 6 [1945]. Proposed that name Gorman formation be used to designate rocks similar to and correlative with those in the composite type section (herein designated). Basal zone characterized by varicolored and very fine grained dolomites—yellows, pinks, browns; upper calcitic facies consists principally of sublithographic, thickly to thinly bedded limestone with locally interbedded microgranular to fine-grained dolomite; a sequence of pure, unusually thick-bedded limestone present in top 40 to 60 feet of formation. Dolomitic facies 81 to 230 feet thick; calcitic facies 237 to 393 feet. Chert common. Where not thinned by post-Ellenburger truncation, between 426 and 498 feet thick.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 9–10, 39–40, 137–138, 158–159, 195–197, 227–229, 235–239, pls. 9, 35 [1946]. Type section described in detail. Stratigraphy described by areas.

Type section: Along and near gorge of Colorado River in vicinity of Gorman Falls, in southeastern San Saba County. Also present in McCulloch, Mason, Gillespie, Lampasas, and Burnet Counties.

Goshen Schist[1]

Precambrian: North Carolina and central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 19, 23, map.

Named for typical occurrence in vicinity of Goshen, in southeastern part of Virgilina district, North Carolina.

Goshen Schist[1]

Silurian(?): Western Massachusetts, southwestern New Hampshire, and southeastern Vermont.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, Mon. 29, p. 177–183, pl. 34.

C. G. Doll, 1943, Am. Jour. Sci., v. 241, no. 11, p. 678. Age of mica schist designated Lower Devonian.

Typical region: Around Goshen, Mass.

Goshute Canyon Formation

Precambrian or Cambrian: Western Utah.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1065–1066, 1068. Prospect Mountain quartzite, in Deep Creek Mountains, Utah, restricted at base to exclude 3,000 feet of alternating quartzite and shale units herein named Goshute Canyon formation. In absence of fossils, formation does not warrant a date more exact than Precambrian or Cambrian or both.

Type section: In and south of Goshute Canyon, Deep Creek Mountains. Section begins in NE¼ sec. 1, T. 11 S., R. 18 W., and ends in SW¼ sec. 36, T. 10 S., R. 18 W.

Gospel Hill Gneiss

Carboniferous: Eastern Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 39–41, pl. 1. Name suggested for a large mass of granitic rocks of Carboniferous age that Emerson (1917) mapped as a variant of Andover granite but in this area is regarded as a granitized product of Nashoba (new) and Marlboro formations. Medium to coarse textured and composed chiefly of microcline albite, quartz, muscovite, and biotite.

Well exposed on southeast slope of Gospel Hill in Hudson, the locality from which it was named. Extends from Concord quadrangle southwestward across Maynard quadrangle through corner of Hudson quadrangle and into Marlboro quadrangle.

Gosport Sand (in Claiborne Group)[1]

Eocene, middle: Southern Alabama and Georgia.

Original reference: E. A.Smith, 1907, Alabama Geol. Survey Bull. 9, p. 5, 18.

C. W. Cooke, 1939, Jour. Paleontology, v. 13, no. 3, p. 337–340. Gosport sand of Alabama, heretofore classified as topmost formation of Claiborne group, and the only known formation of upper Claiborne age, is nearly equivalent to Moodys marl of Mississippi, basal formation of Jackson group. Recommended that name Gosport be replaced by Moodys and that Claiborne group be restricted to formations heretofore classified as lower Claiborne.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 11. Formation is here considered to include overlying lithologically and faunally similar *Poriachus* bed or "*Scutella*" bed which was formerly considered to be basal bed of Jackson group. Entire formation exposed at Claiborne Bluff where it is 24 to 26 feet thick; thickness 35 feet at Willow Branch in Choctaw County. Disconformably overlies Lisbon formation; conformably underlies Moodys Branch marl.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart of outcropping Tertiary formations of Eastern Gulf region shows Gosport sand, in Claiborne group, above Lisbon formation and present in Alabama and Georgia. Base of Gosport sand, which lies disconformably on different parts of Lisbon formation in central eastern Alabama, passes into upper part of Cockfield formation in Mississippi and becomes indistinct. Gosport pinches out just east of Ocmulgee River in central Georgia, but recurs filling channels in Cretaceous beds for some distance to the east. C. W. Cooke believes that Gosport at type locality is entirely of Jackson age, but that in general it represents a facies different faunally from Moodys Branch formation; he does not believe that name Gosport should be used in Georgia.

Named for Gosport, a landing on Alabama River, a few miles below Claiborne Bluff, in Clarke County, Ala.

Goss Mill limestone facies[1] (of Floyds Knob Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 197–208.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Correlation chart lists Goss Mill limestone facies of Floyds Knob formation.

Name derived from abandoned post office, Goss Mill, 6½ miles north of Medora, Jackson County.

Gothic Formation

Pennslvanian (Desmoinesian): Western Colorado.

R. L. Langenheim, Jr., 1951, (abs.) *in* Am. Assoc. Petroleum Geologists 36th Ann. Mtg. [Program], p. 29. Introduced for coarse and fine buff clastic rock assemblage overlying Belden shale and underlying Maroon formation (restricted). Thins toward northeast with concurrent thickening of the Maroon.

R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 550 (fig. 2), 552 (fig. 3), 553–555, 556, 557, 558, 561–563. Thickness varies: 1,763 feet at Jack's Cabin, 1,350 at Granite Basin, 1,266 at Walrod Gulch, 572 at Cement-Taylor Divide, and 1,486 at Copper Creek (type section). Base and top arbitrarily designated; base is bottom of lowest prominent sandstone in section, and top is point where rock becomes predominantly red in color; upper boundary gradational in most places with occasional pink and red beds occurring well below formation boundary. At type section, conformably underlies Maroon formation, and base of section is intrusive contact; overlies Belden shale at Walrod Gulch and Cement-Taylor Divide; base of formation faulted out at Jack's Cabin and Granite Basin, and Gothic directly and unconformably overlain by Entrada sandstone.

Type section: Copper Creek, Crested Butte quadrangle, Gunnison County. Section is measured along top of ridge separating Copper Creek valley and Virginia basin and down wall of unnamed cirque northeast of Virginia basin.

Gould Glacial Substage

Gould Till

Pleistocene (Wisconsin): North-central Colorado.

D. F. Eschman, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1380. Time of next to oldest of four glacial advances in the area. Marked by a nearly complete moraine at elevation of about 9,000 feet. Followed Owl Mountain advance (new), preceded Silver Creek advance (new).

D. F. Eschman, 1955, Jour. Geology, v. 63, no. 3, p. 203–205, fig. 2, table 1. Deposits of substage mapped as Gould till. Till is more sandy than that of Owl Mountain substage but more clayey than that of Silver Creek substage; light gray brown; reddish-brown clayey streaks common in upper 3 feet.

Substage represented by three rather extensive deposits of till: on north side of Middle Fork Michigan River about one-half mile above village of Gould; between Middle Fork and South Fork Michigan River one-third mile south of Gould; and on southwest side of South Fork Michigan River 1½ miles south of Gould. In North Park.

Gould Shale Member (of Monterey Formation)[1]

Miocene, middle: Southern California.

Original reference: G. M. Cunningham and W. F. Barbat, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 4, p. 418.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1616. In Recruit Pass area, an interval of 1,850 feet of well-bedded siliceous light-brown shale, with a minor amount of inter-

bedded tan silt and lentils of massive buff limestone, comprise a single lithologic unit from which have been collected faunules common to both the Gould shale and the Devilwater silt as they are defined on Chico-Martinez Creek. This unit has been termed the Devilwater-Gould member of the Monterey.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip May 9, p. 13 (table) map, topog. profile. Underlies Devilwater silt member; overlies Media shale member of Temblor formation in Chico-Martinez Creek area. Thickness about 550 feet.

Type locality: Near center of W½ sec. 14, T. 29 S., R. 20 E., and continuing to southeast side of Chico-Martinez Creek, Kern County. Name is from Gould Hill near type locality.

Gouldbusk Limestone Member (of Moran Formation)

Permian (Wolfcamp Series): North-central Texas.

R. C. Moore *in* M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 5, 13, sheets 3, 4. New name replacing Drake's Horse Creek limestone. Underlies Santa Anna shale member; overlies Watts Creek shale member.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Name applied to limestone beds and included thin shale that were called Horse Creek limestone by Drake (1893). Sellards (1933, Texas Univ. Bull. 3232) pointed out duplication by Drake in use of this name, as applied to beds in his Strawn division farther east in Colorado River valley and to limestone, now considered Permian(?) in age, exposed in Coleman County; Sellards restricted application of Horse Creek to beds in the Strawn sequence but did not rename the upper beds, which have continued to be called Horse Creek. Member consists of (1) lower massive blue-gray limestone, 1 to 2 feet thick, that is medium grained and weathers brownish; (2) gray to yellowish clay shale, 2 to 6 feet thick, that is unfossiliferous; and (3) upper gray irregularly thin-bedded limestone of fine-grained texture that weathers in slabs and shelly fragments of light-gray color splotched with tan; average thickness of this bed 3 feet. Thickness about 8 feet.

Type locality: Village of Gouldbusk, southwest Coleman County.

Gourd Head Run Clay (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania Geol. Survey Rept. Q, p. 159–161, 308.

In Allegheny County.

Gourdhead Run Limestone in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 159–161, 308.

Crops out locally in valley of Gourdhead Run in Hampton Township, Allegheny County.

Gouverneur Granite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing and D. H. Newland, 1925, New York State Mus. Bull. 259, p. 40–41.

Occurs just northwest of Gouverneur, St. Lawrence County.

Gouverneur Limestone[1]

Precambrian (Grenville Series) : Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 136–138, map.

In Antwerp, Hammond, and Gouverneur quadrangles, St. Lawrence and Jefferson Counties.

Gove chalk

Cretaceous (Mid-Cretacic) : Northwestern Kansas.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 76, no. 4, p. 304 (chart). Name applied to lower formation in Buckskinian series. Consists of chalks about 400 feet thick. Underlies Wallace shale. Overlies Apishapa shale of Pueblan series.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 76, no. 5, p. 371–372. Proposed for heavy chalk formation in northwestern Kansas, heretofore regarded as representing Niobrara chalk of upper Missouri River country.

Occurs in Gove, Logan, and Wallace Counties.

Gove Member (of Berwick Formation)

Gove Member (of Littleton Formation)

Probably Ordovician and Silurian: Southeastern New Hampshire.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 453 (fig. 2), 460, 464, pl. 1. Chiefly silvery mica-schist, some mica-staurolite schist, mica-sillimanite schist and quartzite. Maximum thickness 200 feet. Member of Littleton formation of Lower Devonian age.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000). U.S. Geol. Survey. Reallocated to Berwick formation. Age designated as probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 42, 43. Age of Berwick formation tentatively considered Silurian.

Exposed in narrow belt in Mount Pawtuckaway quadrangle between Nottingham Square and Raymond, Rockingham County. Named from Gove School, 2 miles northeast of Raymond.

Governor Diorite

Miocene, upper: Southwestern Colorado.

McClelland Dings, 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 701–707, fig. 1. Essentially a dark fine-grained diorite. Fresh rock is fine grained and greenish gray to greenish black; weathered surfaces range from dull gray to reddish brown. Most prominent lithologic variation occurs along west-central side of Stony Mountain stock where diorite grades into light-colored hornblende-bearing monzonite facies. Most of outer border of diorite is in contact with San Juan tuff. In contrast to usually wide metamorphic cones developed in San Juan tuff, Silverton and Potosi volcanic rocks generally show only slight metamorphism where intruded by diorite. Older than Stony Mountain diorite (new).

Typically exposed a short distance north of Governor mine in Stony Mountain region, which in turn, is located about 5 miles southwest of Ouray in San Juan Mountains. Vertical range of exposures is 1,875 feet; highest outcrop occurs about 275 feet northwest of summit of Stony Mountain, and lowest in extreme southeast, near junction of Governor and Yankee Boy Creeks.

Gowanda Shale Member (of Perrysburg Formation)

Gowanda Shale[1]

Gowanda Shale Member (of Canadaway Formation)

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1919, Geol. Soc. America Bull., v. 30, p. 157.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899, p. 19, pl. 3. In this report [southwestern New York], the whole series of beds from top of Dunkirk sandstone to highest beds mapped in area—more than 1,000 feet higher—are grouped as Gowanda shale and overlying beds undifferentiated.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 251. Gowanda beds included in Canadaway group.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Rank reduced to member status in Perrysburg formation (new). Includes all rocks between top of South Wales member (new) and base of Laona sandstone. In section exposed along Cattaraugus Creek southeast of town of Gowanda, neither base nor top of Gowanda member can be identified although most of member is exposed in high cliffs bordering the creek. Because top of member has not been found east of Little Indian Creek, Perrysburg quadrangle, Cattaraugus County, name Gowanda is not applied to rock sequence to the east, and local names are used for units found there. Thickness 210 to 276 feet. Figure 4 shows that Canisteo (new), Caneadea, and Gowanda members, although closely related in time of deposition, are not strictly correlative throughout.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2318. Canadaway group reduced to formational status and Gowanda member renamed Forestville member and assigned to new type locality.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 15. Member of Canadaway formation. Overlies South Wales member; underlies Laona siltstone member. Thickness about 240 feet. As the Laona cannot be traced as far east as Gowanda, N.Y., Gowanda shale has no upper limit at its type locality. New type locality is herein assigned; this section described by Pepper and de Witt (1951).

Type locality (Tesmer, 1955): Along Walnut Creek, in vicinity of Forestville. Named for exposures in vicinity of Gowanda, Cattaraugus County.

Gower Dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: W. H. Norton, 1899, Iowa Geol. Survey, v. 9, p. 422, 423.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as underlying Bertram dolomite and overlying Hopkinton dolomite (restricted).

Named for Gower Township, Cedar County.

Graciosa Coarse-Grained Member (of Careaga Sandstone)

Pliocene, upper: Southern California.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1356–1358; W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 42–49,

pl. 1. Made up of two parts: lower consisting of coarse-grained soft sandstone and conglomerate, and upper consisting of coarse-grained soft sandstone. Thickness 25 to 425 feet. Underlies Paso Robles formation; on Graciosa Ridge, in Orcutt field, Graciosa overlaps Cebada member (new) and rests on Sisquoc formation.

Type region: On north flank of Purisima Hills south of Careaga Station on now-abandoned Pacific Coast Railroad, Santa Maria district.

Graford Formation (in Canyon Group)[1]

Graford Group

Upper Pennsylvanian: Central and central northern Texas.

Original references: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145; F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 96–100. Formation redefined for Colorado River area. Winchell member (new) and Cedarton shale member (136 feet thick) are referred to as upper part of Graford and Adams Branch limestone and underlying shale (221 feet) referred to as lower Graford. Interval from top of Palo Pinto limestone of Cheney to top of Winchell member, an interval which may ultimately be found to include parts of Palo Pinto in other areas, is 357 feet. Underlies Brad formation (redefined).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v 24, no. 1, p. 66 (fig. 1), 88. Rank raised to group. Restricted below to exclude beds nearly equivalent to the Brownwood and here included in Whitt group (new). Underlies Brad group. Includes (ascending) Adams Branch limestone. Cedarton shale, and Winchell limestone.

Robert Roth, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 2. Generalized columnar section shows group comprises (ascending) Wolf Mountain shales and sandstone. Staff limestone (Adams Branch limestone), unnamed shale, and Winchell limestone; overlies Whitt group.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. Composite section of Brown and Coleman Counties shows formation comprises (ascending) Brownwood shale, Adams Branch limestone, and Cedarton shale members. Underlies Winchell limestone. Thickness about 300 feet.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 63, pl. 27. Formation as defined by Plummer and Moore (1921) for locality in Palo Pinto County was intended to include a thick limestone forming a prominent cuesta in that country, which they considered to be the Adams Branch, and the underlying shale, down to Palo Pinto limestone. They showed the Palo Pinto to be absent in Colorado River valley and defined basal member of Graford as Brownwood shale (Drake's Brownwood bed), in which they included their Capps limestone lentil and Rochelle conglomerate. They considered Rochelle to underlie Capps lentil, although later workers have found it to be in position of Capps, or to be a channel-fill conglomerate and sandstone of later age which has replaced their Capps. Cheney (1929, Texas Univ. Bull. 2913) showed that limestone at top of Graford in Palo Pinto County was not correlative with Adams Branch, but with part of limestone now called Winchell limestone. Sellards (1933, Texas Univ. Bull. 3232) defined Graford to include his Merriman (equivalent to part of Winchell as later defined) and underly-

ing Cedarton shale of Plummer and Moore (1921) as well as their Adams Branch limestone and Brownwood shale. He included, therefore, in one formation all units he considered equivalent in both Brazos and Colorado River valleys. Graford, as herein redefined for Colorado River valley, includes (ascending) Brownwood shale (redefined), Adams Branch limestone, and Cedarton shale members. Underlies Winchell herein raised to rank of formation; overlies Strawn group. Thickness 285 feet in southern part of Brown County; 340 feet in central part of county.

Named for town of Graford, in Palo Pinto County, Brazos River region.

†Graford Limestone Member (of Graford Formation)[1]

Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Probably named for town of Graford, Palo Pinto County.

Grafton Formation[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, pl. 4.

Punxsutawney quadrangle.

Grafton Member (of Conemaugh Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh quadrangle.

†Grafton Quartzite[1]

Precambrian: Eastern Massachusetts and northern Rhode Island.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

Named for occurrence at Grafton, Worcester County, Mass.

Grafton Sandstone (in Conemaugh Formation)[1]

Grafton (upper) shale and sandstone member

Pennsylvanian: West Virginia, western Maryland, and eastern Ohio.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 244, 255, 298.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 148. Member of Elk Lick cyclothem in report on Athens County. Upper Grafton is used for shale and sandstone, locally massive sandstone, which heretofore has been called Morgantown in Ohio. Thickness 24½ feet. Occurs above Birmingham redbed member and below Elk Lick limestone member. Conemaugh series.

Has been quarried in vicinity of Grafton Hills, Taylor County, W. Va.

Graham Formation (in Cisco Group)[1]

Graham Group

Upper Pennsylvanian: Central and central northern Texas.

Original reference: R. C. Moore, 1921, Am. Assoc. Petroleum Geologists Bull., v. 5, p. 324.

Wallace Lee and C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 12–53, 118–122. Formation, in Brazos River valley, comprises

(ascending) channel deposits, Salem School limestone member, shale and sandstone, Gonzales limestone member, shale and sandstone, Bunger limestone member, shale with numerous channels and unconformities, and Wayland shale member. Thickness at least 590 feet, not counting channel deposits (Kisinger channel) at base. Interval from top of Bunger limestone to top of formation are referred to as post-Bunger deposits or post-Bunger cycles. Nine cycles discussed. Group of limestones in No. 8 post-Bunger cycle is herein named Rocky Mound limestone member. Gunsight member, which at its type locality is overlain by Wayland shale, has not been identified in Stephens County. Underlies Avis sandstone member of Thrifty formation. In Colorado River basin, formation is divided into (descending) Wayland shale, Gunsight limestone, and Bluff Creek members. Thickness 243 feet from top of Home Creek limestone of northern Brown County up to base of *Bellerophon* bed of Drake (1893, Texas Geol. Survey 4th Ann. Rept., pt. 1).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 90. Rank raised to group. Includes following formations (ascending): Gonzales, North Leon, Bunger, post-Bunger cycles 1–7, Gunsight limestone, and Wayland shale. Underlies Thrifty group; overlies Caddo Creek group.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 4. Generalized columnar section shows that group comprises (ascending) Salem School limestone, Bunger limestone, Number 3 limestone, Upper Gunsight limestone, Rocky Mound limestone, Wayland shale, Number 9 limestone, Avis sandstone, Ivan limestone, Blach Ranch limestone, Breckenridge limestone.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Composite section of Brown and Coleman Counties shows that formation comprises (ascending) Bluff Creek shale, Gunsight limestone, Wayland shale, and Ivan limestone. Underlies Thrifty formation; overlies Caddo Creek formation. Thickness about 260 feet.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 68–69, pl. 27. Boundary between Graham and Thrifty formations has been defined as base of Avis sandstone member (Sellards, 1933, Texas Univ. Bull. 3232; Lee and Nickell, 1938), a prominent sandstone in Brazos River valley. In Colorado River valley [this report], this boundary is not mappable because only discontinuous lenses of sandstone are present at stratigraphic position of Avis. Also, the Ivan limestone member which overlies the Avis is discontinuous. Recommended that base of Speck Mountain limestone, a persistent member throughout Colorado River valley and probably equivalent to Blach Ranch limestone in Brazos River valley, be designated boundary between Thrifty and Graham formations. In areas where Speck Mountain limestone member has been replaced by channel-fill conglomeratic sandstone, as by Parks Mountain sandstone member in southeastern Coleman County, boundary between the Graham and the Thrifty is considered base of sandstone. Thickness of Graham, as herein defined, is about 265 feet in southeastern Coleman County and about 290 feet in northern Brown County. Comprises (ascending) Bluff Creek shale, Gunsight limestone, Wayland shale, and Ivan limestone members. Overlies Caddo Creek formation of Canyon group.

Type locality: Bluff on Salt Creek, west of Graham, Young County, Brazos River region.

†Graham Jasper (in Niobrara Formation)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 51.

Named for Graham County.

Graham Limestone (in Bluefield Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 387.

Type locality: In a cut of Norfolk & Western Railway, about one-half mile northwest of new station at Graham (now Bluefield), Tazewell County, Va.

Graham Sandstone (in Bluefield Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Marion, and Summers Counties, p. 299, 385.

Type locality: In cut of Norfolk & Western Railway, about one-half mile northwest of new station at Graham (now Bluefield), Tazewell County, Va.

Graham Shale (in Bluefield Formation)[1]

Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 299, 387.

Type locality: In cut of Norfolk & Western Railway, about one-half mile northwest of new station at Graham (now Bluefield), Tazewell County, Va.

Graham Ferry Formation

Pliocene: Southeastern Mississippi.

G. F. Brown and others, 1944, Mississippi Geol. Survey Bull. 60, p. 45–54. Series of deltaic sediments overlying Pascagoula formation and disconformably underlying Citronelle formation. Continental and brackish-water deposits predominate although type locality contains marine fossils. Thickness ranges from 113 feet in Jackson County to 975 feet at Gulfport.

Type sections: Rice Bluff, NW¼NW¼ sec. 38, T. 5 S., R. 7 W., and bluff beneath power line near center of irregular sec. 38, T. 5 S., R. 7 W., west bank Pascagoula River, Jackson County. Midway between the two bluffs is an old river crossing locally known as Graham Ferry.

Grahamville Formation

Cambro-Ordovician: East-central Vermont.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 47–48, tables 2, 3. Dark-gray-green massive albite grit occurs at base. Above is a variety of dark fine-banded sandstones, sandy graphitic phyllites, and, in southern part of outcrop area, buff ankeritic sandstone. At top is Plymouth member consisting of massive gray dolomite and white vitreous thinly bedded quartzite. Total thickness ranges from about 700 feet at Chittenden to 1,500 feet at Plymouth, depending on thickness of middle unit. Underlies Pinney Hollow formation; overlies Tyson formation. Upper boundary difficult to trace in this area because of color similarities of phyllites;

arbitrarily placed beneath lowest green phyllite bed 50 feet or more in thickness. Name credited to Thompson (unpub. thesis).

Well exposed in lower slopes of Ottauquechee and Black River valleys south of West Bridgewater in Rutland area.

Grainger Shale[1] or Formation

Mississippian: Northeastern Tennessee, western North Carolina, and southwestern Virginia.

Original references: A. Keith, 1895, Phil. Soc. Washington Bull. 12, p. 74, 78, pl. 1; 1896, U.S. Geol. Survey Geol. Atlas, Folio 27, p. 3.

J. E. Sanders, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1295. Grainger formation traced and mapped in detail in Greendale syncline northeastward from type locality in Grainger County, Tenn., to Tennessee-Virginia line. Basal member, 200 to 300 feet thick, changes laterally from fissile gray shale in Grainger County to fossiliferous green siltstone in Hawkins County, and to yellowish silty shale near State line. Lower sandstone member composed of 75 to 200 feet of very fine grained medium-bedded sandstone that locally includes pebbly layers and fossiliferous beds. Middle sandstone member predominantly structureless green fossiliferous siltstone with a few beds of fine-grained sandstone, shale, and fossiliferous glauconitic material. Upper sandstone member, 100 to 150 feet thick, is gray, coarse grained, crossbedded feldspathic sandstone and conglomerate. Fossils indicate formation spans part of Kinderhook and probably most of Osage intervals of Mississippian standard section. Grainger formation, as used here, agrees with "Grainger shale" of Campbell (1894, U.S. Geol. Survey Geol. Atlas, Folio 12) and requires that "Grainger shale" of Keith (1896) be redefined in its type section to exclude Devonian beds included by Keith.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 106–107, pt. 1, pls. Formation mapped in eastern Tennessee. Overlies Chattanooga shale; underlies Newman limestone; grades into Fort Payne chert. Thicknesses: 1,100 feet on southeast side of valley in Blount and Monroe Counties; about 900 feet in belt southeast of Clinch Mountain; about 500 feet in belts in Hancock and eastern Claiborne Counties; less than 350 feet at Cumberland Gap.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. In Blockhouse quadrangle, Tennessee, formation consists of siltstone, sandstone, and conglomerate. Gray and blue-gray noncalcareous siltstone dominant in lower two-thirds; gray medium- to coarse-grained, crossbedded calcareous sandstone with layers of pebble conglomerate in upper third. Thickness 1,000 feet. Overlies Chattanooga shale; underlies Greasy Cove formation (new) which replaces term Newman as used in this area. Brachiopods, pelecypods, and bryozoans abundant in some areas suggest correlation with Keokuk limestone of Mississippi Valley.

Named for Grainger County, Tenn.

Grampian Limestone[1]

Cambrian(?) and Ordovician: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

E. H. East, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1825. Upper contact marked by extensive overthrust, and contact with Morehouse quartzite is not conformable as proposed by Butler (1913),

necessitating stratigraphic revision to replace Grampian by Ely limestone, Kanosh shale, and unnamed interval of Cambrian beds.

Type locality: Grampian Hills, Frisco district.

Grampian Hills Member (of Nanafalia Formation)

Eocene, lower: Alabama.

B. W. Blanpied and R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 128. Shown on correlation chart as upper member of formation. Overlies Salt Mountain limestone member.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 96 (fig. 32), 100, 101, 102, 108 (fig. 38), 109–110, 112, 116, 117, pls. 2, 3. Allocated to member status in Nanafalia formation. Blanpied and Hazzard did not specify type locality or section. At type locality and section, herein designated, entire thickness, including upper and lower contacts, is exposed. Consists of yellowish- to greenish-gray indurated clay or claystone; includes several beds of greenish-gray coarse-grained glauconitic sand and sandstone and, in upper part, gray to greenish-gray massive blocky clay. Thickness 80 to 110 feet in Grampian Hills area. Overlies unnamed middle member of formation; underlies Tuscahoma sand.

Type locality and section: In continuous roadcut along Alabama Highway 41 on south side of Gravel Creek valley, 7.1 miles south of Camden on road to Monroeville, Wilcox County. Named for exposures in Grampian Hills, southern part of Wilcox County.

Grampus Gneiss[1]

Precambrian: Eastern New York.

Original references: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2; 1907 New York State Mus. Bull. 115, p. 463, 467–469.

Named for exposures around Grampus Lake, Hamilton County.

Granby Conglomerate[1]

Pennsylvanian(?): Southwestern Missouri.

Original reference: E. R. Buckley and H. A. Buehler, 1906, Missouri Bur. Geol. and Mines, v. 4, 2d ser., p. 33, 87, 88, 100, 102, pl. 14.

Probably named for Granby or Granby Junction, Newton County, or for Granby Branch Junction, Jasper County.

Granby Tuff (in Newark Group)[1]

Upper Triassic: Connecticut and south-central Massachusetts.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 494–497, pl. 1. Consists of four mappable units: Granby tuff, a brown, purple, or maroon compact or stratified diabase tuff or tuffaceous sandstone; a diabase flow, the Hampden diabase of Emerson (1898), a fine-grained locally altered compact or vesicular diabase; intrusive diabase pipes, dikes and sills of fine-grained diabase; and Black Rock diabase breccia. Maximum thickness 500 feet. Younger than earliest beds of Longmeadow sandstone; older than middle and upper parts of the Longmeadow. Triassic.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, table 1. Correlation chart shows Granby tuff in Connecticut.

Exposed in vicinity of Granby, southeastern Hampshire County, Mass.

Grandad Limestone[1]

Silurian: Southeastern Indiana.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 138, 143, 146.

Derivation of name not stated.

Grand Bayou Member (of Hall Summit Formation)

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Named in stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 59; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 130–131, pl. 10. Typical carbonaceous shale. Maximum thickness 80 feet on south flank of Sabine uplift. In northeastern part of uplift, believed to thin and merge with overlying Bistineau member; overlies Loggy Bayou member. Paleocene. Type locality designated. Mapped in Texas.

Type locality: Exposures in secs. 19, 20, 29, and 30, T. 14 N., R. 9 W., Red River Parish, La. Outcrop belt extends into Shelby County, Tex.

†Grand Canyon Group[1]

Precambrian: Northern Arizona.

Original reference: C. D. Walcott, 1883, Am. Jour. Sci. 3d, v. 26, p. 440–441.

†Grand Canyon Schist[1]

Precambrian: Northern Arizona.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains.

Occurs at bottom of Grand Canyon.

Grand Canyon Series[1]

Precambrian: Northern Arizona.

Original reference: J. W. Powell, 1876, Geology of the eastern portion of Uinta Mountains, p. 43, 61–62, 70.

C. E. Van Gundy, 1934, Grand Canyon Nature Notes, v. 9, no. 8, p. 345–346; 1951, Geol. Soc. America Bull., v. 62, no. 8, p. 953–959, pl. 1. Series includes more than 12,000 feet of sediments, diabase, and basalts. Comprises (ascending) Unkar, Nankoweap (new), and Chuar groups. Algonkian.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 38, no. 2, p. 107 (table). Table shows series (Proterozoic) comprises (ascending) Hotauta, Newberry (new), Bass, Hakatai, Shinumo, and Dox formations. Thickness 5,350, feet. Underlies Cardenasan series (new); overlies Proterozoic.

C. A. Anderson, 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1333. Overlies older Precambrian rocks which include Vishnu schist.

Grand Creek Sand Member (of Nanafalia Formation)

Probably lapsus for **Gravel Creek Sand Member** (of Nanafalia Formation).

Grand Detour Formation (in Platteville Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. Consists of dolomite or limestone, alternately pure and argillaceous, partly cherty, thin- to thick-bedded. Thickness about 500 feet. Subdivided into seven members (ascending): Dement, Walgreen, Stillman, Clement, Hely, Victory, and Forreston (all new). Underlies Nachusa formation (new); overlies Mifflin formation.

Occurs in Dixon-Oregon area.

Grande limestone[1]

Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-Monthly Bull. 19, p. 7–21.

At Lake Valley, Sierra County.

Grandeur Member or **Tongue** (of Park City Formation)

Permian: Utah, Idaho, Montana, and Wyoming.

T. M. Cheney and others *in* V. E. McKelvey and others, 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 3 (fig. 1), 12–17, 36–37, pls. 2, 3. Defined as the interbedded carbonate rock, cherty carbonate rock, carbonitic sandstone, and carbonitic siltstone that overlie Weber quartzite in Utah, Wells formation (restricted) in Idaho, Tensleep sandstone in Wyoming, and Quadrant formation in Montana. Underlies Meade Peak phosphatic shale member (new) of Phosphoria. Thickness at type locality about 280 feet. Present at all outcrops of Park City formation in Uinta Mountains except east of Lake Fork on south flank and ranges in thickness from featheredge to about 350 feet.

Type section: About 1 mile southwest of Grandeur Peak, in sec. 36, T. 1 S., R. 1 E., on north side and near mouth of Mill Creek Canyon, Salt Lake County, Utah.

Grand Falls Chert Member (of Boone Formation)[1]

Grand Falls Chert Member (of Keokuk Limestone)

Grand Falls Formation

Lower Mississippian: Southwestern Missouri, southeastern Kansas, and northeastern Oklahoma.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 7, 417–419.

R. C. Moore, G. M. Fowler, and J. P. Lyden, 1939, Geol. Soc. America Spec. Paper 24, p. 3, 10. Named subdivisions of Keokuk are Grand Falls chert, at base, and Short Creek oolite near top. Grand Falls is an irregularly bedded mass of dense "butcher knife" chert, mostly light gray but appears light yellowish brown or dark brown in weathered exposures. Thickness at type locality (including beds below water level) 35 feet. Locally discontinuous but identified over hundreds of square miles in Tri-State district. Osage series.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 197, 204. Report refers to Grand Falls chert at top of Reeds Spring member of Chouteau formation. Also refers to Reeds Spring limestone and quotes at length from unpublished manuscript by Clark (1941) who classed the Grand Falls as member of Reeds Spring.

E. L. Clark and T. R. Beveridge, 1952, Kansas Geol. Soc. Guidebook 16th Field Conf. p. 13 (fig. 1), 14–15 (fig. 2), 38 (fig. 12), 40 (fig. 15), 41 (fig. 16), 53 (fig. 26), 72 (fig. 1). Report refers to Grand Falls formation. Overlies Reeds Spring formation or Pierson formation; underlies Burlington formation or Keokuk formation.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1959, Deutschen Geol. Gesell. Zeitschr. v. 110, pt. 3, p. 517 (fig. 2). Chart shows Grand Falls member of Boone formation below Short Creek member and above Reeds Spring member. Thickness 6 to 38 feet.

Named for development around Grand Falls, Newton County, Mo.

Grand Falls Formation

Lower Cambrian: Central Maine.

Rudolf Ruedemann and E. S. C. Smith, 1935, Am. Jour. Sci., 5th ser., v. 30, no. 178, p. 354. Name proposed for thick sequence of metamorphic shales and sandstones.

R. B. Neuman, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B166–B167. Discussion of pre-Silurian stratigraphy in Shin Pond and Stacyville quadrangles. Grand Falls formation (Ruedemann and Smith, 1935) occurs in this area. Name Grand Falls is preoccupied.

Exposed for several miles along the Grand Falls of the Penobscot River, Penobscot County.

Grandfield Conglomerate[1]

Pliocene or Pleistocene: Southwestern Oklahoma.

Original reference: M. J. Munn, 1914, U.S. Geol. Survey Bull. 547, p. 17, 28–30.

Named for Grandfield, Tillman County.

Grand Forks Schist[1]

Age(?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 9, 10.

Mapped at and around Township of Grand Forks, British Columbia.

Grandge Slate

Lower Ordovician: Northwestern Vermont.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1014. 1072–1074, 1075. Slate containing limestone blocks and calcareous sandstone. Probably several hundred feet thick. Unconformably overlies Highgate formation. May be same unit as Georgia slate.

P. E. Raymond, 1937, Geol. Soc. America Bull., v. 48, no. 8, p. 1080, 1134. Replaces Georgia slate. Type section described as shale.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. no. 5, p. 550. Name Grandge slate abandoned. Included in Highgate formation as herein defined.

Type locality: On Oliver Grandge Farm, 4½ miles north of Highgate Center, Franklin County.

†Grand Gulf Group[1]

Miocene: Gulf Coastal Plain.

Original reference: E. W. Hilgard, 1860, Report on agriculture and geology of the State of Mississippi: [Mississippi Geol. Survey], p. 3, 108, 147–154.

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook] Field Trip, Feb. 10, 11, chart. Group includes (ascending) Bucatunna clay, Chickasawhay (lower and upper), Catahoula sand, Hattiesburg clay, and Pascagoula clay. Occurs above Vicksburg group [boundary between Oligocene and Miocene is queried, and Bucatunna and Chickasawhay may be considered part of Vicksburg group].

H. N. Fisk, 1940, Louisiana Geol. Survey Bull. 18, p. 138–174. Term Grand Gulf group revived. Considered to include all sediments exposed in central Louisiana from Vicksburg Oligocene to southernmost exposures of Tertiary sediments in Rapides Parish. As thus defined, includes Catahoula and Fleming formations.

Named for exposures in bluff at Grand Gulf, Claiborne County, Miss.

†Grand Gulf Sandstone[1]

Miocene: Southern Mississippi and southern Alabama.

Original reference: B. L. C. Wailes, 1854, Report on agriculture and geology of Mississippi: [Mississippi Geol. Survey], p. 216–219.

Named for exposures in bluff at Grand Gulf, Claiborne County, Miss.

Grandhaven Limestone Member (of Stotler Limestone)

Grandhaven Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: R. C. Moore, May 1935, Kansas Geol. Survey Bull. 20, table opposite p. 14.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc, Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Stotler limestone (new). Overlies Dry shale member; underlies Friedrich shale member of Root shale (new).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 11, fig. 5. Bluish gray, weathers to buff brown, commonly micaceous and argillaceous; upper part tends to be slabby. Thickness about 2 feet. Underlies Friedrich shale; overlies Dry shale. Wabaunsee group. Condra and Reed suggest that their Morton limestone may occupy horizon of Grandhaven limestone.

Type locality: In sec. 31, T. 13 S., R. 14 E., near Grandhaven, Shawnee County, Kans.

Grandian Epoch or Series[1]

Pleistocene (Nebraskan and Aftonian): Illinois and Iowa.

Original reference: G. F. Kay, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 449–452.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38. In Iowa and Illinois, the Pleistocene is classed as a Period (System), and four Epochs (Series) are used to include a glacial-interglacial pair each. These are Grandian (Nebraskan and Aftonian), Ottumwan (Kansan and Yarmouthian), Centralian (Illinoian and Sangamonian), and Eldoran (Wisconsinan and Recent). Of these units, each of first three essentially coincides with a glacial cycle; present data indicate that the youngest (Eldoran) includes two distinct cycles, each of which is complex within itself. These terms have not been adopted for official use in Kansas partly because of this inconsistency and partly because retention of Quaternary

as the System-Period with Pleistocene as its contained Series-Epoch would force erection of new category of names to include these terms and thus produce further complication of classification system.

Named for Grand River valley, southwestern Iowa.

Grand Island Formation[1]

Grand Island Member (of Meade Formation)

Pleistocene (Kansan): Southern and eastern Nebraska, eastern Colorado, western Iowa, and Kansas.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

J. C. Frye, Ada Swineford, and A. B. Leonard, 1948, Jour. Geology, v. 56, no. 6, p. 520 (fig. 3), 521, 522; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 15. Lower member of Meade formation in Kansas. Underlies Sappa member. Thickness commonly 25 feet.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 12 (fig. 6). Correlation table shows relation of Nebraska Pleistocene formations to continental glaciations on cyclic basis involving erosion, alluviation, eolation, and soil formation. Grand Island sand and gravel (Kansan) divided into "Upper Grand Island" and "Lower Grand Island". Thickness of Upper Grand Island about 28 feet in Little Sioux Valley, near Harrison-Monona County line, Iowa.

C. B. Schultz, E. C. Reed, and A. L. Lugn, 1951, Science, v. 114, no. 2969, p. 547–548. Proposed that name Grand Island be restricted to Upper Grand Island, and name Red Cloud sand and gravel be applied to Lower Grand Island of Condra and Reed (1950), which includes pro-Kansan sand and gravel. The restricted Grand Island was deposited during retreat and waning of Kansas ice sheet (late Kansan and early Yarmouth Sappa time).

D. R. Hill and J. M. Tompkin, 1953, U.S. Geol. Survey Bull. 1001, p. 9 (table 1), 23–24. Geographically extended into Wray area, Colorado. Does not crop out in natural exposures. Thickness about 10 feet, measured in gravel pits. Overlies Ogallala formation.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 258, no. 1, p. 55 (fig. 1). Chart of revised classification of Kansas Pleistocene shows Grand Island as member of unnamed formation in Meade group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown as formation in Kansas.

Named for exposures at and around Grand Island, Hall County, Nebr.

Grand Lake Member[1] (of Presque Isle Stage)

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1915, unpublished ms., as reported by E. R. Pohl, 1930, U.S. Natl. Mus. Proc., v. 76, art. 14, p. 4, 25.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 573, 580. Pohl (1930) showed Presque Isle stage composed of Bell shale, Grand Lake, and Long Lake members. In classification of Traverse rocks of Thunder Bay region, Presque Isle series or stage with its synonym, Long Lake series, are abandoned. It might have been possible to have used name Grand Lake limestone instead of Rockport Quarry, but term Grand Lake had never been adequately described.

Probably named for Grand Lake, eastern part of Presque Isle County.

Grand Ledge cyclothem (in Saginaw Formation)

Pennsylvanian: Southern Michigan.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28. One of seven cyclothems in the Saginaw. Consists of irregularly laminated sandy shale and shaly sandstone overlain by a hard, fine-textured underclay; underclay is overlain by coal above which are basal beds of a younger cyclothem.

Exposed in vicinity of Grand Ledge, Eaton County.

†Grand Portage Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 35, 69.

Named for occurrence in old Grand Portage mine, Houghton County.

†Grand Portage flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Grand Portage Graywacke[1]

Precambrian (upper Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4, p. 510.

Occurs in Grand Portage Indian Reservation, Cook County.

†Grand Prairie Formation[1]

Lower Cretaceous: Eastern Texas.

Original reference: R. T. Hill and R. A. F. Penrose, 1889, Am. Jour. Sci., 3d, v. 38, p. 470.

Named for prairie, known to old travelers as the "Grand Prairie," which extends from 4 miles east of Fort Worth to 7 miles west of Weatherford, Parker County.

Grand Rapids Group[1]

Mississippian: Michigan.

Original reference: A. C. Lane, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66; reported by M. E. Wadsworth.

G. M. Ehlers and W. E. Humphrey, 1944, Michigan Univ. Contr. Mus. Paleontology, v. 6, no. 6, p. 114–117. Discussion of fauna from Point au Gres limestone at Grand Rapids. History of nomenclature reviewed, and references made to work of Lane (1893, 1895, 1899, 1900, 1909). Concluded that Point au Gres instead of "Grand Rapids" or "Bayport" should be used for limestone under discussion. Usage is based on definition of Point au Gres by Douglass (1841 [1839]). Continued reference to limestone as "Bayport" would be unfortunate because this name and "Grand Rapids" were used only in casual manner by Lane.

Named for exposures at Grand Rapids, where Bayport limestone is quarried.

†Grand Rapids Limestone[1]

Mississippian: Michigan.

Original reference: A. C. Lane, 1899, U.S. Geol. Survey Water-Supply Paper 30, p. 81.

Grand Rapids Sandstone[1]

Devonian(?): Northwestern Ohio.

Original references: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 20; 1890, Ohio Geol. Survey 3d Organization, 1st Ann. Rept., p. 24.

Wood County.

Grand River Formation

Grand River Group

Pennsylvanian: Southern Michigan.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 159, 206–214. Pennsylvanian formations in Michigan, which are stratigraphically higher than beds of the Saginaw group, have been variously called Woodville, Ionia, and Red beds. However, either term, Woodville or Ionia, implies correlation of all younger beds than the Saginaw although there are few facts to substantiate such correlation. Grand River group proposed to include various formations, which stratigraphic evidence indicates are younger than Saginaw, though not strictly to be correlated with each other as occupying the same position in the geologic time scale. Group would include Woodville sandstone, Ionia sandstone, Eaton sandstone (new), and any other formations correlated with them.

G. V. Cohee, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 11. Grand River formation, youngest Pennsylvanian formation in area, is present only in northern Eaton and Ingham Counties.

G. V. Cohee, Carol Mach, and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Recommended that Eaton and Ionia sandstones be considered members of Saginaw formation and that Woodville be restricted to a sandstone in member of lower part of Saginaw.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28–29. Herein considered a formation with Eaton and Ionia as members.

Formations of group are exposed in mines and quarries, and natural outcrops in valley and drainage basin of the Grand River, from vicinity of Jackson to that of Ionia.

Grand River Limestone

Mississippian (Chester Series): Northeastern Oklahoma.

R. A. Brant, 1941, *in* Tulsa Geol. Soc. [Guidebook] Field Trip, Oct. 18, strat. sections. Fossiliferous, coarsely oolitic limestone as much as 65 feet thick. Overlies Batesville formation; underlies Fayetteville formation. Formerly a part of the "Mayes" formation.

R. C. Slocum, 1955, Oklahoma Geol. Survey Circ. 35, p. 12. Brant (1941) applied term "Grand River" to limestones between Fayetteville shale and "Batesville" siltstone along Grand River in Mayes County. Although term is ideal for this locality, it is preoccupied. Term Hindsville is substituted for purpose of this report.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey.

Type section: Along Grand River in sec. 26, T. 20 N., R. 19 E., Mayes County.

Grandstand Formation (in Nanushuk Group)

Lower Cretaceous: Northern Alaska.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 235–237, figs. 2, 4, 5. Predominantly marine but contains several interfingering units of Killik tongue (new) of nonmarine Chandler formation in upper part. Thick sandstone beds in lower part, which, consequently, is better exposed. Basal part of formation predominantly fine-grained light-olive-gray to dark-yellow-red sandstone, with thin greenish "salt-and-pepper" sandstone bed at base, and subordinate amounts of siltstone and shale. In upper part, siltstone and silt shale constitute about 50 percent of unit; minor amounts of coal in sequence. Thickness of type section about 1,700 feet. Unconformably overlies Tuktu formation (redefined); underlies and intertongues with Killik tongue. Age shown on chart as Lower(?) and Upper (?) Cretaceous.

F. M. Robinson, 1959, U.S. Geol. Survey Prof. Paper 305–J, p. 527, fig. 46. Age given as Lower Cretaceous.

Type locality: On left bank of Anaktuvuk River, where river breaches Grandstand anticline, lat 68°56′ N., long 151°10′ W.

Grand Tower Limestone[1]

Grand Tower Limestone (in Ulsterian Group)

Middle Devonian: Southwestern Illinois and eastern Missouri.

Original reference: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30, 42.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 16, 25, 26; 1944, Illinois Geol. Survey Bull. 68, p. 89, 95. Described in Illinois, where it is included in Ulsterian group. Best exposed at Devil's Bakeoven north of Grand Tower; here nearly entire thickness of formation, 124 feet, is present. In northern Union County, outcrops are restricted; formation thins out southward and is not known to extend much south of Highway 146. Succeeds Dutch Creek sandstone conformably but appears to be separated by an unconformity from overlying "Lingle" limestone; this contact has been observed only in hills north of Grand Tower where an abrupt change in lithology and fossils occurs. Strata intervening between the Grand Tower limestone (or Dutch Creek sandstone where Grand Tower is absent) and the Mountain Glen shale (or Springville shale where the Mountain Glen is absent) have been referred by Savage (1920) to the Misenheimer shale and the Lingle and Alto limestones. Restudy of this area suggests that recognition of these formations may be neither stratigraphically logical nor practically feasible.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown as Lower and (or) Middle Devonian.

Carey Croneis, 1944, Illinois Geol. Survey Bull. 68, p. 103 (chart), 115–119, 121. Described in southeastern Missouri where it crops out in synclinal block of Little Saline fault zone southeast of Ozora and in Quarry Hill structure to northeast. Also occurs in small patches in hills south of Little Saline Creek on St. Mary's road south of Ozora. In Perry County, distribution is limited to two exposures: a narrow strip less than 2 miles

long in fault zone between Bailey and Burlington escarpments near Union School, and the other, one-half mile south of Ridge School, is bounded on south by faults. Thickness in Ste. Genevieve County 225 to 250 feet; in Perry County 100 feet or less. In Ste. Genevieve County, no basal arenaceous beds are present, contact with Little Saline strata is gradational, and first appearance of cherty limestone is arbitrarily assumed to mark base of formation. Underlies Beauvais formation in Little Saline fault area; in Perry County, underlies St. Laurent formation.

Named for exposures in vicinity of Grand Tower, Jackson County, Ill.

Grand View Dolomite[1]

Upper Devonian: Southern central Idaho.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

C. P. Ross, 1947, Geol. Soc. America., v. 58, no. 12, pt. 1, p. 1109–1110, pl. 1. Thickness 2,115 feet in Borah Peak quadrangle, Idaho. Overlies Jefferson dolomite; underlies Three Forks limestone.

Type locality: Grand View Canyon, near center T. 12 N., R. 20 E., south of Challis, Custer County.

Grandview Limestone (in Brazil Group)

Pennsylvanian (Pottsville Series): Southwestern Indiana.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 87 (fig. 1), 89, 90. Light-gray finely crystalline crinoidal limestone with bedded gray chert. Thickness 5 feet. Lies near top of group about 15 feet below Buffaloville coal in Staunton group.

Type exposure: Along State Highway 66 east of Grandview in Ohio River bluffs in SE¼NE¼ sec. 15, T. 6 S., R. 4 W., Spencer County.

Graneros Shale (in Colorado Group)[1]

Graneros Shale Member (of Mancos Shale)

Graneros Shale (in Benton Group)

Lower and Upper Cretaceous: Eastern Colorado, northwestern Iowa, western Kansas, southeastern Montana, Nebraska, northeastern New Mexico, South Dakota, and eastern Wyoming.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 564.

A. J. Collier, 1922, U.S. Geol. Survey Bull. 736, p. 79–84, table. In Osage oil field, Weston County, Wyo., Graneros shale comprises about 1,000 feet of shale in which following members can be distinguished (ascending): Skull Creek shale, Newcastle sandstone, Nefsy shale (new), Mowry shale, and Belle Fourche shale. Overlies Dakota sandstone; underlies Greenhorn limestone. Colorado group.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc: Wichita, [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar 21–23]. Overlies Solomon formation (new) of Dakota group.

M. E. Wing, 1940, South Dakota Geol. Survey Rept. Inv. 35, p. 3–6, chart facing p. 10. Formation, in Butte County, comprises lower unit, 250 to 300 feet thick, of dark shale, with sandstone at top that is believed to be Newcastle; middle unit, or Mowry, 250 feet thick; upper unit, about 600 feet thick, of dark shales, with limestone ledge herein named Middle Creek limestone. Overlies Fall River (Dakota) sandstone; underlies Greenhorn limestone.

B. F. Latta, 1941, Kansas Geol. Survey Bull. 37, p. 74. In Hamilton County, conformably overlies Cockrum sandstone (new) of Dakota group.

Norman Plummer and J. F. Romary, 1942, Kansas Geol. Survey Bull. 41, pt. 9, p. 330–331 (fig. 4), 337. Overlies Janssen clay member of Dakota formation.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7), 18. Thickness 60 to 70 feet in northeastern Nebraska (near Ponca and Homer); 40 to 90 feet in subsurface in Republican Valley; 550 to 700 feet in northern Dawes County; about 900 feet in exposures around Black Hills. Formation changes facially westward becoming the argillaceous Belle Fourche shale above and gray calcareous Mowry shale below in western Nebraska, eastern Wyoming, and southwestern South Dakota. Underlies Greenhorn limestone; overlies Omadi sandstone (new) of Dakota group.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. As shown on correlation chart, Graneros shale in southern Great Plains occupies interval between Dakota sandstone below and Greenhorn limestone above. In northern Great Plains, the equivalent interval is occupied by (ascending) Mowry shale and Belle Fourche shale. Newcastle sandstone is shown equivalent to Dakota sandstone, and Skull Creek shale is shown as a Lower Cretaceous formation below the Newcastle and above Fall River sandstone of Inyan Kara group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153, 155 (fig. 3). Consists of shale and clay shale, fissile, noncalcareous, and blue black, that weathers to dark gray and coffee brown. Thickens southward across western Kansas. Thickness 30 to 35 feet in Russell County; 65 feet near Colorado line. Overlies Janssen clay of Dakota formation; underlies Lincoln limestone member of Greenhorn limestone. Colorado group; Gulfian series.

B. C. Petsch, 1946, South Dakota Geol. Survey Rept. Inv. 53, p. 43, 44 (fig. 13), 47. Basal formation in Benton group. Underlies Greenhorn limestone; overlies Dakota formation. Outcrops of Graneros present in bluffs along east side of Big Sioux River in Iowa between Westfield and Sioux City.

N. W. Bass, C. E. Straub, and H. O. Woodbury, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 68. As used in this report [Model anticline, Las Animas County, Colo.] Graneros shale is 105 feet thick and includes interval between Dakota sandstone below and Lincoln limestone member of Greenhorn limestone. Includes Thatcher limestone member (new). As originally defined by Gilbert (1896), Graneros shale in vicinity of Pueblo was 200 to 210 feet thick and included in its upper part beds that are herein designated Lincoln limestone and Hartland shale members of Greenhorn limestone. If these younger beds were included in the Graneros, its total thickness over Model anticline would be 153 feet. Upper Cretaceous.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. Lowermost member of Mancos shale in area of this report [eastern side of San Juan basin, Rio Arriba County, N. Mex.]. Consists chiefly of gray and black evenly thin-bedded shale; locally shale is sandy in basal 6 to 10 feet. Thin beds of bentonite present, particularly in lower and upper part. Underlies Greenhorn limestone member; overlies Dakota sandstone. Upper Cretaceous.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 8–15. In Black Hills region Graneros formation divided into (ascending) Skull Creek shale, Newcastle sandstone, Nefsy shale, Mowry shale, and Belle Fourche shale members. Estimated thickness 1,200 feet in area of this report [Whitewood anticline]. Nefsy not distinguished from Mowry in area of present report. Overlies Dakota (Fall River) formation; underlies Greenhorn formation. Unit termed Middle Creek limestone by Wing (1940) is herein renamed Orman Lake limestone and classified as bed in Belle Fourche member.

A. J. Crowley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 83–107. Newcastle sandstone, formerly regarded as member of Graneros shale, is herein assigned to Lower Cretaceous. Table 1 shows restricted Graneros shale comprises (ascending) Mowry shale and Belle Fourche shale in Black Hills area.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Cretaceous system in area of this report [northwestern Mora County, N. Mex.] is represented by Dakota sandstone and Benton formation; the Benton consists of Graneros shale, Greenhorn limestone, and Carlile shale equivalents. Upper Cretaceous.

U.S. Geological Survey currently designates the age of the Graneros as Lower and Upper Cretaceous. This age designation is made on the basis that the base of Colorado Group is drawn at top of Mowry and its equivalents. Base of Colorado group thus drawn is accepted as boundary between Upper Cretaceous and Lower Cretaceous. Where the Mowry is not present the age of the Graneros is designated as Upper Cretaceous.

Named for Graneros Creek, Walsenburg quadrangle, Pueblo County, Colo.

Granger Sandstone Member (of Spoon Formation)

Pennsylvanian: Northern Kentucky and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45 (table 1), 65, pl. 1. Proposed to replace Curlew sandstone in order to retain name Curlew for the limestone. In southeastern Illinois, stratigraphically above O'Nan coal member (new) and below Creal Springs limestone (new). Thickness 20 to as much as 60 or 70 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: Indian Hill, near Curlew, Union County, Ky. Name derived from village of Grangertown, about 5 miles southeast of Indian Hill.

Granite Creek Granodiorite[1]

Probably Jurassic or Cretaceous: Northern Idaho.

Original reference: J. L. Gillson, 1927, Jour. Geology, v. 35, no. 1.

Named for exposures around mouth of Granite Creek, Bonner County.

Granite Falls Garnetiferous Quartz Diorite Gneiss

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1481–1482, pl. 2. Forms part of basic complex of area. Characterized by abundant pink garnet. Contains numerous quartz veins and quartz and granite stringers, which in general follow foliation of the gneiss but frequently cut across it. Locally, the large amount of introduced siliceous material results in an abnormally light-gray color. Just south of Minnesota River, the gneiss

is characterized by fairly uniform nearly east-west strike of foliation with average dip of 40° to south. Structure is reflected in topography by a number of east-west ridges with scarp-like slopes on north side and more gentle slopes on south side.

Underlies an area of about 2 square miles south of Granite Falls, Yellow Medicine County.

Granite Falls Limestone

Upper Pennsylvanian and (or) Permian: Northwestern Washington.

R. A. Anderson, 1941, Washington State Coll. Research Studies, v. 9, no. 3, p. 189, 201. Fusulinid-bearing limestone composed largely of cryptocrystalline calcite. Lies in contact with a dark basic rock.

Exposed in quarry near E¼ cor. sec. 5, T. 30 N., R. 7 E., about 3 miles northeast of Granite Falls and on south side of Canyon Creek, Snohomish County.

Granite Gap Granite

Precambrian: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 9–10, 12, table 1, pl. 1. Where fresh and unaltered, granite is a holocrystalline equigranular medium-grained light-pink to gray rock with a hypidiomorphic texture. Unconformably underlies Bolsa quartzite.

Named from exposures at Granite Gap, where Highway 80 crosses the Peloncillo Range, Hidalgo County. In vicinity of Granite Gap, exposures occupy an area of 1½ miles square. Also crops out in narrow band, a few hundred feet wide to one-half mile, between main ridge of Peloncillo Mountains and smaller ridge north of Preacher Mountain.

Granite Mountain Porphyry[1]

Tertiary, lower(?): Central Arizona.

Original reference: F. L. Ransome, 1919, U.S. Geol. Survey Prof. Paper 115, p. 126, pl. 45.

E. D. Wilson, 1952, Arizona Geol. Soc. Guidebook for Field Trip Excursions in Southern Arizona, p. 8. Age shown as Laramide (Late Cretaceous to early Tertiary).

Principal body is the irregular intrusive mass that makes up much of Granite Mountain.

Granite Park Member (of Siyeh Formation or Limestone)[1]

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1896–1897. Thickness ranges from 280 to 900 feet. At type locality, which is here designated, member consists of 285 feet of dolomites, argillites, and thin quartzites, with thin strata of oolite, sandstone, and mud breccia. Clastic materials diminish northwestward on crest of Lewis Range. Represents final stage of Siyeh sedimentation. Separated from underlying Goathaunt member by *Collenia frequens* zone. Underlies Spokane formation.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 138–139. Discussion of stromatolites of Belt series, *Collenia multiflabella* zone of Siyeh limestone represents Granite Park member of Fenton and Fenton (1937).

Type locality: Cliffs of Continental Divide southeastward from Granite Park, Glacier National Park, where strata are crossed by trail to the dike above Grinnell Glacier. Well exposed in Hole-in-the-Wall Basin, near Boulder Peak, and on trail from Alderson to Carthew Lakes, Waterton Lakes Park.

Graniteville Granite

Precambrian: Southeastern Missouri.

H. B. Graves, 1938, Acad. Sci. St. Louis Trans., v. 29, no. 5, p. 119. Proposed for granites of area [St. Francois Mountains] that appear to be related to the granites at Graniteville. Granite at Graniteville is red and coarse grained, and much of it is porphyritic; pegmatitic phases appear in southern part of area. Similar granite occurs near Cornwall and Coldwater.

Graniteville is in northeastern Iron County.

Grant Conglomerate[1]

Precambrian (probably middle Huronian): Northern Minnesota.

Original reference: J. W. Gruner, 1929, Lake Superior Min. Inst. Proc., v. 27, p. 184–187.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1600. In Knife Lake area, a granite pebble conglomerate lies on greenstone in secs. 10 and 11, T. 65 N., R. 6 W., east of Hanson Lake. It lies in a wedge formed by two faults; hence, its relationship to other members is not clear. Thickness does not exceed 600 feet. It was called Grant conglomerate by Gruner (1929); however, it does not deserve an individual name because it probably does not represent as long an erosion interval as was thought at first.

Well exposed in vicinity of Grant Lake, Lake County.

Grant Shale Member (of Winfield Limestone)

Grant Shale (in Chase Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 50.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Member of Winfield limestone. Consists of gray calcareous fossiliferous shale; a distinct unit except in southern Kansas where it probably has been included in lower part of Cresswell limestone member. Thickness in northern part about 10 to 12 feet; in central about 6 feet. Overlies Stovall limestone member. Wolfcamp series.

Type locality: Between 5 and 6 miles north of Florence, Marion County, Kans. Named for Grant Township in Marion County.

Grant Mills Granodiorite

Grants Mills Granite[1]

Devonian or older: Northern Rhode Island.

Original reference (Grants Mills granite): C. H. Warren and S. Powers, 1914, Geol. Soc. America Bull., v. 25, p. 437 (map), 458.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 15, geol. map. Redescribed as gray to greenish-gray medium-grained grano-

diorite, generally porphyritic and massive to foliated in structure. Contains inclusions of greenstone, schist, and quartzite. Grades into Esmond granite; relative ages unknown. Intrusive into an unnamed quartz diorite in Olney Pond area. Magmatic origin suggested. Devonian or earlier.

Occurs near Grants Mills, Providence County.

Granton trap[1]

Upper Triassic: Northern New Jersey.

Original reference: N. H. Darton, 1890, U. S. Geol. Survey Bull. 67.

Occurs midway between Jersey City, Hudson County, and Hackensack, Bergen County.

Grantsville Formation

Middle Triassic: Southwestern Nevada.

S. W. Muller and H. G. Ferguson, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1592–1594, pl. 2. Divided into two members: a lower conglomerate member with minor argillites and an upper limestone member with minor shales. Thickness of lower member, several hundred feet; upper member 100 to 300 feet. Rests unconformably upon a thick section of altered volcanic rocks and overlain unconformably by Luning formation.

N. J. Silberling, 1959, U.S. Geol. Survey Prof. Paper 322, p. 10–14, pls. 10, 11. Described in Union district, Shoshone Mountains, Nev., where it is about 700 feet thick. Overlies Pablo formation; underlies Luning formation.

Type locality: On crest of spur separating mouth of Union Canyon from next large canyon to the north. Named after mining camp on west flank of Shoshone Mountains in north-central part of Tonopah quadrangle. Outcrops also on ridge due north of Grantsville, at mouth of Grantsville Canyon, and on low isolated hill just south of Union Canyon.

Granville Beds[1]

Mississippian: Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d, v. 16, p. 217–219.

Named for Granville, Licking County.

Granville Enstatite Serpentine[1]

Silurian: Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 90.

Occurs in Old Hampshire County now divided into Franklin, Hampshire, and Hampden Counties.

Granville Formation

Lower Cambrian: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 49–55, 116. Typically a gray to black rusty-weathering graphitic albite-quartz-chlorite-miscovite schist. Thin beds of blue-gray quartzite are interbedded with the schist in places. Beds of dark-green albite-epidote-calcite-chlorite schist and lenses of buff-colored dolomitic marble also occur. Thickness about 350 to 400 feet throughout the area with a slight thickening probably toward the northern border. Underlies Pinney Hollow formation; overlies Monastery formation (new).

Named from exposures in township of Granville. Lithology well displayed in outcrops in White River three-tenths of a mile northwest of village of Granville, Rochester quadrangle.

Granville shale facies[1] (of Cuyahoga Formation)

Mississippian (Kinderhook) : Central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 679–682.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 43 (fig. 2), 46–47. Includes Black Hand siltstone member and Raccoon shale member. Lies between Toboso conglomerate facies to the northeast and the Hocking Valley conglomerate facies to the southwest.

Occurs in Morrow, Knox, Fairfield, Licking, and Perry Counties.

Grape Creek Limestone Member (of Clyde Formation)

Grape Creek Formation (in Clyde Group)

Grape Creek Shale and Limestone (in Clyde Formation)[1]

Permian: North-central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 412, 427.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Given formational status in the Clyde herein given group status.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. In Colorado River valley, member constitutes lower three-fifths of formation. Consists of thin beds of uniform blue-gray limestone. Thickness uniformly about 325 feet. Underlies Talpa limestone member; overlies Bead Mountain limestone member of Belle Plains formation. Division of the Clyde into members in this area is not as natural as in the area north of Abilene; in this mapped area they might appropriately be treated as formations.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 275. Grape Creek limestone member, in Brazos River valley, is 20 to 45 feet thick, and consists of upper and lower limestone beds separated by shale. Limestone beds range from 2 to 8 feet in thickness and shale from 15 to 40 feet. Overlies unnamed shale member at base of formation; separated from overlying Talpa limestone member by unnamed shale member.

Named for Grape Creek, Coleman County.

Grapevine conglomerates[1]

Tertiary, lower: Southern California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Named for exposures around base of Grapevine Range, on east side of Death Valley, Inyo County.

Grapevine Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 211.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 62, 84. In this report, the Kanawha is considered a group.

Type locality: At mouth of Grapevine Creek, Mingo County.

Grapevine Gulch Formation (in Ash Creek Group)

Precambrian (Yavapai Series) : Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 17–20, pl. 1. Six map units recognized in the formation: coarse-grained lithic tuffaceous sedimentary rock; fine-grained tuffaceous sedimentary rock interbedded with chert and siltstone; volcanic breccia; jasper-magnetite beds; intercalated dacitic flows that in part grade into dacitic intrusive masses; and intercalated andesitic flows. Estimated thickness 8,000 to 10,000 feet. Overlies dacite of Burnt Canyon southwest of Mingus Mountain but elsewhere rests upon and intertongues with Deception rhyolite. Top of formation not exposed.

Well exposed southwest of Mingus Mountain where it forms broad northwestward-trending belt, cut off by Shylock fault to the west and by younger quartz diorite to the south and east. Named from excellent exposures along Grapevine Gulch, Jerome area, Yavapai County.

Graphic lavas[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico, Des Moines, Robert Henderson, State Printer, p. 4, 7.

Derivation of name not given.

†Graphic-Kelly Limestone[1]

Mississippian: Central or southwestern New Mexico.

Original reference: C. L. Herrick, 1904, Am. Geologist, v. 13, p. 310–312.

Occurs in Kelly mining district, Socorro County.

Grass Creek Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 1), 140, 141, 143 (fig. 2), 145 (fig. 3). Consists of basal unit, 600 to 700 feet, of lenticular coarse-grained sandstone and reddish clay shales of fluviatile origin; upper unit contains thin-bedded tan sandstone alternating with thin layers of gray shale, 275 to 325 feet thick. Upper unit seems to correlate with Trexler's Meadow Creek sandstone member (new). Contains early Niobrara fauna. Overlies Dry Hollow sandstone member (new); underlies Judd shale member (new).

Named for exposures in lower drainage of Grass Creek valley near Echo Reservoir and in Lewis Canyon southwest of reservoir, Summit County.

Grasselli Dolomite (in Kingsport Formation)

Ordovician (Canadian) : Eastern Tennessee.

C. R. L. Oder and H. W. Miller, 1945, Am. Inst. Mining Metall. Engineers Tech. Pub. 1818, p. 4, 6 (table 2). Composed of dark fine-grained to finely crystalline dolomite through which are scattered a few white spots and at base of which is a green shale and some quartzite grains. Underlain by brown limestone which may be altered to crystalline dolomite; overlain by 3 to 5 feet of fine-grained to finely crystalline mottled and sparsely spotted greenish to pinkish medium-gray dolomite. Thickness about 5 feet.

Named because of its prominent position in ore section in Grasselli mine at New Market, Jefferson County, about 14 miles northeast of Mascot.

Grass Valley Formation

Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Dominantly shales and quartzitic sandstones. Shales are mostly slaty, in part micaceous, olive drab, or black, with prominent worm trails. Quartzitic sandstones are white, gray, or black, and locally crossbedded. In Tobin Range, nearly all quartzite; in Stillwater Range, up to 30 percent limestone, mostly in upper part, remainder slate and quartzite; at type locality, limestone lenses near top. Thickness may exceed 2,000 feet. Underlies Dun Glen formation (new); overlies Natchez Pass formation (new).

Type locality: Mountain slope facing Grass Valley, northern part of East Range, Winnemucca quadrangle.

Grass Valley Formation

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 18–20, 59, 61. Includes, in ascending order, a basal limestone, thin andesite flow, and two ignimbrites. Limestone is hard, dense, and pure, dominantly white with some pale-pink bands; bedding thin but irregular; maximum thickness of 100 feet; well exposed near crest of divide at north end of Grass Valley. Dull black augite amygdaloidal andesite flow attains thickness of about 50 feet. Volcanic sandstone and soft white ashy tuff at base of lowest vitric-crystal rhyolite ignimbrite or red-violet color on fresh surface; thickness up to 700 feet. Upper ignimbrite with brick-red groundmass is about 150 feet thick. Maximum thickness of formation about 1,000 feet. Overlies with apparent angular unconformity all older extrusive rocks in area. Upper ignimbrite truncated by an unconformity. Underlies Atchinson formation (new).

Exposed in Grassy Flat Canyon, on east side of Grass Valley, and in area northwest and west of Pine Valley, Washington and Iron Counties.

Grassy Member (of Blackhawk Formation)

Upper Cretaceous (Montana): Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 186, figs. 2, 3, pl. 3. Consists of basal littoral marine sandstone with maximum thickness of about 60 feet and series of coal-bearing rocks with maximum thickness of about 50 feet. Basal white-capped sandstone first appears at Sunnyside and fades into underlying Mancos shale at Coal Canyon. It is a medium-grained, buff sandstone, which grades downward and eastward from massive into thin-bedded sandstone and finally into marine shale tongue. This shale rests disconformably on coal-bearing rocks of Sunnyside member (new). Thin beds of coal present. Disconformably underlies tongue of Mancos shale which separates it from overlying Desert member (new).

Named from exposures in vertical cliffs east of railroad siding of Grassy, Emery County. In Book Cliffs.

Grassy Creek Shale[1]

Grassy Creek Formation (in Sulphur Springs Group)

Grassy Creek Shale (in Champ Clark or Fabius Group)

Upper Devonian or Mississippian: Northeastern Missouri, western Illinois, and southeastern Iowa.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59–63.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, chart 5; J. M. Weller, 1948, (abs.) Am. Jour. Sci., v. 246, no. 3, p. 150. Basal formation in Fabius group (new). Underlies Saverton shale. Devonian or Mississippian.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 39–43. Formation described in Boone County where it is basal formation of Sulphur Springs group. Here, consists of basal, fine- to medium-grained, calcareous sandstone overlain by gray to brown shale. Thickness about 7 feet. Underlies Bushberg formation; overlies Callaway limestone.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 14–16. Reallocated to Champ Clark group (new) proposed to replace Fabius group of Weller and others (1948). Name Grassy Creek is applied in western and central Illinois and east as far as Champ Clark group can be differentiated. Farther east, the Grassy Creek is equivalent to part of New Albany shale. Overlies discontinuous Sylamore sandstone; underlies Saverton shale; north of area in which Saverton has been differentiated, seems to be directly overlain by Maple Mill shale of Hannibal group.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 22–27, pl. 1. Formation described in Bowling Green quadrangle where it is 1 to 44 feet thick and consists of brownish-black fissile shale with a 4- to 8-inch basal conglomerate in some areas. Conformably overlain by Saverton formation; in some areas, lies conformably on Edgewood formation of lower Silurian age; where Edgewood is absent, lies unconformably on Upper Devonian Maquoketa formation. No general agreement as to age of formation. Occurring as it does near disputed Devonian-Mississippian contact, it has been assigned to Devonian by some geologists and to Mississippian by others.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 81–85, 105. In Pike County, Mo., includes Turpin sandstone member (new) at base. Discussion of controversy in use of terms Grassy Creek and Saverton. Keyes did not mention precise type locality, but it is evident that he intended type locality to be in vicinity of Louisiana in area of the thin Grassy Creek and not "10 miles west of Grassy Creek," where the shales attain thickness of 30 feet. Type locality designated in this report is type locality of Grassy Creek as amended by Keyes (1913, Am. Jour. Sci., v. 36, 4th ser.). This section is figured by Branson and Mehl (1933, Missouri Univ. Studies, v. 8, no. 3). Branson and Mehl (1933) did not distinguish between their supposed distribution of the Grassy Creek conodont fauna and the distribution of the Grassy Creek shale. Hence, they seem to suggest the substitution of the name Grassy Creek for such regional designations of strata as Noel, Chattanooga, and others. This procedure is now believed to be ill-advised. Considered Upper Devonian.

Type locality (Mehl, 1960): Mississippi River bluff in Pike County, Mo., some distance above Champ Clark Bridge (approximately SW¼NW¼ NE¼ sec. 18, T. 54 N., R. 1 W.). This is same type locality at given for Saverton shale.

Grassy Knob Chert[1]

Lower Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1925, Am. Jour. Sci., 5th, v. 10, p. 139–144.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 127, 128; 1940, Illinois Geol. Survey Rept. Inv. 71, p. 22–23. Recognized in Illinois only where Backbone limestone can be identified to separate it from Clear Creek chert. Beds assigned by Bassett (1925, Illinois Acad. Sci. Trans., v. 18) to Grassy Knob chert attain thickness of 225 feet at north end of Devonian exposures in Mississippi River bluffs. There appears to be no stratigraphic break between this formation and underlying Bailey limestone, and it is probable that in the midst of this succession unweathered beds have been referred to the Bailey and weathered strata at same horizon have been assigned to the Grassy Knob.

L. E. Workman, 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 1. There is actually no means of separating the so-called Grassy Knob chert above from the Bailey limestone below. Evidently the chert is a concentration of silica in upper part of a single formation, the Bailey. It is recommended that only the term Bailey be used to designate the strata underlying the Little Saline and overlying Silurian strata.

Type locality: West side of Grassy Knob, 3½ miles southeast of Grand Tower, Jackson County.

Grassy Mountain Basalt[1]

Miocene and Pliocene(?): Southeastern Oregon.

Original references: K. Bryan, 1929, U.S. Geol. Survey Water-Supply Paper 597, p. 55; B. C. Renick, 1930, Jour. Geology, v. 38, p. 506.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Brothers, Inc., p. 109. Overlies Pinnacle Point beds (new).

Named for the fact it caps Grassy Mountain, Malheur County.

Grassy Swale Lavas

Cenozoic. Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 295. Name applied to lavas that lie near contact between black andesites of Central Plateau and the pale flows of Saddle Mountain (Saddle Mountain lavas), but whether they are older or younger, intrusive or extrusive, is not known.

Grassy Swale shown on map in Lassen Volcanic National Park east of Mount Lassen.

Graters Member (of Brunswick Formation)

Graters Shales (in Brunswick Formation)[1]

Upper Triassic: Southeastern Pennsylvania and western New Jersey.

Original reference: D. B. McLaughlin, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 179.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook for field trips Atlantic City Mtg., p. 51. Stratigraphic section shows Graters member consists of (ascending) red shale, 220 feet; black and gray shale and argillite, 50 feet; red shale, 42 feet; black and gray shale and argillite, 42 feet. Occurs about 2,000 feet above base of formation.

Named for exposures in Landis Brook just west of Grater's Ford, on Perkiomen Creek, Montgomery County, Pa.

Gratiot Flow (in Portage Lake Lava Series)

Precambrian (Keweenawan) : Northern Michigan.

J. C. Wright and H. R. Cornwall, 1954, Bedrock geology of the Bruneau Creek quadrangle, Michigan: U.S. Geol. Survey Geol. Quad. Map [GQ–35]. Ophitic basalt flow wih numerous pegmatitic layers in upper half. About 850 feet thick near road to Lake Gratiot. Thins rapidly toward southwest and about 1 mile west of Bruneau Creek quadrangle is only 130 feet thick. Where it is thinnest, many thin melaphyre layers occupy the interval between it and the Scales Creek flow.

Exposed near road to Lake Gratiot in sec. 36, T. 58 N., R. 31 W., Bruneau Creek quadrangle.

Gratton Limestone

Middle Ordovician : Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 836–838, 872–873, 884 (fig. 3), pl. 5. In Tazewell County the strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Gratton limestone applied to lower laminated limestone (zone 14) and overlying third calcilutite (zone 15). Thickness varies from 0 to 120 feet and averages about 60 feet in northeastern half of county. In Clear Fork Valley and in Clinch-Bluestone belt northeast of Five Oaks, directly underlies upper laminated limestone (zone 22, included in newly defined Witten limestone) and overlies Burkes Garden member of Benbolt limestone (both new) ; in other parts of the county, underlies Wardell formation (new) ; between Pisgah and Five Oaks, overlies either Cliffield formation (new) or Shannondale member (new) of Benbolt limestone. The Gratton corresponds to lower part of Butts' Lowville-Moccasin east of Tazewell, but he includes it in his Ottosee formation southwest of Tazewell.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1165–1166. Geographically extended into northeastern Tennessee. Formation thins toward southwest as underlying Benbolt and overlying Wardell thicken. Between Tazewell and Sharps Chapel, the Gratton rests directly on Beekmantown dolomites and locally has thickness of several hundred feet.

Type section: Tazewell County Farm, Tazewell County, Va. Named for exposures near Gratton, about 5 miles east of Tazewell.

Gratz Shale[1] Member (of Cynthiana Formation)

Middle or Upper Ordovician : Northern Kentucky and southern Ohio.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 416–418, 569, pl. 27.

J. J. Wolford, 1937, Geol. Soc. America Proc. 1936, p. 113. At type locality, Gratz division of the Cynthiana series is 40 feet thick. Middle Ordovician.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 8, p. 1643. Consists of rather barren shale and fine-grained earthy limestone forming upper part of Cynthiana in Henry and Owen Counties. Essentially a barren facies including in its upper part the Rogers Gap. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. In northeastern Kentucky, uppermost member of Cynthiana. Overlies Bromley member.

Type locality: Village of Gratz, Owen County, Ky.

Gravel Creek Sand Member (of Nanafalia Formation)

Eocene, lower: Southwestern Alabama.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 96 (fig. 32), 98, 99 (fig. 33), 100–106, 110–111, 120–121, pls. 2, 3. Name applied to lowest member of formation. Consists of white to yellow medium- to coarse-grained crossbedded sand with thin lenses of fine gravel and clay pebbles. Thickness 2 to 80 feet; 47 feet at type locality. Thickest in updip exposures; pinches out downdip to south in separate narrowing lenses of sand; absent in some areas. Generally unfossiliferous except for borings of *Halymenites*. Underlies unnamed middle member; unconformably overlies Coal Bluff member of Naheola formation. Transgressive and in places oversteps older formations. Sand beds included in member have been called Fearn Springs sand member (MacNeil, 1946), type locality of which is in Winston County, Miss. Boundary positions at Fearn Springs type locality are in dispute, and stratigraphic relationships with section in Alabama uncertain; hence, new name used in this report.

Type locality: South wall of Gravel Creek, 7.1 miles south of Camden, Wilcox County, on highway to Monroeville. Present in outliers far north of normal outcrop area.

Gravel Point Limestone or Formation

Gravel Point Stage[1]

Middle Devonian: Northwestern Michigan.

Original reference: E. R. Pohl, 1930, U.S. Nat. Mus. Proc., v. 76, art. 14, p. 2–25.

L. L. Sloss, 1939, Jour. Paleontology, v. 13, no. 1, p. 52. For purposes of this report, Pohl's divisions of Traverse beds, Petoskey, Charlevoix, and Gravel Point, are referred to as faunal zones.

G. A. Cooper and A. S. Warthin *in* G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1763, chart 4. At base of Gravel Point limestone (or formation), a foot of calcareous shale contains fossils like those in blue shale 40 feet below top of Alpena limestone; at top of Gravel Point, another blue shale, "the upper blue shale," or zone 6 of Pohl, contains crinoids and brachiopods similar to those of Dock Street clay at top of Alpena. Therefore, interval occupied by Gravel Point is essentially that of upper 40 feet of Alpena.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 448 (fig. 1), 455–460. In Afton-Onaway area, formation subdivided to include Gorbut member near middle. Overlies Koehler formation and underlies Beebe School formation (both new).

Named for exposures south of Gravel Point, 1½ miles west of Charlevoix, Charlevoix County.

Graves Creek Formation[1]

Pleistocene: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

On Graves Creek, Webster County.

Graves Gap Group

Pennsylvanian (Pottsville Series) : Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau : Tennessee Div. Geology [folio], p. 1, 11, 19, pls. 2, 3, 4, 6, 8. Includes all strata from top of Indian Bluff group (new) below to base of Redoak Mountain group (new) above; that is, between the top of the Pioneer sandstone and the top of the Windrock coal. In type section where Armes Gap sandstone (new) is thin and Roach Creek sandstone (new) is apparently absent, thickness of group is 365 feet; in Cross Mountain-Briceville-Graves Gap area, thickness averages 360 feet but elsewhere is 200 to 300 feet. Includes (ascending) shale interval, Armes Gap sandstone (new), and Windrock coal.

Type locality : Cross Mountain, Lake City quadrangle, Anderson County. Section begins with top of Pioneer sandstone at Mountain View Church and ends at top of Windrock coal about 80 feet above Cumberland Mountain Church. Name derived from Graves Gap on State Highway 116 in southwestern part of quadrangle.

†Gravina Series[1]

Upper Triassic and Jurassic or Cretaceous : Southeastern Alaska.

Original reference : A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p. 40–52, map.

Occurs at Dall Head and elsewhere on southern end of Gravina Island.

Gravoisan glacial epoch[1]

Pleistocene : Missouri.

Orignal reference : C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 140–141.

Named for occurence on Gravois Creek, near Osage River, Morgan County.

Gray Porphyry Group[1]

Upper Cretaceous(?) or Tertiary, lower : West-central Colorado.

Original references : S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1883, U.S. Geol. Survey Leadville Atlas; 1886, U.S. Geol. Survey Mon. 12, p. 80; 1927, U.S. Geol. Survey Prof. Paper 148.

C. H. Behre, Jr., 1953, U.S. Geol, Survey Prof. Paper 235, p. 46–47, pl. 1. As used in this report, includes Iowa Gulch, Lincoln, Sacramento, Evans Gulch, and Johnson Gulch porphyries. Mount Zion porphyry not recognized in immediate area [west slope of Mosquito Range].

Term originally applied in Leadville district.

Grayback Flows, Lavas

Pleistocene to Recent : Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 37. Probably first dacites erupted by Mount Mazama were those forming Grayback Ridge and southern end of Vidae Ridge. They predate time of maximum glaciation of Mount Mazama and are older than lavas of Llao Rock, Cleetwood Cove, Grouse Hill, and Redcloud Cliff. Grayback flows thicken southward to as much as 1,000 feet in southeast corner of park.

Grayback Ridge is south of Crater Lake.

Grayback Formation[1]

Devonian : Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1 and 2, p. 128, map.

Occurs at Little Grayback, a peak in Siskiyou County.

Grayback wash[1]

Quaternary: Central southern Colorado.

Original reference: G. M. Butler, 1910, Colorado Geol. Survey Bull. 2, p. 59–61, pl. 2.

In Grayback mining district, Costilla County.

Grayback Mountain Rhyolite Tuff

Upper Cretaceous(?) or (?) Tertiary, lower: West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 21–22, pl. 3. Rather massive welded rhyolite tuff. Classified as lithic-crystal-vitric. About 500 feet of tuff exposed in thicker sections. Rests on an eroded surface of unnamed alaskite porphyry.

Exposed only on Grayback Mountain, in southwestern corner of Bagdad area, Yavapai County.

†Gray Bull Beds[1]

Gray Bull Member[1]

Eocene, lower: Western Wyoming.

Original reference: W. Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 202–205.

G. L. Jepson, 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 238. Overlies Clark Fork beds in Polecat Bench formation (new).

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 20–21. Although usually considered a faunal zone, Gray Bull should be considered a member of the so-called "Bighorn Wasatch", a formation for which no valid name has yet been proposed.

G. L. Jepson and F. B. Van Houten, 1947, Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 148 (chart 1). Chart shows Gray Bull beds in basal part of Willwood formation. Occur below Lost Cabin or Lysite beds.

Named for exposures along Gray Bull River.

Grayburg Formation (in Whitehorse Group or Artesia Group)

Permian (Guadalupe Series): Subsurface and surface in southeastern New Mexico and subsurface in western Texas.

R. K. DeFord, 1939, *in* Addison Young, Max David, and E. A. Wahlstrom, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1551. Name Grayburg will be proposed by R. I. Dickey.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 44–47. Basal unit of Whitehorse group. In type well, underlies Queen formation and overlies San Andres formation. Lies between depths of 2,380 feet and 2,647 feet. Predominantly dolomite, gray, pink, white; locally sandy, some beds of anhydrite present.

W. R. Moran, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1288. At surface type section, herein designated, Grayburg is 475 feet

thick, consists of alternating sandstone and dolomites and underlies Queen formation.

P. T. Hayes and R. L. Koogle, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–112. Described in Carlsbad Caverns West quadrangle which contains Moran's type section. Top of formation, as proposed by Moran, is unmodified in this report. Basal contact is probably 40 to 50 feet above that used by Moran who apparently included part or all of what is here mapped as tongue of San Andres formation. Basinward gradation of Grayburg into lower part of Goat Seep limestone (Newell, 1953) is not exposed in this quadrangle but can be seen in quadrangles to west and southwest [Whitehorse group not used in area of this report].

Term Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) used in preference to Whitehorse Group in New Mexico.

Type well: Cecil H. Lockhart's Root Permit No. 2, in center SW¼SW¼ sec. 7, T. 17 S., R. 30 E., Eddy County, N. Mex. Name derived from Grayburg Pool.

Type section (surface): On a spur and in an unnamed canyon above Sitting Bull Spring in NE¼ sec. 9, T. 24 S., R. 22 E., Eddy County.

†Gray Cliff group[1]

Jurassic(?): Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of Henry Mountains, p. 6, 7.

Henry Mountains region.

†Gray Cliff Sandstone[1]

Jurassic(?): Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of Henry Mountains, p. 6, 7.

Henry Mountains region.

Graydon Channel Sandstone[1]

Graydon Formation (in Cherokee Group)

Pennsylvanian: Western and central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 7, p. 422–425.

T. R. Beveridge, 1951, Missouri Geol. Survey and Water Resources, v. 32, 2d ser., p. 53–55, pl. 11. Youngest indurated formation exposed in Weaubleau Creek area. Underlies Dederick subgroup of the Cherokee (Des Moines series); where the Dederick is absent, lies on deeply eroded Mississippian or Ordovician.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 47. Name "Graydon" is now used informally by the Missouri Geological Survey to refer to deposits which lie below the Cheltenham clays in northeastern Missouri. Term Graydon applied in southwestern Missouri apparently includes much of the deposits now assigned to the Venteran age, and the deposits below the Cheltenham clays cannot now be assigned with certainty to any part of it.

Named for exposures at Graydon Springs, Polk County.

Graydon Shales[1]

Pennsylvanian: Southwestern Missouri.

Original reference: E. M. Shepard, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, p. 56.

Green County.

†Graydon Springs Sandstone and Conglomerate[1]

Pennsylvanian: Western and central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 7, p. 422–425.

Probably named for exposures at Graydon Springs, Polk County.

Gray Gulch Formation

Tertiary: Central Utah.

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 37–38, [pl. 1]. Consists of sandstones and shales, some of volcanic derivation and others not; fresh-water limestones; bentonites; ash beds; agglomerates; and other volcanic derivatives, generally gray to blue but locally punctuated by beds and blotches of bright orange. Provisionally divided into two units which may prove on detailed study to be distinct formations. Disconformably overlies Crazy Hollow formation (new); unconformably underlies unnamed lava beds. It is possible that formation is same as the Bullion Canyon, and, if so, that name will be used. At present, correlation is too uncertain to allow use of either Moroni or Bullion Canyon.

D. P. McGookey, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 5, p. 605–606. Formation as designated by Spieker (1949) includes strata equivalent to Bald Knoll formation of Gilliland (1951), part of Bullion Canyon volcanics of Callaghan (1939) and a previously unnamed interval that was mapped as Gray Gulch(?) by Lautenschlager (1952, unpub. thesis). Proposed that term Gray Gulch be abandoned. Term Bald Knoll formation used for lower part of interval formerly assigned to Gray Gulch. Name Dipping Vat (new) applied to upper coarse interval of lacustrine beds formerly included in Gray Gulch. Type section stated.

Type section: Exposed in Gray Gulch, W½ sec. 32, T. 21 S., R. 1 E., Salina district.

Grayhorse Limestone Member (of Vanoss Formation)

Grayhorse Limestone Member (of Wood Siding Formation)

Grayhorse Limestone Member (of Caneyville Formation)

Grayhorse Limestone Member (of Sand Creek Formation)[1]

Pennsylvanian (Virgil Series): Central northern Oklahoma and eastern Kansas.

Original reference: K. C. Heald, 1918, U.S. Geol. Survey Bull. 686–K, p. 130.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 172. Classed as member of Caneyville limestone in Kansas. Overlies unnamed shale; underlies Pony Creek shale.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Reallocated to Wood Siding formation herein redefined. Overlies Plumb shale member (new); underlies Pony Creek shale member.

U.S. Geological Survey currently classifies the Grayhorse Limestone as a member of the Vanoss Formation in Oklahoma.

Named for exposure on crest of Little Grayhorse anticline in NW¼ sec. 11, T. 24 N., R. 6 E., Osage County, Okla.

Graylock Formation

Lower Jurassic: Northeastern Oregon.

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Overlies Rail Cabin formation (new). Hettangian.

Type locality and derivation of name not stated. Report discusses Izee area, Grant County.

Gray Mesa Member (of Madera Limestone)

Pennsylvanian: West-central New Mexico.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Thick- to thin-bedded, predominantly cherty and gray to dark-gray ledgy limestone with minor amount of gray shale and gray to brown fine- to coarse-grained sandstone. Thickness 850 to 900 feet. Conformably underlies Atrasado member (new); conformably overlies Sandia formation.

Extends in continuous outcrop from Comanche Arroyo along steep east face of Gray Mesa and southward past Monte de Belen. Another belt extends from Red Tanks Arroyo near Salaido Ranch southeastward into west slopes of Ladron Mountains. Most completely exposed section lies in steep east face of Monte de Belen, Socorro and Valencia Counties.

Grayson Granodiorite Gneiss

Grayson Granite Gneiss[1]

Precambrian: Southwestern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. of geol. map of Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 38–41, pl. 1. Porphyritic gneiss of granodiorite composition; hence, termed Grayson granodiorite gneiss. Injected by aplite and diabase of Mount Rogers volcanic series.

Covers most of Grayson County. Forms crest of Point Lookout Mountain, the southeastern spurs of Brierpatch Mountain, and crest of Buck Mountain. Widely distributed in Elk Creek anticline.

Grayson Marl, or **Formation** (in Washita Group)

Grayson Marl Member (of Denison Formation)[1]

Upper Cretaceous (Comanche Series): Northeastern Texas, central southern Oklahoma, and northern Mexico.

Original reference: F. W. Cragin, 1894, Colorado Coll. Studies, v. 5, p. 43–48.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Correlation chart shows Grayson shale in Washita group. Upper Cretaceous (lower Cenomanian). Underlies Buda limestone; overlies Georgetown limestone and in some area, Main Street limestone. [Grayson replaces Del Rio which is abandoned.] Present in Chihuahua, Mex.

L. W. Stephenson, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 10, p. 1538–1541. Discussion of fossils from limestone of Buda age in Denton

County. If it is admitted that this limestone is a facies of Buda age in upper part of Grayson marl, then the Grayson is not exact equivalent of Del Rio but includes equivalents of both Del Rio and Buda.

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1139–1140, pl. 1. Grayson clay described in Buck Hill quadrangle, Texas, where it is 60 to 76 feet thick; overlies Georgetown limestone and disconformably underlies Buda limestone. Lower Cretaceous.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 11 (table 1), 27–31, pl. 1. In Eagle Mountains, Tex., formation is divided into (asending) Carpenter limestone (new), reef-limestone, and Eagle Mountains sandstone (new) members. Thickness 200 feet. Overlies Georgetown limestone; underlies Buda limestone. Upper Cretaceous.

L. W. Stephenson, 1953, U.S. Geol. Survey Prof. Paper 243–E, p. 58. Grayson marl (formerly Del Rio clay) unconformably underlies Pepper shale member of Woodbine formation.

Robert Greenwood, 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 167–177. Shale described in Uvalde County, Tex., where it includes West Prong lentil (new) in basal part. West Prong shows penecontemporaneous relationship with overlying volcanic materials of Grayson. Overlies Georgetown limestone; underlies Buda limestone. Thickness 100 to 150 feet. In west and south Texas, formation has been called Del Rio clay.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 9–10, pl. 1. Formation described in Terlingua district, Texas, where it is 80 to 200 feet thick; overlies Devils River limestone and underlies Buda limestone. Undifferentiated in this area.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 35–38. In Fort Worth area, Grayson marl member of Denison is about 80 feet thick and divisible into four subdivisions (ascending): yellowish-gray marl 18 feet thick with abundant *Exogyra arientina* Roemer, containing in lower 3 to 5 feet a small number of lenticular bodies of hard highly fossiliferous clastic limestone about 5 to 8 feet long and 1 foot in maximum thickness; unfossiliferous yellow to greenish-gray marly clay 24 feet thick; highly fossiliferous gray marl 21 feet thick with buff marly limestone and clay; greenish-gray marly clay less fossiliferous than underlying unit. Overlies Main Street limestone member; underlies Buda limestone.

Named for numerous outcrops in Grayson County, Tex.

†Graysonton Formation[1]

Lower and Middle Cambrian: Southwestern Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 175, 183, pl. 4.

Named for Graysonton, Montgomery County.

Graysville Limestone

See Grayville Formation.

Graysville Member (of Stonehenge Limestone)

Lower Ordovician (Canadian): Central Pennsylvania.

A. C. Donaldson, 1960, Dissert. Abs., v. 20, no. 9, p. 3693. Overlies Spring Creek member (new); underlies Baileyville member (new). Contains

pebbles but lacks oolites which characterize underlying Spring Creek member.

Type locality and derivation of name not stated.

Grayville Formation[1]

Grayville Limestone (in McLeansboro Formation)

Grayville Limestone (in Wabash Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

Original reference: M. A. Harrell, 1935, Indiana Dept. Conserv. Pub. 133.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 7. Gray fossiliferous limestone in McLeansboro formation. Underlies Lawrenceville shale (new); separated from underlying Mumford Hills sandstone (new) by Aldrich coal.

Marshall Harrell, 1935, Indiana Div. Geology Pub. 133, p. 73 (chart). Chart shows post-Alleghenian Grayville formation as a subdivision of the Wabash. In the sequence occurs between Buffkin above and McClearys Bluff formation.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 85. There is some doubt that these beds [Grayville formation] overlie McClearys Bluff beds and underlie Buffkin beds; superposition of formations may be erroneous.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, Chart 6 (col. 25). Correlation chart shows Graysville limestone in Wabash formation below Livingston limestone and above Buffkin limestone.

Named from typical exposures at Grayville, White County, Ill.

Grazier Formation (in Hatter Group)

Grazier Member (of Hatter Formation)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 193. Middle member of formation. Described as dark, dense, heavy ledged stylolitic limestone with wavy argillaceous partings; tends to weather with rows of holes. Thickness 33 feet at type section. Underlies Hostler member (new); overlies Eyer member (new). Chazyan series.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 10. Thickness 7 to 60 feet; thins southeastward. Conformably underlies more siliceous Hostler member in all exposures. Disconformably overlaps Eyer member northeastward from type section so as to lie on Clover member of Loysburg formation. Contact with Clover is a slightly undulating stylolitic bedding plane separating sharply differing lithologies. Derivation of name.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. [1402], 1407. Rank raised to formation in Hatter group or Hatterian subseries (Bolarian series).

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 82, 102. Discussed as a member.

Type section: On two sides of Pennsylvania Railroad cut north of Union Furnace, Huntingdon County. Named for Grazier Mills northeast of Union Furnace.

Greasy Cove Formation

Upper Mississippian: Eastern Tennessee.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Gray argillaceous limestone (about 40 percent), red shale and fine-grained sandstone (10 percent), gray shale and siltstone (25 percent), and gray fine-grained sandstone (25 percent), all interbedded. Thickness at least 400 feet, top faulted. Overlies Grainger formation. Name replaces Newman limestone formerly used in this area because Newman at its type locality consists of relatively pure limestone.

Type section: Along small unnamed creek southeast of Butterfly Gap, Blockhouse quadrangle. Named from Greasy Cove.

Greasy Creek facies (of Fort Payne Formation)

Lower Mississippian: Northern Tennessee and southern Kentucky.

H. J. Klepser, 1937, Ohio State Univ. Abs. Doctors' Dissert. 24, p. 182. Listed as northern facies of Fort Payne formation.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 49, 53, 76. Variable in lithology, ranging from silty shale to siltstone to crinoidal limestone; gray siltstone, which prevails, is generally massive. Facies overlies Maury formation in Tennessee. Listed under Brodhead formation in Kentucky. Derivation of name given.

Named from Greasy Creek, central Russell County, Tenn.

Great Conglomerate[1] (in Copper Harbor Group)

Precambrian (Keweenawan): Northern Michigan and Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 186, pls. 17, 18.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 679. Name appears in stratigraphic column of Michigan copper district. Thickness 1,757 feet.

Named for fact it was supposed to be very much thicker than Outer conglomerate.

Great Bend coal group[1]

Paleocene: North Dakota.

Original reference: A. G. Leonard, 1908, North Dakota Geol. Survey 5th Bienn. Rept.

†Great Bend Conglomerate[1]

Pennsylvanian: Pennsylvania.

Original reference: F. A. Randall, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 51–54.

At Great Bend, Warren County.

Great Bend Limestone (in Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d. Geol. Survey Rept. G_5, p. 91.

Occurs at Great Bend, Susquehanna County.

Great Blue Limestone[1] or Formation

Upper Mississippian: Central northern Utah.

Original reference: J. E. Spurr, 1895, U.S. Geol. Survey 16th Ann. Rept., pt. 2, p. 374–376.

H. R. Cramer, 1954, Dissert. Abs., v. 14, no. 10, p. 1681. Discussion of coral zones in Mississippian of Great Basin area. Great Blue limestone, which is stratigraphically and lithologically similar to the more properly though later named Ochre Mountain limestone, is dropped.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 15 (fig. 4), 20–22. Described in East Tintic Mountains where it is 2,400 to 2,600 feet thick; underlies Manning Canyon shale and overlies Humbug formation. Includes (ascending) basal limestone member about 400 feet thick; limestone and shale member about 650 feet; shale and quartzite member 850 to 1,000 feet; and an upper limestone member about 600 feet.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 46–48. Described in Stansbury Mountains where it is 980 to 1,300 feet thick; overlies Humbug formation and underlies Manning Canyon formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 90–93, 172–173, 174–177, pl. 1. Formation described in Sheeprock Mountains area where it is about 4,139 feet thick and is divided into lower limestone, 911 feet; Chiulos shale member (new), 1,818 feet; and upper limestone, 1,410 feet. Gradationally overlies Humbug formation; in fault contact with Pennsylvanian Oquirrh formation.

J. R. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 55–58. Spurr (1895) did not designate type area for formation. Gilluly (1932, U.S. Geol. Survey Prof. Paper 173) applied name only in slightly different manner than used by Spurr, in his study of Stockton and Fairfield quadrangles. Great Blue limestone crops out in much of southwestern part of mapped area [southern Oquirrh Mountains]. Overlies Humbug formation; lower boundary arbitrarily taken in most places at top of highest orthoquartzite, quartzitic sandstone, or calcarenite of significance in the Humbug. Three major divisions: lower limestones, shales below the middle, and limestone above. Gilluly's (1932) Long Trail shale member recognized and mapped.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 166–167. In Five Mile Pass and northern Boulter Mountain area, comprises three members. Lower consists of 368 feet of massive dark-gray-blue fine to coarse crystalline and medium-grained limestones which weather light blue gray. Upper consists of blue-gray and gray-blue limestones which superficially resemble basal member. Overlies Humbug formation; underlies Manning Canyon shale.

First described in Oquirrh Mountains region.

†Great Falls coal series[1]

†Great Falls Group[1]

Lower Cretaceous: Central northern Montana.

Original references: J. S. Newberry, 1887, School Mines Quart., v. 8, p. 328; 1891, Am. Jour. Sci., 3d v. 41, p. 193.

Great Falls region.

Great Falls Lake Sands

Pleistocene: Northwestern Montana.

J. B. Lyons. 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 449 (fig. 2), 452, pl. 1. Fine-grained, well-bedded yellow sands. Thickness 0 to 250 feet; 150 feet at Craig. Unconformably overlie Adel Mountain volcanics (new). Present only in river valleys.

Derivation of name not stated. Area of report includes about 990 square miles of northern end of Big Belt Range and adjacent plains.

Great Hill Formation

Lower Silurian: Central Connecticut.

G. P. Eaton and L. J. Rosenfeld, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 2, p. 170 (fig. 1), 171 (table 1). Quartzite, quartzite conglomerate, and kyanitic quartz-sericite schist. Unconformably overlies Collins Hill formation; underlies Mine Brook formation (new). Previous workers with the exception of Percival (1842, Report on the Geology of the State of Connecticut: New Haven), grouped the sequence of rocks from Collins Hill schist through Camp Jenkins schist (new) as a single formation, and believed it to be intruded by Glastonbury, Maromas, and Haddom gneisses. Present work shows that these rocks represent four distinct formations, with unconformity separating Collins Hill from the others.

Great Hill is in central part of Middle Haddam quadrangle, Middlesex County.

Great Meadows Formation

Lower Ordovician: East-central New York.

John Rodgers, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for field trips in New England, p. 35 (table 2). Described as mainly dolomite. Prominent basal crossbedded sandstone. Includes Fort Ann limestone, a persistent layer at top. Thickness 110 feet. Overlies Baldwin Corner formation (new). Refers to R. H. Flower (unpub. ms.).

Occurs in Fort Ann quadrangle.

Great Sitkin Volcanics

Tertiary and Quaternary: Southwestern Alaska.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 63, pls. 4, 5; 1955, U.S. Geol. Survey Bull. 1028–B, p. 29–31, pl. 5. Comprise the rocks of the main cone of Great Sitkin Volcano. Included are rocks of the cone itself, a newly formed crater dome and five older plugs, basalt flow of Sitkin Valley, and parasitic tuff cone on northwest flank of main cone. Main cone is composite of flows and tuff beds with flows predominating, at least in upper part of cone. Flow rocks predominantly of porphyritic andesite and basalt. Excellent exposures of lavas displayed in walls of crater. Crater occupied by a dome composed of black glassy porphyritic basalt. Basalt flow near head of Sitkin Creek was extruded from flank of cone and is only fairly young flow known; 100 to 125 feet thick, with prominent columnar jointing. Great Sitkin volcanics unconformably overlie Sand Bay volcanics (new). Most of the rocks of main cone buried under thin blanket of pumice and rock fragments.

Great Sitkin Volcano forms northern half of Great Sitkin Island, in central part of Aleutian Islands.

Great Smoky Group

Great Smoky Conglomerate[1]

Great Smoky Formation or Quartzite

Precambrian (Ocoee Series): Central northern Georgia, eastern Tennessee, and western North Carolina.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 3.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1381. In Nantahala, Ellijay, and Tate folios, Great Smoky formation, which is at base of sequence here included in Talladega series, is mapped with unconformable relation to Carolina gneiss. However, there is complete lack of field evidence to support statements that Great Smoky formation, "Hiwassee" schist, or any other formation belonging in Talladega series rests unconformably on Precambrian rocks in Georgia or North Carolina.

G. W. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233; 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 278–282. Great Smoky quartzite included in Ocoee series, Late Precambrian. Overlies Hurricane graywacke (new) and underlies Nantahala slate. Term quartzite considered more appropriate than formation. Consists of lower member of thickbedded white to gray arkosic quartzite, middle member of light- to dark-gray, poorly bedded quartzite containing pebble beds, and upper member of coarse-grained dark quartzite, pebbly in places, and interbedded black slaty graywacke. Extends from northeast end of belt of Ocoee series (Roan Mountain quadrangle) southwestward across northwestern North Carolina and southeastern Tennessee, passes into Georgia, and continues to point 10 miles east of Cartersville. Thickness about 4,100 feet.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 9, p. 631 (table 4), 639. Conglomerate included in Ocoee series. Thickness in Great Smoky Mountains about 6,000 feet. Underlies Nantahala slate. Type area is in Great Smoky Mountains of Knoxville quadrangle; probably it also includes outcrops of formation in Mount Guyot quadrangle to east. It is here capable of precise delimitation and should be restricted to unit as defined in this area and its equivalents. Further south, as in Nantahala and Ellijay quadrangles, term has come to be used as general expression for rocks of Ocoee type. This usage is improper, and term Ocoee series should be substituted.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27, 28. Great Smoky formation included in Talladega series believed to be Precambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 26 (table 2), 31–32, pt. 1, pls. Conglomerate mapped in eastern Tennessee where, southwest of Pigeon River mountain belt, it underlies Nantahala slate and overlies sandstone and slate forming lowest part of Ocoee series.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 55, p. 7, 8–45, pl. 1, geol. map. In Mineral Bluff quadrangle, Georgia, oldest rocks belong to Great Smoky group, a sequence of graywacke-type metasediments at least 15,000 feet thick, of probable Precambrian age. Group includes (ascending) Copperhill, Hughes Gap, Hothouse, and Dean formations (all new). Underlies Nantahala slate. Cambrian-Precambrian boundary provisionally drawn between Great Smoky group and Nantahala slate.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 957–960. Group, in Great Smoky Mountains, is divided into (ascending) Elkmont sandstone (new), Thunderhead sandstone, Anakeesta formation (new), and unnamed higher strata. Group lies in upper plate of Greenbrier fault, terminates northwestward along trace of fault, and extends thence 20 or 25 miles southeastward. Southwestward, outcrop belt continues more than 100 miles with about same width into northern Georgia. East of Great Smoky Mountains, group is preserved only in isolated downfolds in older Precambrian rocks. Through most of its extent in Great Smoky Mountains, base of group is cut off by Greenbrier fault, but, in southeast part of mountains, it lies conformably on Snowbird group. Near Middle Prong of Little River, as much as 25,000 feet of group is present, but base and top are not exposed. Ocoee series. Late Precambrian.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 35, 36; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Ocoee series in North Carolina includes (ascending) Snowbird formation, Great Smoky conglomerate, Nantahala slate, and Sandsuck shale. Great Smoky is most extensive member of Ocoee series. Covers large areas in Cherokee, Graham, Swain, and Hayward Counties and smaller areas in Macon, Jackson, and Madison Counties. Precambrian.

Named for extensive development in Great Smoky Mountains, in southern part of Knoxville quadrangle, which adjoins Nantahala quadrangle on north.

Gredal Formation

Gredal Member (of Lodo Formation)

Eocene, upper; Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Variegated green-red claystone containing occasional sandstone beds and considerable glauconite. Maximum thickness 1,000 feet. Unconformably underlies Point of Rocks sandstone; overlies Mabury formation (new).

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 281–282 Rank reduced to member status in Lodo formation; overlies Mabury member.

Occurs in Devils Den oil field district in northwestern Kern County, adjacent to Kings County line, about 40 miles from Paso Robles and about 60 miles northwest of Bakersfield.

Greece Ranch horizon[1]

Oligocene: Southwestern Washington.

Original reference: B. L. Clark, 1924, Pan-Pacific Sci. Cong., Australia, 1923, Proc., v. 1, p. 877.

Occurs on Greece Ranch locality near Vader, on Cowlitz River, southwestern Lewis County.

Greeley Gypsum (in Sumner Group)[1]

Permian: Central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 10.

Named for Greeley Township, Saline County.

Greenbrier Limestone[1] **or Formation**

Greenbrier Limestone Member (of Mauch Chunk Formation)

Greenbrier Limestone (in Mauch Chunk Group)

Greenbrier Series

Upper Mississippian: Northern West Virginia, eastern Kentucky, western Maryland, southern Pennsylvania, and Virginia.

Original reference: W. B. Rogers, 1879, Macfarlane's Geol. Railway Guide, p. 179.

D. B. Reger, 1926, West Virginia Geol. Survey [County Repts.] Mercer, Monroe, and Summers Counties, p. 445–491. Greenbrier series is assemblage of preeminently calcareous rocks lying just below Mauch Chunk series and just above Maccrady series. Includes (ascending) Hillsdale limestone, Sinks Grove limestone, Patton shale and limestone, Taggard shale and limestone, Pickaway limestone, Union limestone, Greenville shale, and Alderson limestone members. Thickness about 1,800 feet.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 266–279. Series described in Greenbrier County where thickness varies from about 475 to 750 feet. Subdivisions as named by Reger (1926) recognized.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 170, 171, chart 5 (column 102); M. N. Shaffer, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Correlation chart shows Greenbrier limestone in Mauch Chunk group in Pennsylvania.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38. Chart shows Meramec-Chester age.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 34–44. Described in Garrett County, Md., as formation. Overlies Pocono formation and underlies Mauch Chunk formation. Includes Loyalhanna member in lower part. Thickness about 250 feet.

R. H. Wilpolt and D. W. Marden, 1959, U.S. Geol. Survey Bull. 1072–K, p. 593–596, 598 (fig. 26), pls. 28, 29. Rocks called Greenbrier limestone in this report have been referred to as Greenbrier series by other writers. Consists of thick sequence of dense and crystalline, highly fossiliferous, locally cherty limestone which commonly ranges in color from gray to brownish gray to black. Hillsdale and Taggard members differentiated in some areas; main body of Greenbrier is undifferentiated. Thickness 250 to 848 feet. Overlies Maccrady; underlies Bluefield formation. Geographically extended into Kentucky.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mauch Chunk formation includes Greenbrier limestone in Fayette, Westmoreland, and Somerset Counties; Loyalhanna limestone at base in southwestern Pennsylvania.

Named for exposures on Greenbrier River, Pocahontas County, W. Va.

†Greenbrier Shales[1]

Mississippian: West Virginia.

Original reference: W. B. Rogers, 1879, Macfarlane's Geol. Railway Guide, p. 179.

Greenbush Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), pl. 1. Assigned member status in Spoon formation (new). Occurs above Wiley coal member and below Isabel sandstone member. Coal named by Wanless (1931, Illinois Geol. Survey Bull. 60). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: E¼ sec. 24, T. 8 N., R. 1 W., Warren County.

Greenbush cyclothem (in Spoon Formation)

Greenbush cyclothem[1] (in Tradewater Group)

Pennsylvanian: Western, central, and southern Illinois and western Indiana.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 188, 192.

J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1586 (fig. 1), 1589. Underlies Abingdon cyclothem (new). Includes Greenbush limestone.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63, 81–82, 191, 197, 198, 200, 201, 202. Thickness of cyclothem as much as 14 feet; average 6 to 10 feet. Rests with apparent conformity on Wiley cyclothem; underlies Abingdon cyclothem; Isabel sandstone rests on Greenbush shale with an abrupt contact and truncates shale at some places. Greenbush limestone is discontinuous and is commonly 3 to 6 inches thick and is fine grained, light gray, and nearly lithographic. Cyclothem is present in western Kentucky where it includes the highest beds referred to the Tradewater group. Gives type exposure.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 2. In Spoon formation (new). Above Wiley cyclothem and below Abingdon cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type exposure: In ravine tributary to Swan Creek in E½ sec. 24, T. 8 N., R. 1 W., Greenbush Township, Avon quadrangle, Warren County, Ill.

Green Canyon Group

Pennsylvanian (Derry Series): Central and southern New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 32, 35. Term proposed to include the two basal formations of the Derry series (ascending): Arrey and Apadoca (both new).

Type locality: West facing slope of hill approximately three-fourths of a mile east of Derry, near center of sec. 32, T. 17 S., R. 4 W., Sierra County. Name derived from Green Canyon about one-half mile north of village of Derry.

Greencastle Bed[1] (in Chambersburg Limestone)

Greencastle Formation

Middle Ordovician: South-central Pennsylvania.

Original reference: R. S. Bassler, 1919, Maryland Geol. Survey, Cambrian and Ordovician Volume, p. 49, 120, 133, 140–147, 152, 153, 154.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1964. Rank raised to formation; includes uppermost part of Chambersburg limestone. Consists of black massive limestone with a thin locally occurring basal calcarenite. Thickness 63 feet at type locality. Underlies Martinsburg shale; overlies Mercersburg formation (new) and converges with it in western belts of outcrop in Cumberland Valley. Type locality designated.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 738–739. Name abandoned. Original use appears to have been inconsistent. Excessive restriction of the bed was necessary in defining the formation. As described at Marion, base was at an indefinite horizon in middle of Kauffman member (new) of Mercersburg formation. In section at Greencastle, base appears to have been drawn at base of Kauffman member; upper part of this section poorly exposed. Replaced by Oranda formation except for *Sinuites* zone at top, which is referred to base of Martinsburg formation.

Type section: Two miles southwest of Marion, Franklin County. [Named for Greencastle, Franklin County.]

Green Cove Beds[1]

Eocene: Western Wyoming.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat History Bull. 67, art. 5, p. 245–249.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull. v. 52, no. 1, p. 21, pl. 1. Bridgerian.

Named for section at Green Cove, east of Hailey, Fremont County.

Greendale Limestone Member (of Cynthiana Formation)[1]

Middle Ordovician: Central northern Kentucky.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10, 19, 211.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 11 (footnote), 20–22. Overlies Sulphur Well beds (new) in Jessamine County. Although Bromley is given in literature as post-Greendale in age, it underlies the Greendale at Butler, Pendleton County, and at Clay's Ferry in northern Madison County.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1641, 1643. Division of the Cynthiana. There has been little precision in use of name. In general, it has been used for rather fossiliferous limestones and shales around Frankfort and Lexington. Foerste (1909) defined the Greendale as including that part of the Cynthiana below Nicholas limestone. However, because of wedging-out of the Nicholas, Greendale lithologic characteristics and fauna continue to near top of formation. At type locality of Cynthiana, much of exposed section is the Nicholas. More or less equivalent to Millersburg limestone. Term Sulfur [Sulphur] Well member has been used for limestone and shale rich in bryozoans underlying the Greendale and Millersburg in much

of thickened Cynthiana section of southern and southwestern Bluegrass. In present report, this pre-Greendale division of the Cynthiana is recognized as facies of upper Lexington, but containing a Cynthiana fauna.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of the interval between the top of the Benson limestone and base of the Eden formation should be referred to as members of the Cynthiana. This includes as members the lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 265, 268. Rogers Gap limestone and Fulton shale, which cannot be distinguished faunally, rest northwardly on the Nicholas and southwardly on the Greendale. It is suggested that lowest occurrence of *Cryptolithus tesselatus* marks base of Nicholas member; beds below this zone carry a typical Greendale fauna, and name Greendale should be applied to these beds. Cincinnatian series should be extended downward to embrace Cynthiana formation.

Probably named for Greendale, Fayette County.

Greene Formation (in Dunkard Group)[1]

Greene Group

Greene Series

Lower Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 35–44.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 217. Permian rocks of Ohio divided into Washington series below and Greene series above. Each series separated into members. Base of Green series is base of Jollytown "A" coal; top is top of Gilmore sandstone and shale.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 152–153. Green group forms upper part of Dunkard series. Lies above Washington group. Composed of highest and youngest consolidated rocks in Fayette County [this report]. Only lowest part of group preserved in area of this report. Base of group is at top of Upper Washington limestone, and only shales and sandstone have been preserved above this stratum. Group has been divided into nine parts, only lowest of which, Donley sandstone, is preserved in county. Stevenson noted presence of sandstone about 10 feet above top of Upper Washington limestone in his Greene group for Washington County. He did not name the sandstone. In this report, it will be called Dunlap.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 117–121, 135, 138. Washington and Greene groups of Dunkard series are herein ranked as series and considered of equal rank with Pennsylvanian Monongahela series. The Greene is about 700 feet thick. Base is at base of Jollytown coal below Jollytown sandstone; top is at top of Upper Proctor sandstone. Monongahela, Washington, and Greene series crop out in elliptical synclinorium (Huntington-Pittsburgh basin) which extends southwest from Pittsburgh area into eastern Ohio and western West Virginia to Kentucky.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Greene formation consists of cyclic

sequences of sandstone, shale, and red beds, limestone and coal; base at top of upper Washington limestone. Permian [Dunkard group not used on map].

H. L. Berryhill, 1960, *in* C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, p. 1789–1790. There are no reasons, lithologic nor faunal-flora, for differentiating Washington and Greene formations anywhere in Dunkard basin. Subdivision of Stevenson (1876) has been handed down through tradition. Stevenson's Washington group is actually a facies. Away from northern edge of basin, Washington "group" has few lithologic characteristics of the "type" area. During recent mapping of Belmont County, Ohio, by U.S. Geological Survey, no bases for subdivision of these rocks were found. In that area, these rocks were classified as Washington-Greene formations undifferentiated.

Named for exposures in central and southwestern parts of Greene County, Pa.

†Greene County Group[1]

Pennsylvanian and Permian: Western Pennsylvania.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 503–507.

Greenefield Bed[1]

Upper Triassic: Central Massachusetts.

Original reference: B. K. Emerson, 1897, Geol. Soc. America Bull., v. 8, p. 65–72.

Occurs in vicinity of Greenfield, Franklin County.

Greeneville Limestone

See Greenville Dolomite.

†Greenfield Dolomite (in Whitehorse Sandstone)[1]

Permian: Southwestern Oklahoma.

Original reference: C. D. Stephenson, 1925, Am. Assoc. Petroleum Geologists Bull., v. 9, no. 3, p. 626–631.

Named for exposures just west of Greenfield, Blaine County.

Greenfield Dolomite[1] Member (of Bass Islands Dolomite)

Greenfield Dolomite or Formation (in Bass Islands Group)

Upper Silurian: Western Ohio and northern Kentucky, and Ontario, Canada.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 307, fig. 1. facing p. 310.

Wilber Stout, 1941, Ohio Geol. Survey Bull. 42, p. 38–39, chart facing p. 46. Basal formation of Bass Island[s] group in Ohio. Consists of dolomite, thin- to massive-bedded, gray to brown. Thickness commonly 175 to 225 feet. Underlies Tymochtee formation; upper limit very indefinite and fixed more on faunal than stratigraphic evidence. Type locality stated; distribution noted.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows occurrence in Ontario, Canada.

Type locality: Near Greenfield, Highland County, Ohio. From Greenfield the formation extends northwestward and crops out in belt across parts of Fayette, Logan, Shelby, Auglaize, Allen, Van Wert, and Paulding Counties.

†Greenfield Limestone[1]

Upper Cambrian: Eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 9, 12, table 2.

Probably named for Greenfield, Saratoga County.

Green Gulch Volcanics (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 31–32, pl. 1. Comprises basaltic and andesitic flows and sedimentary tuffaceous rocks of variable composition. Flow unit lies east of tuff. Most flows are medium to dark gray with greenish cast. Locally in flows, relict pillow and breccia structures, amygdules, vesicles, and bedding are preserved. Tuffaceous rocks range in composition from rhyolitic to basaltic. Most characteristic rock ranges in color from greenish black to greenish gray or dark to light olive gray. Fine-grained dark-gray siliceous rocks that weather to light pinkish gray and lesser amounts of light-gray porcellaneous slate are also present. Tuffaceous rocks range from finely laminated phyllite to more massive and locally coarser grained rocks. Thickness not known. Outcrop width about 10,500 feet. Formation bounded on east by Chaparral fault; on west, extends beyond map area; to north covered by Cenozoic rocks of Lonesome Valley.

Named for exposures along Green Gulch in southeastern part of Prescott quadrangle, Yavapai County. Forms triangular-shaped mass in extreme southwest corner of Jerome area.

Green Hill Member (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama and northeastern Mississippi.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Light-brownish-gray oolitic thick-bedded limestone in lower part and olive-gray thin-bedded calcareous shale in upper part. Basal limestone is equivalent to upper limestone of Southward Bridge formation of Morse (1928); upper shale is equivalent to the lower part of the Forest Grove formation of Morse (1928), these strata were referred to by Butts (1926) as the Golconda formation. Maximum thickness about 80 feet near Mingo, Miss.; thins to 30 feet or less in Colbert County, Ala., at type locality 20 feet. Conformably overlies Mynot member (new); underlies Hartselle sandstone, contact poorly exposed, but evidence suggests an unconformity of at least local extent.

Named for exposure at roadside near head of Green Hill Branch about 3 miles south of Barton, Colbert County, Ala., in SW¼NW¼ sec. 22, T. 4 S., R. 13 W.

Greenhorn Bentonite Bed (in Colorado Formation)

Cretaceous: Southwestern Montana.

Great Northern Railway Co. Mineral Research and Development Department, 1960, Great Northern Railway Co. Mineral Research and Devel. Dept., Rept. 12, pt. 2, p. 38, 42. About 250 feet above Geyser bentonite bed (new). Thickness about 4 feet. Greenhorn bentonite is 20 to 30 feet below base of Greenhorn equivalent (Vine, 1956, U.S. Geol. Survey Bull. 1027–J).

Most westerly outcrop is north of Arrow Creek in S½ sec. 13, T. 18 N., R. 11 E; easternmost exposures are along Surprise Creek in sec. 36, T. 18 N. R. 11 E., and sec. 30, T. 18 N., R. 12 E.

Greenhorn Calcareous Member (of Cody Shale)

Greenhorn Limestone Member (of Colorado Shale or Mancos Shale)

Greenhorn Limestone[1] or Formation (in Colorado Group)

Greenhorn Member or Formation (of Benton Formation or Group)

Upper Cretaceous: Eastern Colorado, northwestern Iowa, western Kansas, southeastern Montana, Nebraska, northeastern New Mexico, and South Dakota.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 564.

W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 45–50. In western Kansas, subdivided into four members (ascending): Lincoln limestone, unnamed member, Jetmore chalk (new), and unnamed member. Thickness about 100 feet. Overlies Graneros shale; underlies Fairport chalky shale member (new) of Carlile shale.

N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 31–35, 66–71. In Ellis County comprises (ascending) Lincoln limestone, Hartland shale (new), Jetmore chalk, and Pfeifer shale (new) members. In Hamilton County, comprises (ascending) Lincoln limestone, Hartland shale, and Bridge Creek limestone (new) members.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. As shown on correlation chart, Greenhorn limestone overlies Belle Fourche shale and underlies Carlile shale in northern Great Plains region.

R. C. Moore, J. C. Frye and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Consists of chalky limestone and calcareous shale interbedded, thin-bedded, light-gray to dark-gray; weathers yellow gray to light gray. Thickness 85 feet in Barton County; 95 feet in Ellis County; 132 feet in Hamilton County. Comprises (ascending) Lincoln limestone, Hartland shale, Jetmore chalk, and Pfeifer shale members. Where Pfeifer shale and Jetmore chalk cannot be distinguished, they are termed Bridge Creek member. Overlies Graneros shale; underlies Carlile shale. Colorado group. Gulfian.

B. C. Petsch, 1946, South Dakota Geol. Survey Rept. Inv. 53, p. 17 (fig. 5), 46. Middle formation of Benton group. Crops out on east side of Big Sioux River north of Sioux City, Iowa. Underlies Carlile formation; overlies Graneros formation.

N. W. Bass, C. E. Straub, and H. O. Woodbury, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 68. Greenhorn limestone, as used in this report [Model anticline, Las Animas County, Colo.], is 93 feet thick and consists of (ascending) Lincoln limestone, Hartland shale, and Bridge Creek limestone members. Underlies Codell member of Carlile shale; upper boundary drawn on basis of faunal change and placed within a zone that lies about 35 feet above base of Bridge Creek member; overlies Graneros shale.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. Member of Mancos shale in area of this report [eastern side San Juan basin, Rio Arriba County, N. Mex.]. Consists of alternating beds of marl and limestone. Thickness about 70 feet. Overlies Graneros shale member; underlies Carlile shale member. Upper Cretaceous.

W. A. Cobban and J. B. Reeside, Jr., 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Trip, p. 61 (fig. 2). In Black Hills area, includes Orman Lake limestone member at base. Overlies Belle Fourche shale; underlies Carlile shale.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. In Hardin area, Big Horn and Yellowstone Counties, Mont., the Greenhorn is classed as calcareous member of Cody shale.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2183–2187, 2197 (fig. 2). Formations in Black Hills that are equivalent to Colorado shale of central and northwestern Montana are (ascending) Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Greenhorn formation attains maximum known thickness of 360 feet on east flank of Colony-Albion anticline in E½ sec. 9, T. 57 N., R. 61 W., Crook County, Wyo. In Carter County, Mont., formation thins sharply to 180 feet or less and, in addition, becomes less calcareous.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwestern Mora County, N. Mex., the Benton shale is represented by equivalents of Graneros shale, Greenhorn limestone, and Carlile shale.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 47–48, 56, pls. Described as calcareous member of Cody shale in Buffalo-Lake De Smet area, Johnson and Sheridan Counties, Wyo. Thickness about 136 feet. Overlies lower unnamed shale member and underlies Carlile shale member.

U.S. Geological Survey currently classifies the Greenhorn Limestone as a member of the Colorado Shale in the Cleveland quadrangle, Blaine County, Mont., on the basis of a study now in progress.

Named for Greenhorn Station, 14 miles south of Pueblo, Colo., and for Greenhorn Creek [Pueblo and Walsenburg quadrangles].

Greenhorn Mountain Quartzite

Precambrian (Belt Series): West-central Montana.

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 839. Notably feldspathic; feldspar consisting of clear limpid microcline. Lower part of formation is massive quartzite, in places showing festoon cross-lamination; upper third is well stratified in beds of uniform thickness ranging from 1 to 2 inches. Thickness 1,800 feet. Overlies Marsh formation; top is bounded by erosion surface on which rests Flathead quartzite (Middle Cambrian). In extant geologic maps, Greenhorn Mountain quartzite has been included with "undifferentiated Devonian and Cambrian" strata, with the result that the Flathead, which averages 100 feet in thickness over a distance of scores of miles, is implied to have thickness of several thousand feet on Greenhorn Mountain.

Constitutes country rock of Continental Divide, making up bulk of Greenhorn Mountain, which forms highest summit between Mullan Pass and Marysville.

Greenian series[1]

Eocene: Wyoming.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 66, 279, 308.

Greenland Sandstone Member (of Atoka Formation)

Pennsylvanian (Atoka Series) : Northwestern Arkansas.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1946–1947, 1948 (fig. 2). Consists of silty ripple-marked flaggy sandstone with shaly partings. Locally, marine quartz-gravel conglomerate, which alters on exposure to contorted limonite-cemented sand, lies at base of unit or interfingers with it at higher levels. In some areas, lenses of marine quartz-gravel sandstone that are more or less massive or cross-bedded either interfinger or partly cut out parts of the member. Overlies Kessler limestone lentil of Bloyd shale.

Named from characteristic exposures and development in vicinity of Greenland, Washington County.

†Greenleaf Sandstone[1]

Lower Cretaceous : Southwestern Kansas.

Original reference: G. N. Gould, 1898, Am. Jour. Sci., 4th ser., v. 5, p. 170–174.

B. F. Latta, 1947, Kansas Geol. Survey Bull. 65, p. 86, 87. Not differentiated as stratigraphic unit. Included in Kiowa shale.

Named for Greenleaf Ranch, on upper Medicine River, 10 or 12 miles west of Belvidere, Kiowa County.

Green Lodge Formation[1]

Upper Cambrian : Eastern Massachusetts.

Original reference: E. J. Rhodes and W. H. Graves, Jr., 1931, Am. Jour. Sci., 5th, v. 22, p. 364–372.

Occurs at Green Lodge, Dedham quadrangle.

†Green Mountain Beds[1]

Green Mountain Conglomerate

Eocene : Central Colorado.

Original reference: G. L. Cannon, Jr., 1893, Colorado Sci. Soc. Proc., v. 4, p. 253.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 111–113. Sediments herein designated as Green Mountain conglomerate were assigned to division "D" of Denver formation (Cross, 1896, U.S. Geol. Survey Mon. 27). Hares (1926) suggested that these conglomerates be removed from Denver formation. Marr (1930, unpub. rept.) gave name Green Mountain conglomerate series to unit. In this report, name Green Mountain conglomerate is retained and unit is removed from Arapahoe-Denver formation. Thickness at least 600 feet.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, p. 111. Green Mountain conglomerate should be abandoned because it is a partial representative of Dawson formation as herein restricted.

Exposed on slopes of Green Mountain, Denver basin region.

Green Mountain Gneiss[1]

Green Mountain Series

Precambrian : Southwestern to northwestern Vermont.

Original reference: C. B. Adams, 1845, Vermont State Geologist 1st Ann. Rept., p. 60–61.

E. C. Jacobs, 1938, Vermont State Geologist 21st Rept. 1937–1938, p. 36–37. Age of Green Mountain series is Precambrian.

Green Mountains cross the State of Vermont.

Green Pond Conglomerate[1]

Silurian: Northern New Jersey and southeastern New York.

Original reference: H. D. Rogers, 1836, New Jersey Geol. Survey, p. 127.

P. K. Sims, 1958, U.S. Geol. Survey Prof. Paper 287, p. 42, pl. 1. Crops out on both Copperas and Green Pond Mountains in Dover district where it overlies Precambrian rocks. Silurian.

Named for Green Pond Mountains, N.J.

†Green Pond Quartzite[1]

Silurian: New Jersey.

Original references: N. H. Darton, 1894, New Jersey Geol. Survey Ann. Rept. State Geologist; H. B. Kummel and S. Weller, 1902, New Jersey Geol. Survey Ann. Rept. State Geologist.

†Green Pond Mountain Formation[1]

Silurian: New York.

Original reference: D. S. Martin, 1888, Geologic map of New York City and vicinity.

†Green Pond Mountain Group[1]

Devonian: New Jersey and New York.

Original reference: F. J. H. Merrill, 1887, New York Acad. Sci. Trans., v. 6, p. 59.

Extends from northern New Jersey through Orange County, N.Y., to Hudson River and for some distance beyond.

Green River Formation[1]

Eocene, lower and middle: Southwestern Wyoming, northwestern and central Colorado, and eastern Utah.

Original references: Henry Engelmann, 1859, Preliminary report on the geology of the country between Fort Bridger and Camp Floyd, Utah Territory, and southwest of the latter place, along Captain J. H. Simpson's routes, 1858; Appendix A *in* Report of the Secretary of War communicating, in compliance with a resolution of the Senate, Captain Simpson's report and map of wagon road routes in Utah Territory: U.S. 35th Cong. 2d sess., S. Ex. Doc. 40, p. 45–75; F. V. Hayden, 1869, U.S. Geol. Survey Terr. 3d Ann. Rept.

W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168, 58 p. Formation of Colorado and Utah is series of lake beds of middle Eocene age that occupy two broad, shallow, structural basins: the Piceance Creek in northwestern Colorado, and the Uinta in northeastern Utah. Average thickness about 2,000 feet; about 1,200 feet at north end of Piceance Creek basin, and about 2,800 feet in central part of basin; about 4,900 feet in western part of Uinta basin. In both basins, underlain by beds of sandy mudstone of Wasatch formation. In Piceance Creek basin, rocks of the Green River are youngest rocks exposed except in one area where they are overlain by 400 feet of sandy beds of fluviatile origin that appear to be lithologically and stratigraphically equivalent to basal beds of Bridger formation of Uinta basin. In Uinta basin, the Green River is conformably overlain by Bridger formation, and that, in turn, is subdi-

vided into (ascending) Douglas Creek, Garden Gulch, Parachute Creek, and Evacuation Creek members (all new). West of Bitter Creek, Utah, formation is not divided into members. In at least two localities, it contains thick deltaic facies. In western part of Uinta basin, lower beds interfinger with Wasatch formation. Locally contact between Green River and overlying Bridger has been greatly distorted by differential compaction.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 120–121. Most of southern part of Uinta basin consists of outcrops of Green River formation. Varies in thickness; along Indian Canyon, exceeds 5,000 feet; farther east at Duchesne County line, about 1,800 feet present; at Colorado border 2,000 feet. Along north of Uinta basin, lower boundary of Green River is surface of overlap. From Asphalt Ridge, eastward along Rim Rock, beds unconformably overlie Mesaverde group. Throughout this distance, base of Green River rises stratigraphically until, at Raven Ridge, the Wasatch is exposed. On south side of Uinta basin, Green River shale overlies and interfingers with Colton formation (new). It also concordantly overlies Flagstaff limestone at north end of Wasatch Plateau. Throughout south and middle parts of Uinta basin, Green River strata are conformably overlain by Uinta formation. Part of unit herein termed Uinta(?) may be facies change of Green River formation similar to Cathedral Bluff tongue of northwestern Colorado.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205-D, p. 122, 140, 141 (fig. 18). Formation, on northern and western borders of Wasatch Plateau, is about 5,000 feet thick. In eastern area, overlies Colton formation (formerly considered an upper member of Wasatch), and, in western area, overlies Flagstaff limestone (formerly considered member of Wasatch).

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 13 (table), 35. Overlies Colton formation and locally Flagstaff formation and underlies Crazy Hollow formation (new) in Sanpete-Sevier district.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 63. In Sublette and Lincoln Counties, Wyo., includes Fontenelle member (new). Fontenelle overlies Knight member of Wasatch. Middle Eocene.

J. R. Donnell, 1953, Rocky Mountain Assoc. Geologists Guidebook Field Conf. May 14–16, chart facing p. 17. Comprises (ascending) Anvil Points (new), Parachute Creek, and Evacuation Creek members in area between Rifle and De Beque Canyon, Colo. Overlies Wasatch formation. Thickness about 3,000 feet.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 405–425. Discussion of stratigraphic and facies relationships of upper part of Green River formation and lower part of Uinta formation in Duchesne, Uintah, and Wasatch Counties, Utah. Parachute Creek member of Green River is an approximate time-equivalent zone across Uinta basin, as shown by correlation of extensive thin tuff beds within the member. Top of overlying Evacuation Creek member is regarded as base of Uinta formation. This formation boundary rises stratigraphically toward center of basin, as also shown by correlation of tuff beds. Much of lower part of fluviatile beds of Uinta formation as exposed along Colorado-Utah line grades westward into beds that are in considerable part of lacustrine, playa, and mudflat origin in area of which Indian Canyon is

center. These beds, formerly considered saline facies of Green River are here included as part of Uinta formation.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100–103. Discussion of central part of Great Divide basin, Sweetwater County, Wyo. The Green River comprises Luman tongue (new), Tipton tongue, Laney shale member, and Morrow Creek member, Intertongues with Wasatch formation. Battle Spring formation (new) intertongues with all parts of Wasatch and Green River formations except Laney shale member. In northern part of area, the Battle Spring replaces all parts of Wasatch and Green River formations except Morrow Creek member. Underlies Bridger formation.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1072–1075. Discussion of revision of stratigraphic nomenclature of Green River formation of Wyoming. In southwestern Wyoming, lacustrine Green River formation of early and middle Eocene age intertongues laterally with fluviatile deposits of Wasatch formation. For many years, the Green River has been subdivided into Tipton tongue (or Tipton shale member) as base, Laney shale member, and, at top, Morrow Creek member. East of eastern margin of Bridger basin, the Cathedral Bluffs tongue of the Wasatch separates Tipton tongue from Laney shale member. A comparable tongue of the Wasatch enters Green River formation along western margin of Bridger basin. Donavan (1950) named this tongue the New Fork tongue of Wasatch and named the basal unit of Green River in that area the Fontenelle member. Concluded from present study that what has until now been called Laney shale member of Green River in Bridger basin is older than type Laney and is time equivalent of Cathedral Bluffs and New Fork tongues of Wasatch formation. Beds in Bridger basin formerly thought to be Laney shale member of Schultz (1920) are herein named Wilkins Peak member of Green River. Morrow Creek member is equivalent to Schultz' type Laney shale member; term Morrow Creek is herein abandoned. Luman tongue of Green River continues upward into base of Tipton tongue. Laney shale is overlain by Bridger formation.

Type locality: At town of Green River, Sweetwater County, Wyo.

Greensburg or Flat Rock stone[1]

Silurian: Southeastern Indiana.

Original reference: E. T. Cox, 1879, Indiana Geol. Survey 8th, 9th, and 10th Ann. Repts., p. 57, 88–89.

Extensively quarried on Flat Rock Creek, near St. Paul, and near Greensburg, Decatur County.

Greenstone Flow[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. (see index), pls. 17 and 18.

H. R. Cornwall, 1951, Geol. Soc. America Bull., v. 62, no. 2, p. 164, 165. Southwest of Ahmeek, consists of ophitic basalt and columnar basalt topped by cellular amygdaloid. Contains amygdaloidal inclusions and streaks. Thickness at Quincy mine 55 feet; at Delaware 1,299 feet.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Included in Portage Lake lava series.

So named because its great basal bed forms the well-known Greenstone Ridge, Keweenaw County.

Greenup cyclothem (in McLeansboro Group)

Greenup cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 26–27. Lies above Newton cyclothem (new) and below Gila cyclothem (new). Includes Greenup limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Mattoon formation (new). Above Bogota cyclothem and below Woodbury cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Just north of town of Greenup, Cumberland County.

Greenup Limestone Member (of Mattoon Formation)

Greenup Limestone (in McLeansboro Group)

Pennsylvanian: South-central Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 26–27. Included in Greenup cyclothem, McLeansboro group. Commonly light-gray limestone; fossiliferous. Thickness 2½ to 3 feet. Overlies massive to thin-bedded sandstone that varies in thickness from few feet to more than 25 feet. Stratum above limestone may be thin-bedded to massive sandstone, or it may be poorly bedded slightly greenish shale which grades into basal member of Gila cyclothem above.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 19 (fig. 4), 28–29 [1943]. In Cumberland County, consists of about 4 feet of light-gray earthy limestone that is nodular in places; thins southward and in Jasper County is represented by 1 foot of hard brownish-gray limestone or more or less inconspicuous zone of limestone nodules. No coal or underclay is present beneath the Greenup, and locally it is in direct contact with underlying sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 41, 51 (table 1), 79, pl. 1. Assigned to member status in Mattoon formation (new). Occurs below Gila limestone member and above Bogota limestone member. Thickness 3 feet at type outcrop. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality; Near center W½NE¼ sec. 3, T. 9 N., R. 9 E., Cumberland County.

Green Valley Formation

Pliocene, lower: Western California.

Carlton Condit, 1938, Carnegie Inst. Washington Pub. 476, p. 248. Name applied to formation consisting of interbedded brown sands and gray shales occurring in quarry on south side of Mount Diablo.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 195. Series of continental beds (previously referred to as Orinda formation). Overlies marine beds of lower Pliocene age, locally known as Alamo formation; underlies lacustrine deposits locally known as Tassajara formation. Type section noted.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189 (fig. 72), 191 [1941]. Above the Alamo are between 2,000 and 3,000 feet of continental beds, the Green Valley formation. Name Green Valley is used here for first time. It is equivalent to "Orinda formation," the name used by Clark (1935, Geol. Soc. America Bull., v. 46, no. 7) for continental deposits which immediately overlie the Alamo in section to west and southwest of Mount Diablo. Underlies Tassajara formation and separated from it by series of tuffaceous deposits, the "Moraga" tuff (Clark, 1935).

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. Heterogeneous series of continental deposits may be in part lacustral; thickness 300 feet. Shown on chart as overlying Diablo formation (new name for Alamo formation) and underlying Tassajara formation.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 143–144. Diablo formation grades upward into at least 6,000 feet of nonmarine floodplain and lacustrine sediments to which name Green Valley has been given.

Type section: Immediately to west and southwest of Mount Diablo.

Green Valley Tonalite

Upper Cretaceous: Southern California.

F. S. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1408–1409. Incidental mention in discussion of San Marcos gabbro.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 53–57, pl. 1. Gray medium-grained tonalite; uniform in character; resembles Bonsall tonalite but lacks abundant streaked inclusions of that tonalite. Intrudes Triassic sedimentary, Jurassic volcanic rocks, and San Marcos gabbro; intruded by Woodson Mountain granodiorite.

D. L. Everhart, 1951, California Div. Mines Bull. 159, p. 74–78, pls. 2–5. Described in Cuyamaca Peak quadrangle. Older than Bonsall tonalite; younger than Cuyamaca gabbro. Age considered to be Upper Cretaceous.

Richard Merriam, 1958, California Div. Mines Bull. 177, p. 12–13, pl. 1. Limited to two small masses at west edge of Santa Ysabel quadrangle. In contact with younger Lake View Mountain tonalite. No other contacts exposed, but relations elsewhere show the Green Valley to be younger than San Marcos gabbro and older than Bonsall tonalite.

Named for its development in southeastern part of San Luis Rey quadrangle.

Green Valley Volcanic Series

Tertiary: Southwestern Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Lake deposits, pyroclatics, and intercalated lava flows which rest on basement of Cretaceous strata. Lower 900 feet of series is named Pruett formation, and the upper 1,000 feet, the Duff tuff; these two formations are separated by basaltic lava flows up to 325 feet thick which are designated the Cottonwood Springs basalts. Duff tuff is overlain by Mitchell Mesa rhyolite (new) which is youngest rock of series.

Occurs in Green Valley on southern Davis Mountain from in Trans-Pecos Texas, in Buck Hill quadrangle, Brewster County.

Greenville Dolomite[1]

Upper Cambrian: Northeastern Tennessee.

Original references: E. O. Ulrich, 1924, Tennessee Dept. Education, Div. Geol. Bull. 28, p. 34; Bull. 31, p. 16.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 4, 15. Abandoned. It is not clear whether name Greeneville limestone used by Ulrich was intended to represent a part of or a bed beneath the Copper Ridge.

Type locality not stated but understood to be Greenville, Greene County.

Greenville Shale (in Greenbrier Limestone[1] or Series)

Mississippian (Meramecian): Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 449, 466.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 267, 271–272; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Shale in Greenbrier series (Meramec). Underlies Alderson limestone; overlies Union limestone.

Type locality: In road on north side of Indian Creek, 0.1 mile northwest of Hunter Spring School and 1.6 miles southeast of Greenville, Monroe County.

Greenwater volcanics[1]

Tertiary: California and Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Probably named for exposures at or near Greenwater, east of Death Valley, in Inyo County, Calif.

Greenwater Volcanics

Pliocene(?): Southern California.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, 955, 966. Glassy andesitic and latitic lavas, tuffs, and breccias, which in Greenwater Canyon interfinger with pumiceous water-laid tuffs. Thickness 2,500 feet. Unconformably underlies Funeral fanglomerate (new); unconformably overlies Furnace Creek formation. Name credited to T. P. Thayer.

Typically exposed between Greenwater Canyon and Brown's Peak, in Greenwater Range, southern Death Valley region.

†Greenwich Formation[1]

Precambrian(?): Southwestern Connecticut.

Original reference: J. G. Percival, 1842, Connecticut Geol. Survey Rept., p. 46, 49, 58, 63, 72, map.

Occurs in Stamford and Greenwich, Fairfield County, and extends along the Sound from east side of Stamford Harbour into New York State.

†Greenwich Formation[1]

Lower Cambriam: Eastern New York.

Original reference: T. N. Dale, 1904, U.S. Geol. Survey Bull. 242, p. 43, 50, pl. 1.

U.S. Geological Survey has abandoned the term Greenwich Formation on the basis that C. D. Walcott's manuscript [not Walcott, 1910, Smithsonian Misc. Colln., v. 53, no. 6] for which the name was approved was never published.

Occurs in Washington and Rensselaer Counties. Named for exposures at Greenwich, Washington County.

Greenwich Shale[1]

Cretaceous(?): Southeastern Colorado.

Original reference: W. T. Lee, 1901, Jour. Geology, v. 9, p. 343–352.

In Purgatoire Canyon near mouth of Plum Canyon.

Greenwood Iron-Formation Member (of Michigamme Slate)

Greenwood Iron-Formation[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: J. Zinn, 1933, Michigan Acad. Sci., Arts and Letters, v. 18, p. 442, 443, 451–454.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 36. Lower part of Michigamme slate in Marquette area includes Bijiki iron-formation, Clarksburg volcanics, and Greenwood iron-formation members.

Type locality and derivation of name not stated. Greenwood is in Marquette County.

Greenwood Sandstone[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Greenwood, Sebastian County, Ark.

†Greer Formation[1]

Permian: Southwestern Oklahoma and central and northern Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 52.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Was named to designate rocks of the Blaine and rocks mistakenly thought to correlate with it.

Type locality: Butte known as Cedar Top in northwestern corner of Kiowa County, Okla. Named for Greer County, Okla.

Greggs Breccia[1]

Tertiary, upper; Northwestern Arizona.

Original reference: W. T. Lee, 1908, U.S. Geol. Survey Bull. 352, p. 17.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1414. Pliocene(?).

Exposed south of Colorado River and east of Greggs Ferry and fills Grand Wash Trough [northwest corner of Mohave County].

Greggs Landing Marl Member (of Tuscahoma Sand)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1886, Alabama Geol. Survey Bull. 1, p. 12.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 65, pl. 3. Described in Choctaw County where it lies about 25 feet below the Bells Landing marl member.

Named for exposures at Greggs Landing, on Alabama River, in northwestern part of Monroe County.

†Greggs Landing Series[1]

Eocene, lower: Alabama.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 346.

Gregorian series[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 63, no. 4, p. 281.

Derivation of name not stated.

Gregory Member (of Pierre Shale)

Gregory zone (in Sully Member of Pierre Formation)

Upper Cretaceous: Central South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 10–20, pls. 2, 3. Includes all beds from top of Niobrara to base of Oacoma zone of Sully member (new) south of the Great Bend and, northward from this locality, all beds lying below Agency shale zone of Sully. At and near type locality, divisible into two lithologically and faunally distinct subdivisions. Lower consists of dark bentonite-bearing bituminous shales which contain fish scales. Upper is thin zone of chalk, chalky shale, argillaceous chalk, or marl. From vicinity of mouth of White River, Lyman County, to northernmost exposures near DeGrey, Hughes County, lower and upper Gregory are separated by thin but persistent sandstone bed. Thickness 12 to 145 feet.

W. V. Searight, 1938, Iowa Acad. Sci. Proc., v. 45, p. 137. Microfaunal studies indicate that chalky beds of Gregory underlying Agency faunal zone of Sully member are closely related to the Sully and that beds previously described as upper Gregory should be included in Sully as lowermost zone of that member. Name Gregory [marl] is retained for this zone. Beds described as lower Gregory are contemporaneous with the Sharon Springs of Kansas and Colorado and the name [Sharon Springs] is adopted for beds between the Niobrara and Gregory zone of Sully as revised.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2, p. 20, 22. Gregory marl [zone] in Sully member consists of marl, shale, and chalky shale. Underlies Agency shale [zone].

J. P. Gries and E. P. Rothrock, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 8 (table 1), 11–14. Name Gregory resurrected and used to include all beds between base of Gregory marl and base of upper calcareous zone herein named Crow Creek zone of Sully member. These beds form distinct lithologic unit in type locality and as far north as Hughes County, where they pass beneath river level. Overlies Sharon Springs member; underlies Sully member.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2346. Underlies Crow Creek herein given member status in Pierre; overlies Sharon Springs member. Thickness at type section 34 feet. Consists of beds of light-gray to buff-colored shale with concretions and calcareous layers, and locally, as in Gregory County, basal marl beds. Gregory member as here adopted is Gregory member of Gries and Rothrock (1941).

Type locality: Outcrops along Missouri River in eastern Gregory County. Well exposed in cut bank at south end of Rosebud Bridge, south of Wheeler. Also well exposed to east of Missouri River, especially south of U.S. Highway 18 in Charles Mix County.

Grenada Formation (in Wilcox Group)[1]

Eocene, lower: Mississippi, Kentucky, and western Tennessee.

Original reference: E. N. Lowe, 1913, Mississippi Geol. Survey Bull. 10, p. 23–25.

[Tom McGlothlin] 1940, Mississippi Geol. Soc. [Guidebook 2], p. 3, 4–5. At least upper part, and perhaps all of Grenada formation belongs in Tallahatta section.

Tom McGlothlin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 53. Suggested that term Grenada be abandoned.

G. F. Brown, 1947, Mississippi Geol. Survey Bull. 65, p. 34. Discussion of geology of alluvial plain of northwestern Mississippi. Outcrop beds earlier assigned to the Wilcox were divided into three formations: basal Ackerman, Holly Springs sand, and Grenada. Grenada is now known to be of Claiborne age, and outcrops of sand around Holly Springs are exposures of Meridian sand member of Tallahatta formation (basal Claiborne).

Benjamin Gildersleeve, 1953, Kentucky Geol. Survey Spec. Pub. 1, p. 18 (fig. 1). Generalized section—embayment region of Tennessee and Kentucky—shows Grenada formation above Holly Springs formation and below Jackson formation. Wilcox group. Lower Eocene.

Named for exposures at Grenada, Grenada County, Miss., especially on Yalobusha River, near Grenada.

Grenola cyclothem

Lower Permian (Wolfcamp): Eastern Kansas.

N. G. Lane, 1958, Kansas Geol. Survey Bull. 130, pt. 3, p. 150–156. Defined as beginning at base of unfossiliferous red and green shale in the Roca formation next below the Grenola.

Study was made at type area of Grenola formation in Elk and Cowley Counties.

Grenola Limestone (in Council Grove Group)

Grenola Formation[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47–48. Grenola limestone in Council Grove group. Redefined in accordance with usage of Nebraska Geological Survey to include strata between base of Sallyards limestone and top of Neva limestone. As thus redefined, includes (ascending) Sallyards limestone, Legion shale, Burr limestone, Salem Point shale, and Neva limestone members. Underlies Eskridge shale; overlies Roca shale. Thickness 38 to 48 feet. Lower Permian, Wolfcamp series.

Type section: Ravines and creeks north and south of Highway 160, 4 to 5 miles west of Grenola, Elk County, Kans. All five members present in type section.

†Grenville Limestone[1]

Precambrian: Quebec, Canada, and northern New York.

Original references: W. E. Logan, 1859, Canada Geol. Survey Rept. Prog. 1858, p. 35–40; 1863, Canada Geol. Survey 15th Rept. Prog., p. 43–45; 1865, Canada Geol. Survey 16th Rept. Prog., p. 20, map.

Grenville Quartzite[1] or Amphibolite[1]

Precambrian: Northern New York.

Original reference: R. Balk, 1932, New York State Mus. Bull. 290, p. 14.

Grenville Series[1]

Precambrian: Ontario, Canada, and New York.

Original references: W. E. Logan, 1863, Canada Geol. Survey 15th Rept. Prog., p. 43–45; F. D. Adams, 1893, Jour. Geology, v. 1, p. 328–330.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 64, no. 5, p. 515. Term "Hudson Highlands complex" or "Highlands complex" includes entire sequence of crystalline rocks older than Storm King granite. Grenville sediments (quartzitic micaceous, and calacareous beds) comprise oldest formation in Hudson Highlands. The rocks are characteristically layered and have been intensely metamorphosed. At Bear Mountain, where Grenville series constitutes major part of Highlands complex, biotite, hornblende, epidote, and graphite schists and garnetiferous biotite gneiss are common. Pochuck diorite phase and Canada Hill granite phase associated with Grenville metamorphics.

R. J. Bean, 1953, Geol. Soc. America Bull., v. 64, no. 5, p. 515. Grenville formation mentioned in relation of gravity anomalies to geology of central Vermont and New Hampshire.

For detailed discussion of Grenville Series, see A. F. Buddington, 1939, Geol. Soc. America Mem. 7, 354 p. (Adirondack region), and J. E. Thomson, ed., 1956, The Grenville Problem: Toronto, Canada, Univ. Toronto Press and Royal Soc. of Canada, 119 p.

Name derived from Grenville Township, Argenteuil County, Ontario, Canada.

Greybull Sandstone Member (of Cloverly Formation)[1]

Lower Cretaceous: Central northern Wyoming and central southern Montana.

Original reference: F. F. Hintze, Jr., 1915, Wyoming Geologists Office Bull. 10.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 44, 45. In upper part of Cloverly formation which is considered to be Lower Cretaceous in age. Underlies "rusty beds" here included in Cloverly.

D. L. Eicher, 1960, Yale Univ. Peabody Mus. Nat. History Bull. 15, p. 7–8, 15–16. Term Greybull sandstone member (Hewett and Lupton, 1917, U.S. Geol. Survey Bull. 656) has been applied to some sandstone beds in this general section. Inasmuch as type locality was not designated accurately, it is not now possible to ascertain whether term referred only to channel sandstones in upper part of Cloverly or to sandstone beds at base of rusty beds, or to some of each. Term Greybull should not be used beyond confines of Greybull oil field where originally it was informally applied to an oil sand.

Named for Greybull, Wyo.

Greyhorse Limestone (in Wabaunsee Group)[1]

Pennsylvanian: Oklahoma, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 9.

Type locality: In NW¼ sec. 11, T. 24 N., R. 6 E., Osage Reservation, Okla. Correct spelling is Grayhorse.

†Greylock Limestone[1]

Silurian: Massachusetts.

Original reference: R. Pumpelly, 1894, U.S. Geol. Survey Mon. 23.

Greylock Mountain region.

Greylock Schist[1]

Middle Ordovician: Northwestern Massachusetts and southern Vermont.

Original reference: T. N. Dale, 1891, Am. Geologist, v. 8, p. 1–7.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Described in Cheshire quadrangle where it crops out in vicinity of Saddle Ball Mountain. In this report, color was used as primary distinction between Berkshire schist below and Greylock: black for Berkshire, green or greenish blue for Greylock. Some rocks formerly mapped as Greylock are included in Berkshire schist of this report.

J. B. Thompson, Jr., 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 72, 77, 86. Geographically extended into Vermont. Thickness about 1,000 feet. If Berkshire schist is equivalent to Ira formation, Greylock schist may represent rocks that overlie Ira unconformably. However, Greylock closely resembles Biddie Knob formation of Castleton area which is believed to underlie conformably fossiliferous Cambrian of Taconic slate belt. Age uncertain.

Named for exposures on Mount Greylock, Mass.

†Greylock Series[1]

Precambrian: Massachusetts.

Original references: W. H. Hobbs, 1892, Geol. Soc. America Bull., v. 3, p. 460; 1893, Jour. Geology, v. 1, p. 717–736.

Occurs in Mount Greylock region.

Greyson Shale (in Missoula Group)

Greyson Member (of Spokane Formation)

Greyson Shale[1] (in Piegan Group)

Precambrian (Belt Series): Western central Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1898. Member of Spokane formation. Consists of thinly bedded gray and greenish-gray shales that weather olive brown; conglomerate, pinkish sandstone, and brown sandy lenses in lower portion. Thickness 2,300 to 3,000 feet. In little Belt Mountains, consists of about 1,000 feet of gray argillite. Underlies Prickly Pear member (new).

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Shale distinguished only in vicinity of Helena. In Piegan group.

U.S. Geological Survey currently classifies the Greyson Shale as a formation in the Missoula Group on the basis of a study now in progress.

Type locality: On side of ridge between Deep and Greyson Creeks in Belt Mountains, southeast of Townsend.

Gries Ranch Formation

Gries Formation

Gries Ranch horizon[1]

Oligocene, lower: Western Washington.

Original reference: W. L. Effinger, 1936, Geol. Soc. America Proc. 1935, p. 411.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 108–109. Term Gries Ranch zone was applied by Dickerson (1917, California Acad. Sci. Proc., 4th ser., v. 7, no. 6) to relatively thin section of brownish-gray sandstone and sandy shale exposed in south bank of Cowlitz River, in south part of sec. 24, and north part of sec. 25, T. 11 N., R. 2 W., Cowlitz County. Collection of fossils made by Anderson and Martin was described by Dickerson as representing a lower facies of the *Molopophorus lincolnensis* zone. Original description of type locality was designated by Martin as "Locality 181 on east bank of Cowlitz River, just back of Greece ranchhouse about 4 miles east of Vader. There appear to be two formations represented at this point. The fossils occur in a sandstone which is associated with a conglomerate composed of basalt pebbles and boulders. These two beds dip northwest at very small angle varying from 1° to 5°. A few yards to south a well-stratified coarse gray compact sandstone is exposed dipping south at angle of 10° and striking N. 70° E. This sandstone is probably Eocene. About 20 feet south of fossil beds a mass of coarse conglomerate is butting perpendicularly against sand to the south. This conglomerate appears to be same as that where the fossils occur." Term Grecco ranch is used in description given by Dickerson. As ascertained by present writer [Weaver], the name of people who originally owned this ranch was spelled Gries and this name should be used rather than Grecco. Several years ago the property was sold by Gries family who moved some distance up river. Because name Gries Ranch fauna has become familiar to investigators of marine Oligocene, it is herein suggested that small headland on river on property formerly owned by Gries family be named Gries Point and that beds exposed in river bank and west of the point be termed Gries formation. Strata of Gries formation are exposed in south bank of Cowlitz River for distance of about 1,200 feet where they occupy nose of shallow faulted syncline, which plunges toward north, and whose dips in either limb are under 4°. Formation is commonly regarded as lowermost Oligocene and is probably in part at least equivalent to Keasey formation in Oregon.

W. L. Effinger, 1938, Jour. Paleontology, v. 12, no. 4, p. 355–390. Description of Gries Ranch fauna. Measured section at Gries Ranch locality gives thickness of Gries Ranch beds as 106 feet. Seems likely that the Gries Ranch may be correlated with Willapa River shales of southwestern Washington and Keasey shales of Oregon, but their faunas are apparently of deeper water facies.

Type locality: Outcrop on southeast bank of Cowlitz River, in Lewis County, about 4 miles east of Vader, sec. 25, T. 11 N., R. 2 W. Named for Gries Ranch.

Griffin Bed[1]

Miocene, lower: Western Florida and southwestern Georgia.

Original reference: A. F. Foerste, 1894, Am. Jour. Sci., 3d, v. 48, p. 52–54.

Named for exposures on Griffins Creek, 4½ miles south of Bainbridge, Decatur County, Ga., and about one-half mile west of Griffin's House.

Griffin Sandstone Member (of Lake Murray Formation)

Pennsylvanian: Southern Oklahoma.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists. p. 137 (fig. 2), 140, 141 (fig. 3). Middle member of Lake Murray formation (new). Overlies Bostwick member: underlies Frensley member.

Derivation of name not stated. Area of report is Harrisburg trough, Stephens and Carter Counties.

Griffith Beds

Cretaceous(?): Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 7 (table 1), 18–19, pl. 1. Sandstone and fanglomerate about 2,500 feet thick. Separable into four units or members (unnamed): lowest, about 500 feet consists predominantly of thick-bedded medium-grained arkose with beds of silty clay shale, siltstone, and pebble conglomerate; second, about 150 feet, is thick beds of cobble conglomerate and arkose; third and fourth members are boulder conglomerate; third has about 20 percent arkose matrix as compared to 30 to 40 percent in the fourth member. Probably oldest sedimentary unit in area. Unconformably overlies pre-Cretaceous(?) basement rocks; underlies Cahuenga beds (new). Griffith beds occupy an isolated fault block; unit is in fault contact with sediments of Topanga formation and Hollycrest formation (new) on all sides.

Occurs in Griffith Park area, city of Los Angeles.

Grimes Siltstone Member (of West Falls Formation)

Grimes Sandstone[1]

Upper Devonian: Western and west-central New York.

Original reference: D. D. Luther, 1902, New York State Mus. Bull. 52, p. 616–629.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Unit termed Grimes sandstone by Luther is here designated as Grimes siltstone member of West Falls formation (new). Consists largely of light-greenish-gray and light-bluish-gray siltstone in lenticular beds 1 inch to 6 feet thick. Maximum thickness not more than 60 feet; 1 foot in west-central Livingston County; 15 feet near Dansville, Livingston County; about 50 feet in southern Ontario and western Yates Counties; 5 feet in Steuben County. Overlies Hatch shale member; underlies Gardeau shale member; both contacts gradational.

Named for exposures in Grimes Glen at Naples, Ontario County.

Grimes Canyon Sand and Gravel Member (of Santa Barbara Formation)

Pleistocene, lower: Southern California.

California State Water Resources Board, 1953 (revised 1956), California State Water Resources Board Bull. 12, v. 2, p. B–24, B–103–B–104, pls.

B–1C, B–2. Sand and gravel 100 to 1,000 feet thick near top of formation; rusty-brown color; slightly cemented. Underlies Fox Canyon member (new) of San Pedro formation.

T. L. Bailey, 1954, *in* Pacific Petroleum Geologist, v. 8, no. 9, p. 1; R. G. Thomas and others, 1954, California Div. Mines Bull. 170, chap. 6, p. 20, pls. 2, 6, 7. Marginal facies of formation. Grades from fine sand ranging from 20 feet thick in Las Posas Hills to 1,000 feet thick in southernmost part of Oxnard Plain.

Exposed in Grimes Canyon and southeastward, mostly on flank of Oak Ridge, Ventura County.

Grimsby Sandstone (in Albion Group)

Grimsby Sandstone[1] (in Medina Group)

Lower Silurian: Ontario, Canada, and New York.

Original reference: M. Y. Williams, 1914, Science, new ser., v. 39, p. 915–918.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 21, 22 (fig. 6), 24–26. Top formation in Albion group, Medinan series. Oldest rock exposed in Clyde and Sodus Bay quadrangles. Underlies Thorold sandstone of Clinton group.

Tracy Gillette, 1947, New York State Mus. Bull. 347, p. 13 (fig. 2), 30, 31 (fig. 4). In area of Fulton, the Grimsby underlies Oneida conglomerate.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1982 (fig. 3), 1991–1993. Top formation in Medinan group. Correlation chart shows that Grimsby underlies Thorold sandstone and overlies Cabot Head shale in all areas except Lockport where it is unconformable below the Neagha and overlies Fish Creek shale (new). Thickness 3 to 70 feet.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Term Medina group used in this report in preference to Medinan group. Term Rumsy Ridge replaces preoccupied name Fish Creek. Chart shows Grimsby overlies Rumsy Ridge in some areas.

Named for exposures along east side of Niagara Gorge at Grimsby, Ont.

Grindstaff cyclothem (in Abbott Formation)

Grindstaff cyclothem (in Tradewater Group)

Pennsylvanian: Southwestern and southeastern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). In list of cyclothems of southern Illinois, the Grindstaff occurs at base of Tradewater group and underlies Delwood cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 5, 9, pl. 1. Includes (ascending) Grindstaff sandstone, Willis coal, and Boskydell marine horizon. Underlies Delwood cyclothem; overlies Pounds cyclothem of Caseyville group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Abbott formation (new). Above Pounds cyclothem and below Delwood cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NE¼ sec. 28, T. 10 S., R. 8 E., Gallatin County.

Grindstaff Sandstone Member (of Abbott Formation)

Grindstaff Sandstone Member (of Tradewater Formation)[1]

Grinsdtaff Sandstone (in Tradewater Group)

Middle Pennsylvanian: Southeastern Illinois and western Kentucky.

Original reference: C. Butts, 1925, Illinois Geol. Survey Bull. 47, p. 44.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 40. Rank raised to formation in Tradewater group. Underlies Delwood formation (new).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), 62. Rank reduced to member in Abbott formation (new). Thickness about 50 feet in type section of Abbott. Occurs above Reynoldsburg coal member and below Willis coal member (both new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

U.S. Geological Survey has discontinued use of the name Tradewater in Illinois.

Type locality: NE¼ cor. sec. 28, T. 10 S., R. 8 E., Gallatin County, Ill. Area is known as Grindstaff Hollow.

Grindstone Group

Upper Jurassic (Knoxville): Northern California.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint 1941]. Shown as middle group of Knoxville series. Underlies Newville group (new): overlies Elder Creek group (new).

F. M. Anderson, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 926–929. Begins with well-marked basal conglomerate; upper parts dark sandstone and black sandy shale. Thickness on Grindstone Creek between Chrome and Elk Creek village 5,400 feet; on Redbank Creek 2,800 feet—due to faulting; west of Bennett Creek and Toms Creek, 6,600 feet or more. In some areas, rests directly upon Klamath complex; in other areas, overlies Elder Creek group or overlies Paleozoic limestones. South of Cold Fork, conglomerates lie discordantly on Elder Creek group in disconformable overlap, and constitute a belt that stands out in relief along strike of beds. Derivation of name given.

Named from Grindstone Creek which crosses the group 1 to 2 miles west of road between Chrome and Elk Creek village, Glenn County. Well exposed in sec. 26, T. 28 N., R. 9 W., on northeast slope of Tedoc Peak, northwest Tehama County.

Grindstone Creek Formation (in Millsap Lake Group)

Grindstone Creek Member (of Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Millsap Lake herein given group status. Includes (ascending) "Buck Creek sandstone", Santo limestone, Goen limestone-Ricker limestone. Underlies Garner formation; overlies Lazy Bend formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 18–20, fig. 3, pl. 4. Chiefly a succession of shales, sandy shales, and sandstones occurring immediately above Brannon Bridge limestone. Thickness about

450 feet. In this report, includes Santo limestone bed about middle of formation and Goen limestone bed at top. Top of formation has been defined in Palo Pinto County (Plummer and Hornberger 1936, Texas Univ. Bull. 3232) as base of Thurber coal where present and top of Goen limestone where coal is missing. Thurber coal is missing in Parker County, and the Goen can be traced from Palo Pinto County only one-half mile eastward into Parker County; hence, in this report, boundary between Grindstone Creek and overlying Garner is mapped by projection of topographic and structural position of Goen limestone, but this method is considered unsatisfactory.

Type locality: West of Grindstone Creek, Parker County. Exposures occur in scarps and artificial cuts near Brazos River; lower shales are exposed in scarp north of U.S. Highway 80, east of river; middle part exposed in roadcut southeast of Bennett. Upper part composes scarp west of Bennett; type section includes these exposures and extends from top of Brannon Bridge limestone to top of easternmost Goen limestone on highland west of Bennett.

Grinnell Formation
Grinnell Argillite[1] } (in Ravalli Group)

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta and southeastern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 322.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1887–1888. Red or purplish argillites and white to light-green quartzites. Formation comprises three members (ascending): Rising Wolf, Red Gap, and Rising Bull. Thickness 1,500 to 3,500 feet. Overlies Appekunny formation; underlies Siyeh formation. Type locality restated.

C. P. Ross, 1950, U.S. Geol. Survey Bull. 974–E, p. 142, 144 (table), pl. 4. Argillite, in Ravalli group, underlies Wallace formation in Hamilton quadrangle, Montana.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 27–33, pls. 1, 2. Grinnell argillite, in Flathead and Swan Ranges, crops out extensively with Appekunny argillite below and Siyeh limestone above, evidently in normal stratigraphic relations uncomplicated by deformation. Formation consists largely of pale- and grayish-blue-green, grayish-purple, and grayish-red-purple siliceous argillite, in part calcareous, and some quartzite. In Swan Range, lowest and thickest part of formation is dominantly pale- and grayish-red-purple argillite, nowhere well exposed. Above this is middle member in which proportion of red-purple beds decreases upwards, and much of rock is quarzitic argillite and argillaceous quartzite, with thin argillite partings, commonly rather dark-red-purple. Uppermost member commonly consists of grayish-blue-green calcareous argillite and argillaceous limestone, constituting transition zone below Siyeh limestone of Piegan group. Thickness 1,000 to 4,000 feet. Fenton and Fenton (1937) studied the Grinnell mainly in and north of northern part of Glacier National Park in localities not examined closely during present study. The members they proposed differ from those in Swan Range.

Type locality: Grinnell Point (Stark Point of some maps), at head of Swiftcurrent formerly McDermott Lake, Glacier National Park, Mont.

Griswold Conglomerate
Griswold Gap Conglomerate } (in Pocono Formation)[1]
Griswolds Gap Conglomerate

Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 56, 57.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 255, 279, 282. Griswold Gap conglomerate at base of Pocono. Above Mount Pleasant red shale.

Well exposed opposite Grisword's Gap, just east of Forest City, Susquehanna County.

Grizzly Formation

Precambrian: Southwestern South Dakota.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563. Name appears on list of Precambrian rocks of area. Phyllite, about 3,000 feet thick. Overlies Flag Rock formation (new).

J. A. Noble and J. A. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944 (fig. 1), 962. Consists almost wholly of fine-grained gray to dark-gray sericitic phyllite with no distinctive character and almost no bedding. Thickness about 3000 feet not allowing for possible duplication by undisclosed folding; probably thicker in vicinity of Deadwood. Top of formation not observed overlies Flag Rock formation.

Occurs at Homestake mine, in vicinity of Lead, Lawrence County.

Grizzly Formation[1]

Silurian(?) (may be Ordovician): Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

P. A. Lyndon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Gray quartzite and slaty sandstone (pre-Permian). Mapped with Paleozoic marine sedimentary and metasedimentary rocks.

Named for exposures on east and northeast slopes of Grizzly Mountains, Plumas County.

Grizzly Creek Member (of Crack Canyon Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Listed as upper member of formation. Overlies Blue Ridge member (new); underlies Leesville member of Little Valley formation (both new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Grizzly Mountain Rhyolite[1]

Tertiary: Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1935, Colorado Sci. Soc. Proc., v. 13, no. 8, p. 477, map.

Named for Grizzly Mountain Sawatch Range.

†Grizzly Peak Andesite[1]

Grizzly Peak Basalt

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pubs. Dept. Geol. Bull., v. 2, p. 379, map.

[O. P. Jenkins], 1949, *in* Mineral Inf. Service, v. 2, no. 2, p. 7, 14 (map). Described and mapped as Grizzly Peak basalt. Includes agglomerates, tuffs, and mud flows. Underlies Siesta formation; overlies Orinda formation.

D. E. Savage and O. E. Bowen, 1955, *in* Geol. Soc. America Cordilleran Sec. [Guidebook] Apr. 28–30, Trip 2, p. 2. Lower member of Moraga volcanic series is locally called Grizzly Peak basalt.

Forms Grizzly Peak, in Berkeley Hills, San Francisco region.

Grizzly Peak Rhyolite[1]

Tertiary: Central Colorado.

Original reference: J. V. Howell, 1919, Colorado Geol. Survey Bull. 17.

Occurs in Grizzly Peak, Chaffee County.

Groat Sandstone Bed (in Gammon Ferruginous Member of Pierre Shale)[1]

Upper Cretaceous: Southeastern Montana, western South Dakota, and northeastern Wyoming.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

M. E. Wing, 1940, South Dakota Geol. Survey Rept. Inv. 35, p. 10, columnar section. Geographically extended into Belle Fourche district, South Dakota. Apparently not extensive in South Dakota.

Named for exposures along Groat Creek in T. 7 S., R. 56 E., Carter County, Mont.

Groesbeck Dolomite[1]

Permian: Central northern Texas and southwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 357.

Named for Groesbeck Creek, Hardeman County, Tex.

Groos Quarry Member (of Trenton Formation)

Middle Ordovician: Northern Michigan.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14, 33, 34. Middle member of formation. Underlies Haymeadow Creek member and overlies Chandler Falls member (both new). Forty feet of rock exposed in Groos quarry section; lower 6 feet consist of even-bedded dolomite that grades upward into irregularly bedded argillaceous limestone; parting lenses and thin layers of black shale present throughout section; disconformity about 12 feet above base.

Type locality: Abandoned Bichler quarry at Groos, sec. 1, 39 N., 3 W., Delta County, 5 miles north of Escanaba.

Gros Ventre Formation[1]

Gros Ventre Group

Gros Ventre Member (of Depass Formation)

Middle Cambrian: Northwestern Wyoming and central southern Montana.

Original reference: E. Blackwelder, 1918, Washington Acad. Sci. Jour., v. 8, p. 417.

B. M. Miller, 1936, Jour. Geology, v. 44, no. 2, p. 119–123, 129, 132, 134. Formation in northwestern Wyoming comprises lower shale division, Death Canyon member (new), and upper shale division. Thickness 675 feet. Overlies Flathead formation; underlies Gallatin formation.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1096–1098, 1101 (fig. 3), 1103. Rank reduced to member status in Depass formation (redefined). Overlies Flathead sandstone member. Underlies Maurice member of Boysen formation (new). Thickness 300 feet.

A. J. Bertagnolli, Jr., 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1732 (table 1), 1733. Restricted in La Barge region, Wyoming, to exclude Death Canyon limestone herein raised to formation rank. Thickness 450 to 800 feet. Consists of dark fissile shales with thin gray fossiliferous limestones. Underlies Gallatin formation.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Rank raised to group in western Wyoming where it includes three mappable formations (ascending): Wolsey shale, Death Canyon limestone, and Park shale. Where Death Canyon limestone is missing, entire green shale sequence may be called Gros Ventre formation, but where these rocks are in a brown to red sand and siltstone facies, name Buck Spring formation (new) is applied. Overlies Flathead sandstone; underlies Gallatin group.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 11–13. Formation as used in this report includes Wolsey shale, Death Canyon limestone, and Park shale members. Overlies Flathead sandstone; underlies Boysen limestone.

First described in Gros Ventre Range, Wyo.

Groton Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist, 16th Rept., table opposite p. 288.

Quarried in southwestern part of Groton Township, Calendonia County.

Grouse Hill Dacite Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 36, 111. Name given to dacite flow on Grouse Hill. About same relative age as Cloud Cap dacite flow (new). On inner slope, a layer of pumice beneath flow of Llao Rock overlaps Grouse Hill flow, showing that Grouse Hill flow is older than Llao Rock eruption. At south base of Grouse Hill, the dacite is regularly banded, and on hill next northeast of Llao Rock it is spherulitic. [See Sun Creek Dacite Flow.]

J. E. Allen, 1936, Jour. Geology, v. 44, no. 6, p. 737–739. Grouse Hill flow lies on fairly smooth surface which slopes northward about 250 feet to mile. Flow is almost 2 miles long, 1 mile wide, and averages 250 feet in thickness, rising to over 800 feet in center. This point of highest elevation probably indicates location of vent. Flow has suffered only minor amount of erosion.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 49–51, 137–138. Diller supposed that lava of Grouse Hill was older than Llao Rock flow because it seemed to have suffered more erosion and because it was partly overlain by same sheet of pumice that underlies dacite cliffs

of Llao. First of these arguments is questionable, and second is invalid because pumice on top of Grouse Hill is part of same sheet that lies above Llao flow. There is no way of telling which of the two flows is the older. Probably they are about the same age. Dominant lava is pale-gray minutely vesicular and glassy dacite, richly charged with phenocrysts of plagioclase, pyroxene, and hornblende.

Grouse Hill is on north rim of Crater Lake.

Grove Limestone[1]

Lower Ordovician: Western Maryland

Original reference: G. W. Stose and A. I. Jonas, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 564–565.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept.] Carroll and Frederick Counties, p. 43, 47–52, 84. Thick-bedded high-calcium limestone with beds of massive dolomite in lower part and highly quartzose limestone at base. Thickness in quarry near LeGore, 590 feet. Overlies Frederick limestone; underlies New Oxford formation. Distribution noted.

Named from Grove Quarry and Grove Station, on Baltimore and Ohio Railroad, Frederick County. In middle of Frederick Valley, forms belt about 1 mile wide that extends from point south of Buckeystown northward to LeGore, where it is overlapped diagonally by Triassic sedimentary rocks; belt widens north of Fountain Rock, and at north end, west of Woodsboro, attains width of 2 miles; several narrower bands lie to west of main belt, and extend from south end of Chestnut Hill southwestward to U.S. Highway 40, west of Frederick.

Grove Creek Formation

Grove Creek Limestone (in Gallatin Group)

Grove Creek Member (of Boysen Formation and Snowy Range Formation)

Upper Cambrian: Southern Montana and northwestern Wyoming.

Erling Dorf and Christina Lochman, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 276; 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 543–545. Formation consists of glauconitic limestone rounded pebble conglomerates with patches of white crystalline limestone containing large star-shaped crinoid stem plates overlain by a series of intercalated yellow-green fissile shales, thin gray limestone, and thin-bedded buff to orange-red sandy dolomites. Average thickness 30 feet; at type locality 47 feet. Underlies Bighorn formation; overlies Snowy Range formation (new). Trempealeau equivalent. Term Gallatin formation not applicable in this area [southern Montana].

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1092–1093, 1101 (fig. 3), 1105. Rank reduced to member status in Boysen formation (new) in Wind River area, Wyoming. Uppermost member of formation; overlies Snowy Range member. Thickness 40 feet in type section of Boysen.

A. B. Shaw, 1954, Billings Geol. Soc. Guidebook 5th Ann. Field Conf., p. 32–34. Name Grove Creek limestone adopted here for capping limy unit in Gallatin group in both Pryor and Bighorn Mountains. Dorf and Lochman defined unit as Trempealeau equivalent, but name is used here in lithic sense, rather than time-rock, for these upper limestones regardless of their age, which is not exclusively Trempealeauan. There is a need for

inclusive rock term for entire limy sequence (now called upper Gallatin limestone) above Dry Creek shale. Time-rock terms Grove Creek and Snowy Range of Dorf and Lochman are not legitimately usable where faunal evidence is lacking. Grove Creek of Pryor Mountains comprises 260 feet of predominantly green or gray-green massive flat-pebble conglomerate with thinner beds of fine-grained limestone; interbedded with limestones are green and gray-green arenacous and calcareous, apparently glauconitic shales. Thickness 160 feet in northern Bighorns, flat-pebble conglomerates predominating.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 397, 400, 401. Formation described east and southeast of Livingston, Mont., where it is 50 feet thick and consists predominantly of conglomeratic limestone and shale with stringers of sandstone and siltstone. Overlies Snowy Range formation; underlies Bighorn dolomite.

W. G. Pierce, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 611 (fig. 15), 612. In Heart Mountain thrust area, Wyoming, Grove Creek locally underlies Crandall conglomerate (new).

R. E. Grant, 1958, Dissert. Abs., v. 18, no. 6, p. 2107. Reallocated to member status in Snowy Range formation. Upper member of formation overlies Sage member; underlies Maywood formation. Thickness about 25 feet; member nowhere complete; upper part removed by erosion in some areas and by faulting in others. Report covers Horseshoe Hills and Bridger Mountains, Mont., and Yellowstone Park vicinity.

Type locality: South side of North Fork of Grove Creek, a tributary of Clark Fork of Yellowstone River, in Beartooth front, 5 miles southeast of Red Lodge, Carbon County, Mont. Section measured in N½NW¼ sec. 36, T. 8 S., R. 20 E.

†Groveland Formation[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: H. L. Smyth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 114–121, 137–139.

Well exposed in central part of sec. 31, T. 42 N., R. 29 W., in vicinity of abandoned Groveland mine, in Felch Mountain district.

Grover Gravel

Miocene(?): Eastern Missouri and western Illinois.

Leland Horberg, 1950, Illinois Acad. Sci. Trans., v. 43, p. 173. Incidental mention as Grover gravel of St. Louis region.

W. M. Rubey, 1952, U.S. Geol. Survey Prof. Paper 218, p. 12 (chart), 61–74. Name applied to thin layer of gravel that lies between highest Mississippian or Pennsylvanian formations and overlying Pleistocene deposits. Gravels formerly called "Lafayette." Throughout most of Hardin and Brussels quadrangles (this report), the Grover seems to be merely a thin veneer of pebbles, and in a number of places it is absent. In southern part of Brussels quadrangle, formation is commonly 2 to 5 feet and in a few places 10 feet thick. In parts of St. Louis County, Mo., thickness is slightly more than 30 feet.

Type locality: Uplands near Grover, St. Louis County, Mo. Occurs only on uplands where it caps the high narrow remnants of an old and once much more extensive upland surface.

Grundy Knob Limestone (in Lisman Formation)

Pennsylvanian: Northern Kentucky.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 8. Incidental mention; equivalent to New Haven limestone of Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 85. Marine limestone in Lisman formation. Locality noted. Formerly called Carthage limestone.

Exposed in Grundy Knob, Union County, Ky., 5 miles northeast of Shawneetown, Ill.

Guadalupan series

Late Carbonic: New Mexico.

C. R. Keyes, 1940, Pan-Am. Geologist, v. 74, nos. 2 and 3, p. 106, 136, 139. Guadalupan series, as shown on chart of geologic formations, spans interval between Mescaleran series below and Malagan (Pecosan) series above. Comprises Otero, Word, Capitan, and Chaves terranes.

Guadalupe Series

Guadalupe Group[1]

Lower and Upper Permian: Western Texas, southern Kansas, eastern New Mexico and Oklahoma.

Original reference: G. H. Girty, 1902, Am. Jour. Sci., 4th, v. 14, p. 363–368.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1675–1676, 1678. Rank raised to series. Thickness 4,100 feet at type locality, south end of Gaudalupe Mountains; consists of 2,300 feet of sandstone overlain by 1,800 feet of (Capitan) limestone. Rests on Bone Spring limestone of Leonard age. Because of erosion, youngest beds of series missing from type section. Getty Oil Co.'s Dooley No. 7 in sec. 24, T. 20 S., R. 29 E., Eddy County, N. Mex., penetrated thickness of 5,250 feet. In Delaware basin, series represented by sandstone facies, Delaware Mountain sandstone, which is 3,000 to 3,500 feet thick at outcrop in Delaware Mountains and is there divided into three approximately equal formations. Series in and around Delaware basin subdivided into two paleontologic units. Lower unit, which includes lower and middle formation of Delaware Mountain sandstone, the equivalent Word formation, and certain limestones of the marginal belt, contains ammonoid *Waagenoceras* and is characterized by species of genus *Parafusulina* more advanced than primitive genus of same species found in underlying Leonard series. Upper unit, which includes upper formation of Delaware Mountain and equivalent Capitan limestone, characterized by fusulind genus *Polydiexodina*. Underlies Ochoa series (new). Includes Whitehorse group and equivalent beds in Texas, Oklahoma, and Kansas. Cimarron series of northern midcontinent region should be abandoned and its strata reclassified as belonging to Leonard series and Guadalupe series.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 575–608, 699–709. Series in Glass Mountains consists of Word formation below followed by a complex of deposits divided into Altuda formation, Capitan limestone, and Gilliam limestone. If this classification is correct, beds of upper Guadalupe age in eastern Glass Mountains are much more

restricted than they were thought to be in 1931, when they were supposed to include Vidrio, Gilliam, and Tessey limestones. The Tessey has been shown to be younger (King, 1938), and it is suggested herein that the Vidrio is older. Rocks of Guadalupe series in Delaware basin constitute Delaware Mountain group, composed dominantly of sandstone and divided into (ascending) Brushy Canyon, Cherry Canyon, and Bell Canyon formations. Away from basin, the sandstones tend to disappear. Their lower part passes out by overlap, and higher part is replaced by thick reef masses, Goat Seep and Capitan limestones. In shelf area, the reef masses grade into a complex of limestone, sandstone, and evaporite that forms Carlsbad and Chalk Bluff formations.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 37. Rocks of Guadalupian series crop out in southern Kansas. They comprise unfossiliferous deposits that seem to have been laid down partly on land and partly in shallow basins occupied by strongly saline waters. Thickness of outcropping rocks of series about 290 feet. Subsurface thickness averages about 400 feet in southwestern part of state.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. As shown on correlation chart, Guadalupian stage is Middle Permian.

G. V. Cohee, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 9, p. 1578–1579. U.S. Geological Survey recognizes a two-fold subdivision of the Permian. Reference sequence for United States is designated as outcrops on northwestern Trans-Pecos Texas (Delaware Mountains, Guadalupe Mountains, and Sierra Diablo Mountains) where approximate faunal boundary is taken as that between Cherry Canyon and Bell Canyon formations which are encompassed by Guadalupe provincial series.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 233 (table 1). In Oklahoma, series includes El Reno and Whitehorse groups.

Type locality: South end of Guadalupe Mountains. Named for Guadalupe Point, south end of Guadalupe Mountains, El Paso, Tex.

Guadalupe Mountain Quartz Diorite

[Jurassic]: Central California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 6. Discussed in report dealing with potassium-argon age determinations. Age given as 142.9 million years.

Occurs in Guadalupe Mountain pluton which intrudes Mariposa formation and older rocks. Dated specimen collected from side of road through southern end of Guadalupe Mountains in Indian Gulch quadrangle, NE¼ sec. 24, T. 6 S., R. 17 E.

Guadalupian Series or Stage

See **Guadalupe Series.**

Guajataca Member (of Cibao Formation)

Oligocene: Puerto Rico.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. Introduced to designate sequence of gravels, sands, and shales with interfingering argillaceous limestone that occurs in upper part of Cibao marl. Gravel beds reach several meters in thickness and contain some cobbles up to 10 centimeters in diameter. Apparently reaches maximum thickness of 120 meters in area about 7

kilometers east of Moca; northwest and west of Moca, beyond point of disappearance of Lares limestone, apparently rests directly on San Sebastian sandstone; thins eastward from the Lago de Guajataca as clastic beds interfinger and intergrade with marls and limestones of the Cibao.

Named from exposures along escarpment east and west of the Lago de Guajataca in Quebradillas quadrangle.

Gualala Group

Gualala Series

Middle or Upper Cretaceous: Northwestern California.

Original references (Wallala beds): G. F. Becker, 1885, U.S. Geol. Survey Bull. 19, p. 7–17; (Wallala group): C. A. White, 1885, U.S. Geol. Survey Bull. 22, p. 8.

C. E. Weaver, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1959. Described as Gualala series. Consists predominantly of massive and stratified brownish-gray medium- to coarse-grained quartzose sandstones; conglomerate lenses common near base and middle of series; also thick layers of clay shale; interstratified shaly sandstones and sandy shales constitute 30 percent of stratigraphic section. Thickness approximately 20,000 feet. Beds lie in two major synclinal and two anticlinal folds whose axes trend diagonally to course of San Andreas fault.

C. E. Weaver, 1943, California Div. Mines Bull. 118, pt. 3, p. 628, 629, 630 (table), 631 (fig. 280). Stratigraphic table shows Gualala series as underlying Skooner Gulch basalt (new) and overlying Franciscan group (Franciscan absent west of San Andreas fault).

C. E. Weaver, 1944, Washington [State] Pubs. in Geology, v. 6, no. 1, p. 6–17. Referred to as Gualala group. Unconformably underlies Iversen basalt (new). Middle Cretaceous.

Occurs in Point Arena-Fort Ross region in Mendocino and Sonoma Counties. Named from town of Gualala at mouth of Gualala River, Mendocino County.

Guanajibo Formation

Miocene, upper, or Pliocene, lower(?): Puerto Rico (subsurface).

C. L. McGuinness, 1948, Ground-water resources of Puerto Rico: [San Juan?] Puerto Rico Aqueduct and Sewer Service, p. 226–227. Comprises series of light-yellow to gray limestones, sandy or earthy and ranging from soft to fairly hard and sands, silts, and clays. Deepest well to end in these sediments is well Mg36, 256 feet deep.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 347–348. Guanajibo formation was described in subsurface, but there are valid surface exposures on north side of Lajas Valley, about one-fourth mile east of western intersection of Routes 4 and 306.

Penetrated by wells at Mayagüez. Name derived from Guanajibo Channel.

Guayabal Group

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83. Includes Naranjo and Augustinillo formations (both new). Intruded by Anon andesite-diorite (new). Footnote states group is currently called Jacaguas.

Occurs in Ponce-Coamo area, south-central part of island.

Guayabal Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: G. J. Mitchell, 1922, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 3, p. 256.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). In Ponce district, underlies Ensenada shale; overlies Coamo tuff limestone. Thickness 400 feet. Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper(?) Cretaceous, but text and other table headings do not qualify Upper Cretaceous.

Type locality: Vicinity of Guayabal Reservoir north of Juana Díaz, where rock makes conspicuous white hills to east and west, Ponce district.

Guayama Limestone

Guayama Series[1]

Upper Cretaceous: Puerto Rico.

Original reference: E. T. Hodge, 1920, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 2, p. 142.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4), 51, 60 (table 7). Thickness of Guayama series 2,600 feet. Overlies Sierra de Cayey series. Term series taken from original surveys but is misnomer. Limestone lenses occurring mostly in upper part of Guayama series are here referred to as "Guayama limestone." Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper(?) Cretaceous, but text and other table headings do not qualify Upper Cretaceous.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm., and Princeton Univ. Dept. Geology, p. 24, 44. Toa Vaca formation (new) includes Río Jueyes and Guayama series of Hodge (1920). Ildefonso formation (new) also includes part of Hodge's Guayama series.

Named for city of Guayama located upon series in southeastern corner of Coama-Guayama district.

Guaynabo Formation[1]

Upper Cretaceous(?): Puerto Rico.

Original reference: H. A. Meyerhoff and I. F. Smith, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 275.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 46, 60 (table 7). Thickness 850 feet. Underlies La Muda limestone; overlies Hato Puerco tuffs. Upper Cretaceous.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 3), 10 (fig. 4), 12–13, pl. 2. Redefined as study indicates: (1) in several places, sediments sharply terminated by volcanic rocks—Tortugas andesite (new), (2) in several places La Muda limestone, as herein defined, rests either on this volcanic sequence or is separated from it by varied thickness of noncarbonate rocks—Frailes formation (new), and (3) beds cropping out in vicinity of Guaynabo do not include sedimentary rocks having stratigraphic position given by Meyerhoff and Smith. As thus redefined, includes only the section of noncarbonate sediments overlying Hato Puerco tuff and underlying Tortugas andesite, or, where latter horizon is missing, the Frailes formation. Consists of several thousand feet of stratified tuffaceous sandstone or graywacke, conglomerate or

shale. May attain thickness of 4,500 feet in Barrio Cupey, although lower contact is an inferred fault. No identifiable fossils found. Since formation in places seems to be conformable with younger Frailes, which contains late Upper Cretaceous fauna, it is designated Late Cretaceous(?). Report discusses San Juan metropolitan area.

Named for occurrence near Guaynabo, Fajardo district. Town lies near southwestern edge of broad formational outcrop, which extends beyond limits of district to Bayamon, where sediments lose their identity in residual soils.

Guayo Conglomeratic Sandstone Member (of Naranjo Formation)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 85–94; 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 84. Thickness 0 to 9,280 feet. Occurs in beds 2 to 20 feet thick. Contains boulders and pebbles of most Eocene rocks as well as many Cretaceous. Interfingers with Coamo Springs limestone and Río Descalabrado members of Naranjo and with Collores member of Augustinillo formation (new).

Type locality: In bed of Río Guayo, opposite kilometer post K2H1 on road to Collares, northeastern Ponce quadrangle.

Gubik Formation

Gubik Sand[1]

Pleistocene: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 233–252.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 167, fig. 2. Formation as redefined ranges in thickness from few feet to 150 feet, but in most exposures is 10 to 30 feet. Largely marine predominantly of loosely consolidated cross-bedded brown or buff gravel, sand, silt, and clay. Mantles much of Arctic Coastal Plain of northern Alaska. Unconformably overlies Sagavanirktok formation (new) [in some areas] and Colville group in other areas. Type locality designated.

F. S. MacNeil, 1957, U.S. Geol. Survey Prof. Paper 294–C, p. 100. Striking difference in fauna from different localities may suggest that Gubik is not one unit but consists of several thin units of slightly different age.

Type locality: Bluffs along west bank of Colville River from mouth of Anaktuvuk River to Ocean Point. Name is from Eskimo name of Colville River. Eskimo name for the lower river is Kupik or "big river." Gubik, now the accepted spelling, is misspelling of Kupik.

Guernsey Formation[1]

Devonian and Mississippian: Southeastern Wyoming.

Original reference: W. S. T. Smith and N. H. Darton, 1903, U.S. Geol. Survey Geol. Atlas, Folio 91.

J. D. Love, L. G. Henbest, and N. M. Denson, 1953, U.S. Geol. Survey Oil and Gas Inv. Chart OC–44. In Hartville area, formation divisible into two units, upper consists of limestone and dolomite of Mississippian age

and lower consists of dolomite and sandstone of Devonian age. Thickness as much as 300 feet. Underlies Hartville; overlies Precambrian.

Mapped around town of Guernsey, Platte County.

Gueydan Ash Member (of Catahoula Formation)

†Gueydan Formation[1]

Oligocene or Miocene, lower: Southern Texas.

Original reference: T. L. Bailey, 1924, Science, new ser., v. 59, p. 299–300.

G. R. Pinkley, 1958, South Texas Geol. Soc. [Guidebook] Fall Field Trip, p. 35. Referred to as Gueydan ash basal member of Catahoula in discussion of Fashing field area, Atascosa County. Overlaps entire Frio to southwest and to north has covered Upper Jackson lying on beds of Manning (Hockley shales) around Falls City.

Named for exposures on Gueydan Ranch and survey, southeastern McMullen County.

Gueydan Group[1]

Oligocene and Miocene(?): Southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 700–727.

Guffey Volcanics

Oligocene: Central Colorado.

J. E. Bever, 1954, Dissert. Abs., v. 14, no. 7, p. 1088. Oligocene extrusive rocks here named Guffey volcanics with upper section correlated with Thirty-nine Mile andesite series, and lower section here designated Chumway rhyolite. They covered most of area with flows and tuffs thousands of feet thick.

Guffey area [Park County].

Guilarte Limestone[1]

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 47, 48 (table 4). Distinctive blue-black limestone.

Occurs near Monte Guilarte, Ponce district.

Guilford Granite

Post-Glenarm: Central Maryland.

Ernst Cloos and C. H. Broedel, 1940, Geologic map of Howard County and adjacent parts of Montgomery and Baltimore Counties (1:62,500): Maryland Geol. Survey. Biotite-muscovite granite, structureless, closely associated with pegmatite. Named on map legend with units older than Glenarm series. Age of Glenarm series uncertain.

R. W. Chapman, 1942, Geol. Soc. America Bull., v. 53, no. 9, p. 1301, 1320–1321, pl. 1. Bounds Laurel granite on north.

Type locality and derivation of name not stated.

Guilford Slate[1]

Silurian(?): Southeastern Vermont.

Original reference: C. H. Hitchcock, 1912, Vermont State Geologist 8th Ann. Rept., p. 127.

Guilmette Formation[1]

Middle and Upper Devonian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 68–69. In Gold Hill region, varies in thickness from 1,400 feet to 890 feet within distance of 3 miles and is overlain either by Madison limestone of Lower Mississippian age or by Woodman formation of Upper Mississippian age. Overlies Simonson dolomite.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1763, chart 4. Shown on correlation chart as Middle and Upper Devonian.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 21 (fig. 4), 22. In Confusion and House Ranges, underlies Pilot shale and overlies Sevy(?) dolomite. Thickness 1,200 feet.

G. W. Crosby, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 3, p. 19–20, 52, pl. 11. In south Pavant Range, conformably underlies Cove Fort quartzite (new); conformably overlies Simonson dolomite. Thickness 570 feet. Middle Devonian.

Named for exposures in Guilmette Gulch, Gold Hill region.

Guinda Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Listed as underlying Forbes formation and overlying Funks formation (new).

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282, 283–284, 291, 293. Described as consisting primarily of massive- to well-bedded, fine- to medium-grained, gray- to buff-weathering concretionary sandstone. Thickness varies from 30 feet to 2,975 feet. Typical exposures noted.

Typically exposed in headwaters of Petroleum and Salt Creeks in central and northern parts of T. 12 N., R. 3 W., Yolo County and along faulted western slope of Rumsey Hills, between town of Rumsey on north and Tancred Siding (abandoned) on south.

†Gulf Group[1]

Tertiary: Gulf Coastal Plain.

Original reference: O. Meyer, 1888, Am. Geologist, v. 2, p. 88–89, 93–94.

Comprises states from Alabama to Texas.

Gulf Series[1]

Upper Cretaceous: Gulf Coast region.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d ser., v. 33, p. 298.

R. W. Imlay, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 10a. In terms of European equivalents, Gulf series includes upper Cenomanian, Turonian, Santonian, Campanian, and Maestrichtian stages. Overlies Comanche series which includes lower part of Cenomanian stage. Rock units included in standard section (ascending): Woodbine, Eagle Ford, Austin, Taylor, and Navarro.

Named for extensive development along Coastal Plain of Gulf of Mexico.

Gulf Hammock Limestone

Eocene (Claiborne or Jackson) : Florida.

D. B. Ericson, 1945, Science, v. 102, no. 2644, p. 234. Proposed for surface exposures of limestone that correlates with subsurface Avon Park. Name Avon Park should be dropped.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 104. Gulf Hammock formation, as defined by Ericson, includes Inglis member (new) of Moodys Branch formation and upper part of Avon Park limestone as used in this report. Since Avon Park limestone is very thin in parts of outcrop area and since regional unconformity separates it from Moodys Branch formation, Ericson's correlation of Gulf Hammock formation with Avon Park is inexact, and use of term Gulf Hammock should be abandoned.

Named for exposures at Gulf Hammock, Levy County.

Gullette Bluff Beds (in Nanafalia Formation)

†Gullette Bluff Beds (in Wilcox Group)[1]

Eocene, lower : Southwestern Alabama.

Original reference: J. E. Brantly, 1920, Alabama Geol. Survey Bull. 22, p. 148–150.

L. D. Toulmin, Jr., 1940, Alabama Geol. Survey Bull. 46, p. 28. Nanafalia formation, as restricted by Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2) is equivalent to Gullette Bluff beds of Brantly.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour. v. 16, p. 42. Listed as uppermost unit in Nanafalia formation. Overlies "Nanafalia Landing (*Ostrea thirsae*) marl".

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 96 (fig. 32), 97. Middle and upper divisions of Nanafalia of Smith and Johnson (1887) are equivalent to the "Gullette Bluff beds" of Brantly (1920), and in present report comprise middle and Grampian Hills members of Nanafalia.

Named for exposures at Gullette Bluff, Wilcox County.

Gum Sulphur Siltstone Member (of New Providence Formation)

Lower Mississippian : Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 117–119. Brittle shelly roughly bedded siltstone up to 40 or more feet thick. Occurs in central part of Dicks River facies (new) of formation. Underlain by an argillaceous basal shale, up to 45 feet thick and overlain by clayey shale as much as 75 feet thick.

Named for village of Gum Sulphur, northwestern Rockcastle County, three-fourths mile east of Lincoln County line. Well exposed along valley sides across Dicks River to the north.

Gunflint Iron-Formation[1] (in Animikie Group)

Precambrian : Northeastern Minnesota.

Original reference: C. R. Van Hise and J. M. Clements, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 401–409, map.

D. A. White, 1954, Minnesota Geol. Survey Bull. 38, p. 3 (table 1), 4. In Gunflint district, the three units of Animikie group corresponding to

Pokegama, Biwabik, and Virginia formations of Mesabi district are called, respectively, Kakabeka, Gunflint, and Rove formations.

Well developed on north shore of Gunflint Lake.

Gunn Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 155. Name applied to the relatively fine-grained unit overlying Lacey member (new). Type section extends from depths of 1,648 to 1,880 feet. Thickness 71 to 260 feet. Underlies Charter member (new).

Type well: McQueen No. 1 (well 6), in SW¼NE¼NE¼ sec. 27, T. 42 N., R. 3 E., Dekalb County. Name derived from Gunn School, 2¾ miles northwest of type well.

Gunners Cove Formation

Oligocene or Miocene: Alaska.

R. Q. Lewis, W. H. Nelson, and H. A. Powers, 1960, U.S. Geol. Survey Bull. 1028–Q, p. 560–561, pl. 70. Includes, in approximate order of decreasing abundance, tuffaceous conglomerate and sandstone, crystalvitric basaltic tuff, and thin flows of basaltic lava. Beds dip from 5° to 35° in diverse directions; structural details not determined; hence, no estimate of total thickness made. Inferred to be younger than Rat formation (new), but contact not exposed; trace of contact trends north-south across high crest of island and is probably high-angle normal fault. On basis of fauna, believed to be Oligocene or Miocene.

Makes up about two-thirds of Rat Island, which is on midpart of segment of Aleutian Ridge that includes Amchitka and southern Kiska Islands. Formation exposed from sea level to an altitude of about 1,050 feet. Named for Gunners Cove, a small embayment on north side of island.

†Gunnison Formation[1]

Upper Jurassic: Central western Colorado.

Original reference: G. H. Eldridge, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

Named for exposures in canyon of Gunnison River, Delta and Mesa Counties.

Gunnison or Gunnisonian series

Upper Jurassic: Arizona, Colorado, New Mexico, and Utah.

C. R. Keyes, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 314; 1940, Pan-Am. Geologist, v. 74, no. 2, p. 106 (chart); no. 3, p. 252 (chart). Series in Upper Jurassic. Unconformable above Zunian series and below Morrisonian series. Includes McElmo shales.

Gunnison Tillite

Gunnison Volcanic Conglomerate

Miocene: West-central Colorado.

W. W. Atwood and W. R. Atwood, 1925, (abs.) Geol. Soc. America Bull., v. 36, no. 1, p. 168. Pre-Pleistocene tillite that probably correlates with Ridgway tillite.

W. W. Atwood and W. R. Atwood, 1926, Jour. Geology, v. 34, no. 7, pt. 1, p. 612–622. Light-buff-brown to light-gray tillite overlain by volcanic tuff. Probably mid-Eocene. Type locality stated.

F. B. Van Houten, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 383–385, 387 (table 1). Referred to as Gunnison volcanic conglomerate. Believed to be volcanic-rich mudflow and stream deposit that seemingly is basal part of Miocene San Juan tuff.

Type locality: Along State highway, 3 miles east of Gunnison, Gunnison County.

Gunnison River Series[1]

Precambrian: Colorado.

Original reference: T. S. Lovering and others, 1935, Geologic map of Colorado.

Series includes the following named units: Irving Greenstone, Dubois Greenstone, River Portal Mica Schist, Black Canyon Schist, and Swandyke Hornblende Gneiss.

Named for exposures in Black Canyon of Gunnison River.

Gunn Peak Formation[1]

Carboniferous(?): Central Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 7, p. 34–50.

C. E. Weaver, 1937, Washington [State] Univ. Pub. in Geology, v. 4, p. 19. Intruded by Index granodiorite.

Named for Gunn Peak region, Snohomish County.

Gunpowder Granite[1]

Post-Glenarm: Northeastern Maryland.

Original reference: E. B. Knopf and A. I. Jonas, 1929, Maryland Geol. Survey Baltimore County, Rept., p. 104, 125.

U.S. Geological Survey currently considers the Glenarm Series to be Lower Paleozoic(?).

Named for outcrops along Gunpowder Falls, Baltimore County.

†Gunsight Formation (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Named for Gunsight, Stephens County.

Gunsight Limestone Member (of Graham Formation)[1]

Gunsight Limestone (in Graham Group)

Upper Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Graham group. Underlies Wayland shale; overlies units referred to as post-Bunger cycles 1 to 7. Cisco series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 70, pl. 27. Member of Graham formation. Overlies Bluff Creek shale member; underlies Wayland shale member. Generally fine-grained and pale-brownish-yellow to gray fossiliferous limestone. Thickness about 17 feet along Colorado River to as much as 25 feet in north-central Brown County.

Member was called *Campophyllum* bed by Drake (1893, Texas Geol. Survey 4th Ann. Rept., pt. 1); Hudnall and Pirtle (1931, Geologic map of Brown County: Texas Univ. Bur. Econ. Geology) divided Gunsight limestone of Plummer into Upper Gunsight and Lower Gunsight limestones.

Named for Gunsight, Stephens County.

Gunstock Gneiss[1]

Age(?): Eastern New Hampshire.

Original reference: L. V. Pirsson and H. S. Washington, 1906, Am. Jour. Sci., 4th, v. 22, p. 505.

Winnipesaukee quadrangle, Lake Winnipesaukee region. Probably named for Gunstock River.

Gunter Sandstone Member (of Van Buren Formation)[1]

Gunter Formation (in Prairie du Chien Group)

Gunter Member (of Gasconade Formation)

Lower Ordovician: Central and southern Missouri and northern Illinois.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 26.

R. D. Knight, 1954, Kansas Geol. Soc. Guidebook 17th Ann. Field Conf., p. 57–59. [Reprinted as Missouri Geol. Survey and Water Resources Rept. Inv. 17.] Member of Gasconade formation. Unconformably overlies Eminence formation; conformable with overlying nonsandy dolomites of Gasconade. Consists of sandstone and sandy dolomite. Average thickness 25 to 30 feet; maximum 50 feet in localized area. Missouri Geological Survey no longer uses Van Buren as formational name because unit is only locally distinctive. In parts of Kansas and Oklahoma, recognized in subsurface as member of Arbuckle group.

H. B. Willman and J. S. Templeton, 1951, Illinois Acad. Sci., v. 44, p. 111 (fig. 2), 116–117. Geographically extended into Illinois. Formation consists principally of argillaceous, silty, finely glauconitic greenish-gray to cream chalky dolomite which contains fine muscovite flakes and is slightly sandy in lower 2¾ feet. Thickness about 10¼ feet. Overlies Trempealeau; underlies Oneota. Lower Ordovician. Exposures confined to quarry near Rochelle, Lee County, and to prospect pit and ravine in Ogle County.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 3. Shown on chart as formation in Prairie du Chien group.

Type section: At Hahatonka [Gunter or Hahatonka Springs], Camden County, Mo. Named from now abandoned Gunter post office in Miller County.

Gunther dolomite (in Chuaran series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Mainly of massive dolomite; downward the section seems to merge into a calciferous sandstone. Constitutes prominent cliff-forming ledge. Thickness 150 feet. Underlies Jupiter shales (new); overlies Chiquito sandstone (new).

Name comes from Gunther Castle, opposite mouth of Little Colorado River. The "Castle" is mainly fashioned from this rock. Grand Canyon region.

Gurnee Formation (in Pottsville Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: G. H. Ashley and S. H. Cathcart, 1932, Pennsylvania Topog. and Geol. Survey Bull. 102A, p. 6.

Type locality: Vicinity of Gurnee, Tioga County.

Guthrie Dolomite[1] (in Double Mountain Group)

Guthrie Dolomite Member (of Dog Creek Formation)

Permian (Guadalupe Series): Central northern Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 26, pl. 1.

R. L. Clifton, 1942, Jour. Paleontology, v. 16, no. 6, p. 686 (table 1). In this report, classed as member of Dog Creek formation.

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 30 (fig. 9). Shown on correlation chart as member of Dog Creek formation; occurs below Wagon Yard gypsum member and above Mangum dolomite member. Permian (Guadalupe).

Underlies town of Guthrie, King County. Crops out along South Wichita River east of town.

Guthrie Creek Member (of Harrodsburg Limestone)[1]

Guthrie Creek Member (of Warsaw Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1929, Indiana Acad. Sci. Proc., v. 38, p. 233–242.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 805. Reallocated to member status in Warsaw formation. Overlies Leesville member (reallocated); underlies massive regularly bedded limestone of upper part of formation.

Named for exposures along Guthrie Creek, in southeastern part of Lawrence County.

Guttenberg Limestone Member[1] (of Decorah Formation)

Guttenberg Limestone (in Galena Group)

Guttenberg Submember (of Decorah Shale Member of Galena Formation)

Middle Ordovician: Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: G. M. Kay, 1928, Science, new ser., v. 67, p. 16.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 81, 83, 84, 86. Considered submember of Decorah shale member of Galena formation in Minnesota. Lies at base of restricted Decorah shale member and begins with pebbly corrosion zone at top of *Stictoporella* bed. Largely shale in St. Paul area where it is about 43 feet thick; to south limestone layers increase in importance; chiefly limestone at type locality. Underlies Ion submember.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. Considered formation in Galena group in Dixon-Oregon area, Illinois. Thickness about 5 feet. Includes Garnavillo member below and Glenhaven (Garnet) member above (both new). Underlies Dunleith formation (new); unconformable above Quimbys Mill

formation of Platteville group; Spechts Ferry formation absent in this area.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 763. Members of Decorah formation (Spechts Ferry, Guttenberg, and Ion) not recognizable rock units in Minnesota.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 289–293; A. V. Heyl, Jr., 1959, U.S. Geol. Survey Prof. Paper 309, p. 16. Member commonly 12 to 14 feet thick; less than 2 feet near Rockford, Ill.; about 6½ feet near Blanchardville, Wis. Limestone, brown, fine-grained, thin-bedded, nodular conchoidal; dark-brown shale; some sections dolomitic; bentonite layer in shale seam near base at Spechts Ferry, Iowa, and northeast of Galena, Ill., also noted in drill holes in Grant County, Wis. Underlies Ion member and, in some areas, is poorly distinguished or indistinguishable from it; overlies Spechts Ferry member. Where Spechts Ferry member is absent, Guttenberg lies with slight regional disconformity on Quimbys Mill member of Platteville.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1034. In this report [Fillmore County, Minn.], the unit of green calcareous shale between limestone and Platteville formation and limestone of Galena formation is called Decorah. Therefore Decorah formation of this report includes shaly upper part of Spechts Ferry, the Guttenberg, and, in places, the Ion of Stauffer and Thiel (1941).

Type section: In bluff of Mississippi River just northwest of Guttenberg, Clayton County, Iowa.

Guyandot Sandstones (in Sewell Formation)[1]

Guyandot Sandstones (in New River Group)

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 77.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 227, 229. In Greenbrier County, Guyandot sandstone (Campbell, 1902) is massive, grayish white, and coarse grained; somewhat lenticular, its interval being occupied locally by sandy shale. Thickness 30 to 50 feet. Underlies Castle coal; overlies Skelt shale; locally apparently coalesces with stratigraphically higher Harvey sandstone. Lower Guyandot sandstone (Hennen and Gawthrop, 1915) is massive coarse grained and grayish white in northern part of county; in Meadow Bluff district, its position in column is, in whole or in part, occupied by sandy shale. Thickness 10 to 30 feet. Underlies Sewell "A" coal; overlies Hartridge shale. Both sandstones are included in New River group.

Named from exposures along Guyandot River from Pineville, Wyoming County to Gilbert, Mingo County.

Guye Formation[1]

Eocene: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 810–811. Paleobotanical evidence indicates Eocene age.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 101 (table 1), 111–113, pl. 1. Name was applied by Smith and Calkins to heterogeneous group of sedimentary and volcanic rocks whose structure was not clearly known. As a result, rocks of several ages were included in the formation. This composite unit erroneously dated Miocene from small collection of fossil leaves, although Smith and Calkins and most later workers realized that the rock types and structure resembled lower Tertiary rocks more closely than Miocene. Because the Guye was one of the few dated units in region, its age was used to date more widespread formations. Guye formation of Smith and Calkins here separated into four formations: Denny (new), Guye (restricted), Mount Catherine rhyolite (new), and Naches. Exposure south from Snoqualmie Pass is bounded on three sides by Mount Catherine rhyolite which dips away from the Guye on all sides and apparently unconformably overlies it. Structure interpreted as anticline in the rhyolite with homoclinal Guye exposed in core. On Denny Mountains, underlies Keechelus andesite, apparently unconformably. Locally intruded by Snoqualmie granodiorite. Formation is thick sequence of shale, sandstone, and conglomerate; fluviatile origin shown by lenses of conglomerate that are interbedded with sandstone and leaf-bearing shale. Conglomerate, sandstone, and shale are mixed in all proportions; beds or lenses range from thin to massive. Conglomerate, percentagewise is the least important rock type but is the most distinctive. Thickness about 5,000 feet. Paleobotanic evidence and stratigraphic relationships suggest an Eocene or Paleocene age. Type area designated.

Type area: Coal Creek and its tributaries, on east side of Snoqualmie Pass. Area almost parallels strike; hence, stratigraphic exposure is limited. Named from exposures on Guye Creek.

Guymard Quartzite

Lower to Middle Silurian: Eastern New York.

C. F. Kilfoyle, 1954, New York State Mus. Bull. 348, p. 499, 500, 591, 650. Incidental mention in faunal list.

Occurs at Otisville, Orange County.

Guzmán Formation[1]

Upper Cretaceous: Puerto Rico.

Original reference: H. A. Myerhoff, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 267.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 41, 60 (table 7). Thickness about 750 feet. Underlies Hato Puerco tuffs. Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper (?) Cretaceous, but text and other table headings do not qualify the Upper Cretaceous.

Named from occurrence in western part of Barrio Guzmán Abajo, where they crop out along Río Canovanas about 9 miles south of village of Canovanas.

Gwinn Series[1]

Precambrian (middle Huronian): Northwestern Michigan.

Original reference: R. C. Allen, 1914, Jour. Geology, v. 22, p. 567, 569.

Named for occurrence at and around Gwinn, Marquette County.

†Gwynedd Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original references: B. S. Lyman, 1893, Pennsylvania Geol. Survey geol. and topog. map of Bucks and Montgomery Counties; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

Exposed at Gwynedd Tunnel, Bucks and Montgomery Counties.

†Gym Limestone[1]

Permian: Southwestern New Mexico.

Original reference: N. H. Darton, 1916, U.S. Geol. Survey Bull. 618, p. 19, 35.

V. C. Kelley and L. E. Bogart, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 8, p. 1644–1648. Stratigraphic studies in Florida Mountains Luna County, have revealed that type locality of Gym limestone consists mostly of Fusselman dolomite of Silurian age. Preliminary examination of other principal localities [see this report for discussion] of supposed Gym limestone shows either similar misidentification or considerable dissimilarity. Until all localities of Gym can be restudied, it appears best to restrict term Gym to the small outcrops in southeastern part of Florida Mountains. Gym as originally described is in Luna County.

U.S. Geological Survey has abandoned the term Gym Limestone.

Type locality: Gym Peak and vicinity, Deming region, Luna County.

Gypsum Spring Formation

Gypsum Spring Member (of Twin Creek Limestone)

Gypsum Spring Formation (in Chugwater Group)

Gypsum Spring Member (of Chugwater Formation)

Middle Jurassic: Wyoming, Montana, and South Dakota.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 42–43, 45, 46. Uppermost member of Chugwater. Overlies Popo Agie member; underlies Sundance formation. Consists of sequence of limestone, shale, and gypsum. Thickness 181½ feet where exposed on Red Creek.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 126 (fig. 2), 136. Rank raised to formation in Chugwater group. Uppermost formation of group; overlies Wyopo formation (new) and where Wyopo is absent rests on Popo Agie formation. Thickness 20 to 200 feet. Triassic.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 14. Classed as formation; all or parts of unit have been included in Chugwater by some geologists and in Sundance by others; it has been defined both as a formation and as a member of Chugwater. Consists of basal red blocky slightly sandy siltstone overlain by 50 to 125 feet of massive white gypsum on surface and white anhydrite in subsurface. Overlying the gypsum bed is alternating sequence of thin beds of gypsum, red shale, gray ribbon dolomites, and fine slabby limestone. Maximum thickness about 250 feet (northwestern part of Wind River Basin). Unconformable above Nugget sandstone; underlies unit referred to as lower Sundance. Contains marine Middle Jurassic fossils.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 231 (table 1), 236–247, strat. sections. Term Gypsum Spring formation

extended to include gypsiferous beds in northern Wyoming and Montana. In Black Hills area, rather thin beds directly below the Sundance are herein called Gypsum Spring formation because they occupy same stratigraphic position of formation in north-central Wyoming and southernmost Montana, directly beneath beds containing *Arcticoceras henryi* (Meek and Hayden), and because they show considerable lithologic resemblance to typical Gypsum Spring formation. If this correlation is correct, formation extends across Powder River Basin in subsurface, a distance slightly more than 100 miles. In Black Hills area, South Dakota and Wyoming, Gypsum Spring represents first widespread invasion and withdrawal of marine waters during Jurassic in Western Interior region; formation is Middle Jurassic in age and correlative with Gypsum Spring and Sawtooth formations farther west. Represents upper Bajocian and Bathonian stages and is separated from adjoining formations by disconformities. Beds herein included in Gypsum Spring comprise two laterally intergrading facies: one consists of gypsum commonly interbedded with soft maroon siltstone and shale, locally attains thickness of 45 feet, and extends roughly on the western side of Black Hills from Elk Mountain to Sundance and on the northeast side from about 10 miles south of Sturgis to vicinity of Spearfish; second facies consists of interbedded gray shale, limestone, and dolomite, occurs in northwestern end of Black Hills, attains at least 21 feet in thickness, and is well exposed on road from Hulett to Alva. Underlies Stockade Beaver shale member (new) of Sundance formation; underlies Canyon Springs sandstone member (new) of Sundance formation at type section of Canyon Springs. Overlies unit referred to as Nugget(?); locally overlies Spearfish formation.

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 32. Basal part of Piper formation (new) locally includes equivalents of type Gypsum Spring of central Wyoming as defined by Love.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 967–968, chart 8C (columns 44, 45, 46, 50, 51, 53). Formation represents basal deposits of transgressive sea; may not be same age throughout its extent, and may represent much more time at one locality than at another. Imlay considers that rocks assigned to Gypsum Spring formation by U.S. Geological Survey parties in Big Horn Basin of Wyoming are identical with Piper formation of eastern Montana and that they include more than type Gypsum Spring as defined by Love (1939; 1945). This observation has been disputed for sections along west side of Big Horn Mountains. Piper formation was first identified by Imlay (1947) as Gypsum Spring, but later work demonstrated that Gypsum Spring of type area in central Wyoming represents only basal Middle Jurassic and correlates with lower member of Gypsum Spring, as employed by U.S. Geological Survey parties in Montana and in parts of Big Horn basin of Wyoming. This usage in Montana arose because it was practical in mapping and because Gypsum Spring was assumed to include all beds of Middle Jurassic older than type Sundance formation. Because beds equivalent to type Gypsum Spring in Montana are not mappable, name Piper is employed in that state for beds hitherto called Gypsum Spring.

T. P. Storey, 1958, Alberta Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Upper and Middle Jurassic of Williston Basin region comprises nine stratigraphic units or regional correlation intervals and two regional unconformities. On basis of faunal, environmental, and tectonic

evidence, these units are grouped into four major depositional sequences or stagelike intervals which Imlay refers to as Gypsum Spring (or Piper), Sawtooth, Rierdon, and Swift formations. Miscorrelation of type section of these formations are result of variations in stratigraphic succession caused by sub-Swift and sub-Rierdon unconformities which correspond respectively to Arkell's (1956, Jurassic geology of the World: New York, Hafner Publishing Co.). Lower Callovian and uppermost Callovian to Lower Oxfordian marine transgressions. Recognition of regional extent and significance of these unconformities suggests that these are the following stratigraphic variations from those generally accepted: (1) the lower Swift (Stockade Beaver-Hulett of lower Sundance) is older than type Swift and younger than type Rierdon formations; and (2) Sawtooth is discrete stratigraphic unit which is younger than Piper or Gypsum Spring.

R. E. Skinner, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 129–130. Stratigraphically extended below to include Kendall sandstone member (new).

U.S. Geological Survey currently classifies the Gypsum Spring as a member of Twin Creek Limestone in Lincoln County, Wyo., on the basis of a study now in progress.

Named for the gypsum spring on Red Creek, Fremont County, Wyo.

Gypsy Quartzite

Cambrian: Northeastern Washington.

C. F. Park, Jr., 1938, Econ. Geology., v. 33, no. 7, p. 713 (chart), 714. Named on stratigraphic chart and map. Thickness 5,300 to 8,500 feet. Underlies Maitlen phyllite (new); overlies Monk formation.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 13–15, pl. 1. Consists of alternating beds of quartzite and phyllite in nearly equal parts. Grades downward into Monk formation and upward into Maitlen phyllite; limits of quartzite placed where quartzite and grit beds predominate over beds of other types. Derivation of name given.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 602 (table 4), 608–609, 611, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for Metaline quadrangle. New names replace those given by Weaver (1920). Correlative with Gypsy quartzite is a small part of Boundary argillite.

Named for exposures in high amphitheaters of Gypsy Ridge, Pend Oreille County.

Hackberry Shale[1]

Upper Devonian: Northeastern Iowa.

Original reference: C. L. Webster, 1889, Am. Nat., v. 23, p. 242, 243.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1737 (fig. 1), chart 4. Figure 1 A (attributed to Stainbrook) shows undifferentiated Hackberry below the Sheffield and above Shell Rock; figure 1 B (attributed to Cooper and Warthin) shows Hackberry including Juniper Hill, Cerro Gordo, and Owen; probable true position of Independence between Juniper Hill and Cerro Gordo.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 67. Hackberry formation of Webster and authors includes Cerro Gordo and Owen mem-

bers of Lime Creek but not Juniper Hill shale. Column of Iowa Devonian ascribed by Cooper and others to present writer [Stainbrook] has Hackberry intercalated between Shellrock and Sheffield. Hackberry as an Iowa formational term is not recognized by Iowa Geological Survey and has never been used as equivalent to Lime Creek by present writer. Lime Creek, including Juniper Hill, Cerro Gordo, and Owen, is used in Iowa for interval between Sheffield and Shellrock.

Named for exposures at Hackberry Grove, Cerro Gordo County.

Hackberry Shale (in Cimarron Group)[1]

Permian: Central southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 46.

Named for Hackberry Creek, Clark County, Kans.

Hackett Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 353.

Type locality: On ridge road between Hackett and Island Creeks, 1.6 miles northeast of Pettry, Mercer County.

Hackett Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 354.

Type locality: On ridge road between Hackett and Island Creeks, 1.6 miles northeast of Pettry, Mercer County.

Haddam Granite Gneiss[1]

Haddam Tonalite

Paleozoic(?): South-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 143, 145, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 51, 52, 54, pl. 1. Referred to as orthogneiss and mapped as Monson orthogneiss.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Age unknown; possibly the same as Monson gneiss, here designated Devonian.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 25–33, 51, pls. 1, 2. Haddam tonalite constitutes Killingworth dome which covers large part of Guilford quadrangle. Present study has shown that entire dome can be mapped as one tonalite mass with peripheral zone of mixed rocks. Entire formation is herein designated Haddam tonalite. Term Haddam preferred to Monson. No petrographic study of rocks between Haddam, Conn., and Monson, Mass., (type locality of Monson) has been made. Foye (1949) correlated Haddam, Eastford, and Glastonbury gneisses of Connecticut with Monson of Massachusetts, but verification awaits detailed study of very difficult region. Mamacoke gneiss shown by Gregory and Robinson (1907, Connecticut Geol. Nat. History Bull. 7) near Guilford village has been eliminated from present map as has Madison hornblende gneiss of Foye (1949). Former is a mixed facies zone of granite and Haddam tonalite, and latter

a facies of the Haddam with a hornblende content above average. Haddam is in contact with Middletown gneiss throughout most of the area. Concordant relationship with Clinton granitic gneiss.

Typically exposed about Higganum, Haddam Township, on both sides of Connecticut River.

Hades quartzite[1]

Upper Devonian: Utah.

Original reference: C. R. Keyes, 1924, Pan.-Am. Geologist, v. 41, p. 37, 47–53, 281, 287, 290.

Well exposed in towering cliffs on the hot, gloomy, and inhospitable canyon on east side of Duchesne River.

Hagan Shale Member (of Clinch Sandstone)

Lower Silurian: Southwestern Virginia and northeastern Tennessee.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (2 sheets); 1954, Virginia Geol. Survey Bull. 71, p. 141–143, 188; R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 90, p. 76, 122, pl. 1. Consists of green shale, with interbeds of fine-grained sandstone and siliceous sandstone; massive sandstone 1 to 2 feet thick at base. Thickness 70 to 77 feet. Underlies Poor Valley Ridge member (new); overlies Sequatchie formation.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Lower Silurian.

Named for exposures along Louisville and Nashville Railroad cut in gap through Poor Ridge Valley near Hagan, Lee County, Va.

Hager Formation (in Plattin Group)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2053–2058. Named as third of four formations in group. Generally fine-textured calcite rocks; shows three principal facies and their mutual gradations, major part of formation is slabby light-olive-gray calcite with buff-weathering partings; calcarenite and calcilutite constitute lesser part of formation; calcitite facies, principally developed in southern thicker sections, grades downward into calcarenite; calcilutite facies overlies the calcitite in type area but grades laterally into calcarenite in Ste. Genevieve County exposures. Thickness at type locality 66 feet; thickens southward and thins northward. Underlies Macy formation (new); overlies Beckett formation (new).

Type section: Near Hager School, in NW¼NW¼ sec. 29, T. 35 N., R. 12 E., Perry County.

†Hagerman Lake Beds[1]

Pliocene, upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 31, 52–56, pl. 4. Thickness about 600 feet. Overlie Banbury volcanics. Upper Pliocene.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 17. Term Hagerman lake beds is essentially synonymous with

Idaho formation for area in which it has been applied but has the advantage that it is tied to upper Pliocene fossils whose stratigraphic relations are known definitely. These show that Hagerman lake beds appear to be continuous with Idaho formation of areas farther west, but detailed relationships remain to be determined.

Type locality: Hagerman Valley, Gooding and Twin Falls Counties, where it forms prominent bluffs along Snake River.

Haggard Limestone (in Cumberland Sandstone)

Upper Ordovician: South-central Kentucky.

W. R. Jillson, 1953, The Haggard limestone: Frankfort, Ky., Roberts Printing Co., p. 9–12. Name applied to fossiliferous group of gray semicompact and crystalline limestones and shaly limestone beds at top of Cumberland sandstone. Thickness 35 feet. Stratigraphically above Burkesville limestone lentil; underlies Chattanooga shale.

Exposed on farm of B. P. Cary near headwaters of Haggard Branch, a south-flowing tributary of Cumberland River, near Burkesville, Cumberland County.

Hagman Formation

Hagman Andesite

Eocene, upper: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 50–51]. Hagman andesite consists of two-pyroxene andesite lava, agglomerate, and tuff. Lower part is mainly lava and agglomerate; upper part mainly agglomerate and tuff, which is locally arenaceous and shows crossbedding. Relationship to Sankakuyama liparite not clear because no contact observed, but Hagman is believed to be younger.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 46–51, pl. 2, chart 2. Formation includes andesitic pyroclastic rocks, lava flows, and water-laid volcanic sediments, some of which contain late Eocene fossils. Its three principal facies comprise occurrences of andesite flow rock 30 feet or more thick, breccias and tuffs, and conglomerate and tuffaceous sandstone. Differs from Sankakuyama formation below in being dominantly andesitic, and from Densinyama formation mainly above in generally lacking quartz and quartz-bearing rocks. Thickness as much as 1,100 feet.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique, Strat. Internat., v. 6, Océanie, fasc. 2, p. 37. Age of Hagman andesite given as lower Oligocene-Eocene.

Type section: Exposures at Point Hagman (Puntan Hagman).

Hague Gneiss[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. N. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs above Trumbull gneiss and below Dixon schist.

Type locality: Lakeside mine, at Hague, Warren County.

Haigler Formation

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1504–1506, pl. 1. Much of the rock is rhyolite, but formation believed to include thick sections of basic extrusive rock and volcanic sedimentary rock. Lower member mapped as five submembers (sequence not stated): gray to black albite porphyry rhyolite; black or brown rhyolite with vitreous luster; tuff breccia of coarse, irregular volcanic or accidental ejecta in matrix of tuff; and two separate conglomerates composed of rock types that underlie them—rocks subrounded and well sorted. Stratigraphic continuity of members overlying lower member not established, and therefore type section not described for them. Lower member tentatively believed to be overlain in succession by at least 1,450 feet of rhyolite, 1,000 feet of basic and intermediate volcanic and sedimentary rocks, at least 1,100 feet of rhyolite, largely tuff, and 1,600 feet of sedimentary and pyroclastic rocks. Underlies Oxbow Mountain rhyolite (new); overlies Board Cabin formation (new).

Type section of lower member begins at upper contact of Board Cabin formation just east of Board Cabin Draw in hillside southwest of abandoned "Hot Shot" mine and extends northeast to east fork of Board Cabin Draw, Diamond Butte quadrangle. Name derived from Haigler Creek, in northeastern part of quadrangle.

Haiku Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 84–85. Lava flows of nepheline basalt containing pegmatoid veinlets and segregations, and associated cinder and palagonite tuff, containing fragments of Koolau lavas. Pyroclastic rocks more than 30 feet thick in places, and lava flow more than 20 feet. Unconformably overlies Koolau volcanic series and underlies noncalcareous nonmarine and marine sediments. Probably erupted during plus 95-foot (Kaena) stand of sea. Pleistocene.

Named for Haiku Stream along which it is exposed.

Hailey Conglomerate Member (of Wood River Formation)

Pennsylvanian (Morrowan through Derryan): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Comprises gradation upward from immature graywackes to supermature orthoquartzites. Thickness, 1,900 feet. Late Morrowan where it interfingers with limestones east of Muldoon trough; in the west, upper boundary is Desmoinesian. Older than Slate Creek member (new); overlies Muldoon formation (new).

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3). Correlation chart shows the Hailey at base of Wood River formation in Bellevue area. Underlies unnamed lower sandy limestones of formation; unconformable above Milligen formation.

Deposited in Muldoon trough, aligned N. 30° W., Bellevue area.

Hailey Shale[1]

Upper Cretaceous: Central Wyoming.

Original reference: S. W. Williston, 1905, Science, new ser., v. 22, p. 504.

Probably named for town of Hailey, eastern Fremont County.

Haines Granite[1]

Post-Triassic and pre-Tertiary: Northeastern Oregon.

Original reference: U. S. Grant and G. H. Cady, 1914, Oregon Bur. Min. and Geol. Min. Resources Oregon, v. 1, no. 6, p. 133–144.

Named for town in Baker district.

Hakatai Shale (in Unkar Group)[1]

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

J. H. Maxson, 1949, (Abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1963. Thickness 600 feet in Bright Angel quadrangle. Includes diabase sills. Overlies Bass limestone; underlies Shinumo quartzite.

Named for Hakatai Canyon, where typically exposed, Grand Canyon region.

Halcyon Lake Formation

Lower Ordovician: Southeastern New York.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212; 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1817. Consists of sandstones, dolomites, and calc-dolomites; estimated thickness 350 feet. Conformably underlies Rochdale limestone; younger than Briarcliff dolomite (new).

Described in area of Stissing Mountain, Dutchess County.

Haldeman Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 180, 184, pl. 16. Included in Morehead facies of Brodhead formation (new). Thickness 32 to 70 feet. Underlies Indian Fort shale (new), Irvine facies, and Perry Branch siltstone (new), Morehead facies; overlies Frenchburg siltstone (new). Persistent for many miles away from type locality.

Type area: Vicinity of Haldeman, 7½ miles northeast of Morehead, Rowan County.

Hale Formation[1]

Hale Sandstone Member (of Morrow Formation)[1]

Lower Pennsylvanian (Morrow Series): Northern Arkansas, southern Missouri, and northeastern Oklahoma.

Original reference: G. I. Adams and E. O. Ulrich, 1905, U.S. Geol. Survey. Geol. Atlas, Folio 119.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 295. Geographically extended into Barry County, Mo., where it is composed of yellowish-brown massive crossbedded sandstone. Unconformably overlies Fayetteville and, in some places, the Keokuk and Reeds Spring.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1936–1938. In type area, formation is divided into two members: Cane Hill below and Prairie Grove above.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 75–80. Described in northeastern Oklahoma on the flanks of the Ozark uplift where it ranges in thickness from zero in portions of Mayes and Craig Counties to 136 feet on Ross Mountain. Rests with pronounced unconformity upon Pitkin and older strata; grades upward into Bloyd formation; contact is typically placed at base of first prominent shale above the massive Hale limestone. It is basal part of Morrow series of the midcontinent section.

Named for Hale Mountain, Washington County, Ark.

Hales Limestone[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1933, Nevada Univ. Bull., v. 27, no. 3, p. 15.

Named for Hales shaft of Tybo mine, northern Nye County.

Half Dome Quartz Monzonite[1] (in Tuolumne Intrusive Series)

Cretaceous: East-central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 126, map.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2121, 2122, 2123 (fig. 1). Discussed in paper dealing with potassium-argon dating of igneous rocks. Age given as 84.1 millions of years. Younger than Sentinel granodiorite and older than Cathedral Peak granite.

Named for fact that it composes Half Dome in Yosemite National Park.

Halfway horizon (in Duchesne River Formation)[1]

Eocene (Duchesnean): Eastern Utah.

Original reference: J. L. Kay, 1934, Carnegie Mus. Annals, v. 23, p. 357–359.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 21, pl. 1. Overlies Randlett horizon; underlies Lapoint horizon. Eocene (Duchesnean).

Well exposed along Halfway Hollow, basin which drains that district in Tps. 4 and 5 S., Rs. 19 and 20 E. Salt Lake meridian, Uintah County.

Halgaito Tongue or Member (of Cutler Formation)[1]

Halgaito Formation (in Cutler Group)

Permian: Northeastern Arizona and southeastern Utah.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1420, 1423, 1424, 1441, 1443, 1446.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2054, cross secs. Chart of new terminology shows Halgaito formation in Cutler group; underlies Cedar Mesa formation; overlies Rico transition facies. Pennsylvanian and Permian.

Well exposed near Halgaito Spring, southwest of Mexican Hat (Bluff post office), Utah, but between Lees Ferry and Kayenta, Ariz.

Halifax Chlorite Schist[1]

Upper Cambrian(?) : Southeastern Vermont.

Original reference: George D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 288–291, map.

Probably named for development in Halifax Township, Windham County.

Hall cyclothem (in McLeansboro Group)

Hall cyclothem (in Modesto-Bond Formation)

Pennsylvanian: Northern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 16 (fig. 2). Pennsylvanian succession between the Gimlet and La Salle cyclothems, exposed in upper Illinois valley, contains several prominent but thin limestones which are basis for recognition of incomplete cyclothems to which the names (ascending) Turner, Hicks, and Hall have been applied by H. B. Willman.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Includes Hall limestone. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Modesto-Bond formations (both new). Above Hicks cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: NW¼SW¼ sec. 33, T. 16 N., R. 11 E., Bureau County.

Hall Limestone Member (of Bond Formation)

Hall Limestone (in McLeansboro Formation)

Hall Limestone (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (col. 29). Shown on correlation chart as limestone in McLeansboro formation. Occurs below La Salle limestone and above Hicks limestone (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Shown on correlation chart as limestone in McLeansboro group. Included in Hall cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1). Reallocated to member status in Bond formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NW¼SW¼ sec. 33, T. 16 N., R. 11 E., Bureau County.

Hall Canyon Formation[1]

Pleistocene, lower: Southwestern California.

Original reference: J. E. Eaton, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 2, p. 111–151.

J. E. Eaton, 1943, California Div. Mines Bull. 118, pt. 2, p. 204, 205 (fig. 86) [preprint 1941]. Shown as unconformably overlying Barlow Ranch [beds].

T. L. Bailey, 1943, Geol. Soc. America Bull., v. 54, no. 10, p. 1557. Name abandoned in Hall Canyon, the type section of the Pleistocene of Ventura Basin.

Best exposed in Hall Canyon, Ventura Basin.

Hall Canyon Member (of Oquirrh Formation)

Pennsylvanian (Morrowan) : Utah.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 94–100, pls. 1, 2. Consists essentially of 915 feet of bioclastic and crystalline limestones which are black, dark gray, and medium brown gray; a massive, in part cherty, crystalline, and bioclastic limestone bed that is commonly 40 to 50 feet thick comprises uppermost unit of member. Conformably underlies Meadow Canyon member (new) ; overlies Manning Canyon shale; contact commonly transitional.

Type locality: Eastern ½ sec. 19, T. 5 S., R. 3 W., Tooele County. Named for outcrops in Hall Canyon.

Hall City Limestone[1]

Carboniferous: Northern California.

Original reference: J. S. Diller, 1903, Am. Jour. Sci., 4th, v. 15, p. 342–362.

Hall City mines, Klamath Mountains.

Hallett Formation or Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series) : Northeastern Oklahoma.

C. C. Branson, 1956, Oklahoma Geology Notes, v. 16, no. 11, p. 122–125. Name given to predominantly shale sequence from top of Bird Creek limestone to base of Wakarusa limestone. Thickness about 105 feet. Name credited to P. B. Greig (unpub. thesis).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 50–53, pl. 1. Thickness 105 to 110 feet. Overlies Bird Creek limestone; underlies Wakarusa limestone. Equivalent section in Kansas contains nine subdivisions, none of which can be identified in Pawnee County. In Wabaunsee group.

Type section: Exposed south of village of Hallett, Pawnee County.

Hallian Stage

Pleistocene: Southern California.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. Uppermost of four stages, based on foraminiferal assemblages, in Pliocene and Pleistocene of southern California. Occurs above Wheelerian stage; division between the two is within the upper Pico or "Mud Pit shale". Upper Hallian is marine part of series of coarse sediments sometimes referred to as the Saugus in the Ventura area. [Saugus is considered Pliocene and Pleistocene.] Chart shows Hallian as wholly Pleistocene.

Hall Lake Member (of McRae Formation)

Upper Cretaceous and Tertiary(?) : Southwestern New Mexico.

H. P. Bushnell, 1955, Compass, v. 33, no. 1, p. 11 (table), 14–16. Mainly purple, maroon, and chocolate-brown shales among which are interspersed purple, maroon, olive, buff, or gray sandstone and a few purple conglomerate beds. Occasional nodular limestone beds distributed through section. Shale units generally thick and make up as much as 80 percent of section at type locality. A few conglomerate beds scattered

throughout member. Total thickness measured at type locality is 1,660 feet where an additional estimated 1,200 feet of section are covered by water of the lake. Conformably overlies Jose Creek member (new).

Type locality: On east shore of Hall Lake, northeast of Elephant Butte and south of McRae Canyon, Sierra County. Named from Hall Lake, which is formal name of lake backed up by Elephant Butte Dam. Crops out widely in McRae Canyon area and in Jornada del Muerto.

Halloran Complex

Precambrian: Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 499–500. Includes, in order of age, metasediments, variable altered and granitized diorite, and variably altered granite.

Named for exposures in the area of about 40 square miles of small mountains extending from vicinity of Halloran Spring westward to north of Silver Lake village, San Bernardino County. Best and most typical exposures occur in vicinity of Silver Lake; complex might better be named for that locality, but name is preoccupied.

Halloran Spring Complex

See Halloran Complex.

Hallowell Member (of Cobourg Formation)

Middle Ordovician (Mohawkian): Southern Ontario, Canada, and northern New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 278–280, pl. 4. Lower Cobourg limestone of earlier reports. Lower part lithologically similar to underlying Sherman Falls formation. Upper part composed of gray medium- to coarse-textured massive limestone with very few intercalated shales; contrasts with more argillaceous Hillier member (new) above. Thickness about 100 feet.

Type section: At Picton, Hallowell Township, Prince Edward County, Ontario.

Halls Diorite Porphyry

Miocene, middle or upper: Northwestern Oregon.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 10. Varies from fine-grained purple-gray porphyry at the contact to a medium-grained almost white porphyry containing hornblende and plagioclase phenocrysts. Intrudes Sardine lavas.

Exposed in a roughly rectangular area of about 1 square mile in North Santiam River gorge; southeastern contact is approximately 1,000 feet east of Halls siding, Marion County.

Hall Summit Formation

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

Grover Murray, Jr., 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941–942. Youngest of three named divisions of Midway sediments that crop out in northwestern Louisiana and outline the highest structural portion of Sabine uplift. Consists of basal sand member, middle lignitic shale member, and upper calcareous member. Overlies Logansport formation (new).

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Includes (ascending) Loggy Bayou, Grand Bayou, and Bistineau members (all new).

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 58–60; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 127–129, pl. 10. Maximum thickness more than 300 feet in northern Sabine Parish; thins to north and west to an estimated 150 feet in Shelby County, Tex. Underlies Marthaville formation; overlies Logansport formation; both contacts gradational. Paleocene. Type locality designated.

Type locality: Exposures in vicinity of village of Hall Summit in T. 14 N., R. 9 W., Red River Parish, La.

Hamakua Volcanic Series

Tertiary, upper(?) and Quaternary: Hawaii Island, Hawaii.

G. A. Macdonald, 1945, Am. Jour. Sci., v. 243, pt. 1, no. 4, p. 211–217. Chiefly olivine basalts with a few intercalated thin ash beds. Greatest exposed thickness 650 feet. Unconformably underlies Laupahoehoe volcanic series (new).

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 152–157, 195. Separated into two members: Lower consists largely of olivine with abundant primitive picrite-basalt; upper largely olivine basalt but associated with it are andesites and picrite-basalts of augite-rich type. Underlies Pahala ash. Type section described in detail.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 85. Late Tertiary(?) and Quaternary.

Type section: Southern wall of Laupahoehoe Gulch. Named for exposures along Hamakua coast, northwest of Hilo, where it is well exposed in sea cliffs and in walls of large gulches.

†Hambergian series[1] or Hamburgian[1]

Upper Cambrian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 79.

Hambre Sandstone (in Monterey Group)[1]

Miocene, middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. A. Hall, Jr., 1958, California Univ. Pub. Geol. Sci., v. 34, no. 1, p. 20, fig. 2, geol. map. Thickness about 500 feet in Pleasanton area. Conformably overlies Tice shale; conformably underlies Briones formation with contact gradational in most places. In Concord quadrangle, separated from Briones by Rodeo shale. In Pleasanton area, lower member of Briones is generally interbedded with brown silty shale layers ranging from 10 to 20 feet in thickness. It is possible that, from Concord quadrangle, the Rodeo grades laterally into interbedded sandstone and shale of Hambre and Briones in Pleasanton area. Upper Miocene. Term Monterey group not considered appropriate in this area.

Named for exposures along Arroyo del Hambre, Concord quadrangle, Contra Costa County.

†Hamburg Beds[1] or Clays[1]

Upper Cretaceous: Western South Carolina.

Original reference: E. Sloan, 1904, South Carolina Geol. Survey, ser. 4, Bull. 1, p. 68, 72–75.

Named for exposures at Hamburg, Aiken County.

Hamburg Limestone[1] or Dolomite

Middle and Upper Cambrian: Eastern Nevada.

Original reference: Arnold Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 255–259.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geol. and Mining Ser., no. 31, p. 25–26, 30, fig. 3. Referred to as Hamburg dolomite. Composed of light-gray coarsely crystalline limestone, dolomitic limestone, and dolomite that has been badly shattered and filled with calcite stringers. Thickness 900 to 1,225 feet. Underlies Dunderberg shale; overlies Secret Canyon shale. Locally in fault contact with Eldorado formation. Upper Cambrian.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 15 (fig. 2), 16–18. Hamburg dolomite described in vicinity of Eureka. Overlies Clarks Spring member (new) of Secret Canyon shale; underlies Dunderberg shale. Middle and Upper Cambrian. Type locality noted.

Type locality: At Hamburg mine in southern branch of New York Canyon, Eureka district.

Hamburg Member (of Hannibal Formation)

†Hamburg Oolite (in Kinderhook Group)[1]

Mississippian: Southwestern Illinois.

Original reference: S. Weller, 1906, St. Louis Acad. Sci. Trans., v. 16, p. 464–467.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 15. In Carlinville quadrangle, Hannibal formation consists of Hamburg and Maple Mill members. Hamburg member is 72 to 87 feet thick. Conformably underlies Maple Mill member; separated from underlying Louisiana limestone by sharp unconformity.

Named for occurrence at Hamburg, Calhoun County.

†Hamburg Shale[1]

Upper Cambrian: Eastern Nevada.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 255–256.

Well exposed opposite Hamburg and Dunderberg mines and in ravine north of Adams Hill, Eureka district.

Hamburg Slate[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weldman, 1907, Wisconsin Nat. History Survey Bull. 16, p. 61.

In Berlin and Hamburg Townships, Marathon County.

†Hamburg Mountain Gneiss[1]

Hamburgh Mountain Gneiss Series

Precambrian: Northern New Jersey.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 439.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 468. Hamburgh Mountain gneiss series is oldest in sequence of metasedimentary and metavolcanic rocks in Franklin-Sterling area. Thickness unknown because of intrusion by Byram gneiss; probably more than 2,000 feet. Older than Franklin marble.

Type locality not given but town of Hamburg is in Sussex County.

Hamden Limestone or Member (of Allegheny Formation)[1]

Hamden limestone member

Pennsylvanian (Allegheny Series): Southeastern Ohio.

Original reference: Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 173.

R. C. Moore and others, 944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 10). Shown on correlation chart as limestone in Allegheny series.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 46, 47, table 1. Hamden limestone included in Lower Kittanning cyclothem, Allegheny series, although not well represented in Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 66. Hamden limestone member of Strasburg cyclothem in report on Athens County. Stout and others (1923, Ohio Geol. Survey, 4th ser., Bull. 26) described in Oak Hill underclay a carbonate zone consisting of limestone, ferruginous limestone, and (or) ironstone. Restudy of type Hamden has revealed that the member is nonmarine and not marine limestone as Stout (1918) intimated and that it belongs to Oak Hill underclay and not to marine shale and limestone overlying Lower Kittanning coal. In this report, name Hamden is restricted to limestone and ironstone member associated with Oak Hill underclay. Thickness about 2 feet. Allegheny series.

Named for its occurrence at stratigraphic horizon of Hamden iron ore of southern Vinton and northern Jackson Counties.

Hamilton Group[1] or Formation

Hamilton Member (of Romney Shale)

Middle Devonian: New York, Indiana, Maryland, New Jersey, Pennsylvania, Virginia, and West Virginia.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 380.

Bradford Willard, 1937, Am. Jour. Sci., 5th, v. 33, no. 196, p. 264–278. Term Hamilton group is here expanded to include all of the Middle Devonian, that is, all beds from subjacent Oriskany formation to superjacent Portage group. This use makes Hamilton synonymous with Middle Devonian. Although number of subdivisions recognized increases from Maryland to New York, three important divisions are almost everywhere present. At

base is Onondaga, above is Marcellus, and upper part is Mahantango or its equivalent, the "Hamilton" of Maryland Survey and earlier writers. Group is discussed in New York, New Jersey, Pennsylvania, and Maryland.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 132–136, 161–200. Term Hamilton group has been used as synonymous with Middle Devonian. Validity of this usage is questioned. Group is restricted at base to exclude Onondaga group. In Pennsylvania, group includes Marcellus formation below and Mahantango formation above. New York terms Skaneateles, Ludlowville, and Moscow are retained as facies of Mahantango formations. Erian stage.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1055–1072. Hamilton group in Indiana comprises (ascending) Speeds, Deputy, Silver Creek, Swanville, and Beechwood formations. Overlies Jeffersonville formation of Onondaga; underlies New Albany shale. Terms Sellersberg and Sellersberg beds, as they have been used, are each equivalent to term Hamilton group as used in this paper.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 42, 235–279. Hamilton beds (in Coxsackie quadrangle) include (ascending) Bakoven shale (Marcellus "black shale"), Mount Marion beds, Ashokan shales and flags, and Kiskatom beds.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 308–311. In West Virginia, it is not advisable to differentiate members within what has been previously called Hamilton and what, therefore, corresponds to post-Marcellus Hamilton of New York and Pennsylvania. Hamilton can be used in either, but not both, of two ways. It can be retained in its original West Virginia use, which is for interval between Marcellus shale and Tully limestone, in which case it is not available for group name to include the Marcellus. If used as a group name, it would be necessary to have a new name for post-Marcellus, pre-Tully beds. Name Erie (Erian) group is used for Marcellus-Hamilton group of this report.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1). Group in Albany County comprises (ascending) Bakoven shale, Mount Marion formation, Ashokan formation, and Kiskatom formation. Underlies Onteora formation; overlies Onondaga limestone.

A. J. Mozola, 1951, New York State Water Power and Control Comm. Bull. GW–26, p. 10 (table 3). Group in Seneca County comprises (ascending) Marcellus, Skaneateles, Ludlowville, and Moscow shale. Underlies Tully limestone; overlies Onondaga limestone.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 88. Member of Romney shale in Maryland. Overlies Marcellus shale member; underlies Jennings formation.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3–4. Group, in east-central Pennsylvania, includes Montebello and Sherman Ridge (new) formations. Mahantango formation embraces that part of Hamilton group above Marcellus formation and below Susquehanna group in west-central Pennsylvania.

Named for Hamilton, Madison County, N.Y.

Hamlin Shale[1] Member (of Janesville Shale)

Hamlin Shale (in Admire Group)

Permian: Southeastern Nebraska and eastern Kansas.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg.] March 21–23: Wichita; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 8–9.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Rank reduced to member of Janesville shale (new). Locally contains Houchen Creek limestone bed [also Oaks shale bed and Stine shale bed]. Uppermost member of Janesville; overlies Five Point limestone member. Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 51–52, pl. 2. Hamlin shale member described in Wabaunsee County, Kans. Strata now known as Hamlin shale member was included in West Branch shale by Condra (1927) in his reclassification of Admire shale of Adams (1903). Moore, Elias, and Newell (1934) included Stine shale, Houchen Creek limestone, and Oaks shale as members of Hamlin shale. Moore and Mudge (1956) reduced Hamlin to rank of member. Herein suggested that Houchen Creek limestone bed be used as formal name. Recent field work has shown that this bed of Hamlin shale could not be correlated south of Pottawatomie County. Hamlin consists of silty to clayey shales, beds of sandy shale and sandstone, and beds of siltstone, limestone, and conglomerate. Thickness 35 to 45 feet. Overlies Five Point limestone member; underlies Americus limestone member of Foraker limestone.

Type locality and derivation of name not given; Hamlin was included in section from Forest City, Mo., to Dubois, Nebr.

Hammar Bluff Formation[1]

See **Hammer Bluff Formation,** correct spelling.

Hammer Bluff Formation

Miocene: Western Washington.

Original reference: S. L. Glover, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 77–78

D. R. Mullineaux, L. M. Gard, and D. R. Crandell, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 3, pt. 1, p. 692–694. Crops out in both valley walls of Green River. On south side of river, consists of about 100 feet of brown to greenish-gray sandy montmorillonitic and kaolinitic clay and clayey sand; near base of section is about 20 feet of cross-bedded pebble gravel underlain by 7 feet of gray kaolinitic quartz sand. Logs as large as 1½ feet in diameter and 15 feet long are scattered throughout the sand and gravel. On north side of river, formation consists of more than 25 feet of quartz sand and kaolinitic plastic clay which contains a layer of woody lignite 2 to 3 feet thick; sand and gravel are overlain by more than 30 feet of brown to greenish-brown sand and pebble gravel. Unconformably overlies sandstone of Puget group; unconformably underlies glacial drift of Orting(?) age. Miocene. Name has been spelled Hammar Bluff.

Named for occurrence near Hammer Bluff, a few miles east of Auburn, King County.

Hammett Shale

Lower Cretaceous: Southeastern Texas (subsurface and surface).

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 69; J. R. Sandige, chm., 1956, Gulf Coast Assoc. Geol. Soc. Guide Book Ann. Mtg. Field Trip, p. 12–13, fig. 5. Name applied to unit between Sycamore sands below and Cow Creek limestone above. Where exposed, lower 20 feet consists of buff-colored shales, dark when fresh, with thin fossiliferous limestone at base. Remaining 40 to 45 feet, as revealed in cored section, is largely shale with fine sand streaks in base and middle, latter associated with a bed of small clams; uppermost part contains fossiliferous dolomitic limestones. Cow Creek boundary is transitional, arbitrarily determined at base of lowermost well-developed limestone; lower contact is surface of disconformity marked sporadically by pebble and boulder layer immediately above top of Sycamore.

Type section: Completely cored section at Hamilton Pool core holes 1 and 2. Name derived from Hammett Crossing, about 1 mile west of Hamilton Pool in western Travis County.

Hammond Fire Clay (in Kanawha Formation)[1]

Hammond Fire Clay (in Kanawha Member of Pottsville Formation)

Pennsylvanian: Northeastern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 369.

J. B. McCue and others, 1948, West Virginia Geol. Survey [Rept.], v. 18, p. 18. Hammond clay occurs about 90 feet below top of Pottsville.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 23 (table 6). Listed as clay in Kanawha member of Pottsville.

W. A. Tallon, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 17. Hammond clay grades downward into horizon here named Bessemer clay.

Named for Hammond, Marion County.

Hammondville Gneiss[1]

Precambrian: Eastern New York.

Original reference: D. H. Newland, 1908, New York State Mus. Bull. 119, p. 43–50.

Occurs at Hammondville mines, Crown Point Township, Essex County.

Hampden Basalt (in Newark Group)

Hampden Diabase (in Newark Group)[1]

Hampden Lava Member (of Meriden Formation)

Upper Triassic: Central Massachusetts and central Connecticut.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Rank reduced to member status in Meriden formation. Greenish-black rock, weathering

bright orange, grading from basalt near contacts to coarse dolerite in interiors. Interior parts are massive and commonly show good columnar jointing; upper parts are commonly vesicular, and upper and lower parts may show flow brecciation. Separated from underlying Holyoke lava member by unnamed upper sedimentary member; underlies Portland arkose.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 495. Diabase is included in Granby tuff and mapped as an unnamed unit.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 6–25 pl. 1. Term Meriden formation not used in this report [Middleton quadrangle]; rock units involved are given formational status. Newark group comprises (ascending) New Haven arkose, Talcott basalt, Shuttle Meadow formation (new), Holyoke basalt, East Berlin formation (new), Hampden basalt, and Portland arkose. Hampden basalt is exposed in series of low ridges trending generally north across center of quadrangle and in northwest corner. Belt of outcrop has been offset and repeated by faulting. Width of outcrop belt is variable, ranging from 600 feet in northwest corner of quadrangle where dip of basalt is at maximum (17° to 20°) to about 3,500 feet in Miramichi area west of Middleton where low dip (7° to 8°) of Hampden and topography combine to widen belt.

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Described in Avon quadrangle, Connecticut, where it is probably 150 to 200 feet thick, neither upper or lower contact exposed.

Crops out across Hampden County, Mass.

Hampshire Formation[1]

Upper Devonian: Eastern West Virginia, western Maryland, Pennsylvania, and western Virginia.

Original reference: N. H. Darton, 1892, Am. Geologist, v. 10, p. 13, 17, 18.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1993–1994; H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 497–529. Inasmuch as redbeds of Catskill Mountains of New York have been determined to be of Portage and Hamilton age, it seems unwise further to apply name "Catskill" in Appalachian region to redbeds that are post-Chemung. Name Hampshire formation, applied by Darton to exposure of this series in Hampshire County, is here revived for rocks previously called "Catskill" in West Virginia. Term also applies to unit previously called "Catskill formation" by Maryland Geological Survey. Formation is well developed along the Potomac where it attains maximum thickness of about 3,000 feet in Morgan and Hampshire Counties; thins westward and southward. Includes red and green sandstones and shales which overlie Chemung formation and occur below beds of "Pocono" facies, either highest Devonian or lowest Mississippian.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Described in Hollidaysburg and Huntingdon quadrangles, Pennsylvania. Thickness 2,000 to 2,500 feet. Overlies Chemung formation; underlies Pocono formation.

Named for Hampshire County, W. Va.

†Hampton Clays[1]

Pleistocene: Coastal Plain of South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20.

Probably named for development in Hampton County.

Hampton Formation[1]

Mississippian (Kinderhook): Central northern and southeastern Iowa.

Original reference: L. R. Laudon, 1930, Geol. Soc. America Bull., v. 41, p. 174.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 68, 69). Correlation chart shows Hampton formation including (ascending) Chapin beds, Maynes Creek limestone, Eagle City beds, and Iowa Falls members in north-central Iowa where it underlies Gilmore City limestone and overlies English River sandstone. In southeastern Iowa, includes North Hill beds below and Wassonville limestone. Underlies Burlington limestone and overlies English River sandstone. Kinderhook. [Laudon, 1935, restricted Hampton by excluding North Hill member and part of Chapin beds.]

Named for exposures at Hampton, Franklin County.

Hampton Granodiorite[1]

Devonian(?): Southeastern New Hampshire.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 148, 149.

Probably named for exposures at Hampton or in Hampton Township, Rockingham County.

Hampton Shale[1] or **Formation** (in Chilhowee Group)

Lower Cambrian(?): Eastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: M. R. Campbell, 1899, U.S. Geol. Survey Geol. Atlas, Folio 59, p. 3.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 35–37, pls. Consists of beds between Erwin above and Unicoi below. Composed of alternating beds of clay shale, siltstone, vitreous quartzite, and arkosic quartzite. Thickness commonly 1,200 to 1,400 feet. On Embreeville Mountains, formation may be as much as 2,500 feet thick. In sections southeast of Hampton, about 500 feet thick. No consistent sequence of members present. Amount of shale varies from place to place, and few shale bodies are consistent. No part of section can be set off as unit to be designated "Hampton shale." No specific type section was designated, but formation crops out along Doe River both northwest and southeast of Hampton. Sections at the two places are of unlike character. That to northwest is on Shady Valley thrust sheet and is typical of formation in much of region. That to southeast is in Mountain City window and is thinner than elsewhere and less characteristic.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 16–18, pl. 1. In Hot Springs area, formation is subdivided into three members: upper shale, middle quartzite, and lower shale. Contacts are readily mappable, and Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) used

same horizons as formational boundaries between Murray slate and Nebo quartzite and between Nebo and underlying Nichols slate. Thickness 910 to 1,430 feet. Overlies Unicoi formation; underlies Erwin formation. Two sets of names for Lower Cambrian clastic rocks are in use in eastern Tennessee and western North Carolina. Northeast Tennessee names, Unicoi, Hampton, and Erwin, are used for same rocks which Keith (1904) and Stose and Stose (1947, Am. Jour. Sci., v. 245, no. 10) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 19, pl. 1. In this report [Rockingham County], term Hampton formation used in preference to Harpers shale. Estimated thickness 800 to 2,750 feet. Overlies Weverton formation; underlies Erwin (Antietam) quartzite. Cambrian.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28, 32, 40–41, pls. 1, 12. Formation described in northeasternmost Tennessee where it crops out along Doe River both northwest and southeast of Hampton, the two sections being unlike and lying in different structural blocks. Section to northwest is herein designated type locality. Consists of interbedded layers of clay, shale, siltstone, arkosic sandstone, and vitreous quartzite. Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 151) believed that strata between underlying Unicoi and overlying Erwin was single shale unit 100 to 300 feet thick; in many places, he invoked complex faulting to explain wide band of outcrop and apparent repetition of shaly layers within it. As now defined, the Hampton is 1,200 to 1,400 feet thick in area of Holston Mountain and Iron Mountains; appears to thicken to nearly 2,000 feet immediately south of Tennessee-Virginia State line; 500 feet or less in Doe ridges. Nowhere Ridge, and on Doe River southeast of Hampton. In southwestern part of Iron Mountains and Holston Mountain, includes Cardens Bluff shale member (new) at base Chilhowee group. Lower Cambrian.

Type locality: Section to northwest of Hampton, Carter County, Tenn.

Hana Volcanic Series

Pleistocene and Recent: Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 63, 65 (table), 66 (table), 90–102, pl. 1. Comprises all volcanics laid down since the great valleys reached their maximum size. In Nahiku area, includes (ascending) Big Falls picritic basalts. Makapipi basalt, Waiaaka basaltic andesite, Kapaula basaltic andesite, Makaino basaltic andesite, Mossman picritic basalt, Kuhiwa basaltic andesite, Paakea basalt, and Hanawi basaltic andesite; in Keanae area (ascending). Pauwalu basalt, Wailuanui basalt, Ohia basalt, Piinaau basalt, Waiokamilo basalt, and Keanae basalt; in Kipahulu Valley, Kipahulu member. Commonly separated from Kula lavas (new) by erosional unconformity; in deep valley where Kula lavas were probably removed by erosion, Hana lavas lie either on alluvium or on Honomanu basalts (new).

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 238–254, 292–302. Described in Nahiku area. Petrography discussed.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat, Internat., v. 6, Océanie, fasc. 2, p. 86. Pleistocene and Recent. Includes Kaupo mudflow.

Named for village of Hana where typical lavas and cones of series are exposed. Covers three areas: east end, southwest end, and summit depression of Haleakola (East Maui) volcano.

Hanaupah Formation[1] (in Telescope Group)

Precambrian: Southeastern California.

Original reference: F. M. Murphy, 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 355, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Hanaupah formation is correlated with upper part of Johnnie formation here assigned to Precambrian as defined in this report.

Name probably derived from proximity to Hanaupah Canyon, in southern part of Panamint Range.

Hanawi Basaltic Andesite (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 253–254, pl. 1. Aa lava; vertical jointing prominent but not regular enough to be columnar. At highway, visible thickness 30 feet with base not exposed; remnant of Hanawi north of Big Spring is about 100 feet thick, which is probably close to original thickness. Relative ages of Hanawi, Kuhiwa, and Paakea lavas not accurately determined; they are nowhere in contact; their topographic position and degree of erosion are similar, and they are regarded as approximately contemporaneous.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 86. Forms single band along Hanawi Gulch. Completely filled valley south of Koolau ditch but only partly filled it farther north where valley was deeper; Haleakala (East Maui) volcano. Pleistocene(?).

†Hanbury Slate[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

C. A. Lamey and C. E. Dutton, 1941, Michigan Dept. Conserv., Geol. Survey Div. Prog. Rept. 6, p. 10–13. Type locality restudied in 1940. Term Hanbury rejected because of lack of definite age relations at type locality and because of possibility that Hanbury of type locality is a complex of several formations.

Type locality: Hanbury Hill, south of Hanbury Lake, Menominee district.

Hance Formation (in Breathitt Group)

Hance Formation (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky and northeastern Pennsylvania.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 37, 207 pl. 40A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 55, 57, 65–68, 141. Includes strata below Lower Hance coal (Mingo formation) and above Naese sandstone (Lee formation); approximately correlated wih Briceville formation (Tennessee).

U.S. Geological Survey currently classifies the Hance as a formation in the Breathitt Group on the basis of a study now in progress. U.S. Geological Survey does not use the term Pottsville Group in Kentucky.

Named for Hance Ridge, Bell County, Ky.

Hancock Amygdaloid[1] (in Ashbed Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for its occurrence in old Hancock mine, Houghton County.

Hancock Conglomerate[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

Named for exposures in a ravine just east of Hancock mine, Houghton County.

Hancock Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for its occurrence in old Hancock mine, Houghton County.

Hancock Limestone[1] **or Dolomite**

Upper Silurian or Silurian and Devonian: Northeastern Tennessee and western Virginia.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 27, p. 3.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104, sheet 2; 1954, U.S. Geol. Survey Bull. 990, p. 83–86. Hancock dolomite described in Jonesville district, Lee County, Va. Consists of basal pebbly sandstone, overlain by bluish-gray ribbon limestone or mottled limestone; upper part is massive-bedded gray fine-grained dolomite. Formation becomes dominantly limestone at east edge of district. Thickness 168 to 188 feet. As used here, formation includes only beds of Cayugan age. Disconformably overlies Clinton shale; unconformably overlain by Upper Devonian shale.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 103. Hancock limestone in eastern Tennessee consists chiefly of fairly thick-bedded limestone and dolomite, many layers being sandy and a few cherty; some layers, especially at base or where formation is thin, contain so much sand as to grade into calcareous or dolomitic sandstone; some sand carries Lower Devonian fossils. May be more than 300 feet thick locally in

belt on south side of Powell Mountain, but elsewhere is thinner. Occurs above Rockwood formation.

Named for Hancock County, Tenn.

Hancock Member (of Pinney Hollow Formation)

Lower Cambrian: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 55, 57–58, 59. Dark-green albite-epidote-calcite-chlorite schist occurring in middle of Pinney Hollow formation. West of Hancock, thin beds of white quartz-tremolite-calcite granulite are interstratified with schist; locally, thin discontinuous beds of buff-weathering dolomitic marble are present. Thickness approximately 500 feet in vicinity of Rochester and Hancock; thins to about 200 feet toward northern border of Rochester quadrangle.

Named from exposures in Hancock Tunnel. Crops out in Rochester-East Middlebury area.

Hancock West Conglomerate[1] (in Ashbed Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 77, 83, chart.

Probably named for old Hancock mine, Houghton County.

Haney Limestone Member (of Golconda Formation)

Haney Limestone

Mississippian (Chester Series): Southeastern Illinois, southwestern Indiana, and northeastern Kentucky.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 18, 19. New name is needed for the "Golconda" as recognized east of Todd County, Ky., and north into Indiana. Haney limestone is proposed for upper "Golconda." At type section, consists of 12½ feet of moderate-light-gray, yellowish-gray, and light-brownish-gray limestone with oolite near base; 11 feet of shale and limestone; and 7 feet of light-gray to light-olive-gray coarsely crystalline fossiliferous slightly crossbedded limestone. Unit somewhat thin at this outcrop; upper shale reaches maximum of 30 to 40 feet but occurs only as sporadic remnants beneath pre-Hardinsburg unconformity; main Haney limestone is typically 40 to 50 feet thick, with extremes of 20 to 70 feet along south-central border of Illinois basin; oolite increases westward from type section, and an oolite zone has been named Marigold member [oolite] in western Illinois (Sutton, 1934). Underlies Hardinsburg sandstone; overlies Fraileys shale (new) or Big Clifty sandstone.

U.S. Geological Survey currently classifies the Haney Limestone as a member of the Golconda Formation on the basis of a study now in progress.

Type locality: Easternmost exposure of the Golconda in Illinois, on south slope of hill along west edge of NE¼SE¼ sec. 9, T. 12 S., R. 10 E., Cave in Rock quadrangle, Hardin County, Ill. Outcrop faces Ohio River, 4 miles upstream from Cave in Rock, through a gap in bluff made by branch of Honey Creek (not named on topographic map) but locally known as Haney Creek.

†Hanging Rock Limestone (in Allegheny Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 888, 892–895, pls. opposite p. 889, 900, 912, 921.

Named for Hanging Rock district.

Hanging Rock Sandstone[1]

Pennsylvanian: Southeastern Illinois.

Original reference: F. H. Bradley, 1869, Indiana Geol. Survey 1st Ann. Rept., p. 157.

Named for Hanging Rock, on Big Vermilion River, Vermilion County.

Hanging Rock Sandstone[1]

Pennsylvanian: Central western Indiana.

Original reference: A. H. Worthen, 1875, Illinois Geol. Survey, v. 6, p. 51–60.

Hanging Rock bluff, 3 miles northeast of Mount Carmel, Wabash County.

Hanley Sandstone (in Cattaraugus Formation)

Devonian: Northwestern Pennsylvania.

C. R. Fettke, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. M–21, p. 36, 37–38. Name given to fine- to medium-grained dark-reddish- to purplish-gray very fossiliferous sandstone in lower part of formation. Discoidal quartz pebbles sparingly distributed through upper part. Thickness 14 feet. Occurs approximately half way between Salamanca and Wolf Creek horizons. Apparently a local development.

Exposed in shale quarry at Hanley Co. plant, Lewis Run, McKean County.

Hanna Formation[1]

Eocene: Central southern Wyoming.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Prof. Paper 108, p. 228, 231.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 21. Supposedly Paleocene and Wasatchian (Eocene).

Well exposed north and west of town of Hanna, Carbon County.

Hannah Formation

Miocene, lower: Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Divisible into three shaly members separated by two sandstones. Thickness about 2,180 feet. Unconformably underlies Escudo sandstone (new); unconformably overlies Wagonwheel formation.

Occurs in Devils Den oil field district in northwestern Kern County, adjacent to Kings County line, about 40 miles east of Paso Robles and about 60 miles northwest of Bakersfield.

†Hannan Limestone or Formation

Mississippian: Northwestern Montana.

Charles Deiss, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1896. One of nine sedimentary formations identified in Sawtooth Range.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 212 (table 1), 228–231. Name Hannan limestone proposed for all strata which lie between Devonian and Jurassic rocks in Saypo quadrangle. Basal lime-

stone-breccia overlain by gray limestone and alternating units of shaly-bedded argillaceous limestone which grades upward into hard tan- and pale-gray crystalline fossiliferous limestone. Contains much pale-gray chert in nodules and beds as much as 7 inches thick. Upper 200 feet consists of white-gray finely crystalline thin- and thick-bedded dolomite. Thickness 1,370 feet. Disconformably underlies Ellis formation.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1294, 1296. In Swift Reservoir and Sun River sections, unconformably underlies Sawtooth formation (new).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 38). Correlation chart shows Hannan limestone to include (ascending) Saypo limestone, Dean Lake chert, Rooney chert, and Monitor Mountain limestone. Kinderhookian, Osagean, and Meramecian.

J. M. Andrichuk, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85. Assignment of group status to the Madison of northwestern Montana by U.S. Geological Survey precludes any need for term Hannan.

Name taken from Hannan Gulch where Mississippian rocks form crest of both sides of gulch [Teton County]. Almost the complete section of the Hannan is exposed on north side of Sun River Canyon at south end of Castle Reef, which forms east side of Hannan Gulch.

Hanna Valley Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 383.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 74. Clay, about 200 feet thick. Overlies Cottonwood Creek bed; underlies Rough Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Hannegan Volcanics

Tertiary, middle: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 18. The flat-lying Hannegan volcanics are later than any of the folding of the Northern Cascades.

Prominently exposed around Hannegan Pass, Whatcom County.

Hannibal Shale[1]

Hannibal Group

Hannibal Shale (in Easley Group)

Lower Mississippian: Northeastern Missouri, western Illinois and southeastern Iowa.

Original reference: C. R. Keyes, 1892, Geol. Soc. America Bull., v. 3, p. 289.

J. M. Weller, 1948, (abs.) Am. Jour. Sci., v. 246, no. 3, p. 150. In type area in Mississippi Valley, Easley group (new) consists of Hannibal shale and Chouteau limestone and related groups or formations.

L. A. Thomas, 1949, Geol. Soc. America Bull., v. 60, no. 3, p. 410. Lateral tracing by means of well cores and similarity of conodont assemblages indicates that Hannibal formation grades laterally into English River and Prospect Hill siltstones of Iowa. Term Hannibal has priority over English River; therefore English River and Prospect Hill are considered members of Hannibal formation.

M. A. Stainbrook, 1950, Am. Jour. Sci., v. 248, no. 3, p. 209, 210. English River siltstone and Maple Mill shale are not considered members of Hannibal shale.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 20–28. Rank raised to group. Includes formations that lie above Louisiana limestone and beneath the Chouteau. Comprises (ascending) Glen Park siltstone, Maple Mill shale, and English River siltstone. Where the Louisiana is absent, group rests on the Saverton, and where Saverton is absent it lies on Grassy Creek shale. In small area in westernmost Illinois, McCraney formation of North Hill group overlies the Hannibal and where neither the Chouteau nor McCraney is present, the Hannibal is overlain by Osage strata.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 34–39, pl. 1. Formation described in Bowling Green quadrangle where it is 90 to 121 feet thick. Composed of two lithologies: upper siltstone to fine-grained sandstone and lower silty shale. Unconformably overlies Louisiana wherever latter is present; where Louisiana is absent, formation lies unconformably on Saverton. Underlies Chouteau formation; where Chouteau is absent, underlies Burlington formation.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 98, 99. Unconformably overlies Cuivre shale (new) in Pike County, Mo.

Named for exposures at Hannibal, Marion County, Mo.

Hanover Diorite Porphyry

Hanover Granodiorite Porphyry

Upper Cretaceous or younger: Southwestern New Mexico.

Harrison Schmitt, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 780, 782, 784. Incidental mention as diorite porphyry sill. Sills. sheets, and laccoliths of quartz diorite porphyry intruded Colorado shale but are truncated by prominent widespread angular unconformity probably representing early Tertiary (Eocene?) erosion.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 287–288, fig. 3. Granodiorite porphyry is body (stock) of relatively unaltered rock in region of intense mineralization. Generally coarsely crystalline showing prominent phenocrysts of plagioclase, hornblende, and biotite, ranging from porphyritic to granular. Ground mass dense and gray to buff.

Sill in Pewabic mine area, in Central Mining district, near Hanover, Grant County. Stock [approximately 1 mile northwest of Santa Rita in southeast corner of Santa Rita quadrangle].

Hanover Limestone[1]

Hanover Limestone (in Lake Valley Limestone)

Lower Mississippian: Southwestern New Mexico.

Original reference: Harrison Schmitt, 1933, Am. Inst. Mining Metall. Engineers Contr. 39.

Harrison Schmitt, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 780–781, pl. 2. Underlies Parting shale (new) in Pewabic mine area, Hanover.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 7. Appears that Hanover as originally defined included both Kelly and top part of Lake Valley formation.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284. Lake Valley limestone divided into lower blue limestone and overlying crinoidal or Hanover limestone.

H. L. Jicha, Jr., and Christina Lochman-Balk, 1958, New Mexico Bur. Mines Mineral Resources Bull. 61, p. 59. New Mexico Bureau of Mines and Mineral Resources recommends suppression of the name Hanover limestone.

In vicinity of Hanover, in Central Mining district or Santa Rita-Hanover-Fierro district, Grant County.

Hanover Limestone (in Carbondale Group)

Hanover Limestone Member (of Carbondale Formation)

Pennsylvanian: West-central and southern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 22, 85. In type area, irregularly laminated light-gray fairly pure limestone with knobby upper surface; overlies soft dark-gray shale. In Knox County, thinner than in type area and quite glauconitic and sandy with scattered pebbles of dark-gray phosphatic limestone.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 101, 190, 195, 196, 204. Most persistent near Pleasantview, Beardstown quadrangle, where limestone is conglomerate with dark-blue-gray limestone masses in matrix of light-gray limestone. Commonly massive, but in thickest exposures shows rude bedding. Thickness 1 to 4 feet near Pleasantview but 6 inches or less elsewhere. In most exposures, unconformably underlies St. David underclay and underclay limestone. Included in Summum cyclothem. Name credited to J. R. Pelt (1928, Illinois Geol. Survey field notes).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 47 (table 1), 66, pl. 1. Rank reduced to member status in Carbondale formation (redefined). Occurs above Summum (No. 4) coal member and below Harrisburg (No. 5) coal member. Thickness 10 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NE¼SW¼ sec. 27, T. 10 N., R. 11 W., Greene County.

†Hanover Pebble Bed (in Cuyahoga Formation)

Mississippian: South-central Ohio.

J. E. Hyde 1953, Ohio Geol. Survey Bull. 51, p. 98. Name applied by Hyde in 1910 manuscript to unit now termed Berne member of Cuyahoga formation. Described as thin pebble bed capping massive conglomerates of Toboso conglomerate province of the Cuyahoga. In Licking County, can be traced westward to beyond Newark where it overlies Cuyahoga shales of Granville province. Bed cannot be traced from outcrop to outcrop in Hocking Valley area.

Named from exposures near Hanover, Licking County.

Hanover Shale Member (of Java Formation)

Hanover Shale[1]

Hanover Shale Member (of Chemung Formation)

Upper Devonian: Western and west-central New York.

Original references: C. A. Hartnagel, 1912, New York State Mus. Handb. 19, p. 76; G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, p. 96, 98, 193, 198, 199, 357.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 37. In western and central New York, includes Pipe Creek shale member at base. Eastward, intertongues with siltstone of Wiscoy sandstone. Underlies Dunkirk shale; overlies Angola shale in west and Nunda sandstone in east.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. In area between Dunkirk, Chautauqua County, and Franklin Gulf, Erie County, Hanover shale underlies Dunkirk, member of Perrysburg formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1). Considered member of Chemung formation.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Chart OC–55. Overlies Angola shale member of West Falls formation (new).

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1934, 1935 (fig. 2). Redefined as member of Java formation (new). Consists largely of medium to medium-greenish-gray slightly calcareous shale and blocky weathering mudrock. East of central Wyoming County, Wiscoy sandstone member of Java separates Hanover member from Dunkirk shale member of Perrysburg.

Type exposure on Silver Creek, Hanover Township, Chautauqua County.

Hanoverian series[1]

Cambrian: Iowa.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 65, no. 4, p. 315.

Named for township in Allamakee County.

Hans Lollik Formation (in Virgin Island Group)

Upper Cretaceous: Virgin Islands.

T. W. Donnelly, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Minimum thickness 10,000 feet. Poorly exposed either the youngest unit present or equivalent to Louisenhoj formation (new), which it resembles lithologically, and faulted into place. Virgin Island group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Hanson Beds

Silurian: Subsurface in northwestern North Dakota and northeastern Montana, and surface and subsurface in southern Manitoba, Canada.

Saskatchewan Geological Survey, 1958. Report of the Lower Paleozoic names and correlations committee: Saskatchewan Geol. Soc., p. 14, 15, charts A and B. Uniformly pale-colored microcrystalline and lithographic dolomites with interbedded porous dolomitized fossiliferous-fragmental and ostracodal limestones. Occasional dark-colored argillaceous dolomites and shale seams. Basal anhydrite in central part of Williston Basin. Depositional thickness ranges from 300 to 365 feet. Underlies Risser beds (new) with possible unconformity; variably truncated by pre-Middle Devonian unconformity beyond edge of Risser beds.

Type locality: Amerada No. 3-C. Hanson (center SW¼NW¼ sec. 18, T. 158 N., R. 94 W., Montrail County, N. D.) between 11,825 and 12,165 feet; Williston Basin, N. Dak.

Hansonburg Group

Pennsylvanian (Missouri Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 63–65. Proposed for group of rocks in upper part of Missouri series between top of Veredas group (new) and base of Keller group (new) of Virgil series above. Includes Burrego (base) and Story formations (both new). Thickness ranges from 115 feet at type locality to more than 200 feet in Mocking Bird Gap. With the exception of interval of red shale, sandstone, and gray shale from 38 to 57½ feet below top, type section consists entirely of light-gray to purple massive to nodular limestones.

Type locality: On northeast side of Oscura Mountains, on north bluff of large arroyo that drains northwest past Julian Tank, in and near east part of SE¼ sec. 31, T. 5 S., R. 6 E., Socorro County. Name derived from Hansonburg, headquarters of Bursum Ranch, about 5 miles east of north end of Oscura Mountains.

Hanson Creek Formation

Middle(?) and Upper Ordovician: Central Nevada.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 10–11, pl. 1; C. W. Merriam and C. A. Anderson, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1681 (table 1), 1685–1686. Lowest calcareous member of formation is dark-gray to blackish medium-grained poorly stratified dolomitic limestone containing small crinoid stems and irregular calcite veins—about 40 feet thick at type section; grades upward into very fine-textured poorly bedded noncrinoidal medium- to dark-gray limestone with many calcite veinlets and small black chert nodules —about 45 feet; above is 140 feet of thin-bedded slabby and shaly very fossiliferous limestone; succeeding 140 feet is dark-gray poorly stratified limestone; upper 180 feet is massive dark-gray fine-grained limestone. Thickness at type locality 560 feet. Overlies Eureka quartzite with probable unconformity; underlies Roberts Mountains formation (new). Formerly included in lower part of Lone Mountain limestone.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 32–34. In sections east of Eureka, Roberts Mountains formation appears to be absent, and interval between Hanson Creek and strata of Devonian age is occupied by thick-bedded poorly fossiliferous dolomites that have been included within Lone Mountain dolomite. Thickness 318 feet at Lone Mountain; 300 feet in Antelope Valley.

Type section: Northwest side of Roberts Creek Mountain and crosses east fork of Pete Hanson Creek, about 24 miles northwest of Eureka and 20 miles north of Lone Mountain.

Happy Hollow Limestone Member (of Scranton Shale)[1]

Happy Hollow Limestone (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, southeastern Nebraska, and northeastern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, p. 40, 58.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 211–212. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Overlies White Cloud shale; underlies Cedar Vale shale. Thickness 1 to 8 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Rank reduced to member of Scranton shale here reintroduced a formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Overlies White Cloud shale member; underlies Cedar Vale shale member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 14, fig. 5. Formation in Wabaunsee group. Poorly exposed in Iowa. In limited exposure in Adams County, a fine-grained sandy limestone that weathers yellowish is tentatively identified as Happy Hollow. In drill hole near Coin, unit is about 2 feet thick. Underlies Cedar Vale shale; overlies White Cloud shale.

Type locality: Vicinity of Happy Hollow ravine, below mouth of Big Nemaha River, southeast of Rulo, Richardson County, Nebr. Moore (1936) gave type locality as Happy Hollow Creek, northeastern Doniphan County, Kans.

Haragan Shale[1] or **Limestone** (in Hunton Group)

Haragan Formation (in Kite Group)

Lower Devonian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1911, Am. Jour. Sci., 4th, v. 32, p. 256–258.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 132–134. Basal formation in Kite group (new). Underlies Cravatt limestone (new); overlies Henryhouse formation. Helderbergian.

T. W. Amsden, 1947, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7, 35–38. Formation (in Hunton group) is fossiliferous, argillaceous, and silty calcilutite which is here called marlstone. It is thin bedded, the beds ranging up to 3 or 4 inches in thickness and commonly weathering with irregular, nodular appearance. Maximum thickness is in vicinity of old Hunton townsite where there is 230 feet of strata between Chimneyhill and Bois d'Arc formations; however, this includes a 100-foot covered interval just above Clarita member (new) of Chimneyhill formation and this could be in part Henryhouse. Thins to north, and on Lawrence uplift is only a few feet thick; in area of Wapanucka, largely replaced by Bois d'Arc cherty beds; in belt extending west to Reagan, the Haragan is thin or absent; thickness about 50 feet in most westerly area studied. Variation in thickness is probably result of its facies relationship with Bois d'Arc formation. Henryhouse and Haragan have been studied at numerous places, and no reliable field criterion, other than fauna, has been found for separating the two and in this report they are grouped under term Hunton marlstone. Reeds named Haragan from small creek in SW¼ sec. 17, T. 2 S., R. 3 E., short distance northwest of White Mound. This is good type area because formation is well exposed and is about 100 feet thick. Type section designated.

T. W. Amsden, 1958, Oklahoma Geol. Survey Bull. 82, p. 7–13. Stratigraphic and faunal evidence indicate that entire Bois d'Arc formation is facies of Haragan formation. Base of Bois d'Arc formation arbitrarily placed at base of lowest cherty bed of any appreciable thickness. Defined in this manner, the Haragan is almost chert free.

T. W. Amsden, 1958, Oklahoma Geol. Survey Bull. 78, p. 9–144. Formation conformably overlain by Cravatt member of Bois d'Arc formation, which is lithologically much like Haragan, being thin-bedded yellowish-gray argillaceous calcilutite. Cravatt carries varying amounts of chert, and on this basis Bois d'Arc is distinguished from Haragan. Formation carries prolific and well-preserved Lower Devonian fauna. Present report is study of Haragan articulate brachiopods.

Type section: SE¼NE¼ sec. 20, T. 2 S., R. 3 E., Carter County. Named for exposures on Haragan Creek.

Harbison Meta-Granodiorite

Age not stated: Northern South Carolina.

S. D. Heron and J. W. Clarke, 1958, South Carolina Div. Geology Mineral Industries Lab. Bull. 2, no. 10, p. 69–75. Medium-gray meta-granodiorite characterized by small phenocrysts of feldspar embedded in fine-grained ground mass. Surrounding rocks are felsic varieties of Carolina slate.

Occurs in small pluton, mostly in Irmo quadrangle, near Columbia. Named for occurrence in Harbison State Forest.

Harbison Quartz Diorite[1]

Late Mesozoic: Southern California.

Original reference: W. J. Miller, 1935, Calif. Jour. Mines and Geology, v. 31, no. 2, p. 115–141, map.

W. J. Miller, 1946, Geol. Soc. America Bull., no. 5, table 4. Shown in plutonic sequence as younger than Alpine quartz diorite and older than Descanso granodiorites.

Type is in north part of Harbison Canyon, Peninsular Range, San Diego and Imperial Counties.

Harbor Hill Stade, Drift

Harbor Hill Substage[1]

Pleistocene (Wisconsin): Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, pl. 1, map.

U.S. Geological Survey currently recognizes the term Harbor Hill Drift for till and associated outwash from Harbor Hill moraine.

Named for the fact that gravels occur at Harborhill, near Roslyn, Long Island.

Hardesty Shale[1]

Pennsylvanian: Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 93, 97.

Derivation of name not stated.

Hardgrave Sandstone[1]

Lower Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map 1–175. Age shown as Lower Jurassic.

Named for exposures on Hardgrave's Ranch, near Taylorsville, Plumas County.

Hardgrave Tuff[1]

Middle Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Mount Jura.

Hardin Sandstone Member (of Chattanooga Shale)[1]

Hardin Sandstone Member (of Dowelltown Formation)

Upper Devonian: Western Tennessee and northern Alabama.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 136, 137.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 881, 891, 892, 894. Basal member of Dowelltown formation (new). Fine-grained gray to black sandstone that weathers yellow or brown. Reaches maximum thickness of 16 feet in vicinity of Olive Hill and from there thins in all directions; 2 feet at Iron City, southwest Lawrence County; 1 to 3 feet in southern Hardin County; 1½ to 3 feet along Tennessee River; 7 to 10 feet northward from Olive Hill to near Wayne-Perry County line and eastward to Forty Eight Creek. Where the Hardin has been certainly identified, a conglomeratic base has never been mentioned.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 15–16. Basal member of Chattanooga shale; underlies Dowelltown member. As much as 16 feet thick and consists chiefly of siliceous fine-grained sand and silt. Early Late Devonian although some part may be slightly older. Geographic extent and good exposures noted. Ulrich and Bassler (1926, U.S. Natl. Mus. Proc., v. 68, art. 12) considered Hardin to be widespread deposit of Mississippian age. They described conodonts collected from sandstone at Mount Pleasant, Tenn., and identified bed as Hardin sandstone. Believed now that sandstone bed from which Ulrich and Bassler's (1926) conodont fauna came is neither same age as Hardin sandstone member of present report nor of early Mississippian age.

Named for Hardin County, Tenn. Part of widespread basal sandstone of Chattanooga and restricted to vicinity of Wayne, Perry, Lawrence, and Hardin Counties, Tenn., and adjoining part of Alabama. Well exposed along secondary road by stone church, 0.15 mile south of U.S. Highway 64 at Olive Hill, Hardin County, Tenn.

Harding Sandstone[1] **or Quartzite**

Harding Formation

Middle Ordovician: Central Colorado.

Original reference: C. D. Walcott, 1892, Geol. Soc. America Bull., v. 3, p. 154–167.

Ogden Tweto, 1949, Colorado Soc. Proc., v. 15, no. 4, p. 152 (table 1), 166–169. Harding quartzite, in Pando area, unconformably overlies Peerless formation and unconformably underlies Parting quartzite member of Chaffee formation. Tan, white, and greenish quartzite and some greenish sandstone.

W. C. Sweet, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 284–305. Referred to as formation, dominantly fine-grained sandstone.

Thickness in Harding quarry section 120 feet; in Priest Canyon section 157 feet; maximum thickness 186 feet, 2½ miles north of Cotopaxi in Fremont County. On regional basis, overlies Manitou dolomite, but, in all sections south of Priest Canyon, rests directly on Precambrian; in Harding quarry section, overlies Precambrian Idaho Springs. Underlies Fremont formation.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 12–13. In Garfield quadrangle, 10 to 38 feet thick and extends entire length of belt of Paleozoic rocks. Almost entirely quartzite, white, pink, brown, gray, or bluish black. Unconformably overlies Manitou dolomite and unconformably underlies Fremont dolomite.

Named for exposures in Harding quarry, 1 mile northwest of State Penitentiary, at Canon City, Fremont County. Quarry now one of several pits operated under name of Bernite Gannister Quarries.

Hardinsburg Sandstone[1]

Hardinsburg Formation (in Stephensport Group)

Hardinsburg Sandstone (in Homberg Group)

Upper Mississippian (Chester Series): Western Kentucky, southern Illinois, southern Indiana, and northern Tennessee.

Original reference: A. D. Brokaw, 1916, Illinois Geol. Survey Extr. for Bull. 35; 1917, Illinois Geol. Survey Bull. 35.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135, 136; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 831–832. Assigned to Homberg group (new). Underlies Glen Dean limestone; unconformably overlies Golconda limestone. Absent from Chester section in Missouri.

A. C. McFarlan and others, 1955, Kentucky Geol. Survey, ser. 9, Bull. 16, p. 19. Overlies Haney (upper Golconda) limestone (new).

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 26–27, pl. 1. Described in Indiana where it commonly consists of thin-bedded ripple-marked sandstone, shaly sandstone, and interbedded drab shale. Locally massive and crossbedded. Thickness 25 to 45 feet; complete sections rare. Underlies Glen Dean limestone; overlies Golconda formation. Term Homberg group not applied in Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 39, pl. 1. Formation included in Stephensport group (redefined). Consists mostly of gray shales, siltstones, and mudstones and in places includes thin-bedded fine-grained sandstones, some of which are ledge forming. Thickness ranges from 62 feet in area where Hardinsburg is mostly sandstone to 43 feet in drill hole in which formation is mostly shale. Overlies Golconda limestone (restricted) with transitional contact; underlies Glen Dean limestone.

Named for Hardinsburg, Breckinridge County, Ky.

Hardin School Limestone (in Wichita Group) [1]

Permian: Central Texas.

Original reference: F. M. Bullard and R. H. Cuyler, 1935, Texas Univ. Bull. 3501, p. 254–255.

Well exposed on hills just north and west of Hardin School, in southwestern part of Coleman County.

†Hardiston[1] or Hardistonville Quartzite[1]

Lower Cambrian: Northern New Jersey and northeastern Pennsylvania.

Original references: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 442–443, 454–456; H. B. Kummel and S. Weller, 1901, Geol. Soc. America Bull., v. 12, p. 149–150.

Exposed at brook section in Hardistonville, Sussex County, N.J., and on hill 1 mile south of Hardistonville.

Hardman Fire Clay (in Allegheny Formation)[1]

Pennsylvanian: Northern West Virginia, western Maryland, and southwestern Pennsylvania.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 347.

J. B. McCune and others, 1948, West Virginia Geol. Survey [Repts.], v. 18, p. 16. Hardman clay (Allegheny series) occurs few feet below Upper Kittanning underclay.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 210. Noted in Somerset County.

First described near Hardman, Preston County, W. Va.

Hardscrabble Limestone

Mississippian: Eastern Colorado.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39; 1951, World Oil, v. 133 (Oct.), p. 89–91. Lower part of beds previously called Madison limestone along Front Range form lithologic unit bounded by unconformities. This unit here named Hardscrabble limestone. Characterized by light-buff to dark-brown, finely crystalline to dense limestone, upper layers of which contain red to orange dense chert and abundant medium-sized oolites. In Williams Canyon and Missouri Gulch, lower part of formation includes several beds of pink-gray-white dolomite and dolomitic limestone; tan to brown chert sparingly present locally; base marked by thin bed of conglomeratic limestone at South Hardscrabble and Beulah localities; spirifers common. Thickness at type locality 124 feet; 100 feet above Cave of the Winds; 41 feet in Missouri Gulch. Overlies Williams Canyon limestone; underlies Beulah limestone. Meramec(?).

Type locality: Almost vertical exposure on thrust block southwest of Wetmore on South Hardscrabble Creek about one-half mile west of North Creek Bridge in S½ sec. 11, T. 22 S., R. 69 W., Custer County.

Hardwick Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Quarried west of Hardwick, in Hardwick Township, Caledonia County.

Hardwick Granite[1]

Late Carboniferous or post-Carboniferous: Central Massachusetts and southwestern New Hampshire.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 239–241, 317–318, pl. 34.

Named for occurrence at and around Hardwick, Worcester County, Mass.

Hardwood Gneiss

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 27, 30 (table 1), 32. Dark medium-grained gneiss composed of hornblende, plagioclase, and pyroxene, which is interlayered with dark fine-grained gneiss, beds of light-colored gneiss with light and dark laminae, garnet-quartz-mica schist, and light-colored rock that resembles quartzite. Layers are a fraction of an inch to a few feet in thickness; layering in general dips easterly at angles less than 40°. Known thickness, including metagabbro sills, possibly no more than several hundred feet. Separated by covered interval from strata of Dickinson group (new); may be equivalent to or part of group but exposures are inadequate to establish relationship.

Exposed principally in secs. 5 and 8, T. 41 N., R. 27 W., Dickinson County, a short distance west of Harwood for which unit is named.

Hardwood Point Shales and Flags (in Lower Marshall Sandstone)

Mississippian (Kinderhook): Southern Michigan.

Shown on map legend: H. M. Martin, 1936, The centennial geologic map of the southern peninsula of Michigan (1:500,000): Michigan Geol. Survey Div. Pub. 39, Geol. Ser. 33.

Hardy Creek Limestone

Hardy Creek Limestone Member (of Moccasin Formation)

Middle Ordovician: Southwestern Virginia.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 76 (2 sheets); R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 104–106. Hardy Creek limestone member proposed for upper part of Moccasin limestone. Consists of even-bedded limestone and siliceous limestone, with abundant oval chert nodules in some beds. Thickness 141 to 154 feet. Overlies lower unnamed member consisting of buff-weathering highly fossiliferous argillaceous and shaly limestone 138 to 143 feet thick. Underlies Eggleston limestone.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Rank raised to formation. Overlies Ben Hur limestone (new).

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 58–61, 121–122, pl. 1. Further described and type section given. Discussion of correlation problems and summarizes nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 65–66. Underlies Cane Creek limestone (new).

Type section: In cut of a spur of Louisville and Nashville Railroad along headquarters of Hardy Creek near Hagan, Lee County.

Hardy Hill Quartzite Member (of Orfordville Formation)

Middle Ordovician(?): Western New Hampshire and eastern Vermont.

C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500); J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. Consists of gray to white quartzite and quartz conglomerate with some quartz-mica schist and mica schist. Outcrops are discontin-

uous. Middle member of formation. Occurs above Post-Pond volcanic member and below Sunday Mountain volcanic member (both new). Middle Ordovician(?).

C. A. Chapman, 1939, Geol. Soc. America Bull., v. 50, no. 1, p. 132–133. Occurs in middle of black schists near top of Orfordville formation. Maximum thickness 250 feet.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 12, 15. Geographically extended to Vermont. Ordovician.

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 112, 114, 116, pl. 1. Assigned stratigraphically lower position in Orfordville formation; placed below Post Pond volcanic member.

Mapped in several narrow belts in vicinity of Hardy Hill Brook in northwestern corner of Mascoma quadrangle, New Hampshire.

Hardyston Quartzite[1]

Hardyston Formation

Lower Cambrian: Northern New Jersey and northeastern Pennsylvania.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 442–443, 454–456.

B. L. Miller and P. B. Myers *in* B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 206–223, 227, pl. 1. In Northampton County, overlies Precambrian crystalline formations and underlies Tomstown formation (extended into this area as substitute for Leithsville).

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, p. 1361. Chickies quartzite used rather than Hardyston in Buckingham area, Pennsylvania. Hardyston reserved for those areas where Lower Cambrian quartzite can be closely correlated with type formation in New Jersey.

M. E. Johnson, 1950, Geologic map of New Jersey (1:250,000): New Jersey Dept. Conserv. Econ. Devel. As mapped, underlies Cambro-Ordovician Kittattiny limestone.

Bradford Willard, 1955, Geol. Soc. America Bull., v. 66, no. 7, p. 821, 824–825, 826–827, 832. Base of Cambrian in eastern Pennsylvania. Thickness 25 to 300 feet. Underlies Leithsville formation with contact conformable at all but one locality where there is local disconformity; overlies Precambrian, contact changes from place to place but always nonconformable.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Hardyston formation.

Named for exposures at Hardistonville (now Hardyston), Sussex County, N.J.

Harebell Formation

Upper Cretaceous; Northwestern Wyoming.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1899, 1900–1904. Succession of olive-drab to gray sandstone, conglomerate, claystone, and shale. Three facies present. In type area, lenses of quartzite pebble conglomerate present throughout sequence; in Blackrock Creek area quartzite pebble conglomerate lenses are in upper part; and in southernmost outcrops, conglomerate lenses are composed of rock fragments of Paleozoic and Mesozoic ages with lesser amounts of quartzite. Thickness about 5,000 feet in type area. Unconformable contacts with overlying Pinyon conglomerate and underlying Bacon Ridge sandstone.

Type locality: Extends from head of Snake River gorge southward over Big Game Ridge, about 2 miles east of Mount Hancock, and on across Wolverine Creek to north base of Pinyon Peak. Name derived from Harebell Creek, westward-flowing stream in Snake River drainage system along south margin of Yellowstone National Park. In Jackson Hole, Teton County.

Hares Valley Limestone and Shale Member (of Newton Hamilton Formation)

Middle Devonian: Central Pennsylvania.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2860 (fig. 2), 2864 (fig. 3), 2865, 2867–2868. Interbedded shale and argillaceous limestone with limestone generally increasing upward in section. Thickness about 21 feet. Overlies Beaverdam Run shale member (new); underlies Marcellus black shale. Willard (1939) applied name Selinsgrove to upper noncherty "Onondaga" limestones of central Pennsylvania, but without specific statement as to type locality or typical section. I. C. White (1883) used name Selinsgrove for five different subdivisions of Middle Devonian. Name seems too indefinite to be used in Mount Union quadrangle. Name Hares Valley applied to upper shale and limestone of Newton Hamilton formation where it occurs north of mouth of Hares Valley at Mapleton.

Type section: In Dowell sand pit 1½ miles north of Mapleton, Mount Union quadrangle, Huntingdon County.

Harg Shale Member or facies (of Portwood Formation)

Upper Devonian: Eastern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 862–863, 866. Proposed for the tripartite facies of Portwood (new) in area between Berea and Olympia. Lower division of Harg is greenish, gray, or bluish-black argillaceous shale, 2½ feet thick and associated with layers of limestone at Harg, but typically represented with thickness of 10 feet at Witt Schoolhouse; middle division is carbonaceous-calcareous shale, 9½ feet thick at Harg, 23 feet at Witt Schoolhouse, and 13 feet at Rice Station; upper division is stony light-gray argillaceous shale, its layers varying in hardness, 3 feet thick at Harg, 5½ feet at Rice Station. The three divisions seldom have same relative representation at any two localities. Different levels of Harg rest on the Hamilton and commonly a layer of limestone belonging to the Harg is basal layer of the New Albany. Considered coeval facies with Duffin dolomite, and Ravenna shale facies (new). Replaces the Duffin dolomite in area where former appears and is transitional between the Duffin and Ravenna. Underlies Trousdale shale.

Type section: In cut on Louisville and Nashville Railroad, one-half mile north of Harg, 6 miles northwest of Irvine, Estill County. Lower and middle division typically represented at Witt Schoolhouse; upper division well exposed at Rice Station; all three divisions occur together at Harg.

Hargett Sandstone (in Chester Group)[1]

Hargett Sandstone or Shale Member (of Alsobrook Formation)

Mississippian (Chester Series): Northeastern Mississippi.

Original reference: W. C. Morse, 1935, Mississippi Geol. Survey Bull. 26, p. 9, 10.

W.C. Morse, 1936, Mississippi Geol. Survey Bull. 32, p. 11. Listed as middle member of Alsobrook formation. Overlies unnamed limestone; underlies Cripple Deer sandstone or shale member. Chester series.

Occurs in Tishomingo County.

Harkers Fanglomerate (in Salt Lake Group)

Pliocene: Central northern Utah.

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23, 24 (fig. 6), 28–30. Salt Lake group, in Lower Jordan Valley, divided into (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and Travertine unit. Fanglomerate, tan to gray, poorly consolidated; occasional channels and lenses of reddish silts; torrential bedding and cut and fill structure common. Thickness at least 300 feet. Within Jordan Narrows proper, fanglomerate is in fault contact with Camp Williams unit or overlies it unconformably. Exact relationship to Travertine unit unknown; may be contemporaneous.

A. J. Eardley, 1955. Utah Geol. Soc. Guidebook 10, fig. 9. Contemporaneous with Huntsville fanglomerate in Morgan Valley and Mink Creek conglomerate in Cache Valley.

Type locality: Harkers Canyon, which cuts through northern part of Oquirrh foothills just south of Bacchus, Salt Lake County. Lower Jordan Valley is defined as that part of Jordan Valley northward from Traverse Mountains to great Salt Lake.

Harkness Lavas, Basalts, Flows.

Cenozoic: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 272–280. Earliest Harkness lavas are generally pale-gray massive andesitic basalts that weather to whitish crust and are rich in conspicuous phenocrysts of bright-yellowish-green augite. Nearer the vent, the later lavas usually darker, often purplish, weathering to pinkish crusts, and more vesicular, whereas in the crater rim the flows are almost black. Cinders forming summit cone are black and scoriaceous. Younger than flat-lying Saddle Mountain lavas (new).

Mount Harkness is in Plumas County in southeastern part of Lassen Volcanic National Park.

Harlan Sandstone

Harlan Formation

Harlan Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky and southwestern Virginia.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 31.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 114–118, 142. Harlan sandstone (or formation) is uppermost division of Pennsylvanian in Black Mountains, Harlan and Letcher Counties, Ky., and Wise and Lee Counties, Va. Overlies Wise formation. Includes massive cliff-forming conglomeratic sandstone at base (probably Campbell's original Harlan sandstone). Base commonly stated to be 5 to 50 feet above High Splint coal. Although it contains shales and coals, the formation has commonly been called Harlan sandstone. May be lower Allegheny in age.

Named for Harlan County, Ky.

Harlem Clay (in Conemaugh Formation)[1]

Harlem clay or underclay member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

[Original reference] : Wilber Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 458.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 71. Harlem clay included in Harlem cyclothem, Conemaugh series. Not recognized with certainty in area of report [Perry County]. Within the cyclothem, position of clay is below Harlem coal and above unit termed Harlem shale and (or) sandstone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 133. Underclay member of Harlem cyclothem in report on Athens County. Average thickness 2¼ feet. Above Rock Riffle limestone member (new).

Named for association with Harlem coal.

Harlem cyclothem

Pennsylvanian (Conemaugh Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 15. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 71–72, table 1, geol. map. Includes (ascending) Harlem shale and (or) sandstone, 25 feet; Harlem clay and coal (not recognized with certainty in Perry County) ; unnamed shale; and Ames limestone, 1 to 2½ feet. Occurs above Barton cyclothem and below an unnamed cyclothem. In area of this report, Conemaugh series is described on cyclothemic basis; seven cyclothems named. [For sequence see Mahoning cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 129–134. In Athens County, comprises (ascending) Saltsburg, Round Knob, Rock Riffle, and Harlem members. In sequence, occurs above Upper Bakerstown cyclothem and below Ames cyclothem. In this report Conemaugh series described on cyclothemic basis; 15 cyclothems named, [For sequence see Mahoning cyclothem.]

Harlem Gneiss[1]

Precambrian : Southeastern New York.

Original reference : R. P. Stevens, 1867, New York Lyc. Nat. History Annals, v. 8, p. 116–120.

Along southern shore of Spuyten-Duyvel Creek and Harlem River, Manhattan Island.

Harlem shale and (or) sandstone member

See Harlem cyclothem.

Harlow Bridge Quartzite Member (of Cram Hill Formation)

Middle Ordovician : Central Vermont.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1493, 1495. Buff to pale-green platy to massive quartzite beds with intercalated siliceous schists. Basal member of formation. Thickness approximately 300 to 800 feet. Overlies unnamed Ordovician(?) schists.

Type locality : Vicinity of large railroad bridge (Harlow Bridge) 2.4 miles south-southwest of Northfield, Barre quadrangle.

Harmon Formation (in Maysville Group)[1]

Upper Ordovician: Southeastern Indiana.

Original reference: E. R. Cumings and J. J. Galloway, 1913, Indiana Dept. Geology and Nat. Resources 37th Ann. Rept. p. 359.

Probably named from Harmon's Station, Dearborn County.

Harmon Hill Gneiss[1]

Precambrian: Southwestern Vermont.

Original reference: C. E. Gordon, 1914, Vermont State Geologist 9th Rept. p. 345, 349.

In vicinity of Bennington, Bennington region, Vermont.

Harmony Formation

Upper Cambrian: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]. Described as chiefly greenish-brown sandstone, arkose, grit, and green, red, or black shale, calcareous shale, and limestone. Lower beds interbedded sandstone, arkose, grit, and shale. Upper beds principally sandstone, shale, limy shale, and thin limestone beds. Thickness estimated to exceed 3,000 feet. In thrust contact with Scott Canyon, Comus, and Valmy formations; overlain unconformably by Battle formation. Mississippian(?).

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Thickness at type locality may exceed 5,000 feet.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2827–2828. Harmony formation, previously regarded as Mississippian(?) now known to be of latest Cambrian age. Determination based on trilobites.

Type locality: Harmony Canyon, Sonoma Range, Winnemucca quadrangle.

Harmony Hill Formation (in Ancell Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 21, figs. 3, 12. Consists of green platy shale about 6 feet thick. Shown on columnar section as uppermost formation of Ancell group (new). Underlies Hennepin member (new) of Pecatonica formation; overlies Loughridge formation (new).

Occurs in Dixon-Oregon area.

Harmony Hills Tuff Member (of Quichapa Formation)

Oligocene: Southwestern Utah and eastern Nevada.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90, 92 (fig. 2), 94–95. Uppermost member of formation. At type locality, overlies Bauers tuff member (new); underlies Rencher formation; elsewhere lava flows or other volcanic rocks, local in origin and extent, at contacts. Characteristically tan to light red brown. Only moderately indurated, but does not show signs of welding. May be an ignimbrite or may be an airfall tuff. Thickness 300 to 350 feet. Zircon age of Leach Canyon tuff member is 28 million years; this suggests that Quichapa formation is Oligocene. Discussion of ignimbrites of area.

E. F. Cook 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 138 (fig. 3). Geographically extended into eastern Nevada.

Type locality: Harmony Hills specifically south side of Right Quichapa Canyon, Mount Stoddard quadrangle, Iron Springs district, Utah.

Harney Formation[1]

Pliocene(?): Southeastern Oregon.

A. M. Piper, 1936, Geol. Soc. Oregon County News Letter, v. 2, no. 8, p. 10. Includes massive basaltic tuff and breccia, sandstone and siltstone, and some incoherent gravel. Thickness about 750 feet. Overlies Danforth formation (new) with angular and erosional nonconformity; underlies an extensive plain of intermediate altitude in west-central part of Harney Basin. Outliers occur along all margins of central district except northern Pliocene(?).

A. M. Piper, T. W. Robinson, and C. F. Park, Jr., 1939, U.S. Geol. Survey Water-Supply Paper 841, p. 38–41, pl. 2. Detailed description. Thickness 468 feet at type section herein designated. [This is reference cited in Wilmarth Lexicon as "in press"].

W. D. Wilkinson, [1939], Geologic map of Round Mountain quadrangle, Oregon (1:96,000): Oregon Dept. Geology and Mineral Industries. Mapped in Round Mountain quadrangle, Crook County.

Type section: East face of Dog Mountain, along boundary between secs. 20 and 28, T. 25 S., R. 30 E., Harney County.

†Harney Granite[1]

Precambrian: Southwestern South Dakota.

Original reference: H. G. Ferguson and F. N. Turgeon, 1908, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, p. 273–281.

Occurs in northern Black Hills.

Harney Peak Granite[1]

Precambrian: Southwestern South Dakota.

Original reference: C. R. Van Hise, 1898, Geol. Soc. America Bull., v. 9, p. 311.

G. L. Taylor, 1935, Am. Jour. Sci., 5th ser., v. 29, no. 171, p. 281. Dikes of Harney Peak fine-grained granite cut Game Lodge granite (new).

L. R. Page and others, 1953, U.S. Geol. Survey Prof. Paper 247, p. 6–7. Discussed in pegmatite investigations in Black Hills 1942–1945.

Present in Black Hills region.

Haro Formation[1]

Upper Triassic: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. in Geology, v. 2, p. 93, 112–113.

Composes peninsula known as Davidson Head at northern extremity of San Juan Island.

Harold Formation

Pleistocene upper (?): Southern California.

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Well-stratified variable sequence of interbedded deposits; gravel, coarse arkosic sand with pink feldspar,

in part lime-cemented and resembling travertine; buff sand and silt; whitish nodular marly clay in lower part of formation; brown gypsiferous clay beds locally at base of formation wherever it overlies gypsiferous Anaverde formation. Thickness generally 100 feet or less, 200 feet in some areas, but top is eroded. In some areas not easily differentiated from Nadeau gravel (new).

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Described in Valyermo quadrangle where it underlies Shoemaker gravel (new). Formation gently folded; most dips less than 20°.

Type locality: Hills one-half mile southwest of San Andreas fault and 1 mile southeast of Harold Siding on Southern Pacific Railroad.

Harper Siltstone (in Nippewalla Group)

Harper Sandstone (in Cimarron Group)[1]

Harper Sandstone (in Nippewalla Group)

Permian: Central southern Kansas and northern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 18–20.

G. H. Norton, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557. Includes (ascending) Ninnescah shale (new), Stone Corral, Chikaskia sandstone (new), and Kingman sandstone (new) members.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 11. Typical Harper redbeds overlie Afton limestone member (new) of Wellington formation.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782–1786. Assigned to Nippewalla group (new) and restricted below to exclude Ninnescah shale and Stone Corral formations.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 159. Includes (ascending) Chikaskia member and Kingman sandstone member. Thickness about 220 feet. Overlies Stone Corral dolomite of Sumner group; underlies Salt Plain formation; northward is overlapped by Cenozoic rocks. Outcrops are in Harper, Kingman, Reno, and Rice Counties. Included in Nippewalla group, Leonard series.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Harper siltstone comprises (ascending) Chikaskia siltstone and Kingman siltstone members. Overlies Stone Corral formation; underlies Salt Plain siltstone. Nippewalla group.

Named for exposures in Harper County, Kans.

Harpers Shale[1] Schist,[1] Slate,[1] Phyllite,[1] or Formation (in Chilhowee Group)

Lower Cambrian(?): West Virginia, Maryland, southeastern Pennsylvania, and Virginia.

Original references: A. Keith, 1893, as reported by G. H. Williams and W. B. Clark, in Maryland, its resources, industries, and institutions, chap. 3, p. 68; 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 333–335, pls. 22–23.

G. W. Stose, 1906, Jour. Geology, v. 14, p. 207. In southern Pennsylvania, Harpers schist includes Montalto quartzite member (new).

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 15 (fig. 5), 19–20, pl. 1. Formation in Chilhowee group. In Elkton area, Virginia [this report], shale constitutes only small part of unit, remainder being largely siltstone and fine-grained sandstone; hence, unit designated as formation.

Thickness about 900 feet. Overlies Weverton formation; underlies Antietam quartzite.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 49–51, pl. 1. Discussion of structure of Sugarloaf Mountain area, Maryland. Phyllites of area, which have been considered volcanic members of Glenarm series (Stose and Stose, 1946) are Harpers phyllite. This conclusion based on structural evidence that local stratigraphic section is reverse of that previously reported—that is, anticlinal not synclinal. Stose and Stose divided this phyllite into Ijamsville and Urbana phyllites largely on basis of color and lack of calcareous bands in the Ijamsville. Although this division may be valid, it is difficult to map the contacts accurately and the Ijamsville and Urbana are herein considered part of the Harpers. Lower Cambrian age of Harpers is based on its position conformably below Antietam quartzite on Catoctin Mountain west of Sugarloaf area. Overlies Weverton quartzite.

A. J. Stose and G. W. Stose, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 697–699. Discussion of Scotford article. Stose and Stose reiterate their conclusions that Sugarloaf Mountain quartzite is synclinal and not anticlinal; the phyllites that surround the quartzite are not Harpers but phyllites of an eastern shale sequence containing volcanic flows and tuffs, which are Urbana and Ijamsville phyllites.

J. C. Whitaker, 1955, Geol. Soc. America Bull. v. 66, no. 4, p. 445–446. Studies indicate that Catoctin Mountain is not a syncline as previously interpreted but a tightly folded eastward-dipping sequence which forms upper and east limb of South Mountain anticlinorium. Strata formerly mapped as Loudoun along eastern border of Catoctin Mountain constitute a zone including upper Weverton quartzite and basal Harpers phyllite. The Harpers overlies Weverton quartzite in normal sequence along eastern slopes of Catoctin Mountain. Formation extends from northern end of area southward to 3 miles north of Leesburg, Va., where it is cut off by Triassic border fault. Underlies Antietam quartzite throughout most of area; between Thurmont and Mount St. Marys in northern Maryland, underlies Frederick limestone; just north of Potomac River, underlies Tomstown dolomite.

R. O. Bloomer and H. J. Wheeler, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 595–597, pl. 1. In Blue Ridge region, central Virginia, formation includes Snowden member (new). Transitional between Unicoi formation below and Antietam quartzite above. Thickness 800 to 1,200 feet.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation including Montalto member.

Named for exposures in gorges of Potomac and Shenandoah Rivers at Harpers Ferry, W. Va.

†Harpersville Formation (in Cisco Group)[1]

Pennsylvanian: Central and northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132; 1922, Jour. Geology, v. 30, p. 24, 31, 39.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 61–74, 128–132. In Brazos River valley, extends from top of Breckenridge limestone member of Thrifty formation to base of Pueblo formation, an interval of 233 feet. It is part of a chaotic series of thin lime-

stones, relatively thin lenticular sandstone, variegated sandy and clay shales, and thin coals. This complex series of beds, interrupted by unconformities expressed in large and small channels, extends with progressive changes upward beyond limits of Harpersville to middle of Moran formation. Formation comprises (ascending) unnamed limestone and shale interval, Crystal Falls limestone, unnamed shale interval. "Upper Crystal Falls limestone," unnamed shale and limestone interval, Belknap limestone, unnamed interval, and Saddle Creek limestone. In Colorado River valley, includes Waldrip bed of Drake and Saddle Creek limestone member. Thickness 238 feet. Overlies Thrifty formation; underlies Pueblo formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Term abandoned. Pennsylvanian-Permian boundary is placed at disconformity in Harpersville formation. This boundary is 40 to 150 feet below Saddle Creek limestone. Harpersville beds below boundary are assigned to Obregon (new) and Chaffin formation of Thrifty group; those above the systemic boundary to Saddle Creek formation of expanded Pueblo group.

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 5–23. Three clays, Quinn, Curry, and Craddock, named in this report. The Quinn is described as next to lowest clay in the Harpersville as defined in report and map by Plummer and Moore (1921). Curry clay occurs between upper and lower layers of Crystal Falls limestone.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 21–26, pl. 1. Discussion of lower part of Harpersville formation in Stephens County. Here includes (ascending) Quinn clay, Crystal Falls limestone, and Curry clay members.

Named for Harpersville, 10 miles south of Breckenridge, Stephens County.

†Harpeth Shale[1]

Mississippian: Central Tennessee.

Original reference: P. M. Jones, 1892, Geology of Nashville and immediate vicinity; Nashville, Tenn., Univ. Press, June 1892, p. 14.

Named from fine presentation in picturesque bluffs, along Big Harpeth River, in Cheatham County.

†Harpeth and Tennessee River Group[1]

Silurian and Devonian: Western Tennessee.

Original reference: J. M. Safford, 1851, Am. Jour. Sci., 2d, v. 12, p. 353, 357–358.

Named for Harpeth River, Cheatham and Dickson Counties.

Harpole Mesa Formation

Pleistocene: Southeastern Utah.

G. M. Richmond, 1956, Dissert. Abs., v. 16, no. 6, p. 1127–1128. Consists of three unnamed members, lower two of which comprise till, alluvial gravel, and eolian deposits. Upper member comprises eight lithofacies, including till and several kinds of alluvial, colluvial, and eolian deposits. Tills form sheetlike deposits on high interfluves and broad valley surfaces. Alluvial gravel of lower member trends across present canyons. Similar very strongly developed soils occur on each member. Rarely distinguishable, they are jointly called the Spring Draw soil. Older than Placer Creek formation (new).

Located in La Sal Mountains area.

Harrell Shale (in Susquehanna Group)

Harrell Shale (in Portage Group)[1]

Harrell Member (of Fort Littleton Formation)

Upper Devonian: Central Pennsylvania and West Virginia.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th ser., v. 46, p. 523, 532, 536.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 201, 217–218. Restricted at base to exclude Burket black shale and rank reduced to member status in Fort Littleton formation. Underlies Brallier member of Fort Littleton.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 390–412. Rock previously called "Genesee black shale" by Maryland and West Virginia Geological Surveys appears to be continuous extension of Harrell shale of Pennsylvania. Believed that Pennsylvania name appropriate for outcrops in West Virginia. Shale thinnest in Eastern Panhandle, where it is 5 to 20 feet thick, and wholly absent from easternmost sections. Thickens westward, being about 300 feet along U.S. Highway 50 near Hampshire-Mineral County boundary. Overlies Hamilton formation; underlies Brallier shale.

U.S. Geological Survey currently classifies the Harrell Shale as a formation in the Susquehanna Group on basis of a study now in progress.

Named for exposures at Harrell, Blair County, Pa.

Harriett Formation

Silurian: Western Ohio.

Wilber Stout, 1941, Ohio Geol. Survey, ser. 4, Bull. 42, p. 90–91. Name tentatively applied to a limestone 21 feet thick that occurs below Cedarville dolomite and above Lilley dolomite.

Occurs in Harlan Skeen quarry located on Sinking Spring-Hillsboro Road (Route 124), three-fourths of mile northeast of Harriett, 2 miles south of Marshall, Highland County.

Harriman Chert[1]

Harriman Formation

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 747.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

C. W. Wilson, Jr., Tennessee Div. Geology Bull. 56, p. 306–309, fig. 88. Harriman formation, locally referred to as Harriman limestone or Harriman chert depending upon phase represented, used to include both Dunbar's "Harriman novaculite and Quall limestone." The Quall considered unweathered phase of the Harriman. Formation consists of two contemporaneous lithologic phases of limestone and chert. Thickness 37 to 55 feet. Unconformably overlies Flat Gap limestone where present; elsewhere unconformably overlies either Ross limestone member or Birdsong shale member of Ross formation (new). Unconformably underlies Chattanooga shale, or, as in Decatur and Benton Counties, Camden formation.

Named for Harriman Creek, Decatur County. [Harriman Creek is called Herron Creek on Jeanette planimetric quadrangle, Tennessee Valley Authority, Wilson, p. 307.]

Harriman Shale Member (of Lykins Formation)

Permian: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31–33. Name proposed to represent lowermost unit of Lykins formation. In Glennon Canyon, member consists primarily of red arenaceous thin-bedded shales and mudstones containing several thin layers of white massive fine to medium crystalline limestone in lower third. Limestone layers rarely exceed 6 inches in thickness and contain black brittle bituminous material along fractures and in minute vugs, Bituminous material also occurs sporadically throughout lower half of shale in thin discontinuous streaks along and transverse to bedding planes. Shales immediately adjacent to bituminous material are of bluish-green tints. Thickness 58 to 92 feet in area. Underlies Falcon limestone member (new); rests sharply on conglomeratic phase of Lyons formation.

Type section: In west tributary of Glennon Canyon, Golden-Morrison area, Jefferson County, where typically developed and well exposed. Named from Harriman irrigation canal, which receives water from Bear Creek at town of Morrison.

Harrington Formation[1]

Lower Triassic: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

Type locality: Harrington-Hickory mine, southeast of Frisco district.

Harris Formation[1]

Miocene or Pliocene: Southern California.

C. F. Tolman, 1927, Econ. Geology, v. 22, no. 5, p. 459. Named in stratigraphic column. Described as massive diatomite 2,000 feet thick. Underlies Foxen formation and overlies Monterey formation.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 36. Harris formation is Sisquoc formation of current usage.

Occurs in Santa Maria district.

Harrisburg Coal Member (of Carbondale Formation)

Pennsylvanian: Southern and eastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 36, 47 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). In southern area, occurs above Hanover limestone member and below St. David limestone member; in eastern area, occurs above Summum coal (No. 4) member and below Herrin (No. 6) coal member. Coal named by Shaw and Savage (1912, U.S. Geol. Survey Geol. Atlas, Folio 185). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: In coal mines in vicinity of Harrisburg, Saline County.

Harrisburg Gypsiferous Member (of Kaibab Limestone)[1]

Permian: Southwestern Utah and northwestern Arizona.

Original reference: H. Bassler and J. B. Reeside, Jr., 1921, U.S. Geol. Survey Bull. 726–C, p. 90–92.

E. D. McKee, 1938, Carnegie Inst. Washington Pub. 492, p. 35. The α, or uppermost member of Kaibab, as described herein, has been referred to variously as the A member, the Super Aubrey, Bellerophon limestone, and Harrisburg gypsiferous member.

Named for occurrence in Harrisburg dome, 8 miles east of St. George, Washington County, Utah.

Harrisite Dolomite

Middle Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–330, p. 105; M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 25–26, pl. 1. Massive dark-gray to black locally banded dolomite, containing as much as 20 percent black chert chiefly as nodules and discontinuous layers along the bedding; lower 10 feet has mottled appearance and is commonly limy. Thickness 110 to 174 feet. Overlies Bell Hill dolomite and underlies Lost Sheep dolomite (both new).

Type section: Steep west side of canyon 2,000 feet northeast of Harrisite mine, sec. 10, T. 13 S., R. 12 W., Juab County. Named for exposures that cap hill a short distance east of Harrisite mine.

Harrison Diorite[1]

Harrison Gneiss

Pre-Triassic: Southwestern Connecticut and southeastern New York.

Original reference: F. J. H. Merrill, 1898, New York State Mus. 15th Ann. Rept., v. 1, p. 30.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as a dark-gray to greenish gneiss; composed of andesine, quartz, hornblende, and biotite. Augen structure locally present. Pre-Triassic.

Crops out extensively in town of Harrison, Westchester County, N.Y.

Harrison Formation

Harrison Member (of Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original references: W. Stout, 1916, Ohio Geol. Survey, 4th ser., Bull. 20, p. 481; 1927, Ohio Geol. Survey, 4th ser., Bull. 31, p. 67, 68.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 20–21, table 1. Rank raised to formation in Pottsville series. Harrison formation conforms with contour of post-Mississippian-pre-Pottsville erosion surface. Formation overlapped by various strata of lower Pottsville age from Anthony shale up to Massillon sandstone.

Named for deposits in Scioto County. Formerly worked for iron smelting at Harrison Furnace.

Harrison Sandstone (in Arikaree Group)

†Harrison Beds[1]

Harrison Formation (in Arikaree Group)

Harrison Member (of Arikaree Formation)

Miocene, lower: Western Nebraska, southern South Dakota, and eastern Wyoming.

Original reference: J. B. Hatcher, 1902, Am. Philos. Soc. Proc., v. 41, p. 117.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, no. 210, p. 442–443, 444. Formation considered uppermost unit in Arikaree group. Overlies Monroe Creek formation; underlies Marsland formation (new). Harrison used

here as defined by Hatcher. Peterson (1906, Annals Carnegie Mus., v. 4) applied term "Lower Harrison" to the whole of the already named Harrison beds of Hatcher, and "Upper Harrison" was used for the overlying buff-colored deposits which Hatcher miscalled the Nebraska beds of Scott. This has resulted in much confusion of what constitutes the Harrison. "Upper Harrison" beds here named Marsland formation.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 226, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1252, 1253–1254. Thickness of formation 200 feet. Harrison here used as defined by Hatcher. Overlying Marsland formation not included in Harrison of Hatcher. Application of name "Upper Harrison" to these beds by Peterson and others in recent years is unfortunate as these beds (Marsland) have no close stratigraphic or faunal relation to true Harrison (in Hatcher sense) and are separated from underlying Harrison by most significant and important structural and erosional unconformity in western Nebraska.

H. J. Cook and J. T. Gregory, 1941, Jour. Paleontology, v. 15, no. 5, p. 549–552. Described fauna from "Upper Harrison." States that Marsland as defined by Schultz includes two separable formations—"Upper Harrison" and higher previously unnamed deposits. Marsland is restricted to deposits at type locality and, as thus restricted, is equivalent to unnamed beds between "Upper Harrison" and the Sheep Creek as shown in columnar section of region by Cook and Cook (1953, Nebraska Geol. Survey Paper 5). New name is not proposed for "Upper Harrison".

R. C. Cady and O. J. Scherer, 1946, U.S. Geol. Survey Water-Supply Paper 969, p. 22–26, pls. 1, 7. Described as sandstone in Box Butte County where it is 85 to 130 feet thick. Unconformably overlies Monroe Creek sandstone and underlies Marsland formation.

S. G. Collins, 1959, Geology of the Martin quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Considered member of Arikaree formation in South Dakota. Consists of light-pink to brown or grayish-buff poorly consolidated mostly calcareous very fine sand and silt with discontinuous zones of calcareous concretionary nodules increasing in abundance upward; upper part contains thin zones of white limy sandstone and local lenses of garnetiferous sandstone. Thickness as much as 150 feet. Overlies Monroe Creek member; contact gradational and difficult to locate precisely. Underlies Valentine formation.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Formation in Arikaree group. Consists of up to 125 feet of massive gray, partly crossbedded, poorly consolidated fine to very fine sands. Includes "Rosebud" facies. Overlies Monroe Creek formation.

S. G. Collins, 1960, Geology of the Patricia quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Formation in Arikaree group. Maximum thickness estimated to be 60 to 80 feet. Overlies Monroe Creek formation. On regional scale, the Harrison and Monroe Creek become less distinct as separable units eastward from source area; believed that there is little practical value in attempting to map them separately eastward from Patricia and Martin quadrangles. Underlies Ogallala group (Valentine formation).

Well exposed in bluffs of all small streams that head near summit of Pine Ridge in vicinity of Harrison, Sioux County, Nebr. Named from exposures in vicinity of Harrison, Sioux County, Nebr.

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†Harrison Series[1]

Precambrian: Southern Idaho and northwestern Utah.

Original reference: A. L. Anderson, 1931, Idaho Bur. Mines and Geology Bull. 14, p. 24.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 470, 471 (table 1). Geographically extended to Ashbrook mining district, Utah. Generalized stratigraphic section of Ashbrook district shows Harrison series below Cambrian(?) Sentinell quartzite.

Best exposed on flanks of Mount Harrison, Cassia County, Idaho.

Harrodsburg Formation or Limestone

†Harrodsburg Limestone (in Meramec Group)[1]

Lower Mississippian: Indiana and northern Kentucky.

Original reference: T. C. Hopkins and C. E. Siebenthal, 1897, Indiana Dept. Geology and Nat. Resources 21st Ann. Rept., p. 296.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 72–73, 75, 224, pl. 25. Harrodsburg limestone has become well established formation in Indiana since its introduction in 1897. Stockdale (1929, Indiana Acad. Sci. Proc., v. 38) divided unit into Upper Harrodsburg limestone and Lower Harrodsburg limestone consisting of (descending) Guthrie Creek, Leesville limestone, and Ramp Creek members. In Indiana from south side of Floyd County northward, there is lithologic contrast between top of Borden group and overlying Ramp Creek member; southward from Floyd County into Kentucky, cherty, impure limestone appears at successively lower horizons beneath upper boundary of Borden group until more than entire topmost Borden unit (Edwardsville of Indiana) is of siliceous calcareous facies identical with Ramp Creek member to north. Distinctive Warsaw fauna is feature of Upper Harrodsburg, which is pure limestone in most of southern Indiana. Hence basal Harrodsburg beds are placed with Borden group as part of uppermost unit herein named Muldraugh formation. "Upper" division referred to as Harrodsburg (restricted) formation in this report.

W. N. Melhorn and N. M. Smith, 1959, Indiana Geol. Survey Rept. Prog. 16, p. 8 (table 1), 14. Harrodsburg limestone, in Mount Carmel fault area, is 80 to 90 feet, and is divided into upper and lower units. Gradational into underlying Edwardsville formation through series of thin-bedded argillaceous limestones interbedded with layers of brown to blue-gray massive coarse-grained crinoidal limestone. Underlies Salem limestone.

Named for Harrodsburg, Monroe County, Ind.

Harshberger Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: F. and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 222, 223, pl. 13.

Named for Harshberger quarries at Forwardstown, Somerset County.

Hart Limestone Member (of Stratford Formation[1] and Wichita Formation)

Permian: South-central Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2, p. 137–140.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Hart limestone is at base of Wichita formation in southwest and central southern part of state; is member of Stratford formation of Pontotoc group in Pontotoc, Garvin, and Murray Counties.

Named for typical development near village of Hart, western part of Pontotoc County.

Harter Shale Member (of Frankfort Formation)

Upper Ordovician (Cincinnatian): Central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 601 (fig. 3). Name appears on stratigraphic diagram. Overlies Utica formation.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 64–66. Lowest member of Frankfort formation. Consists of greenish-gray laminated claystone grading imperceptibly into black shale of underlying Utica formation with which it has been mapped. Shale weathers into small conchoidally fractured chips in contrast to more platy, larger fragments of the weathered Utica. Thin cross-laminated siltstones or fine quartz sandstones, similar to sandstones in Moyer member (new), present locally near top. Thickness about 100 feet. Underlies Hasenclever member (new) with sharply defined contact useful as a mapping horizon. Typical exposures described and derivation of name stated.

Typical exposures in ravine south of Harter Hill, located along east-central border of Utica quadrangle.

Hartford Clay[1]

Pleistocene, upper: Central Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

W. D. Urry, 1948, Am. Jour. Sci., v. 246, no. 11, p. 689–700. Age about 18,000 years. Determination made on basis of study of radium content in varved clays.

Occurs in vicinity of Hartford, Hartford County.

Hartford Limestone[1]

Pennsylvanian: Western-central Kentucky.

Original reference: C. J. Norwood, 1884, Kentucky Geol. Survey Repts. on western coal field, Ohio County, p. 174.

Probably named for Hartford, Ohio County.

Hartford Limestone Member (of Topeka Limestone)

†Hartford Limestone (in Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and northwestern Missouri.

Original reference: M. Z. Kirk, 1896, Kansas Univ. Geol. Survey, v. 1, p. 80.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 142 (fig. 29), 162; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Hartford limestone member of Topeka formation. Underlies Iowa Point shale member, overlies Calhoun formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21. Condra and Reed (1937, Nebraska Geol. Survey Bull. 11, 2d ser.) were uncertain regarding relation of the Hartford of southern Kansas to lower member of the Topeka in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa so proposed name Wolf River for basal member of Topeka in this area. Nebraska Survey will drop name Wolf River if it proves to be correlative with the Hartford, which was loosely defined by Kirk (1896) and may have priority if it does not include beds of Du Bois, Iowa Point, and Wolf River age. Type locality stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16–17, fig. 5. Commonly one bed of light- to blue-gray massive limestone; locally contains thin shale bed. Thickness 1 foot near Thurman, Fremont County; 0.5 foot near Howe, Adair County. Basal member of Topeka limestone; underlies Iowa Point shale member; overlies Calhoun shale. Called Wolf River in Nebraska.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, pl. 1. In Douglas County, member is 6 to 8 feet thick and consists of two limestone beds separated by thin shale bed just below middle of member. Underlies Iowa Point Shale member; overlies Calhoun shale.

Type locality: Where member passes under Neosho River at Hartford, Coffee County, Kans. Well exposed just north of Hartford.

Hartford Hill Rhyolite Tuff

Oligocene(?): Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299 (table 1). Name Hartford Hill rhyolite appears only on table. Miocene(?). Thickness 400 feet.

V. P. Gianella, 1936, Nevada Univ. Bull. 30, no. 9, p. 35 (table), 45–52. Described as biotite rhyolite with some quartz latite; occasional underlying lenses of dacite; in places rhyolite overlies fanglomerate or auriferous gravels. Exposures commonly buff to reddish-brown, although some dense glassy facies are lavender; usually light colored, commonly almost white on fresh surfaces. Attains thickness of 450 feet.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 50, pl. 3. Redescribed as light-pink to dull-purple vitric-crystal tuff, tuff-breccia, and welded tuff. Includes a few feet of conglomerate at its base on south slopes of Hartford Hill. Fragments of granitic and metamorphic rocks are common and, in a few places, constitute as much as 10 percent of the rock. Thickness at type locality about 1,000 feet. Some interbedding with overlying Alta formation. Type locality and geographic extent indicated.

Type locality: Hartford Hill, near Silver City. Extensively exposed in Comstock Lode district and south and southwest of Virginia City quadrangle.

Hartgrove Limestone Member (of Talpa Formation)[1]

Permian: Central Texas.

Original reference: W. Kramer, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1579, 1582.

Named from exposure on Mack Hartgrove's Ranch, where it crops out 0.4 mile south of and 37 feet lower than the ground at Eugene Mays well, about 4.5 miles southeast of Paint Rock, Concho County.

Hartland Formation

Hartland Schist[1]

Paleozoic: Western Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 96–100, map.

R. M. Gates, 1952, *in* R. M. Gates and W. C. Bradley, Connecticut Geol. Nat. History Survey Misc. Ser. 5. Termed a formation. Includes variety of rock types from mica quartzites to mica-quartz schists which are interlayered on scale of inches and feet. Locally characterized by crystals of garnet, staurolite, and kyanite. Color varies from metallic silvery gray to dark brownish black. Fine to coarse grained; very schistose to nearly massive. Individual beds few inches to 100 feet thick. Intruded by Mount Tom hornblende gneiss. Cambro-Ordovician.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Subdivided to include the Straits schist member. Age changed to pre-Triassic.

R. M. Gates, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–121. Formation described and mapped in Roxbury quadrangle. Rock types in Hartland separated into three groups: group A, rocks composed of muscovite, biotite, quartz and feldspar without—or with subordinate—garnet staurolite, or kyanite; group B, rocks composed of micas, quartz, and feldspar with prominent garnet, staurolite, and kyanite; group C, various minor types. Intruded by Mount Tom hornblende gneiss. Stratigraphic position of Hartland uncertain. In the north, the Hartland forms east flank of Berkshire Hills, which are considered part of Precambrian core of Green Mountain anticlinorium, and must be Paleozoic in age. From Berkshire Hills southward, the Hartland separated from known Precambrian rocks to west by belt of marble or gneiss, or both, of unknown age—the Woodville marble of Rodgers and others (1956), and Waramung formation of Gates and Bradley (1952) respectively. Paleozoic.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 6–12, pl. 1. Described in Naugatuck quadrangle where it is divided into three parts arranged in probable order decreasing as follows: (1) The Straits schist member (2) undifferentiated Hartland (3) quartzitic member. In most places, intruded and interbanded with granites and granite gneisses of varied compositions. Occurs in belt west and south of Waterbury gneiss. Area here mapped as undifferentiated Hartland was formerly mapped as part of Prospect gneiss (Rice and Gregory, 1906). Prospect gneiss here restricted to dark-gray biotite augen gneiss and excludes interbanded schists which are considered to be part of undifferentiated Hartland. Prospect gneiss occurs between The Straits schist member and quartzitic member of Hartland. Orange phyllite is mapped to east of Hartland. Undifferentiated Hartland intruded by Ansonia granite. Pre-Triassic.

Named for development in Hartland [Township], Hartford County.

Hartland Shale Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 33.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 25. Chalky shale, a few thin beds of chalky limestone and bentonite. Thickness 23

feet in Kearny County to 35 feet in Ellis County. Underlies Jetmore chalk member; overlies Lincoln limestone member.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 115–116, 117 (fig. 42). In Baca County, Colo., consists almost entirely of light-gray chalky shale; locally contains one or more thin beds of dense chalky limestone and a few thin layers of bentonite. Thickness about 30 feet. Underlies Bridge Creek limestone member; overlies Lincoln limestone member.

Named for exposures along Arkansas River from a short distance west of Hartland, Kearney County, to Kendall, Hamilton County, Kans.

Hartley Augen Gneiss[1]

Precambrian: Northern Maryland and southeastern Pennsylvania.

Original reference: E. B. Knopf and A. I. Jonas, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 43, 44.

Ernst Cloos, 1937, Maryland Geol. Survey [Rept.], v. 13, pt. 1, p. 80. Underlies and does not transgress Setters formation.

Named from outcrops at Hartley Mill on Long Green Creek, eastern Baltimore County, Md.

Hartley Shale and Sandstone (in Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 19, pl. 2. Predominantly deep red shales and lesser fine-grained sandstone beds mainly only a few inches in thickness. Towards top of section, small slumped areas in the red shales are indicative of salt which has been dissolved away. Minor gypsum also occurs in section. Thickness 280 feet. Prominent cliff-forming bed of arkosic sandstone at top of Hartley beds is 5–15 feet thick and weathers light brown to white. Underlies Fire Clay Hill bentonitic shale (new); overlies Shinarump formation.

Named from exposures measured northwest of Leeds Cemetery, Silver Reef (Harrisburg) Mining District, Washington County.

Hartline Chert

Upper Mississippian: Southern Illinois.

J. M. Weller, 1944, Illinois Geol. Survey Bull. 68, p. 99. Incidental mention.

J. M. Weller *in* J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 7, 19–20. In Dongola quadrangle, consists of about 50 feet of massive gray novaculitic chert in well-defined beds 1 foot or more thick; chert appears to thin and change in character northwestward. Appears to unconformably overlie Springville shale; relation of Hartline to overlying beds not known because contact was not observed; general succession of strata in outcrops along bluff west of Ullin suggests that Hartline grades upward into cherty Osage limestone.

Well exposed in face of bluff west of Ullin in sec. 21, T. 14 S., R. 1 W., Dongola quadrangle, Union County.

Hartmann Limestone[1]

Hartmann Group

Middle Cambrian: Central northern Utah.

Original reference: James Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 17–21. Rank raised to group. In southern Oquirrh Mountain area, includes Teu-

tonic limestone below, and Herkimer limestone above. Dagmar dolomite, which normally separates the Teutonic and Herkimer, not recognized in area. Constant difference in lithology used as contact. Overlies Ophir group; underlies Bowman limestone.

Named from exposures on western side of Hartmann Gulch (sometimes called Graveyard Gulch), just north of Ophir, Tooele County.

Hartridge Shale (in New River Group)

Hartridge Shale (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Northern West Virginia.

Original reference: D. B. Reger, 1918, West Virginia Geol. Survey Rept. Barbour and Upshur Counties, p. 288.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 229. Dark to black argillaceous laminated shale containing plant fossils. Thickness as much as 5 feet. Underlies lower Guyandot sandstone; separated from underlying Welch sandstone by Sewell coal and unnamed shale interval. Included in New River group, Pottsville series.

Exposed at Hartridge, Randolph County.

Hart School Bed (in Moran Formation)[1]

Permian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 179, 180.

Crops out on road at Hart School, sec. 2969, T. E. and L. survey, 6 miles north of Putnam, Callahan County.

Hartselle Sandstone[1]

Upper Mississippian: Northern, central, and eastern Alabama.

Original reference: E. A. Smith, 1894, Alabama Geol. Survey geol. map of Alabama with explanatory chart.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. In northwestern Alabama, overlies Green Hill member of Pride Mountain formation (both new); underlies Bangor limestone. Thickness about 140 feet in central Colbert County; thins eastward to 10 feet at Monte Sano, Madison County. Consists chiefly of fine-grained sandstone; a few beds of siltstone and shale present at most localities; asphaltic at many places. Contains marine fossils and plant fossils.

Named for exposures at Hartselle, Morgan County.

Hartshorne Sandstone[1] (in Krebs Group)

Pennsylvanian (Des Moines Series): Eastern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 436.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 21–26. Described in Haskell County where it is 100 to 200 feet thick, overlies Atoka formation and underlies McAlester formation. Two coal beds, Upper and Lower Hartshorne coals, associated with the sandstone. Common usage has placed upper boundary of formation at top of first sandstone below Upper Hartshorne coal. Hitherto unrecognized coalescence of the two coals, in northwestern Le Flore and Haskell Counties,

requires redefinition of upper boundary of the Hartshorne; proposed here to include both coals in Hartshorne sandstone. Underlies McAlester formation; overlies Atoka formation.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523, 1524. Basal formation in Krebs group (new).

E. W. Reed, S. L. Schoff, and C. C. Branson, 1955, Oklahoma Geol. Survey Bull. 72, p. 63–65. Described in Ottawa County. Proposed that name Hartshorne be that of the formation which embraces rocks from top of Atoka to top of Upper Hartshorne coal. At type locality, formation consists of Upper Hartshorne coal, "Hartshorne sandstone", Lower Hartshorne coal and underclay, and shale tongues locally developed between those members. Specific sandstone bed called Hartshorne is given its older but seldom used name, Tobusky sandstone (Chance, 1890). In Ottawa County, formation consists of rocks from top of Mississippian to top of Riverton coal, or where coal is absent, to base of Warner sandstone member of McAlester formation.

J. A. Reinemund and Walter Danilchik, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–192. Described and mapped in Waldron quadrangle, Arkansas. As much as 270 feet thick. Consists dominantly of sandstone in lenticular beds that collectively form first continuous sandstone unit below Lower Hartshorne coal bed. Stratigraphic equivalence of Hartshorne in Waldron quadrangle with Hartshorne in Fort Smith district and western Oklahoma is in doubt. It is possible that the true Hartshorne is absent in Waldron quadrangle and that unit herein called Hartshorne is facies of sandstone elsewhere identified as upper part of Atoka. Overlies Atoka formation; underlies McAlester formation.

Named for exposures near Hartshorne, Pittsburg County, Okla.

Hartsville Limestone[1]

Silurian (Niagaran): Southeastern Indiana.

Original reference: J. A. Price, 1900, Indiana Dept. Geol. and Nat. Res. 24th Ann. Rept., p. 84–85.

Charles Schuchert, 1943, Stratigraphy of the eastern and central United States: New York, John Wiley & Sons, Inc., p. 582. Abandoned.

Named for Hartsville, Bartholomew County.

Hartville Formation[1]

Mississippian(?), Pennsylvanian, and Permian: Southwestern Wyoming.

Original reference: W. S. T. Smith and N. H. Darton, 1903, U.S. Geol. Survey Geol. Atlas, Folio 91.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2–5. Condra and Reed (1935, Nebraska Geol. Survey Paper No. 9) subdivided the Hartville into six divisions (I–VI, descending). These divisions are herein named: Fairbank formation (VI), Reclamation group (V), Roundtop group (IV), Hayden group (III), Meek group and Wendover group (II), Broom Creek group and Cassa group (I). Nomenclature problems of Hartville uplift discussed. Term Minnelusa has priority over Hartville.

R. L. Bates, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 10, p. 1986–1990. Smith (1903) applied name Hartville to rocks between Guernsey limestone below and Opeche shale above. Hartville as used in this report is restricted to exclude unit named Fairbank formation by Condra,

Reed, and Scherer (1940). Thickness 1,123 feet in Sand Canyon, Platte County, Wyo. Early Permian (Wolfcamp), Pennsylvanian, and possibly Late Mississippian.

First described and mapped in area around Hartville.

Hartwell Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 244.

Exposed at Hartwell, McDowell County, and quarried one-half mile southeast of Hartwell.

Hartwell Sandstone[1]

Pennsylvanian: Western Arkansas.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Derivation of name not known, but probably named for town of Hartwell, Madison County.

Hartwick dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 150.

Named for Hartwick, Poweshiek County.

Harvard Conglomerate Lentil (of Worcester Formation)[1]

Carboniferous: Eastern Massachusetts.

Original reference: W. O. Crosby, 1876, Rept. on geologic map of Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 1, 20–23, pl. 1. Reassigned to redefined Worcester formation. Lies at base of formation; underlies Vaughn Hills member (new). States type locality as designated by Emerson (1917).

Type locality: Pin Hill in town of Harvard, Worcester County.

†Harvard Granite[1]

Late Carboniferous: Massachusetts.

Original reference: B. K. Emerson, 1889, Geol. Soc. America Bull., v. 1, p. 560.

Harvest Home shale member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 134, table opposite p. 61.

Well exposed along Rock Creek, Greenwood Township, Crawford County, especially at Peterson's Falls on edge of which is located the Harvest Home Grove.

Harvey Conglomerate Lentil (in Sewell Formation)[1]

Harvey Sandstone (in New River Group)

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 77.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 226. Harvey (conglomerate) sandstone 20 to 60 feet thick; medium to coarse grained grayish white or light brown; lenticular, its interval locally occupied in part or entirely by sandy shale. Underlies Iaeger sandstone; locally apparently coalesces with Guyandot sandstone, cutting out intervening Sandy Huff shale and Castle coal.

Named for exposure at village of Harvey (now Bolt post office) on headwaters of Marsh Fork of Coal River, Raleigh County.

Harveyville Shale Member (of Emporia Limestone)

Harveyville Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, southeastern Nebraska, and northern Oklahoma.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 10.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. Rank reduced to member status in Emporia limestone (redefined). Overlies Reading limestone member; underlies Elmont limestone member.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 57–58. Described in Pawnee County where it is 35 to 53 feet thick. Overlies Reading limestone member; underlies Elmont limestone member. Extends southward across Pawnee County into Payne County; southern extent not known.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Geographically extended into southwestern Iowa where it is classified as formation in Wabaunsee group. Where exposed in Fremont County consists of gray shale in lower part, limy nodules near center, and brown shale in upper part. Thickness 3 feet. Underlies Elmont limestone; overlies Reading limestone.

Type locality: Near Harveyville, southeastern Wabaunsee County, Kans.; well exposed in sec. 25, T. 15 S., R. 13 E.

Hasenclever Sandstone Member (of Frankfort Formation)

Upper Ordovician (Cincinnatian): Central New York.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 64, 66. Name proposed for middle member of formation. Composed of finely cross-laminated buff-weathering thin-bedded fine sandstones and interbedded greenish shales. Shale occurring in beds a few inches to 1 foot or more thick normally comprises one-third to one-half of unit's total thickness of 40 feet. Sandstones similar to those in overlying Moyer member (new). Overlies Harter shale member (new) with sharply defined contact.

Typically exposed south of Harter Hill, located near east-central border of Utica quadrangle. Also occurs on Hasenclever Hill about 2 miles southwest of Harter Hill.

Haskell Limestone Member (of Stranger Formation)[1]

Haskell Limestone Member (of Cass Formation)

Pennsylvanian (Virgil Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 130 (fig. 24), 135. In Kansas, commonly 2 to 4 feet thick. Underlies Robbins shale member; overlies Vinland shale member.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 16, 17. In Missouri, overlies Vinland shale member and underlies Lawrence formation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29. In Nebraska, uppermost member of Cass formation. Overlies Little Pawnee shale member (new); underlies Robbins shale. Thickness 12 to 15 feet.

Type locality: On 15th St., NE¼ sec. 5, T. 13 S., R. 20 E., at eastern edge of Lawrence, Douglas County, Kans. Named from Haskell Institute.

Haskew Gypsum Member (of Blaine Formation)[1]

Permian (Leonard Series): Northwestern Oklahoma and southern Kansas.

Original reference: N. Evans, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 402–432.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1798. Geographically extended into southern Kansas where it is about 1 foot thick and is exposed about 5 feet above Shimer gypsum member, red shales separating the beds.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 31–33. Uppermost member of Blaine. In Harper County, consists of 4 feet of gypsum underlain by 4 feet of brownish-red shale. Overlies Shimer member.

Named for exposures near old store known as Haskew Store, NE cor. sec. 2, T. 25 N., R. 19 W., Woodward County, Okla.

Hasmark Formation[1] or Dolomite

Upper Cambrian: Western Montana.

Original reference: F. C. Calkins and W. H. Emmons, 1913, U.S. Geol. Survey Prof. Paper 78.

Christina Lochman and Donald Duncan, 1944, Geol. Soc. America Spec. Paper 54, p. 13–14. Upper Cambrian section at Philipsburg correlated with section at Mount Helena and name Hasmark extended into area. Thickness about 500 feet. Underlies unit correlated with Red Lion formation.

W. T. Holser, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1058 (table 1), 1061. Hasmark dolomite, in Philipsburg region, consists of limestone, light blue-gray to white weathering buff to white, aphanitic to fine-grained, massive; dolomitic. Average thickness about 900 feet, but thinning to 350 feet near intrusives. Overlies Silver Hill formation; underlies Red Lion formation.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2140 (fig. 5), 2144–2145. Formation described in extreme southwestern Montana. Name has priority over term Maurice which is considered equivalent. Unit is as much as 242 feet thick. Underlies Red Lion formation and is transitional into underlying Park shale.

Named for abandoned settlement southeast of Philipsburg, Granite County.

Hastings Creek Formation[1] or Limestone

Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 398–399. Overlies Morgan Corner[s] dolomite; underlies Naylor Ledge limestone. Thickness 315 feet. Phillipsburg series. Beekmantown.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

†Hatbox Tongue (of Chandler Formation)

Lower Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 164, figs. 2, 3. Lower part of nonmarine Chandler formation (new) and lies between marine Tuktu and Topagoruk members (new) of Umiat formation (new). Approximately 3,000 feet thick at type locality and wedges out northward.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 237, fig. 4. Renamed the Killik tongue (new), and type locality changed because sequence is better exposed along Killik River than at Hatbox Mesa.

Type locality: Hatbox Mesa in Chandler River drainage, in northern Foothills section of Arctic Foothills province.

Hatch Shale Member (of West Falls Formation)

Hatch Formation (in Naples Group)

Hatch Shale[1]

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1903, New York State Mus. Bull. 69, p. 1005, map.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Luther (1903) applied name Hatch flags and shales to sequence of rocks below his Grimes sandstone and above his Rhinestreet shale. The sequence of rocks is here designated Hatch shale member of West Falls formation (new). Composed of medium-dark-gray and dark-gray silty shale containing many layers of even-bedded to crossbedded siltstones, ranging from laminae to beds 1½ feet thick, and some layers of black shale. Muddy limestone concretions and calcareous siltstone concretions present, mainly in lower part of member. Thickness about 160 feet at Calabogue Gulf; 342 feet in Conklin Gully on Hatch Hill; 370 feet in Big Gully; 400 feet in Urbana Glen. Underlies Grimes siltstone member; where Grimes is absent, Hatch cannot be distinguished from Gardeau shale member; overlies Rhinestreet shale member.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2826. Hatch shale member can be traced from type exposures near Naples at south end of Canandaigua Lake eastward to vicinity of Van Etten, south of Cayuga Lake. Hatch constitutes much of lower part of Cayuta shale member of Chemung formation (Williams, 1906) in area around Van Etten.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 11, 19–20. Uppermost formation in Naples group. Overlies Rhinestreet black shale; underlies Grimes sandstone.

Named for Hatch Hill, at Naples, Ontario County.

Hatchetigbee Formation (in Wilcox Group)[1]

Eocene, lower: Southern Alabama and eastern Mississippi.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 39–43.

M. V. Foster, 1940, Mississippi Geol. Survey Bull. 41, p. 14, 61–66. Lowe (1933, Mississippi Geol. Survey Bull. 25) described unconformity between lignitic sands and clay-shales of typical Hatchetigbee and thick red sand which immediately underlies the claystone in Mississippi and limited formation to that section lying between basal Claiborne sands and the Bashi. It is in latter sense that term has since been used in Mississippi. In Lauderdale County, composed of lignitic sands, sandy silts, and silty or sandy clays interbedded one with the other. Commonly, basal part of formation is more sandy than upper part. In some areas, separable into two members: an upper composed of clay-shale, including one well-developed lignite bed 1 to 2½ feet thick, and a lower member composed of relatively fine- or medium-grained sand locally grading down into coarse grit-bearing sand. Thickness 75 to 150 feet. Overlies Bashi formation; underlies Meridian formation.

F. S. MacNeil, 1944, Southeastern Geol. Soc. [Guidebook] 2d Field Trip, p. 27–28. Proposed that Hatchetigbee be expanded to include Bashi marl at base.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 21–22. Uppermost formation of Wilcox group in Alabama. At type locality is a fossiliferous exposure at crest of Hatchetigbee anticline, downdip from main outcrop. Unfossiliferous along main outcrop above Bashi marl member (restricted to exclude sands, shales, and lignites included in Tuscahoma sand). Thickness about 150 feet in western Alabama; thins to east to less than 15 feet at Chattahoochee River. Overlies Tuscahoma sand.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 178–188, pls. 1, 5. Described in Kemper County, where it consists of fine-grained gray and olive sands and brown or chocolate-colored carbonaceous clays more or less interbedded and containing lignite seams. Bashi marl member is primarily a glauconitic sand containing fossil prints. Thickness about 100 feet. Overlies Tuscahoma sand. Wilcox group. Historical summary of usage of name.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 19–22, 141–145, pls. Described in Wilcox County, Ala., where it is about 250 feet thick. Includes Bashi marl member at base. Overlies Tuscahoma sand; underlies Tallahatta formation.

Named for exposures at Hatchetigbee Bluff, on Tombigbee River, in sec. 16, T. 18 N., R. 1 W., Washington County, Ala.

Hatchet Mountain Formation

Eocene, upper: Southwestern Washington.

M. H. Pease, Jr., and Linn Hoover, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–188. Named on correlation chart. Overlies Cowlitz formation; underlies Toutle formation (new). Name credited to A. E. Roberts (in press).

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (chart), 19–24, pl. 1. Consists of lava flows, flow breccias, pyroclastic rocks, and tuffaceous

sedimentary rocks. Thickness more than 2,750 feet. Overlies Cowlitz formation; unconformably underlies Toutle formation.

Typically exposed in vicinity of Hatchet Mountain in secs. 30 and 31, T. 11 N., R. 2 E., and secs. 25 and 26, T. 11 N., R. 1 E., Toledo-Castle Rock district. Exposed along both flanks of Napavine syncline.

Hatch Hill Formation

Upper Cambrian: Eastern New York.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 53, 55. Applied to unit consisting of sooty-black pyritic rusty-weathering shales interbedded with rotten-weathering bluish dolomitic sandstones. Locally crossbedded and characteristically traversed by numerous quartz veins. Overlies West Castleton formation; underlies Lower Ordovician Poultney formation. Contains graptolite fauna considered to be Upper Cambrian.

Type locality: Western flank of Hatch Hill in Thorn Hill quadrangle, Washington County.

Hat Creek Basalt

Recent: Northern California.

C. A. Anderson, 1940, Am. Jour. Sci., v. 238, no. 7, p. 477–492. Name applied to basalt erupted along a line of north-south fissures north of Lassen Peak.

Occurs in Hat Creek valley about 10 miles north-northeast of Lassen Peak.

Hat Creek Beds[1]

Oligocene, middle: Wyoming.

Original reference: H. F. Osborn, 1918, Am. Mus. Nat. History Mem., new ser., v. 2, pt. 1, p. 11.

Hathaway Formation

Middle Ordovician: Northwestern Vermont.

David Hawley, 1957, Geol. Soc. America Bull., v. 68, no. 1, p. 58, 68–77. Includes argillite and bedded radiolarian cherts, commonly intensely deformed, with included small fragments to large blocks of quartz sandstone, coarse graywacke, dolomite, limestone, and chert. Considered a submarine slide breccia. Thickness more than 100 feet. Overlies Iberville formation.

Named for Hathaway Point on southeastern St. Albans Point, St. Albans quadrangle. Also exposed on several nearby islands in Lake Champlain.

Hathaway Formation[1]

Pliocene, lower(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pubs., Dept. Geol. Sci., v. 13, no. 9, p. 344, 375, 376–378, 384, map.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 324 (fig. 2), 325 (table 1), 326–327, pls. 2, 3. Redefined and restricted to exclude sedimentary rocks north of Banning (included by Vaughan in original description). Paleontological evidence shows these rocks to be much younger than type Hathaway in Lion Canyon, and they are assigned tentatively to San Timoteo formation. As redefined, consists of two unnamed members: a lower, 1,100 feet thick, consisting of tan to light-gray arkosic sandstone with subordinate siltstone and lenticular beds of conglomer-

ate; and an upper, 650 feet thick, consisting of massive conglomerate and breccia. Conformably underlies Imperial formation; map shows Hathaway in fault contact with San Gorgonio igneous-metamorphic complex. Type section designated.

Type section: In main branch of Lion Canyon, north of Cabazon, Riverside County. Named for Hathaway Creek, on and near which it is exposed.

Hato Puerco Tuff[1]

Upper Cretaceous(?): Puerto Rico.

Original reference: H. A. Meyerhoff and I. F. Smith, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 272.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 40, 60 (table 7). Thickness 4,000 feet. Underlies Guaynabo formation; overlies Guzman formation. In some areas, the tuffs are in juxtaposition with Lower Cretaceous Río de la Plata series.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 3), 10 (fig. 4), 11–12, pl. 2. Recognized in San Juan area, although Guzman formation does not outcrop, and Guaynabo is herein redefined. Consists characteristically of massive pyroclastic rocks with thick sections of flow rocks; some well-bedded to obscurely bedded tuffs, prevailingly green to dark blue. Shows somewhat higher degree of regional metamorphism than later rocks. No estimate of thickness made owing to massiveness of formation. Unit probably formed main mass of volcanic cone or complex. No fossils found. Meyerhoff and Smith thought entire older complex of Puerto Rico to be within Upper Cretaceous. Recent work has revealed that Paleocene or early Eocene faunas, as well as Late Cretaceous faunas occur in older complex (Kay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1). At present time, age of Hato Puerco is designated Late Cretaceous(?).

Named for Barrio Hato Puerco situated on Río Canovanillas midway between Barrio Guzman Abajo and Trujillo Bajo, Fajardo district.

Hatter Limestone, Formation, Group

Middle Ordovician: Central Pennsylvania.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1964. In Cumberland Valley, Mercersburg limestone (new) is separated from Shippensburg limestone (new) by Hatter limestone and Snyder member of Benner limestone.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Dark siliceous limestone, 96 feet at type section. Underlies Loysburg formation. "Carlim group", Chazyan(?) series.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 191 (fig. 2), 193; 1944; Jour. Geology, v. 52, no. 1, p. 3 (fig. 2), 6–14. Subdivided into (ascending) Eyer, Grazier, and Hostler members (all new). Thickness 102 feet at Union Furnace. Overlies Clover member of Loysburg formation; underlies Snyder member of Benner limestone. Chazyan.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1198–1199. Hatterian, lower part of Bolarian series (new), comprises in Virginia: Ward Cove, Peery, and Benbolt limestones; and in Pennsylvania: Eyer, Grazier, and Hostler limestones. In New York and Ontario, the Pamelia is thought to be facies of the higher Hatterian. Upper Bolarian is Hunterian (new).

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1406–1407. Rocks between Lincolnshire limestone, or in its absence, the Five Oaks or Clover calcilutite and top of Hostler, or correlated Benbolt limestone, form rather constant time-stratigraphic unit that loses older beds northward along east side of Allegheny synclinorium. Name Hatter was applied to rocks in this sequence in Pennsylvania as formational name. Subsequently the Hatter was divided into three members: Eyer, Grazier, and Hostler; these can be classed as formations in a group. About the same time, Ward Cove, Peery, and Benbolt formations were described in Tazewell County, Va., the first two assigned to Cliffield group. Relations of the two sequences were not considered; the three Virginia units were thought to be represented in the Hatter, though the lower incomplete. Proposed that Hatter be considered a group or subseries comprising rocks younger than post-Lincolnshire regional unconformity, and older than top of Hostler and Benbolt formations, though essentially synchronous. The Hatterian forms lower and older part of Bolarian series-epoch. Older than Hunterian group or subseries.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 82. Name Hatter formation can be applied in Pendleton County, W. Va., to rocks between Lincolnshire and McGlone limestone (new) where it is not possible to recognize Ward Cove, Peery, and Benbolt formations; also referred to Hatterian stage. Bolarian series.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7. Name Bolarian includes two divisions—Hatterian and Hunterian. These terms are unsatisfactory to show relationships as understood in this report. Hatter formation, whose time designation is Hatterian, appears to be same as Hunterian if, as shown in this report, the Hatter is equivalent to Ridley formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as Hatter formation.

Type section: Hatter Creek, north of Roaring Spring, Blair County, Pa.

Hatterian Subseries or Stage

See Hatter Limestone or Group.

Hattiesburg Clay[1]

Miocene, lower and middle: Coastal Plain of Alabama, Mississippi, Louisiana, and Texas.

Original reference: L. C. Johnson, 1893, Science, v. 21, p. 90–91.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart of outcropping Tertiary formations of eastern Gulf region shows Hattiesburg clay above Catahoula sandstone and below Pascagoula clay. Exact equivalence of the Pascagoula and Hattiesburg clays with any of named formations of Florida has not been demonstrated.

Named for exposures at Hattiesburg, Forrest County, Miss.

Hatton Tuff Lentil (of Stanley Shale)[1]

Mississippian (Meramec): Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. D. Miser, 1920, Geol. Soc. America Bull., v. 31, p. 125.

W. H. Hass, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1582. Paleontological evidence suggests that Hatton tuff is Meramec in age.

Well exposed in cut of Kansas City Southern Railway half a mile south of Hatton, Polk County, Ark.

Hauns Bridge Group[1]

Upper Devonian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 92.

Named for 1,000-foot exposure at Hauns' Bridge in Juniata Township, Huntingdon County.

Haupu Formation (in Waimea Canyon Volcanic Series)

Haupu Volcanic Series

Pliocene(?): Kauai Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 85 (table), 87. Composed of an extra-caldera or lower member of thin-bedded primitive-type olivine basalts dipping 8° to 15° away from central vent and an upper member of horizontal massive basalts filling a caldera 1½ miles across. Upper and lower members separated by partly exhumed fault scarp and talus breccia. Series is remains of independent volcano about 2,300 feet high on side of ancient Waimea volcano. Separated from underlying Waimea volcanic series by zone of weathering and from overlying Koloa series by angular erosional unconformity.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954. Volcano Letter 526, p. 2; D. A. Davis and G. A. Macdonald in Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 87. Included in Waimea Canyon series. Caldera member designated Haupu formation; extra-caldera member unnamed. Maximum thickness formation 1,850 feet; base not exposed. Approximately coeval with Olokele formation (new) and later than most of Napali formation (new). Pliocene(?).

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 40–42, table facing p. 20, pl. 1. Haupu volcanic series (Stearns, 1946) herein restricted to rocks occupying small filled caldera in Haupu Ridge and named Haupu formation of Waimea Canyon volcanic series. Rocks of formation surrounded by lavas of Napali formation, and separated from them by buried caldera walls. Base not exposed; maximum exposed thickness 1,850 feet. Formation and filling of Haupu caldera believed to have taken place contemporaneously with eruption of upper portion of Napali formation, or Olokele formation. Probably Pliocene.

Type locality: Southern side of Haupu Ridge, between Haupu Peak and a point 0.3 mile east of Kamaulele Peak.

Havallah Formation

Pennsylvanian and Permian: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Intertonguing chert, slate, and quartzite with some limestone lenses and quartzose grit; rare greenstone near base. Quartzite, light-brown, very fine and even-grained; locally cross-

bedded and conglomeratic near base. Limestone grades into calcareous slate or into coarse sandstone with calcareous matrix. Chert is evenly bedded, mostly light colored. Incomplete section at type locality exceeds 10,000 feet. Underlies Koipato formation with major angular unconformity and overlies Pumpernickel formation (new) with contact gradational. Permian(?) (Wolfcamp and possibly Leonard).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2824 (fig. 5), 2847–2848. Pennsylvanian and Permian.

Type locality: On ridge south of Hoffman Canyon in Tobin Range, Golconda quadrangle. Named for Havallah Range which is Indian name for Tobin Range (40th Parallel Atlas).

Havasu Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 109–110. Variable in lithology, consisting of mottled, aphanitic limestone in places, and mottled, fine-grained dolomite elsewhere. In general, limestone forms lower beds and dolomite forms upper, but relative positions and amount of each type not constant. Much of the dolomite is red or pink, mottled with tan. Upper limit marked by group of thin carbonate beds. At type locality, forms sheer cliff overlying narrow bench marked by flat-pebble conglomerate. Thickness throughout most of Grand Canyon about 100 feet but in extreme western part averages closer to 120 feet. Top member of formation in Grand Canyon area; younger than Gateway Canyon member (new).

Type locality: Near mouth of Havasu Canyon, in Grand Canyon.

Havasupai sandstones (in Aubreyan series)[1]

Carbonic: Northern Arizona.

Original reference: C. [R.] Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 336.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart), 223. Overlies Huethawali limestone. Carbonic age.

Probably named for Havasupai Point. Best exposed in rim wall near Bass Camp, west of El Tovar, Grand Canyon.

Havensville Shale Member (of Wreford Limestone)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 32.

D. E. Hattin, 1957, Kansas Geol. Survey Bull. 124, p. 39–43. Middle member of formation; overlies Threemile limestone member; underlies Schroyer limestone member. Condra and Upp (1931) state that thickness of Havensville at type locality is 18 to 19 feet, but 5 feet of shale and limestone at base is not definitely assigned to either the Threemile or the Havensville. These questioned beds are here included in Havensville. Also, at type locality, a limestone bed and overlying shale unit, both included as lower 3 feet of Schroyer limestone by Condra and Upp, are lithologically and paleontologically part of the Havensville. Thus, thickness of Havensville at type locality is 27 feet. Thickness varies from north to south across State; minimum thickness 1½ feet in Chase County.

Type locality: In cuts on Highway 63 about 2 miles south of Havensville, Pottawatomie County, Kans.

Haverhill Granodiorite

Upper Devonian(?) : West-central New Hampshire.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500) : New Hampshire Highway Dept. Described as medium-grained white or gray granodiorite, locally weakly foliated. Included in New Hampshire magma series.

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 143, 148, pl. 1. Consists of two small stocklike masses of biotite granodiorite in Mount Cube area. Slightly finer grained aplite dikes are associated with northern body. Represents latest intrusions of New Hampshire magma series in this area. Structurally and petrographically similar to larger body south of town of Haverhill in Woodsville quadrangle.

Exposed in western part of Orford Township, Grafton County.

Hawaiiloa Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper : Oahu Island, Hawaii.

Original reference : H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6. Océanie, fasc. 2. p. 87–88. Cinder cone and lava flow of melilite-nepheline basalt; lava appears to be subaerial. Flow more than 100 feet thick; cone 337 feet high above sea level, base not exposed. Unconformably underlies Ulupau tuff. Extent noted.

Named for Puu Hawaiiloa, cinder cone at source of flow. Covers about 0.75 square mile on western part of Mokapu Peninsula, on northeast coast of Oahu about 13 miles northwest of Makapuu Head.

Hawarden shale[1]

Upper Cretaceous : Northwestern Iowa.

Original reference : C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148.

Probably named for Hawarden, Sioux County.

Hawi Volcanic Series

Pleistocene : Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 173 (table), 178–180; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 88. Lavas chiefly oligoclase andesites with several flows of trachyte and one of andesine andesite. Flows 10 to 150 feet thick and average about 40 feet. Total thickness about 500 feet. Separated from underlying Pololu volcanic series (new) by erosional unconformity. Overlain by Pahala ash and overlapped by lavas of Hamakua volcanic series.

Type locality : Kohala Sugar Co. quarry at 400 feet altitude in Kumakua Gulch, near Hawi, on north slope of Kohala Mountains. Covers summit area and part of slopes of Kohala Mountains. Name derived from Hawi, main town on mountain.

Hawkeye Granite Gneiss

Hawkeye Granite[1]

Precambrian : Northern New York.

Original reference : W. J. Miller, 1919, Jour. Geology, v. 27, p. 29; 1919, Econ. Geology, v. 14, p. 512.

A. W. Postel, 1952, U.S. Geol. Survey Prof. Paper 237, p. 8–10, 37 (table), pl. 1. Termed granite gneiss. Has pronounced phacoidal texture; strongly foliated. Miller described Hawkeye granite as facies of his Lyon Mountain granite, but it is here considered to be an older separate unit. Interpreted as having been intruded into original Grenville series.

A. W. Postel, C. L. Dodson, and L. D. Carswell, 1956, U.S. Geol. Survey Geol. Quad Map GQ–63. Granite gneiss described and mapped in Loon Lake quadrangle. Commonly a dark-greenish coarse well-foliated phacoidal-textured rock composed of quartz and feldspar, with lesser amounts of pyroxene, hornblende, and biotite. In some areas, lacks planar foliation and is rod or pencil gneiss. Locally fresh rock is pink instead of greenish.

Named for exposures just east of Hawkeye post office. Clinton County. Forms major anticlinal bodies in Lyon Mountain quadrangle.

Hawkhill Formation

Eocene, middle: Northern California.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Consists of four members: lower siltstone 110 feet thick, lower sandstone 160 feet thick, upper siltstone 650 feet thick, and upper concretionary fine sandstone 270 feet thick. Disconformable with underlying Cretaceous strata and with overlying Eocene strata referred to Domengine formation.

Type section: Exposed in roadcuts near Hawkhill in Mount Diablo Park on south side of Mount Diablo.

Hawkins Formation[1]

Pre-Jurassic(?): Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Prof. Paper 19.

C. A. Lamey and P. E. Hotz, 1952, U.S. Geol. Survey Bull. 978–B, p. 30, pl. 9. Dark greenish-gray altered rock resembling greenstone. Pre-Jurassic(?).

R. C. Ellis, 1959, Dissert. Abs., v. 20, no. 3, p. 990. Rocks of Mount Stuart block, Dutch Miller Gap area, are exposed along east margin of map area and consist of Hawkins greenstone, Ingalls peridotite (new), and Mount Stuart granodiorite.

Makes up Hawkins Mountain, Mount Stuart quadrangle.

Hawkins limestone[1]

Cambrian: Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 8.

Exposed in Grant County.

Hawkins Limestone Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 133. Basal member of formation. Thin-bedded brown limestone as much as 9 feet thick. Underlies Keel limestone member (new); unconformably overlies Sylvan shale.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 9. Replaced by name Ideal Quarry member; name Hawkins preoccupied. States Maxwell's type locality for Hawkins.

Type locality: NE¼ sec. 8, T. 2 N., R. 6 E., about one-fourth mile southeast of Chimneyhill Creek, Pontotoc County.

Hawkins Creek Member (of Modin Formation)

Upper Triassic: Northern California.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert., v. 27, p. 436. Lowest member of formation. Underlies Devils Canyon member (new); overlies Brock shale.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 9–10, pl. 1. Formal proposal of name. Consists of series of beds of volcanic material in form of conglomerate, agglomerate, volcanic breccia, and tuff. Maximum thickness about 900 feet. Underlies Devils Canyon member: overlies Brock shale.

Type area: Section in Devils Canyon beginning at contact with overlying Devils Canyon member about 1 mile west of confluence of Devils Canyon and Alder Creek, extending west along Devils Canyon to contact with Brock shale, Big Bend quadrangle. Shasta County. Named from exposures near head of Hawkins Creek in vicinity of Little Meadows.

Hawkins Point Clays[1]

Lower Cretaceous: Northeastern Maryland.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 334.

Occur at Hawkins Point on lower Patapsco, where they form extensive cliff 40 feet high, with width along shore of nearly one-half mile toward Swan Creek, Anne Arundel County.

Hawley Schist[1]

Ordovician: Northwestern Massachusetts and southeastern Vermont.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 163–171, pl. 34, map.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 2. Shown on correlation chart of east Vermont above Savoy formation and below Shaw Mountain formation.

Named for exposures in Hawley Township, Franklin County, Mass.

Hawleyville Granite Gneiss[1]

Precambrian(?): Western Connecticut.

Original reference: W. M. Agar, 1934, Am. Jour. Sci., 5th, v. 27, p. 355.

Northwest of Hawleyville, Fairfield County.

Hawpatch (glacial) Gravel and Sand[1]

Pleistocene: Southeastern Indiana.

Original reference: M. N. Elrod, 1882, Indiana Dept. Geol. and Nat. History 11th Ann. Rept., p. 156–158.

Occurs in Bartholomew County from Flat Rock River on northwest and Haw Creek on southeast, and reaches from White River bottoms to Shelby County.

Hawthorn Formation (in Alum Bluff Group)[1]

Hawthorn facies (of Alum Bluff Stage)

Miocene, lower and middle: Central northern, northern, and southern Florida, southern and southeastern Georgia, and South Carolina.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 81–82, 107–112, 157, 158, 326.

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 89–98, pl. 1. Name Hawthorn here applied to widespread formation, to different part of which Veatch and Stephenson (1911, Georgia Geol. Survey Bull. 26) applied names Alum Bluff formation, Marks Head marl, and Altamaha (Lafayette) formation (part). Thickness about 300 feet; thickest near Florida line, from which it extends northward as thinning sheet. Supposed to lie conformably on Tampa limestone, but overlaps beyond the Tampa on Suwannee limestone, Flint River formation, Cooper marl, and Barnwell formation.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 144–161. Formation, in northern Florida, consists chiefly of gray phosphatic sand and lenses of green or gray fuller's earth. Probably lies conformably on Tampa limestone and unconformably on older formations. Merges westward into Chipola formation and probably includes equivalents of Shoal River formation; unconformably underlies Duplin marl.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 39, 45. Considered lithofacies of Alum Bluff stage.

M. H. Bergendahl, 1956, U.S. Geol. Survey Bull. 1030–B, p. 69–73, pl. 1. Formation, as used in this report [De Soto and Hardee Counties], includes all marine rocks in central and southern peninsular Florida that are younger than Tampa limestone, of early Miocene age, but older than lowermost sediments of late Miocene age. Lower and middle Miocene.

C. W. Hendry, Jr., and J. E. Yon, Jr., 1958, Florida Geol. Survey Rept. Inv. 16, p. 29, 31–32, 34. Hawthorn referred to as a formation and as a facies of Alum Bluff stage. Facies overlies Chattahoochee facies of Tampa stage.

K. B. Ketner and L. J. McGreevy, 1959, U.S. Geol. Survey Bull. 1074–C, p. 65–71. Hawthorn of this report [area between Hernando and Hardee Counties] includes formation as described by Cooke (1945), middle Miocene rocks in hard-rock phosphate belt including those generally assigned to Alachua formation, and middle Miocene rocks in land-pebble phosphate district including noncalcareous rocks which have not always been distinguished from Bone Valley formation. Middle Miocene.

Named for exposures at Hawthorn, Alachua County, Fla.

†Hawthorne Formation[1]

See **Hawthorn Formation,** the approved spelling.

Hawxby Shale Member (of Onaga Shale)

Hawxby Shale[1] (in Admire Group)

Hawxby Shale Member (of Chicago Mound Formation)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: R. C. Moore and G. E. Condra, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., classification chart.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 37. Member of Chicago Mound formation (new). Underlies Falls City member; overlies Aspinwall member. Thickness 10 to 12 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Reallocated to member status in Onaga shale (new). Overlies Aspinwall limestone member; underlies Falls City limestone.

Type locality: Hawxby Farm, SE¼ sec. 7, T. 4 N., R. 15 E., about 5 miles west of Nemaha, Nemaha County, Nebr.

†Haybro Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell report was not published. Name Haybro Formation appeared in bold face in Wilmarth Lexicon on basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used name Haybro Formation on Cretaceous correlation chart and cited Wilmarth Lexicon. U.S. Geological Survey has abandoned the name Haybro Formation.

Named for exposures at coal-mining village of Haybro, in Yampa coal field.

Hay Creek Formation[1]

Lower Cretaceous: Western South Dakota and northeastern Wyoming.

Original reference: W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 593, fig. 122, map.

Probably named for Hay Creek, Crook County, Wyo., and Butte County, S. Dak.

Hayden Group

Pennsylvanian (Des Moines): Eastern Wyoming and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3, 22, 45, fig. 10. Consists mostly of dark-gray to black sandstones, shales, and dolomites. Some red sandstone. Comprises Division III of Hartville "formation" (Condra and Reed, 1935). Thickness 120 feet. Underlies Meek group (new); overlies Roundtop group (new).

Type locality: Hayden Cliff, sec. 22, T. 27 N., R. 66 W., Platte County, Wyo.

Hayden Branch Formation

Upper Pennsylvanian: Southwestern Indiana and southeastern Illinois.

C. A. Malott *in* K. A. Payne, 1937, Jour. Paleontology, v. 11, no. 4, p. 276, 277, 279. At type locality, includes 6 inches of underclay, 1 inch of coal, 1 inch of very fossiliferous soft gray shale containing ostracodes, and 6 inches of dark fossiliferous limestone with black phosphatic concretions that weather white. Separated from overlying Merom sandstone by an interval of shales and sandstones; separated from underlying Murphys Bluff sandstone (new) by 4 feet of gray shale.

Type locality: In north-central part of sec. 10, T. 8 N., R. 10 W., Turman Township, Sullivan County, Ind. Crops out in bed of Hayden Branch about 100 yards south of section-line road which crosses Hayden Branch about three-fourths mile east of town of Dodds Bridge.

†Hayden Gulch Sandstone Member (of Haybro Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell report was not published. Name Hayden Gulch Member appeared in bold face in Wilmarth Lexicon on basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used name Hayden Gulch on Cretaceous correlation chart, and cited Wilmarth Lexicon. U.S. Geological Survey has abandoned the terms Haybro Formation and Hayden Gulch Sandstone Member.

Named for exposures in Hayden Gulch, Yampa coal field.

Hayden Peak Latite[1]

Tertiary: Southern Colorado.

Original reference: H. B. Patton, 1916, Colorado Geol. Survey Bull. 9, p. 21–63.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, the volcanics in order of succession are Rawley andesite, Bonanza latite, Squirrel Gulch latite, Porphyry Peak rhyolite, and Bremer [Brewer] Creek latite. In South Bonanza district, the volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and Bonanza latite is replaced by Hayden Peak latite.

Occurs on summit of Hayden's Peak and North Hayden's Peak, Saguache County.

Hayes Canyon Member (of Devils Gate Limestone)

Middle and Upper Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 49–50, 51, pl. 2. Made up mostly of thick-bedded limestones containing biostromes of corals. Basal bed is dark-gray oolitic argillaceous ostracod bearing limestone that in most places weathers to shades of pink. Upper 150 feet or so consist of limestone beds that average about a foot in thickness, many of which contain stringers or lenses of dark chert. Thickness 780 feet in northern part of Newark Mountain. Contact with underlying Meister member (new) marked by basal oolitic limestone bed. Boundary with overlying Pilot shale is sharp, but no evidence of unconformity at contact.

Well exposed along crest of Newark Mountain and named from Hayes Canyon, which drains west slope of Mountain, vicinity of Eureka, White Pine County.

Hayes River Beds[1]

Tertiary: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 172–173, 184.

Named for exposures along Hayes River near junction with Skwenta.

Hayfield Limestone[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1925, Geol. Soc. America Bull., v. 36, p. 463, 464.

Type locality: Hayfield Township, Crawford County.

Hayfield monothem[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Palentology, v. 21, no. 71, p. 103, 116–119.

Hayfield Shale[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Name invalid because unit is found to be Bedford shale in present investigation; name Bedford has priority. Validity of included Littles Corners [Littles Corner] limestone as a unit questioned.

Type locality: In Hayfield Township, Crawford County.

Hay Flat Limestone (in Bisbee group)

Cretaceous (Albian): Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 296, 297 (table). Consists of massive limestone. Younger than Mural limestone; older than Molly Gibson formation (new).

Hay Fork Beds[1]

Miocene: Northwestern California.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 43–44.

Occurs near town of Hay Fork, Trinity County.

Hay Hollow Sandstone Lentil (in Tallant Formation)

Hay Hollow Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: M. I. Goldman and H. M. Robinson, 1920, U.S. Geol. Survey Bull. 686–Y, p. 362–363.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 39. Reallocated to Tallant Formation. Described as a lens of little lateral extent near top of formation.

Named for occurrences along upper part of Hay Hollow in secs. 25 and 36, T. 28 N., R. 11 E., Osage County.

Haymaker Beds[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1934, Geol. Soc. America, Prel. list of titles and abstracts of papers to be offered at 47th Ann. Meeting, Rochester, N. Y., Dec. 27–29, 1934, p. 12.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown as uppermost unit in Chadakoin formation. Underlies Panama conglomerate; overlies Tanner Hill [Tanners Hill].

Occurs on Genesee-Olean meridian in Genesee River region.

Haymeadow Creek Member (of Trenton Formation)

Middle Ordovician: Northern Michigan.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14. Uppermost member of formation. Overlies Groos Quarry member (new) although actual contact not observed. Underlies Bills Creek beds and formerly considered basal part of them. Consists of

shale that differs from typical Bills Creek shale in that it is darker and does not weather with light-gray surface.

Probably named for exposures along Haymeadow Creek, near Rapid River, Delta County.

Haymond Formation[1]

Lower Pennsylvanian: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 46.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 64–73, pls. 10, 15, 16, 23, 24. Consists mostly of layers of sandstone and carbonaceous shale a fraction of an inch to several inches thick, in regular rhythmic alternation; there are a few thicker sandstone beds at long intervals, and near base some thick bodies of shale. Upper part contains thick layers of massive arkose, and in syncline east of Haymond station are several members of boulder-bearing mudstone as much as 150 feet thick. Thickness locally exceeds 3,000 feet. Overlies Dimple limestone; underlies Gaptank formation. No exposure known where there is complete and uninterrupted sequence from base to top.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 289 (fig. 1). Chart shows Haymond formation in Atokan or Derryan stage.

Named for exposures northwest and southeast of Haymond, Brewster County. Exposed in two synclines; both are broad and open but overturned and faulted on southeast.

Haynesville Formation

Upper Jurassic: Subsurface in Louisiana, Alabama, Arkansas, Mississippi, and Texas.

T. H. Philpott and R. T. Hazzard, 1949, *in* Shreveport Geol. Soc. Guidebook 17th Ann. Field Trip. fig. 5 (correlation chart). Shown on chart with basal Buckner member. Unconformable below Bossier formation; overlies Smackover formation.

L. A. Goebel, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1978–1979. Name proposed for red sands, shales, and anhydrite formerly included in basal part of Cotton Valley formation but separated from gray sands, silts, and variegated shales in upper part of that formation by major unconformity. Thickness varies from 400 feet in some wells to more than 2,000 feet as in Hunt Oil Co. No. 1, sec. 3, T. 23 N., R. 7 W., Claiborne Parish, La.

Type area; Wells in Haynesville oil field, northern Louisiana.

Haynies Limestone[1] Member (of Deer Creek Limestone)

Pennsylvanian (Virgil Series): Southwestern Iowa and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 49, 50.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 22. Underlies Burroak shale member; overlies Larsh shale member. [Not treated as a subdivision of Deer Creek by Kansas Geological Survey].

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. In Missouri, uppermost limestone of Deer Creek may include Haynies limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 17–18, fig. 5. Well exposed in outcrops and quarries near Pacific Junction, Mills County, where it is a single massive bed, dark-gray, argillaceous, and fossiliferous. Thickness 1 foot or less. Underlies Burroak shale; overlies Larsh shale. Where Haynies is absent Burroak and Larsh shales coalesce and are difficult to differentiate.

Type locality: In Missouri River bluffs southeast of Haynies Station, Mills County, Iowa.

Hay Ranch Formation

Pliocene, middle, to Pleistocene, middle: Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1199–1203. Consists of lake deposits of clay, vitric tuffs (mostly altered to zeolites), limestone, and tan tuffaceous siltstones and sandstones, which interfinger with conglomerates and fanglomerates. Except for northern part of valley, where it dips about 15° E., formation is essentially undisturbed. Overlain by extensive deeply dissected pediment Structural evidence indicates formation is thick. By correlating outcrops in southern part of area, a 420-foot section was measured. Overlies Carlin formation (new).

Named for Hay Ranch in NW¼ T. 29 N., R. 52 E., vicinity of Carlin. Covers most of floor of Pine Valley.

†Hays Limestone Member (of Niobrara Formation)[1]

Upper Cretaceous: Western Kansas and eastern Colorado.

Original reference: S. W. Williston, 1893, Kansas Acad. Sci. Trans., v. 13, p. 108–109.

Named for old Fort Hays, a well-known landmark in western Kansas.

Haystack Gypsum Member (of Blaine Gypsum)[1]

Permian: Southwestern Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bien. Rept., p. 42, 55.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 21–22, pls. 1, 2. Described in Carter area where it is the lowermost gypsum member of the Blaine. Separated from overlying Cedartop gypsum member by shale unit; overlies unnamed shale unit at top of Flowerpot shale; this shale unit overlies Kiser gypsum which is here removed from the Blaine and reallocated to Flowerpot shale. Type locality noted.

Type locality: Haystack Butte, in sec. 23, T. 7 N., R. 23 W., about 6 miles west of Moravia, Greer County.

Haystack Rhyolite[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 107–109, 153–156.

Probably named for Haystack Mountain, Aroostook County.

Hayward sandstone member[1]

Permian: Central northern Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geoligists Bull., v. 10, p. 786–799.

Named for exposures at Hayward, Garfield County.

Hazel Sandstone[1] **or Formation**

Precambrian: Western Texas.

Original reference: E. T. Dumble, 1902, Texas Acad. Sci. Trans., v. 4, pt. 2, no. 6, p. 1–3.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 144 (fig. 1), 145 (table), 148, 149–150. Restored to formal nomenclature. Millican formation (Richardson, 1914), divided into two formations and term Millican abandoned. Dumble's term Hazel sandstone is applied to upper of the two formations and Allamoore limestone is proposed for lower formation. Consists of conglomerate which passes upward into red sandstone. Thicknesses of conglomerate and sandstone not measured but estimated to be thousands of feet. At many places where conglomerate stands vertically it forms belts of outcrop nearly a mile wide (may be some duplication by folding). North of Hazel mine on Sierra Diablo escarpment exposed thickness of red sandstone is at least 2,000 feet, neither base nor top exposed. Succeeded by Van Horn sandstone.

P. B. King and P. T. Flawn, 1953, Texas Univ. Bur. Econ. Geology Pub. 5301, p. 23, 84–89. As used by Dumble, term Hazel was applied only to red sandstones, but since these are linked with conglomerate of almost equal volume term was extended to include conglomerate also. In this report, unit designated formation.

Named for Hazel mine, Diablo Mountains, El Paso County.

Hazel Slate (in Chilhowee Group)[1]

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: Arthur Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 958. Keith originally placed upper part of sequence here termed Great Smoky group in Hazel slate and Clingman conglomerate; these names now abandoned. Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 143) connected Hazel outcrops with those of Nantahala slate and assumed they were correlative. As mapped by Keith in northern Great Smoky Mountains, the Hazel corresponds to argillaceous rocks that are now placed in Anakeesta formation (new).

Named for outcrops on Hazel Creek, Swain County, N.C., on southern slope of Great Smoky Mountains.

Hazel Green Member (of Quimbys Mill Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9, 15C. Consists of massive whitish-weathering dolomite about 1 to 3 feet thick. Shown on columnar section as basal member of Quimbys Mill formation. Underlies Shullsburg member (new); overlies Everett member (new) of Nachusa formation (new).

Occurs in Dixon-Oregon area.

Hazelhurst [Formation]

Pleistocene: South Carolina and Middle Atlantic Coast.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook for South Carolina Coastal Plain Field Trip, Nov. 16–17, table 1, following p. 1. Name appears in list of Pleistocene formations. Occurs below Coharie formation.

Hazelton Group[1]

Jurassic(?): Southeastern Alaska, and British Columbia, Canada.

Original reference: W. W. Leach, 1910, Canada Geol. Survey Summ. Rept. 1909, p. 64.

F. M. Byers, Jr., and C. L. Sainsbury, 1956, U.S. Geol. Survey Bull. 1024–F, p. 126, pl. 13. Mapped in part of Hyder district.

Named for town of Hazelton, British Columbia. In Hyder district, Alaska.

Hazelton Bridge Formation

See Hazleton Bridge Formation.

Hazelwood Member (of Mifflin Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 16. Limestone, thick-bedded; dolomite, pure, nonshaly, medium-bedded. Thickness 5 to 7 feet. Shown on columnar section as underlying Briton member (new) and overlying Establishment member (new).

Occurs in Dixon-Oregon area.

†Hazlet Sands[1]

Upper Cretaceous: New Jersey.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 315, 329.

Named for Hazlet, Monmouth County.

Hazleton Group[1]

Jurassic(?): Southeastern Alaska, and British Columbia, Canada.

See **Hazelton Group,** the correct spelling.

Hazleton Bridge Formation

Upper Pennsylvanian: Southwestern Indiana.

C. A. Malott, 1939, (abs.) Indiana Acad. Sci. Proc., v. 48, p. 114; 1947, v. 57, p. 130, 134, 135, 136 [1948]. Consists of 20 to 25 feet shale, locally containing one or more thin coals, a thin limestone, and black shale; locally fossiliferous. Underlies Dicksburg Hills sandstone (new); overlies Merom or Inglefield sandstone.

Type locality: At road level in White River bluff just south of White River bridge west of Hazleton on U. S. Highway, northern Gibson County.

Head Member (of Day Point Formation)

Middle Ordovician (Chazyan): Northwestern Vermont and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 821, 824 (fig. 3), 825 (fig. 4), 826 (fig. 5), 844–845, geol. sections. Defined as 16 feet of dark-gray, greenish-tinged dense fine calcareous quartz sandstone to siltstone and interbedded silty argillite that disconformably overlies Bridport dolomite south of Scott Point, Isle La Motte; proportion of shaly argillite varies and is locally dominant. Thickness on Valcour Island 15 feet; on South Hero 11 feet. Near Vergennes, brown-weathering dolomite interbeds near base contrast with finer textured Bridport. Along Otter Creek 3 miles west of Ferrisburg, 3 feet of calcareous coarse quartz sandstone lies on an erosion surface on *Isoteloides*-bearing Bridport dolomite. Underlies Scott member (new).

Type locality: The Head, a bluff at south end of Isle La Motte, Vt.

Headquarters Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

C. A. Merritt, 1958, Oklahoma Geol. Survey Bull. 76, p. 28–33, pl. 1. Described in Lake Altus area as brownish-red finely crystalline granite containing local porphyritic phases. Geographically restricted to western part of Headquarters Mountain and to small hills north of mountain.

Probably named for occurrences near Headquarters Mountain, near Granite, Greer County.

Headquarters Schist[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 627.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist. Nash marble series, Seminoe formation, and Towner greenstone.

Present in Medicine Bow Mountains, Headquarters Park located on outcrop.

Healing Springs Sandstone Member (of New Scotland Limestone)[1]

Healing Springs Sandstone

Lower Devonian: Central western Virginia and West Virginia.

Original reference: F. M. Swartz, 1930, U.S. Geol. Survey Prof. Paper 158–C.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1986. South of latitude of Monterey, Va., the cherty New Scotland limestone apparently gives way to calcareous Healing Springs sandstone, which is well developed in Browns Mountain anticlinal area of Greenbrier County.

H. P. Woodward, 1943, West Virginia Geol. Survey [Rept.], v. 15, p. 89, pls. 10, 11. Healing Springs sandstone attains maximum thickness of 33 feet along Knapp Creek near Alvon, Greenbrier County. Because of general stratigraphic location the Healing Springs can be confused with Ridgeley sandstone of later age, or the older Clifton Forge member of the Keysers.

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 118, p. 20 (table 2), 47–48. In Clifton Forge district overlies Coeymans limestone and underlies Licking Creek limestone, geographically extended into area to replace New Scotland and Becraft limestones as used by Butts (1940). Thickness as much as 25 feet.

Named for exposures in gap west of Healing Springs, Bath County, Va.

Healy Glaciation

Pleistocene: Central southern Alaska.

Clyde Wahrhaftig, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 8, 13 (table 1); 1958, U. S. Geol. Survey Prof. Paper 293–A, p. 17–18, 32–33, pls. 2, 3, 5. Four distinct glacial advances separated by marked ice withdrawals recognized along Nenana River. Healy succeeded Dry Creek glaciation (new); preceded Riley Creek glaciation (new).

End moraine is prominent curved compound till-ridge. Modified lateral moraine ridges and patches of till, preserved on gentle sloping topography, identify position of upper surface of glacier. Outwash terrace about 470 feet above Nenana River near end moraine.

Moraine on terrace about 450 feet above Nenana River, 2 miles northeast of Healy, Nenana River valley area. Ice occupied U-shaped gorge between Healy and McKinley Park Railroad Station.

Heart Metagraywacke[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 631.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Present in Medicine Bow Mountains. Heart Lake is located on outcrop.

Heartwellville Schist[1]

Upper Cambrian(?): Southwestern Vermont.

Original reference: G. D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 278–283, 291, 293, 315, map.

Named for fact that town of Heartwellville, Bennington quadrangle, lies on large area of the schist.

Heath Formation[1] **or Shale** (in Big Snowy Group)

Upper Mississippian: Central northern Montana.

Original reference: H. W. Scott, 1935, Geol. Soc. America Proc. 1934, p. 367.

E. S. Perry, 1937, Montana Bur. Mines and Geology Mem. 3, p. 16. In type locality, Big Snowy group comprises (ascending) Kibbey, Otter, and Heath formations. Consists of 450 feet of black petroliferous shale with sandstone lenses.

P. A. Mundt, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 46, 47; 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1918 (fig. 2), 1919–1920, 1923 (fig. 4). Upper limit of Heath formation as defined by Scott is not acceptable. Upper part of Scott's Heath includes prolific oil sands (Tyler sandstone), and unit is separated from lower nonsandy part of Heath by angular unconformity. Thus, Heath formation should be restricted to beds below the unconformity, and beds above, which were formerly included in the Heath, should be designated as separate unit and name Tyler (Freeman, 1922) is herein applied to this formation.

H. D. Hadley and P. J. Lewis, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 142. Underlies Cameron Creek formation (new).

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 333 (fig. 2), 334 (fig. 3), 335, 340–341, 346–347. In revision of Big Snowy group, Heath formation overlies the Otter and underlies Cameron Creek formation. Thickness, at composite standard section of revised Big

Snowy group, 423 feet. Reasons presented for not using Tyler formation in this classification.

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1942 (fig. 2), 1943–1948. In this report, Heath considered uppermost formation in Big Snowy group. Overlies Otter formation and underlies Tyler formation. Faunal data indicate a late Mississippian (probably Chester) age.

Type section: On north flank of Big Snowy Mountains, in sec. 6, T. 12 N., R. 20 E.

Heber limestone[1]

Carboniferous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 37.

Derivation of name not stated.

Hebron Formation

Hebron Gneiss[1]

Hebron Quartz Schist

Pre-Pennsylvanian: Eastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 121, 122, 140, 142, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 73–76, pl. 1. Referred to as a quartz schist; discussed under heading of Hebron, or Paxton quartz schist. Was earlier mapped in part as Woodstock quartz schist. Age designated Precambrian or early Paleozoic.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Paleozoic(?).

J. W. Aitken, 1955, Connecticut Geol. Nat. History Survey Quad. Rept. 6, p. 9–10, 18–20. Termed a formation. Epidote amphibolite gneiss and skarn occurring along Hebron-Bolton boundary in Rockville quadrangle are here transferred from the Bolton to the Hebron.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Gneiss redefined to include following geographic phases: Hebron gneiss of original definition, Scotland schist, Woodstock quartz schist, and Pomfret phyllite. Derivation of name given.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619. East of Middle Haddam, has indefinite contact with Monson gneiss.

Named for town of Hebron, Tolland County.

Hecla Sandstone (in Allegheny Fomation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5, p. 96, 124, 128, 1025, 1026.

Probably named for Hecla, Lawrence County.

Hedgehog Trachyte[1]

Devonian(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 109–110, 161–162.

Forms Hedgehog Mountain, Aroostook County.

Hedges Shale (in Pocono Group)[1]

Lower Mississippian: Northeastern West Virginia and western Maryland.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 101). Shown on correlation chart as shale in Pocono group. Underlies Myers shale; overlies Purslane sandstone. Kinderhookian series.

C. B. Read, 1955, U.S. Geol. Survey Prof. Paper 263, p. 1. In Meadow Branch syncline, Maryland and West Virginia, the Pocono includes only Rockwell formation, Purslane sandstone, and Hedges shale.

Named for occurrence on Hedges Mountain, Berkeley County, W. Va.

Hedwig Breccia Member (of Esmeralda Formation)[1]

Miocene, upper: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Crops out in vicinity of Hedwig claim, Manhattan district.

Heebner Shale Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 32, 33, 37.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 148–149. Heebner shale member of Oread formation; underlies Plattsmouth member; overlies Leavenworth limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness about 3 feet in section measured near Winterset, Madison County.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 40–41, pl. 1. Thickness 5 to 8 feet in central and northern Douglas County; 14 to 18 feet in south-central part of county, south of Worden fault.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 22, fig. 5. Characteristically olive clay shale split near base by black fissile shale. Thickness 2½ feet in Cass County; 3 feet in Adair County; 5 feet in Montgomery County. Overlies Leavenworth limestone member; underlies Plattsmouth limestone member.

Type locality: Two and one-half miles west and 1½ miles north of Nehawka, Cass County, Nebr. Named for Heebner Farm and Creek.

Hefty Formation[1]

Precambrian: Northwestern Montana, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey, Dept. Mines Mem. 38, map 2.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1881. Correlates with Singleshot member of Appekunny formation.

Mapped just west of Mount Hefty, Mont.

Heglar Canyon Member (of Wells Formation)

Pennsylvanian (Derryan) : Idaho.

H. J. Bissell, 1960. Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Underlies Sublett member (new) ; overlies Calder Creek member (new).

Present in Sublett Mountains area.

Hegler Limestone Member (of Bell Canyon Formation)

Upper Permian (Guadalupe Series) : Western Texas and southern New Mexico.

P. B. King *in* A. K. Miller and W. M. Furnish, 1940, Geol. Soc. America Spec. Paper 26, p. 9. Incidental mention.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 582, 585 (fig. 7), pl. 2. Along foot of reef escarpment is a dark-gray lumpy, slabby limestone about 15 feet thick. In Delaware Mountains, straight-bedded, platy limestones occupy same position. Lies below Pinery limestone member; base of the Hegler marks lower boundary of formation; it is oldest bed to grade northwestward into the Capitan limestone. Overlies Manzanita limestone member of Cherry Canyon formation.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 54–55, pl. 3 [1949]. In southeast part of southern Guadalupe Mountains, consists of 30 to 40 feet of dark-gray fine-grained limestone in beds a few inches thick, interbedded with platy sandstone. Mapped in New Mexico.

Named for Hegler Ranch, 6 miles east-northeast of Guadalupe Peak, near foot of Reef escarpment, Culberson County, Tex.

Heidlersburg Sandstone Member (of Gettysburg Shale)

Heidlersburg Member (of Gettysburg Shale)[1]

Upper Triassic: South-central Pennsylvania.

Original reference: G. W. Stose, 1929, U.S. Geol. Survey Geol. Atlas, Folio 225.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 115–118. Gettysburg shale, in York County, comprises red shale and sandstone with (1) thick, lenticular zone in which are numerous beds of hard red pebbly arkosic sandstone and conglomerate, called Conewago conglomerate member, near base, (2) a zone in which hard gray and red sandstones and coarse conglomerate predominate, called Heidlersburg member, near middle, and (3) quartzose fanglomerate and limestone conglomerate at top. In type area, Adams County, the Gettysburg is predominantly red shale and sandstone with interbedded hard gray to white sandstones in Heidlersburg member and coarse fanglomerate. called Arendtsville fanglomerate lentil at top. Thickness of Heidlersburg 3,000 to 4,800 feet.

Named for exposures in vicinity of Heidlersburg, Adams County.

Heights Fanglomerate[1]

Quaternary : Southern California.

Original reference: F. E. Vaughan, 1922, Calif. Univ. Pub., Geol. Sci. Bull., v. 13, no. 9, p. 344, 392–393, map.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 324 (fig. 2), 325 (table 1), 331–332, pl. 1, 2, 3. Described in western San Gorgonio Pass

area as tan to dark-brown ill-sorted conglomerate, dominantly dark clasts of gneissic rock. Maximum thickness 500 feet. Unconformably overlies Cabezon fanglomerate.

Best exposures are on west wall of San Gorgonio Canyon. Named for Banning Heights, Riverside County.

Heiskell Shale[1]

Lower Ordovician: Northeastern Tennessee and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1165. Type "Heiskell" appears to be part Benbolt and part Wardell. Ulrich did not define the Heiskell, and upper and lower limits cannot be definitely drawn. His application of the Heiskell at Speers Ferry, Va., indicates lower limit to be the "Holston" at Speers Ferry and upper limit to be the Bays (Moccasin). Because Bowen formation contains red claystone, like Moccasin claystone, Ulrich's basal Moccasin was most likely drawn below the Bowen which would then make the "Heiskell" equivalent to all the Benbolt, Gratton, and Wardell.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 66. Abandoned. Ulrich's (1911) reference is apparently only use of name. Shaly beds exposed in center of village of Heiskell contain fossils of the Benbolt formation; beds beneath are limestones and red beds. Thus, only rocks answering lithologically to Heiskell are Benbolt shales [of Middle Ordovician age]. Since name Heiskell was never established by definition or designation of type section, it cannot replace well-established and validly proposed name Benbolt.

Probably named for Heiskell, Knox County, Tenn.

Helderberg Group[1] or Limestone[1]

Lower Devonian: New York, western Maryland, New Jersey, eastern Pennsylvania, Virginia, and northern West Virginia.

Original reference: T. A. Conrad, 1839, New York Geol. Survey, v. 3, p. 62.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 29–91. Keyser limestone removed from group and assigned to Silurian. Units included in group: Coeymans limestone, New Scotland limestone, Mandata shale (new), Becraft limestone, and Port Ewen shale.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 32–127. Group comprises (ascending) Keyser limestone, Coeymans limestone, New Scotland limestone, Port Ewen chert and shale, and Port Jervis limestone.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 81–85. In Maryland, Helderberg limestone comprises (ascending) Coeymans, New Scotland, and Becraft members. Overlies Keyser limestone; underlies Oriskany formation. Thickness 290 to 350 feet.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 13. Helderberg formation comprises (ascending) Mandata shale, New Scotland limestone, and Coeymans limestone members. Member units separable on faunal basis but not defined clearly enough for mapping purposes. Thickness 50 to 180 feet. Overlies Keyser formation; underlies Oriskany formation.

K. F. Bick, 1960, Virginia Div. Mineral Resources Rept. Inv. 1, p. 20–21, pl. 1. In Lexington quadrangle, group conformably overlies Keyser limestone and is conformably overlain by Ridgeley sandstone. Comprises (ascending) Coeymans, New Scotland, and Licking Creek limestones. Thickness 100 to 150 feet. Early Devonian (Ulsterian).

U.S. Geological Survey includes the following units in Helderberg Group: Alsen, Becraft, Coeymans, Kalkberg, Manlius, New Scotland, and Port Ewen.

Named for the fact that deposits form basal part of Helderberg Mountains in Albany County, N.Y.

Helderberg Stage

Lower Devonian: North America.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1732–1733, chart 4. Devonian is subdivided into nine stages. Group term Helderberg is elevated to stage rank. Helderberg is lowermost stage and is succeeded by Deerpark stage (new). Ulsterian series.

Helderbergian Series

Helderbergian[1] Period or Group

Lower Devonian: New York and adjacent areas.

[Original reference]: J. M. Clarke and Charles Schuchert, 1899, Science, new ser., v. 10, no. 259, p. 876, 877.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 21st Ann. Mtg., p. 7–8. Helderbergian series consists of nine formations, five of which are in central New York: Cobleskill, Rondout, Manlius, Coeymans, and Kalkberg. New Scotland (restricted), Becraft, Alsen, and Port Ewen not present in central New York.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. Base of Devonian system in New York apparently not at base of Coeymans limestone of eastern New York where it has been placed for many years. Proposed that term Helderberg be elevated to series rank. Revised Helderbergian series would include all Lower Devonian strata from base of Cobleskill to top of Port Ewen.

Helena Dolomite (in Missoula Group)

Helena Limestone[1] (in Piegan Group)

Precambrian (Belt Series): West-central Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. E. Erdmann, 1944, U.S. Geol. Survey Water-Supply Paper 866–B, p. 48. Upper member of Siyeh limestone known as Helena limestone in some localities.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Limestone shown on map legend as part of Siyeh group.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112. Where limestone is recognizable, which at present is only in vicinity of Helena, it is regarded as upper formation of Piegan group.

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 837–838. Marysville stock surrounded by late Precambrian rocks of Belt series (ascending): Empire formation; Helena limestone, here renamed Helena dolo-

mite; Marsh formation; and Greenhorn Mountain quartzite (new). Helena consists largely of buff-weathering aphanitic dolomite. Thickness about 4,000 feet. This buff-weathering feature has been mentioned as being typical of the formation by investigators since Walcott, but no one has mentioned its dolomitic composition. Formation contains subordinate limestone, which weathers gray or "bluish" gray, some siliceous limestone oolite, and beds of edgewise conglomerate up to 2 feet thick. Contains *Collenia* biostromes, up to 10 feet thick, that occur at intervals from top to bottom of formation.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Shown on map legend as limestone at top of Piegan group.

U.S. Geological Survey currently classifies the Helena as a formation in Missoula Group on the basis of a study now in progress.

Exposed in upper part of city of Helena and on hill slopes to the east.

Helenan series[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 215, 217.

Helenmode Formation (in Chilhowee Group)

Helenmode Member (of Erwin Formation)

Helenmode Member (of Hesse Sandstone)

Lower Cambrian: Eastern Tennessee and western North Carolina.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 31–32, 33, fig. 6, pls. 3, 5, 6. Helenmode member of Erwin formation consists of so-called "transition beds" of earlier reports. They embrace yellow finely laminated clays, which evidently were originally calcareous shale, and soft mealy arkosic sandstones, some stained red and purple with iron, others of a greenish color, due to contained glauconite grains. At top are coarse grits of rounded quartz grains, from which the former calcareous cement has been dissolved leaving a porous layer or loosely coherent mass, in many places stained with manganese oxide or rusty with iron oxide. Thickness about 100 feet near Helenmode mine; elsewhere thinner; 67 feet on U.S. Highway 19E between Valley Forge and Hampton. Overlies unit termed upper quartzite member; underlies Shady dolomite.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 15–16. Geographically extended into Madison County, N.C., where it is considered member of Erwin formation.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 35 (table 3). Shown on table as member at top of Hesse sandstone and as member at top of Erwin formation. Cambrian.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 964. Rank raised to formation at top of Chilhowee group. Cambrian.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 43–44. In northeasternmost Tennessee, considered uppermost member of Erwin formation. Overlies Hesse quartzite member; underlies Shady dolomite. Unit mapped around whole periphery of Shady Valley and Stony Creek Valley where it has thickness of 100 feet or a little less; 67 feet thick in section on U.S. Highway 19E, south of Valley Forge. Coarse sandstone bed here placed at top of Helenmode has been variously

classified; in southwest Virginia, a similar layer has been called initial deposit of Shady dolomite. Lower Cambrian.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Formation described in Blockhouse quadrangle, Tennessee, where it is 100 feet thick. Overlies Hesse quartzite; underlies Shady dolomite. Most of Chilhowee group is questionably assigned to Early Cambrian because recoverable fossils of Early Cambrian age are confined to Helenmode, youngest formation of group.

Named for Helenmode pyrite mine near Sadie in Stony Creek district, Carter County, Tenn.

Hellam Conglomerate Member (of Chickies Quartzite)[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 360–362.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1361. Chickies quartzite is used rather than Hardyston in Buckingham area, Bucks County. In Buckingham Valley, the quartzite carries a basal conglomerate believed to be the Hellam.

Bradford Willard and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 10, 38, 40, pl. 2. There is confusion as to use of Hellam conglomerate as separate unit or member of Chickies quartzite. Latter use is followed in this report [Bucks County] as serving to distinguish Chickies quartzite from Hardyston quartzite. Thickness about 300 feet.

Named for exposures in Hellam Hills, 3 miles west of Chickies Rock, York County.

Hellam Quartzite[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: P. Frazer, 1886, Am. Philos. Soc. Proc., v. 23, p. 396, 398–400.

Named for exposures in Hellam Township, York County.

Hell Creek Formation[1]

Hell Creek Member (of Lance Formation)

Upper Cretaceous: Eastern Montana, northwestern North Dakota, northwestern and northern South Dakota, and northeastern Wyoming.

Original reference: B. Brown, 1907, Am. Mus. Nat. History Bull., v. 23, art. 33, p. 829–835.

E. P. Rothrock, 1937, South Dakota Geol. Survey Rept. Inv. 28, p. 7, 10–11. In Harding County, Hell Creek member of Lance formation includes Bull Creek sand (new). Underlies Ludlow member.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, p. 15 (table), 16–20. For purposes of present report [Fort Union of Crazy Mountain field. Montana], it is assumed that beds up to and including the true dinosaur-bearing Lance and Hell Creek and their equivalents belong to the Cretaceous and that overlying beds without dinosaurs (except by redeposition) and with mammals of Tertiary type (including carnivores, condylarths, and others) from the Puerco and its equivalents upward, are to be placed in the Tertiary. It is also assumed that Paleocene is accepted as separate epoch. Hell Creek formation underlies Bear formation (new).

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 10–11, pls. 1, 3. In McCone County, Mont., Hell Creek beds, mapped as member of Lance formation, overlie Colgate sandstone member of Fox Hills formation and underlie Tullock member of Lance. Thickness about 135 feet. Footnote (p. 10) states that since the present report was written, Hell Creek and Tullock members have been raisd to rank of formations in official classification of the U.S. Geological Survey; Hell Creek is assigned to the Cretaceous and the Tullock to Cretaceous or Eocene. Lance of the present report is placed in Eocene(?).

Erling Dorf, 1940, Geol. Soc. America Bull., v. 51, no. 2, p. 213–236. Discussion of relationship between floras of type Lance and Fort Union formations. Lance formation (equivalent to Hell Creek formation) is placed in Upper Cretaceous; Tullock formation (equivalent to Ludlow formation and Cannonball marine member) is placed at base of Paleocene Fort Union group.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 9–15. Described in Morton County where it is about 250 feet thick in complete exposures. Includes Breien member (new). Overlies Fox Hills formation; underlies Ludlow formation of Fort Union group.

O. A. Seager and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1415, 1418. Youngest Cretaceous formation known in North Dakota. Consists largely of gray bentonitic sands and shales with which are lenticular beds of lavender-brown lignitic shale and rusty-brown to purplish-black ferruginous concretions. Thickness varies from 575 feet near Marmarth to less than 100 feet in Souris River area. Underlies Cannonball member-Ludlow member of Fort Union.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 81. Laramie formation (redefined) is equivalent to the Lance, and thus becomes equivalent to the Hell Creek.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 17–20. Described in Emmons County where it is about 270 feet thick. Overlies Fox Hills formation and underlies Cannonball formation.

R. E. Curtiss, 1952, Areal geology of the Isabel quadrangle (1:62,500); 1954, Areal geology of the Firesteel Creek quadrangle (1:62,500): South Dakota Geol. Survey. Overlies Colgate sandstone member of Fox Hills. Thickness about 230 feet. Contains Isabel-Firesteel coal member [facies], 0 to 6 feet thick.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in northeastern Wyoming. Consists of brown and gray sandstone and shale, thin coal, and carbonaceous shale beds.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows that Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

R. E. Stevenson, 1957, Geology of the McIntosh quadrangle (1:62,500): South Dakota Geol. Survey. Comprises a lower unit about 60 feet thick, at top of which is Isabel-Firesteel facies, and upper unit about 80 feet thick. Interfingers with overlying Ludlow formation; overlies Colgate member of Fox Hills formation.

Typically exposed on Hell Creek, north of Jordan, Garfield County, Mont., and nearby tributaries of Missouri River.

Heller Dacite[1]

Tertiary (may be upper Miocene) : Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 37.

Composes Heller Butte, near town of Tonopah, Tonopah district.

Hell Gate Dolomite

Early Paleozoic: Southeastern New York.

T. W. Fluhr, 1939, Municipal Engineers Jour., v. 25, p. 24, 25 (map), 29 (geol. profile). Named in list of formations in area of Triborough Bridge project. Occurs between Inwood limestone and Fordham gneiss.

T. W. Fluhr, 1957, Geol. Soc. America Eng. Case Histories No. 1, p. 2. Some workers regard this as one of larger interbedded limestone members in Fordham series, but it is herein interpreted as an infolded and infaulted belt of the Inwood, from which it is lithologically and chemically indistinguishable. Early Paleozoic. Discussion of geology of Queens midtown tunnel.

Derivation of name not given.

Hell Gate Glacial Substage

Pleistocene (Mankato) : West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 333, fig. 2, table 4. Time of Wisconsin glaciation in Frying Pan Valley during which outwash deposits and Hell Gate moraines were deposited. Older than Chapman Gulch glaciation (new) ; younger than Ivanhoe glacial substage (new).

Type locality for deposits of Hell Gate advance is on Ivanhoe Creek, 1 mile above precipitous Hell Gate gorge. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Hell Gate Porphyry[1]

Precambrian: Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1932, Am. Jour. Sci., 5th, v. 24, p. 474.

Well exposed at Hell Gate Narrows, 5 miles west of divide on Lake Fork-Ivanhoe section, Lake Fork-Ivanhoe region.

Hellgate Quartzite Member (of Miller Peak Argillite)

Hellgate Formation[1]

Hellgate Quartzite (in Missoula Group)

Precambrian (Belt Series) : Central western Montana.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 679, figs. 2, 3.

F. S. Honkala, 1958, Soc. Vertebrate Paleontology Guidebook 8th Field Conf., p. 22. Hellgate quartzite is pink, weathers brown, massive. In Missoula group.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Rank reduced to member status in Miller Peak argillite.

Type section: On north side of Mount Sentinel, in south wall of Hellgate Canyon, Missoula-Helena region.

Hell Inlet Glacial Stage

Pleistocene: North-central Colorado.

R. L. Ives, 1942, Geog. Rev., v. 32, no. 3, p. 450 (table 1). Name appears only on table giving late Pleistocene chronology of Monarch Valley. Older than Walden Hollow glacial stage (new).

Monarch Valley, Grand County.

Hell Roaring Formation

Paleocene-Eocene: Southwestern Montana and northwestern Wyoming.

C. W. Brown, 1958, Dissert. Abs., v. 18, no. 1, p. 194. Incidental mention.

In Yellowstone National Park.

Hell Roaring Member (of Altyn Formation)

Precambrian (Belt Series): Southern Alberta, Canada, and northwestern Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1882–1883, fig. 2. Dolomite and dolomitic limestones, variably siliceous; blue gray to greenish gray, weathering to gray, buff, or cream; beds 2 to 24 inches thick. Many beds show laminae of limestone and dolomite and dolomite nodules. Thickness 1,200 to 1,300 feet. Underlies Carthew member (new); overlies Waterton member, contact gradational. This is "lower member" of Willis' Altyn descriptions.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 137. Discussion of stromatolites of Belt series. Hell Roaring member of Fenton and Fenton is represented by *Collenia frequens* zone of Altyn limestone.

Type locality: Hell Roaring Falls, Waterton Lakes Park, Alberta. Well exposed on eastern slope of Mount Carthew.

Hells Canyon Formation (in Durst Group)

Hells Canyon Member (of Morgan Formation)

Pennsylvanian: Northwestern Colorado and northeastern Utah.

M. L. Thompson, 1945, Kansas Geol. Survey Bull. 60, pt. 2, p. 29, 31–34, geol. sections. Proposed for lithologic and faunal unit above Belden formation and below Youghall formation (new). About 294 feet thick at type locality where it is composed of highly fossiliferous limestones and gray shales, red to purplish shales, gray fissile shales, purplish siltstones, and thin beds of gray to red fine-grained sandstones.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 70, 71–75. Formation included in Durst group (new).

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Rank reduced to member status in Morgan formation.

Type locality: In Hells Canyon, west bluff Hells Canyon, sec. 31, T. 6 N., R. 102 W., a tributary canyon of Yampa River in Moffat County, Colo.

Hells Gate Rhyolite

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1506. Recrystallized rhyolite tuff. Some of rock is intrusive, as for example south of Tonto Creek it intrudes Houden formation (new) on large scale. But large parts, as northwest of Hell's Gate, display

columnar structure, and some specimens display pyroclastic texture. Thickness more than 10,000 feet. No direct evidence for stratigraphic position of columnar rhyolite, but it probably belongs high in stratigraphic column of Precambrian rocks. Name given on table as Hells Gate rhyolite but unit described in text as rhyolite of the Hell's Gate area.

Covers area 25 to 50 miles square between Lost Camp Mountain and granite of the Payson area. Exposed northeast of Hell's Gate, Diamond Butte quadrangle.

Hells Mesa Member (of Datil Formation)

(?) Miocene, upper: Southwestern New Mexico.

W. H. Tonking, 1954, Dissert. Abs., v. 14, no. 2, p. 340. Welded and "semi-welded" rhyolite tuff. Underlies La Jara Peak member (new); overlies Spears member (new).

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 26, 29–30, fig. 2, 1 [preprint? 1954?]. Color of basal half of section in eastern and northern Bear Mountains ranges from pink below to white or light gray higher in section. Upper half of member is white to light gray, capped by about 25 feet of pink tuff. Thickness about 250 feet in northern Bear Mountains, approximately twice as thick southward along eastern mountain front, and may be more than 2,000 feet in Gallinas Mountains. Source of name given.

D. B. Givens, 1957, New Mexico Bur. Mines Mineral Resources Bull. 58. p. 15–18, pl. 1. Further described from Gallinas Mountains.

Named for conspicuous peak in secs. 17 and 20, T. 1 N., R. 4 W., popularly called Hells Mesa, Puertecito quadrangle, Socorro County.

Hell To Finish Formation

Age unknown: Southwestern New Mexico.

R. A. Zeller, Jr., 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 10 (chart). Name appears on chart only. Consists of red beds, including red shale, siltstone, sandstone, gypsum, and andesite. Thickness between 1,000 and 2,000 feet. Underlies U Bar formation (new) of Lower Cretaceous age and overlies rocks of Permian age—Concha limestone(?) of Naco group.

R. H. Weber and F. E. Kottlowski, 1959, New Mexico Bur. Mines Mineral Resources Bull. 68, p. 13. In Big Hatchet Mountains, several thick beds of gypsum occur in lower part of Lower Cretaceous strata. Gypsum beds are at top of red-bed sequence, Hell To Finish formation, and just below massive- to thin-bedded limestone of U. Bar formation.

In Big Hatchet Peak quadrangle, Hidalgo County.

Helmet Fanglomerate

Miocene, lower(?): Southwestern Arizona.

J. R. Cooper, 1960, U.S. Geol. Survey Bull. 1112–C, p. 77, 89, pl. 1. Deformed postmineralization formation. Predominantly coarse ill-sorted and ill-bedded conglomerate characterized by angular pebbles, cobbles, and boulders in silty matrix. Intercalated are lava flows of porphyritic andesites, thin beds of rhyolitic tuff and tuffaceous sediments, and lentils and tongues of monolithographic breccia. Thickness at least 10,000 feet. Along northwest side, in depositional contact on rhyolitic tuff and probably Cretaceous(?) rocks; to northeast, extends beneath Quaternary allu-

vium; other boundaries are fault contacts with Precambrian granite, Paleozoic sedimentary rocks, and granodiorite. No fossils; tentative correlations suggest that fanglomerate may be of early Miocene age.

No type section designated. Most continuous exposures are along north-trending line from point three-fourths mile southeast of Helmet Peak to point 1¼ miles north-northwest of Twin Buttes village, Pima mining district, Pima County.

Helmick Formation

Eocene: Northwestern Oregon.

J. A. Cushman, R. E. Stewart, and K. C. Stewart, 1947, Oregon Dept. Geology and Mineral Industries Bull. 36, pt. 5, p. 95–96. Term Helmick formation used in this paper for unit described as Helmick beds by M. J. Mundorff (unpub. thesis). Consists chiefly of micaceous sandstone with some clay shales and an occasional concretionary lens firmly cemented with calcite. Sandstones are typically medium-grained thin-bedded friable bluish-gray rocks which weather buff or brown. Concretions commonly contain organic material. Uppermost part of unit is clay shale of which at least 40 feet or more are exposed along river north of Buena Vista.

Typically exposed in highway roadcut at Helmick Hill and along Willamette River at Buena Vista, Polk County.

Helms Formation[1]

Mississippian: Western Texas and southeastern New Mexico.

Original reference: J. W. Beede, 1921, Texas Univ. Bull. 1852, p. 8, 30, 36.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60 no. 1, p. 8–9, 16–17, 19–20, 23, 32, 35, 39. Beede designated all rocks between Silurian and Pennsylvanian systems in Hueco Mountains as Helms. Name here restricted to upper part of these strata. As thus restricted, consists of green shale, shaly sandstone, and impure limestone beds, containing Chester fossils. In type area, unconformably overlies Rancheria formation (new) and unconformably underlies Pennsylvanian rocks. Thickness 98 feet in Franklin Mountains, N. Mex.

Well exposed about 1 mile south of Helms Peak, Hueco Mountains, Hudspeth County, Tex.

Hely Member (of Grand Detour Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 3. Shown on columnar section as underlying Victory member (new) and overlying Clement member (new).

Occurs in Dixon-Oregon area.

Hemingford Group

Miocene: Nebraska and Wyoming.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 226, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1253–1254. Includes Marsland below and Sheep Creek formations. Thickness 250 to 350 feet. Unconformable above Arikaree group (redefined) and below Ogallala group (redefined). Name suggested by C. B. Schultz.

Town of Hemingford is in Box Butte County, Nebr.

Hemingfordian Age

Miocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term, based on the Hemingford group, including the Marsland and, especially, the limited or lower Sheep Creek fauna (Cook and Cook, 1933), and not on the formation limits as extended upward (Lugn, 1939). Covers interval between Arikareean and Barstovian ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Hemlock Formation (in Baraga Group)

Hemlock Greenstone[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: J. M. Clements, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 45–63, pl. 9.

J. E. Gair and K. L. Wier, 1956, U.S. Geol. Survey Bull. 1044, p. 14 (table 2), 41–51, pl. 1. Name Hemlock formation reinstated because term greenstone is too restricted to include all its units. Mainly greenstone; predominantly metabasalt in southwestern part, basic schist in northeastern part, and metarhyolite (including sericite slate) in southeastern part of Kiernan quadrangle. Formation completely surrounds Amasa oval (uplift). Thickness ranges from about 2,300 feet on east side of oval to about 20,000 feet on west side of oval (in region including type locality). Underlies Fence River formation; overlies Goodrich quartzite.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Includes Mansfield iron-bearing slate member near base and newly defined Bird iron-bearing member about 1,300 feet below top. Assigned to newly defined Baraga group.

Occurs in Crystal Falls district, Iron County. Named for the fact that Hemlock River flows through formation for a number of miles.

Hempfield shale member[1] (of Shenango monothem)

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 141.

R. E. Sherrill and L. S. Matteson, 1939, Pennsylvania Geol. Survey Bull. 122, p. 7. In Hillards quadrangle, a shale unit, 75 to 100 feet thick, underlying the Burgoon sandstone is referred to as Hempfield (Shenango) shale member. Occupies stratigraphic position of Shenango shale, renamed Hempfield shale by Caster, of Crawford County.

First described in vicinity of Greenville, Hempfield Township, Mercer County.

Hemphill Beds[1]

Pliocene, lower: Northwestern Texas.

Original reference: L. C. Reed and O. M. Longnecker, Jr., 1932, Texas Univ. Bull. 3231, p. 16–43, 70–83, map.

Hemphill County.

Hemphillian Age

Pliocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 12, pl. 1. Provincial time term, based on Hemphill member of Ogallala, which includes both Hemphill local fauna from the Coffee Ranch Quarry and the Higgins local fauna, Hemphill County, Texas. Covers interval between the Oligocene Clarendonian (older) and Blancan ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Hempstead Gravel Member (of Manhasset Formation)[1]

Pleistocene: Southeastern New York and islands of southern New England.

Original reference: M. L. Fuller, 1914, U.S. Geol. Survey Prof. Paper 82.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Top member of Manhasset; overlies Montauk member. Manhasset is considered to be of Wisconsin age.

Named for exposures in upper part of many large gravel pits along west side of Hempstead Harbor, Long Island. Present on Marthas Vineyard, Block Island, No Mans Land, and probably Nantucket Island and Cape Cod.

Henderson Gneiss

Henderson Granite[1] or Granite Gneiss

Ordovician to Devonian: Western North Carolina and northwestern South Carolina.

Original reference: A. Keith, 1905, U.S. Geol. Survey Geol. Atlas, Folio 124, p. 4.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 26. Intrudes Brevard schist.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 16–17; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. As mapped, Henderson granite gneiss unit is essentially Henderson granite as named and described by Keith (1905) and further described by Keith (1907, U.S. Geol. Survey Geol. Atlas, Folio 143). Recently the Henderson has been mapped to near Linville Falls, McDowell County, where it makes contact with what is considered southern extension of Cranberry granite. Both units are considered to be metasedimentary in origin and stratigraphically equivalent. Henderson composed essentially of rocks with pronounced gneissoid structure. Mapped as Precambrian(?).

H. W. Jaffe and others, 1959, U.S. Geol. Survey Bull. 1097–B, p. 115. Paleozoic on basis of Lead-alpha age determination.

U.S. Geological Survey currently designates the age of the Henderson Gneiss as Ordovician to Devonian on the basis of a study now in progress.

Named for extensive exposures in Henderson County, N.C.

Hendricks Dolomite (in Burnt Bluff Group)

Hendricks Member (of Burnt Bluff Formation)

Hendricks Series[1]

Middle Silurian (Niagaran): Northern Michigan and eastern Wisconsin.

Original reference: R. A. Smith, 1916, Michigan Geol. Survey Pub. 21, p. 155.

C. K. Swartz, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Burnt Bluff group in Michigan and Wisconsin includes Byron dolomite below and Hendricks dolomite above

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 11, 15–19. Hendricks dolomite, in type area, includes Fibron limestone member. Thickness about 60 feet. Overlies Byron dolomite; underlies Schoolcraft dolomite of Manistique group; contact marked by disconformity.

Type section: Abandoned Hendricks quarry, NW¼ sec. 6, T. 44 N., R. 8 W., and NE¼ sec. 1, T. 44 N., R. 9 W., Mackinac County, Mich.

Hendricks Sandstone[1]

Upper Devonian: Northern West Virginia.

Original reference: D. B. Reger and W. A. Price, 1923, West Virginia Geol. Survey Rept. Tucker County, p. 103, 240, 241, 245–254.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 303. Comprises upper member of Chemung series and marks lower limit of Catskill series in Greenbrier County. Commonly grayish brown to reddish brown, massive, and contains numerous flattened quartz pebbles. Thickness 10 to 50 feet.

Named for exposure 1 mile northeast of Hendricks, Tucker County, in Black Fork district.

Hendry Ranch Member (of Tepee Trail Formation)

Eocene, upper: Northwestern Wyoming.

H. A. Tourtelot, 1957, Smithsonian Misc. Colln., v. 134, pt. 1, p. 11–14, fig. 2. Name applied to gray and greenish-gray claystone and siltstone and tan siltstone rich in volcanic material that forms upper part of Tepee Trail formation in five areas along northern margin of Wind River basin. Maximum thickness about 550 feet. Overlies lower part of formation referred to as green and brown member.

Type section: Composite including three localities, all in Natrona County: NE¼ sec. 31, T. 39 N., R. 88 W., which includes contact with green and brown member; SW¼ sec. 14, T. 39 N., R. 89 W., which displays exposures of fossiliferous gray and greenish-gray rocks; NE¼ sec. 23, T. 39 N., R. 89 W., which contains tan siltstone that makes up upper part of member.

Henefer Formation

Upper Cretaceous: Northeastern Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 840–842, 845, pl. 1. Red, pink, purple, and light-gray shales; red and gray sandstones with numerous lenses of pea and pebble conglomerate; gray, tan, brown, and red pebble and boulder conglomerate; 200-foot bed of volcanic tuff near base. Thickness 1,250 feet at Echo Dam; 10,000 feet in Harris Creek Canyon. Overlies Frontier formation; underlies Pulpit conglomerate [member] (new) of Almy conglomerate. Norwood tuff (new) is inlaid in the Henefer in Little East Canyon. Lower Paleocene, post-Montana or upper Montana. Probably equivalent to all or part of the Hilliard, Adaville, and Evanston.

A. J. Eardley, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1435. Henefer conformably underlies beds considered Almy, and is probably a lower member of the Almy.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 142. Frontier formation redefined. Name Henefer as originally defined is preferred to term Wanship of Williams and Madsen (1959) in restricted sense. This opinion is based on premise that upper boundary of Frontier should be placed on basis of gross lithologic character. The Henefer would then be defined as lying between the highest white sandstone of the Frontier (Upton member, new) and Echo Canyon (formerly Pulpit) conglomerate.

Named for exposures in Harris Creek Canyon northeast of Henefer, Summit County. From Franklin County westward, forms both sides of Henefer Valley to marrows of upper Weber Canyon.

Henley Beds[1]

Cretaceous: Oregon.

Original reference: F. M. Anderson, 1902, California Acad. Sci. Proc., 3d ser., v. 2, p. 1–62.

In southern part of Oregon Basin.

Henley Shale Member (of Cuyahoga Formation)[1]

Henley Shale Member (of New Providence Formation)

Henley shale facies (of Cuyahoga Formation)

Mississippian (Kinderhook): Southern Ohio and northern Kentucky.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 758, 760, 762, 769.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 129, 130. Geographically extended into northern Kentucky where it is classed as member at base of New Providence formation; underlies Farmers siltstone member (new). In area of Bledstone facies, as much as 12 feet thick.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 45. Henley shale facies includes Henley shale member.

Named for Henley, Scioto County, Ohio.

Hennepin Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 12. Dolomite, argillaceous, silty, thin-bedded. Shown on columnar section as underlying Chana member (new) and overlying Harmony Hill formation (new).

Occurs in Dixon-Oregon area.

Hennessey Shale[1]

Permian: Central and southwestern Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 786–799.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped with Cedar Hills sandstone member in upper part.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 11–12, pl. 1. In southwestern Oklahoma overlies Wichita formation and underlies Duncan sandstone, or Flowerpot shale, where the Duncan is absent. Thickness in central Oklahoma 300 to 600 feet. In Carter area

(this report), where only uppermost 40 to 50 feet is exposed, predominantly yellowish-gray to buff unfossiliferous shale; a few thin gray, blue-gray, or buff silty fine-grained calcareous sandstone stringers occur in the section as well as thin beds of bright red, brown, maroon, orange, yellow, and blue shales.

Named for exposures at Hennessey, Kingfisher County.

Hennessey Bayou Member (of Bucatunna Marl and Clay)

Oligocene (Vicksburg): Central western Mississippi.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. Proposed for lower Bucatunna transgressive unit heretofore included in Byram formation. Bentonite deposits occur in Bucatunna clays immediately above the marine Hennessey Bayou unit.

Typically exposed on Hennessey Bayou, 3 miles south of Vicksburg.

†Henrietta Formation[1] or Group[1]

Pennsylvanian (Des Moines Series): Western Missouri, southern Iowa, and eastern Kansas.

Original reference: C. R. Keyes, 1897, Iowa Acad. Sci. Proc., v. 4, p. 23–24, 25.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2). Columnar section shows group includes (ascending) Fort Scott limestone, Labette shale, Pawnee limestone, Bandera shale, Altamont limestone, and Nowata shale. Overlies Cherokee group; underlies Pleasanton group.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, v. 28, 2d ser., p. 95, 96. A sandstone (Squirrel) commonly included in Cherokee group here included at base of Henrietta group in Fort Scott formation.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2027; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 5; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 43. Abandoned in favor of Marmaton.

Named for Henrietta escarpment, near Henrietta, Johnson County, Mo.

Henryhouse Shale,[1] Limestone, or Formation (in Hunton Group)

Silurian: Central southern Oklahoma.

Original reference: C. A. Reeds, 1911, Am. Jour. Sci., 4th, v. 32, p. 256–268.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 132, 134. Underlies Haragan formation in Kite group (new).

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), 7, 26–35. Typical lithology is fossiliferous argillaceous and silty calcilutite, commonly referred to as marlstone. Thinly bedded, beds ranging up to 3 inches and commonly weathering with irregular or nodular appearance. Chert absent or extremely rare. Maximum thickness about 230 feet on Lawrence uplift; thins rapidly to south; absent at Coal Creek; about 180 feet at Henryhouse Creek. Overlies Chimneyhill formation. No reliable field evidence, other than fauna, has been found for separating Henryhouse from overlying Haragan formation. These two formations are here grouped under term Hunton marlstone. Included in Hunton group. Silurian fauna appears to be closely related in age to the Brownsport of Tennessee but its position in terms of eastern Silurian faunas is in question.

Named for Henryhouse Creek, Carter County, which crosses the outcrop about 3 miles east of Woodford (SE¼ sec. 30, T. 2 S., R. 1 E.).

Henrys Chapel Ball Clay (in Wilcox Group)

Eocene, lower: Eastern Texas.

H. B. Stenzel, 1950, Texas Univ. Bur. Econ. Geology Pub. 5019, p. 15 (fig. 4). Shown on stratigraphic section as occurring at top of Wilcox group (undivided) in Troup district, Smith County.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 10 (fig. 3), 14–17, 30. Gray and black ball clay. Thickness 20.1 feet. Overlies silty clays of undifferentiated Wilcox group; underlies shaly silts of Carrizo formation, contact sharply defined.

Named for occurrences in Reliance Brick Co. quarry near Henrys Chapel, Smith County.

†Henrys Fork Group[1]

Upper Jurassic and Upper Cretaceous: Northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 50, 153.

Type locality: South side of Henry's Fork, Uintah County, Utah, at and above where it unites with Green River.

Henryville Formation (in New Albany Shale)

Henryville Member (of New Albany Shale)

Mississippian (Kinderhookian): Southeastern Indiana.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 837, 851. Summit bed of New Albany formation. Overlies Falling Run member of Sanderson formation (both new), or Underwood formation (new) where it is present; underlies Jacobs Chapel shale (new). Consists of black fissile shale never more than 1 to 2 feet thick. Cannot be distinguished from Sanderson shale except by presence of Falling Run or Underwood between the two.

H. H. Murray and others, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 43, pl. 1. Mississippian part of New Albany has been divided into (ascending) Sanderson, Underwood, and Henryville "formations". Indiana Geological Survey uses these terms with rank of member.

Type section: On Caney Fork Creek, in Clark Grant 252, 1½ miles southwest of Henryville, Clark County.

Hensell Sand Member (of Travis Peak Formation)

Hensell Shale Member (of Pearsall Formation)

Hensell Sand (in Travis Peak Formation[1] or Glen Rose Formation)

Hensell Sand Member (of Shingle Hills Formation)

Lower Cretaceous (Comanche Series): Central Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 141–144, 152.

R. H. Cuyler, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 633–635. Referred to as member of Travis Peak; sand in lower part; conglomerate, sandstone, sandy limestone, and sandy shale in upper part. Thickness 40 to 183 feet. Overlies Cow Creek member.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Hensell shale is uppermost member of Pearsall formation (new) in subsurface. At type section of Pearsall, the Hensell is about 340 feet thick, and consists of calcareous black shale interbedded with considerable black to dark-gray shaly limestone and hard dense partly fossiliferous, black to light-brown limestone, or, less commonly, light-gray to white chalky limestone. Overlies Cow Creek limestone member. Occupies same stratigraphic position as Hensell sand member of Travis Peak.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 6, 6–7 (fig. 1), 8. Reallocated to member status in Shingle Hills formation (new). Underlies Glen Rose limestone member.

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 68, 69, 70, figs. Referred to as Hensel sand. Overlies Cow Creek formation. Hensel considered correct spelling.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2336, figs. Hensell sand considered basal member of Glen Rose.

Named for Mr. Hensell's place, at Travis Peak post office, Burnet County.

Henshaw Formation[1]

Upper Pennsylvanian: Northwestern Kentucky.

Original reference: Wallace Lee, 1916, Geology of Kentucky part of Shawneetown quadrangle: Kentucky Geol. Survey.

Named for Henshaw, Union County.

Henson Formation (in Silverton Volcanic Group)

Henson Tuff (in Silverton Volcanic Series)[1]

Tertiary, middle and upper: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1907, U.S. Geol. Survey Geol. Atlas, Folio 153.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 80–81. Youngest member of Silverton volcanic series. Pyroclastic formation consisting chiefly of well-bedded fine-grained greenish- or brownish-gray sandy tuff composed of dark quartz latitic material. Thickness 100 feet. Older than lavas of Potosi volcanic series.

U.S. Geological Survey currently classifies the Henson as a formation in the Silverton Volcanic Group and designates the age as middle and late Tertiary on the basis of a study now in progress.

Named for exposures on Hensen Creek, Ouray quadrangle. Also exposed in parts of Silverton and Lake City quadrangles.

Hepler Sandstone (in Bourbon Group)

Hepler Sandstone (in Pleasanton Group)

Pennsylvanian (Missouri Series): Eastern Kansas and western Missouri.

J. M. Jewett, 1940, Kansas Geol. Survey Bull. 30, p. 8–9, fig. 2. A persistent sandstone, at base of Bourbon group generally not more than 3 or 4 feet thick but as much as 20 feet thick north of Pleasanton, Linn County, Kans., where it is asphalt bearing. Conformably underlies gray, yellow, and black shale; disconformably overlies upper layers of Marmaton group. Columnar section shows the Hepler overlying Memorial shale.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 73; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 91. Reallocated to Pleasanton group which replaces Bourbon group (suppressed).

Type exposure is in center sec. 14, T. 27 S., R. 22 E., 1½ miles north of Hepler, Bourbon County, Kans.

Heppsie Andesite

Miocene(?): Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Name applied to andesitic flows that are generally thick-bedded, massive though locally slightly platy, gray to blue-gray porphyritic rocks with a microcrystalline groundmass. Occurs above red agglomeratic andesitic horizon that delimits top of tuff of Wasson formation (new). Flows extend out of quadrangle for many miles to base of basalts of Pliocene and Pleistocene age; within quadrangle they are typical "andesites of the Western Cascades" of other writers.

Name derived from Heppsie Mountain, Jackson County, where andesites are well exposed.

Herald Beds

Ordovician: Subsurface in northwestern North Dakota, and southern Saskatchewan, Canada.

Saskatchewan Geological Society, 1958, Report of the Lower Palaeozoic names and correlations committee: Saskatchewan Geol. Soc., p. 6, 7, charts A and B [p. 18, 19]. Through the Williston Basin, interior beds comprise several cyclic or rhythmic sequences of fossiliferous dolomitic limestones, argillaceous dolomites, and evaporitic anhydrites reaching maximum known thickness of 130 feet in northwestern North Dakota. Evaporites absent from outlying areas of basin. Conformably overlies Yeoman beds (new).

Type locality: Imperial Herald No. 1–31 (Lsd. 1, sec. 31, T. 1, R. 20, W 2nd Mer., Saskatchewan) between 9,520 and 9,599 feet; Williston Basin.

Herat Shale Member (of Ochre Mountain Limestone)[1]

Upper Mississippian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, Oct. 19, p. 421–432.

Named for exposures near Herat claims, Gold Hill quadrangle.

Herbert Conglomerate[1] Member (of Bon Air Sandstone)

Herbert Member (of Lee Formation)

Herbert Sandstone

Pennsylvanian (Pottsville Series): Eastern Tennessee.

Original reference: W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–A, p. 49–50.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 17). Correlation chart shows Herbert sandstone underlying Eastland formation and overlying Whitwell [shale].

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of Cumberland Plateau. Tennessee Div. Geology [Folio], p. 4. The conglomeratic phase of Newton sandstone in southern Cumberland and northern Bledsoe Counties was the type "Herbert conglomerate" erroneously considered by Nelson (1925) to be older than Newton. Shale

thought to be between sandstones and named "Eastland shale" by Nelson is actually Whitwell shale; therefore, names "Herbert" and "Eastland" are discarded.

First described on Glade Creek just north of where road from Herbert, Bledsoe County, to Sparta crosses stream.

†Herculean Shale Member (in Monterey Group)[1]

Miocene: Central western California.

Original reference: C. E. Weaver, 1909, California Univ. Pubs., Bull. Dept. Geol., v. 5, p. 251.

In San Pablo region.

Hercules Shale Member (of Briones Sandstone)[1]

Miocene, upper: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 69 (table 14), 75, 77, pl. 12. In Carquinez and Mare Island quadrangles, the Hercules is well-defined unit averaging 500 feet thick. Lithologically it is siliceous light-brownish-gray shale; in places sandy with abundant flakes of muscovite. Overlies a 1,100-foot sandstone in lower part of Briones and underlies an upper 850-foot sandstone.

Named for Hercules Station on San Pablo Bay, San Francisco region.

Hercules Tower Sandstone (in Lutie Member of Theodosia Formation)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy, Tech. Ser., v. 15, no. 2, p. 29, 31, pl. 2. A massive red to reddish-brown medium-grained friable sandstone about 10 feet thick. Occurs near middle of Lutie and is separated from overlying Pocket Hollow oolite (new) by black and white chert and beds of finely crystalline dolomite and "cotton rock".

Well exposed on Missouri Highway 125 south of Brush Creek about midway between village of Hercules and Hercules fire lookout tower, Taney County, Mo.

Herendeen Limestone[1]

Lower Cretaceous: Southwestern Alaska.

Original reference: W. W. Atwood, 1911, U.S. Geol. Survey Bull. 467, p. 25, 39.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U. S. Geol. Survey. Appears on map legend.

Exposed from Herendeen Bay to Port Moller, Alaska Peninsula.

Herington Limestone (in Chase Group)

Herington Limestone Member (of Nolans Limestone)

Herington Limestone (in Sumner Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: J. W. Beede, 1909, Kansas Acad. Sci. Trans., v. 21, pt. 2, p. 253.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Member of Nolans limestone. Consists of limestone and dolomite, yellowish-tan, soft and dense, more dolomitic in southern and central Kansas than in northern part of state. Outcrops characterized by siliceous and calcareous geodes and concretions and cauliflowerlike masses of drusy flint weathered from matrix; molluscan fauna abundant. Thickness 7 to 10 feet in northern part and about 30 feet in southern Kansas. Overlies Paddock shale member; underlies Wellington formation of Sumner group. Wolfcamp series.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Herington limestone in Chase group.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 229–235. Term Lyon series (Lyonian epoch) proposed for Sakmarian rocks of Oklahoma. Series would include rocks from top of Brownville limestone to top of Herington limestone.

Named for Herington, Dickinson County, Kans.

Herkimer Limestone[1]

Herkimer Limestone (in Hartmann Group)

Middle Cambrian: Central northern Utah.

Original reference: W. Lindgren and G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 7. Described in East Tintic Mountains where it is 350 to 450 feet thick; conformably overlies Dagmar limestone and underlies Bluebird dolomite. Subdivided into three members: lower, about 180 feet thick, composed of medium-bedded blue-gray limestone mottled by thin discontinuous layers and irregular splotches of yellowish-brown argillaceous material; middle, shale, about 20 feet thick; and upper, about 150 to 250 feet thick, composed of thin beds of limestone, limestone flat-pebble conglomerate, and calcareous oolite all separated by shale partings.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 14 (fig. 3), 17. In Stansbury Mountains, as much as 145 feet thick; underlies Bowman limestone, and overlies Dagmar dolomite (limestone).

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 18–21, pl. 1. Assigned to Hartmann group in southern Oquirrh Mountains. Herkimer of this report includes upper half of what Gilluly (1932) mapped as Hartmann limestone. Where best exposed, along Lynch Ridge north of town of Ophir, 466 feet thick. Overlies Teutonic limestone with contract gradational; underlies Bowman limestone with contact conformable and gradational.

Named for occurrence near Herkimer shaft 1½ miles south-southwest of Eureka, Juab County.

Herkimer Sandstone[1] (in Clinton Group)

Middle Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 22 (fig. 6), 35; 1947, New York State Mus. Bull. 341, p. 13, 15, 16, 23, 111–113, geol. secs. Top of Clinton group in section east of Cayuga County. Thickness

approximately 75 feet. Underlies Lockport dolomite; overlies Willowvale shale; locally overlies Kirkland iron ore; equivalent to Rochester shale of west and west-central New York.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 10, fig. 1. In area of Vanhornesville, observed to unconformably underly Brayman shale.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. no. 1. Underlies Ilion shale (new).

Type locality: On Steeles Creek, 5 miles southwest of Herkimer village, Herkimer County.

Herman Creek Lava[1]

Pleistocene: Central northern Oregon and southwestern Washington.

Original reference: R. W. Chaney, 1918, Jour. Geology, v. 26, no. 7, p. 577–592.

Herman Creek is in Hood River County, Oreg.

†Hermansville Limestone[1]

Hermansville Formation

Upper Cambrian and Lower Ordovician: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

F. T. Thwaites, 1942, Michigan Acad. Sci., Arts and Letters Papers, v. 28, p. 488. Hermansville of Van Hise and Bayley is not clear. In view of this uncertainty of definition, name Hermansville could very well be dropped.

G. V. Cohee, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 9. Hermansville limestone, as originally defined and later used in Northern Peninsula, included dolomite and sandstone of both Lower Ordovician and Cambrian age which can be traced in subsurface studies into northeastern Wisconsin. Jordan sandstone as recognized in this report forms part of Hermansville as currently used in Northern Peninsula.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Div. Pub. 51, p. 6 (fig. 1), 116–117. Inasmuch as no type locality or type section was presented by Van Hise and Bayley or by any subsequent workers for term Hermansville, and since type of lithology and age of rocks referred to by that term has been vague and confused, name should be abandoned. Au Train formation is proposed for these rocks.

Named for exposures near Hermansville, Menominee County.

Hermit Shale (in Aubrey Group)[1]

Hermit Formation

Permian: Northern Arizona, southeastern Nevada, and southern Utah.

Original reference: L. F. Noble, 1922, U.S. Geol. Survey Prof. Paper 131–B, p. 26, 28, 64.

E. D. Koons, 1945, Geol. Soc. America Bull., v. 56, no. 2, p. 154. Discussion of geology of Uinkaret Plateau. Hermit formation, 1,053 feet thick, overlies Supai formation and underlies Coconino sandstone. Lower 200 feet contains cross-laminated beds of sandstone; upper 800 feet composed of weak shales and sandstones.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 515 (fig. 2), 526, 527–528. Referred to as formation. Designation shale is

misnomer. Noble in description of type section used term sandstone for compact massive beds and shale for thinly laminated soft beds which are in reality fine-grained sandstones. Thickness: 933 feet at South Hurricane Cliffs; 700 feet at North Grand Wash Cliffs. Underlies Coconino sandstone; overlies Queantoweap sandstone (new) with contact transitional in interval ranging from 5 to 50 feet. If unconformity at base of Hermit at Bass Trail and at Jumpup Canyon on Kanab Creek, described by Noble (1922, and 1928, U.S. Geol. Survey Prof. Paper 150), is present in sections west of Kanab Creek, it would occur between the Queantoweap and Hermit; it may have been overlooked in present work.

Type locality: Hermit Basin, Arizona.

Hermitage Formation[1] **or Limestone** (in Lexington Group)

Hermitage Formation (in Nashville Group)

Middle Ordovician: West-central Tennessee and southern Kentucky.

Original reference: C. W. Hayes and E. O. Ulrich, 1903, U.S. Geol. Survey Geol. Atlas, Folio 95, p. 1.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41, 42. Included in Lexington group. Overlies Curdsville limestone; underlies Jessamine limestone. Thickness 35 feet near Lexington, Ky.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 81–107, measured sections. Basal formation in Nashville group (redefined). Includes Curdsville member (at base) and facies or members referred to as laminated argillaceous silty nodular limestone; *Dalmanella* coquina; granular phosphatic; *Ctenodonta*; and blue clay-shale. Maximum thickness 180 feet. Underlies Bigby-Cannon formation; unconformably overlies Carters limestone of Stones River group. Hayes and Ulrich referred to section in vicinity of Hermitage Station but did not locate or reproduce the section. Bassler (1932, Tennessee Div. Geology Bull. 38) stated location of section and gave thickness as 67 feet. In present study, several sections were measured in vicinity of Hermitage Station which together present complete succession of formation in type area. Thickness of 67 feet was measured in section in bed of Stoner Creek and northward up hill located just west of bridge on Central Pike over this creek. This is probably locality where section was measured by Ulrich and Bassler.

Type area: Near Hermitage Station on hill between Stoner Creek and Lebanon-Nashville and Central Pikes. Named for occurrence at Hermitage Station, Davidson County, Tenn.

Hermon Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Name applied to thin unit formerly termed Lower DeLong coal. Stratigraphically above Seville limestone member and below Brush coal member which name replaces unit formerly termed Middle Delong coal. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Brush Creek, secs. 6 and 8, T. 9 N., R. 2 E., Knox County. Named for village of Hermon about 2½ miles south of type outcrop.

Hermon cyclothem (in Spoon Formation)

Pennsylvanian: Northern and western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 52 (table 1), pl. 1. Name applied to cyclothem formerly called Lower DeLong. In sequence, occurs above Seville cyclothem and below Seahorne cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Brush Creek, secs. 6 and 8, T. 9 N., R. 2 E., Knox County. Named for village of Hermon, about 2½ miles southeast of type locality.

Hermon Granite Gneiss

Hermon type[1] granite

Precambrian: Northeastern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 52–81.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 142–145. Typical Hermon type of granite is moderately coarsely porphyritic augen gneiss, with phenocrysts of feldspar in coarse- to medium-grained ground mass. Borders Antwerp type granite. Granite occurs in sheet in Grenville belt.

Occurs in sheet extending from Hermon, St. Lawrence County, to Evans Mills.

Hermosa Formation[1]

Hermosa Group

Middle Pennsylvanian: Southwestern Colorado, northeastern Arizona, northwestern New Mexico, and southeastern Utah.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60, p. 8.

A. A. Baker, 1933, U. S. Geol. Survey Bull. 841, p. 18–23. Overlies Paradox formation (new).

W. S. Burbank and E. N. Goddard, 1937, Geol. Soc. America Bull., v. 48, no. 7, pl. 3. Discussion of thrusting in Huerfano Park region, Colorado. Stratigraphic column for region shows "type of sediments like Hermosa formation" underlying "type of sediments like Rico formation".

N. W. Bass, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 7, accompanied by paper on Paleozoic stratigraphy as revealed by deep wells in parts of southwestern Colorado, northwestern New Mexico, northeastern Arizona, and southeastern Utah. Formation in Animas River valley is about 2,000 feet thick and consists of alternating thick beds of greenish tan-gray arkosic sandstone, grit, and locally conglomerate, thin beds of dark-blue-gray, dense, fossiliferous limestone, and at least one zone that contains beds of gypsum. Includes Paradox member which overlies and underlies unnamed parts of formation. Underlies Rico formation; overlies Molas formation.

S. A. Wengerd, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1038–1051. Formation, exposed in San Juan Canyon where it transects Monument upwarp in southeastern Utah, contains several biostromal layers, one of which changes laterally into small bioherms with typical reef-limestone breccia making up greater part of deposit. At least eight

bioherms have been breached by San Juan River, several of which are exposed on only one canyon wall. Reef limestones present through approximately two-thirds of Hermosa thickness below Hermosa-Rico gradational contact. Fossils suggest bioherms are Des Moines in age. Exposed thickness about 1,000 feet.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2165–2166, 2167 (fig. 7), 2173–2174, 2188–2190. Described in Paradox salt basin, Four Corners region, Colorado and Utah. Original Hermosa included all beds from top of Rico member of Cutler formation to top of Leadville limestone. Devonian strata referred to by Spencer was actually the presently known Leadville limestone of Mississippian age. Section measured in this report is almost exactly the one designated as type section by Roth (1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 7). Hermosa of this report is restricted to clastic facies and carbonate facies that occur above Paradox here treated as a formation. Fusulind control shows carbonate facies as Wolfcamp, Virgil, Missouri, Des Moines (Marmaton, and locally Cherokee); clastic facies is Wolfcamp, Virgil, and Missouri. Top of Hermosa has been recognized, in past, in beds ranging from Wolfcamp to Des Moines in age, throughout stratigraphic interval of at least 800 feet. Inconsistent definitions of gross sections and their lithologic character without paleontologic control are responsible for this situation. Research has led to establishment of "R" datum, commonly a sandy limestone found in or near base of marine Wolfcamp series and approximately equivalent to Mendenhall sandstone at Honaker Trail, San Juan Canyon, Utah. This datum believed to be almost true time surface whose position does not vary more than 100 feet from some, as yet unidentifiable, true time-stratigraphic surface. In parts of region, this datum is exactly on top of section commonly considered to be the true Hermosa section and for purposes of regional correlation is considered to mark top of Hermosa section as chosen by Roth in type locality. "R" datum plane is approximately base of Rico transition facies here treated as basal member of Cutler formation.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–71. Formation described in Davis Mesa quadrangle, Colorado, where it comprises two members: lower or Paradox, consisting largely of intrusive salt and gypsum; and the upper or limestone member. All known surface occurrences of Paradox member are intrusive and beds are complexly folded and contorted; undisturbed thickness of member not known. Wells drilled in Paradox Valley penetrated about 2,300 feet of beds belonging to limestone member and more than 10,800 feet of intrusive beds without reaching pre-Paradox strata. Base of section. Underlies Cutler formation.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–77. Described in Anderson Mesa quadrangle, Colorado, where it consists of Paradox member below and an upper limestone member. Base of section; unconformably underlies Chinle formation.

J. R. Clair, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 31–46. Group, in subsurface, comprises (ascending) Lime Ridge formation (new), Pinkerton Trail formation, Barker Creek zone, Paradox formation, Ismay zone, and Honaker Trail formation.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2056. Rank raised to group. Comprises (ascending) Pinkerton Trail, Paradox, and Honaker Trail (new) formations. Overlies Molas formation; underlies Cutler group.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1911. Discussion of stratigraphy in Sangre de Cristo Mountains between La Veta Pass and Westcliffe, Colo. Name Madera replaces Hermosa and Rico formations of Burbank and Goddard (1937) in south-central Colorado and restricts these terms to southwestern Colorado west of San Luis-Uncompahgre highland.

R. W. Fetzner, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1377–1388. Formation used in this report [Pennsylvanian paleotectonics of Colorado Plateau] comprises lower Hermosa member, Paradox member, and upper Hermosa member. Nomenclature of Wengerd and Matheny (1958) not used in present report because Honaker Trail formation includes early Permian Cutler carbonate facies that occurs in northwestern Paradox Salt basin and present investigation requires Permo-Pennsylvanian division in order to define Pennsylvanian lithofacies.

Type section (Roth): Secs. 26 and 35, T. 37 N., R. 9 W., La Plata County, Colo. Named for Hermosa Creek, which flows into Animas River north of Durango. This is composite section measured across strata which dip gently southward into San Juan basin.

Hermosa Lens (in Newcastle Formation)

Upper Cretaceous: Western South Dakota.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 17. Predominantly sandstone. Thickness 16 feet at north end, about 8 feet in middle, and 54 feet at south end. In this report, seven lenses are named in the Newcastle.

Present in T. 2 S., R. 8 E., near town of Hermosa, Custer County.

Hernshaw Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 155.

Named for Hernshaw, Kanawha County.

Hero Member (of Valcour Formation)

Middle Ordovician (Chazyan): Northwestern Vermont and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 825 (fig. 4), 826 (fig. 5), 834–836, 843, 846. In South Hero, lower 101 feet of the Valcour, the Hero member, is dark-gray silt-laminated calcarenite argillicalcisiltite, massive-bedded but weathering to nodular shaly rubble; *Solenoporo* sp. abundant in top 3 feet, and present sparingly with sponge *Zittelella varians* (Billings) and a few *Stromatocerium* masses below. At Chazy, N.Y., member has interbedded dolomite and calcilutite; calcilutites of lower 17 feet here are the dove limestone of authors, earlier mistaken for Beldens limestone. At Sheldon Lane, central Isle La Motte, Rockwell Bay, and Tiger Point, Valcour Island, member has *Glaphurus*-bearing reefs. Underlies Beech member (new); overlies Crown Point formation.

Type section: In South Hero, Vt., near Rutland Railroad station.

Herod Gravel Member (of Manhasset Formation)[1]

Pleistocene: Southeastern New York and islands of southeastern New England.

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Basal member of Manhasset. Underlies Montauk till member; overlies Jacob sand. Manhasset is generally considered to be of Wisconsin age.

Occurs at nearly all points from Long Island to Boston.

Herrick Formation

Herrick Gravels

Pleistocene: Southeastern South Dakota.

R. E. Stevenson and L. A. Carlson, 1950, Areal geology of the Bonesteel quadrangle (1:62,500): South Dakota Geol. Survey. Fluvial coarse feldspathic sands and gravels on upland surface.

R. E. Stevenson, R. L. Hale, and H. C. Skogstrom, Jr., 1958, Geology of the Gregory quadrangle (1:62,500): South Dakota Geol. Survey. Formation consists of series of lensing crossbedded very coarse to medium-grained arkosic sands with local streaks of small pebbles of granite, quartz, schist, and petrified wood. Thickness as much as 54 feet; at paratype section, 35 to 40 feet. Lies on nearly flat surface developed on Ash Hollow formation.

Paratype section: In Burke Stone and Sand Company pit, 1½ miles west of Burke, Gregory County. Named for exposures near town of Herrick, 7 miles southeast of Burke.

Herrin Coal Member (of Carbondale Formation)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 36, 48 (table 1), 65, pl. 1. Assigned member status in Carbondale formation (redefined). In southern area, occurs above Vermilionville sandstone member and below Brereton limestone member; in northern and western area, occurs above Big Creek shale member and below Brereton limestone member; in eastern area, occurs above Harrisburg (No. 5) coal member and below Danville (No. 7) coal member. Thickness about 5 feet. Name Brereton limestone is extended to caprock of No. 6 coal to replace name Herrin, now restricted to the coal. Coal named by Worthen (1870, *in* Geology and Paleontology, v. 4, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: In mines in vicinity of Herrin, Williamson County.

Herrin Limestone (in Carbondale Group)

Herrin Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: G. H. Cady, 1926, Illinois Acad. Sci. Trans., v. 19, p. 262.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 27, 44. Included in Brereton cyclothem, Carbondale group. Overlies Herrin No. 6 coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35. Replaced by Brereton limestone member of Carbondale formation (redefined). Name Herrin now restricted to Herrin (No. 6) coal member.

Named because of its association with Herrin coal. First described in Saline County.

Herringa Flow or Tongue (of Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 112, 133, 134, 143 (fig. 20). East of type locality, Clayton basalt consists of many long tongues. For purpose of this report, these tongues have been named, from south to north, Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that gave rise to these basalts are unknown.

Present in eastern Union County.

Herschel Quartzite[1]

Lower Cretaceous(?): Southeastern Arizona.

Original reference: J. A. Church, 1903, Am. Inst. Mining Engrs. Trans., v. 33, p. 3–37.

Tombstone district.

Hersey Red Shale Member (of Pembroke Formation)[1]

Upper Silurian: Southeastern Maine.

Original reference: E. S. Bastin and H. S.Williams, 1914, U.S. Geol. Survey Geol. Atlas, Folio 192, p. 6–7.

Named for exposures on Hersey Neck, Pembroke Township, Washington County.

Hershey Limestone

Middle Ordovician: Southeastern Pennsylvania.

Carlyle Gray, 1952, Pennsylvania Geol. Survey Prog. Rept. 140, p. 4–5; 1952, Pennsylvania Acad. Sci. Proc., v. 26, p. 86, 88. Dark-gray graphitic, shaly or silty limestone. Less pure and darker in color than typical Myerstown limestone below. Weathered exposures typically brownish gray and show well-developed cleavage. Bedding marked by shaly laminations. Beds of conglomerate occur at base in eastern part of mapped area; consist of angular to subrounded fragments of dolomite and magnesian limestone in matrix of dark-gray graphitic shaly limestone and are interbedded with normal Hershey limestone. Total thickness several hundred feet. Conglomerate zone may be more than 100 feet thick in Berks County where it is mapped as an unnamed member. Underlies Martinsburg formation. Unit formerly included in Leesport formation. Name credited to C. E. Prouty.

Carlyle Gray and C. E. Prouty, 1954, Field Conf. Pennsylvania Geologists 20th Ann. Mtg., p. 28–29; C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 20–28. Thickness about 435 feet at type section. Overlies Myerstown; underlies Martinsburg.

Type section: Near covered bridge across Swatara Creek, Dauphin County. Named for Hershey, Dauphin County. Maximum development north of Womelsdorf in Berks County. Poorly exposed in Lebanon County.

Hertha Limestone (in Kansas City Group)[1]

Hertha Limestone (in Bronson Group)

Hertha Limestone Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: G. I. Adams, 1899, Kansas Acad. Sci. Trans., v. 16, p. 58, 59.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 193. Hertha limestone, in Bronson group, includes (ascending) Critzer limestone, Mound City shale, and Sniabar limestone members. Thickness, featheredge to about 30 feet. Overlies Bourbon shale; underlies Ladore shale.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028–2029, 2031 (fig. 4). Underlies Ladore formation; overlies Pleasanton group. Kansas City group redefined in Kansas and Nebraska; lower boundary placed at base of Hertha formation. Bronson reduced to subgroup of Kansas City group (revised). This is classification agreed upon by Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 10, 11. In Missouri, Hertha includes (ascending) Critzer limestone, Mound City shale, and Sniabar limestone members.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 421. Thickness about 3 feet in Madison County, Iowa. Underlies Ladore shale; overlies Pleasanton shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Basal formation in Kansas City group. In Madison County, typically composed of three limestones with one thin shale separating the lower two. Middle limestone bed fragmental and fossiliferous; upper and lower limestones argillaceous and lenticular. Thickness about 4 feet in Madison County; about 9 feet in cores from Council Bluffs area. Underlies Ladore shale; overlies Pleasanton group.

Named for occurrence in vicinity of Hertha, Neosho County, Kans.

Hess Limestone Member (of Leonard Formation)

Hess (thin-bedded) Limestone Member (of Leonard Formation).

Permian: Western Texas.

Original reference: J. A. Udden, 1917, Texas Univ. Bull. 1753, p. 43, pl. 3.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 98. Limestones northeast of Hess Ranch were named Hess formation in 1917 because they were thought to be separated by unconformity from Leonard beds above. Later work has shown that this unconformity does not exist, and evidence was presented (King, 1932, Am. Jour. Sci., 5th ser., v. 34) which indicated that limestones of typical Hess formation were largely equivalent to shales and thin limestones typical of Leonard formation. The two facies were interpreted as being separated by limestone reefs. In present report, the two units are brought together in single formation, the Leonard, in accordance with Udden's original definition, and the Hess is designated as Hess thin-bedded limestone member.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 651, pl. 2. Term Hess limestone member used in this report.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 49, no. 9, p. 299. Lenoxhills formation (new) is lower 200 to 300 feet of Hess formation of Udden (1917).

Well exposed on Hess Ranch, Glass Mountains, Marathon region.

Hesse Quartzite[1] or **Sandstone** (in Chilhowee Group)

Hesse Quartzite Member (of Erwin Formation)

Lower Cambrian: Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

C. E. Resser, 1939, Geol. Soc. America Spec. Paper 15, p. 4, 5. Hesse sandstone abandoned; evidently synonym for Erwin quartzite.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13 (table 3). Two sets of formation names for Lower Cambrian clastic rocks in use in eastern Tennessee and western North Carolina (table 3). Northeast Tennessee names Unicoi, Hampton, and Erwin are used in this report for same rocks which Keith (1904, U.S. Geol. Survey, Geol. Atlas, Folio 116) and Stose and Stose (1947, Am. Jour. Sci., v. 245, no. 10) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn. Hot Springs area lies midway between type localities for each group of names. Hampton and Erwin formations, as used in this report [Hot Springs Window area], include Hesse quartzite.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 35 (table 3). Table shows Hesse includes Helenmode member at top.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 964. Chilhowee group as whole is classed as Cambrian and Precambrian(?). Helenmode formation at top of group is Cambrian and remaining unfossiliferous formations [including Hesse quartzite] are termed Precambrian(?).

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ-131. Hesse quartzite described in Blockhouse quadrangle. Tennessee, where it is 500 feet thick. Overlies Murray shale; underlies Helenmode formation. Lower Cambrian(?).

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 43. In northeasternmost Tennessee, considered quartzite member of Erwin formation. In places, as many as three ledges, each 25 to 50 feet thick, are separated by beds of siltstone. Only uppermost persists throughout area. Overlies Murray shale member; underlies Helenmode member. Lower Cambrian.

Named for Hesse Creek, Blockhouse quadrangle, Blount County, Tenn.

Heumader Shale Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 94, 96.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Heumader shale member of Oread limestone; underlies

Kereford limestone member; overlies Plattsmouth limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 25. Thickness in southeastern Nebraska 2 to 4 feet.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness 7 feet in section measured near Winterset, Madison County.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 21, fig. 5. Olive green, brown, black; locally black carbonaceous zones and black subfissile beds. Average thickness 3 feet. Overlies Plattsmouth limestone member; underlies Kereford member; where Kereford is missing, underlies Kanwaka shale.

Type locality: Heumader quarry, bluffs of Missouri River just north of St. Joseph, Buchanan County, Mo.

Heuvelton Member (of Tribes Hill Formation)

Heuvelton Sandstone[1]

Lower Ordovician: Northern New York.

Original reference: G. H. Chadwick, 1915, Geol. Soc. America Bull., v. 26, p. 289–291.

R. H. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939; 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence valleys. Lower "typical" Theresa is physically and faunally separated from "Upper Theresa" (now Heuvelton member of Tribes Hill formation). Two marine cycles represented by Tribes Hill formation (containing Norton equivalent to Heuvelton, Fort Ann equivalent to Bucks Bridge, Benson equivalent to Ogsdenburg members) and Cassin formation, constitute Beekmantown series.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 19). Heuvelton sandstone, shown on correlation chart as Lower Ordovician, occurs below Tribes Hill dolomite.

Probably named for Heuvelton, St. Lawrence County.

Hewetts Branch Sandstone (in Allegheny Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5, p. 116.

At Carbondale, Athens County.

Hewittville Calcilutites (or Beds)[1]

Lower Ordovician (Beekmantown): Northern New York.

Original reference: G. H. Chadwick, 1920, New York State Mus. Bull. 217, 218, p. 33.

Cap Bucks Bridge formation on west bank of Raquette River just below concrete dam of lower mills at Hewittville, Canton quadrangle.

Hex Formation

Upper Jurassic(?): Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 6–8, pls. 1, 2. Brown and gray clay with bentonite at Hex Hill, grading westward into light-blue tuffaceous shale; abun-

dant belemnites and some Foraminifera. Whitish, irregular limestone masses scattered throughout formation. Bedding has been destroyed by squeezing in core of Avenal Ridge piercement anticline. Because of plastic deformation, true thickness of formation cannot be determined. Contacts with other formations are everywhere discordant. Unit rests in fault contact against Badger shale, Risco formation, Serpiente sandstone, Moonlight formation, and probably Red Man sandstone (all newly named units). Fossils have been assigned tentatively to Late Jurassic.

Type locality: Hex Hill, just south of Devils Den, northwestern Kern County. Crops out east of Orchard Peak as single band about one-half mile wide and more than 4 miles long, paralleling base of scarp formed by Avenal Ridge. Occupies core of Avenal Ridge piercement anticline.

Hiawatha Graywacke (in Paint River Group)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 38. Predominantly graywacke with considerable amounts of interbedded slate; lower part is commonly a breccia that consists of scattered angular chert fragments in a graywacke matrix. Ranges in thickness from 50 feet or less in eastern part of district to 400 feet more in western part. Underlies Stambaugh formation (new); overlies Riverton iron-formation (new).

Named for Hiawatha mine at Iron River, Iron County. Rocks are exposed in scattered outcrops and formation is crossed by extensive mine workings. Locally well exposed along course of Paint River at north edge of town of Crystal Falls.

Hiawatha Member (of Knight Formation)

Hiawatha Member (of Wasatch Formation)[1]

Paleocene and Eocene, lower: Northwestern Colorado, northeastern Utah, and southwestern Wyoming.

Original reference: W. T. Nightingale, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 8, p. 1019–1040.

W. J. Morris, 1955, Dissert. Abs, v. 15, no. 3, p. 394. Name Knight formation extended from Bridger basin to include dominantly fluviatile Wasatchian deposits of Washakie basin. Hence, Hiawatha is considered member of Knight formation.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 40 (fig. 4), 41. Referred to as member of Wasatch. Geographically extended into Daggett County, Utah. Lower half, considered Paleocene, consists of drab claystone, shale, sandstone, coal, coaly shale, and conglomerate; upper half, considered Eocene, consists of varicolored claystone with minor amounts of coal, and coarse sandstone and conglomerate. Thickness as much as 3,500 feet. Underlies Tipton tongue of Green River formation; overlies Fort Union formation.

Names for development on Hiawatha and West Hiawatha domes, Tps. 12 N., Rs. 100 and 101 W., Moffat County, Colo.

Hickey Formation

Pliocene(?): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 56–58, fig. 2, pl. 1. Interbedded basaltic volcanic rocks and gravels. Volcanic rocks comprise chiefly olivine basalt and lesser amounts of oli-

vine andesite, agglomerate, and basaltic sedimentary rock. Gravel beds consist of boulders and cobbles derived chiefly from local bedrock. Locally gravel is crudely bedded and cemented by lime. In one locality, thin bed of rhyolitic tuff intercalated between flows. Some flows more than 50 feet thick. Thickness about 1,400 feet along northern boundary of Mingus Mountain quadrangle, Jerome area. Erosion has removed top of formation in Jerome area. Unconformably underlies Verde formation; overlies Supai formation.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 549–556, pls. 45, 46, 47. In Clarkdale quadrangle, formation consists of much more volcanic than sedimentary rocks. Well exposed on Woodchute Mountain where there are about 1,400 feet of volcanic flows plus about 50 feet of gravel in minor channels at base of flows. Older than Perkinsville formation (new).

B. E. Sabels, 1960, Dissert. Abs., v. 21, no. 3, p. 596. Late(?) Miocene.

Named from exposures on Hickey Mountain, an upland area contiguous to Mingus Mountain, Jerome area, Yavapai County. Typically exposed on Mingus Mountain, but name Mingus preoccupied.

Hickman Group[1]

Pleistocene: Southwestern Kentucky.

Original reference: R. H. Loughridge, 1888, Kentucky Geol. Survey Rept. Jackson's Purchase Region, p. 37–41.

Named for bluffs of Mississippi River at Hickman, Fulton County, and to the south.

Hickory Sandstone Member (of Oil Creek Formation)

Ordovician: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey. Name used by Edson (1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1127) for member at base of Oil Creek formation. Name preoccupied. No replacement of preoccupied name made, and none seems necessary.

Northeastern flank of Arbuckle Mountains.

Hickory Sandstone Member (of Riley Formation)

Hickory Sandstone[1]

Upper Cambrian: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept. p. lxi, 285, pl. 3.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 154 [1945]. Rank reduced to member status in Riley formation (new). Basal member of formation. Sandstone is noncalcareous, and color varies through different shades of brown. Upper boundary is placed at change from calcareous to noncalcareous sandstone. This restricts the member vertically as some quite sandy beds are thus allotted to overlying Cap Mountain limestone member. Thickness in Johnson City area 335 feet.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 27, 29, 253 [1946]. In Riley Mountains, member rests nonconformably on varied but mostly dark and schistose metasedimentary rocks of Precambrian Packsaddle schist.

Named for Hickory Creek, Llano County.

Hickory Creek Shale[1] Member (of Plattsburg Formation)

Pennsylvanian (Missouri Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 93, 97.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33. Thickness in Nebraska 1 to 3 feet or more; in Kansas 1 foot in a few places to maximum locally of 15 feet or more. Underlies Spring Hill limestone member; overlies Merriam limestone member. Type locality stated.

Type locality: In railroad cut near center east side sec. 14, T. 15 S., R. 23 E., southern Johnson County, Kans.

Hickory Ridge Member (of Oneota Formation)

Lower Ordovician: Southwestern Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 86–87, 89 (fig. 3), 92–93. Lower 35 to 40 feet of Oneota formation comprise natural unit that can be subdivided into two members and these further subdivided into a number of distinctive strata herein designated by numbers 1 to 9. Below base of stratum 4 (Chiton stratum), dolomites are for the most part arenaceous and are interbedded with sandstones, whereas little sand occurs above. On this basis, the unit is divided into Hickory Ridge member below and Mound Ridge member above. All oolite is confined to Hickory Ridge member, and "chitons" and most of chert are in Mount Ridge member. Overlies Sunset Point formation. Average thickness 24 feet. Fossils rare, but trilobite *Symphisurina* and small planospiral gastropods present locally.

Type section: Quarry and Mississippi bluff in NE¼SE¼ sec. 32, T. 13 N., R. 7 W., Stoddard quadrangle, 1 mile south of Genoa, Vernon County.

Hicks cyclothem (in McLeansboro Group)

Hicks cyclothem (in Modesto Formation)

Pennsylvanian: Northern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 16 (fig. 2). Pennsylvanian succession between Gimlet and La Salle cyclothems, exposed in upper Illinois valley, contains several prominent but thin limestones which are basis for recognition of incomplete cyclothems to which names (ascending), Turner, Hicks, and Hall, have been applied by H. B. Willman.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Includes Hicks limestone. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Modesto formation (new). Occurs above Trivoli cyclothem and below Hall clothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NW¼SW¼ sec. 33, T. 16 N., R. 11 E., Bureau County.

Hicks Formation[1]

Upper Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., 5th, v. 20, no. 17, p. 421–432.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 17–18, 53–54. Thickness in Deep Creek Range 599 feet. Underlies Dunderberg shale; overlies Lamb dolomite. Because of lithic

similarities and age relationships, it is recommended that Orr formation and underlying Weeks limestone be extended to other areas of similar lithology in preference to Hicks and Lamb formations.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1067. Evidence indicates that an unconformity is not present at top of Hicks formation; rather the Hicks thins depositionally, and the Cambro-Ordovician boundary lies within the Chokecherry dolostone.

Named for exposures in Hicks Gulch, in North Pass Canyon, Gold Hill district.

Hicks Limestone (in McLeansboro Formation)

Hicks Limestone (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 29). Shown on correlation chart as limestone in McLeansboro formation. Occurs below Hall limestone (new) and above Turner limestone (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Shown on correlation chart as limestone in McLeansboro group. Included in Hicks cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38. Discontinued. Name Hicks preempted. No new name proposed.

Type locality: NW¼ SW¼ sec. 33, T. 16 N., R. 11 E., Bureau County.

Hidalgo Volcanics (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 532, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 20–21, pl. 1. Consists primarily of basaltic lava flows. Breccia common at the base in Little Hatchet Mountains, and a little pyroclastic material present at other horizons. Locally contains 200 feet of thin-bedded light-gray and red limestone, red and green shale, and some conglomeratic layers. Exposed thickness ranges from 900 to 5,000 feet, the wide range being due to disconformities at top and bottom. Underlies Howells Ridge formation (new); overlies Ringbone shale (new) and Broken Jug limestone (new). Trinity age.

Named from Hidalgo County, over which the formation seems to be widely distributed. In Eureka district of Little Hatchet Mountains.

Hidden Falls Member (of Platteville Formation)

Middle Ordovician: East-central Minnesota.

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 58 (table 1), 60–61. Name applied to the argillaceous dolomitic limestone unit at about the middle of the Platteville in the Twin Cities area, where it is about 6 feet thick; includes bentonite or bentonitic shale at top. Thins to the east, grades into Magnolia lithology, and is not present at Ellsworth, Wis.; extends as far south as Faribault, where it is 17 inches thick, and Cannon Falls, where it is about 8 feet thick and is overlain directly by the Carimona member. In Twin Cities area, underlies Magnolia member and overlies Mifflin member.

R. E. Sloan, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2955–2956. Formal proposal of name. Type section designated.

Type section: In Hidden Falls Park on Mississippi River half a mile south of Ford Motor Co. plant in St. Paul, Ramsey County.

Hidden Treasure Limestone[1]

Lower Mississippian: Central northern Utah.

Original reference: F. M. Wichman, 1920, Eng. Mining Jour., v. 110, no. 12, p. 563.

Probably named for Hidden Treasure mine, Ophir district.

Hidden Valley Dolomite

Silurian and Lower Devonian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 15, pl. 1, 2, 3. Uniformly consists of dolomite but contains nodular chert near base and a little silt and sand near top. In lowest and highest units dolomite is medium gray and weathers light olive gray and yellowish gray; middle is light gray or creamy; chert is light gray or light brown and weathers to dark brown; contains silicified fossils. Thickness 1,365 feet at type locality and in Andy Hills. Underlies Devonian Lost Burro formation (new); overlies Ely Springs dolomite. Lower fossiliferous part of Hidden Valley is Silurian; near upper boundary of formation is a 50-foot zone containing Lower Devonian fossils. Thus Silurian-Devonian boundary falls within uppermost part of the Hidden Valley; the persistent lithologic change is above the Lower Devonian fossils, and this distinctive formational boundary has been mapped over a broad area.

J. F. McAllister, 1955, California Div. Mines Spec. Rept. 42, p. 9 (fig. 3), 12, pl. 2. In Ubehebe Peak quadrangle, underlies Lippincott member (new) of Lost Burro formation.

Type locality: On eastern flank of mountain about 2½ miles north of Ubehebe Peak, and about three-fourths mile west of the road in Racetrack Valley. Named for good exposure on eastern side of Hidden Valley, about 3 miles east-southeast from bench mark 5980 near Lost Burro Gap, northern Panamint Range, Inyo County.

Higginsville Limestone Member (of Fort Scott Limestone)

Pennsylvanian (Des Moines Series): Western Missouri, southwestern Iowa, southeastern Kansas, and northeastern Oklahoma.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2), 36, 63. Proposed for upper limestone of Fort Scott formation. Traced into Appanoose County, Iowa.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, p. 308, 309. Overlies Little Osage shale member (new). Underlies Labette shale. Average thickness in Kansas about 16 feet.

F. C. Greene, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6. Overlies Flint Hill sandstone bed (new) in Little Osage member of Fort Scott.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 14, 16 (fig. 2). Reaches maximum thickness of 35 feet in Craig County and passes into shale in western Rogers County.

H. G. Hershey, and others, 1960, Iowa Highway Research Board Bull. 15, p. 33, fig. 5. Medium gray, finely crystalline, and massive. Somewhat more fossiliferous to southeast than in Madison County. Thickness 2 feet in Appanoose County; 1 foot in Madison County. Shale section underlies Higginsville; in Appanoose County, carbonaceous shale is found immedi-

ately below the limestone; in Madison County, this shale is reddish brown and contains large ostracodes. Shale interval between Higginsville and overlying Houx limestone member is about 15 feet in Appanoose and about 7 feet in Madison County.

Well exposed east of Higginsville, Lafayette County, Mo.

Higham Grit[1]

Triassic(?): Southeastern Idaho, northeastern Utah, and western Wyoming.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 473, 475–476, fig. 2. Use extended southward to Park City area and as far east as upper Weber River section, Utah, to replace part of Ankareh shale which is stratigraphically restricted.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 34, pl. 1. Mapped as Higham grit in Ammon and Paradise Valley quadrangles, Idaho. Underlies Deadman limestone; overlies Timothy sandstone. Type locality designated.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 179–181, fig. 18. Timothy sandstone, Higham grit, Deadman limestone, and Wood shale are each distinct lithologically and are equivalent to Ankareh formation of Wasatch and Uinta Mountains and of western Wyoming. In present report, the Timothy is considered uppermost member of Thaynes formation. The Higham unconformably overlies Timothy sandstone member. Higham grit and Deadman limestone are recognized as independent formations, but Wood shale is considered westward extending tongue of Ankareh. Thickness of 105 feet at Cokeville, Sublette Range, Wyo. Age shown on table as Upper Triassic.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 104. Discussion of stratigraphy of Triassic sequence in Wasatch and western Uinta Mountains. The thin conglomeratic sandstone unit above Ankareh formation in this area is litho-stratigraphic equivalent of Higham grit of southeastern Idaho and Shinarump(?) conglomerate of eastern Uinta Mountains. Use of names Higham and Gartra to refer to this unit in this region ignores rule of priority. Older name Shinarump conglomerate is recommended.

Type locality: Higham Peak, from which unit takes its name, in sec. 23, T. 3 S., R. 37 E., about 4 miles west of Paradise Valley quadrangle, Idaho.

†High Bluff Blue Sands[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 75–77, 188.

Named for exposures in High Bluff of Ouachita River, 1½ miles northeast of Arkadelphia, Clark County.

†High Bluff Greensand[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72–75, 188.

Named for exposures in High Bluff of Ouachita River, 1½ miles northeast of Arkadelphia, Clark County.

High Bluff Member (of Pendleton Formation)

Eocene, lower: Northwestern Louisiana and northeastern Texas.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 184 (fig. 4), 186, 187. Consists of basal section of fossiliferous glauconitic sand overlain by sand containing calcareous concretions. These sands grade upward into about 65 feet of thin-bedded lignitic silts and sands: uppermost 30-foot part consists of crossbedded sands. Approximately 130 feet thick. Overlies Slaughter Creek member (new); underlies Pierson [Pearson] glauconite bed (new) in Sabinetown formation.

Typically exposed at High Bluff on Sabine River, Sabine Parish, La. Traced from Geneva, Tex., to Hagewood, Natchitoches Parish, La.

High Bridge Gneiss[1]

Precambrian: New York.

Original reference: R. P. Stevens, 1867, New York Lyc. Nat. History Annals, v. 8, p. 116–120.

Along southern shore of Spuyten-Duyvel Creek and Harlem River.

High Bridge Limestone[1] or Group

Middle Ordovician: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 2.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 12–13; D. K. Hamilton, 1948, Econ. Geology, v. 43, p. 40–41. High Bridge group comprises (ascending) Camp Nelson, Oregon, and Tyrone limestones.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Refers to High Bridge limestone, with Camp Nelson, Oregon, and Tyrone members.

Named for exposures at High Bridge (Highbridge), Jessamine County.

High Cascade series

Pliocene, Pleistocene, and Recent: Northern California and Oregon.

Eugene Callaghan, 1933, Am. Geophysical Union Trans., p. 243–249. Discussion of volcanic sequence in Cascade Range in Oregon. Cascade Range south of Mount Hood divided into two parts, Western Cascades and High Cascades, on basis of pronounced unconformity in stratigraphic sequence of lavas. Rocks that form the High Cascades are characterized by large mass of gray olivine basalt, large cones composed mainly of hypersthene andesite, rhyolite and pyroclastics, and small cones, some of them quite recent, of andesite, calcic andesite, and basalt.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 35–49. Most of Macdoel quadrangle occupied by volcanic rocks. These belong to two series: first, the Western Cascade series, Eocene to Miocene, and second, High Cascade series of Pliocene, Pleistocene, and Recent age. Named units in area include Plutos Cave, Butte Creek, Alder Creek, Whaleback, and Copco basalts and Goosenest flows.

High Falls Shale[1] or Formation[1]

Upper Silurian: Eastern New York, northern New Jersey, and northeastern Pennsylvania.

Original reference: C. A. Hartnagel, 1905, New York State Mus. Bull. 80, p. 342–357.

Freeman Ward, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–10, p. 4, 5 (fig. 2), 6–7. High Falls formation mapped in Pennsylvania below Delaware Water Gap. Overlies Shawangunk formation; underlies Cayuga group (formation). High Falls (synonymous with Bloomsburg red beds) is shaly but contains some sandstone. Predominantly red with some dull greenish beds. Occurs in wide band on northern and lower slopes of Kittatinny Mountain.

Well exposed on farm of Patrick Winn at High Falls, Ulster County, N.Y.

Highgate Formation

Highgate Slate[1]

Lower Ordovician: Northwestern Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 114–115.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1015, 1021, 1047, 1048, 1070–1074. Referred to as formation. In type area, a tectonic limestone breccia underlies the limestones and slates. Hungerford formation named to distinguish some beds formerly included in this formation. Lower Ordovician. Type locality cited.

A. B. Shaw, 1958, Geol. Soc. America Bull. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 550–553, pl. 1. Keith's first description of Highgate included rocks now assigned to Highgate as well as parts of Gorge formation, Hungerford slate, and Skeels Corners slate. Schuchert included certain Morses Line slates in Highgate. Formation, as herein defined, includes beds named Grandge slate by Schuchert. Beds exposed below Highgate Falls (Schuchert's type area) are now included in Gorge formation; hence, new type locality is designated. Lowest Highgate beds lie above Highgate Falls thrust in north and east walls of Highgate Gorge. These beds were inaccurately called Upper Gorge formation by Shaw (1951, Jour. Paleontology, v. 25; 1953, Jour. Paleontology, v. 27). Several angular unconformities present in formation. Section consists of lower limestone unit 500 to 1,000 feet thick; middle shaly unit about 1,500 feet thick and an upper conglomerate and limestone. These units are gradational vertically through several hundred feet. Overlies Gorge formation; underlies Morses Line formation.

Type locality (Shaw): Series of outcrops above Highgate Falls thrust and on western edge of Highgate Center. Formation lies in strip ½ to 1 mile wide trending about N. 20° E., from type locality. Type area (Schuchert): Upper sequence in gorge of Missiquoi River at Highgate Falls, Franklin County.

Highgate Springs sequence

See Highgate Springs Series.

Highgate Springs Series[1]

Lower and Middle Ordovician: Northwestern Vermont, and southern Quebec, Canada.

Original references: W. E. Logan, 1863, Geology of Canada: Canada Geol. Survey, p. 273–275, 855–859; H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 179–192.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1016, 1017. Highgate Springs sequence mentioned in report on Cambrian and Ordovi-

cian of northwestern Vermont. Sequence is overthrust by Winooski dolomites. Logan (1863) noted Highgate Springs series consisted of Trenton, Black River, and probably Chazy formations.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 65–96. Ordovician rocks at Highgate Springs, Franklin County, Vt., are of a distinctive sequence that outcrops in scattered areas from east of St. Hyacinthe, Quebec, to southwest of St. Albans, Vt., for about 80 miles. Succession has been called Highgate Springs series by McGerrigle, the lower part being Division E of Quebec group of Logan (1863). Term Highgate sequence used in this report to avoid connotation that it is a formal stratigraphic series. At Highgate Springs, Vt., sequence includes Beldens limestone, Carman quartzite, Youngman formation, Isle La Motte limestone, Glens Falls limestone, and Canajoharie shale.

Most complete exposure at Highgate Springs, Franklin County, Vt.

Highland Gneiss[1]

Precambrian: Southeastern New York.

Original reference: D. S. Martin, 1888, Geologic map of New York City and vicinity.

T. W. Fluhr, 1950, New York Acad. Sci. Trans., ser. 2, v. 12, no. 6, p. 182, 185. At Somers, Highlands gneisses have been overthrust on the Inwood limestone, the fault plane dipping at 60° to northwest beneath the Highlands massive. Fordham gneiss has been correlated with the gneisses of the Highlands, but evidence which proves that the gneisses of the Highlands are Precambrian is not necessarily applicable to the Fordham. [Author may or may not have intended to use this term in a formal sense.]

Occurs in Highlands of the Hudson.

Highland Shale Member (of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5–6. Consists of soft clay, predominately greenish, and a few thin beds of claystone. Red clays infrequent in north, more frequent to south. Approximately 45 feet thick. Underlies Slate Creek limestone member (new); overlies Carlton limestone member.

Type locality: Highland Township, T. 22 S., R. 1 E.

Highland Boy Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 41, map.

C. H. Behre, Jr., 1937, Mining Technology, v. 1, no. 1, Tech. Pub. 767, p. 8. Mentioned in discussion of bedding-plane faults and their economic importance.

Occurs in vicinity of Highland Boy mine, Bingham district.

Highland Church Sandstone

Highland Church Sandstone Member (of Forest Grove Formation)[1]

Mississippian: Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

Benjamin Gildersleeve, 1946, Tennessee Valley Authority Rept. 2, p. 8, 13. Referred to as Highland Church sandstone. Thickness 10 to 30 feet.

Forms cliffs about Highland Church, east of Tishomingo City, Tishomingo County.

Highlandcroft Granodiorite (in Highlandcroft Plutonic Series)

Upper Ordovician(?): Northwestern New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 25, map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 499–500, pl. 1. Map bracket shows Highlandcroft granodiorite above Partridge formation and below Clough conglomerate. Late Ordovician?

Large estate called "Highlandcroft" on St. Johnsbury road, 1½ miles west-northwest of Littleton, located on largest body of this rock in Littleton and Moosilauke quadrangles.

Highlandcroft Plutonic Series

Highland Croft Magma Series[1] or Granodiorite

Upper Ordovician: West-central and northwestern New Hampshire and east-central Vermont.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 499. Magma series includes Highlandcroft granodiorite in Littleton-Moosilauke area, New Hampshire, Lost Nation quartz monzonite of Percy area, New Hampshire, and Fairlee quartz monzonite of Mount Cube quadrangle, New Hampshire-Vermont.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 46–48, 106–107, 121–122, 148, 186–187. Summary discussion. Plutonic series includes diorite, quartz diorite, granodiorite, quartz monzonite, and granite. Many are massive but locally show weak to strong secondary foliation. Rocks assigned to series correlated chiefly on basis of lithologic similarity. Type area given.

Type area: Body of plutonic rocks 2 miles northwest of Littleton, Grafton County, N.H. Named from a large farm about 1½ miles west-northwest of Littleton.

Highland Mills Member (of Esopus Formation)

Lower Devonian: Southeastern New York.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 728, 731 (fig. 2), 732–733. Name applied to strata that overlie Connelly conglomerate and grade up into middle member (unnamed) of Esopus formation. Consists of interbedded yellow to gray sandstone and dark-gray shale. Sandstone beds thicken and thin rapidly and are not continuous along strike. Basal bed is layer of dark-bluish-gray paper-thin shale which makes abrupt contacts with Connelly conglomerate below and with sandstone above. Fossiliferous. Thickness about 50 feet.

Type section: West side of Thruway cut at Highland Mills, Orange County. Member is known definitely only in this vicinity. Section is located on eastern side of Green Pond-Schunemunk Mountain outlier.

Highland Peak Limestone[1]

Middle and Upper Cambrian: Eastern Nevada.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Min. and Met. Engrs. Trans. 1647, p. 6; 1932, U.S. Geol. Survey Prof. Paper 171.

H. E. Wheeler and D. W. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 33, 37–42, 45–47, fig. 10. Described in detail in Pioche district. Composite section given; parts derived from north end of Bristol Range in vicinity of Bristol mine; hills northeast of Panaca; west side of Highland Range in vicinity of Comet Peak. Seventeen lithologic units described (designated by letters A to Q). Total thickness 4,080 feet. Overlies Chisholm shale; underlies Mendha limestone. Middle and Upper Cambrian.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., no. 34, p. 12 (fig. 2), 13–14, 17–33. Two unconformities occur in lower part of Highland Peak as originally defined. Hence, Highland Peak is herein restricted to exclude units named (ascending) Peasley and Burrows. Base of restricted formation coincides with base of Highland Peak unit C, as defined by Wheeler and Lemmon (1939). Thickness as restricted about 3,325 feet.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 36–37, 42–43, fig. 5. Further restricted; includes only units H to Q of Wheeler and Lemmon (1939). Unit C is herein named Burnt Canyon limestone; units D–E and F–G are same as Dome and Swasey formations, respectively, of House Range, Utah. These names are extended into Nevada.

R. H. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50 (fig. 4). In Pioche district, overlies Whirlwind formation (new). Restricted to Wheeler's units C-K.

Named for exposures on western slope of Highland Peak, in Highland Range, Pioche district.

High Park Lake Beds[1]

Miocene, upper, or Pliocene: Eastern Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

Named for High Park, Pikes Peak region.

†High Point Sandstone[1]

Upper Devonian: West-central and southwestern New York.

Original references: H. S. Williams (High-point beds), 1883, Am. Jour. Sci., 3d ser., v. 25, no. 136, p. 100, 101; J. M. Clarke, 1885, New York State Geol. Rept. 1884, p. 22, map; 1885, U.S. Geol. Survey Bull. 16.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 15. Nunda sandstone overlies West Hill formation. Luther (1902, New York State Mus. Bull. 52) traced this sandstone from its type locality at Nunda eastward into Naples quadrangle and showed that it is same sandstone as that which caps High Point, a hill 2½ miles northwest of Naples. Name Nunda is used in this report [southwestern New York] in place of High Point sandstone (discarded) which Clarke and Luther (1904, New York State Mus. Bull. 63) later used in Canandaigua and Naples quadrangles.

Named for exposures on summit of High Point, in Naples, highest mountain in Ontario County.

High Rock Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: G. H. Ashley, 1899, Indiana Dept. Geology and Nat. Resources 23d Ann. Rept. 1898, p. 113.

Daviess and Greene Counties.

High Rock Sandstone[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: I. B. Browning and P. G. Russell, 1919, Kentucky Geol. Survey, 4th ser., v. 5, pt. 2, p. 15.

Named because it is found on several high points exposed in cliffs called High Rocks by natives.

High Tower Granite[1]

Cambrian(?): Northwestern Georgia.

Original reference: W. S. Bayley, 1928, Georgia Geol. Survey Bull. 43, p. 37, map.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 43. Name Hightower was applied by Bayley (1928) for granite in northwestern Forsyth County, but may be appropriately used for granite gneiss on southwestern side of Ashland belt in Dawson, Lumpkin, and White Counties. Intrusive into Carolina series.

Well developed around Hightower, Forsyth County.

Highway Limestone

Middle Pennsylvanian: North-central Nevada.

H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Described as massive light-gray limestone. In places cherty near base; thin pebbly and sandy layers throughout. Thickness at type locality 200 feet. Overlies Battle formation at some localities; other places, overlies Preble formation with angular unconformity. Underlies Antler Peak limestone. Lower Pennsylvanian.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2842. Highway limestone, about 200 feet thick, in Osgood and Edna Mountains, is facies of Battle formation composed of limestone and some interbedded conglomerate and calcareous clastics. Middle Pennsylvanian.

Type locality: East flank of Edna Mountain, north of Highway 40.

Highwood Syenite[1]

Eocene(?): Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

Southern part of Highwood Peak, Fort Benton quadrangle.

Hignite Formation (in Breathitt Group)

Hignite Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 43, pl. 40–A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 7, passim. Underlies Bryson formation; overlies Catron formation. Includes Reynolds sandstone member.

U.S. Geological Survey currently classifies the Hignite as a formation in Breathitt Group on the basis of a study now in progress. Term Pottsville Group not used in Kentucky.

Named for Hignite Creek, near Middlesboro, Bell County, Ky.

Hiirippo (Hirippo) Limestone

Aquitanian: Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Named on correlation chart. Correlated with Tapotchau limestone on Saipan and Raso limestone on Tinian. Miocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 54, table 4 [English translation in library of U.S. Geol. Survey, p. 65]. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 39. The Hiirippo consists of pinkish hard compact limestone, red sandy limestone, and calcareous sandstone. Overlies Taihanom and Mariiru limestones. Aquitanian. Refers to S. Sugawara (unpub. ms., 1939) and K. Asano (1939, Jubil. Pub. Yabe's 60th Birthday).

Typically exposed in Hiirippo, Rota Island.

Hilina Volcanic Series

Pleistocene(?): Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 102, pls. 1, 20A. Comprises lava flows and pyroclastics laid down by Kilauea volcano prior to deposition of Pahala ash. At type locality, 1,000 feet of thin-bedded basalts and thin vitric tuff beds are capped by 30 feet of Pahala ash. Lowest tuff bed is 200 feet above base of cliff, and numerous thin tuff beds crop out between it and the top. Base not exposed. Series was formerly mapped as Pahala basalt, but name Pahala herein restricted to persistent ash formation.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 89. Pleistocene(?).

Type locality: At Hilina Pali on south slope of Kilauea. Also exposed in windows in faces of fault cliffs on southern slope of Kilauea.

Hillabee Chlorite Schist[1]

Post-Carboniferous: Eastern Alabama.

Original reference: W. M. Brewer, 1896, Alabama Geol. Survey Bull. 5, p. 84, 89, 92.

E. W. Heinrich and J. C. Olson, 1953, U.S. Geol. Survey Prof. Paper 248–G, p. 404. Mentioned in discussion of mica deposits of southeastern Piedmont. Considered to be post-Carboniferous.

Named for exposures at Hillabee, on Hillabee Creek, Clay County.

Hill Creek Beds or Member (of Lazy Bend Formation)

Hill Creek Beds or Member (of Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107. From manuscript report by G. Scott and J. M. Armstrong on geology of Parker County.

W. E. Russell, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin sec. [Guidebook] Spring Mtg. and Field Symposium May 11–12, p. 19–27. Referred to as Hill Creek beds in Lazy Bend formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 13–16, pl. 1. Member of Lazy Bend formation. Consists of 277 feet of beds between base of Dennis Bridge limestone bed and top of Meek Bend limestone bed. Underlies Steussy shale member; overlies undifferentiated Pennsylvanian beds. Type section designated; derivation of name given.

Type section: Section measured across the strike south of Brazos River, Parker County. Outcrop of beds extends to Cretaceous on either side of Brazos River and from bridge at Dennis westward to a scarp west of Hill Creek. Name derived from Hill Creek, a small tributary flowing from southwest into Brazos River at point about midway of outer curve of Lazy Bend of river.

Hillen facies

See **Ludlow Member** (of Fort Union Formation).

Hilliard Formation[1] or **Shale**

Upper Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: W. C. Knight, 1902, Eng. Mining Jour., v. 73, p. 721.

R. H. Peterson, D. J. Gauger, and R. R. Lankford, 1953, Utah Geol. and Mineralog. Survey Bull. 47, p. 16 (fig. 4), 17–18. Near Evanston, Wyo., Hilliard formation consists of 5,500 to 6,800 feet of gray to black sandy shales and shaly sandstones. Lenses of white sandstone 3,000 to 3,800 feet occur above base of formation. Overlies Frontier formation; underlies Adaville formation.

W. R. Hansen and M. G. Bonilla, 1954, Colorado Sci. Soc. Proc., v. 17, no. 1, p. 4 (fig. 1), 9, 10. Geographically extended into Daggett County, Utah, where it is 6,300 feet thick in Flaming Gorge area; underlies Blair formation and overlies Frontier formation. In Clay Basin, replaces Blair formation and intertongues with overlying Rock Springs formation.

W. R. Hansen, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–101. In Clay Basin quadrangle, Utah, described as chiefly dark-gray soft silty, somewhat gypsiferous shale about 6,200 feet thick. Only upper part crops out in area. Intertongues with overlying Mesaverde group, contact with Rock Springs formation mapped arbitrarily.

Typical section: Shale beds west of Kemmerer, Lincoln County, and extending as far as east portal of Oregon Short Line tunnel, Wyoming. Town of Hilliard located on formation.

Hillier Member (of Cobourg Formation)

Middle Ordovician (Mohawkian): Ontario, Canada, northern Michigan, and western New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 280–281, pl. 4. Upper Cobourg limestone of earlier reports. Light-gray marly limestones in central Ontario and northern Michigan; darker colored limestone with shaly interbeds in New York and southeastern Ontario. Near the base, beds are argillaceous limestones in contrast to massive and resistant crystalline limestones at top of underlying Hallowell member (new); transition zone is 20 feet thick. Thickness 60 to 70 feet; thins rapidly in Lewis County, N.Y. Underlies Collingwood formation in central Ontario with transitional contact; disconformably underlies Deer River shales in northwestern New York.

Exposed for several miles along northern shore of Lake Ontario, west of Wellington, Hillier Township, Prince Edward County, Ontario. Named for the township.

Hillman Gneissoid Tonalite

Precambrian (late Algoman) : Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1009, 1011, pl. 1. Gray; foliated medium granitoid, locally seriate; foliation in part primary mostly from lit-par-lit injection of schist; inclusions and schlieren of Thomson formation common, locally making more than half the rock surface; foliation strongest where inclusions are most abundant. One of five major intrusives in late Algoman; these cannot be shown to be members of a single magma series. Age relations of the named intrusive, St. Cloud gray granodiorite, Hillman tonalite, Freedhem tonalite, and Warman quartz monzonite are indeterminate because no contacts are exposed.

Crops out along Hillman Creek, Morrison County, in vicinity of Skunk and Little Skunk Rivers, and on Rum River.

Hillman Limestone[1]

Pennsylvanian : Northeastern Pennsylvania.

Original reference: C. A. Ashburner, 1886, Pennsylvania 2d Geol. Survey Rept. 1885.

Exposed in cut of Lehigh Valley Railroad, southwest of Hillman Colliery breaker, Luzerne County.

Hill Ridge Biotite Schist (in Tacoma Series)

Cambro-Ordovician(?) : Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations. Belongs to Tacoma series (new). Older than Minwah limy gneiss (new) ; younger than Stetson Brook limestone (new).

Occurs in Lewiston area, Androscoggin County.

Hillsboro Plutonic Series

Devonian(?) : Southeastern New Hampshire.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 45, 65–69, 186–187. Name given to group of plutonic rocks. Consists of four units: Diorite and granodiorite (including Dracut diorite and Exeter diorite) ; granite, quartz monzonite and granodiorite; Ayer granodiorite; and another granite. Foliation is common. Treated as separate series, but may belong to New Hampshire plutonic series. Has many characteristic features of latter, but ages may be different.

Hillsboro Sandstone[1]

Silurian(?) : Southwestern Ohio.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 301, 306–307.

J. K. Rogers, 1936, Ohio Geol. Survey, 4th ser., Bull. 38, p. 81–83. Occurs in two types of deposits: bedded sandstone resting on either Niagaran or Greenfield dolomites; masses of sandstone which are cavity fillings enclosed in either Niagaran or Greenfield dolomites. White or yellowish sandstone frequently stained to reddish brown.

Occurs near Hillsboro and a few other localities in Highland County.

Hillsdale Member (of Greenbrier Limestone)

Hillsdale Limestone (in Greenbrier Limestone[1] or Series)

Upper Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 451, 487.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 157–159, pl. 15. Described in Burkes Garden quadrangle where it is about 55 feet thick and overlies Little Valley formation. Name Hillsdale used to replace name St. Louis, used by Butts (1940) for same succession in southwestern Virginia. Some geologists include so-called Warsaw, or Little Valley limestone, in the Hillsdale. Underlies "Ste. Genevieve" limestone.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Rank reduced to member status in Greenbrier limestone. Consists of dark-gray grayish-black to black cherty limestone. Lies about 50 to 100 feet below Taggard red member. Equivalent to St. Louis limestone as defined by Butts in southwestern Virginia. Does not extend into northeastern Kentucky. Upper Mississippian (Meramec).

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 887–902. Hillsdale formation conformably underlies Denmar formation (new) from southern Mercer County to northern end of Pocahontas County. Overlies Maccrady, but nature of contact uncertain.

Type locality: In Monroe County, W. Va., in road just east of Hillsdale, on west limb of Hillsdale anticline.

Hillside Mica Schist

Precambrian (Yavapai Series): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 7, 11–12, pl. 3. Muscovite schist, quartz-muscovite schist, and muscovite quartzite, representing metamorphosed shale and impure sandstone. Minimum thickness 3,000 to 4,000 feet. Overlies Butte Falls tuff (new) with gradational contact. Intruded by Dick rhyolite and Lawler Peak granite, and Cheney Gulch granite (all new).

Most complete section exposed along Boulder Creek in vicinity of Hillside mine, for which this formation has been named; Bagdad area, Yavapai County.

Hills Pond Peridotite

Cretaceous(?): Southeastern Kansas.

H. C. Wagner, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–49. Name proposed for a medium-grained peridotite; olive gray when fresh, grayish yellow when weathered. Occurs in sill-like intrusive bodies.

Type locality: Five hundred feet east and 100 feet south of center of north line of sec. 32, T. 26 S., R. 15 E., south of pond on Hill Farm in southern Belmont Township, Woodson County.

Hilltop Formation

Pennsylvanian (Missouri Series): Central Oklahoma.

W. F. Tanner, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 2046–2050; 1956, Oklahoma Geol. Survey Bull. 74, p. 6, 84–88, pls. 1, 2. Proposed for those beds in Seminole County that conformably overlie

Belle City limestone and its sandstone equivalents and unconformably underlie Vamoosa formation. Type section is sequence of dark-blue-gray shales grading upward into massive buff siltstones and fine-grained sandstones and containing thin limestone in lower part of formation. In southern part of county (Seminole), red shales or typical blue-gray shales, as much as 70 feet thick, occur locally as erosional remnants between the Belle City and the Vamoosa. Also in this part of county the Hilltop contains, about 22 feet above base, a single multicolored conglomerate of limestone cobbles, clay plates, and chert and jasper pebbles; this bed is white, yellow, and purple. Thickness ranges from featheredge to 200 feet; variations in thickness due primarily to post-Missouri, pre-Virgil erosion.

Type section: In sec. 11, T. 8 N., R. 7 E., in and near Wewoka Brick and Tile Company pit, north side of Wewoka Creek, in sec. 11, T. 8 N., R. 7 E., Seminole County, traced into Pontotoc County where it is truncated by unconformity at base of Ada formation.

Hilton Shale Member (of Portage Formation)[1]

Upper Devonian: Southwestern Virginia and northeastern Tennessee.

Original reference: J. H. Swartz, 1929, Am. Jour. Sci., 5th, v. 17, p. 436–448.

Named for exposures at or near Hilton, Scott County, Va.

Himes Member (of Cloverly Formation)

Lower Cretaceous: Northwestern Wyoming.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1139 (fig. 1), 1143 (fig. 2), 1148–1149, 1151 (fig. 5), pl. 1. Comprises three principal lithologies: commonly at base is olive-gray and reddish-brown clay matrixed salt- and pepper sandstone; most of member is variegated reddish- and yellowish-brown and gray kaolinitic claystone and mudstone, containing veinlets and hardpans of iron oxides; clean quartz sandstones which filled fluvial channels are laced through the claystones. Thickness at type section 92 feet. Overlies Little Sheep mudstone member (new) with contact marked by channelling in many places and in others, a disconformable relationship, or at least a hiatus; underlies Sykes Mountain formation (new). In this report [northern Bighorn basin], Cloverly formation is redefined on lithogenetic basis.

Type section: Sec. 15, T. 55 N., R. 95 W., on Little Sheep Mountain. Well exposed between Himes and Lovell, Big Horn County.

Hinchman Sandstone[1]

Hinchman Formation

Upper Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Formation consists of metamorphosed fossiliferous andesite tuff and conglomerate. Mapped with Jurassic and (or) Triassic metavolcanic rocks.

Named for exposures at Curtice Cliff, in lower part of Hinchman Ravine, Plumas County.

Hinckley Sandstone (in Keweenawan Group)

Hinckley Sandstone[1] (in Lake Superior Series)

Precambrian: Southeastern Minnesota.

Original reference: N. H. Winchell, 1886, Minnesota Geol. Nat. History Survey 14th Ann. Rept., p. 336–337.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1240–1241. Discussion of St. Croixian series of Minnesota. Hinckley sandstone not considered base of St. Croixian in Minnesota. Mount Simon, basil member of Dresbach, can be distinguished from underlying Hinckley, and over large areas microscopic studies of sedimentary rocks show that both Mount Simon and Hinckley are present between Eau Claire member of Dresbach and Red Clastic series. Atwater and Clement (1935) suggested that term Hinckley be applied only to sandstones that crop out in northeastern Minnesota. There is no structural or petrographic basis for such limitation. Believed in present study that exclusion of Hinckley from the St. Croixian (Stauffer, 1925) and its association with Red Clastic series is correct, but assumption that this implies correlation of Hinckley with Mount Simon (Atwater and Clement, 1935) is not warranted. Recent work indicates Hinckley is equivalent of Devils Island sandstone of Wisconsin.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 10, 15–23. Geologic column shows Hinckley sandstone as upper formation in Lake Superior series. Occurs above Fond du Lac beds. Contact with underlying Fond du Lac not exposed in east-central or southeastern Minnesota. Underlies Mount Simon member of Dresbach. Thickness about 102 feet at Sandstone, Pine County. Now that quarry at Hinckley has been abandoned, section at Sandstone is regarded as typical development of the formation.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1061–1062. Included in upper part of Keweenawan group.

Type section: At Hinckley (T. 41 N., R. 21 W.), Pine County.

Hindostan Whetstone[1] or Beds (in Mansfield Sandstone)

Pennsylvanian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 81, 105; 1876, Indiana Geol. Survey 7th Ann. Rept., p. 6–8.

F. D. Spencer, 1953, U.S. Geol. Survey Circ. 266, p. 13, 14 (fig. 4). Series of thin fine-grained laminated beds in lower part of Mansfield sandstone.

Named for village which was once county seat of Martin County. Village abandoned since 1870.

Hindsville Limestone

Hindsville Limestone Member (of Batesville Sandstone)[1]

Upper Mississippian: Northern Arkansas, southern Missouri, and eastern Oklahoma.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 263–265. Geographically extended into southern Missouri, where, in Cassville quadrangle, it is preserved in a down-faulted area. Essentially light- to dark-gray, fine- to medium-grained oolitic limestone with basal chert pebble

conglomerate set in limestone matrix; thin mineral-gray to olive-drab calcareous shales, siltstones, and sandstones distributed irregularly through the limestone. Thickness about 47½ feet. Conformable and in places transitional with overlying Batesville; unconformable on Keokuk limestone and chert with limestone filling depressions in weathered Keokuk.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Hindsville limestone.

N. B. Degraffenreid, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 163–165. Term "Grand River" (Brant, 1941) is preoccupied. Further, the "Grand River" limestone has been found to be the equivalent of Hindsville limestone member of Batesville formation of Arkansas. Accordingly, "Grand River" should be suppressed as facies term, and name Hindsville should be applied.

Named for exposure near Hindsville, Eureka Springs quadrangle, Madison County, Ark.

Hinkley Valley Complex

Paleozoic or older: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 44, no. 1, p. 77–79. Consists largely of metasediments, mostly crystalline limestone, together with some quartzites and schists; igneous material subordinate. Contact with Hodge complex not distinct, differentation made on basis of igneous material present. Considered oldest known rocks in Barstow and Victorville map areas. Paleozoic or older with early Precambrian most probable.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 503–504. Faunal evidence indicates age may be wholly Paleozoic.

Named for outcrops in and around Hinkley Valley, Barstow quadrangle. Not recognized in Victorville area.

Hinsdale Formation[1]

Hinsdale Series

Pliocene(?): Southwestern Colorado and northwestern New Mexico.

Original reference: W. Cross, 1911, U.S. Geol. Survey Bull. 478, p. 22, 29, map.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 11, 192–207, pl. 1. Subdivided into two members: latite basalt and rhyolite. In general, succession from bottom to top is local rhyolite and quartz latite flows and tuffs followed by flows of basalt that form great plateaus. Thickness commonly 200 feet, although latite basalt may be as much as 1,000 feet and rhyolite as much as 2,000 feet. Generally directly overlies older volcanic rocks, but in extreme southern part of Colorado overlies Los Pinos gravel, and some basalts are interlayered with the gravels. In most places, forms the surface rock, but in San Luis Valley and south into New Mexico gravels overlie the basalt.

Fred Barker, 1958, New Mexico Bur. Mines and Mineral Resources Bull. 45, p. 51–52, pl. 1. Hinsdale series redefined to include Cisneros basalt, Dorado basalt, and Servilleta formation (all new). Cisneros basalt overlies Cordito member (new) of Los Pinos formation with slight angular unconformity. [Proposed by Cross as Hinsdale volcanic series.].

Named for exposures in Hinsdale County, Colo.

Hinsdale Gneiss[1]

Precambrian: Connecticut and western Massachusetts.

Original reference: B. K. Emerson in 1892 used Hinsdale gneiss on U.S. Geol. Survey Hawley sheet, that is, proof sheets of geological maps and text intended for geological folio, but never completed and published in that form, although cited in U.S. Geol. Survey Bull. 191, 1902.

Named for occurrence at Hinsdale, Berkshire County, Mass.

†Hinsdale Limestone[1]

Precambrian: Western Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18, 24–26.

Exposed 50 feet west of Hinsdale Station, Berkshire County.

Hinsdale Member (of Chadakoin Formation)

Hinsdale Sandstone[1]

Hinsdale Sandstone (in Conneaut Group or Chadakoin Group)

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, p. 200, 203.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 33–37. Included in Conneaut group in Wellsville quadrangle, N.Y., where it is about 15 feet thick; overlies Wellsville formation (new), and underlies Whitesville formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 16. Rank reduced to member status in Chadakoin formation. Overlies Wellsville member; underlies Whitesville member.

L. V. Rickard, 1957, New York State Geol. Assoc. [Guidebook] 29th Ann. Mtg., p. 17 (table 2), 19. Hinsdale sandstone included in Chadakoin group. Inasmuch as Upper Devonian strata are still not thoroughly understood, a more or less permanent classification satisfactory to a majority of workers may not be obtained for some time.

Type locality: Ed Hull quarry on hill face east of Scott Corners and about 1 mile north of Hinsdale village, Cattaraugus County, N.Y.

Hinshaw sandstone[1]

Upper Cretaceous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 280.

Derivation of name not stated.

Hinton division[1]

Upper Cambrian or Lower Ordovician: Central Texas.

Original reference: T. B. Comstock, 1890, Texas Geol. Survey 1st Ann. Rept., p. 301–306, pl. 3.

Named for Hinton Creek, San Saba County.

Hinton Formation[1] (in Pennington Group)

Hinton Group

Upper Mississippian: Southern West Virginia, eastern Kentucky, and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487.

P. H. Price and E. T. Heck, 1939, Virginia Geol. Survey, Greenbrier County, p. 255–262. Hinton group consists of (ascending) Stony Gap sandstone, unnamed shales, Avis limestone, unnamed shales and sandstones. Thickness 500 to 850 feet. Underlies Princeton group; overlies Bluefield group.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Shown on correlation chart as group. In Randolph County, W. Va., includes (ascending) Stony Gap sandstone, Avis limestone, and Falls Mills sandstone; in southern West Virginia, includes (ascending) Stony Gap sandstone, Payne Branch sandstone, Avis limestone, and Falls Mills sandstone. Chesterian.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Upper Mississippian.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Assigned to Pennington herein raised to group rank.

R. H. Wilpolt and D. W. Marden, 1959, U.S. Geol. Survey Bull. 1072–K, p. 599–601. Basal formation in Pennington group. The Hinton is identical with Pennington formation as used by Cooper (1944) and with lower half of Pennington of southwestern Virginia as originally defined by Campbell (1896). Traced in surface exposures from Pennington Gap northeastward to Princeton, W. Va., and from Hurricane Gap, in Kentucky, northeastward along Pine Mountain to Blowing Rock Gap. In present report, divided into (ascending) Stony Gap sandstone member, middle red member, limestone member (Avis limestone of Reger), and upper red member. Overlies Bluefield formation; underlies Princeton sandstone.

Named for Hinton, Summers County, W. Va.

†Hinton Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: C. E. Krebs, 1916, West Virginia Geol. Survey Rept. Raleigh County, and western portions of Mercer and Summers Counties, p. 75, 76, 88.

Probably named for Hinton, Summers County.

Hinton (Upper) Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 167.

Occurs one-half mile southwest of Meadow Creek, Richmond district.

Hinton Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 77.

Occurs at Hinton, Summers County.

Hiram Till

Pleistocene (Wisconsin): Northeastern Ohio and northwestern Pennsylvania

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey, ser. 4, Bull. G–32, p. 10 (fig. 3), 13 (fig. 4), 41–42, pl. 1. Gray to bluish-gray, sparingly pebbly, calcareous, clay to silty clay till deposited during Hiram advance near close of Cary time. Hiram advance preceded by Lavery advance and followed by Ashtabula advance. Name credited to G. W. White (in press).

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 8–9. Thickness 10 to 30 feet. Generally underlain unconformably by Kent till. In Portage and Trumbull Counties, Ohio, Windham sand (new) intervenes between tills. Underlies Ashtabula till. Type section designated.

Type section: Northern Hiram Township, in roadcut 100 yards east of Silver Creek and one-half mile east of intersection of east-west road and Hiram-Welshfield Road, 1½ miles north of village of Hiram, Portage County, Ohio.

Hite Bed (in Church Rock Member of Chinle Formation)

Upper Triassic: Southeastern Utah.

J. H. Stewart and others, 1959, U.S. Geol. Survey Bull. 1046–Q, p. 518, 519, 520 (fig. 79). Composed of pale-red and light-greenish-gray very fine grained sandstone and many lenses of pale-reddish-brown siltstone. Thickness 10 to 50 feet. Occurs in upper part of member.

Well developed on exposures about 2 miles south of Hite, San Juan County.

Hitz Limestone Member (of Saluda Limestone)[1]

Hitz Limestone Member (of Whitewater Formation)

Upper Ordovician: Southeastern Indiana and north-central Kentucky.

Original reference: A. F. Foerste, 1903, Am. Geologist, v. 31, p. 347.

James Conkin, 1952, Kansas Acad. Sci. Trans., v. 55, p. 128 (fig. 2), 129, 130. Columnar section (Sleepy Hollow, Oldham County, Ky.) shows Hitz limestone as upper member of Whitewater formation; overlies Saluda limestone member. Thickness 4½ feet; lower 2 feet are silty; upper 2½ feet are dense bird's-eye type, magnesium limestone.

Named for Hitz Hill, near Madison, Jefferson County, Ind. Extends from near Floydsburg, Oldham County, Ky., to southern boundary of Ripley County, Ind.

†Hiwassee Slate[1]

Lower Cambrian: Eastern Tennessee, northern Georgia, and western North Carolina.

Original reference: A. Keith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 116, p. 5.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, no. 10, p. 627, 629. In Hot Springs area, North Carolina, name Sandsuck shale is substituted for slate mapped as Hiwassee by Keith.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Hiawassee [Hiwassee] included in Talladega series believed to be Precambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 27. Sandsuck shale as mapped northeast of Pigeon River corresponds roughly to what Keith mapped as Hiwassee slate in same area. In its type area along Hiwassee River, Hiwassee slate corresponds roughly to whole fine grained part of Ocoee series, and its correlation with units farther northeast is uncertain.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 961 Walden Creek group (new) corresponds approximately to Wilhite slate, Citico conglomerate, and Pigeon slate, as mapped by Keith in Knoxville quadrangle (1895, U.S. Geol. Survey Geol. Atlas Folio 16), and also to the more inclusive Hiwassee slate of his later terminology. Name Hiwassee has been used so confusingly that it is properly abandoned.

Named for exposures on Hiwassee River, Polk County, Tenn.

Hoadley Formation

Precambrian (Belt Series) : Northwestern Montana.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 211, 213 (table 1), 216–217. Dark-green-gray and maroon thick-bedded siliceous argillite and some vitreous fine-grained quartzite overlain by red and buff arenaceous calcareous argillite and fine-grained sandstone which grades upward into greenish-buff-weathering calcareous sandstone and much interbedded pink sandstone and argillite; upper part brilliant- and dark-red soft thin- and thick-bedded platy ripple-marked sandstone interbedded with some pale-red argillite. Overlies Cayuse limestone (new) ; underlies Ahorn quartzite (new). Miller Peak argillite, Cayuse limestone, Hoadley formation, and Ahorn quartzite are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931) in Sapphire and Garnet Ranges.

Named from Hoadley Reef, which is less than 1 mile southwest of largest exposure of these rocks in Saypo quadrangle.

Hoback Formation

Paleocene and Eocene, lower : Western Wyoming.

A. J. Eardley and others, 1944, Hoback-Gros Ventre-Teton Field Conf. [geologic map] ; privately printed. Interbedded gray sandstone and shale; several conglomerate lenses and fresh-water impure limestone beds; coal in lower part, Thickness about 15,000 feet. Unconformably overlies Frontier formation; unconformably underlies Pass Peak conglomerate (new).

J. A. Dorr, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 64–71, pls. 1, 3, 4. Described in detail. Chart shows age ranging from Paleocene (upper Puercan) into lower Eocene (Wasatchian). Type locality designated.

Type locality: Exposures on southeastern side Game Hill, opposite mouth of Cliff Creek, T. 38, N., R. 114 W., Sublette County. Along Hoback River and U.S. Highway 187.

Hobart Hill Andesite[1]

Devonian(?) : Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 113. 169, 172–173.

Forms Hobart Hill, Aroostook County.

Hobble Formation

Pennsylvanian : North-central Utah.

H. J. Bissell, 1963, Iowa Acad. Sci. Proc., v. 43, p. 240, 241–242. Predominantly limestone and sandstone. Thickness 1,751 feet. Overlies Kelly formation (new). Unit formerly referred to Oquirrh formation. Proposed in this report to elevate Oquirrh to rank of series in this region.

Type section: In Hobble Creek Canyon, east-central part T. 7 S., R. 3 E., east of Springville, Utah County.

Hobo Gulch Formation[1]

Middle Cambrian : Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 436, map.

Forms well-marked group of strata seen in railroad cuts near tailing dams and in Queen Gulch, Elkhorn region.

Hoboken Serpentine[1]

Precambrian (?) : Northeastern New Jersey and southeastern New York.

Original reference: C. P. Berkey and J. R. Healy, 1912, Columbia Univ. Contr., v. 20, p. 1907–1912.

C. P. Berkey, 1948, Geol. Soc. America Guidebook 61st Ann. Mtg., pl. 1. Shown on map legend of Lower Manhattan. A metamorphosed basic intrusive cutting Manhattan schist.

Forms elevated portion of Staten Island, N.Y., and the Knob at Castle Point in Hoboken, N.J.

Hochelagan Formation[1]

Pleistocene : Canada, and New York and Vermont.

Original reference: J. B. Woodworth, 1905, New York State Mus. Bull. 84, p. 206–222, map.

Probably named for Indian settlement of Hochelaga, Canada.

Hockingport Sandstone

Upper Carboniferous : Southeastern Ohio.

W. D. Martin, 1955, Dissert. Abs., v. 15, no. 8, p. 1371. Relatively local sandstone occurring in parts of Washington, Athens, and Meigs Counties. Ohio, and adjacent parts of West Virginia. Previously considered as part of Waynesburg sandstone. Waynesburg sandstone here restricted in areal extent to southwestern Pennsylvania and northern West Virginia, and term Hockingport is applied to sandstone of southeastern Ohio.

Named for village of Hockingport, Athens County.

Hocking Valley conglomerate facies[1] (of Cuyahoga Formation)

Mississippian (Kinderhook) : Central Ohio.

Original reference : J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 669, 678.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 43, 45–46. Here includes Black Hand conglomerate, Fairfield sandstone, and Lithopolis sandstone members. Lies between Granville shale facies to the northeast and the Henley shale facies to the southwest.

Occurs in Hocking Valley, Fairfield and Hocking Counties.

Hockley Mound Sand Member (of Willis Sand)[1]

Pliocene (?) : Southeastern Texas and southern Louisiana.

Original reference: J. Doering, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 5, p. 655, 656, 660–665.

G. R. Pinkley, 1958, South Texas Geol. Soc. Fall Field Trip, p. 35, geol. map. Text refers to Manning (Hockley) shales around Falls City, Hockley shale shown on geologic map.

Named for Hockley Mound, on Willis Plain, 4 miles southwest of Hockley, Harris County, Tex.

Hodge Complex

Paleozoic and (or) Mesozoic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 44, no. 1, p. 79, 97–98. Igneous and metamorphic rocks consisting largely of dioritic and granitic rocks together with remnants of older Hinkley Valley metasediments. Not sharply separable from Hinkley Valley complex except that more igneous material is present in Hodge. Precambrian.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 503–504. Diorite and granite of Hodge complex considered Late Paleozoic or Mesozoic: granite quite certainly is Late Mesozoic.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 36–42. Renamed and redefined as Hodge volcanic series.

Exposed near Hodge, near Barstow, in Barstow quadrangle.

Hodge Volcanic Formation

Hodge Volcanic Series

Mesozoic or older: Southern California.

O. E. Bowen, Jr., 1953, *in* L. A. Wright and others, California Jour. Mines and Geology, v 49, no. 1, pl. 2. Shown on columnar section as sheared tuff and flow lava more than 10,000 feet thick; base not exposed.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 34–36, pls. 1, 2, 3, 8. Originally included by Miller (1944) in Hodge complex, series is withdrawn, renamed, and redefined. As herein described, Hodge volcanic series is predominantly rocks of the andesite-dacite-rhyolite association. Lower half of the 10,000-foot-thick series consists principally of massive reddish-brown, purplish-brown, and dark-green rocks, chiefly weakly sheared quartz latites and dacites. Upper half consists of alternating variable thicknesses of black, white, and gray-green, strongly sheared metavolcanics and tuffaceous metasediments. Age-determining features of series are few, as series is not in contact with other units except where invaded by igneous intrusions considered Jura-Cretaceous in age. Best estimate is that series is post-Fairview Valley and pre-Sidewinder in age, probably Upper Permian. Figure 2 and plate 1 show age as Upper Paleozoic(?).

U.S. Geological Survey designates the age of the Hodge Volcanic Formation as Mesozoic or older on the basis of a study now in progress.

Named from a homoclinal section exposed north of Mojave River a few miles northwest of Hodge, San Bernardino County. Entire section is exposed on well-eroded hills and on partly dissected, exhumed pediment surfaces.

Hodgeman Shale Member (of Solomon Formation)

Cretaceous: Northwestern Kansas.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc., Wichita: [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23.] Named on chart. Occurs in lower part of formation below an unnamed sandstone. Unconformable above Rocktown sandstone member of Ellsworth formation (new).

Derivation of name not given. Solomon formation was mapped in 1937 along Solomon River.

Hodges Shale Member (of Bloomington Formation)[1]

Middle Cambrian: Northeastern Utah and southeastern Idaho.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 406–407.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 650, 651–653, 672, 673 (fig. 3). Described near Richmond, Utah, where it is 540 feet thick, and is separated from overlying Calls Fort shale member (new) by unnamed limestone interval about 720 feet thick; overlies Blacksmith formation.

Named for exposures in Hodges Canyon, Rich County, Utah.

Hoffman Flow

Recent: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 276–278, 288, pl. 1; C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 373. Composed of dacite lava. About 75 feet thick. Partly buried by later flows. Probably older than Medicine flow.

Occurs in Modoc Lava-Bed quadrangle.

Hoffman Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland and northern West Virginia.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

Occurs in Georges Creek valley, Allegany and Garrett Counties.

Hoffman Quartz Monzonite

[Cretaceous]; Eastern California.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2122, 2123 (fig. 1). Shown on map in paper dealing with potassium-argon dating of igneous rocks. Age shown on map legend as 83.3 millions of years. Shows intrusive relationships toward older Cathedral Peak granite but does not come into contact with younger Johnson granite porphyry.

Occurs in Yosemite National Park.

Hoffman Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: W. A. Price and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

Named for occurrence in Hoffman Drainage Tunnel, Allegany and Garrett Counties.

Hoffner Beds (in Ste. Genevieve Limestone)

Hoffner Member (of Ste. Genevieve Limestone)

Mississippian (Meramec Series): Southern Illinois.

J. M. Weller *in* Stuart Weller and F. F. Krey, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 7, 8. Predominantly sandy shale and fine-grained sandstone that is locally massive. Associated with these strata are red shales at several horizons and in middle part of member one or more limestones. Thickness between 50 and 80 feet. Overlies Levias member; unconformably underlies Renault limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 152–153, chart 5 (column 73). Shown on correlation chart as Hoffner beds in Ste. Genevieve limestone, Meramecian series.

Well exposed along Swan Creek northeast of Anna in E½ sec. 17, T. 12 S., R. 1 W., and east of Hoffner School in W½ sec. 8, T. 13 S., R. 1 E., Union County.

Hogan Formation

[Cretaceous] : Montana.

G. W. Viele, 1960, Dissert. Abs., v. 21, no. 4, p. 853. Name applied to 2,477 feet of andesitic to latitic volcanic-rich sedimentary rocks which are stratigraphically equivalent to middle and upper Two Medicine formation. Locally divided into members ascending A through E which consist of A, basal breccias; B, welded tuffs; C, volcanic-rich mudstone, argillites, and shales; D, volcanic-rich graywackes; and E, volcanic-rich graywackes, mudstones, breccias, and tuffs. Disconformably overlies lower Two Medicine; underlies St. Mary River formation.

Report discusses Flat Creek area, Lewis and Clark County.

†Hogback Sandstone[1]

Upper Cretaceous : Southwestern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern part of Uinta Mountains, p. 40, 48, 155.

Hogback Schist[1]

Precambrian or Precambrian(?) : South-central Maine.

Original reference: E. H. Perkins and E. S. C. Smith, 1925, Am. Jour. Sci., 5th ser., v. 9, 204–228.

J. M. Trefethen, 1937, Jour. Geology, v. 45, no. 4, p. 358–359. Age designated Precambrian(?).

Forms long ridge known as Hogback Mountain, including Frye Mountain Range, in town of Knox, Waldo County.

Hog Creek Formation (in Caddo Creek Group)

†Hog Creek Shale Member (of Caddo Creek Formation)

Pennsylvanian : Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 397.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 115–116. Caddo Creek formation consists of Hog Creek shale member, whose type locality is in northern Brown County, and overlying Home Creek limestone of northern Brown County, which has been correlated with a limestone also called Home Creek occurring at same horizon in Brazos River basin in Palo Pinto County. At section on west side of Mukewater Creek half a mile above its junction with Home Creek, in southeastern Coleman County, the Hog Creek member is 39 feet thick, underlies Home Creek limestone member, and overlies Ranger limestone member of Brad formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as Hog Creek shale in Caddo Creek group. Underlies Home Creek limestone; overlies Ranger limestone of Brad group.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 20. Proposed that name Hog Creek shale, misapplied by Drake and others, be dropped and that name Colony Creek shale be given to beds between Ranger and Home Creek limestones.

Named for Hog Creek, Brown County, Colorado River region.

Hogeye Tuff (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Proposed for 195-foot sequence of tuff and tuff breccia with basalt member near base. Unconformably overlies Cretaceous rocks in most places; overlies Permian rocks along southern edge of Wylie Mountains and other prevolcanic highs; upper contact with Pantera trachyte (new) disconformable.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Geol. Quad. Map. 23. Described in Van Horn Mountains. Overlies Buckshot ignimbrite; underlies Pantera trachyte. In northeastern Van Horns, the Hogeye lies on Permian and Cretaceous rocks (Hueco, Yearwood, Cox, Finlay, Benevides, and Loma Plata formations). Thickness 187 to 435 feet.

Type section: South tip of Hogeye Butte, Jeff Davis County.

Hog Mountain Sandstone (in Mineral Wells Formation)[1]

Hog Mountain Sandstone Bed (in East Mountain Formation)

Hog Mountain Sandstone Member (of East Mountain Formation)

Pennsylvanian (Strawn): Central northern Texas.

Original reference: F. B. Plummer, 1929, Texas Bur. Econ. Geology, geol. map of Palo Pinto County.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as member of East Mountain shale.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 22, fig. 3. Referred to as sandstone bed in East Mountain formation. In area of this report [Parker County], 22 feet thick, fine to medium grained, poorly to well cemented, and ranges from thick bedded to flaggy.

Typically exposed on top of Hog Mountain, 3 miles southeast of Mineral Wells.

Hogshooter Limestone[1] (in Skiatook Group)

Pennsylvanian (Missouri Series): Northeastern, central northern, and central Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchinson, 1910, Oklahoma State Univ. Research Bull. 3, p. 1, 2.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 39–47; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 720 (table 1), 723–725. Included in Skiatook group. As defined here, is substantially equivalent to Dennis formation of Kansas, as redefined by Jewett (1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.). As a formal formation name for this unit, Dennis is perhaps older, but Hogshooter is oldest name in Oklahoma for this formation and is firmly entrenched in literature and usage; therefore, name Dennis is rejected, and Hogshooter retained in Oklahoma. Underlies Nellie Bly formation; overlies Coffeyville formation. Includes (at various places) Winterset limestone, Stark shale, Canville limestone, and Lost City limestone members. Type locality stated.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 60–64. Described in Okfuskee County.

Type locality: Along Hogshooter Creek, T. 26 N., R. 14 E., Washington County.

Hogskin Member (of Lincolnshire Formation)

Middle Ordovician (Mohawkian) : Northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 66–67, chart 1 facing p. 130). Proposed for yellow-weathering shale and cobbly limestone, both of "Ottosee type" and usually confused with that formation, lying between Eidson member (new) of Lincolnshire and Ward Cove or Rockdell formations. Name credited to B. N. Cooper and G. A. Cooper.

Well exposed along road to Thorn Hill to Washburn especially at Red Hill about 4 miles west-southwest of Thorn Hill, Grainger County.

Hoh Formation[1]

Miocene, middle : Northwestern Washington.

Original reference: C. E. Weaver, 1915, Am. Inst. Min. Engrs. Bull. 103, p. 1424–1427.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 17, 186–187. Type locality designated since none was given in original description. At newly designated type section, formation consists of at least 16,000 feet of coarse gray gritty sandstone; strata are involved in a westerly plunging, highly compressed syncline, which has been eroded and elevated, and upon their beveled surface rest nearly 3,000 feet of basaltic lavas, tuffs, and agglomerates of early and possibly middle Eocene age. Formations in western part of Olympic Mountains which originally were included in general term Hoh formation by Weaver (1915, 1916) are considered as consisting of two separate formations, one of Oligocene and Miocene age, the other, exposed south of Lake Crescent, as pre-Tertiary in age. The latter is included in Solduc formation originally defined by Reagan (1909). Hoh formation restricted to sandstones and shales in vicinity of mouth of Hoh River which contain fossil evidence indicating middle Miocene age.

S. L. Glover, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2022–2023. Restricted in coastal area of Jefferson County to exclude 5,000-foot unit of buff to gray arkosic sandstone and thin-bedded dark-gray mudstones here termed Browns Point formation.

Type section : Exposures occurring between north fork of Solduc River and Lake Crescent, Clallam County.

Hoing Sandstone[1]

Silurian : Central eastern Iowa.

Original reference: W. H. Norton, 1928, Iowa Geol. Survey, v. 33, p. 30–31, 431.

Hoko Formation[1]

Pliocene(?) : Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 202.

Occurs from Hoko River in its lower course east to Clallam Bay.

Holbrook Sandstone[1] Member (of Moenkopi Formation)

Triassic : Eastern Arizona.

Original reference: D. Hager, 1922, Mg. and Oil Bull., v. 8, nos. 1, 2, 3, p. 26. 33–34, 73, 81–94.

E. D. McKee, 1951. New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 86, 87 (fig. 1). Characterized by red beds—shaly siltstones and structureless

mudstones—alternating with resistant thick-bedded sandstones. Estimated thickness 110 feet. Overlies Winslow member (new); underlies Shinarump conglomerate.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, p. 18 (table 4), 19. Present classification of Moenkopi in Little Colorado River area is (ascending) Wupatki, Moqui (new), and Holbrook members.

Exposed in cliffs just north of railroad between Winslow and Holbrook.

Holcomb Quartz Monzonite

Cretaceous(?): Southern California.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Light-gray to pinkish quartz monzonite, probably varying to granodiorite; cut by aplite and pink pegmatite. Texture normal granitic north of Hidden Springs and Holcomb faults; south of faults, limestone, granodiorite, and rocks of Pleasant View complex are injected by the quartz monzonite.

Type locality: Holcomb Ridge, Valyermo quadrangle. Monzonite is continuous with granitic rocks north of San Andreas Fault in Pearland quadrangle.

†Holden Group[1]

Pennsylvanian: Northwestern Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Iron Ores, pt. 2, p. 169, 194.

Named for exposures at Holden, Johnson County.

Holdenvillle Shale[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Central Oklahoma, southeastern Kansas, and southwestern Missouri.

Original reference: J. W. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 42–47, pl. 11. Memorial shale, by definition, extends upward from top of Lenapah limestone to base of Seminole formation, and, likewise, Holdenville shale extends upward from top of Wewoka to base of Seminole. As Lenapah has been traced into uppermost Wewoka, the Memorial and Holdenville lie between same stratigraphic limits and are equivalent. Holdenville has priority and is commonly used term. Thickness 40 to 200 feet in Tulsa County. Includes Sasakwa and Homer limestone [members]. In northern Oklahoma and in Kansas, unit occurs in thin ragged patches.

W. B. Howe, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 9, p. 14–16. Uppermost formation in Marmaton group. Lies between Lenapah formation and base of Hepler sandstone, basal Pleasanton, of Missouri series. Term Memorial, formerly applied to post-Lenapah, pre-Pleasanton beds in Missouri, has been dropped. Use of name Holdenville follows recent work by Oklahoma Geological Survey. Formation in western Missouri is predominantly gray shale. Thickness 0 to at least 15 feet.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart at top of Marmaton group. Overlies Lenapah limestone; underlies Hepler sandstone.

Named for Holdenville, Hughes County, Okla.

Holder Formation (in Magdalena Group)

Pennsylvanian (Virgilian) : Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Consists of limestone, gray and red calcareous shale, sandstone, and conglomerate. Bioherms at base locally. Thickness as much as 850 feet. Underlies Bursum formation; overlies newly named Beeman formation.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 18–25, pl. 1. Revised to include strata that occur between top of Beeman formation and base of overlying Laborcita (new) or Abo formation. Holder includes Fresnal and Keller groups in classification of Thompson (1942). Thompson's detailed section of Fresnal forms upper 530 feet of Pray's Holder formation and is overlain by Laborcito formation. Thickness 900 feet north of La Luz Canyon. Type section and derivation of name given.

Type section: In NW¼NW¼ sec. 14, T. 17 S., R. 10 E., in central part of Sacramento Mountains. Name derived from Holder Ridge which is capped by basal limestone of formation. Widespread along fringe of Tularosa basin in north and south ends of Sacramento Mountains; in central area, occurs as isolated resistant caps on many high ridges at west front of mountains.

†Holderness Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell's report not published. The name Holderness Formation appeared in bold face in the Wilmarth Lexicon on the basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. Bull. v. 63, no. 10) used the name of Holderness on the Cretaceous correlation chart and cited the Wilmarth Lexicon. U.S. Geological Survey has abandoned the term Holderness Formation.

Well exposed in Holderness Gulch, Yampa coal field, Daton Peak quadrangle.

Holdrege Formation[1]

Holdrege Member (of Blanco Formation)

Holdrege Member (of Chase Channel Formation)

Pleistocene (Nebraska) : Southern Nebraska and western Kansas.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

O. S. Fent, 1950, Kansas Geol. Survey Bull 85, p. 64. Basal member of Chase Channel formation (new), a subsurface unit in western Kansas. Thickness 28 to 56 feet. Medium to fine gravel and sand with fragments of Cretaceous shells and fragments of red shale and siltstone where it overlies Permian rocks. Grades upward into Fullerton member.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 12 (fig.), 17–18. Formation is coarse, gravelly to pebbly valley fill at high levels in South Platte, Lodgepole, Pumpkin Creek, and North Platte valleys where it originated from Rocky Mountain glaciers and from gravelly Tertiary deposits of High Plains. Occurs in lower course of Nio-

brara Valley and adjacent areas and on Holt and Springview plains; lies below flood plain of the Platte in vicinity of Grand Island and westward for some distance.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 15; J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 59, 61. Member of Blanco formation in Kansas.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Chart of revised classification of Kansas Pleistocene shows Holdrege as member of unnamed formation in Meade group. Occurs below Fullerton member and above Nebraskan till.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown as formation in Kansas.

Named for Trees deep test for oil and gas near Holdrege, Phelps County, Nebr.

Hole-In-The-Wall Member (of Boulder Pass Formation)

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc America Bull., v. 48, no. 12, p. 1877. Name suppressed in favor of Spokane.

Derivation of name not stated but probably Hole-in-the-Wall Falls, Glacier National Park, Flathead County.

Hole-In-The-Wall Member (of Isom Formation)

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 99. Upper member of formation at type locality; overlies Baldhills member (new). Latite porphyry, lithoidal in texture and purplish gray in color, with light-gray lenticules. Thickness seldom more than 40 feet. Exhibits some features of ignimbrites of highly welded type but also has internal structural features indicative of viscous flow. Discussion of ignimbrites of area.

Named for occurrence at east end of Hole-in-the-Wall Pass, 2 miles north of type locality of Isom formation.

†Holiknuk Series[1]

Upper Cretaceous: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 159–161, 182.

Probably named for Holiknuk River.

Holitna Group

Ordovician(?), Silurian, and Devonian: Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 23–27, pl. 1. Includes various types of limestone that have been changed from an originally dense fine-textured rock to more coarsely crystalline types. Recrystallized facies partly dolomitic. Nondolomitic limestone is gray on freshly broken surface and weathers to lighter shades. Dolomitic facies characteristically buff colored. Massive rather than thin-bedded limestone predominates. Small reeflike masses in several places, Intraformational conglomerates and breccias, composed of limestone fragments in limestone matrix, common locally. Neither basal nor upper contacts are exposed in sections studied along Holitna and Chilnuk Riv-

ers. Estimated thickness at least 5,000 feet and probably closer to 10,000 feet. In fault contact with overlying Kuskokwim group (new) along bluffs of Holitna River 9 miles northeast of Nogamut.

Type locality: On Holitna River in area where limestone crosses southwestward plunging major axis of geanticline. Typically exposed between mouths of Itulilik and Portage Creeks.

Holland Limestone (in Staunton Group)

Pennsylvanian: Southern Indiana.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 30, 87. In Ditney folio [84] area, Holland coal below Rock Creek coal is described as having Holland limestone as its roof. Recent field studies showed three locally mined coals cropping out near Holland, each with a limestone roof. It is not known to which of these coals name Holland was originally applied.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 89, 91. Name Holland applied to uppermost of the three limstones as it is most distinctive. Light-gray dense limestone with brown mottling on weathered surface. Thickness 2 feet. Occurs about 7 feet above base of group in exposure near Holland.

Exposed in SE¼NE¼NE¼ sec. 26, T. 3 S., R. 6 W., near Holland, Dubois County.

Holland Sandstone[1]

Lower Devonian: Northwestern Ohio.

Original references: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 20; 1890, Ohio Geol. Survey 3d Organization, 1st Ann. Rept. p. 24.

Named for Holland, Lucas County

Holland Patent Formation or Shale

Holland Patent Member (of Utica Shale)

Holland Patent[1] zone

Ordovician: Eastern New York.

Original reference: R. Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 286, pl. 4. Holland Patent formation or Holland Patent member of Utica formation is the "upper Utica, or zone of *Climacograptus pygmeus*" and *Glossograptus quadrimucronatus timidus* of Ruedemann. Consists of about 200 feet of black shales. Grades upward into arenaceous Frankfort shale; disconformably overlies lower Cobourg (Hallowell) limestone.

Holland Patent, Oneida County.

Holland Quarry Shale

Devonian: Northern Ohio.

J. E. Carman, 1960, Fieldiana: Geology, v. 14, no. 1, p. 1–5. Fossiliferous unit that occupies depression in Raisin River dolomite. Underlies Sylvania sandstone.

Occurs in Holland Quarry, 3 miles south-southwest of town of Holland, Monclova Township, Lucas County.

Hollenberg Limestone (in Sumner Group)[1]

Hollenberg Limestone Member (of Wellington Formation)

Permian (Leonard) : Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 63–66.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull. 2, p. 5; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 40–41. Included in Wellington formation.

Named for exposures along Little Blue River 3½ miles southeast of Hollenberg, Washington County, Kans.

Holliday shale[1]

Cambrian : Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Hollis Member (of Deese Formation)

Pennsylvanian : Central Oklahoma.

C. C. Branson, 1955, The Hopper, v. 15, no. 10–11, p. 129. Shown on manuscript map by Guthrey and Milner in 1933. Name preoccupied by Hollis quartzite (Adams 1926) in Precambrian of Alabama. Renamed Natsy by Tomlinson (1937).

Type locality: On Hollis Farm in SW¼SW¼ sec. 8, T. 5 S., R. 2 E., Carter County.

Hollis Quartzite[1]

Hollis Quartzite (in Pine Mountain Group or Series)

Precambrian : Eastern Alabama and central western Georgia.

Original reference: G. I. Adams, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 33–34, map.

G. W. Crickmay *in* L. M. Pringle, 1935, Georgia Geol. Survey Bull. 46, p. 32 Geographically extended into Georgia where it underlies Manchester formation (new). Included in Pine Mountain series.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 27–28, 30, pl. 1. In Warm Springs quadrangle, Georgia, overlies Sparks schist (new); underlies Manchester schist; in southeast corner of quadrangle, overlies Woodland gneiss (new). Thickness ranges from 275 feet at Dunn's Gap to nearly 800 feet along Flint River at the Cove; along Oak Mountain, seldom more than 300 feet. Chewacla marble, associated with Hollis in Alabama, is not present in Georgia.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 6 (table), 11–14, pls. 3, 10. Described in Thomaston quadrangle where it is 800 to 1,100 feet thick. Underlies Manchester formation; unconformably overlies Woodland gneiss. Included in Pine Mountain group.

Named for exposures at and near Hollis, Lee County, Ala.

Holloway Prairie Formation or terrace

Recent : Southwestern Louisiana.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1822 (table 1), 1826 (fig. 2), 1830, 1831 (table 2), 1833 (fig. 3), 1837 (table 3), 1848 (fig. 8). In description of physiography of southwest Loui-

siana the following new formation names are introduced (descending): Sicily Island, Holloway Prairie, Eunice, and Oberlin. However, text discusses the Holloway Prairie as a terrace. Name is used for terrace areas given by Fisk (1938) as type localities of his "Prairie terrace;" new name is used to avoid extended correlations of the Prairie.

Well developed at Holloway Prairie, Marksville, Big Cane, Mansura, and Grand Prairie, in Rapides and Avoyelles Parishes.

Holly Creek Formation (in Trinity Group)

†Holly Creek Clay[1]

Lower Cretaceous (Comanche): Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. C. Vanderpool, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 1079–1080.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Referred to as Holly Creek formation; includes Ultima Thule gravel member. Underlies De Queen limestone; overlies Dierks limestone (rank raised). Subsurface equivalents discussed.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Geographically extended into southeastern Oklahoma.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16–17, 20–22, pl. 1. In McCurtain County [this report], Dierks limestone is absent, and name Holly Creek applies to the Cretaceous stratum below De Queen limestone. Thickness 30 to 100 feet in outcrop area; as much as 1,070 feet in subsurface. In eastern half of area, the Holly Creek is basal unit of Trinity age and rests unconformably upon Paleozoic rocks.

Named for exposures near Little Holly and Holly Creeks, southeast of Dierks, Howard County, Ark.

Hollycrest Formation

Miocene, middle: Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 6 (table 1), 23–24, pl. 1. Consists of thin-bedded light-brown medium- and fine-grained arkose and white to gray silty clay shales. Composed of two unnamed members: a basal conglomerate and a sandstone, contact between the two is conformable and gradational; thin beds of conglomerate are present in lower 50 feet of the sandstone. Thickness about 1,700 feet. Underlies Modelo formation, but nature of contact uncertain, may or may not be a fault; unconformably overlies Topanga formation; locally overlies Cahuenga beds (new).

Occurs in Griffith Park area, city of Los Angeles. Exposed in Griffith, Cahuenga Peak and Cahuenga Pass fault blocks. Name Hollycrest taken from highest point in Cahuenga Pass.

Holly Springs Sand (in Claiborne Group)

Holly Springs Sand Member (of Tallahatta Formation)

Holly Springs Formation (in Wilcox Group)

Holly Springs Sand (in Wilcox Group)[1]

Eocene, middle: Mississippi, Kentucky, and western Tennessee.

Original reference: E. N. Lowe, 1913, Mississippi Geol. Survey Bull. 10, p. 23–25.

Tom McGlothlin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 53. With exception of Bashi and Hatchetigbee in Lauderdale County, Miss., surface Wilcox deposits of the State might well be called undifferentiated Wilcox. It may be true that general zones can be traced locally, but wisdom of giving formational rank to "Ackerman" and "Holly Springs" is questioned. Exposures of typical "Ackerman" are plentiful in area that is supposed to be underlain by "Holly Springs" sand, and many of the exposures of Holly Springs are probably Pleistocene terrace deposits.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 17. Type Holly Springs of northern Mississippi, formerly included in Wilcox and correlated with Tuscahoma sand of Alabama, is nonmarine equivalent of Tallahatta formation to south. Name Holly Springs abandoned in favor of Tallahatta for all of Mississippi.

F. S. MacNeil., 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Holly Springs sand member of Tallahatta in Mississippi. Note states that nonmarine facies of Tallahatta formation in northern Mississippi was formerly called Holly Springs sand and placed in Wilcox group. For 1945 geologic map of Mississippi, Holly Springs was abandoned in favor of Tallahatta, but it should probably be retained for northern Mississippi, Tennessee, and Kentucky. Claiborne group.

J. S. Attaya, 1951, Mississippi Geol. Survey Bull. 71, p. 14, 20–21. Name Holly Springs should be dropped from literature inasmuch as sands included in formation are actually equivalents of three formations, the Meridian, Tallahatta, and Kosciusko. Discussion of Lafayette County.

Benjamin Gildersleeve, 1953, Kentucky Geol. Survey Spec. Pub. 1, p. 18 (fig. 1). Generalized section—embayment region of Tennessee and Kentucky —shows Holly Springs formation below Grenada formation and above Ackerman formation in Tennessee. Wilcox group. Lower Eocene.

Typically developed at and for several miles east of Holly Springs, Marshall County, Miss.

Holmesville Shale Member (of Doyle Shale)

Holmesville Shale (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 43.

K. L. Walters, 1954, Kansas Geol. Survey Bull. 106, p. 42 (table 10), 53–55, pl. 1. Member of Doyle shale. In Marshall County, consists of about 20 feet of green, gray, and maroon calcareous shale; lenticular limestone beds about 1 foot thick present in lower few feet of member. Underlies Towanda member; overlies Fort Riley member of Barneston limestone.

Type locality: One and one-half miles west and one-half mile north of Holmesville, Gage County, Nebr.

Holokuk Basalt

Eocene(?) to Miocene(?): Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 53–55, pl. 1. Chiefly flows, now disconnected but believed to have formed widespread and rather continuous plateau before stream dissection. Flows and less abundant water-deposited detritus of the flows made up almost exclusively of basalt. Dikes of similar composition well ex-

posed and near valleys of Kolmakof River, upper Oskawalik River, and Vreeland Creek. Volcanic rocks are black on fresh surfaces; weather to browns and buffs. Basalt nearly everywhere porphyritic and little altered. Thickness at least 3,000 feet along southeast slopes of Horn Mountains; 1,500 feet in area east of Holokuk Mountain; and less than 1,000 feet on Kaluvarawluk Mountain. Unconformably overlies Kuskokwim group (new). Probably is older than and overlies Getmuna rhyolite group (new).

Typically exposed in Kaluvarawluk and Kiokluk Mountains east of Holokuk River. Also crops out in flanks of Horn Mountains, north of Kuskokwim River. Named for Holokuk River.

Holston Marble, Limestone, or **Formation**

Holston Marble or Limestone (in Blount Group)[1]

Middle Ordovician: Eastern Tennessee, northwestern Georgia, western North Carolina, and western Virginia.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, map.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 148–154. With single exception, Holston limestone, wherever present in Virginia, succeeds Lenoir limestone. Northwest of Clinch Mountain, the Holston is directly overlain by Ottosee limestone with hiatus between, resulting from absence of Athens and Whitesburg. Southeast of Clinch Mountain, the Holston is overlain by Whitesburg limestone or Athens shale. Blount group. Chazyan series.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 816–886. Lower Middle Ordovician succession of Tazewell County, southwestern Virginia, is subdivided into 29 distinctive zones grouped into eight formations. Study has led to recognition of inconsistencies in use of names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. In proposed revised stratigraphic nomenclature, Cliffield formation includes beds which Butts (1940) has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee. Some coarse-grained limestones which have been called Holston underlie beds carrying fauna of Murfreesboro limestone. Other so-called Holston beds overlie limestones containing fossils which are supposed to be valid guides to Ottosee and Lowville.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 59–60. In Burkes Garden quadrangle, term Holston replaced by Effna limestone (new). Previous workers have identified the limestone as Holston though without adequate basis. Direct correlation on basis of fossils is impossible. Beds identified by Butts (1940) as Holston along northwest base of Clinch Mountain are facies of limestone which interfingers with the Blackford, Five Oaks, Lincolnshire, Ward Cove, and Peery members of Cliffield in Russell and Scott Counties, Va. This belt of so-called Holston continues southwest into Tennessee where it was mapped as lentils of marble in Chickamauga limestone by Keith. Because Keith's Holston marbles interfinger with beds of different ages, name should not be used to imply time equivalency of any similar appearing beds far away from Knoxville region in Tennessee.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1156, 1182. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Measured sections compared with revised clas-

sification of Tazewell County, Va. Holston should be discontinued as definite formational name. "Holston" marble of Knoxville area is renamed Farragut limestone.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 28, geol. map. Holston marble occurs only in one narrow belt extending into Georgia from Tennessee just east of State Highway 71 to within 6 miles north of Dalton. Thickness 50 to 100 feet. Overlies Lenoir limestone. North of Dalton, underlies Ottosee (Sevier) shale. Blount group.

John Rodgers, 1952, Geology of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map. Holston limestone, 400 feet thick, underlies Ottosee shale and overlies Athens shale. Athens has been mistakenly placed above Holston limestone instead of below. Name Tellico sandstone has been applied to Holston in this area.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 68–75, pls. Name Holston marble was first used by Keith on maps in Knoxville (1895), Loudon (1896), and Morristown (1896) folios, but he did not mention it in text until Maynardville folio (1901). He apparently considered it a member or lentil in Chickamauga limestone and did not specify type locality, though clearly he named it for Holston River. Type locality herein proposed. In belt next southeast of Saltville fault, rocks above Knox group are continuous from about 3 miles west of New Market to 2 miles north of Athens. To northeast, a few small outliers extend past Jefferson City; to southwest, beyond a 30-mile break, the rocks reappear with virtually no change 4 miles south of Cleveland and continue to Georgia line and some miles beyond. Rocks are divided into (ascending) Lenoir limestone, Holston formation, Ottosee shale, and Bays formation. This sequence is here considered as standard of reference for rocks of this age, and belt is referred to as standard belt. Thickness of Holston 200 to 400 feet in standard belt. Holston formation of standard belt consists of several different kinds of rock that together form mappable unit. All are composed largely of calcite, and most contain large amount of finely divided hematite, which colors the rocks and derived soils pink to dark red. Dominant lithology is pink to red, coarsely crystalline limestone ("marble") showing crossbedding; this lime-sandstone (calcarenite) has furnished bulk of "Tennessee marble" of commerce, but it is neither the whole of the Holston nor confined to it. A second rock type is dark-red fine-grained limestone that contains algal heads, unbroken bryozoans, and crinoid bases; this lithology occurs as irregular masses and heads surrounded by limestones and clearly formed reef masses. A third rock type resembles the lime-sandstone but contains more quartzite; in many places, it overlies the other rock types. Keith and others have mapped this third rock type as Tellico sandstone. For present map, the rocks that Keith and others have mapped Tellico are included in the Holston. Holston in other belts differs slightly from that in standard belt. Overlies Athens shale in Blount County.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 157. In Tellico-Sevier belt. Chota formation (new) is same unit as sandstone lentil of Sevier formation of Keith and Holston formation of Rodgers (1953).

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76; 1960, Map GQ–126. In Shooks Gap and Bearden quadrangles, Tennessee, Hol-

ston formation overlies Lenoir limestone and underlies Chapman Ridge sandstone (new).

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 67–68. Because of uncertainty and inaccuracy of present application of Holston, name should be dropped as a stratigraphic term.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

Type locality (Rodgers): Along and near Holston River, 7 miles east-northeast of center of Knoxville where Holston River leaves standard reference belt just south of the John Sevier yards; includes quarry of Volunteer Portland Cement Co., just went of Holston River.

Holt Shale Member (of Topeka Limestone)[1]

Pennsylvanian (Virgil Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 42, 52, 53.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 128 (fig. 22), 164; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Holt shale member of Topeka formation; underlies Coal Creek limestone member; overlies Du Bois limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May, 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 15, fig. 5. Fossiliferous dark- to light-gray shale with an underlying black fissile shale. Thickness 2 to 3 feet. Underlies Coal Creek member; overlies Du Bois limestone member; where Du Bois is absent, overlies Turner Creek shale member.

Type locality: In Missouri River bluff southeast of Forest City, Holt County, Mo.

Holtsclaw Sandstone[1]

Lower Mississippian: Western and northern Kentucky and southern Indiana.

Original reference: Charles Butts, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 2, p. 151.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 143–144. Name abandoned. Holtsclaw Hill facies (new) off Brodhead formation (new) comprises the two units "Rosewood shale" and "Holtsclaw sandstone" proposed by Butts (1915).

Named for Holtsclaw Hill, Jefferson County, Ky.

Holtsclaw Hill facies (of Brodhead Formation)

Lower Mississippian: North-central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 139–145. Consists of silty shale that grades upward into massive siltstone. Thickness 200 to 220 feet. Lacks consistent horizons to justify its subdivision into smaller units of stratigraphic rank. Facies combines the Rosewood shale and Holtsclaw sandstone of Butts (1915) and is the equivalent of Locust Point formation, Spickert Knob facies, and Carwood formation, Knob Creek facies, in Indiana. At type area, underlies Floyds Knob

formation and overlies Silver Hills facies of New Providence formation. Passes laterally eastward into Pilot Knob facies (new).

Typical exposure: At Holtsclaw Hill, 12½ miles south of Ohio River at Louisville, along winding road following ravine immediately west of hill, Jefferson County. Named for Holtsclaw Hill, just north of southern boundary line of Jefferson County.

Holts Summit Formation

Upper Devonian: Central Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 78–80. Alternating beds of sandstone and arenaceous shale. Average thickness about 4 feet with maximum not more than 8 or 10 feet. Unconformably overlies Snyder Creek or Callaway; unconformably underlies Massie Creek formation (new).

Type locality: NE¼SE¼SE¼ sec. 11, T. 45 N., R. 11 W., on major branch of Clifton Creek about 2½ miles northwest of Holts Summit, Callaway County.

Holy Cross Sandstone

Silurian: Central Kentucky.

W. R. Jillson, 1952, The Holy Cross sandstone: Frankfort, Ky., Roberts Printing Co., p. 5–14. Tawney fine-grained shaley fossiliferous sandstone 6 to 8 feet thick. Occurs above Crab Orchard shale and is separated from Middle or Upper Devonian strata by major unconformity.

Occurs about 0.8 miles south of village of Holy Cross, Marion County.

Holy Cross Schist[1]

Precambrian: Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1935, Colorado Sci. Soc. Proc., v. 13, no. 8, p. 466–479, map.

The Mountain of the Holy Cross occurs in midst of mass mapped as Holy Cross schist and migmatite. The other schist seems to have been named for Sawatch Range.

Holyoke Basalt (in Newark Group)

Holyoke Diabase (in Newark Group)[1]

Holyoke Lava

Holyoke Lava Member (of Meriden Formation)

Upper Triassic: Central Massachusetts and central Connecticut.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

G. W. Bain, 1941, Am. Jour. Sci., v. 239, no. 4, p. 266, 267–268, fig. 1. Referred to as lava. Overlies Sugarloaf arkose.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Rank reduced to member occurring between upper and lower sedimentary members of Meriden formation.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 486–494, pl. 1. Current description and summary discussion of diabase in Mount Holyoke quadrangle, Massachusetts.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 8 (table 1), 12–14, pl. 1. Term Meriden not used in this report [Middletown quadrangle]; units given formational status in Newark group. Holyoke basalt crops out extensively along west edge of quadrangle in belt 3,000 to 5,000 feet wide, trending slightly east of north. Estimated stratigraphic thickness 450 to 500 feet. Represents two successive lava flows, the second being thinner. Overlies Shuttle Meadow formation (new); underlies East Berlin formation (new).

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Described in Avon quadrangle, Connecticut, where it is 250 to 350 feet thick. Lower contact not exposed in quadrangle. Conformably underlies East Berlin formation.

Named for occurrence in Mount Holyoke Range, Mass.

Holyoke Conglomerate[1]

Precambrian (middle Huronian): Northwestern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 63–66.

Named for occurrence at Holyoke, in Cascade Range, Marquette district.

Holyoke Formation[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: M. E. Wadsworth, 1890 and 1891, Lake Superior along the south shore, by Julian Ralph, p. 77–99; 1st ed., 1890; 2d ed., 1891.

Named for occurrence at Holyoke, in Cascade Range, Marquette district.

Holz Shale Member (of Ladd Formation)

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Upper member of Ladd formation (new). Dark-bluish- to brownish-gray micaceous sandy shale or siltstone, with interbedded arkosic sandstones and nonpersistent coarse conglomerate lenses; fossiliferous in upper half. Thickness about 1,500 feet. Unconformably underlies Schulz member of Williams formation (both new); overlies Baker member of Ladd formation (both new).

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 171–173. Type locality designated.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Shown on stratigraphic section as underlying Silverado formation (new).

Type locality: Holz Ranch on north side of Silverado Canyon just west of mouth of Ladd Canyon. Holz is most persistent and thickest member of Cretaceous sequence in Santa Ana Mountains; extends in virtually unbroken exposure from Santa Ana Canyon south to near Trabuco Canyon —about 15 miles.

Homberg Group

Mississippian (Chester Series): Southern Illinois and western Kentucky.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135. In southern Illinois and western Kentucky, consists of four formations (ascending): Cypress sandstone, Golconda limestone, Hardinsburg sandstone, and Glen Dean limestone. In this area, the sand-

stones are prominent and persistent formations; in Mississippi River counties, they thin, become shaly, and locally, the Hardinsburg sandstone is entirely absent. In Mississippi River counties, succession is Ruma formation at base and Okaw limestone. Underlies New Design group (new); overlies Elvira group (new).

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 829–830. Derivation of name given.

Name derived from village of Homberg, Pope County, Ill., near which group is well and typically developed.

Home Glacial Substage

Pleistocene (Wisconsin): Southern Rocky Mountains.

L. L. Ray, 1938. (abs.) Geol. Soc. America Proc. 1937, p. 314. Two stages of glaciation, believed to be of Wisconsin age, are recognized along northern Front Range. Older is designated Home stage and the younger Corral Creek stage.

L. L. Ray, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; Kirk Bryan and L. L. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 30–33; L. L. Ray, 1940, Geol. Soc. America Bull., v. 51, no. 12, pt. 1, p. 1857–1860. Represents second of five substages in southern Rocky Mountains. Preceded by Twin Lakes (new) and followed by Corral Creek substage.

Named for Home post office where terminal moraine stretches almost completely across Cache la Poudre Canyon.

Home Creek Limestone Member (of Caddo Creek Formation)[1]

Home Creek Limestone (in Caddo Creek Group)

Upper Pennsylvanian: Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 398.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Caddo Creek group. Redefined to include shales found locally above highest limestone member of Home Creek formation and below disconformity at base of the Cisco. Overlies Hog Creek shale; underlies Gonzales formation.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 20. Overlies Colony Creek shale (new) which replaces Hog Creek shale.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 51. Member consists of limestone, light-gray to nearly white, nodular to slabby to thick-bedded, fine-grained, locally cherty; middle part generally marly, contains "seaweed" structures and a few fusulinids. Contains reefs in vicinity of Colorado River. Thickness about 30 feet. Overlies Colony Creek shale member; underlies Bluff Creek shale member of Graham formation.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 67–68, pl. 27. Unusual thickening of limestone units in uppermost part of Canyon group near junction of Home Creek and Colorado River has resulted in confusion in correlation with limestone units in Caddo Creek and Brad formations as mapped elsewhere. Drake originally applied term "Home Creek bed" to upper noncherty limestone in walls of creek and name

"Cherty bed" to lower massive limestone, which contains abundant nodules of rounded nodules of chert. The chert bearing limestone is now included in Brad formation. Plummer and Moore (1921, Texas Univ. Bull. 2132) applied name "Home Creek" to prominent limestone at top of Canyon group in Brazos and Colorado River valleys. By tracing this member across northern McCulloch County to the type locality, and by studying stratigraphy of northern Brown County, Nickell (1938, Texas Univ. Bur. Econ. Geology Pub. 3801) found that limestone called Home Creek limestone by most geologists correlated with one higher on the slope than the one to which Drake had originally applied term "Home Creek" at type locality. Drake's Home Creek limestone, he found, was the one that Plummer and Moore had subsequently named Ranger. Other miscorrelations to north have been made in the past. Beds mapped as Home Creek across southern Brown County to outlier of Cretaceous rocks on which town of Bangs is located were mapped as Ranger limestone member of Brad formation (Plummer and Moore, 1921) north of outlier. Thus, Hog Creek shale of Drake (1893), named for creek north of outlier—in which Bluff Creek shale as used by Cheney (1948, Abilene Geol. Soc. Guidebook, Spring Field Trip, June 11–12) is exposed—was believed to lie below Plummer and Moore's Home Creek limestone. Actually, Hog Creek shale of Drake lies above the Home Creek. Because of this confusion, Cheney proposed name Colony Creek to replace term Hog Creek.

Named for Home Creek, Coleman County.

Homer Limestone Member (of Wayan Formation)[1]

Lower(?) Cretaceous: Southeastern Idaho.

Original reference: G. R. Mansfield, 1921, Geol. Soc. America Bull., v. 32, p. 249–266.

Named for exposures in valley of Homer Creek, Cranes Flat quadrangle.

Homer Limestone Member (of Holdenville Shale)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2, p. 104–105.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 107. Abandoned by Oklahoma Geological Survey. Name preoccupied; no replacement of name made.

Named for exposures near Homer School, in sec. 25, T. 4N., R. 6E., Pontotoc County.

Homer Quartzite (in Kaweah Series)

Triassic(?): Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 1, p. 15, 116, fig. 29, geol. map. Third in sequence (ascending) of four units. Younger than Lemon Cove schist and older than Three Rivers schist (both new). Consists predominantly of graphitic schists or phyllites and bedded siliceous rocks, which are interpreted in origin, as cherts. Thickest section, which occurs in central part of Dry Creek area, measures about 7,000 feet.

Named for Homer Ranch in Dry Creek Valley, in the southern Sierra Nevada, north-central Tulare County.

Homestake Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Min. Journal-Press, v. 115, p. 793–799, 836–843, maps.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563–565. In Lead district, underlies Ellison formation and overlies Poorman formation. Consists chiefly of quartz carbonate schist, locally much altered. Thickness 200 to 300 feet. Unit tightly folded.

E. P. Rothrock, 1944, South Dakota Geol. Survey Bull. 15, p. 24. In vicinity of Homestake mine, underlies Ellison formation and overlies De Smet formation. Thickness 70 feet.

J. A. Noble and J. O. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944, 945, 946–947. Term De Smet dropped; unit included in Poorman formation; hence, Homestake underlies Ellison formation and overlies Poorman formation. In Rochford district, where Northwestern formation is missing, Flag Rock formation cuts across Ellison and in some places rests on Homestake.

Derivation of name not stated but probably Homestake mine, Lead district, Lawrence County.

Homestake Limestone Member (of Carmel Formation)

Homestake Limestone[1]

Jurassic: Southwestern Utah.

Original reference: C. R. Leith and E. C. Harder, 1908, U.S. Geol. Survey Bull. 338, p. 24.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. Limestone portion of Leith and Harder's Homestake limestone is redefined as Homestake limestone member of Carmel formation, Carmel being herein geographically extended into Iron Springs area. Member consists chiefly of gray, "blue," and black limestone, massive to thick-bedded, which ranges in thickness from 220 to 250 feet in Granite Mountain area. Grades upward through a few feet of mud-cracked and ripple-marked limy mudstone into Entrada sandstone. Jurassic.

First mapped and described in vicinity of Homestake mine, Iron Springs quadrangle.

Homewood Formation (in Pottsville Group)

Homewood Sandstone Member (of Pottsville Formation)[1]

Homewood Sandstone and Shale (in Mercer Formation)

Homewood sandstone member

Homewood shale and (or) sandstone member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 67.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40–41. Homewood shale and (or) sandstone member of Brookville cyclothem in report on Perry County. Base of Homewood considered boundary between Pottsville and Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 50–51. Homewood sandstone member of Brookville cyclothem in report on Athens County. At type exposure, the Homewood is reported to include coalesced sandstones of several cycles of deposition, but in Ohio, Homewood member is recognized as the sandstone immediately below the Brookville member and above Tionesta coal. Either Brookville underclay or marine Putnam Hill shale overlies the Homewood, contact, where observed, is thin gradational one. Thickness 30 feet.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 909, 910 (fig. 2). Homewood sandstone and shale is at top of Mercer formation.

Named for occurrence at Homewood Station, Beaver County, Pa.

Homewood (Lower) Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 56.

†Hominy Formation[1]

Pennsylvanian and Permian: Central northern Oklahoma.

Original reference: C. N. Gould, 1905, U.S. Geol. Survey Water-supply Paper 148, map.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey.

Named for Hominy, Osage County.

Homochitto Member (of Pascagoula Formation)

Miocene: Southwestern Mississippi.

G. F. Brown and W. F. Guyton, 1943, Mississippi Geol. Survey Bull. 56, p. 22, 23 (chart), 32–37. Proposed to replace preoccupied name Knoxville member. Consists of sand, blue-green clay, and silt; very coarse sand or fine gravel at base. Thickness 181 to 252 feet. Underlies Fort Adams member; overlies a shale, sandy shale, siltstone unit 362 to 466 feet thick in lower portion of formation.

Crops out in narrow belt across southwestern Franklin County.

Honaker Limestone[1] or **Dolomite**[1] (in Conasauga Group)

Middle Cambrian: Southwestern Virginia, western North Carolina, and northeastern Tennessee.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44, p. 2.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 51–53. In eastern Tennessee, Conasauga [group] varies in lithology, and three phases are recognized; in southeastern phase sequence includes (ascending) Honaker dolomite, Nolichucky shale, and Maynardville limestone. Dolomite in Honaker includes all types—light and dark, fine- and coarse-grained, shaly and massive. Limestone is also present. Thickness about 1,300 feet. Overlies Rome formation.

Named for exposures at Honaker, Russell County, Va.

Honaker Trail Formation (in Hermosa Group)

Pennsylvanian and Permian: Southeastern Utah.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2056, 2075, 2080, figs. 3, 17. Introduced to replace

previously used phrase "Upper Hermosa" in Four Corners region. Comprises gray to reddish-gray fine-crystalline to coarsely granular limestone with gray and red chert, and reddish-gray to buff-gray calcareous sandy siltstones. This lithologic association, however, is typical of only one of the several high stable-shelf associations found in formation. Westward and northwestward high on the shelf, formation grades into dolomite, basinward into sandier arkosic facies, and near Uncompahgre uplift it contains massive lentils of greenish-gray mica-siltstones and arkosic granulite. Thickness ranges from 0 to 1,750 feet in a northeasterly direction toward Uncompahgre uplift. Underlies Rico formation; overlies Paradox formation. Late Cherokee, Marmaton, Missourian, and Virgilian age.

S. A. Wengerd, 1958, Intermountain Assoc. Petroleum Geologists Guidebook 9th Ann. Field Conf., p. 115, figs. 4, 5, table 1. Upper Des Moines, Missouri, Virgil, and Wolfcamp.

Type locality: At Honaker Trail in sec. 29, T. 41 S., R. 18 E., along San Juan Canyon in San Juan County, Utah. Isopachous map shows formation in northeastern Arizona, southwestern Colorado, northwestern New Mexico, and southeastern Utah.

Honda Formation

Upper Jurassic: Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 22, pls. 1, 2. Consists of several thousand feet of dark greenish-brown clay shale commonly containing buff-weathering calcareous concretions; poorly bedded and intensely sheared; locally contains thin layers of fine-grained sandstone. Unconformably underlies Espada formation (new); either overlies or is intruded by serpentinized pyroxenite to the north. Hondo shale may be equivalent to type Knoxville, but its highly sheared condition and unconformable relationship to Espada formation suggests that it may be shale member of Franciscan.

Type locality: North side of Canada Honda 3 miles east of Point Pedernales, Santa Barbara County.

Hondo Sandstone Member (of San Andres Limestone)

Hondo Sandstone Member (of Chupadera Formation)[1]

Permian: Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 542 (fig. 2), 687, pl. 2. Hondo sandstone reallocated to member status in San Andres herein rank raised to formation. Term Chupadera abandoned.

Crops out near bottom of valley of Hondo River and its tributaries.

Hondo Shale or Formation

See **Arroyo Hondo Shale Member** (of Lodo Formation).

Hondo Slate

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 11, 13 (table 1), 23, pl. 2. Characteristically black carbonaceous slate, has well-developed schistosity. Weathers rusty color. In many places, particularly along Arroyo Hondo, the black slate grades into quartz-muscovite schist. Ranges up to a mile in thickness. Overlies Ortega quartzite (new).

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 6, 19. Renamed Pilar phyllite member of Ortega formation because name Hondo preempted.

Most conspicuous occurrence is belt extending from near Dixon northeast to central part of drainage system of Arroyo Hondo. Smaller belt between Harding mine and Copper Hill. Also exposed along Dixon-Penasco Road a few miles east of Dixon.

Honesdale Sandstone Member (of Catskill Formation)

Honesdale Sandstone Group (in Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 66–68, 132, 140.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 279 (table 30), 288–291, fig. 72. Honesdale sandstone included in Catskill facies.

Harry Klemic and R. C. Baker, 1954, U.S. Geol. Survey Circ. 350, p. 2. Willard's (1939) classification interpreted as Honesdale sandstone member of Catskill formation. Occurs above Damascus red shale member and below Cherry Ridge red beds member.

First described at Honesdale, Wayne County.

Honey Creek Formation (in Timbered Hills Group)

Honey Creek Limestone[1]

Upper Cambrian: Central southern Oklahoma.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 624, 642, 661, 666, pl. 27.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 19–20, measured sections. Uppermost formation in Timbered Hills group. In most places, rests directly on Reagan formation; contact gradational in many areas. Along west edge of Blue Creek Canyon, overlaps the Reagan and rests directly upon Precambrian igneous rock. Underlies Fort Sill formation. Thickness 51 to 90 feet in Arbuckle Mountains; 44 to 226 feet in Wichita Mountains.

E. A. Frederickson, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1349–1355. Redefined to include units termed Cap Mountain and "basal limestone" in Timbered Hills group by Decker (1939). Both units are equivalents of all or portions of Honey Creek formation.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 23 (fig. 2), 31–39. Formation in Mill Creek-Ravia area consists of sandy and nonsandy dolomite 63 to 234 feet thick, overlying Reagan sandstone and underlying, with slight disconformity Fort Sill limestone.

Named for Honey Creek, a tributary of Washita River which rises in Arbuckle Mountains and flows northeastward around west end of East Timbered Hills.

Honeycut Formation (in Ellenburger Group)

Lower Ordovician: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 1, 3–7, 31–41. Uppermost formation in group. Overlies Gorman formation (new). Limestone and dolomite.

Thickness at type section (Blanco County) 679 feet; Cherokee Creek section, San Saba County, 142 feet.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 146–147, pls. 4, 6 [1945]. All known Ellenburger strata above Gorman formation here termed Honeycut formation. Upper and lower parts consist of interbedded limestones and dolomites separated by prominent median sequence of microgranular to very fine grained dolomite; this tripartite division is fairly persistent laterally. Cannonballs of chert and siliceous limestone common. Due to post-Ellenburger truncation, Honeycut ranges in thickness from maximum of 678 feet at type section in southeast corner of Llano uplift to a feather edge, disappearing entirely in western part of uplift.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 40–42, 197, 257, 314, 321–333, pls. 3, 13 [1946]. Type section and local stratigraphy described in detail.

V. E. Barnes, P. E. Cloud, Jr., and Helen Duncan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 1033. Stratigraphic relations at base of Burnam limestone (new) uncertain. Whether these Upper Ordovician rocks rest directly on Honeycut formation, or whether other rocks intervene between Honeycut and Burnam cannot be determined without drilling, if then. In north-central and northwestern parts of area, Stribling rocks rest directly on flat Honeycut rocks. In northeastern part of same area, horizontal beds of Stribling formation directly overlap steeply dipping beds of Honeycut.

Type section: In reach of Pedernales River known as Honeycut Bend, about 5 miles east of Johnson City, Blanco County. Also present in Burnet and Llano Counties.

Honolua Volcanic Series

Pliocene, upper(?), or Pleistocene, lower: Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 159 (table), 173–179, pl. 1. Andesites and soda trachytes characterized by platy cleavage. Individual flows range from 25 to 300 feet in thickness; some are 500 feet near vents. Lavas attain maximum thickness of 750 feet near Eke. Separated from underlying Wailuku volcanic series (new) by thin red soil.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 320–325. Petrography discussed.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 89. Late Pliocene(?) or early Pleistocene.

Named from village of Honolua West Maui Mountains on northwest coast Maui Island. Village is on bay bounded on both sides by cliffs of andesitic lavas 100 to 150 feet high.

Honolulu Volcanic Series[1]

Honolulu Series

Pleistocene and Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrog. Bull. 1.

Horace Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 1–48. Termed Honolulu series. Units correlated with Pleistocene and Recent stands of sea.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 90–91. Series of olivine basalt, nepheline basalt, melilite-nepheline basalt lava flows, and associated cinder cones and ash beds, and tuff cones. Overlies Koolau volcanic series, erosional unconformity. Correlated with successive stands of sea higher or lower than present stand during Pleistocene time.

Includes following named units (not in sequence) : Ainoni Volcanics, Aliamanu Basalt. Aliamanu Tuff, Black Point Basalt, Castle Volcanics, Diamond Head Tuff, Haiku Volcanics, Hawaiiloa Volcanics, Kaau Volcanics, Kaimuki Basalt, Kalama Volcanics, Kalihi Volcanics, Kamanaiki Basalt, Kaneohe Volcanics, Kaohikaipu Volcanics, Kaupo Basalt, Koko Volcanics, Makalapa Tuff, Makawao Breccia, Manana Tuff, Maunawili Volcanics, Mauumae Volcanics, Mokapu Basalt, Mokolea Basalt, Moku Manu Volcanics, Nuuanu Volcanics, Pali Volcanics, Punchbowl Volcanics, Pyramid Rock Basalt, Rocky Hill Volcanics, Salt Lake Tuff, Sugar Loaf Basalt, Tantalus Basalt, Training School Volcanics, and Ulupau Tuff.

Named for city and county of Honolulu, in which it occurs. Present as many small masses and valley-filling lava flows covering total of about 27 square miles on both southwest and northeast flanks of southeast end of Koolau Range.

Honomanu Volcanic Series

Tertiary, upper(?) : Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 61, 63, 65 (table), 66 (table), 68–74, pl. 1. Oldest rocks in East Maui. Exposed over less than 1 percent of Haleakala but believed to form basement of entire mountain to an unknown depth below sea level. Underlies Kula volcanic series (new).

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat. v. 6, Océanie, fasc. 2, p. 90–91. Late Tertiary(?).

Type locality: Northeast slope Haleakala (East Maui) volcano in Honomanu Valley, a gorge 1,300 feet deep. Basalts form lower 950 feet of cliff and are exposed northwestward in sea cliffs and in mouths of deeper gulches as far as Waipo Bay. Exposed eastward from type locality nearly to Nahiku and for 5½ miles up Keanae Valley.

Hood Glacial Epoch

Pleistocene : Central northern Oregon.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 836, 841 (table 1). Youngest of series of five glacial epochs in area. Preceded by Jeffersonian epoch.

Hoodoo Quartzite[1]

Precambrian (Belt Series) : Southern central Idaho.

Original references: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth ; 1934, U.S. Geol. Survey Bull. 854.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 7. Belt series in vicinity of middle Fork of Salmon River, includes Yellowjacket formation, at least 9,000 feet thick, overlain by Hoodoo quartzite over 3,560 feet thick.

Type locality : Hoodoo Creek, northwestern part of Casto quadrangle.

Hood River Conglomerate[1] or Formation

Miocene, upper, or Pliocene, lower: Northwestern Oregon and southwestern Washington.

Original reference: J. P. Buwalda and B. N. Moore, 1927, Science, new ser., v. 66, p. 236.

R. W. Chaney, 1938, Carnegie Inst. Washington Pub. 476, p. 208–212. Plant fossils from formation indicate Pliocene rather than Pleistocene age.

C. R. Warren, 1941, Am. Jour. Sci., v. 239, no. 2, p. 106–127. Conglomerate deeply weathered, moderately well indurated, fluvial conglomerate resting conformably or nearly so on Yakima basalt and deformed with it. Traced from type locality northeast past Golden, Wash., to Sunnyside. Contemporaneous with Dalles and Ellensburg formations, both of late Miocene and early Pliocene.

Type section: In cut immediately east of Columbia River Highway bridge across Hood River, east of town of Hood River, Oreg.

Hook Limestone Member (of Macy Formation)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2060–2061. Name applied to lower member of formation. Composed of yellowish-brown fucoidal, fine calcitite with irregular buff-weathering dolomitic partings, and layers of intraformational conglomerate. Thickness at type locality 55 feet; here contains a 6-inch bed of orange metabentonite at 27 feet and a 1-inch bed of metabentonite at 46 feet; generally thins northward; thickens southward to 69 feet in Perry County. Underlies Zell member (new); overlies Hagar formation (new).

Type exposure: Along Missouri Highway 25, east of Macy, Ste. Genevieve County.

Hooker Slate[1]

Lower Cambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 402.

E-an Zen, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1829–1830. Revised stratigraphic sequence proposed for north end of slate belt, Taconic Range. Consists of basal Biddie Knob formation (new); intermediate Bull formation; and the Hooker, a black slate formation with subsidiary dolomite, limestone, and quartzite beds. Fossils in Bull and Hooker formations indicate bulk of section is early Cambrian although some Ordovician slate may be present at top.

Named for Hooker Hill 2 miles north of Castleton, Rutland quadrangle.

Hook Mountain Flow

See **Watchung Basalt or Lava Flows.**

Hookton Formation

Pleistocene, middle to upper: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 57–63, pls. 1, 2. Sediments include gravel, sand, silt, and clay; characteristically yellow-orange in color. Thickness as much as 400 feet. Stratigraphically below, though not in contact with, Rohnerville formation (new); unconformably overlies Carlotta formation (new). No positive age can be established for formation; inferences suggest that it is probably middle to upper Pleistocene. [Columnar section shows Pleistocene; map bracket shows upper Pleistocene.]

Name derived from Hookton-Table Bluff area where there are numerous, more or less typical, random exposures. Area of study, Eel River valley, Humboldt County. Exposed on north and south sides of Eel River syncline; passes over Tompkins Hill anticline where folding has been more intense.

Hooper Clay Member (of Rockdale Formation)

Hooper Formation

Eocene, lower (Wilcox): East-central Texas.

W. W. Sharp, Jr., 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ: Paleontologists and Mineralogists, Soc. Explor. Geolphysicists Guidebook Field Trip Routes Joint Ann. Mtg. March, p. 53 (geol. map) Black to gray carbonaceous clay and shale containing lignite, concentric concretionary clayironstone, and sand layers. Disconformably underlies Simsboro formation.

R. L. Folk (leader), 1960, Texas Univ. Geol. Soc. Tertiary Field Trip, Dec. 10, p. 5, strat. section. Shown on stratigraphic section as clay member of Rockdale formation. Underlies Simsboro member; overlies Caldwell Knob member of Seguin formation.

Mapped in northern Bastrop County.

Hoosac Schist[1]

Hoosac Formation

Lower Cambrian(?): Western Massachusetts, western Connecticut, and southern Vermont.

Original reference: J. E. Wolff, 1894, U.S. Geol. Survey Mon. 23, p. 23–107.

J. B. Thompson, Jr., 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, p. 40–41. Formation subdivided in southeastern Vermont. Contains Bull Hill member near base and Turkey Mountain and Plymouth members in upper part. Underlies Pinney Hollow formation; overlies Tyson formation. Cambrian or Lower Ordovician.

Occurs on top of Hoosac Mountain, northwestern Massachusetts.

Hooser Shale Member (of Bader Limestone)

Hooser Shale (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 20, 25.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 166; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Member of Bader limestone. Consists of shale and impure limestones. Thickness across line of outcrop in Kansas about 10 feet. Underlies Middleburg limestone member; overlies Eiss limestone member.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 79–80, pls. Member described in Wabaunsee County, Kans., where it is 5½ to 15½ feet thick, overlies Eiss limestone member and underlies Middleburg limestone member.

Type locality: Highway cut and ravine just east of Hooser, Cowley County, Kans.

Hoover conglomerate unit (in Sycamore Canyon Member of Puente Formation)

Miocene, upper: Southern California.

C. J. Kundert, 1952, California Div. Mines Spec. Rept. 18, p. 6 (fig. 2), 7, pl. 2. Cobble-pebble conglomerate bed containing some boulders and a few intercalated sandstone lenses in a red sandy or earthy matrix. Thickness about 750 feet. Overlies Cental Fee sandstone unit (new).

Occurs in Whittier-La Habra area, south of Whittier fault, Los Angeles County.

Hoover division[1]

Upper Cambrian or Lower Ordovician: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxii, 295–306, pl. 3.

Named for Hoover Valley, Burnet County.

†Hop Brook Limestone[1]

Precambrian: Massachusetts.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159, p. 52.

Exposed in bottom and steep banks of Hop Brook at Sodom, eastern part of Berkshire County.

Hope Gypsum (in Sumner group)[1]

Permian: Central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 10, 11.

Named for Hope, Dickinson County.

Hope Limestone[1]

Silurian(?): Central southern Maine.

Original reference: C. T. Jackson, 1837, 1st Rept. Maine, p. 57–58.

Extensively quarried in Hope Township, Knox County.

Hope Valley Alaskite Gneiss

Mississippian(?) or older: Southern Rhode Island.

G. E. Moore, Jr., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Pinkish gray to flesh colored, generally coarse to medium grained but locally medium to fine grained. Characterized by low content of biotite and by flattened rod-shaped aggregates of quartz, commonly 15 to 20 mm long, that produce strong lineation. Foliation moderately strong in southern part of area; generally weak or absent elsewhere. Locally porphyritic, with somewhat granulated phenocrysts of pink feldspar as much as 20 mm long. Intrusive into and contains inclusions of the Blackstone series, Intruded by sills and dikes of fine-grained granite, aplite, and pegmatite.

U.S. Geological Survey currently designates the age of the Hope Valley Alaskite Gneiss as Mississippian(?) or older on basis of a study now in progress.

Named for exposures on low knobs 1 mile north of village of Hope Valley, Hope Valley quadrangle. Particularly well exposed on one of these knobs known as Goat Rock. Widespread in southern part of state.

Hopewell Series

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 10–11, 13 (table 1), 21–22, 42–43, pls. 2, 3. Succession of metamorphosed igneous flows, with

which are interspersed metamorphosed sediments in Picuris and Petaca areas. Flows were principally andesite and basalt (Picuris basalts), most of which are now dark hornblende-chlorite schists. There are some flows of rhyolite and trachyte (Vallecitos rhyolites), most of which are but little changed. Contains some slates and arkosites. In Picuris area, the most conspicuous quartzite is mapped separately as Badito quartzite. In Petaca area, between Tusas and Kiawa Mountains a particularly prominent member is called Cleveland Gulch quartzite. As exposed up to 1½ miles in thickness, may be considerably thicker. Underlies Ortega quartzite.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 14. Name has been applied previously to another formation and is therefore replaced by name Moppin metavolcanic series for greenschist amphibolite, schist, and other, much less abundant rock types exposed in northwest-trending belt extending from Hopewell to Cow Creek, American Creek, and in part, the southeast part of Kiawa Mountain.

Mapped in Picuris and Petaca areas between towns of Hopewell on northwest and Picuris on southeast, Rio Arriba and Taos Counties.

Hopkinton Dolomite[1]

Middle Silurian: Eastern Iowa.

Original reference: S. Calvin, 1906, Jour. Geology, v. 14, p. 572, 574.

E. H. Scobey, 1938, Jour. Geology, v. 46, no. 2, p. 207, 215, 216. About 70 feet of beds formerly referred to lower part of Hopkinton formation of Niagaran series are placed in Alexandrian series. Illinois formation names Edgewood and Kankakee are extended into Iowa sections. Hopkinton overlies Kankakee and in most areas grades conformably into it.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 34 (table 2), 35, table 3), 37, 38 (fig. 1). Consists of maximum of 180 feet of medium-bedded to massive, buff dolomite with zones containing beds and nodules of white chert. Text refers to underlying Gower, but tables and figures show Gower overlying Hopkinton.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Hopkinton (restricted) below Gower dolomite and above Waucoma limestone.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 43–44, pls. 1, 3. Described in Dubuque South quadrangle, Iowa-Illinois, where it is about 195 feet thick. The Hopkinton, as used in this report, includes all beds overlying Kankakee formation, as Gower dolomite of Norton (1899, Iowa Geol. Survey, v. 9) which overlies Hopkinton in eastern Iowa, has not been recognized in Dubuque South Quadrangle.

Named for Hopkinton, Delaware County.

Hopkintonian series

Silurian (Early Yorkic): Missouri.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 75, no. 2, p. 157 (chart). Name appears on chart of formations in Missouri. Includes (ascending) Noix limestones, unnamed interval, Bowling Green dolomites. In sequence, younger than Maquoketan series and older than Goweran series.

Hoppin Slate[1]

Hoppin Formation

Lower Cambrian: Eastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 36.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Referred to as formation.

Exposed at Hoppin Hill, North Attleboro and in Wrentham.

Hopwood Conglomerate

Lower Mississippian: Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 14. Name will probably be used, following more definitive study of area, for unit here termed Conglomerate F and described as sandstone and conglomerate member. Consists of two parts, a lower massive cliff-making brown-gray sandstone and an upper conglomerate composed of white vein-quartz pebbles in a matrix of coarse greenish-gray sandstone. Conglomerate is contorted into large boulderlike masses in zone near its base. Total thickness about 28 feet. Conformably underlies Sandstone G (Pine Knob sandstone); lower contact not exposed.

Type section: Cliff at highway scenic lookout about one-fourth mile below Summit Hotel on Route 40, east of Hopwood, Fayette County.

Hordes Creek Limestone Lentil (in Admiral Formation)[1]

See **Hords Creek Limestone Member** (of Admiral Formation)

Hords Creek Limestone Member (of Admiral Formation)

Hordes Creek Limestone Lentil (in Admiral Formation)[1]

Hords Creek Formation (in Admiral Group)

Permian (Wolfcamp Series): Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 422.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Admiral herein restricted and given group status. Underlies Fisk formation (new); overlies Coleman Junction formation in Putnam group.

R. C. Moore *in* A. K. Miller and Walter Youngquist, 1947, Kansas Univ. Paleont. Contr. 2, Mollusca, art. 1, p. 1 (footnote). Hords Creek limestone underlies Wildcat Creek shale member (new) of Admiral formation.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Columnar section shows Hords Creek limestone member underlying Wildcat Creek shale member and overlying Lost Creek shale member of Admiral formation.

Named for Hords (Hordes) Creek, Coleman County.

Hornbrook Formation

Upper Cretaceous: Northern California and southwestern Oregon.

F. G. Wells, 1955, U.S. Geol. Survey Mineral Inf. Field Studies Map MF–38. Named on map legend. Indurated uniform fine-grained greenish-gray arkosic sandstone with local lenses of coarse conglomerate and sandy shale; fossiliferous and calcareous in places.

D. L. Peck, R. W. Imlay, and W. P. Popenoe, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1968–1984. Defined to include Upper Cretaceous sedimentary rocks in southwestern Oregon and northernmost

California. These rocks have generally been referred to as Chico group although they are more than 80 miles north of nearest exposures of Upper Cretaceous rocks in Sacramento Valley, near Redding, Calif., and more than 140 miles north of type locality of Chico. These upper Cretaceous rocks nonconformably overlie deformed and in part metamorphosed volcanic and sedimentary rocks, ranging in age from Paleozoic to Late Jurassic, and granitic intrusive rocks, of Late Jurassic or Early Cretaceous age, and are overlain disconformably by clastic sedimentary rocks and volcanic rocks of Eocene age; in Hornbrook area, unconformably overlie Triassic Applegate group. Comprises at least 2,500 feet of arkosic wacke sandstone, siltstone, mudstone, and conglomerate and contains fossils of Cenomanian, Turonian, and Campanian age. In Hornbrook area, formation consists of six unnamed members (numbered I to VI from oldest to youngest) ; which have been traced northward from south side of Klamath River to vicinity of Hilts, Calif. An unconformity of unknown magnitude occurs between members II and III. The 700 feet of nonfossiliferous rock above the unconformity and the 100 feet of nonfossiliferous rock below it could represent either much or very little of the Coniacian to early Campanian stages. If future mapping demonstrates that more than one formation name is necessary, it is suggested that term Hornbrook be restricted to members I and II. Comparisons of time span of the Hornbrook with the Chico at its type locality shows that most of the Hornbrook is either younger or older than the Chico and that the unconformity within the Hornbrook represents most and perhaps all of the time represented by the Chico. Also the Cretaceous sequence in Redding area, which lies between the Chico and Hornbrook areas, is mostly older than type Chico. Therefore, distinct formational names are needed for each area in order to avoid ambiguity of geologic discussions. Type locality designated.

Type section: Exposures near town of Hornbrook, Siskiyou County, Calif. Discontinuous exposures form a northwest-trending band that extends from near Yreka, Calif., along valleys of Cottonwood and Bear Creeks to Grave Creek, Oreg.

Horned Toad Formation

Pliocene, lower and middle: Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138 (fig. 2), 143. Name applied to sequence of stream-laid and lacustrine sediments. Composed of upper member of gray gypsiferous clay, middle member of indurated green muddy sandstone with several layers of white caliche, and lower member of gray-white arkosic sands and interbedded light-reddish sandy siltstone with a basal granitic conglomerate. Formation moderately deformed. Thickness 1,055 feet. Mammalian fossils indicate early or middle Pliocene age. Overlies quartz monzonite of pre-Tertiary age and intrusive quartz latite of Tertiary age; unconformably underlies light-reddish sand, siltstone, and fanglomerate of probable Plestocene age.

Type locality: Horned Toad Hills, 4 miles northwest of Mojave, Mojave quadrangle, Kern County. Crops out from Warren Station, southwestward about 3 miles.

Hornerstown Sand (in Rancocas Group)

Hornerstown Formation

Hornerstown Marl (in Rancocas Group)[1]

Paleocene: New Jersey and Delaware.

Original reference: W. B. Clark, 1907, Johns Hopkins Univ. Circ., new ser., 1907, no. 7, Whole No. 199, p. 3.

S. K. Fox, Jr., and R. K. Olsson, 1955, [abs.] Jour. Paleontology, v. 29, no. 4, p. 736. Stratigraphic evidence indicates an unconformity between Cretaceous and Tertiary formation in New Jersey. Hornerstown rests successively from northeast to southwest on Tinton, Red Bank and Navesink formations. In each case, the Hornerstown lies upon a weathered surface, and basal few feet contain fragments of the underlying formation.

H. W. Miller, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 722–736. Formation correlated with Midway stage (Paleocene) of Gulf Coast. Presence of "middle greensand" unit between Navesink (Cretaceous) and Hornerstown formation recognized, and it is suggested that this is southwestward extension of Red Bank formation (Cretaceous).

A. R. Loeblich, Jr., and Helen Tappan, 1957, Jour. Paleontology, v. 31, no. 6, p. 1113 (fig. 2), 1128 (fig. 5), 1129–1132. Paleocene (Danian-Landenian). Determination made on basis of foraminiferal studies. Overlies Monmouth group; underlies Vincentown formation. Report summarizes opinions of several workers and cites bibliography.

H.G. Richards, J. J. Groot, and R. M. Germeroth, 1957, Geol. Soc. America Guidebook Field Trips Atlantic City Mtg., p. 184 (table 1), 186 (table 3), 198–199, 201 (table 4). Marl (formation) lies disconformably on Navesink marl in southern New Jersey. In Monmouth County where Red Bank and Tinton formations are present, relationship may be conformable. Consists of glauconite with clay and sand; resembles parts of Navesink, but distinguished from it by its more sandy natures. Thickness at outcrop 30 feet; average dip 30 feet per mile. Exact age uncertain; recent work on microfossils has shown formation should be regarded as Paleocene. Geographically extended into Delaware.

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063–2064. Units studied: Navesink, Redbank, Tinton, New Egypt (new), and Hornerstown formations. The New Egypt in outcrop is lateral equivalent of Tinton formation and in subsurface represents both Tinton and Hornerstown formations. Paleocene-Eocene boundary lies within a lithic unit [in subsurface] (Hornerstown and New Egypt formations).

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184. Rancocas group includes (ascending) Hornerstown sand, Vincentown formation, and Manasquan formation.

Named for occurrence at Hornerstown, Monmouth County, N. J. Extends in belt across New Jersey from vicinity of Atlantic Highlands through Freehold, Hornerstown, Birmingham, Mullica Hill, Sewell, and Woodstown to Delaware River and then into Delaware.

Hornsboro Sandstone[1] or zone[1]

Upper Triassic: Northeastern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 11, 12.

Named for exposures around Hornsboro, Chesterfield County.

Hornsilver Dolomite Member (of Minturn Formation)

Pennsylvanian: Northwestern Colorado.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 199, 216–217. Massive gray dolomite 12 to 16 feet thick overlain by 8 to 14 feet of thin-bedded gray dolomite. About 2,900 feet above base of formation. Lies about 800 feet below base of Resolution dolomite member (new); about 300 feet above Wearyman dolomite member (new).

Named for outcrops on south slope of Hornsilver Mountain, Pando area, Eagle County.

Horquilla Limestone (in Naco Group)

Middle and Upper Pennsylvanian: Southeastern Arizona and southwestern New Mexico.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 16–18, 31–35. Series of thin-bedded blue-gray limestones with a few thicker beds, as much as 6 or even 8 feet thick. A few beds of reddish-weathering shaly limestone intercalated in upper half of formation. Most limestone is dense and pinkish gray on fresh fracture. Some beds, especially the thicker ones, are coarsely crystalline limestone consisting largely of crinoidal fragments. Base of limestone is obscure surface of disconformity which, north of Dragoon Mountains, appears to fall in weak zone of shale immediately above Black Prince limestone. No complete section exposed in Tombstone Hills or Dragoon Mountains, Pearce or Benson quadrangles. Total thickness estimated at 1,200 feet; type section 999 feet thick. Southward in Gunnison Hills, unfaulted section has thickness of 1,600 feet. Underlies Earp formation. Pennsylvanian.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 36–39, pl. 5. Lower and lower Upper Pennsylvanian.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 31–35, tables 1, 2, pl. 1. Most widespread Paleozoic formation in Peloncillo Mountains, N. Mex., where it consists almost entirely of limestones. A 14-foot argillaceous sandstone layer about 250 feet above base. Incomplete section 819 feet thick at Silver Hill mine, total much thicker. Overlies Paradise formation. Rocks of all middle and lower Pennsylvanian series and of Wolfcamp series of Permian are present.

U. S. Geological Survey currently designates the age of the Horquilla Limestone as Middle and Upper Pennsylvanian on basis of a study now in progress.

Type section: On spur of east Horquilla Peak from which it takes its name, Tombstone Hills, central Cochise County, Ariz., about 1 mile southeast of Ajax Hill. Widespread in Tombstone Hills, also in Mule Mountains, Dragoon Mountains, and in Courtland and Gleeson districts. In Peloncillo Mountains, N. Mex.

Horry Clay

Pleistocene: Eastern South Carolina.

C. W. Cooke, 1937, Washington Acad. Sci. Jour., v. 27, no. 1, p. 1–5. Dark-brown clay containing plant fragments, woody tissues, and diatoms. Thickness 3 feet; covered by water at high tide. Cypress stumps and knees rotted at top. Some of the stumps extend a few inches above clay into overlying shell bed. Top of clay perforated by tubular holes, presumably made by boring creatures. Presence of rooted stumps beneath thick

marine deposit that evidently accumulated in quiet water gives evidence that sea stood lower on land when they grew than in immediately succeeding epoch. Underlies Pamlico formation. Apparently represents early part of Peorian stage.

D. G. Frey, 1952, Am. Jour. Sci., v. 250, no. 3, p. 212–225. Thickness about 9 feet. Horry clay below section described by Cooke is fresh-water deposit. Nearby Myrtle Beach peat (new) is presumably younger than the Horry though stratigraphic relationship uncertain. No known unconformable relationship exists between Horry clay and Pamlico formation.

Named for Horry County. Section described is west of railway bridge across Intracoastal Waterway 2½ miles northwest of Myrtle Beach.

Horse Bench Sandstone Bed (in Evacuation Creek Member of Green River Formation)

Horse Bench Sandstone Lentil (in Green River Formation)[1]

Eocene: Northeastern Utah.

Original reference: W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168, p. 16.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 409 (fig. 2). Shown on chart as Horse Bench sandstone bed in Evacuation Creek member of Green River formation.

Named for fact that it forms broad tableland between Minnie Maud Creek and Jack Creek known as Horse Bench in northeastern Carbon County.

Horse Creek Clay and Shale (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 479.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec. [Guidebook] Spring Field Trip, May 11–12, p. 70. Overlies Fox Ford bed; underlies Bull Creek sandstone. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds," as he termed them, and numbered them from top to bottom, 4 to 23. Only Drake's name for upper unit, the Ricker, in common use today, and that name has been restricted to base of Drake's Ricker bed.

Named for Horse Creek, San Saba County.

Horse Creek Formation (in Moran Group)

†Horse Creek Limestone Member (of Moran Formation)[1]

Permian (Wolfcamp Series): Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 419.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Moran group. Overlies "Dothan" formation; underlies Sedwick formation Wolfcamp series.

R. C. Moore, 1949, U. S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Name Gouldbusk is here applied to limestone beds and included thin shale that were called Horse Creek limestone by Drake. Sellards (1933, Texas Univ. Bull. 3232) pointed out duplication by Drake in use of this

name, as applied to beds in his Strawn division farther east in Colorado River valley and to limestone, now considered Permian(?) in age, exposed in Coleman County. Sellards restricted application of Horse Creek to beds in Strawn sequence but did not rename the upper beds, which confusingly have continued to be called Horse Creek (Cheney, 1940; King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4).

Named for Horse Creek, Coleman County.

Horsehead Tongue (of Mancos Shale)

Upper Cretaceous (mid-Carlile) : Northwestern New Mexico.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 9, 11, 13, 35, pl. 12. Dark-gray marine shale. Thickness 40 feet in area of typical exposures and thins southward, and assumed to pinch out in that direction. Underlies lower part of Gallup member of Mesaverde and overlies Atarque member (new) of Mesaverde formation.

Named from typical exposures on east side of valley of Horsehead Creek, in Ts. 9 and 10 N., R. 17 W., McKinley County.

Horseshoe Bar Quartz Diorite

[Jurassic] : Northern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 6. Discussed in report dealing with potassium-argon age determinations. Age 142.9 million years. Rock dated was called gabbro by Lindgren and considered to be local variation of Rocklin granodiorite which surrounds it.

Dated samples collected from quarry in NE¼ sec. 18, T. 11 N., R. 8 E, MD., approximately 3 miles southeast of Loomis.

Horse Spring Formation[1]

Eocene(?) : Southeastern Nevada and northwestern Arizona.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th v. 1, p. 53; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1423. Highly tilted strata near mouth of Bitter Spring Wash that include breccia, gray sandstone, and peculiar green volcanic tuff, in addition to clay and gypsum previously assigned to Horse Spring formation found to be conformable with overlying Muddy Creek deposits and now believed to belong in later unit.

T. B. Nolan, 1943, U.S. Geol. Survey Prof. Paper 197–D, p. 163. Probable that formation is of Upper Cretaceous age.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34 (fig. 4), 35. Age probably either very Late Cretaceous or Early Cenozoic. Thickness probably exceeds 3,000 feet in Muddy Mountains where it unconformably overlies Overton fanglomerate and unconformably underlies Muddy Creek formation. In Frenchman Mountain area, unconformably overlies Thumb formation (new).

C. M. Tschanz, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B293. Assigned to Miocene on basis of potassium-argon (K–Ar) date of biotite from interbedded tuff. Horse Spring previously assigned to Cretaceous or early Tertiary on basis of plants, ostracodes, and snails.

U.S. Geological Survey currently designates the age of the Horse Spring as Eocene(?).

Well exposed on east side of Horse Spring Valley, near St. Thomas Gap, Clark County, Nev.

†Horsetail Creek Beds[1]

Horsetail Creek facies (of Chadron Formation)

Horsetail Creek Member (of White River Formation)

Oligocene, lower: Northeastern Colorado.

Original reference: W. D. Matthew, 1901, Am. Mus. Nat. History Mem., v. 1, pt. 7, p. 355–374, 444.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 22, pl. 1. Referred to as Horsetail Creek facies of Chadron formation, Chadronian age.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 12–14, 15 (fig 5), 24, 25, 27 (fig. 8). Referred to as member of White River formation. As herein described, based on exposures in Logan County where gray massive silts rest upon Cretaceous surface (Fox Hills sandstone and Pierre shale). Top grades upward into tan to pink silt of Cedar Creek member or is separated from it by erosional unconformity. Locally, member contains beds of olive-colored silt and freshwater limestone with interfingering beds of whitish-gray silt at top. Thickness at type locality 110 feet. Location of type section for Horsetail Creek beds, as described Matthew, is matter of debate; therefore, type locality is herein designated.

Type locality: Secs. 29, 31, and 32, T. 11 N., R. 53 W., Logan County. Named for Horsetail Creek, Logan and Weld Counties.

Horsethief Formation

Pliocene: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Horsethief Sandstone (in Montana Group)[1]

Upper Cretaceous: Northwestern Montana, and southern British Columbia, Canada.

Original reference: E. Stebinger, 1913, Am. Inst. Mining Engrs. Bull. 81, p. 2337.

J. G. Bartram, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7, p. 910. Suggests abandonment of term and inclusion of unit in Fox Hills sandstone.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 118. Restricted to massive cliff-forming sandstone above slope-forming unit here termed Bearpaw-Horsethief transition beds. This unit had been included in Horsethief by Stebinger (1914, U.S. Geol. Survey Bull. 540). Near Blacktail Creek, where Horsethief sandstone is 90 feet thick, threefold division is apparent: lower 45 feet is cliff-forming massive fine-grained sandstone; 20 feet of soft fine-grained highly crossbedded sandstone that contains large calcareous sandstone concretions weathering dark brown; and 25 feet massive cliff-forming crossbedded medium- to coarse-grained sandstone. On Blackfeet Indian Reservation, top few feet is titaniferous magnetite sandstone. West of South arch, upper 30 to 40 feet weathers dark brown and locally contains pebbles of igneous rocks. Underlies St. Mary River formation.

Type locality: Horsethief Ridge, Blackfoot quadrangle, Montana.

Horsetown Formation[1]

Horsetown Group

Horsetown Stage

Lower Cretaceous (Shasta Series): Northern California and southern Oregon.

Original reference: C. A. White, 1885, U.S. Geol. Survey Bull. 15, p. 19–32.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 38 (table 1), 61–68, table 2. Upper group of Shasta series. Overlies Paskenta group. Comprises Cottonwood beds (new) below and Hulen beds (new) above. Top of Horsetown indicated generally by basal beds of Chico series resting unconformably upon it. Group typically developed in Cottonwood district. Becomes progressively thicker southward from North Fork of Cottonwood Creek toward delta axis, increasing from thickness of 6,430 feet near Ono to more than 12,500 feet in its maximum section. No clearly marked stratigraphical break between Paskenta and Horsetown groups has been found here, although conglomerate beds extending south from Ono may be taken as such. Otherwise, only an arbitrary line has been drawn for it. Fauna of Ono zone at bottom of Horsetown group seems to represent a low Hauterivian horizon on scale of Europe and, for this reason, forms convenient reference plane, serviceable for correlation. Term Horsetown, as formational name for succession of strata to which it has been applied, is not a good choice. The area about the old mining camp of this name is detached from district in which group is most typically and completely represented and at best exposes not more than 500 feet of uppermost Shasta series, which beds are scarcely representative of great body of older strata included under the name by White, Stanton, and Diller, and later writers. Name retained in this report only because it is well established in literature. Term Cottonwood group would be more appropriate.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint 1941]. Underlies Pioneer group of Chico series.

J. M. Kirby, 1943, California Div. Mines Bull. 118, pt. 3, p. 606–608. Oldest strata exposed along axis of Sites anticline [north-central Colusa and central Glenn Counties] belong to Lower Cretaceous Shasta group. About 5,000 feet of beds belonging to Horsetown formation and consisting chiefly of well-bedded dark-gray to greenish drab siltstones and shales with interbedded hard thin sandstones and dense limestone layers form pronounced anticlinal valley and lowland west of lower Chico group rimrock. Formation underlies Golden Gate formation of Chico group. [Preoccupied name Golden Gate later replaced by Venado formation.]

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 458–459. Anderson (1938) divided Lower Cretaceous in northern California into Paskenta and Horsetown groups. There is no justification for use of group as designation for these beds. It is believed that names Paskenta and Horsetown should be used as approximate faunal stages rather than group terms. Name Marmolejo formation proposed for Lower Cretaceous of Santa Lucia Range.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 23–24. Rocks of Horsetown formation occur in two fault-wedge blocks along Tesla fault zone in Tesla quadrangle. Thickness 0 to 500 feet. Eastern mass of Horsetown rocks is wedge between Franciscan and Panoche formations. In Corral Hollow, the shales have vertical attitude and are

separated from Franciscan by Tesla fault zone. Contact with Panoche not exposed.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 14–15. Formation, in Kerby quadrangle, Oregon, crops out in southern part of Illinois Valley. To the south, unconformably overlies steeply dipping Galice formation. Covered by Recent alluvium to the west and north. Exposed thickness about 5,000 feet.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 22. Name Wisenor formation proposed for strata of Horsetown age in Ortigalita Peak quadrangle.

F. G. Wells, 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–38. Formation mapped in southern Oregon.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2100–2103, 2112–2119. Discussion of Lower Cretaceous stratigraphic units of northern California. District is type area for stratal unit previously called Horsetown "group" or "formation", here redefined as Horsetown stage. Eight biostratigraphic zones, ranging in age from Hauterivian to late Albian in European time scale, defined within this stage. Upper and lower boundaries of stage are defined by the bases of zones *Pervinquieria hulenana* and *Neocraspedites aguila*, respectively. As defined by Anderson (1938), "Horsetown group" is separated from units above and below by faunal criteria. At type section, "Horsetown group" lies within single formational unit here termed Ono formation. Since a group must contain two or more formations, Horsetown strata as restricted by Anderson cannot be designated properly by term "group". If Horsetown group were to be redefined to include Ono and Rector formations of this report, then obstacle to retention of term would be removed. However, such a redefinition would require that about 200 feet of strata above Anderson's "Horsetown group" be included in redefined group and that base of redefined group be lowered to coincide with unconformity at base of Cretaceous section. First requirement would include in the Horsetown younger strata than have been included in it before, and second requirement would lead to restriction or perhaps suppression of the Paskenta as stratal unit. Until more extensive mapping has been done, it does not seem wise to recommend further modification of use of stratigraphic unit named "Horsetown." As defined by Anderson, it is a stage which encompasses most of Neocomian, Aptian, and lower Albian of European authors. It seems best to continue to use it as defined by Anderson and to recognize that he misused term "group" as that term presently is defined.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Franciscan group is widely held to be restricted to Late Jurassic age, the Knoxville formation to be an upper shaly phase of the group, and the two to be overlain by detrital strata of Cretaceous age. Paleontologic evidence indicates this view to be incorrect. Rather, Franciscan group seems mainly to have been deposited contemporaneously with Knoxville, Paskenta, Horsetown, and lower Upper Cretaceous strata.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2783. Name Days Creek formation (new) replaces Horsetown formation and Cretaceous part of Knoxville formation, as used by Diller and Kay (1924, U.S. Geol. Survey Geol. Atlas, Folio 218).

Type district (Anderson, 1938): Cottonwood district, north of delta axis, Tehama County, Calif. Named for exposures at Horsetown, Shasta County, Calif.

Hortontown basic eruptives[1]

Age(?): Southeastern New York.

Original reference: C. E. Gordon, 1911, New York State Mus. Bull. 148, p. 11, 37–39.

Probably named for occurrences at Hortontown, Poughkeepsie quadrangle.

Hortonville Slate[1]

Middle Ordovician: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 369.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 522 (fig. 3)-524 (strat. column), 558–561. In west-central Vermont, overlies Glens Falls limestone. An interbedded zone, in most places less than 5 feet thick, forms gradation between the Glens Falls and Hortonville east of Champlain thrust. Thickness about 400 feet.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 13, 34–37, pl. 1. Includes all autochthonous black slate and phyllite previously included in Keith's Ira slate which had same stratigraphic position and is now abandoned. Maximum thickness in Castleton area at least 1,000 feet. Overlies Whipple marble (new).

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Discussion of stratigraphy and structure at north end of Taconic Range and adjacent areas. "Hortonville formation" overlies the Glens Falls perhaps unconformably. This is a black slate or phyllite which resembles West Castleton formation (new) and also some of black slate of Poultney River group (new). Age of type Hortonville subject to question. Writer [Zen] suggests reviving Keith's (1932) name Ira formation for belt that runs from Florence south toward Dorset Mountain, a belt that cannot be traced into type Hortonville with certainty.

E-an Zen, 1959, (abs.) Geol. Soc. America Bull., v. 70, no. 12, pt. 2, p. 1705. Hortonville of west-central Vermont is largely black slate unit. Its Late Trenton age assignment was based on correlation with Snake Hill formation, separated from Hortonville by major faults, and underlying fossiliferous Glens Falls limestone near Hortonville village. Dale's graptolites in the black slate have not been authenticated, and localities yielded no new specimens. Recent mapping in Lower Cambrian allochthonous Taconic sequence immediately south of Hortonville shows that contact between type Hortonville and the Glens Falls may be a fault. Type Hortonville slate was traced into an outcrop from which Schuchert reported *Olenellus*(?) fragments. Stratigraphically and geometrically, type Hortonville corresponds to Lower Cambrian black slate of Taconic sequence, and in field no contact is discernible between them. Hortonville also reported as traceable into fossiliferous Upper Trenton black slate in Middlebury synclinorium. It is urged that name Hortonville not be used with time connotations.

Well exposed around Hortonville, Castleton quadrangle.

Hoskinnini Member or **Tongue** (of Moenkopi Formation)

Hoskinnini Member (of DeChelly Sandstone)

Hoskinnini Tongue or Member (of Cutler Formation)[1]

Triassic(?) : Southeastern Utah and northeastern Arizona.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1422, 1423, 1441, 1443, 1446.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 90. Reallocated to member status in DeChelly sandstone herein raised to formational rank.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1852–1868. Recent work indicates unit originally defined as Hoskinnini tongue of Cutler formation extends into parts of southeastern Utah, where it has not been previously reported. Hoskinnini is correlated with part or all of unit defined as Tenderfoot member of Moenkopi formation in salt anticline region of east-central Utah and west-central Colorado. Hoskinnini redefined as member of Moenkopi. The Hoskinnini and laterally continuous strata in Tenderfoot member are exposed within a north-northeast oriented area about 180 miles long and 50 miles wide extending from Monument Valley area, in northeastern Arizona and southeastern Utah, to west-central Colorado. Thickness of Hoskinnini 0 to 126 feet; in most areas 50 to 120 feet. Overlies Organ Rock tongue of Cutler in most of southeastern Utah; overlies DeChelly sandstone member of Cutler near junction of Green and Colorado Rivers and southward into White River Canyon area. Problems of nomenclature discussed.

Named for exposures on north face of Hoskinini [Hoskinnini] Mesa, San Juan County, Utah. Exposed in elongate area extending from Monument Valley in Arizona to about 6 miles southwest of Moab, Utah. Gregory (1916, U.S. Geol. Survey Water-Supply Paper 380) shows Hoskinnini Mesa in southern part of San Juan County, Utah.

Hosmer Conglomerate[1]

Hosmer Run Conglomerate[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1883, Pennsylvania 2d Geol. Survey Rept. T_4, p. 250, 254, 259, 268.

On Hosmer Run, near east line of Spring Creek Township, Warren County.

Hospital Porphyry

Pliocene(?) : Southwestern Arizona.

James Gilluly, 1946, U.S. Geol. Survey Prof. Paper 209, p. 44. Dark-gray fine-grained rock with phenocrysts of glassy plagioclase as much as 2 centimeters in length. Microscopic studies suggest that it is an augite andesite porphyry approaching a latite. Forms group of dikes which range in thickness from a few feet to 125 feet, and individual segments are from a few hundred feet to 2,500 feet long. Much younger than Cornelia quartz monzonite because it cuts Locomotive fanglomerate, which rests on eroded surface of the monzonite, and petrographically strongly resembles porphyritic latite of Childs latite flows; thus is probably related to this much younger regional volcanic activity rather than to Cornelia quartz monzonite.

Rocks named for good exposures on hill just west of Phelps Dodge Hospital at Ajo, where they form a group of dikes trending north-northwestward in region between Ajo and Black Mountain, western Pima County.

Hosselkus Limestone[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 7, pl. 1. Described in Big Bend quadrangle, Shasta County, where it is about 150 feet thick in Devils Canyon and 20 feet thick near Hawkins Creek. Overlies Pit formation; underlies Brock shale.

Named for fact it forms prominent ledges on divide between Genesee Valley and Hosselkus Creek, 1 mile northeast of Hosselkus Ranch, Plumas County.

Hosselkus Series[1]

Upper Triassic: Northern California.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, p. 1106–1108.

Hosston Formation

Lower Cretaceous: Subsurface in Louisiana, Arkansas, and eastern and southern Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 28–30. Name chosen by Shreveport Geological Society to designate Lower Cretaceous red and gray shales, dolomites, and sandstones above Cotton Valley formation and below Sligo formation. Replaces Travis Peak, as applied to beds older than real Travis Peak of Texas. Base of Hosston is placed above highest black shale unit of Cotton Valley formation; it is marked by a basal conglomerate in Arkansas and in northern Louisiana. Formation grades offshore, south of Shreveport area, into fossiliferous dark shales and limestones which contain minor amounts of interbedded red shale and sandstone. Thickness ranges from about 800 feet in Arkansas to over 2,000 feet in northern Louisiana and eastern Texas.

Type well: Dixie Oil Co. Robertshaw No. 92 (Dillion No. 92), in sec. 13, T. 21 N., R. 15 W., Caddo Parish, La. Named after town of Hosston located about 7 miles north of top of Pine Island anticline.

Hosta Tongue (of Point Lookout Sandstone)

Hosta Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1934, U.S. Geol. Survey Bull. 860–A.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156. In revised nomenclature of lower part of Mesaverde, Point Lookout sandstone as a formation in Mesaverde group replaces Hosta sandstone member where that member is undivided, and also replaces upper part of Hosta sandstone member where its lower part is absent or is separated from its upper part by tongue of Mancos shale. Hosta tongue of Point Lookout sandstone replaces lower part of Hosta sandstone member where that is present.

Named for exposures on Hosta Butte, Gallup region.

Hostetter Limestone and Clay

Permian (Greene Series): Eastern Ohio.

A. T. Cross, W. H. Smith, and Thomas Arkle, Jr., 1950, Field guide for the special conference on the stratigraphy, sedimentation, and nomenclature

of the Upper Pennsylvanian and Lower Permian strata (Monongahela, Washington, and Greene series) in the northern portion of the Dunkard basin of Ohio, West Virginia, and Pennsylvania: West Virginia Geol. and Econ. Survey, [pl. 1]. Hostetter limestone and clay shown on columnar section of names of strata applied in Ohio. Occurs above Fish Creek sandstone and below (Burton sandstone).

Hostler Formation (in Hatter Group)

Hostler Member (of Hatter Formation)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 193, 195. Uppermost member of formation. Lower part dark, tan-weathering, siliceous and argillaceous limestone, massive in fracture, richly fossiliferous, and less impure near base; upper part dark impure well-bedded, somewhat laminated limestone, sparsely fossiliferous. Thickness 63 feet in type section. Overlies Grazier member (new); underlies Snyder member of Benner limestone. Chazyan series.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 10–11. Lower limit of unit normally not sharply defined because lower beds become similar to Grazier member. Middle zone with brachiopod- and bryozoan-rich very siliceous, and argillaceous limestone or calcareous siltstone readily recognizable. Upper zone, well-bedded and containing fucoidal siliceous partings, is in places difficult to separate from less siliceous coarser, commonly cross-laminated ledges of lowest Snyder limestone. In type section, top of unit is at re-entrant beneath white-weathering sub-lithographic limestone ledges of the Snyder. Thickness 40 to 60 feet in most localities. Derivation of name.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1402 (fig. 2), 1407. Rank raised to formation in Hatter group or Hatterian subseries (of Bolarian series).

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 82, 102. Discussed as a member.

Type section: On two sides of Pennsylvania Railroad cut north of Union Furnace, Huntingdon County. Named for village of Hostler in Centre County, 9 miles northeast of Union Furnace.

Hotauta Conglomerate (in Unkar Group)[1]

Hotauta Formation

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (table), 109–110. Basal formation in Grand Canyon series. Somewhat irregular formation; sometimes attains thickness of 50 feet. Underlies Newberry formation (new).

R. P. Sharp, 1940, Geol. Soc. America Bull., v. 51, no. 8, p. 1242–1243. Conglomerate is dark-reddish-brown, poorly bedded and poorly sorted sandstone or conglomerate, locally arkosic. Maximum thickness 30 feet, although average is between 2 and 6 feet. In Hotauta Canyon, underlies Bass limestone.

Named for Hotauta Canyon, Shinumo quadrangle, Grand Canyon region.

Hothouse Formation (in Great Smoky Group)

Precambrian: Central northern Georgia and southwestern North Carolina.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 35–40, pl. 1, map. Interbedded metagraywacke, quartzite, and metaconglomerate at top; downward these beds become less and less prominent; base principally mica schist. Estimated thickness 8,000 to 11,000 feet; dip of bedding steep; no important repetition of beds recognized. Underlies Dean formation (new); hybrid character of rocks between the two makes position of boundary largely interpretative; overlies Hughes Gap formation (new).

Crops out in two parallel belts in Mineral Bluff quadrangle; each belt is limb of Murphy syncline; larger belt trends northeast-southwest across central part of quadrangle; second belt crosses southeastern corner of quadrangle. Named from Hothouse Creek which flows along central part of larger belt, Fannin County, Ga.

Hot Springs Formation[1]

Quaternary: Yellowstone National Park.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

Named for Hot Springs, which formed deposit.

Hot Springs Formation (in Mud Springs Group)

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 37–39. Name applied to basal formation of Mud Springs group (new). At type locality, composed of dark- to light-gray massive to nodular highly cherty limestone and thick shale beds; at least six distinct limestone sequences present. Thickness at type locality about 85 feet; about 24 feet thick at Derry where it is composed almost entirely of limestone. Underlies Apodaca formation (new); overlies Cuchillo Negro formation (new); in northern part of area, overlaps on the Precambrian and there contains coarse clastics in its lower part.

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73. Replaced by Fra Cristobal formation (new). Term Hot Springs preoccupied.

Type locality: West end of Whiskey Canyon and just west of westernmost box canyon, near north end of Mud Springs Mountains, Sierra County. Name derived from town of Hot Springs on Rio Grande about 3 miles southeast of south end of Mud Springs Mountains.

Hot Springs Sandstone[1]

Mississippian: Southwestern Arkansas.

Original reference: A. H. Purdue, 1910, Jour. Geology, v. 18, p. 282–283.

W. H. Hass, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1578, 1582. On basis of conodont studies, Stanley shale is regarded as ranging in age from the Meramec part of Mississippian into basal Pennsylvanian. Hot Springs sandstone which underlies Stanley shale in vicinity of Hot Springs is considered to be Mississippian (Meramec).

August Goldstein, Jr., 1959, *in* Geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 103. Exposed only in and near city of Hot Springs where it ranges in thickness up to about 200 feet. Unconformably overlies Arkansas novaculite; underlies Stanley shale, contact gradational.

First described in vicinity of Hot Springs, Garland County.

Houchen Creek Limestone Bed (in Hamlin Shale Member of Janesville Shale)

Houchen Creek Limestone[1] Member (of Hamlin Shale)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 89.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12). Permian.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Rank reduced to bed in Hamlin shale herein reduced to member status in Janesville shale (new). Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 51. Suggested herein that Houchen Creek limestone bed be used as formal name. Recent work has shown that this bed of Hamlin shale cannot be correlated south of Pottawatomie County. Algal limestone identified as Houchen Creek in Chase County (Moore, Jewett, and O'Connor, 1951, Kansas Geol. Survey Rept., v. 11, pt. 1) does not correlate with type section of Houchen. Pottawatomie County, the Houchen Creek limestone bed does correlate northward with type section in stratigraphic position and lithologic and paleontologic characteristics.

Named for exposures on Houchens Creek, sec. 29, T. 6 N., R. 13 E., Nemaha County, Nebr.

Houden Formation

Precambrian: East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1501–1502, pl. 1. Can generally be subdivided into three or four members: basal gravel conglomerate 40 to 100 feet thick; lower quartzite 380 to 1,200 feet thick, lower part of which is cross-laminated in beds 3 to 8 inches thick, upper part vitreous, faintly bluish or greenish; middle member distinguished by gray, purple, or brick-red, predominantly fine-grained quartzite in lower part and slate and graded wacke in upper part, thickest section 380 feet on Houden Mountain; and upper quartzite 390 to 420 feet thick divisible into three submembers in Board Cabin Draw. Unconformably overlies Flying W formation (new); conformably underlies Board Cabin formation (new).

Type section: On southwestern corner of Colcord Mesa and begins on boundary of section 18, one-quarter mile west of elevation marker 5687, from which it extended N. 25° W. for approximately one-half mile, or to elevation marker 5651. Other good sections on Board Cabin, Houden Mountain, and Spring Creek opposite Buzzard Roost Mesa. Name derived from Houden Mountain in south-central part of Diamond Butte quadrangle.

Houghton Conglomerate[1] (in Portage Lake Lava Series)

Precambrian (middle Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 80–81, chart.

W. S. White, 1952, Jour. Sed. Petrology, v. 22, no. 4, p. 190–198. One of about 20 sedimentary beds included within Portage Lake lava series (new). At Allouez No. 3 shaft of Calumet & Hecla Consolidated Copper Co., the conglomerate lies about 3,750 feet stratigraphically below top of series. Separated by about 500 feet of lava flows from the next higher conglomerate bed, the Allouez, and by 850 feet of lava flows from the next lower, the Calumet and Hecla. At the shaft, the conglomerate is a

lenticular body, 1,000 to 1,800 feet wide measured parallel to the strike, at least 4,000 feet long in direction of dip, and ranging in thickness from less than 1 foot as its lateral margins to as much as 25 feet along its principal axis.

Named for occurrences in Houghton County.

Hounsfield Bentonite[1]

Hounsfield Metabentonite

Middle Ordovician (Mohawkian): New York, Iowa, Kentucky, Minnesota, Missouri, Tennessee, and Wisconsin.

Original reference: G. M. Kay, 1930, Science, new ser., v. 72, p. 365.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 252–253. Restudy of sequence at type section indicates that metabentonite occurs 3 feet above base of Selby member (new) of Rockland formation (Mohawkian). Previously was mistakenly believed to separate Leray and Watertown members of Chaumont formation. [Kay (1930, 1931) shows unit occurring in several named formations; assignment to formation depends on geographic area.]

Type section: In small quarry just north of Dexter-Brownville Road at foot of west slope of hill 2 miles east of Dexter, Jefferson County, N.Y.

House Limestone (in Pogonip Group)

Lower Ordovician (Canadian): West-central Utah.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 9 (fig. 2), 12–13, 29 (fig. 4), 30–37. Lowermost formation of Pogonip group (restricted). Underlies Fillmore limestone (new); overlies Notch Peak limestone. At type locality, consists of 475 feet of typically medium-gray medium- to thin-bedded cherty silty calcilutite; limestone contains much fine quartz detritus. Chert nodules and stringers common in middle third of formation, becoming less prominent upwards. Southward from type section, the House limestone disappears below overlying strata in Yersin Ridge syncline, and upper beds reappear on south limb in Ibex section B.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 71–72. In Sheeprock Mountains area, conformably overlies Ajax limestone. House and Fillmore formations not differentiated. Thickness of House-Fillmore sequence 1,088 to 1,111 feet. House limestone probably represents lower 160 feet of 1,088-foot sequence measured in West Lookout Hills.

Type section: North side of small butte near mouth of westward-flowing wash, about one-half mile east of Tule Valley Grazing Service road, and approximately in sec. 23, T. 20 S., R. 14 W., Millard County, at south end of House Range where Ordovician beds, dipping from Notch Peak, approach valley level.

House Mountain Shales[1]

Upper Ordovician: Central western Virginia.

Original reference: J. L. Campbell, 1879, Am. Jour. Sci., 3d, v. 18, p. 29.

Houston Andesite[1]

Tertiary: Southwestern New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures in valley of Houston Canyon, in southeastern part of Mogollon district.

Houston Group[1]

Pleistocene: Coastal Plain of eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 780.

Crops out along coastal border of Gulf of Mexico. Named for city of Houston, Harris County.

Houston Marl[1]

Upper Cretaceous: Northeastern Mississippi.

Original reference: E. W. Hilgard, 1860, Mississippi Geology and Agriculture Rept., p. 96–97.

Houston, Chickasaw County.

Housum Member (of Mercersburg Formation)

Middle Ordovician (Trentonian): South-central Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 732–733. Name proposed for lower member of formation. Described at type section as tan to medium-gray fine-grained argillaceous slabby cream- to buff-weathering limestone with 10-foot interval of dark-gray thin crinkly gray-weathering limestone near top. Contains lowest metabentonite of formation. Buff-weathering beds not present in western belts of outcrop of formation. Maximum thickness 67 feet at type locality; thins northeastward. Conformably underlies Kauffman member (new); disconformably overlies Fannettsburg member (new) of Shippensburg formation. Beds originally included in Shippensburg formation.

Type section: Along Cumberland Valley Railroad 2 miles southwest of Marion, Franklin County. Named for small community 1.7 miles north of type section.

Houten sandstone[1]

Eocene: New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 8.

Derivation of name not stated.

Houx Limestone Bed (in Little Osage Limestone Member of Fort Scott Formation)

Houx Limestone Member (of Fort Scott Formation)

Pennsylvanian (Des Moines Series): Western Missouri, southern Iowa, and eastern Kansas.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 36, 37. Northward from type locality, Fort Scott limestone has three limestone members termed by Missouri Survey: lower Fort Scott (Mulky cap rock), "Rhomboidal," and upper Fort Scott (Lexington bottom-rock). Term Houx limestone proposed for the "Rhomboidal." These limestones are herein named Blackjack Creek, Houx, and Higginsville. The limestones persist into Iowa.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 306. In Kansas, occurs in Little Osage member (new) of Fort Scott. Thickness a few inches to little more than 1 foot.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 6. In Missouri, considered limestone

bed in Little Osage member of Fort Scott. Underlies Blackwater Creek shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 33, fig. 5. Houx limestone member is persistent and maintains its position from Madison County southward into Missouri. Consists of light- to dark-gray shale, characteristically earthy and very fossiliferous. Thickness varies from 8 inches in south to 4 inches in Madison County. Underlying Houx is shale that varies in thickness with greater development in the south. Shale interval between Houx and Higginsville is about 15 feet in Appanoose County and about 7 feet in Madison County.

Type locality: Well exposed at Houx Ranch, in sec. 15, T. 46 N., R. 27 W., Johnson County, Mo.

Houy Formation

Middle(?) Devonian to Lower Mississippian: Central Texas.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 807–816. Devonian-Mississippian transition outcrops of central Texas described summarily and assigned to new stratigraphic unit, the Houy formation. Beds included are mainly Upper Devonian but partly Lower Mississippian; locally a basal fraction may be Middle Devonian. Deposits are diverse, and their associations are complex. Maximum surface thickness about 17 feet. In more complete sections, formation characteristically includes (ascending) 1 to 3 feet of chert breccia, the Ives breccia member; 2 to 15 feet of black, fissile shale, the Doublehorn shale member (new); 2 feet or less of phosphoritic material of early Mississippian and, at places, of late Devonian age. King Creek marl member of Plummer's (1950) Chappel formation is an argillaceous limestone that has been surely identified only at its type site where it constitutes a few inches of the Houy. Underlies Chappel limestone and in places Barnett formation; overlies beds ranging in age from Middle or Lower Devonian to Lower Ordovician. The Houy is central Texas representative of the widespread Upper Devonian and Lower Mississippian black shale succession that includes such eastern and midcontinent deposits as Chattanooga, Ohio, New Albany, and Woodford shales.

W. H. Hass, 1959, U.S. Geol. Survey Prof. Paper 294–J, p. 366. Houy formation is early Late (and probably late Middle) Devonian to early Mississippian (early Kinderhook).

Type section: At juncture of Burnam Branch with Doublehorn Creek in an eastward extension of the R. M. Burnam Ranch, southeastern Burnet County. Name taken from reference section on Houy Ranch.

Howard Arkose[1]

Miocene(?): Central Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 7, p. 34–50.

Named for Howard Creek, just below Howard Lake, Snohomish County.

Howard Limestone (in Wabaunsee Group)

Howard Limestone or Limestone Member (of Shawnee Group or Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: Erasmus Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 67, 105.

R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 20, 21, 94, 96. Comprises (ascending) Bachelor Creek limestone, Aarde shale, Church limestone, Winzeler shale, and Utopia limestone members. Included in Wabaunsee group. Type locality given.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 20–21. Bachelor Creek limestone missing in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa where base of Church limestone member marks boundary between the Howard and Severy. Aarde shale missing in northeastern Kansas and southeastern Nebraska. Wabaunsee group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20–21. Church, Winzeler, and Utopia members distinguishable in Missouri. Bachelor Creek is possibly a sandy limestone previously included in Severy shale; Aarde shale member not identified in Missouri. Wabaunsee group.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 57 (fig. 22), 60. Consists of three limestone members and two shale members. Middle limestone [Church] is the most persistent. Thickness of formation ranges from about 8 to 40 feet. Underlies White Cloud shale; overlies Severy shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull., v. 15, p. 14, fig. 5. Forms caprock for persistent Nodaway coal and can be identified on that basis. In eastern part of area, the Howard is dark-gray to black coarsely crystalline limestone. To the west, fine-grained gray limestone occurs above this bed, and in some places a dark shale is present separating the limestone beds. Thickness seldom more than 1½ feet. In areas where development of Howard is complete, it is composed of three limestones and two shale units. Lowermost limestone missing in Iowa section, and lower shale unit and included Nodaway coal are considered part of underlying Severy shale. Wabaunsee group.

Type locality: Near Howard, Elk County, Kans., T. 30 S., R. 10 E.

†Howard Sandstone Member (in Tuscarora Sandstone)[1]

Silurian: Central Pennsylvania.

Original reference: F. M. Swartz, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 101.

Near Mount Union, Huntingdon County, and Lewistown, Mifflin County.

Howard Quarry Sandstone

Upper Devonian (Conewango): Northwestern Pennsylvania.

K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 81. Incidental mention. Name is synonymous with Panama conglomerate member of Venango stage.

K. E. Caster, 1939, Jour. Paleontology, v. 13, no. 5, p. 532. Represents basal part of Conewango series. Geographic location stated.

Occurs in old Howard quarry, Howard Falls, Erie County.

Howe Limestone[1] Member (of Red Eagle Limestone)

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Member of Red Eagle limestone variable in lithology and thickness; contains

foraminifera in central Kansas. Thickness ranges from less than 1 foot to maximum of about 15 feet. Overlies Bennett shale member; underlies Roca shale. Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 61–62. Thickness 2 to about 5 feet in Wabaunsee County, Kans. Overlies Bennett shale member; underlies Roca shale.

Named for exposures south of Howe in T. 4 N., R. 14 E., Nemaha County, Nebr.

Howell Formation[1]

Howell Limestone

Middle Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 11.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1135–1138, 1141 (fig. 5), 1144–1145. Howell limestone (emended) overlies Tatow limestone (new) and underlies Dome limestone. Thickness 835 feet. Lower 275 feet consists of black and dark-gray fine-grained extremely thick- to thin-bedded limestone which contains buff clay flakes and nodules and numerous algae. Next 340 feet composed of pale-gray, pinkish, and light tan-gray massive fine-grained more or less argillaceous thick- and thin-bedded limestone which contains blebs of white calcite and tan clay flakes interbedded with pinkish zones near middle. Upper 225 feet composed of alternating thicker zones of dull- and black-gray fine-grained limestone which contains buff and reddish-tan clay flakes with thinner zones of gray and tan fissile shale. Walcott gave thickness 435 feet. Emended section approximately 5 miles south of Walcott's type locality.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser. no. 48, p. 38. In House Range, Burnt Canyon limestone (new) consists of uppermost 225 feet of Howell limestone as emended by Deiss (1938).

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50–51. Proposed that definition of Howell be further restricted to include only carbonate sequence of western Utah that underlies Chisholm formation and overlies Busby and Tatow formations or their equivalents. Further proposed that Millard limestone be rank reduced to member status to include *Girvanella* limestone facies of Howell when other carbonate lithofacies are also represented in the formation. Upper member of Howell in House Range left unnamed at present.

Type locality: Slopes of Howell Peak on west side of House Range, about 5 miles west of Antelope Springs.

Howells Ridge Formation (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 533, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 21–23, pl. 1. Lower part consists commonly of red beds of mudstone, shale, limestone, sandstone, and conglomerate; locally beds are gray to black. There is transition along the strike from one kind of rock to another within very short distances. Topmost part of formation in Eureka section consists of massive and thin-bedded black limestone and massive crystalline creamy white limestone. In Sylvanite part, the limestone at the top is much thinner than in the Eureka part. Locally the formation contains a layer

of andesite flows and breccia whose thinner parts grade into purple shaly mudstone and arkosic volcanic grit. Thickness approximately 4,900 feet in Sylvanite section; may range from 1,100 feet to 5,200 feet in Eureka section. Conformably underlies Corbett sandstone (new); overlies Hidalgo volcanics (new).

Named from high cliff-capped ridge in Eureka section that is composed entirely of rocks of this formation, Little Hatchet Mountains.

†Howenstein Limestone (in Allegheny Formation)[1]

Pennsylvanian: Northeastern Ohio.

Original reference: G. F. Lamb, 1910, Ohio Nat., v. 10, p. 130.

M. T. Sturgeon, 1943, Ohio Jour. Sci., v. 43, no. 6, p. 236. Lamb, apparently the first to observe and mention Vanport limestone in this area [Columbiana and Mahoning Counties], described it in 1910 under name of Howenstein limestone on Ira Unger Farm along tributary to Meander Creek in NW¼ sec. 4, Green Township, Mahoning County.

Named for Howenstein (Howenstine), Stark County.

Howson Andesite[1]

Pliocene(?): Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 110–111, pl. 1. Apparently youngest formation in area of this report [northern parts of Mount Stuart and Snoqualmie folios] and surrounding area. Overlies Swauk formation that has been intruded by Teanaway dikes. Howson, unlike other andesites in area, is unaltered and is very similar to hornblende andesite boulders in Ellensburg formation. Smith and Calkins suggested that it may be source of Ellensburg detritus. This may put upper limit on age of Howson, as age of Ellensburg, according to Waters (1955, Geol. Soc. America Bull., v. 66. no. 6) lies near Miocene-Pliocene border.

Named for exposures on Sasse Mountain north and northeast of Howson Creek, Snoqualmie quadrangle.

Hoxbar Formation[1]

Hoxbar Group

Pennsylvanian (Missouri Series): Central Oklahoma.

Original reference: W. L. Goldston, Jr., 1922, Am. Assoc. Petroleum Geologists Bull., v. 6, no. 1.

R. H. Dott, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1667–1668. Restricted to exclude Confederate member which is assigned to underlying Deese formation. Disconformity at top of Confederate member taken as top of the Des Moines. Missouri beds of Ardmore basin are wholly represented by the Hoxbar as thus restricted. Where best developed south of Ardmore is about 4,000 feet thick. Named members include (ascending) Crinerville sandstone and limestone, 400 to 500 feet above base; Anadarche conglomerate and limestone, about the middle; Daube limestone; and Zuckerman sandstone about 500 to 1,000 feet below top.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 697, chart 6 (column 37). Shown on correlation chart as Hoxbar group. Lower Hoxbar beds are Missourian in age; upper Hoxbar deposits, including

Zuckerman sandstone, are tentatively correlated with the Vamoosa and Ada formations and may be Virgilian in age.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 40–44. Group, in Ardmore basin, includes (ascending) Confederate limestone, Crinerville beds, Anadarche beds, Daube member, and Zuckerman beds. Overlies Deese group; underlies Vanoss formation (Pennsylvanian).

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 213 (fig. 3), 216–220. Group (in subsurface) in Cement Pool area, Caddo and Grady Counties, includes (ascending) Crinerville, Dolman, and No-Ho-Co (new) formations. Overlies Deese group; underlies Cisco group.

Named for exposures west of Hoxbar, Carter County.

Hoyt Dolomite[1]

Hoyt Limestone Member (of Theresa Dolomite)[1]

Hoyt Limestone Member (of Whitehall Formation)

Upper Cambrian: Eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 16, chart.

R. H. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence Valleys. Revisions involve definitions and succession of previously accepted Cambro-Ordovician formations: Potsdam, Theresa, Hoyt, and Little Falls of Upper Cambrian and Whitehall, Tribes Hill, and Beekmantown of Lower Ordovician. Hoyt fauna occurs in lower half of emended Whitehall formation above Little Falls dolomite. Each revised unit tied in with Divisions A through E of original "Calciferous" formation.

R. H. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Base of Whitehall formation raised to coincide with contact of Little Falls dolomite and Hoyt limestone, and latter redefined as lower member of Whitehall formation. In corrected Skene Mountain section, Hoyt limestone member, about 40 feet thick, underlies Skene dolomite member (new).

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci. v. 249, no. 11, p. 795–813. Evidence is presented to substantiate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs region. Previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland?, Hull Sherman Fall representatives) and Canajoharie shale. Term "Theresa" not applicable in area; name Galway formation reintroduced for strata younger than Potsdam and older than Hoyt. Strata formerly classed as lower Hoyt are here included in redefined Galway. Wheeler (1942) classified the Hoyt as basal member of Whitehall formation and the Skene as upper member, the latter being a very late Upper Cambrian offlapping unit. It is evident that he mistook Ordovician Gailor dolomite for older Little Falls dolomite, for the Hoyt and his supposed "Little Falls" are in fault contact in his

"unfaulted" area 4 miles west of Saratoga Springs. In some areas Hoyt underlies Mosherville sandstone, and in some areas Ritchie limestone.

Named for exposures at Hoyt's quarry, 3 miles west of Saratoga Springs, Saratoga County.

Hozomeen Series[1]

Carboniferous: Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 14, 15.

C. E. Weaver, 1937, Washington [State] Univ. Pub. in Geology, v. 4, p. 16. Cherty quartzite together with greenstone and phyllite beds. Believed to be oldest rocks exposed on western side of summit of Cascades immediately south of international line.

Occurs in Hozomeen Range, British Columbia, and on Mount Hozomeen, Wash.

Hualalai Volcanic Series

Hualalai pyroclastic materials

Pleistocene and Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 88, 147. Ash and cinder formations of Hualalai Rift referred to as Hualalai pyroclastic materials.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 139–148; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6., Océanie, fasc. 2, p. 92. Series includes all volcanic rocks of Hualalai volcano. All are basalts except Waawaa volcanics member (new) which consists of trachyte cone and flow. As defined, includes most series of ash beds named Kona tuff formation (Wentworth, 1938). Maximum thickness 500 feet; base not exposed. Interfinger with Kau volcanic series (new).

Type locality: Western slope of Hualalai volcano near Kailau. Eruption continued into historic time; series includes flows of 1800–1801.

Hualpai Limestone

Pliocene(?): Northwestern Arizona and southeastern Nevada.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, p. 1429–1431. Consists chiefly of white though gray to pink or light-brown limestone, in thin and rather regular beds, many of which have porous structure characteristic of travertine. Rock compact and nearly aphanitic between scattered openings. Contains scattered pebbles and sand near base, and locally includes thin beds of shale and siltstone. Also contains gray to pink or light-brown chert nodules and lenses. Degree of porosity varies considerably from bed to bed as well as laterally in any one layer. In some parts, openings occupy full fifty percent of the volume, and rock would be described as tufa. Opening diameters range from one-half inch down to limit of visibility. In most western outcrops, thickness varies up to 150 to 200 feet. Delmar Butte and Temple, north of Colorado River are capped by 80 to 100 feet of limestone. Original maximum thickness certainly exceeded 1,000 feet.

C. B. Hunt, 1956, U.S. Geol. Survey Prof. Paper 279, p. 16 (fig. 12), 33, 34, 35. Overlaps edges of underlying fanglomerate and extends onto Precam-

brian rocks along east and west sides of Grand Wash trough. Overlies Muddy Creek formation.

Displayed prominently along Hualpai Wash, Arizona, from which unit is named. Distributed over irregular area, measuring 25 miles east-west and comparable distance north-south, Mohave County, Ariz., and Clark County, Nev.

Hubbard Hill Member (of Littleton Formation)

Lower Devonian: Western New Hampshire.

M. T. Heald, 1950, Geol. Soc. America Bull., v. 61, no. 1, p. 45–50, 55, pl. 1. Lowermost part of Littleton formation in Lovewell Mountain quadrangle. Thickness about 6,000 feet. Composed chiefly of mica-quartz schist, sillimanite schist, pseudo-sillimanite schist, quartz conglomerate, and quartzite, interbedded lime-silicate granulite and schist, and amphibolite. Underlies May Pond member (new. In northern part of quadrangle, the two members are separated by a sill of Kinsman quartz monzonite.

C. A. Chapman, 1952, Geol. Soc. America Bull., v. 63, no. 4, p. 387–390, pl. 1. In Sunapee quadrangle, the Hubbard Hill underlies Dakin Hill member and overlies undifferentiated Littleton.

Hubbard Hill is in Cheshire County.

Hubbardston Granite[1]

Late Carboniferous or post-Carboniferous: Central Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 231–236, map.

Named for occurrence at Hubbardston, Worcester County.

Hubbardton Slate[1]

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 401.

Named for occurrence in village of Hubbardton, Rutland County.

Huckleberry Andesites[1]

Cenozoic: Northern California.

Original reference: H. Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 251, 252, 254.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 678. Cenozoic.

Named for occurrence near Huckleberry Lake, Lassen National Park.

Huckleberry Clay (in Pottsville Formation)[1]

Pennsylvanian (Pottsville series): Northern Kentucky and southeastern Ohio.

Original reference: W. Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 150–151.

N. K. Flint, 1951, Ohio, Geol. Survey, 4th ser., Bull. 48, p. 23 Included in Huckleberry cyclothem.

Type locality and derivation of name not given.

Huckleberry Conglomerate

Lower Cambrian: Northeastern Washington.

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 8. Pebble conglomerate of quartzite, argillite, and carbonate rocks. Coarseness of

fragments increases northeastward concurrently with diminution in thickness, which ranges from a few hundred feet at north to approximately 3,000 feet at south. Generally schistose but in southwest becomes hard flinty hornfels. Apparently deposited on eroded surface of Deer Trial rocks [group]; overlain by what appears to be Lower Cambrian greenstone in overlapping relations.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Included in Huckleberry group.

Crops out along east side of Huckleberry Mountain and north of Spokane Indian Reservation, Stevens County.

Huckleberry cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 18. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 22–23, geol. map, table 1. Includes Huckleberry shale and (or) sandstone, Huckleberry clay, and coal members. Occurs above Anthony cyclothem and below Quakertown cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Most exposures are in Monday Creek Township and in vicinity of Junction City, Jackson Township, Perry County.

Huckleberry Greenstone

Lower Cambrian: Northeastern Washington.

H. E. Culver, 1939, Washington State Coll. Monthly Bull., v. 22, no. 7, pt. 1, p. 19. In sequence of formations named, Huckleberry greenstone underlies Addy quartzite and overlies a conglomerate.

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 8–9. Described as predominantly metamorphosed basaltic flows in which ferro-magnesiam minerals have been chloritized. Thickness ranges from about 3,000 feet on Stensgar Mountain to a few hundred feet at north and south ends of formation. Overlaps on underlying [Huckleberry] conglomerate and on upper part of Deer Trail group; appears to wedge out laterally beneath Addy quartzite.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Included in Huckleberry group.

Crops out north of Colville Valley; main mass follows east slope of Huckleberry Mountain, crosses the divide west of Red Marble quarry, and wedges out to the south, Stevens County

Huckleberry Group

Precambrian (Belt Series): Northeastern Washington.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as group including Huckleberry conglomerate and Huckleberry greenstone. Unconformably overlies Deer Trail group; unconformably underlies Addy quartzite.

Report discusses magnesite belt, Stevens County.

Huckleberry Lavas

See Union Peak Lavas.

Hudson Formation,[1] Shales,[1] or Group[1]

See Hudson River Formation.

Hudson Grits or White Beds

See Poultney River Group.

Hudson Member (of Franconia Sandstone)[1]

Upper Cambrian: Western Wisconsin and southeastern Minnesota.

Original reference: A. C. Trowbridge and others, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 81, 92, 134, 140, 159, 160, 431, 446, 449, 454.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2); C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 40. In Minnesota overlies Taylors Falls member (new). Replaces name Minneiska member.

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 869. Name abandoned. Franconia member names used by Twenhofel, Raasch, and Thwaites (1935) are geographic names applied to faunal zones. New member names proposed to designate rock types, as distribution of faunal zones in formation is largely independent of natural rock units. Hudson member is *Ptychaspis-Prosaukia* zone. This zone is represented in Reno and Mazomanie members.

First described at Hudson, St. Croix County, Wis.

†Hudson Schist[1]

Precambrian, Cambrian, and Ordovician: Eastern New York.

Original reference: F. J. H. Merrill, 1902, U.S. Geol. Survey Geol. Atlas, Folio 83.

Occurs along Hudson River.

†Hudson System[1]

Cambrian: Eastern New York.

Original reference: T. A. Conrad, 1839, New York Geol. Survey 3d Rept., p. 57–63.

Hudson River region.

Hudson trilobite beds[1]

Upper Cambrian: Western Wisconsin.

Original reference: L. C. Wooster, 1878, Wisconsin Geol. Survey Rept. 1877, p. 36–41.

Probably named for Hudson, St. Croix County.

Hudson Bridge Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 21.

Crops out about 3 miles southeast of Bridgeport, on south side of West Fork of Trinity River, in east end of Rebecca Coleman survey, along margin of Trinity River flood plain, and crosses road 200 yards south of Hudson Bridge, Wise County.

Hudson Highlands Complex

Precambrian: Southeastern New York.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 142–144, 150–157, pls. 2, 3. Term Hudson Highlands complex or Highlands com-

plex includes entire sequence of crystalline rocks older than Storm King granite. Colony (1921, New York State Mus. Bulls. 249–250) considered Highlands complex synonymous with Highlands crystallines, that is, including Storm King granite. Complex is cut by a variety of pegmatities, and it is not always easy to relate individual ones to specific magmatic interval. Complex includes Grenville metasediments (oldest units of complex), Pochuck diorite phase, and Canada Hill granite phase.

Report discusses area around Bear Mountain, a prominent summit of Hudson Highlands, about 40 miles north of New York City. Complex, in this area, is a relatively broad syncline or synclinorium plunging about 40° NE. Storm King granite fills core of syncline.

†Hudsonian Substage (of Wisconsin Stage)[1]

Pleistocene, upper: Great Lakes region.

Original reference: M. M. Leighton, 1931, Jour. Geology, v. 39, p. 51–53.

Name derived from Hudson Bay about which the ice fields were developed.

†Hudson River Formation,[1] Beds,[1] Group,[1] Shales, or Phyllite

Cambro-Ordovician: Southeastern New York.

Original reference (Hudson River slate group): W. W. Mather, 1840, New York Geological Survey 4th Rept., p. 212, 256–258.

Sidney Paige, 1956, Geol. Soc. America Bull., v. 67, no. 3, p. 391, 392 (fig. 1), 393. Hudson River shales and phyllite mentioned in discussion of Cambro-Ordovician age of "Inwood" limestone and "Manhattan" schist near Peekskill. Hudson River shales and phyllite stratigraphically above Wappinger dolomite and limestone.

Southeastern counties of New York.

Hueco Limestone[1]

Permian (Wolfcamp Series): Western Texas and southern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 32–38.

C. O. Dunbar, 1953, Am. Jour. Sci., v. 251, no 11, p. 798–804. In Sierra Diablo, Trans-Pecos, Texas, includes Kriz lens in upper part.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5, p. 19, 20 (fig. 5). Fusulinid faunas indicate that upper part of Hueco, commonly referred to the Leonardian with question, is younger than type section of Wolfcampian. Proposed here that Wolfcampian series be defined to include upper Hueco limestone.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 6 (table 2), 49–52. Summary description in San Andres Mountains area. Thickness 417 to 1,355 feet. Overlies Bursum formation; underlies Abo redbeds; in some areas, overlies Panther Seep formation (new). Wolfcampian.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map. 21. As described in Wylie Mountains and vicinity, overlies Powwow conglomerate and underlies Victorio Peak formation. Well in area penetrated 1,240 feet of Hueco limestone.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull,. v. 69, no, 6, p. 690 (fig. 1), 693 (fig. 2), 694 (fig. 3), 695. Described in Sand Canyon area, New Mexico. In most of mapped area, Hueco comformably overlies Danley Ranch tongue (new) of Abo sandstone into which it grades laterally northward; locally rests with angular unconformity on lower part of

Magdalena group; upper part grades laterally into, and is conformably overlain by sequence of red beds herein referred to as Lee Ranch tongue of Abo sandstone. Thickens from about 350 feet 1 mile north of map area to nearly 600 feet near Culp Canyon, a distance of about 5 miles; most of this gain is attributed to intertonguing with Abo. All but uppermost part is probably Wolfcamp; at south end of Sand Canyon area, uppermost beds are known to be lateral equivalents of part of Lee Ranch tongue of Abo, which is apparently early Leonard.

Named for exposures in Hueco Mountains, El Paso County, Tex.

†Huehue Flow

Recent: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrog. Bull. 9, p. 148. Olivine basalt flow. Contains partly charred wood.

Believed to have been erupted from last activity of Hualalai in 1801.

Huelster Formation (in McCutcheon Volcanic Series)

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 342–345, pl. 1. Composed almost entirely of tuff, with thin layers of sandstone and conglomerate, lenses of fresh-water limestone, and trachydoleritic lava. At type locality approximately 400 feet thick; thins eastward,. Includes Jeff conglomerate member (new) at base. Forms lower part of series. Overlies marine Upper Cretaceous; underlies Star Mountain rhyolite (new).

Type locality: Near head of deep ravine about 1½ miles south of ruins of Huelster ranchhouse in northwestern part of Barrilla Mountains, Reeves County.

Huerfano Formation[1]

Eocene, lower and middle: Southeastern Colorado.

Original reference: R. C. Hills. 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 148–164.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Formation, deposited during Wasatch and early Bridger time, unconformably overlies Cuchara formation at southern end of Huerfano Park. Consists of lower member of red and tan semiconsolidated sandstone and red, green, and gray shale and upper member of rust-colored granule and pebble conglomerate and tan shale.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 717–718. In Raton basin, formation unconformably overlaps Cuchara formation, Poison Canyon formation, and Pierre shale. Thickness as much as 2,000 feet. Consists mainly of variegated maroon shale beds with gray and green zones, and red, white, and tan sandstone beds. Underlies Farisita conglomerate (new), which unit has been mapped as Huerfano by Burbank and Goddard (1937, Geol. Soc. America Bull., v. 48, no. 7).

Typical exposure occurs on drainage of Muddy Branch of Huerfano River, Huerfano County.

†Huerfano Series[1] or Beds

Eocene: Southeastern Colorado.

Original references: R. C. Hills, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 148–165; 1893?, Colorado Sci. Soc. Proc., v. 4, p. 7–9.

Well exposed in Muddy Branch of Huerfano River.

Huerto Quartz Latite or Formation (in Potosi Volcanic Group)

Huerto Andesite (in Potosi Volcanic Series)[1]

Tertiary, middle or upper: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 36.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 93 (table 18), 143–144. Huerto quartz latite proposed to replace Huerto formation [andesite]. Defined as that body of quartz latites that lies between Alboroto rhyolite below and Piedra rhyolites above. Lower contact regular; upper contact irregular. Thickness in central part about 2,500 feet.

U.S. Geological Survey currently designates the age of the Huerto Quartz Latite or Formation as middle or late Tertiary. This designation made on the basis of age change of Potosi Volcanic Group.

Named for occurrences on Huerto Peak in southern part of San Cristobal quadrangle, west of Huerto Creek.

Huethawali limestones[1] (in Aubreyan series)

Carbonic: Northern Arizona.

Original reference: C. [R.] Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 336.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart), 223. Underlies Havasupai sandstones; overlies Chiquito sandstones. Carbonic.

In Grand Canyon region. Derivation of name not stated, but probably Huethawali Peak, which is just west of head of Bass Canyon.

Huevo member (of Serpiente Sandstone)

See Serpiente Sandstone.

Hughes Creek Shale Member (of Foraker Limestone)

Hughes Creek Shale[1]

Permian: Southeastern Nebraska, northeastern Kansas, and Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 85, 89.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 168. Reallocated to member status in Foraker limestone. In northern Kansas comprises light-gray to nearly black shale and thin limestone beds containing fusulines, and in lower part, a brachiopod fauna; in southern Kansas is a nearly continous limestone section, massive in lower part and containing much light-blue flint. Thickness about 40 feet. Underlies Long Creek limestone member; overlies Americus limestone member. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 82–83, pl. 1. Described in Pawnee County, Okla., where it is classified as member of Foraker limestone. Thickness 30 to 43 feet. Overlies Americus limestone member; underlies Long Creek limestone member. Wolfcamp.

Named for Hughes Creek, Nemaha County, Nebr.

Hughes Gap Formation (in Great Smoky Group)

Precambrian: Central northern Georgia and southwestern North Carolina.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 9, 21–35, pl. 1, map. Characterized by garnet-mica schist, staurolite schist, metaquartzconglomerate, quartzite, and pseudodiorite with beds of metagraywacke and

mica shist near base. Strata range in thickness from fraction of inch to more than 50 feet; commonly less than 10 feet thick; changes in thickness and lithology common along strike. Thickness difficult to determine as present outcrop pattern is due partly to facies changes in original sediments and partly to local structures, but repetition of beds is not common; estimated thickness 4,000 to 6,000 feet.Underlies Hothouse formation (new); overlies Copperhill formation (new) with transistion zone a few hundred feet thick.

Named from Hughes Gap, Mineral Bluff quadrangle, Fannin County, Ga., where an almost complete section is exposed. Formation crops out in a belt that enters Mineral Bluff quadrangle near Franklin Mountain, N.C., and leaves the quadrangle in vicinity of Gravelly Gap, Ga.

Hughes River Flint (in Conemaugh Formation)[1]

Pennsylvanian: Northwestern West Virginia.

Original reference: R. V. Hennen, 1911, West Virginia Geol. Survey Rept. Wirt, Roane, and Calhoun Counties, p. 258.

Probably named for occurrence on South Fork of Hughes River.

Huginnin Porphyrite[1]

Precambrian: Northern Michigan.

Original reference: A. C. Lane, 1898, Michigan Geol. Survey, v. 6, pt. 1, p. 98, 141, 205–206, 207, 209, 212, pls. 1, 13.

Named for exposures in bed of Huginnin Creek, about 50 feet from shore of Huginnin Cove and about 200 feet from mouth of the creek, in Isle Royale.

Huichica Formation

Pleistocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 98, pl. 11. Terrace deposits composed of poorly stratified gravels, conglomerates, sands, and clays; nonmarine. Basal deposits consist of reworked tuffs, pebbly conglomerates, and poorly consolidated clayey sandstone; upper beds largely pebbly sandstone and conglomerate. Thickness 250 to 500 feet. Unconformably overlies tilted andesites and rhyolites. May be contemporaneous with Glen Ellen formation (new).

Named from Huichica Creek at head of San Pablo Bay in northern part of Mare Island quadrangle, Napa County. Exposed around margins of Napa and Sonoma Valleys.

Hulah Sandstone Member (of Tallant Formation)

†Hulah Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: M. I. Goldman and H. M. Robinson, 1920, U.S. Geol. Survey Bull. 686–Y, p. 362, 365.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 37–38. Reallocated to Tallant formation. Well exposed north of Caney River, Osage County, where it is a fossiliferous yellow or orange sandstone about 4 feet thick. South of Caney River, the Hulah appears in upper part of Revard sandstone member and would therefore seem to be an equivalent of the latter. The Hulah mapped at type locality by Goldman and Robinson (1920) is believed to be the Bigheart, and elsewhere in same township the bed

named Hulah appears as a lens between the Bigheart and Revard members; unit was given a name in this report because of its distinctive appearance north of Caney River.

Type locality: Top of small ridge at east edge of Hulah, near center SE¼ sec. 5, T. 28 N., R. 12 E., Osage County.

Hulen Beds (in Horsetown Group)

Lower Cretaceous (Shasta Series): Northern California.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 32 (fig. 1), 38 (table 1), 67–68, table 2. Name applied to upper part of Horsetown group. Beds contain succession of distinctive faunal zones. Underlies lowest beds of Chico series or Tehama formation; overlie Cottonwood beds (new) of Horsetown group; boundary is more one of paleontological distinction. In type area, lower part of beds consists of dark argillaceous shales with only occasional layers of sandstone and sandy shales and zones of fossiliferous calcareous concretions. Thickness (fig. 1), 2,645 feet.

Type area; North fork of Cottonwood Creek [Shasta County]. Area is traversed by eastern branches of Hulen Creek, hence the name.

Hulett Sandstone Member (of Sundance Formation)

Hulett Sandstone Member (of Rierdon Formation)

Upper Jurassic: Northwestern Wyoming and southwestern South Dakota.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 255–257, geol. sections. Includes 25 to 120 feet of marine sandy beds consisting mainly of grayish, moderately hard thin- to thick-bedded, fine-grained, calcareous, glauconitic, ripple-marked sandstone. Thickness at type section 82 feet. Grades into underlying Stockade Beaver member and overlying Lak member (both new).

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475, 482. Reallocated to member status in Rierdon formation herein assigned to Sundance group.

Type section: On north side of Bush Canyon about 2½ miles north of Hulett, Crook County, Wyo., in secs. 25 and 36, T. 55 N., R. 65 W.

Huling Tongue (of Ono Formation)

Lower Cretaceous: Northern California.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2101 (fig. 2), 2104 (fig. 3) 2106–2107 (fig. 4), 2111–2112. Mostly graywacke; mudstone and thick extremely lenticular conglomerate units interbedded in lower part. Lowest unit, about 500 feet thick, is lenticular cobble conglomerate with well-rounded clasts, predominantly granitic, volcanic, and argillaceous rocks, which are uniform in size and roundness. About 200 feet of sandy mudstone and thinly bedded graywacke overlies the conglomerate. Next in sequence is interbedded graywacke and conglomerate unit. Next 200 feet of section starting at upper end of gorge along Huling Creek is a well-indurated massive non-bedded sandstone that grades into flaky weathering, very thickly bedded unit that comprises upper 500 feet of Huling tongue. Latter is fossiliferous in its upper half and zone of sandstone concretions. Lower contact usually very distinct and lower beds form north-facing cuesta-like escarpment overlooking less resistant mudstone of lower Ono. Upper contact gradational with overlying mudstones.

Named for exposures along Huling Creek, Shasta County.

Hull Agglomerate[1]

Middle Jurassic: Northern California.

Original references: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81; no. 5, p. 895–903.

Occurs in lower end of Hinchman Ravine and many other places on slopes of Mount Jura.

Hull Limestone[1] or Formation

Middle Ordovician: Ontario and Quebec, Canada, and northern New York.

Original reference: P. E. Raymond, 1914, Canada Geol. Survey Summ. Rept. 1912, p. 348.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 261–262. In southeastern Ontario and New York, formation extends from top of *Triplecia cuspidata*-bearing Napanee member (new) of Rockland formation to base of Sherman Fall limestone, in which *Prasopora orientalis* Ulrich is abundant. *Parastrophina hemiplicata* (Hall), normally abundant in basal Hull in New York, is rare in top of Rockland and recurs at higher horizons; thus, its presence aids in distinguishing Hull from Rockland. Thickness 85 to 110 feet. Formation enters New York at Sackett Harbor, forms narrowed belt south and west of Black River as far as Boonville, and then thins rapidly toward Mohawk Valley where it constitutes Larrabee member (new) of Glens Falls formation. In its original usage, term Kirkfield limestone was synonymous with Hull formation, but term Kirkfield later was applied as provincial name for Trenton group of central Ontario.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599. Discussion of West Canada Creek area, New York. Term Kirkfield used in preference to term Hull for unit overlying Rockland limestone and underlying Shoreham limestone. Term Kirkfield has priority over term Hull.

Named for exposures at Hull, Quebec, Canada.

Hull Meta-Andesite[1]

Hull Formation

Upper Jurassic: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Formation consists of metaandesite tuff and breccia. Mapped with Jurassic and (or) Triassic metavolcanic rocks.

Named for exposures east of Hull diggings (called Taylor diggings on Taylorsville map).

Hull porphyry[1]

Precambrian: Northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; 1914, Science, new ser., v. 40, p. 144.

Probably named for Hull, Sioux County.

Hull Stage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Rockland and Hull are early Trenton stages.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 260–262, 293, 298. Discussion of stratigraphy of Trenton group. Hull limestone and Larrabee member (new) of Glens Falls formation are of Hull age. In late Rockland time, seas overlapped Adirondack arch in a narrow strait somewhat north of Mohawk Valley. Hull stage is essentially a continuation of this overlap.

Name derived from Hull, Quebec, Canada, for which Hull limestone was named.

Humboldt Formation[1]

Humboldt Limestone Member (of Syrena Formation)

Pennsylvanian: Southwestern New Mexico.

Original reference: H. Schmitt, 1933, Am. Inst. Mining Metall. Engineers Contr. 39, p. 2, 13.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. Schmitt's term Humboldt is three times preoccupied. It is not used in this report as stratigraphic name for Pennsylvanian rocks in New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284–285. Syrena formation has been divided into two mapping units by Schmitt: lower is Mountain Home member and upper is Humboldt limestone (also called Don limestone). Consists of some 250 feet of alternating limestone and shale with several discontinuous quartz diorite sills. Underlies Beartooth quartzite.

Derivation of name not indicated.

Humboldt Formation[1]

Miocene and Pliocene(?): Northern Nevada.

Original reference: C. King, 1878, U.S. Geol. Expl. 40th Par., v. 1, p. 434–443.

R. P. Sharp, 1939, Jour. Geology, v. 47, no. 2, p. 133–160. Consists of 5,800 feet of continental deposits which range in grain size from coarse fanglomerate to fine shale and in composition from lake deposits of limestone and oil shale to stream-laid conglomerate sandstone, and mudstone interbedded with fine pyroclastics of water-laid and air-borne types. Beds divided into three members: lower, mostly lake beds; middle, characterized by ash and tuff beds; upper, mostly stream-laid deposits. As here defined consists of beds deposited chiefly in late Miocene and possibly early Pliocene. Lake Lahontan beds should not be included in Humboldt. Type section suggested.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2245. Overlaps Tomera formation (new) at Tomera Ridge.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 10, p. 1695 (fig. 1), 1699. Unconformably overlies Carlin Canyon formation (new).

Type section: Exposures along Huntington Creek, tributary of South Fork of Humboldt River, Elko County. Formation occupies basins separated by northward-trending fault-block mountains.

Humboldt Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: R. Hay, 1887, Kansas Acad. Sci. Trans., v. 10, p. 7.

Probably named for Humboldt, Allen County.

Humboldt Oolite (in Kinderhook Group)[1]

Mississippian: Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 109–114.

Occurs in east bank of West Fork of Des Moines River in southwestern part of town of Humboldt, Humboldt County.

Humbug Formation[1]

Upper Mississippian: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 625–626.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 15 (fig. 4), 19–20, pl. 1. In East Tintic Mountains, overlies Deseret limestone (replaces Pine Canyon) and underlies Great Blue limestone. Thickness 600 to 675 feet.

A. E. Disbrow, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–131. Mapped in Fivemile Pass quadrangle where it consists of alternating beds of brown crossbedded sandstone and light-gray weathering limestone interbedded with thin beds of dolomite and shale; about 600 feet thick. Underlies Great Blue limestone; overlies Deseret limestone.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 45–46. In Stansbury Mountains, overlies Pine Canyon formation and underlies Great Blue limestone. Thickness 710 to 900 feet. Pine Canyon used here in preference to Deseret.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 52–55. In southern Oquirrh Mountains, 635 feet thick; underlies Great Blue limestone and overlies Deseret limestone (restricted).

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 158, 161–163, pl. 1. In Fivemile Pass and North Boulter Mountains quadrangles, conformably overlies Pine Canyon formation and underlies Great Blue limestone. Thickness 450 to 475 feet.

Named for exposures near Humbug tunnels, 1¼ miles southeast of Eureka.

†Humbug Limestone[1]

Mississippian: Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2159–2151.

In Tintic district.

Humbug Sandstone[1]

Upper Mississippian: Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

In Tintic district.

Hume Shale Member (of Perrysburg Formation)

Hume Shale (in Canadaway Group)

Hume Shale Member (of Canadaway Formation)

Upper Devonian: Western and west-central New York.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Name applied to about 70 feet of predominantly black, brown, and dark-gray shale exposed above Canaseraga sandstone member in stream and along banks of Wiscoy Creek at Mills Mills. Member rests

on siltstone of upper part of Canaseraga along Wiscoy Creek and grades laterally eastward into siltstone of Canaseraga in area between Mills Mills and Dalton. In Genesee River Valley, overlain by Caneadea member.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10, fig. 1, 16. Reallocated to member status in Canadaway formation.

L. V. Rickard, 1957, New York Geol. Soc. Guidebook 29th Ann. Mtg., p. 15, 17, 18. In Wellsville area, term Perrysburg formation not applied. Hume shale considered formation in Canadaway group.

Type locality: At Mills Mills, on Wiscoy Creek, Hume Township, Allegheny County.

Hummel facies (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 214–217. Characterized by unit of gritty siltstone in lower part. Bounded by greenish-black bands of glauconitic silt and argillaceous limestone with bluish to greenish shaly partings in upper part. Thickness 35 to 50 feet or more. Contains Wildie siltstone member (new) at base. Merges with Maretburg facies (new) on the west and with Olive Hill facies (new) on the east. Underlies unclassified Upper Mississippian rocks; overlies Floyds Knob formation.

Well exposed at northwest end of tunnel of Louisville and Nashville Railroad 1½ miles south-southeast of Wildie, Rockcastle County. Section is in center of facies area. Name derived from Hummel, station on Louisville and Nashville Railroad, 4 miles northeast of Mt. Vernon, north-central Rockcastle County.

Humpback Gneiss

Precambrian (Archean?): Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, TVA Div. Geology Bull. 4, p. 11–12. A light-gray rock of sedimentary origin composed mostly of fragments of feldspar and quartz in matrix of secondary micas, chlorites, and other metamorphic minerals. A thin yellowish clay schist commonly interbedded with the more coarse and thick-bedded materials.

Appears along Humpback Mountain in Linville Falls quadrangle.

Humphrey Shale (in Wabaunsee Group)[1]

Pennsylvanian: Northeastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: A. J. Smith, 1905, Kansas Acad Sci. Trans., v. 19, p. 151.

Named for exposures on Humphrey's Ford, 6 miles southeast of Emporia, Kans.

Humphrey Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian: Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.

Hundred Sandstone (in Washington Formation)[1]

Permian: Northern West Virginia and southeastern Ohio.

Original reference: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 214.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 153, table facing p. 108. Geographically extended into Ohio where it is 17 feet thick and occurs below Upper Washington limestone and above Upper Marietta sandstone.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Sandstone in Washington series. Above Hundred coal and below Upper Washington limestone.

Named for village of Hundred, Wetzel County, W. Va.

Hungerford Formation

Hungerford Slate (in Woods Corners Group)

Middle Cambrian: Northwestern Vermont.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1045, 1047–1049, 1055. Chiefly blue-black to gray well-banded slates with local lentils of sandy dolomites also many white limestone bioherms. Hungerford beds formerly considered same as Highgate formation. Near Highgate Center, the name, Russell slate, is abandoned and beds are named Hungerford. Maximum thickness about 700 feet. Disconformably underlies Rockledge breccia (new) or Georgia formation; overlies Mill River breccia, St. Albans slate, or Parker slate.

B. F. Howell, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1964. Stratigraphically restricted. Lowermost fossiliferous beds named Skeels Corners formation; the sandstone disconformably overlying them named Saxe Brooke formation.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 547–548, pl. 1. Schuchert (1937) misinterpreted structures at type locality and believed that Hungerford slate lay below Rockledge conglomerate. Detailed mapping has proved that Rockledge plunges northward under slate at Hungerford Brook and that Hungerford slate is younger than Rockledge conglomerate. Because of this misinterpretation of stratigraphic position of Hungerford, Schuchert and subsequent workers have referred to Hungerford slate all beds now designated as Skeels Corners slate. Ruedemann (1947) referred to this formation as Russell slate. Consists almost entirely of black slate, commonly in beds 2 to 10 mm thick, alternating with beds of fine-grained white sandstone, commonly less than 3 mm. thick. Thickness about 400 feet at type locality; about 200 feet at international boundary. Overlies Rockledge conglomerate, contact gradational; overlies Skeels Corners slate where Rockledge is absent; underlies Gorge formation. Uppermost formation in Woods Corners group (new). Middle Cambrian.

Type area: Where Hungerford Brook crosses Highgate Road, about 1¼ miles south of Highgate, Franklin County. Thick sections also found west of Georgia Center and in Milton Township.

Hungry Run Sandstone Member (of Orangeville Shale)

Mississippian: Northwestern Pennsylvania.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1347, 1351, 1364–1366; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 18 (fig. 9), 43–45. Name proposed for massive iron-stained coarse-grained sandstone and underlying massive siltstone. Sandstone is crossbedded, conglomeratic in upper part, and includes zone of clay galls and lens of petroliferous sandstone. Lenses of flattened discoidal pebbles occur in conglomerate. Thickness 12

feet. Overlying beds not exposed at type locality; in some Crawford County localities, underlies dark silty part of Orangeville shale. Overlies either siltstones of Corry sandstone or Cussewago sandstone. Lower Mississippian.

Type locality: Small quarry on a headwater of Hungry Run, 1 mile west of southeastern corner of Union Township, Erie County. Also exposed in Crawford County.

Hungry Valley Formation (in Ridge Basin Group)

Pliocene, upper: Southern California.

J. C. Crowell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 8, p. 1626 (fig. 4), 1629 (fig. 5), 1633–1637. Name applied to about 4,000 feet of nonmarine sandstone and conglomerate conformably overlying Peace Valley beds (new). Consists of five unnamed lithologic members (ascending): conglomerate-breccia, brown conglomerate, white sandstone, gray silty sandstone, and buff sandstone. Basal contact of formation in type area is gradational. Youngest exposed beds of formation crop out along San Andreas fault zone and Frazier Mountain thrust near northern boundary of area.

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. Shown on columnar section as the top 4,500 feet of Ridge Basin group.

Type section: Just east of Hungry Valley and along Freeman Canyon. Hungry Valley is in Transverse Ranges about 55 miles northwest of Los Angeles.

Hunt Beds (in Bluestone Group or Formation)

Hunt Member (of Bluestone Formation)

Mississippian (Chester Series): Southwestern Virginia and southeastern West Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 185–186, pl. 15. Reger (1926) subdivided the 50 feet of the Bluestone into 3 units (ascending): Hunt shale, Hunt sandstone, and Hunt coal. These three units here considered the Hunt member of the Bluestone. In Burkes Garden quadrangle, member is 50 to 74 feet thick and consists of maroon-drab, apple-green, and reddish-buff shales; the redbeds are overlain by 12-foot zone of black carbonaceous shale, gray underclay, and coal. Underlies Bent Mountain member (new); overlies Bratton sandstone member. Relations indicate Hunt member is in trough of overturned syncline.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98). Correlation chart shows Hunt beds in Bluestone group or formation.

Type locality: Near Hunt School, Mercer County, W. Va.

Hunt Sandstone (in Bluestone Formation)[1]

Hunt Shale (in Bluestone Formation)[1]

Mississippian (Chester Series): Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 293, 317.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 185. Hunt shale, Hunt sandstone, and Hunt coal, named by Reger (1926), here considered the Hunt member of Bluestone formation.

All units exposed in Stony Gap section, Mercer County, on north side of Big Ridge, about three-fourths mile south of Belcher School.

Hunt Creek Sandstone (in Mancos Shale)

Upper Cretaceous: Northwestern Colorado.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 42, fig. 3. Prominent sandstone sequence at base of upper Mancos shale consisting of three prominent yellowish-gray to light-gray fine-grained crossbedded sandstone units with intervening slope-forming sandy shale and thin sandstone zones, 240 to 260 feet thick.

Exposed in escarpment along Hunt Creek, 2 miles southwest of Phippsburg.

Hunter Group

Hunterian Subseries

Middle Ordovician (Bolarian): Pennsylvania, Maryland, New York, Virginia, and West Virginia, and Ontario, Canada.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, p. 1198–1199. Upper Bolarian (Hunterian) comprises Snyder, Stover, and Curtin limestone, about 300 feet at Bellefonte, Pa., thinning by truncation to about 60 feet, predominantly Snyder, near Maryland, and to about 30 feet of Snyder at James River. The thickening Gratton, Bowen, Wardell, and basal Witten take the place of the Snyder west of New River, and Witten type section in Tazewell County seems to contain the Stover-Nealmont disconformity within the "*Camarocladia* zone." Lower Bolarian is the Hatterian (new).

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1409–1410. Hunter group includes Snyder, Stover, and Curtin limestones of central Pennsylvania. First two described as members of Benner formation. Hunterian subseries is of rocks younger than base of Snyder and older than unconformity separating the Curtin and lower Trentonian Nealmont limestone. Inasmuch as the Curtin is thickening northwestward beneath an unconformity as it passes beneath the Appalachian Plateau, there are Hunterian sediments younger than those exposed.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 97. Hunter group (Kay, 1948) is not significant, and Benner group should be applied to upper Bolarian.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7. Bolarian includes two divisions—Hatterian and Hunterian. These names unsatisfactory to show relationships as understood in this report. Hatter formation, whose time designation is Hatterian, appears to be same as Hunterian if, as shown in this report, the Hatter is equivalent to Ridley formation.

Name derived from Hunter Park, on Bellefonte Central Railroad in Centre County, Pa.

Hunter Sandstone and Conglomerate (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as underlying Peculiar shale (new) and overlying Cubierto shale (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Sandstone, conglomerate, and clay shale 216 feet thick. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon in southeastern Puente Hills, between Chino and Santa Ana River, San Bernardino County.

Hunter Canyon Formation (in Mesaverde Group)[1]

Upper Cretaceous: Western Colorado.

Original reference: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 22, 33.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 22, pl. 1. Late Montanan to early Lance.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187. Proposed to drop terms Mount Garfield and Hunter Canyon formations and to adopt term Neslen facies for all coal-bearing rocks of Price River formation and term Farrer facies for non-coal-bearing rocks above Neslen facies.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11 (table), 20. Consists of massive brown-buff and gray sandstone and soft gray shale beds. Thickness 375 to 1,400 feet. Overlies Mount Garfield formation. Essentially equivalent to Tuscher formation.

Named for Hunter Canyon, Book Cliffs coal field.

Hunter Mountain Quartz Monzonite

Cretaceous(?): Eastern California.

J. F. McAllister, 1956, U.S. Geol. Survey Geol. Quad. Map GQ-95. Name applied to map unit of plutonic rocks. Described as principally light-gray medium- to coarse-grained hornblende quartz monzonite but includes wide range of border facies (commonly syenodiorite, monzonite, syenite), pegmatite, aplite, and lamprophyre. Greatest topographic relief of an exposed part is about 4,000 feet in Nelson Range. Plutonic rocks intruded and metamorphosed Bird Spring(?) formation of Pennsylvanian and Permian age and lie nonconformably under continental deposits of late Pliocene or Pleistocene age.

Named for Hunter Mountain in Panamint Range. Exposed continuously from contact at least 8 miles east of quadrangle, across Hunter Mountain and for 17 miles along Nelson Range. Exposure is at least 10 miles broad across Hunter Mountain and southward to Darwin quadrangle.

Hunters Island Iron-Bearing Series[1]

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 118.

Occurs on east extension of north arm of Vermilion Range, Vermilion district.

Huntersville Chert (in Onodaga Group)

Huntersville Chert (in Oriskany Group)[1]

Lower or Middle Devonian: Southeastern West Virginia.

Original reference: P. H. Price, 1929, West Virginia Geol. Survey Rept. Pocahontas County, p. 106, 108, 233, 236–237, 397.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 256–278. Huntersville is rock unit for which it is difficult to find precisely descriptive lithologic term and to which name chert is only partly appropriate. Mostly it is highly silicified black shale which contains many beds that have been brecciated and recemented with amorphous silica; at least one prominent glauconitic-bearing sandstone and numerous other sandy phos-

phatic, or glauconitic, layers are commonly present; many layers of brittle clay-shale, but little or no limestone and less true chert than commonly supposed. Thickness 15 to nearly 100 feet. Unconformably overlies Ridgeley sandstone; where it underlies Needmore shale, the two formations grade into each other; where Needmore is absent, underlies Marcellus black shale. Present in southwestern Virginia. Included in Onondaga group, Middle Devonian.

J. M. Dennison, 1960, Dissert. Abs., v. 21, no. 3, p. 593. Includes Bobs Ridge quartz sandstone member (new). Needmore shale, Huntersville chert, and Onondaga limestone are contemporaneous facies of Onesquethaw stage.

Type locality: Vicinity of Huntersville, southeastern Pocahontas County.

Hunter Valley[1] Cherts (in Amador Group)

Middle or Upper Jurassic: East-central California.

Original reference: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283, 303–323. Assigned to Amador group. Consist of red, chocolate, gray, green, and black radiolarian chert, both massive and thin-bedded with partings of red, lilac, purple, chocolate, gray-green, and black slates and tuffaceous slates; schistose green tuffs and thin flows; impure cherts and siliceous mudstones near top of section. In Merced River section, Hunter Valley cherts overlie pillow basalts and underlie Penon Blanco volcanics. Thickness 950 feet. Age of Amador group believed to be upper Middle to lower Upper Jurassic.

Occurs along Merced River in southern type section of Amador group. [Name probably derived from Hunter Valley, Mariposa County.]

Huntingdon Formation[1]

Eocene: Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 17.

H. A. Coombs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1498. Sedimentary sequence several thousand feet thick borders western margin of Mt. Baker. Various sandstones, shales, arkoses, and thin coal seams are known collectively as Chuckanut formation. Daly (1912) gave name Huntingdon formation to similar strata to the north, but this is only a provisional name to be used until definite correlation can be made with the Chuckanut.

Occurs at and north of Huntingdon, British Columbia, and in northern Washington.

Hunting Hill Greenstone (in Blackstone Series)

Precambrian(?): Northeastern Rhode Island.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948 *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 12–13, geol. map; A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Dark-green to nearly black fine- to medium-grained greenstone, partly massive and partly schistose; includes several types of metamorphosed basaltic rocks. Fine-grained porphyritic andesite facies occurs one-half mile south of Olney

Pond. Contains several small serpentine and talc bodies, also inclusions and intercalated beds of schist, quartzite, and marble. In some areas, interbedded with Mussey Brook schist (new); locally intrudes Westboro quartzite; dikes and sills of Hunting Hill greenstone occur in Sneech Pond schist (new). Included in Blackstone series.

Named for Hunting Hill, Pawtucket quadrangle, Providence County. Numerous ledges of greenstone exposed on top and west side of this hill.

Huntington Dolomite[1]

Middle Silurian: Northeastern Indiana and west-central Ohio.

Original reference: E. M. Kindle, 1904, Indiana Dept. Geology and Nat. Resources 28th Ann. Rept., p. 408.

D. A. Busch, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1976. Huntington (restricted) represents that part of Huntington formation of northern Indiana which contains Guelph fauna. Lower 43 feet of 70-foot section of Huntington, as exposed at Ridgeville, Randolph County, Ind., relegated to underlying Cedarville formation. Huntington (restricted) and overlying New Corydon limestone are geographically extended into west-central Ohio.

J. B. Patton, 1949, Indiana Div. Geology Rept. Prog. 3, p. 12. Existence of Huntington as a formation has been questioned. Although dolomite identified as Huntington is exposed at numerous places throughout an area of more than 1,600 square miles, contact of base of Huntington on an older formation has not been observed. Many exposures termed Huntington are reefs or beds associated with reefs. Some reefs formerly called "Huntington" are now considered to be Liston Creek or even Mississinewa in age.

J. B. Sangree, Jr., 1960, Dissert. Abs., v. 21, no. 6, p. 1528. Revision of Silurian stratigraphy of northern Indiana proposed, including abandonment of Huntington dolomite of Cumings and Shrock [1928, Indiana Dept. Conserv., Div. Geology Pub. 75].

Type section (redefined): Along dredged rock channel of Little River from NE cor. SW cor. NE¼ sec. 13, T. 28 N., R. 10 E., eastward to west line of sec. 8, T. 28 N., R. 10 E., Huntington County, Ind.

Huntington Series[1]

Triassic(?): Northeastern Oregon.

Original reference: W. Lindgren, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 579.

Occurs in vicinity of Huntington, Baker County.

Hunton Limestone[1] **or Group**

Silurian and Devonian: Southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 131–136. Taff gave name Hunton formation to series of limestones and shale that occur between Sylvan shale of Ordovician and Woodford chert of Mississippian(?) age. Reeds (1911, Am. Jour. Sci., 4th, v. 32) divided Taff's Hunton into four units of formational rank (ascending): Chimneyhill limestone (Silurian), Henryhouse shale (Silurian), Haragan shale (Devonian), and Bois d'Arc limestone (Devonian). Reeds (1926) added Frisco limestone (Devonian) above the Bois d'Arc. In this report, Hunton formation as defined by Taff and redefined and subdivided by Reeds is again redefined as follows: Silurian, Chimneyhill limestone with Haw-

kins, Keel, Cochrane, and Dillard members; Henryhouse formation; Devonian, Kite group with Haragan and Cravatt formations; Bois d'Arc limestone; and Frisco limestone.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 1–57; 1959, Oklahoma Geol. Survey Bull. 84, pt. 6, p. 7–311 [1960]. Group consists of sequence of limestones and marlstones unconformably underlain by Sylvan formation and unconformably overlain by Woodford formation. Thickness ranges up to slightly more than 400 feet, but at most places it is much less, due in part to unconformities and facies changes. In areas where group is relatively thick and complete, typical sequence consists of basal series of calcilutites and calcarenites (Chimneyhill formation), overlain by marlstones (Henryhouse and Haragan formations), followed by cherty marlstones (lower Bois d'Arc formation) and calcarenites (upper Bois d'Arc formation) and, locally, Frisco formation. Interpretation of stratigraphic and faunal relationships within group differs from that given by previous workers. However, names introduced by earlier authors, even those proposed in abstract form, have been retained if they are not preoccupied.

Named for exposures near former townsite of Hunton (T. 1 S., R. 8 E.), Coal County. Well exposed within Arbuckle complex and known to have wide distribution in subsurface.

Huntsville Fanglomerate

Pliocene, upper: North-central Utah.

A. J. Eardley, 1955, Utah Geol. Soc. Guidebook 10, p. 39, fig. 9. Incidental mention in discussion of Tertiary history of north-central Utah. Deposited contemporaneously with Harkers fanglomerate in Jordan-Oquirrh area and Mink Creek conglomerate in Cache Valley. Name credited to B. Lofgren.

Recognized in Morgan area.

†Huntsville[1] (Formation)

Mississippian: Northeastern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama: Birmingham, Roberts & Son, pamph.

Named for exposures at Huntsville, Madison County.

Huron Gritstone[1]

Mississippian: Michigan.

Original reference: A. Winchell, 1871, Am. Philos. Soc. Proc., v. 11, p. 73–82.

Probably named for outcrops along Lake Huron in Michigan.

†Huron Group[1]

Upper Devonian and Mississippian: Michigan.

Original reference: A. Winchell, 1861, Michigan Geol. Survey 1st Bienn. Rept. Prog., p. 71, 139.

Probably named for outcrops along Lake Huron in Michigan.

†Huron Group[1]

Mississippian: Indiana.

Original reference: T. C. Hopkins, 1902, Geol. Soc. America Bull., v. 13, p. 519–520.

Named for Huron, Lawrence County.

Huron Member (of Ohio Shale)

Huron Shale[1]

Upper Devonian: Northern Ohio.

Original reference: J. S. Newberry, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 18.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 15–16. Member of Ohio shale. Consists of grayish-black shale which contains large septarian concretions in lower part and thin beds of cone-in-cone limestone in upper part. Cleveland and Huron members essentially identical in lithologic character, and in Erie and Lorain Counties contact between these black shales is drawn arbitrarily below lowest cone-in-cone layer and uppermost zone containing large concretions.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 16–18. In northern Ohio, the Ohio shale regarded as consisting of three members (ascending): Huron, Chagrin, and Cleveland. Stratigraphic position of Ohio and Chagrin has been disputed. Some researchers regard the Huron as basal member and others the Chagrin. Huron and Cleveland members are for most part lithologically identical. Base of Huron taken as the black shale bed resting upon highest most gray shale (or limestone) bed of underlying formation or unit, which in different places is Plum Brook shale, Prout limestone, Ten Mile Creek dolomite, Olentangy shale, or locally, Silurian or Devonian limestone. Upper limit defined as uppermost black shale in area where gray carbonaceous Chagrin is present, or as top of uppermost layer of carbonate concretions, or base of cone-in-cone structure, if these are observable. Such an arbitrarily placed boundary leaves much to be desired. No divisions have been established in Huron shale. Generally supposed that shale termed "Huron shale" by Newberry comprises all of black shale which Andrews, later in same report, named "Ohio black shale." Newberry's Huron shale represented only the lower mass of black shale which occurs in northern part of State. Presently top of Ohio shale in southern Ohio is considered as corresponding to top of Cleveland shale. Andrew's Ohio shale is regarded equivalent to Newberry's Huron, Chagrin, and Cleveland shales of northern Ohio. Hass (1947, Jour. Paleontology, v. 21) found from study of conodonts that certain genera and species are common only to Huron shale (zone). These same conodonts are mutually present in south-central Ohio as well as in northern part of State. Hass referred to "Huron shale" of central and northern Ohio as the lower Ohio shale zone. Total thickness of Huron not seen in outcrop. Reported average thickness 410 feet.

Named for exposures on Huron River, Huron and Erie Counties. From Berea west to Norwalk, the Huron forms cliffs 5 to 70 feet high along many streams and along shore of Lake Erie.

Huron Bay Slates[1]

Age(?): Northeastern Michigan.

Original reference: T. B. Brooks, 1873, Michigan Geol. Survey, v. 1, pt. 1, p. 155.

Huron City Sandstones and Shales (in Lower Marshall Sandstone)

Mississippian (Kinderhook): Southern Michigan.

H. M. Martin, 1936, The centennial geological map of the southern peninsula of Michigan (1:500,000): Michigan Dept. Conserv., Geol Survey Div. Pub. 39, Geol. Ser. 33. Shown on map legend.

Huronian Series[1]

Precambrian: Great Lakes region.

Original references: W. E. Logan and T. S. Hunt, 1855, Esquisse géologique du Canada p. 29–31; F. D. Adams and others, 1905, Jour. Geology, v. 13, p. 103–104.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1070, 1072. In Minnesota classification, the Precambrian is divided into Earlier Medial, and Later. Later Precambrian includes Animikie and Keweenawan groups. Term Huronian not used, principally because only tentative correlations can be made with type Huronian. A further reason to avoid use of term Huronion for Animikie formations is based on original naming of Huronian. When Logan named formations north of Lake Huron, he thought (J. F. Alcock and Committee, 1934, Royal Soc. Canada Trans., v. 28, no. 4) the Animikie and Keweenawan were Paleozoic and excluded them from the Huronian.

Named for exposures on shores of Lake Huron.

Hurrah Slate[1]

Post-Ordovician(?): Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geo. Survey Bull. 433, p. 50, 59.

Well exposed in Big Hurrah mine located at junction of Big and Little Hurrah Creeks, and on lower 2 or 3 miles of Big Hurrah Creek, Seward Peninsula.

Hurricane Graywacke

Precambrian (Ocoee Series): Western North Carolina, northern Georgia, and eastern Tennessee.

G. W. Stose and A. J. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233. In list of formations, oldest unit in Ocoee series; underlies Great Smoky quartzite.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 274–277, pl. 1. Name Hurricane graywacke is applied to oldest formation of Ocoee series because of its fine exposures on Little Hurricane Creek and at Hurricane settlement, North Carolina, 6 miles northeast of Hot Springs, N.C. Initial sediments of graywacke in this vicinity and northeastward rest on granite gneiss of injection complex. In Asheville and several folios, Keith (1904, folio. 116; 1905, folio 124; 1907, folio 151; Mount Guyot, unpub.) used name Snowbird formation for these beds which he assigned to Lower Cambrian. He included part of Great Smoky conglomerate in Snowbird formation at type locality and elsewhere. In 1904 and 1907, he applied name Snowbird also to well-established Lower Cambrian rocks. For these reasons, it is believed that name Snowbird is misleading, and new name Hurricane is applied to graywacke which underlies Great Smoky quartzite and is basal formation of Ocoee series. Hurricane is fine- to medium-grained grayish-black or grayish-green graywacke consisting principally of angular grains of glassy quartz and feldspar in matrix of mica and black, iron-oxide dust. On southeast side of belt of series, the Hurricane rests unconformably on Precambrian injection complex. On northwestern side of belt it is exposed in places along Great Smoky overthrust. Occurs in anticlines within the belt, and in Georgia surrounds early Precambrian rocks exposed in Fort Mountain, Corbin, and Salem Church anticlines. North of Blairsville, Ga., the Hurricane is basal part of Ocoee series that was mapped as Carolina

gneiss by La Forge and Phalin (1913, U.S. Geol. Survey Geol. Atlas, Folio 187). Southwest of Cartersville, Ga., and in Alabama, the formation is green phyllite. In Georgia, Hayes (unpub. folio) called part of this phyllite Gilmer schist, and Crickmay (1936) included it in Talladega series. In Alabama, it was mapped as Talladega slate by Butts (1926, Paleozoic rocks of Alabama: Alabama Geol. Survey). In Corbin anticline, the Hurricane is thrust over Corbin granite. In Fort and Cohutta Mountains, overlies Fort Mountain gneiss.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 26–27. Discussion of Hot Springs Window, Madison County. Term Snowbird considered preferable to Hurricane graywacke in this area.

Type locality: Exposures on Little Hurricane Creek and at settlement of Hurricane, N.C., at junction of the creek with Big Laurel Creek (Asheville quadrangle), 6 miles northeast of Hot Springs, N.C. Southeastern belt extends from 3 miles southwest of Erwin, Tenn., through type locality, and southwestward to northern Georgia and ends at Mount Oglethorpe.

Hurricane Marine Lentil (in Landrum Member of Cook Mountain Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1665–1670. Fossilliferous, bentonite-bearing marine lentil about 25 feet thick in lower part of Landrum member [of middle Eocene age].

Probably named for occurrence near Hurricane Bayou, Houston County.

Hurricane Bridge Limestone

Middle Ordovician: Southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Cryptocrystalline tan and gray thin-bedded limestone with prominent zones of massive-bedded cryptocrystalline birdseye limestone and zones of buff- and red-weathering argillaceous shaly limestone. Thickness 288 to 368 feet. Overlies Martin Creek limestone (new); underlies Woodway limestone (new). Same as redbed member of Lowville limestone on U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 47–51, pl. 1. Further described, and type locality and type section given. Discussion of problems of correlation and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Type locality: Vicinity of Hurricane Bridge and Hurricane Chapel on Powell River 2½ miles southwest of Jonesville, Lee County, Lee County, Va. Type section is along State Route 70 north of Sewell Bridge.

Hurricane Mesa Volcanics

Tertiary: Northwestern Wyoming.

R. D. Krushensky, 1960, Dissert. Abs., v. 21, no. 4, p. 849. Flows, tuffs, and tuff-breccias. Overlie unit referred to as post-Closed volcanics.

Hurricane Mesa area, Park County.

Hurwal Formation

Upper Triassic: Northeastern Oregon.

W. D. Smith and J. E. Allen, 1941, Oregon Dept. Geology and Mineral Industries Bull. 12, p. 6 (fig. 2), 13–14. Name applied to conformable series of argillaceous sediments that lies both stratigraphically and topo-

graphically above Martin Bridge formation. Grades within a few tens of feet from underlying Martin Bridge limestone through argillaceous limestone and calcareous shale, to shale and hornfels. Thickness 1,500 feet on Hurricane Divide and Sentinel Peak. Top not exposed although upper limestone interbedded in formation on Hurricane Divide may represent highest Mesozoic horizon in area.

Named from Hurwal Divide in center of Wallowa quadrangle, Wallowa County.

Hushpuckney Shale[1] Member (of Swope Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, and northwestern Missouri.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guide Book, p. 85, 90, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 88; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. Hushpuckney shale member of Swope formation; underlies Bethany Falls limestone member; overlies Middle Creek limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 421. Thickness about 4 feet in section measured near Winterset, Madison County.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Gray and fossiliferous above and black and fissile at base. Underlies Bethany Falls limestone member; overlies Middle Creek limestone member.

Typically exposed at railway cut, center north side sec. 13, T. 19, S., R. 23 E., Miami County, Kans. Named for creek south of Fontana.

Hutchinson Salt Member (of Wellington Formation)

Hutchison Salt Bed (in Sumner Group)[1]

Permian: South-central Kansas (subsurface).

Original reference: I. Perrine, 1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 73–90.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 40–41. Occurs in middle part of Wellington; does not crop out.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as Hutchinson Saltstone Member of Wellington.

Probably named for Hutchinson, Reno County.

Hutchison limestones[1]

Devonian: Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 56, p. 318, 348.

Hyampom Lake Beds[1]

Miocene: Northwestern California.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 41–43.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 41–43. Oligocene or Eocene.

Occurs in Hyampom Valley, Trinity County.

Hyco Quartz Porphyry[1]

Precambrian: South-central Virginia and central northern North Carolina.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 15, 19, 20–23, map.

H. E. LeGrand, 1960, Virginia Div. Mineral Resources Bull. 75, p. 16–17. Underlies Aaron slate in Halifax County.

Named for exposures along Hyco River, Halifax County, Va.

Hyde Formation (in Izee Group)

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 255–259. More than 1,000 feet of massive blue-gray sandstones in lower part of Izee group. Underlies Snowshoe formation (new); overlies Warm Springs formation of Colpitts group (both new).

Type area: At South Fork Bridge, sec. 30, T. 17 S., R. 28 E., in bottom of South Fork Valley. Named for John Hyde Ranch at mouth of Poison Creek, Crook County.

Hyde Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 85, 86–88.

Occurs southwest of Hickory Lake in bend between Hickory Creek, Hammond quadrangle. Probably named for Hyde School.

Hyde Manor Limestone[1]

Middle Ordovician: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 368–369.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 34. Keith (1932) named Hortonville slate from town off Hortonville, where it overlies Trenton "Hyde Manor limestone" (Orwell and Glens Falls).

Named for exposures at summer resort, called Hyde Manor, south of Sudbury, Brandon quadrangle.

Hyder Quartz Monzonite[1]

Jurassic or Cretaceous: Southeastern Alaska.

Original reference: A. F. Buddington, 1929, U.S. Geol. Survey Bull. 807, p. 29–39, 58–59, maps.

F. M. Byers, Jr., and C. L. Sainsbury, 1956, U.S. Geol. Survey Bull. 1024–F, p. 126, pl. 13. Mentioned in report on tungsten deposits of Hyder region. Hyder quartz monzonite and Boundary granodiorite are included in younger Coast Range intrusives.

Named for exposures at Hyder.

Hye Granite

Precambrian: Central Texas.

V. E. Barnes, R. F. Dawson, and G. A. Parkinson, 1947, Texas Univ. Bur. Econ. Geology Pub. 4246, p. 49, 50 (fig. 3). Mapped as Hye granite. Crops out as mass of weathered boulders and is part of old monadnock of

Precambrian peneplain which is surrounded by Cambrian sediments up to base of Wilberns formation.

Outcrops in area along Pedernales River at Blanco-Gillespie County line, about 22 miles from Fredericksburg.

Hygiene Sandstone Member (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: N. M. Fenneman, 1905, U.S. Geol. Survey Bull. 265.

G. R. Scott and W. A. Cobban, 1959, Rocky Mountain Assoc. Geologists 11th Ann. Field Conf. Symposium, p. 124–126, 129 (fig. 3). About 6 miles north of Boulder, consists of basal 240-foot thick light-olive- to yellowish-gray thin-bedded friable sandstone with large light-gray silty limestone concretions in upper part; a medial 38-foot dark-gray clayey shale with orange-brown iron-stained limestone concretions; and an upper 126-foot-thick ridge-forming dusky-yellow thick-bedded friable medium-grained sandstone. Three miles north of Kassler, member is 1,420 feet above base of Pierre, is 600 feet thick and consists of dusky-yellow soft shaly sandstone that contains, in lower part and at top, masses as much as 12 feet in diameter of gray rough hard crystalline limestone; beds of orange-brown ironstone present in upper half. Separated from younger Terry member by as much as 387 feet of olive-gray sandy shale. Marine invertebrate megafossils.

Typically developed in ridge which passes within 1½ miles of village of Hygiene, Boulder County.

Hyndman Formation[1]

Precambrian(?): Central Idaho.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10–17.

C. P. Ross and J. D. Forrester, 1947, Geologic map of the State of Idaho (1:500,000): U.S. Geol. Survey. Precambrian(?)

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 3. Precambrian(?) rocks in Pioneer Mountains include Hyndman formation, about 6,600 feet thick, and East Fork formation, about 1,560 feet thick. Hyndman consists mainly of quartzite but includes green hornfels in upper part and schist member in lower part.

Well exposed in Hyndman Peak and in cirques at its southern base, Hailey quadrangle.

Hyrum Dolomite Member (of Jefferson Formation)

Devonian: Northern Utah.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1139, 1140. Predominantly black dolomite and limestone; minor amounts of calcareous sandstone. Thickness 840 to 1,200 feet. Underlies Beirdneau sandstone member (new), contact gradational; disconformably overlies Water Canyon formation (new).

Named for exposures in mouth of Blacksmith Fork Canyon, sec. 7, T. 10 N., R. 2 E., east of town of Hyrum, Logan quadrangle.

Iaeger Sandstones (in New River Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 186–191.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Repts.] Greenbrier County, p. 215, 216, 224–226. Occurrence of Iaeger sandstones and shales discussed in Greenbrier County. Included in New River group, Pottsville series.

Named for occurrence at Iaeger, McDowell County.

Iatan Limestone (in Pedee Group)

Iatan Limestone (in Lansing Group)

Iatan Limestone or Limestone Member (in Douglas Group or Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, and eastern Kansas.

Original reference: C. R. Keyes, 1899, Am. Geologist, v. 23, p. 306.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 28. Included in Pedee group in Missouri.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 294 (table), 295. Iatan and Weston formations included in Lansing group. Term Pedee dropped from Iowa nomenclature.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 15. Overlies Weston shale. Youngest known formation of Missouri series in Missouri.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 121–122. Conformably overlies Weston shale and disconformably overlain by Stranger formation of Virgil series. Limestone is light bluish gray or nearly white, but parts are mottled brown after prolonged weathering. Thickness less than 5 feet to about 22 feet, maximum is short distance south of Iatan. In Kansas, occurs southward to vicinity of Baldwin, Douglas County. Limestone that has been called Iatan in country farther south is mostly a lower Virgilian unit, the Haskell, but some limestone outcrops may represent true Iatan. Pedee group.

Named for exposures at Iatan, Platte County, Mo.

Iberville Formation[1]

Middle Ordovician: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 5.

David Hawley, 1957, Geol. Soc. America Bull., v. 68, no. 1, p. 58, 63–68. Noncalcareous shale, rhythmically interbedded with thin quartz-silty dolomite beds; uniform, fine-grained dolomite beds; and in lower part, with calcareous shale. Thickness 1,000 to 2,000 feet. Underlies Hathaway formation (new); overlies Stony Point formation. Derivation of name given.

Named for wide outcrop belt in Iberville County, southern Quebec.

Ibex Limestone

Lower Permian: North-central Texas.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 5. Proposed to replace preoccupied "Dothan" limestone. Normally 2 to 3 feet thick, between clays of Watts Creek shale. Resistant bed; outcrops characterized by large slabs at various angles.

Typical outcrops occur 500 feet east of northwest corner of Blind Asylum Survey No. 51, one-half mile southeast of Ibex townsite, and also just north and west of Ibex field along Hubbard Creek. Name derived from Ibex oil field in east-central Shackelford County.

Ice Box Shale

Middle Ordovician: Western South Dakota.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 45–46. Olive-green shale 30 to 45 feet thick. Conformably underlies Roughlock siltstone (new); conformably overlies Aladdin sandstone (new).

Type section: In secs. 14 and 23, T. 5N., R. 3 E., about one-half mile west of junction of U.S. Highways 14 and 85 [Lawrence County]. Named from Ice Box Gulch.

Ice Springs Craters Flow

Recent: Central Utah.

G. B. Maxey, 1946, Am. Jour. Sci., v. 244, no. 5, p. 328, pl. 1. Basalt flow. Occurred subsequent to disappearance of Lake Bonneville and probably at a time well into Recent. Covers small area on eastern edge of Pavant flow (new), earliest flow in area.

P. E. Dennis, G. B. Maxey, and H. E. Thomas, 1946, Utah State Engineer Tech. Pub. 3, p. 26, pl. 1. Basalt scoria, lapilli, and lava in flows having thickness of 30 feet or more. Maximum thickness 400 feet.

Occurs in Pavant Range, about 8 miles west of Fillmore, Millard County.

Iconium Member (of Wellington Formation)[1]

Permian: Central northern Oklahoma.

Original reference: J. M. Patterson, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 3, p. 243, 249.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1522 (fig. 2). Permian of Oklahoma divided into three major time divisions (ascending) Wanette, Minco, and Upper Red-Beds. Iconium shale is in Minco division.

Named for town of Iconium, near [S¼ cor. sec. 10,] T. 16 N., R. 1 E., Logan County.

Idaho Group

Idaho Formation[1]

Pliocene and Pleistocene: Western and southern Idaho and southeastern Oregon.

Original reference: E. D. Cope, 1884, Philadelphia Acad. Nat. Sci. Proc. 1883, v. 35, p. 135.

H. E. Wheeler and E. F. Cook, 1954, Jour. Geology, v. 62, p. 528. Discussion of structural and stratigraphic significance of Snake River capture, Idaho-Oregon. On basis of this study it is believed that Idaho formation as restricted by Lindgren (1898, U.S. Geol. Survey Ann. Rept., pt. 3) is essentially valid and that Idaho formation as redefined by Kirkham (1931 Jour. Geology, v. 39, no. 3) is composite and invalid.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 16–17. Rocks shown on Idaho State map (Ross and Forrester, 1947) as Payette and related strata include beds that, although having many resemblances, have considerable range in age. Rocks so grouped have affinities to Payette formation (commonly regarded as Miocene), Latah formation (middle or upper Miocene), and Idaho formation (Pliocene). Early concept that Payette and Idaho formations represent two successive stages of large lake, with division between them at some horizon not definitely fixed, within sedimentary succession above Columbia River basalt (Lindgren, 1898) is so much at variance with facts now

known that it must be abandoned. Kirkham (1931) restricted Payette to sedimentary rock that generally occurs interbedded with Columbia River basalt, commonly 600 feet below top of basalt unit—a suggestion that has much to commend it in areas in which he worked. In a general way, term Idaho formation is applied to Cenozoic sedimentary rocks in and near western part of Snake River Plain that have broad lithologic and genetic resemblance to Payette but are younger. Strata of Idaho formation as thus limited are, on the average, somewhat finer grained and less firmly consolidated than Payette, but this distinction not sufficient to be readily used in mapping. The unit [Idaho], probably several thousand feet thick, is most extensive of those grouped as Payette and related strata on State map. It is interbedded with Snake River basalt and overlies silicic and older rocks, in many places with appreciable unconformity. Name Idaho formation has not been applied in eastern Idaho although similar rocks exist there. In those places, the tendency has been to assign local names to strata of Idaho affinities, as for example, name Hagerman lake beds.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Brothers, Inc., p. 108. Thick series of continental sediments that crop out along eastern margin of [Owyhee] reservoir have been referred to as Idaho formation in accordance with usage proposed by Kirkham (1931) in which he restricted Payette formation to pre-Owyhee basalt sediments and included remaining post-basalt Tertiary sediments in Idaho formation. Idaho formation as originally used by Cope referred to beds that are probably younger in age and somewhat different in lithology. Evidence indicates that several stratigraphic units are present in post-Owyhee continental sediments and term Idaho formation is not applicable. It is used here in broader sense as Idaho group.

Name was applied to sediments deposited in Lake Idaho.

Idaho Springs Formation[1]

Precambrian (Gunnison River Series) : Central northern Colorado.

Original reference: S. H. Ball, 1906, Am. Jour. Sci., 4th, v. 21, p. 374.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 19–20, pls. Oldest known rocks in Front Range. Consists chiefly of quartz-biotite schists and quartz-biotite-sillimanite schists; quartzite, quartz schists, or quartz gneisses are common in some localities. Full thickness unknown; estimated thickness about 20,000 feet. Underlies Swandyke hornblende gneiss.

Richard Van Horn, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–103. Described in Golden quadrangle where it is principally gneiss and schist; some quartzite; hornblende gneiss; and garnet gneiss. Intruded by pegmatite and biotite syenite dikes. Underlies Fountain formation, angular unconformity.

Typically exposed in hills surrounding Idaho Springs, Georgetown quadrangle.

†Idak Basalt

Tertiary and Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 3, p. 28, pl. 3. Thickness of about 2,000 feet of basalt flows and subordinate interbedded tuff-breccia. Individual flows from 10 to 100 feet thick. Flow rocks are gray basalt and range in texture from aphanitic to coarsely porphyritic. Lava flows composing peak of Mount Idak are

intruded by closely spaced network of dikes comprising 20 to 30 percent of total rock.

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 309. Name abandoned. Unit included in Ashishik basalt (redefined).

Exposed on Mount Idak and ridges to the northeast, which are remnants of an ancient volcano, herein named Idak Volcano, on Umnak Island in eastern part of Aleutian Islands.

Idalia Clay[1]

Tertiary: Southeastern Missouri.

Original reference: C. F. Marbut, 1902, Missouri Univ. Studies, v. 1, no. 3, p. 18, 21, 32.

Named for exposures at Idalia, Stoddard County.

Ideal Quarry Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 2), 7, 9-11, fig. 4. Name introduced to replace Maxwell's (1936) Hawkins limestone which is preoccupied. Maximum thickness 5 feet; commonly 3 feet or less. Member actually represents basal part of the Keel and grades upward into it through transitional beds; upper contact arbitrary, but below this transitional zone the strata have a distinctive lithology and color which warrants their separation from the overlying Keel. Overlies Sylvan formation.

Type section: Ideal quarry of the Ideal Cement Company at Lawrence, sec. 36, T. 3 N., R. 5 E., Pontotoc County.

Idenbro Limestone Member (of Lenapah Limestone)

Pennsylvanian (Des Moines Series): Southeastern Kansas, south-central Iowa, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 339, 340. Light-gray nodular crystalline algal limestone. Thickness about 3 feet. Overlies Perry Farm shale member (new); underlies Memorial shale.

J. M. Jewett, 1945, Kansas Geol. Survey Bull. 58, p. 69–70. Discussed as cyclothem in Lenapah megacyclothem.

L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 25; C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 134. Idenbro limestone can be traced into Sni Mills limestone member in Jackson County, Mo.; therefore, name Idenbro is suppressed as a synonym of Sni Mills.

Type locality: SW¼ sec. 2, T. 32 S., R. 18 E., Labette County, Kans.

Iditarod Basalt

Lower(?) and Upper Cretaceous: Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 42, 47–50, pl. 1. Chiefly massive basalt lava flows underlain by comparatively thin but widely distributed basal zone of sedimentary breccia. Similar breccia zones, irregularly distributed, are interbedded with flows. Dense, uniformly fine-grained and massive, dark-colored basalt predominates. Fresh specimens commonly greenish black, though some are blue black and purplish black. Rock weathers brown. Breccia commonly mottled with dark shades against light background; weathers shades of brown and mottling does not show on weathered surface. Brec-

cia composed of rock eroded chiefly from lava flows. Thickness estimated between 2,000 and 3,000 feet. Disconformably overlies Kuskokwim group (new) and possibly intertongues with group. Believed to be of middle or late Late Cretaceous age.

Typically and best exposed in wide tract northeast of Montana Creek in vicinity of DeCourcy Mountain. Forms range of hills southeast of Iditarod River, and named after the river. Range extends northeastward from Russian Mountains for nearly 50 miles.

Idlefornso Formation

See Ildefonso, correct spelling.

Ignacio Quartzite[1]

Upper Cambrian: Southwestern Colorado.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60, p. 8.

Harley Barnes, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1780–1791. Heretofore Ignacio quartzite in southwestern Colorado has been thought to be Late Cambrian in age, disconformably overlain by Elbert formation of Late Devonian age, and everywhere underlain by eroded older rocks. Recent fieldwork suggests that the quartzite is Devonian in age, that it forms essentially continuous depositional sequence with overlying Elbert formation and Ouray limestone, and that, in Animas River valley, Ignacio has been intruded by granite porphyry of Devonian or younger age.

F. H. T. Rhodes and J. H. Fisher, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2508–2518. Referred to Late Cambrian or Early Ordovician on basis of occurrence of oboloid brachiopods. This is contrary to recent conclusion of Barnes (1954) but in support of age provisionally assigned by earlier workers. Major unconformity occurs between Ignacio and overlying Elbert of Late Devonian age. Ignacio was deposited on essentially Precambrian terrane. Suggested that rocks underlying Ignacio in Animas Valley are not intrusive into the Ignacio. Thickness about 112 feet. Locally overlies Twilight granite.

Named for development on bench where Ignacio Lake is situated, Silverton quadrangle.

Ignek Formation[1]

Lower and Upper Cretaceous: Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 120, map.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 246). Lower and Upper Cretaceous.

Type locality: On south side of Red Hill, in Ignek Valley at west end of Sadlerochit Mountains.

Iisa Beds or Formation

Pliocene: Caroline Islands (Kusaie).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 70 (table 5) [English translation in library of U.S. Geol. Survey, p. 85]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 40. Conglomerate and gravelly agglomerate; resembles conglomerate of East Caroline beds. In

contact with lower basalt and East Caroline beds. Some silicified wood and marine mammalian bones.

Kasaie Island.

Ijamsville Phyllite

Lower Paleozoic(?) (Glenarm Series) : Western Maryland.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346. Blue, green, or purple phyllitic slate probably of tuffaceous origin. Part of a volcanic series including green metabasalt, blue meta-andesite, and purplish-red aporphyolite flows. In part, contains flattened amygdaloidal blebs, but in many places close folding and metamorphism have obscured its volcanic character. In places, is infolded with Silver Run limestone (new). Lies to west of Marburg schist (new) and may be in part equivalent to it. Precambrian(?).

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 66, 67, 121–126. In vicinity of Shriver's Mill, phyllite is bordered on southeast by Wissahickon albite-chlorite schist and west and southwest of Taylorsville by Marburg schist. From point near New Windsor westward to Bark Hill, band of phyllite follows north border of Sams Creek metabasalt (new) and Wakefield marble. In region southwest of Union Bridge, phyllite is folded with the metabasalt and [Libertyville] metarhyolite (new). Near Ijamsville and Moravia, the Ijamsville is surrounded by Urbana phyllite. Along western edge of Martic overthrust block, east of Frederick Valley, phyllite forms narrow belt that extends from vicinity of Ladiesburg, at border of Triassic rocks, southwestward to Monocacy River. Sugarloaf Mountain syncline encloses Urbana phyllite and associated quartzites, and Sugarloaf Mountain quartzite. Syncline is overturned to northwest and beds dip southeast.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 49. Phyllites of Sugarloaf area, which have been considered volcanic members of Glenarm series (Stose and Stose, 1946), are Harpers phyllite. This conclusion based on structural evidence that local stratigraphic section is reverse of that previously reported and therefore section shows same sequence of beds as known Cambrian section 8 miles to west. Stose and Stose, who considered area to be a syncline, divided phyllite [Harpers] into Ijamsville and Urbana phyllites. Although this division may be valid, it is difficult to map the contacts accurately and both units are considered to be part of the Harpers.

U.S. Geological Survey currently designates the age of the Glenarm Series as Lower Paleozoic(?)

Named from Ijamsville, Frederick County, Md., where it has been quarried.

Ilchester Granite[1]

Precambrian(?) : Eastern Maryland.

Original reference: W. H. Hobbs, 1889, Am. Jour. Sci., 3d, v. 38, p. 225–228.

Occurs at Ilchester, Howard County.

Ildefonso Formation

Upper Cretaceous : Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 24–44, geol. map. Consists of volcanic conglomerate, conglomeratic sandstone, tuffaceous siltstone, thin-bedded argillaceous limestone, and mas-

sive argillaceous limestone. The massive limestone occurs as lenses throughout formation; the two largest lenses are herein named Santa Ana and Jueyes. Total thickness difficult to calculate because of irregular structural trends imposed by Palmarejo stock and because top of formation is nowhere exposed. Lower part of formation (Santa Ana lens to base) is about 3,000 feet. Intruded by Pasto andesite (new). Formation includes part of Río Jueyes, Guayama, and Sierra de Cayey "series" of Hodge (1920) which could not be recognized in present study. Part of Hodge's Río Descalabrado[s] "series" also assigned to Ildefonso. Disconformably overlies Robles formation; unconformably underlies Jacaguas group; interfingers with Toa Vaca formation (new).

Type area: Barrio San Ildefonso to southeast of Coamo. Crops out largely in Coamo quadrangle but extends into Barranquitas, Orocovis, and Río Descalabrado quadrangles.

Iles Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: Named by E. T. Hancock, but publication of report delayed so that name first appeared in U.S. Geol. Survey Press Memo. 16037, Oct. 1, 1923 on map of Hamilton and Seeping Spring Gulch domes and vicinity, Moffat County.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 154–157, pl. 19. In lower part of Mesaverde group. Conformable with Mancos shale below and Williams Fork formation above. Lower two-thirds of formation, 1,000 to 1,100 feet, consists of massive ledge-forming beds of light-brown, light-gray, and white sandstone interbedded with gray sandy shale, shale, and, in its upper part, coal beds; upper one-third is shale sequence capped by cliff-forming sandstone, which together are about 600 feet thick. Contains four persistent sandstones: Tow Creek member at base, double ledge-forming sandstone sequence 400 feet or more above base; light-gray sandstone sequence of variable composition associated with upper (no. 3) coal of lower group and situated about 900 to 1,000 feet above base; and Trout Creek limestone member at top.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Ann. Field Conf., p. 43–44, figs. 3, 4. Described in Yampa district. Thickness 1,350 to 1,580 feet. Includes Tow Creek sandstone member at base, Oak Creek sandstone member (new) 920 feet above base, and Trout Creek sandstone member at top. Overlies Mancos shale; underlies Williams Fork formation.

Forms nearly all of Iles Mountain.

Ilion Shale

Middle Silurian (Lockportian): Central New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Consists of about 60 feet of sparsely fossiliferous calcareous gray-black shale with interbedded dolomite layers containing stromatoporoids. Overlies Herkimer sandstone; underlies Vernon shale.

Type section: Starch Factory Creek, 5 miles west-southwest of Ilion, Herkimer County.

Illahe Formation[1]

Oligocene, middle: Northwestern Oregon.

Original reference: T. P. Thayer, 1933, Pan-Am. Geologist, v. 59, no. 4, p. 317.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 703, 704; 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1614. May be 2,000 to 3,000 feet thick. Middle Oligocene

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 6–7. Underlies Stayton lavas. Type locality designated. As geological mapping of Willamette Valley progresses, it may be advisable to drop name Illahe as synonym for either Eugene or Pittsburg Bluff formations.

Type locality: Illahe Hill, which crosses range line east of sec. 1, T. 8 S., R. 4 W., about one-half mile east of Willamette River, Marion County.

Illinoian Glaciation

Illinoian Drift,[1] Till

Illinoian Stage, Age

Illinoian stage of glaciation[1]

Pleistocene: Mississippi Valley.

Original reference: T. C. Chamberlain, 1896, Jour. Geology, v. 4, p. 872–876.

M. M. Leighton and H. B. Willman, 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). Illinoian stage includes (ascending) Payson, Jacksonville, and Buffalo Hart substages.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 35, 52 (fig. 2), 110. Illinoian age (stage) is glacial interval next following Yarmouthian. Followed by Sangamonian. Illinoian stage represented in Kansas by Crete and Loveland members of Sanborn formation. Crete and Loveland are classed as formations in Nebraska. In Iowa and Illinois, term Centralian used to include Illinoian and Sangamonian.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 133–139. Illinoian stage subdivided into Loveland, Payson, Jacksonville, and Buffalo Hart substages. Illinoian drift forms principally till plains or ground moraines —the Buffalo Hart, which crosses Beardstown and Vermont quadrangles, and the Jacksonville, which crosses Beardstown quadrangle and is overridden by Buffalo Hart moraines in northeast part of quadrangle.

Name amended to Illinoian Glaciation to comply with Stratigraphic Code adopted 1961.

Named for development in Illinois.

Illipah Formation

Upper Mississippian: Nevada and Utah.

F. W. Christiansen, 1951, Utah Geol. Soc. Guidebook 6, p. 76. Mentioned in summary of structural history of Great Basin province in Utah and eastern Nevada. Referred to as tongues of sandstone and conglomerate that lense eastward into dark-gray marine shales.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). As shown on correlation chart and diagrams, the Illipah underlies Ely, Callville, and Bird Spring formations and overlies Chainman, Rogers Spring, and Monte Cristo formations.

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 81–82, 83 (fig. 1), 84. Discussion of aspects of Chainman formation. The Chainman is recognized as a valid stratigraphic unit. Rather than formally recognize Diamond Peak and Scotty Wash as distinct units, the writer [Sadlick] prefers to refer to these as

facies within the Chainman. Term Illipah (Christiansen, 1951) is suppressed as synonomous with Diamond Peak, and term should not be used for limestone sequence in upper part of Chainman.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 99. Scotty Wash quartzite of Pioche district and Illipah sandstone of Hamilton district are same lithogenetic units. Scotty Wash quartzite has priority; recommended that name Illipah be abandoned.

Type locality and derivation of name not stated.

Illipah Formation

Eocene: Northeastern Nevada.

T. E. Eakin, 1960, Nevada Dept. Conserv. Nat. Resources Rept. 1, p. 26. Fresh-water limestone, conglomerate, and interbedded tuff. Thickness 1,500 feet or more. Unconformably underlies Lake Newark formation (new); unconformably overlies Newark Canyon formation. Name credited to F. L. Humphrey (in press).

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 41–42, pl. 1. Formal proposal of name. Includes two members; lower consists of limestone and chert conglomerate, calcareous sandstone, and vuggy limestone which resembles tufa; and upper member contains well-bedded marl and fresh-water limestone with interbedded altered tuffs near middle. Total thickness, measured from partial sections, more than 1,500 feet. Unconformably underlies Lake Newark formation; overlies unnamed conglomerate and sandstone.

Named for exposures on Illipah Creek in northern part of White Pine mining district, White Pine County.

Ilmon Basalt

Miocene, lower(?); Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 37–38, pls. 1, 2, 3. Dark-brown basic andesite lava. Thickness ranges from less than 1 inch to 100 feet. Conformably overlies Walker formation in Caliente Canyon. Underlies Bena gravels and sandstone (new). About 3 miles northwest of Bena, where lava is about 15 feet thick, it separates Walker formation below from Freeman-Jewett shale above.

Lava is traceable through series of isolated outcrops from point 2 miles west of Ilmon Station northwestward for about 3 miles to west border of map [Breckenridge Mountain quadrangle, Kern County].

†Ilo Formation[1]

Upper Cretaceous: Northwestern Wyoming.

Original reference: D. F. Hewett, 1914, U.S. Geol. Survey Bull. 541, p. 91, 103.

H. E. Summerford and others, 1947, *in* Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 19. Road log of Bighorn basin mentions Ilo Ridge member of Lance formation on east flank of Grass Creek anticline. Basal unit of formation; overlies Meeteetse formation.

Well exposed in open valley, in Park County, northwest of Ilo, settlement 50 miles southeast of Cody, hence the name.

Ilo Ridge Member (of Lance Formation)

See Ilo Formation.

Imperial Formation[1]

Miocene, lower: Southern California.

Original reference: G. D. Hanna, 1926, California Acad. Sci. Proc., 4th ser., v. 14, no. 18, p. 434–435.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1782. Marine mudstone, siltstones, and sandstones unconformably overlying all older rocks. Thickness 0 to 3,600 feet. Overlies Alverson Canyon formation (new); underlies Palm Spring formation. Upper Miocene.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4), 22. Age in doubt. Latest evidence, unpublished, seems to suggest that Pliocene assignment of early workers is preferable to Miocene allocation adopted by some authors. Includes Latrania sand member.

J. W. Durham, 1950, Geol. Soc. America Mem. 43, pt. 2, p. 30–33. Believed that San Marcos and Imperial formations are best assigned to lower Pliocene.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22, 23. Formation is series of marine clays and sandstones that lie with essential concordance on Alverson andesite or lava (new), Split Mountain formation, and Fish Creek gypsum (new), or in some areas, unconformably on basement rocks. Grades upward into Palm Spring formation. Canebrake conglomerate (new) is coarse marginal conglomerate facies of Imperial and Palm Spring formations. Fauna indicates upper Miocene or possibly lower Pliocene.

C. R. Allen, 1954, California Div. Mines Bull. 170, map sheet 20; 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 327–328. In San Gorgonio Pass area, formation is about 300 feet thick; conformably overlies Hathaway formation (restricted and redefined) and conformably underlies Painted Hill formation (new). Considered to be early Pliocene(?).

Type locality: Coral reef exposed in Alverson Canyon on south side of Coyote Mountain [also called Carrizo Mountain], Imperial County.

Incarnacion Fire Clay[1]

Pennsylvanian: Central northern New Mexico.

Original reference: C. L. Herrick, 1904, Jour. Geology, v. 12, p. 242.

Occurs near Socorro, Socorro County. Named for mining district in which it occurs.

Incarnacion Granite[1]

Age(?): Central New Mexico.

Original reference: C. L. Herrick, 1904, Jour. Geology, v. 12, p. 237–251.

Named for mining district in which it occurs.

Indart Sandstone

Eocene: West-central California.

N. L. Taliaferro, 1945, Geologic map of the Hollister quadrangle, California (1:62,500): California Div. Mines Bull. 143, pls. 1, 2 [preprint?]. Shown on map legend as underlying Los Muertos Creek shales and unconformably overlying Cretaceous sandstones, shales, and conglomerates.

Present west of Tres Pinos fault, in southeastern part of quadrangle. Locality is west of Indart Ranch.

†Independence Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: E. Haworth and W. H. H. Piatt, 1894, Kansas Univ. Quart., v. 2, p. 115–117.

Named for Independence, Montgomery County.

Independence Shale

Independence Shale Member (of Wapsipinicon Limestone)[1]

Middle Devonian: Central eastern Iowa.

Original reference: S. Calvin, 1878, Am. Jour. Sci., 3d, v. 15, p. 460–462.

G. A. Cooper and A. S. Warthin *in* G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1737 (fig. 1), 1766–1767, chart 4. Position and age of Independence shale have been subjects of debate for many years. One group holds that the Independence normally underlies the Cedar Valley and the other that the shale is not in its true stratigraphic position. Stainbrook (1935) maintains that the shale underlies the Cedar Valley conformably but overlies Davenport limestone of the Wapsipinicon unconformably and cites as supporting evidence the sinking of an artesian well at Shellsburg which showed Independence shale carrying typical fossils below 65 feet of Cedar Valley limestone. Writers hold that the Independence is not in normal position because (1) it fills sinks and caverns; (2) its occurrence is spotty, there being no definite outcrop belt; and (3) its fauna is that of the Nunda or High Point (Chemung) sandstone and the Frasnian (F) of Belgium.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 1, p. 66–83; no. 2, p. 138–158. Discussion of age and stratigraphic position of Independence shale and summary of all available evidences noted in natural and artificial exposures and secured from deep and shallow well records. All evidence indicates that, normally, Independence lies immediately below Cedar Valley limestone and above Wapsipinicon formation. Fauna is definitely lower Upper Devonian.

Named for occurrence at Independence, Buchanan County.

Index Granodiorite[1]

Jurassic(?): Central Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 7, p. 34–50.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 19. Intrudes Gunns Peak formation.

Typically exposed near Index, Snohomish County.

Indian Conglomerate[1]

Eocene(?): Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 10, p. 344, 350–352, pl. 46, map.

Well developed in and named for Indian Canyon, Santa Barbara County.

Indiana glaciation

Indiana till[1]

Pleistocene (pre-Nebraskan): Illinois and Indiana.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203,217.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 68, no. 2, p. 129. Referred to as glaciation.

Indianan till[1]

Pleistocene: Indiana

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 45, p. 151.

Indian Bluff Group

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 6, pls. 2, 3, 4. Includes strata between top of Slatestone group (new) and base of Graves Gap group (new). Thickness at type section 455 feet; in southwestern part of Cumberland Mountains 300 to 470 feet; thins northwestward; on Cumberland Block, 150 to 200 feet. Includes (ascending) shale interval, Seeber Flats sandstone (new), shale interval, Stockstill sandstone (new), shale interval, Indian Fork sandstone (new), shale interval, and Pioneer sandstone. Indian Fork sandstone not present at type locality.

Type section: Cross Mountain, Lake City quadrangle. Named from Indian Bluff on eastern edge of Braden Flats, a short distance northeast of Graves Gap, Anderson County. Section begins at top of Jellico coal on Militia Hill and ends on top of Pioneer sandstone upon which Mountain View Church is located.

Indian Cave Channel Sandstone Bed (in Towle Shale Member of Onaga Shale)

Indian Cave Sandstone[1]

Indian Cave Sandstone Member (of Towle Shale)

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12), 201.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 37. Gives areal distribution and derivation of name.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 52. Member of Towle shale. Consists of sandstone, siltstone, and locally conglomerate in part; occurs as local channel fillings that grade upward into basal part of the unnamed upper member of the Towle. Reported maximum thickness about 200 feet. Type locality in Nebraska. Wolfcamp series.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Rank reduced to bed in Towle shale member of Onaga shale.

Occurs at Peru, in southeastern Nemaha County (at Indian Cave), and near Falls City, Richardson County, Nebr., and at places in Kansas.

Indian Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 386.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 74. Shaly sandy clay. Overlies Antelope Creek bed or, where that is absent, Comanche Creek bed; underlies Ricker bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units,

or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in conmmon use today, and that name has been restricted to base of Drake's Ricker bed.

Named for Indian Creek, Brown County.

Indian Creek Granite

Precambrian: Central Colorado.

M. F. Boos and E. J. Aberdeen, 1936, (abs.) Geol. Soc. America Proc. 1935, p. 67; 1940, Geol. Soc. America Bull., v. 51, no. 5, p. 699, 728, pl. 1. Name applied to granite in Indian Creek pluton. In field relationships, physical appearance, and crystalline character, closely related to granite of Silver Plume batholith.

Named for Indian Creek Park. Crops out as a group of plutons which make four belts of subparallel, slightly en echelon, granite bodies concentrically aligned along north and east margins of Rosalie lobe of Pikes Peak batholith.

Indian Creek Shale Member (of Admiral Formation)[1]

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 423.

R. C. Moore *in* A. K. Miller and Walter Youngquist, 1947, Kansas Univ. Paleont. Contr. 2, Mollusca, art. 1, p. 1, 2; R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Renamed Wildcat Creek shale. Name Indian Creek preoccupied by Indian Creek of Pennsylvanian age.

Named for Indian Creek, Coleman County.

Indian Fields Formation[1]

Silurian: East-central Kentucky.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 60.

Named for Indian Fields, Clark County.

Indian Fork Member (of Wells Formation)

Permian (Wolfcampian): Idaho.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Overlies Sublett member (new); underlies unnamed cherty orthoquartzite member.

Present in Sublett Mountain area.

Indian Fork Sandstone (in Indian Bluff Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Thickness 15 to 60 feet. Separated from overlying Pioneer sandstone by shale interval that is as much as 80 feet thick in places; separated from underlying Stockstill sandstone (new) by a shale interval that averages 40 to 60 feet in thickness.

Named from exposures along incline on north side of Indian Fork, Fork Mountain quadrangle, Anderson County.

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Indian Fort Shale Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 170, 174, 188, pl. 15. Uppermost member of Brodhead formation (new) in area of Irvine facies (new). Typically silty to argillaceous shale, olive-gray with distinct maroon to purple patches. Thickness 30 to 45 feet. In type area, underlies Floyds Knob formation and overlies Combs Mountain siltstone member (new) of Brodhead formation. Extends beyond area of Irvine facies across the southwestern third of the area of the Morehead facies (new), as far as Rowan County. In area of Morehead facies, Indian Fort overlies Haldeman siltstone member (new). In this area the Indian Fort member together with Rothwell shale member (new) of Muldraugh formation (new) and intervening Floyds Knob horizon constitute "Morris Mountain shaly member" (Butts, 1922) which name should be discarded as a single stratigraphic unit.

Type section: Along secondary road up steep hill to old Indian Fort; base of section at juncture with State Highway 21, 1¼ miles east of road intersection at Big Hill, 3½ miles east-southeast of Berea, Madison County. Named for old Indian Fort located on cliff 3½ miles southeast of Berea.

Indian Gap Limestone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 52, 108, 326, 340.

Occurs at Indian Gap, Raleigh County.

Indian Gulch[1] (Formation)

Mesozoic: East-central California.

Original reference: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

Occurs on Merced River and southward into Indian Gulch quadrangle.

Indian Hill Series[1]

Upper Cretaceous: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 340, pl. 20, map.

Probably named for Indian Hill on Marthas Vineyard.

Indian Hills Volcanics (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 20–21, pl. 1. Divided into two interbedded (lithologic and not stratigraphic) units: one andesitic and basaltic, the other rhyolitic. Andesitic and basaltic flows greenish black. Rocks porphyritic with holocrystalline, but commonly aphanitic, groundmass. Amygdules, composed of members of epidote group, and vesicles abundant. Rhyolitic flows inconspicuously porphyritic. Groundmass aphanitic; in places appears siliceous. Thickness not known because base of formation does not crop out. Outcrops in hills west of Coyote Spring ranch reveal maximum width of 6,500 feet. Conformably underlies Spud Mountain volcanics (new). Younger than Texas Gulch formation (new).

Named from exposures in low hills of this name along western front of Black Hills, Jerome area, Yavapai County. Only other major outcrops are 2 miles to north in low hills west of Coyote Spring Ranch.

Indian Hollow Sands[1]

Pleistocene: Northwestern Pennsylvania.

Original reference: E. H. Williams, Jr., 1920, Am. Philos. Proc., v. 59, p. 62, 73.

Named for Indian Hollow, Warren County.

Indian Ladder Formation

Indian Ladder Beds[1]

Upper Ordovician: Eastern New York.

Original reference: J. M. Clarke, April 15, 1911, New York State Mus. Bull. 149, p. 10–12.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 9 (table 1), 11 (fig. 3), 13, pl. 2. Formation described in Albany County where it consists of dark-gray to black argillaceous shales, which alternate with thin, yellow, rusty-looking calcareous sandstone beds; occasional heavy sandstone bed present. Thickness about 400 feet. Underlies Brayman shale; overlies Schenectady formation.

Named for exposures at Indian Ladder, near Meadowvale, Albany County.

Indian Meadows Formation

Eocene, lower: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 10, 11 (fig. 2), 58–63, pl. 17. Proposed for lower Lower Eocene strata unconformably overlying rocks ranging from Precambrian to Upper Cretaceous, and unconformably underlying Wind River and other younger rocks. Chiefly variegated clays, sandstones, and coarse and fine conglomerates; a few algal ball limestones and small amounts of volcanic material. Thickness about 1,000 feet.

Type section: Eastern side North Fork River valley, in secs. 14, 15, and 16, T. 6 N., R. 6 W., in Wind River basin, 6 miles from front of Washakie Range. Name derived from Indian Meadows, a bottom-land area along North Fork River, about 1½ miles north of Circle Ranch, southwestern corner Kirwin quadrangle.

Indian Mills Sandstone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Mercer, Monroe, and Summers Counties, p. 300, 400.

Type locality: On north side of Indian Creek just west of Indian Mills, Summers County, W. Va.

Indian Mills Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 401.

Type locality: On north side of Indian Creek just west of Indian Mills, Summers County.

Indian Mountain Leucogranodiorite

Cretaceous: Southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 85–87, pl. 1. Nearly white in color, rather fine grained, and contains very little biotite. Upper part of mass shows faint streaking due to orientation of dark minerals, and this becomes more prominent as lower contact is approached. For some feet above base, the rock is well-banded micaceous gneiss with much more mica than usual. In contact with and intrudes Bonsall tonalite.

Named from exposures on Indian Mountain, northern part of San Luis Rey quadrangle.

Indianola Group

Upper Cretaceous: Central Utah.

S. L. Schoff, 1938, Ohio State Univ. Abs. Doctors Dissert. 25, p. 378. Series of conglomerates, sandstones, shales, and minor limestones. Thickness 9,350 to 14,680 feet. In Gunnison Plateau, overlies Arapien shale (new); underlies Price River formation. Name credited to E. M. Spieker.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 126–130. In Thistle, Sixmile, and Salina Canyon areas, the unit, truncated by Price River and younger formations, is subdivided into four formations (ascending): Sanpete, Allen Valley shale, Funk Valley, and Sixmile Canyon (all new); in other areas undifferentiated. Overlies the Morrison(?) formation. Type area designated.

S. L. Schoff, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 622, 624–627. In Cedar Hills, undifferentiated Indianola is about 14,680 feet thick. Unconformably overlain by fluviatile and lacustrine deposits ranging from Montana to Eocene in age (Price River, North Horn, Flagstaff, Colton, and Green River formations).

Type area: Indianola district [Sanpete and Utah Counties], Wasatch Plateau.

Indian River Hornblende Syenite

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 85, 285, 286. Mentioned in discussion of Adirondack igneous rocks. Hornblende syenite near village of Indian River is described under heading of Diana quartz syenite complex.

Village of Indian River is in Lowville quadrangle, Lewis County.

Indian River Slate[1]

Indian River Formation

Middle Ordovician: Eastern New York and southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 403.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 53, 56. Referred to as Indian River formation. Overlies Poultney formation; underlies unnamed Normanskill greywackes and black slates.

Named for Indian River, a few miles south of Granville, Washington County, N.Y.

Indian Spring Redbeds
Indian Spring Sandstone } (in Tonoloway Limestone)[1]

Upper Silurian: Northern Maryland.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey Silurian vol., p. 46–49.

H. P. Woodward, 1941, West Virginia Geol. Survey [Repts.], v. 14, p. 213. Indian Springs sandstone and associated Indian Springs red beds apparently represent extensions of the red Bloomsburg facies into the Tonoloway.

Named for occurrence at Indian Spring, Washington County.

Indian Springs Member (of Bird Spring Formation)[1]

Upper Mississippian: Southeastern Nevada.

Original reference: C. R. Longwell and C. O. Dunbar, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 9, p. 1200–1207.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503. Incidental mention in discussion of revision of Devonian and Carboniferous sections, Nopah Range, Inyo County, Calif.

Described in vicinity of Indian Springs, 50 miles northwest of Las Vegas.

Indian Springs Shale[1]

Mississippian (Chesterian): Southwestern Indiana.

Original reference: C. A. Malott and J. D. Thompson, Jr., 1920, Science, new ser., v. 51, p. 521–522.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, pl. 3. On chart showing evolution of nomenclature in Chester series of Indiana, unit termed Indian Springs shale is apparently included in Golconda formation.

Probably named for Indian Springs, Martin County.

†Indian Territory division[1]

Lower Cretaceous: Oklahoma.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504.

†Indio Formation[1]

Miocene, middle or upper: Southern California.

Original reference: J. P. Buwalda and W. L. Stanton, 1930, Science, new ser., v. 71, p. 101–106.

C. R. Allen, 1954, California Div. Mines Bull. 170, map sheet 20; 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 328. Preoccupied name Indio replaced by Painted Hill formation (new). Bramkamp (1934, unpub. thesis) termed this unit [Painted Hill] Indio formation because its stratigraphic position is similar to that of Indio formation in Indio Hills (Buwalda and Stanton, 1930). Dibblee (1954) included in Palm Spring formation those beds of Indio Hills that are immediately post-Imperial in age. No assurance that post-Imperial rocks at Painted Hill and those in Indio Hills are actually parts of same formational unit.

Type section: Along northeast-southwest line through Indio Hills, about 2 miles northwest of Thousand Palm Canyon, Riverside County.

Indio Formation (in Wilcox Group)[1]

Eocene, lower: Southern Texas.

Original reference: A. C. Trowbridge, 1923, U.S. Geol. Survey Prof. Paper 131–D.

C. C. Mason, 1960, Texas Board Water Engineers Bull. 6003, p. 15–25. Composed predominantly of thin-bedded to laminated clayey sand and sandy shale, but includes some thick layers of sandstone, discontinous beds of lignite, and numerous calcareous, arenaceous, and ferruginous concretions. Thickness 0 to about 1,520 feet in Dimmit County. Lies unconformably on and overlaps Kincaid formation. Underlies Carrizo sand. Wilcox group. Type locality stated.

Type locality: On old Indio Ranch in Maverick and Dimmit Counties. Crops out in belt extending northward from Rio Grande through western Dimmit and western Maverick Counties.

Ingalls Formation

Oligocene(?): Northeastern California.

Cordell Durrell, 1959, California Univ. Pubs. in Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 167–170. Pyroxene and hornblende andesite mudflow breccia; local thin volcanic conglomerate at base; black-weathering craggy outcrops. Thickness along Red Clover Creek about 550 feet; in west-central part of quadrangle, maximum thickness appears to be about 800 feet, but section may be partly duplicated by faulting. Separated from underlying Eocene Lovejoy formation and overlying middle Miocene(?) Delleker formation by unconformities, both intervals marked by extensive faulting and erosion. In Red Clover Creek area, the Ingalls is on Lovejoy at all points where base is exposed; in east-central part of quadrangle, rests in many places on granitic and metamorphic rocks; in west-central part, lies on basement of metamorphic rocks but also overlaps edge of channels of unit here referred to as auriferous gravel, and in several instances it rests on metamorphic rocks on one side of a fault and on auriferous gravels on the other. No area can be designated as type because of variability of composition and thickness from one part of quadrangle to another.

Named for Mount Ingalls in northern part of Blairsden quadrangle. Well exposed along Red Clover Creek.

Ingalls Peridotite

Pre-Tertiary: Northwestern Washington.

R. C. Ellis, 1959, Dissert. Abs., v. 20, no. 3, p. 990. Rocks of Mount Stuart block exposed along east margin of mapped area consist of Hawkins greenstone, Ingalls peridotite (largely sepentinized), and Mount Stuart granodiorite.

Report discusses geology of Dutch Miller Gap area.

Inglefield Sandstone[1]

Upper Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 87. Massive sandstone between Wabash above and Ditney formations; later erroneously correlated with Merom sandstone.

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 131. Part of Fuller's Inglefield formation (as mapped in Ditney and Patoka folios) is included in Dicksburg Hills sandstone.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as overlying Ditney formation and separated from overlying Parker limestone by Parker coal.

Named for Inglefield, Vanderburgh County.

†Ingles Conglomerate Member[1] (of Price Formation)

Silurian: Southwestern Virginia.

Original reference: M. R. Campbell, 1925, Virginia Geol. Survey Bull. 25.

Exposed on Ingles Mountain, back of Radford, Montgomery County.

Ingleside Chert Member (of Franciscan Formation)

Ingleside Chert (in Franciscan Group)[1]

Jurassic and Cretaceous: Northern California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

U.S. Geological Survey currently classifies the Ingleside Chert as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures in San Miguel Hills, east of Ingleside, San Francisco County.

Ingleside Formation[1]

Lower Permian: Central northern Colorado.

Original reference: R. M. Butters, 1913, Colorado Geol. Survey Bull. 5, p. 68, 75.

C. S. Lavington and W. O. Thompson, 1948, Colorado School Mines Quart., v. 43, no. 2, p. 38–40. Overlies and interstratifies with Fountain formation; underlies Lyons sandstone. Considered southward tongue of Casper formation of Wyoming.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 34. Increases in thickness from featheredge near Boulder to about 250 feet near Wyoming-Colorado line. At type locality, near Fort Collins, formation consists of three beds of limestone separated by layers of crossbedded red sandstone. Rests with slight unconformity on Fountain formation; conformably underlies Satanka shale north of Ingleside, but to south unconformably underlies Permian Lyons sandstone.

E. K. Maughan and R. F. Wilson, 1960, *in* Guide to the geology of Colorado: Denver, Rocky Mountain Assoc. Geologists, p. 35–37, 41. Ingleside formation, part of Casper formation equivalent to Ingleside, and part of Fountain formation equivalent to Ingleside are of early Permian age.

Typically developed at Ingleside quarries and at Owl Canyon, 3 miles north of Ingleside, Larimer County.

Ingleside Formation

Recent: Southern Texas.

W. A. Price, 1939, (abs.) Am. Assoc. Petroleum Geolgists Bull., v. 23, no. 12, p. 1875. Lake Charles formation (new) and Ingleside formation replace Beaumont formation.

Present in Rio Grande delta. Type locality and derivation of name not given.

Inglis Formation (in Ocala Group)

†Inglis Limestone

Inglis Member (of Moodys Branch Formation)

Eocene, upper: Florida.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 115–140. Member is base of Jackson group in Florida and is a miliolid- and echinoid-rich cream-colored marine limestone. Complete thickness not exposed in any one place; as much as 54 feet in core holes; outcrops 2½ to as much as 30 feet. Conformably underlies Williston member (new); unconformably overlies Avon Park limestone.

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2, p. 130; 1957, Florida Geol. Survey Bull. 38, p. 24–28. Rank raised to formation in Ocala group. Type locality stated.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1), 3. Referred to as limestone. Rocks now assigned to Inglis, though equivalent to the Moodys Branch were formerly included in Ocala limestone. Contains late Eocene echinoids.

Type locality: Around town of Inglis, Levy County, where limestone is exposed in several pits and quarries, and also along Withlacoochee River.

Ingramian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 985–987, 1005. One of six stages, based on foraminiferal assemblages, in Upper Cretaceous column between top of Moreno and base of Panoche, as defined by Anderson and Pack (1915). Roughly correlative with upper part of type Panoche formation. Includes interval between Ciervian stage (new) above and Tracian stage (new) below.

Occurs in Great Valley in both surface and subsurface. Named from Ingram Creek [Fresno County].

Inman Formation (in Eden Group)

Upper Ordovician: Central Tennessee.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 175–179. Greenish-gray calcareous shale with zones of red shale interbedded with beds of uniformly bedded greenish-gray to gray dove-colored fine-grained, dense limestone; at some localities limestone is clayey and laminated and in other places is uniformly medium grained. Beds of limestone range between 1 and 6 inches in thickness. Thickness 45 feet in Giles County, 48 feet in Franklin County, and 40 to 70 feet in Sequatchie Valley. Overlaps upon Catheys and overlapped by Leipers.

Named for exposures at Inman, Marion County. Restricted to synclinal belt in southwestern Lincoln County and east-central Giles County and in similar belt in Franklin and Moore Counties that is connected with the formation as exposed in Sequatchie Valley.

Inola Limestone Member (of Boggy Shale)[1]

Pennsylvanian (Des Moines Series): Northeastern Oklahoma.

Original reference: S. W. Lowman, 1932. Summaries and abstracts of technical papers presented before Tulsa Geol. Soc. 1932, unpaged.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 12, 16 (fig. 2). Immediately above Bluejacket sandstone member is sequence of four cyclical units, each containing zone of marine fossils. Cap rock limestone of lowest of these cycles contains abundant fusulinids. Name Inola here

restricted to lowest limestone, the only one that yields fusulinids. Fusulinids reported from Inola at type locality.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 6. Referred to as Inola coal cycle.

Named for outlier on hill east of Inola, Rogers County.

Inskip Formation

Mississippian(?): North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Lower half, mostly quartzite and slate with thin beds of limestone, some chert, a few greenstone flows, some graywacke, conglomerate, and quartzitic grit. Upper half, thin-bedded limestone interbedded with siliceous and calcareous slate and quartzite. Thickness more than 9,000 feet at type locality. Underlies Tallman fanglomerate (new) and Koipato formation with angular unconformities.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2848. Throughout most of outcrop area Inskip and Leach formations are in fault contact, and their stratigraphic relations are not definitely known. The Leach appears to underlie the Inskip. Probably Late Mississippian.

Type locality: Inskip Canyon, west flank of East Range, Winneumcca quadrangle.

Institute Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth, 1894, Kansas Univ. Quart., v. 2, p. 122, 124.

Exposed at Haskell Institute, Lawrence, Douglas County.

Interior Formation[1]

Interior Member (of Pierre Shale)

Upper Cretaceous: Southwestern South Dakota and northwestern Nebraska.

Original reference: F. Ward, 1922, South Dakota Geol. Nat. History Survey Bull. 11, p. 18–20, map.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2, p. 20, 23–25. Rank reduced to member status in Pierre shale. Name has precedence over Mowbridge member. Underlies Elk Butte member; overlies Virginia Creek member.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1950, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2 (revised), p. 20, 23. Replaced by Mowbridge now the accepted term.

Named for development in vicinity of town of Interior, Jackson County, S. Dak.

Intermediate Dolomite Member (of Boardman Formation)

Intermediate Limestone

Lower Ordovician: West-central Vermont.

G. W. Bain, 1931, Am. Jour. Sci., 5th ser., v. 22, no. 132, p. 508, 509. Intermediate limestone is slightly silicified dolomitic rock. Maximum thickness 190 feet.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 25, 26. Rank reduced to Intermediate dolomite member, the middle member of Boardman formation in Castleton area, Rutland County. Formally described as thick-bedded rather porous light-gray dolomite generally containing some sandy beds and typical large quartz knots. Some patches of white marble enclosed in dolomite. Underlies Columbian marble member of Boardman formation; overlies Sutherland Falls marble member of Boardman formation.

Occurrence: Addison and Rutland Counties.

Intervale Clay Slate[1]

Silurian (?): East-central New Hampshire.

Original reference: M. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, p. 80, map.

Occurs two miles northeast of Intervale [village], Carroll County.

Intracanyon basalt formation

Recent: Central Oregon.

E. T. Hodge, 1940, Oregon State Coll. Studies in Geology, Mon. 1, [map with text]. Named and mapped as Intracanyon basalt formation. Described as basalt flows occupying and partly filling Deschutes, Crooked, and Metolius River canyons. Lies against old talus slopes, or Madras sediments.

Occurs in Madras quadrangle, Jefferson County.

Inwood Limestone[1]

Inwood Marble (in New York City Group)

Precambrian: Southeastern New York and western Connecticut.

Original reference: F. J. H. Merrill, 1890, Am. Jour. Sci., 3d, v. 39, p. 389–390.

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 673. Inwood marble included in New York City group (new). Overlies Fordham gneiss; underlies Manhattan formation. White to gray, moderately silicated, medium-grained rock ranging in composition from calcite to nearly pure dolomite. Indistinguishable lithologically from marble layers occurring within Fordham and Manhattan formations. Correlations indicate lower Paleozoic age for New York City group.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 18–21, geol. map. Geographically extended into Danbury quadrangle, Connecticut. On State Geological Map of 1906, it is called Stockbridge limestone. In subsequent work dealing with the quadrangle, Moore (1935, Connecticut Geol. Nat. History Survey Bull. 56) used term Stockbridge series; Balk (1936, Geol. Soc. America Bull., v. 47, no. 5) used term Wappinger marble. Inwood lies stratigraphically above Fordham gneiss and below Manhattan formation. It is excellent stratigraphic marker and helps to distinguish Manhattan and Hartland formations. New York City group.

Named for exposures in vicinity of Inwood on Manhattan Island.

Inwood Sandstone[1]

Silurian(?): Southeastern Pennsylvania.

Original reference: C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, p. 635.

Bradford Willard, 1952, Pennsylvania Acad. Sci. Proc., v. 26, p. 75. Mentioned in report on lower Oriskany contact in eastern Pennsylvania. Thickness 49 feet. Occurs between Bloomsburg red beds and Onondaga limestone. Age unknown. Probably Silurian.

Occurs in section east of Swatara Creek at Swatara Gap near Inwood Station on Philadelphia and Reading Railway.

Inyan Kara Group[1]

Lower Cretaceous: Northeastern Wyoming and western South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

K. M. Waagé, 1959, U. S. Geol. Survey Bull. 1081–B, p. 13–90. Darton's subdivision of beds, originally called Dakota in Black Hills, has been difficult to apply outside of limited area in southeastern Black Hills in which names were first applied. In 1930, principal subdivisions, Lakota, Fuson, and Fall River (Dakota of Darton) formations, were placed in Inyan Kara group because they could not be distinguished consistently as separate units. Early miscorrelation of the Fall River (Dakota) with Dakota sandstone of southeastern Colorado has led to confusion in application of Darton's terminology outside of Black Hills. Stratigraphic studies of group reveal basic twofold lithogenetic subdivision which has been recognized in equivalent beds elsewhere in western interior region. Deposits of lower part of this division are dominantly sandy sediments of varied continental facies and are allied lithogenetically with underlying Morrison formation. Deposits of upper part are dominantly sandy sediments of marginal marine facies allied lithogenetically and gradational with overlying marine Skull Creek shale. Contact of the two parts is transgressive disconformity [see Dakota group for explanation] of regional extent marking initial incursion of Cretaceous sea. Subdivision and nomenclature of group is adjusted to conform to this lithogenetic division by redefinition of Fall River formation so that it corresponds with upper part and extending term Lakota, which here comprises Minnewaste and Fuson members, to include entire lower part. The transgressive disconformity becomes contact of Lakota and Fall River formations. Because of strictly local nature of much of the group, neither its name nor names Fall River and Lakota should be used outside of Black Hills region.

Named for exposures along Inyan Kara Creek, northeastern part of Moorcroft quadrangle, Crook County, Wyo.

Inyo Granite[1]

Upper Jurassic: Eastern California.

Original reference: J. H. Maxson, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 311.

On east side of Inyo Range.

Inyo Marble[1]

Lower Cambrian: Eastern California.

Original reference: H. G. Hanks, 1886, California State Mining Bur. 6th Ann. Rept. State Min., pt. 1, p. 25.

Caps White Mountain, Inyo Range.

Inyo Series[1]

Lower and Middle Triassic: Eastern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, table opposite p. 217.

Inyo Range.

Inyoan series[1]

Lower Triassic: Southeastern California and southwestern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 59, 79.

Named for Inyo County, Calif.

†Iola Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Iola Limestone (in Kansas City Group)[1]

Iola Limestone (in Ochelata Group)

Iola Limestone Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart. v. 2, p. 109.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40 (table 1), 43. Included in Ochelata group in Oklahoma. Overlies Chanute shale; underlies Lane-Vilas shale. Comprises (ascending) Paola limestone, Muncie Creek shale, and Avant limestone members. Avant has priority over Raytown.

M. G. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 718 (fig. 2), 720 (table 1), 726. In Oklahoma, overlies Chanute formation; underlies Wann formation (revived, restricted, redefined).

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. In Missouri, Iola limestone comprises (ascending) Frisbie limestone. Quindaro shale, and Argentine limestone members. Overlies Liberty Memorial shale member (new) of Chanute shale; underlies Island Creek shale member of Lane shale, Kansas City group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 13. Iola formation redefined for Missouri. Iola of Kansas was incorrectly correlated with higher limestone, the Argentine, in Missouri by Haworth and Bennett (1908, Kansas Univ. Geol. Survey, v. 9), and the correlation was accepted by Hinds and Greene (1915, Missouri Bur. Geology and Mines, v. 13). Error was discovered by Newell in 1932, but change was not made in Missouri until 1947, when Kansas and Missouri geologists traced the Paola, Muncie Creek, and Raytown succession into type section of Iola. Hence, Iola formation in Missouri, like that of Kansas, consists of Paola limestone, Muncie Creek shale, and Raytown limestone members. Overlies Chanute shale (redefined for Missouri); underlies Lane shale (redefined for Missouri). Kansas City group.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 35–36. Thickness of formation 9 feet, Cass County, Nebr.; about 7 feet, Winterset, Iowa; 10

to 12 feet, Kansas City, Mo.; 7 to 8 feet, northeastern Kansas; 10 to 30 feet, Iola, Kans. Includes Paola limestone, Muncie Creek shale, and Raytown limestone members.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness of formation about 10 feet in Madison and Adair Counties, Iowa. Includes only Raytown limestone member. Underlies Lane formation; overlies Chanute shale. Kansas City group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Includes Raytown limestone member, 9 feet; Muncie Creek shale member about 2½ feet; Paola limestone, about 1 foot. Overlies Chanute shale; underlies Lane shale. Kansas City group.

Typically developed at Iola, Allen County, Kans.

†Iola Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth, 1894, Kansas Univ. Quart., v. 2, p. 124.

Probably named for Iola, Allen County.

Ion Dolomite Member[1] (of Decorah Formation)

Ion Submember (of Decorah Shale Member of Galena Formation)

Middle Ordovician: Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: G. M. Kay, 1928, Science, new ser., v. 67, p. 16.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 81, 83–85. Considered submember of Decorah shale member of Galena formation in Minnesota. Occurs at top of Decorah; overlies Guttenberg submember. Consists of calcareous shale with layers or lenses of argillaceous limestone. Thickness 15 to 20 feet in St. Paul area.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 763. Members of Decorah formation (Spechts Ferry, Guttenberg, and Ion) not recognizable rock units in Minnesota.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 285, 293–295. Member of Decorah formation. Type section, herein redescribed, consists of limestone, gray, or greenish gray, gray mottled, thin bedded, fossiliferous—1.3 feet; limestone, thin bedded, argillaceous, interbedded greenish shaly partings, ledge containing *Glyptorthis*—3.2 feet; shale, greenish, calcareous, and thin grayish-green shaly limestone beds, ledges contain *Glyptorthis* and *Dinorthis*—15.5 feet; shale, green, *Prasopora*—0.5 foot; limestone, grayish, coarsely crystalline, fossiliferous, numerous, *Prasopora*—1 foot; shale, olive-brown—0.3 foot. Total thickness 22 feet. Overlies Guttenberg limestone member; underlies cherty zone of Galena dolomite. In eastern part of zinc-lead mining district, Ion is predominantly dolomitic. Hence, consists of two facies: a western, typified by type section, and an eastern, of light- to medium-grayish-blue crystalline to granular vuggy medium- to massive-bedded less fossiliferous dolomites, with subordinate amounts of olive-gray argillaceous patches and dolomitic shale beds.

Type locality: In ravine along road in NW¼ sec. 35, T. 96 N., R. 4 W., about 1 mile southwest of hamlet of Ion, Allamakee County, Iowa.

Ione Formation[1]

Eocene: Northern California.

Original reference: W. Lindgren, 1894, U.S. Geol. Survey Geol. Atlas, Folio 5.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Includes "Dry Creek" sandstone member. A similar silty sand in a similar stratigraphic position has been described in Sierra foothills, 25 miles north of Marysville, by Allen (1929) who named it Dry Creek formation. However, name Dry Creek was preoccupied by Dry Creek shale in Montana. Although a valid name should be assigned to the unit, "Dry Creek" is used here in a quotational sense.

Named for exposures at Ione, Amador County.

Ionia Sandstone Member (of Saginaw Formation)

Ionia Sandstone[1]

Ionia Sandstone (in Grand River Group or Formation)

Pennsylvanian: Southern Michigan.

Original reference: A. Winchell, 1871, Michigan Geol. Survey Rept. Prog., p. 26–33.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 207. Name applied to crossbedded, coarse-grained, varicolored sandstones outcropping in Grand River valley near Ionia. Overlies shales and micaceous sandstones of Saginaw group. Included in newly proposed Grand River group. Stratigraphic relations to Eaton sandstone (new) not determined.

G. V. Cohee, Carol Macha and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Recommended that Ionia sandstone be considered a member in Saginaw formation.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28, 29. Herein considered member of Grand River formation. It is probable that future study will show that the Eaton is a brown-weathering facies of the Ionia as exact stratigraphic position of Eaton and Ionia members in the Grand River is not known. No paleontological evidence available to establish age of Ionia.

Probably named for exposures in abandoned quarries near Grand River between Lyons and Ionia, Ionia County.

Iowa Marble[1]

Mississippian: Central northern Iowa.

Original reference: C. A. White, 1870, Iowa Geol. Survey, v. 2, p. 312–313.

In Le Grand quarries, Marshall County.

Iowa Series[1]

Mississippian: Mississippi Valley region.

Original reference: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 282; no. 5, p. 408–416.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 777–822. Series comprises (ascending) Kinderhook, Osage, and Meramec groups. Underlies Chester series. Report follows classification of Illinois Geological Survey. However, authors believe that Mississippian should have three-fold division, that

Kinderhook should be raised to rank of series, and that Valmeyer series should be recognized.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 12. In previous Illinois Geological Survey reports, Kinderhook strata have been considered a group in Iowa series. In this report, Kinderhook is raised to series rank. Name Iowa is dropped, following usage in Mississippian correlation chart of Weller and others (1948). Valmeyer series is accepted to include Osage and Meramec groups.

Probably named for Iowa.

Iowa Falls Dolomite[1]

Iowa Falls Dolomite Member (of Hampton Formation)

Mississippian: Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52, 92, 97.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. Shown on correlation chart as uppermost member of formation. Overlies Eagle City beds; underlies Gilmore City limestone.

L. A. Thomas, 1960, Tri-State Geol. Soc. Guidebook 24th Ann. Field Conf., p. [3, 17–19]. Stratigraphic reconstruction of Lower Mississippian rocks across Iowa Falls area, when adjusted to orthodox system of classification, presents anomalous situation that is irreconcilable with stratigraphic relationships observed elsewhere in State. Believed that this stems from miscorrelations resulting in exaggerated thickness of Eagle City limestone and misunderstanding of relationships of Gilmore City limestone to Iowa Falls dolomite. Van Tuyl (1925) considered Eagle City limestone to be about 80 feet thick, to consist of two limestones separated by thick dolomite, and to be unconformable beneath Iowa Falls dolomite. Present evidence suggests that formation is essentially limestone, about 20 feet thick, and conformable with Iowa Falls and Maynes Creek dolomites. Van Tuyl considered Gilmore City limestone to be younger than Iowa Falls dolomite. Present study suggests that Iowa Falls is in part a dolomitized lateral equivalent of Gilmore City limestone.

Named for exposures in gorge of Iowa River at Iowa Falls, Hardin County.

Iowa Gulch Porphyry (in Gray Porphyry Group)

Upper Cretaceous(?) or Tertiary, lower: Central Colorado.

C. H. Behre, Jr., E. N. Goddard, and A. E. Sandberg, 1939, Preliminary geologic map of west slope of Mosquito Range in vicinity of Leadville, Colorado (1:12,000): U.S. Geol. Survey. Named on map legend. In older part of Gray porphyry group.

C. H. Behre, Jr., 1939, Colorado Sci. Soc. Proc., v. 14, no. 2, p. 64–65. Includes two facies—a typical porphyry and a breccia. The porphyry, which is more common, is light gray to brownish gray, nonclastic, distinguished by conspicuous well-crystalized phenocrysts of white feldspar and brown biotite in a dark-gray stony groundmass, frequently characterized by flow structure. The breccia, highly localized, shows matrix of finely fragmental material containing sharp-edged rock fragments of same composition as porphyry and very rarely small blocks of the sedimentary rocks cut by the breccia. Cut by Johnson Gulch porphyry. Type occurrence and derivation of name given.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 46, 54–56, pl. 1. Megascopically most varied of rocks in Gray porphyry group. Differs from Johnson and Lincoln types in lack of conspicuous quartz phenocrysts and from Sacramento in its larger proportion of ground mass; resembles Evans Gulch and Mount Zion in its relatively fine texture and small average size of its phenocrysts, but is somewhat darker, more stony, and as a whole its texture more distinctly porphyritic; blue-gray facies in contrast to lighter gray or flesh colors of Evans Gulch. In igneous sequence, intrusion of Evans Gulch, Sacramento, and Lincoln porphyries was followed by intrusion of Iowa Gulch porphyry; relative ages of Evans Gulch, Sacramento, and Lincoln not determinable. Igneous rocks that are younger than Precambrian in area of this report [west slope of Mosquito Range] are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene in age.

Well exposed in Iowa Gulch, west slope of Mosquito Range, where type occurrence is thick sill that lies under Manitou limestone, about 1 mile west of Hellena mine, Lake County.

Iowan Stade

Iowa(n) Drift,[1] Loess, Till

Iowan Glacial Substage

Iowan stage of glaciation[1]

Pleistocene (Wisconsin) : Mississippi Valley.

Original reference: T. C. Chamberlain, 1895, Jour. Geology, v. 3, p. 270–277.

M. M. Leighton and H. B. Willman, 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). 603–604. Chart shows Iowan substage between Farmdale (pro-Wisconsin) substage and Tazewell substage. Materials of Iowan are loess and till. In Illinois, west and south of Shelbyville, terminal moraine (outermost Tazewell), the Iowan loess constitutes lower part of Peorian loess. No clear separation of Iowan and Tazewell loesses, except at border of Wisconsin drift, where Iowan drift lies under and Tazewell loess lies upon Shelbyville drift.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24, 36, 37, 44, 52, 123, 128. Five substages of Wisconsinan recognized in Kansas: Iowan, Tazewellian, Bradyan (new), Caryan, and Mankatoan; also mentions Iowa and Iowan loess, Iowa till, Iowan stage and subage.

R. V. Ruhe, Meyer Rubin, and W. H. Scholtes, 1957, Am. Jour. Sci., v. 255, no. 10, p. 671–689. New radiocarbon dates in Iowa permit a grouping of age values and raise new problems in stratigraphic correlation of late Pleistocene deposits in Iowa and adjacent regions. An older group of ages greater then 29,000 years dates Iowan substage and pre-Iowan deposits. An old group of ages of 22,900 to 25,100 years dates the Farmdale substage. An intermediate group of ages ranges 14,000 to 17,000 years. A possible interpretation of the dates places Iowan substage in older position than the Farmdale rather than younger as heretofore believed. Iowan till yields wood with dates beyond present range of radiocarbon dating.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 3, 7. Presentation of revised time-stratigraphic classification of Wisconsinan stage of Lake Michigan lobe. Stage consists of (ascending) Alton-

ian, Farmdalian, Woodfordian, Twocreekan, and Valderan substages. Radiocarbon dates indicate that till of type Iowan of Iowa is older than type Farmdale of Illinois rather than younger. This reverses relative position of these two units. Dates from Iowan till are greater than 35,000 years and do not define age of the till or indicate its placement with the Illinois glacial succession. The Woodfordian includes Iowan substage of Illinois usage (but not of the type), type Tazewell and Cory substages.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Presentation of classification of Wisconsin glacial stage of north-central United States. Iowan glacial substage is separated from older Farmdale glacial substage by Farm Creek intraglacial substage and from younger Tazewell glacial substage by Gardena intraglacial substage. Author [Leighton] does not agree with classification presented by Frye and Willman (1960) and cites reasons.

Name amended to Iowan Stade to comply with Stratigraphic Code adopted 1961.

Named for exposures in eastern Iowa.

Iowa Point Shale Member (of Topeka Limestone)

Iowa Point Shale (in Calhoun Shale)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 51, 102.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 7, 12, 15, 20, 46, 51. Reallocated to member status in Topeka limestone. Underlies Cruzen [Curzon] limestone member; overlies Wolf River limestone member (new). Occurrences in Iowa noted.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 162–163; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Iowa Point shale member of Topeka formation: underlies Curzon limestone member; overlies Hartford limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21. Condra and Reed (1937) were uncertain regarding relation of the Hartford of southern Kansas to lower member of Topeka in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa, so they proposed name Wolf River for basal member of Topeka in this area. Nebraska Survey will drop name Wolf River if it proves to be correlative with the Hartford, which was loosely defined by Kirk (1896) and may have priority, if it does not include beds of Du Bois, Iowa Point, and Wolf River age.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16, fig. 5. Commonly olive to dark brown in upper part grading to greenish gray below. Varies locally from calcareous shale to a complex of thin limestone beds. Thickness ranges from about ½ foot to 3½ feet. Member of Topeka limestone; underlies Curzon limestone member; overlies Hartford limestone member.

Type locality: In Missouri River bluff just east of Iowa Point, Doniphan County, Kans.

Ipava Shale and Sandstone (in Carbondale Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

Probably named for Ipava, in Fulton County.

Ira Slate[1]

Lower Ordovician: Southwestern Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 398.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 34. Name abandoned. Has similar lithology to and is in same stratigraphic position as Hortonville slate in which beds are now included.

E-an Zen, 1959, New England Intercollegiate Geol. Conf., 51st Ann. Mtg., p. 3, Age of type Hortonville subject to question. Herein suggested that Keith's name Ira formation be revived for belt that runs from Florence south towards Dorset Mountain, a belt that cannot be traced into type Hortonville. Name Ira is appropriate as the writer [Zen] has found Middle Ordovician fossils in limestone lenses in the phyllite near Ira village.

Exposed in town of Ira which is south of West Rutland in Castleton quadrangle.

Irasburg Conglomerate[1]

Ordovician(?): Northeastern Vermont, and Quebec, Canada.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 82.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1488, 1508, 1509. Considered an intraformational bed in the Waits River formation which is designated Middle Ordovician or later(?).

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 15, 32–33. Basal conglomerate of Barton River formation of Silurian age. Type locality stated more specifically.

Named for Irasburg, Orleans County, Vt., where it is best represented in bed of Lords Creek and on adjacent slope to south.

Irasburg Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for Irasburg Township or Irasburg village, in Orleans County.

Ireland Sandstone[1] **Member** (of Lawrence Shale)

Pennsylvanian (Virgil Series): Central Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 93, 96, 113.

H. C. Wagner and L. D. Harris, 1953, U.S. Geol. Survey Oil and Gas Inv. Chart OC–48. In Fredonia quadrangle, generally a 5- to 20-foot grayish-orange to moderate-brown channel-filling sandstone, locally crossbedded and ripple-marked; sparsely fossiliferous. Shales in lower part of Lawrence thin and thicken laterally, and in places where the shales are missing the lower sandstones of Lawrence merge into single unit, making

the Ireland as much as 60 feet thick. Filling of channels cut into underlying rocks abnormally increases thickness of Ireland also: locally, channels are cut as much as 15 feet into underlying Robbins shale member of Stranger formation. Basal member of formation; separated from overlying Amazonia member by an unnamed interval of shale and sandstone lenses.

Type locality: On Ireland Creek and farm of W. E. Ireland, 5 miles southwest of Yates Center, Woodson County.

Irene Conglomerate[1]

Precambrian (Belt Series): Southeastern British Columbia, Canada, and northwestern Idaho.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 6, 7.

Named for outcrops on summit and slopes of Irene Mountains, British Columbia.

Irene Volcanic Formation[1]

Precambrian (?): Southeastern British Columbia, Canada and northwestern Idaho.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 6, 7.

Named for outcrops along west slope of Irene Mountains, British Columbia.

Ireson Felsite

Upper Silurian or Lower Devonian: Southeastern Maine.

G. H. Chadwick, 1939, Am. Jour. Sci., v. 237, no. 5, p. 361. Incidental mention.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1796, 1797. Occurs in form of laccolith and intrusive dikes. Older than Prettymarsh diorite (new); younger than Frenchmans Bay series. Upper Silurian or Lower Devonian.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 173, 177. Dikes described as pink weathering. Areal distribution given.

Occurs at Ireson's Hill and its cliffs at The Ovens on north shore of Mount Desert Island, Hancock County. Other exposures also on this island.

Iron Canyon Agglomerate Member (of Tuscan Formation)

[Pliocene]: Northern California.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. Tuscan formation subdivided into five members. Iron Canyon agglomerate fourth in sequence (ascending). Underlies Sacramento tuff and sand member; overlies Seven-Mile tuff and sand member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

Iron Creek Glaciation

Pleistocene: West-central Alaska.

D. M. Hopkins, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289. p. 10, 13 (table 1). Four Quaternary glaciations recognized on Seward Peninsula. Iron Creek, the earliest, preceded Nome River glaciation (new). Represented by till and outwash encountered at Iron Creek. Faceted spurs adjoining bedrock benches several hundred feet above stream grade in Nome River valley and in nearby valleys assigned to Iron Creek glaciation.

D. M. Hopkins, F. S. MacNeil, and E. B. Leopold, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 4, p. 46–57. Discussion of coastal plain at Nome. Three marine stratigraphic units (Submarine Beach, Third Beach-Intermediate Beach, and Second Beach) record at least three distinct intervals during which sea level stood as high or higher than at present and during which sea temperatures were warmer than at present. A fourth interval of high sea level may be represented by "Fourth Beach" at inner edge of coastal plain. Glacial drift of Iron Creek (Nebraskan or Kansan) glaciation and of Nome River (Illinoian) glaciation separates the three units. Outwash, alluvium, colluvium, windblown silt, and peat that accumulated during Wisconsin and Recent time cover the glacial drift and youngest of marine sediments.

In southwestern part of Seward Peninsula.

Irondale Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia, western Maryland, and southern Pennsylvania.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 95.

Occurs at Irondale, Preston County, W. Va., and adjoining regions.

Irondequoit Limestone (in Clinton Group)

Irondequoit Limestone Member (of Clinton Formation)[1]

Middle Silurian: Central and western New York, and Ontario, Canada.

Original reference: J. M. Clarke, 1906, New York State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Irondequoit limestone in Clinton group, above Williamson shale and below Rochester shale. Niagaran series.

D. W. Fisher, 1953, Buffalo Soc. Nat. Sci. Bull., v. 21, no. 2, p. 27 (fig. 1), 32. In Niagara Gorge, unconformably overlies lower Reynales limestone; in Genesee Gorge overlies Williamson shale.

Named for town of Irondequoit, just north of Rochester, Monroe County, N.Y.

Iron Gate facies (of Clinton Formation)

Silurian (Niagaran): Southwestern Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 238, 239, 242–243, 439b (pl. 55). Clinton formation in Virginia is composed almost entirely of shale and sandstone and varies geographically in character and proportions of its constituents. About midway of Appalachian Valley (in Virginia), where crossed by James and New Rivers, lower half of formation, which is composed of shale and sandstone, including highly ferruginous sandstone beds, has been termed Cacapon division; the upper half is composed mainly of white sandstone (closely resembling the Clinch), interbedded with shale, both constituting the Keefer member; it is proposed to designate this lithologic expression of formation the Iron Gate facies. Merges laterally into Cumberland facies (new). Well illustrated by section in the Narrows of New River, Giles County, where 157 feet of Cacapon division and 156 feet of Keefer sandstone are exposed.

Type section: Iron Gate arch in gorge of James River through Rich Patch Mountain, about 1½ miles southeast of Clifton Forge, Alleghany County.

Iron Hill Member (of Windrow Formation)

Cretaceous: Northeastern Iowa, southeastern Minnesota, and southwestern Wisconsin.

G. W. Andrews, 1958, Jour. Geology, v. 66, no. 6, p. 599, 605–607. The porous concretionary iron oxide deposit included in Windrow formation by Thwaites and Twenhofel (1921) is here designated Iron Hill member and is defined to include iron oxide deposits relatively free of coarse clastic material. Thickness about 15 feet. Unconformably underlies East Bluff member (new); unconformably overlies Cedar Valley limestone.

Named for exposure in roadcut on State Highway 9 near Iron Hill, about 1 mile north of Waukon, Allamakee County, Iowa.

Iron King Volcanics (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 26–28, pl. 1. Andesitic tuffaceous sedimentary rock and basaltic and perhaps andesitic flows. All but upper 500 to 1,000 feet is basalt; upper unit is andesitic tuffaceous sedimentary rock and is free of lava flows. Tuffaceous beds occur in transition zone with underlying Spud Mountain volcanics (new) and as interbeds in the flow. Basaltic flows range from grayish green to greenish black. Pillow structures in flows. Belt of Iron King volcanics ranges in width from 9,500 feet near Humboldt to 11,500 feet at south edge of map area. Because of duplication by the major syncline, formation is only about 5,500 feet thick.

Named from exposures in Iron King Gulch, Jerome area, Yavapai County.

Iron Mine Member (of Muldoon Formation)

Upper Mississippian (Chesterian): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Composed of clastics. Thickness, 3,600 feet. Underlies Wildhorse member (new); overlies Garfield member (new).

Deposited in Muldoon trough, aligned N. 30° W.

Iron Mountain Conglomerate[1]

Upper Cambrian: Southeastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 354.

Named for Iron Mountain, St. Francois County.

Iron Mountain intrusive[1]

Cretaceous(?): Western Texas.

Original reference: C. Schuchert, 1927, Am. Jour. Sci., 5th, v. 14, p. 400.

Forms an intrusive stock north of Marathon, Brewster County, known as Iron Mountain.

Iron Mountain Porphyry[1]

Precambrian: Southeastern Missouri.

Original references: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30; 1895, Missouri Geol. Survey Sheet Rept. 4, v. 9.

Named for Iron Mountain, St. Francois County.

†Iron Mountain Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvii, 274, pl. 3.

Named for Iron Mountain, northwest of Valley Spring, Llano County.

Iron Ridge ore bed[1]

Silurian: Southeastern Wisconsin.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 561.

Iron River Iron-Formation Member (of Michigamme Slate)[1]

Precambrian (upper Huronian): Northern peninsula of Michigan and northeastern Wisconsin.

Original reference: C. K. Leith, R. J. Lund, and A. Leith, 1935, U.S. Geol. Survey Prof. Paper 184.

In Iron River, Mich., Crystal Falls, Mich., and Florence, Wis., districts.

Ironside Beds[1]

Pliocene: Northeastern Oregon.

Original reference: J. C. Merriam, 1916, California Univ. Pub. Dept. Geology Bull., v. 10, no. 9, p. 129.

H. E. Wood 2d, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 22. Clarendonian.

At Ironside, Malheur County.

Ironside Dolomite Member (of Sultan Limestone)[1]

Middle and Upper Devonian: Southeastern Nevada and Southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 14.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 40. Sultan limestone mapper in San Bernadino County, Calif. Each of the three members of Sultan limestone recognized in Goodsprings quadrangle appear to be present throughout region in which formation is recognized. Thickness 60 to 200 feet. Underlies Valentine limestone member.

U.S. Geological Survey currently considers the Sultan Limestone and its members to be Middle and Upper Devonian in age.

Well exposed near Ironside mine, 1 mile north of Boss mine, on west side of Spring Mountain Range, Goodsprings region, Nevada.

Iron Springs Formation

Upper Cretaceous(?): Southwestern Utah.

J. H. Mackin, 1947, Utah Geol. Soc. Guidebook 2, p. 7–8, 9, fig. 4. Gradational sequence of conglomerates, limestones, sandstones, and siltstones (lettered A–F); boundaries within sequence arbitrary; individual members vary in thickness and are probably not everywhere contemporaneous. Relations indicate regional warping or gentle folding of Iron Springs, with tight folding. Rarely preserved in full thickness (4,000 to 5,000 feet); ranges generally between 1,000 and 3,000 feet. Unconformably underlies Claron formation with angular discordance commonly less than 30° but locally as much as 90°. Separated from underlying Homestake formation by sandstone-shale unit probably equivalent in part to Jurassic Entrada.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. In Granite Mountain area. Iron County, term Pinto sandstone is abandoned and the part of that formation between the Entrada and the Claron is designated Iron Springs formation. Here, formation is composed of lenticular beds of sandstone, shale, conglomerate, and fresh-

water limestone; locally three stratigraphic units can be distinguished in lower part (A, B, and C). Total thickness of A, B, and C, about 400 feet; maximum thickness formation 3,000 feet.

Named for occurrence in vicinity of Iron Springs, Iron County.

Ironstone Quartz Diorite[1]

Devonian(?): Central and southern Massachusetts and northeastern Connecticut.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 168–170, map.

Named for exposures in railroad cut at Ironstone, in town of Blackstone, Worcester County, Mass.

Ironton Granite

Precambrian: Southeastern Missouri.

H. B. Graves, 1938, Acad. Sci. St. Louis Trans., v. 29, no. 5, p. 119. Fine-grained red granite.

Crops out in two areas west of Ironton, Iron County. Granite near Hogan, Fredericktown, and Knoblick may belong to same generation as that at Ironton.

Ironton Sandstone Member (of Franconia Sandstone)[1]

Upper Cambrian: Southwestern Wisconsin and southeastern Minnesota.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, p. 550.

C R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902; 1939, v. 50, no. 8, p. 1238 (table 2), p. 1239; C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 37–40 measured sections. In Minnesota, underlies Taylors Falls member (new) which name is used in preference to term Goodenough member as used by Twenhofel, Raasch, and Thwaites (1935).

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 861–862, 863. Name abandoned. Franconia member names proposed by Twenhofel, Raasch, and Thwaites (1935) are geographic names applied to faunal zones. New member names are proposed to designate rock types, as distribution of faunal zones in formation is largely independent of natural rock units. Ironton member carries *Camaraspis* (*Elvinia*) fauna. This fauna is present in Woodhill and Birkmose members.

Type locality: Ironton, Sauk County, Wis.

Ironton slate[1]

Precambrian: Southeastern Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Probably named for Ironton, Iron County.

Irontown Member (of Page Ranch Formation)

Oligocene, upper, or Miocene, lower: Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 97. Crudely bedded fanglomerate, made up chiefly of subangular blocks of Harmony Hills tuff (new) and other Quichapa ignimbrites. Underlies Kane Point tuff member (new); overlies Rencher formation. Zircon age of Kane tuff is 19 million years; this suggests that Rencher-Page Ranch period of extrusive-intrusive igneous activity is late Oligocene or early Miocene. Discussion of ignimbrites of area.

Exposed in east-facing scarp 2 miles northwest of Page Ranch and 1 mile southwest of Old Irontown historic site, Page Ranch quadrangle, Iron Springs district.

Ironwood Iron-Formation[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: C. R. Van Hise, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 338.

W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501–505. Subdivided to include following members (ascending): Plymouth ferruginous chert, Yale, Norrie ferruginous chert, Pence ferruginous slate, and Anvil ferruginous chert.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 82–116. Detailed discussion of origin of formation. Included in Animikie series. Underlies Tyler formation; overlies Palms quartzite. Thicknesses (taken from bore holes) 421 and 513½ feet.

City of Ironwood, Mich., is partly located on formation.

Iroquois Flow or Amygdaloid (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. More persistent lava flow in Portage Lake lava series, above Calumet and Hecla conglomerate and below Houghton conglomerate.

E. S. Davidson and others, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–54. Amygdaloid is at top of flow in Mohawk quadrangle.

Amygdaloid is principal mineralized unit being mined in Iroquois mine, Mohawk quadrangle.

Iroquois Stage[1]

Pleistocene: Great Lakes region.

Original reference: W. Upham, 1895, Am. Geologist, v. 16, p. 106.

Irvine facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 166–177. Predominantly massive siltstones with lesser amounts of silty and argillaceous shales; no significant amount of limestone present. Thickness 150 to 195 feet. To the west-southwest, facies merges into the Liberty facies (new); to the north-northeast, merges into Morehead facies (new). Comprises Indian Fort shale, Combs Mountain siltstone, and Conway cut siltstone members (all new) of Brodhead formation (new). At type locality, underlies Floyds Knob formation and overlies New Providence formation, Boone Gap facies (new).

Type locality: Along State Highway 52 at hill west of Fitchburg Furnace Branch, Estill County, extending along highway 1½ miles northwest from bridge. Named for city of Irvine, located on lowland of Kentucky River.

Irvine Formation[1]

Pliocene or Pleistocene: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 3.

W. R. Jillson, 1947, Pliocene deposits of lower Kentucky River valley: Frankfort, Ky., Roberts Printing Co., p. 6–12. Occurrence in Franklin County discussed.

Named for Irvine, Estill County.

Irvine Shale (in Santiago Formation)

Eocene: Southern California.

George Lunetta, 1953, California Div. Mines Inf. Service, v. 6, no. 10, p. 4–6. Marine mudstone. Massive beds of shale from 40 to 60 feet thick alternate with thin beds of clayey sandstone and clayey limestone. Medium-grained sandstone occurs in lenticular beds up to 3 feet thick. Beds of limestone are generally 1 to 6 feet thick.

Occurs in Gypsum Canyon on Irvine Ranch, 2½ miles south of State Highway 18, in extreme northern end of Santa Ana Mountains, Orange County.

Irvineton parvafacies[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 28.

Named from village of Irvineton, on Allegheny River, 4 miles west of Warren, Warren County.

Irving Greenstone[1]

Precambrian (Gunnison River Series): Southwestern Colorado.

Original reference: E. Howe, 1904, Jour. Geology, v. 12, p. 501–509.

Well exposed in southeastern part of Needle Mountains quadrangle and forms Irving Peak.

Irvington Gravels, Beds, or deposits

Pleistocene, lower: Northern California.

G. D. Louderback, 1951, California Div. Mines Bull. 154, p. 81. Southeast of Irvington, on east side of bay, a deposit of older alluvium has been cut and its eastern part elevated along a fault. Subsequent erosion has exposed gravels which have been excavated for commercial use. These Irvington beds have yielded a mammalian fauna considered to be lower Pleistocene in age.

D. E. Savage, 1951, California Univ. Dept. Geol. Sci. Bull., v. 28, no. 10, p. 219–224, 289. Terms Irvington gravels and Irvington deposits are used in this report [Late Cenozoic vertebrates, San Francisco Bay area], but terms are not formally defined. Irvington fauna was described from these gravels, and Irvingtonian stage was proposed for time of deposition of these rocks.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 31–33, fig. 2, geol. map. No formal naming of the formation (Irvington gravels) or type locality has been given in any publication. Savage (1951) used term Irvington gravels repeatedly throughout his report on Cenozoic vertebrates of San Francisco Bay region, and he is here considered to have named the unit. These gravels have been referred to as Santa Clara gravels by previous workers. Irvington gravels composed of crossbedded stream and, possibly in part, lake deposits. Dips 20° to 25° to the north or northeast. Unconformably overlies Briones sandstone. General appearance of formation is much like that of Livermore gravels, but mountain ridge separates Irvington and Livermore gravels; hence, the two units

are mapped separately. Savage regarded Irvington fauna as "earlier Pleistocene" or post-Blancan, pre-Rancholabrean. Irvingtonian stage proposed by Savage (1951) for time of deposition of these rocks is lower Pleistocene in age.

Exposed at foot of Mission Peak (referred to by Savage as "Irvington-Mission San Jose bench"), Alameda County. Outcrop area is bounded on north by alluvium from Mission Creek and west by Hayward fault.

Irvingtonian Age

Pleistocene, early: North America.

D. E. Savage, 1951, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 28, no. 10, p. 289. Provincial time term typified by Irvington (vertebrate) fauna. Irvingtonian is post-Blancan to pre-Rancholabrean.

Irwinton Sand Member (of Barnwell Formation)

Eocene, upper: East-central Georgia.

P. E. LaMoreaux, 1946, Georgia Geol. Survey Bull. 50, pt. 1, p. 3 (fig. 1), 10–11, 13, 17–18; 1946, Georgia Geol. Survey Bull. 52, p. 52, 59. At type locality and in Washington, Wilkinson, and Twiggs Counties, consists of 30 to 50 feet of light-yellow, gray, and white fine- to medium-grained micaceous quartz sand interbedded with thin gray to yellow layers, and an occasional bed of coarse white sand with carbonaceous zones. Thins updip to about 15 to 20 feet. Becomes coarse grained, and has an increasing number of clay beds so that in southern Jones, Baldwin, Hancock, and northern Washington Counties it contains about equally thick, 1- to 6-inch alternating beds of fine, medium or coarse sand and yellow and gray clay layers. May be in part equivalent to Sandersville limestone member (Cooke, 1943). Conformably overlies Twiggs clay member; underlies, with possible unconformity, a coarse red sand in upper part of formation. Believed to merge laterally with Twiggs clay into Ocala limestone in western half of Georgia.

Type locality: In gullies on Hatfield property 150 yards west of a cemetery which is 0.3 mile south of courthouse at Irwinton along Georgia Highway 29, Wilkinson County.

Isabel Sandstone[1] (in Carbondale Group)

Isabel Sandstone Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 83–84, 191, 197, 198, 199. Fairly well indurated; upper part commonly thin bedded and lower part more massive. Six inches to about 10 feet thick, reaching maximum thickness near type outcrop. Included in Abingdon cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), 62, pl. 1. Rank reduced to member status in Spoon formation (new). Occurs above Greenbush coal member and below Abingdon coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois.

Type locality: High bank on southeast side of ravine, NW¼NE¼ sec. 16, T. 4 N., R. 3 E., Havana quadrangle, Fulton County. Named for Isabel Township.

Isabel-Firesteel facies or coal member (of Hell Creek Formation)

See **Hell Creek Formation.**

Isabella Granodiorite[1]

Upper Cretaceous: Southern California.

Original reference: W. J. Miller, 1931, California Univ. Pub. Dept. Geol. Sci. Bull., v. 20, no. 9, p. 343–352.

W. J. Miller and R. W. Webb, 1940, California Jour. Mines and Geology, v. 36, no. 4, p. 357–358, 378 (fig. 31), pl. 2. Shown on map and columnar section as Jurassic(?).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 512, table 4. Late Mesozoic.

E. M. MacKevett, Jr., 1960, U.S. Geol. Survey Bull. 1087–F, p. 181-189, pls. Lead-alpha age determinations range from 85 to 96 million years. Average age is 90 million years, nearly equivalent to beginning of Late Cretaceous epoch. Younger than Kernville series.

Typical occurrence in vicinity of Isabella, Kernville quadrangle, Kern County.

Isabella Stage[1]

Quaternary: Puerto Rico.

Original reference: B. Hubbard, 1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 95.

†Ischua Sandstone[1]

Upper Devonian: Western New York.

Original reference: E. N. Horsford, 1840, New York Geol. Survey 4th Ann. Rept., p. 466, 469–470.

Occurs in Ischua stone quarries, Machias, Cattaraugus County.

†Ishawooa intrusives[1]

Miocene: Yellowstone National Park, Wyoming.

Original reference: A. Hague and others, 1904, U.S. Geol. Survey Mon. 32, Atlas; Canyon, Lake Crandall, and Ishawooa sheets.

Named for exposures on west side of Ishawooa Mesa, Yellowstone National Park.

Ishpeming Basic Volcanics

†Ishpeming Formation[1]

Precambrian (Huronian): Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 590.

W. A. Seaman, 1944, Michigan Dept. Conserv., Geol. Survey Div. Prog. Rept. 10, p. 12 (table 1), 15. Term originally used to include conglomerate, quartzite, and slates above the Negaunee, but is here restricted to the volcanics accompanying the local upheaval that stopped deposition of Negaunee iron formation. Succeeded by Goodrich conglomerate, quartzite, and slate.

Named for occurrences in vicinity of Ishpeming, Marquette County.

Isla Mona Limestone

Miocene, lower or middle: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–C, p. 146–147, pl. 12. Thick-bedded, dense, and finely crystalline limestone and dolomite; white on fresh surface but in cliffs stained yellow. Unconformable below Lirio

limestone (new). On basis of corals, age appears to be Miocene, probably early or middle.

Forms main mass of Isla Mona and Monito.

†Island Series[1]

Upper Cretaceous: Southeastern Massachusetts and southeastern New York.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 335–336.

Extends from Staten Island to Marthas Vineyard.

Island Creek Shale[1] Member (of Wyandotte Formation)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf., correlation chart.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033. Island Creek shale member of Wyandotte formation; underlies Farley limestone member; overlies Argentine limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. Previously, Missouri had classed Island Creek as basal member of Lane shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 35. Thickness 2 to 3 feet or more in Iowa and Nebraska, about 20 feet in northwestern Missouri, maximum 40 feet in Kansas. Additional data on type locality.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25. As exposed in quarry in Madison County, Island Creek is a gray, platy, fossiliferous shale with limestone nodules near top. Thickness 4½ feet. Underlies Farley limestone member; overlies Argentine limestone member.

Type locality: In quarry, NW cor. sec. 11, T. 10 S., R. 23 E., near Wolcott, Wyandotte County, Kans. Named for Island Creek.

Island Hill Formation[1]

Lower Devonian: Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

Fossiliferous limestone about 3 feet thick, above New Scotland limestone and below Whetstone Branch shale.

Exposed in Tishomingo County. Named for isolated hill on Yellow Creek about 3 miles above its mouth.

Island Mesa Beds[1]

Upper Devonian: Northern central Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 500.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Jerome formation.

Exposed 12 miles northeast of Jerome, on Verde River, and southwest of Island Mesa.

Island Mine Conglomerate[1] (in Eagle River Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1898, Michigan Geol. Survey, v. 6, pt. 1, p. 99, 204, 206, 217, pl. 1.

Named for occurrence in Island mine, Isle Royale.

Isle La Motte Limestone or Formation

Isle La Motte Marble[1]

Middle Ordovician: Northwestern Vermont and northeastern New York.

Original reference: Ebenezer Emmons, 1842, Geology New York, pt. 2, div. 4, geology of 2d dist., p. 386.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 260–261, pl. 2. Limestone assigned to Trenton group of Mohawkian series. Described at type locality as black gray-weathering medium-textured heavy-ledged limestone. Probably includes underlying blue-black limestone. Total thickness 12½ feet. Underlies Larrabee member of Glens Falls formation; overlies Lowville limestone or Amsterdam limestone. Type section designated.

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1172. Overlies Youngman formation (new) in Highgate Springs sequence, northwestern Vermont.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 27, 61, 66, 68–69, 85–89, pl. 1. Further described on Isle La Motte and in several fault blocks on South Hero Island in Lake Champlain. Maximum thickness in latter area 40 feet.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 85–87. Considered lower Trentonian by Kay (1937). This designation now considered to be in error. Isle La Motte is now classified as Blackriveran and correlated with Chaumont limestone of Black River group of northwestern New York.

Type section: In Hill quarry on east side of Isle La Motte in Lake Champlain, Grand Isle County, Vt.

Isle La Motte Sandstone[1]

Lower Ordovician: Northwestern Vermont.

Original reference: H. M. Seely, 1906, Vermont State Geologist 5th Rept., p. 174–187.

Named for Isle La Motte, northern part of Lake Champlain.

Isle Royale Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 195.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 678 (fig. 1). Name appears on geologic section of Michigan copper district.

Named for occurrence in Isle Royale mine, Houghton County.

Isle Royale Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

†Isle Royale trap[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Islesboro Formation[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 2–3.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in area of Rockland quadrangle, Knox County, is (ascending) Islesboro formation containing Coombs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, a siliceous limestone member above the quartzite, and Rockport limestone member at top.

Named for development on Islesboro, Waldo County.

Isom Formation

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 98–99. Chiefly ignimbrites and lava flows with intercalations of sedimentary rocks. At type locality, consists of an ignimbrite of Leach Canyon type, a few tens of feet thick, which has not been definitely identified elsewhere and needs no formal name. Lower unit is Baldhills member (new); upper is Hole-in-the-Wall member (new). Thickens greatly and is widespread in High Plateaus. Underlies Quichapa formation; at type locality, overlies Needles Range formation (new); in some areas, overlies Claron formation or on volcanic rocks of local origin. Needles-Isom sequence is probably Eocene or early Oligocene in age. Discussion of ignimbrites of area.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 36–37, geol. map. Present in Bull Valley district, Washington County, where it has maximum thickness of 170 feet and consists of andesite(?) flows overlain by two thin, highly welded, latitic, vitric ignimbrites with sparse phenocrysts. Overlies Claron formation; underlies Quichapa formation. Wedges out southward. Tertiary.

Type locality: Southern slope of east-west ridge just north of Isom Creek in northwestern part of Iron Springs district (Three Peaks quadrangle, sec. 5, T. 35 S., R. 12 W.).

Ithaca facies sub-group[1]

Upper Devonian: Central southern New York.

Original reference; K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202. Ithaca region.

Ithaca Member (of Genesee Formation)

Ithaca Shale

Ithaca Shale Member (of Portage Formation)[1]

Upper Devonian: Central New York.

Original reference: James Hall, 1839, New York Geol. Survey 3d Rept., p. 318–325.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1743, chart 4. Ithaca shale consists of six members of uncertain

relationships: Renwick shale, Six Mile shale, Cascadilla shale, Williams Bridge shale, Marathon sandstone, and Triphammer shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814, 2815, 2821–2822. Reallocated to member status in Genesee formation. Near Cayuga Lake is a heterogeneous sequence of fine-grained sandstone, siltstone, silty shale, and silty mudrock. This sequence, which is about 400 feet thick near Ithaca, constitutes Ithaca group of Hall (1839) and most of Ithaca shale member of Portage formation (Williams and others, 1909, U.S. Geol. Survey Geol. Atlas, Folio 169). Name Ithaca member is here restricted to rocks above Renwick shale member and below West River shale member. Term shale is dropped from member name because the Ithaca is composed largely of siltstone and other nonfissile rocks. Thickness 413 feet at reference section, herein designated. Top of member is placed at top of thick-bedded sequence of siltstone, above which the rocks consist largely of silty gray shale containing much thinner beds of siltstone, a few thin beds of black shale, and scattered silty calcareous nodules. In Coy Glen and in some lentil of coquinite about 1 foot thick is present at top of member. Mapped westward from outcrops near Ithaca to exposures at the north end of West Branch of Keuka Lake. Intertongues with lower part of West River shale member in area between Keuka Lake and valley of West River. In vicinity of Keuka and Seneca Lakes, the Ithaca member of this paper was named Starkey tongue of Sherburne formation by Grossman.

Reference section: Coy Glen, 2 miles southwest of center of Ithaca, Tompkins County. Named for occurrence at Ithaca.

Ithaca Peak Granite

Ithaca Peak Porphyry

Mesozoic(?): Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 667, fig. 2; 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 403–405, pl. 1. Ithaca Peak porphyry comprises two intrusions of granite porphyry within the Cerbat complex (new). Intrusion in Chloride district is curved steeply dipping sill from 2,000 to 5,000 feet thick, whereas intrusion in Mineral Park district is stock that has roughly circular exposed area 3½ to 4 miles in diameter. Several thick tongues extend out from southeast side of stock, largest reaching 1½ miles through Union Basin to Golconda mine. Tertiary(?).

M. G. Dings, 1951, U.S. Geol. Survey Bull. 978–E, p. 130–132, pl. 18. Cited as Ithaca Peak granite and restricted to Mineral Park district. Granite near Chloride tentatively assigned to Precambrian and renamed Chloride granite (new). Main mass of granite stock weathers buff to reddish brown. Fresh rock typically light-gray fine- to medium-grained porphyritic granite. Outlying bodies of granite particularly abundant from Mineral Park south into Stockton and Cerbat camps, some of which grade into granite porphyry, although most are of porphyritic granite. Geographic distribution given.

Named after imposing crag in Mineral Park district. Both Ithaca Peak and Turquoise Mountain composed of the granite. All in Wallapai mining district, Mohave County.

Itkillik Glaciation

Pleistocene: Central northern Alaska.

R. L. Detterman *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 11–12, 13 (table 1). Four Quaternary glacial advances recognized

in Sagavanirktok-Anaktuvuk district. Itkillik preceded Echooka glaciation (new); succeeded Sagavanirktok glaciation (new). Till covers approximately 1,000 square miles and forms thin mantle 30 to 50 feet thick over much of area. Drift forms fan-shaped deposits at mouths of major valleys. A few well-developed moraines as much as 200 feet thick. Terminal and lateral moraines as well as knob and kettle topography easily recognized. Numerous kettle lakes. Piedmont lobe formed at time of Itkillik glaciation.

Named after Itkillik River in central part of Sagavanirktok-Anaktuvuk region.

Iuka Formation[1]

Lower Mississippian: Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

Named for Iuka, Tishomingo County.

Ivan Limestone Member (of Graham Formation)

Ivan Formation or Limestone (in Thrifty Group)

Ivan Limestone (in Graham Group)

Ivan Limestone Member (of Thrifty Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as Ivan formation in Thrifty group. Underlies Speck Mountain formation (Blach Ranch formation); overlies Avis sandstone.

M. G. Cheney and H. D. Eargle, 1951, Geologic map of Brown County, Texas (1:62,500): Texas Univ. Bur. Econ. Geology. Shown on columnar section as Ivan limestone in Thrifty group.

M. G. Cheney and H. D. Eargle, 1951, West Texas Geol. Soc. Guidebook Spring Field Trip, June 1–2, p. 1 (fig. 1). Listed on chart as Ivan (Rocky Mount), *"Bellerophon"* member of Thrifty formation. Occurs above Avis sandstone and below Speck Mountain (Blach Ranch member).

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, fig. 4. Shown on generalized columnar section as Ivan limestone in Graham group. Underlies Blach Ranch limestone; overlies Avis sandstone.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Shown on composite section of Brown and Coleman Counties as Ivan limestone member of Graham formation. Consists of gray algal limestone that locally contains abundant horn corals and fusulinids. Thickness about 15 feet. Overlies Wayland shale; stratigraphically below Speck Mountain limestone member of Thrifty formation.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 71, pl. 27. Name Ivan limestone member of Graham formation extended into Brown and Coleman Counties and applied to unit that was described as *Bellerophon* bed by earlier authors (Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801). Locally the Ivan changes in lithologic character from limestone to calcareous sandstone and (or) shale within short distances. Overlies Wayland shale member; separated from overlying Speck Moun-

tain limestone member of Thrifty formation by shale unit that was called Speck Mountain clay bed by Drake (1893). Thickness as much as 18 feet.

Named for exposures in vicinity of Ivan, Stephens County.

Ivanhoe Glacial Substage

Pleistocene (Cary) : West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 331–333, fig. 2, table 4. Time of Wisconsin glaciation in Frying Pan Valley during which outwash deposits and Ivanhoe moraines were deposited. Older than Hell Gate glacial substage (new); younger than Biglow glacial substage (new).

Name derived from area just east of Ivanhoe. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Ivanhoe Limestone Member (of Rome Formation)

Ivanhoe Limestone Member (of Shady Dolomite)[1]

Lower Cambrian: Southwestern Virginia.

Original reference: Charles Butts, 1933, Virginia Geol. Survey Bull. 42, p. 3, map legend.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 8, 9. Reallocated to member status in Rome formation.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 41, 44–46, 52. In Wythe and Pulaski Counties, Ivanhoe is uppermost member of Shady dolomite; overlies Austinville dolomite member (new); underlies Rome formation. Thickness 542 to 547 feet.

Named for exposures in vicinity of Ivanhoe, Wythe County.

Iversen Basalt

"Between late Cretaceous and Oligocene": Northern California.

C. E. Weaver, 1944, Washington [State] Univ. Pubs. in Geology, v. 6, no. 1, p. 4, 17–18, pl. 2. Dark-gray to black dense fine-grained basalt with alternating flows of vesicular and amygdaloidal rock and intercalated lenslike masses of tuffaceous sandstone; pillow structure. Thickness 800 feet. [This part of description is identical with initial description given of unit termed Skooner Gulch basalt by Weaver, 1943. In 1944, Weaver redescribed the Skooner Gulch as a sandstone formation.] Lavas stand at high angles with prevailing northwestward dip. Rests unconformably upon sandstones and shales of Gualala group and lies with erosional unconformity below Oligocene(?) or lower Miocene sediments. Stratigraphic table shows basalt underlying redescribed Skooner Gulch formation.

Exposed in sea cliffs, highway cuts, and in outcrops on hill slopes within an area approximately 100 feet wide by 3 miles long and extending from near Iversen Point northward to and beyond mouth of Skooner Gulch, Mendocino County.

Ives Breccia Member (of Houy Formation)

Ives Breccia

Ives Conglomerate Member (of Chappel Formation)

Middle(?) and Upper Devonian: Texas.

F. B. Plummer, 1939, *in* West Texas Geol. Soc. [Guidebook] Nov. 11–12, p. 15. Basal conglomerate of Chappel formation. Made up of rounded chert

cobbles derived from the Ellenburger; fairly firmly cemented into layers 8 inches to 1 foot thick.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 27, 42, 44 (fig. 2), 46–49. Unit raised to formational rank and designated Ives breccia because of commonly angular character of chert pebbles and granules it contains. At locality cited by Plummer (1950), the Ives overlaps beds of Honeycut formation. Considered older than Chappel limestone. Correlated with beds considered to be basal Mississippian by some and uppermost Devonian by others.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 26, 27. Underlies Espey Creek limestone member and overlies King Creek marl member (both new). Mississippian. Exposures noted.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1958, Geol. Soc. America Bull., v. 68, no. 7, p. 810, pl. 1. Rank reduced to member status in Houy formation (new). Occurs near base of formation and below Doublehorn shale member (new). Includes lag deposits of detrital chert of varied age and source. Zesch formation of Barnes and others (1947) is a partial synonym for Ives breccia. Middle(?) and Upper Devonian. Type site designated.

Type locality: Along Ives Branch on Gibbons Ranch 2½ miles southwest of Hall, San Saba County. This is Plummer's (1950) locality 205–T–125 which he designated as best exposure of Ives conglomerate.

Ivy Point Member[1] (of Ludlowville Shale)

Middle Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 11, 47.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Underlies Spafford member; overlies Otisco member.

Type section: In first ravine north of Ivy (or Willow) Point on east side of Skaneateles Lake, three-fourths mile north and slightly west of Spafford Landing, Skaneateles quadrangle.

Iwana Green Schist[1]

Post-Carboniferous(?): Eastern Alabama.

Original reference: W. M. Brewer, 1896, Alabama Geol. Survey Bull. 5, p. 84, 89, 92.

Named for exposures about Iwana, Coosa County.

†Izard Limestone[1]

Lower and Middle Ordovician: Northern Arkansas.

Original reference: R. A. F. Penrose, Jr., 1891, Arkansas Geol. Survey Ann. Rept. 1890, v. 1, p. 102, 112–113, 121–124, 587–593.

Type locality: Penters Bluff, southeastern Izard County.

Izee Group

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 255. Consists of two noncalcareous formations, Hyde below and Snowshoe above (both new). Thickness 3,880 feet. Overlies Colpitts group (new); extends northeastward into Silvies River region, beveling both Colpitts and Mowich groups and lying discordantly upon Triassic strata; unconformably underlies Trowbridge shale (new).

Widely exposed along Ochoco anticline from western end of Jurassic rock area northeastward across South Fork Valley and into west side of Bear Valley. Named for Izee Grange and Schoolhouse near South Fork River between Poison Creek and Rosebud Creek, Crook County.

Jacaguas Group

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 70–103, geol. map. Includes two formations, Naranjo to east of the Río Guayo and Augustinillo to west of the Río Guayo. Thickness about 17,000 feet. Bounded on south by Cerrillos-Descalabrado fault that obscures its exact thickness.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83. Name replaces Guayabal group, used to include Naranjo and Augustinillo formations.

Named after the Río Jacaguas near Juana Díaz.

Jacalitos Formation[1]

Jacalitos Stage

Pliocene, lower: Southern California.

Original reference: R. Arnold and R. Anderson, 1908, U.S. Geol. Survey Bull. 357.

S. S. Siegfus, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 27 (fig. 2), 32–36. Overlies Reef Ridge shale. Confusion in defining upper contact of Reef Ridge has resulted to some extent from difference of opinion regarding lower limit of the Jacalitos. Various interpretations discussed.

W. P. Woodring, 1940, U.S. Geol. Survey Prof. Paper 195, p. 27 (table), 114–117. Underlies Etchegoin formation (restricted), although Jacalitos (as shown in table on page 27) is included in the Etchegoin by some geologists.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 240. Term Etchegoin group is used in this report to include Jacalitos, Etchegoin, and possibly San Joaquin formations which cannot be distinguished in field in this report [San Benito quadrangle].

B. L. Clark, 1943, California Div. Mines Bull. 118, p. 190 [preprint 1941]. Marine lower Pliocene of San Joaquin Valley area may be referred to as Jacalitos stage. This is lower part of Etchegoin formation as redefined by Nomland (1917). He recognized two faunal zones in deposits referred originally by Arnold and Anderson to the Jacalitos.

C. W. Jennings, 1953, California Jour. Mines and Geology, v. 49, no. 3, p. 279. Formation, in Kings County, consists of about 3,500 feet of marine sandstone and conglomerate. Overlies Reef Ridge shale; underlies Etchegoin formation. Crops out as wide band in Kreyenhagen Hills and in Avenal syncline on west side of Reef Ridge.

J. W. Durham, R. H. Jahns, and D. E. Savage, 1954, California Div. Mines Bull. 170, chap. 3, p. 60 (fig. 2). Chart shows Jacalitos megafaunal "stage" equivalent to the Repettian and upper part of Delmontian microfaunal stages.

Named for exposures both north and south of Jacalitos Creek, and in Jacalitos Hills, Fresno County.

Jack Creek Formation (in Pacheco Group)

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 11, p. 2095. Unconformably underlies sediments of Asuncion group.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 474–484. Light- to dark-gray sandy clay shales and silts with thin interbeds of fine-grained silty commonly crossbedded and ripple-marked sandstone; contains lenses and thin layers of ferruginous limestone and lenses of sandstone up to 25 feet thick in places. Thickness 1,600 to 2,900 feet. Has been tilted, folded and faulted. Underlies Asuncion group. Angular discordance between the two varies from a few degrees to 70°; unconformably overlies the Franciscan. In fault contact with Lower Cretaceous Marmolejo formation (new). Type section designated.

Type section: On Jack Creek extending for 1½ miles southeast of Dover Canyon Road, in southeast part of Adelaida quadrangle, Santa Lucia Range.

Jackfork Sandstone[1]

Jackfork Group

Mississippian: Southeastern and central southern Oklahoma and southwestern Arkansas.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

David White, 1937, U.S. Geol. Survey Prof. Paper 186–C, p. 43–67. Age considered to be Pennsylvanian on basis of paleobotanic evidence. Previously regarded as uppermost Mississippian.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856–857, 878–889. Rank raised to group. Divided into (ascending) Wildhorse Mountain, Prairie Mountain, Markham Mill, and Wesley formations (all new). Thickness as much as 8,700 feet. Overlies Chickasaw Creek formation (new) in Stanley group; underlies Union Valley sandstone. In Pushmataha (new) and Morrow series, both of which are included in the Bendian, shown as post-Chester and pre-DesMoines.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 35). Sandstone shown on correlation chart below Johns Valley shale and above Stanley shale. Morrow series.

C. L. Cooper, 1945, Jour. Geology, v. 53, no. 6, p. 390–397. Stanley and Jackfork formations have been correlated with Pennsylvanian, but their exact age is still a problem. Flora from these formations is unlike any known flora in North America and is younger than that from Wedington sandstone member of Fayetteville shale (Chester) and older than that in Baldwin coal in Bloyd shale of Morrow group (middle Pottsville).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 106, chart 5 (column 57). Sandstone shown on correlation chart as Chesterian. Age still debatable.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Pennsylvanian.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 101, 102 (chart). Studies in central Ouachita Mountains revealed two complete stratigraphic sequences of Jackfork group: one southeast of Albion in eastern Pushmataha County, in Kiamichi Range, and one southeast of Big Cedar in Le Flore County. Exposures reveal Jackfork to be 5,600 and 5,700 feet thick

respectively. This is much less than previous estimates. Also study reveals that upper part of type Wildhorse Mountain formation duplicates an equivalent interval in lower part of type Prairie Mountain formation. By definition Harlton's (1938) type Prairie Mountain includes type locality of Prairie Hollow maroon shale member; however, Prairie Hollow also occurs in midst of Wildhouse Mountain type section; stratigraphic overlap amounts to about 3,600 feet; hence, thickness of Jackfork group in Tuskahoma syncline should be considerably less than previously estimated. Harlton's (1938) Union Valley sandstone not equivalent to Union Valley of type locality and here considered part of Jackfork group. Age of group Chesterian or Morrowan.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 131 (fig. 1), 135–136. Group includes (ascending) Wildhorse Mountain, Prairie Mountain, Markham Mill, Wesley, and Game Refuge (new) formations. Game Refuge replaces name Union Valley sandstone extended into area (Harlton, 1938). Overlies Chickasaw Creek formation of Stanley group; underlies unit referred to as Johns Valley shale of published reports. Pushmataha series (Carboniferous).

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 42–58, pl. 1. Group includes (ascending) Wildhorse Mountain, Prairie Mountain, Markham Mill, Wesley, and Game Refuge formations. Thickness 5,600 to 5,800 feet. Overlies Stanley group; stratigraphically below Johns Valley shale. Meramecian and Chesterian.

H. D. Miser and T. A. Hendricks, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1829–1834. Mississippian. Brief summary of development of different age interpretations that have been given for Jackfork sandstone, Stanley shale, and Johns Valley shale.

O. B. Shelburne, Jr., 1960, Oklahoma Geol. Survey Bull. 88, p. 17 (fig. 2), 26–33, pl. 1. Group described in Boktukola syncline where it is 5,400 to 6,500 feet thick. Overlies Stanley group; underlies Johns Valley shale. Mississippian, Chesterian; however, on figure 2, Meramec-Chester boundary is queried.

Named for Jackfork Mountain, Pittsburg and Pushmataha Counties, Okla.

Jackman Granite

Middle Devonian: West-central Maine.

H. W. Fairbairn and P. M. Hurley, 1957, Am. Geolphys. Union Trans., v. 38, no. 1, p. 105 (table 8), 106 (table 9). Incidental mention. Intrusive into Lower Devonian sediments.

Occurs at Jackman, Somerset County.

Jackpile Ore-Bearing Bed (in Brushy Basin Member of Morrison Formation)

Upper Jurassic: Northwestern New Mexico.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 317, 318. Very pale orange and locally white sandstone that is dominantly fine to medium grained with minor coarse grains at base. Characterized by scour-and-fill crossbedding, but some parallel bedding, often marked by claystone partings, is present also. Ranges from knife edge, where cutout by pre-Dakota(?) erosion, to about 175 feet at Jackpile mine. Constitutes uppermost 65 feet of member at Laguna section.

Traced from Laguna section, sec. 28 T. 10 N., R. 5 W., in nearly continuous exposures, into ore-bearing sandstone at Jackpile mine of Anaconda Copper Mining Co., Valencia County.

†Jacksboro Formation (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Occurs in sandstone hills southwest of Jacksboro, Jack County, and also in Young County.

Jacksboro Limestone Member (of Graham Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Named for exposures in vicinity of Jacksboro, Jack County.

Jacksina Formation[1]

Pre-Permian: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 26, in column of table credited to "Schrader, geologic reconn. of headwater region of Copper and Tanana Rivers, Alaska: Prof. Paper, in preparation."

†Jackson Formation[1]

Pennsylvanian: Michigan.

Original reference: A. C. Lane, as reported by M. E. Wadsworth, 1893. Michigan Geol. Survey Rept. 1891 and 1892, p. 66.

Named for exposures at Jackson, Jackson County.

Jackson Formation[1] or Group

Eocene, upper: Gulf Coastal Plain from Georgia to southern Texas.

Original references: T. A. Conrad, 1856, Philadelphia Acad. Nat. Sci. Proc., v. 7, p. 257–258; E. W. Hilgard, 1860, Rept. Geology and Agriculture Mississippi, p. 128–135

M. A. Hanna and Donald Gravell *in* James McGuirt, 1934, Shreveport Geol. Soc. [Guidebook] 11th Ann. Field Trip, chart facing p. 30. Correlation chart shows Jackson comprises (ascending) Moodys Branch, Yazoo, and Danville Landing (new) groups. Danville Landing group contains Danville Landing beds. [Use of term group not explained.]

B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 13–55. Group comprises (ascending) Caddell (Moodys marl), Wellborn (with Bedias and Carlos sandstones), Manning (with Dilworth and Yuma sandstones), and Whitsett formations. Overlies Yegua formation of Claiborne group; underlies Catahoula formation.

H. N. Fisk, 1938, Louisiana Dept. Conserv., Geol. Bull. 10, p. 89–111. In central Louisiana, outcrop of Jackson group extends southwestward in narrow belt from Ouachita River in southern Caldwell Parish to Red River south of Montgomery. Covers most of northwestern La Salle Parish and northern third of Grant Parish. Includes (ascending) Moodys Branch marl, Yazoo clay, and Danville Landing beds. Underlies Vicksburg group; overlies Cockfield formation of Claiborne group, transition zone. Upper Eocene.

C. W. Cooke, 1939, Jour. Paleontology, v. 13, no. 3, p. 337–340. Jackson raised to group rank in Mississippi where Moodys marl is basal formation. Name Moodys replaces name Gosport. Hence, Claiborne group restricted to formations heretofore classified as lower Claiborne.

L. D. Toulmin, Jr., 1940, Alabama Geol. Survey Bull. 46, p. 40–46. Gosport sand has been transferred from Claiborne group to Jackson group (Cooke, 1939). Cooke (1939) and Gardner (1939, U.S. Geol. Survey Prof. Paper 189–F) advocate dropping name Gosport and applying name Moodys marl to deposits in Alabama heretofore known as Gosport. In present report, name Gosport sand is retained for those beds in Alabama traditionally known by that name. Formations of Jackson group west of Tombigbee River are Moodys marl and Yazoo clay. Ocala limestone in eastern Alabama, southwestern Georgia, and Florida is probably equivalent to Moodys marl and Yazoo clay. Disconformably overlies Claiborne formation; conformably underlies Red Bluff clay of Vicksburg group.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1837–1839. In central Gulf Coastal Plain, sediments of Jackson age crop out in northwest-southeast-trending belt across central Mississippi and southern Alabama and in southwest-trending belt across central Louisiana. Isolated outcrops exposed in Embayment areas as far north as Kentucky. In type area, Jackson [group] consists of thin basal transgressive beach sand (Moodys formation) and an upper blue-gray fossiliferous clay (Yazoo). Yazoo is increasingly calcareous eastward and, in eastern Mississippi and western Alabama, is divisible into four members (ascending): North Creek clay (new), Cocoa sand, Pachuta marl (new), and Shubuta clay (new). In central Louisiana, Danville Landing formation is present above Yazoo clay. Farther east in Alabama entire Jackson changes to lime facies (Ocala limestone). Above Claiborne group; below Vicksburg group.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 11–172. Applin and Applin (1944) recognized in Jackson group and in Ocala limestone an upper and lower member and separated from base of Ocala limestone by about 80 feet of section that is composed of two lithologically and faunally distinct beds, about 30 and 50 feet thick. This interval is correlated with Moodys Branch formation, and names Williston and Inglis are here proposed for the two members. As used in this report [Citrus and Levy Counties], the upper Eocene, Jackson group of peninsular Florida, is composed of two formations, Ocala limestone (restricted) and Moodys Branch formation, Jackson-Claiborne contact is placed at top Avon Park limestone. Jackson group separated from older beds by disconformity.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321–347. Discussion of Jackson group in Georgia. Outcrop area extends along inner edge of Coastal Plain from Seminole County to Savannah River Includes Ocala limestone and Barnwell formation. Cooper marl not believed to be present in Georgia.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2623–2635. Jackson group in south-central Texas consists of (ascending) Caddell, Wellborn, McElroy, and Whitsett formations. Group is used in this report only as rock unit term.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 94–102, maps. In Sabine Parish, group comprises (ascending) Moodys Branch formation, Yazoo formation, Danville Landing beds, and Mosley Hill formation (redefined). Overlies Cockfield formation of Claiborne group; underlies Sandel formation (new). Oligocene.

Named for exposures at Jackson, Miss., along Peak River and Moodys Branch.

Jackson Limestone (in Greene Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 97, 110, 112.

Exposed in Center and Jackson Townships, Greene County.

Jacksonboro Limestone[1]

Miocene, lower: Eastern Georgia.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 83–84.

Occurs near confluence of Brier Creek and Beaver Dam Creek, which together form a tributary of Savannah River, 3 miles below Jacksonboro, Screven County.

Jacksonburg Limestone[1]

Middle Ordovician: Northern New Jersey and eastern Pennsylvania.

Original reference: H. B. Kümmel, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

R. L. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1687–1718. At type locality, the Jacksonburg consists of 135 feet of limestone, the lower 58 feet of which contain *Leperditia fabulites* Conrad and *Doleroides* sp. cf. *D. gibbosus* Billings. These beds are probably of Rockland age. Remaining 77 feet is of Hull and Sherman Fall age. Unconformably overlies Kittatinny limestone; underlies Martinsburg shales, some disconformity. In Pennsylvania, faunas of Hull and Sherman Fall age are present. In main belt of Jacksonburg, *Leperditia* zone has not been recognized, and near Stockertown the basal beds seem to be Hull. Formation divided into two parts on basis of lithology, the lower being the "cement limestone" facies and the upper being the "cement rock" facies. "Cement rock" east of Schuylkill River, which has been called Leesport, is assigned to Jacksonburg. Underlies Martinsburg shales; overlies Beekmantown.

Carlyle Gray, 1951, Pennsylvania Geol. Survey Prog. Rept. 136, p. 15–19. Name Jacksonburg applied in this paper to all impure limestones in part formerly called Leesport lying between Annville or Beekmantown formation and Martinsburg formation in Berks County. Thickness varies. Formation is absent in at least one area due to an erosional unconformity and elsewhere due to thrust-faulting. Intense folding and faulting and lack of large exposures make it difficult to estimate thickness. West of Womelsdorf, basal conglomeratic part of formation is estimated to be about 250 feet thick where fully developed and rest of formation may be as much as 750 feet thick. Whole formation disappears abruptly east of Womelsdorf, being hidden by thrust fault. Present in anticlinal embayment of Martinsburg shale northeast of Womelsdorf where basal conglomerate is absent and rest of formation is estimated to be not more than 700 feet thick. East of Schuylkill River and in bluffs 3 miles south of West Leesport, formation is more than 270 feet thick.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2716 (fig. 3), In Berks County, Pa., overlies Ontelaunee formation (new) of Beekmantown group.

Bradford Willard, 1958, Pennsylvania Acad. Sci. Proc., v. 32, p. 177–183. In Lehigh and Delaware River valleys, overlies Coplay formation, name reinstated to replace term Beekmantown as applied to Lower and lower

Middle Ordovician beds between Upper Cambrian Allentown and Middle Ordovician Jacksonburg formations.

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 28–29. Interval between Beekmantown group and Martinsburg formation, embodying essentially the Leesport in east-central Pennsylvania and in restricted sense the Jacksonburg of eastern Pennsylvania and western New Jersey, is divided into (ascending) Annville, Myerstown, and Hershey limestones. Myerstown corresponds to "cement limestone" of Jacksonburg and the Hershey to the "cement rock." Comparison of the Myerstown and Hershey to Jacksonburg of New Jersey indicates several megascopic as well as faunal differences; also, base of Jacksonburg is older than base of Myerstown. Subdivision of approximate Jacksonburg equivalents in Pennsylvania into formational units does not necessarily call for reclassification of Jacksonburg formation in New Jersey as classification in Pennsylvania does not involve typical Jacksonburg. However there is a separate problem as to status of type Jacksonburg. If Weller (1903, New Jersey Geol. Survey Rept. Paleontology, v. 3) is correct in assuming a Black River age for the lower and a Trenton age for the upper Jacksonburg, there is good cause for erecting separate formation names for upper and lower units and abandonment or redefinition of term Jacksonburg. If Miller (1937) is correct in assuming Trenton age for entire Jacksonburg (a view favored by present author), then there would be some cause to assign new names to the highly different lower and upper Jackonsburg, in which case the latter term might be elevated to group status, or alternatively, the subdivisions might be assigned formal member names with Jacksonburg maintaining its present formational status. Since a disconformity probably exists between lower and upper Jacksonburg, the choice of one name (Jacksonburg) to include units separated by a potential break might be an unfortunate one. As name Jacksonburg is deeply bedded in literature, it might best be preserved.

Named for occurrence at Jacksonburg, Warren County, N.J.

Jackson Butte Andesite

Neocene: Central California.

F. L. Ransome, 1899, U.S. Geol. Survey Geol. Atlas, Folio 63, p. 6. Massive andesite 400 to 500 feet thick. Light colored with slight reddish tint; small porphyritic crystals of dark hornblende.

Forms Jackson Butte, Amador County, Mother Lode district.

Jacksonian Stage

Eocene: Gulf and Atlantic Coastal Plain.

G. E. Murray and L. J. Wilbert, Jr., 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1990–1997. Jacksonian stage introduced as time and time-rock unit replacing Jackson formation and Jackson group as major division of Eocene sediments of Gulf and Atlantic Coastal Plain. Jacksonian stage is a time-rock unit which embraces all sediments deposited during time occupied by advance and retreat of late Eocene sea in Gulf and Atlantic coastal region. In this view, the earliest sediment which can be associated definitely with advance of this sea, or can be found to have been deposited during time sea was advancing, becomes Jacksonian; latest stratum which can be tied to retreat of this sea is included likewise. Identification of Jacksonian deposits is principally paleontological problem. Inherent in concept of Jacksonian stage is the thought that other major "lithologic" divisions of Gulf Coast Tertiary should be reconstitu-

ted in same manner. Hilgard (1860, Rept. of the geology and agriculture of State of Mississippi) used "Jackson stage;" Heilprin (1884, Philadelphia Acad. Nat. Sci. Jour., v. 9) and Dall (1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2) used "Jacksonian;" most workers since then implied what we now know as "time-rock terminology" in their use of Jackson.

L. J. Wilbert, Jr., 1953, Arkansas Geol. Survey Bull. 19, p. 1–125. Discussion of Jacksonian stage in southeastern Arkansas. The outcrop areas is minimum distance of 60 miles from nearest Jacksonian exposure in coastwise belt. Jacksonian deposits include both marine and nonmarine strata. Name White Bluff formation given to marine unit and Redfield given to nonmarine unit. White Bluff formation overlies beds of Claiborne group. Paleontology of stage discussed.

Alan Cheetham, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 89–97. Fauna of Shubuta clay, "Red Bluff", marl, Forest Hill formation, and Bumpnose limestone has been considered intermediate between "typical Jacksonian" and "typical Vicksburgian" faunas. Cheilostome bryozans in these sediments are much more similar to those of Vicksburgian than to those of Jacksonian. Name *Spondylus dumosus* zone is proposed to designate sediments containing this fauna. Boundary between *Spondylus dumosus* zone and underlying Jacksonian is contact between what are commonly regarded as Oligocene and Eocene series in eastern Gulf Coast region. Correlation chart shows Moodys marl. Williston limestone, Inglis limestone, North Creek clay, Crystal River limestone, Cocoa sand, and Pachuta marl as Jacksonian.

C. W. Stuckey, Jr., 1960, Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 285–298. Literature is reviewed relating to Jacksonian stage. Term Jacksonian stage is used as proposed by Murray and Wilbert (1950). All formation and member names from Rio Grande River in Texas, through Louisiana and Mississippi to western Alabama are incorporated in report.

Type section of Jackson group or Jackson formation (exposures in and around town of Jackson, Hinds County, Miss.) is designated as typical of Jacksonian stage. Outcrops in Jasper, Clarke, and Wayne Counties, Miss., and in Choctaw and Clarke Counties, Ala., are cited as alternative standard sections.

Jackson Park Shale Member (of Kanwaka Shale)[1]

Pennsylvanian (Virgil Series): Eastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 94, 96.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 67. Basal member of Kanwaka shale; underlies Clay Creek limestone member; overlies Kereford limestone member of Oread limestone. Thickness 16 to 52 feet.

Type locality: Jackson Park, southeastern part of Atchison, Atchison County, Kans.

Jacksonville Drift

Jacksonville Substage

Pleistocene (Illinoian): Illinois.

M. M. Leighton and H. B. Willman, 1949, *in* Itinerery of State Geologists Field Conference of late Cenozoic Geology of Mississippi Valley, p. 7

(table 1); 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). Illinoian stage is divided into (ascending) Loveland, Payson, Jacksonville, and Buffalo Hart substages.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 125 (fig. 50), geol. section 46, 48, 55, 58, 59, 64, 66. At maximum advance, Jacksonville glacier formed a large lobe that extended down broad lower Illinois Valley. Jacksonville drift contains much outwash sand and gravel. Greatest thickness of gravel is 46 feet, about one-third mile northwest of Frederick, in NE¼SE¼ sec. 7, T. 1 N., R. 1 E. Derivation of name given.

Named for Jacksonville in Scott County, which is on Jacksonville moraine.

†Jacksonville Formation[1]

Miocene, upper: Northeastern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 124–125, 157, 158, 327.

Named for exposures in excavation made for city waterworks at Jacksonville, Duval County.

Jack Valley Formation

Silurian: Western Utah.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 9, 12 (fig. 3), 21–25, 40–41 (fig. 9), 53 (fig. 11), 60. Prososed for argillaceous black nodular dolomite ranging up to 250 feet thick, bearing strophomenid brachiopods. Overlies Roberts Mountain [s] dolomite; unconformably underlies Decathon dolomite (new). Part of Jack Valley is exposed in fault blocks in Ibex Hills and at head of Kings Canyon; base of unit not exposed at any of these localities where Jack Valley lies in fault contact with other units. Upper part of Jack Valley is series of interbedded medium- and dark-gray dolomite beds that differ somewhat from typical nodular dolomite below. Probably unsolved facies or stratigraphic tongue problem exists in Jack Valley unit.

Well exposed on west side of Jack Valley, in Confusion Mountains, sec. 25, T. 21 S., R. 15 W., Millard County.

Jacob Sand[1]

Pleistocene: Southeastern New York and islands of southern New England.

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Jacob sand is supposedly transition zone between interglacial Gardiners clay below and glacial Manhasset formation above. At type locality, buff fine-grained clayey sand, consisting chiefly of quartz grains, muscovite, and some dark minerals.

Named for exposures [type locality] near Jacobs Hill on north shore of Long Island, 8 miles northeast of Riverhead.

Jacobs Chapel Shale

Lower Mississippian: Indiana.

Guy Campbell, 1946, Geol. Soc. America Bull. 57, no. 9, p. 855–856. Soft greenish to dark-green glauconitic sparsely fossiliferous shale. Thickness about 9 inches. Lies between top of New Albany shale and Rockford limestone. Included in the Kinderhook and in Rockford by some workers.

Type section: One mile west of Jacobs Chapel Church, in lot 85 Clark Grant, Clark County.

Jacobsville Sandstone[1]

Jacobsville Formation

Precambrian or Cambrian; Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 692.

F. T. Thwaites, 1943, Michigan Acad. Sci., Arts and Letters Papers, v. 28, p. 496–497, 501. Age of Jacobsville sandstone not yet established; quite likely Upper Keweenawan. Probably nonmarine deposits.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Sandstone as exposed in southeast corner of Ahmeek quadrangle consists primarily of buff or salmon-colored fine- to coarse-grained sandstone with subordinate amounts of reddish-brown pebble conglomerate. Beds cropping out in quadrangle probably represent about 500 feet of formation. Drill hole records indicate thickness of at least 1,800 feet. Precambrian or Cambrian.

W. K. Hamblin, 1958, Michigan Dept. Conserv. Geol. Survey Div. Pub. 51, p. 6 (fig. 1), 15–69. Formation discussed in detail. Four lithic units recognized in formation; conglomerate facies, lenticular sandstone facies, massive sandstone facies; and red siltstone facies. Thickness varies because of relief of Precambrian surface on which formation was deposited. Underlies Munising formation; in some areas, covered by glacial drift. Along most of Lake Superior coast from Munising to Beaver Lake, the Jacobsville is below water level. Age has been matter of conjecture for many years. Discussion of factors favoring Keweenawan age and evidence opposing Keweenawan age. Unconformity between Jacobsville and Munising formations exposed at Grand Island proves that the Jacobsville is older than Upper Cambrian. It is impossible to estimate magnitude of this unconformity and to state whether the Jacobsville is Lower and Middle Cambrian or Upper Keweenawan. Evidence opposing Keweenawan age for Jacobsville appears to be quite substantial. Writer [Hamblin] concludes that the Jacobsville represents continental deposition in an enclosed basin during time marine sediments of Lower and Middle Cambrian age were being deposited in other parts of country. Formation was named by Lane and Seaman (1907). Term was applied to red sandstone east of Copper Range. It includes "lower red member" of Houghton's "Lake Superior sandstone" and most of "Eastern sandstones" of Irving (1883, U.S. Geol. Survey Mon. 5).

Named for exposures at Jacobsville, Houghton County.

Jacque Mountain Limestone Member (of Minturn Formation)

Jacque Mountain Limestone Member (of Battle Mountain Formation)

Jacque Mountain Limestone Member (of Maroon Formation)[1]

Pennsylvanian: Western central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Tenmile Spec. Folio 48.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1376 (fig. 1), 1378 (fig. 2), 1379–1380, 1389. Reallocated to member status in Battle Mountain formation (new). Overlies Robinson limestone member; lies near top of formation, about 120 feet below State Bridge

formation (new). Thickness about 30 feet; locally splits into two limestone beds 100 feet apart.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 204–205, 207–208. Reallocated to member status in Minturn formation. Overlies White Quail limestone member; top of member marks top of Minturn as here defined. Typically 15 to 25 feet of dark-bluish to light-gray fine-grained limestone, some parts of which are characteristically oolitic. Contains cephalopods and gastropods that might be either Pennsylvanian or Permian, but evidence slightly favors Pennsylvanian age.

First described from slopes of Jacque Mountain, Tenmile district.

Jacumba Volcanics[1]

Tertiary, upper, and Quaternary: Southern California.

Original reference: W. J. Miller, California Jour. Mines and Geology, v. 31, no. 2, p. 138–140, map.

G. B. Oakeshott, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 258. Listed on generalized stratigraphic section as basalt and pyroclastics several hundred feet thick. Older than Saugus formation and younger than Pico formation.

Exposed in several areas north and east of Jacumba, San Diego County.

Jaeger Diorite Complex

Age not stated: Central southern Arizona.

Leonid Bryner, 1958, Dissert. Abs., v. 19, no. 6, p. 1341. With metamorphic inclusions. Comprises oldest group of rocks in mapped area. Intruded by Ko Vaya quartz monzonite (new). Older than clastic sediments of continental, fluviatile origin, which are inferred to be Lower Cretaceous.

In South Comobabi Mountains and Ko Vaya Hills, Papago Indian Reservation, Pima County.

Jagger Bend Limestone Member (of Belle Plains Formation)[1]

Jagger Bend Limestone (in Belle Plains Group)

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 426.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Belle Plains group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Mostly dark-blue-gray medium-grained hard even layers that contain abundant minute vermicular foraminiferal debris; lowermost limestone bed is rather conspicuous yellow-brown limestone 2 to 3 feet thick; other beds mostly weather gray; thin shales between the limestones are dark blue to brownish and clayey. Thickness about 85 feet. Underlies Valera shale member; overlies Voss shale member.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081-G, p. 274, pls. 11, 12. Member geographically extended into Brazos River valley. Thickness 60 to 120 feet. Overlies Voss shale member; underlies Valera shale member, boundary not distinct.

Named from westward loop of Colorado River located short distance southwest of Leaday, Coleman County.

Jake Creek Sandstone Member (of Carbondale Formation)

Jake Creek Sandstone (in Carbondale Group)

Pennsylvanian: West-central Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 89, 204. Thin-bedded fine-grained micaceous sandstone in Liverpool cyclothem. Sandstone only locally present but has maximum thickness of about 18 feet. Occurs above Francis Creek shale and below Oak Grove beds.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35. Rank reduced to member status in Carbondale formation (redefined). Occurs above Francis Creek shale member and below Lowell coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: On Jake Creek, NE¼ sec. 13, T. 4 N., R. 1 E., Vermont quadrangle, Fulton County.

Jakes Creek Formation

Pennsylvanian: Eastern Nevada and western Utah.

Grant Steele, 1960, Dissert. Abs., v. 20, no. 12, p. 4635. Incidental mention in stratigraphic interpretation of Pennsylvanian-Permian systems of eastern Great Basin. In list of formations [sequence not stated], Jakes Creek follows Strathearn and precedes Carbon Ridge.

Type locality and derivation of name not stated.

Jalama Formation

Upper Cretaceous: Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 23–24, 38 (fig. 2), pls. 1, 2. Consists of about 4,000 feet of clay shales and sandstones overlying Espada formation (new) and disconformably underlying Eocene Anita shale. At type locality, 2,850 feet exposed; here relationship to overlying Anita shale is accordant. In Santa Rosa hills, overlain by Anita shale and Sierra Blanca limestone with angular unconformity of about 15°.

Type locality: Divide between Santa Anita and Bulito Canyons, in the Santa Ynez Mountains, Santa Barbara County.

Jameco Gravel[1] or **Formation**[1]

Pleistocene: Southeastern New York and islands of southern New England.

Original reference: A. C. Veatch, 1903, Jour. Geology, v. 11, p. 766–776.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 145–146. Thickness of gravel about 100 feet in western Long Island. Recognized in well samples by its characteristically high content of diabase fragments and its position beneath Gardiners clay. Not recognized with certainty in eastern part of island. Considered younger than Mannetto gravel on basis of degree of weathering.

Named for Jameco pumping station of Brooklyn water works, a few miles south of Jameco, N.Y., where borings first revealed the beds. Recognized on Block Island, Marthas Vineyard, and Cape Cod.

James Limestone (in Trinity Group)

James Limestone Bed (in Pine Island Member of Glen Rose Formation)

James Limestone Member (of Pearsall Formation)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, and Texas.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 961 (fig. 4), 970. Bed in upper part of Pine Island member of Glen Rose. Oolitic coquinoid to sandy gray lime and fine sand. Apparently correlative with Dierks limestone of outcrop.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Referred to as James limestone (in Trinity group). Underlies Rodessa formation; overlies Pine Island shale.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2342–2346. Member of Pearsall formation; overlies Pine Island member. For purposes of this study, defined as stratigraphic interval and its correlative rock equivalents in W. C. Feazel's Tonway Smith well No. 1, sec. 18, T. 21 N., R. 2 E., Union Parish, La., between depths of 4,255 and 4,370 feet. Separated from overlying Rodessa by variable interval referred to as Bexar shale member of its equivalent. Cow Creek member is both rock-stratigraphic and time-stratigraphic equivalent of James member.

Named for Arkansas Fuel Oil Co. James well No. 1 in sec. 14, T. 20 N., R. 1 E., Union Parish, La., from 3,827 to 3,917 feet.

†Jamesburg Formation[1]

Pleistocene: New Jersey.

Original reference: R. D. Salisbury, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 60–72.

Well exposed in upper part of railway excavation near Jamesburg, Middlesex County.

Jameson Shale Member (of Markley Sandstone)

Eocene: Northwestern California.

C. E. Weaver, 1941, Geol. Soc. America Mem. 35, p. 17 (table 3), 62–64. Consists of light-creamy-white to tan thinly laminated siliceous and sandy shales, often paper shales. Thickness 200 to 1,200 feet. Base of shale about 1,400 feet above base of Markley; both top and base of Jameson are gradational into sandstone.

Named from Jameson Canyon in Carquinez quadrangle, north of San Francisco Bay. Occupies a single area between Elkhorn Peak and Napa Junction, Napa County.

†James River Series[1]

Lower Cretaceous: Eastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 318.

Well exposed on James River from Richmond to Dutch Gap Canal, on Appomattox from below Petersburg to near its mouth, and on west bank of Potomac between Mount Vernon and Aqui Creek.

James River Shale[1]

Devonian(?): Southwestern Missouri.

Original reference: E. M. Shepard, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 2, p. 56, 67.

Occurs along and near James River.

Jamestown Coal Member (of Carbondale Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 48 (table 1), pl. 1. Assigned member status in Carbondale formation

(redefined). Occurs above Brereton limestone member and below Conant limestone member (new). Coal named by Bell and others (1931, Illinois Geol. Survey Ill. Pet. 19). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NW¼NE¼ sec. 34, T. 5 S., R. 4 W., Perry County.

Jamestown Conglomerate[1]

Upper Devonian: Western New York.

Original reference: G. D. Harris, 1891, Am. Geologist, v. 7, p. 164–174.

Occurs at Jamestown, Chautauqua County.

Jamestown cyclothem (in Carbondale Formation)

Jamestown cyclothem (in Carbondale Group)

Pennsylvanian: Southeastern Illinois.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). In list of cyclothems in McLeansboro, occurs below Bankston Fork cyclothem and above Brereton cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 10, pl. 1. Shown on correlation chart at top of Carbondale group. Includes Pokeberry limestone in western Illinois and Jamestown limestone in southern Illinois. Type locality given.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 113. Believed to be equivalent of Pokeberry cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Carbondale formation (redefined). Above Brereton cyclothem; in some areas, below Sparland cyclothem and in others below Bankston. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: NW¼NE¼ sec. 34, T. 5 S., R. 4 W., Perry County.

Jamestown Limestone (in Carbondale Group)

Jamestown Limestone (in McLeansboro Group)

Jamestown Limestone Member (of McLeansboro Formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: A. H. Bell, C. Ball, and L. McCabe, 1931, Illinois Geol. Survey Press Bull. 19.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1943, Illinois Geol. Survey Bull. 67, p. 17 (fig. 3). Shown on columnar section as limestone in McLeansboro group; stratigraphically below Anvil Rock sandstone and above Herrin limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Inf. Circ. 217, p. 10. Shown on correlation chart as limestone in Jamestown cyclothem at top of Carbondale group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 54 (table 3). Replaced by Conant Limestone Member (new) of Carbondale Formation (redefined). Name Jamestown will be used for the coal beneath the limestone. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent rock-stratigraphic classification.

Type locality: NW¼NE¼ sec. 34, T. 5 S., R. 4 W., in vicinity of Jamestown, Perry County.

Jamesville Limestone Member (of Manlius Limestone)

Jamesville Limestone[1] (in Manlius Group)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 26, 27, 30–31.

G. H. Davis 3d, 1953, New York State Mus. Circ. 35, p. 8, 9, 10. Termed a member.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 2 (columnar section), 4–5, 7. In central New York, underlies Deansboro member (new) of Coeymans limestone. Jamesville and Clark Reservation are grouped together under heading of transitional beds between Manlius group and Helderberg group above.

U.S. Geological Survey currently classifies the Jamesville as a member of the Manlius and designates its age as Lower Devonian on the basis of a study now in progress.

Type section: At "Green Lake" State Park (Clark Reservation), west of Jamesville, town of De Witt, Onondaga County.

Jane Lew Sandstone (in Conemaugh Formation)[1]

Jane Lew Sandstone (in Pittsburgh Redbeds)

Pennsylvanian: Southwestern Pennsylvania and northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 153.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 95. Jane Lew is a thin hard sandstone, 8 to 10 feet thick; occurs at several places in Pittsburgh redbeds.

Named for exposures on Hackers Creek, just east of Jane Lew, Lewis County, W. Va.

Janesville Shale (in Admire Group)

Permian: Southeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Defined to include strata between Foraker limestone above and Falls City limestone below. Average thickness 75 feet. Includes (ascending) West Branch shale, Five Point limestone, and Hamlin shale members.

Type section: In cut on east-west road in SW¼SE¼ sec. 23, T. 23 S., R. 10 E., Greenwood County. Name derived from Janesville Township.

Jangle Limestone Member (of Cadiz Formation)

Jangle Limestone

Middle Cambrian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 339–340, pls. 32, 33. Name Jangle limestone substituted for Peasley limestone of Wheeler (1940) in Pioche and Groom districts because of differences in thickness, lithologic characteristics, and possibly in formational boundaries. Subdivided into three units each of which consists of limestone. Lower unit, 80 feet thick, consists of dark-smoky-gray to steel-gray prominent ledge-forming limestone containing buff irregular silty partings. Lower 40 feet of this unit includes some well-bedded finely crystalline limestone beds a few inches thick; remaining 40 feet dominantly resistant calcitic poorly to fairly well-bedded limestone. Middle

unit, 115 feet thick, consists of dark-gray limestone containing buff to reddish-brown silty material which is distinctive for its slope-forming character. Upper unit, 80 feet thick, consists of dark-gray to smoky-gray ledge-forming limestone containing a few buff silty partings and round, concentric algal masses. Thickness 275 feet where completely exposed on Jangle Ridge. Conformably overlies Chisholm shale; conformably underlies Yucca Flat formation (new). Lower boundary is at lithologic break between shale and overlying limestone. Upper contact is at break between dark-gray limestone of Jangle and lowest, light-gray limestone bed of Yucca Flat.

U.S. Geological Survey classifies the Jangle Limestone as a member of the Cadiz Formation on the basis of a study now in progress.

Named for outcrops on Jangle Ridge, Atomic Energy Commission Nevada Proving grounds area, Nye County.

Janssen Clay Member (of Dakota Formation)

Upper Cretaceous: Central and north-central Kansas.

Norman Plummer, 1942, (abs.) Compass, v. 22, no. 4, p. 327. Dakota as defined here is subdivided into two members, Terra Cotta (lower) and Janssen (upper).

Norman Plummer and J. F. Romary, 1942, Kansas Geol. Survey Bull. 41, pt. 9, p. 336–340. Consists largely of gray to dark-gray clay and silt, some beds of fissile shale, and commonly a bed of lignite or highly lignitic clay; gray clay in lower half contains zones of siderite or limonite pellets, but no hematite. Thickness 30 to 80 feet, near minimum thickness in type area. Overlies Terra Cotta member, contact is drawn at top of marked concentration of concretionary "iron"; in places "quartzitic" silt or fine sand underlies concretionary "iron" bed; underlies Graneros shale.

Type area: Near center line sec. 3, T. 16 S., R. 9 W., near Janssen Station, Ellsworth County.

Jarbidge Rhyolite

Miocene, upper (?): Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–690, Book 2, p. 305–306. Quartz-rich rhyolitic rocks. Thickness at least 2,000 feet; unit sliced into number of fault blocks and reliable stratigraphic markers not recognized within it; hence, total thickness difficult to determine. Overlies Deadhorse tuff (new). In northeastern quarter of quadrangle, disconformably underlies Gods Pocket dacite (new); locally 30 to 50 feet of pale-gray vitric tuff separates the units.

U.S. Geological Survey currently considers the Jarbidge Rhyolite to be upper Miocene(?) in age.

Named for occurrence in Jarbidge quadrangle.

Jardine Basalt

[Pre-Paleozoic]: Southwestern Montana.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 16–17, pl. 4. "Basalt" exposed at summit of minor peak which is composed of Precambrian schist. Exposure is weathered brown. Rock is metamorphosed. Degree of metamorphism comparable to that exhibited by the schist, so that locally the rock is true schist, and elsewhere, where intimately penetrated by silica, is fine-textured gneiss. Rock probably represents an

ancient basic intrusion in old metamorphic rocks, because Paleozoic formations show no such metamorphism.

Caps mountain on east side of Bear Gulch ("Bear Creek" of Yellowstone folio), just east of town of Jardine. Lies at altitude of about 8,400 feet.

Jarita Basalt Member (of Los Pinos Formation)

Miocene(?) or Pliocene(?): Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38 (table 5), 46–48, pl. 1. Flows of olivine basalt; widely separated, disconnected single and multiple flows. Divided into unnamed northern, central, and southern types based primarily on petrographic characteristics. Maximum thickness 50 feet. Disconformably underlies Cordito member (new); overlies Esquibel member (new). Name credited to Butler (unpub. dissert.).

Named from an elongate exposure along western rim of La Jarita Mesa northeast of Vallecitos; Las Tablas quadrangle.

Jarvis Church Conglomerate Member (of Konawa Formation)

Permian: East-central Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 110–111, pl. 1. Name applied to multicolored cherts that occur about 250 feet above base of formation. Member is a single bed about 10 feet thick. Crossbedding and torrent bedding are common; uppermost horizon is clay pebble conglomerate which grades upward into thin crossbedded sandstone, thin limy sandstone, or marllike shale.

Typically developed near Jarvis Church, in sec. 23, T. 10 N., R. 5 E., Seminole County.

Jasper conglomerate[1]

Precambrian: Southwestern Minnesota and northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; 1914, Science, new ser., v. 40, p. 144.

Probably named for Jasper, Pipestone County, Minn.

Jasper Member (of Everton Formation)

Jasper Limestone[1]

Middle Ordovician: Northern Arkansas.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

E. E. Glick and S. E. Frezon, 1953, U.S. Geol. Survey Circ. 249, p. 3 (fig. 2), 4, 5, 6. Rank reduced to member of Everton. Separated from underlying Newton sandstone member by sequence of dolomite, sandy dolomite, and dolomitic sandstone beds about 90 feet thick; underlies St. Peter sandstone. Middle Ordovician.

Named for Jasper, Newton County.

Jasper Creek Shale (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 33.

Occurs in valley of Jasper Creek, Wise County, and on slopes of escarpment to west.

Jasper Knob zone (in Negaunee Formation)[1]

Precambrian (middle Huronian) : Northern Michigan.

Original reference : J. L. Adler, 1935, Jour. Geology, v. 43, no. 2, p. 113–132.

Type locality : Southeastern part of Ishpeming, northern slope of Jasper Knob, Marquette County.

Jasper Lake Greenstone Conglomerate or Agglomerate (in Knife Lake Series)

Precambrian : Northeastern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1593–1594, pl. 1. Name applied to greenstone conglomerate or agglomerate that extends from Conglomerate Lake to end of map area 7 miles to east. Consists principally of two kinds of fragments : hornblende andesite with phenocrysts (metacrysts) of hornblende, and dense andesitic ones without any visible crystals. Unweathered rock is grayish or bluish green. Thickness 10,000 to 15,000 feet ; this may be result of repetition of beds due to shallow asymmetric folding (pl. 1, cross section S–T). In this report, Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Jasper Lake greenstone conglomerates as unit 4 occurring above Disappointment Mountain and Moose Lake greenstone conglomerates and below unnamed quartz porphyry conglomerates.

Extends from Conglomerate Lake in sec. 24, T. 65 N., R. 6 W., Lake County, Knife Lake area.

Java Formation

Upper Devonian : Western and central New York.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1933–1939. Proposed for cyclically deposited Upper Devonian rocks in western and central New York that have been described previously (Pepper and de Witt, 1950) as Wiscoy sandstone and equivalent Hanover shale. Thicknesses : 94 feet at Silver Creek ; 113 feet at Java village ; 165 feet at Wiscoy ; 185 feet in western Steuben County ; more than 200 feet in central and eastern Steuben County. Comprises Pipe Creek shale, Hanover shale, and Wiscoy sandstone members. In western part of State, offshore shale and mudrock facies, Pipe Creek and Hanover members are dominant ; in central part of State, near-shore siltstone and sandstone facies, Wiscoy sandstone, is dominant. Overlies West Falls formation ; underlies Perrysburg formation.

Type section : Exposures along Beaver Meadow Creek above Angel Falls. Recognizable from Silver Creek, Chautauqua County eastward for more than 120 miles across parts of Cattaraugus, Erie, Wyoming, Allegany, Ontario, and Steuben Counties. Named from Java Township, Wyoming County.

Jawbone Conglomerate Member (of Kiawa Mountain Formation)

Precambrian : Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 1, 10, 25, pl. 1. Mostly quartz-pebble conglomerate with varying amounts of interlayered gray quartzite. The pebbles are light-gray, red, and black quartz, range from 4 to 25 mm in size, and are moderately well sorted, very well rounded, and mostly ovoid in shape. Granules and coarse grains of sand about as abundant as the pebbles. Matrix of conglomerate mostly blue-gray vitreous fine-grained kyanitic quartzite with hematitic layers. Crossbedding widespread. Some conglomerate is dark gray and slightly

micaceous. Thickness on Jawbone Mountain at least 500 feet and perhaps as much as 2,000 feet; about 500 feet in canyon 1 mile southwest of Hopewell, and from there southeastward member appears to finger out into [lower] quartzite member. Underlies [lower] quartzite member and overlies Moppin series (new) from about 1½ miles west-northwest of Burned Mountain northwestward for several miles to west boundary of quadrangle.

Underlies Jawbone Mountain in extreme northwest corner of Las Tablas quadrangle. Also mapped in small area about 1½ miles northwest of Burned Mountain.

Jayville Granite (in Diana Syenite Complex)

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 84, 85, 285, 286. Thought to be facies of Diana complex. Contains band of amphibolite and local masses of skarn thought to represent metamorphosed Grenville calcareous beds.

Present in Oswegatchie quadrangle. Jayville is in St. Lawrence County.

Jealousy Formation

Oligocene, upper: St. Croix, Virgin Islands (subsurface and surface).

D. J. Cederstrom, 1941, Am. Jour. Sci., v. 239, no. 8, p. 557. Name applied to gray clays and associated conglomerates that underlie Kingshill marl. Not known to crop out.

D. J. Cederstrom, 1950, U.S. Geol. Survey Water-Supply Paper 1067, p. 19–20, 68 (table 3), pl. 1. In central part of plain, test hole near Bethlehem shows that Kingshill marl is underlain by dark clayey formation known to be at least 1,938 feet thick; maximum thickness not known as base not reached. Section shows (ascending) 305 feet of dark clay with streaks of limestone, 5 feet of calcareous conglomerate, and 987 feet of greenish-gray clay. Name Jealousy formation is given to these sediments; above described section is type section. Near Jealousy estate, formation is 368 feet thick, and test drilling (well 39) shows 61 feet of hard calcareous conglomerate immediately above basement of Mount Eagle volcanics. Calcareous conglomerate that underlies Kingshill marl in stream beds near Jealousy is believed to be basal conglomerate of Jealousy formation.

Type section: Well 41, at Fredensborg.

Jeddito Formation

Pleistocene: Northeastern Arizona.

J. T. Hack, 1941, Geog. Review, v. 31, no. 2, p. 262–263; 1942, Harvard Univ. Peabody Mus. Am. Archaeology and Ethnology Papers, v. 35, no. 1, p. 48–51. Composed dominantly of russet-colored sand. Derived primarily by erosion of deposits on the mesas, sorted and transported by streams, ephemeral or perennial. Portion in lower part of valley is sandy, flood-plain deposit. In upper part of valley it is probably in places a channel deposit and in places a flood-plain deposit. Contains abundant layers of hard caliche in many places. Capped by 2 feet of fairly pure and hard limestone at one locality; more common are thin layers of sand, cemented by calcium carbonate. Recognized in most places by russet color and concretionary layers of caliche. Thickness at one measured section 9 feet. Underlies Tsegi formation (new). Contains proboscidian remains. Late Quaternary age.

C. B. Hunt, 1953, U.S. Geol. Survey Bull. 996–A, p. 4. In western Navajo country, proposed boundary between Pleistocene and Recent would be at top of Jeditto formation.

Best exposed in central part of Jeddito Valley [spelled Jadito on U.S. Geol. Survey Topog. Map or Arizona (1:500,000) for 1957] in stretch between Jeddito Trading Post and Awatovi, in western Navajo country.

Jeff Conglomerate (in Vieja Group)

Jeff Conglomerate Member (of Huelster Formation)

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 343, pl. 1. Name applied to a sandstone and conglomerate unit constituting lowest beds of Huelster formation (new). Average thickness 25 feet. Conformably underlies volcanic tuff; lies with slight angular unconformity upon Taylor marl and Austin chalk.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 14. Usage of name extended into Rim Rock country and applied to basal conglomerate of Vieja group. In southern part of area, Gill breccia (new) intervenes between the basal conglomerate and Colmena tuff (new); northward the breccia pinches out and the conglomerate thickens, presumably as the lower part of Colmena tuff grades into conglomerate so that on north a major part of the interval between Buckshot ignimbrite (new) and base of Vieja group is occupied by conglomerate.

Type locality: In tributary ravine on left bank of Horse Thief Canyon about 3½ miles upstream from its junction with Limpia Creek near the Jeff Ranch, Barrilla Mountains, Reeves County.

Jeff Davis Granite

Precambrian(?): Northwestern Georgia.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. ix, 6 (table), 23–28, pl. 3. Garnetiferous biotite granite intrusive into metasediments overlying quartzite member of Manchester formation.

Named for exposures near Jeff Davis School, 5 miles northwest of Thomaston. Upson County. Batholith underlies large part of central and eastern parts of Thomaston quadrangle.

Jefferson Limestone,[1] Dolomite,[1] Formation, or **Group**

Upper Devonian: Montana, south-central and northern Idaho, northern Utah, and western Wyoming.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 41–45. Jefferson limestone, in northwestern Montana, subdivided into (ascending) White Ridge limestone, Glenn Creek shale, Coopers Lake limestone, Lone Butte limestone, and Spotted Bear limestone members. Middle Devonian.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 19, pls. 1, 6. In Randolph quadrangle, Utah-Wyoming. Jefferson dolomite consists of about 1,200 feet of massive fine-grained dark-colored dolomite, which weathers to characteristic brown. Overlies Laketown dolomite and underlies Three Forks limestone; both contacts conformable. Middle Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768–1769, chart 4. Upper Devonian.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 9 (fig. 3), 10–14. In Three Forks area, formation consists of dark-colored limestone in lower part and dark-colored dolomite in upper part. Unconformably overlies Dry Creek shale; underlies Three Forks formation. Middle and Upper Devonian.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1407–1410, 1411–1412, 1415–1418. Formation, in central Montana, composed of an upper dolomite member, including some anhydrite or evaporite-solution breccia, and lower dense limestone member. In Three Forks area, breccia zone and overlying nonresistant shale of Three Forks formation are imperfectly exposed or entirely covered. To facilitate mapping, it would be more logical to revise Peale's (1893) classification and assign the breccias and associated shales to the Three Forks; but where the breccias are well exposed, as in type section, their genetic and lithologic relationships with main body of dolomite below are clear. Thickness 715 feet at Logan. Term Potlatch is applicable throughout Sweetgrass area subsurface and its use is recommended over Three Forks and Jefferson for that area.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1107–1108. In Borah Peak quadrangle, Idaho, Jefferson dolomite is about 1,000 feet thick, overlies Laketown dolomite and underlies Grand View dolomite.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table), 1139–1141. Formation, in Logan quadrangle, Utah, subdivided into (ascending) Hyrum dolomite and Beirdneau sandstone members (both new). Thickness as much as 2,120 feet. Overlies Water Canyon formation (new); underlies Madison formation.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1719. In northeastern Utah, underlies Leatham formation (new).

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2314–2322. Sloss and Laird (1947) in effect redefined the Jefferson to include at top a breccia and shale unit that Peale (1893) described as reddish- and brownish-yellow calcareous shale and mapped at base of overlying Three Forks formation. The two units that resulted from Sloss and Laird's revision are cartographically impractical because both the breccia zone and the overlying shales of the Three Forks are rarely visible. In present report, term Jefferson formation is used as defined by Peale and not as redefined by Sloss and Laird. Jefferson is raised to group status in subsurface of Williston basin and central Montana east of 111° meridian. Includes all beds overlying Souris River and underlying the Three Forks. Divided into Duperow formation and overlying Birdbear formation (new). Upper Devonian.

Named for exposures in hills on both sides of Missouri River just below junction of Three Forks of the Missouri, and on both sides of the Jefferson a few miles above its mouth, in Three Forks quadrangle, Montana.

Jefferson City Dolomite[1]

Jefferson City Formation (in Knox Dolomite)

Jefferson City Group

Lower Ordovician: Missouri and northern Arkansas.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 373, 375.

C. R. L. Oder, 1934, Jour. Geology, v. 42, p. 474 (table 1), 484–486. Geographically extended into eastern Tennessee where classified as formation in Knox dolomite. Occupies interval between top of Nittany and base of Cotter-Powell beds. Consists of 55 to 400 feet of thin- to heavy-bedded, dove- and dark- to brownish-gray fine-grained limestone and extremely light- to dark-green fine-grained to dense dolomite. Thin greenish-blue siliceous shales present on some bedding planes; coarse edgewise limestone conglomerates present locally.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser. v. 15, no. 2, p. 15, 17–32. Term Jefferson City has had many usages in the literature since originally defined by Winslow. Term should be dropped from the literature because of this. It is retained in this report as group term for following reasons: (1) a boundary between Rich Fountain and Theodosia formations (both new) is present within those beds originally defined as Jefferson City by Winslow; (2) predominant usage of them by most writers since Winslow has been in sense of group, even though it has not been defined as such; (3) term too well established in Missouri stratigraphic literature to be disposed of especially when beds involved are essentially same as those of previous usage. Underlies Cotter formation; unconformably overlies Roubidoux formation.

O. R. Grawe, 1945, Missouri Geol. Survey and Water Resources, 2d ser., v. 30, p. 52 (fig. 2), 59–62. Term Jefferson City formation used in this report [pyrite deposits of Missouri] in its older, unrestricted sense to include all dolomite beds above top of Roubidoux formation.

T. R. Beveridge, 1951, Missouri Geol. Survey and Water Resources, 2d ser., v. 32, p. 23–27, pl. 9. In this report [Weaubleau Creek area], no attempt is made to differentiate the Cotter from the Jefferson City, and name Jefferson City formation is used in unrestricted sense. Base not exposed in area; records from two wells which penetrated formation from top to bottom give thicknesses of 200 to 205 feet. Underlies Chouteau formation and in some areas the Sylamore. Ordovician, Canadian series.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23. Kingsport limestone replaces Jefferson City formation as used by Oder (1934). Jefferson City, Cotter, and Powell are names of formations exposed in Missouri and Arkansas, and there is no possibility that they can be traced into Appalachian Valley.

Named for exposures at Jefferson City, Cole County, Mo.

†Jefferson City Group[1]

Lower Ordovician (Beekmantown) : Missouri.

Original reference: C. L. Dake. 1921, Missouri Univ. School Mines and Metallurgy, v. 6, no. 1.

Jeffersonian Series or Stage

Ordovician (Canadian) : North America.

R. H. Flower, 1957, New Mexico Bur. Mines Mineral Resources Mem. 2, p. 18. Divisions within Canadian system favor natural division into four major units: Gasconadian, Demingian, Jeffersonian, and Cassinian. Jeffersonian (Early Upper Canadian) beds are restricted geographically. Includes Jefferson City (Rich Fountain and Theodosia), Cotter, and Powell.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–32. Canadian series includes Gasconadian, Demingian, Jeffersonian, and Cassinian stages.

Jeffersonian Stage[1] or Glacial Epoch

Pleistocene: Central northern Oregon.

Original reference: E. T. Hodge, 1930, Monthly Weather Rev., v. 58, p. 405–411.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 841 (table 1). Fourth of five glacial epochs in area. Occurs in interval between Willamettian epoch and Hood epoch.

Jeffersonville Limestone[1]

Middle Devonian: Indiana and north-central Kentucky.

Original reference: E. M. Kindle, 1899, Bull. Am. Paleontology, v. 3, no. 12, p. 8, 23, 110.

D. G. Sutton and A. H. Sutton, 1937, Jour. Geology, v. 45, no. 3, p. 331. Term Jeffersonville is synonym of Geneva, and by custom of priority latter name should be applied to all Indiana rocks of Onondaga age.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1060. South of Sellersburg, Jeffersonville is overlain by Silver Creek formation; northward Speeds formation lies between Jeffersonville and Silver Creek.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Lower or Middle Devonian.

E. M. Luttrell and Ann Livesay, 1952, Kentucky Geol. Survey, ser. 9, Bull. 11, p. 8. In western Kentucky, near Kentucky Lake, overlies Camden (Clear Creek) chert.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 38–39, pl. 1. In type section, Jeffersonville is divided into three zones: lower is brown to gray, dense to crystalline, dolomitic, contains prolific coral fauna and is generally known as "coraline zone"; middle is lighter gray or brown, dense to crystalline, and includes *Spirifer gregarius* beds; upper is tan or light-gray crystalline thick-bedded extremely fossiliferous limestone and includes *Spirifer acuminatus* zone. Thickness 26 to 46 feet. At type locality and northward through most of Clark County, overlies Louisville limestone; from northern Clark County northward, overlies Geneva dolomite; throughout southern Indiana, overlain by rocks of Hamilton age.

Named for Jeffersonville, Clark County, Ind., where formation is well exposed in the falls of the Ohio.

Jellico Formation[1]

Pennsylvanian: Northern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 14, 18–21.

C. W. Wilson, Jr., J. W. Jewell, and W. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], p. 1. As result of recent fieldwork names Briceville, Jellico, Scott, and Anderson are discontinued, and complete new classification is presented.

Named for occurrence of Jellico coal within formation.

Jelm Formation[1]

Upper Triassic: Central Wyoming and northern Colorado.

Original reference: S. H. Knight, 1917, Geol. Soc. America Bull., v. 28, no. 1, p. 168.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 6. Stratigraphic section in vicinity of Owl Creek Canyon section, northern Colorado, shows Jelm formation, about 60 feet thick, unconformably above Spearfish (redefined) and unconformably below Sundance beds.

J. D. Love, 1948, Wyoming Geol. Assoc. Geologists Guidebook 3d Ann. Field Conf., p. 100. Name Popo Agie is used in central Wyoming in preference to Jelm. Correlation of the two units has neither been definitely established nor disproved.

G. N. Pipiringos, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 36 (chart), 37–38 correlation chart. Restricted to exclude upper 50 feet which are included in Nugget formation. As used here, name Jelm is applied only to lower part, about 200 feet thick in type area, of original Jelm formation. Consists of two well-defined members. Overlies Alcova formation.

R. G. Hubbell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2743–2748. In Freezeout Hills area, stratigraphically expanded above to include unit here named Troublesome Creek sandstone member. Underlies Sundance formation; overlies Alcova member of Chugwater.

G. N. Pipiringos, 1957, Wyoming Geol. Survey Bull. 47, p. 13, 15–17, pl. 5, strat. sections. Upper part of original Jelm formation is lithologically continuous with basal Sundance sandstone of Lee (1927, U.S. Geol. Survey Prof. Paper 149), the Entrada (Front Range, Colo.) of Baker, Dane, and Reeside (1936), and Heaton (1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 8), and Nugget(?) sandstone of Neely (1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 6). Fact that upper part of original Jelm formation (Nugget) is lithologically closely related to Sundance formation while rest of Jelm contains redbeds identical to those of underlying Chugwater, and a well-developed persistent conglomerate near its top, indicates that original Jelm straddles Triassic-Jurassic boundary. Proposed that name Jelm be applied only to part which rests disconformably on Chugwater and whose top grades into overlying Nugget sandstone within a few feet above Jelm conglomerate. Type section of Jelm (restricted) is at Red Mountain where it is 190 feet thick.

R. F. Walters, 1957, Rocky Mountain Assoc. Geologists Guidebook to geology of North and Middle Park Basins, Colorado, p. 85–86. In Independence Mountain area, North Park, Colo., formation is an 85-foot sequence consisting of basal clay gall conglomerate overlain by alternating red, pink, and white beds of fine- to coarse-grained calcareous sandstone and conglomerate interbedded with red shale. Unconformably overlies Chugwater; unconformably underlies Nugget(?).

Named for exposures near eastern base of Jelm Mountain, near southern line of Albany County, Wyo. Type section Jelm (restricted) is at Red Mountain 25 miles southwest of Laramie; section is in SW¼NW¼ sec. 16, T. 12 N., R. 76 W.

Jemez Marl[1]

Jemez Shales

Tertiary: Central northern New Mexico.

Original references: A. B. Reagan, 1903, Am. Geol., v. 31, p. 86; C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, no. 4, p. 289.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 74. Puerco shale, as restricted by Mathews (1921, Am. Jour. Sci., 5th ser., v. 2, p. 220) could be properly renamed Jemez shales.

Derivation of name not given.

Jemison Chert[1]

Jemison Chert (in Talladega Series)

Lower Devonian: Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Special Rept. 14, p. 57, 145–147, map.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 21. Jemison chert, Yellow Leaf quartz schist, Dempsey marble, and Erin shale occur in upper part of Talladega series.

Named for exposures at and near Jemison, Chilton County.

Jenkins Clay (in Cimarron Group)[1]

Jenkins Clay Member (of Cave Creek Formation)

Permian (Cimarron Series): Central-southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 27–28.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1793, 1794, 1795. Unit formerly termed Jenkins clay is included in Nescatunga gypsum bed (new) in Blaine formation.

Named for former post office of Jenkins, Comanche County, Kans.

Jenkins Branch Chert Bed (in Cotter Dolomite)

Lower Ordovician: Northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 35, pl. 2. Fossiliferous reddish- to brown chert bed that occurs stratigraphically above the Crooked Creek chert bed (new) about the middle of the Cotter; texture is open and porous and probably not more than 40 percent of the mass is chert. Readily recognizable only on partly weathered surfaces.

Well exposed in roadcut south of Jenkins Branch in NE cor. SW¼NE¼ sec. 7, T. 19 N., R. 15 W., Yellville quadrangle, Marion County.

Jenness Pond Member (of Littleton Formation)

Lower Devonian: Northern New Hampshire.

M. T. Heald, 1955, The geology of the Gilmanton quadrangle, New Hampshire: New Hampshire State Plan. Devel. Comm., p. 9, 10 (table 1), geol. map. Thin-bedded pseudoandalusite schist, pyritiferous schist, and mica schist. Underlies Durgin Brook member (new); overlies Pittsfield member (new).

Typical exposures in vicinity of Jenness Pond, Gilmanton quadrangle.

Jennings Formation[1]

Upper Devonian: Northern Virginia, western Maryland, and eastern West Virginia.

Original reference: N. H. Darton, 1892, Am. Geologist, v. 10, p. 13, 17, 18.

C. S. Prosser and C. K. Swartz, 1913, Maryland Geol. Survey, Middle and Upper Devonian Volume, p. 411–422. In Maryland, subdivided into (ascending) Genesee black shale, Woodmont shale (new), Parkhead sandstone, and Chemung sandstone members. Overlies Romney shale; upper limit not well defined, red sediments of Catskill type alternate with lighter colored fossiliferous sediments of Jennings type in upper part of Jennings.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 89–92, 99. Described in Washington County, Md. Thickness 4,000 to 4,800 feet.

Named from exposures at Jennings Gap on Jennings Branch, Augusta County, Va.

Jennings Mountain Complex

Precambrian: Northeastern New York.

A. F. Buddington, 1948, Geol. Soc. America Mem. 28, p. 25, Incidental mention in discussion of granitic rocks of the northwest Adirondacks.

Occurs in vicinity of Jennings Mountain.

Jerome Formation[1]

Upper Devonian: Central Arizona.

Original reference: A. A. Stoyanow, 1930, Pan-Am. Geologist, v. 53, no. 4, p. 316–317.

R. H. Denison, 1951, Fieldiana: Geology, v. 11, no. 5, p. 254. In upper Devonian (Chautauquan stage).

Section at Jerome, Yavapai County, described in detail.

Jeromian series

Paleozoic [Upper Devonian]: Arizona.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228. Jerome formation (of Stoyanow) regarded as series. Includes (ascending) Vecol limestone (new), 250 feet thick; Sycamore sandstone, 75 feet; and East Verde limestone (new), 350 feet. Older than Island Mesa limestone; younger than Tombstonian series (new).

[In Jerome region.]

Jerry Lava Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 37, 47, 53, 89, 101, 114, 115. Discussion of Mount Multnomah ancient ancestor of the Three Sisters. Lava flow that issued from Cinder Cone. Rests on morainic material.

Derivation of name not given. Cinder Cone is north of North Sister Mountain and south of Yapoah Crater.

Jerseyan Drift[1]

Jerseyan Glaciation[1]

Jerseyan Till

Pleistocene: New Jersey.

Original reference: T. C. Chamberlin and R. D. Salisbury, 1906, Geology, v. 3, p. 383–387.

Paul MacClintock, 1940, Geol. Soc. America Bull., v. 51, no. 1, p. 103–115. Discussion of weathering of Jerseyan till. Two pre-Wisconsin drift

sheets are present in New Jersey. No evidence has come to light to modify Salisbury's and later Leverett's correlation with the Illinois and Kansan. Jerseyan, as used by Chamberlain and Salisbury, becomes group name equivalent to "pre-Wisconsin".

Named for development in New Jersey.

†Jessamine Limestone[1] (in Lexington Group)

Jessamine Limestone (in Lexington Limestone)

Middle Ordovician: Central northern Kentucky.

Original reference: A. M. Miller, 1919, Kentucky Dept. Geology and Forestry, ser. 5, Bull. 2, p. 25.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1634–1635. Limestone in lower Lexington limestone; underlies Benson limestone; overlies Logana formation. Thickness 75 to 80 feet.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41, 42; 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 13–14. Limestone in Lexington group. Overlies Logana formation; underlies Benson limestone.

Named for Jessamine Creek, Jessamine County.

Jessamine Series[1]

Middle Ordovician: Central northern Kentucky.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10.

Type locality not stated, but probably Jessamine, Jessamine Creek, or Jessamine County.

Jesse Sandstone Member (of Catron Formation)[1]

Middle Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 41.

Named for Jesse Creek, Bell County, Ky.

Jessup Formation

Pleistocene: Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19 (fig. 3). Named on diagram showing formations of Pleistocene age in Indiana. Name appears below Trafalgar formation (new). Name credited to W. J. Wayne (in preparation).

Type locality and derivation of name not given.

Jester Dolomite Member (of Blaine Formation)[1]

Permian: Southwestern Oklahoma.

Original references: G. G. Suffel, 1929, Stanford Univ. Abs. Dissert., v. 4, p. 90; 1930, Oklahoma Geol. Survey Bull. 49, p. 29, 55–57, 63.

Exposed where road from Jester, Greer County, crosses heavy gypsums at SE cor. sec. 25, T. 7 N., R. 24 W.

Jetmore Chalk Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Central western Kansas.

Original reference: W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 46, 51.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 24, 25. Chalky shale and chalky limestone, interbedded, "Shell-rock limestone"

bed at top, gray, weathers to light gray. Thickness 20 feet (Ellis and Russell Counties) to 25 feet. Overlies Hartland shale member; underlies Pfeifer shale member; in Hamilton County, Pfeifer shale and underlying Jetmore chalk are thicker than farther east; they cannot be distinguished and have been together designated the Bridge Creek limestone member.

Named for prominent exposures south and east of Jetmore, along south side of Buckner Creek, Hodgeman County.

Jewell Phyllite (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 141, 142–143. Mentioned in discussion of Pejepscot correlatives. Pejepscot formation (new) extends northward from Portland toward Lewiston and Brunswick and must include formations included in Berwick, Kittery, and Casco Bay group of Katz. Hornblende-epidote-chlorite schist crops out at Bunganac Landing conformably above Pejepscot gneiss. This schist, which is lithologically same as Spring Point greenstone of Katz, appears to be southwestern continuation of hornblende-rich gneiss which overlies marble at locality C (fig. 9). Phyllites, slates, and limestone of Casco Bay group overlie Spring Point greenstone in Portland area. Jewell phyllite is characterized by its silky sheen and its metacrysts of ottrelite, garnet, and staurolite. In these features it is same as Winthrop phyllite which carries transition from Sabattus sillimanite schist into Waterville slates in Winthrop area. Katz placed Jewell phyllite above Spurwink limestone and below Mackworth slate.

Named for development on Jewell Island in Casco Bay, Cumberland County.

Jewett Silt Member[1] (of Temblor Formation)

Miocene: Southern California (subsurface and surface).

Original reference: A. Diepenbrock, 1933, California Oil Fields, Div. Oil and Gas, v. 19, no. 2, p. 16, 22, pl. 2.

A. M. Keen, 1943, San Diego Soc. Nat. History Trans., v. 10, no. 2, p. 26 (fig. 1), 28 (fig. 2), 29. Mapped as Jewett silt in Kern River area near Round Mountain. Considered member of Temblor. Underlies Olcese sand; overlies Walker formation. Also referred to as Freeman and Jewett silts, often indistinguishable and grading downward locally in Pyramid Hill sand or "grit zone".

Named in subsurface from Shell Oil Co. Well No. "Jewett" 1, sec. 29, T. 28 S., R. 29 E., Kern County.

Jicara Formation

Paleocene, upper, to Eocene, middle: Puerto Rico.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, p. 200. A complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from volcanic rocks, is divided into eight formations [sequence not indicated]: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new), San Germán and Jicara formations are separated from underlying Ensenada and Río Yauco formations, at least locally, by unconformities. Complex ranges in age from Senorian to late Paleocene, possibly Eocene.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 19 (correlation chart). Paleocene, upper, to Eocene, middle.

P. H. Mattson. 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 345–346. Slodowski (1956, unpub. thesis) described formation as composed of thin- to thick-bedded fine-grained siliceous and calcareous tuffs; massive limestone and massive volcanic conglomerate locally present at base; minimum thickness 1,000 meters. Formation in Mayagüez area [this report] unconformably overlies Mayagüez group. San Germán and Jicara formations form structural unit south of Sabana Grande, the only area where they occur together.

Type locality: Region around Estacion La Plata and intersection of Routes 117 and 327, about 2 kilometers east of Mayagüez area, southeast of San Germán.

Jim Creek Shale Member (of Root Shale)

Jim Creek Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 94, 96.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 21. Jim Creek limestone is highest Pennsylvanian limestone identified in Missouri.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Root shale (new). Underlies French Creek shale member; overlies Friedrich shale member.

H. G. Hershey and others. 1960, Iowa Highway Research Board Bull. 15, p. 11, fig. 5. Geographically extended into southwestern Iowa where it is classified as formation in Wabaunsee group. Consists of dark-blue to black argillaceous limestone that weathers red or brown; upper part commonly thin bedded and lower part massive. Thickness about 1 foot. Fossils include *Chonctes* and *Myalina*. Overlies Friedrich shale; underlies French Creek shale.

Type locality: On Jim Creek, sec. 29, T. 7 S., R 11 E., Pottawatomie County, Kans.

Jim Ned Shale Member (of Belle Plains Formation)

Jim Ned Shale (in Belle Plains Group)

Permian: Central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 96. Proposed to replace Coleman bed of Drake (1893); name Coleman preoccupied. Lower half of formation consists of channel sandstone deposits and sandstone lentils (becoming more prominent northward), sandy shales, thin lignitic coals and black shales with plant remains, and thin limestone beds; upper part green and reddish shales with thin dolomitic members. Thickness 100 to 125 feet. Underlies Elm Creek limestone and extends downward to disconformity at top of Fisk formation (new).

R. C. Moore *in* M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets 3, 4; R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Reduced to member status in

Belle Plains formation. Underlies Elm Creek limestone member; overlies Overall limestone member of Admiral formation.

Type locality: In south part of the Newschaffer Survey No. 750 just west of highway bridge over Jim Ned Creek on Coleman-Baird Highway about 10 miles north of Coleman, Coleman County.

Joachim Dolomite[1]

Middle Ordovician: Eastern Missouri, northern Arkansas, and southwestern Illinois.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 352.

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 1, p. 11–12, pl. 3. Chiefly dolomite, magnesian limestone, and thin beds of shale and sandstone. Approximately 60 feet above base of formation is bed of fine-grained sandstone 4 to 10 feet thick. Overlies Dutchtown formation (new).

J. G. Grohskopf, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 3, p. 360, 362–364. Underlies Rock Levee formation (new). The Rock Levee includes some beds previously assigned to Joachim. Previous workers have stated that no chert occurs in the Joachim. However, in residues from well cuttings, a few fragments of light-gray to almost white chert was noted in many wells. This chert became a marker in subsurface work and has been traced for several hundred miles in eastern Missouri. It has been noted at two surface localities. Careful surface mapping will no doubt reveal its presence at many localities. It is here proposed that name Joachim be restricted to rocks overlying either the Dutchtown or St. Peter and including the chert zone at top. As thus defined, the Joachim is 175 feet thick at Cape Girardeau and gradually thins northwest until it is overlapped by the "Decorah" in vicinity of Kimmswick.

Named for exposures along Joachim Creek, Jefferson County, Mo.

Joana Limestone[1]

Joana Limestone Member (of White Pine Shale)

Lower Mississippian: Eastern Nevada and western Utah.

Original reference: A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 24, 26, map.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 21 (fig. 4), 23. Joanna [Joana] limestone geographically extended into House and Confusion Ranges, Utah, where it is 100 to 300 feet thick, underlies Chainman shale and overlies Pilot shale.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Shown as member of White Pine shale on correlation chart of recommended revision of stratigraphic units in Great Basin.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 4 (fig. 1), 54–56. Described in stratigraphic section in vicinity of Eureka where it is as much as 125 feet thick; overlies Pilot shale and underlies Chainman shale. Early Mississippian.

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pub. Geol. Sci., v. 38, no. 2, p. 108 (fig. 5), 110. Discussion of Quartz Spring area, Inyo County, Calif. Formations Tin Mountain limestone, Perdido formation, and Rest Spring shale, as defined by McAllister (1952),

are utilized in this discussion and description of rocks in area. On other hand, Joana limestone, Peers Spring formation, and Chainman shale, with somewhat different limits, are the formations to which these same rocks would be assigned in regional discussion of Mississippian stratigraphy in Great Basin.

Named for Joana mine, on south side of Robinson Canyon, 2 miles above Ely, White Pine County, Nev.

Joaquin Ridge Sandstone Member (of Panoche Formation)

Upper Cretaceous: Central California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2), 989. Mentioned in discussion of Weldonian stage (new). Shown on chart as underlying Ragged Valley shale and overlying Alcade shale (new). Name credited to J. Q. Anderson.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 31. Referred to as member of Panoche in discussion of Moreno Grande formation (new) and Moreno formation.

Occurs in San Joaquin Valley in Coalinga-Ortigalito area.

Joe Lott Tuff

Pliocene(?): Southwest-central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 449–450. Several discrete areas of white to light-yellow or brownish tuff are grouped as Joe Lott tuff. Thickness of outcrops highly variable; in Clear Creek basin aggregate thickness more than 1,000 feet; here tuff is in massive beds, in places between 50 and 100 feet thick; these beds show no lamination, but thin pinkish interbeds are commonly laminated. Upper part of tuff, exposed in northwestern part of region, interbedded with abundantly porphyritic latite and quartz-latite flows of Dry Hollow latite (new). Commonly overlies Dry Hollow latite; locally overlies Mount Belknap rhyolite (new) and Bullion Canyon volcanics (new). Tertiary.

U.S. Geological Survey currently considers the Joe Lott tuff to be Pliocene (?). This designation made on the basis of a restudy of units in area.

Named for exposures on Joe Lott Creek in northern part of Marysvale region. Largest exposures are in Clear Creek basin west of Sevier and in Beaver River basin southwest of Delano Peak.

Joes Canyon Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3). Discussion of Paleozoic continental margin in central Nevada. Clipper Canyon sequence comprises (ascending) Charcoal Canyon, Petes Summit, Sams Spring, and Joes Canyon formations (all new). Clipper Canyon sequence isolated by surrounding Tertiary volcanic rocks.

Clipper Canyon, Toquima Range, Nye and Lander Counties.

†Joes Rock Granite[1]

Devonian(?): Southeastern Massachusetts.

Original reference: C. H. Warren and S. Powers, 1914, Geol. Soc. America Bull., v. 25, p. 456, map.

Mapped at Joes Rock, west of Sheldonville, Norfolk County.

Joes Valley Member (of North Horn Formation)

Paleocene: Central Utah.

C. L. Gazin, 1941, U.S. Natl. Mus. Proc., v. 91, no. 3121, p. 6. Proposed for Paleocene part of North Horn formation. Defined as beginning with the highly colored clay and sandy clay, locally black carbonaceous shales, resting abruptly but without apparent disconformity on massive sandstones capping dinosaur-bearing North Horn beds. Upper part includes greater quantity of buff sandstone, with thicker zones of more uniformly colored sandy clay, ending abruptly beneath Flagstaff limestone. Estimated thickness several hundred feet.

Well exposed on mountain slopes adjacent to Joes Valley, Emery County. Also exposed in Dragon Canyon and on North Horn Mountain.

Johannesburg Gneiss[1]

Precambrian: Southern California.

Original reference: C. D. Hulin, 1925, California State Mining Bur. Bull. 95, p. 21–23, 28, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 509, table 4. Older Precambrian; older than Rand schist.

Named for exposures 2 miles north of Johannesburg, Kern County.

John Day Formation[1]

Oligocene, upper, and Miocene, lower: Central northern Oregon.

Original reference: O. C. Marsh, 1875, Am. Jour. Sci., 3d, v. 9, p. 52.

Morton Green, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1538–1539. Since 1902, formation has been considered divisible into three parts: lower reddish trachytic tuffs, middle blue-green, and upper buff andesitic tuffs. Early studies indicated that a rhyolitic flow separates middle and upper beds. Plant remains from lower beds have been determined as upper Oligocene in character, and mammal remains in middle and upper divisions as lower Miocene. Recent studies indicate that the rhyolite is welded tuff, ignimbrite, and this grades into andesitic tuff of upper division. Since characteristics for middle and upper beds are the same, separated only by local extrusive variant, it seems evident that any division is artificial.

Howel Williams, 1957, A geologic map of the Bend quardangle, Oregon, and a reconnaissance geologic map of the central portion of the High Cascade Mountains (1:125,000): Oregon Dept. Geology and Mineral Industries. Oldest rocks in Bend quadrangle. Consists principally of flows and domes of rhyolite, welded rhyolite tuffs, bedded rhyolite tuffs, and varicolored fluviatile and lacustrine tuffaceous sediments; flows of andesite and basalt subordinate. Maximum thickness not over 5,000 feet and may be less. Underlies Columbia River basalt. Upper Oligocene and lower Miocene.

R. V. Fisher and R. E. Wilcox, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B302–B304. Formation exposed mainly in southern part of Monument quadrangle. Aggregate thickness about 950 feet. Tentatively divided into three unnamed members, which do not strictly conform to those proposed by Merriam (1901, Geol. Soc. America Bull., v. 12, p. 496–497) for section at Picture Gorge. Lower member consists of deep-red friable mudstones and siltstones, 67 feet thick. Middle member, 530 feet thick, divided into two parts: lower dominantly reddish and upper colored in

light shades of red, yellow, gray, and green, welded tuff present locally. Upper member, 346 feet thick, characterized by light-gray or buff colors and weathers to silty powdery soil. Late Oligocene and early Miocene.

Typical localities are along John Day River. Well exposed in Picture Gorge.

Johnnie Formation[1]

Precambrian: Eastern California and southeastern Nevada.

Original reference: T. B. Nolan, 1928, Am. Jour. Sci., 5th, v. 17, p. 461–472.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 952–953. Geographically extended into southern Death Valley region, where it overlies Noonday dolomite and underlies Stirling quartzite. Hazzard (1937, California Jour. Mines and Geology, v. 33, no. 4) described Johnnie(?) formation in Resting Springs and Nopah region, California. Name Johnnie used here without query with the understanding that not all of type Johnnie is represented in Death Valley.

C. R. Longwell, 1952, Washington Acad. Sci. Jour., v. 42, no. 7, p. 212. Suggestion made that Johnnie formation, Noonday dolomite, Deep Springs formation, and Reed dolomite of Inyo region be carried under "age unknown" because there is no firm basis for drawing lower boundary of Cambrian in Death Valley region.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 372–375, figs. 1, 3. Described in Manly Peak quadrangle, California, where it it 2,000 to 2,500 feet thick; underlies Stirling quartzite and overlies Noonday dolomite. Nonfossiliferous. In this report, beds below *Olenellus* zone are referred to the Precambrian. In Nopah-Resting Springs Ranges, top of Johnnie formation is 4,500 feet below lowest occurrence of *Olenellus*; hence, formation is well within late Precambrian as defined in this report.

First described in Johnnie Wash, north of Johnnie mine, Spring Mountains region, Nevada.

Johnny Bull Sandstone (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 52–53, table 1, pl. 1. Interbedded light-colored fine-grained well-sorted well-cemented orthoquartzite, dark-grayish-brown fine-grained well-cemented subgraywacke, and brown shale. Sandstone and interbedded shale comprise major part of formation. Shale beds typically thin bedded. No complete section observed. Thickness at type locality 1,047 feet. Conformably overlies Still Ridge formation (new).

Type section: Central part is about a mile due west of Johnny Bull mine, from which unit is named. Section measured along south side of prominent hill just north of road to Silver Hill mine, in SE¼ sec. 4, T. 25 S., R. 21 W., Peloncillo Mountains, Hidalgo County.

Johnny Lyon Granodiorite

Precambrian: Southeastern Arizona.

P. E. Damon, 1959, Arizona Geol. Soc. Guidebook 2, p. 19 (table 3), 20. Briefly mentioned in paper on geochemical dating of igneous and metamorphic rocks. Alpha-lead dates for zircon separates given as 615 and 815 million years.

In Johnny Lyon Hills, about 50 miles east of Tucson.

Johnsburg Limestone[1]

Precambrian: Northeastern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

Type locality: Johnsburg, Warren County.

Johnson Granite Porphyry[1] (in Tuolumne Intrusive Series)

Cretaceous: Eastern California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 127–128, map.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2121, 2122, 2123 (fig. 1). Discussed in paper dealing with potassium-argon dating of igneous rocks. Age given as 82.4 millions of years. Younger than Cathedral Peak granite and Hoffman quartz monzonite (new).

Named for fact it forms Johnson Peak in Yosemite National Park.

Johnson Gravels[1]

Miocene: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 371–394.

Extend south of 40th parallel, through Cascade mine to vicinity of Haskell Peak, Taylorsville region.

Johnson Shale[1] (in Council Grove Group)

Permian: Southeastern Nebraska, northeastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 168; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Gray shale that locally, in northern Kansas, contains thin beds of argillaceous limestone; dark carbonaceous material occurs in upper part of shale in north; lower and middle parts are commonly somewhat sandy. Thickness ranges from about 16 feet in northern part of Kansas to about 25 feet in southern part. Underlies Long Creek limestone member of Foraker limestone. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 85–86. In Kansas and Nebraska, rocks of interval above Long Creek limestone and below Glenrock limestone member of Red Eagle limestone are known as Johnson shale. In Pawnee County, Red Eagle limestone has not been subdivided, and it is not certain that Glenrock member is present. Name Johnson shale has been retained and applied to beds between Eagle Rock and Long Creek limestone member of Foraker limestone. Unit extends southward into Lincoln County. Thickness 35 to 60 feet in Pawnee County.

Named for exposures 1½ miles north of Johnson County, Nebr.

Johnsonburg Sandstone[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 139–140.

Occurs in southern suburb of Johnsonburg, Elk County.

†Johnson Creek Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 527, 546, 554, 555.

Probably named for exposures on Johnson Creek, Houghton County.

Johnson Gap Formation

Triassic(?): Southeastern Colorado and northeastern New Mexico.

R. B. Johnson and E. H. Baltz, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1896 (fig. 1), 1897–1899. Sequence of thin to thick beds of gray silty siliceous limestone conglomerate that contains pebbles and cobbles of gray finely crystalline limestone. Conglomerate interbedded with gray and light-red silty and siliceous limestone; red, siliceous, thin-bedded siltstone; greenish gray and brown plastic shale; and gray and red, fine-grained quartzose sandstone. Thickness at type locality about 90 feet. Thickens southward from wedge-edge about 2 miles north of Johnson Creek to about 100 feet at State line, and about 110 feet at Gold Creek, about 8 miles south of Johnson Creek and 3 miles into New Mexico. Rests with apparent unconformity on Sangre de Cristo formation. Upper beds truncated by erosion surface at base of overlying Entrada sandstone.

Type locality: Johnson Creek, secs. 19 and 20, T. 34 S., R. 69 W., Sangre de Cristo Mountains, Colo. Named for exposures in gap of Johnson Creek, locally known as Johnson Gap, 3 miles west of Tores, Las Animas County, Colo.

Johnson Gulch Porphyry[1] (in Gray Porphyry Group)

Early Tertiary: Northern central Colorado.

Original reference: S. F. Emmons, J. D. Irving, and G. F. Loughlin, 1927, U.S. Geol. Survey Prof. Paper 148.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 53–54, 57, pl. 1. Younger than Iowa Gulch porphyry. Intrusion of Johnson Gulch porphyry was latest event in igneous sequence in area [west slope of Mosquito Range]. Igneous rocks younger than Precambrian in area of this report are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene.

U.S. Geological Survey currently designates the age of the Johnson Gulch Porphyry as early Tertiary on basis of a study now in progress.

Named for development in Johnson Gulch, Leadville district, Lake County.

Johnson Mill Graphite Schist

[Precambrian]: Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–49, p. 140. Overlies Lynchburg gneiss; underlies Charlottesville formation (new).

Report discusses structure and stratigraphy of the Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is an overturned anticline, with axial plane dipping 28° to southeast, and thrust fault bordering it on its western edge.

Johnson Peak Formation

Upper Cretaceous: Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 16–18, pls. 1, 2. Approximately 65

percent of formation at Johnson Peak consists of pale- to dark-green silty shale which weathers light brown; locally shale contains fine carbonaceous particles; limestone nodules and thin limestone beds common throughout shale; some thin layers of yellowish-green siltstone present; thinly bedded arkosic sandstones make up the remaining 35 percent. About 200 to 300 feet below top of formation is a prominent lens of massive thinly bedded concretionary graywacke which attains maximum thickness of about 380 feet northeast of Orchard Peak; this lens is named Enebro sandstone member (Spanish for "juniper") in reference to numerous junipers that thrive on its sandy soil. [Enebro not considered formal name.] Thickness at type section 2,250 feet; about 800 feet near western limit of outcrop; about 950 feet at eastern limit, near Devil's Den. Except where faulted, conformably overlies Risco formation (new); conformably underlies Aguila sandstone (new). Presence of single *Baculites* sp. indicates Late Cretaceous age.

Type locality: Section through Johnson Peak, Three Peaks anticline, Tent Hills quadrangle, Kern County. Crops out mainly east and northwest of Orchard Peak and in Three Peaks anticline.

Johnson Run Sandstone

†Johnson Run Sandstone (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1879, Geol. map of McKean County: Pennsylvania 2d Geol. Survey.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 57, 103. Johnson Run sandstone (Pottsville series) is separated from underlying Kinzua Creek sandstone by Alton coal group. Forms top of Pottsville in many areas.

First described in McKean County. Also noted in Cameron and Clinton Counties.

Johnson Spring Formation

Johnson Spring Formation (in Eureka Group)

Middle Ordovician: East-central California.

H. R. Pestana, 1960, Jour. Paleontology, v. 34, no. 5, p. 862–873. Interbedded limestone, dolomite, and quartzite. Thickness 163 to 384 feet; 208 feet at type section. Conformably overlies Barrel Spring formation; conformably underlies Ely Springs dolomite. This is unit referred to as undifferentiated upper part of Eureka group by Langenheim and others (1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9).

Type section: Lead Canyon Trail section, Independence quadrangle, Inyo Mountains. Outcrops of formation parallel outcrops of other Paleozoic formations along eastern side of Mazourka Canyon.

Johns Pond Formation

Silurian(?): Central western Maine.

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Passes from low-grade greenstones in north through hornblende-epidote-(albite or oligoclase) amphibolites to middle-high-grade almandite-hypersthene-biotite-andesine granulites in the south. Thickness about 1,600 feet. Underlies Perry Mountain formation; overlies Lost Brook formation (new).

In Kennebago Lake quadrangle.

Johnstone Peak Tuff Breccia (in Glendora Volcanics)

Miocene, middle or older: Southern California.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 65–67, pls. 1, 4. Name applied to accumulations of tuff that occur at various horizons in volcanics in foothills area. Contains numerous scattered subangular fragments and blocks ranging in diameter from fraction of inch to over 10 feet. Proportion of blocks to tuff matrix ranges from about 10 to over 50 percent. In most outcrops, deposit is chaotic with no sign of bedding; locally contains lenses and thin streaks of bedded tuff matrix. Breccias lie between and upon the three lava members of volcanic series and range in thickness from about 100 to 700 feet.

Typically exposed south of Johnstone Peak, in San Gabriel Mountains, Los Angeles County.

Johnston Hill Glaciation

Pleistocene: Southwestern Alaska.

E. H. Muller, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 2, 13 (table 1). Four major glaciations tentatively recognized in northern part of Alaska Peninsula. Johnston Hill was second early ice advance, or major recessional phase of preceding (unnamed) glaciation. Includes bouldery outwash in shore bluffs west of Johnston Hill and till in bluffs at mouth of Naknek River. Characteristic topographic expressions of glaciation largely destroyed by succeeding glaciations. Succeeded by Mak Hill glaciation (new). Name credited to Abrahamson (unpub. dissert.).

Named for prominent till ridge 12 miles southwest of Naknek, northern Alaska Peninsula.

Johnstown Limestone Member (of Allegheny Formation)[1]

Johnstown Limestone (in Allegheny Group)

Upper Pennsylvanian: Western Pennsylvania.

Original reference: H. M. Chance, 1880, Pennsylvania 2d Geol. Survey Rept. V_2.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 60 (table), 74, fig. 21. Included in Kittanning subdivision of Allegheny group. Thickness as much as 10 feet. Separated from overlying Freeport sandstone by Upper Kittanning coal; overlies Upper Westernport sandstone.

Named for occurrence at Johnstown, Cambria County.

Johns Valley Shale[1]

Mississippian and Pennsylvanian: Southeastern Oklahoma and central and western Arkansas.

Original reference: E. O. Ulrich, 1927, Oklahoma Geol. Survey Bull. 45, p. 6, 21–23, 30, 36–37.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 896. Name abandoned. Replaced by Round Prairie formation (new).

R. C. Rea, 1947, Tulsa Geol. Soc. Guidebook Field Conf., May 8, 9, 10, p. 47–49. Johns Valley shale of Pennsylvanian age (some say Bendian) lies conformably between Jackfork sandstone below and Atoka formation above in normal sequence at all localities where it was observed in western Ouachita Mountains. Measured sections indicate minimum of

300 feet and maximum thickness of 900 feet. Characterized by presence of erratic and exotic boulders ranging from Cambrian to Mississippian in age.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Pennsylvanian.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 103–106. Upper part of Johns Valley shale is partial equivalent of Mississippian Caney formation of Arbuckle province. Type locality of the Johns Valley is in bowl-shaped Johns Valley in trough of Tuskahoma syncline. Also type locality of Caney shale is along Caney Creek (originally Cane Creek) which is also in Johns Valley topographic basin. Many Mississippian fossils illustrated by Girty (1909, U.S. Geol. Survey Bull. 377) were collected in Johns Valley. With recognition of exotic boulders of Arbuckle and (or) Ozark facies that are embedded in the shale, Ulrich (1927) proposed name Johns Valley for the boulder-bearing shale. He acknowledged the Mississippian age of rocks containing Caney fauna, but held that they were erratics which had been transported to Johns Valley in early Pennsylvanian time. The pre-Mississippian boulders and blocks in Johns Valley are foreign to Ouachita province, but it is now believed that the so-called "Caney boulders" are sideritic concretions indigenous to Caney, that the Caney "blocks" are substantially where the shale was deposited, and that the type Caney is in reality the lower part of the type Johns Valley as defined by Ulrich.

L. M. Cline and O. B. Shelburne, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas Geol. Soc. and Ardmore Geol. Soc., p. 193–204. Formation discussed in detail. Harlton's (1938) name Round Prairie not accepted by later workers. Overlies Game Refuge sandstone; underlies Atoka formation. Thickness 425 to 900 feet. Mississippian-Pennsylvanian.

H. D. Miser and T. A. Hendricks, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1829–1832. Discussion of age of Johns Valley shale, Jackfork sandstone, and Stanley shale. Geologic evidence establishes presence of both Pennsylvanian and Mississippian beds in Johns Valley shale.

Typically exposed in center of Tuskahoma syncline, particularly in north half of T. 1 S., R. 16 E. Named for settlement (on Cane Creek, in northwest part of Pushmataha County, about 6 miles north of Eubanks) which is now called Johns Valley, but which, at time Taff named Caney shale, was locally known as Caney and which Taff in 1925 stated was type locality of Caney shale.

Johns Wash Limestone

Upper Cambrian: East-central Nevada.

Harald Drewes and A. R. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 106 (fig. 2), 108 (fig. 3), 115, 117; Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 224 (fig. 2), 226, pl. 1. Name applied to 250-foot unit of coarsely crystalline and clastic, light- to dark-gray limestones that commonly makes cliff above Lincoln Peak formation (new). Underlies Corset Spring shale (new).

Type section: Head of Johns Wash, Mount Washington-Lincoln Peak area, Snake Range.

Joins Formation[1] (in Simpson Group)

Middle Ordovician: Central southern Oklahoma.

Original references: E. O. Ulrich, 1928, Manuscript chart exhibited at New York meeting of Geol. Soc. America; C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1495.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 55–61. Consists of thin limestones and shales with several intraformational conglomerates near base; limestones are light to dark gray and vary from fine grained and resistant to coarsely crystalline and crumbling; shales are characteristically green and less abundant and thinner bedded than those of overlying Simpson formations. Thickness at type locality approximately 300 feet; thins to 160 feet in southeastern end of Arbuckle Mountains; ranges from 200 feet at northwestern end to zero at northeastern end. Overlapped by Oil Creek formation; unconformably overlies Arbuckle dolomitic limestone. Ostracoda indicate more indirectly than directly Chazyan age; none of the Ostracoda in the Joins has been recorded from Chazyan strata outside Oklahoma; similarity of Joins and Oil Creek (Chazyan) Ostracoda is indirect evidence of Chazyan age.

Type locality: Exposures along Spring Creek on Johns Ranch, in Carter County, T. 2 S., R. 1 W., northwest of Woodford, near western end of Arbuckle Mountains.

Joins Ranch Formation[1]

Lower Ordovician (Chazy): Central southern Oklahoma.

Original reference: E. O. Ulrich *in* C. E. Decker, Dec. 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1495.

Arbuckle and Wichita Mountains.

Joliet Conglomerate[1]

Pleistocene: Northeastern Illinois.

Original reference: J. W. Goldthwait, 1909, Illinois Geol. Survey Bull. 11, p. 42.

Named for Joliet, Will County.

Joilet Limestone[1]

Joliet Dolomite

Joliet stage

Middle Silurian: Northeastern and western Illinois.

Original reference: G. A. Shufeldt, Jr., 1865, Am. Jour. Sci., 2d, v. 40, p. 389.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Joliet dolomite (restricted) as underlying Cordova dolomite (new) and overlying Rockdale dolomite (new).

J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 191 (table 8). Shown on table of general classification of geologic time as Joliet stage in Niagaran epoch.

Well exposed in quarry of National Stone Co., Joliet, Will County.

Jolliff Conglomerate Member (of Golf Course Formation)

Jolliff Limestone Member (of Dornick Hills Formation)[1]

Pennsylvanian (Morrow Series): South-central Oklahoma.

Original reference: J. A. Waters, 1927, Jour. Paleontology, v. 1, p. 129.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1). Correlation chart shows Jolliff below Otterville and above Limestone Gap shale (new).

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 138. Member of Golf Course formation (new). Overlies Primrose sandstone member; underlies Otterville limestone member. South of Ardmore the Jolliff conglomerate is lowest unit of Morrowan age.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 20. Jolliff limestones and conglomerates occur south of Ardmore where they were described by Tomlinson (1929, Oklahoma Geol. Survey Bull. 46) as basal member of Dornick Hills formation, now regarded as group. Along much of its 15-mile outcrop, consists of two coarse conglomerates, each 10 to 30 feet thick. Conglomerates locally disappear or grade into thin tan limestones. Where these occur, they are the first extensive limestones above the Sycamore (Mississippian). They are also lowest conglomerates in sedimentary section here, above Cambrian arkosic conglomerates at base of Reagan sandstone—except for intraformational flat-pebble conglomerates in the Joins and upper Arbuckle beds (Ordovician) and the very local 4-inch bed in Lake Ardmore formation. Tan to black shales fill the varying interval (50 to 200 feet) between major competent strata of Jolliff unit. South of Ardmore, about 800 feet of black shale with sideritic layers intervene between Jolliff conglomerates and Otterville limestone—next higher resistant member of Dornick Hills group.

Named for outcrops in Jolliff Prairie, on allotment of Norman Criner Jolliff, in sec. 24, T. 5 S., R. 1 E., Carter County, east of axis of Overbrook anticline.

Jolly Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: F. M. Hutchinson, 1912, Kentucky Geol. Survey Bull. 19, p. 30–125.

Probably named for Jolly, Webster County.

Jolly Limestone Member (of Savanna Sandstone)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: G. D. Morgan, 1924, [Oklahoma] Bur. Geology Bull. 2, p. 74–75.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Rejected by Oklahoma Geological Survey. Name preoccupied.

Well exposed in road in front of J. S. Jolly's house, 300 yards east of NW cor. sec. 8, T. 1 N., R. 7 E., Pontotoc County.

Jollytown Limestone Member (of Washington Formation)[1]

Jollytown Limestone (in Washington Group)

Permian: Southwestern Pennsylvania, western Maryland, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22, 23, 24, 29, 34.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 151. Included in Washington group, although not exposed in Fayette County.

Named for exposures in vicinity of Jollytown, Greene County, Pa.

Jollytown Sandstone (in Washington Formation)[1]

Jollytown Sandstone Member (of Greene Formation)

Permian: Southwestern Pennsylvania, eastern Ohio, and western West Virginia.

Original reference: E. V. d'Invilliers, 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2573.

Wilber Stout, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 154, chart facing p. 108. In Ohio, termed sandstone member of Greene formation, Dunkard series.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). In Harrison County, W. Va., Jollytown sandstone is shown as underlying unnamed shale below Dunkard coal and overlying Jollytown coal and (or) slate and shale. Included in Greene formation, Dunkard group.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Shown on table of classification of Greene series. Above Jollytown coal and below Dunkard coal.

First described near mouth of Hoover Run on Dunkard Creek, Washington County, Pa.

Jonesboro Limestone[1]

Mississippian: Southwestern Illinois.

Original reference: H. Engelmann, 1868, Illinois Geol. Survey, v. 3, p. 43.

Well exposed one-half mile west of Jonesboro, Union County.

Jonesboro Limestone[1] (in Knox Group)

Lower Ordovician: Northeastern Tennessee and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 564, 637, 671–674, pl. 27.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 62, 63–64, pl. 11. In proposing term Jonesboro limestone, Ulrich included within it virtually whole southeastern phase of Knox group, as exposed in Jockey Creek section, and at same time included in his Copper Ridge virtually whole northwestern phase as exposed in Thorn Hill section, because he believed rocks in Knox group in Thorn Hill section were almost entirely older than those in Jockey Creek section. Later studies have shown that the rocks in the two sections cover almost the same span. The Jonesboro is restricted, in Jockey Creek section and elsewhere, to the Ordovician part of Knox group (southeastern phase). On present map, this phase of Knox group is divided into Jonesboro limestone above and Conococheague limestone below. The Jonesboro consists largely of dark-blue-weathering limestone some of which is "ribboned" with thin layers of silty dolomite; fairly thick sandstone beds occur in lower 400 feet or so. Thickness about 2,000 feet.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (tables), 56–57, 126, pl. 1. Thickness 1,700 feet in Denton Valley, north-central Shady Valley quadrangle. Overlies Conochocheague lime-

stone. Top formation in Knox group in this area. Underlies Lenoir limestone. Lower Ordovician.

First described in vicinity of Jonesboro, Washington County, Tenn.

Jonesburg Sandstone Member (of Vamoosa Formation)

Jonesburg Sandstone Member (of Nelagony Formation)[1]

Pennsylvanian (Virgil Series): Southern Kansas and central northern Oklahoma.

Original reference: M. I. Goldman, 1920, U.S. Geol. Survey Bull. 686–W, p. 329–330.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 48–50, pl. 1. Reallocated to Vamoosa formation in Oklahoma. Thickness 38 to 54 feet. Upper part consists of buff fine-grained sandstone, middle part of alternating flaggy siltstones and shales, and lower part of contorted buff sandstone and greenish-gray siltstone. Lower part lies at about same stratigraphic position of Bowhan sandstone member; top lies about 100 feet below Middle Oread limestone. The 100-foot interval from the Jonesburg to the Middle Oread is primarily shale, with many lenses of sandstone and a few lenses of limestone; south of southern limit of the Jonesburg, this lenticular zone extends from Labadie limestone member to the Middle Oread, a thickness of about 170 feet; that is, the Jonesburg sandstone is a named member in lower part of an otherwise unsystematized sequence of lenses.

Named for exposure on top of ridge west of Jonesburg, Chautauqua County, Kans.

Jones Point Shale Member (of Topeka Limestone)

Jones Point Shale (in Calhoun Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 51.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 15, 46, 49–50. Reallocated to member status in Topeka limestone; underlies Sheldon limestone member; overlies Curzen [Curzon] limestone member. Occurrences in Missouri noted.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035. Member of Topeka formation. Overlies Iowa Point shale member; underlies Sheldon limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16, fig. 5. Light- to dark-gray argillaceous to calcareous fossiliferous shale with some beds of thin fossiliferous limestone. Thins to northeast; thickness 7 feet near Thurman, Fremont County; 2.3 feet west of Macedonia, Pottawatamie County; 0.7 foot near Howe, Adair County. Member of Topeka limestone; underlies Sheldon limestone member; overlies Curzon limestone member.

Named for Jones Point, spur in Missouri River bluffs east of Union, Cass County, Nebr.

Jones Ranch Beds

Pleistocene: Southwestern Kansas.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 110–111, pl. 15B. Name applied provisionally to deposits from which Jones Ranch fauna was described by Hibbard (1940, Kansas Acad. Sci. Trans., v. 43). Consist of poorly consolidated sand, silt, and clay. Thickness 34 to 60 feet. Vertebrate faunas indicate Pleistocene age, probably early.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, p. 411, 416. Included in Meade formation (redefined).

T. G. McLaughlin, 1946, Kansas Geol. Survey Bull. 61, p. 123. Considered part of Kingsdown silt.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Listed among units classed at least in part as Sanborn formation.

Occur along headwaters of Sand Creek, in southern part of T. 32 S. and northern part of T. 33 S., R. 27 W., southeast of Meade, Meade County.

Jonestown Beds or Formation (in Martinsburg Formation or Group)

Ordovician: East-central and central Pennsylvania.

Bradford Willard, 1939, Pennsylvania Acad. Sci. Proc., v. 13, p. 129, 131. Name proposed for beds or formation in upper part of Martinsburg "formation." Described as basically dark shale weathering to buff chips; also includes many red shale bands and lenticular bodies of platy or brecciated, rarely massive, limestone. This alternation of dark shale, red shale, and limestone is not sharply defined below but passes over into nonred limestone-poor older Martinsburg shales. Maximum thickness 500 feet. Underlies Shochary sandstone.

Bradford Willard, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1068, 1074, 1075, 1090, 1116 (fig. 8), 1118. Beds further described as including cross-bedded sandy layers, oolite, and an abundance of limestone breccia or edgewise conglomerate associated with the limestones and red beds. Continental quivalent of marine Martinsburg with which it intergrades. In eastern outcrops of Martinsburg group, unit lies stratigraphically near base of sandstones ("Fairview" and Shochary) and extends down into underlying shale (Dauphin).

Named for exposure along Swatara Creek north of Jonestown, Lebanon County.

Jonestown Volcanics

Ordovician: Central Pennsylvania.

Owen Bricker, 1960, Pennsylvania Geologists Guidebook 25th Ann. Field Conf., p. 92–99. Consists of volcanics interbedded with series of shales, sandstones, and limestone. Section shows (ascending) dark-gray shale, green arkosic sandstone, thin beds of red shale; red basalt breccia, massive basalt and some porphyritic basalt, about 600 feet; dark-gray shale containing beds of red and purple shale, green arkosic sandstone, and thin limestone, about 125 feet; hard white sandstone with angular fragments of green clay, about 150 feet; dark-gray shale with thin beds of red, purple, and green shale; about 50 feet; dark-greenish-gray basalt breccia, massive basalt, and amygdaloidal basalt, about 500 feet; fine- to medium-grained blue-gray limestone, about 150 feet; dark-gray to black fissile shale. Stratigraphic position of volcanics is within main belt of Martinsburg formation.

Volcanics are south of Jonestown, Lebanon County. Form topographic high known locally as Bunker Hill.

Jordan Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 38, map, sections.

Named for occurrence in Old Jordan mine, Bingham district.

Jordan Sandstone[1]

Jordan Sandstone Member (of Trempealeau Formation)

Upper Cambrian: Southern Minnesota, northern Illinois, Iowa, and Wisconsin.

Original reference: A. Winchell, 1872, Rept. of geol. survey of Belle Plaine, Scott County, Minn., 16 p.

G. O. Raasch, 1939, Geol. Soc. America Spec. Paper 19, p. 97–105. Trempealeau formation subdivided into (ascending) St. Lawrence, Lodi, and Jordan members.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 46–49, measured sections. Described in southeastern Minnesota where it includes Norwalk member below and Van Oser member above. Overlies Lodi member of St. Lawrence formation; underlies Oneota dolomite; in some areas, separated from Oneota by Kasota sandstone and Blue Earth siltstone. St. Croixian series.

J. N. Payne *in* H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 191 (table 8), 192. Jordan stage of Cambrian period mentioned in discussion of geologic history of pre-Pennsylvanian in Illinois.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 4, chart 1 (column 61). Shown on correlation chart as member of Trempealeau formation.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 150. Uppermost member of Trempealeau formation. Overlies Lodi member; underlies Sunset Point formation (new) which name replaces term Madison formation as previously used in Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 94. Includes Van Oser submember.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 165–184. Discussion of Upper Croixan stratigraphy of Upper Mississippi Valley. Terminology adopted represents return to early lithologic classifications in which St. Lawrence and Jordan formations are recognized as dolomitic strata and massive sandstone, respectively. Urged that term Trempealeau, previously employed as formation name to include all these strata and also as stage name, be restricted to Trempealeauan stage.

R. R. Berg, C. A. Nelson, and W. C. Bell, 1956, Geol. Soc. America Guidebook Minneapolis Mtg. Field Trip 2, p. 13–20. Formation consists of massive- to well-bedded fine- to coarse-grained sandstone lying above Lodi member of the St. Lawrence. Contact with St. Lawrence generally sharp and drawn above highest siltstone and at base of continuous sandstone. Thickness 20 to 150 feet; average about 100 feet. Trowbridge and Atwater (1934) suggested member terminology, Norwalk and overlying Van Oser. This subdivision officially adopted for Minnesota classification by Stauffer and others (1939, Geol. Soc. America Bull., v. 50, no. 8). These units are of limited applicability and have been used in few pub-

lished measured sections of Jordan. They serve to emphasize general upward gradation of the Jordan from fine- to coarse-grained sandstone. Relation of Jordan sandstone to Madison (Irving, 1875) or Sunset Point (Raasch, 1951) sandstone of eastern Wisconsin not clear. Twenhofel, Raasch, and Thwaites (1935, Geol. Soc. America Bull., v. 46, no. 11) appear to be only workers who have applied term Madison away from type section at Madison, Wis., and their usage is ambiguous; unit not recognized in Minnesota. Difficulty that various workers have experienced in clearly differentiating Jordan from Madison in a single section suggests that they represent lateral facies of one another. The Madison (Sunset Point) may bear same relation to the Jordan as does the Kasota sandstone. These strata lie between true Jordan and true Oneota dolomite deposits. Disconformity commonly suggested at top of Jordan is based on catastrophic concept that Jordan sandstone cannot contain post-Cambrian fossils (as does the Kasota) and has yet to be clearly demonstrated on physical evidence. Croixan series.

Named for exposures in Sand Creek at Jordan, Scott County, Minn.

Jordan Narrows unit (in Salt Lake Group)

Oligocene, middle, to Miocene, middle: North-central Utah.

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23, 24 (fig. 6), 25–26. Salt Lake group, in Lower Jordan Valley, is divided into (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and Travertine unit. Jordan Narrows unit is chiefly white marlstone with oolitic argillaceous and cherty limestone, sandstone, clays, and rhyolitic tuffs, all fresh-water lacustrine deposits. Total thickness unknown but exceeds 300 and perhaps 2,000 feet. Interfingering relationships with Traverse volcanics.

Type locality: Jordan Narrows and Beef Hollow. Areal extent of unit not definitely known but may underlie entire Jordan Valley. Lower Jordan Valley is defined as that part of Jordan Valley northward from Traverse Mountains to Great Salt Lake.

Jornada Basalt

Quaternary: Central southern New Mexico.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 72. Vesicular basalt. Thickness from 50 to 100 feet. Partly covered by thin sheet of Recent windblown sand and clay.

Occupies rectangular-shaped area, about 20 miles from east to west and 11 miles from north to south on northwest side of Jornada del Muerto, Socorro County.

Jornada Gravels

Age not given: Southwestern New Mexico.

F. E. Kottlowski, 1958, Roswell Geol. Soc. Guidebook, 11th Field Conf., p. 109. Gravels are of angular pebbles typical of alluvial fan gravels and dissimilar to rounded gravels now found along the Rio Grande.

Exposed along Highway U.S. 70, 65 miles southwest of Alamogordo.

Jornada Limestone (in Montoya Group)

Upper Ordovician: Southwestern New Mexico.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2201 (table), fig. 2. Thickness ranges from fraction of a foot to 400 feet. Underlies Fusselman limestone; overlies Cable Canyon sandstone.

Exposed in Caballo Mountains.

Jornadan series[1]

Quaternary: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 8.

Jose Butte Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 122, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined. Jose Butte is youngest in known sequence. Overlies Robinson Mountain basalt. Thickness unknown although topographic breaks along margin indicate at least 20 feet. Rock is medium-gray holocrystalline porphyritic olivine basalt.

Jose Butte lies along Colfax-Union County line, and basalt from it covers several square miles northwest of Capulin Mountain.

Jose Shale Member (of Yegua Formation)

Eocene (Claiborne): Western Texas, and Tamaulipas, Mexico.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 265. Name applied to predominantly red and green bentonitic shales above Mier sandstone tongue and below Loma Blanca sandstone tongue of Yegua formation. Thickness 70 to 130 feet.

Named from Jose ranchhouse located 1¾ miles northeast of village of Falcon, Falcon quadrangle, Texas.

Jose Creek Member (of McRae Formation)

Upper Cretaceous: Southwestern New Mexico.

H. P. Bushnell, 1955, Compass, v. 33, no. 1, p. 11 (table), 12–14. Lower part of member at type locality consists of green shale and siltstone beds interbedded with coarse-grained tan to dark-brown or greenish andesitic sandstone beds. Upper part distinguished by coarse-grained andesitic sandstone beds that weather dark brown and by tan to cream-colored bedded chert. Conglomerate interspersed with sandstone beds at type locality. Contains sequence of coarse volcanic conglomerate beds in vicinity of Elephant Butte Dam. Thickness at type locality 394 feet. Conformably underlies Hall Lake member (new); unconformably overlies Mesaverde formation.

Type locality: Immediately east of Elephant Butte Reservoir, north of McRae Canyon, Sierra County. Outcrops of member observed only near Elephant Butte Reservoir in McRae Canyon, and at south end of Fra Cristobal Mountains.

Joserita Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11–12, 15, pl. 27. Consists of following units (ascending): soft sandstone and arenaceous shale, gray shaly limestone, soft shale and sandstone, Baga shale and limestone (new), yellow dolomite, Espinal grit (new), Corta sandstone (new), and Quimbo dolomite (new). Thickness 123 feet. Underlies Saavedra member (new); overlies Pacheta member (new).

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north

of international border in vicinity of international monument No. 91, southeast of Bisbee Junction in Southern Pacific Railway, Cochise County.

Joshua Schist

Pre-Triassic: Western Massachusetts.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Name proposed for well-foliated, coarse-grained muscovite-quartz-biotite schist and gneiss. Large iron-stained flakes of muscovite cause gilded appearance. Partly pegmatized; cut by granite dikes and sills. Overlies Erving hornblende schist. Mapped previously as part of Amherst schist; new name introduced since unit can not be traced to other areas of the Amherst and latter at its type locality underlies the Erving. Gneissic beds were formerly mapped as Williamsburg granodiorite. Pre-Triassic.

Named for Joshua Hill, east of Mount Toby, Mount Toby quadrangle.

Joshua Schist (in Evington Group)

Lower Paleozoic(?): South-central Virginia.

W. R. Brown, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1547. Incidental mention.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1). Blue-gray phyllite and fine-grained schists. Biotite porphyroblasts common. Calcareous in part. Thickness from a fraction of a foot to 500 feet. Overlies Candler formation (new); underlies Arch marble (new), all in Evington group (new). Type locality designated. Paleozoic(?).

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 16. Included in Archer Creek formation (new).

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2). Age shown on columnar section as Lower Paleozoic(?).

Type locality: Along parts of Joshua Creek 6½ miles east of Lynchburg, Campbell County. Lynchburg quadrangle.

Joshua Submember (of Otisco Member of Ludlowville Formation)

Middle Devonian: Central New York.

W. A. Oliver, Jr., 1951, Am. Jour. Sci., v. 249, no. 10, p. 709–713, 716–717, fig. 6 (facing p. 724). Name proposed for upper coral bed in Otisco member. Consists of mass of closely packed rugose coral skeletons; interstices filled with same shaly sediments as that constituting body of Otisco. Maximum thickness 50 feet. Thins laterally and marked at edges by thin fingers extending into shale of the Otisco. Base lies in sharp contact with shale without sandstone platform. Interval between base and Centerfield limestone member of Ludlowville 90 to 100 feet. Lower coral bed is Staghorn Point submember (Smith, 1935).

Named for exposures at Lord's Hill near Joshua, Onondaga County. Areal extent northeast-southwest is 9 miles.

Joyita Sandstone Member (of Yeso Formation)

Permian: Central New Mexico.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1660. Name applied to soft crossbedded sandstone that forms uppermost unit of formation. In Joyita Hills, 160 feet thick and consists of pink, orange, and yellow thin-bedded sandstone that weathers to rounded ledges; orange color and manner of weathering distinguish member.

Thickness 185 feet at Yeso type section; 120 feet at Chupadera Mesa; 105 feet at Bend. Overlies limestones of middle evaporites or Canas gypsum member (new); underlies Glorieta sandstone.

Named from section in canyon of west-flowing tributary of Rio Grande in La Joyita Hills 18 miles north of Socorro and about 4½ miles south of village of La Joya, Socorro County.

Juab Limestone (in Pogonip Group)

Lower Ordovician (Chazyan): Western Utah.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 17–18, 57, 58. Proposed for the fine sandy calcisiltite limestone that overlies Wahwah limestone (new) and underlies Kanosh shale (new). Thickness at type locality 139 feet.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 73–74, pl. 1. Described in Sheeprock Mountains where it is 161 to 204 feet thick; conformably overlies Wahwah (Wah Wah) limestone and conformably underlies Kanosh shale. Included in Pogonip group.

Type locality: NE¼ sec. 31, T. 22 S., R. 14 W., Millard County. Name derived from Juab County.

Jualin Diorite[1]

Lower Cretaceous(?): Southeastern Alaska.

Original reference: A. Knopf, 1911, U.S. Geol. Survey Bull. 446, p. 24–25, map.

Exposed at Jualin and in Jualin mine, Berners Bay region.

Juan Ascencio Chert Beds[1]

Cretaceous(?): Puerto Rico.

Original reference: D. R. Semmes, 1919, New York Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, v. 1, p. 65.

Juan Ascencio Member (of Fajardo Shale)[1]

Upper Cretaceous: Eastern Puerto Rico.

Original reference: H. A. Meyerhoff, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 288.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2). Thickness of Fajardo shale with Juan Ascencio member 1,100 feet. Upper Cretaceous.

Occurs in Fajardo district.

Juana Díaz Formation

Juana Díaz Marls[1] or Shales[1]

Oligocene, middle: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 10, 17.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. Formation includes about 655 meters of middle Oligocene conglomerate, sandy limestone, and shales. Roughly divided into three members: upper shale 140 meters; middle sandy limestone and limy shale 375 meters; and lower sandy conglomerate 140 meters. Basal Tertiary in south Coastal Plain; underlies Ponce formation.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 57. Northeast of town of Juana Díaz, formation rests unconformably upon rocks believed to be the Cañas Arriba formation (new).

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 103–107. In area north of Juana Díaz, formation rests unconformably on rocks of lower middle Eocene Jacaguas group (new). Underlies Oligocene-Miocene Ponce formation.

Named for exposures east of village of Juana Díaz and along the Río Jacaguas to west.

Juana Lopez Member (of Mancos Shale)

Juana Lopez Sandstone Member (of Carlile Shale)

Upper Cretaceous: Northern New Mexico and western Colorado.

C. H. Rankin, 1944, New Mexico Bur. Mines Mineral Resources Bull. 20, p. 7, 12, 19–20, fig. 3. Very calcareous thin-bedded sandstone near top of Carlile; weathers brown; grades into shale at base. Thickness 10 feet. Contains abundant Frontier fauna. For mapping purposes in northern New Mexico, top of Juana Lopez could well be used as top of Carlile.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 463, 466, pl. 1. In Galisteo-Tonque area, New Mexico, Carlile-Niobrara contact not marked by mappable lithologic horizon, but Juana Lopez member is close approximation. This member, about 6 feet of interbedded arenaceous shale and very thin-bedded arenaceous fetid limestone, forms low persistent hog-back 300 to 475 feet above Greenhorn limestone and marks break between "lower Mancos shale" and "middle Mancos shale." Juana Lopez is overlain by about 500 feet of argillaceous shale ("middle Mancos shale").

C. E. Stearns, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 967–968. Persistent horizon marker, but since lithology varies it seems advisable to retain name but avoid lithologic designation.

U.S. Geological Survey currently classifies the Juana Lopez as a member of Mancos Shale on the basis of a study now in progress.

Type section: In sec. 32, T. 15 N., R. 7 E., on Mesita Juana Lopez Grant, 6 miles northwest of Cerrillos, Santa Fe County, N. Mex. Widespread in New Mexico and Colorado.

Jubilee phase (of Amargosa chaos)

Post-Miocene(?): Southern California.

L. F. Noble, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1936. Listed as a phase of the Amargosa chaos, an assemblage of blocks on overthrust plate of Amargosa thrust.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 965, 972–977. Mosaic of fault blocks composed mostly of sedimentary and volcanic rocks and breccias of granitic, sedimentary, and metamorphic rocks ranging in age from Precambrian to Tertiary. Maximum thickness not over 1,000 feet. Jubilee phase lies at one place on Virgin Spring phase and at another place forms the sole of the thrust. Calico and Jubilee phases not in contact in the area, and their relative position is not known. Unconformably overlain by Pliocene(?) Funeral fanglomerate.

Occurs in Virgin Spring area near Death Valley. Name derived from Jubilee Wash, where mosaic is exposed on both sides of Shoshone-Death Valley Highway at Chaos Ridge.

Judd Shale Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 1), 140, 141–142, 143 (fig. 2), 145 (fig. 3). Where well exposed, consists of gray marine shale 690 to 760 feet thick. Apparently thins to west because it is not recognized in section along Echo Reservoir north of Coalville. Represents a tongue of Hilliard shale of southwestern Wyoming. Lies between Grass Creek member (new) below and Upton sandstone member (new) above. Name credited to D. W. Trexler (unpub. thesis).

Exposed in Judd Canyon, 6 miles east of Coalville, Summit County.

Judd Creek Latite

Tertiary: Western Utah.

G. H. Thomas, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 4, p. 13–14, pl. 1. Fine-grained aphanite with porphyritic texture; locally reddish color.

Named from exposures near Judd Creek, Tooele County. Covers about 3 square miles in and around sections 16 and 17, T. 10 S., R. 7 W.

Judith River Formation (in Montana Group)[1]

Upper Cretaceous: Central, northern, southeastern, and southern Montana and northwestern Wyoming.

Original references: F. B. Meek and F. V. Hayden, 1856, Philadelphia Acad. Sci. Proc., v. 8, p. 267; 1858, v. 9, p. 123; 1862, v. 13, p. 418; 1862, Am. Philos. Soc. Trans., new ser., v. 12.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. As mapped, Montana group includes Telegraph Creek and Eagle sandstones, Claggett shale, and Judith River formation along north margin of Yellowstone National Park.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 12 (fig. 3), 34–36, pls. 1, 2. Formation, as mapped near Montana-Wyoming boundary, comprises two members: Parkman sandstone and an upper unnamed member. Thickness about 255 feet as exposed east of Hardin, Mont. Overlies Claggett shale member of Cody shale; underlies Bearpaw shale.

Named for occurrence near mouth of Judith River, Mont.

Judkins Formation

Quaternary: Western Texas.

R. M. Huffington and C. C. Albritton, Jr., 1941, Am. Jour. Sci., v. 239, no. 5, p. 327–329. An aeolian deposit consisting of reddish-brown massive sandstone with interstitial clay and fine silt. At type locality, maximum thickness 6 feet; base not exposed. Underlies Monahans formation (new); surface of contact sharply defined and irregular in profile; in different places, rests on rock of Triassic, Cretaceous, and older Quaternary age.

Type locality: South side of Highway 80, 6½ miles northeast of Monahans, near Sand Hills, Ward County. Probably named from nearby village of Judkins [also spelled Judkin].

Judson Member (of St. Lawrence Formation)

Upper Cambrian (St. Croixian): Minnesota.

C. R. Stauffer, G. M. Schwartz, and G. M. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902. Named as lower member of formation. Underlies Lodi member; overlies Franconia formation. [Probably replaced by Nicollet Creek member.]

Type locality of St. Lawrence formation is in Scott County.

Jueyes Lens (in Ildefonso Formation)

Upper Cretaceous: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 34. Massive limestone lens in upper part of formation.

Named from village of Río Jueyes near which it is located.

Julian Group[1]

Triassic or older: Southern California.

Original reference: F. J. H. Merrill, 1914, Geology and Mining Resources San Diego and Imperial Counties; California State Mining Bur., p. 11–12.

Named for village of Julian, San Diego County.

†Julian limestone[1]

Middle Ordovician: Iowa.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 37, p. 252–255.

Named for Julian Township.

Julian Schist[1]

Triassic(?) or older: Southern California.

Original reference: F. J. H. Merrill, 1914, Geology and mineral resources of San Diego and Imperial Counties: California State Mining Bur., p. 11–12.

D. L. Everhart, 1951, California Div. Mines Bull. 159, p. 58–60, pls. 2, 3, 4, 5. Consists essentially of quartz-mica schist and quartzite; the former far more abundant. Older than other intrusive rocks in area. Shown on map as Triassic(?). Previous workers have assigned various ages to the schist, and in one instance age is given as Jura-Triassic.

Richard Merriam, 1958, California Div. Mines Bull. 177, p. 9–11, pl. 1. Described and mapped in Santa Ysabel quadrangle. Older than Stonewall quartz diorite.

Named for village of Julian, Santa Ysabel quadrangle, San Diego County, which occurs in midst of mass.

†Julian series[1]

Middle Ordovician: Iowa.

Original reference: C. R. Keyes, 1927, Pan-Am. Geologist, v. 47, p. 146–148, Dubuque region.

Juliand Member[1] (of Enfield Formation)

Juliand zone

Upper Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, p. 99, 285.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Juliand zone, below Van Etten zone and above Kattel shale.

Named from exposures in Juliand Hill just east of village of Greene, Greene County.

Jumbo Dolomite Member (of Talladega Slate)[1]

Jumbo Dolomite (in Talladega Series)

Paleozoic(?): Eastern Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 53, map.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 20. Included in lower part of Talladega series.

Named for exposures and quarries at and near Jumbo, Chilton County.

Jumbo Volcanics[1]

Late Paleozoic or Mesozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 95, map.

Occurs at headwaters of Fifteen Mile Creek, at east end of Jumbo Mountain, Stevens County.

Jumonville Sandstone

Upper Devonian (Conewango): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 11, 12. Name will probably be used, following more definitive study of area, for unit here termed Sandstone D in Riceville stage and described as interbedded gray-brown sandstones and shales with some lenses of white quartz-pebble and clay-gall conglomerate. More sandy than underlying shale. Thickness 135–152 feet. Disconformably underlies Mississippian beds; conformably overlies Shale C (Watering Trough shale).

Type locality: Along the National Pike at Watering Trough Inn below crest of Chestnut Ridge, Fayette County. Longer section exposed in Youghiogheny Gorge through Chestnut Ridge in vicinity of mouth of Indian Creek.

Juncal Formation

Eocene, middle: Southern California.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1730 (fig. 2), 1733 (fig. 3), 1734 (fig. 4), 1747, 1749–1756. In type area, north of Santa Ynez fault, separable into three members: lower shale with lenticular sandstone, middle sandstone, and upper shale and sandstone. Changes in facies are pronounced, and threefold division not always recognizable in other areas. South of the fault, formation is sandstone and shale as in type section, but composition and thickness of the three members are quite different and none of members mapped in type section can be identified with certainty. Thickness at type locality 3,360 feet; south of fault where formation includes Camino Cielo sandstone member (new), thickness is 5,520 feet. In and

near type locality, Juncal lies with angular unconformity on Upper Cretaceous strata (Pendola shale) and is conformably overlain by upper Eocene Matilija sandstone; south of fault, Juncal disconformably(?) overlies Upper Cretaceous Debris Dam sandstone (new) and the Romero conglomerate lentils (new). In vicinity of Mono Debris Dam, conformably overlies Sierra Blanca limestone; 1½ miles southwest of Pendola Guard Station, where strata are exposed in core of an anticline, Debris Dam sandstone is missing, and Juncal unconformably overlies undifferentiated Cretaceous shale.

W. R. Merrill, 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists Mineralogists, Soc. Explor. Geophysicists Joint Ann. Mtg. Guidebook, p. 17. Includes Wheeler sandstone member in area from Ojai to Ozena.

Type locality: In crestal region of Agua Caliente anticline, Santa Barbara County. Section extends from point in small canyon 10,200 feet N. 55° E. of Pendola Guard Station to point 9,500 feet N. 21° E. of Juncal CCC Camp. Extends northward beyond limits of mapped area where it is involved in structural complexities; south of type section, it is truncated by Santa Ynez fault, reappears south of Santa Ynez River valley, and is traceable entire lateral extent of map area on crest and flanks of Santa Ynez Mountains. Nelson (1925, Bull. California Univ. Geol. Sci., v. 15, no. 10) mapped unit as "undifferentiated Eocene" in upper India and Mono Creeks area; there it conformably overlies Sierra Blanca limestone.

Juncos Gabbro[1]

Age(?) Puerto Rico.

Original references: C. R. Fettke, 1924, New York Acad. Sci., Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 153; 1924, Am. Inst. Mining and Metall. Trans., v. 70, p. 1026–1042.

Junction limestone[1]

Upper Jurassic: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 301.

Derivation of name not stated.

Junction City facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 115–117. Soft argillaceous shale, blue gray, olive gray, to drab. "Clayey character is outstanding". Foerste (1905) named the unit Linietta clay. Thickness 70 to 125 feet; thinnest along axis of Cincinnati Arch in Casey County. Merges with Keith Knob facies (new) westward and with Dicks River facies (new) eastward. Underlies New Albany black shale.

Named for Junction City, located at edge of Lexington Plain, at foot of Plateau escarpment in southeastern Boyle County. Good outcrops occur along the fairly even line of escarpment westward across southern Boyle County along irregular belt southward into Lincoln County.

Junction City Quartzite[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 91.

Exposed in vicinity of Junction City, Portage County.

Junction Creek Sandstone (in San Rafael Group)

Junction Creek Sandstone Member (of Morrison Formation)

Junction Creek Sandstone Member (of Wanakah Formation)

Upper Jurassic: Southwestern Colorado.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1748 (fig. 2), 1750–1751, 1753 (table 1). Proposed for uppermost member of Morrison formation. Estimated thickness 300 feet. Overlies Wanakah marl member. [See La Plata sandstone.]

E. G. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 27 (table), 29–30, pl. 2. Rank raised to formation. Predominantly massive white to light-buff friable crossbedded sandstone; thin partings of greenish-gray or light-red shale partings numerous. Thickness 200 to 500 feet. Overlies Wanakah formation (redefined); underlies Morrison formation.

L. C. Craig and C. N. Holmes, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 94. Reallocated to member status in Wanakah formation. Similar to and appears to occupy same stratigraphic position as Bluff sandstone. Relation of Junction Creek to Morrison formation not definitely established; upper part may have been deposited synchronously with lower bed of Morrison in southwestern Colorado.

L. W. Kilgore, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 120, fig. 2. Suggested that Eckel's interpretation of Junction Creek as separate formation be followed and its age relationship placed with San Rafael group. Generalized cross section of Animas River valley shows Junction Creek sandstone overlying Summerville formation and underlying Salt Wash sandstone of Morrison group.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–221. Mapped in Moqui SE quadrangle, Colorado, where it is 250 to 300 feet thick and consists of three gradational units. Upper unit, 20 to 50 feet thick, is argillaceous fine-grained reddish sandstone with obscure flat stratification. Middle unit, about 150 feet thick, of fine- to coarse-grained poorly sorted sandstone, cross-stratified at high angle; weathers to a "slick rim." Lower unit, 30 to 50 feet thick, has same general lithology as middle unit but with low-angle cross-stratification and numerous horizontal truncations. Overlies Summerville formation, contact gradational; underlies Salt Wash sandstone member of Morrison formation. San Rafael group. Upper Jurassic.

Named from exposures opposite Animas City Mountain between Junction Creek and Animas River, La Plata County.

June Bell Rhyolite[1]

Tertiary: Central northern Nevada.

Original reference: E. H. Rott, Jr., 1931, Nevada Univ. Bull., v. 25, no. 5.

Occurs in small area on June Bell claim in Gold Circle or Midas mining district, western part of Elko County.

June Lake Basalt

Pleistocene: Eastern California.

W. C. Putnam, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1939. Basalt flow from small cinder cone in floor of June Lake glacial trough.

Occurs in region about June Lake in east-central Sierra Nevada.

Juniata coal measures[1]

Devonian: Pennsylvania.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey H_2, p. xxiii–xxx.

Juniata Formation[1]

Upper Ordovician: Central southern and eastern Pennsylvania, western Maryland eastern Tennessee, western Virginia, and eastern West Virginia.

Original reference: N. H. Darton, 1896, U.S. Geol. Survey Geol. Atlas, Folios 28 and 32.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1165–1198. Discussion of Ordovician-Silurian relations in Pennsylvania. Term Oswego has been misapplied in Pennsylvania. For beds commonly referred to by that name, Bald Eagle is revived and treated as basal Juniata. Overlies Martinsburg formation; underlies Tuscarora formation. There is a disconformity between Bald Eagle and Tuscarora east of Susquehanna River and either a disconformity or unconformity below Bald Eagle or Tuscarora or Shawangunk from Susquehanna River to southeastern New York. Either hiatus might be used as Ordovician-Silurian line of separation. If lower is accepted, Juniata is Silurian; if upper is used, then Juniata is Ordovician.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 203, 205, 207, 221–229. Occupies space between Oswego sandstone below and Tuscarora sandstone above in northern end of Appalachian Valley in Virginia; farther southwest, it is overlain by Clinch sandstone and rests everywhere upon *Orthorhynchula* zone of Martinsburg shale. In Lee County, the equivalent Sequatchie formation also succeeds *Orthorhynchula* zone. Maximum thickness about 725 feet, northwest of Monterey, Highland County.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., supp., diagram (following p. 4), fig. 3. Underlies unit termed Run Gap sandstone.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 387–408. Juniata formation, as herein defined, is uppermost member of Ordovician in West Virginia. Directly underlies Tuscarora sandstone. Overlies Oswego sandstone, or where Oswego is absent, Martinsburg formation. Thickness 150 to 800 feet. In previous West Virginia Geological Survey reports, the Juniata has been called "Red Medina" and regarded as a Silurian formation.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 97–98, pls. Mapped in eastern Tennessee. Juniata and Sequatchie formations form sheet of red or maroon sediments similar in lithology to older sheet represented by Bays and Moccasin formations and long confused with it. The Juniata and Sequatchie, like Bays and Moccasin formations, are respectively the less and more calcareous parts of the sedimentary sheet; they intergrade laterally and boundary between them is arbitrary. For present map, it has been taken along line of Hunter Valley and Whiteoak Mountain faults, but belts northwest of these faults as far as Powell River anticline and Kingston fault are transitional and, though shown on map as Sequatchie, could equally well have been mapped as Juniata.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. Formation, from Tyrone Gap to Susquehanna Gap, includes (ascending) East Waterford red sandstone member (new), Plummer Hollow red mudstone and sandstone member (new), and Run Gap red sandstone member. Overlies Bald Eagle sandstone (Spring Mount sandstone member, new, in western part of area) and Lost Run conglomerate in eastern part.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Name Juniata abandoned in Clinch Mountain area of Duffield quadrangle, Virginia, and term Sequatchie extended into area.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 6–7, pl. 1. Juniata is the Red Medina of Pennsylvania Second Geologic Survey and is presently correlated with Queenston of New York. Thickness varies from 85 feet at Susquehanna Gap to 2,000 feet near Lewistown. Overlies Bald Eagle formation; underlies Tuscarora formation, transitional.

Named for typical occurrence on Juniata River in Pennsylvania.

Juniata River Series[1]

Devonian: Pennsylvania.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H., p. 6, 8.

Juniper Andesites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 678. Cenozoic. Overlie Willow Lake basalts.

Occur in Lassen National Park.

†Juniperan Stage

Eocene, early: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903. Named as one of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Includes interval between Ulatisian above, and Paleocene Bulitan [Bulitian] stage.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 34. Replaced by Penutian stage (new).

Juniper Flat Granite

Triassic or Jurassic: Southeastern Arizona.

W. G. Hogue and E. D. Wilson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 21, fig. 7. Intrudes Precambrian schist and is overlain by basal conglomerate of Cretaceous, but its relation to Paleozoic not clear.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 53–55, pl. 5. Light reddish brown in outcrop and pinkish gray on fresh fracture. Most of it is porphyritic within central Cochise County, although much of it along Tombstone Canyon is equigranular. Considerable range in grain size. Forms discordant intrusive masses that cut all formations up to and including Horquilla limestone. Rough tendency to form sills beneath

Bolsa quartzite; all other contacts appear to be clean cut and without regard to preexisting structures. Older than Glance formation. Triassic or Jurassic. Type locality designated.

Type locality: Juniper Flat on west side of Mule Mountains, where granite is well exposed. Also well exposed on northeast wall of Tombstone Canyon. In west-central Cochise County.

Juniper Hill Formation[1]

Juniper Hill Shale Member (of Lime Creek Formation)

Upper Devonian: Central northern Iowa.

Original reference: A. O. Thomas, 1925, Iowa Geol. Survey, v. 30, p. 116, footnote.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, pt. 1, p. 182, 187. Rank reduced to member status in Lime Creek formation. Basal member of formation; comprises about 45 feet of sparsely fossiliferous blue shale. Underlies Cerro Gordo member; overlies Nora member of Shellrock formation.

Named for exposures on Juniper Hill, about 1 mile northwest of Rockford Brick and Tile Plant, Floyd County.

Junipero Sandstone

Eocene: West-central California.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as underlying Lucia shale (new) and unconformably overlying basement complex. Thickness as much as 125 feet.

R. R. Thorup, 1943, California Div. Mines Bull. 118, pt. 3, p. 463–465. Described as white to light-gray, coarse to pebbly, feldspathic sandstone. Lies unconformably on basement complex (Sur "series" and Santa Lucia quartz-diorite) and has basal conglomerate which averages 8 feet in thickness. Conformably underlies Lucia shale. Formerly considered part of Vaqueros which is herein stratigraphically restricted in its type area.

Type locality: NE¼ sec. 34, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County.

Juniper Ridge Sandstone (in Panoche Formation or Group)

Upper Cretaceous: Central western California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Panoche group (or formation) is subdivided into 10 units. Juniper Ridge sandstone is fourth in sequence (ascending). Occurs between units termed Lower Waltham shale and Upper Waltham shale. Assigned to Delevanian stage (new). Name credited to J. Q. Anderson.

Occurs in Coalinga-Ortigalito area, San Joaquin Valley.

Jupiter shales

Precambrian (Chuaran series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Shales mainly dark colored, often black. Thickness 1,700 feet. Underlie Oso beds (new); overlie Gunther dolomite (new).

Best developed in valleys paralleling west rim of Marble Canyon. Particularly conspicuous and complete under the cliff ruins known as Jupiter's Temple, situated a few miles below mouth of Little Colorado River; Grand Canyon region.

Jurupa Series[1]

Paleozoic and Paleozoic(?) : Southern California.

Original reference: J. W. Daly, 1935, Am. Mineralogist, v. 20, no. 9, p. 638–647, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 475–476, table 4. Paleozoic and probable Paleozoic. Series includes undifferentiated complex (metasedimentary), Chino crystalline limestone, quartzite and schist, and Sky Blue crystalline limestone.

Occurs in Jurupa Mountains, Riverside County.

Kaaterskill Formation[1] or Sandstone

Middle Devonian: Southeastern New York.

Original reference: Bradford Willard, 1933, Geol. Soc. America Bull., v. 44, no. 3, p. 498.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Kaaterskill sandstone, Middle Devonian.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 121, 122–125, 127, geol. map. Referred to as Kaaterskill sandstones and mapped with overlying Kiskatom redbeds in Catskill and Kaaterskill quadrangles. Underlies Onteora red beds. Thickness 250 to 300 feet. Middle Devonian.

Ledges make the falls of the Kaaterskill [Greene County].

Kaaterskillian series

Devonian (Devonic) : Eastern North America.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 75, no. 4, p. 157 (chart), 311. Name proposed for the eastern Devonic; Linnian series applied to western Devonic. The two series overlap at the Mississippi River in Missouri. In Missouri, includes (ascending) Bailey limestone, Clear Creek limestones, Grand Tower limestones, and Wittenberg shales.

Kaau Basalt or Tuff

See **Kaau Volcanics** (in Honolulu Volcanic Series).

Kaau Mud Flow

Pleistocene: Oahu Island, Hawaii.

H. T. Stearns, 1940, Hawaii Div. Hydrography Bull. 5, p. 51–52. Consists chiefly of small nodules of Kaau basalt, a few bombs and olivine segregations, and numerous fragments of Koolau basalt set in gray dirty matrix. No bedding present. Deposit reaches height of about 60 feet above adjacent Kaau basalt. Also referred to as Palolo Valley mud flow.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 93. Probably correlative with Kaau volcanics in lower part of Honolulu volcanic series. Locally rests on tuff of Kaau volcanics.

Well exposed over small area in Palolo Valley, 1 mile above mouth of Waiomoa Stream, on south side of Koolau Range, about 9 miles west of Makapuu Head.

Kaau Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 93–94. Tuff and meli-

lite-nepheline basalt lava erupted from Kaau Crater; tuff was formed in part by phreatic explosions; secondary deposits of tuff occur below crater along Pukele, Waiomo, and Palolo Valleys. At least two flows are present, separated by tuff. Upper flow averages about 20 feet thick. Rests in part on Koolau volcanic series and in part on older alluvium. Volcanics erupted during high stand of sea preceding minus 60-foot (Waipio) stand, and probably the plus 95-foot (Kaena) stand. Terms Kaau basalt and Kaau tuff have been used for parts of the volcanics. Pleistocene.

Named for Kaau Crater, which is believed to have been its source. Covers fraction of square mile in upper part of Palolo Valley and its tributaries, on south side of Koolau Range about 9 miles west of Makapuu Head.

Kachess Rhyolite[1]

Eocene: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 45, 51. Kachess rhyolite consists of numerous flows intercalated within Naches formation. On eastern side of Lake Kachess the rhyolites unconformably overlies Swauk formation and unconformably underlies Teanaway basalts. Swauk, Naches, and Kachess are probably in part contemporaneous.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 105. Silver Pass volcanic rocks (new) include type area for Smith and Calkins' Kachess rhyolite. Mapping for present study has shown that rhyolites of many different ages were included in Kachess rhyolite by Smith and Calkins. They were aware of these inconsistencies and described relationships of the Kachess as peculiar, noting that it was interbedded with the Swauk, Teanaway, and Naches formations and occurred between the Naches and Teanaway formations. These relationships would require extrusion of the Kachess to have begun in Swauk time, to have extended across the unconformity between the Swauk and Teanaway, and to have continued until post-Teanaway time. In mapped area, rocks called Kachess by Smith and Calkins can be separated into two groups, presumably of different ages, the Silver Pass volcanic rocks of post-Swauk and pre-Teanaway age and the rhyolite within Naches formation.

Well exposed on northeast side of Kachess Lake [Kittitas County], Snoqualmie quadrangle.

Kagel Fanglomerate[1]

Pleistocene or Recent: Southern California.

Original reference: M. L. Hill, 1930, California Univ. Pub., Dept. Geol. Sci. Bull., v. 19, no. 6, p. 141, 144.

B. F. Howell, 1954, California Div. Mines Bull. 170, map sheet 10. Referred to as Kagel alluvium. May be same age as Beehive Mesa alluvium (new). Pleistocene or Recent.

Named for exposures in Kagel Canyon, Los Angeles.

Kagman Andesite

See **Hagman Formation.**

Kaguyak Formation

Upper Cretaceous: Central southern Alaska.

A. S. Keller and H. N. Reiser, 1959, U.S. Geol. Survey Bull. 1058–G, p. 273–278, pls. 29, 32. Divided into three informal members: lower fossilif-

erous siltstone member, 2,000 feet thick at type locality; middle massive locally crossbedded concretionary sandstone and interbedded siltstone and silty shale member, 1,090 feet; and upper thin-bedded sandstone and siltstone member, 1,460 feet. Total measured thickness 4,550 feet. Overlies Naknek formation; upper contact of formation not seen.

Type section: Includes exposures at Kaguyak and the sequence exposed in the sea cliffs from mouth of Big River to Swikshak River, Mount Katmai area, Alaska Peninsula.

Kaguyak Formation

Upper Cretaceous: Southern Alaska.

T. C. Hiestand, 1957, Oil and Gas Jour., v. 55, no. 49, p. 194 (table 1). Listed on chart only. Marine. Thickness 10,000 feet.

Under heading—Alaska Peninsula, Kenai Peninsula, Sustina district, and Copper River district.

Kahuku Volcanic Series

Pleistocene: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 64 (chart), 67 (table), 68–71. Comprises all basalt flows and interbedded ash beds that are unconformable on Ninole volcanic series and that were laid down before end of deposition of ash member (Pahala) at its top. Unit is the Pahala basalt renamed, name Pahala being here restricted to top ash member. At type locality, consists of about 600 feet of interbedded aa and pahoehoe flows overlain by 40 feet of yellow ash; one massive flow 100 feet above base is about 100 feet thick; other flows average about 15 feet in thickness. Underlies Kau volcanic series (new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956. Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 94. Pleistocene.

Type locality: Kahuku Pali, a fault scarp running north from South Point. Exposed intermittently in windows in Kau and Puna volcanic series around eastern and southern sides of Mauna Loa from Hilo Point and at Kealakekua Bay on west side of island.

Kaibab Limestone (in Aubrey Group)[1]

Kaibab Limestone (in Park City Group)

Kaibab Formation

Permian: Western Utah, northern Arizona, southeastern California, and southeastern Nevada.

Original reference: N. H. Darton, 1910, U.S. Geol. Survey Bull. 435, p. 21, 28, 32.

E. D. McKee, 1937, Carnegie Inst. Washington Year Book 36, p. 341–343. In typical exposure, Kaibab consists of two massive limestone members, above and below each of which are units composed of red beds, gypsum, and impure thin-bedded limestones; unconformity present at top of middle red-bed member. Proposed that name Kaibab be restricted to upper massive limestone together with associated members above and below and that these be termed Kaibab formation. Members below unconformity are here named Toroweap formation.

E. D. McKee, 1938, Carnegie Inst. Washington Pub. 492, p. 12, 35–61, strat. sections. Based on approximately 50 measured sections, classification has been developed embodying principal divisions of the Kaibab. Formation

used in restricted sense is divided vertically into three members, designated as α, β, and γ, from top to bottom. These members are characterized as (α) time of receding sea, (β) time of most extended sea, and (γ) time of advancing sea. The α or uppermost has been referred to variously as the A member, the Super Aubrey, Bellerophon limestone, and Harrisburg gypsiferous member; middle division, commonly termed "cherty limestone" is B member of most earlier writers. The γ or lowermost is local in distribution and is recognized only on Mogollon Plateau; it is unrecorded in earlier literature. Facies of members discussed in detail. Underlies Moenkopi. Overlies Toroweap formation or in areas where Toroweap is absent, as on Mogollon Plateau south of Flagstaff, the Kaibab overlies Coconino sandstone.

N. D. Newell, 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1045 (fig. 2), 1057. Geographically extended into Confusion Range, Utah, where it is about 2,000 feet thick and consists of cherty drab to dark-gray relatively unfossiliferous limestone. Underlies Phosphoria formation; overlies Supai equivalents.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 226, 227; 1950, U.S. Geol. Survey Prof. Paper 220, p. 50–55. Unconformably underlies underlies Timpoweap member (new) of Moenkopi formation.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, 5, p. 930 (table 1), 931. In Muddy Mountains, Nev., consists of upper and lower limestone members separated by middle member, chiefly gypsum. An additional upper unit, Harrisburg member of Reeside and Bassler, present locally. Lower limestone unit and overlying gypseous beds may correspond to McKee's (1938) Toroweap formation of the Plateau. Thickness 600 to 800 feet. Overlies unnamed red beds; unconformably underlies Moenkopi formation.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 46–47, pl. 1. Described in Henry Mountains region where it is restricted to steep flanks of San Rafael Swell and Circle Cliffs. Consists of white, buff, light-gray limestone and limy sandstone containing siliceous concretions. Thickness commonly 50 to 100 feet. Overlies Coconino sandstone; underlies Moenkopi formation.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 45–46, pl. 1. Mapped in San Bernardino County, Calif.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2178–2180. In Confusion Range, basal formation of Park City group. Consists of 480 feet of somewhat cherty bioclastic limestone. Underlies Plympton formation (new); overlies Arcturus formation.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Spring Mountains area, Nevada, overlies Spring Mountain formation (new).

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 109–112. West of Gold Hill mining district, Nevada, a sequence of thin- to thick-bedded cherty limestones overlies Loray formation (upper beds of Nolan's Oquirrh formation). Nolan (1935) named this sequence Gerster formation. Nolan placed lower contact of Gerster at top of "Oquirrh formation" and upper contact at base of overlying Triassic limestones and shales. Present study shows that lower 170 feet of Nolan's Gerster is lithologically equivalent to Kaibab

formation. Seems appropriate to restrict Gerster to those limestones above the light-gray cherty carbonates of the Kaibab.

Type locality: Kaibab Gulch, a deep canyon cut entirely across northern part of Kaibab Plateau, about 8 miles southwest of abandoned settlement of Paria, Utah, about 6 miles north of Arizona line. Caps Kaibab Plateau on north side of Grand Canyon. At type locality, overlies Hermit shale.

Kailua Volcanic Series[1]

Pliocene(?): Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrog. Bull. 1.

H. T. Stearns, 1940, Hawaii Div. Hydrog. Bull. 5, p. 48–50. Kailau amygdaloidal basalts, formerly regarded as part of an independent volcano older than Koolau volcano, are believed to represent caldera complex of Koolau volcano.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 95. Composed of amygdaloidal flows of basalt and olivine basalt pahoehoe and aa accumulated in caldera of Koolau volcano, and the dike complex cutting them. Flows as much as 60 feet thick. Total exposed thickness about 1,650 feet; rocks extend below sea level. Probably separated from adjacent extra-caldera Koolau lavas by faults and buried fault scarps. Formerly considered older than Koolau lavas, they are now believed probably contemporaneous with, or even younger than, lavas of Koolau volcanic series in crest region of Koolau Range.

Named for occurrence near town of Kailau. Crop out over about 15 square miles in Kailau area on northeast side of Koolau Range, 6 to 12 miles northwest of Makapuu Head.

Kaimuki Basalt (in Honolulu Volcanic Series)

Kaimuki Volcanics[1]

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 40, 42, 44.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 95–96. Referred to as Kaimuki basalt. Consists of nepheline basanite lava flows with some cinder and spatter composing small lava shield. Lava varies from dense to very scoriaceous. Maximum thickness about 400 feet. Overlies Diamond Head tuff; underlies marine limestone of plus 25-foot (Waimanalo) stand of sea, and lithified calcareous sand dunes of minus 60-foot (Waipio) stand.

Type locality: Kaimuku Hill. Covers about 2 square miles on south side of Koolau Range about 10 miles west of Makapuu Head.

Kaiparowits Formation[1]

Upper Cretaceous: Central southern Utah.

Original reference: H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 109–110, 128, 130–131. In Zion Park region, consists of bluish-drab fine- to moderately coarse-grained arkosic sandstone and sandy shale, with weak calcareous cement; forms slopes and badlands; plants, vertebrates,

and fresh- and brackish-water shells. Thickness 600 to 750 feet. Unconformably underlies Wasatch formation; unconformably overlies Wahweap and Straight Cliffs sandstones. Forms part of Gray Cliffs and is continuously exposed across Kolob and Skutumpah terraces.

E. F. Cook, 1952, Utah Geol. Soc. Guidebook 7, p. 96. In Pine Valley Mountains, unconformably underlies Claron conglomerate. Thickness about 1,200 feet.

First described in Kaiparowits Plateau region. Occurs on Kaiparowits Peak.

Kalama Volcanics[1] (in Honolulu Volcanic Series)

Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 96. Lava flow of nepheline basanite with spatter and cinder at its source. Thickness unknown; at least 10 feet, base not exposed. Underlies Koko tuff. No reef of plus 25-foot (Waimanalo) stand of sea present on lava; hence, eruption is believed to be later than Waimanalo stand (last high stand of sea during Pleistocene).

Named for Kalama Crater, a symmetrical crater about 500 feet across and 50 feet deep, at source of flow. Covers about three-fourths square mile on south side of Koolau Range 1 to 2 miles southwest of Makapuu Head.

Kalama River Mud Flow

Recent: Western Washington.

Don Mullineaux, 1960, Oregon Country Geol. Soc. Newsletter, v. 26, no. 5, p. 40. Hot mud flow; contains charred logs as much as 3 feet in diameter. Radiocarbon dating on wood gave age of 2,000 years ± 250.

Came down west side of Mount St. Helens and flowed down Kalama River valley to Merrill Lake, distance about 8 miles.

Kalamazoo Volcanics

Tertiary: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 160, 164–165. Flows, volcanic breccias, conglomerates, and lapilli, and subordinate ignimbrites. Thickness approximately 2,000 to 3,500 feet. Overlies Kinsey Canyon formation (new); unconformably underlies North Creek formation (new).

Named for exposures at Kalamazoo Pass-upper Kalamazoo Canyon, Schell Creek Range area, Ely quadrangle.

Kalaupapa Basalt

Pleistocene(?): Molokai Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 69 (table), 73; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 11, p. 25–26, 109, table facing p. 16; G. A. Macdonald, and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 96–97. Porphyritic olivine basalt pahoehoe. Maximum thickness 405 feet; base not exposed. Separated from East Molokai volcanic series (new) by erosional unconformity.

Type locality: Kalaupapa Peninsula. Covers about 6¼ square miles, comprising all Kalaupapa Peninsula.

Kalihi Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 97. Lava flow of melilite-nepheline basalt and associated cinder cone remnant. Cone more than 100 feet thick. Lava about 50 feet thick. Rest with erosional unconformity on Koolau volcanic series. Extent noted.

Exposed in area of about 1.7 square miles along Kalihi Valley, from crest of Koolau Range southwestward to sea, about 14 miles west of Makapuu Head.

Kalkberg Limestone[1] (in Helderberg Group)

Kalkberg Limestone Member (of Coeymans Limestone)

Kalkberg Limestone Member (of New Scotland Formation)

Lower Devonian: Eastern and east-central New York and northern Pennsylvania.

Original reference: G. H. Chadwick, 1908, Science, new ser., v. 28, p. 346–348.

F. M. Swartz, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 55–56, 60, 88. Rank reduced to member status in New Scotland formation. Geographically extended into Pennsylvania.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 128. Referred to as Kalkberg member of Coeymans limestone.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 64, 67–71 [1946]. Member of New Scotland; underlies Catskill shaly limestone member.

Winifred Goldring, 1946, New York State Mus. Bull. 332, p. 159–161. Member of New Scotland; underlies Catskill shaly limestone member. Thickness 40 feet in type area; about 20 feet in Capital district (Helderberg area).

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 15. Kalkberg is transition formation between underlying Coeymans limestone and overlying New Scotland limestone. Thickness about 25 feet in Albany County. Lower Devonian.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7–8, 9. Kalkberg cherty limestone is considered to be a distinct mappable formation separated from the Coeymans below and the shaly New Scotland above. Extends as far west as Oriskany Falls where it is represented by uppermost 6 feet of limestone just beneath Oriskany sandstone in Oriskany Falls quarry where it is much younger than it is in eastern New York. Helderbergian series.

Well exposed on Catskill Creek, Greene County N.Y. Name Kalkberg (lime hill) is local Dutch designation for Helderbergian Ridge, and is pronounced Collak-barrakh.

Kalorama Member[1] (of Santa Barbara Formation)

Pleistocene: Southern California.

Original reference: E. D. Pressler, 1929, California Univ. Pub. Bull. Dept. Geol. Sci., v. 18, no. 13, p. 325–345.

T. L. Bailey, 1943, Geol. Soc. America Bull., v. 54, no. 10, p. 1557, 1560. Pleistocene.

Occurs in vicinity of Santa Barbara, Ventura County.

Kaltag Formation[1] (in Shaktolik Group)

Lower Cretaceous: Central western and central Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 395–412, chart opp. p. 474.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 246). Lower Cretaceous.

T. G. Payne, 1955, U.S.. Geol. Survey Misc. Geol. Inv. Map I–84. Nonmarine formation included in Shaktolik group in Koyukuk geosyncline and Hogatza uplift areas.

Named from exposures on northwest bank of Yukon River between Kaltag and the Williams mine. In Nulato-Norton Bay district, Lower Yukon River region, and Koyukuk River region.

Kalua O Lapa Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1245, 1246. pl. 1 (fig. 1). Consists of a single flow. Radiocarbon dating gives age about 200 years. Overlies part of Kamahena flow (new).

On southwest side of Haleakala.

Kamahena Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1245, 1246, pl. 1 (fig. 1). Consists of a single flow. Lower part of flow buried by Kalua O Lapa flow (new). Radiocarbon dating gives age about 890 years.

On southwest side of Haleakala.

Kamanaiki Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 97–98. Fresh dark-gray slightly vesicular basalt. Shows well developed columnar jointing. Unconformably overlies Koolau volcanic series and sediments laid down during stand of sea higher than present one; underlies limestone of the plus 25-foot (Waimanalo) stand of sea. Extent noted.

Named for occurrence in Kamanaiki Valley where it forms a 40-foot V-shaped fill in a waterfall at 750 feet altitude. Occurs as patches at other localities in valley and adjacent valleys.

Kamehame Basalt[1]

Pleistocene, upper(?) and Recent: Hawaii Island, Hawaii.

Original reference: H. T. Stearns, 1926, Geol. Soc. America Bull., v. 37, p. 151; 1930, U.S. Geol. Survey Water-Supply Paper 616, p. 69.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 103. Rocks on western and southern slopes of Kilauea were mapped as Kamehame basalt; because this name included both lavas from Mauna Loa and Kilauea, it is herein replaced by new name, Puna volcanic series.

Named for Kamehame Hill, 3½ miles south of town of Pahala.

Kameset Agglomerate

See Gamsetu Agglomerate.

Kamiah Volcanics[1]

Tertiary: Northern Idaho.

Original reference: A. L. Anderson, 1930, Idaho Bur. Mines and Geology Pamph. 34.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 13. Report is an expansion of map explanation of Geologic map of Idaho, 1947. North of westward flowing stretch of Salmon River, rocks that resemble Challis volcanics are rare. The only rocks there grouped with Challis volcanics are Kamiah volcanics of Anderson (1930). These rocks are andestic and latitic flows, erosion remnants of which constitute buttes in small area in Idaho County. They are surrounded and overlapped by Columbia River basalt.

Represented in outline and area by Kamiah Buttes, about 12 miles south of town of Kamiah, Lewis County.

Kamishak Formation

Kamishak Chert[1]

Upper Triassic: Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 485, p. 47, table facing p. 30, map.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8. p. 203 (table 1), 204. Kamishak formation exposed at Cold Bay is dominantly limestones. Underlies Bidarka formation (new).

Typically exposed on west shore of Kamishak Bay, especially in vicinity of Bruin Bay; Cook Inlet region.

Kanab limestone[1]

Carbonic: Northern Arizona.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 66, p. 216.

Named from Kanab plateau bordering the Kanab side-canyon opposite Cataract Canyon, in Grand Canyon region.

†Kanab Sandstone[1]

Upper Triassic and Jurassic(?): Southwestern Utah.

Original reference: E. Huntington and J. W. Goldthwait, 1903, Jour. Geol. ogy, v. 11, p. 46–63.

Kane County.

Kanab Canyon Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 102–105. Changes in lithology considerably from east to west. At type locality consists of single massive cliff of uniform lithology composed of mottled limestone; 25 miles to southeast at Bass trail it includes sandy shale in basal 10 feet, and 8 miles farther in the same direction, it is divisible, on basis of lithology, into two parts of about equal thickness. Thickness increases westward and northward as far as Granite Park, and ranges from 62 to 143 feet. Underlies Gateway Canyon member (new); overlies Peach Springs member (new).

Type locality: At mouth of Kanab Canyon, where it is lowest massive cliff-forming unit, not far above level of Colorado River, Lowest subdivision of Muav formation throughout eastern part of Grand Canyon.

Kanaka Formation[1]

Mississippian: Northern California.

Original reference: H. G. Ferguson, 1929, Am. Inst. Mining Metall. Engineers Pub. 211, p. 4.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 58, no. 2, chart 5 (column 15). Shown on correlation chart above Tightner formation and below Relief quartzite.

Named for exposures in valley of Kanaka Creek, Sierra County.

Kanapou Volcanic Series

Pliocene(?): Kahoolawe Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 63, 65 (fig. 1). Name applied to thin-bedded pahoehoe and aa basalt together with few thin beds of firefountain debris and cinder cones and associated intrusives that make up Kahoolawe volcanic dome. Two groups of lavas distinguished in series: pre-caldera lavas and the caldera-filling lavas some of upper members of which are slightly differentiated. Five post-erosional lavas and pyroclastics of Recent age lie unconformably on cliff at Kanapou Bay.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 98–99. Pliocene(?).

Type section: Cliffs in Kanapou Bay.

Kanawha Black Flint (in Allegheny Formation or Group)

Kanawha Black Flint (in Kanawha Formation[1] or Group)

Pennsylvanian: Northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 98.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 88. Marine chert previously considered near top of Kanawha group but here placed in lower Allegheny.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). Shown on correlation chart below Roaring Creek sandstone and above Buffalo Creek limestone and coal.

Exposed along Great Kanawha River, on Elk River, and at other places in Kanawha County.

Kanawha Formation (in Pottsville Group)[1]

Kanawha Group

Kanawha Series

Middle Pennsylvanian: West Virginia, Kentucky, and Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 214, 215, 220–222. Kanawha group comprising upper part of Pottsville series, is youngest group of stratified rocks in Greenbrier County; only basal part represented; maximum thickness 250 feet. Overlies New River group.

M. G. Cheney, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 142, 146. Pennsylvanian system divided into six series in standard Appalachian section and in standard Midcontinent section. Kanawha series of Appalachian section is correlated with Lampasas series of Midcontinent section. Succeeds New River series and is followed by Allegheny series.

C. B. Read and S. H. Mamay, 1960, U.S. Geol. Survey Prof. Paper 400–B p. B381. Middle Pennsylvanian on basis of fossil plants.

U.S. Geological Survey currently classifies the Kanawha as a formation in the Pottsville Group in West Virginia.

Complete section exposed in hills north of Kanawha Falls, W. Va.

Kanawha volcanic zone (in Eagleford Formation)

Cretaceous: Northeastern Texas.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 138–140, 143. Ferruginous sands, clayey tuffaceous sands, tuffaceous sands with fossil casts; characterized by development of fossiliferous sandy limestone lenses and fossiliferous, calcareous sandstone lenses. Thickness 15 to 20 feet. Separated from overlying Medill volcanic zone by an interval of 80 to 90 feet of bluish-gray bedded clay shales; separated from underlying Pine Bluff volcanic zone by shale interval that varies from 158 to 212 feet in thickness.

Named from exposures near Kanawha, Red River County.

Kanayut Conglomerate

Upper Devonian: Northern Alaska.

A. L. Bowsher and J. T. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 3, 5, 7–13, figs. 2–4, pl. 2. Probable nonmarine conglomerate, sandstone, and shale. Comprises three members (ascending): lower, about 1,400 feet thick; middle, of massive chert-pebble conglomerate, 1,030 feet thick; and Stuver member at top, about 860 feet of orthoquartzite, gray, red, and green shale, and conglomerate. Composite section 3,300 feet thick. Disconformably underlies Kayak shale (new); overlies unnamed shale and sandstone.

Type locality: On ridge south of Mount Wachsmuth, Shainin Lake area, central Brooks Range. Typically exposed along east side of Alapah Creek upstream from Shainin Lake. Named from Kanayut River which originates at north end of Shainin Lake.

Kandik Formation[1]

Lower Cretaceous: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1930, U.S. Geol. Survey Bull. 816, p. 136.

J. T. Dutro, Jr., and T. G. Payne, 1957 Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Typically exposed in valley of Kandik River from the Yukon northeast probably to boundary [international], in Eagle-Circle district.

Kane Limestone (in Allegheny Formation)[1]

Pennsylvanian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1885, Pennsylvania 2d Geol. Survey Rept. R_2, p. 72, 73.

Quarried at Gen. Kane's quarry, west of road leading from Catholic Church to J. Pistner's, Elk County.

Kanektok Silts and Gravels[1]

Pleistocene: Central southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 177.

Extend along lower course of Kanektok River to Oklune Mountains and farther up Kanektok River.

Kaneohe Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2 ,p. 99. Cinder cones and lava flow of nepheline basalt and melilite-nepheline basalt. Pleistocene.

Type locality: Main highway 2 miles south of Kaneohe village. Covers about 1½ square miles on northeast side of Koolau Range, 11½ miles northwest of Makapuu Head.

Kane Point Tuff Member (of Page Ranch Formation)

Oligocene, upper, or Miocene, lower: Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 97, 98. Consists of vitric ignimbrite of rhyolite composition. Overlies Irontown member (new). Zircon age 19 million years; this indicates that Rencher-Page Ranch period of extensive-intrusive igneous activity is late Oligocene or early Miocene. Discussion of ignimbrites of area.

Named for peak several miles southwest of east-facing scarp near Page Ranch, Page Ranch quadrangle, Iron Springs district.

Kangaroo Formation[1]

Pennsylvanian(?) and Permian: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 70.

J. W. Gabelman, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 8, p. 1588. Sangre de Cristo formation is probably correlative with Maroon formation of Mosquito Range and has some counterpart in the Kangaroo of the Sawatch Range.

Named for Kangaroo Gulch, Monarch district.

Kankakee Limestone[1] **or Formation**

Kankakee stage

Lower Silurian: Northeastern, central, and western Illinois and eastern Missouri.

Original reference: T. E. Savage, 1916, Geol. Soc. America Bull., v. 27, p. 305–324.

J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 191 (table 8), 194. Shown on table of general classification of geologic time as Kankakee stage of Alexandrian epoch. Younger than Edgewood stage. During Kankakee stage, seas became clear and little or no clastic material was deposited.

E. C. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 40–42, pl. 3. Described in Dubuque South quadrangle, Iowa-Illinois. Ranges in thickness from 50 feet where it overlies Edgewood dolomite in southeastern part of quadrangle to 45 feet northwest of Dubuque airport.

Comprises grayish-yellow dense fine-grained dolomite and as much as 50 percent bedded chert in upper 40 feet. Overlies Tete des Morts member (new) of Edgewood dolomite; underlies Hopkinton dolomite.

Well exposed along Kankakee River about 5 miles south of Richey, Macon County, Ill.

Kanosh Shale (in Pogonip Group)

Lower or Middle Ordovician: West-central Utah and eastern Nevada.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 9 (fig. 2) 18–19, 29 (fig. 4), 57–58, 64–66. Predominantly yellowish-brown, olive-gray, or pink fissile shale with intercalated thin-bedded limestones; several thin-bedded orange-weathering siltstones and fine sandstones in upper part. Fossiliferous. Thickness about 500 feet in Ibex area, Utah; about 370 feet at Scipio. Overlies Juab limestone (new); underlies Lehman formation (new). Lower Ordovician.

R. E. Cohenour, 1959, Utah Geol. and Mineralog, Survey Bull. 63, p. 74–75. Described in Sheeprock Mountains area where it is present in East and West Lookout Hills as narrow band dipping beneath cliff-forming Swan Peak quartzite. Conformably overlies Juab formation. Thickness 205 feet; neither top nor base exposed. Kanosh shale is approximate age equivalent of lower part of Swan Peak formation of Ross (1949, Am. Jour. Sci., v. 247, no. 7) in northwestern Utah, of upper half of Antelope Valley limestone of Eureka, Nev., and of Orient shale member of Orient formation in West Tintic mining district on eastern edge of Sheeprock Range (Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2). Proposed that names Orient formation and its subdivision Orient shale and Orient quartzite be supplanted by Kanosh shale and Swan Peak quartzite.

J. A. Teichert, 1959, Utah Geol. and Mineralog. Survey Bull. 65, p. 12 (fig. 2), 25, 29–31, fig. 3. Described in southern Stansbury Range, Utah, where it is about 162 feet thick, overlies Garden City formation, and underlies Fish Haven dolomite. Middle Ordovician.

Type locality: Flank of Fossil Mountain, W¼ cor. sec. 19–30, T. 22 S., R. 14 W., Millard County, Utah. Named for village of Kanosh. Extends westward to Snake Range in Nevada.

Kanouse Sandstone[1]

Kanouse Sandstone and Conglomerate (in Onondaga Formation or Group)

Middle Devonian: Northern New Jersey and southeastern New York.

Original reference: H. B. Kummel, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

Bradford Willard, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 196, p. 271, 272. In proposed succession in Green Pond Mountain area, New Jersey, Kanouse sandstone and conglomerate is assigned to Onondaga formation. Occurs below Cornwall shale and above Decker limestone (basal Helderberg) Lower Devonian.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 138. Referred to as Kanouse member of Onondaga group.

G. A. Cooper, 1942, Geol. Soc. America Bull. v. 53, no. 12, pt. 1, chart 4, Age of Kanouse sandstone given as Lower or Middle Devonian.

C. H. Kindle and S. H. Eidman, 1955, Jour. Paleontology, v. 29, no. 1, p. 183–185. At Highland Mills, N.Y., overlies Schoharie grit. Contains fauna that is distinct from the Schoharie-Esopus. Apparently represents a near-

shore facies of Onondaga sea, deposited contemporaneously with Onondaga limestone of Catskill and Schoharie regions.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 734–735. In Highland Mills area, New York, overlies Woodbury Creek member (new) of Esopus formation. Upper contact with overlying Cornwall shale, of Hamilton age, not exposed. Minimum thickness 50 feet. Contains fauna of Onondaga age. Lower Devonian.

Well exposed in Valley west of Kanouse Mountain, Passaic County, N.J.

Kansan Glaciation

Kansan Drift[1]

Kansan stage of deglaciation[1]

Pleistocene: Mississippi Valley.

Original references: T. C. Chamberlain, 1894, *in* James Geikie, The Great Ice Age, 3d ed.: London, Edward Stanford, p. 724–775; 1895, Jour. Geology, v. 3, p. 270–277; 1896, Jour. Geology, v. 4, p. 872–876.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38, 52 (fig. 2), 70–104. Kansan age (stage) is interval between Aftonian and Yarmouthian. It is assumed that Kansas is type region for this stage. Kansan stage contains Atchison formation, Kansas till, and Meade formation which includes Grand Island sand and gravel member at base and Sappa member with Pearlette volcanic ash bed. In Nebraska, stage contains Red Cloud formation, Atchison formation, Kansan till, Grand Island formation, and Sappa formation. In Iowa and Illinois, term Ottumwan is used to include the Kansan and Yarmouthian.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 130–132. Kansan deposits include early Kansan calcareous laminated silt, pro-Kansan loess and peat soil, till, and sand and gravel. Kansan drift is present in each of quadrangles, Beardstown, Glasford, Havana, and Vermont, of this report, in exposures generally limited to bedrock valleys or places of moderately low altitude. In many exposures, silt or loess of early Kansan, Yarmouth, or Aftonian age is directly overlain by Illinoian till. Because Kansan till is missing in these exposures, it seems likely that Kansas glacier did not entirely cover this area.

Name amended to Kansan Glaciation to comply with Stratigraphic Code adopted 1961.

Named for development in Kansas.

Kansan Period[1]

Pennsylvanian: Kansas.

Original reference: L. C. Wooster, 1906, Kansas Acad. Sci. Trans., v. 20, pt. 1, p. 75–82.

Kansas Till

Pleistocene (Kansan): Kansas.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24, 36, 37, 44, 52, 123, 128. Kansas till, used here as stratigraphic unit of formation rank, includes deposits made directly by Kansas glacier and some water-laid sediments interstratified with the till. Does not include pro-glacial silts, sands, and gravels deposited in front of advancing glacier (Atchison formation) or outwash deposits from retreating glacier (Meade formation). No type section specified since term has been accepted for more than 50 years, but reference sections designated. Thickness

as much as 300 feet; 9 feet at Iowa Point section, Doniphan County, where it overlies Nebraska till and underlies Loveland silt member (Illinoian stage).

Reference sections: Exposures in cut banks about one-half mile southwest of type locality of Atchison formation, NE¼ sec. 10, T. 6 S., R. 20 E., Atchison County. Exposures north of Atchison along Missouri River bluffs. Iowa Point section, NE¼SE¼ sec. 6, T. 2 S., R. 20 E., Doniphan County.

Kansas City Group[1]

Kansas City Formation[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: H. Hinds, 1912, Missouri Bur. Geol. and Mines, v. 11, p. 7.

H. S. McQueen and F. C. Greene, 1938, Missouri Geological Survey and Water Resources, 2d ser., v. 25, p. 27, pl. 5. Term Kansas City group, as used in this report [northwestern Missouri], includes all beds between base of Hertha limestone and top of "Iola" limestone. It appears that bed designated Iola at Kansas City by early geologists is a higher bed than that which was named Iola limestone at Iola, Kans. According to Kansas Geological Survey, the true Iola can be traced into the Raytown at Kansas City. Left thus without a name, the "Iola" in the vicinity of Kansas City has been given name Argentine for upper gray part and name Frisbie for basal yellowish beds by Kansas Geological Survey. Outcrops upon which changes in nomenclature have been based are in Kansas and the field work was done in that State. Overlies Pleasanton group; underlies Lansing group, basal formation of which is Lane shale according to Missouri Survey usage.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028–2033; 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 74–111; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi, 10–14; H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24–28, fig. 5. At conference, May 1947, revised definition of Kansas City group was agreed to by State Geological Surveys of Iowa, Kansas, Missouri, and Nebraska; this term not applicable to Missourian deposits in Oklahoma. Lower boundary of group placed at base of Hertha formation, and upper boundary at base of Plattsburg formation of Lansing group. This modifies originally designated limits (Hinds, 1912) by addition of "Lane shale" of Missouri usage (Island Creek shale, Farley limestone, and Bonner Springs shale) at top of group and to same extent changes usage that has been followed by Missouri Geological Survey since 1912. Newly agreed upper boundary coincides with definition of this line that has been employed for past 15 years in Kansas (Moore, 1932) and Nebraska (Condra, 1935, Nebraska Geol. Survey Paper 8), but lower limit of group (top of Dennis formation) used by Kansas and Nebraska Geological Surveys in recent years differs from definition accepted by the conference, which follows original Missouri Survey usage and that followed in Iowa. Group is subdivided into (ascending) Bronson, Linn (new), and Zarah (new) subgroups. Redefined group thus comprises (ascending) Hertha limestone, Ladore shale, Swope limestone, Galesburg shale, Dennis limestone, Cherryvale shale, Drum limestone, Chanute shale, Iola limestone, Lane shale, Wyandotte limestone, and Bonner Springs shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 34–42. Group in Nebraska includes (ascending) Hertha, Ladore, Swope, Galesburg, Dennis, Fontana, Sarpy (new), Drum, Chanute, Iola, Lane, Wyandotte, and Bonner Springs formations.

Named for exposures at Kansas City, Mo.

†Kansas City Limestone[1]

Pennsylvanian: Northwestern Missouri.

Original references: J. A. Gallaher, 1898, Missouri Geol. Survey Bienn. Rept., p. 51; 1900, Missouri Geol. Survey, v. 13, p. 206.

†Kansas City Oolite[1]

Pennsylvanian: Northwestern Missouri.

Original reference: G. C. Broadhead, 1886, St. Louis Acad. Sci. Trans., v. 4, p. 483.

Kanuti Group[1]

Paleozoic: Northern central Alaska.

Original reference: W. C. Mendenhall, 1902, U.S. Geol. Survey Prof. Paper 10, p. 37, pl. 5.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Mapped with Mississippian volcanic rocks.

Kanuti River flows for 30 miles through canyon cut in these rocks.

Kanwaka Shale (in Shawnee Group)[1]

Kanwaka Shale Member (of Shawnee Formation)[1]

Kanwaka Shale Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 163.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 142 (fig. 29), 150–151; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 62 (fig. 23), 67. Name applied to beds between top of Oread formation and base of Lecompton formation. Includes both marine and nonmarine deposits. Thickness 40 to 145 feet. Divisible into three members recognized from central Kansas northward (ascending): Jackson Park shale, Clay Creek limestone, and Stull shale. A few feet below the Lecompton is a persistent sandstone which thickens southward to form main part of Elgin sandstone in Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24. Thickness 7 to 9 feet in Weeping Water Valley, Cass County.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 419. Thickness about 10 feet in measured section near Winterset, Madison County.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 30–32. Referred to as shale member of Vamoosa formation. Beds limiting Kanwaka formation of Kansas not present in Pawnee County section. Most southerly outcrops of Oread limestone are in Osage County, and only top limestone member of Lecompton formation extends as far south as Pawnee County. Hence, true Kanwaka as defined in Kansas cannot be delimited. However, interval between Wynona sandstone and Lecompton limestone in Pawnee County contains unit lithologically similar to Kanwaka formation, and, because it occupies essentially same stratigraphic position, name

Kanwaka will be applied in this report. Elgin sandstone wedges into section as member within Kanwaka interval. Thickness about 265 feet. Overlies Wynona member; underlies Lecompton limestone member of Pawhuska.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20–21, fig. 5. At type locality, Kanwaka consists of two shale members separated by limestone member. In Iowa, where it is thin, the limestone member is not well defined and is undifferentiated. Between Griswold and Lewis, the Kanwaka is gray to buff fossiliferous shale commonly containing nodular limestone beds. Clay Creek limestone member not recognized, and Kereford limestone member of Oread does not appear to be present; therefore, this shale interval probably includes equivalents of Kereford and Heumader intervals of the Oread. Thickness here about 10 feet. Near Stennett, Kereford limestone has been recognized, and it is possible to distinguish between Kanwaka and upper Oread, although Kanwaka members are undifferentiated; thickness here 6½ to 7 feet. Thickness about 10 feet east of Greenfield. Underlies Lecompton limestone; overlies Oread limestone. Shawnee group.

Type locality: Exposures east of Stull, in Kanwaka Township, about 9 miles due west of Lawrence, Douglas County, Kans.

Kaohikaipu Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc, 2, p. 99. Red cinder, bombs, and spatter and associated black pahoehoe olivine basalt lava flow containing many phenocrysts of olivine. Volcanics are isolated, and relationships to other units of Honolulu series not known. Partly overlain by lithified calcareous sand dunes. Includes Kaohikaipu lava (Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 21).

Named for Kaohikaipu Island which consists largely of these volcanics.

Kapaula Basaltic Andesite (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 244–246, pl. 1. Single flow of aa; interflow clinker present locally and in such there may be more than one flow but elsewhere above basal clinker entire thickness is composed of dense rock. Columnar jointing not prominent; platy jointing rare; phenocrysts seldom present. Resembles Makaino flow (new) and occupies approximately same stratigraphic position; the two may be branches of same flow or separate flows erupted simultaneously from different points on same fissure. Exposed thickness 40 to 50 feet; 140 feet in test hole 20. Overlies Waiaaka lava (new). Each member in series is underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 100. Pleistocene(?).

Occurs as a narrow valley-filling flow which followed valley of ancient Kapaula Stream, Haleakala (East Maui) volcano. Exposed from coast to 2,000 feet south of Koolau ditch, where it disappears beneath later Paakea lava.

Kara Bentonitic Member (of Pierre Shale)

Upper Cretaceous: Northeastern Wyoming.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 103 (fig. 2), 111–113. Sequence of gray shale and gray bentonite. Thickness about 100 feet. At type section, top of member is about 300 feet stratigraphically below base of Fox Hills sandstone, and base of member is estimated to be about 2,100 feet above base of Pierre shale and about 1,000 feet above Mitten black shale member of Pierre. In northwestern Crook County, Wyo., and in Carter County, Mont., rocks of same age as Kara bentonitic member apparently are represented either by upper part of black shale unit that overlies Monument Hill bentonitic member, or possibly by Fox Hills sandstone.

Type section: NW¼ sec. 2, T. 48 N., R. 67 W., 1½ miles south of Kara, Weston County.

Karla Kay Conglomerate Member (of Burro Canyon Formation)

Lower Cretaceous: Southwestern Colorado and southeastern Utah.

E. B. Ekren and F. N. Houser, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 195–199. Lowest conglomerate in Burro Canyon formation. Part of a system of shoestring channel-filling conglomerate and conglomeratic sandstone lenses. Lenses thin sharply toward sides of channel, but a thin gently cross-laminated fine-grained sandstone of the channel-fill commonly extends laterally, beyond channel edge, several tens to hundreds of feet. Rarely are channel fills more than 2,000 feet wide or more than 65 feet thick; commonly 500 to 800 feet wide.

Named from an exposure at the Karla Kay mine in McElmo Canyon, Montezuma County, Colo., where one of the channel-fills is well exposed.

†Kasaan Greenstone[1]

Lower Cretaceous(?): Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p. 40–52, map.

C. W. Wright, 1915, U.S. Geol. Survey Prof. Paper 87, p. 68. Kasaan greenstone, as used by Brooks (1902) not used in this report.

E. N. Goddard, L. A. Warner, and M. S. Walton, Jr., 1944, Copper-bearing iron deposits of the Mount Andrew-Mamie area, Kasaan Peninsula, Prince of Wales Island, southeastern Alaska: U.S. Geol. Survey [Mineral deposits of Alaska-Short Prelim. Repts.]. p. 3–4, fig. 3. Made up of metamorphosed interlayered volcanic rocks, pyroclastics, limestones, and poorly sorted sediments in Mount Andrew-Mamie area. Volcanics predominate in lower part of section, and sediments predominate in upper part.

Occurs in peninsula lying between Clarence Strait and Kasaan Bay: Ketchikan region.

Kashong Member (of Moscow Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 218, 231.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 375–377, pl. 1. Name proposed by Cooper for shale sequence above Portland Point member and Windom shale member. Thickness about 38 feet in Batavia

quadrangle [this report]. Overlies Menteth limestone member; underlies Windom shale member.

Type section: On Kashong Creek, Seneca Lake.

†Kaskaskia Limestone,[1] Formation,[1] or Group[1]

Mississippian: Western Illinois, western Kentucky, and eastern Missouri.

Original reference: J. Hall, 1857, Am. Assoc. Adv. Sci. Proc., v. 10, p. 55–56.

Named for Kaskaskia, Ill., near mouth of Kaskaskia River.

Kaskaskia sequence

Devonian (Chautauquan) to Mississippian (Osagean): Central and western United States.

L. L. Sloss, W. C. Krumbein, and E. C. Dapples *in* C. R. Longwell, chm., 1949, Geol. Soc. America Mem. 39, p. 112 (table 2), 115–121. "Operational unit" for use in interregional facies analysis. Named for Kaskaskia River in south-central Illinois. Limits of sequence in Illinois are Ste. Genevieve limestone-Wapsipinicon limestone; in Kansas, Ste. Genevieve limestone-"Chattanooga shale"; in Wyoming, Madison limestone-Darby formation.

Kasota Sandstone[1]

Lower Ordovician (Beekmantown): Southeastern Minnesota.

Original reference: L. H. Powell, 1935, St. Paul Inst. Sci. Mus., Sci. Bull. 1, p. 2–16.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 7 (geol. column), 50 (fig. 13), 54–55. Lies at base of Ordovician. Varies from a few inches to 6½ feet in thickness. White sandstone with medium to coarse well-rounded grains. Bedding slightly irregular; occasionally contact with underlying Jordan is uneven, indicating disconformity. Separated from overlying Oneota dolomite by thin Blue Earth siltstone.

Known only at Kasota and at St. Peter along Minnesota River, Le Sueur County.

Kassler Sandstone Member (of South Platte Formation)

Lower Cretaceous: North-central Colorado.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 31, figs. 10, 17, 19. Throughout most of nonmarine phase of South Platte formation (new) in southern part of northern foothills area, the first sandstone subunit at top of South Platte lies on dip slope of hogback, and crest of hogback is formed by second sandstone subunit. Latter is here named Kassler sandstone member. It is dominant ledge-forming sandstone of formation from Golden quadrangle, where it is about 30 feet thick, south to Kassler quadrangle, where it is between 75 and 100 feet thick. North of Golden quadrangle, too thin to be mapped. Can be traced as far as El Dorado Springs quadrangle, where it is about 10 feet thick. To the north appears to grade gradually into marine siltstone and shale member.

Type section: At end of hogback 0.5 mile north of South Platte River at Kassler. Named for exposure in Kassler quadrangle. It is part of composite type section of South Platte formation. In northern Front Range foothills.

Kasutesyo (Kasuteshio) Limestone

See Castiyo Limestone.

Katahdin Granite[1]

Post-Lower Devonian: Central Maine.

Original reference: C. H. Hitchcock, 1861, Maine Bd. Agric. 6th Ann. Rept., p. 259.

A. J. Boucot, 1954, Am. Jour. Sci., v. 252, no. 3, p. 144–148. Probably post-Lower Devonian. Discussion of stratigraphic relationships of Katahdin granite with Toppan's Ripogenous [Ripogenus] series, and Fisher's [in Willard, 1945] Chesuncook limestone and Ripogenus volcanics

Exposed in Mount Katahdin area in eastern Piscataquis and western Penobscot Counties.

Katalla Formation[1]

Oligocene and Miocene: Southeastern Alaska.

Original reference: G. C. Martin, 1905, U.S. Geol. Survey Bull. 250, p. 13.

D. J. Miller, D. L. Rossman, and C. A. Hickcox, 1945, Preliminary report on petroleum possibilities in the Katalla area, Alaska: U.S. Geol. Survey, p. 6–8; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Consists of about 8,600 feet of marine shale, sandstone, and conglomerate in Katalla area. Compiled from continuous, apparently conformable, section measured from Split Creek southward along Redwood Creek-Burls Creek divide and Redwood Creek-Puffy Creek divide to point near southern end of latter divide. Divided into seven members (ascending): unnamed shale, Split Creek sandstone, Basin Creek member (new), Burls Creek shale, organic shale, Point Hey member, and Puffy member. Measured section in many respects representative of average thickness and lithology of formation as exposed in Katalla area. Oligocene(?).

W. Waloweek and W. L. Norem, 1957, Jour. Paleontology, v. 31, no. 3, p. 674–675. Oligocene and Miocene.

Typically exposed in region northeast of Katalla, along banks of whole of peninsula between Bering Lake and Controller Bay and cropping out in most of hills south and east of Bering River.

†Katemcy Series[1]

Upper Cambrian: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxi, 289–293, pl. 3.

Named for Katemcy Creek, Mason County.

Kate Peak Formation

Kate Peak Andesite or Andesite Series

Miocene or Pliocene, lower: Western Nevada.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 68–73, pl. 1. Pyroxene andesites, glassy lavas, tuffs, breccias, and agglomerates. Some flows with prominent biotite and hornblende phenocrysts. Estimated thickness about 1,200 feet. Plate shows age as early Pliocene; text states that fossil evidence places upper part of andesites in lower Pliocene and lower part of series possibly extruded in late Miocene time.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042-C, p. 54–55, pl. 3. Formation described in Virginia City quadrangle. Most abundant rock in formation is coarse agglomerate that contains blocks of andesite of contrasting color and texture; flows and flow breccias also present. Contains vitrophyre member in northeastern part of quadrangle. Maximum thick-

ness more than 2,000 feet. Vitrophyre member at least 1,000 feet thick and probably nearly 2,000 feet in thickest part. Top of formation intertongues with overlying Truckee formation. Miocene or early Pliocene.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 32, 64. Underlies Coal Valley formation (new).

D. I. Axelrod, 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 2, p. 97, map 1. From type area in Silver City region, andesite can be traced almost continuously into Verdi basin where it is exposed chiefly in Carson Range south of Truckee River. Section largely one of interbedded agglomerates; mudflow breccias, and lavas. Thickness 1,500 to 2,500 feet. Underlies Coal Valley formation. Rests on all older rocks in area; near Fleish lies on granodiorite or on metamorphic rocks. Outside mapped area rests on Alta andesite; on basis of interfingering relationships with Mehrten formation of Sierra Nevada, Kate Peak andesites were erupted chiefly during span of time ranging from Mio-Pliocene transition to later part of early Pliocene with a few episodes extending into early middle Pliocene.

D. I. Axelrod and W. S. Ting, 1960, California Univ. Pubs. Geol. Sci., v. 39, no. 1, p. 3. In fault contact with upper Pliocene Wichman formation (new).

Named for Kate Peak in Flowery Range, east of Silver City. Covers an extensive area in Virginia City quadrangle.

Katherine Granite[1]

Precambrian: Northwestern Arizona.

Original reference: C. Lausen, 1931, Arizona Bur. Mines Bull. 131, p. 22–27, pl. 2.

Katherine district, Mohave County.

†Katmai Series[1]

Jurassic: Central southern Alaska.

Original reference: W. C. Mendenhall, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 317 (table).

Katmai, Katmai Point and on Katmai River.

Katsberg Red Beds[1]

Upper Devonian: Eastern New York.

Original reference: G. H. Chadwick, 1933, Am. Jour. Sci., 5th, v. 26, p. 480, 482–483, 484.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 135–139, geol. map. Described in Catskill and Kaaterskill quadrangles. Thickness about 3,000 feet where complete. Although formation is here called redbeds (which it actually is farther west) it contains very little red in this area. This absence of abundant red color has puzzled many observers and has been one of reasons for their thinking that later rocks here supervened upon the Catskill. Include Stony Clove sandstone member at base and Wittenberg conglomerate member in upper part. Overlies Onteora redbeds; underlie Slide Mountain conglomerate.

Type section: On steep slopes of highest peak, Slide Mountain in Catskill Mountains. Katsberg is old Dutch name for mountains miscalled "Catskills" by the English.

Kattel Shale[1]

Upper Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1932, Eastern States Oil and Gas Weekly, v. 1, no. 17, p. 7.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 52, no. 12, pt. 1, chart 4. Shown on correlation chart above Cincinnatus shale and sandstone and below Juliand "zone" of Enfield shale.

Type locality: Kattel Hill, especially the long Lackawanna Railway cut around its east base, between Chenango Bridge and Chenango Forks, Broome County.

Kau Volcanic Series

Pleistocene, upper(?), and Recent: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 38 (fig. 12), 62 (table), 64 (table), 65 (fig. 17), 67 (table), 76–78. Assemblage of Recent and latest Pleistocene rocks laid down by Mauna Loa volcano. Separated into lower or prehistoric member and upper or historic member. Lavas form thin veneer, commonly one flow thick, on lower slopes of Mauna Loa but thicken toward summit and in walls of Mokuaweoweo exceed 600 feet. Chiefly porphyritic or nonporphyritic aa and pahoehoe basalts; flows average about 15 feet in thickness. Rocks of Ninole and Kahuku volcanic series form kipukas in Kau lavas. One of latest prehistoric lavas is Keamuku lava flow. Overlapped by Puna lavas (new) between Kilauea caldera and Keaau. Overlies Kahuku volcanic series (new) and Pahola ash. Kau and Puna volcanics formerly included in Kamehame basalt.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 100. Late Pleistocene(?) and Recent.

Type locality: In wall of Mokuaweoweo caldera. Named from Kau district where rocks are well exposed.

Kauai Lavas.

Pliocene(?): Kauai Island, Hawaii.

N. E. A. Hinds, 1930, Bernice P. Bishop Mus. Bull. 71, p. 56–57. Basaltic lava flows; make up main cone of Kauai volcano. Consist of lower and upper lavas separated by Waimea conglomerate (new). Thickness of lower lavas about 4,000 feet. Unconformable below lavas and pyroclastics of late Kolea volcanic episode.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 100–101. Included in what is now known as Waimea Canyon volcanic series. Pliocene(?).

Distributed over most of island.

Kauffman Member (of Mercersburg Formation)

Middle Ordovician (Trentonian): South-central Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 734–738. Name proposed for upper member of formation. Described at type section as dark-gray fine- to medium-grained, thin crinkly to slabby gray-weathering limestone. Thick slabby or thin cobbly beds developed locally in eastern belts of outcrop; usually platy bedded in western belts. Four metabentonites present at type section; each is immediately succeeded by several feet of olive-drab to green shale or blocky siltstone. Maximum thickness 168 feet; thins northeastward. Conformably overlies Housum member (new); disconformably underlies Oranda formation.

Type section: In fields adjacent to Cumberland Valley Railroad, 2.1 miles southwest of Marion, Franklin County. Named for village of Kauffman, 1.6 miles southeast of type section.

Kaupo Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davies *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 101. Flow of olivine basalt pahoehoe that issued from talus at foot of windward cliff (Pali) of Koolau Range 200 feet above sea level and flowed to ocean. Surface only sparsely soil covered, and neither Manana tuff nor reef of the plus 25-foot (Waimanalo) stand of sea is present on it. Extent noted.

Named for abandoned Kaupo village situated on flow. Forms small peninsula, with area of about 0.1 square mile, 1 mile northwest of Makapuu Head.

Kaupo Mud Flow (in Hana Volcanic Series)

Pleistocene: Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 67 (table), 107–108, pls. 1, 21B. Coarse breccia with blocks reaching 50 feet across. Forms hills that project through later Hana lavas (new) and cliffs 300 feet high along coast. Exposed thickness 355 feet in sea cliff at Puu Maneoneo; extends below sea level.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 101. Included in Hana volcanic series. Pleistocene.

Named for exposures at mouth of Kaupo Valley, Haleakala (East Maui) volcano.

†Kaupulehu Flow

Recent: Hawaii Island, Hawaii.

G. A. Macdonald, 1949, U.S. Geol. Survey Prof. Paper 214–D, p. 75. Several flows were extruded from Hualalai Volcano probably during years 1800 and 1801. Kaupulehu flow originated at vent between 5,500 and 6,000 feet above sea level on northwest flank. Another flow, Huehue, originated at row of cones at 1.500 feet altitude shortly after Kaupulehu flow. Kaupulehu is largely aa and Huehue flow is largely pahoehoe.

Kaweah Series

Triassic(?): Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci., v. 25, no. 1, p. 13, 116, fig. 29, geol. map. Metamorphic series made up of great variety of sedimentary and intrusive and extrusive rocks. Divided into four stratigraphic units (ascending): Yokohl amphibolite, Lemon Cove schist, Homer quartzite, and Three Rivers schist. Age of series unknown, but Triassic age is suggested by comparison with Mineral King beds and rocks of Inyo Range.

Occurs in southern Sierra Nevada in north-central part of Tulare County.

†Kawishiwin Agglomerate,[1] Greenstones,[1] or Series[1]

Precambrian (Keewatin): Northeastern Minnesota.

Original reference: N. H. Winchell, 1889, Minnesota Geol. Survey 17th Ann Rept. 1888, p. 41–42, 45–46, 68, 70.

Probably named for Kawishiwi River, Vermilion district.

Kawvian Series or Epoch

Upper Pennsylvanian: North America.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 284–285, 286, 288–289 (fig. 1), 297–300. Analysis of physical characters and paleontological features of Pennsylvanian rocks in North America leads to conclusion that stratigraphic cleavage at two positions within system has paramount significance. Three series recognized: Ardian-Lower Pennsylvanian, Oklan-Middle Pennsylvanian, and Kawvian-Upper Pennsylvanian. Approximately upper one-third of Pennsylvanian system belongs to Kawvian series which includes formations from oldest Missourian to base of Permian. Kawvian rocks divided into Missourian stage below and Virgilian stage above. Time equivalent is Kawvian epoch.

Typically displayed in valley of Kaw (Kansas) River in northeastern Kansas. Name derived from commonly used alternative designation of Kansas (or Kaw) River which joins the Missouri at Kansas City.

Kayak Shale

Lower Mississippian: Northern Alaska.

A. L. Bowsher and T. J. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 4, 6, 14–15, figs. 2–4, pl. 2. At type locality composed of five unnamed members (ascending): sandstone, 130 feet thick; lower black shale, 595 feet; argillaceous limestone, 80 feet; upper black shale, 140 feet; and red limestone, 10–15 feet. Total thickness approximately 960 feet. Disconformably underlies Wachsmuth limestone (new); disconformably overlies Kanayut conglomerate (new).

Type locality: In saddle near foot of south slope of Mount Wachsmuth, Shainin Lake area, central Brooks Range. Name taken from Kayak Creek, which joins Alapah Creek south of Shainin Lake.

Kaycee Formation

Recent: Eastern Wyoming.

L. B. Leopold and J. P. Miller, 1954, U.S. Geol. Survey Water-Supply Paper 1261, p. 10–11. Described as uniform tan or light-brown silt consisting of moderately well sorted grains, predominantly quartz. Grains subrounded but not pitted. Lenses of sand or fine gravel locally present. In places there is a thin basal gravel. Unconformably overlies Ucross formation (new).

Type locality: Left bank in the reach of Powder River from Kaycee to Sussex.

Kayenta Formation (in Glen Canyon Group)[1]

Upper Triassic(?): Northeastern Arizona, southwestern Colorado, and southeastern and southern Utah.

Original reference: A. A. Baker, C. H. Dane, and E. T. McKnight, 1931, U.S. Geol. Survey Prelim. map showing structure of parts of Grand and San Juan Counties, Utah.

A. A. Baker, C. H. Dane, and J. B Reeside, Jr, 1936, U.S. Geol. Survey Prof. Paper 183, p. 5. pls. Name Kayenta here used for beds in northern Arizona and southeastern Utah that have been previously designated "Todilto" and "Todilto(?)" formation. Overlies Wingate sandstones; underlies Navajo sandstone. Middle formation of Glen Canyon group which is herein classified as Jurassic(?). Type locality stated.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 79–81, pl. 2, geol. sections. Described in Zion Park region where it is 75 to 100 feet thick in Johnson Canyon, 118 to 200 feet in Kanab Canyon, 130 to 165 feet in Sand Canyon, 0 to 180 feet in Zion Park, and 25 to 310 feet east of Paria. Underlies Navajo sandstone; overlies Wingate sandstone.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2520–2523. As redefined in southwestern Utah and along Echo Cliffs of northern Arizona, includes sequence of beds between top of Springdale sandstone member of Moenave formation and base of Navajo sandstone. Sequence 1,190 feet thick at Cedar City, Utah; 714 feet at Zion Canyon; 680 feet at Kanab; and 150 to 500 feet in Echo Cliffs area. At Cedar City, includes Cedar City tongue (new); in Kanab area includes Tenney Canyon tongue (new). Divided locally into two parts by Shurtz and Lamb Point tongues (both new) of Navajo sandstone, but elsewhere is single unit with fairly well-defined boundaries. Jurassic(?).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (table), 17–19, pl. 2. At type locality, is represented by sandstone facies typical of unit throughout most of Colorado Plateau; to southwest of type locality, increases in silt content. Thickness: 55 feet at Rock Point near its eastern limit; 144 feet at Kayenta; 466 feet at Gap where it includes many silty units that are tongues of silty facies; 678 feet along Ward Terrace. In eastern half of Navajo country, conformably overlies Wingate sandstone (Lukachukai member); in western half of country, conformably overlies Moenave formation. Intertongues with basal part of overlying Navajo sandstone. Contains *Tritylodontoids*; study of these fossils is incomplete, but they seem to be closest to Old World forms generally referred to Upper Triassic.

U.S. Geological Survey currently designates the age of the Kayenta Formation as Upper Triassic(?) on the basis of a study now in progress.

Type locality: In Comb Ridge, 1 mile northeast of Kayenta, Navajo County, Ariz.

Keanae Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 95 (table), 96. Dark-gray olivine basalt containing phenocrysts of olivine and augite. Last lava flow to reach lower part of Keanae Valley.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 102. Pleistocene(?).

Named for exposures at Keanae village, Haleakala (East Maui) volcano. At an altitude of 1,300 feet, lava covers entire floor of Keanae Valley, but farther north it divided into two branches, one followed eastern wall of valley to altitude of 500 feet and the other followed gulch of present Piinaau Stream at foot of western wall. At the coast, western branch spread out to form lava delta on which village of Keanae is located.

Keanakakoi Formation

Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 92–102. Applied to whole series of surface ash layers which appear to have resulted from successive explosions of Kilauea during present phys-

iographic epoch; as thus defined, includes not only 1790 ash but also that of 1924 as component members. Includes variety of materials; some parts largely lapilli and dust produced by phreatic explosions; other parts reticulite and pyroclastics thrown out by magmatic explosions. Maximum thickness over 30 feet, on tongue of caldera rim.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 108. Treated as aa member of Puna volcanic series (new).

Type locality: Surface in vicinity of Keanakakoi Crater.

Kearny Formation

Pennsylvanian (Morrow): Southwestern Kansas (subsurface).

M. L. Thompson, 1944, Kansas Geol. Survey Bull. 52, pt. 7, p. 414–417. Name proposed for 127 feet of rocks encountered between base of producing sand at depth of 4,752 feet and top of highly oolitic limestone, believed to be of Mississippian age, at depth of 4,879 feet in type well. Type section composed of greenish-gray, bluish-gray, and dark-gray coarsely crystalline to dense glauconitic fossiliferous limestones interbedded with dark-gray and green fossiliferous shales. Subordinate amount of sandstone and sandy glauconitic fossiliferous limestone occurs in lower part. Four different although gradational lithologic zones can be recognized.

Type well: Stanolind Oil and Gas Co. No. 1 Patterson well, SE cor. sec. 23, T. 22 S., R. 38 W., Kearny County.

Kearsarge Amygdaloid[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan

Original reference: L. L. Hubbard, 1895, Michigan Geol. Survey, v. 5, pt. 1, p. 117, footnote.

H. R. Cornwall, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–51. Included in Portage Lake lava series.

At Kearsarge [mining] location, Houghton County.

Kearsarge Andalusite Group[1]

Paleozoic(?): Central southern New Hampshire.

Original reference: C. H. Hitchcock, 1877, Geology of New Hampshire, pt. 2, p. 585–588, 674, pl. 24.

Occurs on Mounts Kearsarge and Ragged, constituting a band 12 miles long and from 3 to 4 miles wide in towns of Warner, Sutton, Andover, and Salisbury, Merrimack County.

Kearsarge Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt 2, p. 114, chart.

H. R. Cornwall, 1951, Geol. Soc. America Bull., v. 62, no 2, p. 161. Incidental mention in report on Keweenawan lavas.

Named for occurrence in old Kearsarge mine, Houghton County.

Kearsarge Flow[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

At the Kearsarge [mining] location, Houghton County

Kearsarge West Amygdaloid[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for fact that it lies west of Kearsarge amygdaloid.

Kearsarge West Flow[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Keasey Shale[1] or **Formation**

Keasey Stage

Eocene, upper, and Oligocene, lower: Northwestern Oregon and southwestern Washington, and British Columbia, Canada.

Original reference: H. G. Schenck, 1927, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 12, p. 457, 459.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v 4, p. 104, 105. Thickness of formation in Rock Creek area, near Keasey, about 1,200 feet. Lower part composed of dark-grayish-brown somewhat stratified medium-grained tuffaceous sandy shales containing several species of fossil mollusca; upper two-thirds composed of medium to dark-brownish-gray rather massive medium- to coarse-grained shaly sandstone within which fossils are scarce. Underlies Pittsburg Bluff formation; basal contact not observed. Lower Oligocene.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 592, chart 11. In southwestern Washington, a section consisting of Metchosin volcanics and Keasey, Lincoln, and Astoria formations has been folded and deeply eroded so as to expose over 3,000 feet of the Metchosin. Keasey rests unconformably on the volcanics; also present on Vancouver Island. Eocene and Oligocene.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 42. Shale described west of Willamette River. Thickness about 1,800 feet in vicinity of Sunset Tunnel on Wolf Creek Highway. Overlies Cowlitz formation; disconformably underlies Pittsburg Bluff formation. Upper Eocene or lower Oligocene.

W. C. Warren and Hans Norbisrath, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 225–228. Formation described in upper Nehalem River basin. Thickness 1,800 to 2,000 feet. Overlies Cowlitz formation; underlies Pittsburg Bluff formation.

J. W. Durham, 1950, Geol. Soc. America Bull., v. 61, no. 11, p. 1254–1255. A stage based on faunal assemblages.

M. L. Steere, 1955, Geol. Soc. Oregon Country News Letter, v. 21, no. 10, p. 85. In Sunset Tunnel area, Columbia County, Oreg., overlies Nehalem formation (new).

Typically exposed on railroad at Keasey Station, Columbia County, Oreg.

†Keddie Formation[1]

Pennsylvanian : Northern California.

Original reference: J. S. Diller, 1892, Prelim, proof-sheet ed. U.S. Geol. Survey Lassen Peak Folio.

Forms narrow belt on northeast slope of Keddie-Dyer Ridge, Plumas County.

†Keechelus Andesitic Series[1]

Keechelus Andesite or Formation

Eocene to Miocene: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

H. A. Coombs, 1936, Washington [State] Univ. Pubs. in Geology, v. 3, no. 2, p. 150–171. Series described in Mount Rainier National Park. Includes rock types referred to as Mineral Mountain andesite porphyry, Sheepskull Gap tuffs, Sourdough Mountain breccias, Chinook Pass diorite porphyry, Longmire acid breccias, Starbo altered tuffs, Cayuse Pass acid hornfels, and Mowich hypersthene basalt. Overlies rocks of Puget group with angular unconformity; intruded by Snoqualmie granodiorite. Exact upper age limit of Keechelus unknown. Only materials definitely overlying the younger capping flows in vicinity of park are [Mount] Rainier volcanics; elsewhere volcanic activity in Keechelus may have extended into Pliocene and judging from freshness of flows, may be equivalent to [Mount] Rainier lavas in age.

G. E. Goodspeed and H. A. Coombs, 1937, Am. Jour. Sci., v. 34, 5th ser., no. 199, p. 12–15. Miocene age of Keechelus is in doubt. "Type locality" given.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 795–802. In Mount Aix quadrangle, upper part of Keechelus andesitic series is mapped as separate unit—Fifes Peak andesite. Marginal flows of Yakima basalt overlap Fifes Peak andesite and are clearly younger than the andesite. Snoqualmie granodiorite probably intermediate in age between lower part of Keechelus and Fifes Peak andesite. Overlies undifferentiated rocks considered to be pre-Oligocene. Map bracket shows Keechelus Oligocene(?) to Miocene.

R. V. Fisher, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1340. Formation, covering hundreds of square miles in southern Washington Cascades, is thick sequence of andesitic volcanic breccias, tuffs, flows, and interbedded continental sediments. It is gently folded and intruded by small dioritic stocks and diabasic dikes. Age variously regarded as Miocene and (or) Oligocene. On basis of single oreodont, it is now thought to be mainly Oligocene. Immediately south of Mount Rainier, lower part of Keechelus is interbedded with upper part of the probable upper Eocene Puget group. Keechelus, therefore, appears to belong in part to upper Eocene.

D. R. Crandell and L. M. Hard, Jr., 1959, U.S. Geol. Survey Geol. Quad. Map GQ–125. Series described in Buckley quadrangle where it conformably overlies Puget group. Eocene to Miocene.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 118–121, pl. 1. Referred to as Keechelus andesite. Term andesitic series considered inappropriate. Type area designated because none was stated by Smith and Calkins. Most workers have considered east shore of Lake Keechelus as the type. Relationship of Keechelus of various workers to new type area must be established by further mapping. Section along Lake Keechelus is metamorphosed; at newly designated type area, Keechelus consists of sequence of bedded andesites with minimum of 3,500 feet exposed. Here, overlies Naches formation and is intruded by Snoqualmie granodiorite.

At Denny Mountain, Keechelus is andesite breccia; appears to overlie Guye formation unconformably. In area of this report, base of Keechelus may be as old as Eocene; no younger rocks are in stratigraphic contact with Keechelus.

Type locality (Goodspeed and Coombs): Along eastern shore of Lake Keechelus, about 70 miles southeast of Seattle on Sunset Highway which connects Puget Sound region with eastern Washington. Type area (Foster): West face to Rampart Ridge at altitude of Rachel Lake which drains into south branch of Box Creek, Kittitas County.

Keechi Creek Formation (in Whitt Group)

Keechi Creek Shale and Sandstone (in Mineral Wells Formation)[1]

Pennsylvanian (Canyon): Central northern Texas.

Original references. F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 25, 31; Texas Univ. Bull. 2132, p. 78.

M. G. Cheney, 1940, Am Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Whitt group (new). Expanded below to base of Turkey Creek sandstone. Underlies Palo Pinto formation; overlies Salesville formation. Name Mineral Wells dropped in this report.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 25, fig. 3, pl. 1. This report [Parker County] follows Cheney's (1940) definition of Keechi Creek. However, objection is raised to Cheney's procedure of reclassification. Group terminology not used in this report.

Typically exposed along Keechi Creek west of Mineral Wells, Palo Pinto County.

Keefer Sandstone Member (of Clinton Formation)[1]

Keefer Member (of Mifflin Formation)

Keefer Sandstone (in Clinton Group)

Middle Silurian: Western Maryland, central Pennsylvania to northeastern West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 522, 545, 591, pl. 28.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 18, p. 8, 92–106, measured sections. Keefer sandstone described in West Virginia. Thickness 5 to 30 feet. Overlies Rose Hill formation; underlies Rochester shale. Included in Clinton group. Middle Silurian, Niagaran series.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows that Clinton—central Pennsylvania to northeastern Tennessee—comprises (ascending) Rose Hill shale, Keefer sandstone, and Rochester shale. Niagaran series.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 6, 21, 23. Rank reduced to member status in Mifflin formation (new). Underlies Rochester member; overlies Rose Hill formation. Thickness commonly 40 to 50 feet; locally absent. At Mount Union section referred to as Keefer formation; thickness 47 feet. The Keefer is the "Ore sandstone" of Pennsylvania Second Geological Survey Reports.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Clinton group, as mapped, includes Rose Hill formation, Keefer sandstone, and Rochester shale.

Named for Keefer Mountain a few miles northeast of Hancock, Washington County, Md.

Keel Limestone Member (of Chimneyhill Limestone)

Lower Silurian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 134. An oolitic limestone 6 to 8 feet thick. Underlies Cochrane member (new); unconformably overlies Hawkins member (new).

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 4 (fig. 2), 6 (fig. 3), 11–16, fig. 4. Unconformably overlies Ideal Quarry member (replaces Hawkins limestone member); unconformably underlies Cochrane member. Type locality designated.

Type locality: NW¼NE¼NE¼ sec. 36, T. 3 N., R. 5 E., Pontotoc County. Name taken from allottee who originally owned land.

Keeler Canyon Formation

Pennsylvanian to Lower Permian: Eastern California.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4–7. Consists of thin-bedded medium- to dark-gray impure silty and arenaceous to pebbly limestones and limy siltstones, with intercalations of pinkish or maroon fissile shale. Silicified fusulinids are sometimes an important constituent of the pebbly limestones. All rocks show clastic texture, and bedding is inclined to be platy or flaggy with few layers as much as 3 feet thick. Formation highly folded; section overturned in Darwin Hills. Thickness averages 2,200 feet; in Darwin quadrangle, formation thickens to about 4,000 feet. Where section is greatly thinned, there is evidence that segments have been cutout by faulting. Conformably overlies Chainman shale in New York Butte quadrangle; in Darwin quadrangle, overlies an unnamed limestone which seemingly overlies the Chainman; unconformably underlies Owens Valley formation (new) with angular discordance of about 15° in some places.

W. E. Hall and E. M. MacKevett, 1958, California Div. Mines Spec. Rept. 51, p. 7 (table 1), 9–10, pl. 1. In Darwin quadrangle, consists of a lower member, about 2,300 feet thick, of thin-bedded limestone with intercalated limestone-pebble conglomerate and an upper member, about 1,700 feet thick of calcilutite and fine-grained calcarenite with lesser shale and limestone-pebble conglomerate. Underlies Owens Valley formation; overlies Rest Spring shale. Ranges in age from probable Atoka or Des Moines (Pennsylvanian) to probable late Wolfcamp (Permian).

Type locality: East of the Estelle Tunnel portal and 2 miles southwest of Cerro Gordo Peak, southern Inyo Mountains.

Keen Conglomerate

Pennsylvanian (Strawn): Central Texas.

Robert Pavlovic, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 891–892. Massive coarse green chert conglomerate with wavy closely banded black and white chert common. Thickness about 25 feet. Occurs approximately in middle(?) of the Strawn.

Named from Keen Creek in southeast corner of Zephyr quadrangle, Mills County. Traced about 6 miles along strike from Pompey Creek on Mullin topographic sheet to head of Rough Creek where it is hidden by the Cretaceous.

Keene Gneiss[1]

Precambrian: Northern New York.

Original reference: W. J. Miller, 1918, Geol. Soc. America Bull., v. 29, p. 400–462, geol. map.

M. H. Krieger, 1937, New York State Mus. Bull. 308, p. 15, 41–42, 43, 47, geol. map. Keene gneiss included in discussion of anorthosites in Thirteenth Lake quadrangle.

Named for exposures along State road just north of village of Keene, Lake Placid quadrangle, Essex County.

Keene Limestone[1]

Upper Cambrian and Middle Devonian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 438, 505, map.

Named for Keene mine, Elkhorn region.

Keeseville Sandstone[1]

Upper Cambrian(?): Northern New York.

Original reference: E. Emmons, 1841, New York Geol. Survey 5th Rept., p. 130, 131.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 333. Although Emmons (1841) treated Keeseville sandstone as variety of Potsdam sandstone, name was later revived for upper predominantly white part of the Potsdam, and name Potsdam was restricted to lower, largely red, part (Chadwick, 1920, New York State Mus. Bull. 217–218). Because reddish and white sandstone interfinger, advisability of using two names is questioned. Not considered valid name.

A. W. Postel, A. E. Nelson, and D. R. Wiesnet, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–123. Potsdam sandstone in Nicholville quadrangle is divided into two members. Nicholville conglomerate (new) below and upper unnamed orthoquartzite member. Unnamed upper member corresponds to Keeseville sandstone of Emmons.

Extends from Keeseville to Hopkinton, St. Lawrence County.

Keetley Volcanics

Tertiary, lower(?): North-central Utah.

M. B. Kildale, 1958, Utah Mineralog. Soc. Field Trip, Aug. 17, 1958, p. 8. Series of volcanic rocks largely of andesitic flows, agglomerates, and tuffs. Unconformably overlie older folded sedimentary rocks. Probably early Tertiary in age. Altered by hydrothermal solutions southeast of Keetley.

In eastern and northeastern parts of Park City mining district. Well exposed in cuts along new highway between Silver Fork junction and Hailstone, and occur in vicinity of Keetley.

Keewatin Group, Volcanics

Precambrian: Northern Minnesota and Canada.

Original reference: A. C. Lawson. 1885, Report on the geology of the Lake of the Woods region with special reference to the Keewatin (Huronian?) belt of the Archaean rocks: Canada Geol. and Nat. History Survey, 1885, the same being part CC of Canada Geol. and Nat. History Survey Ann. Rept., new ser., v. 1, 1886, p. 10CC–13CC, 14CC–15CC.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1023–1029, 1074. Lawson (1885) named the Keewatin from exposures on

Lake of the Woods, most of which are in Canada. No doubt the series is equivalent to outcrops south of the boundary. Outcrops run east on Canadian side nearly to Port Arthur and almost connect with the Minnesota belt from Saganaga Lake to Cass County. West of that, drift cover is thick. Hays and others (1905, Jour. Geology, v. 13, no. 2) found original Keewatin a fairly well developed unit and approved name to cover greenstone, green schist, and the iron-formation of basement complex, apparently considering it below Knife Lake (Seine) group. Keewatin group in Minnesota divided into Ely greenstone and Soudan iron-bearing formation. Keewatin having been named from outcrops on Lake of the Woods has its type locality in Minnesota. Widespread use of term is based on evidence (not all equally good) that other rocks can be correlated with those near Lake of the Woods. Possible that greenstones resembling those at type locality may be of different ages. Pettijohn (1937, Geol. Soc. America Bull., v. 48, no. 2) reported greenstones of two ages north of type locality. He would restrict the Keewatin to the older of the two series. Cooke and others (1931, Canada Geol. Survey Mem. 166) suggest that there are larger, well-exposed, and less-metamorphosed greenstones in northern Ontario and Quebec, which have so long been agreed upon as Keewatin that it would be well to substitute that as type locality. Term Earlier Precambrian System as used in this report includes Keewatin Period.

Type locality: Keewatin district, Lake of the Woods area, northern Minnesota.

Keewatin Series[1]

Precambrian: Lake Superior region.

Original reference: A. C. Lawson, 1885, Report on the geology of the Lake of the Woods region with special reference to the Keewatin (Huronian?) belt of the Archaean rocks: Canada Geol. and Nat. History Survey, 1885, the same being part CC of Canada Geol. and Nat. History Survey Ann. Rept., new ser., v. 1, 1886, p. 10CC–13CC, 14CC–15CC.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1023. Early Precambrian System, as used in this report [Precambrian of Minnesota], includes Keewatin Period and the time of the following period of invasion, orogeny, and erosin. Rocks include (1) Keewatin flows and associated Soudan iron formation and minor sediments, and (2) pre-Knife Lake granite, usually designated Laurentian.

Name derived from Keewatin district.

†Keg Creek Sand[1]

Eocene, upper: Eastern Georgia.

Original reference: S. W. McCallie, 1919, Jour. Geology, v. 27, p. 176.

Named for exposures on Keg Creek, Washington County.

Keith Knob facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 112–114. Predominantly a gray, blue-gray, olive-gray to drab argillaceous shale with local siltstone layers in lower part. Thickness 125 to 175 feet, in harmony with general southward thinning of formation. Merges with Silver Hills facies (new) to north and west and with Junction City facies (new) to east. Underlies Culver Springs shale member of Brodhead formation, Pilot Knob facies (all new); overlies New Albany shale.

Well exposed along U.S. Highway 62, one-half mile southwest of Boston, Nelson County. Named for Keith Knob, westernmost prominence in Nelson County.

Kekekabic Granite[1]

Precambrian: Northeastern Minnesota.

Original reference: N. H. Winchell, 1900, Minnesota Geol. Survey Final Rept., v. 5, pt. 1, p. 32.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1036. Intrudes Knife Lake series in Kekequabic area. Presumably contemporaneous with Vermilion granite (batholith).

Occurs along south side of Kekekabie [Kekequabic] Lake, Vermilion district, Lake County.

Kekekabic Tuffs, Agglomerates, Slates, and Andesite Porphyry (in Knife Lake Series)

Precambrian: Northern Minnesota.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1606–1608, 1624. Overlies Amoeba Lake graywackes, slates, and tuffs. Porphyry is interstratified with tuffs, agglomerates, and slates in vicinity of Kekekabic Lake; near Eddy Lake, lies on top of other sediments. Thickness 2,000 to 4,000 feet. Difficult to limit series upward because transition is gradual. In this report, Knife Lake series is divided into 20 members. Table of approximate chronologial sequence (ascending) shows Kekekabic tuffs as member 11.

Type locality not stated. Probably named for occurrence at Kekekabic Lake.

Kekekabic Lake Tuffs, Agglomerates, Slates, and Andesite Porphyry

See Kekekabic Tuffs, Agglomerates, Slates, and Andesite Porphyry.

Keller Group

Pennsylvanian (Virgil Series): Central and southern New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 69–71. Proposed for group of rocks between top of Hansonburg group (new) of Missouri series below and the base of the Fresnal group (new). Includes Moya (top) and Del Cuerto formations (both new). At type locality, group is about 132 feet thick and is composed largely of limestone; several thick beds of arkosic sandstone, conglomerate and shale occur in lower two-thirds of group. Lithology varies markedly among some localities.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 19. Holder formation includes Fresnal and Keller groups in the classification of Thompson (1942).

Type locality: At north end of Oscura Mountains on northeast bluff of canyon that cuts across northern part of mountains. Located mainly in NE¼ sec. 31, T. 5 S., R. 6 E., but extends a short distance into west-central part of sec. 32, Socorro County. Name derived from Keller Spring on east slope of Oscura Mountains about 2 miles east of South Oscura Peak.

Kellogg Shale

Eocene, upper: Northern California.

B. L. Clark and A. S. Campbell, 1942, Geol. Soc. America Spec. Paper 39, p. 1, 4 (fig. 3), 5–9. Name applied to 130-foot shale unit lying stratigraphi-

cally below Markley formation, and in western part of area forms upper part of series of sands and shales which have been known locally as "Nortonville" shales. Shale is uniform; some layers are thin-bedded paper shales and others more massive; unweathered rock, buff to light-chocolate; weathered surface almost pure white. In type area, underlies San Pablo formation.

Type section: On bank of road between Kellogg Creek and Byron Hot Springs, northeast of Mount Diablo.

Kelly Formation

Pennsylvanian: North-central Utah.

H. J. Bissell, 1936, Iowa Acad. Sci. Proc., v. 43, p. 240, 241. Predominantly sandstone and limestone interbedded; minor amounts of conglomerate and shale. Thickness 1,885 feet. Underlies Hobble formation (new). Rocks have been referred to Oquirrh formation. Proposed in this report to elevate Oquirrh to rank of series in this region.

Type section: In Hobble Creek Canyon, central part T. 7 S., R. 3 E., east of Springville, Utah County.

Kelly Limestone

Kelly Formation[1]

Mississippian: Southwestern New Mexico.

Original reference: G. L. Herrick, 1904, Am. Geol., v. 13, p. 310–312. [See Graphic-Kelly limestone.]

S. B. Talmage and T. P. Wootton, 1937, New Mexico Bur. Mines Mineral Resources Bull. 12, p. 27. Since its definite correlation with the Lake Valley limestone has been established, it seems preferable to discontinue use of local term, Kelly limestone, in Magdalena Mountains.

V. T. Stringfield, A. H. Koschmann, and G. F. Loughlin, 1942, U.S. Geol. Survey Prof. Paper 200, p. 14–16, pl. 2. In Magdalena district, for most part it is light bluish-gray medium- to coarse-grained thick-bedded high-calcium limestone with persistent bed of dense argillaceous limestone in middle part known as "silver pipe" or "indicator." Thickness ranges from 90 to 135 feet; exceeds 110 feet in most places.

A. K. Armstrong, 1958, New Mexico Bur. Mines Mineral Resources Mem. 5, p. 3, 5, 11, figs. 6, 8, 9. Formation ranges in thickness from 0 to 75 feet in Magdalena, Lemitar, and Ladron Mountains. Disconformably overlies Caloso formation. Keokuk (Osage) age.

Named for Kelly, Magdalena district, Socorro County.

Kelly Hill facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 186–191.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 2. Mississippian facies nomenclature discussed. Correlation chart lists Kelly Hill facies of Carwood formation.

Name taken from hill 2 miles southwest of Nashville which is crossed by State Highway 46, NE¼NW¼ sec. 35 and SW¼SE¼ sec. 26, T. 9 N., R. 2 E., Brown County.

Kelso Shale

Lower Cambrian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 241. Listed as underlying Chambless limestone and overlying Tough Nut quartzite (new). Thickness 55–57 feet.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 30, 32. Name preoccupied; unit renamed Latham shale.

Area is in Providence Mountains, San Bernardino County.

Kelvin Formation

Kelvin Conglomerate[1]

Lower Cretaceous: Central northern Utah.

Original reference: A. A. L. Mathews, 1931, Oberlin Coll. Lab. Bull., new ser., no. 1.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 970. Considered to be equivalent to Cedar Mountain group (new).

D. A. Andrews and C. B. Hunt, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 70. Shown on map legend as Kelvin formation.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 15, pl. 1. Formation discussed in geology of central Wasatch Mountains. Conglomerates form its most prominent outcrops, but formation consists in greater part of pale reddish-brown to purple siltstone with smaller amounts of sandstone. Thickness in Parleys Canyon about 1,500 feet. Conformably overlies Morrison(?) formation; underlies Frontier formation.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 138. Frontier formation, in Coalville anticline, contains a middle red-bed sequence 3,150 feet thick considered by some writers as belonging to Kelvin formation. This sequence is here named Chalk Creek member of Frontier.

Named for exposures at Kelvins Grove, Emigration Canyon, about 8 miles east of Salt Lake City.

Kemp Clay (in Navarro Group)[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 342–344.

L. W. Stephenson, 1941, Texas Univ. Bur. Econ. Geology Pub. 4101, p. 27–30. Youngest formation in group. Unconformably underlies Midway group; overlies Corsicana marl; in Bexar County, merges westward along strike into Escondido formation. Maximum thickness not determined; well records in Limestone County show thickness of about 370 feet, but that figure may be exceeded in places. Locally formation appears to be no more than 160 feet.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 52–53. Foraminifera described.

Presumable type locality is faulted inlier near Kemp, Kaufman County.

Kemper Member (of Naheola Formation)

[Paleocene]: West-central Alabama and east-central Mississippi.

W. F. Roux, Jr., 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Upper Midway Naheola formation composed of Matthews Landing, Oakhill, and Kemper members.

Type locality and derivation of name not given.

Kenai Formation[1]

Eocene(?) and Oligocene: Central southern Alaska.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 234.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–D, p. 143. In recent years, formation has been restricted to rocks of the type locality on Kenai Peninsula.

F. F. Barnes and E. H. Cobb, 1959, U.S. Geol. Survey Bull. 1058–F, p. 224–229, pls. Only known bedrock in Homer district. Consists of moderately indurated sand, silt, and clay in generally thin and intergrading beds and lenses, interbedded with a few lenses of fine conglomerate and many beds of subbituminous and lignitic coal ranging from a few inches to 7 feet in thickness. Total thickness of formation not known, because neither top nor base has been recognized, but probably exceeds 4,700 feet; this figure is aggregate thickness of sections measured along northwest shore of Kachemak Bay.

Type locality: Homer district, Kenai Peninsula.

Kendall Sandstone Member (of Gypsum Spring Formation)

Jurassic: Western Wyoming.

R. E. Skinner, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 129–130. Marine type clastics including sandstone, siltstone, and some thin limestones; buff, tan, and red. Thickness in outcrop about 20 to 25 feet. Basal member of formation. Unit has been termed "Nugget Pay" and included in Nugget formation.

Well exposed in southwest part of sec. 25, T. 38 N., R. 110 W., Sublette County. Name derived from nearby Kendall Ranger station and local name for valley in which station is located and sandstone exposed.

Kendall Tuff[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 41.

Named for Kendall mine, Goldfield district.

Kendall Green Slate[1]

Precambrian: Eastern Massachusetts.

Original reference: W. E. Hobbs, 1899, Am. Geologist, v. 23, p. 109–115.

Occurs in Kendall Green area, Middlesex County.

Kendrick Shale (in Breathitt Formation)

Kendrick Shale (in Pottsville Group)[2]

Pennsylvanian: Southeastern Kentucky.

Original reference: W. R. Jillson, 1919, Kentucky Dept. Geology and Forestry, ser. 5, v. 1, p. 96–104.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 88. Marine shale in Breathitt formation; directly overlies Amburgy coal.

R. E. Hauser, 1953, Kentucky Geol. Survey Bull. 13, p. 11, 17. Thickness at type locality 50 feet.

Type locality: (Morse, 1931) On Cow Creek in Floyd County, approximately 15 miles east of Paintsville.

Kenilworth Member (of Blackhawk Formation)

Upper Cretaceous (Montana) : Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 184–185, figs. 2, 3, pl. 3. Consists of massive cliff-forming basal sandstone, an overlying series of coal-bearing rocks, and offshore bar sandstones behind which they were deposited. Basal sandstone grades into underlying tongue of Mancos shale, has sharply defined top, is white capped, and is medium grained, thick bedded, and buff colored with maximum thickness of 85 feet; crossbedding common in more massive beds. Coal-bearing rocks of about 160 feet of gray to black shale with lenses of white and buff sandstone and four minable coal beds which are (ascending) : Kenilworth or Castlegate "D", Gilson, Fish Creek, and Rock Canyon. Separated from Sunnyside member (new) above and Aberdeen member (new) below by tongues of Mancos shale.

Named from exposures near Kenilworth, Carbon County. In Book Cliffs.

Kennebec Formation

Age not stated : West-central Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Thinly bedded black sulfide-rich limestones, phyllites, and quartzites. Position and formational status of Kennebec still in doubt.

In Anson quadrangle.

†Kennedy Gravels,[1] Drift

Pleistocene (pre-Wisconsin) : Northwestern Montana, and Alberta, Canada.

Original reference: B. Willis, 1902, Geol. Soc. America Bull., v. 13, p. 315, 328–330.

Leland Horberg, 1954, Geol. Soc. America Bull., v. 65, no. 11, p. 1102. Pre-Wisconsin Mountain drift of Glacier Park was described by Willis (1902) as Kennedy gravels and considered a fluvial deposit. Alden (1932, U.S. Geol. Survey Prof. Paper 174) determined its glacial origin and included it in his pre-Wisconsin Mountain drift. Inasmuch as references are clearly to same deposits, original name should be retained. Kennedy drift, which is at least 100 feet thick, includes both till and outwash and in places is cemented by calcium carbonate into tillite and conglomerate. Upper 20 feet in places is weathered and leached, so that residue of insoluble pebbles occur in yellow-brown, limonitic, clayey matrix.

G. M. Richmond, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B223. Discussion of correlation of alpine and continental glacial deposits of Glacier National Park and adjacent high plains, Montana. Three alpine glaciations occurred. Tills of these three ancient glaciers are all included in Kennedy drift of Horberg (1954). They have no continental counterparts in this region but are correlated with Nebraskan, Kansan, and Illinoian tills of central interior.

Type locality: Gravel mesa, 5,800 feet high, 5 miles east of Chief Mountain, north of Kennedy Creek and 900 feet above it, in northwestern part of Teton County, Mont.

Kenneth Limestone[1]

Upper Silurian or Lower Devonian : North-central Indiana.

Original reference: E. R. Cumings and R. R. Schrock, 1927, Indiana Acad. Sci. Proc., v. 36, p. 76–77.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Cayugan series, but may be Devonian.

D. J. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 37–39. Gray to tan dense cherty and irregularly bedded limestone 30 to 40 feet thick. Overlies Kokomo limestone; underlies Pendleton sandstone. Lower Devonian.

Exposed in quarries at Kenneth Station and vicinity, Cass County.

Kennett Formation[1]

Middle Devonian: Northern California.

Original reference: J. P. Smith, 1894, Jour. Geology, v. 2, p. 591–593, 598.

A. R. Kinkel, Jr., W. E. Hall, and J. P. Albers, 1956, U.S. Geol. Survey Prof. Paper 285, p. 1, 32–38, pl. 1. Composed almost entirely of shale and limestone, but minor beds of shaley tuff and crystal tuff are interbedded with shale near base. Black shale forms lower part; it is commonly a black siliceous, thinly bedded rock which is locally crumpled and cut by a network of tiny quartz veins. Limestone forms upper part and is largely a coral reef. Maximum thickness probably not more than 400 feet; folding and repetition by faulting make it impossible to obtain exact thickness. Overlies Balaklala rhyolite; rhyolitic tuff of Kennett is interbedded with shale and grades downward through transition zone to rhyolitic tuff beds that are part of Balaklala rhyolite; conformably underlies Mississippian Bragdon within mapped area [West Shasta copper-zinc district]; outside area, Kennett has been uplifted by warping and erosional unconformity separates the two formations.

Exposed between Squaw and Backbone Creeks, about 4 miles west of Kennett, on Sacramento River. Exposed in northern part of West Shasta district as discontinuous erosion remnants on present topography of a much more continuous formation. Also exposed in southern part of Behemotosh Mountain quadrangle.

Kennett Limestone[1]

Precambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc. 1900, pt. 1, p. 235–242.

Probably named for Kennett Square Station, Chester County.

Kenney Formation

Oligocene, upper, or Miocene, lower: Eastern central Idaho.

A. L. Anderson, 1957, Idaho Bur. Mines and Geology Pamph. 112, p. 13, 14, 16–17, pl. 1. Composed of beds of shale and to lesser extent of sandstone, conglomerate, and locally tuff and bentonite. Conglomerate beds are generally thin and not very persistent and are scattered here and there throughout formation. Much of the shale is light colored and generally somewhat sandy. Beds of sandstone are white or pale buff. Inferred thickness is several hundreds of feet. Passes beneath beds of Geertson and Carmen formations and unconformably overlies Challis volcanics in Baker quadrangle. Underlies Kirtley formation (new name to replace preoccupied Carmen). Thickness about 500 feet in North Fork quadrangle. Late Oligocene or early Miocene.

Named for Kenney Creek along which more or less typical exposures are to be found. Confined to Lemhi Valley, Lemhi County.

Kennicott Formation[1]

Lower Cretaceous: Central Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 424–440, pl. 52.

F. H. Moffit, 1938, U.S. Geol. Survey Bull. 894, p. 70–71. Rocks of type locality of Rohn's Kennicott formation in Fourth of July Pass now considered Lower Cretaceous. Those that overlie Upper Triassic rocks and, on paleontologic grounds, properly belong to Kennicott formation include conglomerate, brown sandstone, crumbly gray shale, and black shale.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Type locality: In Fourth of July Pass, Copper River region. Occurs on Bear and Fourth of July Creeks between Fohlin Creek and Kennicott Glacier.

Kenosha Shale Member (of Tecumseh Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 47, 52.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23. Underlies Ost limestone member; overlies Avoca limestone member of Lecompton formation.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 156. Not distinct enough to be treated as subdivision of Tecumseh in Kansas.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Bluish argillaceous shale with *Crurithyris* near base. Thickness about 6½ feet near Thurman, Fremont County. Underlies Ost limestone member; overlies Avoca limestone member of Lecompton limestone.

Type locality: In Missouri River bluffs near mouth of Kenosha Valley, south of King Hill, Cass County, Nebr.

Kensington Granite-Gneiss

Age unknown: Eastern Maryland and District of Columbia.

Ernst Cloos *in* C. W. Cooke and Ernst Cloos, 1951, Geologic map of Prince Georges County and the District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Highly foliated; coarse biotite granite. This youngest crystalline rock is a discordant granodiorite invading the schist in bodies which are too small to be shown on map. The granodiorite may be responsible for a great deal of the metamorphism of this area. Mapped in District of Columbia west of Rock Creek Park.

Ernst Cloos *in* C. W. Cooke and Ernst Cloos, 1953, Geologic map of Montgomery County and District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Mapped in Montgomery County, northward from District of Columbia through Kensington to vicinity of Norwood.

Derivation of name not given, but probably named for occurrence at Kensington, Md.

Kent Bed[1]

Lower Cretaceous (Comanche Series): Southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 383.

Derivation of name not stated.

Kent Till

Pleistocene (Wisconsin) : Northern Ohio and northwestern Pennsylvania.

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–32, p. 10 (fig. 3), 13 (fig. 4), 31–35, pl. 1. Bluish-gray moderately pebbly to pebbly calcareous loam to sandy loam till deposited during Kent advance in early Cary time. Kent advance followed Mogadore advance and preceded Lavery advance. Name credited to G. W. White (in press).

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 5–6. Thickness about 17 feet. Where base is exposed, lies unconformably upon bedrock or Mogadore till. Where Kent does not form surface material, it is commonly overlain unconformably by Hiram till; in places, Windham sand (new) lies between the tills. Locally overlain by Lavery till.

Named for exposures in vicinity of Kent, Portage County, Ohio.

Kentucky Shale[1]

Mississippian : Eastern Kentucky.

Original reference: N. S. Shaler, 1877, Kentucky Geol. Survey, new ser., v. 3, p. 183–186.

Kenwood Beds[1]

Kenwood Member (of Wapsipinicon Formation)

Middle Devonian : Eastern Iowa.

Original reference: W. H. Norton, 1894, Iowa Acad. Sci. Proc., v. 1, pt. 4, p. 23.

E. H. Scobey, 1940, Jour. Sed. Petrology, v 10, no. 1, p. 38 (fig. 1), p. 40. Composed chiefly of interbedded thinly laminated impure limestones and shales. Maximum thickness about 20 feet attained near Cedar Rapids. Underlies Spring Grove member; bluish shale at base rests with sharp lithologic break on Otis member. Kenwood here considered good member name as Independence shale with which it has been correlated is believed to be Lime Creek in age and therefore occupies much higher stratigraphic position. Middle Devonian (?). Type section designated.

Type section: Exposure along Indian Creek in Kenwood Park in northern Cedar Rapids, Linn County.

Kenwood Sandstone[1]

Kenwood Sandstone Member (of New Providence Formation)

Lower Mississippian: Western and northern Kentucky, southern Indiana, and southeastern Wisconsin.

Original reference: C. Butts, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 2, p. 148.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 79, 108, 109–111. Rank reduced to member status in New Providence formation; occurs in Silver Hills facies of formation. Reasons for change are: areal extent is quite limited, it is a local facies feature of what both to north and to south is shale undifferentiated from that beneath; sandstone layers constitute minor part of interval; interbedded shale is of nature of shale below.

F. T. Thwaites, 1947, Michigan Acad. Sci., Arts, and Letters Papers, v. 33, p. 249 [1949]. Kenwood formation at Milwaukee, known only from fossils collected from dump of tunnel, believed to be Misssissippian.

Named for Kenwood Hill, near Louisville, Jefferson County, Ky.

Kenyon Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154–155. Name proposed for thin conglomeratic sandstone overlying Crane member (new). Type section extends from depths of 2,975 to 3,105 feet. Thickness 34 to 130 feet. Where less than 80 feet thick is composed chiefly of coarse-grained sandstone containing quartz granules; where thicker, consists of conglomeratic sandstone interbedded with nonconglomeratic layers. Underlies Lowell member (new).

Type well: Wyman No. 1 (well 7), in NE¼NE¼SE¼ sec. 35, T. 41 N., R. 5 E., Dekalb County. Name derived from Kenyon School, 3¼ miles southeast of type well.

Keokuk Limestone

Keokuk Limestone (in Osage Group)[1]

Lower Mississippian (Osage Series): Iowa, Illinois, western Kentucky, and eastern Missouri.

Original reference: D. D. Owen, 1852, Rept. Geol. Survey Wisconsin, Iowa, and Minnesota, p. 91, 92., Philadelphia.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132–133. Keokuk limestone listed in Osage group, Valmeyer series. Burlington and Keokuk limestones not readily separable in southwestern Illinois and southeastern Missouri.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 795. Limestone in Osage group, Iowa series. Classification follows Illinois Geological Survey. Consists of 60 to 80 feet of interbedded limestone and chert with minor amounts of shaly material. Lower 30 feet is very cherty limestone known as Montrose member. In Ste. Genevieve County, Mo., is separated into two parts by unconformity, below which beds are lithologically indistinguishable from Burlington limestone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 150–156, chart 5. In standard Mississippian section, Keokuk limestone is uppermost formation of Osagean series. Occurs above Burlington limestone and below Warsaw limestone of Meramecian series.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 44–46, pls. Described on southwestern flank of Ozark uplift where it consists of massive white to buff and gray-mottled fossiliferous chert; locally interbedded with irregular stringers of blue-gray dense fine-grained limestone. Crinoidal reefs or bioherms present locally. Thickness 0 to 250 feet; average thickness between 60 and 80 feet. Overlies Reeds Spring formation with unconformity. This hiatus represents most or all of Burlington time. Succeeded unconformably by various facies of Moorefield formation, the Hindsville, or locally by Fayetteville shale. Osagean.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook St. Louis Mtg., Field Trip 3, p. 1, 4 (fig. 3). Generalized geologic column for field trip area [western Illinois] shows the Keokuk in Valmeyer series above the Burlington and below the Warsaw.

Named for exposures at Keokuk, Iowa. Well exposed along Soap Creek in quarry in Mississippi River bluff near mouth of creek.

Keonehunehune flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1245, 1246, pl. 1 (fig. 3). Consists of single flow. Radiocarbon dating gives age of about 650 years.

On southwest side of Haleakala.

Keosauqua Sandstone[1]

Mississippian: Southeastern Iowa.

Original reference: C. H. Gordon, 1895, Jour. Geology, v. 3, p. 304–305.

Named for exposures in southern bank of Des Moines River about 2½ miles below Keosauqua, Van Buren County.

Keota Sandstone Member (of McAlester Formation)

Keota Sandstone Member (of Savanna Sandstone)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 42–44, pl. 1. Reallocated to member status in McAlester formation. Sequence of lenticular sandstone and arenaceous shale beds, locally including one or more thin coal seams. Within town limits of Keota are two sandstone units, each comparable to that described as Keota sandstone member in Muskogee County; these two units and the intervening shale are considered as constituting the Keota within the Cowlington syncline in Haskell County; in the Sanbois and Stigler synclines, only one sandstone unit seems to be present at this horizon. Conformably overlies an unnamed shale that lies above Tamaha sandstone or above the horizon of the Tamaha where the Tamaha is not present; conformably underlies an unnamed shale in upper part of formation.

Type locality: Comprises town of Keota and area immediately adjacent to northwest, Haskell County.

†Keownville Limestone Member (of Ripley Formation)

Upper Cretaceous: Northeastern and east-central Mississippi.

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 18–20. Commonly less than 100 feet thick and consists of yellowish-brown sandy limestone beds which are no more than 5 feet thick and are interbedded with yellow to dark-blue-gray fossiliferous sand units. At type section, 47 feet of yellow-brown sandy sideritic fossiliferous limestone in beds 1 to 3 feet thick alternate with yellow to gray micaceous fossiliferous layers of sand and represents full thickness of member. These beds are unconformably overlain by 8½ feet of fossiliferous sand and clay of Prairie Bluff chalk; below limestone sequence is about 120 feet of fossiliferous sand and sandstone beds of upper part of Ripley.

Type section: Roadcuts on Mississippi State Route 30, 1.4 to 2.1 miles south of Keownville, Union County, on north-facing slope of Willhite Creek valley and parallel to Daniel Creek, a north-flowing tributary of Willhite Creek, in E½ sec. 31, T. 6 S., R. 4 E.

Kerber Formation[1]

Pennsylvanian: Southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

L. R. Litsey, 1958, Geol. Soc. America Bull., v. 69, no. 9, p. 1147 (fig. 2), 1159–1160. Composite Paleozoic section in northern Sangre de Cristo

Range shows Kerber formation, 0 to 150 feet thick, between Leadville limestone below and Minturn formation above. No fossil or plant remains. On basis of stratigraphic position, may be Morrowan or Atokan.

D. R. Williamson and Lorraine Burgin, 1960, Colorado School Mines Mineral Industries Bull., v. 3, no. 1, p. 11. Correlation chart shows Kerber formation underlying Sharpsdale formation (new).

Named for exposures along Kerber Creek, Bonanza district, Saguache County.

Kereford Limestone Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 45.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Kereford limestone member of Oread limestone; overlies Heumader shale member; underlies Kanwaka formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness 7 feet in section measured near Winterset, Madison County.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 40–41, pl. 1. In Douglas County, consists of 2½ to 9 feet of gray limestone and a calcareous shale beds, which weather light gray to tan. Underlies Jackson Park shale member of Kanwaka shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 21, fig. 5. Commonly light to medium gray, fine grained and dense; occurs as one massive bed. Near Red Oak, Montgomery County, it is a 2-foot massive finely oolitic bed with *Osagia* in upper part, and fusulinids throughout. Overlies Heumader shale member; underlies Kanwaka shale. Absent in some areas.

Type locality: Kereford quarry at south edge of Atchison, Atchison County, Kans.

Kerens Member (of Wills Point Formation)[1]

Paleocene: Northeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 559, 562.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 25. Upper member of Wills Point formation. Includes Wortham aragonite lentil. Overlies Mexia member.

Type locality: Exposures along Trinity River north of St. Louis & Southwestern Railroad, east of Kerens, Navarro County.

Kern Park Formation

See Mon Bluff Formation.

Kern River Group,[1] Formation,[1] or Series[1]

Miocene, upper, to Pliocene, middle: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 187–188, 191.

R. W. Wilson, 1937, Carnegie Inst. Washington Pub. 487, p. 13, 34. Middle Pliocene on the basis of vertebrate fauna.

C. C. Church, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 15. Formation in outcrop unconformably overlies Mon Bluff formation (new) in vicinity of Kern River. Unconformably overlies lower part of Round Mountain silt north of Poso Creek fault. There is evidence from downdip well sections that formation rests with transitional contact on Santa Margarita sand indicating transgression of upper part of unit onto its lower members and then onto middle Miocene rocks. Such relation indicates upper Miocene age for unit in downdip areas. Upper Miocene-Pliocene.

Exposed on Kern River, 2 to 6 miles east of Oil City, Kern County.

Kernville Series[1]

Pre-Cretaceous: Southern California.

Original reference: W. J. Miller, 1931, California Univ. Pub., Bull. Dept. Geol. Sci., v. 20, no. 9, p. 335–343.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 512, table 4. Age not certain; probably Carboniferous. Intruded by Summit gabbro.

T W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 18. Pampa schist (new) may be phase of Kernville series, but its relationship to Kernville is obscured by granitic intrusions.

E. M. MacKevett, Jr., 1960, U.S. Geol. Survey Bull. 1087–F, p. 176–180, 195, pl. 1. Consists mainly of mica schist and impure quartzite but includes some calc-hornfels and marble Older than Isabella granodiorite that is considered Late Cretaceous on basis of lead-alpha determinations.

Named for exposures in vicinity of Kernville, Kern County.

Kerr Ranch Schist

Pre-Franciscan (pre-Devonian?): Northwestern California.

G. A. Manning and B. A. Ogle, 1950, California Div. Mines Bull. 148, p. 7, 13–18, pls. 1, 2. Series of quartz-muscovite schists, green schists, semischists, and slates; only slightly metamorphosed. In fault contact with overlying Franciscan. Thickness undetermined. Name replaces term Redwood Creek schist, used by authors in unpublished theses.

Type locality: Near Kerr Ranch in southeastern part of Blue Lake quadrangle, Humboldt County.

Kerton Creek Coal Member (of Carbondale Formation)

Pennsylvanian: Northern and western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Pleasantview sandstone member and below Summum coal (No. 4) member. Coal named by Ekblaw (1930, Illinois Acad Sci. Trans., v. 23, no. 3); Wanless (1957, Illinois Geol. Survey Bull. 82) credited name to W. V. Searight, unpublished manuscript. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: North side of Kerton Creek, NE¼NE¼ sec. 15, T. 3 N., R. 2 E., Fulton County.

Kessler Limestone Member (of Bloyd Shale)[1]

Kessler Limestone Lentil (in Bloyd Shale)

Lower Pennsylvanian (Morrow Series): Northwestern Arkansas and northeastern Oklahoma.

Original reference: F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. 26, 103–105.

C A. Moore, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 3, p. 430–432. Geographically extended into Adair County, Okla., where its maximum thickness is less than 10 or 12 feet. Lies immediately below the Atoka sandstone.

W. H. Easton, 1942, Arkansas Geol. Survey Bull. 8, p. 25–26. Referred to as a lentil within Bloyd shale.

L. G. Henbest, 1953, Am Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1942. Bloyd shale consists of (ascending) Brentwood limestone member, Woolsey member (new), and an unnamed shale division which includes the Kessler limestone lentil and which represents upper half to two-thirds of formation. Kessler underlies Greenland sandstone member (new) of Atoka formation.

Named for Kessler Mountain, Washington County, Ark.

†Ketchikan Series[1]

Carboniferous and Upper Triassic: Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p 40–52, map.

Occurs along east margin of Gravina Island, west margin of Revillagigedo Island, and in vicinity of Ketchikan, on both sides of Tongass Narrows, on Cleveland Peninsula, along George Inlet, on east arm of Behm Canal, Ketchikan region.

Ketchum Bluff Conglomerate[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 4OPP, p. 11.

Exposed on Ketchum's Bluff along Red River, in sec. 24, T. 7 S., R. 6 W., and adjoining sections to the east in Jefferson County

Ketona Dolomite[1]

Upper Cambrian: Northern central Alabama.

Original references: C. Butts, 1910, U.S. Geol. Survey Bull. 400, p. 14; U.S. Geol. Survey Geol. Atlas, Folio 175, p. 3.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 17. Coarsely crystalline light-gray thick-bedded dolomite 200 to 250 feet thick. Overlies Brierfield dolomite in Sixmile Creek; in western Alabama overlies *Blountia* zone of Nolichucky, here it is 400 to 600 feet thick. Underlies Bibb dolomite.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 23. Listed with formations of Cambrian or Ordovician age.

Named for exposures at Ketona, Jefferson County

Kettle Meta-Andesite[1]

Kettle Formation

Pennsylvanian: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

P. A. Lydon, T. E. Gay, Jr., and C W. Jennings, 1960, Geologic map of California Westwood sheet (1:250.000): California Div. Mines. Formation consists of fossiliferous andesite and dacite breccia, tuff, conglomerate, and sills or flows. Mapped with Jurassic and (or) Triassic metavolcanic rocks.

Named for development around Kettle Rock, northeast of Taylorsville, Plumas County.

Kettleman Lake Bed[1]

Pliocene(?): Southern California.

Original reference: J. G. Cooper, 1894, California Acad. Sci Proc., 2d ser., v. 4, p. 167.

Type locality not stated, but beds are probably the fresh-water deposits mentioned as occurring on west border of Kettleman Plains.

Kettle River Formation[1]

Oligocene(?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Rept. Mines Mem. 38, maps.

Mapped along Kettle River, British Columbia, north of 49th parallel.

Keuka Flagstone[1] (in Standish Formation)

Keuka Flagstone Lentil (in Starkey Tongue of Sherburne Formation)

Upper Devonian: West-central New York.

Original reference: I. W. Fox, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 7, p. 677, 683, 687.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 67, pl. 1. Reallocated. Lentil occurs at top of Starkey tongue of Sherburne formation. Described as cross-laminated coarse quartz siltstone with considerable calcite.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2825. A highly cross-laminated, ripple-marked layer of siltstone 1 to 2 inches thick is present at base of upper third of West River shale member of Genesee in most exposures of member between Lake Erie and Canandaigua Lake. This key bed, which is present in more than 500 square miles in western and west-central New York, was traced eastward to Keuka Lake where it was found to be the 3- to 4-inch Bluff Point flagstone of Torrey (Torrey and others, 1932, Am. Petroleum Inst. Div. Production Paper 826–4A), the same bed that was named Keuka flagstone by Fox (1932).

Named for excellent exposures on all shores of Keuka Lake.

Kevin Shale Member (of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2795–2796; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 91–92. Subdivided into three units on basis of relative abundance of bentonite beds and on lithology of concretions. Lowest unit characterized by many beds of bentonite, grey limestone concretions and concretionary limestone, and some brown prismatic calcite having cone-in-cone structure. Middle unit has numerous concretionary layers of ferruginous limestone and dolostone

that weather dark reddish brown to very dusky red. Also contains thin but very widespread conglomerate bed—MacGowan concretionary bed (new). Top unit contains several concretionary limestones that weather yellowish gray, some beds of concretionary dolostone that weather reddish brown, and a few thin layers of bentonite and shaly sandstone; upper half of unit locally calcareous. Thickness of member about 620 feet at type section. Top marked by thin persistent layer of gray bentonite on north side of Kevin-Sunburst dome. Disconformably overlies Ferdig shale member (new); underlies Telegraph Creek formation.

Type section: Composite from outcrops a few miles north and northwest of Kevin in secs. 3, 4, 12, 15, and 17, T. 35 N., R. 3 W., Toole County. Named from town of Kevin on Shelby-Sweetgrass branch of Great Northern Railway in SW¼ sec. 35, T. 35 N., R. 3 W., Toole County, Shelby quadrangle, northwest flank of Kevin-Sunburst dome.

Kewanee Group

Middle Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 31–36, 45–46 (table 1), pl. 1, geol. sections. Middle group of Pennsylvanian formations. Comprises Spoon (new) and Carbondale formations. Overlies McCormick group (new); underlies McLeansboro group. Characterized by widespread development of minable coals. Sandstones compose about 25 percent of group. Limestones commonly 1 to 5 feet thick. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois. Cyclical classification is retained but is independent of rock-stratigrapic classification.

Type locality: Vicinity of Kewanee, Henry County.

Keweenawan Series[1]

Keweenawan Group

Precambrian: Michigan, Minnesota, and Wisconsin, and Canada.

Original references: T. B. Brooks, 1876, Am. Jour. Sci., 3d ser., v. 11, p. 206–211; F. D. Adams and others, 1905, Jour. Geology, v. 13, no. 2, p. 102.

F. F. Grout and G. M. Schwartz, 1939, Minnesota Geol. Survey Bull. 28, p. 12–15. Lower Keweenawan includes Puckwunge formation (as used by Winchell, 1897); middle Keweenawan includes Keweenaw Point volcanics (new) and Beaver Bay complex.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 10, 11–23. Geological column shows upper Keweenawan includes Lake Superior series, made up of Fond du Lac beds (Orienta) and Hinckley sandstone (Devils Island). The Keweenawan underlies St. Croixian series and occurs above the Huronian.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1017–1078. Keweenawan group overlies Animikie group. Group in Minnesota includes Puckwunge formation in lower part; Keweenaw Point volcanics, Beaver Bay complex and Logan intrusives, Duluth gabbro, and scattered intrusives in middle part; Fond du Lac beds and Hinckley sandstone in upper part. Unconformably underlies Cambrian (Upper Cambrian in Minnesota). Upper Keweenawan of Minnesota correlates with Oronto and Bayfield groups of Wisconsin and Michigan.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior, Geology, Apr. 21–22, p. 1. Three gab-

broic intrusions (Beaver River, Beaver Bay ferrogabbro, and Black Bay) with minor associated rock types form Beaver Bay complex in southeastern Lake County, Minn. The gabbros intrude middle Keweenawan North Shore volcanic group (new).

Named for occurrence on Keweenaw Peninsula, northern Michigan.

Keweenaw Point Volcanics

Precambrian (middle Keweenawan): Northern Michigan and eastern Minnesota.

F. F. Grout and G. M. Schwartz, 1939, Minnesota Geol. Survey Bull. 28, p. 12, 13. Term applied to series of Middle Keweenawan flows and associated sediments which are best known as they appear on Keweenaw Point (Michigan) in Lake Superior. Irving (1883, U.S. Geol. Survey Mon. 5) used term Keweenaw series, and Van Hise and Leith (1911, U.S. Geol. Survey Mon. 52) used phrase Keweenawan series for rocks here named Keweenaw Point volcanics. Irving limited his Keweenaw series to the volcanic and associated rocks and some sediments conformably above, using term Keweenawan series for all Keweenawan rocks, including sediments above, below, and interbedded with volcanics. Term Keweenaw Point volcanics should therefore be applied as a formation to flows and associated fragmental rocks included by Irving in lower division of Keweenaw series and by Van Hise and Leith in middle divisions of Keweenawan series. Table of formations shows Keweenaw Point volcanics above Puckwunge formation and below Beaver Bay complex.

G. M. Schwartz, 1949, Minnesota Geol. Survey Bull. 33, p. 18, 37. Estimated thickness 20,800 feet. Overlies Puckwunge formation.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1053–1054. Included in middle part of Keweenawan group. Also referred to as Keweenawan Point volcanics.

Named for occurrence at Keweenaw Point (Michigan) in Lake Superior.

†Key Sandstone[1]

Lower Ordovician: Northern Arkansas.

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 20, 95–97.

Named for Key, near Rogers, Benton County.

Keyhole Sandstone Member (of Fall River Formation)

Lower Cretaceous: Western South Dakota and northeastern Wyoming.

R. E. Davis and G. A. Izett, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 11, p. 2745–2750. Generally light-brown to medium-brown very fine grained massively bedded cross-stratified sandstone, commonly containing iron-cemented concretions ranging from less than an inch to about 1 foot in diameter and, less commonly, gray calcareous concretions ranging from a few inches to nearly 4 feet in diameter. Thickness ranges from 15 to about 80 feet and averages about 30 feet; at type section 31.6 feet. Underlies upper silty unit of Fall River formation with sharp contact; overlies lower silty unit with gradational contact.

Type section: In NE¼SE¼ sec. 21, T. 51 N., R. 66 W., Crook County, Wyo., about one-fourth mile north of Keyhole Dam on Belle Fourche River. Carlile quadrangle. Traced throughout large part of northern Black Hills.

Key Largo Limestone[1]

Pleistocene: Southern Florida.

Original reference: S. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 209, 214–218, table.

M. C. Schroeder and E. W. Bishop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 9, p. 2183. Pleistocene deposits older than Pamlico sand (which represents youngest Pleistocene) include Miami oolite, Fort Thompson formation, Anastasia formation and Key Largo limestone, all more or less contemporaneous in age.

Named for exposures in cuts and borrow pits on Key Largo, at frequent intervals from south shore of Lake Surprise to west end of island at Tavernier Creek, a distance of 15 miles.

Keyser Limestone

Keyser Group

Keyser Limestone (in Cayugan Group)

Keyser Limestone Member (of Helderberg Limestone)[1]

Upper Silurian and Lower Devonian(?): Northern West Virginia, western Maryland, Pennsylvania, and western Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 563, 590, 591, pl. 28.

F. M. Swartz, 1929, U.S. Geol. Survey Prof. Paper 158–C, p. 29–38. In West Virginia, formation includes Big Mountain shale member (new); near Clifton Forge, Va., includes Clifton Forge sandstone member (new). Lower Devonian.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 29–91. Keyser limestone separated from Helderberg group and tentatively assigned to Silurian.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1182–1184. Term Keyser group proposed for three formations of Keyser age: Decker sandstone, Rondout limestone, and Manlius limestone. Group, as thus defined, extends from southeastern Pennsylvania to southeastern New York. Bossardville limestone immediately underlying Keyser group is uppermost formation of undoubted Silurian in area. Keyser limestone presents both Silurian and Devonian aspects. It is tentatively assigned to Silurian.

J. R. Mills and R. N. Taylor, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 49–57. Silurian-Devonian relationships discussed in Schuylkill County. Keyser limestone (Silurian, Cayugan group) overlies Bossardville limestone; underlies Ridgeley sandstone (Devonian, Oriskany group).

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 118, p. 19 (table 1), 20 (table 2), 42–45, pls. Formation described in Clifton Forge area where it includes Clifton Forge sandstone member in lower part. Thickness about 116 feet. Overlies Tonoloway limestone; underlies Coeymans limestone. Upper Silurian.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4–5, 13–14, 28. Keyser formation lies immediately above and is transitional with Tonoloway formation throughout most of Pennsylvania. Underlies Helderberg. Thickness 125 to 200 feet.

W. A. Oliver, Jr., 1960, U.S. Geol. Survey Bull. 1111–A, p. 4. Corals comparable to Beck Pond species are found in Coeymans limestone, Helderberg

age, in New York, and in Keyser limestone. Late Silurian and Early Devonian(?) age, in Maryland and West Virginia. *Halysites* indicates Late Silurian age for at least part of the formation.

Named for exposures at Keyser, Mineral County, W. Va.

Keystone Sandstone (in Pocahontas Group)

Keystone Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 237.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 88. Included in lower part of Pocahontas group.

Exposed at Keystone, McDowell County.

†Key West Oolite[1]

Pleistocene: Southern Florida.

Original reference: E. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 209, 218–221, table opposite p. 50.

Crops out on shores of Harbor Key and Content Key, and on most of keys to south and southwest, and forms surface of Boca Grande, 10 miles west of Key West.

Kialagvik Formation[1]

Middle Jurassic: Southwestern Alaska.

Original reference: S. R. Capps, 1923, U.S. Geol. Survey Bull. 739, p. 90, 91, 94, map.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1), 205, 208 (table 2). Subdivided into (ascending) Aleuts and Kolosh members (new). Thickness 1,600 feet. Underlies Tuxedni formation; overlies Bidarka formation (new). Lower Jurassic.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv Prelim. Map 95 [1949]. Oldest Jurassic marine strata exposed on Iniskin Peninsula. Consists of about 2,500 feet of siltstone, sandstone, and conglomerate. Divided into lower unnamed sandy shale member and upper unit, the Gaikema sandstone member (new). Siltstone member predominantly of dark-gray arenaceous siltstone which weathers light brown: fine-grained sandstone beds present throughout; approximately 1,600 feet thick.

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, table 5, facing p. 60. Age given as Middle Jurassic for exposures at Wide Bay. Underlies Shelikof formation. Gaikema sandstone and unnamed underlying members reassigned to Tuxedni formation.

Forms bluffs along beach of northwest shore of Kialagvik Bay from near mouth of Pass Creek to southwest end of bay. Recognized at least as far south along Alaska Peninsula as Wide Bay.

Kiamichi Formation (in Fredericksburg Group)

Kiamichi Clay Member (of Georgetown Formation)

Kiamichi Formation (in Washita Group)[1]

Lower Cretaceous (Comanche Series): Central southern and southeastern Oklahoma and northeastern Texas.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 515.

J. F. Smith, Jr., 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 601 (fig. 2). Geologic map of Sierra Blanca area, Texas, shows Kiamichi as upper formation of Fredericksburg group. Overlies Finlay formation; underlies Washita group.

F. E. Lozo, Jr., 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 8, p. 1060–1080. Discussion of bearing of Foraminifera and Ostracoda on Lower Cretaceous Fredericksburg-Washita boundary of north Texas. On the basis of ostracode affinities, Kiamichi is uppermost formation of Fredericksburg group. At exposure studied, there is no conclusive physical evidence of hiatus between Kiamichi and overlying Duck Creek formation. Contact with underlying Goodland not exposed.

E. R. Leggat, 1957, Texas Board of Water Engineers Bull. 5709, p. 13 (table 2), 27–31, pls. In Tarrant County, Tex., the Kiamichi, uppermost formation of Fredericksburg group, crops out in narrow sloping band in bluffs overlooking Clear Fork and West Fork of Trinity River. Consists of dark-blue to brownish-yellow marl, thin limestone, and flaggy sandstone. Lower half is marly, contains thin limestone and sandstone layers, overlain by 8 feet of thin limestone ledges alternating with marl in which *Gryphaea navia* is abundant and distinctive. Upper part is marly and less fossiliferous. Thickness 0 to 40 feet; thins southward. Overlies Goodland limestone; underlies Duck Creek formation.

O. B. Shelburne, 1959, Texas Univ. Bur. Econ. Geology Pub. 5905, p. 105–130. Described in central Texas where it is uppermost formation in Fredericksburg group. Enclosed by Edwards limestone below and Georgetown limestone above. Thickness 25 feet near Blum in Hill County; thins southward along outcrop and disappears in southern McLennan County. Twenty stratigraphic sections measured and described from surface exposures in southern Fort Worth Prairie in Hill, Bosque, Coryell, McLennan, and Bell Counties.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 22–24, pls. 1, 2. In this report [Fort Worth-Weatherford area], Kiamichi is considered basal formation in Washita group. Consists chiefly of yellow and bluish-gray calcareous and arenacous marls, flaggy limestone, and fissile sandstones. Thickness 25 to 35 feet. Underlies Duck Creek formation, possible unconformity; overlies Benbrook limestone member (new) of Goodland formation.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Conf., p. 88, 90, pl. 14. In this report [Grand and Black Prairies, east-central Texas], Kiamichi clay is considered basal member of Georgetown limestone; underlies Duck Creek member. Generally found in outcrops on streams that have cut into underlying Edwards and Comanche Peak formations. Thickness as much as 10 feet; consists of black to dark-gray clays with several 6- to 10-inch limestone beds.

Named for historic plains of Kiamitia (correctly spelled Kiamichi) River near Fort Towson, Choctaw County, Okla.

Kiawa Mountain Formation

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 1, 10, 24, pl. 1. Defined as the quartzite including and overlying the Big Rock conglomerate and overlying the Moppin metavolcanic series from

Cleveland Gulch to Jawbone Mountain. Consists of (ascending) Big Rock (new) conglomerate member, lower quartzite member, amphibolite member, Jawbone (new) conglomerate member, and upper quartzite member, Several thousand feet thick.

Exposed on Kiawa Mountain and in other areas of Las Tablas quadrangle.

Kibbey Sandstone (in Big Snowy Group)

Kibbey Sandstone Member (of Quadrant Formation)[1]

Upper Mississippian: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

W. H. Scott, 1935, Geol. Soc. America Proc. 1934, p. 367; 1935, Jour. Geology, v. 43, no. 8, pt. 2, p. 1026–1027. Included in Big Snowy group (new).

E. S. Perry, 1937, Montana Bur. Mines and Geology Mem. 3, p. 16. In type locality, Big Snowy group comprises (ascending) Kibbey, Otter, and Heath formations. Kibbey, 130 feet thick, consists of red to brown shaly or calcareous fine-grained sandstone.

O. A. Seager, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 863. In subsurface in Cedar Creek anticline, southeastern Montana, overlies Charles formation (new).

L. R. Laudon, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 210. Kibbey, Heath, Otter, and Amsden are believed to represent shore facies of various parts of early Pennsylvanian seas.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 333 (fig. 2), 334 (fig. 3), 341–342, 346–347. Thickness 220 feet in composite standard section of revised Big Snowy group. Underlies Otter formation; unconformably overlies Mission Canyon limestone of Madison group.

Named from Kibbey post office, Fort Benton region, central Montana.

Kickapoo Beds[1]

Pleistocene (Wisconsin): Central western Illinois.

Original reference: C. O. Sauer, 1916, Illinois Geol. Survey Bull. 27.

Well developed about mouth of North Kickapoo Creek, Illinois Valley.

†Kickapoo Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and J. Bennett, 1908, Kansas Acad. Sci. Trans., v. 21, pt. 1, p. 81.

Named for Kickapoo, Leavenworth County, Kans., 5 miles south of Iatan, Platte County, Mo.

†Kickapoo Marl[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 308.

Derivation of name not stated.

Kickapoo Creek Group

Pennsylvanian (Lampasas): North-central Texas (subsurface and surface).

M. G. Cheney, 1947, Jour. Geology, v. 55, pt. 2, p. 209–210. Proposed for section between Millsap Lake group (restricted) and Bend group; that is,

from disconformity at or near top of Dennis Bridge limestone down to top of Smithwick. Upper 200 feet of group crops out between villages of Dennis and Lipan, but for the most part group must be studied from well samples. Well data indicate that approximately 2,600 feet of section should be assigned to group in southwestern Parker County and 3,500 feet or more in Fort Worth basin. Stratigraphic section assigned to group includes Rayville (new), Parks, and Caddo Pool formations which extend from depths of 380–1,350, 1,350–2,125, and 2,125–3,000 feet, respectively, in type wells. Kickapoo Creek group proposed in preference to elevation of Parks formation to group status as suggested in 1945.

Some reports place Kickapoo Creek group in Strawn series.

Type section: Logs of Gilbert No. 1 and Wheeler No. 1 wells of southeastern Parker County, 5 miles northeast of Lipan. Name derived from Kickapoo Creek of southwestern Parker and northwestern Hood Counties.

Kickapoo Falls Limestone (in Millsap Lake Formation)[1]

Kickapoo Falls Limestone Member (of Dickerson Formation)

Kickapoo Falls Limestone Member (of Lazy Bend Formation)

Pennsylvanian (Strawn): Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on correlation chart as Kickapoo Falls limestone member of Lazy Bend formation. Occurs below Dennis Bridge limestone member; occurs above Dickerson formation.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2. p. 163. Kickapoo Falls limestone may be classified as top member of Dickerson formation in harmony with common practice in this region [Texas] of placing important limestone at top of formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 12–13. On basis of studies in Kickapoo Creek valley and Dennis area on Brazos River, Kickapoo Falls limestone believed to occupy slightly higher stratigraphic position than Dennis Bridge limestone.

Named for prominent exposures at Kickapoo Falls on Kickapoo Creek, in northern edge of Hood County.

Kidd Member (of Salem Limestone)

Mississippian (Valmeyer Series): Southwestern Illinois.

J. W. Baxter, 1959, Dissert. Abs., v. 19, no. 11, p. 2910. Salem limestone subdivided into four members [sequence not indicated] to which names Kidd, Fults, Chalfin, and Rocher are assigned. Kidd member is skeletal calcarenite composed of medium- to coarse-grained crinoid columnals and fine bryozoan debris.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2, 6–7, 12, 19–22, pl. 1. Typically consists of gray or brownish-gray, fine- to coarse-grained limestone composed of fragmented fossils, chiefly crinoid columnals and bryozoan detritus. In most outcrops in Monroe County, only upper part of member can be observed because lower contact is either below level of bottomland or covered by faults. East of village of Kidd, Warsaw-Salem contact rises above talus slopes where an anticline intersects bluff southwest of Renault. At this location, the Kidd is about 90 feet thick. Underlies Fults member; overlies Warsaw formation.

Type section: NE¼ sec. 1, T. 5 S., R. 10 W., Monroe County. Named from village of Kidd.

Kiddville Limestone[1]

Lower or Middle Devonian: East-central Kentucky.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 92, 93.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart below Boyle limestone. Lower or Middle Devonian.

Named for hamlet 1 mile north of Indian Fields, Clark County.

Kiekie Volcanic Series

Pleistocene: Niihau Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 91; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 12, p. 14–15 (table), 19–24, 45–49; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 102–103. Olivine basalts and vitric-lithic tuff cones. Thickness above sea level as much as 290 feet; believed to rest on bench cut into Paniau lavas (new) 300 feet below sea level.

Form low coastal plain of Niihau.

Kiewitz shale zone (in Stoner Limestone Member of Stanton Formation)[1]

Pennsylvanian (Missouri Series): Southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 42, 55.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. Zone consisting of grayish calcareous fossiliferous shale 3 feet thick. Underlies unnamed limestone unit; overlies Dyson Hollow limestone zone or member (new).

Named for exposures in Kiewitz quarry located in Platte Valley bluffs west of Meadow Station, Sarpy County.

Kiger Group (in Cimarron Series)

Kiger division (in Cimarron Group[1] or Series)

Permian: Central southern Kansas and northwestern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 39.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1803–1813. Cimarron series in Kansas includes all Permian redbeds overlying salt-bearing and gypsum-bearing gray shales of Wellington formation. These redbeds were earlier divided by Cragin into Salt Fork and Kiger divisions. The Kiger includes strata from base of Whitehorse sandstone to base of Big Basin formation.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 25, 26. Referred to as group in Cimarron series. Data in this report are from subsurface records.

Named for Kiger Creek, Clark County, Kans.

Kigluaik Group[1]

Lower Paleozoic or older: Northwestern Alaska.

Original reference: A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901, Reconn. in Cape Nome and Norton Bay regions, Alaska, in 1900: U.S. Geol. Survey Spec. Pub., p. 27, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

First found in heart of Kigluaik Mountains, Seward Peninsula.

Kiheki Sandstone Member (of Vamoosa Formation)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 45, pl. 1. Name applied to single, more-or-less continuous sandstone ledge, 5 to 25 feet thick, that occurs in the shale interval between the Cheshewalla and the Labadie members. Commonly occurs within 30 feet below the Labadie, or within 50 to 75 feet above the Cheshewalla sandstone.

Type section: Along road in sec. 25, T. 26 N., R. 10 E., Osage County. Named for siding and cattle loading platform on Missouri, Kansas and Texas Railroad in sec. 3, T. 25 N., R. 10 E.

Kii Point Limestone

Pleistocene or Recent: Oahu Island, Hawaii.

C. K. Wentworth and J. E. Hoffmeister, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1560–1561. Wedge-shaped mass of limestone composed chiefly of oyster and barnacle shells. Maximum thickness 30 feet; thickness 20 feet at sea level; pinches out at height of 45 feet. Basal 6 feet consists of irregularly imbricated oyster shells and large number of barnacle shells; in next 2 to 4 feet oysters become less numerous and barnacles more numerous; formation grades to calcareous sandstone composed of beach detritus.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6 Océanie, fasc. 2, p. 103. Rests on eroded surface of Ulupau tuff; overlain by old alluvium. Pleistocene or Recent.

Type locality: Kii Point. Crops out as two small patches on east side of Ulupau Peninsula, one at Kii Point and the other about 1,000 feet to south; also small exposure on northwest side of peninsula.

Kilbeck Granite Gneiss

Precambrian: Southern California.

J. C. Hazzard and E. F. Dosch, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 309. Defined as being younger than Fenner gneiss (new). In contact with lower member of Essex series (new).

Occurs in southern end of Old Woman Mountains, San Bernardino County.

Kilby Formation

Pleistocene: Eastern Virginia.

W. E. Moore, 1956, Virginia Acad. Sci., Geology sec., Field Trip Guidebook, no pagination. Composed of clayey sands and gravels; base characterized over wide areas by thin cobble and boulder zone which contains boulders of exceptional size. Plates and concretions of limonite occur at contact with Sedley formation (new). Overlies Sedley and directly underlies both Sunderland and Wicomico terrace surfaces. New formation names necessary because names Sunderland formation and Wicomico formation are meaningless. Both of these terraces are underlain by same formation, not two different formations as previously believed. Terrace as used here refers to land form only and does not refer to nor imply existence of any deposits genetically related to them.

Area discussed is south of James River.

Kilea Volcanics (in Lahaina Volcanic Series)

Pleistocene(?) : Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 158 (table), 181. Fine-grained nepheline basanite flow 15 feet thick. Rests on consolidated older alluvial fan of Olowalu Stream.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 103–104. Pleistocene(?).

Originated from cinder cone, Puu Kilea, one-half mile north of Olowalu on south bank of Olowalu Stream, West Maui Mountains.

Killarney Granite[1]

Precambrian : Western Ontario, Canada, and northern Michigan.

Original reference: W. G. Miller and C. W. Knight, 1914, Ontario Bur. Mines Report, v. 22, pt. 2, p. 125.

W. T. Stuart, E. A. Brown, and E. C. Rhodehamel, 1954, Michigan Dept. Conserv., Geol. Survey Div. Tech. Rept. 3, p. 11 (table 3). Table of geologic formations in Marquette district shows Killarney granite above Keweenawan, but footnote states stratigraphic position doubtful.

First described on north shore of Lake Huron, Ontario, Canada.

Killbuck Conglomerate Lentil (of Cattaraugus Formation)[1]

Devonian or Carboniferous : Southwestern New York.

Original references: L. C. Glenn, 1903, New York State Mus. Bull. 69, p. 977; 1904, Geol. Soc. America Bull., v. 14, p. 522–531.

Well exposed northeast and east of Kilbuck [Kill Buck], Cattaraugus County.

Killbuck shale facies (of Cuyahoga Formation)

Mississippian (Kinderhook) : Northeastern Ohio.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 43 (fig. 2), 49–50. One of seven facies in the formation. Includes Black Hand shale member, Armstrong sandstone member, and Burbank member. Lies between River Styx conglomerate facies (new) to the northeast and Tobosa conglomerate facies to the southwest.

Occurs in Huron, Lorain, Medina, Ashland, and Wayne Counties.

Killians Member (of Genshaw Formation)

Killians Limestone[1]

Middle Devonian : Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 583–584. Rank reduced to member status in Genshaw formation (redefined).

G. V. Cohee, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 28, footnote 22. Michigan Geological Survey considers Killians limestone a formation.

Type locality: Exposures along French Road, one-half mile south of Killians resort, Long Lake, Alpena County.

Killik Tongue (of Chandler Formation)

Lower Cretaceous: Northern Alaska.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 237–239, figs. 4, 5. Lower and thickest tongue of formation, formerly called the Hatbox tongue. Renamed and type locality changed because sequence is better exposed along Killik River than at Hatbox Mesa. Nonmarine in origin with some marginal facies. Separated into upper and lower part in southernmost exposures. Lower part at type locality is 1,095 feet thick and comprises abundance of thick-bedded bluff-forming sandstones. Above base, sandstones tend toward varous shades of yellow red in addition to "salt-and-pepper" appearance; also includes grayish micaceous carbonaceous siltstone and silt-shale with numerous thick coal seams. Upper part at type locality 1,720 feet thick and characterized by series of massive white quartz conglomerate ledges; rest of constituents quite similar to those of lower part. Overall thickness at type locality 2,815 feet. In most exposures, tongue underlies marine Ninuluk formation (new), overlies marine Tuktu formation (revised), and overlies and interfingers with marine Grandstand formation (new). Age shown on chart as Lower (?) and Upper(?) Cretaceous.

F. R. Collins, 1958, U.S. Geol. Survey Prof. Paper 305–F, p. 343. Lower Cretaceous.

Type locality: Along east bank of Killik River between lat 68°52′ N. and 68°55′ N., and long 153°26′W.

Killingworth Leucotonalite

Carboniferous(?), middle: South-central Connecticut.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 52–53, 54, pl. 1. Bluish-gray medium- to coarse-grained igneous rock with little foliation. Occurs at core of large batholithic area of Monson orthogneiss.

H. M. Mikami and R. E. Digman, 1959, Connecticut Geol. Nat. History Survey Bull. 86, p. 25–26. Present study shows that entire Killingworth dome should be mapped as one tonalite mass with peripheral zone of mixed rocks. Entire formation here designated Haddam tonalite.

Mapped in towns of Killingworth, Middlesex County, and Madison, New Haven County.

Kimball Formation (in Ogallala Group)

Kimball Member (of Ogallala Formation)

Pliocene, upper: Southwestern Nebraska, northern Colorado, and northwestern Kansas.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 224, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1262–1264, 1266 (table 2). Uppermost formation in group. Consists of silt, clay, and fine sand more or less cemented with caliche, with 1 or 2 algal limestone beds at top; pinkish to reddish. Thickness 25 to 50 feet. Overlies Sidney gravel (new). Very late Pliocene.

C. B. Schultz and T. M. Stout, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 553–588. Formation includes Sidney gravel and silt member. Discussion of Pleistocene mammals and terraces in Great Plains. Unconformity between Kimball and Broadwater formations is most significant stratigraphic break in upper Tertiary and Pleistocene deposits of western Nebraska and Great Plains in general. Faunal break between Kimball and

Broadwater is most important one paleontologically in same area. This break believed to be Pliocene-Pleistocene boundary.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 20. Member of Ogallala formation in Kansas.

Typical exposure: At the High Plains level about 2 miles south of Kimball, Kimball County, Nebr., in vicinity of adjoining corners of secs. 5, 6, 7, and 8, T. 14 N., R. 55 W.

Kimberling Shale[1]

Upper Devonian: Southwestern Virginia and southeastern West Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 177, pl. 4.

Named for Kimberling Creek, Bland County, Va.

Kimbrel Bed[1]

Eocene, upper: Northwestern Louisiana.

Original reference: T. L. Casey, 1902, Science, new ser., v. 15, p. 716.

Named for outcrops on estate of T. W. Kimbrel, south of Montgomery, Grant County.

Kimmswick Limestone[1]

Middle Ordovician: Eastern Missouri, northern Arkansas, and southwestern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 111.

E. O. Ulrich, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 106 (correlation table), 107. In Cape Girardeau sections, overlies Plattin limestone. Decorah absent.

J. M. Weller *in* Stuart Weller and J. M. Weller, 1939, Illinois Geol. Survey Rept. Inv. 59, p. 7, pl. 1. Exposed in limited area in Kimmswick quadrangle where Ordovician rocks have been brought to surface in Mississippi River bluff at crest of Valmeyer anticline. Consists of pure white to flesh-colored crystalline limestone free from chert except in a zone about 8 feet thick near middle of formation. Thickness about 100 feet. Overlies Decorah limestone; underlies Maquoketa shale.

C. J. Wells, 1949, Arkansas Div. Geology Bull. 15, p. 9. In Independence County, Ark., formation is chiefly an even-bedded massive light-gray medium- to coarse-grained limestone with characteristic surgary texture. Overlies Plattin limestone; underlies Fernvale limestone.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2044 (fig. 2), 2064, 2066. In southeastern Missouri, disconformably overlies Decorah formation.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 116. Overlies Barnhart formation (new).

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 8–13. Described in Bowling Green quadrangle where it consists predominantly of limestone beds 3 feet thick; thinner beds of dolomitic limestone and shaly to silty limestone present near top. Thickness 80 feet, base not exposed. Unconformably underlies Maquoketa formation. On basis of fauna and stratigraphic position, considered to be Middle Ordovician (Trenton) in age and approximately correlative with lower part of Galena formation.

Named for exposures at Kimmswick, Jefferson County, Mo.

Kincaid Formation (in Midway Group)[1]

Paleocene: Eastern Texas and southern Arkansas.

Original reference: Julia Gardner, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 6, p. 744.

C. W. Cooke and others, 1943, Geol. Soc America Bull., v. 54 no. 11, chart 12. Shown on correlation chart as underlying Wills Point formation. Paleocene.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 4), 13–25, pls. In Texas, comprises (ascending) Littig glauconitic, Pisgah, and Tehuacana members. Geographically extended into bauxite region of Arkansas where it is as much as 185 feet thick and consists of greenish- and dark-gray clay, sandy in places, interbedded with fossiliferous marl, sandy glauconite limestone, and calcareous sandstone. Not differentiated although equivalents of the Texas members are present. Underlies Wills Point formation Overlies Late Cretaceous (in some areas Arkadelphia marl). Paleocene.

Type exposure: On old Kincaid Ranch (Lewis Ranch), three-fourths mile above Bob Evan's apiary to one-quarter mile below it [Uvalde County], Tex.

Kinchloe Limestone[1]

Pennsylvanian: Western Kentucky.

Original reference: F. M. Hutchinson, 1912, Kentucky Geol. Survey Bull. 19, fig. 28.

Derivation of name not stated, but probably named for Kinchloes Bluff, Muhlenberg County.

Kindblade Formation (in Arbuckle Group)

Lower Ordovician: Southwestern Oklahoma.

C E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 16 (table 1), 25–26, 47–48; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1313, 1320, table 1. Name proposed to replace preoccupied Alden (Decker, 1933). Chiefly dark-gray limestones in groups of beds in which one or two thick ones alternate with zones of thinner beds. Thickness near type section about 956 feet; in Arbuckle Mountains aggregates 1,216 to 1,536 feet. Grades into Cool Creek formation below and West Spring Creek formation above.

Type section: Outcrop on Kindblade Ranch, E½ sec. 26, T. 6 N., R. 14 W., 10½ miles southwest of Carnegie, Comanche County. Well exposed along east side of ranch.

Kinderhook Series

Kinderhook Group[1]

Lower Mississippian: Mississippi Valley.

Original reference: F. B. Meek and A. H. Worthen, 1861, Am. Jour. Sci., 2d, v. 32, p. 288.

E. B. Branson, 1938, Missouri Univ. Studies, v. 13, no. 3, pt. 1, p. 5–6. Term Lower Mississippian used here as name for division of Mississippian to take place of term Kinderhook. Because several Devonian formations have been included in the Kinderhook, the name is not suitable for Mississippian division.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132. Basal series of Mississippian in Mississippi Valley. Varies

greatly from place to place, and no standard section can be set up for it. Unconformable below Valmeyer series. Some units included are: Sulphur Springs formation in Missouri, Mountain Glen, and Springville shales in Illinois.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 777–793. Basal group of Iowa series. In standard section, includes (ascending) Grassy-Saverton shale, Louisiana limestone, Hannibal shale and sandstone, and Chouteau limestone. Underlies Osage group. This report follows classification of Illinois Geological Survey. Authors believe, however, that Mississippian should have threefold division, that Kinderhook should be raised to rank of series, and that Valmeyer series should be recognized.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 100–101, chart 5. Series subdivided into two groups. Easley includes all Kinderhookian strata which are almost universally recognized to be of Mississippian age. Fabius consists of Kinderhookian strata which are believed by some to be Mississippian but by others to be Devonian. Standard section comprises (ascending) Grassy Creek shale, Saverton shale, Louisiana limestone, Maple Mill shale, Chouteau limestone, Sedalia limestone, and Gilmore City limestone. Underlies Osage (Osagean) series.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71–79. Kinderhookian-Osagean boundary defined as being contact of Northview and the overlying Pierson formation. Both formations here considered co-extensive throughout western Missouri. Northview has commonly been considered Kinderhookian, but Pierson has been assigned to either Osagean or Kinderhookian by various writers.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 12–38. In previous Illinois Geological Survey reports, Kinderhook strata have been considered a group in Iowa series. In this report, Kinderhook raised to series rank. Name Iowa dropped, following usage of Mississippian correlation chart (Weller and others, 1948). Series in northwestern, western, and central Illinois divided into three groups: North Hill above, Hannibal middle, and the Champ Clark (new) below. In eastern and southern Illinois, series is divided into two formations: Chouteau above and New Albany below. Name Valmeyer is accepted by Illinois Survey as a series name to include Osage and Meramec groups.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art, 5, p. 92–94. Use of term Kinderhook discussed. If Louisiana limestone is Devonian, as believed by some stratigraphers, and is equivalent to McCraney, as is maintained by some, there is possibility that no strata of Mississippian Kinderhook age are exposed at Kinderhook. If term is interpreted in broad sense in which it was originally proposed, there is no necessity for new name or designation of type locality. Proposed here that Kinderhook be used to designate all strata of Mississippian age that are older than Osage. Recommended that terms Easley and Fabius groups be dropped from list of stratigraphic designations in Missouri. If there is no doubt of Mississippian age of a unit that is older than Osage, it may be called Kinderhook in age and, with somewhat more refinement, it may be designated as early of late Kinderhookian.

Named for exposures at Kinderhook, Pike County, Ill.

Kineo Rhyolite[1]

Devonian: West-central Maine.

Original reference: W. H. Perkins, 1925, Am. Jour. Sci., 5th ser., v. 10, p. 371

H. W. Fairbairn and P. M. Hurley, 1957, Am. Geophys. Union Trans., v. 38, no. 1, p. 104 (table 7), 106. Enclosed by Lower Devonian strata; age designated Lower Devonian.

Forms Mount Kineo and several other hills in Moosehead Lake quadrangle.

King Limestone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1898, Missouri Geol. Survey, v. 12, pt. 1, p. 49, 71–74.

Named for outcrops on King Branch and King Mound, Greene County.

Kingak Shale[1]

Lower-Upper Jurassic: Northeastern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 119, map.

George Gryc and others, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 163 (fig. 2). Lower, Middle, and Upper Jurassic. Underlies Okpikruak formation (new).

Identified at Kingak Cliff, near Camp 263, at southeast end of Sadlerochit Mountains.

King City Formation

Pliocene: Southern California.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no 12, pt. 2, p. 1956–1957. Name applied to series of deposits at base of Pliocene in Salinas Valley area. Unconformably overlies basement complex; underlies Poncho Rico formation.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 190 [preprint 1941]. Has basal arkosic sand which, in places, is more than 100 feet thick, overlain by series of white shale, in turn overlain by Poncho Rico formation.

Type area: East and southeast of King City between Peach Valley and Salinas Valley.

King Creek Marl Member (of Chappel Formation)

Mississippian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 26. Dark-gray colloidal nonlaminated fossiliferous partially cemented hard marl that fills depressions, cavities, and holes in Ellenburger surface on which Chappel formation was deposited. Commonly less than 1 foot thick and quite erratic in its distribution. Chappel comprises [ascending] King Creek marl, Ives conglomerate, Espey Creek limestone, and Whites Crossing coquina members.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 810–811 (footnote). "King Creek marl member" of Plummer's Chappel formation is argillaceous limestone surely identified only at its type site where it constitutes a few inches of Houy formation (new). Although it contains conodonts and megafossils of early Kinderhook sorts, type "King Creek marl" occurs beneath Ives breccia (here

reallocated to member status in newly defined Houy formation) which has yielded only Devonian types of conodonts.

Typically exposed on King Branch on Sloan Ranch one-quarter mile northwest of King Spring and 300 feet east of road crossing, Lampasas County.

Kingdom Formation (in Ancell Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 12. Consists of argillaceous silty fine and coarse-grained sandstone about 9 feet thick. Shown on columnar section as underlying Daysville formation(new) and unconformably overlying St. Peter sandstone.

Occurs in Dixon-Oregon area.

King Ferry Shale Member (of Ludlowville Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th ser., v. 19, p. 219, 228.

R. S. Boardman, 1960, U.S. Geol.. Survey Prof. Paper 340, p. 6–7. Generally considered lateral equivalent of Wanakah shale, Tichenor limestone, and Deep Run members. Trepostomatous Bryozoa discussed.

Type locality: At Clearview, King Ferry, Cayuga County, near Cayuga Lake.

†Kingfisher Formation (in Cimarron Group)[1]

Permian: Southern Kansas and central Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 352–355.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101 Abandoned by Oklahoma Geological Survey.

Named for Kingfisher Creek and town in Kingfisher County, Okla.

King Hill Shale Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p 44, 45, 47.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 66. Thickness 4 to 6 feet in Nebraska, about 20 feet in northwestern Missouri, and 5 to 20 feet in Kansas. Underlies Avoca limestone member; overlies Beil limestone member.

H G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Dark- to greenish-gray massive shale with seams of nodular limestone. Thickness 6 to 7½ feet. Underlies Avoca limestone member; overlies Beil limestone member.

Type locality: One and one-half miles south and 1 mile east of Rock Bluff, Cass County, Nebr. Name derived from King Hill, a high point in Missouri River bluffs.

King Lear Formation

Lower Cretaceous: Northwestern Nevada.

Ronald Willden, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2381 (table 1), 2382–2391, 2394. Consists of clastic rocks, including

pebble to boulder conglomerate with interbedded siltstone and graywacke and lenses of limestone. Basal part invariably poorly sorted conglomerate composed almost entirely of subrounded to rounded clasts of subjacent rock type overlain by pebble to cobble conglomerate with some interbedded red siltstone. Conglomerates typically bimodal. Basal conglomerate 200 to 300 feet thick and overlain by 300 to 500 feet of dusky-red and greenish-gray to brown siltstone interbedded with greenish-gray to brown sandstone and graywacke. Lenticular bodies of light- to dark-gray finely crystalline dense limestone occurs locally in basal conglomerate and overlying siltstone-sandstone unit. Siltstone-sandstone unit overlain by about 200 feet of pebble to cobble conglomerate interbedded with sandstone, graywacke, and siltstone which is in turn overlain by upper unit of uncertain thickness consisting of interbedded siltstone, graywacke, and sandstone. Total thickness 200 to 3,000 feet. Overlies pre-Cretaceous volcanic series at most localities where exposed. Unconformably underlies Pansy Lee conglomerate (new).

Type section: Along road south of DeLong mine, Jackson Mountains, Humboldt County. Named from exposures on southeast side of King Lear Peak. Also exposed west of crest of range in vicinity of Deer Creek Peak, Parrot Peak, and DeLong Peak.

Kingman Sandstone Member (of Harper Sandstone)

Permian (Leonard Series): Southern Kansas and northern Oklahoma.

G. H. Norton, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557; 1939, v. 23, no. 12, p. 1785–1786. An 80-foot unit of silty red sandstone containing a 3-foot white sandstone at base. Overlies Chikaskia sandstone member (new). Top not distinct, but placed arbitrarily at bed of maroon shale at base of Salt Plain measures of Cragin.

Named for exposures in and around Kingman, Kingman County, Kans. U.S. Highway 54 cuts through ridge of the sandstone about three-fourths mile east of Kingman; here basal bed and lower part of member are exposed.

Kingman Series

Tertiary: Northwestern Arizona.

B. E. Thomas, 1949, Econ. Geology, v. 44, no. 8, p. 667, fig. 2. Comprises rhyolite tuffs, breccias, and flows. Disconformably overlies Bull Mountain series (new); unconformably underlies Big Wash andesite (new).

B. E. Thomas, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 408, pl. 1. Two northernmost mapped exposures contain visible section approximately 700 feet thick of coarse reddish breccias. Rocks distinctly stratified and well consolidated. In three exposures to the south, several hundred feet of strata must be represented, but maximum thickness of any one section is about 80 feet. Rock types present are (ascending) loosely consolidated grayish-yellow to light-brown tuff; welded tuff, 10 to 15 feet thick; and reddish-brown tuffaceous breccia, about 30 feet thick.

Best exposed in and around Kingman, Mohave County. Occurs discontinuously along east flank of Cerbat Mountains.

King Peak Rhyolite

Precambrian: West-central Arizona.

C. A Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 12, pl. 3. Fine-grained nonporphyritic rock containing quartz and feldspar. Generally massive, and foliation is rare. White and sugary in appearance on unweathered surfaces, but outcrops typi-

cally are tan in western belt near Niagara Creek. Eastern exposures are brown. Distinguished from Dick rhyolite (new) by its nonporphyritic texture. Oldest intrusive in area. Mass of King Peak rhyolite exposed west of Niagara Creek is essentially concordant with southwestern belt of Bridle formation (new), but evidence proves that the rhyolite is intrusive. Pattern of outcrops indicates that the King Peak also intrudes Dick rhyolite.

Exposed on King Peak, for which the rock has been named, in southern part of Bagdad area, Yavapai County

Kings Limestone[1]

Devonian: Missouri.

Original reference: E. M. Shepard, 1904, Drury Coll., Bradley Geol. Field Sta. Bull., v. 1, p. 41.

Kings Branch Limestone[1]

Age(?): Southwestern Missouri.

Original reference: E. M. Shepard, 1905, Drury Coll., Bradley Geol. Field Sta. Bull., v. 1.

Greene County.

Kingsbridge Marble[1]

Precambrian: Southeastern New York.

Original reference: L. D. Gale, 1839, New York Geol. Survey 3d Ann. Rept., p. 183.

Probably named for Kingsbridge on Manhattan Island.

Kingsbury Conglomerate Member (of Wasatch Formation)[1]

Eocene, lower: Northern Wyoming.

Original reference: N. H. Darton, 1906, U.S. Geol. Survey Prof. Paper 51, p. 13, 60.

R. P. Sharp, 1948, Jour. Geology, v. 56, no. 1, p. 1–14. Underlies Moncrief gravel (new).

J. D. Love and J. L. Weitz, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–122. Underlies Moncrief gravel herein allocated to member status in Wasatch formation.

R. K. Hose, 1956, U.S. Geol. Survey Bull. 1027–B, p. 67–70. Described in Crazy Woman Creek area, Johnson County, where it unconformably overlaps Fort Union formation. North of mapped area, successively overlaps Lance formation, Bearpaw shale, and Parkman sandstone. Four miles north of mapped area, unconformably underlies Moncrief member. Thickness 400 to 600 feet in vicinity of Kingsbury Ridge.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 63–64. Described in Buffalo-Lake De Smet area where it is as much as 800 feet thick. Underlies Moncrief member with angular discordance near Bighorn Mountains; eastward both members grade laterally into conformable nonconglomerate sequence of sandstone, shale, and coal that makes up Wasatch formation east of area. Overlies Fort Union formation with angular unconformity.

Named for Kingsbury Ridge, 6 miles southwest of Buffalo, Johnson County

Kings Canyon Dolomite

Devonian(?): Western Utah.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 23 (fig. 5), 26–27, 31 (fig. 6), 35 (fig. 7), 37 (fig. 8), 41 (fig. 9), 53 (fig.

11), 60. Proposed for light-gray microcrystalline dense laminated dolomite 460 feet thick that conformably overlies Decathon dolomite (new) and conformably underlies Simonson dolomite. No fossils. Considered Devonian because of stratigraphic position below Simonson and lithologic similarity to Sevy dolomite.

Type locality: Fantastic Canyon, sec. 13, T. 21 S., R. 15 W., 5 miles south of Kings Canyon in Confusion Mountains, Millard County. Also well exposed in eastern front of Confusion Mountains between Kings Canyon and Ibex.

†Kings Creek phase[1] or silex[1]

Eocene, upper, or Oligocene: Western South Carolina and southeastern Georgia.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies, published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, name only, not defined; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 435, 464–465.

Occurs between Johnson's Landing, near mouth of Lower 3 Runs, Barnwell County, S.C., to point immediately south of King's Creek and about 1 mile west of river road.

Kingsdown Silt or Formation (in Sanborn Group)

Kingsdown Marl[1]

Pleistocene: Southwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 53–54.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 111–116. Cragin's loosely defined Kingsdown marl of supposed late Pliocene age, redefined as Kingsdown formation to include beds of Pleistocene age only. It was included in Tertiary marl as mapped by Hay (1890, U.S. Geol. Survey Bull. 57). Formation consists of light-colored sand and gravel grading upward into characteristically light-buff even-bedded silt and clay containing some small and scattered calcareous concretions. Thickness 64 feet at section measured in Clark County. Here the Kingsdown overlies Rexroad formation (new). Overlain by loess and seems locally to grade upward into loess from which it differs little except in its bedding.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, pt. 13. p. 410–411. Redefined to include overlying loess. Overlies Meade formation (redefined).

C. W. Hibbard, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 745–752. Kingsdown marl apparently referred to by Cragin is divisible into an upper and lower part separated by a disconformity. Lower Kingsdown consists of light-buff silt and some sand and caliche pebbles, unconformable upon Meade formation and unconformably overlain by upper Kingsdown silt. Where well exposed in SE¼ sec. 17, T. 30 S., R. 23 W., Clark County, the lower Kingsdown is 25 feet thick. Here the Kingsdown is channelled into the Meade formation. Upper Kingsdown silt consists of light-tan silt and fine sand, thin-bedded at base grading upward into massive silt and loess. Well exposed in NE¼ sec. 13, T. 30 S., R. 23 W., Clark County (section measured by Smith, 1940).

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no 4, p. 80–84. Formation redefined to include sands and gravels at base of silt

not recognized by Cragin but included by Hibbard (1944) in lower Kingsdown silt. Term formation used here instead of marls because unit here defined as formation consists both of channel sands and gravels and flood-plain silts containing large amounts of calcium carbonate. Use of formation as here restricted and redefined, is not use of term as defined by Smith (1940). Typical section given by Smith is of beds younger than those described by Cragin as Kingsdown marls and belongs to later cycle of erosion and deposition named and defined in this paper as Vanhem formation. In some areas, overlies Meade formation; in others, Crooked Creek formation (new). Type locality designated

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Kingsdown marl or formation listed among units that consist in part or entirely of deposits known to be of Illinoian or younger age, and which are properly classed at least in part as Sanborn formation.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Lower formation in Sanborn group. Overlies Crooked Creek formation; underlies Vanhem formation.

Named for Kingsdown, Ford County.

Kingshill Marl

Kingshill Series

Oligocene and Miocene: St. Croix, Virgin Islands.

J. F. Kemp, 1926, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, v. 4, pt. 1, p. 49 (reprinted? from J. F. Kemp, 1923, Report to H. H. Hough, Captain, U.S.N., Governor, Virgin Islands. Printed at the Naval Station, St. Thomas [not seen]). Kingshill series consists of white or cream-colored soft limestones, chalky beds and marls. Thickness may be 500 or 600 feet. Rests on upturned edges of older Mount Eagle series.

D. J Cederstrom, 1941, Am. Jour. Sci., v. 239, no. 8, p. 556–557. Referred to as Kingshill marl. In test wells, overlies Jealousy formation (new). Oligocene to lower Miocene.

D. J. Cederstrom, 1950, U.S. Geol. Survey Water-Supply Paper 1067, p. 20–27, pl. 1. Exposed thickness of marl may be more than 600 feet. Subsurface thickness as much as 180 feet. In some areas directly overlies Mount Eagle volcanics. Calcareous conglomerate underlying Kingshill is exposed in stream beds near Jealousy. This is believed to be basal conglomerate of Jealousy formation. Oligocene-Miocene contact is within Kingshill marl and is at least 108 feet above base of formation in test well at Fair Plain.

Probably named for Kings Hill in western part of island.

Kingsley Red Shale Member (of New Milford Formation)[1]

Kingsley shale member (of Wellsburg monothem)

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571–589.

K E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 44, 45 (fig. 7), 46–47, 49–50. Reallocated to lower part of Wellsburg monothem and described in vicinity of Lanesboro. Not properly termed "red" shale. Stratigraphically restricted; basal 105 feet of shale in original definition included by inference in Starruca shale member. Underlies Lanesboro formational suite

of Wellsburg monothem; overlies Starrucca shale member of Cayuta monothem.

Well exposed in railroad cut at Kingsley, Susquehanna County.

Kings Mill Sandstone[1]

Upper Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, 2d Pennsylvania Geol. Survey Rept. F2, p. 73–77.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 33. Described as marine unit intercalated with Catskill continental facies in Perry County.

Exposed near King's Mill 2 miles northwest of Duncannon, Perry County.

Kings Mill Shale[1] and Sandstones

Upper Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F–2, p. 77.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Kings Mill shales and sandstones shown on correlation chart below Dellville sandstone.

Named for King's Mill, 2 miles northwest of Duncannon, Perry County.

†Kings Mountain Group,[1] Series,[1] or Slates[1]

Precambrian and Cambrian: Western North Carolina and northwestern South Carolina.

Original reference: O. M. Lieber, 1858, Rept. of survey of South Carolina for 1856, p. 23, 30.

Named for development on Kings Mountain, in Cleveland and Gaston Counties, N C.

Kings Mountain Quartzite[1]

Kings Mountain Group

Ordovician to Mississippian: Southern North Carolina and northwestern South Carolina.

Original reference: A. Keith and D. B. Sterrett, 1931, U.S. Geol. Survey Geol. Atlas, Folio 222.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 30–31; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Rocks of Kings Mountain group consist of two parts, one of highly siliceous rock and the other largely calcareous. They are mapped as Stokes County and Kings Mountain belts. Precambrian(?) or Lower Paleozoic(?).

U S. Geological Survey currently designates the age of the Kings Mountain Quartzite as Ordovician to Mississippian on the basis of a study now in progress.

Named for development in Kings Mountain, in Cleveland and Gaston Counties. N.C.

Kingsport Formation or **Dolomite** (in Knox Group)

Lower Ordovician: Eastern Tennessee and southwestern Virginia.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic

Minerals Inv. Prelim. Map. Name appears on map legend. Occurs below Mascot dolomite (new).

C. R. L. Oder and H. W. Miller, 1945, Am. Inst. Mining Metall. Engineers Tech. Pub 1818, p. 1, 2–9. In Mascot-Jefferson City zinc district, Kingsport formation consists of four divisions: upper, 101 to 135 feet, fairly light to dark fine-grained dolomite with some interbedded brown limestone; underlying 44 to 50 feet, light-brownish-gray to nearly white fine-grained dolomite, some of which is lithographic in texture; variable zone 33 to 38 feet, light- to dark-gray to brownish fine-grained to finely crystalline dolomite and some brown limestone; lower 178 to 216 feet, mainly brown limestone locally altered to crystalline dolomite; interbedded with limestone is light- to dark-gray fine-grained dolomite; cherty layers numerous. Includes Grasselli dolomite (new) near top. Separated from overlying Mascot formation by chert matrix sand about 6 inches thick; overlies Longview formation. Name chosen, jointly by Josiah Bridge and Oder. [Description based on mine sections.]

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 25–27. Described in Lee Valley, Hawkins County, where it is 218 feet thick. Consists typically of thick-bedded compact blue to brown limestone below interbedded with and grading up into light- to dark-gray finely crystalline well-bedded dolomite. Thickness 218 feet. Underlies Mascot dolomite; overlies Longview dolomite

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 26–28, pl. 1. Described in Jonesville district, southwestern Virginia, where it underlies Mascot dolomite and overlies Longview dolomite. Thickness 119 to 272 feet.

Josiah Bridge, 1956. U.S. Geol. Survey Prof. Paper 277, p. 49–54, pl. 1. Kingsport limestone replaces names Jefferson City formation (Oder, 1934, Jour. Geology, v. 42) and Forked Deer formation (Hall and Amick, 1934). As defined here, Kingsport includes units 459 to 519 of Thorn Hills section (Hall and Amick, 1934) and units 240 to 256 of Lee Valley section (Rodgers and Kent, 1948). Thickness at type locality, here designated, 280 feet. Discussion of boundaries of Kingsport as used here with boundaries drawn by Oder and Miller (1945).

Type section: On east side of U.S. Highway 23 just northwest of Kingsport, Sullivan County, Tenn. Top of formation is 0.55 mile north of traffic light at intersection of U.S. Highways 23 and 11W; base is 0.23 mile farther north.

Kings River Sandstone Member (of Everton Formation)[1]

Middle Ordovician: Northwestern Arkansas.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

U.S. Geological Survey currently considers the Everton Formation and its members Middle Ordovician in age.

Named for exposures along Kings River, Eureka Springs quadrangle, [Carroll County].

†Kingston Beds[1]

Lower Devonian: Eastern New York.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

Typically exposed in vicinity of Kingston, Ulster County.

Kingston Conglomerate[1] (in Portage Lake Lava Series)

†Kingston Conglomerate (in Central Mine Group)

Precambrian (middle Keweenawan) : Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 114, chart.

W. S. White, H. C. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Shown on map legend as one of 16 units included in newly defined Portage Lake lava series

Named for occurrence on Kingston Farm, on Keweenaw Point.

Kingston Peak Formation

Precambrian (Pahrump Series) : Southern California.

D. F. Hewett, 1940, Washington Acad. Sci. Jour., v. 30, no. 6, p. 240; 1956, U.S. Geol. Survey Prof. Paper 275, p. 27, 28, pl. 1. Consists of sandstone and limestone with thick coarse conglomerate in middle. Conglomerate made up largely of subangular cobbles of limestone up to 12 inches in diameter with quartzite and granite cobbles predominating near base. Resembles debris, called fanglomerate, that forms fans on border of present valleys. About 1,900 feet thick along western part of outcrop belt but thickens toward east. Conformably overlies Beck Spring dolomite (new); underlies Paleozoic rocks that are Lower Cambrian in age.

D. F. Hewett, 1948, California Div. Mines Bull. 129, p. 199. In Kingston Range, San Bernardino County, underlies Cambrian Noonday dolomite.

L. A. Wright, 1952, California Div. Mines Spec. Rept. 20, p. 12. In Superior talc area, southern Death Valley-Kingston Range region, formation, at least 1,900 feet thick, consists of a lower one-fourth of quartzite and shale and an upper three-fourths of conglomeratic quartzite locally containing much diabase debris.

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 360–369, fig. 3, 378 (fig. 7). Described in Manly Peak quadrangle, Death Valley region. In northern part of quadrangle, divided into three members (ascending): Surprise (conglomerate subgraywacke), Sour Dough limestone, and South Park member (new) consisting of conglomerate, sandstone, and shale. Key to subdivision was Sour Dough limestone which forms prominent escarpments and hogbacks that contrast with smoother weathering members. Separation into members in southern part of area not possible, mostly because of insufficient time to trace outcrops of thinner and topographically less well defined Sour Dough in this rather inaccessible part of quadrangle. Base of thickest part of section not exposed, but it has minimum thickness of 2,700 feet in northern part of quadrangle; thickness decreases to a few tens of feet near Lotus mine. Base of formation exposed on west limb of anticline in Coyote Canyon and in Goler Wash; in both places, it rests unconformably on Archean gneiss or Archean metaconglomerate; throughout region, underlies Noonday dolomite with slight angular discordance; also pronounced color contrast marks contact—Noonday buff, Kingston Peak dark. Widely distributed over much of southern Death Valley region and exposed over more of western side of southern Panamint Range than any of other sedimentary formations; crops out discontinuously from Goler Wash at least as far north as Wildrose Canyon and Harrisburg Flat

Crops out in belt 20 miles long around north and east slopes of Kingston Range, Ivanpah quadrangle. Formation is interrupted by several faults. Name derived from Kingston Peak, highest point in range.

Kingston Range Monzonite Porphyry

Upper Cretaceous or Tertiary, lower: Southern California.

D. F. Hewett, 1948, California Div. Mines Bull. 129, p. 199–200; 1956, U.S. Geol. Survey Prof. Paper 275, p. 24, 26, 67–68, pl. 1. Uniform in composition and texture. In Kingston Range, Precambrian Pahrump series forms large dome in center of which is core of igneous rock, the Kingston Range monzonite porphyry.

Kingston Range, about 10 miles in diameter, lies near northeast corner of San Bernardino County.

†Kingstown Series[1]

Carboniferous: Central southern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 331–347, pl. 31, map.

Typically exposed in South and North Kingstown, Washington County.

Kings Valley Siltstone Member (of Siletz River Volcanic Series)

Eocene, lower: West-central Oregon.

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. Thin-bedded tuffaceous siltstone and waterlaid tuffs that interfinger with volcanic rocks in upper part of Siletz River volcanic series. Thickness about 3,000 feet in vicinity of Kings Valley. Underlies Tyee formation.

Extensively exposed along east and south edges of Kings Valley in northwestern part of Corvallis quadrangle. No complete sequence exposed in map area.

Kinishba Beds (in Supai Formation)[1]

Permian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 533–536.

Named for occurrence in walls of old Indian pueblo, known as Kinishba, on bank of dry wash, southwest of White River settlement and northwest of Fort Apache, at foot of Kelly Butte, Navajo County.

Kinkaid Limestone[1]

Kinkaid Limestone (in Elvira Group)

Upper Mississippian (Chester Series): Southern and western Illinois, southern Indiana, and western Kentucky.

Original reference: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 281–290; no. 5, p. 395–416.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136, 137; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 839–841. Assigned to Elvira group (new). Youngest formation of Chester series. In standard Mississippian section, overlies Degonia sandstone. In southwestern Indiana, Negli Creek limestone and the underlying shale are probably equivalent of Kinkaid formation.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Name Kinkaid limestone extended into southern Indiana where it replaces term Negli Creek limestone. Local Indiana names of upper

Chester are dropped, and formations given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Kinkaid limestone shown on stratigraphic column of upper Chester in Indiana as 20 to 35 feet of gray lithographic to medium-grained crystalline fossiliferous limestone and gray platy shale. Unconformable below Pennsylvanian Mansfield formation. Term Elvira group not used in Indiana.

Named for exposures along Kinkaid Creek and some of its tributaries in Jackson County, Ill.

Kinney Limestone Member (of Matfield Shale)

Kinney Limestone (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 37.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 45. Member of Matfield shale. Limestone and shale; generally an upper and lower gray fossiliferous limestone separated by gray fossiliferous shale. Thickness 1 to 24 feet. Underlies Blue Springs shale member; overlies Wymore shale member. Wolfcamp series.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 12 (table 2), 93–94, pls. Thickness 1 to 15 feet in Wabaunsee County, Kans. Overlies Wymore shale member; underlies Blue Springs shale.

Type locality: Burlington Railroad cut just east of Kinney, Gage County, Nebr.

Kinnick Formation[1]

Miocene, middle: Southern California.

Original reference: J. P. Buwalda, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 310.

H. E. Wood, 2d, and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 23, pl. 1. Included in Hemingfordian and Barstovian ages.

J. P. Buwalda and G. E. Lewis, 1955, U.S. Geol. Survey Prof. Paper 264–G, p. 147–148. Described as consisting mainly of stratified green basic volcanic tuffs, largely ash beds with some coarse agglomerates; upper part gray sandy shale with, locally, white freshwater diatomaceous beds and cherts; some basic lava flows. Thickness not less than 1,500 feet. Strata moderately deformed with dips generally not more than 30°. Lies with strong angular unconformity across edges of Witnet formation; probably conformable with overlying Bopesta. Type locality designated; derivation of name given.

Type section: Base at unconformity north of confluence off Cache, Oil and Sand Creeks (SW cor. sec. 11, T. 32 S., R. 34 E.), thence northward through California Institute of Technology locality 503 in saddle west of Hill 5,015, Mojave quadrangle, in NW¼ sec. 34, T. 31 S., R. 34 E., M D B and M, Kern County. Named from Kinnick Ridge, north of Cache, Oil and Sand Creeks.

Kinnikinic Quartzite[1]

Upper Ordovician: Southern central Idaho and extreme southwestern Montana.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1102–1104, 1195, pl. 1. Described in Borah Peak quadrangle, Idaho, where it is about 3,000 feet thick, underlies Saturday Mountain formation and overlies Ramshorn(?) slate. Early part of Upper Ordovician.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2148. Described in extreme southwestern Montana along crest of Beaverhead Range where it is a few tens of feet thick. Exposed above Beltian quartzites.

Named for exposures along Kinnikinic Creek, which reaches the Salmon River at Clayton, Idaho.

Kinnison Shale Member (of Cherokee Formation)

Kinnison Shale Member (of Mulky Formation)

Kinnison Shale Member (of Senora Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma.

W. B. Howe, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2092. Member of Cherokee formation. Shale, dark gray at base, lighter above; upper 2 feet calcareous, fossiliferous, containing nonpersistent rough limestone in which crinoid fragments and *Chonetes* are most abundant fossils; includes a dark- to medium-gray conglomeratic limestone about 6 inches thick at base. Thickness a little more than 6 feet. Underlies Breezy Hill limestone member; overlies Iron Post coal.

C. C. Branson, 1954, Oklahoma Geol. Survey Guidebook 2, p. 5. Listed as Kinnison shale member of Mulky coal cycle in Senora formation.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 84. Reallocated to member status in Mulky formation. Kinnison shale and underlying Iron Post coal pinch out abruptly approximately at latitude of Oklahoma-Kansas line.

Well exposed in W½SW¼ sec. 36, T. 29 N., R. 19 E., Craig County.

Kinsey Canyon Formation

Tertiary: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 160, 163–164. Conglomerate and lacustrine beds. Oldest Tertiary unit in area. Underlies Kalamazoo volcanics (new). Rests with slight angular unconformity on underlying upper Paleozoic rocks, locally contact is conglomerate-filled channels in Ely limestone. Tentatively correlated with the Eocene and early Oligocene(?) Sheep Pass formation.

Named for exposures in Kinsey Canyon, Schell Creek Range area, Ely quadrangle.

Kinsman Quartz Monzonite (in New Hampshire Plutonic Series)

Kinsman Granodiorite[1]

Upper Devonian(?): Southwestern and west-central New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, p. 69–78.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 506–507. Described as quartz monzonite.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Includes Meredith granite of Lake Winnipesaukee region,

also "Franconia" breccia. Belongs to New Hampshire plutonic series of Upper Devonian(?) age.

Named for Kinsman Notch in Moosilauke quadrangle.

Kintla Argillite }[1]
Kintla Formation } (in Missoula Group)

Kintla Member (of Miller Peak Formation)

Precambrian (Belt Series): Northwestern Montana, and southeastern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 324.

C. L. Fenton and M. A. Fenton, 1937, Geol Soc. America Bull., v. 48, no. 12, p. 1901–1902. Rank reduced to member status in Miller Peak formation. Consists of argillites and argillaceous sandstones, thinly bedded, dominantly bright red; thin beds of quartzite and pinkish-gray limestone. Contains 30 to 40 feet of purplish amygdaloidal lava. Ripple marks, mud cracks, channels, rain prints, and casts of salt crystals characteristic. Thickness 860 to 900 feet. Type locality and good exposures cited. Underlies Roosville member; overlies Sheppard formation.

S. D. Theodosis, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 62, chart facing p. 62. In Glacier Park area, only 860 feet of Missoula group is present, represented by Kintla formation, a red argillite which occurs in Kintla Lake area in northwestern part of park.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 43–44. Willis (1902) proposed name Kintla argillite for part of Belt series above Shepard formation in northern part of Glacier National Park. He observed thickness of 800 feet and, because he saw no beds above his Kintla, assigned no upper limit. It is now known that Missoula group extends thousands rather than hundreds of feet above Purcell basalt. Because there is no way of separating Kintla argillite of Willis from similar beds at horizons above those he saw, name Kintla not useful at present.

Type locality: Willis gives it as pyramidal peaks on 49th parallel, at head of Kintla drainage [Glacier National Park, Mont.]. Fenton and Fenton give pyramidal peaks of Akamina Ridge, west of Waterton Lakes National Park [British Columbia]. Well exposed on Mount Rowe, Mount Carthew, Mount Custer, and on Boulder Peak.

Kinzers Formation[1]

Lower Cambrian: Southeastern Pennsylvania, Maryland, and Virginia.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 362–363.

A. I. Jonas, 1936, Geol. Soc. America Bull., v. 47, no. 10, p. 1668 (table 1). Correlation chart shows Kinzers (shale) in Appalachian Valley, Hagerstown, Md.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 21, 22. Proposed to extend names Vintage dolomite, Kinzers formation, and Ledger dolomite to comparable Lower Cambrian formations in Austinville area, Wythe and Carroll Counties, Va. In this area, the Kinzers is about 850 feet thick. Consists of (ascending) massive white crystalline and blue to dove-colored fine-grained fossiliferous limestone, 200 feet thick; argillaceous to sandy ridge-making limestone, buff, and earthy-weathering impure limestone, thin shale, and thin dolomite, 150 feet; thin slabby, fine-grained to compact blue limestone, thick dolomite, and

limestone conglomerates, thick-bedded coarse limestone conglomerates at base, 500 feet. Overlies Vintage limestone; underlies Ledger dolomite.

Named for exposures in Pennsylvania Railroad cut at Kinzers, Lancaster County, Pa.

Kinzua Creek Sandstone

†Kinzua Creek Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Northwestern and central northern Pennsylvania.

Original reference: C. A. Ashburner, 1879, Geologic map of McKean County: Pennsylvania 2d Geol. Survey.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 57, 103. Kinzua Creek sandstone (Pottsville series) is separated from overlying Johnson Run sandstone by Alton coal group and from underlying Olean conglomerate by Marshburg coal and clay. [Also referred to as Kinzua sandstone.]

Named for exposures in Kinzua Creek valley, McKean County. Also noted in Cameron and Clinton Counties.

Kiowa Shale[1]

Kiowa Shale Member (of Purgatoire Formation)

Lower Cretaceous: Central southern Kansas, eastern Colorado, and western Oklahoma.

Original reference: F. W. Cragin, 1894, Colorado Coll. Studies, 5th Ann. Pub., p. 49.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 28. Consists of light-gray, dark-gray, and black fissile shale; contains thin limestone beds throughout, with Champion shell bed at base in type area. Locally, lenticular sandstones occur at any position within shale. Thickens across central and western Kansas toward south and southwest. Thickness 60 to 150 feet. Overlies Cheyenne sandstone; underlies Dakota formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County as member of Purgatoire formation and in northwestern Oklahoma as Kiowa shale.

T. G. McLaughlin, 1955, U.S. Geol. Survey Water-Supply Paper 1256, p. 99–100. Upper member of Purgatoire formation in Baca County, Colo. Commonly overlies Cheyenne sandstone member, although it overlies Morrison formation in Cimarron County, Okla. Underlies Dakota sandstone. Average thickness about 45 feet in southwestern part of Baca County; about 90 feet in places in northeastern part of county.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 43–46, pl. 1. Name Kiowa shale applied in Harper County to Cretaceous sandstones and shales unconformably overlying Cloud Chief formation. Consists of black to yellow resistant sandstones and thin white, somewhat chalky limestones. Maximum observed thickness 52 feet. Crops out as widely scattered outliers and is overlain by Quaternary sand dunes. Comanche series.

Named for Kiowa County, Kans.

Kipahulu Formation (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 91–92, pl. 18. Chiefly fine-grained aa in dense

beds, some of which are columnar jointed. Total thickness may exceed 1,500 feet.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat: Internat., v. 6, Océanie, fasc. 2, p. 104. Pleistocene(?).

Fills deep ancestral Kipahulu Valley cut at end of Kula time. Exposed over an area 6 miles long by ½ to 1 mile wide, East Maui.

†Kirby Clay[1]

Lower Cretaceous (Comanche Series) : Central southern Kansas.

Original reference: C. N. Gould, 1898, Am. Jour. Sci., 4th, v. 5, p. 170–174.

Named for Kirby, or C. W., or Fullington Ranch, on upper Medicine River, 10 to 12 miles west of Belvidere, Kiowa County.

Kirby Granite[1]

Age(?) : Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept.

On Kirby Mountain, eastern part of Kirby Township, Caledonia County.

Kirby Quartz Monzonite (in New Hampshire Plutonic Series)

Devonian: Northeastern Vermont.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 28–29, pl. 1. Light-gray to white hypidiomorphic quartz monzonite consisting essentially of gray glassy quartz, biotite, microcline, albite-oligoclase, and, in some specimens, muscovite; in some places where microcline is abundant, rock is true granite. Emplaced after main period of Acadian deformation (Late Devonian).

Exposed in three small bodies, two on north border of Littleton quadrangle in town of Kirby, third near Stiles Pond in town of Waterford.

Kirby Lake Dolomite (in Arroyo Formation or Group)

Kirby Lake Dolomite (in Clear Fork Group)

Permian (Leonard) : West-central Texas.

Gayle Scott and others, 1941, West Texas Geol. Soc. [Guidebook] Spring Field Trip, May 10–11, correction sheet. Proposed for preoccupied Cedar Creek. Name credited to [V. C.] Perini.

V. C. Perini, Jr., and J. R. Day, 1946, Abilene Geol. Soc. [Guidebook] November Field Trip, p. 5, 26. Stratigraphic section shows Kirby Lake dolomite in Arroyo formation above Lytle limestone and below Standpipe dolomites and limestone, or 145 feet above Lueders limestone. Page 26 states that Kirby Lake dolomite is member of Arroyo group.

Exposed at spillway at northwest corner of Kirby Lake, southwest of Abilene, Taylor County.

Kirker Tuff[1]

Oligocene: Western California.

Original reference: B. L. Clark, 1918, California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. Shown on correlation chart as unconformable below Cierbo sandstone and uncomformable above a 50-foot unit termed "Kirker sandstone".

Type locality: On Kirker Creek, north Mount Diablo, San Francisco Bay region.

Kirkers Pass Beds[1]

Miocene: Western California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, table opposite p. 226.

Mount Diablo region.

Kirkfield Limestone or Formation

Kirkfield Limestone Group[1]

Middle Ordovician: Ontario, Canada, and northwestern New York.

Original reference: R. A. A. Johnson, 1911, Canada Geol. Survey Summ. Rept. 1910, p. 190.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599. Along West Canada Creek, N.Y., Kirkfield limestone, 45 feet thick, disconformably overlies Rockland limestone and underlies Shoreham limestone. Name Kirkfield preferred to "Hull" of previous reports. Kirkfield has precedence over Hull. Type Hull at Hull, Quebec, has stratigraphic position of Kirkfield of southern Ontario and northwestern New York, for it lies between "*Triplesia* zone" (Rockland) and "*Cryptolithus* zone" (Shoreham); latter forms basal part of "*Prasopora* beds" (Sherman Fall) of Johnston and Raymond. There are faunal differences between the Hull and Kirkfield but the writer believes them equivalent. There has been assumption by some authors that all echinoderms at Hull, Quebec, are from Hull limestone and are synchronous with those described from type Kirkfield, whereas many are younger.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1411–1412. Summary of Middle Ordovician bordering Allegheny synclinorium. Lower Trentonian formations of northwestern New York and eastern Ontario, the Rockland and Kirkfield or Hull limestones, disconformably overlap Black River rocks, lying locally on Canadian and Cambrian along Mohawk River, and on Precambrian in Ontario; the Rocklandian and Kirkfieldian are considered to be stages.

G. W. Sinclair, 1954, Ohio Jour. Sci., v. 54, no. 1, p. 31–41. Formation studied in Ontario. Concluded that Kirkfield of central Ontario is same age as the Rockland of Ottawa Valley. No beds of Hull age have been recognized in central Ontario.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 523–525. Formation described in Black River valley, New York, where it is about 100 feet thick. Overlies Rockland formation; underlies Shoreham formation. Trentonian.

Named for occurrence in vicinity of Kirkfield, Victoria County, Ontario.

Kirkfieldian Stage or Substage

Middle Ordovician: Eastern North America.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1413–1414. Stage in lower Trentonian series. [Apparently replaces Hull stage.]

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30, 33. Rocklandian and Kirkfieldian substages included in Nealmontian stage of Trentonian.

Name derived from Kirkfield, Victoria County, Ontario, Canada, for which Kirkfield limestone was named.

Kirkland Formation[1]

Silurian: Maryland, New York, and Pennsylvania.

Original reference: E. O. Ulrich, 1918, Geol. Soc. America Bull., v. 29, p. 82.

Kirkland Limestone and iron ore[1] (in Clinton Formation or Group)

Silurian: New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 107–111. The Kirkland at Clinton is fossiliferous hematitic limestone. Thickness 5½ feet on Dawes Quarry Creek; 54 inches at Willowvale. Lower limit of formation sharp. Separated from Dawes sandstone (new) at Clinton and Willowvale shale at Willowvale by unconformity. Underlies Herkimer sandstone.

Well exposed at town of Kirkland, Oneida County.

Kirkman Limestone

Permian: Northeastern Utah.

A. A. Baker and J. S. Williams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 623 (fig. 4), 625–626. Gray to black in part sandy fetid limestone, commonly finely laminated and locally containing some oolitic phosphate. Maximum thickness 1,350 feet; thins southward to 75 feet in Spanish Fork; estimated thickness 500 feet at mouth of Kirkman Hollow. Conformably underlies Diamond Creek sandstone (new); overlies Oquirrh formation.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 588–589. Described in Strawberry Valley quadrangle. Forms almost continuous outcrop band from Bennie Creek northeast of Mount Nebo in southern Wasatch Mountains northeastward through south-central Wasatch Mountains; disappears beneath Tertiary cover in area between Left Fork of Hobble Creek and Round Valley of Provo Canyon. Thickness 375 feet in North Strawberry Valley. Underlies Diamond Creek sandstone.

Named for exposures in Right Fork of Hobble Creek at mouth of Kirkman Hollow, Utah County.

Kirkwood Formation[1]

Miocene, middle: Eastern New Jersey.

Original reference: G. N. Knapp, 1904, New Jersey Geol. Survey Ann. Rept. State Geologist 1903, p. 81–82.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 23, pl. 1. Shown on plate 1 as Arikareean and Hemingfordian.

Named for exposures at Kirkwood, Camden County.

Kirschberg Evaporite (in Edwards Limestone)

Cretaceous: Central Texas.

V. E. Barnes, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 40–43 [1944]. Name applied to bed of gypsum, approximately 35 feet thick, in Edwards limestone. Lies about 140 feet above base of Edwards.

Named for occurrence in Cherry Mountain area, Gillespie County. Deposits extend for 10 miles along east-west ridge of Edwards limestone northwest of Fredericksburg. Kirschberg is original German name for Cherry Mountain.

Kirtland Shale[1]

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: C. M. Bauer, 1916, U.S. Geol. Survey Prof. Paper 98–P.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Described in Red Mesa area, La Plata and Montezuma Counties, Colo. Consists of three members: unnamed lower shale, Farmington sandstone, and unnamed upper shale. Upper shale member includes 95 feet of pebble-bearing sandstone and sandy shale included in McDermott formation by Reeside (1924). Thickness about 1,125 feet. Overlies Fruitland formation; underlies Animas formation.

E. C. Beaumont and R. B. O'Sullivan, 1955, U.S. Geol. Survey Coal Inv. Map C–32. Mapped in Kirtland quadrangle. Upper and lower members composed principally of greenish-gray shale and separated by predominantly yellowish-green and gray Farmington sandstone member. Overlies Fruitland formation and underlies Ojo Alamo sandstone.

Named for exposures at Kirtland post office, San Juan County, N. Mex.

Kirtley Formation

Miocene: Central eastern Idaho.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 15, 21, 27–28, pl. 1. Proposed as substitute for name Carmen formation, which has been used elsewhere as formational name, and use here is discontinued. Although a little conglomerate occurs at or near base, formation characteristically without coarse clastic materials, consisting largely of moderately well-indurated thin-bedded fine-grained rocks, mostly shales with some intercalated sandstone and sandy shale. Good stratification in shales. Some beds highly siliceous; many are sandy. In Salmon quadrangle shale in places darkened by vegetable debris, otherwise, beds are white or light gray. Bentonitic beds not observed in North Fork quadrangle, though conspicuous farther south. Several hundred feet of beds exposed in southern part of North Fork quadrangle, but total thickness probably several times that amount. Text gives age as middle Miocene or younger; mapped as Miocene. Overlies Geertson formation.

Named from Kirtley Creek which flows across it near center of Salmon quadrangle. Extends less than 2 miles into southern part of North Fork quadrangle. Widespread south of lower Carmen Creek in more central part of Salmon Basin.

Kiser Gypsum Member (of Blaine Formation)[1]

Kiser Gypsum Member (of Flowerpot Shale)

Permian: Southwestern Oklahoma and western Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 55.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 30. Shown on chart as member of Flowerpot shale in western Texas.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 16, 17 (fig. 3), 18, pl. 1. Described in Carter area, Oklahoma, as greenish to reddish very shaly well-bedded gypsum, 2 to 5 feet thick. Occurs about 25 feet below top of Flowerpot; stratigraphically above Chaney gypsum member. Blaine formation redefined in this report.

Named for Kiser Salt Plain on Elm Fork of Red River, Greer County, Okla.

Kiskatom Formation[1] (in Hamilton Group)

Kiskatom Redbeds

Middle Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1932, Eastern States Oil and Gas Weekly, v. 1, no. 17, p. 7.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 273–279 [1946]. Kiskatom beds typically consist of an alternation of red and greenish or gray sandstones with interbedded green and red shales, sometimes dark shales. Estimated 2,300 feet of beds in Catskill front where they have maximum thickness. In this area, they include entire Ludlowville and Moscow formations and upper part of Skaneateles formation; west of Kingston, probably no more than the Ludlowville and Moscow, if all of the former; in northern Helderbergs and on Durham quadrangle, the major part of Skaneateles, the Ludlowville, and the Moscow.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 119–122. Redbeds described in Catskill and Kaaterskill quadrangles. Beds here termed Kiskatom reds, with thickness of 2,300 feet, prove to be Middle Devonian, Hamilton age. They are, at least, approximately, the beds formerly taken here to be Oneonta of Naples age (lower "Portage"), though early mapped as "Chemung." Moreover they are the beds to which the name "Catskill" was first applied among these Middle and Upper Devonian red strata. Overlie Ashokan flagstones; underlie Kaaterskill sandstones.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 15. Formation at top of Hamilton group. Maximum thickness in Albany County about 1,000 feet. Overlies Ashokan formation; underlies Onteora formation. These are continental red beds which were formerly regarded equivalent in age to Oneonta sandstone. Middle Devonian.

Kiskatom is in Greene County.

Kitchen Brook Dolomite (in Stockbridge Group)

Lower Cambrian: Western Massachusetts.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Fine-grained white to light bluish-gray, or white-weathering, yellowish-gray massive dolomite; thinner bedded and quartz-feldspar-calcite rich in upper part. Thickness at type locality 450 feet; in Pontoosuc Lake-Town Brook valley thickness may be in excess of 1,800 feet. In vicinity of MacDonald Brook, in Cheshire, the Kitchen Brook is cut out altogether by an unconformity beneath Berkshire schist. Nowhere in quadrangle can complete cross section through dolomite be seen; lower contact, with Cheshire quartzite, and upper contact, with Clarendon Springs dolomite, were not observed in field.

Type section: Along Kitchen Brook, in village of Cheshire, Cheshire quadrangle, Berkshire County.

Kitchener Quartzite[1]

Precambrian (Belt Series): Southeastern British Columbia, Canada, and northern Idaho and northwestern Montana.

Original reference: R. A. Daly, 1905, Canada Geol. Survey Summ. Rept. 1904, p. 96–100.

Named for station on Canadian Pacific Railway (in Kootenay Province of British Columbia).

Kitchi Schist[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 490, 492, 496.

W. T. Stuart, E. A. Brown, and E. C. Rhodehamel, 1954, Michigan Geol. Survey Tech. Rept. 3, p. 11 (table 3). Table of geologic formations of Marquette district shows Kitchi schist (Keewatin) below Palmer gneiss and above Mona schist.

Exposed on Kitchi Hills, in vicinity of Deer Lake, Marquette district.

Kite Group

Lower Devonian: South-central Oklahoma.

R. A. Maxwell, 1936, Northwestern Univ. Summ. of Doctoral Dissert., v. 4, p. 132, 134. Name applied to series of argillaceous limestone, cherty limestone, and shale. Thickness about 200 feet. Comprises Haragan formation below and Cravatt formation (new) above. Underlies Bois d'Arc limestone; unconformably overlies Henryhouse formation.

Occurs in Arbuckle Mountain region.

Kitsap Clay Member (of Orting Drift)

Pleistocene: Western Washington.

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 17–19, pl. 1. Consists chiefly of clay but contains strata of peat, sand, gravel, and glacial till. Member is well stratified; clay strata are, in most places, finely laminated, and sand and silt are in thin layers. Thickness less than 30 feet to more than 200 feet. Underlies Puyallup sand; overlies unnamed lower member of Orting gravel.

Type section: In sea cliff along Colvos Passage near Maplewood, in Pierce County, south of Kitsap County line, sec. 21, T. 22 N., R. 2 E.

Kittanning coal group (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania and Maryland.

Original reference: J. P. Lesley and I. C. White, 1876, Pennsylvania 2d Geol. Survey map of southern Butler County.

Named for town of Kittanning, Pa.

Kittanning Fire Clay (in Allegheny Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

See Lower Kittanning Clay.

Named for occurrence at Kittanning, Armstrong County.

Kittanning Formation[1] (in Allegheny Group)

Pennsylvanian: Western Pennsylvania.

G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, no. 25, p. 1108; 1926, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 65, p. 28, pl. 4. Allegheny group comprises (ascending) Clarion, Kittanning, and Freeport formations. Kittanning formation extends from top of Upper Kittanning coal to base of clay under Lower Kittanning coal.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 37–40. Discussion of Brookville quadrangle. Kittanning formation comprises (ascending) Lower Kittanning clay, Lower Kittanning coal, Middle Kittanning coal, Upper Kittanning sandstone, and Upper Kittanning coal. Overlies Clarion formation (with Lower Kittanning sandstone at top); underlies Freeport formation. Allegheny group.

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 65, 67. Formation, in Smicksburg quadrangle, comprises (ascending) Lower Kittanning coal, Middle Kittanning coals, Johnstown limestone, and Upper Kittanning coal. Overlies Clarion formation which includes Vanport limestone at top; underlies Freeport formation. Allegheny group; Pittsburgh series.

R. R. Dutcher, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 70 (fig. 5), 71, 82–114 (includes road log). Middle formation of Allegheny group. In area of present study [Armstrong, Cambria, Clearfield, and Jefferson Counties], formation is about 100 feet thick. Comprises (ascending) Lower Kittanning coal and clay, Middle Kittanning coal, and Upper Kittanning coal. About 50 feet of sedimentary rocks, principally sandstone and shale, lie between each of these beds. Recent studies indicate that at least three more beds are sufficiently distinctive and widespread enough to merit tentative names. Also subdivided into (ascending) unnamed lower part; Lower Kittanning marine shale; Middle Kittanning complex; Nicely Run siltstone and sandstone member (new); Upper Kittanning marine shale; and unnamed upper part. Formation is approximately equivalent to middle Des Moines rocks of Midcontinent region.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). Includes Lower, Middle, and Upper Kittanning coals. Overlies Clarion formation; underlies Freeport formation.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1 :250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as middle formation of Allegheny group.

Named for Kittanning, Armstrong County.

Kittanning Limestone (in Allegheny Formation)[1]

Pennsylvanian: Ohio.

Original reference: E. Orton, Jr., and S. V. Peppel, 1904, Ohio Geol. Survey Bull. 3, p. 92.

Probably named for Kittanning, Armstrong County, Pa.

Kittanning Sandstone Member (of Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 71. Kittanning (Clarion) sandstone discussed in Al-

legheny group in this report [Fayette County]. In standard section for southwestern Pennsylvania, both Kittanning and Clarion sandstones lie between Lower Kittanning and Clarion coals. Since the sandstones are normally separated by Vanport limestone, which is absent in Fayette County, it is difficult to say definitely whether sandstone lying below Lower Kittanning coal is the Kittanning or Clarion, but, because sandstone commonly occurs in upper part of interval, it is here called Kittanning. Average thickness about 10 feet.

Named for Kittanning, Armstrong County, Pa.

Kittanning Shale (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

See Lower Kittanning shale.

Named derived from Kittanning, Armstrong County.

Kittatinny Limestone[1]

Upper Cambrian and Ordovician: Northern New Jersey and eastern Pennsylvania.

Original reference: H. D. Rogers, 1840, New Jersey Geol. Survey 2d and Final Rept., p. 112.

R. L. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1694 (fig. 1), 1700 (fig. 2), 1704 (fig. 4). Figures 1, 2, and 4 (geol. maps) show Kittatinny limestone in eastern Pennsylvania. New Jersey term, Kittatinny, used here to include dolomitic limestones of Cambrian and Beekmantown age.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart as Upper Cambrian.

M. E. Johnson, 1950, geologic map of New Jersey (1:250,000): New Jersey Dept. Conserv. Econ. Devel. As mapped, consists of three units: lower—massive blue, blue-gray limestone with yellowish or silvery shale (Lower Cambrian); middle—light and dark medium-bedded limestones with cryptozoon heads (Upper Cambrian), unconformity; upper—thin and thick, gray or blue cherty magnesian limestone (Beekmantown), unconformity. Underlies Jacksonburg limestone; overlies Hardyston sandstone. Cambro-Ordovician.

F. B. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1357, 1366. New Jersey Survey designates its Cambrian and Ordovician limestone collectively as Kittatinny. This collective term not applicable in eastern Pennsylvania, and Cambrian sequence includes Hardyston quartzite (Chickies quartzite in Buckingham Valley), Leithsville limestone, Limeport formation (new), and Allentown formation.

First described in Kittatinny Valley, N.J.

†Kittatinny Sandstone[1]

Silurian: New Jersey.

Original reference: H. D. Rogers, 1840, New Jersey Geol. Survey 2d and Final Rept., p. 112.

Kittery Quartzite[1] (in Merrimack Group)

Kittery Formation

Probably Ordovician and Silurian: Southwestern Maine and southeastern New Hampshire.

Original reference: F J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in Merrimack group in New Hampshire. Probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 39–40. Age tentatively considered Silurian.

H. H. Woodward, 1957, Jour. Geology, v. 65, no. 1, p. 61, 67–69. Termed formation. Not quartzite according to usual definition.

Named for exposures in Kittery, York County, Maine.

†Kittitas System[1]

Eocene: Western central Washington.

Original reference: I C. Russell, 1893, U.S. Geol. Survey Bull. 108.

Well exposed in western part of Kittitas County.

Klamath Gravels[1]

Pleistocene: Northern California.

Original reference: N. E. A. Hinds, 1933, California Jour. Mines and Geology, v. 29, nos. 1, 2, p. 120–121.

Type locality: Near Red Bluff, Tehama County. Named for Klamath Mountains.

†Klamath Schists[1] or Schist Series[1]

Precambrian(?): Northern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 225–245. Klamath Mountains.

Kline Member (of Nesson Formation)

Jurassic: Subsurface in North Dakota and Montana, and Manitoba, Canada.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 104, 105–106, fig. 2. Uppermost member of formation; overlies Picard member (new); underlies Piper formation. At type section, consists of (descending) 34 feet of light-gray to white earthy dolomite and fine-grained sandstone; 13 feet of gray-green to purple calcareous shale containing white gypsum; 37 feet of light- to dark-brown finely crystalline limestone, oolitic in part and becoming shaly toward base; 63 feet of light-gray to buff fine- to medium crystalline limestone, earthy, gypsiferous and fossiliferous in part. Pinches out by nondeposition short distance east of Big Snowy uplift and wedges out in like manner on west flank of Bowdoin dome. On west margin of Williston Basin, unconformably overlies either Mississippian, Pennsylvanian, or Triassic beds.

Type section: Interval 4,386 to 4,533 feet in Price Drilling Co. No. 1, Kline well, center SE¼SE¼SE¼ sec. 16, T. 157 N., R. 85 W., Ward County, N. Dak.

Klondike Member (of Columbus Formation)[1]

Middle Devonian: Central Ohio.

Original reference: L. G. Westgate, 1926, Ohio Geol Survey, 4th ser., Bull. 30, p. 17, 22–25.

Wilber Stout and R. A. Schoenlaub, 1945, Ohio Geol. Survey, 4th ser., Bull. 46, p. 21. In southwestern Delaware County overlies Eversole chert member. Thickness about 45½ feet.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 121 (fig. 1). Chart shows Delhi (Klondike) as uppermost member of Columbus. Overlies Eversole member.

Well exposed at quarry of Scioto Lime & Stone Co., popularly known as Klondike quarry, Delaware County.

Klondike Mountain Formation

Oligocene: Northeastern Washington.

Hunting Geophysical Services, Inc., 1960, *in* Washington Div. Mines and Geology Rept. Inv. 20, p. 6. Youngest bedrock formation (aside from certain dikes) in Curlew quadrangle. Unconformably overlies Sanpoil volcanic rocks (new). Consists principally of layers of coarse clastic and pyroclastic rocks with local tuffaceous sandstone, conglomerate, and mudstone in lower part and thick black to gray glassy flows (calcic in composition) in upper part; locally lower part contains black glass, and upper part contains volcanic breccia Includes Tom Thumb member (new) at base. Republic quadrangle and part of Aeneas quadrangle mapped by Muessig and Quinlan (1959, U.S. Geol. Survey Open-file Rept.); Curlew quadrangle mapped by Calkins, Parker and Disbrow (1959, U.S. Geol. Survey Open-file Rept.).

Report discusses parts of Okanogan and Ferry Counties.

Klutina Group[1]

Carboniferous or older: Southeastern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 410, 413.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend under Mississippian rocks undifferentiated.

Forms most of mountains about Lake Klutina, Copper River region.

Knapp Formation[1]

Knapp Formation (in Conewango Group)

Devonian or Carboniferous: Southwestern New York and northern Pennsylvania.

Original reference: L. C. Glenn, 1903, New York State Mus. Bull. 69, p. 967–989.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Knapp sandstone shown on correlation chart as Devonian or Mississippian.

Bradford Willard, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 781–796. Discussion of continental-marine Mississippian relations in northern Pennsylvania. Marine Mississippian consists of Knapp formation including Kushequa shale and Marvin Creek "limestone." In region of marine-continental transition, Mississippian system represented by approximately 150 feet of beds. Marine fossils disappear eastward as discoidal-pebble conglomerates and sandstones of the Knapp merge with Pocono sandstone and conglomerate. Underlies Pottsville (or Olean); overlies Mount Pleasant shale or Oswayo formation.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33–34. Uppermost formation in Conewango group. Approximate thickness 20 feet in Chautauqua County, N.Y Overlies Oswayo formation. Upper Devonian.

Most eastern exposure is at Knapp's Creek Station, Cattaraugus County, N.Y.

Knapp formational suite[1]

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 111, table opposite p. 60.

Knapp monothem[1]

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls Am. Paleontology, v. 21, no. 71, p. 103–104.

Kneeling Nun Rhyolite Tuff

Miocene(?): Southwestern New Mexico.

F. J. Kuellmer and others, 1953, *in* New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 42 (map), 50 (map). Name appears on map explanations.

H L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 44–45, pl. 1. Pale lavender-gray and dark-brown welded tuffs with prominent quartz phenocrysts, columnar jointing. Thickness 10 to 200 feet. Disconformable contacts with Sugarlump tuffs below and Mimbres Peak formation above. Derivation of name.

W. E Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 25–27, pl. 1. In Dwyer quadrangle, Kneeling Nun consists of at least two distinct rhyolite beds. Thickness 200 to 400 feet. Conformable with Sugarlump tuffs and could be considered their uppermost member. Underlies Mimbres Peak formation.

Named after prominent rock monument which overlooks town of Santa Rita, Grant County. Kneeling Nun is isolated column of welded rhyolite tuff which stands short distance in front of high escarpment of same rock.

Knickerbocker Andesite

Pliocene or Pleistocene: Western Nevada.

V. P. Gianella, 1936, Nevada Univ. Bull, v. 30, no. 9, p. 33 (table), 73–76, pl. 1. Dark, almost black, massive pyroxene andesite. In vicinity of Knickerbocker shaft, phenocrysts constitute two-fifths of rock; groundmass is light-brown transparent glass. Thickness 200 feet. In general, this andesite overlies Alta andesite breccias (new). Older than American Flat basalt (new). Late Pliocene.

F. C. Calkins and T P. Thayer, 1945, Preliminary geologic map of the Comstock Lode district, Nevada: U.S. Geol. Survey. Upper Pliocene or Pleistocene.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 57, pl. 3. Calkins (oral commun.) states that lava at Knickerbocker shaft is Alta formation and that what Gianella (1936) described as Knickerbocker is best represented by outcrops on Basalt Hill. Knickerbocker andesite unit, as represented by exposures on Basalt Hill, has general resemblance to

pyroxene andesite member of Alta, but on fresh surface it is darker and on weathered surface is covered by characteristic buff-colored rind. Dikes of it cut Kate Peak formation. Geographical limits discussed. Age shown on plate as Pliocene or Pleistocene.

Typical occurrence is in vicinity of Knickerbocker shaft and another about 1,500 feet further to west. Distinguished only in Comstock Lode district, Virginia City quadrangle.

†Knife Slates[1]

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and J. M. Clements, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 401–409, map.

Named for Knife Lake, Vermilion district, where they are well developed.

Knife Lake Group

Knife Lake Series[1]

Precambrian: Northeastern Minnesota.

Original reference: F. F. Grout, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 992–995.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1029–1041. Knife Lake series divided into (ascending) Moose Lake conglomerate (or Saddlebag Lake conglomerate), Dike Lake slate, Ogishke group (including Peebles conglomerate, West Gull conglomerate, and Zeta Lake conglomerate), and Knife Lake slate (including tuffaceous slate and graywacke, Agawa iron-formation, argillite, tuff and agglomerate).

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1519–1618, pl. 1. Knife Lake series is continental in origin and comprises rocks formerly called Ogishke conglomerate, Agawa iron-formation, and Knife Lake slates. Includes many members (table 1 lists 20); these cannot be separated into three former divisions. No basal conglomerate exists in the sense in which Ogishke conglomerate exists. No distinct Agawa formation present. Conglomerates appear at any horizon in series, and small lenses of iron formation are not restricted to any particular horizon. Named units include (not in sequence): Disappointment Mountain and Moose Lake greenstone conglomerates, Jasper Lake greenstone conglomerates and agglomerates, Ogishke granite pebble conglomerate, Amoeba Lake graywackes, slates, and tuffs, Ensign Lake green slates, tuffs, and graywackes, Kekekabic Lake tuffs, agglomerates, slates, and andesite porphyry, Ensign-Snowbank Lake agglomerates, Ester Lake graywackes, slates and tuffs, Crooked Lake granite pebble conglomerate, and Agamok sediments. Unconformable below Animikie series and above Laurentian series.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1031–1036, 1073–1074, 1075. Summary discussion. In Minnesota, Knife Lake group rests unconformably on Keewatin greenstone and an old granite intrusive into the greenstone; it is intruded by Algoman granite; both the Knife Lake and Algoman granite are overlain unconformably by Animikie group. Thickness 11,500 to 21,000 feet. Correlation with Huronian groups is not certain.

Type locality: Knife Lake, on boundary of Minnesota and Ontario. Exposed westward to vicinity of Lake of the Woods.

†Knife Lake Slates[1]

Precambrian : Northeastern Minnesota.

Original reference: C. R. Van Hise and J. M. Clements, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 401–409, map.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1640. Knife Lake slates included in Knife Lake series.

U.S. Geological Survey has abandoned the term Knife Lake Slates. Approved name is Knife Lake Group.

Named for exposures at Knife Lake.

Knifeton Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series) : Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann Field Conf., p. 18, 20, 22; 1938, Kansas Acad Sci. Trans., v. 41, p. 193, 196. Cherokee group divided into 15 cyclic formational units. The Knifeton, fifth in sequence (ascending), occurs above the Bluejacket and below the Weir. Average thickness about 24 feet. Includes 8-inch coal bed here named Knifeton. [For complete sequence see Cherokee group.]

Type locality and derivation of name not given. Cherokee outcrop in Kansas covers area of about 1,000 square miles and includes parts of Labette, Bourbon, Crawford, and Cherokee Counties.

Knight Conglomerate

Knight Formation (in Wasatch Group)[1]

Knight Member (of Wasatch Formation)

Eocene : Southwestern Wyoming and northeastern Utah.

Original reference: A. C. Veatch, 1907, Jour. Geology, v. 15, p. 547–549.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 60, 61, 62–63. In south-central Sublette County, considered member of Wasatch formation. Overlies New Fork tongue (new) of Wasatch. Conformably underlies Fontenelle member (new) of Green River formation. Early Eocene.

A. J. Eardley, 1952, Utah Geol. Soc. Guidebook 8, p. 52. In northeastern Utah, where Fowkes formation is absent, Knight conglomerate unconformably overlies Almy conglomerate; underlies Norwood tuff and related Park City volcanics. Middle Eocene.

W. J. Morris, 1955, Dissert. Abs., v. 15, no. 3, p. 394. Name Knight extended from Bridger basin into Washakie basin to include dominantly fluviatile Wasatchian deposits. Includes Hiawatha member and Cathedral Bluffs tongue.

M. C. McKenna, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 105. Term Knight formation rejected as junior synonym of Wasatch formation.

B. E. Lofgren, 1955, Utah Geol. Soc. Guidebook 10, p. 74 (table 1), 75. Discussion of Tertiary stratigraphy in Ogden Valley. Thickness of Knight conglomerate about 1,200 feet. In Echo Canyon, Eardley (1944) mapped Almy conglomerate and subdivided it into Saw Mill conglomerate and underlying Pulpit conglomerate, these being separated by angular discordance of 5° to 30°. Since Eardley's original mapping, he and thesis students have remapped area and now consider Saw Mill conglomerate as Knight.

N. C. Williams and J. H. Madsen, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 123 (fig. 1). In Coalville area, Utah, Knight formation, 2,000 feet thick, unconformably overlies Echo Canyon conglomerate (new).

J. I. Tracey, Jr., and S. S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 128, 129, 130. Discussion of stratigraphy of Fossil basin, Wyoming. Confusion in original definition of Almy, Fowkes, and Knight formations as subdivisions of Wasatch group, and their areal distribution as mapped in much of basin, has led to serious doubt as to the validity of these names, particularly as the names Almy and Knight have been widely used in distant areas. It is hoped that future work will clarify the subdivisions of the Wasatch in the area and perhaps relate them to subdivisions in Bridger basin. At present, use of names Almy and Knight seem inadvisable without explicit statements as to their meaning.

Named for Knight Station, Uinta County, Wyo.

Knight Ranch Conglomerate (in Strawn Group)

Pennsylvanian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, pl. 20. Shown on columnar section as thin conglomerate about 250 feet below Rochelle conglomerate.

Occurs in Brady area, McCulloch County.

Knik Glaciation

Pleistocene: Alaska.

T. N. V. Karlstrom, 1957, Science, v. 125, no. 3237, p. 74 (fig. 1). Named on correlation chart of glacial events. Recognized in Cook Inlet area. Y[illegible] er than Eklutna glaciation and older than Naptowne glaciation.

R. D. Miller and Ernest Dobrovolny, 1959, U.S. Geol. Survey Bull. [illegible] 12–54, pl. 3. Youngest pre-Wisconsin glaciation in Anchorage [illegible] Represented by sorted and unsorted drift that forms deposits of a[illegible] outwash, lateral moraine, ground moraine, pitted outwash, and g[illegible] vial and ice-contact deposits. Includes Bootlegger Cove clay (new), which locally separates Knik from overlying Naptowne deposits. Till and advance outwash of Knik glacier locally overlie truncated surface of Eklutna till.

Knob Creek facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 163–167.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Knob Creek facies listed in Carwood formation.

Name derived from Knob Creek, near Edwardsville, Floyd County.

Knob Hill Andesite

Eocene: North-central Washington.

L. B. Wright, 1947, Am. Inst. Mining Metall. Engineers Tech. Pub. 2197, p. 5. Felspar-rich series of flows about 525 feet thick. Overlain by Miocene shales; underlain by tuffaceous and coarsely fragmental flows resting on folded Paleozoic basement.

Occurs at Knob Hill mine, Republic mining district. Traced along crest of low northward-plunging Republic anticline.

Knob Lick Granite[1]

Precambrian: Southeastern Missouri.

Original reference: C. R. Keyes, 1895, Missouri Geol. Survey Sheet Rept. 4, v. 9, p. 18, 19, 24.

Named for Knob Lick, St. Francois County.

†Knob Noster Group[1]

Pennsylvanian: Central western Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Iron Ores, pt. 2, p. 169, 176.

Named for exposures at Knob Noster, Johnson County.

Knobsville (continental) Beds[1]

Middle Devonian: South-central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Pal. Soc. Feb. 28, p. 202, 214, 215, 221.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 199–200. Knobsville continental beds are phase of Mahantango formation and are made up of red and green beds devoid of marine organic remains except for a few poorly preserved specimens of dubious identity which occur at margins of deposit where it passes over into marine strata. This passage is gradual and determines Hamilton age of lower part of the Knobsville. Continental beds thicken eastward until lost through erosion toward Franklin County line.

Well developed between Knobsville and Hustontown, Fulton County, and northward toward Fort Littleton, where they are exposed in highway cuts.

[redacted]own Sand[1] or Sandstone (in Pleasanton Group)

[redacted]ennsylvanian (Missouri Series): Western Missouri and eastern Kansas.

[redacted]iginal reference: F. C. Greene, 1933, Missouri Bur. Geology and Mines [redacted]7th Bienn. Rept., p. 13, 19, App. 2, pl. 2.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 91. In Linn and Miami Counties, upper part of Pleasanton group partly occupied by massive sandstone (Knobtown) which is locally as much as 25 feet thick.

F. C. Greene and W. B. Howe, 1952, Missouri Geol. Survey and Water Resources Inf. Circ. 8, p. 6, 16. Lies above position of Exline limestone. Thickness about 5 feet in Kansas City area.

Named for outcrop north of Knobtown, Jackson County, Mo., on U.S. Highway 50, sec. 22, T. 48 N., R. 32 W.

Knowlton Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S.. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Knowlton mine, Ontonagon County.

Knowlton Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Knox Dolomite[1] **or Group**

Upper Cambrian and Lower Ordovician: Eastern Tennessee, northwestern Georgia, western North Carolina, and southwestern Virginia.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 151, 158–159, 203–226.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 16–18, geol. map. Knox dolomite used in this report for map unit that corresponds nearly to Knox dolomite of type region. Difference is that Newala limestone, which in Georgia overlies the Knox of the region, is included in the typical Knox. Knox of Georgia includes rocks that in Alabama, Tennessee, and Virginia have been separated into (ascending) Copper Ridge dolomite, Chepultepec dolomite or limestone, and Longview or Nittany dolomite. While these units have been recognized in Georgia, the conditions of exposures and scarcity of fossils make their accurate separation impossible without much more detailed investigation than time permitted for present report. Knox of Georgia includes Longview at top and Chepultepec next below. Whatever Knox there is below the Chepultepec and down to the Conasauga is Copper Ridge. Estimated thickness 3,500 feet. Cambrian and Ordovician (U.S. Geological Survey) or Ozarkian and Canadian (of Ulrich).

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 14–32. Referred to as group in Lee Valley, Hawkins County. Comprises (ascending) Copper Ridge dolomite, Chepultepec dolomite, Longview dolomite, Kingsport limestone, and Mascot dolomite.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104, 2 sheets. Group, in Jonesville district, Lee County, Va., comprises Copper Ridge, Chepultepec, Longview, Kingsport, and Mascot dolomites. Overlies Chances Branch dolomite member of Maynardville limestone; underlies Dot limestone (new).

A. C. Munyan, 1951, Georgia Geol. Survey Bull. 57, p. 38–49. Mapped as Knox dolomite in Dalton quadrangle. Undifferentiated. Overlies Conasauga formation; underlies Newala formation.

R. B. Neuman, 1951, Am. Jour. Sci., v. 249, no. 10. p. 744 (table 1). Discussion of Great Smoky fault. Generalized stratigraphic sequence shows Knox group, undivided, 2,000 feet thick. Underlies Mosheim and Lenoir limestones; overlies Rome formation, sequence broken by fault.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 53–64, pls. For present map, the Knox extends from top of Maynardville limestone to marked disconformity, observable everywhere in east Tennessee between Lower and Middle Ordovician rocks. Where Knox is divided into formations, it is referred to as group; where not subdivided, it is considered a formation, Knox dolomite. Where fully subdivided, consists of (ascending) Copper Ridge dolomite, Chepultepec dolomite, Longview dolomite, Kingsport formation, and Mascot dolomite.

A. T. Allen, 1953, Georgia Geol. Survey Bull. 60, p. 178–179. Report gives measured sections of Knox dolomite near Graysville. Comprises (ascending) Copper Ridge, Chepultepec, Longview, and Newala formations. Approximate total thickness 4,500 feet. Contact between Copper Ridge and underlying Conasauga indefinite at this locality. Top of Knox overlain by Blackford formation.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 41–62, table 1, pls. Group described in Rose Hill district, Lee County, where it

is about 2,300 feet thick and comprises (ascending) Copper Ridge, Chepultepec, Longview, Kingsport, and Mascot dolomites. Underlies Murfreesboro limestone; overlies Chances Branch member (new) of Maynardville limestone.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. In Shooks Gap quadrangle, Tennessee, group composed of 2,600 to 3,000 feet of dolomite and limestone. Comprises (ascending) Copper Ridge dolomite, Chepultepec, Longview, and Newala (Kingsport and Mascot undifferentiated).

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 7 (fig. 2), 21–24, pl. 1. Knox group as used in this report [Mascot-Jefferson City Zinc district, Tennessee] comprises all strata above Maynardville limestone member of Nolichucky shale and below Lenoir limestone or its Mosheim member. It is virtually the Knox dolomite of Knoxville, Maynardville, and Morristown folios (Keith, 1895, 1901, 1896). Divided into (ascending) Copper Ridge dolomite of Late Cambrian age and Chepultepec, Longview, Kingsport, and Mascot formations of Early Ordovician age. Historical summary of usage of name.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 55–57, pl. 1. Group, in northeasternmost Tennessee, comprises Conococheague limestone and Jonesboro limestone. Overlies Conasauga group; underlies rocks of Middle Ordovician age (Lenoir limestone at base). Thickness about 3,000 feet in Denton Valley.

Named for development in Knox County, Tenn.

Knox Gneiss[1]

Precambrian: Central southern and eastern Maine.

Original reference: E. H. Perkins and E. S. C. Smith, 1925, Am. Jour. Sci., 5th, v. 9, p. 204–288.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1.
Mentioned in report on aeromagnetic and geologic reconnaissance survey of parts of Hancock and Penobscot Counties. Appears to be older than surrounding formations but not necessarily equivalent to Ellsworth.

Probably named for occurrence in town of Knox, Waldo County.

†Knox Group[1]

Lower, Middle, and Upper Cambrian and Lower Ordovician: Eastern Tennessee, northern Alabama, northwestern Georgia, and western North Carolina.

Original reference: J. M. Safford, 1869, Geology Tennessee, p. 151, 158–159, 203–226.

Crops out in greater part of surface of East Tennessee Valley. Probably named for Knox County, Tenn.

†Knox Sandstone[1]

Lower Cambrian: Eastern Tennessee, northern Alabama, northwestern Georgia, and western North Carolina.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 151, 158–159, 203–226.

Named for Knox County, Tenn.

†Knox Shale[1]

Middle and Upper Cambrian: Eastern Tennessee, northern Alabama, northwestern Georgia, and western North Carolina.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 151, 158–159, 204–226.

Named for Knox County, Tenn.

Knox Mountain Granite[1]

Age(?): Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept.

V. R. Murthy, 1957, Vermont Geol. Survey Bull. 10, p. 79–81. Outcrop area extends from East Barre area [this report] northward into Plainfield and St. Johnsbury quadrangles. Although a separate name is given to this granite, Knox Mountain granite and Barre granite may be separate outcrops of single plutonic body. No positive evidence to attest such relationship attainable for this report. Age not stated Rb/Sr age determination on Barre granite gave 330±25 million years. This suggests a Silurian age for the granite, but it is only slightly higher for Middle Devonian.

Named for Knox Mountains in East Barre quadrangle.

Knoxville Formation[1]

Knoxville Series

Upper Jurassic: California and Oregon.

Original reference: C. A. White, 1885, U.S. Geol. Survey Bull. 15, p. 19–32.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [reprint 1941]; 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 909–1014. Knoxville series subdivided into (ascending) Elder Creek, Grindstone, and Newville groups (all new). Maximum thickness more than 16,000 feet. Underlies Paskenta group, Shasta series. Jurassic (early-middle Portlandian to latest Tithonian).

N. L. Taliaferro, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 2, p. 109–219. Franciscan-Knoxville problem discussed. Term Knoxville used here for sediments and volcanics above what is commonly regarded as Franciscan and below Lower Cretaceous. As commonly described, Knoxville consists of thick series of shales, with minor amounts of sandstone and conglomerate. This is adequate description of bulk of Knoxville in many localities, but it ignores certain important rocks in some localities and entire sections in other regions. Although there is a lithologic difference between Franciscan and Knoxville in many areas, this difference is not universal and types commonly regarded as Franciscan are in many places found in what must be called Knoxville on basis of fauna. The unconformity between Franciscan and Knoxville reported by many writers, is not supported by field evidence. Knoxville is here regarded as upper phase of the Franciscan, and it is suggested that name Franciscan-Knoxville group be used for entire sequence.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18 (table 3), 31–39, pls. In this report [Coast Ranges immediately north of San Francisco Bay region], Knoxville formation is included in Shasta series. In some areas, Knoxville formation, as used here, may include the Horsetown. Thickness about 11,000 to 13,230 feet. No depositional contact noted with Franciscan formation; most areas contacts are along thrust or normal faults.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 26–30, pl. 1. Generalized stratigraphic column (fig. 4) and geologic map of San Jose-Mount Hamilton area shows Knoxville formation above Franciscan formation and below Oakland conglomerate(?). Discussion of unit under heading of Knoxville(?) formation.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 11, 12 (fig. 2), pl. 1. For purposes of mapping in Lower Lake quadrangle, Franciscan-Knoxville group as defined by Taliaferro has been separated into two units, Franciscan group and Knoxville group. Knoxville, which consists mostly of shale, is about 10,000 feet thick. Underlies undifferentiated Cretaceous which in turn is overlain by Martinez formation. Upper Jurassic.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Formation, in Hayward quarangle, unconformably overlies Franciscan group and underlies Oakland conglomerate. Late Jurassic.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Franciscan group is widely held to be restricted to Late Jurassic age, the Knoxville formation to be an upper shaly phase of the Franciscan group, and the two to be overlain unconformably by detrital strata of Cretaceous age. Paleontologic evidence indicates this view to be incorrect. Rather, Franciscan group seems mainly to have been deposited contemporaneously with the Knoxville, Paskenta, Horsetown, and lower upper Cretaceous strata. Franciscan group of Coast Ranges and strata of Sacramento Valley section may represent two facies of same stratigraphic section.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2776, 2783. Name Riddle formation (new) replaces Jurassic part of Knoxville formation as used by Diller and Kay (1924, U.S. Geol. Survey Geol. Atlas, Folio 218) in southwestern Oregon. Name Days Creek formation (new) replaces Horsetown formation and Cretaceous part of Knoxville formation as used by Diller and Kay.

Named for exposures at Knoxville, Napa County, Calif.

†Knoxville Marble[1]

Lower Ordovician (late Chazy) : Eastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 105, 117, 121.

Named for Knoxville, Knox County, near which it is exposed.

Knoxville Member (of Pascagoula Formation)

Miocene : Southwestern Mississippi.

Mississippi Geol. Soc., 1940, Mississippi Geol. Soc. [Guidebook] Field Trip, Feb. 10–11, p. 4. Referred to as Knoxville zone in Pascagoula formation.

G. F. Brown and W. F. Guyton, 1943, Mississippi Geol. Survey Bull. 56, p. 22. Name Knoxville preoccupied; unit renamed Homochitto member. Underlies Fort Adams members.

Present in Franklin and Wilkinson Counties.

Kodak Sandstone (in Clinton Group)

Kodak White Sandstone[1]

Middle Silurian : Western New York.

Original reference: G. H. Chadwick, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 5, p. 702.

D. W. Fisher, 1953, Buffalo Soc. Nat. Sci. Bull., v. 21, no. 2, p. 29. Chadwick (1935) was of opinion that Thorold sandstone was absent at Rochester because grayish-white sandstone there did not contain *Arthrophycus*, which he regarded as indicative of the Thorold. To this presumably younger sandstone beneath Maplewood shale he applied name Kodak white sandstone. There is no necessity for name Kodak because *Arthrophycus* has since been found in this sandstone at Rochester.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Because "Thorold" of Gillette (1947) is not continuous with type Thorold at Thorold, Ontario, name Kodak (Chadwick, 1920 [?]) is revived for basal sandstone of Clinton group in New York, Ontarian stage. Middle Silurian.

Type exposure: Lower Genesee Gorge from lower falls to Kodak Park, Rochester, Monroe County.

Koehler Limestone (in Traverse Group)

Middle Devonian: Northern Michigan.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 448 (fig. 1), 450 (fig. 2), 454–455. Defined to include gray bedded dense limestones of sublithographic texture, which are known to overlie Killians black limestone member of Genshaw formation (redefined), and unconformably underlie Gravel Point limestone. Estimated thickness (substantiated by well cuttings) 30 to 40 feet.

Type locality: Abandoned quarry of Campbell Stone Co., 1 mile north of village of Afton, Koehler Township, Cheboygan County.

Kofa Volcanics

Cretaceous: Southwestern Arizona.

E. D. Wilson, 1960, Geologic map of Yuma County, Arizona (1:375,000): Arizona Bur. Mines. Flows, dikes, and plugs of andesitic to rhyolitic composition.

Type locality and derivation of name not given.

Kogosukruk Tongue (of Prince Creek Formation)

Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Nonmarine unit consisting largely of clay, silt, and shale. Bony coal and bentonitic beds common. Sandstone rare and only one conglomerate, 15 feet thick, has been mapped. Uppermost tongue of formation. Total thickness along Colville River is 2,340 feet but this includes marine units of Sentinel Hill member (new) of Schrader Bluff formation (new). In outcrop belt, overlies Tuluga member (new) of Schrader Bluff formation and is covered by thin mantle of Gubik formation.

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 253, fig. 4. Overlies and intertongues with Sentinel Hill member of Schrader Bluff formation.

Named from Kogosukruk River, along which it is well exposed. Equally good if not better exposures readily accessible along Colville River from near its confluence with Anaktuvuk River to Ocean Point just north of 70th parallel.

Koipato Formation[1] or **Group**

Permian and Lower Triassic: Northern Nevada.

Original references: Clarence King, 1876, U.S. Geol. Expl. 40th Par. Atlas, map V; 1878, U.S. Geol. Expl. 40th Par., v. 2, p. 267–278.

H. E. Wheeler 1939, Jour. Paleontology, v. 13, no. 1, p. 105–107. Permian and possibly Triassic at least in part. Thickness 14,000 feet in Humboldt Range.

S. W. Muller and H. G. Ferguson, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1590. Disconformably underlies Star Peak formation.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Rhyolite and trachyte flows, breccias, and tuffs, some andesite, small amounts of conglomerate, sandstone, and tuffaceous slate. In East Range in lower plate, thickness over 4,500 feet; in Sonoma Range, in upper plate, thickness 300 feet or less, in places missing. Permian.

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Rank raised to group. In Buffalo Mountain quadrangle, includes Rochester trachyte below and Weaver rhyolite above. Underlies Star Peak group. Permian, Permian(?), and Triassic.

U. S. Geological Survey currently considers the Koipato to be Permian(?) and Lower Triassic in age.

First described from West Humboldt Range. Koipato is Indian name for West Humboldt Range.

†Koipatoan series[1]

Middle(?) Triassic: Northern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 59, 79.

Named for exposures in West Humboldt Range, Humboldt County, the Indian name for which is Koipato.

Kokernot Formation

Recent: Southwestern Texas.

C. C. Albritton, Jr., and Kirk Bryan, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. On basis of disconformities in valley-fill complex the Quaternary (late Pleistocene) has been divided into (ascending) Neville, Calamity, and Kokernot formations.

C. C. Albritton, Jr., and Kirk Bryan, 1939, Geol. Soc. America Bull., v. 50, no. 9, p. 1441–1442, 1445–1446, 1450–1451, 1453–1454. Consists predominantly of uncemented quartz sand and silt with interbedded gravel lentils, Contains cultural material at top and bottom; pottery in upper layers shows that beds were deposited within interval 1100–1400 A. D. Thickness varies from less than 1 foot to 13 feet. At type locality, rests disconformably on both Neville and Calamity formations.

Type locality: West bank of Calamity Creek 1 mile northwest of Neville's ranchhouse, Brewster County. Exposed in section at top of Arroyo banks. Named for Kokernot Ranch.

Koko Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 104–105. Well-bedded gray to brown tuff, partly palagonitized, forming row of cones including Koko Head; and five associated small lava flows of alkali olivine basalt. Includes Koko Crater tuff, Koko Head tuff, Hanauma Bay tuff, and Kaohikaipu lava (Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1), none of which are regarded as formal names. Overlies Koolau volcanic series with steep erosional unconformity; also soil-covered emerged reef of plus 25-foot (Waimanalo) stand of sea. Extent noted.

Named for Koko Head and Koko Crater, which are cones composed of the tuff. Covers area of about 3 square miles extending northeastward from Koko Head, 2 to 5 miles southwest of Makapuu Head.

Kokomo Limestone[1]

Upper Silurian: Central Indiana.

Original reference: A. F. Foerste, 1904, Indiana Dept. Geology and Nat. History 28th Ann. Rept., p. 33.

J. B. Patton, 1949, Indiana Div. Geology Prog. Rept. 3, p. 13. Gray to brown banded dolomitic limestone, much of which is finely laminated. Although usually described as argillaceous, analyses show little alumina. At Kokomo and near Peru, upper beds are contorted, faulted, and recemented. Unconformably overlies Liston Creek, Mississinewa, and Niagaran reefs; underlies Kenneth limestone or Middle Devonian limestone. Has been considered Cayugan, but upper part may be Devonian.

Named for exposures at Kokomo, Howard County.

Kolekole Volcanics

Pleistocene(?): Oahu Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 77. Lavas and cinders from secondary eruptions on Waianae Range. Probably correlative with secondary eruptions on Koolau Range. Pleistocene.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc, 2, p. 105. Overlie Waianae volcanic series and decomposed alluvium with erosional disconformity. Thickness about 6 feet. Pleistocene(?).

Crops out near Kolekole Pass in Waianae Range.

†Kolmakof Series[1]

Late Paleozoic to Tertiary(?): Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 161–163, 182.

Crops out along right bank of Kuskokwim River between Kolmakof and beginning of low silt plain just above entrance to Yukon portage route above Kalchagamut.

Koloa Volcanic Series

Koloa Series

Pleistocene and Recent: Kauai Island, Hawaii.

N. E. A. Hinds, 1930, Bernice P. Bishop Mus. Bull. 71, p. 57, 58. Term Koloa series applied to lavas and pyroclastics erupted during Koloa volcanic episode.

H. T. Stearns, 1946, Hawaii Div. Hydrog. Bull. 8, p. 85, 87–89. Volcanic series composed of olivine basalts and ultrabasic rocks carrying nepheline

and melilite. Separated from Waimea and Haupu volcanic series (new) by angular erosional unconformity.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1964, Volcano Letter 526, p. 2 (fig. 1). Overlies Waimea Canyon series [replaces term Waimea series]. Underlies Palikea formation (new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 105–106. Pleistocene and Recent. Type locality stated.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 52–87, table facing p. 20, pl. 1. Koloa volcanic series, as herein defined, is that series of volcanic rocks and closely associated sedimentary rocks laid down on rocks of Waimea Canyon volcanic series and separated from them by profound erosional unconformity. Series includes lava flows of olivine basalt, nepheline basalt, melilite-nepheline basalt, and basanite, related cinder and tuff cones and ash beds, and closely associated or intercalated sedimentary breccia and conglomerates (Palikeo formation). Maximum exposed thickness 2,100 feet. A large part of the series was during Pleistocene epoch, but it is possible that Koloa eruptions began during the Pliocene.

Type locality: Vicinity of town of Koloa, on south side of island. Widely distributed over eastern two-thirds of island.

Kolosh Member (of Kialagvik Formation)

Lower Jurassic: Southwestern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1). Upper part of member of platy to massive medium-grained to conglomeratic greenish-gray sandstone 200 feet thick. Lower part of interbedded sandstone and shale becoming predominantly sandstone at top; 300 feet thick. Overlies Aleuts member (new); underlies Cynthia Falls member (new) of Tuxedni formation.

Kialagvik formation is recognized on Iniskin-Chinitna Peninsula.

Kona Dolomite[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 523.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1436 (table 1), 1461. Palmer gneiss, previously considered pre-Huronian, consists of metamorphic Mesnard quartzite, Kona dolomite, Wewe slate, and Ajibik quartzite. Table 1 shows lower Huronian sequence in Marquette area (ascending) Mesnard, Kona, Wewe. Palmer gneiss not listed on this table.

Composes Kona Hills, on east shore of Goose Lake, Marquette district.

Kona Tuff Formation

Pleistocene(?) and Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 90–91. Very fine grained yellow-brown palagonite ash with small amounts of fragments of olivine and feldspar crystals. Thickens gradually upslope from few inches to 5 feet; forms continuous mantle on mountain; grades into cinder cones at summit.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 142; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others,

1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 106. Included in Hualalai volcanic series (new).

Type locality: Kona district on west side of island. Exposed on southwest slope of Hualalai volcano.

Konawa Formation[1] (in Pontotoc Group)

Permian: East-central Oklahoma.

Original reference: G. D. Morgan, 1924, Bur. Geol. [Oklahoma] Bull. 2, p. 140–141, pls. 3, 27, map.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 108–115, pl. 1. Further described in type area. Composed of shales, sandstones, and conglomerates. Shales are thick, varied in color, with red predominating; sandstones are commonly soft, and buff in color; includes two distinctively colored chert assemblages: dark chert conglomerates, here named Maud chert conglomerate member, and multicolored chert conglomerates, here named Jarvis Church conglomerate member. Thickness 600 to 800 feet; formation thickens downdip. Rests with local unconformity on Vanoss (uppermost Pennsylvanian) formation; contact at top of formation (Asher-Konawa following Morgan) appears to be marked by local unconformity.

A. E. West, 1960, Shale Shaker, v. 11, no. 3, p. 4–7. In this report [Lincoln County], formation includes (ascending) Brownville, Americus(?), Long Creek, and Red Eagle limestone members. For purposes of this report, base of formation is defined as top of Grayhorse limestone; top of formation not distinguishable in area. Pennsylvanian and Permian(?).

Type locality: Town of Konawa, Seminole County, located on extreme western edge of outcrop.

Konocti Volcanics (in Clear Lake Volcanic Series)

Quaternary: Northern California.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), pl. 7. Quartz-, olivine-, and sanidine-bearing dacitic and andesitic lavas 100 to 1,500 feet thick. Shown on columnar section as uppermost unit of series above 50–700 foot unit of obsidian, but age relations of individual units of series are imperfectly known because some units are isolated and contacts of contiguous flows are commonly obscured by sliding.

Covers about 15 square miles south of Clear Lake, Lower Lake quadrangle, in Coast Ranges about 70 miles north of San Francisco. Volcanics also extend beyond quadrangle boundary where they build up Mount Konocti.

Koochiching Granite[1]

Precambrian (Laurentian): Northern Minnesota.

Original reference: A. N. Winchell, 1897, Am. Geologist, v. 20, p. 293–299.

Occurs 2 miles west of Rainy Lake.

Koolau Volcanic Series[1]

Koolau Basalt Series

Pliocene(?): Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30.

H. T. Stearns, 1946, Hawaii Div. Hydrog. Bull. 8, p. 75 (table), 77 (chart), 78. Exposed thickness of flows about 3,000 feet. Consists of thin-bedded pahoehoe and aa with small amount of ash. Includes Kailua volcanic

series, lavas of which are believed to have accumulated in caldera of Koolau volcano. Separated from Waianae volcanic series by erosional unconformity. Older than Honolulu volcanic series.

C. K. Wentworth and Horace Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 49–78. Referred to as Koolau basalt series.

G. A. Macdonald and D. A. Davis, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 106–107. Name Koolau volcanic series preferable because consonant with terminology used in describing rocks on other Hawaiian Islands. Includes all lava flows, intrusive rocks, pyroclastics, breccias, and intercalated soil beds making up Koolau Range except those (Honolulu volcanic series) concurrent with erosion of great valleys on its slope. Pliocene(?). Age assignment on basis of degree of weathering and erosion, and unconformable relationships to later Pleistocene rocks and shore lines. Notes on distribution.

No single type locality designated. Well exposed in Nuuanu Pali, the cliff that faces northeastward along northeastern side of range. Crops out over about 500 square miles.

Kootenai Formation[1]

Lower Cretaceous: Southern Alberta and British Columbia, Canada, and Montana.

Original references: Notes and News (J. W. Dawson?), Sci., v. 5, 1885, p. 531–532; G. M. Dawson, 1886, Canada Geol. Survey, new ser., v. 1, p. 126B–134B, 162B–167B.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1268–1270. Discussion of marine Jurassic formations of Sweetgrass arch, Montana. Overlying Ellis group (herein redefined to include Sawtooth, Rierdon, and Swift formations) are continental beds of Upper Jurassic and Lower Cretaceous age. These beds, 348 to 1,300 feet thick, are divisible into three units. Lower unit, as much as 310 feet thick, rests conformably on Swift formation and consists chiefly of fine-grained rocks, largely clay shale and mudstone, dense gray limestone, and fine to very fine-grained gray and brown sandstone. This unit is considered as Morrison and the other two units, as much as 1,000 feet thick, as Kootenai. West of Kevin-Sunburst dome, the Kootenai rests unconformably on Morrison, Swift, and Rierdon formations. Understanding of this unconformity is important in interpretation of Morrison-Kootenai beds. Cut Bank sandstone is base of Kootenai locally, and younger Sunburst sandstone or bentonitic mudstone is base of formation over rest of Sweetgrass arch area.

R. W. Brown, 1946, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 238–248. Fossil plants support hypothesis that an unconformity in basal part of Kootenai formation in Montana, as it has been generally defined in the literature, and at base of Blairmore formation in Canada, marks Jurassic-Cretaceous boundary. Comparison of floras on both sides of unconformity heightens probability that the part of the Kootenai below the unconformity is to be included in the Morrison, which then is likely equivalent in whole or in large part to Kootenay of Canada, and that the part of the Kootenai of the United States corresponds in large part with lower Blairmore of Canada. Flora of upper part of the Kootenai and of lower Blairmore is an accepted Lower Cretaceous flora.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 241. Beaverhead formation (new) unconformably overlies Creta-

ceous Kootenai, Triassic Dinwoody, and Permian Phosphoria. Angular disconcordance of about 25° between Beaverhead and Kootenai exposed in SW¼SE¼ sec. 11, T. 8 S., R. 10 W., near junction of Grasshopper Creek and Beaverhead River, Mont.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 107–109. Marine formation, chiefly mudstone, siltstone, and sandstone. Crops out along north flank of Little Belt Mountain uplift, along Disturbed belt, and in part of Sweetgrass Hills. Thickens southwestward from about 350 feet near Sweetgrass Hills to more than 1,300 feet in Disturbed belt. Made up of two major members. Lower member, as much as 250 feet thick, composed of several widespread units, each characterized by some lithologic feature. Upper member, as much as 800 feet thick, not readily subdivided. Lower boundary, on northwest flank of Sweetgrass arch, marked by erosional unconformity. Here, basal bed is Cut Bank sand, which is characterized by black chert grains. Across area from Cut Bank oil and gas field to vicinity of Summit, the Kootenai rests unconformably on beveled edges of marine Rierdon and Swift formations and on siltstone and mudstone that may represent the Morrison. In Disturbed belt between Birch Creek and Missouri River, massive coarse-grained crossbedded sandstone that overlies the Morrison is taken as base of Kootenai. Along north flank of Little Belt Mountain uplift, a salt-and-pepper sandstone resting on the Morrison is considered base of Kootenai. In subsurface over much of Sweetgrass arch, the Sunburst sand, a conspicuous white fine- to coarse-grained sandstone is commonly taken as base of Kootenai. Underlies Colorado shale.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 24–26, pl. 1. In southern Elkhorn Mountains, Mont., is 400 to 650 feet thick and comprises basal unit characterized by "pepper and salt" sandstone, a medial unit characterized by red and green shale and siltstone, and an upper unit characterized by gray limestone. Nonmarine origin. Overlies Morrison formation; underlies Colorado formation. Lower Cretaceous.

Name derived from tribe of Indians who hunted over that part of Rocky Mountains.

†Kosciusko Sand or Formation (in Claiborne Group)

†Kosciusko Sandstone Member (of Lisbon Formation)[1]

Eocene: Mississippi.

Original reference: C. W. Cooke, 1925, U.S. Geol. Survey Prof. Paper 140, p. 133–135.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 40–47. Rank raised to formation. Redefined to include all beds above Zilpha shale and below Wautubbee formation. Formation is heterogeneous highly lenticular nonmarine section in which sand and shale are dominant facies. Basal interval of 50 to 200 feet typically composed of massive to highly crossbedded sands colored red, brown, yellow, purple, pink, violet, gray, and white on outcrop. Shales increase in abundance above basal sand until they usually predominate over sand in upper part of section. Thickness increases along strike from 85 feet at Alabama line to maximum of 400 feet in Attala, Holmes, and Carroll Counties.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. Mapped as Kosciusko sand in Claiborne group.

G. F. Brown, 1947, Mississippi Geol. Survey Bull. 65, p. 45–48. Kosciusko sand crops out in belt 6 to perhaps more than 20 miles wide in northern Mississippi, western or upper boundary flanking alluvial plain in Carroll, Grenada, Tallahatchie, and Panola Counties. Sand extends beneath plain, except for small area adjacent to Bluff Hills where alluvium rests on Zilpha clay. In Carroll County, the massive sand overlaps Zilpha clay and part of Winona sand; farther north, there is evidence that it rests on Basic City shale member of Tallahatta and that near Tennessee line, it may overlap Meridian sand member of Tallahatta. Thickness of exposed section about 100 feet in Carroll County. U.S. Geological Survey currently uses term Sparta sand in preference to term Kosciusko sand.

Named for exposures in vicinity of Kosciusko, Attala County.

Kosk Member (of Modin Formation)

Upper Triassic: Northern California.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert., v. 27, p. 436. Upper member of formation. Overlies Devils Canyon member (new); underlies Arvison formation (new).

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6, 11, pl. 1. Formal proposal of name. Dominantly thin-bedded dark-gray to black argillite. Two beds composed of andesitic flows, coarse tuffs, and agglomerates present; both beds approximately 300 feet thick. Thickness about 3,600 feet at type locality. Overlies Devils Canyon member; underlies Arvison formation.

Type locality: Along Kosk Creek and Devils Canyon from point on Kosk Creek about 1 mile north of Arvison Flat, where upper contact of member is exposed, to its lower contact about one-quarter mile west of junction of Devils Canyon and Alder Creek, Big Bend quadrangle, Shasta County.

Koster (joint) Clays[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 79, 81.

Named for occurrence at or near Nicholas Koster's house, sec. 13, T. 7 S., R. 21 W., Clark County.

†Kotlo Series[1]

Precambrian and lower Paleozoic: Southeastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 357.

Kotsina Conglomerate[1]

Jurassic or Cretaceous: Central southern Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 431, map, pl. 52.

F. H. Moffit, 1938, U.S. Geol. Survey Bull. 894, p. 68, pl. 2. Maximum thickness in mountains north of Ellicott Creek not less than 1,500 feet and in all probability is much more, possibly 2,000 or 2,500 feet. Mapped as Middle or Upper Jurassic.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 10–d facing p. 246, column 17. Upper Cretaceous on correlation chart.

Occurs on Kotsina River.

†Kougarok Group[1]

Ordovician, Silurian, and Devonian(?) : Northwestern Alaska.

Original reference: A. J. Collier, 1902, U.S. Geol. Survey Prof. Paper 2, p. 21, map.

Ko Vaya Quartz Monzonite

Age not stated: Central southern Arizona.

Leonid Bryner, 1958, Dissert. Abs., v. 19, no. 6, p. 1341. Intrudes Jaeger diorite complex (new). Older than clastic sediments of continental, fluviatile origin, which are inferred to be Lower Cretaceous.

In South Comobabi Mountains and Ko Vaya Hills, Papago Indian Reservation, Pima County.

Kowak Clay[1]

Pleistocene: Northwestern Alaska.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 265, 327, map.

Occurs in clay bluff, three-quarters mile long and 150 feet high, on left bank of Kowak River, at about long 158°.

Koyukuk Group[1]

Lower Cretaceous: North-central Alaska.

Original reference: F. C. Schrader, 1902, Soc. America Bull., v. 13, p. 246.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000) : U.S. Geol. Survey. Appears on map legend.

Occurs along Koyukuk River and may have very wide extent over Koyukuk Basin.

Kramer Lake Beds (in Ricardo Formation)

Miocene, upper: Southern California.

H. S. Gale, 1946, California Jour. Mines and Geology, v. 42, no. 4, p. 326. Series of borate-bearing beds. Members identified (descending) as "green shale," "blue shale," which includes borates and dark-gray shale. These overlies basaltic lava (Saddleback basalt). Maximum thickness of beds about 350 feet.

Present in vicinity of Kramer, southeastern Kern County.

Krebs Formation (in Cherokee Group)

Krebs Group

Pennsylvanian (Des Moines Series): Central and northeastern Oklahoma, southeastern Kansas, and western Missouri.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1524. Name introduced for lower group of Des Moines series in Oklahoma. Includes all rocks that crop out between top of Atoka formation below and top of Boggy formation above. Comprises (ascending) Hartshorne sandstone, McAlester formation, Savanna formation, and Boggy formation. Extends from northeast flank of Arbuckle Mountains northeastward to Kansas-Oklahoma line and eastward in McAlester basin to Arkansas-Oklahoma line. Thickness about 6,000 feet west of McAlester, along axis of McAlester basin; more than 8,000 feet thick in eastern part of basin; thins southwestward along northeast flank of Arbuckle Mountains; also thinner northeastward, being about 549 feet

along Arkansas River and 340 feet along Kansas-Oklahoma line. Conformable on Atoka formation wherever Atoka is present, but unconformable on older rocks both in Arbuckle Mountains, where Boggy formation rests on Ordovician Fernvale limestone, and in northeastern Oklahoma; unconformable below Cabaniss group (new). Krebs and Cabaniss rocks together are nearly but not quite the same, stratigraphically, as Cherokee rocks of southeastern Kansas.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Group shown on northern Midcontinent composite stratigraphic section as including (ascending) Riverton, Warner, Rowe (new), Dry Wood (new), Bluejacket, and Seville formations.

T. K. Searight, 1954, Missouri Geol. Survey and Water Resources Rept. Inv. 15, p. 23. In southwestern Missouri, group conforms to Midcontinent stratigraphic column. Only Riverton and Warner formations present in Humansville quadrangle.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 27–44. Term Cherokee readopted, and Krebs reduced to rank of subgroup in Cherokee group. Average thickness of outcrop area in Kansas between 200 and 250 feet. Comprises about half of pre-Marmaton Desmoinesian section in Kansas.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as formation in Cherokee group. Includes Warner sandstone and Bluejacket sandstone together with several coal beds. Underlies Cabaniss formation.

Named for town of Krebs, in T. 5 N., R. 15 E., central Pittsburg County, Okla.

Kreyenhagen Shale[1] or **Formation**

Eocene and Oligocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 163–168.

R. D. Reed and J. S. Hollister, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 12, p. 1566 (fig. 9). In Devils Den area, overlies Point of Rocks sandstone (new).

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 13 (table 1). Formation overlies Domengine formation and underlies Tumey shale.

J. A. Cushman and S. S. Siegfus, 1942, San Diego Soc. Nat. History, v. 9, no. 34, p. 385–426, pls. Shale described at Garza Creek, Kings County. This section compares favorably with type locality at Canoas Creek, originally designated by Anderson (1905). In present work, the two localities together are considered type area of Kreyenhagen. Formation divided lithologically into 10 members (A to J inclusive), lowest (J) is Canoas siltstone member. Thickness about 1,000 feet. Overlies Avenal sandstone; underlies Vaqueros(?) sand. Upper part of Kreyenhagen down to base of sandy "D" member considered equivalent in part at least of Tumey formation of Atwill (1935). Because type Kreyenhagen shale south of Coalinga, referred to as "Kreyenhagen" by Atwill, was not believed to include any correlative of Tumey formation, he believed term "Tumey formation" justified, although term "Wagon Wheel formation" had been proposed some years earlier (Johnson, 1909) for beds occupying a similar position in geologic column. Lower part of formation is Eocene; future work may show that part of Kreyenhagen is Oligocene.

I. F. Wilson, 1943, California Jour, Mines and Geology, v. 39, no. 2, p. 210–213. Kreyenhagen shale is group of foraminiferal calcareous, siliceous clay-shales with some interbedded sandstones and limestone. Occurs on both limbs of Butts Ranch syncline in San Benito quadrangle. Thickness 400 to 1,800 feet on northeast limb; 1,500 to 2,500 feet on southwest limb. On southwest side of syncline, shows following units: lower, 300 to 1,000 feet thick, foraminiferal clay-shales and platy shales with some interbedded sandstone and limestone, and thin glauconitic sandstone at base, equivalent to Canoas siltstone member of Coalinga district; Bear Canyon sandstone member (new), 100 to 300 feet thick; siliceous and calcareous foraminiferal platy shales with some limestone, 500 to 1,500 feet thick. Rests everywhere on Domengine sandstone; underlies Temblor group. Upper Eocene.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189 (fig. 73) [preprint 1941]. Correlation chart shows "Kreyenhagen proper" underlying Tumey formation and overlying Canoas silt.

P. P. Goudkoff, 1943, California Div. Mines Bull. 118, pt. 2, p. 248 (fig. 99A), 250 [preprint 1941]. Kreyenhagen shale (formation) shown on correlation chart as underlying Tumey shale and overlying Nortonville claystone in Coalinga area. Forms middle member of Kreyenhagen group and upper part of Clarke and Vokes' (1936) Tejon and Transition stages.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Formation, in area covered by this report, contains much sand and is divided into (ascending) Nortonville shale, Markley sandstone, and "Sidney" shale members. Overlies Domengine formation. Upper Eocene.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 41–44, pl. 1. Kreyenhagen formation of this report [Ortigalita Peak quadrangle] includes Kreyenhagen shale as described by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603) and laminated sandstone and shale, radiolarian shale, and pebbly greensand which are termed lower member of formation. Thickness about 700 feet. Overlies Tesla(?) formation; underlies San Pablo formation.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. In this report [Tumey and Panoche Hills, Fresno County], all strata lying between Domengine sandstone and overlying Temblor formation of Miocene age are included in Kreyenhagen shale. Atwill's sandstone unit of Tumey formation is here called sandstone member of Kreyenhagen. Where sandstone member is absent, the Kreyenhagen consists of about 1,300 feet of thin-bedded chocolate-brown to white soft punky diatomaceous shale and mudstone, with interbedded medium- to coarse-grained sandstone near base and abundant sandstone dikes throughout. Sandstone member is 105 feet thick in Tumey Gulch. Citing of two type areas in original description and assignment of formation to Miocene when later work has shown it to be Oligocene(?) and Eocene in age have led to considerable confusion and extensive bibliography. Woodring and others (1940, U.S. Geol. Survey Prof. Paper 195) described differences in interpretation of Kreyenhagen in general areas and problems that have arisen from them.

H. P. Smith, 1956, California Univ. Pubs. Geol. Sci., v. 32, no. 2, p. 67, 68 (fig. 2), geol. map. Formation, in Devils Den area, consists of tan, buff, and chocolate-brown argillaceous silts about 1,000 feet thick. Van Couvering and Allen's (1943) Welcome formation designated as member of

Kreyenhagen. Conformable on Point of Rocks sandstone; underlies Wagonwheel formation. Eocene or Oligocene.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 55–73, fig. 7. Included in Narizian stage (redefined).

Type locality: At Kreyenhagen wells, on Canoas Creek in central part of Reef Ridge area, about 12 miles south of town of Coalinga, Fresno County.

Krider Limestone Member (of Nolans Limestone)

Krider Limestone (in Sumner Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 60.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 163; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Member of Nolans limestone. Commonly two beds of limestone separated by bed of shale, each about 1 foot thick; in southern Kansas, the separating shale is somewhat thicker. Underlies Paddock shale member; overlies Odell shale. Wolfcamp series.

Type locality: Roadcut one-fourth mile south of Krider, Gage County, Nebr.

Kriley Formation

Eocene(?): Central eastern Idaho.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamph. 118, p. 15, 21–22. Chiefly thick conglomerate, basal part of which occurs in clifflike exposures more than 100 feet high near Kriley Creek. Coarsely textured conglomerate composed of boulders up to 1 foot in diameter firmly cemented in silty and sandy matrix. The generally well water-worn boulders largely derived from Lemhi quartzite with some admixture of granitic rocks. Near Kriley Creek, thick massive bed of conglomerate overlain by light-colored well-stratified beds of sandy shale and sandstone. South of Boyle Creek, conglomerate thicker than usual, showing better developed bedding along lower few tens of feet and made up mostly of boulders ranging up to 6 inches. Thickness of formation over 600 feet. Unconformably overlies Lemhi quartzite near Kriley Creek and unconformably underlies Challis volcanics. Directly underlies Geertson formation south of Boyle Creek. No fossils to date formation. Either deposited in response to Laramide uplifts in Paleocene time, or deposited with post-Laramide Eocene conglomerates. Age given as Paleocene(?) on geologic map and Eocene(?) on composite stratigraphic table.

Named from its position near Kriley Creek, in North Fork quadrangle, Lemhi County. Best and perhaps only exposures are along east side of Salmon River, both north and south of Boyle Creek. Exposures north of Boyle Creek extends nearly to Kriley Creek.

Kriz Lens (in Hueco Formation)

C. O. Dunbar, 1953, Am. Jour. Sci., v. 251, no. 11, p. 799 (fig. 1), 801 (fig. 2), 802–803, pl. 1. Limestone lens about 600 feet across and 150 feet thick at top of Hueco formation. Lower part of Hueco grades upward into light-gray limestone mostly in thin even beds, but with a few thick layers, upper one of which locally thickens to form the Kriz lens.

Occurs in east slope of Victorio Peak in Sierra Diablo, Trans-Pecos Texas. Kriz lens forms convenient landmark near Ellis Porter ranchhouse.

Kruger alkaline body[1]

Kruger Alkaline Syenites

Tertiary: Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 349.

C. D. Campbell, 1939, Am. Jour. Sci., v. 237, no. 9, p. 531–549. Further described as Kruger alkaline syenites. Intrudes Anarchist series; intruded by Similkameen granite.

Occurs on Washington-British Columbia boundary. Probably named from Kruger Mountain, British Columbia.

Kruger Schist[1]

Carboniferous(?): Southern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Probably named for occurrences on roughly tabular Kruger Mountain, British Columbia.

Kruger Mountain Malignite

Mesozoic: Northeastern Washington.

A. C. Waters and Konrad Krauskopf, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1368–1369, pl. 1. Dark coarse-grained rock, consisting dominantly of augite, hastingsite, and microcline. Listed as intrusive rock older than Colville batholith.

Exposures limited to two small hills on either side of Okanogan Valley about 4 miles south of international boundary, Okanogan County.

†Kugruk Group[1]

Ordovician, Silurian, and Devonian(?): Northwestern Alaska.

Original reference: A. J. Collier, 1902, U.S. Geol. Survey Prof. Paper 2, p. 21, map.

Probably named for Kugruk Mountain and Kugruk [Kougarok] River, Seward Peninsula.

Kuhiwa Basaltic Andesite (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 249–251, pl. 1. Single aa flow; locally two or more flow-units separated by clinker are present. Basal clinker generally thin and absent. Sparingly vesicular, locally nonporphyritic, but usually with a few phenocrysts of brownish-green olivine. Maximum thickness in drill holes east of Makapipi Stream 75 feet. Overlies Mossman basalt (new), generally with several inches of soil at contact. Each member of series underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 107. Pleistocene(?).

Named for exposures along Kuhiwa Gulch near highway, Haleakala (East Maui) volcano. Occupies most of area east of Makapipi Stream; tongue

between east and west forks of Makaino Stream is similar in composition and stratigraphic relations and is probably branch of same lava flow.

Kukpowruk Formation (in Nanushuk Group)

Lower Cretaceous: Northwestern Alaska.

E. G. Sable, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2637–2640, figs. 2, 3. Largely marine inshore deposit of interbedded shale, siltstone, and sandstone with minor amounts of claystone, conglomerate, and carbonaceous shale. Rock types vary in abundance both laterally and vertically; thick resistant sandstone units most abundant in southern part of outcrop area, south of type locality. Thins eastward and northward from about 5,000 feet on upper Kukpowruk River to about 2,000 feet along lower Utukok River. Base of formation rises in stratigraphic section by intertonguing with Torok formation, as traced northeastward. Basal contact placed at lowest persistent sandstone beds which form break in slope above lowlands underlain by Torok formation. Underlies nonmarine Corwin formation with gradational contact.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 64–101, pl. 8. Described and mapped in Utukok-Corwin region. Chiefly marine rocks (inshore facies) with some nonmarine rocks (coastal facies) in upper part and in southernmost exposures. Dominant rock types are shale, siltstone, sandstone, and claystone. Northeastward facies changes from sandstone to shale in basal part of formation, which overlies and intertongues with Torok formation. Thins northeastward from more than 5,000 feet to about 2,000 feet. Similar to Grandstand formation of Nanushuk group mapped in areas further east.

Type locality: Along Kukpowruk River between long 162° 42′ and 162° 44′ W., about 34 miles above river mouth. Lower part better exposed in foothills south of type locality. Named from river.

Kula Volcanic Series

Tertiary, upper(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 67 (table), 69, 74–90, pls. 1, 15, 16. Chiefly aphanitic dense gray to steel-blue andesitic type aa flows with thick clinker beds. Lenticular bedding common. Thin-bedded aa and pahoehoe present near summit, but pahoehoe scarce farther seaward, except in transition zone at bottom of series. Flows average about 20 feet in thickness near summit and 50 feet near periphery; some flows 200 feet thick. Numerous erosional unconformities and interstratified soil beds indicate that upper Kula lavas accumulated in waning phase of a volcano when time interval between flows became progressively longer; as the lavas changed to more siliceous composition, they became progressively more viscous and their flows shorter; thus they accumulated chiefly about summit where they attained thickness of 2,000 feet or more. Underlie Hana lavas (new) at shallow depths; in deep valleys, were probably removed by erosion before Hana time because here Hana lavas lie on alluvium or on Honomanu basalts (new). Overlie and generally transitional into Honomanu volcanic series.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 285–291. Discussion of petrography.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 107–108. Late Tertiary(?).

Named for settlement along upper and lower road leading to Kula Sanatorium on west slope.

Kulthieth Formation

Eocene and Oligocene(?) : Southeastern Alaska.

D. J. Miller, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–187, sheets 1 and 2. Nonmarine and marine sandstone and siltstone with many intercalated thin beds of high-rank coal. Includes three predominantly sandy units at type locality—upper 1,400 feet and the intervals, 1,900 to 3,200 feet and 3,600 to 5,400 feet below top. These alternate with three predominantly or conspicuously silty units. About 65 percent of section at type locality of sandstone, most abundant type being massive to crossbedded and arkosic that is gray to olive gray on fresh surfaces and weathers yellowish gray to brown. Total thickness at least 9,300 feet. Underlies Poul Creek formation with apparent conformity.

Type locality : In vicinity of small lake at head of northeasternmost branch of Kulthieth River where what is believed to be the most complete and least disturbed section occurs.

Kummer Series[1]

Kummer Formation (in Puget Group)

Eocene : Western Washington.

Original reference : G. W. Evans, 1912, Washington Geol. Survey Bull. 3, p. 42–49.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 55, 56–57. Uppermost formation of group in Green River area. Consists of alternating layers of well-stratified sandy, carbonaceous shales, and medium- to coarse-grained massive brownish-gray sandstone; intercalated with these strata are thin seams of coal, bone, and impure carbonaceous material; includes 475-foot sandstone at base. [Referred to as Kummer sandstone by Evans.] Maximum thickness 1,800 feet. Overlies Franklin formation. Formations in Green River Canyon are involved in anticlinal and synclinal folds whose axes trend northeast.

Name derived from Kummer, King County.

Kupikipikio Basalt[1]

See **Black Point Basalt.**

Kupikipikio Black Ash[1]

See Diamond Head Black Ash.

Kure Sandstone

Pleistocene, upper : Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 129–130, pls, 63, 64. Vertical cliff exposes four layers (or horizons) which show progressively decreasing consolidation upward; each lies unconformably on the preceding. Maximum exposed thickness of exposure slightly more than 9 feet. Kure sandstone constitutes a hard base layer with its surface averaging about 1 foot above high-tide level. It is of medium texture, infiltrated, in upper few feet, with organic matter and iron and sufficiently consolidated above to be classified as rock. It is so resistant to sandfilled wave and current erosion as to form a shelf extending out into the strand. Locally as much as 14 to 18 feet exposed without base being exposed. Underlies Castalia sand (new); unconformably overlies a coquina rock here designated Cape Fear coquina.

Exposed between Kure's Beach fishing pier and Ethyl Dow Bromine Plant on lower Cape Fear Peninsula.

Kushequa Shale Member[1] (of Knapp Formation or monothem)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 47, 103, table opposite p. 61.

C. R. Fettke, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. M–21, p. 26. Caster considered the Kushequa the basal member of the Knapp and placed base of Mississippian at bottom instead of top of Knapp. In this report, Knapp beds tentatively listed under Mississippian.

Probably named for Kushequa, McKean County.

Kushtaka Formation[1]

Eocene: South-central and southeastern Alaska.

Original reference: G. C. Martin, 1905, U.S. Geol. Survey Bull. 250, p. 14.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Eocene.

Exposed in valley of Bering River and its tributaries and on shores of Lake Kushtaka, Controller Bay region.

†Kuskokwim Gravels and Silts[1]

Pleistocene: Central southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 175–176.

Fills bottom of Ptarmigan Valley on west side of divide between the Skwentna and the Kuskokwim.

Kuskokwim Group

Lower and Upper Cretaceous: Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 35–47, pl. 1. Graywacke and closely related rocks make up practically all of group. Rocks called graywacke are variety of sandstone. Shales, which are about half as abundant, are a siltstone facies of the graywacke which is intimately interbedded with the sandstone. Breccias and conglomerates, also facies of the graywacke, present in a few localities. All rocks are dark. Rocks altered to hornfels in contact-metamorphic zones adjacent to stocks. In general, angularity of grain and poor sorting of grains characterize the group. Estimated thickness between 40,000 and 65,000 feet. Thickest continuous, most readily observed, and essentially unrepeated sections of group exposed in transecting gorge of lower course of Holokuk River downstream from mouth of Chineekluk Creek. Group thins appreciably to the southwest of central Kuskokwim region and also thins northeastward in Kuskokwim Mountain belt. Basal zones of group, comprising 5,000 to 10,000 feet of massive graywacke and shale, overlie and flank rocks of Gemuk group (new) along axis of Gemuk anticlinorium. Overlies Holitna group (new) in some areas, with fault contact. Unconformably underlies Iditarod basalt (new), Holokuk and Waterboot basalts (new). Lower (?) and Upper Cretaceous.

J. M. Hoare and W. L. Coonrad, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–285. In Bethel quadrangle, Kuskokwim group restricted to sedimentary rocks. Fossils of Middle Jurassic age found in volcanic rocks formerly included in the Kuskokwim. Group is Lower and Upper Cretaceous.

Named for Kuskokwim River.

Kuskulana Formation[1]

Upper Triassic: Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 423, 424, 433.

Occurs along valley of Kuskulana River and its tributaries in Kotsina-Kuskulana district.

Kuzitrin Formation[1]

Devonian(?): Northwestern Alaska.

Original reference: A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901, Reconnaissance in Cape Nome and Norton Bay regions, Alaska, in 1900: U.S. Geol. Survey Spec. Pub. 28, map.

Typically exposed in Kigluaik Mountains, Seward Peninsula. Named for Kuzitrin River.

Kwaguntan series

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 109. Comprises (ascending) Oveja, Solitude, Carbon Butte, Echo, Walhalla, and Nunkoweap formations. Consists of sandstones, shales, and limestones. Thickness 1,750 feet. Younger than Chuaran series.

Grand Canyon region.

Kyle sandstone[1]

Tertiary: Southeastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Occupies abandoned canyon of Old Virgen [Virgin] River. Named for exposures at Kyle Station, in Meadow Valley, below Caliente, Lincoln County.

Kyrock Conglomerate

Pennsylvanian: Central Kentucky.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 89; A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 109. Massive conglomeratic sandstone impregnated with asphalt. Equivalent to lower conglomerate of Caseyville and part of channel which connected Eastern Interior and Appalachian coal fields.

Exposed on Nolin River at Kyrock, Edmonson County. Traced eastward into Hart, Green, Taylor, and Larue Counties.

Labadie Limestone Member (of Vamoosa Formation)

Labadie Limestone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–F, p. 45.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 41, 45–47, pl. 1. Reallocated to Vamoosa formation. Described as gray to white limestone characterized by wavy bedding. Commonly 6 to 8 feet thick; in sec. 17, T. 27 N., R. 10 E., total thickness (measured and estimated) about 35 feet; here the Labadie is approximately 170 feet below Middle Oread limestone. Top of Labadie is 60 to 80 feet above Cheshewalla sandstone member at base of formation.

Named for exposures at and near Labadie Point, sec. 9, T. 26 N., R. 10 E., Osage County.

Labahia Member (of Goliad Formation)[1]

Pliocene: Central Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 752, 754.

J. H. Quinn, 1955, Texas Univ. Bur. Econ. Geology Pub. 5516, p. 69–71. Top member of Goliad. Overlies Lagarto member. Contains middle Pliocene fauna.

Typically exposed along San Antonio River near La Bahia Mission, south of Goliad, Goliad County.

Laberdie Limestone Member (of Pawnee Formation)

Pennsylvanian (Des Moines Series): Eastern Kansas.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 315, 320–321, pl. 1. Light-gray crystalline limestone; thin wavy irregular beds in upper part; more massive in lower. Thickness 8 to 30 feet, thickens southward. Overlies Mine Creek shale where that member is present; underlies Bandera shale.

J. M. Jewett, 1946, Kansas Geol. Survey Bull. 58, p. 65. Discussed as cyclothem in Pawnee megacyclothem.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 7; L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 30. Laberdie member is lateral equivalent of Coal City limestone of Iowa. Name Laberdie suppressed in favor of Coal City which has priority.

Type exposure: In quarry in SW cor. sec. 6, T. 23 S., R. 25 E., 1 mile west of Prescott, Linn County. Name derived from Laberdie Creek, which is about 100 feet west of quarry.

†Labette Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Labette Shale[1] (in Marmaton Group)

Labette Shale (in Henrietta Group)

Labette Shale Member (of Henrietta Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 36–37, 92, 94, 100.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 309–312. Comprises beds between Fort Scott and Pawnee limestones. Thickness 40 to 80 feet in Kansas. Includes Englevale sandstone member. Included in Marmaton group. Pro tempore type exposure designated.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2). Columnar section shows Labette shale in Henrietta group.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 26–28, measured sections. South of T. 23 N., Oklahoma, Pawnee and Altamont limestones merge to form Oologah limestone, whose base marks top of Labette from that point southward to vicinity of Broken Arrow, Tulsa County, where Oologah grades abruptly into calcareous shale. In Tulsa County, consists of clay shale, silty to sandy shale, and lenticular sandstone. Thickness

180 to 250 feet. Conformably overlies Fort Scott limestone. In Marmaton group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 32–33, fig. 5. Comprises rocks between Pawnee and Fort Scott formations. Not subdivided, but Mystic and Marshall coals recognized. Thickness 6 feet in Appanoose County; 15 feet in Madison County. Marmaton group.

Type exposure (pro tempore): Exposure beginning near middle of north line and extending to point near NE cor. sec. 22, T. 33 S., R. 20 E., near town of Labette. Named for exposures at Labette, Labette County, Kans.

La Boca Formation

La Boca Marine Member (of Panamá Formation)

Miocene, lower: Panamá.

[T. F. Thompson], 1943, Panamá Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 16–17. Name La Boca formation applied to group of marine-deposited sediments stratigraphically overlying Culebra formation, as originally defined. Composed largely of medium-hard silty or sandy dark-gray tuffaceous shales, with occasional massive crossbedded sandstone members present in lower parts.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 231–242, 246 (fig. 2). Strata assigned to La Boca were formerly referred to Culebra formation, Emperador limestone member of Culebra formation, and Caimito formation. Maximum thickness 600 feet.

W. P. Woodring, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–1; 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 40–41. Rank reduced to member status in Panamá formation. Consists principally of silty or sandy tuffaceous mudstone, flaggy tuffaceous sandstone, calcareous tuffaceous sandstone, conglomerate, and coralliferous limestone. Agglomerate and tuff, presumed to represent tongues from Pedro Miguel agglomerate member and main part of formation, respectively, are other constituents. Overlies Cucaracha formation or interfingers with upper part of formation. Nevertheless if La Boca is correctly identified, it also overlaps Cucaracha and Culebra formations and rests directly on Bas Obispo formation.

Type region: Miraflores Locks area, Canal Zone. Name derived from La Boca, near entrance of Balboa Harbor.

Laborcita Formation (in Magdalena Group)

Pennsylvanian and Permian: South-central New Mexico.

Carel Otte, Jr., 1959, New Mexico Bur. Mines Mineral Resources Bull. 50, p. 16–17, 28–58, 68–69, 95–96, 98–105, pls. 1–9, 12–14; 1959, Soc. Econ. Paleontologists and Mineralogists and Roswell Geol. Soc. Guidebook Joint Field Conf., p. 196–207. Thompson (1942) described strata overlying upper Virgilian beds in La Luz Canyon. These beds, composed of red and gray shale, sandstone, conglomerate, and a few limestones, contain fusulinids of early Wolfcampian age in upper part. Beds of similar age occurring in central New Mexico directly below Abo formation received three different names in 1946. Kelley and Wood introduced name Red Tanks member of Madera limestone in Lucero uplift; Stark and Dapples assigned name Aqua Torres formation in Los Pinos Mountains; Wilpolt and others designated same sequence Bursum formation which term has been widely adopted. Lloyd (1949) and Pray (1952, unpub. thesis [1954, New Mexico Geol. Soc. Guidebook 5th Field Conf.]) applied

name Bursum to Thompson's sequence of "transition beds" that overlie the strata of Fresnal group in La Luz Canyon. In Sacramento Mountains, "transition beds" consist largely of marine sequence of fossiliferous gray shale, limestone, and sandstone, whereas in central New Mexico Bursum formation is predominantly red beds that occur interbedded with a few thin fusulinid-bearing limestones. In addition, upper part of "transition beds" occurring north of Tularosa are younger than "Bursum" age. Term Laborcita proposed for strata consisting largely of gray and red mudstones, gray limestones, sandstones, and conglomerates between top of Holder formation and top of highest marine limestone underlying main mass of Abo red beds. Thickness approximately 480 feet at type section; 536 feet in central area, base and top exposed; about 1,000 feet in northern area.

Type section: Near mouth of Laborcita Canyon, Otero County. Base of section is 700 feet southeast center sec. 13, T. 15 S., R. 10 E., at north side of canyon; top is about 1 mile northeast of base.

Lacey Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 155. Name applied to conglomeratic sandstone overlying Mayfield member (new). Type section extends from depths of 1,880 to 2,070 feet. Thickness 176 to 230 feet. Underlies Gunn member (new).

Type well: McQueen No. 1 (well 6), in SW¼NE¼NE¼ sec. 27, T. 42 N., R. 3 E., DeKalb County. Name derived from Lacey School, 2½ miles east of type well.

Lackawanna Sandstone (in Pocono Formation)[1]

Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 56–57, 235.

Along Roaring Branch, Lycoming County.

Lackawaxen Conglomerate[1]

Upper Devonian: Pennsylvania, western Maryland, and eastern West Virginia.

Original reference: I. C. White, 1882, ser. 2, Pennsylvania Geol. Survey Rept. G_6. p. 73.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Listed as unit in upper part of Chemung sandstone of western Maryland, eastern West Virginia, and south-central Pennsylvania. Underlies Upper shale and sandstone of Chemung; overlies Middle Chemung (Wellsburg sandstone).

Exposed a short distance below Lackawaxen village and at other places in Lackawaxen Township, Pike County, Pa.

Lackey Creek Stage

Pleistocene (Wisconsin): Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, Correlation chart. In proposed time-stratigraphic standard for Rocky Mountains, Lackey Creek stage occurs in Tazewell-Cary interval between Bull Lake stage and Pinedale stage.

Twin Lake area.

Lac La Belle Conglomerate (in Portage Lake Lava Series)

Lac La Belle Conglomerate[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, p. 67–72, pl. 4.

H. R. Cornwall, 1954. U.S. Geol. Survey Geol. Quad. Map GQ–51. Included in Portage Lake lava series. One of several sedimentary rock units which constitute excellent reference planes for stratigraphic subdivision of formation.

Occurs just north of Lac la Belle, Keweenaw County.

Laclede Sandstone[1]

Upper Cambrian : Central Missouri.

Original reference: G. H. Scherer, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 2, p. 59, 61, 62.

Probably named for Laclede County.

Lacomb Gravels

Pleistocene, lower : Northwestern Oregon.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 9, geol. map. Name applied to high-level gravel remnants on hills between Albany and Jefferson. Thickness about 100 feet. Older than Leffler gravels. Name credited to [W. M.] Felts (unpub. thesis).

Type locality: Lacomb, Linn County, about 15 miles southeast of Albany quadrangle.

Lacorocah meta-andesite tuff member (of greenstone complex)

Precambrian : North-central New Mexico.

Parry Reiche, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1186, 1188. Light gray, crudely bedded, and weakly schistose, with clastic texture and rare or no quartz. Some beds crowded with light-gray slaty flattened pebbles. Member shows great diversity; ranges from altered acidic lava, now quartz-albite rock, to talc-tremolite aggregate presumably of very basic igneous origin. Such extreme types not common. Thickness unknown, but certainly more than 2,000 feet.

Extends northeasterly across NW¼ sec. 22, T. 8 N., R. 5 E., Bernalillo County.

La Cruz Peak Formation (in Mesaverde Group)

Upper Cretaceous : West-central New Mexico.

W. H. Tonking. [1954], Geologic map and sections of the Puertecito quadrangle, New Mexico (1:48,000) : New Mexico Bur. Mines Mineral Resources [preprint?] Bull. 41, pl. 1; 1958, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 19–20, 21 (fig. 6), pl. 1. Sequence of olive- to bluish-gray marine shales, sandy shales, and gray to yellow crossbedded quartzose sandstones and subgraywackes. In western half of region, includes three persistent massive grayish-yellow sandstone beds which contain abundant *Halymenites*. Thickness over 600 feet. Top is placed at top of Gallego sandstone of Winchester (1920) which ranges from 0 to 80 feet in thickness; because this sandstone is not present in eastern half of area, upper contact of the La Cruz Peak is drawn at top of marine beds which are generally 75 to 125 feet below coal beds of overlying Crevasse

Canyon formation. Unconformably overlies Tres Hermanos(?) sandstone member in west and Mancos shale in east.

D. B. Givens 1957, New Mexico Bur. Mines Mineral Resources Bull. 58, p. 10. As mapped in Dog Springs quadrangle, differs from formation as defined by Tonking, in that shale, which he included at base of formation, is here included in Mancos shale.

Named for La Cruz Peak in secs. 13 and 24, T. 2 N., R. 6 W. Socorro County.

La Cygne Shale Member[1] (of Marmaton Formation)

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1920, Kansas Geol. Survey Bull. 6, pt. 2, p. 18, 21, 28.

Named for town of La Cygne, Linn County.

Ladd Formation

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named on generalized section of formations in Santa Ana Mountains. Thickness about 1,700 feet. Comprises two members, Baker (at base) and Holz. Unconformably underlies Williams formation (new); overlies Trabuco formation.

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 170–171. In this report, name Baker member altered to Baker Canyon member. (Baker Canyon member has also been referred to as Baker conglomerate). Type locality designated.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Stratigraphic section shows the Ladd underlying Silverado formation (new).

Type locality: Region immediately west of mouth of Ladd Canyon, tributary of Silverado Canyon, Santa Ana Mountains, Orange County.

Ladentown Diabase[1]

Upper Triassic: Southeastern New York.

Original reference: C. A. Hartnagel, 1912, New York State Handb. 19, p. 92.

Near Ladentown, Rockland County.

Ladiga Sandstone[1]

Lower Cambrian: Eastern Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, geographic map of Alabama.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper, 15, p. 4. Shown as abandoned in list of stratigraphic terms of southern Appalachians.

Named for Ladiga, Calhoun County.

Ladore Shale (in Kansas City Group)[1]

Ladore Shale (in Bronson Group)

Ladore Shale Member (of Kansas City Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 238, pls. 1, 2.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 193. Ladore shale included in Bronson group. Thickness 2 to 50 feet. Overlies Hertha limestone; underlies Swope limestone

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. Ladore formation underlies Swope formation and overlies Hertha formation. Kansas City group. Bronson reduced to subgroup of Kansas City group. This is classification agreed upon by Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 41. Thickness of formation 14 feet in south-central Iowa; about 5 feet in Sarpy County, Nebr.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Ladore, in Madison County, near Winterset, is a 14½-foot complex of shale separated by siltstones containing limestone nodules. Upper shales are greenish; basal unit red and silty. Cores from Pottawattamie County show this shale to have same lithology as in Madison County but only 8 feet thick. Underlies Swope formation; overlies Hertha limestone.

Named for exposures at Ladore, Neosho County, Kans.

Ladronesian series[1]

Carboniferous: New Mexico.

Original references: C. R. Keyes, 1906, Science, new ser., v. 23, p. 921; 1906, Am. Jour. Sci., 4th, v. 21, p. 298–300.

Probably named for Sierra Ladrones, 30 miles north of Socorro, Socorro County.

Ladson Formation

Pleistocene: Southeastern South Carolina.

H. E. Malde, 1959, U.S. Geol. Survey Bull. 1079, p. 36–54, pls. 1, 5. Consists of sand and clay, coarse grained or conglomeratic at base. Divided into four members (ascending) characterized, respectively, by phosphate, fine sand, medium-grained sand, and coarse sand. Thickness in type section 33½ feet. Rests on eroded Tertiary deposits (Cooper marl). Pleistocene sequence in area is (ascending) Ladson sand on Tenmile Hill, Pamlico formation, and terrace deposits along Goose Creek. Outcrops in lower part of formation identified by Cooke (1936) as Talbot formation. Sloan (1908) had variously identified beds of Ladson with Lafayette phase, Hampton clays, Tenmile sands, and Accabee gravels—names no longer used. Type section measured from drill hole.

Type section: Auger hole 242, 1 mile N. 58° W. of Ladson, Charleston County. Weathered parts of all units crop out in west bank of Poppenheim swamp west of Ladson.

†Lady Washington Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 145, 146, 160, 298.

Forms high bluff on Ohio River at Rockpoint [Rockport], Spencer County, known familiarly as "The Lady Washington."

†Lafayette Formation[1]

Lafayette Gravel

Late Cenozoic: Central Lowland, Interior Low Plateau, Ozark Plateau province, Mississippi embayment part of Coastal Plain province.

Original reference: E. W. Hilgard, 1891, Am. Geologist, v. 8, p. 130.

P. E. Potter, 1955, Jour. Geology, v. 63, no. 1, p. 1–35; v. 63, no. 2, p. 115–132. Discussion of petrology and origin of Lafayette gravel and history and present status of term Lafayette. Lafayette gravel, as used in this study, refers to distinctive deposit found in Central Lowland, Interior Low Plateau, Ozark Plateau province, and Mississippi embayment part of Coastal Plain province. Consists primarily of insoluble components: chert, sandstone, quartz and quartzite pebbles, cobbles, and boulders associated with noncalcareous sands, silts, and clays, which in the aggregate are either stained or, less commonly, cemented by oxides of iron and manganese. Occurs as local blanket deposits in western Kentucky in area of 1,300 square miles as lenticular terrace and channel deposits, generally poorly exposed beneath glacial drift, and in glaciated regions. Thickness rarely exceeds 50 feet except in axial parts of lower Mississippi delta. In regions underlain by pre-Mesozoic rocks, Lafayette gravel commonly restricted either to higher terraces of more prominent streams, to abandoned channels of previous stream cycles, or to isolated exposures, which in Central Lowland province occupy positions on some of highest and oldest erosion surfaces. By contrast, in Coastal Plain province the gravel is considerably more extensive.

Named for Lafayette County, Miss., where first recognized.

Lafayette Granite Porphyry[1]

Late Carboniferous(?): Northwestern New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, p. 69–78.

Extends length of Franconia Ridge trail from Mount Lafayette, in Franconia quadrangle, to Little Haystack.

Lafayette Serpentine[1]

Precambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc. 1900, pt. I.

Named for occurrence at Lafayette, Montgomery County.

Lafferty Limestone[1]

Silurian: Central northern Arkansas.

Original reference: H. D. Miser, 1920, U.S. Geol. Survey Bull. 715–G.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Middle Silurian (Niagaran).

Well exposed at Tate Spring, 1¼ miles north of Penters Bluff Station, Izard County. Named for West Lafferty Creek which is half a mile east of exposure.

Lagarto Clay[1]

Lagarto Member (of Goliad Formation)

Miocene (?): Southern and eastern Texas.

Original reference: E. T. Dumble, 1894, Jour. Geology, v. 2, p. 560.

H. B. Stenzel, F. E. Turner, and C. J. Hesse, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 7, p. 977–1011. Geographically restricted to

exclude outcrops around Burkeville. On basis of new age determinations, it is believed that term Fleming formation is applicable to these beds.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1724–1725, 1727. Lagarto of Dumble considered member of Goliad formation. Lagarto (emended) by Plummer (1933, Texas Univ. Bull. 3232) is discarded. Part of section assigned to Lagarto (emended) is here included in Cuero formation (new). Unit termed Lower Lagarto by Weeks (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 5) herein assigned to Cuero formation (new). Goliad is considered Pliocene.

Named from Lagarto Creek, Live Oak County, where typically exposed.

Lagarto Creek Beds (in Goliad Sand)[1]

Pliocene: Southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 753, 754.

Crop out on Lagarto Creek, which flows through parts of Live Oak and Jim Wells Counties.

Lagonda Sandstone Member (of Cherokee Shale)[1]

Lagonda Formation (in Cabaniss Group or Cherokee Group)

Lagonda Member (of Senora Formation)

Pennsylvanian (Des Moines Series): Western Missouri, southeastern Kansas, and northern Oklahoma.

Original reference: C. H. Gordon, 1893, Missouri Geol. Survey Sheet Rept. 2, (v. 9), p. 19 [1896].

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 90–93, pl. 5. Rank raised to formation in Cherokee group. Restricted at top by transfer of Squirrel sandstone to Henrietta group. Thickens in northwesterly direction and in northwestern Missouri may attain thickness of nearly 50 feet. Unconformably overlies Bevier formation; unconformably underlies section of shale the base of which is usually marked by Squirrel sandstone.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 86–90. Formation described in Boone County. In this report, term Lagonda not used in original sense but includes beds between Bevier coal (except fossiliferous shales on the coal) and top of the Cherokee (to base of Fort Scott). It here includes "Squirrel" sandstone, Mulky coal, and Breezy Hill limestone. Thickness as much as 30 feet. Overlies "Bevier formation"; in some places unconformably underlies Blackjack Creek limestone member of Fort Scott.

W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. In Livingston and Carroll Counties, formation overlies Bevier formation and underlies Excello formation. Cabaniss group.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Overlies Bevier formation; underlies Mulky formation. Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guidebook 2, p. 5. Listed as Lagonda coal cycle in Senora formation in Oklahoma. Includes Lagonda sandstone, Lagonda shale, upper Lagonda sandstone, and Iron Post coal. Overlies Bevier coal cycle; underlies Mulky coal cycle. Cabaniss group.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 13, 16 (fig. 2). Geographically extended into northeastern Oklahoma where it is allocat-

ed to member status in Senora formation. Occurs above Verdigris member and below Breezy Hill member.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 29 (fig. 19), 37. Base of formation is at top of Bevier coal bed, and in Missouri top is beneath base of Breezy Hill limestone. As presently regarded, formational definition is identical with Gordon's (1893) definition of Lagonda sandstones and shales. The "Squirrel" sandstone is widely recognized zone in this formation. McQueen's (1943) redefinition of Lagonda is not followed. Thickness 29 feet in Vernon County, Mo. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 80–84 strat. sections. Formation includes beds above Bevier coal and extending to top of Iron Post coal. In Oklahoma-Kansas-Missouri area, formation includes a lower limestone and shale member, shale, sandstone, and underclay, and Iron Post coal bed. Only two of these divisions are persistent throughout area; they are the thick shale and overlying sandstone units. Lower limestone and shale member is well developed only in southeastern Kansas and is not known in Oklahoma. Iron Post coal is present only in Oklahoma. In Kansas and Missouri, underlies Breezy Hill limestone member of Mulky formation, Cabaniss subgroup of Cherokee group.

Named for exposures at Lagonda, Chariton County, Mo.

†Lagrange Formation[1]

Eocene: Western Tennessee, southern Alabama, southern Illinois, Mississippi, and southeastern Missouri.

Original reference: J. M. Safford, 1864, Am. Jour. Sci., 2d, v. 37, p. 361, 369–370.

Named for exposures at Lagrange, Fayette County, Tenn.

†La Grange Sandstone (in Chester Group)[1]

Mississippian: Northwestern Alabama.

Original reference: E. A. Smith, 1879, Alabama Geol. Survey Prog. Rept. 1877 and 1878, p. 17, 34, 36.

Named for La Grange, Colbert County.

Lagro Formation

Pleistocene: Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19 (fig. 3). Named on diagram showing formations of Pleistocene age in Indiana. Name appears above Trafalgar formation (new). Name credited to W. J. Wayne (in preparation).

Type locality and derivation of name not given.

Laguna Basalt Flow[1]

Pleistocene: New Mexico.

Original reference: R. L. Nichols, June 1934, Geol. Soc. America Proc. 1933, p. 453.

Occurs in San Jose Valley, Valencia County.

Laguna Formation[1]

Pliocene(?): Northern California.

Original reference: A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 33 (table), 57–61, pl. 1.

G. H. Davis and others, 1959, U.S. Geol. Survey Water-Supply Paper 1469, p. 46–47, pls. Complex assemblage of silt, clay, sand, and minor lenticular gravel. Maximum thickness 400 feet. Overlies Mehrten formation. Apparently at least in part coeval with Tulare formation on west of San Joaquin Valley and with Kern River formation near southern end of valley. General stratigraphic relations and paleontologic data suggest Pliocene(?) and possibly early Pleistocene age.

Type locality: North bank of Hadselville Creek, short distance from its junction with Laguna Creek, San Joaquin County.

Laguna Latite Series

Eocene, middle or younger, or Pliocene(?): Northern Utah.

D. R. Cook, 1957, Utah Geol. Soc. Guidebook 12, p. 65 (fig. 6). As shown on chart, middle Eocene Laguna latite series (new) overlies Packard rhyolite series and is overlain by Swansea quartz monzonite.

J. M. Foster, 1959, Brigham Young Univ. Research Studies, Geol. Ser., v. 6, no. 4, p. 35, 36, 39, pl. 4. Principal types of extrusive rocks in area consist of (ascending) Packard rhyolite series, Laguna latite sequence, and sequence of basalt flows. Age of material just preceding basalt flows probably middle Eocene or younger, possibly as young as Pliocene.

Present in Bismark Peak area, north Tintic district, Utah County.

Laguna Seca Formation

Paleocene and Eocene: West-central California.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 11–13, 16 (fig. 9), 23, pl. 4. Fine-grained gray massive abundantly micaceous concretionary homogeneous sand section, semiplaty in part. Thickness 1,120 feet. Underlies Domengine sandstone; lower contact progressively transgresses northward upon lower members of Moreno formation; in some areas unconformably overlies Cima sandstone lentil of Dos Palos shale of Moreno formation. Is not exact correlative of Martinez and cannot be traced into type locality of Martinez which is about 100 miles north of Laguna Seca Canyon. Cannot be mapped south into type Lodo in Panoche Creek. Cima sandstone and Laguna Seca sandstone of this report were included in "Tejon" (Domingene) by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 37–39, pls. 1, 3. Described in Ortigalita Peak quadrangle as underlying Tesla(?) formation.

Type locality: North branch of Laguna Seca Creek, near NE cor. sec. 18, T. 12 S., R. 11 E., in southeast Panoche Hills, Fresno County.

Lagunita Formation (in San Andres Group)

Permian: North-central New Mexico.

W. F. Tanner, 1956, Jour. Sed. Petrology, v. 26, no. 4, p. 307–308. Contorted brecciated vuggy limestone. Has overall appearance similar to travertine. Fragments in formation are pink, red, gray, dark blue, green, and yellow. Commonly occur in pebble and cobble size ranges. Thickness ranges from a few inches to about 90 feet, but generally does not exceed 20 feet. Represents middle unit of group; underlies Bernal formation; overlies Glorieta formation. Typical beachrock, altered slightly by later solution and recrystallization.

Named from village of Lagunita, near Santa Fe Railroad between Las Vegas and Santa Fe (approximately 35°23′, 105°14′). Better and more accessible exposure at northwest corner of base of Chapelle Hill, on Santa Fe Railroad, between villages of Chapelle and Bernal (approximately sec. 36, T. 14 N., R. 15 E.).

Lagunitas Clastic Member (of Treasure Mountain Rhyolite)

Miocene, upper: Northwestern New Mexico.

W. R. Muehlberger, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 100–101. Interbedded and parallel-bedded volcanic sandstone, volcanic conglomerate, tuffaceous mudstone, and tuffaceous breccia. Thickness 232 feet. Overlies Toltec andesite member (new); underlies Osier Mountain member (new). Name credited to E. L. Trice (unpub. thesis).

Crops out in Chama area, northern Rio Arriba County.

La Habra Formation

La Habra Conglomerate[1]

Pleistocene, upper: Southern California.

Original reference: R. Eckis, 1934, California Dept. Pub. Works, Div. Water Resources Bull. 45, p. 38, 49.

D. L. Durham and R. F. Yerkes, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–195. Lower part of formation consists of poorly bedded to massive sandy pebble to cobble conglomerate. Overlying the conglomerate are friable massive reddish-colored silty sandstone and siltstone beds. Maximum exposed thickness in eastern Puente Hills [this report] about 600 feet. Nonmarine. Rests with widespread unconformity upon fossiliferous marine strata ranging in age from Pliocene to early Pleistocene. Formation assigned late Pleistocene age.

Type area: Foothills south of Whittier fault between Brea and Carbon Canyons, Los Angeles County. Name derived from town of La Habra.

Lahahia Member (of Goliad Formation)[1]

Pliocene: Central Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 752, 754.

J. H. Quinn, 1955, Texas Univ. Bur. Econ. Geology Pub. 5516, p. 69–71. Top member of Goliad. Overlies Lagarto member. Contains middle Pliocene fauna.

Typically exposed along San Antonio River near La Bahia Mission, south of Goliad, Goliad County.

Lahaina Volcanic Series

Pleistocene or Recent(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 180–181, pl. 1. Comprises firefountain deposits and lava flows emitted after erosion approached present stage. Chiefly picritic basalts and nepheline basanite. Commonly lie on gravel deposits and appear to be late Pleistocene or Recent. Comprise Kekaa cinder cone, Laina volcanics, Kilea volcanics, and Hele cinder cone.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 108–109. Pleistocene or Recent(?).

Named from town of Lahaina. Lie on leeward side of West Maui.

LaHood Formation

Precambrian (Belt Series) : Southwestern Montana.

R. G. Alexander, Jr., 1955, Yellowstone-Bighorn Research Proj. Contr. 195, p. 14, 17–36, pl. 3. At type section, consists of arkosic sandstone and conglomerate with very minor amounts of silt shale distributed irregularly throughout unit. Upper 820 feet of section composed of sandstone with only occasional erratic boulders. Next lower 775 feet varies from upper part mainly in being slightly harder so that its exposures are more pronounced. Below this unit is 930 feet of arkosic sandstone containing irregular conglomeratic lenses, of which the largest observed was 240 feet long and 30 feet thick. Combined thickness over 2,700 feet. Underlies Flathead sandstone in type section. In some localities interfingers with, and underlies Greyson shale with transitional contact. Base obscured.

Type section: Along creek which crosses U.S. Highway 10S from the northeast approximately three-fifths mile southeast of LaHood Park, in Jefferson Canyon, sec. 12, T. 1 N., R. 3 W., and sec. 7, T. 1 N., R. 2 W., Jefferson County.

La Huerta Siltstone Member (of Salado Formation)

Permian: Southeastern New Mexico (subsurface).

W. B. Lang, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 63, 68, 72–74. Halite and silt. Massive, variably textured. Dull reddish-brown shale makes 35 percent of core in places. Fine stringers and needle crystals of white anhydrite. Shale makes irregular local bands. Thickness 5 feet.

Described from Fletcher No. 1 well in lot 4, sec. 1, T. 21 S., R. 28 E., Eddy County. Name taken from La Huerta townsite north of Carlsbad, where member would crop out if it were present at surface.

Laina Volcanics (in Lahaina Volcanic Series)

Pleistocene or Recent(?) : Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 158 (table), 180–181. In exposure on north bank of Kahoma stream, consists of 10 feet of vesicular thin-bedded pahoehoe resting on 8 inches of firefountain debris and 3 feet of alluvial soil. Soil overlies 30 feet of bouldery conglomerate, which in turn rests on Wailuku basalts (new). A few thin flows are intercalated with cinders in cone, and on north side 2 feet of pahoehoe overlies 8 feet of fine cinders, which in turn rests on 4 feet of soil and partly decomposed feldspar olivine Wailuku basalt. Laina lavas are covered with 1 to 1½ feet of soil underlain with a few inches of partly decomposed rock.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 109. Pleistocene or Recent(?).

Lavas form valley-fill 60 feet thick on inland side of Puu Laina cone where they pooled in pre-eruption valley of Kahoma stream. Cone is 1 mile northeast of Mala at altitude of 650 feet. Fan on which cone rests is middle or late Pleistocene.

Laird Sandstone

Miocene(?) : Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 65–67, pl. 9. Proposed for light-brownish-gray massive sandstone locally containing shale layers in upper part and subordinate conglomerate at base. Under-

lies Monterey shale; rests on quartz diorite. Thickness ranges from 10 to over 100 feet.

Name derived from Lairds Landing on Tomales Bay, Marin County. Exposed on Point Reyes Peninsula.

La Jara shale[1]

Upper Cretaceous: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 8.

Around southern end of Rocky Mountains. Derivation of name not given.

La Jara Peak Member (of Datil Formation)

Miocene, upper(?): Southwestern New Mexico.

W. H. Tonking, 1954, Dissert. Abs., v. 14, no. 2, p. 340. Composed of flows and flow breccias of basalt in lower parts and basaltic andesite in upper part. Overlies Hells Mesa member (new); underlies Santa Fe formation.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 26, 30–32, fig. 2, pl. 1 [preprint? 1954?]. Flows are dark- to medium-gray aphanophyres, which are in part red, oxidized, and scoriaceous. Lower part of member has distinctive red speckled appearance. Horizontal sheeting common, giving rock stratified appearance. Crude columnar jointing developed in more massive outcrops. Flow breccias, as well as block flows (aa type), abundant throughout section. Three volcanic sandstone and conglomerate beds intercalated in uppermost part of member. Consists of a number of flows; exact number not determined. Maximum thickness about 2,500 feet. Type section contains 1,175 feet of lava and 25 feet of intercalated volcanic conglomerate and sandstone. Type section designated.

Type section: Measured in northern Bear Mountain, in secs. 27 and 34, T. 2 N., R. 5 W., 3 to 3.5 miles south-southwest of La Jara Peak, Puertecito quadrangle, Socorro County. Named for La Jara Peak in secs. 11 and 14, T. 2 N., R. 5 W.

La Jolla Formation[1]

Eocene, middle: Southern California.

Original reference: B. L. Clark, 1926, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 5, p. 103, 111, 117.

L. G. Hertlein and U. S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 65–67. Comprises Delmar sand, Torrey sand, and Rose Canyon shale members. Delmar and Torrey members not positively identified in San Diego quadrangle. Rose Canyon shale attains thickness of at least 300 feet. Underlies Poway conglomerate and in some areas San Diego formation. Middle Eocene.

Named for exposures in La Jolla quadrangle, San Diego County.

Lak Member (of Sundance Formation)

Lak Member (of Rierdon Formation)

Upper Jurassic: Northwestern Wyoming and South Dakota.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 257–259. Defined as 25 to 100 feet, or more, of dominantly red fine-grained sandstone and siltstone gradationally overlying Hulett sandstone member and underlying Redwater shale member (both new). At type

section, consists of at least 80 feet of soft maroon sandstone and siltstone including 2-foot bed of greenish-gray siltstone 15 feet below top.

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475, 482. Reallocated to member status in Rierdon formation herein assigned to Sundance group.

Type section: On west side Stockade Beaver Creek about 5 miles northeast of New Castle, Wyo., in sec. 18, T. 45 N., R. 60 W. Named after Lak Reservoir on L. A. K. Ranch. Reservoir is about 3 miles south of type section.

Lake Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144.

Named for occurrence in Lake mine, Ontonagon County.

Lake Basalt

Pliocene(?) and Pleistocene: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 262–266. Basalt porphyry. Older than Warner basalt.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 364–365, geol. map. Map legend shows Lake basalt younger than Warner basalt.

Type locality: Eastern floor of Medicine Lake basin where it crops out in low glaciated mounds which protrude through mantle of pumice and lake gravel, Modoc Lava-Bed quadrangle.

Lake Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler, 1929, U.S. Geol. Survey Prof. Paper 144.

Named for occurrence in Lake mine, Ontonagon County.

†Lake Gneiss[1]

Precambrian(?) to Carboniferous: Eastern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Geology New Hampshire, pt. 1, p. 508–545.

Lake Winnipesaukee region.

†Lake Quartzite Schist[1]

Lower Paleozoic or older: Northern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 474.

Named for great prominence at Chandalar Lake, Chandalar Lake region.

Lake Quartz Syenite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1895, 1905–1906, pl. 1. Medium-grained subporphyritic to seriate-textured quartz syenite. Subporphyritic aspect most characteristic. Coarser and more equigranular in Diamond Island exposures. Contains inclusions of fine-grained diorite locally. Older than Albany quartz syenite; younger than Sawyer quartz syenite. Assigned to White Mountain magma series.

Excellent exposures on Rattlesnake and Diamond Islands in Lake Winnipesaukee. Also found at Gerrish Point and to the north.

Lake Agassiz Clays[1]

Pleistocene: Mississippi Valley.

Original reference: W. J. McGee, 1888, Am. Jour. Sci., 3d, v. 35, p. 462.

Lake Agnes Quartz Monzonite

Tertiary: Northeastern Colorado.

K. A. Gorton, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 89–90. Light-gray coarsely crystalline equigranular rock with speckled appearance due to sharp contrast between dark hornblende and biotite and light-colored orthoclase and plagioclase. In contact with Precambrian gneiss and with Pierre shale. Later than Laramide thrust faulting.

Well exposed near Lake Agnes in sec. 15, T. 6 N., R. 76 W., Cameron Pass area.

Lake Albany Clays[1]

Pleistocene: Eastern New York and western Vermont.

Original reference: G. H. Chadwick, 1910, New York State Mus. Bull. 140, p. 157–160.

Lake Ardmore Formation (in Springer Group)

Lake Ardmore Sandstone Member (of Springer Formation)[1]

Lower Pennsylvanian: Central southern Oklahoma (subsurface and surface).

Original reference (subsurface): R. Roth, 1928, Econ. Geology, v. 23, p. 45.

C. W. Tomlinson, 1929, Oklahoma Geol. Survey Bull. 46, p. 17–19. Surface outcrop noted; derivation of name given.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as Lake Ardmore sandstone; here the Springer is considered a group. Lower Pennsylvanian.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 11–13. About 500 to 700 feet above Overbrook sandstone is Tomlinson's (1929) Lake Ardmore sandstone member, a persistent unit which is only 15 to 20 feet thick at locality where it was named (NE¼NW¼SE¼ sec. 2, T. 4 S., R. 2 E.). Northeast of town of Springer (NW¼SW¼ sec. 4, T. 3 S., R. 2 E.), three separate sandstone members crop out in uppermost 500 feet of Springeran series as here defined—the 500 feet of section next below Primrose sandstone. One of these, possibly the second from top, may be identical with original Lake Ardmore member. But it is possible that this member has split into several sandstones with intervening shales. Interval between base of Primrose sandstone above and top of Overbrook sandstone some distance below, has increased here to about 1,000 feet, as compared to 800 feet at Lake Ardmore. Name Lake Ardmore formation suggested for these three sandstones in top 500 feet of Springer series near Springer. Formation regarded as extending from base of the Primrose down to base of lowest of the three sandstones of Lake Ardmore formation there. Includes Target limestone of Bennison (1954) as member. Springer group.

Type locality (formation) NW¼SW¼ sec. 4. T. 3 S., R. 2 E., Carter County. Named for a sportsman's lake in sec. 2, T. 4 S., R. 1 E., where it forms narrow peninsulas and islets.

Lake Bonneville Beds[1]

Lake Bonneville Group

Pleistocene: Northern Utah and southeastern Idaho.

Original reference: G. K. Gilbert, 1875, U.S. Geol. and Geog. Survey Terr. W. 100th M., v. 30, p. 89.

K. C. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 21–22. Deposits laid down by Lake Bonneville are divided into three formations each of which represents a different stage in the level of the lake. These are (ascending) Alpine, Bonneville, and Provo, Gilbert (1890, U.S. Geol. Survey Mon. 1) referred to these as Intermediate, Bonneville, and Provo stages of Lake Bonneville.

C. B. Hunt, H. D. Varnes, and H. E. Thomas, 1953, U.S. Geol. Survey Prof. Paper 257–A, p. 1, 17–29, pl. 1. Pleistocene Lake Bonneville group, which includes Alpine, Bonneville, and Provo formations, is unconformable above unnamed pre-Lake Bonneville deposits and below unnamed post-Provo deposits. Lake Bonneville was product of last glacial period and is believed to be of Wisconsin age.

Northern Utah Valley.

Lake Bridgeport Shale[1] (in Graford Formation)

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 29.

H. L. Strimple, 1951, Jour. Paleontology, v. 20, no. 2, p. 200–207. Crinoid fauna described.

Probably named for occurrence near Bridgeport, Wise County.

Lake Charles Formation

Recent: Southern Texas.

W. A. Price, 1939, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1875. Lake Charles formation and Ingleside formation (new) replace Beaumont formation.

Report discusses Rio Grande delta; states that Lake Charles formation is not present on delta.

Lake Church Formation[1]

Middle Devonian: Southeastern Wisconsin.

Original reference: E. R. Pohl, 1929, Pub. Mus. City Milwaukee Bull., v. 11, p. 7–8.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1770, chart 4. Age given on correlation chart as Middle Devonian.

Well exposed in and about Lake Shore stone quarry near Lake Church, Ozaukee County.

Lake City Limestone

Lake City Limestone (in Claiborne Group)

Eocene, middle: Subsurface in northern and central Florida and southern Georgia.

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1681–1682, 1693–1698, 1704 (fig. 25). Name applied to limestone facies of early middle Eocene in northern Florida and the

peninsula. Made up of alternating layers of dark-brown and chalky limestone with gypsum or chert present in some wells and in Cosden's Lawson well No. 1, Marion County, a 25-foot bed of lignite. Lateral gradational lithologic change from limestone facies of the peninsula into clastic facies which contains a fauna related to that of Cook Mountain formation of Claiborne age is noted in wells from Wakulla County west to Walton County. Starting as highly glauconitic chalky limestone, the rock becomes increasingly sandy until it develops into chalky glauconitic sand. Normally 400 to 500 feet thick in Tallahassee area; in Pierce County, Ga., and southern part of peninsula 200 to 250 feet. In north Florida and north half of peninsula, underlies Tallahassee limestone (new) and equivalent nonfossiliferous limestone; along northeast coast and in south half of peninsula, underlies Avon Park limestone (new); in west Florida, where late middle Eocene beds are not definitely known to be present, early middle Eocene clastic facies of Cook Mountain age underlies Ocala limestone; overlies lower Eocene unit. Oldsmar limestone (new), Avon Park limestone, Tallahassee limestone (with its equivalent nonfossiliferous facies), and Lake City limestone represent Claiborne group in peninsular Florida, and where all three units are present they appear to make in most places, a conformable sequence.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 88–89, 90–94. In Claiborne group. As used by Applin and Applin (1944), Lake City limestone is predominantly chalky to granular limestone, containing chert and gypsum in some areas. The limestone grades laterally into clastic facies in series of wells extending from Wakulla County westward to Walton County. In practice, the Lake City is commonly identified from its fauna, the top being marked by first appearance of *Dictyoconus americanus* (Cushman) and as thus used it was faunal zone. Recently, present writer [Vernon] has found, particularly in Citrus and Levy Counties, that formation was lithologic unit having diagnostic lithologic characteristics as well as distinct fauna. Formation characterized by several lithologies which probably occur as thin beds in thick carbonate section. These beds include a pseudo-oolite, a brown to coffee-colored chert, a bentonitic(?) clay, and a brownish-gray laminated finely crystalline dolomite containing seams of black carbon and flattened decalcified specimens of *Fabularia vaughani*, *Coskinolina* sp., *Archaias columbiaensis*, and larger *Valvulinidae* giving it a mottled and laminated appearance. Occasionally last mentioned rock is seamed with peat and not fossiliferous. Applin and Applin (p. 1739) assigned 411 feet of dolomite in Florida Oil Discovery-Sholtz well, Levy County, to the nonfossiliferous limestone [lying between the Lake City and Avon Park], but it is herein considered dolomitized Lake City limestone and included in that formation. Thickness in wells in Levy and Citrus Counties 575 to 923 feet.

Characteristically shown in samples from Lake City well, Columbia County, Fla., No. W–299, of Florida Geological Survey.

Lake Coahuila deposits

Pleistocene, upper: Southern California.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1782. A thin veneer of lake marls covering most of surface below ancient beach line. Thickness as much as 100 feet.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 23 (fig. 2), 25 (fig. 2). Shown on columnar sections as unconformably overlying

Brawley formation (new) or as unconformably overlying Ocotillo conglomerate (new).

This may or may not be the same deposit referred to as Coahuila silt (Hanna, 1926).

Occurs on west side of Imperial Valley.

Lake Creek Coal Member (of Modesto Formation)

Pennsylvanian: Southeastern Illinois (subsurface).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), pl. 1. Name applied to coal encountered at depth of 86½ feet in drill hole. Occurs above Pond Creek coal member (new) and below West Franklin limestone member. Coal has been referred to informally as 3rd Cutler Rider coal. Name credited to Cady (unpub. ms.). Piasa limestone and DeGraff, Pond Creek, and Lake Creek coals may be included in complex West Franklin limestone in eastern part of area. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Consolidated Coal Co. drill hole 91 in SW¼NE¼NE¼ sec. 21, T. 8 S., R. 3 E., Williamson County. Name derived from Lake Creek Township in which drill hole is located.

Lake Creek Formation

Pleistocene (Cary-Mankato): Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene, Rocky Mountain sec. 2d Ann. Field Trip, Oct. 4–5, correlation chart, geol. map. Consists of lower and upper member. Overlies Twin Mountain formation (new); underlies Mount Champion formation (new).

Twin Lakes region, Lake County.

Lake Creek Member (of Wood River Formation)

Pennsylvanian (Virgilian): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Older than Wilson Creek member (new); younger than Slate Creek member (new).

Deposited in Muldoon trough, aligned N. 30° W.

Lake Creek Shale Member (of Pierre Shale)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 22, 23 (fig. 11). Thin-bedded flaky dark-gray and black shale with limestone concretions, zones of concretionary limonite, and locally gypsum. Thickness 200 feet. Overlies Weskan shale member; underlies Salt Grass shale member.

Named for Lake Creek, in northwestern part of Wallace County, along which most extensive outcrops occur.

Lake Crockett Formation

Cretaceous (Eagle Ford): North-central Texas.

C. L. McNulty, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 335–337. Suggested that name Fish Bed conglomerate (Taff, 1893, Texas Geol. Survey 4th Ann. Rept), which is misleading nongeographic and limited in definition, be abandoned and replaced by Lake Crockett formation. Proposed that formation consist of an upper Lake Crockett

member, which shall be the silty shale lying between basal Austin chalk and former Fish Bed conglomerate, and of a lower Lake Crockett sand member, which shall be the Fish Bed stratum and the underlying gray sand, and which is equivalent to the former sub-Clarksville of east Texas basin. At Lake Crockett, underlies Ector formation and is about 26½ feet thick.

Named for exposures in ravine below spillway of Lake Crockett, Fannin County.

Lake Enchantment sediments

Precambrian: Northern Michigan.

Justin Zinn and others, 1955, Studies of stratified rocks occurring below the Huronian succession in the Marquette district, Michigan: Minnesota Univ. Center for Continuation Study, Inst. of Lake Superior Geology [no pagination]. Remnant of metamorphosed stratified rock. Older than Mesnard quartzite; unconformably overlies Keewatin greenstones.

Along margin of Marquette syncline or adjacent to nearby Huronian synclines in Marquette district.

Lake Flirt Marl[1]

Pleistocene and Recent: Southern Florida.

Original reference: E. H. Sellards, 1919, Florida Geol. Survey 12th Ann. Rept., p. 73–74.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Lake Flirt [spelled Flint], Pleistocene, overlies Pamlico formation.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 70. In some places, Miami oolite is overlain by thin fresh-water marl and limestone here classified as Lake Flirt marl. Very late Pleistocene or Recent in age.

M. C. Schroeder, 1954, Southeastern Geol. Soc. 8th Field Trip, p. 18, 20–22. Maximum thickness about 8 feet along Caloosahatchee River in old Lake Flirt bottom. It is doubtful whether use of name is justified outside of Caloosahatchee River area. In many places in upper Everglades, the fresh-water marl lies between the rock floor and overlying organic soils. Although marl is not the same everywhere, some being indurated, it has all been included in the Lake Flirt by Parker and Cooke.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 133 (table 1), 135, 136, 147. Typically overlies Pamlico formation unconformably, but reworking of sediments at many localities makes separation of the two formations difficult. In this report, beds containing abundant fresh-water mollusks definitely assigned to the Lake Flirt. Pleistocene (Wisconsin).

Named for occurrences at Lake Flirt, De Soto County.

Lake Fork Quartz Latite

Lake Fork Andesite[1]

Miocene(?): Southwestern Colorado.

Original references: W. Cross and E. S. Larsen, 1923, U.S. Geol. Survey Prof. Paper 131, table opposite p. 184; 1923, U.S. Geol. Survey Bull. 718, table opposite p. 12.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 64–68, pls. 1, 2. Defined as a group of dark quartz latites, in

part flows, in part clastic beds, that immediately preceded deposition of San Juan tuff. Thickest part—about 4,000 feet—is east of Lake Fork of Gunnison River near heads of Indian and Trout Creeks; from this area, it thins out rapidly in all directions, and 5 or 6 miles from central area is only a few hundred feet thick. Central part not overlain by younger rocks; flanks overlain by San Juan or Potosi rocks. Directly overlies Precambrian and Paleozoic rocks.

Named for exposures in Lake Fork of Gunnison River in Uncompahgre quadrangle. Exposures are confined to area in central part of quadrangle about 20 miles across.

Lake Hanbury Slate Group[1]

Huronian: Northern Michigan.

Original reference: C. Rominger, 1881, Mich. Geol. Survey, v. 4, pt. 2, p. 182.

Crops out north of Norway, Quinnesec, and Chapin mines, Menominee iron region.

Lake Kemp Formation (in Lueders Group)

Lake Kemp Limestone (in Lueders Formation)[1]

Permian (Leonard Series): Central northern Texas.

Original reference: M. M. Garrett, A. M. Lloyd, and G. E. Laskey, Geologic map of Baylor County: Texas Bur. Econ. Geology.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Given formational status in the Lueders herein designated as group. Overlies Maybelle limestone; underlies Arroyo formation of Clear Fork group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Examination of type outcrops of Maybelle and Lake Kemp beds affords no satisfactory ground for classing the limestones as parts of the Lueders. No basis found for recognizing any limestone beds of the Lueders in Colorado River area [mapped in this report] as corresponding to Maybelle and Lake Kemp beds, respectively.

Occurs at east end of Lake Kemp, Baylor County.

†Lake Lahontan Beds[1]

Pleistocene: Northwestern Nevada.

Original reference: I. C. Russell, 1885, U.S. Geol. Survey Mon. 11, p. 143.

U.S. Geological Survey has abandoned the term Lake Lahontan beds.

Sediments deposited in Lake Lahontan.

Lake Lytle Limestone[1]

Permian: Texas.

Original reference: J. Hornberger, Jr., 1932, Texas Bur. Econ. Geology, geol. map of Throckmorton County.

Lake Missoula Beds[1]

Pleistocene: Southwestern Montana.

Original reference: C. M. Langton, 1935, Jour. Geology, v. 43, p. 34–35.

Missoula, Ravalli, and Granite Counties.

Lake Monongahela deposits[1]

Pleistocene: Southwestern Pennsylvania.

Original reference: R. R. Hice, 1905, Am. Ceramic Soc. Trans., v. 7, pt. 1.

Near mouth of Beaver River.

Lakemont Formation[1]

Middle Silurian: Pennsylvania.

Original reference: E. O. Ulrich, 1923, Maryland Geol. Survey, Silurian Volume, index.

Named from section near Lakemont Park, between Hollidaysburg and Altoona, Blair County.

Lake Murray Formation (in Dornick Hills Group)

Pennsylvanian (Atoka Series): Southern Oklahoma.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 139–140. Proposed for strata from top of Otterville to top of Frensley limestone. Attains maximum development in Harrisburg trough where it is over 3,300 feet thick. Not a single sequence and may be divided into three units which are uniform throughout the trough; they are (ascending) Bostwick, Griffin sandstone (new), and Frensley members. Unconformably underlies Big Branch formation (redefined); unconformably overlies Golf Course formation (new).

Named for exposures south of south shore of Lake Murray, Murray County.

Lake Neosho Shale Member (of Altamont Limestone)

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, and northwestern Missouri.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 329, 331–332, pl. 1. Defined as shale between Tina limestone member below and Worland limestone member above. Contains oblong, irregularly shaped phosphatic concretions. Thickness in Kansas 2½ to 6 feet.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 8. Overlies Amoret limestone member (Amoret replaces name Tina).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31, fig. 5. Geographically extended into southwestern Iowa, upper part of shale is dark gray and fossiliferous; beneath shale is persistent coal streak underlain by clay that is gray above and red below. Thickness about 6 feet. Overlies Amoret limestone member; underlies Worland limestone member.

Type section: Southeast of Lake Neosho in Neosho County State Park, SW sec. 23, T. 30 S., R. 20 E., Neosho County, Kans.

Lake Newark Formation

Miocene, upper, and (or) Pliocene: Northeastern Nevada.

T. E. Eakin, 1960, Nevada Dept. Conserv. Nat. Resources Rept. 1, p. 26. Bedded rhyolite tuff and coarser pyroclastics; in part lacustrine. Thickness 430 feet. Unconformably underlies Belmont fanglomerate (new); unconformably overlies Illipah formation (new). Name credited to F. L. Humphrey (in press).

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 43–45, pl. 1. Formal proposal of name. Succession of bedded rhyolite tuffs and pyroclastics Includes both bedded tuffs which were deposited on lake floor and subaerial pyroclastics which were deposited above level of lake. Materials in both types of deposits are of same age and source, but the two members are differentiated because of different depositional conditions which accompanied their formation. Member 1 includes bedded tuffs which are

present up to an altitude of about 7,400 feet. Unbedded pyroclastics are found above this elevation. Member 1 has maximum thickness of about 350 feet. Member 2 is as much as 80 feet thick in places. Unconformably overlies Illipah formation (new); older than Lampson formation (new); underlies Belmont fanglomerate (new). On basis of fossils, tentatively considered upper Miocene or Pliocene. As mapped, includes Lampson formation.

In Newark Valley, White Pine County.

Lake Pinto Sandstone Member (of Mineral Wells Formation)[1]

Lake Pinto Sandstone Member (of Salesville Formation)

Middle Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 25, 31; Texas Univ. Bull. 2132, p. 77, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Salesville raised to formational status and expanded below to base of Lake Pinto sandstone, Lake Pinto underlies Dog Bend limestone member of Salesville and overlies Village Bend limestone member of East Mountain shale. Name Mineral Wells dropped in this report.

Leo Hendricks, 1957, Texas Univ Bur. Econ. Geology Pub. 5724, p. 23–24, fig. 3, pl. 1. In this report [Parker County], Lake Pinto considered basal member of Salesville, although author does not wholly agree with Cheney's reclassification. Sandstone and associated beds show facies changes across county. Thickness as much as 50 feet. Underlies unnamed shale member that includes Dog Bend limestone bed in lower part; overlies shale in East Mountain formation.

J. W. Shelton, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1515–1524, pl. 1. In eastern Palo Pinto County, Strawn-Canyon boundary placed at base of Lake Pinto sandstone which overlies Village Bend limestone.

Named for Lake Pinto, one-half mile west of Mineral Wells, Palo Pinto County.

Lakeport Limestone[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Lakeport hole, Madison County.

†Lake Shore trap[1]

Precambrian (Keweenawan): Northern Michigan and Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 186, pls. 17, 18.

Named for exposures on shore of Lake Superior at Keweenaw Point, Mich.

Lakeside Clay (in Golden Valley Formation)

Eocene: Eastern Montana.

Great Northern Railway Co. Mineral Research and Development Department, 1958, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 5, p. 7, map. Gray clay about 6 feet thick. White Earth clay, South Ross clay, and East Tioga clay occurs in same general area.

Occurs one-half mile north of Lakeside Station, in SW¼SW¼ sec. 18, T. 27, N., R. 59 E., on Great Northern mainline, Roosevelt County.

†Lake Superior Group[1]

[Upper Cambrian] : Northern Michigan.

Original reference: A. Winchell, 1871, Michigan Geol. Survey Rept. Prog., p. 26–27.

Upper Peninsula.

Lake Superior Sandstone[1]

Lake Superior Sandstone Member (of St. Croixan Formation)

Upper Cambrian : Northern Michigan and eastern Minnesota.

Original reference: D. Houghton, 1840, Michigan Geol. Survey 3d Rept. for 1839, H. Doc. 8, p. 13.

A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 691–692, table facing p. 681. In view of uncertainty of relation of the three parts of Lake Superior sandstone, as used by Houghton, separate names seem useful. Term Freda is proposed for that west of Cooper Range; term Jacobsville for that east of Cooper Range and term may apply to all the Lake Superior sandstone skirting the coast at intervals to Grand Island; term Munising sandstone is to apply to upper 250 feet of Lake Superior sandstone which crosses bluffs back of Munising.

S. G. Bergquist, 1937, Michigan Acad. Sci., Arts and Letters Papers, v. 22, p. 421 (footnote). Ulrich seems to have good evidence to support view that St. Croixan formation of Wisconsin area extends into Superior region of Alger County, Mich. So-called Lake Superior sandstone would thus be included as a member of the formation.

See Lake Superior Series.

Named for occurrence on south shore of Lake Superior, northern Michigan.

Lake Superior Series

Precambrian (Keweenawan) : Northeastern Minnesota.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 10, 11–13. In addition to lava flows and other igneous rocks included in the Keweenawan, the thick sediments along south shore of Lake Superior should be included in the series. They are mainly sandstones and shales with occasional important conglomerates, the whole of which may be several thousand feet in thickness. These are the beds which Houghton (1840) called Lake Superior sandstone, part of which was designated by Irving (1883, U.S. Geol. Survey Mon. 5) as the Western sandstone. Since this deposit of arenaceous sediments has been divided into several formations, the earlier term is used as a series name. Although these sandstones and shales have occasionally been considered Cambrian in age, their lack of fossils makes classification more or less indeterminate. They definitely underlie St. Croixian series and may be interbedded with Keweenawan lava flows. Made up of Fond du Lac beds below and Hinckley sandstone above. Precambrian.

Named for occurrence in Lake Superior district.

Laketown Dolomite[1]

Middle and Upper Silurian: Northeastern and western Utah, southern Idaho, and southwestern Wyoming.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 410.

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 11 (table), 19, 23–25. In Bayhorse region, Idaho, overlies Saturday Mountain formation and underlies Jefferson dolomite. Thickness about 2,500 feet.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1137–1138, pl. 1. Described in Logan quadrangle, Utah, where it is 1,150 feet thick, disconformably underlies Water Canyon formation (new) and disconformably overlies Fish Haven dolomite. Middle Silurian.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000); U.S. Geol. Survey. Mapped in southwestern Wyoming.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 28 (fig. 4), 33–34. Described in Stansbury Mountains where it is 614 to 664 feet thick; underlies Sevy dolomite and overlies Fish Haven dolomite. In some areas, as in vicinity of Dolomite, lower part of formation is exposed below Stansbury formation (new).

U.S. Geol. Survey currently considers the Laketown dolomite Middle and Upper Silurian on the basis of studies now in progress.

Named for exposures in Laketown Canyon, Rich County, Utah.

Lake Trammel Sandstone[1]

Permian: Central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 95–96, pl.

Occurs west of Aspermont, Stonewall County, and west of Sweetwater, Nolan County.

Lake Valley Limestone[1]

Lower Mississippian: Southern New Mexico.

Original reference: E. D. Cope, 1882, Eng. and Min. Jour., v. 34, p. 214.

L. R. Laudon and A. L. Bowsher, 1941, (abs.) Tulsa Geol. Soc. Digest, v. 9, p. 73–75; 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 12, p. 2114, 2125–2158. Restricted at base to exclude unit herein named Caballero formation. Subdivided into (ascending) Alamogordo, Arcente, and Dona Ana members. Underlies Magdalena formation. Thickness 29 to 420 feet. Osage.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 13, 22, pl. 2. In Boston Hill mining district, disconformably underlies Magdalena formation disconformably overlies Percha shale. Thicknesses: 657 feet; 325 feet. Not subdivided in this area.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284. In Santa Rita district, underlies Oswaldo limestone (lower Magadalena) and overlies Percha shale.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 31 (table), 83–85. In some parts of Caballo Mountains, underlies Red House formation (new) of Magdalena group; overlies Percha formation. Alamogordo and Nunn members recognized. Thickness 49 feet.

Well exposed in Lake Valley mining district, Sierra County.

Lake Vantage Lavas

Miocene, upper: Central Washington.

G. F. Beck, 1936, Northwest Sci., v. 10, no. 3, p. 22. Name applied to pillow lavas, in which petrified logs from Vantage forest have been buried,

together with underlying sediments. Horizon occurs about 800 feet down in Yakima basalt and extends over an area of 6 miles in diameter.

Occurs near Vantage, on Columbia River.

Lakeview Limestone[1]

Middle Cambrian: Northern Idaho.

Original reference: E. Sampson, 1928, Idaho Bur. Mines and Geology Pamph. 31, p. 9.

C. E. Resser, 1938, Smithsonian Misc. Colln., v. 97, no. 3, p. 3, 4. Overlies Rennie shale. Not overlain by other beds. Consists of two rock types: cliff-forming massive beds which vary from nearly pure limestone to nearly pure dolomite; and shaly beds containing thin-bedded fossiliferous limestone. Fossils described.

Named for exposures at town of Lakeview, near southeast end of Pend Oreille Lake.

Lakeview Quartz-Hornblende Diorite[1]

Lakeview Tonalite

Triassic(?) or Upper Jurassic(?): Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 502, map.

R. H. Merriam, 1941, Am. Jour. Sci., v. 239, no. 5, p. 366–371. Termed Lakeview tonalite in Ramona quadrangle.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 57. Replaced by Lakeview Mountain tonalite (new).

Occurs throughout greater part of Lakeview Mountains, Riverside County.

Lakeview Mountain Tonalite

Cretaceous: Southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 57–58, pl. 1. Replaces name Lakeview quartz-hornblende diorite as proposed by Dudley (1935) and term Lakeview tonalite as used by Merriam (1941). Uniform rather coarse-grained nearly white rock with scattered black plates of biotite and stout prisms of hornblende. In contact with Bonsall tonalite; character of contact indicates Bonsall tonalite intrudes Lakeview Mountain tonalite, but the two probably not very different in age.

Richard Merriam, 1958, California Div. Mines Bull. 177, p. 13–14, 16 (fig. 2), pl. 1. Described and mapped in Santa Ysabel quadrangle. Younger than Green Valley tonalite. Contacts with rocks other than Green Valley tonalite poorly exposed; hence, no definite age determination could be made.

Occurs in Elsinore, San Jacinto, Ramona, and Santa Ysabel quadrangles. Underlies most of Lakeview Mountains in Elsinore quadrangle.

Lake Waco Formation

Cretaceous (Gulf Series): Central Texas.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Series, no. 4, p. 119, 120, 133 (fig. 14), 137 (fig. 16), 139 (fig. 17). Proposed for section [of Eagle Ford] underlain by Woodbine sand or Pepper shale and overlain by emended South Bosque formation. Consists of grayish-white to brownish wavy-bedded limestones and dark silty shales with bentonite layers. Thickness 60 to 80 feet. Includes (ascending) newly defined members Bluebonnet, Cloice, and Bouldin.

Type area and section: West-facing Bosque Escarpment from Lake Waco Dam spillway south to the Moody Hills between McGregor and Moody, McLennan County; type section in Cloice Branch, from cement plant to old South Bosque brickyard pit.

†Lake Winnipesaukee Gneiss[1]

Precambrian(?) to Carboniferous: Eastern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Geology New Hampshire, pt. 1, p. 508–545.

Lake Winnipesaukee region.

Lake Wolford Leucogranodiorite

Cretaceous: Southern California.

E. S. Larsen and N. B. Keevil, 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 490. Named in report on study of batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 82–85, pl. 1. Described as fine-grained light-colored rock with average composition of leucogranodiorite. Makes up several widely separated bodies that differ considerably from place to place in each of main masses. Older than Woodson Mountain granodiorite and believed younger than San Marcos gabbro. Derivation of name given.

Named from its characteristic outcrops about Lake Wolford in western part of Ramona quadrangle. Occurs in San Luis Rey quadrangle, where it underlies an area of about 45 square miles.

Lakota Formation (in Inyan Kara Group)

Lakota Formation (in Dakota Group)

Lakota Sandstone (in Inyan Kara Group)[1]

Lower Cretaceous: Western South Dakota, northeastern Nebraska, and eastern Wyoming.

Original reference: N. H. Darton, 1899, Geol. Soc. America Bull., v. 10, p. 387.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Shown on columnar section as basal formation in Dakota group. Underlies Fuson shale.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1081–B, p. 18–25, 32–33, 34–50, 84–86, strat. sections. Subdivision and nomenclature of Inyan Kara group adjusted to conform with its twofold lithogenetic division; Fall River formation redefined to correspond to upper part, and term Lakota extended to include entire lower part. Regional transgressive disconformity [see Dakota group] is contact between Lakota and Fall River formations. Lakota comprises Minnewaste limestone member and Fuson shale member. Name Lakota should not be used outside Black Hills region. Type section at Lakota Peak not considered adequate for reference or comparison; standard reference section herein designated. At standard reference section, where only Minnewaste member is present, formation is 460 feet thick; overlies Unkpapa sandstone and disconformably underlies Fall River formation. Sequence of Lakota rocks in southern part of Black Hills is markedly different from that in northwestern part. Additional beds are added progressively at base of formation as it thickens eastward and southeastward. Relationship of these beds to underlying Morrison not completely understood, but they do interfinger.

Base of Lakota is an arbitrary, indefinite, and inconstant boundary generally drawn at base of first appreciable sandstone bed above Sundance formation, the local distinctive Unkpapa sandstone excepted.

W. J. Mapel and G. B. Gott, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–218. Referred to as formation—heterogeneous sequence of light-gray to light- to dark-gray siltstone, variegated sandy mudstone and claystone, and some limestone. Thickness as much as 550 feet in Cascade Springs and Angostura Reservoir quadrangles at southern end of Black Hills; thins irregularly westward to less than 100 feet along parts of Inyan Kara Creek and Government Canyon. In some areas, overlies Morrison formation, and in others, Unkpapa sandstone; underlies Fall River formation.

W.A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc., v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

Type locality: Lakota Peak, a summit hogback range, 4 miles northwest of Hermosa, Custer County, S. Dak. Composite reference section. Exposures in valley of Fall River in center W½NW¼ sec. 33, NE½NE¼ sec. 32, and adjacent parts sec. 29, T. 7 S., R. 6 E., Fall River County, Hot Springs quadrangle, South Dakota. Exposures are between 4 and 5 miles south of Hot Springs.

Lalor Sands[1]

Quaternary (probably Recent): Southern New Jersey.

Original reference: J. B. Woodworth, 1911, Harvard Univ. Peabody Mus. American Arch. and Eth. Papers, app., p. 238–241.

Named for Lalor farm, near Riverview Cemetery, Trenton, Mercer County.

Lamar Limestone Member (of Bell Canyon Formation)

Lamar Limestone Member (of Delaware Mountain Formation)[1]

Upper Permian (Guadalupe Series): Western Texas and southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 583–586, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 57–58, pl. 3. Reallocated to member status in Bell Canyon formation (new). Separated from underlying Rader limestone member (new) by several thousand feet of sandstone beds; separated from overlying Castile formation by about 20 feet of fine-grained slabby sandstone. Thickness at type locality about 15 feet; about 150 feet at mouth of McKittrick Canyon.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 18. Crops out at base of reef escarpment just north of south county line of Eddy County, N. Mex.

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region Texas and New Mexico; San Francisco, W. H. Freeman and Co., p. 15, 53. Separated from underlying Rader member by McCombs limestone member (new).

Type locality: Escarpment north of Lamar Canyon, where canyon is crossed by Western Gas pipeline, about 15 miles due east of Guadalupe Point, Delaware Basin, Tex.

Lamb Dolomite[1]

Middle(?) and Upper Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

U.S. Geological Survey currently designates the age of the Lamb Dolomite as Middle(?) and Upper Cambrian on the basis of a study now in progress.

Named for exposures in Lamb Gulch, on north side of Dry Canyon, Gold Hill district.

Lamb Point Tongue (of Navajo Sandstone)

Jurassic and Triassic(?): Southwestern Utah.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no 12, p. 2521. Applied by R. F. Wilson (in press) to rocks in Kanab area, formerly classified as Wingate by Gregory (1950). Consists of grayish-white to grayish-orange fine-to very fine-grained crossbedded sandstone. Base of tongue approximately 300 feet above top of Springdale sandstone member of Moenave throughout Kanab area; east of Sevier fault in vicinity of Moccasin, Ariz., eolian structures are absent in tongue; it is pale reddish-brown sandstone and is assigned to Kayenta formation. Approximately 400 feet thick in Kanab Canyon; 520 feet to east in Johnson Canyon; still farther east, thickens and coalesces with basal part of main body of Navajo; southwest of Kanab, thins from 400 to 142 feet in 5 miles; 93 feet at Moki Mountain southwest of Kanab. Since Lamb Point tongue thins westward from Kanab and since Shurtz tongue (new) thins southward from Cedar City, it is possible that they join somewhere between the two localities. Overlain by Tenney Canyon tongue (new) of Kayenta formation.

Type locality and derivation of name not stated.

Lamoille Glacial Stage[1]

Pleistocene: Northeastern Nevada.

Original reference: E. Blackwelder, 1931, Geol. Soc. America Bull., v. 42, p. 911, 918.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243A, table 2. Listed on correlation chart of mountain glaciations in western United States.

Largest glacier of this stage issued from Lamoille Canyon, Ruby Mountains, northeastern Nevada.

Lamotte Sandstone[1]

Upper Cambrian: Eastern and central Missouri.

Original reference: A. Winslow, 1894, Missouri Geological Survey, v. 6, p. 331, 347–358.

G. F. Brightman, 1938, Jour. Geology, v. 46, no. 3, p. 250 (table 1), 254. Underlies Tom Sauk member (new) of Bonneterre formation.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, p. 16–18. Largely quartz grains varying in color through light gray, reddish brown, red, green, and shades of yellow. Shale layers a few inches thick common throughout formation. Underlies Bonneterre formation. Oldest Cambrian formation that appears at surface in Missouri. No complete section exposed.

Named for Mine La Motte Station, Madison County.

Lamoureux[1] or Lamoureaux shale[1]

Devonian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Named for exposures in Lamoureux Canyon, Eureka district.

Lampasas Series

Pennsylvanian: Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 81–82. Proposed for beds younger than Morrow but older than type Strawn. Series forms extensive wedge between eastward-dipping type Marble Falls and westward-dipping Strawn beds. Type Marble Falls belongs to Morrow series, but Marble Falls beds in McCulloch and Kimble Counties are for most part believed to be post-Morrow. In southeastern Oklahoma, regional unconformities at top of Morrow and at base of Savanna are considered as marking lower and upper boundaries of Lampasas. Upper Pottsville and lower Allegany beds of older classifications included in Lampasas. Includes Big Saline (new) and Smithwick groups. Epoch marks first appearance of family Fusulinidae, possibly excepting genus *Stafella*. Development of *Fusiella* and *Fusinella* occurred during Big Saline time and early types of *Wedekindellina* and *Fusulina* species during Smithwick epoch. Genus *Mesolobus*, characteristic of Strawn (Des Moines) series, is thought to be absent in Lampasas.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 156–164. Type section and correlatives discussed. Proposed that Lampasas-Strawn boundary in Brazos River outcrop section be placed at base of conglomerate which rests on Dennis Bridge limestone at Dennis highway bridge in southwestern Parker County. Placement of Connoquenessing, Mercer, and Clarion groups of Pennsylvanian in Kanawha series (upper Pottsville) favors inclusion of approximately equivalent Big Saline, Smithwick, and Parks groups in correlative series of Mid-Continent region.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 76. Name Lampasas has been applied by Cheney in place of restricted Bend. Type outcrops designated by Cheney are same as those near Bend, type locality for the Bend. Seems confusing to substitute a new name for Bend, a term long in good usage by State and Government surveys.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 181–186. Lampasas not appropriate as series name because in type area it is only partly exposed and because, as defined it includes beds of Des Moines age and excludes part of Marble Falls which is post-Morrow in age.

Type section: Around Llano uplift of central Texas and in area to north. Best outcrops of beds are in western Lampasas and eastern San Saba Counties near village of Bend. McAnnelly's Bend in vicinity of village of Bend has been used as type area of Bend division.

Lampkins Sandstone Member[1] (of Carwood Formation)

Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv. Div. Geology Pub. 98, p. 77, 118, 178, 183, 291.

J. M. Weller and others 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 facing p. 126. Member of Carwood formation. Part of Gent facies of formation.

Named for Lampkins Bridge across Salt Creek, south-center sec. 15, T. 8 N., R. 1 E., 3 miles southwest of Belmont, Monroe County.

Lampson Formation

Pliocene and (or) Pleistocene: Northeastern Nevada.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 45–46. Consists of bedded tuffs and gravels containing basalt pebbles. Thickness in some areas as much as 300 feet. Younger than Lake Newark formation (new). Underlies Belmont fanglomerate (new). Mapped with Lake Newark formation.

Named for exposures in Lampson Canyon, White Pine mining district, White Pine County.

La Muda Limestone Member (of Frailes Formation)

La Muda Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 22.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 10 (fig. 4), 18–19, pl. 2. Rank reduced to member status in Frailes formation (new). La Muda as used in this report follows usage of Berkey and not Meyerhoff and Smith (1931, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, v. 2, p. 3); their La Muda is referred to Trujillo Alto limestone. Texture varies; fine-grained pure limestone; solution openings and veins of coarsely crystalline calcite common; thin sections show Foraminifera, Radiolaria, and small broken grains of calcareous algae. Thickness 35 to 60 feet. Forms lenticular limestone in lower part of Frailes and is not a single bed or stratigraphic horizon. In type area, directly overlies Tortugas andesite (new) in vicinity of El Laberinto; to the northwest, rests on what seems to be the Guaynabo (without the intervening andesite); in type section of Frailes, the La Muda is separated from Tortugas andesite by about 200 feet of noncarbonate rock of Frailes.

Type locality: Vicinity of La Muda, a roadside settlement that fringes highway for a mile or more southeast of intersection of Highways 1 and 20, San Juan area.

Lana Conglomerate[1]

Precambrian: Northwestern Vermont.

Original reference: W. G. Foye, 1919, Vermont State Geologist 11th Rept., p. 85.

Occurs just above Falls of the Lana, north of Silver Lake, southern part of Addison County.

Lana Shale[1]

Precambrian: Northwestern Vermont.

Original reference: E. J. Foyles, 1929, Vermont State Geologist 16th Rept., p. 284.

Probably named for Falls of the Lana, Addison County.

Lanai Volcanic Series

Lanai Basalt[1]

Pliocene and Pleistocene(?) : Lanai Island, Hawaii.

Original reference: C. K. Wentworth, 1925, Bernice P. Bishop Mus. Bull. 24, p. 34.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 9, p. 67; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 110. Thin-bedded and pahoehoe basaltic flows, a few mixed cinder and spatter cones; about 375 feeding dikes. Composes cone of Lanai volcano. Thickness above sea level 3,370 feet; base not exposed. Includes Lanai basalt and Manele basalt. Overlain by marine limestone of probable Pleistocene age.

Well exposed in Kaholo Pali (cliff) on southwest side of island, and in deep canyons on northeastern slope. Covers area of about 135 square miles and comprises entire island except for small areas of alluvium.

†Lancaster Limestone[1]

Cambrian and Ordovician : Eastern Pennsylvania.

Original reference: J. P. Lesley and P. Frazer, Jr., 1880, Pennsylvania 2d Geol. Survey Rept. C_3, map of Lancaster County.

Lance Formation[1]

Upper Cretaceous: Colorado, Montana, North Dakota, South Dakota, and Wyoming.

Original reference: J. B. Hatcher, 1903, Am. Geologist, v. 31, p. 369–375.

W. R. Calvert, 1912, U.S. Geol. Survey Bull. 471, p. 189–198. In eastern Montana and southwestern North Dakota, includes Colgate sandstone member (new).

E. R. Lloyd, 1914, U.S. Geol. Survey Bull. 541, p. 249–250. In Cannonball River lignite field, North Dakota, includes Cannonball marine member (new), 250 to 300 feet thick, in upper part. Eocene(?).

E. R. Lloyd and C. J. Hares, 1915, Jour. Geology, v. 23, no. 6, p. 527–547. In western part of North Dakota and South Dakota, comprises (ascending) unnamed lower part, Ludlow lignitic member (new), and Cannonball marine member.

G. S. Rogers and Wallace Lee, 1923, U.S. Geol. Survey Bull. 749, p. 19–34. In Tullock Creek coal field, Montana, includes Tullock member (new), about 300 feet thick, in upper part.

W. T. Thom, Jr., and C. E. Dobbin, 1924, Geol. Soc. America Bull., v. 35, p. 490, 491–493. Restricted to exclude Colgate sandstone which is allocated to member status in underlying Fox Hills sandstone. Comprises Hell Creek, Tullock, Ludlow lignitic, and Cannonball members.

C. E. Dobbin and J. B. Reeside, Jr., 1929, U.S. Geol. Survey Prof. Paper 158–B, p. 9–25. Discussion of contact of Fox Hills and Lance formations. Writers [Dobbin and Reeside] advocate view that Laramie, Arapahoe, and Denver formations of Denver Basin are represented in Lance formation. Contact between Lance and Fox Hills is conformable except where local unconformities are present along minor erosion planes at many horizons within both formations. Measured sections show Lance present in Montana, Wyoming, North Dakota, and South Dakota.

E. M. Schlaikjer, 1935, Harvard Coll. Mus. Comp. Zoology Bull., v. 76, no. 2, p. 31–54, 65. In Goshen County, Wyo., includes Torrington member (new), 60 to 100 feet thick, as top member.

W. G. Pierce, 1936, U.S. Geol. Survey Bull. 847–B, p. 53–57, pl. 11. In Rosebud coal field, Montana, comprises (ascending) Hell Creek and Tullock members. Underlies Fort Union formation. Age has long been in controversy. Since decision in 1914 by U.S. Geological Survey to refer the Lance tentatively to the Tertiary, there has been much paleontologic and structural evidence which seems to warrant placing at least part of the Lance in the Cretaceous. Tertiary age used in this report inasmuch as studies of age of Lance still in progress. Mapped as Eocene(?).

E. P. Rothrock, 1937, South Dakota Geol. Survey Rept. Inv. 28, p. 4, 6–13. Described in Harding County where it includes Hell Creek and Ludlow members. Thickness 800 feet. Overlies Fox Hills formation; underlies Fort Union.

C. W. Wilson, Jr., 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 1, p. 106–108. In Carbon County, Mont., comprises (ascending) Hell Creek and Tullock members. Thickness 690 feet. Overlies Colgate sandstone; underlies Fort Union formation.

M. H. Stow, 1938, Geol. Soc. America Bull., v. 49, no. 5, p. 735–736, 744–745, pls. 1, 2. Upper Cretaceous Lance formation comprises Hell Creek and Tullock members. Underlies Lebo member of Fort Union; overlies Lennep sandstone. Area of report Big Horn Basin.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 10–11, pl. 3. In McCone County, Mont., where Lance is about 300 feet thick, it is underlain by Fox Hills sandstone of Upper Cretaceous age and underlies Fort Union formation of Eocene age. Footnote (page 10) states that since present report was written the Hell Creek and Tullock members have been raised to rank of formation in official classification of the Geological Survey, the Hell Creek being assigned to the Cretaceous and the Tullock to the Cretaceous or Eocene. Lance is Eocene(?).

Erling Dorf, 1940, Geol. Soc. America Bull., v. 51, no. 2, p. 213–236. Discussion of relationship between floras of type Lance and Fort Union formations. Paleobotanical evidence supports known vertebrate evidence in placing boundary between true Lance and "Fort Union" at base of non-dinosaur-bearing Tullock, Ludlow, or Bear formations or their equivalents; that is, at top of *Triceratops*-bearing Hell Creek or Lance formations as originally defined. Such a view is not contradicted by marine invertebrates of Cannonball beds, which interfinger with the Ludlow and the lower "Fort Union." In proposed revision, Lance formation (equivalent to Hell Creek formation) is restricted to Upper Cretaceous; Tullock formation (equivalent to Ludlow formation and Cannonball marine member) is basal formation of Paleocene Fort Union group. Lance overlies Fox Hills sandstone.

V. H. Kline, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 338. Generalized columnar section for North Dakota shows that Lance, 0 to 800 feet thick, comprises (ascending) Hell Creek, Cannonball, and Ludlow members. Overlies Fox Hills sandstone; underlies Fort Union formation. Tertiary.

O. A. Seager and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1415, 1416. There has been little agreement and no accepted

solution of "Lance-Laramie" problem. In North Dakota, lithology and paleontology of strata formerly classified as "Lance" permit subdivision into formations whose stratigraphic positions are quite definite. Classification shows Cannonball and Ludlow as members of Paleocene Fort Union formation and the Hell Creek a formation in Upper Cretaceous.

Erling Dorf, 1942, Carnegie Inst. Washington Pub. 508, pt. 2, p. 83–159, pls. At type locality, consists of about 2,600 feet of dull-gray sandy shales alternating irregularly with lenticular light-colored sandstones and thin lignite beds. Along Lance and Lightning Creeks are numerous exposures which show that individual units are very irregular, sandstones passing laterally into shales and vice versa. Overlies Fox Hills sandstone; underlies Fort Union group, lower limit of which, in Lance Creek area, is equivalent to Tullock formation. Upper limit drawn at top of dinosaur-bearing beds. This horizon coincides with marked change, without a recognized erosional or structural unconformity, from the characteristic dull-gray shales and shaly sandstones of typical Lance formation to sequence of more persistent ridge-forming yellowish sandstones, yellowish sandy shales, and coal beds. Formation at Lance Creek has yielded abundant fossil remains of vertebrates, invertebrates, and plants. Flora described. Upper Cretaceous.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 79–80. Lance of Wyoming equivalent to Laramie formation (redefined) of Denver Basin.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Discussion of thickness and general character of Cretaceous deposits in Western Interior of United States. Correlation chart shows Lance in northern Great Plains, overlies Fox Hills sandstone and underlies Ludlow formation and Cannonball formation. Upper Cretaceous. [Ludlow and Cannonball previously considered members of Lance.]

H. E. Summerford and others, 1947, *in* Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 19. Road log of Bighorn Basin mentions Ilo Ridge member of Lance formation on east flank of Grass Creek anticline. Basal unit of formation; overlies Meeteetse formation.

G. B. Downs, 1947, Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 140. In Bighorn Basin area, name Lance applied only to Cretaceous or Hell Creek part of "Lance" of early writers. Youngest Mesozoic sequence of Bighorn Basin. Underlies Fort Union formation with angular disconformity; distinguished from underlying Meeteetse formation by general absence of coal beds, absence of coarse sediments, and presence of dark-brown concretions which weather from the sandstone of the Lance. The Lance is predominantly sand or poorly consolidated sandstone with lesser amounts of sandy clay and shale which range in color from gray and drab to light brown. Maximum thickness 1,400 feet.

L. A. Hale, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 55. Area of report, Rock Springs uplift, Sweetwater County, Wyo. Along east side of uplift continental sediments lie conformably on marine Lewis shale and unconformably beneath Wasatch formation. This sequence of beds was named Black Butte coal group by Schultz and later Laramie formation. A thickness of 1,500 feet was given but nowhere is entire formation exposed. Proposed here that term Lance formation be applied in favor of Laramie formation in order to conform with currently accepted terminology of post-Montana pre-Tertiary formation in Wyoming.

Lance consists of basal member of light to yellowish-gray sandstone locally 80 feet thick. This member rests upon Lewis shale and forms prominent hills and precipitous cliffs along contact. Overlying beds consist of sandstone, clay shale, and thin coal beds that are less resistant to weathering than basal sandstone. Formation exposed only on east side of uplift between North Table Mountain and Black Butte Creek. Elsewhere the Wasatch lies unconformably in turn upon the Lewis, Almond, Ericson, and in one locality (T. 15 N., R. 104 W.) upon Rock Springs formation.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 65, pls. 6, 8. Described in Crazy Woman Creek area, Johnson County, Wyo., where it overlies Bearpaw shale and underlies Fort Union formation. Thickness 1,950 to 2,200 feet. Contact with Bearpaw arbitrarily placed at top of 6-inch bentonite bed in Bearpaw. Lower 600 feet, which contains dinosaur bones, is of Late Cretaceous age. No fossils found in upper part within mapped area and assignment of entire Lance to Upper Cretaceous is one of convenience. Lower 100 feet may, in part, be equivalent to Fox Hills sandstone which is recognized about 20 miles south of mapped area.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 59–60, pls. 1, 3. At type locality, Lance beds conformably overlie Fox Hills sandstone and underlie Fort Union formation. Fox Hills sandstone not distinguished in Buffalo-Lake De Smet area, Wyoming [this report], and beds here classified as Lance rest directly on Bearpaw shale. Contact between Bearpaw and Lance placed arbitrarily at top of bed of grayish-yellow bentonite 1 foot thick underlain by 2 to 3 feet of fine-grained light-gray sandstone; this sandstone carries marine fauna. Underlies Fort Union formation. Thickness 1,970 feet 5 miles south of mapped area. Upturned edges of steeply dipping beds in Lance are exposed in southwestern, west-central, and northwestern parts of area in an outcrop band a quarter to a half mile wide trending northwestward parallel to Bighorn Mountain front.

Type locality: Lance Creek area, north-central part Niobrara County (formerly a part of Converse County), Wyo. Mouth of Lance Creek is in sec. 11, T. 39 N., R. 62 W.

†Lance Creek Beds[1]

Upper Cretaceous: Wyoming, northwestern Colorado, Montana, western North Dakota, and South Dakota.

Original reference: J. B. Hatcher, 1903, Am. Geologist, v. 31, p. 369–375.

Named for exposures on Lance Creek, Niobrara County (formerly part of Converse County), Wyo.

Lancha Limestone (in Pacheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12. Grayish, bluish-gray, and pinkish limestone in places arenaceous or partly silicified. Thickness 11 feet. Underlies unnamed yellow dolomite. Overlies Morita formation.

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Landaff Granite[1]

Upper Devonian or Upper Carboniferous: West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 28, Moosilauke map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 511, pl. 12. Fine-grained pink to gray hastingsite granite. May be part of White Mountain magma series.

Mapped largely in Landaff Township, Moosilauke quadrangle, Grafton County.

Lander Sandstone Member (of Bighorn Dolomite)[1]

Lander Sandstone

Upper Ordovician: Western Wyoming.

Original reference: A. K. Miller, 1930, Am. Jour. Sci., 5th, v. 20, p. 196–213.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 18, 19. Well exposed in several localities on southern margin of Absaroka Range. Thickness commonly about 7 feet. Underlies middle massive dolomite member. In some areas, rests with slight erosional unconformity on Gallatin limestone.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 126 (fig. 2), 129. Referred to as Lander sandstone. Overlies Gallatin formation; underlies Bighorn dolomite. Thickness as much as 20 feet.

A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 41. Overlies Open Door limestone (new) of Gallatin group.

Named from exposures about 10 miles southwest of Lander.

Landes Limestone[1]

Middle Devonian: Northeastern West Virginia.

Original reference: D. B. Reger, 1924, West Virginia Geol. Survey Rept. on Mineral and Grant Counties, p. 313, 745.

G. A. Cooper and others, 1952, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart below Genesee shale and above Hamilton shale.

Named for occurrence in public road along North Mill Creek, 0.2 mile north of Landes, Grant County.

Landgraff Sandstone (in Pocahontas Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 235.

Once quarried at Landgraff, McDowell County.

Landisburg Sandstone[1]

Silurian: Central Pennsylvania.

Original reference; J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 761–777.

Landisburg, Perry County.

Landrum Member (of Cook Mountain Formation)

Landrum Shale Member (of Crockett Formation)

Eocene, middle (Claiborne): Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 125, 134–148. Series of brown lignitic shales and marls about 100 feet thick, overlying Wheelock marl member (new) and underlying Spiller sand member (new) of Crockett formation. Lower and upper boundaries transitional and interfingering.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1665–1671. Reallocated to member status in Cook Mountain formation. Includes bentonite-bearing Hurricane marine lentil (new).

Type locality: On north-flowing tributary of Two-Mile Creek which enters Two-Mile Creek on William Johnson Survey; Two-Mile Creek flows through the J. L. Landrum survey near Two-Mile Church, Leon County.

Landston formation[1]

Middle Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

Lane Shale (in Kansas City Group)

Lane Shale (in Lansing Group)[1]

Lane Shale Member (of Lansing Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 277, pl. facing p. 290; 1895, Am. Jour. Sci., 3d, v. 50, p. 460, pl. facing p. 466.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, Mo., shows Lane shale in Lansing group. Includes (ascending) Island Creek shale, Farley limestone, and Bonner Springs shale members. Underlies Plattsburg limestone; overlies Iola limestone which includes (ascending) Frisbie limestone, Quindaro shale, and Argentine limestone members.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032–2033; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 13–14. Settlement of "Iola problem" has led to several changes in Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Liberty Memorial shale (Clair, 1943), overlying Raytown limestone, is no longer considered uppermost member of Chanute shale but is suppressed as junior synonym of Lane shale. Frisbie limestone, Quindaro shale, and Argentine limestone, which were indicated as members of Iola limestone are classified with overlying Island Creek shale and Farley limestone as members of Wyandotte formation. Island Creek shale and Farley limestone, which were associated with overlying Bonner Springs shale as members of Lane shale, are included in Wyandotte formation. Bonner Springs shale is recognized as formational unit between Wyandotte and Plattsburg formations. Hence, Lane shale in Missouri is removed from Lansing group and placed in Kansas City group where it occupies interval between Iola limestone and Wyandotte limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 35. Thickness of formation 14 feet in Sarpy County, Nebr. Overlies Iola formation; underlies Frisbie limestone member of Wyandotte formation. Kansas City group.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness of Lane formation about 10½ feet in Madison and Adair Counties, Iowa. Overlies Iola formation; underlies Frisbie limestone member of Wyandotte formation. Kansas City group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 25, fig. 5. Recognized in Madison County as an olive to dark-gray fossiliferous shale containing limestone lenses; at some localities, has thin bed of maroon and green shale at base. In Union County, consists of greenish-gray to yellow calcareous shale with lenses of gray fossiliferous shale. Thickness 7 feet, Madison County; about 10 feet, Union County. Underlies Wyandotte limestone; overlies Iola limestone. Kansas City group.

Named for exposures at Lane, Franklin County, Kans.

Lanes Tongue (of Ankareh Formation)

Triassic: Eastern Idaho and western Wyoming.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 173, 175 (fig. 18), pl. 38. Prominent tongue of Ankareh in upper part of Thaynes formation pinches out westward toward Fort Hall.

Present in Sheep Creek section, Grays Range, Idaho.

Lanesboro formational suite (of Wellsburg monothem)

Lanesboro Member (of New Milford Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571–589.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 46. Termed formational suite; upper unit in monothem. Further described as typically containing massive sandstone or flaggy zone at top, a predominantly shaly zone in middle, and a prominent sandstone zone at base. Newly named Drinker Creek sandstone occurs at base.

Named for exposures near Lanesboro, Susquehanna County.

†Laneville Shale[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 108.

Named for exposures at Laneville, Labette County, Kans.

Laney Shale Member (of Green River Formation)[1]

Eocene, middle: Southwestern Wyoming.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

J. J. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 63–64. Overlies Fontenelle member (new) of Green River.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1072–1074. At type locality and around Washakie basin and southward into Colorado, Laney shale member is characterized by buff laminated, or massive marlstone, buff tuffaceous sandstone, and soft marly shale, in which ostracods are fairly common. Interbedded with these rocks are

moderate number of oil shale and organic marlstone, algal, and oolitic layers; fish bones, plant fragments, and snail or fresh-water clam shells are characteristic. In Bridger basin, beds that have been called Laney are predominantly white dolomitic marlstone, oil shale, or greenish-gray dolomite; though regularly bedded or laminated, they characteristically lack fossils, algal deposits, and oolites. This unit differs from type Laney in having thick and extensive saline facies; no saline facies of any kind are known in the Laney beyond limits of Bridger basin. Concluded from this study that what has been called Laney shale member in Bridger basin is older than type Laney and is time equivalent of Cathedral Bluffs and New Fork tongues of Wasatch formation. Beds in Bridger basin formerly thought to be Laney shale member of Green River herein renamed Wilkins Peak member. Recognition of Wilkins Peak member and its equivalence to Cathedral Bluffs tongue of Wasatch forces recognition of equivalence of Morrow Creek member with Schultz' type Laney shale member; hence, Morrow Creek member is abandoned, and name Laney shale member substituted. Laney shale member rests on Wilkins Peak member or one or another of tongues of Wasatch formation that are approximate time equivalents of Wilkins Peak member. Laney is overlain by Bridger formation. Tower sandstone lentil of Green River formation is redefined as lentil in Laney shale member.

Named for Laney Rim. Sweetwater County.

†Lang division[1]

Tertiary: Southern California.

Original reference: O. H. Hershey, 1902, Am. Geologist, v. 29, p. 349–372.

Named for exposures at Lang, Los Angeles County.

Langdon Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northwestern Missouri, southwestern Iowa, south-central Kansas, and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42. Proposed for shale between base of Dover limestone above and top of Maple Hill limestone below. Thickness at type locality about 19 feet; 50 feet or more in north-central Kansas; thinner in southeastern Nebraska; replaces name Table Creek shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull., v. 14, p. 15. Occurrence, from southwestern Iowa, southeastern Nebraska, and northwestern Missouri to south-central Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2275–2276. Pillsbury shale (new) replaces Langdon shale (Condra and Reed, 1943); investigations have established Langdon shale, at its type section, as correlative with Wamego shale member of Zeandale limestone (new); accordingly name Langdon shale is abandoned.

Type locality: In Missouri River valley bluffs southeast of Langdon, Atchison County, Mo., or northwest of Craig, Holt County, Mo.

Langston Limestone[1]

Middle Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6, 7.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1114–1115, 1117 (fig. 4), 1119–1120. Walcott's Blacksmith Fork section emended.

Langston consists of series of interbedded dull-tan, blue- and white-gray limestones, and dolomites which weather to red brown, and a basal 75- to 80-foot zone of white-gray calcareous quartzitic thin-bedded sandstone, 75-foot zone of buff-weathering thick-bedded dolomite occurs 68 feet below top of formation. Thickness 575 feet in type section which was measured on spurs that form sides of lower one-half mile of North Cottonwood Canyon on north side of Blacksmith Fork. Overlies Brigham quartzite; underlies Ute limestone (emended).

J. S. Williams and G. B. Maxey, 1941, Am. Jour. Sci., v. 239, no. 4, p. 279–281; J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1132–1133, pl. 1. In Logan quadrangle, Utah, includes Spence shale (formerly considered member of Ute formation) near base. At type locality, essentially two tan-weathering dolomites with an intermediate limestone member. Thicknesses 340 to 380 feet. Northward formation as a whole thickens slightly, but basal dolomite thins and disappears as *Ptarmigania* limestone and Spence shale appear and thicken at base of formation. Overlies Brigham quartzite; underlies Ute formation.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 649–650, 654–655, 656, 657–658, 662, 663, 664, 665, 669–671, 673 (fig. 3). Subdivided to include Naomi Peak limestone member (new). Several measured sections given. Section on north side of High Creek Canyon, sec. 11, T. 14 N., R. 2 E., near Richmond, Utah, considered most typical. Here both Naomi Peak and Spence members are present. Thickness 484 feet. Overlies Pioche formation. Some beds formerly assigned to Ophir and Maxfield formations are here assigned to Langston. Lower and Middle Cambrian.

Most accessible locality is Blacksmith Fork Canyon, Cache County, Utah, but strike of beds carries formation into valley of Langston Creek, Bear County, Idaho.

†Lang Syne Beds[1]

Eocene, lower: Central South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449, 451–452.

Named for exposures at Lang Syne plantation, Calhoun County.

Lanoria Quartzite[1]

Precambrian: Western Texas.

Original reference: G. B. Richardson, 1909, U.S. Geol. Survey Geol. Atlas, Folio 166.

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 1. Overlies Red Bluff granite and unconformably underlies about 1,500 feet of red rhyolite porphyry.

R. L. Harbour, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1786 (fig. 1), 1790. Overlies Mundy breccia (new). Consists of 2,600 feet of quartzite, siltstone, and shale. Underlies unnamed rhyolite.

Named for exposures just west of old settlement near base of Franklin Mountains, 8 miles northeast of El Paso, El Paso County.

†Lanphier Beds (in Cheyenne Sandstone)[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, Am. Geologist, v. 16, p. 361, 367.

Named for draw running through Lanphier claim (which may be called Lanphier Draw), in southeast corner of Kiowa County.

Lansdale Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original references: B. S. Lyman, 1893, Pennsylvania Geol. Survey geol. and topog. map of Bucks and Montgomery Counties; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

Underlies Lansdale, Montgomery County.

L'Anse Series[1]

Age (?): Northeastern Michigan.

Original reference: T. B. Brooks, 1873, Michigan Geol. Survey, v. 1, pt. 1, p. 151–155.

L'Anse iron district, Baraga County.

Lansing Group[1]

Lansing Formation[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: H. Hinds, 1912, Missouri Bur. Geology and Mines, v. 11, 2d ser., p. 7.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 45 (fig. 8), 123–137. Group includes strata from base of Plattsburg to top of Stanton limestone. Average thickness about 75 feet; more than 150 feet in parts of southern Kansas. Overlies Bonner Springs shale of Kansas City group; underlies Weston shale of Pedee group.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 27, pl. 5. Group in Missouri includes (ascending) Lane shale which comprises Island Creek shale, Farley limestone, and Bonner Springs shale members, Plattsburg limestone, Vilas shale, and Stanton limestone. Underlies Weston shale of Pedee group; overlies Iola limestone of Kansas City group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033–2034. Interstate agreement recognized Lansing group as defined by Moore, that is, comprising Plattsburg limestone, Vilas shale, and Stanton limestone.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 14. Lansing group revised for Missouri to accord with interstate agreement. Island Creek shale, Farley limestone, and Bonner Springs shale, formerly included in Lansing group, now included in upper part of Kansas City group.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 31–34. Exposed thickness of group about 52 feet in Nebraska; average thickness 70 feet in northwestern Missouri.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24, fig. 5. Group in southwestern Iowa comprises Plattsburg limestone, Vilas shale, and Stanton limestone. Thickness about 29 feet. Underlies Kansas City group. Pedee-Douglas groups not differentiated.

Type locality: Lansing, Leavenworth County, Kans.

Lansingan series

Paleozoic (Cambric) : Arkansas, Iowa, Minnesota, and Missouri.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 75, no. 1, p. 74–76. Oneota limestone and Richmond sandstone beneath constitute valid, though imperfect taxonomic series for which term Lansingan is proposed. In eastern Missouri, Delassus sandstone, Potosi dolomite, and Eminence cherty dolomite are assigned to the series.

Lantern Hill Silexite

Lantern Hill quartz rock[1]

Age not stated : Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 136.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 64–65. Referred to as silexite. Resistant mass of almost pure silica located in Lantern Hill ; smaller mass occurs to north. Derivation of name.

Named for Lantern Hill located on boundary between towns of North Stonington and Ledyard, New London County.

Lantz Mills facies (of Edinburg Formation)

Middle Ordovician : Western Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 78, 79, 82. Edinburg formation (new) embraces two equivalent facies : one of cobbly to nodular buff-weathering limestone, the Lantz Mills facies, which is mainly developed in northern and western parts of Shenandoah Valley ; and relatively thicker body of black limestone and shale, Liberty Hall facies (new), typically developed in Harrisonburg-Staunton area. Thickness, where typically exposed, 188 feet.

Typically exposed along Swover Creek near Lantz Mills, 4.6 miles N. 69° W. of Edinburg, Shenandoah County.

Laona Sandstone[1]

Laona Siltstone Member (of Canadaway Formation)

Upper Devonian : Western New York.

Original reference : J. Hall, 1841, New York Geol. Survey 5th Ann. Rept., p. 177.

Wallace de Witt, Jr., and G. W. Colton, 1950, U.S. Geol. Survey Geol. Quad. Map GQ–30. In Silver Creek quadrangle, Laona sandstone overlies Gowanda member of Perrysburg formation.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Laona sandstone of Hall overlies Perrysburg formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 2), 17. Referred to as siltstone member of Canadaway formation. Overlies Gowanda member ; underlies Westfield member. Name credited to L. C. Beck (1840, Fourth annual report on the mineralogical and chemical department of the Survey of New York, p. 57–58).

Named for exposures at Laona, Chautauqua County.

Lapa Lava Member (of Robles Formation)

Upper Cretaceous : Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 144, 145. Present in siltstone-

sandstone facies of formation. Rests on rocks of volcanic complex in its southernmost outcrops; toward the north, overlies a lower tongue of siltstone of the Robles. Its stratigraphic position within formation becomes increasingly higher as this siltstone thickens. Thickness of lava ranges from a few inches to more than 1,000 feet; thickest in central and southern parts of island; pinches out toward the east, north, and northwest. Diagnostic features are pillowed structure and prominent phenocrysts. Appears to represent two lava effusions which in southern part of island are separated by thin layers of siltstone. Name credited to Berryhill and Glover (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. Intertongues with Cayey siltstone member (new) in Cayey quadrangle. Thickness about 350 meters at type locality.

Type section: U.S. Military Reservation; begins at base of hill at point 1.2 kilometers N.40°W. of road intersection at Rabo del Buey and extends up ridge southwestward in Coamo quadrangle. Named for exposures in hills west of Río Lapa in Barrio Lapa between Rabo del Buey and Capilla de Santa Marta.

Lapara Sand Member (of Goliad Sand)[1]

Pliocene: Southern Texas.

Original reference: E. T. Dumble, 1893, Brown coal and lignite of Texas, p. 154.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v, 29, no. 12, p. 1727. In southwestern Texas, from central Duval County to the Rio Grande, divisions of the Goliad have been mapped. Section of sand and gravel at the base of the Goliad, ordinarily unconsolidated but in some places cemented to a firm siliceous conglomerate where it overlaps older beds sufficiently to rest on the Catahoula, is considered Lapara; upper section considered Lagarto. More work needed to determine full relations of these units to the Lapara and Lagarto divisions of Dumble in Live Oak County.

Type locality: Exposures along Lapara Creek in Live Oak County.

La Perla Shale Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 264, Green and gray sandy bentonitic shale characterized by abundance of oyster beds. Thickness ranges from 50 to 150 feet. Basal member of formation. Overlies Falcon sandstone member (new) of Cook Mountain formation; underlies Mier sandstone tongue (new) of Yegua formation.

Named for La Perla ranchhouse, located on bank of Rio Grande, north part of San Ygnacio quadrangle.

†La Plata Sandstone[1]

Upper Jurassic: Southwestern Colorado and southeastern Utah.

Original reference: W. S. Cross *in* C. W. Purington, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 759.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1746–1751. Five members differentiated in section covered by name La Plata sandstone. Unit 1 is correlated with Entrada sandstone; other units are considered members of Morrison and named

(ascending) Pony Express limestone, Bilk Creek sandstone (new), Wanakah marl (restricted usage of Burbank's original Wanakah), and Junction Creek sandstone (new).

E. B. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 28. Term Wanakah as used in this report [La Plata district, Colorado] is equivalent to La Plata limestone and middle La Plata shale as these terms are applied by local miners, and to middle part of La Plata sandstone as defined in La Plata folio (no. 60) and other reports on parts of southwestern Colorado. In La Plata district and elsewhere, rocks here placed in Wanakah were formerly regarded as part of Morrison formation.

Named for extensive development in La Plata Mountains, Colo.

Lapoint horizon (in Duchesne River Formation)[1]

Eocene (Duchesnean) : Eastern Utah.

Original reference: J. L. Kay, 1934, Carnegie Mus. Annals, v. 23, p. 357–359.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 23, pl. 1. Overlies Halfway horizon. Eocene (Duchesnean).

Typically exposed along head of Halfway Hollow, east and north of Lapoint, Uintah County.

La Posta Quartz Diorite[1]

Late Mesozoic : Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 115–141.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 485, table 4. Described under Late Mesozoic plutonics. In sequence in San Diego County, La Posta quartz diorite is younger than Descanso granodiorite or Stonewall diorite and older than Rattlesnake granite.

Typical exposures occur in general vicinity of La Posta Valley, southern Peninsular Range, San Diego and Imperial Counties.

Lar Quartz Diorite

Pre-Cretaceous(?) : Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 3, 7 (table 1), 11–12, pl. 1. Fine- to medium-grained quartz diorite in Lar pluton. Separated into three parts: foliated biotite quartz diorite, massive biotite quartz diorite, and sheared biotite quartz diorite. Present also as large blocky inclusions in Feliz pluton and as microbreccia in Cahuenga Peak fault block; makes up entire exposure in Riverside fault block. Suggested sequence of intrusion in area is Vermont quartz diorite (new), Lar quartz diorite, and Feliz granodiorite (new).

Occurs in Griffith Park area, city of Los Angeles.

Laramie Formation[1]

Upper Cretaceous : Eastern Colorado.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, maps 1, 2,.

C. H. Dane and W. G. Pierce, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1310 (fig. 2), 1313–1320. In southeastern part of Denver basin, underlies Dawson arkose; in vicinity of Denver, underlies Arapahoe formation; overlies Fox Hills sandstone.

R. L. Nace, 1936, Wyoming Geol. Survey Bull. 26, p. 9–16. Note on type locality.

R. W. Brown, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 65–86. Discussion of Cretaceous-Tertiary boundary in Denver basin, Colorado. Stratigraphic and paleontologic evidence show that Laramie formation, Arapahoe formation, and the Cretaceous parts of Denver formation and Dawson arkose comprise a unit correlative with Lance formation and its equivalents. Proposed herein that the Laramie be redefined to include all the Upper Cretaceous sequence between top of Fox Hills and base of the Paleocene in Denver basin; that term Arapahoe as Arapahoe conglomerate member be retained for the conglomerate immediately overlying present Laramie formation; that terms Denver formation and Dawson arkose be restricted to the Tertiary strata. The Laramie as expanded is equivalent to typical Lance formation and Hell Creek formation; to Medicine Bow formation plus basal part. of Raton formation with the exception that both the Medicine Bow and Vermejo as now defined may include in their basal parts some strata that should be referred to Fox Hills sandstone.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 56–57, pl. 1. Described in South Park, Colo., where it consists of sandstone, shale, volcanic tuff, and coal. Maximum thickness 375 feet. Overlies Fox Hills formation; unconformably underlies Denver formation.

L. A. Hale, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 55. Along east side of Rock Springs uplift, continental sediments lie conformably on marine Lewis shale and unconformably beneath Wasatch formation . This sequence of beds was named Black Butte coal group by Schultz and later Laramie formation. Proposed here to use term Lance formation in preference to Laramie to conform with currently accepted terminology of post-Montana pre-Tertiary formations in Wyoming.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 107–112, pl. 1,. Discussion of post-Laramie correlations in Denver basin, Colorado. In view of limits set for Arapahoe, Denver, and Dawson formations, the Laramie should be restricted to definition used by Emmons, Cross, and Eldridge (1896, U.S. Geol Survey Mon. 27) rather than extended as proposed by Brown (1943).

Type locality not designated in original description. Since name Laramie is now restricted to strata in Denver Basin of Colorado, it may be considered that type locality is in Denver Basin region east of Front Range of Colorado.

Laredo Formation (in Claiborne Group)

Eocene, middle: Southern Texas and northern Mexico.

Julia Gardner, 1938, Washington Acad. Sci. Jour., v. 28, no. 7, p. 297–298. Proposed for part of measured section of Claiborne group, that in the report on "Geology and ground-water resurces of Webb County, Tex.," by Lonsdale and Day (1937), is included under name Cook Mountain formation, and for all beds of equivalent age in Rio Grande embayment. Overlies Mount Selman formation; underlies Yegua formation. Beds include both soft and indurated, glauconitic sandstone, glauconitic marl and clay, and thin limestones, commonly concretionary. In Laredo district, sands and sandstones make up more than 50 percent of formation; farther north, upper third of formation includes more clay than sandstone. Thickness near Laredo about 630 feet.

Area in which name is to apply extends from Frio, McMullen, and Live Oak Counties, Tex., into Mexico.

Lares Limestone [1] (in Río Guatemala Group)

Oligocene: Puerto Rico.

Original references: B. Hubbard, 1920, Science, new ser. v. 51, no. 1320, p. 396; 1923, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, v. 2, pt. 1, p. 42–44. [States name first used by author in paper presented before New York Academy of Sciences in 1917. Maury (1919, Am. Jour. Sci., 4th, v. 48) used term Lares limestone for beds overlying Sebastian shale; no distribution or stratigraphic limits given.]

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. Included in Río Guatemala group. Limestone occurs in two bioherms. The western, which is more extensive, averages about 400 meters in thickness between the Rio Manati on the east and the Río Guajataca on the west, a distance of about 50 kilometers; westward, thinning is accomplished by lateral intertonguing of lower beds with San Sebastián formation and of upper beds with Cibao marl. Eastern bioherm has maximum thickness of about 250 meters between longitude lines through towns of Morovis and Corozal, a distance of about 10 kilometers; here, too, wedging out is by lateral intertonguing with the San Sebastian and Cibao. Locally underlies Aguda limesonte (new).

Type locality: North of Lares, where it forms the Cuesta and an extensive area of haystack or *pepino* hills.

Lares Shales[1]

Tertiary: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

†Largo Beds[1]

Eocene, lower: Northwestern New Mexico.

Original reference: Walter Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 205–207.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 6, p. 368, 369, 370–374. In type region of San Jose formation (new) are two distinguishable clay facies, corresponding to Granger's (1914) Almagre and Largo beds. "Largo" facies forms upper part of formation throughout type region except where it has been removed by erosion. Intergrades with "Almagre" facies below and no sharp distinction can be made.

Exposed principally in area drained by head of Largo Arroyo, in high bluff west of Ojo San Jose. Simpson measured section near where continental divide crosses pass between head of the Largo and southwest branch of "Almagre" Arroyo, mostly in NE¼ sec. 8, T. 23 N., R. 1 W., Rio Arriba County.

Larimer Sandstone Member (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: M. W. Ball, 1924, Am. Assoc. Petroleum Gologists Bull., v. 8, no. 1, p. 81–87.

G. R. Scott and W. A. Cobban, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf. Symposium, p. 128, 129 (fig. 3). Olive-gray fine-grained massive sandstone with brown calcareous sandy concretions. Commonly con-

sists of two to four thin ledge-forming brown sandstone beds separated by thicker units of softer and lighter colored sandstone. Thickness 141 feet near Douglas Lake; 78 feet at Fossil Creek, Separated from younger Richard sandstone member by 171 feet of sandy shale near Douglas Lake; 115-foot concealed interval between members at Fossil Creek; separated from older Rocky Ridge sandstone member by 164 to 187 feet of soft yellowish-gray sandstone and sandy shale with gray sandstone concretions. Large and varied invertebrate fauna.

Named for exposures in Larimer County Canal 4 miles north of Fort Collins, Larimer County. Well developed from Round Butte southward nearly to Boulder.

Larke Dolomite[1] (in Beekmantown Group)

Lower Ordovician: Central Pennsylvania

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th v. 46, p. 527, 534, 537.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas Folio 227. Described in Hollidaysburg-Huntingdon area where it overlies Mines dolomite and underlies Nittany dolomite. Total thickness 200 feet.

Well exposed at Larke, 3 miles south of Williamsburg, Blair County.

Larrabee Member (of Glens Falls Formation)

Middle Ordovician (Mohawkian): Eastern New York and western Vermont.

G. M. Kay, 1947, Geol. Soc. America Bull., v. 48, no. 3, p. 262–263. Constitutes lower part of Glens Falls formation that is of Hull age, the upper Glens Falls being lowest Sherman Fall. At type section, member is composed of about 20 feet of bedded relatively pure limesones above Isle la Motte limestone; underlies *Cryptolithus*-bearing upper Glens Falls, the Shoreham member (new) of lowest Sherman Fall age. Larrabee varies in lithology and thickness; in lower Mohawk Valley, composed of thin-bedded limestones with coarse-textured ledges in upper part; thickness 15 to 25 feet between Patterson and Fultonville; lies on Lowville to west and on Amsterdam toward east.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 30–31, 61–62, 69–71, 73–74, pls. 1, 2. Described on Isle La Motte and South Hero Islands, Vt., where it is about 70 to 75 feet thick.

Type section: Quarry one-fourth mile south of Larrabee Point, Addison County, Vt.

Larsh Shale Member (of Deer Creek Limestone)

Larsh Shale (in Deer Creek Limestone[1] Member of Shawnee Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 49, 50.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey, 2d ser., Bull. 11, p. 8, 12, 16, 20, 54, fig. 2. Member of Deer Creek limestone in Shawnee group. Overlies Rock Bluff limestone member; underlies Haynies limestone member.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 179. Referred to as Larsh-Burroak shale member of Deer Creek

limestone. Average thickness 3½ feet. Underlies Ervine Creek limestone member; overlies Rock Bluff limestone member.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Interstate agreement recognizes Larsh shale member of Deer Creek formation. Overlies Rock Bluff limestone member; underlies Haynies limestone member.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 17–18. In Missouri, interval between Rock Bluff limestone member and uppermost limestone of Deer Creek is occupied by shale. This shale has been referred to as Rock Bluff-Ervine Creek shale with implication that intervening Haynies limestone is absent in Missouri. Shale is here called Larsh-Burroak. Missouri Survey recognizes the possibility that Burroak shale may be absent in Missouri and that uppermost limestone of Deer Creek may include both Haynies and Ervine Creek members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18, fig. 5. Larsh shale, in southwestern Iowa, is gray to olive green argillaceous and blocky to thin bedded in upper part; lower part black and fissile. Thickness about 2 feet throughout entire area where Burroak and Larsh slates are differentiated. Overlies Rock Bluff limestone member; underlies Haynies limestone member. In some areas referred to as Burroak-Larsh shale.

Type locality: Ervine Creek valley, 2½ miles east and 1¼ miles north of Union, Cass County, Nebr.

LaSalle cyclothem (in Bond-Mattoon Formation)

LaSalle cyclothem (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

J. M. Weller and A. H. Bell, 1936, Illinois Geol. Survey Rept. Inv. 40, p. 26 (fig. 5). LaSalle cyclothem in McLeansboro formation shown on columnar section. Occurs above Macoupin cyclothem.

J. M. Weller and W. A. Newton, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 329. Upper part of McLeansboro, from Shoal Creek limestone up to highest Pennsylvanian strata is divided into following cyclothems (descending): Merom, Shumay, Woodbury, Gila, Greenup, Newton, Upper Bogota, Lower Bogota, Cohn, LaSalle, Macoupin, Flannigan, and Shoal Creek.

J. M. Weller and A. H. Bell, 1941, Illinois Geol. Survey Rept. Inv. 76, p. 7. In Effingham, Fayette, and Shelby Counties, includes LaSalle limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 55 (table 3). In Bond-Mattoon formations (both new).

Type locality not given, but type locality of LaSalle limestone is in sec. 14, T. 33 N., R. 1 E., LaSalle County.

†La Salle Formation[1]

Pennsylvanian: Northeastern Illinois.

Original reference: F. W. De Wolf, 1910, Illinois Geol. Survey Bull. 16, p. 180.

Named for La Salle County.

LaSalle Limestone (in McLeansboro Group)

LaSalle Limestone Member (of Bond Formation)

LaSalle Limestone Member (of McLeansboro Formation)[1]

Middle and Upper Pennsylvanian: Northeastern Illinois.

Original reference: G. H. Cady, 1908, Illinois Geol. Survey Bull. 8, p. 128–134.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Included in LaSalle cyclothem, McLeansboro group. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Reallocated to member status in Bond formation (new). LaSalle and Hall limestone members are only named units in formation in northern Illinois. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Sec. 14, T. 33 N., R. 1 E., La Salle County.

Lasca Formation

Cretaceous: Western Texas.

R. M. Huffington, 1947, Harvard Univ. Summ. of Theses, 1943–45, p. 196. Lasca formation, 600 feet thick, most likely late Washita in age. Overlies Tarantula formation (new); underlies Etholen formation.

Area of report is northern Quitman Mountains, southern Hudspeth County.

Las Cascades Agglomerate

Las Cascades (Cascadas) Formation[1]

Oligocene(?): Panamá.

Original references: D. F. MacDonald, 1913, Isthmian geology, ann. Rept. Isthmian Canal Comm., app. S, p. 568; 1913, Geol. Soc. America Bull., v. 24, p. 708.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 228–229, 236, 246 (fig. 2). Las Cascadas agglomerate, Bas Obispo formation, and Bohío formation, all tentatively considered early Oligocene in age, are oldest formations along the Canal. Las Cascadas agglomerate and pyroclastic Bas Obispo formation are interpreted to represent accumulation of volcanic products at periphery of a volcanic pile. Unconformably underlies Culebra formation.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 28, 31–32, pl. 1. Overlies Bas Obispo formation Las Cascadas agglomerate and the Bas Obispo probably would ordinarily be combined as one formation; however, they differ in induration. Matrix of Las Cascadas consists of soft fine-grained altered tuff and bentonitic clay. Thickness not determined. According to plate 1, near Gamboa agglomerate rests on Bohío formation, Gatuncillo formation, or basement complex; confirmation of this overlap is needed; in eastern part of Gatun Lake area, appears to grade into Caimito formation. No fossils present; doubtfully referred to Oligocene because of inferred relations to Bohío and Caimito formations.

Type region: Northern part of Gaillard Cut, C. Z.

Las Cruces Formation

Mississippian (Meramec); Western Texas and central southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11, 12, 17, 37–38. Hard, dense, black, sublithographic, even-bedded, gray-weathering, sparsely fossiliferous limestone. Distinguished by relatively thin, remarkably even beds from 4 to 16 inches thick, averaging about 10 inches. Free of chert in type section. Maximum thickness approximately 60 feet in type area; 59 feet in type section. Unconformably overlies "Percha" shale (Canutillo formation of Nelson, 1940) and unconformably underlies Rancheria formation (new) in Franklin Mountains. Also overlies Lake Valley formation in some sections in southern part of area.

Type section: On southwest side of small fork of shallow canyon that leaves west slope of Franklin Mountains almost directly east of Vinton, Tex. (SW¼ sec. 67, S. Blk. 82, El Paso County, Tex.). Named from town of Las Cruces, N. Mex. Exposed mainly in Franklin Mountains; also in San Andres Mountains in Bear Canyon.

Las Feveras Formation

Tertiary or Quaternary: Northeastern New Mexico.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Sequence of brownish-red alluvium and gravel. Rests on Sangre de Cristo formation; overlain by basalt flow emitted in part from Ocate volcanic cone. Thickness more than 150 feet about 1 mile northwest of Ocate, but this is not complete representation of formation.

Named for Las Feveras Canyon which drains into northwestern part of Ocate Valley, Mora County. Well exposed in sides of three small basalt-capped buttes west of road about 2 miles north of Ocate.

La Sierra Tonalite

Cretaceous: Southern California.

E. S. Larsen, Jr., and N. B. Keevil 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 488. Named in report on study of the batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 71–72, pl. 1. Described as light-gray tonalite. Intruded by Woodson Mountain granodiorite. Derivation of name given.

Named for its occurrence in hills of La Sierra, north and east of Corona, Riverside County.

Las Juntas Shale

Eocene, lower: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 30–31, pls. 4A, 4B, 4C. Name introduced for clay shales, silty shales, and interbedded sandstones between Vine Hill sandstone (new) below and Muir sandstone (new) above. Thickness at type section 1,017 feet. Las Juntas shale underlying Vine Hill sandstone of this report were classified and mapped jointly as Martinez group in San Francisco folio (Lawson, 1914) and the former as Capay shale in Carquinez quadrangle in 1949 (Weaver, Geol. Soc. America Mem. 35).

B. Y. Smith, 1957, California Univ. Pub., Geol. Sci., v. 32, no. 3, p. 144–146, 147. Since Pacheco syncline generally accepted as type area for the Martinez, it is particularly difficult to follow Weaver's (1953) omission of that term as an appropriate designation for lower part of sequence, and it seems desirable that Weaver's new units, Vine Hill, Las Juntas, and

Muir, be included either as members within Martinez formation or as formations within Martinez group. Systematic description of Foraminifera.

Type section: In east limb of Pacheco syncline in highway cuts and hillside outcrops east and southeast of Martinez, Contra Costa County. Only part of beds are exposed in west limb of fold where they lie adjacent to and along east side of Southampton fault.

Las Marías Limestone

Las Marías Limestone Member (of Río Blanco Formation)

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech, Paper 13, p. 47, 48 (table 4), 94 (cross section). Distinctive grayish-blue limestone. [May be synonymous with Atalaya limestone.]

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 344, pl. 1. Referred to as member of Río Blanco in Mayagüez area. Occurs as lenses of massive hematite-stained fragmental limestone in southern part of Río Blanco outcrop.

First mentioned in Lares district.

Las Posas Formation[1]

Pleistocene: Southern California.

Original reference: E. D. Pressler, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, no. 13, p. 325–345.

T. L. Bailey, 1943, Geol. Soc. America Bull., v. 54, no. 10, p. 1557. Name abandoned. San Pedro as defined in this paper synonymous with Pressler's (1929) Las Posas except that his so-called Kalorama member is retained in Santa Barbara formation.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. Included in upper part of newly defined Hallian stage in Ventura Basin.

Probably named from Las Posas Hills, Ventura County.

Lassen Dacites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, p. 71 (map).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 679. Cenozoic.

Occur in Mount Lassen region.

Lassen sequence, suite, volcanic rocks

Age not stated: Northern California

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 74–85. Collective term used for volcanic rocks in Lassen Volcanic National Park. Includes a number of named units.

Howel Williams (1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8) used term lava sequence of Lassen region.

Lasso Limestone

Aquitanian: Mariana Islands (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Raso limestone named on

correlation chart. Correlated with Tapotchau [Tappotcho] limestone on Saipan, and Hirippo limestone on Rota. Miocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 54, table 4 [English translation in library of U.S. Geol. Survey, p. 65]. Lasso limestone. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 42. Name Lasso limestone credited to M. Kodaira (unpub. ms.) who applied name to pink-colored limestone and underlying limestone conglomerate which unconformably overlies andesitic agglomerate and unconformably underlies Mariana limestone. Aquitanian.

Exposed along base of cliff bounding western margin of Carolinas Plateau in Kanat Tadung.

Last Chance Andesite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures at Last Chance mine, south of Silver Creek, Mogollon district.

Last Chance Quartz Monzonite

Post-Pennsylvanian; Northern Utah.

Bronson Stringham, 1953, Geol. Soc. America Bull., v. 64, no. 8, p. 965. Medium fine-grained granitoid rock. Texture and mineral composition much more uniform than Bingham granite with which it is associated.

Occurs in Last Chance intrusive stock. Crops out in area west, southwest, and south of Bingham copper mine, Salt Lake County.

Las Tetas Lava Member (of Robles Formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 144, 145–146. Varies from pillow lava to very massive igneous rock that could be in part intrusive. Thickness about 1,000 feet in vicinity of Cayey; southward, thins and pinches out. Represents several effusions; in southernmost outcrops, layers are separated by lenses or tongues of volcanic siltstone, volcanic sandstone, and volcanic conglomerate. Lies about 900 feet above Lapa lava member (new) and separated from it by thick middle tongue of siltstone within the formation. Name credited to Berryhill and Glover (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. Overlies Cayey siltstone member (new); underlies Colloa member (new).

Named for exposures at and near prominent topographic features, Las Tetas, which lie west of Highway 1 at point 650 meters southwest of intersection of Highway 1 and Highway 162, Cayey quadrangle.

Las Vigas Formation[1]

Lower Cretaceous: Northern Mexico and southwestern Texas.

Original references: R. H. Burrows, 1909, Min. and Sci. Press, v. 99, p. 293; 1910, Soc. Geol. Mexicana, Bol. t. 7, p. 93.

Gayle Scott, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, p. 973 (chart), 977, 978. Discussion of correlation of Trinity strata on basis of

cephalopod fauna. Las Vigas formation, which underlies the Cuchillo, is older than any Trinity sediments cropping out anywhere else in Texas except in Torcer formation of Malone Mountain area.

Named for exposures in Conchos River valley, northern Chihuahua, Mex., west of Presidio, Tex.

Las Virgenes Sandstone[1]

Eocene, lower: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 11, p. 400–401, map.

Named for typical development at head of Las Virgenes Canyon, on south side of Simi Hills, Ventura County.

Latah Formation[1]

Miocene, middle or upper: Eastern Washington and western Idaho.

Original reference: J. T. Pardee and Kirk Bryan, 1926, U.S. Geol. Survey Prof. Paper 140, p. 4–12.

J. W. Hosterman, 1960, U.S. Geol. Survey Bull. 1091, p. 7–8, pls. 2, 3, 4. In general vicinity of clay deposits in Washington and Idaho, the Latah is interbedded with Columbia River basalt and is divided into an upper an lower part by the unit of basalt on which residual clay is developed.

Typical exposure on slope west of Latah Creek, a short distance south of Spokane, Spokane County, Wash.

Latham Shale

Lower Cambrian: Southern California.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 30 (table 1), pl. 2. Greenish-gray platy shale with thin buff-weathering sandy limestone layers. Thickness 55 to 75 feet. Underlies Chambless limestone; overlies Prospect Mountain quartzite. Replaces preoccupied name Kelso.

Type locality: About a mile southwest of Latham's cabin in northern Providence Mountains, San Bernardino.

Latir Peak Latite

Tertiary: Central northern New Mexico.

P. F. McKinlay, [1955?], New Mexico Bur. Mines Mineral Resources Bull. 42, p. 14. pl. 1. Occurs as thick flows, sills, and dikes. Is porphyritic with an aphanitic to glassy groundmass. Color in most outcrops is light gray, but near Latir Peak much of rock is reddish. Intrusive into rocks of pre-Tertiary age and closely associated with the andesite series of mid-Tertiary(?) age.

Named after Latir Peak, where the rock is well exposed. Makes up most of Latir Peak and high ridges that lie to south of peak. One of the largest exposures is near headwaters of Cabresto and Bitter Creeks, along southern edge of Latir Peak quadrangle, Taos County.

Latonia Shale (in Eden Group)[1]

Upper Ordovician: Northern Kentucky and southwestern Ohio.

Original reference: N. M. Fenneman, 1916, Ohio Geol. Survey, 4th ser., Bull. 19, p. 63.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on chart as formation including

(ascending) Economy, Southgate, and McMicken members. Underlies Fairview formation; overlies Fulton formation.

Named for Latonia, Kenton County, Ky.

Latour Formation[1]

Miocene, middle or upper: Northern Idaho.

Original reference: O. H. Hershey, 1912, Geol. Soc. America Bull., v. 23, p. 529–536.

Deposited in [ancient] Lake Latour, Coeur d'Alene region.

Latrania Sand Member (of Imperial Formation)

†Latrania Sands[1]

Miocene, middle, to Pliocene, lower: Southern California.

Original reference: G. D. Hanna, 1926, California Acad. Sci. Proc., 4th ser., v. 14, no. 18, p. 435.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Listed as sand member of Imperial formation.

Exposed on Coyote Mountain, Imperial County.

La Tuna Member (of Magdalena Formation)

Pennsylvanian: Western Texas.

L. A. Nelson, 1937, Colorado Univ. Studies, v. 25, no. 1, pl. 89. In Franklin Mountains, Tex., Magdalena formation divided into (ascending) La Tuna, Berino, and Bishops Cap member (all new).

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 167, 170. Thickness about 361 feet. Basal part is massive light- to dark-gray limestone, 340 feet thick. Underlies Berino member; overlies Helms shale. Derivation of name given.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. On basis of fusulinid studies, it seems inadvisable to apply Nelson's terms to Pennsylvanian rocks of central New Mexico.

Named for town of La Tuna, Tex., on Santa Fe Railroad at Texas-New Mexico line.

†Lauderdale Chert[1]

Mississippian: Northern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama: Birmingham, Ala., Roberts & Son, pamph., 36 p.

Named for development in Lauderdale County.

Laughery Formation (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana.

Original reference: A. F. Foerste, 1912, Denison Univ. Sci. Lab. Bull., v. 17, p. 22.

Exposed along Laughery Creek in Ripley County.

†Laulau Limestone

Miocene (Aquitanian): Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 56–60.] Variegated, white, black, red, brown, and yellow, tuffaceous, marly, arenaceous, limestones. As exposed at Laulau railway cut, limestone is conglomeratic in

lower part; arenaceous, white, and stratified in middle; upper part, hard pink unstratified limestone. Has been called *Eulepidina* limestone. Unconformably overlies Densinyama beds.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 9–10. Grades laterally into water-laid Donni tuff. Miocene (Aquitanian).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 63. Included in Tagpochau limestone of this report.

Named for exposures in railway cuts on south side of Laulau Mountains northwest of village of Laulau on north side of Laulau (Magicienne) Bay.

Laupahoehoe Volcanic Series

Pleistocene and Recent(?): Hawaii Island, Hawaii.

G. A. Macdonald, 1945, Am. Jour. Sci., v. 243, no. 4, p. 212 (fig. 1), 213, 214. Largely andesites with lesser amounts of olivine basalts. Separated from older Hamakua volcanic series (new) by erosional unconformity.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrog. Bull. 9, p. 153 (table), 159–166. Comprises two members: lower, largely lava flows, predominantly andesitic with lesser amounts of olivine basalts, Pleistocene; and upper, a few andesite flows, Recent.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 110. Maximum exposed thickness about 200 feet; total thickness probably more than 1,000 feet. Pleistocene and Recent(?); age assignment depends on relation to Pahala ash and to glaciation.

Named for exposures at Laupahoehoe Peninsula where typical andesite flow has built lava delta. Comprises entire upper part of Mauna Kea with some flows extending onto lower slopes.

Laurel Dolomite[1] **or Limestone**[1]

Laurel Limestone Member (of Wayne Formation)

Laurel Limestone Member (of Bainbridge Formation)

Laurel Member (of Alger Formation)

Middle Silurian; Southern Indiana, west-central Kentucky, southeastern Missouri, Ohio, and west-central Tennessee.

Original reference: A. F. Foerste, 1896, Cincinnati Soc. Nat. History Jour., v. 18, p. 190–192.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 35, table facing p. 46. In Ohio considered member of Alger formation. Underlies Massie member and overlies Osgood. Thickness 5 to 9 feet; average 6 feet.

J. R. Ball, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 10–11. Laurel limestone geographically extended into southeastern Missouri where it is considered member of Bainbridge formation; overlies Osgood member. Characteristically massive, light-gray, with pinkish calcite crystals.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 248–249. Laurel limestone included in Wayne group. In central Tennessee, uniformly bedded limestone with beds that range from a few inches to a

foot or more in thickness. Fine-grained and light gray with varying amounts of red and pink grains; locally entirely dolomitic; in some areas, contains silt, also may be oolitic at top. Average thickness 30 feet. Conformably overlies Osgood formation; conformably underlies Waldron shale or unconformably underlies Chattanooga shale.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. In Indiana, Laurel formation underlies Waldron and overlies Osgood. Consists of limestone, pale-tan to gray, dense to finely crystalline, thin-bedded, cherty, moderately dolomitic. Thickness 27 to 40 feet. In Clinton group.

Named for Laurel, Franklin County, Ind.

Laurel Gneiss or Pseudomigmatite

Laurel Migmatite

Age unknown (post-Glenarm Series) : Maryland.

Ernst Cloos and C. H. Broedel, 1940, Geologic map of Howard County and adjacent parts of Montgomery and Baltimore Counties (1:62,500) : Maryland Geol. Survey. Migmatite—granitized schist mixed with impure granite; muscovite and biotite granite.

R. W. Chapman, 1942, Geol. Soc. America Bull., v. 53, no. 9, p. 1300–1328. Although Laurel gneiss resembles a true migmatite, term pseudomigmatite is more appropriate. Gneiss is bounded on north by Guilford granite and Wissahickon formation, on northeast by gabbro, on east by Cretaceous gravels, on south by gneiss, and on west by the Wissahickon.

Ernst Cloos *in* Ernst Cloos and C. W. Cooke, 1953, Geologic map of Montgomery County and District of Columbia (1:62,500) : Maryland Dept. Geology, Mines and Water Resources. Mapped in Montgomery County as Laurel gneiss. Very similar to Sykesville formation and possibly its equivalent southwest of Woodstock anticlinorium.

Occurs in vicinity of Laurel, about 17 miles southwest of Baltimore.

Laurel Canyon Formation

Paleozoic : California.

E. B. Mayo, 1934, California Jour. Mines & Geology, v. 30, no. 1, pl. 2. Crystalline limestone (marble). Devonian in part.

O. P. Jenkins, 1938, Geologic map of California (1:500,000) : California Div. Mines, sheet 4. Shown on map legend.

Mapped in Laurel and Convict basins, Mono County.

Laurens Member (of Trimmers Rock Sandstone)

Laurens Member[1] (of Tully Limestone)

Upper Devonian : Eastern New York and eastern Pennsylvania.

Original references: G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544; 1934, Am. Jour. Sci., 5th, v. 27, p. 10.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Middle Devonian.

M. E. Johnson and Bradford Willard, 1957, Geol. Soc. America Guidebook for Atlantic City Mtg., Trip 4, fig. 1. Shown on columnar section as member at base of Trimmers Rock sandstone.

Well exposed in Houghtaling's Glen, 1½ miles northeast of Laurens, Otsego County, N.Y.

Laurentian Series[1]

Precambrian: Lake Superior region.

Original reference: W. E. Logan, 1854, Canada Geol. Survey Rept. Prog. 1852–1853, p. 7, 8.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1029. Term Laurentian widely used but variously defined. Originally used by Logan (1854) to refer to exposures of gneiss, granite, and other old rocks north of St. Lawrence River. Special committee (Hays and others, 1905, Jour. Geology, v. 13, no. 2) approved term for "granites and gneissoid granites which antedate or protrude through the Keewatin, and which are pre-Huronian;" also for granites of unknown age. Cooke (1920, Jour. Geology, v. 28, no. 4) urged that term Laurentian be reserved for those granites that cut all rocks below base of Huronian and that other terms be found for those that cut only Keewatin. Tendency since that time, even among Canadian writers, is to use term Laurentian for oldest granites. Radioactivity determinations may show seven or more Precambrian granites. In Minnesota [Minnesota Geological Survey], three groups are recognized: the first post-Keewatin and pre-Knife Lake; second (Algoman) post-Knife Lake and pre-Animikie; and third Keweenawan. Term Laurentian is commonly used for oldest group (our [Minnesota Geological Survey] pre-Knife Lake granites), but some of them may be older than others.

Named for occurrence north of St. Lawrence River. Area has been named Laurentides in early history of Canada.

La Vaca Formation

Miocene, middle: Panamá.

Incidental mention: R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 59.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 337. An undefined name. Miocene(?).

On Burica Peninsula, Chiriquí Province.

Lava Falls Tongue (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 95. Consists partly of aphanitic limestone and partly of fine-grained dolomite, but nearly everywhere weathers into a resistant cliff with red-brown surface. At type section, divisible into three units; basal ledge-forming dolomitic limestone; middle slope-forming unit of green shale and brown siltstone; and upper cliff-forming carbonate unit. Eastward extension of carbonate deposits from Spencer Canyon member (new) of Muav formation. Thickness at Granite Park 20 feet; farther east at Toroweap 17½ feet, and at Gateway Canyon 16½ feet. Older than Parashant tongue (new); younger than Garnet Canyon tongue (new).

Type locality: About 1 mile east of Lava Falls at foot of Toroweap Valley, Grand Canyon.

Lavender Member (of Fort Payne Chert)

Lavender Shale Member (of Fort Payne Chert)

Mississippian: Northwestern Georgia.

Charles Butts *in* Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 42–45. Dark compact massively bedded calca-

reous shale or argillaceous limestone with small amount of limy material interbedded in Fort Payne chert. Thickness about 50 feet. Overlain by chert locally as much as 50 feet thick; in some areas, rests directly on Chattanooga shale.

V. J. Hurst, 1953, Georgia Geol. Survey Bull. 60, p. 218. Lavender shale not readily separable from dark-colored siliceous argillaceous limestone which occurs with and above it. Much of what Butts called shale is actually limestone; hence, the dark-colored siliceous, argillaceous limestone in lower two-thirds of the Fort Payne together with the associated calcareous shale is referred to in this report as Lavender member. Thickness of Lavender member appears to be reciprocally related to thickness of bedded chert, as 1 mile south of West Rome, 30 to 50 feet of bedded chert is overlain by 80 to 100 feet of Lavender member, whereas 15 miles north, near Gore, about 150 feet of chert is exposed and Lavender member is missing.

Type locality: On railroad one-third mile west of Lavender Station, and in quarry in shale at underpass of U.S. Highway 27, beneath Southern Railway, about 1 mile north of Rome.

La Ventana Tongue (of Cliff House Sandstone)

La Ventana Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: C. H. Dane, 1937, U.S. Geol. Survey Bull. 860–C.

E. C. Beaumont, C. H. Dane,and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2159–2160. Classified as tongue of Cliff House formation. On outcrop, does not connect with Cliff House but does connect in northern part of San Juan Basin with Mesaverde group undivided. Seems possible that somewhere in subsurface it will be found to connect essentially with main body of Cliff House to which, genetically, it is clearly related as part of upper transgressive marine-sandstone sequence of Mesaverde group.

Named from town of La Ventana, Sandoval County, on the Rio Puerco near which unit crops out, and from La Ventana Mesa east of Rio Puerco, on which top of basal unit is exposed.

Laverne Formation[1]

Pliocene, lower: Northwestern Oklahoma and southwestern Kansas.

Original reference: C. N. Gould, 1927, Oklahoma Univ. Bull., Proc. Oklahoma Acad. Sci., v. 6, pt. 2, p. 235–238.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, p. 398–403. Geographically extended into southwestern Kansas where it is well exposed along both sides of Cimarron Valley in southeastern Seward County and in southwestern Meade County. Consists of shale, sandstone, and limestone; locally contains a hard conglomerate; buff, blue gray, and gray. Thickness about 60 feet. Laverne beds dip at angles as much as 15° and are overlain by horizontal beds of the Ogallala. Miocene and lower Pliocene.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 9, no. 5, p. 91–105. Unconformably underlies Rexroad formation in Seward and Meade Counties, Kans.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 47–50, pl. 2. In Harper County, consists of interbedded gray to blue-gray sandy chalk,

blue-gray to tan shales, gray fine-grained thin-bedded sandstone, and massive tan to pink coarse-grained sandstone; basal part is coarse conglomerate containing abundance of black iron-stained pebbles; conglomerate not continuous. Thickness as much as 35 feet. At no place is Ogallala in contact with Laverne. Lower Pliocene (p. 48). Type locality stated.

Type locality: In vicinity of Laverne, Harper County, Okla.

Lavery Till

Pleistocene (Wisconsin): Northwestern Pennsylvania.

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey Bull., 4th ser., G–32, p. 10 (fig. 3), 13 (fig. 4), 38–41, pl. 1. Light-gray moderately pebbly calcareous silt till deposited during Lavery advance in approximately middle Cary time. Lavery advance followed Kent advance and preceded Hiram advance.

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 6–7. In northeastern Ohio Lavery till is underlain unconformably by Kent till and overlain unconformably by Hiram till except in small area where it constitutes surface material.

Type area: At and north of hamlet of Lavery, Erie County, 4½ miles west of Edinboro on U.S. Route 6N.

La Vida Member (of Puente Formation)

Miocene, upper: Southern California.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Defined as basal member of formation. Consists mainly of gray to black laminated siltstone with thin interbedded feldspathic sandstone beds. Maximum exposed thickness about 3,000 feet. Underlies Soquel member (new). In some areas, base is not exposed; in other areas, La Vida rests unconformably on El Modeno volcanics (new) or on Topanga formation or on Sespe and Vaqueros formations, undivided.

Named for La Vida Mineral Springs, located in Carbon Canyon about 3 miles north of Yorba Linda, in eastern part of Puente Hills, Orange County.

Lawler Peak Granite

Precambrian: West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 18–19, pl. 3. Typical Lawler Peak granite is essentially porphyritic biotite-muscovite granite. Orthoclase phenocrysts as much as 3 inches long embedded in medium- to coarse-grained groundmass. In northern exposures, white muscovite granite forms masses more than a mile in length; biotite is absent and muscovite is more abundant than in normal Lawler Peak granite; known as muscovite facies. Also includes a gneissic facies and an altered facies. Intruded by Cheney Gulch granite (new). Intrudes all formations of Yavapai series, and gabbro, alaskite porphyry, and granodiorite gneiss.

Exposed for about 9 square miles in hilly country in northeast corner of Bagdad area, Yavapai County, where outcrops on Lawler Peak suggested name for the granite.

Lawlor Tuff

Pliocene: Northern California.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189. Shown on correlation chart as "Lawler tuff;" underlies Los Medanos formation.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 121–122, pls. 12, 13. Described as pumiceous andesitic tuff. Thickness 50 to 100 feet. Tuffs dip from 15° to 30° NE. In Los Medanos Hills, underlies Wolfskill formation (new) and overlies Neroly formation. Derivation of name given.

Named for exposures in Lawler [Lawlor] ravine, in southwestern Antioch quadrangle, where it forms a bond generally less than 300 feet wide.

Lawrence Clay (in Allegheny Formation)[1]

Lawrence underclay member

Pennsylvanian: Southeastern Ohio and West Virginia.

[Original reference]: Wilber Stout and others, 1923, Ohio Geol. Survey Bull. 26, p. 269.

A. T. Cross and M. P. Schemel, 1956, West Virginia Geol. Survey, v. 22, pt. 2, p. 46. Noted in West Virginia.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 61. Lawrence underclay member of Lawrence-Lower Kittanning cyclothem in report on Athens County. At most places, combined with Lower Kittanning underclay. Allegheny series.

Lawrence coal and clay named from Lawrence Furnace, Elizabeth Township, Lawrence County, Ohio.

Lawrence cyclothem

Pennsylvanian (Allegheny Series): Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40, 46. Includes (ascending) Kittanning shale and (or) sandstone, Lawrence clay, Lawrence coal. Occurs above Scrubgrass cyclothem and below Lower Kittanning cyclothem.

Present in Ohio column but not easily recognized in Perry County; in this report, treated as part of Lower Kittanning cyclothem.

Lawrence Shale (in Douglas Group)[1]

Lawrence Shale Member (of Douglas Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: E. Haworth, 1894, Kansas Univ. Quart., v. 2, p. 122.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 15, 16. Formation in Missouri consists of two unnamed shale members separated by Amazonia limestone member. Ireland limestone member, present in Kansas, not identified in Missouri. Because of absence of this sandstone. Robbins shale at top of Stranger formation cannot be differentiated, if present in Missouri, from shale of Lawrence formation below Amazonia member. Base of Lawrence is drawn in Missouri at top of Haskell limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 26–27. Thickness 23 feet in Platte Valley; about 42 feet in Weeping Water Valley.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 69–72. Extends from base of Toronto limestone member of Oread limestone to disconformity below Ireland sandstone or, in places where disconformity is undeterminable, to top of Haskell limestone member of Stranger for-

mation. Includes Ireland sandstone member below and Amazonia limestone member above. Thickness 40 to 175 feet.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 23–24, fig. 5. In Iowa it is not possible to locate accurately unconformity separating Pedee group of Missouri series from Douglas group of Virgil series. Individual units of interval poorly defined, and for this reason entire interval considered as unit and referred to as Douglas-Pedee group. Locally in subsurface it has been possible to recognize Iatan limestone, uppermost formation of Pedee group, and Stranger shale, lowermost formation of Douglas group. Because it is rarely possible to differentiate these formations in Iowa, entire interval is called Lawrence-Weston shale.

Named for exposures at Lawrence, Douglas County, Kans.

Lawrence shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 61. Lawrence shale and (or) sandstone member included in Lawrence cyclothem in report on Athens County. Shale and sandstone below so-called Lower Kittanning underclay is actually member of Lawrence cyclothem but is usually called (Lower) Kittanning shale and sandstone. Thickness of member about 5 feet. Allegheny series.

Lawrenceville Shale (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 7–8. Calcareous shale containing a gastropod fauna. Underlies New Harmony sandstone (new); overlies Grayville limestone (new).

Named from exposures in and near Lawrenceville, Ill.

Lawson Limestone

Upper Cretaceous: Northeastern Florida (subsurface).

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1681, 1708–1711, 1746 (fig. 31). Name applied to limestone facies of late Upper Cretaceous occurring in northeastern Florida and the peninsula. Occurs below Cedar Keys limestone and above beds of Taylor age. Divided into two members: upper, a white and cream-colored calcitic porous limestone containing gypsum in most wells—thickness ranges from 40 feet in Sholtz well No. 2, Levy County, to 300 feet in Cory well No. 1, Monroe County; lower, a hard white and cream-colored microfossiliferous chalky limestone—commonly 300 to 400 feet thick in Sholtz well No. 2, 75 feet.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 82–84. In recent oil tests, particularly, Humble-Hodges well No. 1, in Taylor County, fauna characterizing upper member occurs very high in section in interval normally considered Cedar Keys formation of Paleocene age. This indicates that upper Lawson is transitional bed including fossils characterizing both Paleocene and Cretaceous; since characteristic Cretaceous fossils are present, it is considered to represent top of Cretaceous in peninsular Florida by most workers.

Name derived from J. S. Cosden's Lawson well No. 1, sec. 25, T. 13 S., R. 20 E., Marion County.

Lawson Shale Member (of Carbondale Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table 1), 65, pl. 1. Proposed for shale above Brereton limestone member in western Illinois, formerly called Sheffield shale; name Sheffield preempted. Thickness about 7½ feet. Stratigraphically below Copperas Creek sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Center sec. 24, T. 16 N., R 6 E., Bureau County. Name derived from Lawson Creek, about 1 mile west of type exposure.

Laytonville Limestone

Upper Cretaceous: Northern California.

H. E. Thalmann, 1943, (abs.) Geol. Soc. America Bull., v. 54, no. 12, pt. 2, p. 1827. Reddish slightly siliceous limestone; contains foraminiferal assemblage that indicates at least a Turonian age. Laytonville limestone regarded as synchronous deposit of Calera limestones of quarries of Permanente Cement Company, Santa Clara County, and of Calera limestone at its type locality in Calera Valley, San Mateo County.

Crops out about 200 yards east of Redwood Highway, 2 miles north of Laytonville, Mendocino County.

Lazeart Sandstone Member (of Adaville Formation)[1]

Upper Cretaceous: Southwestern Wyoming.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56.

R. H. Peterson, D. J. Gauger, and R. R. Lankford, 1953, Utah Geol. and Mineralog. Survey Bull. 47, p. 16 (fig. 4), 17–18. Basal member of Adaville formation. Consists of white sandstone 100 to 200 feet thick. Underlies Adaville-Lazeart coal.

Well exposed at Adaville mine, 2 miles south of Hodges Pass Tunnel, near Kemmerer, on Oregon Short Line.

Lazy Bend Formation (in Millsap Lake Group)

Lazy Bend Member (of Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107, from manuscript of report by G. Scott and J. M. Armstrong, on geology of Parker County.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Millsap Lake group. Underlies Grindstone Creek group; overlies Dickerson group. Includes (ascending) Kickapoo Falls limestone, Dennis Bridge limestone, and Brannon Bridge limestone members.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 163. Lampasas-Strawn boundary in Brazos River outcrop section placed at base of conglomerate which rests on Dennis Bridge limestone at Dennis highway bridge in Parker County. Hence, Lazy Bend formation, Millsap Lake group, and Strawn series of Brazos River out-

crop section are restricted to beds above Dennis Bridge limestone at Dennis.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 13–18, fig. 3, pl. 1. In this report [Parker County], beds cropping out along Brazos River upstream from Dennis Bridge to beyond Lazy Bend are placed in Lazy Bend formation. Includes (ascending) Hill Creek member (with Dennis Bridge limestone bed at base), Steussy member, and Brannon Bridge member. There is no continuous type section of formation; knowledge of succession is gained by mapping key beds between separated outcrops, and type sections are established member by member. Underlies Grindstone Creek formation. Classification in this paper does not go above formation rank.

Named for Lazy Bend on Brazos River, Parker County.

Leach Formation

Mississippian or older: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Altered basic volcanics (greenstone) and pyroclastics, with much dark chert and siliceous argillite, probably largely tuffaceous. Beds of dark vitreous quartzite at top. Interbedded slate, limestone, and conglomerate near forks of Leach Canyon. May be identical with Pumpernickel formation. Thickness may exceed 6,000 feet; base not exposed. Underlies Inskip formation with gradational contact. Pennsylvanian(?).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2847. Throughout most of outcrop area Leach and Inskip formations are in fault contact and their stratigraphic relations are not definitely known, but Leach appears to underlie Inskip. Considered to be Mississippian or older.

Named for Leach Canyon on west flank of East Range, Mount Tobin quadrangle.

Leach Canyon Tuff Member (of Quichapa Formation)

Oligocene: Southwestern Utah and eastern Nevada.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90–91, 92 (fig. 2), 98. Single depositional unit, uniform in lithology through thickness of 450 to 500 feet. Except at base and near top, rock consists of matrix with texture of unglazed porcelain, gray to flesh in color, enclosing fragments of dark-red felsite, light-gray pumice, and other rocks, and crystals of quartz, feldspar, biotite, and other pyrogenic minerals, mostly broken. Basal member of formation; at type locality, underlies Swett tuff member (new); overlies Hole-in-the-Wall member of Isom formation (both new); elsewhere, lava flows or other volcanic rocks, local in origin and extent, present at contacts. Has zircon age of 28 million years; this suggests that Quichapa formation is Oligocene. Discussion of ignimbrites of area.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 138 (fig. 3). Geographically extended into eastern Nevada.

Type locality: South side Leach Canyon, Desert Mound quadrangle, Utah.

Lead System[1]

Precambrian: Southwestern South Dakota.

Original reference: J. J. Runner, 1934, Am. Jour. Sci., 5th, v. 28, p. 354–372.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 4, 6–7, map (on page following title page). Shown on map legend as composed of (ascending) Poorman formation, amphibolite formation, Homestake formation, Ellison formation, Northwestern formation, Garfield formation, and Roubaix group (new). Text states that youngest rocks of Roubaix group in Galena-Roubaix district are younger than and overlie rocks of Lead system.

In the Black Hills.

Lead Creek Limestone[1] (in Tradewater Formation)

Pennsylvanian: Western Kentucky.

Original reference: A. F. Crider, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 279.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 89, Marine limestone above Lead Creek coal, Tradewater formation. Equivalent to Minshall limestone (Indiana), Seville limestone (Illinois), and Curlew limestone (western Kentucky).

Named for Lead Creek, Hancock County.

Lead Point Argillite[1]

Paleozoic(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 79, map.

Derivation of name not stated but probably named for Lead Point, Stevens County.

Leadville Limestone[1] or Dolomite

Lower and Upper Mississippian: Colorado.

Original reference: G. H. Eldridge, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

W. S. Burbank, 1941, U.S. Geol. Survey Bull. 906–E, p. 194, 196 (chart). Name Leadville limestone introduced into Uncompahgre district for beds containing Mississippian fossils that lie just above Ouray limestone which is restricted to dolomitic limestone beds of Upper Devonian age. Lower part of unit consists of predominantly dark blue-gray or brownish-gray limestone with sandy layers near base; upper part mostly coarser textured clastic limestone with interbeds of reddish shale; locally, thin-bedded cherty and ferruginous limestone at top. Thickness 180 to 230 feet.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1386. In Gore area, unconformably underlies Belden shale member (new) of Battle Mountain formation.

Ogden Tweto and T. S. Lovering, 1947, Colorado Mining Resources Board [Bull.], p. 380 (chart). In Gilman district, subdivided to include Gilman sandstone member (new) at base. Overlies Dyer dolomite member of Chaffee formation; underlies Maroon formation.

H. F. Donner, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1220 (fig. 2), 1221–1222. Described in McCoy area where it is about 150 feet thick and

consists of massive- to thin-bedded fine-grained bluish-gray limestone that is locally lithographic. Disconformable contact with overlying McCoy formation and underlying Sawatch formation. Early Mississippian.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 177–186. In Pando area, Mississippian Leadville dolomite comprises basal sandy member, Gilman sandstone, about 20 feet thick, unconformably overlain by dolomite member with average thickness of about 80 feet. Unconformably overlies Dyer dolomite member of Chaffee formation; unconformably underlies Belden shale.

I. H. Mackay, 1953, Colorado School Mines Quart., v. 48, no. 4, p. 29–33. In Thomasville-Woods Lake area, Leadville limestone is 68 to 180 feet thick and consists of arenaceous, gray dolomitic limestone at base rapidly becoming nearly pure, bluish-gray limestones. Unconformably overlies Chaffee limestone; unconformably underlies Weber(?) formation.

J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 63, 65. Many names have been used for rocks of Mississippian age in Four Corners area. Proposed here that Mississippian rocks in area be called Leadville limestone for upper limestone unit and Madison formation for underlying dolomite. Leadville is unconformably overlain by Molas shale and underlain by transitional conformable contact with Madison formation.

W. M. Merrill and R. M. Winar, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2109 (table 1), 2111 (fig. 2), 2115 (fig. 4). In San Juan-Needles Mountain area, disconformably underlies Coalbank Hill member (new) of Molas formation

Named for occurrence in Leadville district.

†Leadville Porphyry[1]

Eocene: Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; U.S. Geol. Survey Leadville Atlas; 1886, U.S. Geol. Survey Mon. 12, p. 76; 1927, U.S. Geol. Survey Prof. Paper 148.

In Leadville district.

†Leander Beds[1]

Lower Cretaceous: Texas.

Original reference: R. T. Hill, 1890, Texas Geol. Survey 1st Ann. Rept., p. 105, 126.

Exposed between Florence and Leander, Williamson County.

Leaning Tower Quartz Monzonite[1]

Cretaceous: California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 123, map.

U.S. Geological Survey currently designates the age of the Leaning Tower Quartz Monzonite as Cretaceous on basis of a study now in progress.

Named for fact that it forms considerable part of slopes of Leaning Tower, Yosemite National Park.

Leatham Formation

Lower Mississippian: Northeastern Utah and southeastern Idaho.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1719–1720, figs. 1, 17. Name proposed for shales, sandy shales, and

nodular limestones which unconformably overlie Devonian Jefferson formation and conformably underlie basal brownish-black shale of Mississippian Madison. Base of formation marked by 3-inch medium-dark-gray arenaceous limonitic conglomeratic limestone. Uppermost 2 feet composed of dark-gray to brownish-gray hard dense thinly bedded silty limestone. Thickness 76 feet at type locality where beds dip 18° N. 77° W.

Type locality: North wall of Leatham Hollow, three-fourths mile west of Left Fork of Blacksmith Fork at NW cor. sec. 34, T. 11 N., R. 2 E., Salt Lake base and meridian, Utah.

Leatherwood Granite[1]

Precambrian: Central southern Virginia.

Original reference: A. I. Jonas, 1928, Geol. map of Virginia, prelim. ed.: Virginia Geol. Survey.

W. R. Griffitts, R. H. Jahns, and R. W. Lemke, 1953, U.S. Geol. Survey Prof. Paper 248–C, p. 144.

Mapped at and around Leatherwood, Henry County.

Leatherwood Quartz Diorite

Post-Cretaceous: Southeastern Arizona.

F. L. Peirce, 1958, Dissert. Abs., v. 19, no. 2, p. 300. Orogeny which apparently took place during Laramide time was accompanied by emplacement of Leatherwood quartz diorite which was followed by emplacement of Catalina granite (new).

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 113–114. Ranges from massive to gneissic in texture and generally composed of biotite, quartz, oligoclase, and epidote. Comprises stock that intrudes Cretaceous rocks.

On northeastern slope of Santa Catalina Mountains.

L'Eau Frais Shale[1]

Eocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 52, 188.

At mouth of L'Eau Frais, Clark County.

Leavenworth Glacial Stage

Pleistocene: Central Washington.

B. M. Page, 1939, Jour. Geology, v. 47, no. 8, p. 785, 795–805. Named as second of three successive stages of valley glaciation in Leavenworth area. Characterized by deposition of Leavenworth till and outwash. Preceded by Peshastin stage (new) and followed by Stuart stage (new).

Leavenworth Limestone Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 32, 33, 38.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 148. Leavenworth limestone member of Oread formation; underlies Heebner shale member; overlies Snyderville shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. In section measured near Winterset, is blue-gray massive limestone about 1 foot thick.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 40, pl. 1. Thickness 0.8 to 2 feet thick in Douglas County, except south of Worden fault where it is 3.4 feet. Composed of single massive bed of hard gray-blue fine-grained limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 22–23, fig. 5. Single massive limestone bed. Thickness 1.1 to 1.3 feet. Overlies Snyderville shale member; underlies Heebner shale member.

Type locality: Highway cut in divide northwest of Federal Penitentiary, Leavenworth, Kans.

†Lebanon Beds[1]

Upper Ordovician: Southwestern Ohio and northern Kentucky.

Original reference: J. S. Newberry, 1873, Ohio Geol. Survey, v. 1, p. 103, 119, table opposite p. 89.

Named for Lebanon, Warren County, Ohio.

Lebanon Gabbro

Pre-Triassic: Eastern Connecticut.

J. M. Aitken, 1951, Connecticut Geol. Nat. History Survey Bull. 78, p. 10 (table 1). Incidental mention in chart. Name credited to W. G. Foye (unpub. ms.).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Dark speckled medium- to coarse-grained gabbro. Many shear zones and local areas of schistose and pencilled gabbro; otherwise fairly massive.

Named for town of Lebanon, New London County.

Lebanon Granite[1] (in Oliverian Plutonic Series)

Lebanon Group

Middle or Upper Devonian(?): West-central New Hampshire.

Original reference: C. H. Hitchcock, 1908, Vermont State Geologist 6th Rept., p. 155–156.

C. A. Chapman, 1939, Geol. Soc. America Bull., v. 50, no. 1, p. 145–146, pl. 6. Group includes Lebanon granite and border gneiss. Term granite is restricted to granitic core-rock. Two types are somewhat gradational near their contacts. Upper Devonian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Lebanon granite of Oliverian plutonic series consists of two mappable units: the granite proper, a subporphyritic granulated biotite granite, and the border gneiss, granulated gneiss varying in composition from amphibolite to quartz monzonite. Middle or Upper Devonian(?).

Named for village of Lebanon in southwestern Grafton County.

†Lebanon Group[1]

Lower Ordovician (Chazy): Tennessee.

Original reference: J. M. Safford, 1869, Geology Tennessee, p. 151, 159, 258–268.

Named for Lebanon, Wilson County.

Lebanon Limestone (in Stones River Group)[1]

Middle Ordovician: Central and western Tennessee and northwestern Georgia.

Original reference: J. M. Safford, 1851, Am. Jour. Sci., 2d, v. 12, p. 353, 354–356.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 22, 26–27, geol. map. Geographically extended into northwestern Georgia where it crops out along both sides of McLemore Cove along outside margin of Stones River belt north to Tennessee. Composed largely of very thin bedded limestone intercalated in gray shelly limestone all more or less argillaceous. Thickness about 200 feet.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 39–44, fig. 11. Consists of dense fine-grained blue to gray and dove-colored limestone with many interbedded layers of medium-grained and coarsely crystalline texture. Limestone beds commonly range from 1 to 6 inches, average 2 to 3 inches in thickness, and are separated by thin partings of gray and grayish-blue calcareous shale. At average interval of 57 feet from base and 33 feet from top of formation is a massive-bedded member that averages 5 feet in thickness. Thickness 74 to 118 feet; average 92 feet. Conformably overlies Ridley limestone; unconformably underlies Carters limestone. Safford did not designate type section; his measured section near Readyville, Rutherford County, is here considered type section. Alternate type section given.

Type section: In Cannon County, Tenn., on western slope of prominent hill behind mill at Readyville, a short distance northeast of where Murfreesboro-Woodbury Highway crosses East Fork of Stones River. Alternate type section: On eastern outskirts of Lebanon, Wilson County; section begins 1 block south of highway to Carthage on eastern city limits of Lebanon and continues northeastward to a massively bedded member near top of hill north of highway.

Lebanon Junction Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 147. A 40-foot gritty siltstone unit in lower part of Pilot Knob facies (new), Brodhead formation (new). Overlies Culver Springs shale member (new).

Measured section on south slope of knob, 1 mile northwest of Lebanon Junction, southern Bullitt County.

Lebeau Member (of Le Moyen Formation)

Recent: Southwestern Louisiana (subsurface and surface)

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 89–90, 91. Basal part is coarse-grained channel-fill deposit of fluviatile origin, upper part is fine-grained silts and clays derived from floodwaters; deposition of member continues to present time. Lies in a pre-Recent channel cut into Pleistocene terrane to depths as great as 300 feet and commonly greater than 200 feet. Essentially contemporaneous with and merges into marine, beach, and marsh deposits of Mermentau member.

Typically represented beneath town of Lebeau in T. 4 S., R. 5 E., in St. Landry Parish, on U.S. Highway 71 about 6 miles southeast of Le Moyen. Underlies all modern floodplain of Mississippi River.

Lebec Quartz Monzonite

Jurassic(?) : Southern California.

J. C. Crowell, 1952, California Div. Mines Special Rept. 24, p. 8–9, pls. 1, 2. Typical quartz monzonite; contains two facies, one, gray and medium grained making up about 80 percent of rock, and the other, buff and more coarse grained. Since Tejon Lookout granite (new) intrudes similar rocks the Lebec and Tejon Lookout are probably related although now separated by Garlock fault.

Exposed over about 14 square miles of Lebec quadrangle northwest of Garlock fault near Lebec, Kern County. Confined to hanging wall block of Pastoria thrust zone and not recognized north of Pastoria thrust or south of Garlock and San Andreas faults.

Lebo Andesitic or **Shale Member** (of Fort Union Formation)[1]

Lebo Formation (in Fort Union Group)

Paleocene : Central northern, southern, and eastern Montana.

Original reference : R. W. Stone and W. R. Calvert, 1910, Econ. Geology, v. 5, p. 746.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, p. 15 (table), 21–29. Basal formation in Fort Union group as used in this report [Crazy Mountain field]. Thickness 1,350 feet. Underlies Melville formation (new) ; overlies Bear formation (new). Paleocene.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 11–13, pl. 3. In McCone County, Mont., Lebo shale member is about 400 feet thick and consists of thick beds of dark shale alternating with thick beds of white sandy clay and sandstone and coal beds. Underlies Tongue River member ; overlies Tullock member of Lance formation. Eocene.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, pl. 1. Paleocene (Dragonian-Torrejonian).

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

W. J. Mapel, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 218 (fig. 1), 220–221. As used in this report Fort Union formation comprises three members (ascending) : Tullock, Lebo shale, and Tongue River.

Named for exposures on Lebo Creek, northeast of Crazy Mountains.

Le Boeuf Conglomerate[1] Member (of Cattaraugus Formation)

Upper Devonian or Mississippian : Northwestern Pennsylvania.

Original reference : I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 101, 103, 104, 112, 239.

I. H. Tesmer, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1651. Listed as member of Cattaraugus formation in proposed sequence of Upper Devonian or Mississippian conglomerates in southwestern New York and northwestern Pennsylvania.

Exposed in Le Boeuf Township, Erie County, along French Creek.

Leclaire Dolomite[1]

Silurian (Niagaran) : Central eastern Iowa.

Original reference : J. Hall, 1858, Iowa Geol. Survey, v. 1, pt. 1, p. 46, 73–75.

Type locality : Leclaire, Scott County.

†Lecompton Beds[1]

Pennsylvanian: Eastern Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rocks system of Kansas.

Named for Lecompton, Douglas County.

Lecompton Limestone (in Shawnee Group)[1]

Lecompton Limestone Member (of Pawhuska Formation)

Lecompton Limestone Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and central northern Oklahoma.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 278, pl. opp. p. 290; Am. Jour. Sci., 3d, v. 50, pl. opp. p. 466.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 179–180. Includes (ascending) Spring Branch limestone, Doniphan shale, Big Springs limestone, Queen Hill shale, Beil limestone, King Hill shale, and Avoca limestone members. Thickness 30 to 50 feet. Underlies Tecumseh shale; overlies Kanwaka shale. Shawnee group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 16, 17. Included in Shawnee group in Missouri.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Lecompton limestone mapped in northern Oklahoma.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49, 50, 51, measured sections. Basal member of Pawhuska formation in Oklahoma; underlies Plummer member. In Creek County, consists of gray fossiliferous sandy limestone, generally thin bedded to platy, and 10 to 30 feet thick.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25–26, 38–41, pls. Described in Pawnee County where it is classified as member of Pawhuska formation. Consists of several thin beds of fossiliferous limestone, flaggy in upper part, and interbedded shale. Commonly 10 feet thick. Separated from overlying Turkey Run limestone member by unnamed shale interval as much as 77 feet thick.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19–20, fig. 5. Formation comprises (ascending) Spring Branch limestone, Doniphan shale, Big Springs limestone, Queen Hill shale, Beil limestone, King Hill shale, and Avoca limestone members. Thickness 34 feet north of Thurman; 30 feet at Stennett; 11 feet north and east of Greenfield. Underlies Tecumseh shale; overlies Kanwaka shale. Shawnee group.

Named for exposures at Lecompton, Douglas County, Kans.

†Lecompton Shale[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 64, 94.

Named for exposures at Lecompton, Douglas County, Kans.

Le Conte Flows

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 53, 62. Discussion of volcanoes of Three Sisters region. Name applied to flows from Le Conte Crater.

Le Conte Crater is south and west of South Sister Mountain.

Ledbetter Slate

Ordovician: Northeastern Washington.

C. F. Park, Jr., 1938, Econ. Geology, v. 33, p. 713 (chart), 714 (fig. 2). Named on map and stratigraphic chart. Thickness 2,500 feet. Underlies Devonian(?) limestone; overlies Metaline limestone (new).

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 19–22, pl. 1. Black fine-grained carbonaceous slate with black limestone near top. Overlies Metaline limestone, base sharply defined; upper contacts poorly exposed. Derivation of name given.

R. G. Yates and J. F. Robertson, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–137. Described in Leadpoint quadrangle where it is about 1,000 feet thick; complete section not exposed. Overlies Metaline limestone. Poorly preserved graptolites indicate Ordovician age.

Named for Ledbetter Lake, Pend Oreille County.

Ledger Dolomite[1]

Lower Cambrian: Southeastern Pennsylvania, and northern Virginia.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 363.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 21. Proposed to extend names Vintage dolomite, Kinzers formation, and Ledger dolomite to comparable Lower Cambrian formations in area southeast of Austinville, Va.

Named for Ledger, Lancaster County, Pa.

Ledyard Formation

Ledyard Member (of Ludlowville Shale)[1]

Middle Devonian: Central and western New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 218, 224.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 364–369, pl. 1. In Batavia quadrangle, about 75 miles west of type locality of Lenyard, Wanakah and Ledyard shale members of the Ludlowville were not separated as defined by Cooper (1930); Ledyard-Wanakah member overlies Centerfield limestone member and underlies Tichenor limestone member.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455 (fig. 2). Referred to as formation. Thickness 26 feet at Jacox Run near Geneseo. Overlies Centerfield formation; underlies Wanakah formation. Ostracodes discussed.

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 4–5. Term Ledyard in this report [trepostomatous Bryozoa] follows usage of Cooper (1930). Thickness 60 to 100 feet at type locality; 30 feet at Lake Erie.

Type locality: On Paines Creek, Ledyard Twp., Cayuga Lake area.

Lee Formation[1] or Group

Lower Pennsylvanian: Southwestern Virginia, eastern Kentucky, and Tennessee.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 36.

W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–A, p. 38–53. Rank raised to group and subdivided into (ascending) Gizzard formation (including Warren Point sandstone), Sewanee conglomerate, Whitwell shale, Herbert conglomerate, Eastland shale lentil, Newton sandstone, Vandever shale, Rockcastle conglomerate, and Duskin formation. Thickness 200 to 1,400 feet. Deposited on top of irregular eroded Pennington formation. Lower Pottsville.

L. C. Glenn, 1925, Tennessee Div. Geology Bull. 33–B, p. 276. Formation, in Fentress County, comprises Rockcastle sandstone above and shale interval below, either simple or complex, for which name Fentress is suggested.

Charles Butts and W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–D, p. 5–17. In Crossville quadrangle, Lee group comprises (ascending) Gizzard formation, Sewanee conglomerate, Whitwell shale, Bonair sandstone with Eastland shale lentil, Vandever shale, and Rockcastle sandstone. Underlies Briceville shale; overlies Pennington shale.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 9–54. Discussion of strata of Lee age in Tennessee and lists following subdivisions (ascending): Gizzard formation, Sewanee conglomerate, Whitwell formation, Herbert sandstone, Eastland shale, Newton sandstone, Vandever shale, Rockcastle sandstone, Duskin Creek formation, Corbin conglomerate or sandstone, and Naese sandstone.

Andrew Brown and others, 1952, U.S. Geol. Survey Circ. 171, p. 9. Formation described in coal field of southwest Virginia where outcrops are confined to northwest and southeast sides of field. Thickness about 900 feet in northwestern exposures; 1,530 to 1,800 feet in southeastern area. Underlies Norton formation; overlies Bluestone formation. Pottsville group.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio]. Lee group as used by Wanless (1946) discontinued, and units included in newly defined Gizzard, Crab Orchard Mountains, and Crooked Fork groups.

K. J. Englund, 1957, U.S. Geol. Survey Coal Inv. Map C–39. In Scott and Campbell Counties, Tenn., formation is about 850 feet thick and consists of massive beds of crossbedded partly conglomeratic medium- to coarse-grained sandstone and thin beds of shale, siltstone, and coal. Overlies Pennington formation; underlies Briceville shale.

K. J. Englund, 1957, U.S. Geol. Survey Coal Inv. Map C–40. Term Lee formation extended into Tennessee by Keith (1896, U.S. Geol. Survey Geol. Atlas, Folio 25). In area of present report [Ivydell quadrangle, Tennessee], formation composed of massive conglomeratic sandstone, interbedded with siltstone, shale, and a few thin beds of coal and underclay. Various sandstone beds have been designated as top of Lee, but, because these beds are gradational and lenticular in this area, upper

contact of Lee is drawn at base of persistent Red coal of Ashley and Glenn (1906, U.S. Geol. Survey Prof. Paper 49). Thickness 900 to 1,400 feet. Overlies Pennington formation; underlies Briceville shale.

R. P. Briggs, 1957, U.S. Geol. Survey Coal Inv. Map C–42. Eyl (1927, Structural geologic map of Lee County, Kentucky: Kentucky Geol. Survey, ser. 6) defined Lee formation as all of lower Pennsylvanian rocks from Mississippian-Pennsylvanian contact to top of Zachariah coal bed. In present report, top of Lee formation is lowered to base of Zachariah coal bed. Locally the Zachariah has a rider coal bed; hence, base of coal bed is more persistent horizon than top. Placing of top of formation at base of Zachariah coal follows Campbell (1898, U.S. Geol. Survey Geol. Atlas, Folio 47) who placed contact between Lee formation and Breathitt formation at base of Pittsburg (Kentucky) coal bed, which is probably equivalent of the Zachariah. Exposed thickness about 275 feet in Campton quadrangle, Kentucky. Underlies Breathitt formation.

K. J. Englund and H. L. Smith, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2015. Upper part of Pennington formation and lower part of Lee formation intertongue in their type area of outcrop, Lee County, Va., and in adjacent parts of Kentucky and Tennessee. Contact between these formations, which has been interpreted as an unconformity between Mississippian and Pennsylvanian systems, is transitional as result of intertonguing and lateral gradation between marine and nonmarine facies. Lateral gradation is most evident in sandstone beds, which in Lee formation are characteristically thickly crossbedded fine- to coarse-grained quartzose, conglomeratic sandstones as much as 300 feet thick. These sandstone tongues of the Lee grade laterally to thin wavy-bedded, very fine- to fine-grained sandstones, 20 to 30 feet thick that are typical of, and are included in, the Pennington. Conversely, tongues of light-olive-gray slightly calcareous shale in upper part of Pennington wedgeout between sandstone tongues of Lee formation. Pennington-Lee contact rises stratigraphically northward in this intertonguing sequence. Marine invertebrate fossils indicate Late Mississippian age of Pennington. Plant fossils have been reported to show that Lee formation is of Early Pennsylvanian age. Intertonguing of Lee and Pennington suggests that they are partly contemporaneous.

Type locality: Lee County, Va.

Lee Quartz Diorite[1]

Precambrian: Western Massachusetts and Connecticut.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

Named for exposure in East Lee, Berkshire County, Mass.

Leecher Metamorphics

Age uncertain (pre-Chelan batholith): Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 166. Series consisting of distinctly banded hornblende schist, quartz-oligoclase-hornblende gneiss, biotite-quartz-oligoclase gneiss, and calc-silicate rocks. Pronounced banding and rapid alternation of rocks of diverse mineral and chemical compositions. Predominant easterly dip that varies from 25° to vertical. In fault contact on the west with Newby formation (new). Invaded from the east by granitic rocks of Okanogan complex, and in contact on the south with Methow gneiss (new).

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Type locality: Curving belt from 1 to 3 miles wide east of Methow River in Leecher Creek drainage and in vicinity of town of Carlton, Methow quadrangle.

Leech River Group[1] or Formation

Pennsylvanian-Cretaceous: British Columbia, Canada, and northwestern Washington.

Original reference: C. H. Capp, 1910, Canada Geol. Survey Summ. Rept. 1909, p. 87.

R. A. Anderson, 1941, Washington State Coll. Research Studies, v. 8, no. 3, p. 201. Suggested that Leech River series may be correlated with Granite Falls limestone on basis of fusilinids.

J. A. Jeletzky, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1270. Suggested that age of Leech River series is more probably Triassic or lower Jurassic than Paleozoic.

W. R. Danner, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2056. Recent studies of geology of San Juan Islands have necessitated revision of at least four major units established by McLellan (1927, Washington [State] Univ. Pubs. in Geology, v. 2). Leech River group, originally designated as Pennsylvanian-Permian was found to include rocks of Early and Middle Pennsylvanian and Cretaceous age.

Occurs on San Juan Islands and Vancouver Island.

Leeds facies (of Schoharie Formation)

Middle Devonian: Eastern New York.

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 683, 686, 691–693. As traced southward, Schoharie grit changes rapidly to a shaly and cherty facies, here termed Leeds facies. Name Saugerties formation—suggested by Chadwick (1940) as possible name for new formation, if such it proved to be —is considered inadvisable.

J. H. Johnson, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Rickard facies (new) passes eastward into sparingly fossiliferous Leeds facies in Albany County. Within New York, the Leeds is divisible into Aquetuck lithofacies below and Saugerties lithofacies above.

Named for exposures in falls of the Catskill in Leeds Gorge, Greene County.

Leeds Sandstone (in Silver Reef Sandstone Member of Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 25, 28, pl. 2. Mainly white to buff fine- to medium-grained sandstone. Sandstone weathers mainly white and buff to brown and stands out as prominent ledge maker. Stream crossbedding prominent in many places. Ripple marks rare; current type noted. Sandstone beds range from massive 15-foot beds to thin platy sandstones. Lenticular interbedded dark-gray to green or locally maroon shales may be present. Sandstones contain clay galls and balls which may be sufficiently abundant locally to form clay ball conglomerates. Clay balls range from ¼ inch to more than 4 feet in diameter. Total thickness as much as 60 feet. Underlies Tecumseh sandstone (new); overlies Trail Hill sandstone (new) with local unconformity.

Named for exposures near Leeds mine, Silver Reef (Harrisburg) Mining District, Washington County.

Lee Flat Limestone

Upper Mississippian and Pennsylvanian(?): Southern California.

W. E. Hall, E. M. MacKevett, 1958, California Div. Mines Special Rept. 51, p. 7 (table 1), 8–9, pl. 2. Predominantly thin-bedded medium- to dark-gray limestone. Locally limestone is broken by thin sandy iron-stained partings or by thin beds and lenses of chert. Estimated to be more than covered by basalt and alluvium, and faulting in exposed section vitiates estimate. At least 520 feet thick at type locality where it conformably overlies Perdido formation. Underlies Keeler Canyon formation of Pennsylvanian and Permian age. Nonfossiliferous; age derived from stratigraphic position; occupies same stratigraphic position that upper part of Perdido formation and Rest Spring shale occupy in Quartz Spring area and Ubehebe Peak quadrangle; the Lee Flat, then, represents facies change from clastic section of siltstone, shale, and minor limestone in the latter areas to fine-grained limestone in Darwin quadrangle.

Type section: Trends south from top of prominent hill nine-tenths mile S. 36° E. of main shaft of Lee mine, Darwin quadrangle, central Inyo County. Named for exposures near Lee Flat, alluviated area east of Santa Rosa Hills.

Leeic period

Paleozoic: Iowa and upper Mississippi Valley.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 75, no. 2, p. 98 (chart), 149–150. Term proposed for time span of so-called Early Carbonic limestone section. Lies between the Carbonic above and the Yorkic below. Includes Mississippian, Chartresan, and Oshawanan.

Name derived from Lee County, Iowa, where rocks are fully exposed.

Lee Ranch Tongue (of Abo Sandstone)

Lower Permian (Leonard Series): Central southern New Mexico.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 690 (fig. 1), 694, 695–697, 698 (fig. 5). At type locality, 106 feet thick and consists predominantly of salmon-red shale and siltstone, but some thin-bedded fine-grained soft-weathering sandstone beds are present. In northern part of area, consists predominantly of reddish-brown very thin bedded cross-laminated very fine-grained sandstone and siltstone. Conformably overlies Hueco limestone and intertongues with it near south end of mapped area. Conformably underlies siltstone and sandstone beds, and locally, white gypsum beds of Yeso formation; contact is gradational and therefore arbitrary, though transition zone does not exceed a few feet.

Type locality: SE¼ sec. 11, T. 20 S., R. 11 E., about 7 miles southwest of O. M. Lee Ranch headquarters, Otero County. Generally poorly exposed in narrow slope-forming outcrop on backslope of topographic shelf formed by Hueco limestone.

Leesport Limestone[1]

Middle Ordovician: Southeastern Pennsylvania.

Original reference: G. W. Stose and A. I. Jonas, 1927, Geol. Soc. America Bull., v. 38, p. 505–536.

R. L. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1687–1718. Discussion of relations of Jacksonburg and Leesport formations. Leesport formation was designated by Stose and Jonas (1927) to include argillaceous limestones ("cement rock") which underlie Martinsburg shales and

overlie Beekmantown or Stones River limestones in area between Lehigh and Susquehanna Rivers. Relations of these beds to Chambersburg limestone of south-central Pennsylvania and to Jacksonburg limestone of eastern Pennsylvania are confused, and paleontological evidence is lacking. Hence, Stose and Jonas deemed it inadvisable to imply any correlation by applying either of these names and designated these beds as new formation. They chose exposure in cut of Reading Railroad at West Leesport on Schuylkill River as type section. Results of present study have led to conclusion that argillaceous limestones east of Schuylkill should all be referred to Jacksonburg rather than Leesport. Reasons for this decision are discussed under following headings: (1) Leesport type section; (2) lithology of Leesport "cement rock"; (3) continuity of "cement rock"; (4) structure of Egypt region; and (5) relation to overlying and underlying beds. Choice of type section was unfortunate in that the section is one of complex structure and lithology is quite unlike typical "cement rock" elsewhere in Leesport belt. Figure 5 [of present report] is structure section traced from panoramic photograph; blank areas in illustration represent covered areas in railroad cut. One hundred and thirty-four feet of beds is exposed, but interrelationship of different parts of exposure is obscure. Contact of limestones with Martinsburg shale is a fault. Lithologically, rocks in this section are strikingly different from "cement rock" which has been called Leesport in areas to east. Platy limestones at north end of section closely resemble limestones interbedded with Martinsburg. Massive calcareous sandstones have their counterpart in limestones which have been provisionally interpreted as within Martinsburg formation. The 70 feet of thin-bedded limestones at south end of railroad cut are only rocks exposed which are lithologically similar to "cement rock". Stratigraphic position of units in this section is uncertain. If name Leesport is used for these enigmatic rocks, the "cement rock" to east should be given another designation. "Leesport cement rock" in areas between Lehigh and Schuylkill Rivers is identical with cement rock facies of the Jacksonburg. One of the reasons why it has not seemed feasible in past to apply name Jacksonburg to western "cement rock" areas is because of discontinuity of belt of outcrop west of Lehigh River. This discontinuity is much more striking on earlier geologic maps than is shown on Figure 4 of present report. According to present interpretation, the Jacksonburg belt is interrupted in Egypt region because of faulting and continues half a mile farther west in its normal position at base of Martinsburg shale hills. Evidence indicates that the "cement rock" disconformably overlies Beekmantown in this area.

Carlyle Gray, 1951, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 136, p. 15. Name Jacksonburg applied in this report to all impure limestones in part formerly called Leesport lying between Annville limestone or Beekmantown formation and Martinsburg formation in Berks County. Name Leesport, defined by Stose and Jonas (1927), not used because much of the lithology at type section not similar to that of beds under discussion. Name Jacksonburg used until Leesport is redefined.

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 5, table 1. Stose and Jonas (1927) mapped argillaceous limestones in Pennsylvania between Susquehanna and Lehigh Rivers that have same stratigraphic position as Jacksonburg below the Martinsburg and above the Beekmantown. Because of uncertain relationship of these limestones to the stratigraphically similar Jacksonburg to northeast and Chambersburg

to southwest of Susquehanna River, they assigned name Leesport formation to these rocks. "Leesport" has not been mapped consistently and has been variously assigned to different units. Type section is highly complex and so problematical that comparative studies cannot be made. It appears that Leesport as defined and mapped should not be considered a valid formation and should either be redefined or renamed. Interval between Beekmantown group and Martinsburg formation, embodying essentially the Leesport in east-central Pennsylvania and in restricted sense the Jacksonburg of eastern Pennsylvania and western New Jersey, is divided into (ascending) Annville, Myerstown, and Hershey limestones.

Type section (Miller, 1937): Cut of Reading Railroad at West Leesport, Berks County.

Leesville Limestone Member (of Harrodsburg Limestone)[1]

Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1929, Indiana Acad. Sci. Proc., v. 38, p. 233–242.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull. 24, no. 5, p. 805. In Indiana, the Warsaw limestone is divisible into two parts. Lower part has been divided into three members (ascending): Ramp Creek, Leesville, and Guthrie Creek. The Leesville is a massive crinoidal limestone layer 1½ to 8 feet thick.

Named for exposures at Leesville, eastern Lawrence County.

Leesville Member (of Little Valley Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Lower member of formation. Underlies Round Mountain member (new); overlies Grizzly Creek member of Crack Canyon formation (both new). Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequence of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Le Fever Limestone

Upper Silurian: Southeastern New York.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 47, 51, 52 [1946]. Name applied to massive "coralline" limestone that underlies Rondout waterlime and overlies Rosendale waterlime as defined by Hartnagel (1905). Previously termed Cobleskill but is later than Cobleskill. Name credited to R. M. Logie (unpub. ms.).

Occurs in area from Kingston, Ulster County, southward.

Leffler Gravels

Pleistocene: Northwestern Oregon.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 9–10. Proposed for alluvial deposit composing terrace on south rim of North Santiam River valley in Stayton quadrangle; also proposed to apply name to similar deposits of equivalent age elsewhere in Willamette Valley and to refer all such deposits to Leffler stage of alluviation. Older than Linn gravels (new).

Type locality: Gravel terrace on south rim of North Santiam River valley, near Leffler, Stayton quadrangle. Name derived from Southern Pacific Railway Station near foot of terrace.

Lefulufulua Trachyte

Pliocene and lower Pleistocene(?) : Samoa Islands (Tutuila)

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1). Named in list of eight trachytes that are described as dense jointed cream-colored trachytic dikes, plugs, and crater fills later than most of Pliocene volcanics. Thickness of series 2,141 feet or more. Lefulufulua plug associated with Olomoana volcanics.

Legion Shale Member[1] (of Grenola Limestone)

Permian : Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Consists of shale, mostly gray but locally zones of black; in central Kansas upper part commonly fossiliferous. Thickness 4 to 12 feet. Underlies Burr limestone member; overlies Sallyards limestone member. Permian. Wolfcamp series.

Type locality: Cuts on U.S. Highway 40, just southwest of American Legion Golf Club grounds, about 1¾ miles southwest of Manhattan. Riley County, Kans.

Legion Creek Granite

Precambrian : Central Texas.

V. E. Barnes, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 51, 53 (geol. map). Coarse-grained granite.

Map is of Cut Off Gap area, Gillespie County.

Lego Limestone Member (of Wayne Formation)[1]

Lego Limestone (in Wayne Group)

Middle Silurian : West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 565, 578–582, 694.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 244, 251–252, figs. 2, 75, 80, 81, 82. Rank raised to formation in Wayne group. Conformably overlies Waldron shale; conformably underlies Dixon formation; locally unconformably underlies Chattanooga shale or Pegram formation. Thickness 25 to 35 feet; average between 27 and 30 feet.

Named for Lego, Decatur County.

†Le Gore Limestone[1]

Lower Ordovician (Beekmantown) : Western Maryland.

Original reference: G. W. Stose and A. I. Jonas, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 564–565.

East of Le Gore quarry, at northern edge of Frederick limestone valley, Frederick County.

Le Grand beds[1]

Mississippian : Central northern Iowa.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 57.

Named for Le Grand, Marshall County.

Lehigh Limestone[1]

Middle Ordovician: Northeastern Pennsylvania.

Original reference: E. C. Eckel, 1904, U.S. Geol. Survey Bull. 225, p. 449, 450.

Lehigh and Northampton Counties.

Lehighton Member (of Tully Formation)

Upper Devonian: East-central Pennsylvania.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 31, 32. Upper member of formation. Consists of abundantly fossiliferous thin-bedded sandy shale. Thickness about 20 feet. Overlies Brodhead Creek member; underlies Brallier [shale]. Lenses out east of Weissport.

Type section: On Pennsylvania Highway 412, one-half mile south of Lehighton, along Mahoning Creek, Carbon County.

Lehigh Valley cement rock[1]

Middle Ordovician: Northeastern Pennsylvania.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 563.

Lehigh and Northampton Counties.

Lehman Formation (in Pogonip Group)

Lower Ordovician (Chazyan): Eastern Nevada and western Utah.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 2, 19–20, 63, 67, 75. Thin- to thick-bedded fossiliferous blue-gray calcilutite with a few beds of sandstone and quartzite. Thickness at type locality about 200 feet; eastward from Ibex, Utah, thins to disappearance; westward, more than doubles in thickness by overlying Swan Peak(?) quartzite grading into Lehman lithology. Overlies Kanosh shale (new); in Ibex area, base is lowest interbedded sandstone ledge; upper limit is top of highest calcilutite beneath Swan Peak(?) quartzite.

Type locality: Bluff on north side of Smooth Canyon and in SE¼ sec. 24, T. 22 S., R. 15 W., near Ibex, Millard County, Utah. Named for exposures in Snake Range near Lehman Caves, Nev.

Lehmer Limestone Member (of Admire Shale)[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 9.

At old Lehmer quarry, 4 miles southwest of Falls City, Richardson County.

Leicester Marcasite Member (of Moscow Formation)

Middle Devonian: Western New York.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 356, 379–380. Name proposed for top member of formation. Consists of lenses of yellowish-brown very fossiliferous sometimes nodular pyrite and marcasite; weathers to reddish-brown limonitic powder. Maximum thickness 6 inches. Overlies Windom member; underlies Genesee group, possibly unconformably. Previously termed Tully pyrite; not equivalent in age to Tully limestone.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2816–2817, 2827. Sutton's Leicester marcasite is lenticular layer of pyrite and marcasite in base of Geneseo shale member of Genesee formation.

Type locality: Along banks of Beards Creek one-fourth mile northwest of Leicester, Livingston County. Extends from west shore of Canandaigua Lake to Lake Erie.

Leigh Dolomite Member (of Bighorn Dolomite)[1]

Leigh Formation

Upper Ordovician: Western Wyoming.

Original reference: C. W. Tomlinson, 1917, Jour. Geology, v. 25, p. 118, 225–257.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 15–16. Rank raised to formation. Underlies Darby formation.

R. B. Boeckerman and A. J. Eardley, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 181. In Jackson quadrangle, Lincoln County, formation consists of slabby gray dolomite with smooth white to yellowish weathered zones. Thickness 30 feet. Unconformably underlies Darby formation; unconformably overlies Bighorn dolomite. Silurian or Devonian.

Named for typical development on Leigh Creek, Teton Range.

Leighton Gray Shale Member (of Pembroke Formation)[1]

Silurian: Southeastern Maine.

Original reference: E. S. Bastin and H. S. Williams, 1914, U.S. Geol. Survey Geol. Atlas, Folio 192, p. 6–7.

Named for exposures on Leighton Neck, Penbroke Township, Washington County.

†Leightons Cove Series[1]

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1886, Am. Jour. Sci., 3d, v. 32, p. 53, 56.

Named for exposures at Leighton's Cove, Cobscook Bay district, eastern coast of Washington County.

Leila Trachyte

Pliocene and lower Pleistocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1). Named in list of eight trachytes that are described as dense jointed cream-colored trachytic dikes, plugs, and crater fills later than most of Pliocene volcanics. Thickness of sequence 2,141 feet or more. Leila plug associated with Alofau volcanics (new).

Leipers Limestone[1]

Leipers Formation (in Maysville Group)

Upper Ordovician: Western Tennessee and northwestern Alabama.

Original reference: C. W. Hayes and E. O. Ulrich. 1903, U.S. Geol. Survey Geol. Atlas, Folio 95.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 179–193. Leipers formation as now defined includes all strata of Maysville group in central basin because it is only formation that has been proposed. Widely diverse facies are included but all carry Maysville fossils. Separated

from underlying Catheys formation of Nashville group and overlying beds, regardless of age, by unconformities; locally underlain with apparent unconformity by Inman formation (new) of Eden group: unconformably underlies Arnheim formation. Thickness throughout most of out-crop belt less than 75 feet; thickens northward in Summer, Macon, Jackson, and Clay Counties to maximum of 175 feet. Hayes and Ulrich proposed no type section other than along Leipers Creek. Section suggested by Bassler (1932, Tennessee Div. Geology Bull. 38) as representing type area is here accepted as type section. It contains only two facies, but no section, anywhere, would contain adequate representations of all facies of Leipers.

G. B. Martin, 1960, Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 202–205. Recommended that in northwestern Alabama upper part of "Chickamauga" limestone be replaced by Leipers and Fernvale formations. Leipers consists of thin-bedded gray coarsely crystalline argillaceous limestone. Exposed thickness 12 feet. Maysville group.

Type section: Along Leipers Creek 2 miles north of Water Valley, Maury County, Tenn.

†Leipers Creek Limestone (in Richmond Group)[1]

Upper Ordovician: Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 432–433.

Named for exposures on Leipers Creek, Maury County.

Leitchfield Formation

Leitchfield Formation (in Chester Group)[1]

Upper Mississippian: Western Kentucky.

Original reference: L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 60.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1). 840. Thick shale which constitues Elvira group in Logan and Butler Counties, and farther east, is known as Leitchfield formation. Derivation of name given.

Preston McGrain and F. H. Walker, 1954, Kentucky Geol. Soc. Field Trip, Apr. 1954, p. 286. Differs from Buffalo Wallow formation (Butts, 1917) in that it includes the Tar Springs as basal member.

Named from town of Leitchfield, Grayson County.

Leitchfield Marl (in Chester Group)[1]

Mississippian: Western central Kentucky.

Original reference: C. J. Norwood, 1876, Kentucky Geol. Survey, v. 1, new ser., pt. 6, p. 12, 13.

Named for exposures at Leitchfield, Grayson County.

Leithsville Formation[1]

Leithsville Limestone

Middle(?) Cambrian: Eastern Pennsylvania.

Original reference: E. T. Wherry, 1909, Science, new ser., v. 30, p. 416.

B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 227. Name abandoned and Tomstown formation extended to area as substitute.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1357, 1361, 1362–1363, 1365, 1366. Revived since use of name Tomstown implies unwarranted correlation with Tomstown type area. Also used in place of Elbrook limestone in Buckingham Valley. Termed limestone and described as mostly dark gray-blue to black dolomitic rock with yellowish to buff beds. Variable bedding and lithologic characteristics. Includes thin-bedded impure high magnesium limestone; argillaceous sericitic shaly limestone to sericitic shale lacking carbonate; and massive dense dolomite limestone in beds up to 10 feet thick. Also contains masses of dark or light chert. Underlies newly named Limeport limestone; overlies Chickies quartzite in Buckingham Valley and disconformably overlies Hardyston quartzite in Lehigh Valley. Lower, Middle and (or) Upper Cambrian.

Bradford Willard, 1955, Geol. Soc. America Bull., v. 66, no. 7, p. 819, 821, 822, 824–825, 827. Interfingers with overlying Limeport. Conformable with underlying Hardyston at all but one contact where there is local disconformity. Middle(?) Cambrian.

Probably named for Leithsville, Northampton County.

Lemhi Formation

Mississippian to Permian (Meramecian through Wolfcampian): Central eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Contains abundant algal, coral, and bryozoan bioherms and biostromes. Cross-stratification, edgewise limestone conglomerates, bottom scouring, cyclic sedimentation, oolite beds and calcarenites indicate shallow-water deposition. Thickness at type section 6,950 feet. Replaces "Brazer." Time equivalent of Muldoon (new) and Wood River formations.

Type section: In southern Lemhi Range.

Lemhi Quartzite

Precambrian (Belt Series): Southern central Idaho.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1096–1097, pl. 1. Principally grayish-green impure quartzite with subordinate argillaceous beds. Latter are darker than the quartzite; some are purple and maroon. Nearly pure white to pinkish quartzite lenses present locally. Thickness 3,000 feet or more; basement exposed. Underlies Swauger quartzite (new) with gradational contact.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamp. 118, p. 16–18. Thickness about 8,000 feet in Lemhi quadrangle. Underlies Swauger quartzite.

Named after Lemhi Range in which it is extensively exposed, Borah Peak quadrange.

Lemon Cove Schist (in Kaweah Series)

Triassic(?): Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci, Bull., v. 25, no. 1, p. 14, 116, fig. 29, geol. map. Second in sequence (ascending) of four units included in series. Considered younger than, or in part equivalent to, Yokohl amphibolite, and older than Homer quartzite (both new). Principal rock type is mica schist. Thickness in Dry Creek area 8,000 feet; base not exposed.

Named for its occurrence near town of Lemon Cove, in southern Sierra Nevada, north-central Tulare County. Also occurs along Sheep Creek in core of large anticline, and at Yucca Creek, where it appears beneath Three Rivers schist.

Lemons Bluff Member (of Big Saline Formation)

Lemons Bluff Member (of Marble Falls Formation)

Lower Pennsylvanian: Central Texas.

F. B. Plummer, 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 33, p. 3, 5, 8. Member of Marble Falls formation; incidental mention in connection with study of limestones suitable for manufacture of rock wool.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 67–69. Black subcrystalline uniformly bedded siliceous chert-bearing limestone weathering to yellowish and grayish-brown tints; locally contains quantities of minute sponge spicules. Layers are 2 to 12 inches thick and characterized by flat smooth surfaces and commonly separated by thin partings of shaly limestone. Member changes to shale beds eastward and crops out at McAnelly's Bend along Colorado River west of Bend as black fissile shale containing thin layers of dense black limestone. This shale has long been considered typical Smithwick; it ranges in thickness from a few feet to 125 feet and unconformably overlies Big Saline beds. Underlies Smithwick formation.

F. B. Plummer, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2), 197–198; 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143, 144. Reallocated to member status in Big Saline formation. Thickness 20 to 60 feet. East of Cavern Ridge (Llano region) underlies Brister member (new) and overlies Aylor member (new); west of Cavern Ridge underlies Soldiers Hole member (new) and overlies Brook Ranch member (new); absent southwest of Brook Ranch in McCulloch County.

Lemons Bluff is on San Saba River, San Saba County.

Lemont Argillaceous Limestone Member (of Carlim Limestone)[1]

Middle Ordovician: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th v. 46, p. 526, 533, 537.

Charles Butts and E. S. Moore, 1936, U.S. Geol. Survey Bull. 855, p. 33–35, pls. 1, 2. Described in Bellefonte quadrangle. Upper part of formation. Thickness 10 to 40 feet. Associated with the Lemont are thin layers of bentonite both above and below it at Bellefonte and at least one layer below it at quarry near Oak Hall. Significant fossil for correlation is *Maclurea magna* (Lesueur) found at Lemont and near Oak Hall and elsewhere in central Pennsylvania. Underlies Lowville limestone. Lower Ordovician.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Nealmont (new) includes type Rodman, Lemont, and Center Hall (Hull and Rockland).

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 195. Terms Carlim, Lemont, and "Lowville" have been applied to different units at various localities. "Lemont member of the Carlim" in Tyrone district is Hostler member (new) of Hatter formation; it is the part of the Valley View limestone [member (new) of Curtin limestone (new)] between metabentonites E and D at Bellefonte, and part of Nealmont limestone at type locality at Lemont.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 20. Type Lemont limestone is equivalent to most Nealmont limestone that overlies Valentine limestone.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 2, p. 101–102. Name "Lemont" has ben applied to units older than beds at type section; Lemont limestone was originally defined as "well exposed in railroad cut a short distance south of the town," west of Oak hall. Species misidentified as *Maclurites "magnus"* Lesueur led to classification as Chazyan and belief that is was older than Curtin and Benner limestones or "Lowville" in Tyrone area.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 71–72. Member named by Butts (1918) for limestone exposed in railroad cut south of Lemont. At this place, a species of *Maclurites* is fairly common as was confused by Butts with *M. "magnus"* Lesueur of Chazy group. Butts thus regarded his Lemont as a part of the Chazy and identified his member elsewhere in Pennsylvania where rock was shaly and had *M. "magnus."* Type section of Lemont is actually top of limestone sequence now called Nealmont (Kay, 1944). Butts' use of name Lemont was generally for brownish shaly rock left as "rib" in quarrying operations to which Kay applied name "Hostler member of Hatter formation." Butts' Lemont of type section is thus part of the Nealmont, and Lemont outside type section is generally Hostler.

Named for Lemont, near State College, Centre County.

Lemont Drift

Pleistocene (Illinoian) : Northern Illinois.

J. H. Bretz, 1939, Illinois Geol. Survey Bull. 65, pt. 1, p. 53. Name applied to glacial and aqueo-glacial deposit underlying Valparaiso till. Strikingly free from clay, the finest material being a silt or very fine sand; contains large percentage of stratified material. Term till is used advisedly.

J. H. Bretz, 1955, Illinois Geol. Survey Bull. 65, pt. 2, p. 57–69. Thickness about 60 feet. Commonly tan to buff. At type locality, highly variable both vertically and horizontally; some of the sand is sufficiently cemented to yield boulder-sized fragments of sandstone and conglomerate. Overlies thick unit termed sub-Lemont drift.

Leland Horberg and P. E. Potter, 1955, Illinois Geol. Survey Rept. 185, p. 9–10, 18. In some areas, underlies buried soil and Tinley till (new). Illinoian.

Well exposed in abandoned quarries about 1 mile west of Lemont, just outside Chicago area. Also exposed along and near Sag Channel and Des Plaines Valley west of Argo, San Bridge and Palos Park quadrangles.

Le Moyen Formation

Recent: Southwestern Louisiana (subsurface and surface).

P. H. Jones, *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Lousiana Dept. Conserv. Geol. Bull. 30, p. 88–89. Partly channel-fill and apartly deltaic deposit beneath Mississippi River flood plain consisting of two essentially equivalent members: the Lebeau (new) containing large amounts of sand and gravel, and the Mermentau (new) containing silty clay or clay. Thickens gulfward. Maximum thickness 300 feet; at type locality about 260 feet; at Le Moyen, the basal sand and gravel is about 115 feet thick and is overlain by dark organic clay. Upper surface is land surface; base lies on rocks ranging in age from Eocene to late Pleistocene.

Penetrated by water wells near town of Le Moyen in T. 3 S., R. 4 E., and in T. 3 S., R. 4 E., in St. Landry Parish, on U.S. Highway 71 about 43 miles southeast of Alexandria.

Lena Member (of Fleming Formation)

Miocene: Central Lousiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 151–154, geol. map. Brackish-water calcareous clays with siliceous silts and local pyroclastic lentils. Dominant lithologic unit is the gray silty clay that occurs near base of typical section; this unit incorporates varying thicknesses of more calcareous clays which in places make up almost all of the section; calcareous beds contain foraminifera, whereas the gray silty clays contain carbonaceous particles and grass. Thickness 75 to 125 feet. Underlies Carnahan Bayou member (new); overlies Catahoula formation.

Typically exposed for 2½ miles north along Highway 71W from near Lena, Rapides Parish, in sec. 34, T. 6 N., R. 4 W., to a point in Natchitoches Parish.

Lenapah Limestone[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southwestern Iowa, southern Kansas, and western Missouri.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchinson, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 10, 11, 12.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 300, 336–340. Subdivided into (ascending) Norfleet limestone, Perry Farm shale, and Idenbro limestone members (all new). Thickness at type exposure about 22 feet. Overlies Nowata shale; underlies Memorial shale. Marmaton group, Des Moines series.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 9. In western Missouri, formation comprises (ascending) Norfleet limestone, Perry Farm shale, and Sni Mills limestone members. Overlies Nowata formation; underlies Memorial shale.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 36–41, pl. 1. Described in Tulsa County. Thickness a few feet to as much as 20 feet. Conformably overlies Nowata formation; conformably underlies Holdenville (Memorial) shale. Where Lenapah has been exposed by pre-Seminole erosion, it is unconformably overlain by Seminole formation. Uppermost beds of Wewoka formation are continuous with Lenapah limestone. Marmaton group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30, fig. 5. Formation represented in Iowa by Cooper limestone (Sni Mills of Missouri). Characteristically white to light gray; has brecciated appearance with dense limestone fragments in light grayish-green argillaceous matrix. Overlies Nowata formation; underlies Pleasanton group. In Marmaton group.

Type exposure in quarry in NW¼NE¼ sec. 30, T. 28, N., R. 16 E., Nowata County, Okla., at Bell Spur, north of Lenapah.

Lennep Sandstone (in Montana Group)[1]

Upper Cretaceous: South-central Montana.

Original reference: R. W. Stone and W. R. Calvert, 1910, Econ. Geology, v. 5, p. 746.

J. G. Bartram, 1937, Am. Assoc. Petroleum Gologists Bull., v. 21, no. 7, p. 910. Suggests name Fox Hills could be extended and such names as Lennep, Horsethief, Milliken, and Trinidad be dropped.

M. H. Stow, 1953, U.S. Atomic Energy Comm. [Pub.] RME–3069, p. 12. In list of sedimentary formations exposed in Yellowstone-Beartooth-Big Horn region. Lennep occurs above Bearpaw and below Lance (Hell Creek).

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

Named for Lennep Station, on Chicago, Milwaukee, St. Paul, and Pacific Railroad, at northern end of Crazy Mountains.

Lenoir Limestone (in Stones River Group)[1]

Middle Ordovician: Eastern Tennessee, northern Alabama, and western Virginia.

Original reference: J. M. Safford and J. M. Killebrew, 1876, Elements of geology of Tennessee, p. 108, 123, 130–131, 137.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 139–147. Lenoir succeeds Mosheim limestone or Murfreesboro limestone, or Beekmantown dolomite where Mosheim is absent, as in Knobs area south of Abingdon, Washington County. With exception of vicinity off Draper, Pulaski County, the Lenoir, so far as known, is universally present throughout Appalachian Valley. Well exposed at top of St. Clair facies (new) of Murfreesboro limestone in following areas: Yellow Branch, southeast of Rose Hill, Lee County; southeast of St. Clair Station west of Bluefield; northeast of Bolar, Bath County; and west edge of Crabbottom, Highland County. Where Blackford facies (new) of Murfreesboro is present, the Lenoir is not obviously recognizable but is probably present above the Mosheim. Thickness 5 feet or less at places in area of Blackford facies northwest of Clinch Mountain; 30 feet in Knobs area near Abingdon; commonly 50 feet throughout most of Appalachian Valley; possible maximum thickness 200 feet northwest of Newport, Giles County. In Stones River group. Underlies Holston limestone of Blount group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, southwestern Virginia, is subdivided into 29 distinctive zones which are grouped into eight formations. Study led to recognition of inconsistencies in use of names Stones River, Murfreesboro, Mosheim, Lenoir, Blunt, Holston, Ottosee, Lowville, and Moccasin. Lenoir limestone of Butts has been identified largely on basis of its superposition with respect to beds supposed to be Mosheim, resulting in identification of two different zones as Lenoir. In proposed revised stratigraphic nomenclature, Cliffield formation (new) includes beds which Butts has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 35–114. In classifying lower Middle Ordovician of Shenandoah Valley, formation names Stones River, Mosheim, Lenoir, Holston, Whitesburg, and Athens have been used without adequate evidence. The Lenoir and Mosheim have been misidentified in much of Appalachian Valley of Virginia, and confusion regarding these formations has resulted in misidentification of many of succeeding formations. Therefore, relationship

of type Lenoir to type Mosheim has been restudied. In limestone belt which passes through Lenoir City and Philadelphia, Tenn., type Lenoir directly overlies Knox dolomite and exhibits three-fold development. Lower 15 to 25 feet composed chiefly of mealy-weathering dolomitic mudrocks with intercalated beds of dove-gray calcilutite; middle division, 25 to 45 feet thick, is impure limestone containing *Mimella nuclea* (Butts), distinctive but undescribed species of *Valcourea* and *Hesperorthis*, and characteristic coral *Billingsaria parva;* upper 100 to 125 feet is dark-gray medium-grained sparsely cherty limestone with *Maclurites "magnus"* the only common fossil. Southwest of Philadelphia, limestones of lower division of Lenoir grade vertically and laterally into dolomitic mudrock. In type exposures of Lenoir, 4 to 9 feet of dove-gray limestone, not unlike beds elsewhere called Mosheim, occur at base of Lenoir and are overlain by 7½ feet of dolomitic mudrock. Basal Lenoir calcilutite and these mud rocks are separated by 2 to 18 inches of shaly limestone containing abundant *Rostricellula pristina* (Raymond). Lithologic similarity, stratigraphic position, and occurrence of this fossil correlate lower dolomitic division of typical Lenoir with lower Blackford of Virginia. If calcilutite at base of type Lenoir were to be called Mosheim, the identification would have to be based wholly on lithologic resemblance which is not very pronounced. Near Friendsville, Tenn., where Lenoir is prominently displayed, Mosheim-type limestone occurs at several horizons. Northeast of Friendsville, where lower "Mosheim" zone is developed, the lower dolomitic division of typical Lenoir is absent, and basal calcilutite is overlain by middle fossiliferous division of the Lenoir. These "Mosheim" beds may be a dove limestone facies of lower Lenoir. Since real Lenoir contains more than one intercalation of dove-gray calcilutite and since substantial part of lower Lenoir seems to be supplanted by this type of limestone, it is believed that beds with "Mosheim" lithology are a facies of the typical Lenoir. Probably type Mosheim is a calcilutite facies representing substantial part of typical Lenoir. Use of name Mosheim for a pre-Lenoir stratigraphic division should not be extended hundreds of miles away from type locality when evidence that the Mosheim underlies the Lenoir is lacking in critical localities. Butts' Lenoir in northern Virginia is apparently not represented in Lenoir of type locality. In proposed reclassification, the lower Middle Ordovician is divided into six time-stratigraphic units (ascending): New Market limestone, Whistle Creek limestone, Lincolnshire limestone, Edinburg formation, Oranda formation, and Collierstown limestone. At least part of New Market limestone is linked with part of New York Chazy and type Lenoir.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1181–1182. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Measured sections compared with revised classification in Tazewell County, Va. Lenoir limestone was named by Safford and Killebrew for nodular argillaceous *Maclurites*-bearing limestone at Lenoir City, Tenn. They considered it to be same as *Maclurea* limestone. Since this was defined as occurring above Knox dolomite (Beekmantown) and below the Marble ("Holston" marble), it is likely that this is definition intended at Lenoir City. This would here include "Mosheim" (Five Oaks) limestone at base. Since the naming of "Mosheim" in 1911, the Lenoir has been generally considered of post-"Mosheim", pre-"Holston" age. Though upper Lenoir in type section is covered, outcrops nearby show typical Lenoir lithology to continue to base of

"Holston." Under strict analysis of original designation, the boundaries are not sufficiently definite to preserve validity of name. In view of its wide use, name should be retained but should be redefined. Lenoir may be defined as the argillaceous nodular limestones occurring between "Mosheim" (Five Oaks limestone) and the "Holston" (Farragut limestone, new). Northwest of Clinch Mountain, the Lenoir would occur chronologically between the Five Oaks and Thompson Valley (new) limestones. The Five Oaks is commonly absent in both areas, and, where Blackford formation is absent, the Lenoir rests directly on the Beekmantown.

R. L. Miller and J. O. Fuller 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76; 1954, Virginia Geol. Survey Bull. 71, p. 84–90. In Rose Hill oil field, Lee County, Va, Lenoir overlies Mosheim limestone and underlies Lowville limestone. Lenoir of Rose Hill area is about same as Lenoir of Butts in southwest Virginia and probably correlates with Lincolnshire of Cooper and Prouty in Tazewell County.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 22, 25–26, geol. map. Lenoir (Ridley) limestone included in Stones River group in northwestern Georgia. Thickness about 100 feet. Overlies Mosheim limestone; underlies Lebanon limestone.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104; 1954, U.S. Geol. Survey Bull. 990, p. 43–47. Martin Creek limestone (new) replaces Lenoir limestone as used by Miller and Fuller (1947, 1954).

John Rodgers, 1952, Geologic map of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map [GQ–19]. Lenoir limestone, in Athens quadrangle, consists chiefly of dark bluish-weathering argillaceous nodular limestone; basal beds, which rest unconformably on Mascot dolomite, vary from place to place. Massive aphanitic limestone, comparable to Mosheim limestone near Knoxville, is present locally in Sweetwater Valley and in extreme southeastern part of area. It is as much as 15 feet thick just south of southeast corner of quadrangle. In other places, basal beds are greenish silty dolomitic limestone containing angular chert fragments. Both rock types appear to be lateral facies of typical Lenoir limestone. Lenoir in Athens area was mapped as Chickamauga by Hayes (1895, Folio 20); however, name Lenoir has priority as applied to these rocks, and typical Chickamauga includes beds equivalent to Ottosee shale and higher formations. Thickness about 250 feet in Sweetwater Valley; 40 feet elsewhere. Contact with overlying Athens shale gradational.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 68–78, pls. In this report, the Mosheim is considered a member of the Lenoir that locally replaces the lower part of the formation. The Lenoir underlies the Holston and overlies Knox group. Lenoir limestone and Athens shale grade into each other in vague belt near Monroe-McMinn County line.

Josiah Bridge, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 727–729. In Douglas Lake area, includes Douglas Lake member (new) in lower part. Overlies Mascot dolomite Underlies unnamed shaly limestone.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Lenoir, in Shooks Gap quadrangle, Tennessee, divided into Mosheim member at base and main body of Lenoir. Thickness 380 to 500 feet. Underlies Holston formation; unconformably overlies Newala formation.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (chart), 147–148, pl. 28. Term Lenoir limestone is applied in this report [Tellico-Sevier belt, eastern Tennessee] to limestones of several distinctive types that comprise basal part of Middle Ordovician section. Main part of formation consists of gray cobbly argillaceous limestone with which name Lenoir is associated by many geologists from Virginia to Alabama, regardless of exact stratigraphic position or fossil content. Also included is dove-gray aphanitic limestone termed Mosheim member, and a discontinuous basal unit characterized by several kinds of detrital limestone to which term Douglas Lake member is applied. Wherever there are exposures, the Lenoir, 26 to 95 feet thick, intervenes between basal beds of Blockhouse shale (new) and highest beds of Knox group. This fact is emphasized because Keith (1895, folio 16; 1896, folio 25) showed Athens shale resting on Knox in most places.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 72. Name Lenoir restricted to sequence exhibited at type locality on east side of Lenoir City. So restricted, the sequence containing *Christiania*, originally referred to the Lenoir by many geologists, is excluded. *Christiania* beds are herein named Arline formation. At type locality, the Lenoir contains three zones (ascending): *Rostricellula, Valcourea-Mimella*, and *Maclurites*. Best development of Lenoir is at Friendsville, Blount County, Tenn., where each zone is fairly thick. To the west of Friendsville area, across strike of various belts, the Lenoir changes lithology and is ultimately cut out. In its changed lithology, the Lenoir appears as a calcarenite well exhibited near Tumbez in Virginia with basal conglomerate containing *Rostricellula*, and massive limestones above it contain *Valcourea* and *Mimella*. Hence, it has been called Tumbez formation (Cooper, 1945). Blackford formation of dolomites, red beds, and conglomerates is equivalent to Tumbez and Lenoir. In belt along Cumberland Front, the Lenoir is missing; Blackford facies (Dot formation) there is equivalent to Hogskin member of Lincolnshire formation.

Named for exposures at Lenoir City, Loudon County, Tenn.

Lenox Limestone Member (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 37, map, sections.

In Lenox mine, Bingham district.

Lenoxhills Formation

Permian (Wolfcamp Series): Western Texas.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 46, no. 9, p. 299–300; 1960, Cushman Foundation for Foraminiferal Research Contr., v. 11, no. 4, p. 120. At type section, composed of 130 feet of conglomerate at base succeeded by 160 feet of sandstone, clastic limestone, and shale. To the southwest, entire formation changes facies into conglomerate; further southwest at Dugout Mountain, conglomerate changes facies into sandstone and shale (150 feet thick) and finally into limestone and shale. Northeast of Lenox Hills, formation changes into shale facies and is thin (120 feet) just west of Iron Mountain. At Leonard Mountain, shale units intertongue eastward into biohermal limestones; in vicinity of Wolf Camp Hills, these biohermal strata intertongue into silty thin-bedded

limestones, 200 to 300 feet thick. Eastward from Wolf Camp Hills the thin-bedded limestones of formation intertongue with red and varicolored shales and green crossbedded sandstone of marginal marine facies. Througout much of eastern area, basal conglomerate of formation fills valleys cut in Gaptank formation. Unconformably overlies Nealranch formation (new); unconformably underlies Leonard formation. Lenoxhills is upper formation of Wolfcamp series in Glass Mountains. It was included in Wolfcamp formation by King (1931, Texas Univ. Bull. 3038) and is lower 200 to 300 feet of Hess formation of Udden (1917). [Name also spelled Lenox Hills.].

Type section: Lenox Hills, one-fourth mile north of Slick-Urschel No. 1 Mary Decie well site 7 miles northwest of Marathon, Brewster County.

Leola Volcanics

Precambrian; Northeastern Washington and western Idaho.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 9–11, pl. 1. Name applied to succession of greenstone and green schist about 5,000 feet thick. Underlies Monk formation; overlies and is gradational into Shedroof conglomerate (new).

Named from section at Leola Peak, Pend Oreille County, Wash. Volcanics crop out from international boundary southwestward and pinch out about Pass Creek.

Leon Series[1]

Upper Cambrian and Lower Ordovician(?): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxii, 295–301, pl. 3.

Named for Leon Creek, Mason County.

Leona Formation[1]

Pleistocene: Southern Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 253–254, 275–276.

W. O. George, 1952, U.S. Geol. Survey Water-Supply Paper 1138, p. 14 (table 7), 28, pl. 2. Described in Comal County where it occurs as terraces mainly in valleys of Guadalupe River and Cibolo Creek and has probable maximum thickness of 65 feet.

Named for Leona River, Uvalde and Zavala Counties.

Leona Rhyolite[1]

Pleistocene, lower or middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Described in Hayward quadrangle. Lower or middle Pleistocene. Pyritic soda rhyolite flows, domes, and dikes. Thickness varies irregularly and abruptly from a few feet to more than 400 feet. Lies mostly, but not invariably, on a fault contact between shale in upper part of Knoxville in eastern part of area and a variety of Franciscan rocks and basic plutonic rocks on west; in some areas, overlies Claremont shale. No younger rocks overlie the rhyolite in area.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 33–34, fig. 2, geol. map. Unconformably overlies Orinda and Briones formations

in Pleasanton area. Thickness about 400 feet. Questionably assigned to Pliocene.

Occurs in San Francisco Bay region. In Hayward quadrangle, crops out discontinuously throughout the front hills in a northwest-trending belt.

Leonard Formation[1] or Series

Lower Permian: Western Texas, Kansas, New Mexico, and Oklahoma.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 51.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1675, 1677–1678. Second division of the Permian, the Leonard series, comprises beds heretofore assigned to Leonard formation, which is thus raised to series rank. At type locality, the Leonard is more than 1,800 feet thick and consists of limestones and dark siliceous shales. Rests disconformably on Wolfcamp series and underlies Word formation of Lower Guadalupe age. Leonard equivalents include Bone Spring formation of Sierra Diablo, Delaware, and Guadalupe Mountains, the Yeso and possibly San Andres formations of New Mexico, and, in terms of older nomenclature, part of the Wichita-Albany group plus all the Clear Fork group plus part of the Double Mountain group in central Texas. In Oklahoma and Kansas, the series extends from horizon near top of Herington limestone up to top of Dog Creek shale, that is, to base of Whitehorse group. Hence, formations of Big Blue and Cimarron series of Kansas and Nebraska should be reclassified according to assignments in Wolfcamp, Leonard, and Guadalupe series. Also recommended that term Minco in Oklahoma be dropped in favor of Leonard series.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 650–651. According to usage herein adopted, Leonard series in Glass Mountains is represented by one formation, also termed Leonard. The Leonard, as now defined, comprises about 2,000 feet of beds, limited below by an unconformity at top of Wolfcamp formation and above by persistent limestone bed that forms base of Word formation.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 38–41. Leonardian series in Kansas represented by about 1,900 feet of rocks that are chiefly unfossiliferous clastics and evaporites. Red silty shale, siltstone, and sandstone predominate in upper part. Gray silty shale is most common rock type in lower part. Comprises formations included in Nippewalla and Sumner groups.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. As shown on correlation chart, Leonardian stage is Middle Permian. Comprises Sumner group and lower part of Nippewalla group.

G. V. Cohee, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 9, p. 1578–1579. U.S. Geological Survey has adopted a two-fold subdivision of the Permian (Lower and Upper series and Early and Late epochs). These subdivisions coincide as nearly as possible with those recognized in type Permian and are drawn according to existing concepts of biotic correlation with type sequence. Reference sequence for United States is Permian outcrops of northwestern Trans-Pecos Texas where approximate faunal boundary is taken as that between Cherry Canyon and Bell Canyon formations which are encompassed by Guadalupe series. Boundary also falls between Word and Capitan formations as recognized in Glass Mountains area. Leonard series is Lower Permian.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 233 (table 1). As recognized in Oklahoma, series comprises Wellington formation, Garber sandstone, and Hennessey shale.

Type locality: On south face of Glass Mountains. Forms greater part of south face of Leonard Mountains. Hess Canyon quadrangle, Brewster County, Tex.

Leonardian Series or Stage

See **Leonard Series.**

Leone Lava

Recent(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 110–111. Pahoehoe flow of limburgitic basalt, 10 to possibly 70 meters thick. Overlies Leone tuff.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1306. Included in Leone volcanics.

Covers about 20 square kilometers near coast 4 miles southwest of Pago Pago Bay.

Leone Tuff

Recent(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 111–113. Tuff comprising two breached cones at Steps Point. Overlies Leone basalt.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1306. Included in Leone volcanics.

Covers area of about 7 square miles along coast 6 miles southwest of Pago Pago Bay.

Leone Volcanics

Recent(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1), 1306–1308. Olivine (picritic) pahoehoe basalt spread from fissure reaching from Olotele Peak to Fagamaa Crater. Lava veneered with tuff over large area. Cinder member forms cones about 250 feet high at source of Tafuna flow. Stony ash member forms cone about 200 feet high composed chiefly of nodular stony essential ejecta and small amount of accessory basaltic ejecta in matrix of black volcanic sand and lapilli. Ash overlain by tuff member. Thin-bedded lithic-vitric tuff member ejected from three craters near Steps Point. Tuff from Fagatele Crater separated by erosional unconformity from overlying Fagamaa tuff, but tuffs cannot be separated along coast near Steps Point. Thickness about 200 feet. Includes Leone tuff and Leone lava (Daly, 1924).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 171. Rests unconformably on Taputapu volcanics and Pago volcanic series. Recent(?).

Covers about 12 square miles, 3½ to 9 miles southwest of Pago Bay. Named for occurrences near Leone and Leone Point.

†Leopard Sandstone[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, p. 456.

In old Hancock quarry.

Leprocomio Limestone Member (of Frailes Formation)

Upper Cretaceous: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (chart), 9 (fig. 3), 10 (fig. 4), 19, pl. 2. Designates the more or less limey well-bedded cuesta-forming sediments in upper part of Frailes. Characteristically light-to medium-gray impure limestone and fine-grained calcareous tuff; some interbedded graywacke, and proportion of limestone to graywacke varies rapidly along strike. Thickness of limey bed variable and apparently reaches maximum development in Trujillo Alto area where it is approximately 1,120 feet thick. Typical weathered impure limestone is generally well-stratified somewhat punky tuffaceous (or argillaceous) rock without much or any carbonate. The Leprocomio is apparently the limestone referred to by Meyerhoff and Smith (1931) when they applied term Trujillo Alto limestone. Their description of a tuffaceous limestone cropping out north of Trujillo Alto agrees with characteristics of Leprocomio as herein defined. Their geologic map, however, shows this limestone in approximately the position of a higher limestone, the Trujillo Alto as used in this report.

Rocks crop out north of bend in Río Grande de Loiza at Trujillo Alto and are well exposed in several quarries east and west off Highway 181. Outcrops are near Leprocomio (Insular leper hospital) after which member is named.

Lequire Sandstone Member (of McAlester Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 37–38, pl. 1. Further described in Haskell County where it is made up largely of thin slabby beds of fine-grained sandstone, commonly showing ripple marks. At type locality, total computed thickness about 150 feet. In some areas, rests on Warner sandstone member but, in other areas, is separated from it by an unnamed member of variable thickness; separated from overlying Keota sandstone member by an unnamed shale member. Type locality mentioned by Wilson (1935) is inapplicable because it is in reality occupied by outcrops of the Warner; new type locality designated.

Type locality: Sec. 31, T. 8 N., R. 21 E., 1½ miles northwest of Lequire, Haskell County.

Leray Limestone Member (of Lowville Formation)[1]

Leray Formation (in Black River Group)

Leray Member (of Chaumont Formation)

Middle Ordovician: Central to eastern New York.

Original reference: R. Ruedemann, 1910, New York State Mus. Bull. 138, p. 72; 1910, New York State Mus. Bull. 145, p. 79–90, 97.

G. M. Kay, 1929, Jour. Geology, v 37, no. 7, p. 664. Chaumont formation (new) comprises (ascending) Leray, Glenburnie (new), and Watertown members.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 251. "Leray beds" of Ottawa district carry fauna in which *Doleroides ottawanus* Wilson is abundant; a similar fauna directly overlies Watertown limestone, at top

of Black River group, at Watertown, N. Y. Believed that "Leray beds" at Rockland, Ontario, are post-Watertown, rather than pre-Watertown Leray limestone of New York. Rockland formation in its type section is revised to include these "Leray beds."

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 599. Chaumont is separable into two members, Leray and Watertown limestones, only in limited area near Watertown.

Named for exposures in town of Leray [now Le Raysville], Jefferson County.

†Leroux Formation[1]

Leroux limestones

Upper Triassic: Northern Arizona.

Original reference: L. F. Ward, 1901, Am. Jour. Sci., 4th v. 12, p. 401–413.

Charles Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 63 (table). Limestones underline Vantana [Ventana] sandstone; overlie Nazlini shales. In Delores-ian series. Thickness 200 feet.

Named for Le Roux Wash, Navajo County.

Leroy Drift

Pleistocene (Wisconsin); North-central Illinois.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, p. 29. In Peoria area, Leroy drift is listed below Bloomington drift and above Shelbyville drift.

Derivation of name not given. Town of Leroy is in McLean County.

†Le Roy Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 110.

Named for development in vicinity of Leroy, Coffey County.

Lester Limestone (in Dornick Hills Group)

Lester Limestone Bed (in Frensley Member of Lake Murray Formation)

Lester Limestone Member (of Dornick Hills Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 14.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as formation in Dornick Hills group.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 140–142. Rank reduced to bed in Frensley member of Lake Murray formation.

Named from exposure on D. G. Lester Farm about 800 feet south of NE cor. sec. 13, T. 4 S., R. 1 E., Carter County.

Lester River Group[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., pl. 14, p. 143–146.

Named for exposures on Lester River.

†Lesueur Dolomite[1]

Upper Cambrian or Lower Ordovician: Southeastern Missouri.

Original reference: C. R. Keyes, 1895, Missouri Geol. Survey Sheet Rept. 4, v. 9, p. 18, 52–53.

Named for Lesueur Hill, St. Francois County.

Letchworth Shale[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 96–99, 193.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 393. Locally abandoned. Although Chadwick (1933) restricted the term Gardeau and called overlying beds Table Rock sandstone and Letchworth shale, measured sections in Batavia quadrangle showed no division of Gardeau possible.

Name derived from Letchworth Park (State reservation), southwest of Mount Morris, Livingston County.

Letham Formation

See **Leatham Formation.**

Levanna Shale (in Hamilton Formation)[1]

Levanna Shale Member (of Skaneateles Formation)

Middle Devonian: Western and central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 217.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 359–361, pl. 1. Described in Batavia quadrangle as shale member of Skaneateles formation. Underlies Stafford limestone member; overlies Centerfield limestone member of Ludlowville formation. Thickness ranges from 43 to 225 feet. Thinning is toward the west but is not uniform.

Type section: In Skaneateles Lake region. Probably named for Levanna, Cayuga County.

Leverett Breccia[1]

Triassic: Central Massachusetts.

Original reference: D. D. Reynolds and D. H. Leavitt, 1927, Am. Jour. Sci., 5th ser., v. 13, p. 167–171.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Included in Mount Toby conglomerate and not mapped by name.

Named for town of Leverett, Franklin County.

Levias Limestone Member (of Ste. Genevieve Limestone)[1]

Levias Member (of Ste. Genevieve Limestone)

Upper Mississippian: Western Kentucky, southern Illinois, and Indiana.

Original reference: A. H. Sutton and J. M. Weller, 1932, Jour. Geology, v. 40, no. 5, p. 430, 439.

J. M. Weller *in* Stuart Weller and F. F. Krey, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 7, 8. In Union County, Ill., underlies Hoffner member (new) of Ste. Genevieve.

C. A. Malott, 1946, Jour. Geology, v. 54, p. 323, 324 (fig. 1). Geographically extended into southwestern Indiana where it is about 22 feet thick in Owen County. Underlies Aux Vases sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 21–22, pl. 1. Termed Levias member by Indiana Geological Survey. Overlies Rosiclare member; unconformably underlies Aux Vases formation or Paoli limestone. Field separation of Levias from Paoli is dependent upon recognition of Aux Vases formation, if present, or of Bryantsville breccia (included in top of Levias). Thickness 25 to 60 feet.

Type locality: East of town of Levias, Crittenden County, Ky.

Levinson Limestone Member (of Boracho Limestone)

Cretaceous (Comanche Series): Southwestern Texas.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 379–382. Name proposed for lower member of Boracho limestone. Lower part of member dominantly shaly. Measured thickness at type locality 149 feet; base not exposed; approximate thickness 169 feet. Underlies San Martine limestone member (new); overlies Finlay limestone with disconformable contact.

Type locality: Area south of Kent, which is part of the Boracho outcrop south of U.S. Highway 80 that extends from vicinity of Levinson Lake westward to Boracho Point, Levinson quadrangle [Culberson County]. Name derived from Levinson Lake.

†Levyville Formation[1]

Eocene, upper: Northern Florida.

Original reference: L. C. Johnson, 1888, Am. Jour. Sci., 3d, v. 36, p. 230–236.

Well exposed at old iron works near Levyville, Levy County.

Lewis Shale[1]

Upper Cretaceous: Western Colorado, northwestern New Mexico, and southern and central Wyoming.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60.

E. T. Hancock, 1925, U.S. Geol. Survey Bull. 757, p. 6 (table), 20–21. Crops out in northern part of Axial and Monument Butte quadrangles, Colorado. Thickness about 1,600 feet. Overlies Williams Fork formation of Mesaverde group; underlies "Laramie" formation.

C. E. Dobbin, C. F. Bowen, and H. W. Hoots, 1929, U.S. Geol. Survey Bull. 804, p. 21–22. Lewis shale as defined in Hanna and Carbon basins, Carbon County, Wyo., includes all typical dark-gray marine shale lying above white sandstone at top of Mesaverde formation and below brown sandstones arbitrarily selected as base of Medicine Bow formation. Thickness about 3,000 feet. In some areas, overlapped by North Park formation.

Erling Dorf, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 275. Medicine Bow formation of southern Wyoming and so-called Laramie formation of northwestern Colorado occupy similar stratigraphic positions above a marine sandstone which carries distinctive Fox Hills fauna, including diagnostic *Sphenodiscus lenticularis*. This marine sandstone, hitherto included in Medicine Bow formation or underlying Lewis shale, is separated as a distinct formation and referred to Fox Hills formation.

R. H. Beckwith, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1452 (table 1). Thickness 3.000 feet in Elk Mountain district, Wyoming. Overlies Mesaverde formation; underlies Medicine Bow formation.

Erling Dorf, 1942, Carnegie Inst. Washington Pub. 508, p. 4, 5 (fig. 2), 7, 8 (fig. 3), 9 (fig. 4), 36 (fig. 8) [preprint 1938]. Discussion of stratigraphy and floras of Fox Hills and Medicine Bow formations. Figure 2 shows Lewis formation, 3,000 feet thick; underlies Fox Hills formation and overlies Mesaverde formation in Hanna basin, Wyoming. Figure 3 shows Lewis formation, 1,600 feet thick; overlies Williams Fork formation and underlies Fox Hills formation in northwestern Colorado. Recognition of the Fox Hills between the Lewis and Medicine Bow is based upon occurrence of *Sphenodiscus* zone, which is of restricted Fox Hills age. Correlation chart shows Lewis formation above Almond formation in southwestern Wyoming.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. In Rio Arriba County, N. Mex., dominantly gray well-bedded calcareous shale containing throughout some beds that are sandy to greater or less degree. Thickness about 2,000 feet. Underlies Pictured Cliffs sandstone; overlies La Ventana sandstone member of Mesaverde formation.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144. Overlies and interfingers with Cliff House sandstone and underlies and interfingers with Pictured Cliffs sandstone in Barker dome-Fruitland area, San Juan County, N. Mex.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2433 (fig. 5), 2436–2439. Lewis and Meeteetse formations throughout central and north-central Wyoming considered stratigraphic equivalents with name Lewis being applied generally in areas where marine strata are present and Meeteetse in areas where rocks are nonmarine in character. These designations are used in this report for interval between Mesaverde and Lance formations. The Lewis is a sequence of dark-gray marine shale and thinly bedded olive-gray sandstone. Thickness about 1,150 feet along southwestern edge of Powder River Basin. Westward from basin intertongues with Meeteetse formation and total thickness of marine strata decreases abruptly. A lower tongue of the Lewis, about 250 to 300 feet thick, overlies Teapot sandstone member of Mesaverde and underlies eastward projection of the Meeteetse. Tentative electric-log correlations from Sand Creek oil field into Elk basin field suggest that lower tongue of the Lewis may be equivalent, in part, to Bearpaw shale of Montana. In Powder River Basin, underlies Fox Hills sandstone.

Named for occurrence at Fort Lewis, in La Plata Valley, sec. 3, T. 34 N., R. 11 W., La Plata County, Colo.

†Lewisburg Group[1]

Upper Triassic: Central southern Pennsylvania.

Original reference: G. H. Ashley, 1931, Pennsylvania Topog. and Geol. Survey Bull. G_1, p. 77.

Occurs in Dauphin and York Counties.

†Lewisburg Limestone[1]

Mississippian: West Virginia and Virginia.

Original reference: W. M. Fontaine, 1876, Am. Jour. Sci., 3d, v. 11, p. 276–284, 374–384.

Probably named for Lewisburg, Greenbrier County, W. Va.

Lewisport Limestone[1]

Pennsylvanian: Western Kentucky.

Original reference: D. B. Chisholm, 1931, Kentucky Geol. Survey, ser. 6, v. 41, p. 221, 225.

Probably named for Lewisport, Hancock County.

Lewis Run Sandstone Member (of Amity Shale)

Upper Devonian: Northwestern Pennsylvania.

R. H. Flower and K. E. Caster, 1935, Bulls. Am. Paleontology, v. 22, no. 75, p. 6–7. Typically deep-reddish-purple coarse quartz-grained sandstone which carries scattering of flat pebbles of vein quartz and rarely of jasper; matrix material is vividly reddish purple; except for red color at type occurrence, member is similar to other conglomerate lenses in Venango stage; contains marine fauna. Horizon is 30 feet below Salamanca conglomerate horizon and at same distance above Wolf Creek conglomerate horizon which is apparently beneath surface at Lewis Run. Beneath the Lewis Run is a red shale member or zone, presumably of Amity age, which is unfossiliferous.

Exposed in ceramic quarries at Lewis Run, McKean County.

†Lewiston Shale[1]

Upper Ordovician (Richmond): Western New York, and Ontario, Canada.

Original reference: G. H. Chadwick, 1908, Science, new ser., v. 28, p. 346–348.

Named for exposures at Lewiston, Niagara County, N.Y.

Lewistonian Stage

Lower Silurian (Niagaran): North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Niagaran series divided into four stages (ascending): Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian). Lewiston stage includes Medina group. At type locality, complete sequence (about 100 feet) is displayed. Does not seem desirable to apply name Albion to this stage because poor exposures exist at and near Albion, N.Y.; also use of name might cause confusion for it has beeen used in series, group, and formational senses.

Type locality: In Niagara Gorge at Lewiston, Niagara County, N.Y.

Lewiston Peak Member (of Oquirrh Formation)

Pennsylvanian (Missourian): Northwestern Utah.

H. J. Bissell, 1959, Utah, Geol. Soc. Guidebook 14, p. 115–120, pls. 1, 2. Sequence of cherty limestones and silty-argillaceous limestones with minor sandstone beds. Characterized by black, dark-sooty-gray, and dark black-brown case-hardened siliceous limestone and impure calcareous chert disposed in 1 inch to 4 inch bands, discontinuous lenses, nodules, and blebs and stringers; these alternate with crystalline dark-gray and dark-blue-gray to fine-textured bioclastic limestones, which weather medium dull gray to medium light blue gray, and some limestones that are argillaceous to almost shaly. Thickness 1,409 feet. Overlies Cedar Fort member and underlies Pole Canyon member (both new).

Type locality: Secs. 28 and 29, T. 5 S., R. 3 W., along Utah-Tooele County line. Named for exposures on Lewiston Peak.

†Lewistown Chert Lentil[1] (in Lewistown Limestone)

Lower Devonian: Northeastern West Virginia.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Lewistown Limestone[1]

Silurian and Devonian: Central Pennsylvania and west-central Virginia.

Original reference: Franklin Platt, 1875, 2d Pennsylvania Geol. Survey, Rept. H., p. 1–9.

R. J. Holden, 1920, (abs.) Geol. Soc. America Bull., v. 31, p. 137. Subdivided in west-central Virginia to include two members: Longdale limestone above and Craigsville limestone below.

Occurs at Lewistown, Mifflin County, Pa.

Lewistown Limestone Shale[1]

Lower Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F., p. xvii–xxxii.

At McVeytown, Mount Union, Huntingdon County, and Lewiston, Mifflin County.

Lewisville Formation or **Member** (of Woodbine Formation)

Lewisville Formation (in Woodbine Group)

Lewisville Marine Member (of Woodbine Sand)[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 114–115, 297.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 475, 476, 477, 480–481 (correlation chart.) Rank raised to formation in Woodbine group. Includes Pine Bluff tuffaceous gravelly member at base. Unconformable above Euless formation; unconformably underlies Eagle Ford formation.

W. H. Monroe, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 23. Correlation chart of outcropping Upper Cretaceous formations in Texas shows Lewisville formation (undifferentiated) in upper part of Woodbine group above Dexter sand.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Member includes beds from top of tuffaceous sandstone and carbonaceous shale of Red Branch member (new) and uppermost glauconitic reef sandstone with abundant *Ostrea soleniscus* shells; underlies Templeton member (new). Thickness 75 to 95 feet.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 4, 5 (table), 7 (fig. 2), 11–15, pls. Lewisville has greatest geographic extent of any of members of Woodbine. As used in this report member includes so-called Pine Bluff member of Hazzard, Blanpied, and Spooner. In Tarrant and Denton Counties, overlies Euless member; in Grayson and Fannin Counties, overlies Red Branch member; in other areas, lower part of Woodbine is either absent or undifferentiated. In Denton, Grayson, Fannin, and Lamar Counties, underlies Templeton member. Fauna described. Notes on type area.

Type area: Timber Creek from point about 2 miles south of center of Lewisville, Denton County, upstream to point about 3 miles southwest of center of Lewisville and about 1 mile above crossing of road to Shiloh Church.

Lexington Glacial Substage

Pleistocene (Wisconsin): Northeastern Massachusetts.

S. S. Judson, Jr., 1949, Peabody Foundation for Archeology Papers, v. 4, no. 1, p. 23–34. Name proposed for substage which includes till, sand, and gravel deposits. Younger than Boston glacial substage.

Well exposed in vicinity of town of Lexington. No specific exposures are designated as type localities.

†Lexington Group[1] or formation

Pennsylvanian: Western Missouri and southern Iowa.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Ores, pt. 2, p. 169, 187.

C. R. Keyes, 1937, Pan-Am. Geologist, v. 67, no. 3, p. 237–240. Lexington formation geographically extended into Iowa. In Appanoose County, merges with so-called Appanoose beds, so that Lexington becomes valid title of Iowa section.

Probably named for exposures at Lexington, Lafayette County, Mo.

Lexington Limestone[1]

Middle Ordovician: Central western Virginia.

Original reference: J. L. Campbell, 1879, Am. Jour. Sci., 3d, v. 18, p. 29.

Great Valley of Virginia.

Lexington Limestone,[1] Formation, or Group

Middle Ordovician: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 2.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 989–996. Lexington limestone restricted to pre-Perryville rocks of Jessamine dome. Thus, Lexington comprises (ascending) Curdsville, Hermitage, Jessamine, Benson, Brannon, and Woodburn. Sequence completely developed only in central Bluegrass counties. To the north and south, there is progressive elimination of upper beds. As a result, post-Lexington beds rest on mid-Benson where they dip under cover in southern Bluegrass and on Jessamine formation in northern Kentucky. Divisions are in part faunal units and in part lithologic.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41–42. Rank raised to group. Comprises (ascending) Curdsville limestone, Hermitage formation, Jessamine limestone, and Benson limestone. Overlies Highbridge group; underlies Brannon limestone.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1632–1640. Lexington limestone, as defined by Campbell, included beds between the High Bridge and Flanagan chert. There is confusion in Campbell's definition of High Bridge-Lexington boundary, though, as it is used now, it is sharpest stratigraphic boundary in section. Divisions of Lexington are in part faunal zones and in part lithologic units. In present report, the Lexington is discussed under three divisions: lower, middle, and upper. Lower Lexington comprises

Curdsville limestone, Logana formation, Jessamine limestone, and Benson limestone; the Perryville is shown to be facies of upper Benson. Middle Lexington consists of Brannon limestone with Woodburn phosphatic member. The so-called Perryville of Franklin and Woodford Counties, renamed Devils Hollow division of upper Lexington, is regarded as facies of upper Woodburn and probably also the lowermost Cynthiana. On the north in Bourbon, Harrison, Franklin, and Fayette Counties, the Brannon fades in a short distance as a useful lithologic unit; the Woodburn also thins. Recognition of these beds becomes more difficult as the Brannon wedges out (lithologic change), but the horizon is well marked wherever *Stromatocerium* and its associates of upper Benson are present. The problem to be solved is the relationship between the thinning upper Lexington and a corresponding thickening "Cynthiana".

Named for development at and around Lexington, Fayette County.

Leyden Argillite[1]

Silurian(?): Central Massachusetts and southeastern Vermont.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 196–208.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–90. Lower part is sequence of black fine-grained argillite layers and glossy phyllitic slate layers, interbedded with many gray-fine-grained quartzite layers. Argillite of upper part lacks abundant quartzite interbeds. East of the valley of Falls River, upper argillite is more highly metamorphosed, containing crystalloblasts of biotite, garnet, and staurolite. Weathered leucoxene grains are characteristic of this upper argillite in northeastern corner of quadrangle. Upper part also contains a few lenses of impure limestone and interbeds of light-gray to white aphanitic to finely granular metatuff. Underlies Bernardston formation or Sugarloaf formation; conformably overlies Conway formation.

Named for occurrence in Leyden Township, Franklin County, Mass.

Libby Formation (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 9, 17–19, pl. 1. Predominantly light-gray, dark-gray, and greenish-gray argillite; some sandstone and impure limestone present. Thickness at least 6,000 feet; 2,250 feet in generalized section on south side of Kootenai River southeast of Flagstaff Mountain. Overlies Striped Peak formation.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Included in Missoula group.

Typical section southeast of Flagstaff Mountain on south side of Kootenai River, Libby qnadrangle. Named for town of Libby, Lincoln County, where unit crops out in ridges that overlook town.

Liberty facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 136–137, 154–166. Constitutes middle zone of Broadhead formation. Consists mainly of siltstone and shale. Thickness commonly 135 to 150 feet; 175 feet where it merges with Athertonville and Pilot Knob facies (both new) in western and northwestern Marion County. Comprises Caney Creek,

McKinney Knob siltstone, and Clementsville limestone members (all new) of Brodhead formation. Underlies Floyds Knob formation; overlies New Providence formation, Junction City facies (new).

Type section: (Same as Brodhead formation) starting at sandstone quarry just east of bridge over Dicks River, at Louisville and Nashville Railroad Station, Brodhead, and along road up hill east-southeast, Rockcastle County. No single exposure gives complete display of the varied characteristics of the facies. Named for town of Liberty, central Casey County.

Liberty Formation or **Limestone** (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana, north-central Kentucky, and southwestern Ohio.

Original reference: J. M. Nickles, 1903, Am. Geologist, v. 32, p. 207.

James Conkin, 1950, Kentucky Nat. History Annals, v. 1, art. 6, p. 45, 48 (fig. 6). In Oldham County, Ky., Liberty formation restricted to 51 feet of alternating shales and thin fossiliferous limestones; the upper part (mollusk horizon), the mudstone of other writers, is believed to be Whitewater. Contact with underlying Waynesville formation is marked by "Bardstown reef" characterized by *Beatricea undulata*, and *Columnaria vacua*.

W. S. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define the Richmond stage of Cincinnatian series.

Named for Liberty, Union County, Ind.

†Liberty Hall Limestone[1]

Liberty Hall facies (of Edinburg Formation)

Middle Ordovician: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 55, 78, 79 (fig. 4), 80 (fig. 5), 81, 82. Liberty Hall facies proposed for black limestone and black shale of the Edinburg. So used, Liberty Hall refers to same succession of black strata originally included in "Liberty Hall limestone" by Campbell (1905). Designation as a facies name signifies that beds exhibiting this lithology do not everywhere fall within same precise stratigraphic limits. Interfingers with Lantz Mills facies, proposed for contrastingly cobbly to nodular buff-weathering limestone. Thickness at type section of Edinburg about 275 feet; south of Harrisonburg about 1,200 feet.

Well exposed on east side of Massanutten syncline and in vicinity of Lexington and Natural Bridge. Named for old historic ruin constructed on and of this rock.

Liberty Memorial Shale Member (of Chanute Shale)

Pennsylvanian (Missouri Series): Northwestern Missouri.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Gray to blue shale, argillaceous to sandy, weathers brownish to buff; heavy channel sand in southwest Jackson County. Thickness 7 to 25 feet in Jackson County; 14 to 61 feet in Cass County. Overlies Raytown limestone member; underlies Frisbie limestone member of Iola limestone.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032–2033; 1949, Kansas Geol. Survey Bull. 83, p. 103. Settlement of "Iola problem" has led to number of changes in Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Liberty Memorial shale, overlying Raytown limestone, no longer considered as uppermost member of Chanute shale. Name suppressed as junior synonym of Lane shale.

Occurs in Cass and Jackson Counties.

Libertytown Metarhyolite

Precambrian: Western Maryland.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. of Geology, Mines and Water Resources [Rept. 12], Carroll and Frederick Counties, p. 58, 65–66. Dense cryptocrystalline rock, purple, bluish-black, or red, with macrophenocrysts of pink or white feldspar and glassy quartz in dense groundmass; interbedded with blue and purple metaandesite containing amygdules commonly filled with white, pink, or green calcite having an outer film of sericite or chlorite. Overlies Wakefield marble and interfingers with Sams Creek metabasalt (new) and Ijamsville phyllite. This unit was mapped as metarhyolite and meta-andesite in Glenarm series on geologic map of Frederick County [Maryland Geol. Survey, 1938]. Precambrian(?).

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43 (table 7), 65. Volcanic series in eastern part of Piedmont province includes Sams Creek metabasalt, Libertytown metarhyolite, Ijamsville phyllite, and Urbana phyllite. Quartzites occur in all members; some quartzites pass directly from the Ijamsville into the Urbana and into the Libertytown, and from the Urbana into the Sams Creek, indicating relative contemporaneity of these formations, all of which are apparently equivalent to Harpers formation. Late Precambrian.

Named from Libertytown, Frederick County. Occurs in belt that lies south and southwest of Union Bridge and north of U.S. Highway 40; eastern part of belt extends into Carroll County to vicinity of McKinstry's Mill.

Lick Creek Sandstone Member (of Caseyville Formation)

Lick Creek Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: J. E. Lamar, 1925, Illinois Geol. Survey Bull. 48, p. 23, 85–91, map.

Stuart Weller and F. F. Krey, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 11. Referred to as member of Caseyville formation. Thick massive ridge and cliff-forming sandstone overlying basal Wayside member.

H. R. Wanless, 1944, Geol. Soc. America Mem. 13, p. 136. Now considered to be Battery Rock sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 55 (table 3). Replaced by Battery Rock sandstone member of Caseyville formation (redefined).

Named for village of Lick Creek, Union County.

Lick Creek Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 179, p. 9.

Named for exposures along Lick Creek in vicinity of Kimberly, Jefferson County.

Licking Shale[1]

Mississippian: Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d v. 16, p. 216.

Named for Licking River, from Newark to Black Hand, Licking County.

Licking Creek Limestone (in Helderberg Group)

Lower Devonian: South-central Pennsylvania, western Maryland, western Virginia, and northeastern West Virginia.

F. M. Swartz, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1923. Name applied to a late Helderbergian limestone in south-central Pennsylvania which had been considered Becraft in age. Not continuous with type Becraft and largely younger than that formation.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 69–71, 85–86. At base is medium-bedded black chert in irregular layers interbedded with limestone. Above is thick-bedded light-gray crystalline limestone with a few nodules and layers of chert; this is overlain by light-gray limestone with numerous layers of black chert. At top of unit is thick-bedded light-gray chert-free crystalline limestone. Thickness 87 feet in type section where unit underlies Ridgeley formation and overlies beds tentatively considered Mandata shale (new). Extends southward in narrow belt through Maryland, West Virginia, and Virginia. In Virginia it had been called Becraft by Swartz (1930, U.S. Geol. Survey Prof. Paper 158–C).

H. P. Woodward, 1943, West Virginia Geological Survey, v. 15, p. 110, 125, 126 (footnote). Abandoned. Throughout most of outcrop belt from Franklin County, Pa., southward across Maryland and into West Virginia, name is replaced by geographically extended Port Jervis limestone and chert since Licking Creek apparently includes exact equivalent of the Port Jervis. Cites dissenting opinion of F. M. Swartz (written commun.) who favors use of separate name, Licking Creek, in Warren Point Monterey-Clifton Forge area because of 200-mile gap between nearest known occurrence of Port Jervis in New Jersey and Licking Creek near Warren Point at Pennsylvania-Maryland line.

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull. Eng. Expt. Sta. Ser. 118, p. 20 (table 2), 48–51, pls. Names New Scotland and Becraft as used by Butts (1940) do not seem justified, and, in this report [Clifton Forge iron district], term Licking Creek sandstone used to include all limestone beds above Healing Springs sandstone and below Ridgeley sandstone. Composed of two distinct lithologies separated to form upper member of light- to medium-gray arenaceous coarse-grained limestone and lower member of medium- to dark-gray cherty fine-grained limestone. Thickness as much as 117 feet. Unconformably overlies Keyser formation where Healing Springs sandstone and Coeymans limestone are absent.

Type locality: Bluff on south side of Licking Creek several hundred feet west of bridge crossing creek about 1 mile east of Warren Point, Franklin County, Pa.

Licklog Formation (in Walden Creek Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962. Chiefly siltstone and shale, dark gray, laminated to

crudely layered, and micaceous. These rocks are interbedded in places with sandstone and quartz-pebble conglomerate resembling those of overlying Shields formation (new). Exposed only in northwest part of outcrop belt of Walden Creek group, where it lies on Great Smoky fault so that its basal relations are unknown; a variable thickness, nowhere more than a few hundred feet, is preserved above fault.

Named for Licklog Hollow where it is typically exposed, near edge of foothills southwest of East Fork of Little Pigeon River [Sevier County].

Lick Run Conglomerate

Lower Mississippian (Oil Lake): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 16. Name will probably be used, following more definitive study of area, for unit here termed Conglomerate I and described as massive conglomerate composed chiefly of rounded or oval white quartz pebbles imbedded in a matrix of coarse gray sandstone. Where sandstone predominates, pebbles usually occur as lenses in coarse sandstone. Thickness averages about 20 feet. Disconformably underlies Sandstone J (Chestnut Ridge sandstone); disconformably overlies Sandstone H.

Type locality: Along Rock Spring Run north of Victoria, Fayette County. Also well exposed on south bank of Youghiogheny River opposit Victoria above Western Maryland Railroad tracks.

Liebre Quartz Monzonite

Jurassic(?): Southern California.

J. C. Crowell, 1952, California Div. Mines Spec. Rept. 24, p. 10–11, pls. 1, 2. Typical quartz monzonite, gray and medium-grained; characterized by closely spaced joints and shears.

Crops out at western tip of Liebre Mountain in southeastern corner of Lebec quadrangle [Los Angeles County], in anticline beneath Hungry Valley and Peace Valley beds at southern border of area, and in slivers within San Andreas fault zone.

Lighthouse Conglomerate (in Lower Marshall Sandstone)

Mississippian (Kinderhook): Southern Michigan.

H. M. Martin, 1936, The centennial geologic map of the southern peninsula of Michigan (1:500,000): Michigan Dept. Conserv., Geol. Div. Pub. 39, (Geol. Ser. 33). Shown on map legend.

Light House Granite[1] or Granitic Gneiss

Lighthouse quartz monzonite facies (of Branford Quartz Monzonite)

Pre-Triassic: South-central Connecticut.

Original reference: F. Ward, 1909, Am. Jour. Sci., 4th ser., v. 28, p. 131, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Redescribed as Lighthouse granitic gneiss. Medium-grained generally well-foliated pink or red gneiss. Part of the East Haven granitic body ,a structural unit. Pre-Triassic.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 89, p. 7, 13. Quartz monzonite facies of Branford quartz monzonite.

Named for Light House Point near East Haven, New Haven County.

Lightning Formation

Recent: Eastern Wyoming.

L. B. Leopold and J. P. Miller, 1954, U.S. Geol. Survey Water-Supply Paper 1261, p. 11. Alluvial fill consisting of light-brown to tan silty fine or medium sand containing occasional lenses of fine gravel or coarse sand but generally devoid of bedding.

Type locality: The reach of Lance Creek in immediate vicinity of town of Lance Creek.

Lightning Creek Diorite[1]

Miocene(?): Washington, and British Columbia, Canada.

Original reference: R. A. Daly, 1913, Canada Dept. Int., Rept. Chief Asst. 1910, v. 2, p. 490.

†Ligonier Sandstone[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1876, Pennsylvania 2d Geol. Survey Rept. L.

Caps highest hill in Ligonier Valley, and town of Connellsville, Fayette County, Pa., is built on it.

Lilac Argillite[1]

Lower Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Occurs at various localities along western base of Mount Jura and elsewhere. [Derivation of name not given. Does not say whether geographic or nongeographic.]

Lilley Formation[1]

Middle Silurian: Southwestern Ohio.

Original reference: A. F. Foerste, 1917, Ohio Jour, Sci., v. 17, p. 189, 190.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Middle Silurian. Occurs below Euphemia dolomite and above Bisher formation.

Exposed at various localities on Lilley Hill, Hillsboro area, Highland County.

Lillibridge Sandstone Member[1] (of Chadakoin Formation or Stage)

Upper Devonian: Southwestern New York.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opp. p. 62, p. 59, 63.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown as lowermost unit in Chadakoin formation. Underlies Dexterville shale [member]; overlies Volusia (Girard) shale.

I. H. Tesmer, 1955, New York State Sci. Service Circ. 42, p. 14, 16. Abandoned since not a distinct lithologic unit. Beds assigned to Hinsdale member of Chadakoin formation.

Named for outcrops along Lillibridge Creek, which flows south to Allegany River 1 mile northeast of Portville, and in quarries adjacent to creek.

Lillis Formation[1]

Oligocene(?): Southern California.

Original reference: J. H. Ruckman, as reported by J. C. Merriam, 1915, Am. Philos. Soc. Trans., new ser., v. 22, pt. 3, p. 194.

North Coalinga region, Fresno County.

Lillydale Shale (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 437.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 255, 265. Lillydale shale of Reger (1926) is represented in Greenbrier County by a dark- to greenish-gray concretionary micaceous shale that is commonly somewhat carbonaceous. Sometimes carries lenticular sandstone (Edray) that may occur at top, base, or within the shale. Thickness 75 to 130 feet. Below Glenray limestone. Base of Bluefield group. Mauch Chunk series.

Type locality: About 4 miles southwest of Union in vicinity of Lillydale, Monroe County, W. Va.

Lima Granite

Age unknown: Southeastern Pennsylvania.

W. H. Tomlinson, 1954, Pennsylvania Acad. Sci. Proc., v. 28, p. 189–192. Gneissic, partly mylonitized rock. Slight banding between mafic and felsic minerals observed. Contains inclusions of several basic rock types; enstatite xenoliths common.

Exposed in Lima quarry on north side of Baltimore Pike (Route 1) about 2.3 miles southwest of intersection with Olive Street, Media, Delaware County.

Lime Creek Glacial Stage

Pleistocene (Illinoian?): West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 327–328, fig. 2, table 4. Time of pre-Wisconsin glaciation in Frying Pan Valley. Marked by moraine and outwash deposits.

Some evidence suggests that terminal position was near junction of Lime Creek and Frying Pan River, hence, the name. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Lime Creek Shale[1]

Lime Creek Formation

Upper Devonian: Central northern Iowa.

Original reference: H. S. Williams, 1883, Am. Jour. Sci., 3d, v. 25, p. 97–104.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 187. Formation includes (ascending) Juniper Hill, Cerro Gordo, and Owen members. Unconformably overlies Shellrock formation. Stratigraphically below Sheffield formation considered by some authors to be Mississippian.

M. A. Stainbrook, 1946, Jour. Paleontology, v. 20, no. 5, p. 402–403. Amana beds are apparently basal member of Lime Creek although they do not crop out in area where Lime Creek is best known.

Named for exposures on Lime Creek, in Cerro Gordo and Floyd Counties.

Lime Hill Formation (in Wilcox Group)

Lime Hill Member (of Logansport Formation)

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13, 14. Named in stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, p. 48 (fig. 2), 57–58; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 117–122, pl. 10. Consists of calcareous silt and shale of a cyclic pattern; heterogeneous; sudden lithologic changes, both vertically and horizontally, into more sandy phases not uncommon; clay-ball conglomerates common in northern part of outcrop where member is much less calcareous; and around Shreveport, consists of 50 to 75 feet of silty shale, silts, and sands with numerous concretionary boulders; thin seam of lignite near top. Attains its maximum thickness of 225 feet on southern flank of Sabine uplift. Overlies Cow Bayou member; underlies Loggy Bayou member of Summit Hill formation; all contacts gradational. Paleocene. Type locality designated. Mapped in Texas.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 58 (fig. 8), 59–62. Rank raised to formation in report on Sabine Parish. At reference locality, herein designated, overlies Converse formation (new) and underlies "Hall Summit" formation. Thickness about 55 feet.

Type locality: Along Louisiana Highway 180 in SW¼ sec. 23, T. 10 N., R. 11 W., and about 2½ miles northeast of Pleasant Hill, Sabine Parish, La. Reference sections: SW¼ sec. 31, T. 10 N., R. 11 W., and SE¼ sec. 36, T. 10 N., R. 12 W., Sabine Parish. Named for exposures on and near Lime Hill. Outcrop area extends into Shelby County, Tex.

Lime Island Dolomite (in Burnt Bluff Group)

Middle Silurian (Niagaran): Northern Michigan.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 3, 9, pl. 1 (fig. 4). Proposed for cream-colored to buff coarsely crystalline dolomite that rests on either Moss Lake formation (new) or Cabot Head shale and is overlain by Byron dolomite. Thickness 6 feet. Name Mayville not used in this classification; highest *Virgiana decussata*-bearing strata of Mayville are placed in the Lime Island.

Type section: Along western shore of Lime Island in St. Marys River. Best exposed on shore adjacent to old lime kiln in NE¼SE¼ sec. 26, T. 43 N., R 3 E., about 1,300 feet north-northeast of powerhouse of North Western-Hanna Fuel Co.

Lime Mountain Dolomite

Silurian: West-central Utah.

P. J. Barosh, 1960, Utah Geol. and Mineralog. Survey Bull. 68, p. 14, 23–24, 49. Consists of two members: lower one of light-gray dolomite 750 feet thick and an upper, about 250 feet, of light-gray dolomite with interbedded shales. No complete measurable section of the Lime Mountain present because base and top of formation occur in different fault blocks; correlation between blocks is not possible, and it is not known whether there is overlapping or missing section; if no faulting is assumed, minimum thickness of 1,000 feet can be assigned. Conformably overlies

Beaver Lake dolomite (new); upper contact poorly exposed, but attitudes across contact suggest conformable relationship with Devonian rocks referred to as Simonson dolomite-Guilmette formation(?).

Forms top of Lime Mountain and ridge to east, at top of ridge containing Galena mine, and a slope east of Galena mine, Beaver Lake Mountains, Beaver County.

Limeport Limestone

Upper Cambrian (Dresbachian): Southeastern Pennsylvania and west-central New Jersey.

B. F. Howell, Henry Roberts, and Bradford Willard, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 1, p. 1360–1361, 1362, 1363, 1364–1366. Name proposed for dolomitic limestones formerly included at base of Allentown limestone. Characterized by thick sandy dolomitic limestone interbedded with shaly limestone and lenses of crossbedded sandstones. Algal biostromes a conspicuous feature throughout; more closely spaced toward top. Differs from Allentown, which it disconformably underlies, by being more sandy and shaly, less uniformly bedded, and having greater abundance of intraformational conglomerates, disconformities, mudcracks, and ripple marks. Thickness 400 to 500 feet in type area. In most of Buckingham Valley where Allentown is absent, the Limeport underlies Beekmantown(?). Conformably overlies Leithsville limestone.

Type locality: Section in southernmost of two abandoned quarries at Limeport at eastern tip of Buckingham Valley, Bucks County, Pa. Locality is 0.3 mile due west of Pennsylvania State Highway 32, 2.1 miles northwest of bridge across Delaware River at New Hope, Pa.

Limerick Keratophyre[1]

Middle(?) Triassic: Northwestern Nevada.

Original reference: C. P. Jenney, 1935, Nevada Univ. Bull., v. 29, no. 6, p. 18–23, map.

H. E. Wheeler, 1939, Jour. Paleontology, v. 13, no. 1, p. 106 (table 1). Limerick keratophyre, more than 5,000 feet thick, underlies Rochester trachyte in which species of *Helicoprion* has been found. Units referred to Anthracolithic time, which includes all late Paleozoic from base of Diantian stage (Mississippian) upward.

Well exposed on Lone Mountain, on north side of Limerick Canyon in upper Sacramento Canyon, and in Spring Valley, Humboldt Range.

Lime Ridge Formation (in Hermosa Group)

Pennsylvanian: Subsurface in southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

J. R. Clair, 1958, Rocky Mountain Assoc. Geologists, Symposium, p. 31, 34, 46, figs. 6. 7. Varies from clean, in part oolitic, dense fossiliferous limestone to interbedded shale and limestone. Beds cherty in part. Cherts generally red, tan, or brown and vitreous. Interbedded shales are red to gray green and contain thin lentils of nodular limestone and nodules of chert. Overlies Molas formation with gradational contact and unconformably underlies Pinkerton Trail formation throughout area of occurrence.

Type section: In the Al Hill et al. No. 1 State [well], sec. 32, T. 40 S., R. 20 E., San Juan County, Utah, on Lime Ridge anticline. Confined in narrow band on shelf rim of the salt basin.

Limestone Creek Beds[1]

Oligocene: Southeastern Mississippi.

Original reference: M. A. Hanna and D. Gravell, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip, p. 17, 41, table opposite p. 30.

Limestone Creek, Wayne County.

Limestone Creek Group[1]

Miocene: Southeastern Mississippi.

Original reference: M. A. Hanna and D. Gravell, 1934, Shreveport Geol. Soc. 11th Ann. Field Trip, table facing p. 30.

B. W. Blanpied and R. T. Hazzard, 1938, (abs.) Am. Assoc. Petroleum Geologists 23d Ann. Mtg., Program. p. 11. Includes Chickasawhay formation above and Bucatunna formation. Miocene. Occurrences noted.

Crops out in Wayne County.

Limestone Gap Member (of Golf Course Formation)

Limestone Gap Shale

Pennsylvanian (Morrow Series): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 858, 901–902. Proposed for the gray-greenish, dark-gray, and black bituminous shale, containing profusion of siderite layers and concretions, that overlies Primrose formation and underlies Wapanucka formation (restricted). Has been considered part of Wapanucka. South of Arbuckles, occurs in interval between the Primrose and the Jolliff. Thickness at type locality 44 feet; 1,250 feet in Ardmore basin, 5 miles west of Springer. Morrow series here included above Pushmataha series (new) in upper part of Bendian period.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1, Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 101–102. Harlton's name Limestone Gap shale, if understood as it appears in column for "south of Arbuckles" in his correlation chart, approximately corresponds to Gene Autry shale (new), because he applies it to interval between the Primrose and the Jolliff in Ardmore basin. When introducing name Limestone Gap formally in text, Harlton defines it as a shale in "frontal belt of the Ouachitas," resting upon the siliceous limestones and shales and to which Ardmore basin term Primrose is applied. By further definition, it is overlain by the Wapanucka in a restricted sense. Hence, the Limestone Gap is, by defintion, a shale unit between the main massive body of the Wapanucka, and the siliceous limestone and shale unit correlated with the Primrose, as these units are exposed at and around Limestone Gap, a town in the frontal belt of the Ouachitas.

B. H. Harlton, 1956, *in* Petroleum geology of southern Oklahoma v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 139. Rank reduced to member in Golf Course formation (new). Overlies Rowland member (new); underlies Otterville member. Pennsylvanian, Morrow series.

Type locality: Limestone Gap, sec. 31, T. 2 N., R. 13 E., Atoka County.

Limones Shale

Miocene(?): Panamá and Costa Rica.

H. N. Coryell and R. W. Mossman, 1942, Jour. Paleontology, v. 16, no. 2, p. 233. Underlies Charco Azul formation. Upper Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 338. An undefined name. Miocene(?).

Present in Burica Peninsula, Chriqúi Province.

Lincoln Formation[1]

Oligocene, middle: Western Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 110–111. Suggests abandoning name Porter shale and retaining name Lincoln formation for entire middle Oligocene of Washington.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 592. In southwest Washington, overlies Keasey formation and unconformably underlies Astoria formation. Thickness 6,000 feet.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 35–53. Formation, in Centralia-Chehalis area, consists of about 2,000 feet of tuffaceous and basaltic marine sandstone and siltstone with associated continental deposits composed predominantly of sediments derived from volcanic rocks and pyroclastic material. Overlies Skookumchuck formation; underlies Astoria(?) formation. Oligocene.

Best exposed on Lincoln Creek near boundary between Lewis and Thurston Counties.

Lincoln Granite

Age not stated: Eastern Maine.

L. S. Wing, 1958, Maine Geol. Survey GP. and G. Survey 3, sheet 1. Incidental mention. Most of discussion deals with Lincoln granite area.

Report deals with parts of Penobscot, Hancock, and Washington Counties.

Lincoln Limestone Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Western Kansas and southeastern Colorado.

Original reference: W. N. Logan, 1897, Kansas Univ. Geol. Survey, v. 2, p. 216.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 25. Chalky shale and chalky limestone, interbedded, light gray; beds of dark-gray petroliferous hard crystalline limestone at base and top; shale contains thin beds of bentonitic clay; member weathers to yellow gray or yellow tan. Thickness 20 feet (Ellis County) to 35 feet. Underlies Hartland shale member; overlies Graneros shale.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 115. In Baca County, Colo., consists mainly of limy shale with thin platy limestone at top and base; shale dark gray to black and generally fissile. Thickness about 25 feet; thins westward to 19 feet in Model anticline in Las Animas County. Underlies Hartland shale member; overlies Graneros shale.

Named for Lincoln, Lincoln County, Kans.

Lincoln Porphyry[1] (in Gray Porphyry Group)

Early Tertiary: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1886, U.S. Geol. Survey Mon. 12, p. 78.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 48–50, 57. Typical Lincoln porphyry is light-gray rock with deep pink or very pale

lavender cast, brownish where weathering has been intense, and locally bleached to white or very light gray; characterized by larger phenocrysts of orthoclase. In igneous sequence, intrusion of quartz diorite porphyry was followed by intrusions of Evans Gulch and Sacramento porphyries and typical Lincoln porphyry; relative ages of these porphyries not determinable. Older than Iowa Gulch porphyry. Igneous rocks that are younger than Precambrian in area of this report [west slope of Mosquito Range] are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene in age.

Ogden Tweto, 1953, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–12. Mapped as early Tertiary in Pando area.

Named for fact it forms summit of Mount Lincoln, north of Alma, Park County.

Lincoln Sandstone

Middle Cambrian: Kentucky (subsurface).

W. R. Jillson, 1948, New horizons in Kentucky: Frankfort, Ky., Roberts Printing Co., p. 27–29. Massive silica sand 610 feet thick. In type well, occurs between depths of 5,110 and 5,720 feet. Overlies, probably unconformably, 41 feet of dolomite and limestone.

Type well: California Oil Co. A. R. Spears No. 1, Lincoln County.

Lincoln Slate[1]

Precambrian: Eastern Massachusetts.

Original reference: W. A. Hobbs, 1899, Am. Geologist, v. 23, p. 109–115.

Named for occurrence near South Lincoln, Middlesex County.

Lincoln Creek Formation[1]

Oligocene: Southwestern Washington.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Philos. Soc. Proc., v. 52, p. 605.

Well exposed on Lincoln Creek near boundary between Lewis and Thurston Counties.

Lincoln Peak Formation

Middle and Upper Cambrian: East-central Nevada.

Harald Drewes and A. R. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 106 (fig. 2), 108 (fig. 3), 113-114, 118; Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 224 (fig. 2), 226, pl. 1. Defined to include more than 1,000 feet of shale and thin commonly fossiliferous limestone beds of late Middle Cambrian and early Late Cambrian age that lie below Johns Wash limestone (new) and overlie Pole Canyon limestone (new). In most of mapped area, separated from underlying Pole Canyon by thrust fault and in many places similarly separated from overlying formations, but in vicinity of type section, upper contact is undisturbed.

Type section: On south slope of south fork of Lincoln Canyon directly below head of Johns Wash, Mount Washington-Lincoln Peak area, Snake Range.

Lincolnshire Limestone

Lincolnshire Limestone (in Cliffield Group)

Lincolnshire Limestone Member (of Cliffield Formation)

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 827, 868, 884 (fig. 3). In Tazewell County, the strata embraced by Chazyan and Black River groups of Butts (1940) are subdivided into (ascending) 29 zones. Lincolnshire limestone member of Cliffield formation (which includes zones 1–9) is proposed for zone 5, which consists of brownish-gray to black medium-grained irregularly bedded limestone averaging 60 feet thick; thickness at type locality 102 feet. Overlies Five Oaks limestone member (new) and underlies Ward Cove limestone member (new).

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 58–59. In valley between Brushy and Walker Mountains, the Lincolnshire is considered a formation in Cliffield group. The Lincolnshire is the Lenoir of Butts in belts southwest of Clinch Mountain but not the same as the Lenoir identified by Butts in some areas north of Clinch Mountain.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 17, 46, 136, 138 (fig. 12). In Russell County, overlies Elway formation (new) and underlies Rockdell formation (new). Used in this area where Ward Cove and Peery limestones cannot be differentiated.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 75–77, 80 (fig. 5). As used in this report [stratigraphy of Shenandoah Valley], the Lincolnshire is a time-stratigraphic name for beds above the New Market or Whistle Creek limestone (new) and below either brownish-weathering "trilobite beds" identified by Butts as Whitesburg, or below base of the lower *Echinosphaerites* zone as developed where the "Whitesburg" is not separately recognized. Includes Murat calcarenite facies. Underlies Botetourt member of Edinburg formation (both new). Name Strasburg was introduced without definition by Ulrich (1939) for part of succession herein identified as Lincolnshire. Since the name had received no precise definition or description at time Lincolnshire was introduced, Strasburg is considered invalid. Geographically extended into northeastern Tennesssee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 61–62, 66–67. In Virginia, overlies Marcem formation (new). In Tennessee, includes Eidson cherty limestone member and Hogskin member (both new).

Type section: In abandoned quarry along County Road 645 about 1 mile north of intersection of U.S. Route 19 and State Highway 61. Named derived from a branch tributary to Clinch River, which parallels County Road 645 about 1 mile west of Five Oaks, Tazewell County, Va.

Lincolnshirian Stage

Middle Ordovician (Chazyan): Virginia and West Virginia.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1401–1402. Middle Ordovician is divided into Chazyan, Bolarian, and Trentonian series. Term Lincolnshirian is used as stage-formation unit in upper Chazyan. In sequence, follows "Blackford-Five Oaks" and is succeeded by Hatterian stage of Bolarian series.

Lincolnville Chert (in Boone Limestone)[1]

Mississippian: Northeastern Oklahoma.

Original reference: S. Weidman, 1932, Oklahoma Geol. Survey Bull. 56, p. 17.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey.

Exposed along Spring River, 10 miles below Baxter Springs, Ottawa County.

Linden Group[1]

Lower Devonian: Western and central Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1876, Elements of geology of Tennessee, p. 108, 142, 146–148.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as including (ascending) Rockhouse shale, Olive Hill formation, Flat Gap limestone, Birdsong shale, and Decaturville chert; occurs below Quall limestone. Rockhouse shale is shown as Silurian; hence, age of group is Silurian and Lower Devonian.

Named for occurrence at Linden, Perry County.

Linderman Sandstone

Lower Mississippian (Oil Lake): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 12–14. Name will probably be used, following more definitive study of area, for unit here termed Sandstone E and defined as basal member of Mississippian system in Fayette County inliers. Consists of sandstone principally cemented with calcite; usual appearance is as friable limonitic sandstone. Thickness 2½ to 5 feet. Conformably underlies Sandstone J (Chestnut Ridge sandstone); unconformably overlies Sandstone D (Jumonville sandstone).

Type locality: On Linderman Farm in the Youghiogheny Gorge through Laurel Hill near Victoria, Fayette County.

Lindley Conglomerate

Eocene, lower: Southwestern Montana.

W. T. Thom, Jr., 1957, Billings Geol. Soc. Guidebook 8th Ann. Field Conf., p. 11 (table 1). Name appears on generalized stratigraphic section. Equivalent to Wasatch formation(?). Fanglomerate material 0 to 500 feet thick. Occurs below Absaroka volcanics and above Fort Union.

Area of section is Crazy Mountain Basin and vicinity.

Lindsey Bridge Member (of Moorefield Formation)

Mississippian (Chesterian): Northeastern Oklahoma.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 55–57, pls. 1–5. Gray medium-crystalline locally oolitic crossbedded calcarenite; characterized by abundance of angular white, tan, and blue chert fragments ranging in size from pebbles to microscopic specks; in some areas, consists of heavy, 4-foot bed of limestone separated from overlying 2-foot ledge by approximately one foot of blue-yellow silty shale. Maximum thickness 24¼ feet. Conformably overlies Bayou Manard member (new) and, where exposed, contact is sharp; locally overlaps the Bayou Manard and rests upon Keokuk chert; believed to be conformable with over-

lying Ordnance Plant member (new), and in some areas, contact is sharp and in others gradational.

Type locality: Along north bank of Grand River in cliff east of Lindsey Bridge, sec. 6, T. 20 N., R. 20 E., southern Mayes County.

Lindside Sandstone (in Pocono Sandstone[1] or Series)

Lower Mississippian: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 505, 518.

J. M. Weller and others, 1948, Geol. Soc. American Bull., v. 59, no. 2, chart 5 (column 98). Shown on correlation chart in Pocono series below Logan sandstone and above Broad Ford sandstone.

Type locality: On Dry Creek about one-half mile southeast of Lindside and just south of Ernest Fleshman coal prospect, Monroe County, W. Va.

Lindwurm Member[1] (of Milwaukee Formation)

Middle Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. 9th Ann. Field Conf., p. 262, 265.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Lindwurm member shown on correlation chart above Berthelet member and below North Point member.

Type locality: Milwaukee Cement Quarry, Milwaukee County. Probably named for village of Lindwurm.

Lingle Limestone[1]

Middle Devonian: Southwestern Illinois and eastern Missouri.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 171, 176.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 15–16; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 24–25, 26. Strata intervening between Grand Tower limestone (or Dutch Creek sandstone where Grand Tower is absent) and Mountain Glen shale (or Springville shale where Mountain Glen is absent) have been referred by Savage to Misenheimer shale and Lingle and Alto limestones. Restudy of area suggests that recognition of these three formations may be neither stratigraphically logical nor practically feasible.

G. A. Cooper and A. S. Warthin, Jr., 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 883. Restricted to limestone exposed above Misenheimer shale on branch of Lingle Creek in SW¼ sec. 26, T. 13 S., R. 2 W., about 3 miles west-northwest of Mill Creek, Ill., where 31 feet of limestone is exposed in slope above the dark shale. Lingle limestone as exposed here is not to be confused nor correlated with Hamilton limestone above Grand Tower limestone at the Devils Backbone and Bake-Oven north of Grand Tower, Ill.

A. S. Warthin, Jr., and G. A. Cooper, 1944, Am. Assoc. Petroleum Geologists Bull. v. 28, no. 10, p. 1523. Term "Lingle" is used to include only those limestones present at type locality, with their correlatives. It rests on St. Laurent limestone and is overlain by the Alto, which is considered to be younger than Hamilton. The Lingle seems to be the most widely

distributed part of the Hamilton in Illinois, being present where any beds of that age are found. Toward the east, the Lingle becomes the Beechwood limestone of the Sellersburg of southern Indiana, and, toward northeast, the Logansport is its equivalent.

Type locality: Along branch of Lingle Creek, in SW¼ sec. 26, T. 13 S., R. 2 W., Union County, Ill.

Linietta Clay[1]

Mississippian: Central northern Kentucky.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145, 156.

Named from exposures in immediate vicinity of Linietta Springs, near Junction City, Boyle County.

Linley Conglomerate[1]

Post-Eocene(?): Central southern Montana.

Original reference: W. R. Calvert, 1916, U.S. Geol. Survey Bull. 641, p. 203.

W. C. Alden, 1953, U.S. Geol. Survey Prof. Paper 231, p. 7. Mentioned in report on physiography and glacial geology of western Montana and adjacent areas. Unconformably overlies Fort Union formation.

Named for development in vicinity of Linley. Occupies about 5 square miles between Linley, Carbon County, and Beartooth Mountains.

Linn Gravels

Pleistocene: Northwestern Oregon.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 11–12, geol. map. Term used to designate gravels of stage of alluviation next younger than Leffler gravels (new); also proposed to use term Linn gravels for all deposits of equivalent age throughout Willamette Valley. Older than Willamette silts.

Type section: Cliff about 30 feet high on left bank of North Santiam River in sec. 30, T. 9 S., R. 1 W., Stayton quadrangle. Named for Linn County where they are well exposed.

Linn Subgroup (of Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, western Missouri, southeastern Nebraska, and northeastern Oklahoma.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2029–2031. Name applied to middle part of Kansas City group. As defined, includes strata from base of Cherryvale formation to top of Iola formation. Comprises (ascending) Cherryvale formation, Drum limestone, Chanute formation, and Iola formation. Occurs above Bronson subgroup and below Zarah subgroup (new).

G. E. Condra, 1949, Nesbraska Geol. Survey Bull. 16, p. 35–38. In Nebraska, includes (ascending) Sarpy, Quivira, Drum, Chanute, and Iola formations.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 82, 84. Thickness in Kansas about 110 feet.

Named from Linn County, Kans., which contains excellent exposures of all constituent units.

Linnian series

Paleozoic [Devonic]: Iowa, Arizona, Missouri, and region northwest.

C. R. Keyes, 1939, Pan-Am. Geologist, v. 72, no. 1, p. 64. Proposed to cover entire Devonic deposition of Iowa-Missouri region and northwestward.

Series is complete cyclic sedimentation and full depositional filling of normal geosyncline. Embraces original Cedar Valley limestones, the Wapsipinicon section below, and the Rockford shales above. Cedarian series as first proposed referred only to median limestone section.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). In Arizona, Linnian series embraces (ascending) Silver shale, Bella shale, and Berenda limestone. Table shows Linnian series below Rockfordian series.

Name derived from Linn County, Iowa, through which Cedar River flows.

Linton Formation

Middle Pennsylvanian: Southwestern Indiana.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1; 1952, Indiana Geol. Survey Bull. 6, p. 12–14. Consists of (ascending) 10 to 20 feet of sandstone and shale, Coal IIIa 8 inches thick, 2 to 5 feet of black fissile shale, 1½ feet limestone, 20 to 30 feet of sandstone and shale, and Coal IV averaging 4 feet in thickness. Rests on Coal III or on 1 to 6 feet of gray shale overlying Coal III; lies above erosional unconformity cut into topmost beds of underlying Staunton formation; overlain by shale or sandstone of Petersburg formation.

S. A. Friedman, 1960, Indiana Geol. Survey Prog. Rept. 23, p. 7, 23–28. Includes Coxville sandstone member at or near base.

Named for exposures along tributaries of Latta Creek in secs. 26 and 27, T. 8 N., R. 7 W., approximately 4 miles north of Linton, Greene County.

Linville Metadiabase[1]

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 3.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 29; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Occurs as irregular outcrops associated with Montezuma schist, Flattop schist, Cambrian quartzite, and as narrow bands in Cranberry gneiss.

Named for Linville, Mitchell County, N.C.

†Linville Slates[1]

Precambrian and Cambrian: Western North Carolina.

Original reference: W. C. Kerr, 1869, North Carolina Geol. Survey Rept. 2, p. 13–36.

Named for exposures on Linville Mountain on boundary between McDowell and Burke Counties.

Linwood Member (of Cedar Valley Limestone)[1]

Upper Devonian: Eastern Iowa.

Original reference: A. C. Trowbridge, M. L. Thompson, and E. H. Scobey, 1935, Kansas Geol. Soc. 9th Ann. Field Conf. Rept., fig. 1, p. 36, 434.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1751. Cooper and Cloud suggested correlation of the Solon member (sometimes called Linwood) with the Rogers City limestone.

Type locality: Quarry at Linwood, Scott County.

Linwood Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 87, 97.

Probably named for occurrence near Linwood, Leavenworth County.

Linwood shales

Pennsylvanian: Northeastern Kansas.

C. R. Keyes, 1937, Pan-Am. Geologist, v. 67, no. 5, p. 366. Proposed for shale from the Bethany to the Plattsburg or Stanton limestone.

Type locality and derivation of name not stated.

Lion Sandstone[1]

Miocene, lower: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 375–376, 378, map.

Named for Lion Canyon, Riverside County.

†Lion Canyon coal group (in Williams Fork Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: E. T. Hancock and J. B. Eby, 1930, U.S. Geol. Survey Bull. 812, p. 197, 206.

Meeker quadrangle.

Lion Canyon Sandstone Member (of Williams Fork Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: E. T. Hancock and J. B. Eby, 1930, U.S. Geol. Survey Bull. 812, p. 197, 206.

Occurs in Lion Canyon, 3 miles west of Meeker, Rio Blanco County.

Lion Hill Formation[1]

Upper Mississippian: Central northern Utah.

Original reference: S. G. Olmstead, 1921, Econ. Geology, v. 16, p. 452.

Exposed over a large area on Lion Hill, Ophir district.

Lion Mountain Sandstone Member (of Riley Formation)

†Lion Mountain Sandstone Member (of Cap Mountain Formation)[1]

Upper Cambrian: Central Texas.

Original reference: Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L.

P. E. Cloud, Jr., V. E. Barnes and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 154–155. Reallocated to member status in newly defined Riley formation. Overlies Cap Mountain (here reduced to member status in Riley); underlies Welge sandstone member of Wilberns formation. Highly glauconitic sandstone, lower part of which contains numerous lenses or tangential beds of coquina-like limestone made up chiefly of trilobites. Thickness 24 feet.

Named for Lion Mountain in northwestern part of Burnet quadrangle. [Burnet County].

†Lipan Beds[1]

Eocene: Southern Texas.

Original reference: E. T. Dumble, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 424–436.

Exposed in Lipan Hills, east of Campbellton, Atascosa County.

Lippincott Member (of Lost Burro Formation)

Middle and Upper Devonian: Southern California.

J. F. McAllister, 1955, California Div. Mines Spec. Rept. 42, p. 9 (fig. 3), 12, pl. 2. Siliceous zone, sporadically cherty and consistently sandy or quartzitic, at base of Lost Burro formation. Thickness 155 to 250 feet. Overlies Hidden Valley dolomite.

Exposures northeast of all workings of Lippincott mine, Ubehebe Peak quadrangle, Inyo County. Best exposures of Lippincott where not metamorphosed is in Andy Hills east of Hidden Valley about 7 miles northeast of Lippincott mine.

Lirio Limestone

Pliocene or Pleistocene: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–C, p. 147–148, pl. 12. A limestone that unconformably overlies Isla Mona limestone (new). On plateau, the two formations cannot be distinguished, but in sea cliff at Punta Este they are distinguished by the unconformity and darker weathered surface of the Lirio. Maximum thickness 50 feet at Punta Este; where identified in sea cliff commonly 10 to 15 feet. On basis of meager fossil evidence, age is taken to be Pliocene or Pleistocene.

Named for Cueva del Lirio, at Punta Este, which lies entirely in it. Occurs on Isla Mona and probably on Monito.

Lisbon Formation[1]

Cambrian or Ordovician: Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Am. Jour. Sci., 3d, v. 7, p. 468–476.

Named for Lisbon, Grafton County.

Lisbon Formation (in Claiborne Group)[1]

Eocene, middle: Southwestern Alabama, Georgia, and Mississippi.

Original reference: T. H. Aldrich, 1886, Alabama Geol. Survey Bull. 1, p. 44–60.

R. E. Grim, 1936, Mississippi Geol. Survey Bull. 20, p. 122. Lisbon formation in Mississippi includes Kosciusko and Chickasawhay (new) members. (Chickasawhay as used here includes Wautubbee marl).

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook] Field Trip, Feb. 10, 11, columnar section. Lisbon formation includes (ascending) Winona sand, Zilpha (new), Kosciusko sand, and Wautubbee members. Overlies Tallahatta formation; underlies Yegua formation.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 29, 40, 48. Winona greensand, Kosciusko, and Wautubbee are treated as formations and not part of Lisbon formation.

F. S. MacNeil, 1946, Southeastern Geol. Soc. [Guidebook] 4th Field Trip, p. 22. Lisbon formation in Alabama is equivalent of Winona sand, Zilpha clay, Sparta sand (Kosciusko), and Cook Mountain formation (Wautubbee) combined.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Chart of outcropping Tertiary formations of eastern Gulf region shows Lisbon formation present in Georgia.

Named for exposures in Lisbon Bluff, on Alabama River, in Clarke County, Ala.

†Lisbon Group[1]

Upper Triassic: Central southern Pennsylvania.

Original reference: G. H. Ashley, 1931, Pennsylvania Topog. and Geol. Survey Bull. G1, p. 77.

Occurs in Dauphin and York Counties.

†Lisbon Quartzite[1]

Upper Ordovician(?): Northwestern New Hampshire.

Original reference: M. Billings, 1933, Am. Jour. Sci., 5th, v. 25, no. 146, p. 149.

Type locality: Lisbon Township, Grafton County.

†Lisbon Shale[1]

Upper Cretaceous: Northwestern Kansas and eastern Colorado.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 52.

Named for Lisbon, Logan County, Kans.

Lisburne Group

Lisburne Limestone[1]

Lower and Upper Mississippian, Pennsylvanian(?), and Permian: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull. v. 13, p. 241.

A. L. Bowsher and T. J. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 3, figs. 2–4. Group consists of two formations in Shainin Lake area, central Brooks Range: the Wachsmuth and the Alapah limestones (new) in ascending order.

W. P. Brosgé, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B351, B352. In south-central Brooks Range, group includes Kayak shale, Kanayut conglomerate, and unnamed sandstone. Devonian and Mississippian(?).

U.S. Geological Survey currently designates age of Lisburne Group as Lower and Upper Mississippian, Pennsylvanian(?), and Permian on basis of study now in progress.

Named for Cape Lisburne in northwestern Alaska. Extends from Cape Lisburne, on Arctic Ocean, east almost if not quite continuously for 600 miles to international boundary.

Lisco Member (of Broadwater Formation)

Pleistocene, lower: Western Nebraska.

C. B. Schultz and T. M. Stout, 1945, Am. Jour. Sci., v. 243, no. 5, p. 232–236. Defined as including all sediments between basal and upper gravel members of formation; at some localities, consists of diatomaceous marl and peat with sand and silt lenses; at other localities, loess-like silt facies is present; alluvial and colluvial silts and sands also are present locally within member. Thickness as much as 8 feet.

Type locality: At Broadwater Locality A of University of Nebraska State Museum, near Broadwater, Morrill County. Name derived from town of Lisco, Garden County.

Lisman Formation[1] (in McLeansboro Group)

Upper Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

E. J. Harvey, 1956, U.S. Geol. Survey Water-Supply Paper 1356, p. 47, 55 (fig. 9), 64–70. In Henderson area, formation consists of (ascending) Providence limestone member, No. 12 coal, Anvil Rock sandstone member, and Madisonville limestone member; these are normally separated by shales and sandy shales. Base of formation is here designated as top of No. 11 coal underlying Providence limestone—it had been placed by Glenn at base of Anvil Rock sandstone member. Thickness in eastern part of quadrangle about 255 feet; in western part where Madisonville is exposed, thickness about 300 feet. Overlies Carbondale formation; almost entirely covered by alluvium and loess.

Apparently named for Lisman, Webster County.

Lissie Formation[1]

Pleistocene. Eastern Texas and northwestern Louisiana.

Original reference: A. Deussen, 1914, U.S. Geol. Survey Water-Supply Paper 335, p. 27, 78–80.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1708. Traced coastward along Colorado River, the surface of Capitol terrace appears to coincide with surface of sand and sandy clay formation near Lissie, to which Deussen gave name Lissie. On basis of priority, name Capitol (Hill and Vaughan, 1898) has preference over name Lissie.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1860 (table 7). Gulf Coast Pleistocene correlation chart shows Lissie younger than Citronelle and older than Oberlin; also older than Capitol of Colorado River section.

Named for Lissie, Wharton County, Tex.

Liston Creek Formation[1]

Middle Silurian: Northeastern Indiana.

Original reference: E. R. Cumings and R. R. Shrock, 1928, Indiana Cons. Comm., Div. Geology Pub. 75, p. 53, 71–94.

J. B. Sangree, Jr., 1960, Dissert, Abs., v. 21, no. 6, p. 1528. Revision of Silurian stratigraphy of northern Indiana proposed. Liston Creek formation and New Corydon formation tentatively considered cherty facies of Mississinewa formation.

Well exposed at mouth of Liston Creek, Wabash County.

Liston Creek Limestone Member (of Liston Creek Formation)[1]

Silurian (Niagaran): Northeastern Indiana.

Original reference: E. R. Cumings and R. R. Shrock, 1927, Indiana Acad. Sci. Proc., v. 36, p. 75–76.

Occurs along Liston Creek, Wabash County.

Litchfield Coal Member (of Spoon Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), pl. 1. Assigned member status in Spoon formation (new). Present in lower part of formation. Coal named by Kay (1915,

Illinois Geol. Survey Min. Inv. 11). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Mine, SE¼NE¼NE¼ sec. 32, T. 9 N., R. 5 W., Montgomery County. Recognized only in vicinity of mine near Litchfield.

Litchfield mafic intrusives

Litchfield Norite[1]

Pre-Triassic: Western Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 74, 111.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Mapped as mafic intrusives. Redescribed to include medium- to coarse-grained mostly massive olivine norite, quartz, norite, and hypersthene pyroxenite. Cut by dikes of several rock types from pyroxenite to granodiorite. Pre-Triassic. Derviation of name stated.

Named for town of Litchfield, Litchfield County.

†Lithodendron Formation[1]

†Lithodendron Member[1] (of Shinarump Formation)

Upper Triassic: Northern Arizona.

Original reference: L. F. Ward, 1905, U.S. Geol. Survey Mon. 48.

Occurs on Lithodendron Creek, a short distance from Petrified Forest.

Lithonia Gneiss or Granite

Lithonia Granite-Gneiss

Precambrian or upper Cambrian(?): Northwestern Georgia.

T. L. Watson, 1902, Georgia Geol. Survey Bull. 9–A, p. 54, 125–127. Name applied to contorted granite-gneiss in vicinity of Lithonia.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 42. Toccoa Falls quartzite (Galpin 1915) is a fine-grained phase of Lithonia granite.

L. A. Herrmann, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1362; 1954, Georgia Geol. Survey Bull. 61, p. 8–15, 34–41, 68–73, 78–79. Metamorphic rocks of area considered Precambrian. Lithonia gneiss was apparently migmatized during or shortly after final deformation of the metamorphic rocks. This deformation may have taken place in early stages of Appalachian Revolution. Intruded by Stone Mountain granite.

Marc Grunenfelder and L. T. Silver, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1574. Age determinations by isotope-dilution methods on zircon concentrations gave age of Lithonia granite as 425 to 485 million years. These data are in contrast with K/A and Rb/Sr ages of 250–290 million years reported by previous workers. These older ages indicate a late Cambrian(?) plutonic episode.

Named for occurrence near Lithonia, De Kalb County.

Lithopolis Member (of Cuyahoga Formation)[1]

Lithopolis Siltstone Member (of Cuyahoga Formation)

Mississippian (Kinderhook): South-central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 670.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 43, 45. Included in Hocking Valley conglomerate facies of formation and name emended to

Lithopolis siltstone member [on p. 45 unit is referred to as sandstone member]. Estimated thickness 180 to 200 feet. Underlies Fairfield sandstone member, contact concealed.

Named for Lithopolis, Fairfield County. Exposures limited to northwestern Fairfield, southeastern Franklin and southwestern Licking Counties.

Littig Glauconitic Member (of Kincaid Formation)[1]

Paleocene: Eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 536, 550, 554.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 13. Basal member of Kincaid. Underlies Pisgah member.

G. R. Kellough, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 150–152. Consists of dark-green sandy shale with streaks of sandstone containing much coarse elongate to free-form dark-green glauconite, shell fragments, fish teeth, phosphate, pebbles, coprolites, and Foraminifera. Thickness 7 feet. Underlies Pisgah member; unconformably overlies Upper Cretaceous Navarro formation.

Type exposure: In road 1½ miles by road southwest of Littig, Travis County, on south side of Wilbarger Creek.

Little Alvord Creek Rhyolite[1]

Tertiary, upper: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington Univ Pub. Geol., v. 3, no. 1, p. 66.

Exposed in Little Alvord Creek, Steens Mountain, Harney County.

Little Bear Formation or residuum

Lower Cretaceous: Mississippi, Alabama, Kentucky, and Tennessee.

F. F. Mellen, 1937, Mississippi Geol. Survey Bull. 34, p. 8–20, 27–29. Name applied to material that originated in situ from decomposition of Paleozoic strata. Outcrops are subjacent to Tuscaloosa formation and extend from Kentucky to west-central Alabama, and perhaps extend to central and eastern Alabama, and western Georgia, if not farther. Deposits vary in character from place to place depending upon nature of original material. Formative process probably began in early Mesozoic, or even late Paleozoic and continued into Cretaceous; formation is for most part Comanchean.

Named for development in drainage area of Little Bear Creek heading 1 mile northeast of Iuka, Tishomingo County, Miss.

Little Belknap Lava, Flows

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 57. Discussion of volcanoes of Three Sisters region. Name is applied to lava and flows from Little Belknap Crater.

Little Belknap Crater is south of Mount Washington and east of Belknap Crater.

Little Black Mountain Quartz Monzonite Porphyry

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 81, 92, pl. 1. Mapped on Little Black Mountain as Little Black porphyry. Cited in

text as Little Black Mountain quartz monzonite porphyry. Intrusive relation to Upper Cretaceous formations.

Most conspicuous mass forms Little Black Mountain and centers in sec. 8, T. 11 S., R. 77 W. Outcrop about 1½ miles long and 1 mile wide. Other smaller masses also mapped in western part of South Park.

Little Brazos Limestone Lentil (in Claiborne Group)[1]

Eocene, middle: Eastern central Texas.

Original reference: B. C. Renick and H. B. Stenzel, 1931, Texas Univ. Bull. 3101, p. 78, 92.

Well exposed along Little Brazos River about 1.4 miles northeast of Bryan Junction, Brazos County.

Little Butte Volcanic Series

Oligocene(?): Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Name applied to a volcanic series, about 3,000 feet thick, that overlies Coleston formation (new) and is capped by Heppsie andesites (new) of Miocene(?) age. Comprises two sequences: lower, Wasson formation, and upper, Roxy formation (both new).

Well exposed in valley of Little Butte Creek, Jackson County.

†Little Cabin Sandstone Member (of Cherokee Formation)[1]

Pennsylvanian: Southern Kansas and northwestern Oklahoma.

Original reference: C. L. Cooper, 1928, Oklahoma Univ. Bull., Proc. Oklahoma Acad. Sci., v. 7, p. 160–164.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 33. Replaced by term Warner sandstone.

Named for exposures along west bank of Little Cabin Creek, Craig County, Okla.

Little Chain Limestone (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 8. Thin ferruginous limestone. Occurs 35 feet above New Haven limestone.

Named from its outcrop at north end of Little Chain Hills, 6 miles northeast of New Haven.

Little Chief Porphyry[1]

Mesozoic: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311; 1933, California Div. Mines Rept. 28 of State Mineralogist July-Oct., 1932, p. 351, map.

C. W. Jennings, 1958, Geologic map of California (1:250,000) Death Valley Sheet: California Div. Mines. Mapped with Mesozoic granite rocks.

Inyo County, Death Valley region.

Little Chief Canyon Member (of Lodgepole Limestone)

Lower Mississippian: Central Montana.

M. M. Knechtel, J. E. Smedley, and R. J. Ross, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2395–2399. Thin conodont-bearing fissile black shale at base of Lodgepole limestone. Thickness

about 1½ feet. In sharp contact with overlying thinly bedded limestone, and rests with equally sharp contact on light-gray blocky clay.

Type locality: Little Chief Canyon of Lodgepole Creek, N½ sec. 27, T. 26 N., R 25 E., Blaine County, about 3½ south-southwest of Lodgepole Subagency of the Fort Belknap Indian Reservation.

Little Clarksburg cyclothem

Pennsylvanian (Conemaugh series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 114 (map 18), 151–153. Embraces interval between Elk Lick cyclothem (new) below and Lower Little Pittsburgh cyclothem (new) above. Normal succession includes six members (ascending): Morgantown redbed, Morgantown shale and sandstone, Clarksburg redbed, Clarksburg limestone, Clarksburg underclay, and Little Clarksburg coal. Average thickness about 60 feet. In area of this report, Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Members of cyclothem occur in discontinuous distribution in Alexander, Ames, Canaan, Dover, and Lodi Townships, Athens County.

Little Clarksburg Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: B. L. Miller, 1925, Pennsylvania Geol. Survey, 4th ser., Bull. M–7, p. 250.

Little Compton Shales[1]

Precambrian: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 281–283, 383.

Extends from Browns Point to south side of Pachet Brook southward within one-half mile of road running north from Little Compton, Newport County, thence westward.

Little Cottonwood Granite[1]

Little Cottonwood Quartz Monzonite

Upper Cretaceous or lower Tertiary: Central northern Utah.

Original references: S. F. Emmons, 1903. Am. Jour. Sci., 4th, v. 16, p. 141–147; F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 85–143.

F. C. Calkins and B. S. Butler, 1943, U.S. Geol. Survey Prof. Paper 201, p. 38–43. Little Cottonwood quartz monzonite incidentally mentioned. Most of discussion is quartz monzonite of Little Cottonwood stock.

Exposed in Little Cottonwood Canyon.

Little Creek Breccia Member (of Quichapa Formation)

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 40. Andesitic flows and breccia. Massive flow rock is dark red to dark purple and black; in addition to these colors, the brecciated rock is gray, olive green, and brown. Maximum thickness 1,200 feet. Overlies Bauers tuff member; underlies Harmony Hills tuff member. Name credited to H. R. Blank, unpublished thesis.

Area of report is Washington County.

Little Dry Glaciation

Little Dry Glacial Stage[1]

Pleistocene: Northwestern Utah and southwestern Wyoming.

Original reference: W. H. Bradley, 1936, U.S. Geol. Survey Prof. Paper 185–I, p. 194–195.

Ernst Antevs, 1945. Am. Jour. Sci., v. 243–A, p. 24, table 2. Nebraskan.

Named for Little Dry Creek, northeastern Utah.

Little Elk Gneissoid Granite

Little Elk Creek Gneissoid Granite

Precambrian: Western South Dakota.

G. L. Taylor, 1935, Am. Jour. Sci., 5th ser., v. 29, no. 171, p. 283–284. Light-gray medium-grained gneissoid granite. Intruded Precambrian sediments. Field evidence did not indicate relative ages of Little Elk, Game Lodge granite (new), Harney Peak granite, or igneous amphibolites.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 5. Referred to as Little Elk Creek gneissoid granite.

Occurs in valley of Little Elk Creek in Galena-Roubaix district, northern Black Hills.

Little Falls Dolomite[1]

Upper Cambrian: East-central and eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Hdb. 19, p. 16, chart.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1576. Discussion of upper Champlain Valley. Name Little Falls proposed by Clarke (1903) for pre-Tribes Hill Calciferous of Mohawk Valley. Ulrich and Cushing (1911, New York State Mus. Bull. 140) extended name into Champlain Valley to include all of Division A and part of Division B, of Brainerd and Seely (1890, Am. Mus. Nat. History Bull., v. 3). There is a significant unconformity 35 feet below base of Division B, and this break seems to correspond with break above the Little Falls in Mohawk Valley. Beds of Division B together with upper 35 feet of Division A are here named Whitehall formation.

R. H. Wheeler, 1941, (abs.) Geol. Soc. America Bull., 52, no. 12, pt. 2, p. 1938–1939. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence Valleys. Revisions involve definitions and successions of previously accepted Cambro-Ordovician formations (Upper Cambrian Potsdam, Theresa, Hoyt, and Little Falls and Lower Ordovician Whitehall, Tribes Hill, and Beekmantown). "Typical" Theresa is physically and faunally differentiated from "Upper Theresa" (now Heuvelton member of Tribes Hill formation); Hoyt fauna occurs in lower half of emended Whitehall formation above Little Falls dolomite; a new upper (Skene) member of Whitehall formation represents late Cambrian offlap; two marine cycles, represented by Tribes Hill formation (containing the Norton-Heuvelton, Fort Ann-Bucks Bridge, Benson-Ogdensburg members) and the Cassin formation, constitute the Beekmantown series. Oneota, Stonehenge, Van Buren, and Gasconade faunas occur in Tribes Hill formation, not in Little Falls as generally believed. Each revised unit is tied in with Divisions A through E of original "Calciferous" formation (Brainerd and Seely, 1890).

R. H. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 522–523. Base of Whitehall formation is raised to coincide with contact of Little Falls dolomite and Hoyt limestone, and latter is redefined as a lower member of Whitehall formation. At corrected Skene Mountain section, Little Falls formation, about 210 feet thick, overlies Theresa formation.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–813. Evidence presented to substantiate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs, region, New York. Previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new) Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland(?), Hull, Sherman Fall representatives) and Canajoharie shale. Term "Theresa" is not applicable in this area; hence, name Galway is reintroduced for strata younger than Potsdam and older than Hoyt. Lower Ordovician beds have been traced into Saratoga region from Mohawk Valley and constitute most of dolomite which has heretofore been regarded as Little Falls dolomite (Upper Cambrian). Wheeler was first to suggest that long-accepted stratigraphy of region was not true one. He stated that Hoyt limestone overlay Little Falls dolomite in Saratoga region and that the dolomite which overlay the Hoyt was a younger formation to which he applied name Skene. He classified Hoyt limestone as basal member of the Whitehall and Skene as upper member, the latter being a very late Upper Cambrian offlapping unit. He mistook Ordovician Gailor dolomite for the older Little Falls dolomite, for the Hoyt and his supposed "Little Falls" are in fault contact in his "unfaulted" area 4 miles west of Saratoga Springs. Tracing of Little Falls dolomite from its type locality at Little Falls, eastward into Saratoga region shows that it is absent there as such, but that its correlatives are facies equivalents, namely, Potsdam sandstone, Galway formation, and perhaps even a part of Hoyt limestone. Little Falls dolomite (restricted) thus represents an offshore, more carbonate phase of the aforementioned formations. Absence of these formations within Mohawk Valley further corroborates this interpretation; wherever exposed, the Little Falls rests directly on the Precambrian.

Named for exposures at pass in Mohawk Valley at Little Falls, Herkimer County.

Little Genesee Conglomerate[1]

Upper Devonian: Southwestern New York.

Original reference: C. S. Prosser, 1892, Rochester Acad. Sci. Proc., v. 2, p. 55, 57, 93, 94, 96.

Exposed north of Little Genesee, Allegany County.

†Little Grizzly Creek Beds[1]

Pennsylvanian: Northern California.

Original reference: H. W. Turner, 1894, Am. Geologist, v. 13, p. 230–231.

Occur by road to Cascade gravel mine and to east of Little Grizzly Creek at southwestern base of Mount Ingalls, Plumas County.

Little Hominy Limestone Member (of Pawhuska Limestone)[1]

Pennsylvanian (Virgil Series) : Northeastern Oklahoma.

Original reference: K. C. Heald and K. F. Mather, 1919, U.S. Geol. Survey Bull. 686–M, p. 150, 152.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49, 50. Pawhuska formation, in Osage County, comprises (ascending) Lecompton, Plummer, Deer Creek, Little Hominy, Pearsonia, and Turkey Run members. Only Lecompton and Turkey Run continue across Pawnee County and into Creek County [this report].

Named for outcrops on Little Hominy Creek in southwestern part of T. 25 N., R. 8 E., Osage County.

†Littlehorn Limestone[1]

Lower Mississippian: Northern Wyoming.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

Named for exposures in Little Horn Canyon on east side of Bighorn Mountains.

Little Kaw Limestone Member[1] (of Stanton Formation)

Pennsylvanian (Missouri Series) : Northeastern Kansas.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans., [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, pt. 1, p. 76–79.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. Shown on chart of Pennsylvanian formations in Missouri as South Bend or Little Kaw limestone.

Named for Little Kaw Creek, north of Lorgin, Leavenworth County.

Little Medicine Member (of Goose Egg Formation)

Little Medicine Tongue (of Dinwoody Formation)[1]

Lower Triassic: South-central Wyoming.

Original reference: H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1664, 1669.

H. A. Tourtelot, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–124. In southeastern Big Horn Mountains, about 25 feet thick and consists of thin beds of gypsum and dolomite resting on red siltstone of a westward-extending tongue of Chugwater.

U.S. Geological Survey currently classifies the Little Medicine as a member of Goose Egg Formation on basis of a study now in progress.

Type locality: Along north bank of Little Medicine Bow River (locally known as Little Medicine) in Flat Top anticline 8 miles north of town of Medicine Bow on road from Medicine Bow to Casper.

Little Missouri Lens (in Newcastle Formation)

Upper Cretaceous: Northeastern Wyoming.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 15. Predominantly siltstone and shale. Maximum thickness 80 feet. Lies north and east of New Haven lens (new).

Occurs on north bank of Little Missouri River, Crook County. Outcrop extends almost to Wyoming-Montana State line and has lateral extent of 15 miles.

Little Missouri Lignites or Ligneous Shales[1]

Eocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 50, 188.

Occurs at mouth of Little Missouri.

Little Natches Member (of Cook Mountain Formation)

Eocene (Claiborne): Northwestern Louisiana.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 87, 101-109, pls. 3, 8 (fig. 2). Consists of a series of sands and shales with weathered zones of greensand and calcareous shale in lower part; sands and lignitic chocolate-brown shales in upper part differ little from overlying Cockfield except that sands contain casts of macrofossils and the shale contains agglutinated types of foraminifers. Thickness in southern part of Winn Parish 60 to 70 feet; in northern part, thickness approximately 50 feet, and here shales with irregular zones of fossiliferous ironstone replace the fossiliferous sands that are present farther south. Overlies Saline Bayou member.

Type section: Southwest corner of NE¼NE¼ sec. 15, T. 9 N., R. 6 W., Winn Parish, along U.S. Highway 71, about a quarter mile southeast of Little Natches Bayou.

Little Oak Limestone[1]

Middle Ordovician: North-central Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 112, map.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 74–75. Consists of thick-bedded dark nodular limestone with nodular chert; in St. Clair County, contains two layers of metabentonite. Maximum thickness 500 feet. Near Siluria, thinned edge of formation rests on black shale of Columbiana formation; along Cahaba Valley, thickens enormously and rests on Lenoir formation.

Named for exposures on west front of Little Oak Ridge, south of Leeds, Jefferson County.

Little Osage Member (of Fort Scott Formation)

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 306–309, pl. 1. Name applied to the shale, coal bed, and limestone bed that lie between Blackjack Creek limestone member below and Higginsville limestone member above. Thickness in Kansas about 5 to 11 feet. Includes Houx limestone bed near top.

F. C. Greene and W. B. Howe, 1952, Missouri Geol. Survey and Water Resources Inf. Circ. 8, p. 19. Columnar section shows the Little Osage as containing (ascending) Summit coal, Houx limestone, Blackwater Creek shale, and Flint Hills sandstone.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 22, 24 (fig. 2). Geographically extended into northeastern Oklahoma.

Type exposure: In northeast part of SE sec. 2, T. 24 S., R. 25 E., Bourbon County, Kans., on south valley wall of Little Osage River.

Little Pavlof Agglomerate

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Includes many interbedded lava flows. Name appears only on geologic map legend.

Mapped on western slope of Little Pavlof Volcano, Alaska Peninsula.

Little Pawnee Shale Member (of Cass Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29. Name applied to middle member of formation. Upper part of member is bluish gray; middle part is dark and somewhat fissile; lower part dark gray and fossiliferous; combined thickness 1½ to 1¾ feet. Underlies Haskell limestone member; overlies Shoemaker limestone member.

Type locality: Little Pawnee Creek valley in SE sec. 9, T. 12 N., R. 10 E., Saunders County.

†Little Pine Ridge Sandstone[1]

Upper Cretaceous: Central Wyoming.

Original reference: C. E. Jamison, 1912, Wyoming State Geologist, ser. B., Bull. 4.

Forms Little Pine Ridge, east of Salt Creek oil field, Natrona County.

†Little Pittsburgh Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania, Maryland, and northern West Virginia.

Original reference: F. Platt, 1877, Pennsylvania Geol. Survey Rept. H_5, p. 55–104.

Northwestern part of Allegheny County, Pa.

Little Pittsburgh Member (of Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh quadrangle.

Little Pittsburgh Underclay

Pennsylvanian: West Virginia.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. Survey Rept. Inv. 17, p. 13. Little Pittsburgh underclay immediately underlies Little Pittsburgh coal. Average thickness 3 feet.

Little River Gneiss

Precambrian: Southwestern Virginia.

R. V. Dietrich, 1959, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 134, p. 58–69, pl. 1. Chiefly highly sheared blue quartz augen gneiss plus or minus feldspar augen. Appears to be mixed with rocks of Blue Ridge complex and to grade upward into rocks mapped as Lynchburg formation (may not be correlative with type locality Lynchburg). Contact with complex poorly defined. Contact with Lynchburg consists of

intercalated layers or rock essentially identical with those of either side of zone plus a few layers of rock intermediate in composition. May be same age as Willis phyllite (new); locally grades into Alum phyllite (new). Absolute, relative, and geologic age data suggest that Little River gneiss and rocks mapped as belonging to Lynchburg formation once belonged to same sedimentary sequence and are of pre-late Precambrian.

Well exposed along eastern side of Route 102, just south of County Road 619 W and in quarry on east side of Route 8, approximately 1.1 miles south of Little River bridge at Floyd-Montgomery county line.

Little River Series

Paleozoic(?): Northeastern Georgia.

A. L. Peyton and H. E. Cofer, Jr., 1950, U.S. Bur. Mines Rept. Inv. 4664, p. 4–5. Undifferentiated metamorphic series considered to be of volcanic and sedimentary origin. Consists of sericitic, chloritic, and amphibole-pyroxene rocks, all of which have been considerably silicified and otherwise altered; subdivided into three general types: mica schist, garnet-mica schist, and weakly to nonschistose amphibole-pyroxene rocks.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 31–33. Little River series is a complex group of sedimentary, extrusive, and intrusive rocks of distinctly younger age than the surrounding more highly metamorphosed schists and gneisses of Carolina series. Of the metamorphic rocks of the State, this series alone may be Paleozoic, but its relationships to known Paleozoic slates further north (Quantico and Arvonia) are unknown. Biotite phyllite occurs in northern Wilkes County where series is intruded by Elberton granite.

Exposed along Little River in Wilkes, Lincoln, and McDuffie Counties. Occupies three separate belts that unite in South Carolina to form the so-called Carolina shale belt.

Little Rock Creek Limestone

Devonian: Northwestern Indiana.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 181. Proposed for the gray brittle conchoidally fracturing limestone above the Logansport; contains fauna including a large *Chonetes*. Thickness 7 feet.

Exposed on Little Rock Creek above road crossing 1 mile above Lockport, Carroll County.

Little Saline Limestone[1]

Lower Devonian: Eastern Missouri and southwestern Illinois.

Original reference: C. L. Dake, 1918, Missouri Bur. Geology and Mines, v. 15, 2d ser., p. 88, 174.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 118–120. Thick-bedded pure crystalline limestone nearly white in color or with slightly pinkish tinge. Crinoidal bed near top. Two bryozoan beds present in upper half. Thickness about 100 feet. Overlies Bailey limestone; underlies Grand Tower formation.

Named for exposures at quarries of Ozora Marble Company, in east bank of Little Saline Creek, just south of bend in stream from northerly to easterly direction, a little less than 1½ miles west of road crossing south of Ozora, Ste. Genevieve County, Mo.

Littles Corner Limestone Member[1] (of Hayfield Shale)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Cussewago limestone of White (1881), renamed Hayfield by Chadwick (1925) and redefined as Littles Corner(s) by Caster, is described as occurring in this shale [Bedford] in outcrop at Bartholomew quarry (outcrop 15 of this report). Examination of exposure shows two siliceous limestones, one in lower part of the Berea and the other in middle of the Cussewago. Either of these limestones may have been called Littles Corners, but no limestone occurs in Bedford shale. Validity of Littles Corners limestone is questioned. Term Hayfield is invalid because unit has been found to be Bedford shale in present investigation.

Named for village of Littles Corner in Cussewago Valley, Crawford County.

Little Shades Sandstone Member (of Parkwood Formation)

Mississippian (Chester): Alabama.

R. B. Morton, 1949, Mississippi Geol. Soc. Guidebook 7th Field Trip, p. 37, 38, 40. Shown on stratigraphic section as sandstone in basal part of Parkwood formation. Occurs above Floyd shale.

Present in Birmingham Valley.

Little Sheep Mudstone Member (of Cloverly Formation)

Lower Cretaceous: Northwestern Wyoming.

R. M. Moberly, Jr., 1958, Dissert. Abs., v. 18, no. 1, p. 198. Proposed for lowest of three members of redefined Cloverly. Consists chiefly of bentonitic (montmorillonitic) mudstones in variegated shades of neutral gray, purple, dusky and pale red, and olive. Other typical lithologies include bentonites, cherts, coaly beds, calcareous nodules, and chert-pebble conglomeratic sandstones. Underlies Lovell member (new); conformably overlies Morrison formation.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1139 (fig. 1), 1143 (fig. 2), 1145–1147, 1151 (fig. 5), pl. 1. Series of bentonitic mudstones, commonly containing some chert-pebble sandstone lenses and beds of a few other lithologies. Thickness 250 feet at type locality. Underlies Himes member (new) and locally overlies Pryor conglomerate member; overlies Morrison formation. In this report [northern Bighorn Basin], Cloverly formation is redefined on lithogentic basis.

Type locality: Sec. 36, T. 56 N., R. 95 W., on northeast flank of Little Sheep Mountains, about 4 miles south-southwest of Kane, Big Horn County.

Little Sitkin Dacite

Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 181–183, pl. 23. Lavas ranging in composition from andesite to rhyodacite, but 90 percent by volume estimated to be low-silica dacite. Most rocks are black glassy to crypto-crystalline dacite. A few massive light-gray nonporphyritic andesites interbedded with other lava. At least 300 feet of dacite exposed in cliffs on Pratt Point and near crater of Little Sitkin volcano. Estimated maximum thickness 1,000 feet. Two members, Pratt Point (new) and West Cove (new), mapped separately from bulk of Little Sitkin dacite. Except for surficial deposits, Little Sitkin dacite overlies all other rocks on island.

Type section: Exposure in crater rim of Little Sitkin volcano at lat 50°57′2″ N., long 178°32′57″ E., Little Sitkin Island, in Rat Islands group of Aleutian Islands. Widespread on east and south sides of volcano.

Littleton Formation[1]

Lower Devonian: Central and southern New Hampshire, north-central Massachusetts, and southeastern Vermont.

Original reference: C. P. Ross, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 267–302.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1015–1019. Extended to include Talford schist in Franconia quadrangle, New Hampshire.

M. P. Billings and others, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 263–266, pl. 1. Subdivided. Contains three mappable units in Mount Washington quadrangle, New Hampshire; middle one which lies about 1,400 feet above base of formation named Boott member.

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–3]. Geographically extended to Massachusetts.

G. E. Moore, Jr., 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1629–1633, 1635, pl. 1. Geographically extended to Vermont. Occurs in limited area west of Connecticut River.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 453 (fig. 2), 459–464, pl. 1. Contains Gove member (new) near base in Mount Pawtuckaway quadrangle, New Hampshire.

M. T. Heald, 1950, Geol. Soc. America Bull., v. 61, no. 1, p. 45–55, pl. 1. Subdivided in Lovewell Mountain quadrangle, New Hampshire. Consists of three members (ascending): Hubbard Hill, May Pond, and Dakin Hill.

M. T. Heald, 1955, Geology of the Gilmanton quadrangle, New Hampshire: Concord, New Hampshire State Plan. Devel. Comm., p. 8–9, 10, 11, map. Subdivided in Gilmanton quadrangle, New Hampshire. Includes Pittsfield member near middle, Jenness Pond member near top, and Durgin Brook member at top.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250:000): U.S. Geol. Survey. Stratigraphically restricted. Gove member reallocated to Berwick formation.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 27–35, 42, 93–94. Complex lithologic variations in metamorphic zones discussed. Maximum thickness about 10,000 feet.

Type locality: Around Slate Ledge, Walker Mountain and district, 1 mile to southwest in Littleton Township, Grafton County, N.H.

Littleton Member (of Cedar Valley Limestone)[1]

Upper Devonian: Eastern Iowa.

Original reference: C. L. Fenton and M. A. Fenton, 1930, Am. Mid. Nat., v. 12, no. 1, p. 12–13.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182, 185. Middle member of Cedar Valley. Overlies Linwood member; underlies Coralville member.

Named for occurrence near Littleton, Buchanan County.

†Little Traverse Group[1]

Middle Devonian: Michigan.

Original reference: A. Winchell, 1871, Michigan Geol. Survey Rept. Prog., p. 26–33.

Crops out at Little Traverse Bay and Grand Traverse, Lower Peninsula.

Little Traverse Bay Limestone[1]

Middle Devonian: Michigan.

Original reference: C. C. Douglass, 1839, Michigan Leg. H. Doc. 27, p. 97–111.

Occurs on shores of Little Traverse Bay, northwestern part of Lower Peninsula.

Little Union Quartz Latite

Tertiary, upper, or lower Pleistocene(?): Colorado.

C. H. Behre, Jr., E. N., Goddard, and E. A. Sandberg, 1939, Preliminary geologic map of west slope of Mosquito Range in vicinity of Leadville, Colorado (1:12,000): U.S. Geol. Survey: C. H. Behre, Jr.. 1939, Colorado Sci. Soc. Proc., v. 14, no. 2, p. 66–67. Rhyolite and quartz latite group of west slope of Mosquito Range includes two members, Little Union quartz latite and a rhyolite that occurs mainly as agglomerate.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 58–59, pls. Occurs as two bodies, one near head of Little Union Gulch and the other 1½ miles west of Empire Gulch. Where fresh, light grayish brown; weathers to darker color with rusty spots. Tertiary or perhaps very early Pleistocene.

Named for occurrence in Little Union Gulch, one-half mile south of ranchhouse on Hatch Ranch, west slope of Mosquito Range, near Leadville, Lake County.

Little Valley Formation

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16 no. 10, p. 1885. Listed as underlying Davis Creek formation and overlying Crack Canyon formation (both new). Comprises Round Mountain member above and Leesville member (both new). Upper Jurassic and Cretaceous section, 40,000 feet thick, consists of sequence of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

†Little Valley Limestone or Formation

Upper Mississippian: Southwestern Virginia.

Paul Averitt, 1941, Virginia Geol. Survey Bull. 56, p. 17–21. Name applied to limestone of Warsaw age that occurs below St. Louis limestone and above Maccrady shale (restricted). Consists of an upper dark-colored unit 100 to 150 feet thick that is generally divided into two parts by beds of argillaceous limestone, and a lower argillaceous and fossiliferous limestone unit approximately 500 feet thick that contains two distinct zones of sandstone.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 69–70. In Tazewell County, Little Valley formation underlies Hillsdale limestone. Thickness about 75 feet. Approximately 2,500 feet stratigraphically above Tonoloway and 4,200 feet above Moccasin formation.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Abandoned by U.S. Geological Survey. Considered equivalent to the part of the Greenbrier limestone underlying the Hillsdale member.

Named for typical exposure in Little Valley, Scott County.

Littel Vermilion cyclothem (in Mattoon Formation)

Little Vermilion cyclothem (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

J. M. Weller *in* C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 14, 16 (fig. 2). A cyclothem overlying LaSalle cyclothem. Includes Litttle Vermilion limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Mattoon formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: SW¼SW¼ sec. 11, T. 33 N., R. 1 E., La Salle County.

Little Vermilion Limestone Member (of Mattoon Formation)

Little Vermilion Limestone (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

J. M. Weller *in* C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 14. Included in Little Vermilion cyclothem in McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), pl. 1. Reallocated to member status in Mattoon formation (new). Only named member of formation in area. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: SW¼SW¼ sec. 11, T. 33 N., R. 1 E., La Salle County.

Little Wabash Sandstone (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 7–8. Coarse, massive sandstone. Overlies a coal about 140 feet above New Haven limestone.

Named because of its prominence along bluffs of Little Wabash River between Concord and New Haven, Ill.

Little Washington cyclothem

Permian (Washington Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 210–213. Embraces interval between Waynesburg "A" cyclothem (new) below and Washington cyclothem above. Thickness about 52½ feet. Includes (ascending) Mannington shale and sandstone, redbed, fresh-water limestone, underclay, Little Washington coal, and Little Washington roof shale members. In some areas, poorly defined and hard to demonstrate owing to coalescing of Mannington and Waynesburg sandstones. In area of this report, Washington series is discussed on

cyclothemic basis; four cyclothems are named. [For sequence see Elm Grove cyclothem.]

Present in Athens County.

Little Washington roof shale member

See Little Washington cyclothem.

Little Waynesburg cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 185–186, 187 (table 25). Embraces interval between Uniontown cyclothem (new) below and Waynesburg cyclothem (new) above. Succession includes six members (ascending): Uniontown sandstone, redbed, Waynesburg limestone, Little Waynesburg underclay, Little Waynesburg coal, and Little Waynesburg roof shale. Consists almost entirely of Uniontown sandstone and the redbed members which grade laterally into each other. Thickness 26 to 45 feet. In area of this report, Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Extensive in Bern, Rome, and Carthage Townships, in hilltops in eastern part of Lodi Township, and along valley of Hocking River and its tributaries in Troy Township, Athens County.

Little Waynesburg rider cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 188. A thin cyclothem, complete to sandstone and redbed members, lying between Little Waynesburg and Waynesburg coal beds.

Discussed in report on Athens County.

Little Waynesburg roof shale member

See Little Waynesburg cyclothem.

Little Waynesburg underclay member

See Little Waynesburg cyclothem.

Little White River Beds[1]

Little White River Formation

Pliocene (Clarendonian): Central southern South Dakota.

Original reference: C. C. O'Harra, 1920, South Dakota Geol. Survey Bull. 13, p. 36.

H. E. Wood, 2d, and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, pl. 1. Shown on correlation chart as Little White River formation; unconformable above Miocene Rosebud beds.

Occurs in Little White River valley and valley of the Niobrara.

Little Willow Series

Precambrian: Central northern Utah.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 3, pl. 1. Sequence of strongly folded gneissic quartzites, quartz-mica schists and stretched-pebble schists, intruded by basic igneous rocks now altered to amphibolites and chlorite-amphibole schists. Oldest rocks exposed in core of Uinta arch structure. Unconformably underlies Big Cottonwood series.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 34, 36, 37 (fig. 2). Precambrian rocks of western Uinta Mountains and central and northern Wasatch Mountains are divisible into two main groups. Older group is subdivided into two sequences: the older, Farmington Canyon complex, and the younger, Little Willow series. The Little Willow differs from Farmington Canyon in that it contains abundant basic rocks and no potash pegmatites. Underlies Big Cottonwood series.

In Little Willow Creek, just north of Little Cottonwood Canyon, in Wasatch Mountains, east of Salt Lake City.

Livengood Chert[1]

Mississippian: East-central Alaska.

Original reference: J. B. Mertie, Jr., 1926, Washington Acad. Sci. Jour., v. 16, no. 3, p. 79.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Exposed in vicinity of Livengood, on Livengood Creek and at Livengood dome, Yukon-Tanana region.

Liveoak Member (of Tejon Formation)

Eocene, middle(?): Southern California.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922. Listed as member of Tejon formation in type area of Tejon. Thickness 1,970 feet. Underlies Metralla sandstone member (new); overlies Uvas conglomerate member (new).

J. G. Marks, 1943, California Div. Mines Bull. 118, pt. 3, p. 535, 536 (fig. 232), 537 (fig. 233). Consists of coarse-grained sediments in lower half and of alternating fine-grained sandstone, silts, and shales in upper half. Conformably overlies Uvas conglomerate member in Grapevine Canyon; rests upon granitic terrane in all other parts of area by either unconformable or fault contact. In its type locality, the Liveoak is only representative of Tejon strata and lies unconformably beneath Tecuya formation. Assigned tentatively to late middle Eocene.

Type locality: Liveoak Canyon, Tehachapi Mountains, Kern County.

Live Oak Bar Formation

Pleistocene: Southern Texas.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1714–1715. Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Inland from a recent offshore bar is line of sand ridges extending through parts of Kleberg, Nueces, San Patricio, Aransas, Refugio, and Calhoun Counties. They have been referred to as Live Oak mature offshore bar (Price, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, p. 907–962). For formation composing this bar, which is correlative with one or more of the Quaternary units, name Live Oak Bar is proposed. Approximately Beaumont age.

Name derived from Live Oak ridge shown on Aransas Pass topographic sheet.

Livermore Gravel[1]

Pliocene, upper, and Pleistocene: Northern California.

Original reference: B. L. Clark, 1930, Geol. Soc. America Bull., v. 41, p. 774, 779, pls. 15. 20.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 47–48, pls. 1, 2, 3. Described in Tesla quadrangle as continental deposits of gravels, sands, and clays 4,000 feet thick. Formation dips at angles of 10° to 30° northward toward Livermore Valley; at different places, rests unconformably on following formations: Neroly, Cierbo, Oursan(?), Panoche, and Franciscan: underlies Tulare formation. Name credited to F. P. Vickery (1925, unpub. ms.)

Crops out from La Costa Valley north to town of Livermore, and eastward from Old Hearst Ranch into Tesla quadrangle.

Livermore Shale Member (of Lykins Formation)

Permo-Triassic: Northern Colorado.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Underlies Poudre limestone member (new); overlies Forelle limestone member.

Liverpool cyclothem (in Carbondale Group)[1]

Liverpool cyclothem (in Spoon-Carbondale Formations)

Pennsylvanian: Western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 188, 192.

J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1589. Restricted below; unit formerly referred to as Lower Liverpool is herein named Abingdon cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 62–63, 85–94, pl. 5. Liverpool is one of most widely exposed cyclothems in area and includes prominent key beds (ascending): Browning sandstone, Colchester (No. 2) coal, Francis Creek shale, Jake Creek sandstone (new), Oak Grove beds, and Purington shale. Maximum thickness nearly 100 feet; minimum about 5 feet; range in thickness due mostly to truncation by Pleasantview sandstone, locally as much as 70 feet. Separated from adjacent cyclothems, Abingdon below and Summum above by major erosional unconformities, the most prominent in Pennsylvanian strata of western Illinois. Gives type exposure.

R. M. Kosanke and others, 1960. Illinois Geol. Survey Rept. Inv. 214, p. 41, 42, 52 (table 2), pl. 1. In Spoon (new) and Carbondale (redefined) formations. Name discontinued in southern Illinois because it included strata not in cyclothem in type area. Name Tonica proposed for strata in northern Illinois previously referred to Liverpool cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois: cyclical classification independent of rock-stratigraphic classification.

Type exposure: In secs. 17 and 20, T. 5 N., R. 4 E., Liverpool Township, Havana quadrangle, Fulton County.

Livingston Conglomerate (in Lee Formation)

Livingston Conglomerate (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: A. M. Miller, 1908, Kentucky Geol. Survey Rept. Prog. 1906, 1907, p. 28.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 90. A channel of conglomerate sandstone at base Pennsylvanian; in Lee formation, below Rockcastle conglomerate.

Occurs on Roundstone Creek, north of Livingston, Rockcastle County.

Livingston Group

Livingston Formation[1]

Upper Cretaceous: Southwestern Montana.

Original references: W. H. Weed, 1893, U.S. Geol. Survey Bull. 105; J. P. Iddings and W. H. Weed, 1894, U.S. Geol. Survey Geol. Atlas, Folio 1; A. C. Peale, 1896, U.S. Geol. Survey Geol. Atlas, Folio 24; R. W. Stone and W. R. Calvert, 1910, Econ. Geology, v. 5, p. 551–557, 652–669, 741–764.

J. S. Vhay, 1939, Am. Geophys. Union Trans., v. 20, pt. 3, p. 433–437. Formation is series of pyroclastic rocks several thousand feet thick cropping out on north side of Beartooth Mountains. These pyroclastic rocks grade laterally into Claggett, Judith River, Bearpaw, and Lennep formations of Montana group. They are of Upper Cretaceous age and antedate Laramide orogeny. Present report describes formation where it is exposed in Nye No. 2 quadrangle along southeast edge of its outcrop. At several places, transition contact with Eagle formation is exposed, and the sandstones contain more and more volcanic material until somewhere in Claggett(?) formation true volcanic conglomerates come in and these give way above to typical pyroclastic rocks. At least 1,000 feet of Livingston is exposed here; upper limit lies outside area. Consists of fine to coarse tuffs, lapilli-tuffs, tuff breccias, and breccias, and some intercalated tuffaceous sandstones. Term agglomerate and tuff-agglomerate might be preferable for many of these rocks. Concluded that much of formation was formed by mudflows and that certain chloritized beds were deposited by hot mudflows.

W. H. Parsons, 1942, Geol. Soc. America Bull., v. 53, no. 8, p. 1175–1186. Name Livingston formation first applied by Weed (1893) to about 7,000 feet of sandstones, shales, and conglomerates north and east of Livingston. Later studies by Stone and Calvert (1910) and others have shown that this formation grades laterally into Claggett, Judith River, Bearpaw, Lennep, Lance, and Fort Union formations and has resulted in considerable remapping of Livingston formation areas. Present-day use of term Livingston formation (Vhay, 1939) often refers only to Weed's (1893) agglomerate member of Livingston—a member mapped as basic andesitic breccia in Livingston Folio (Iddings and Weed, 1894) and including all pyroclastic rocks discussed in present report. In view of changes in use of name Livingston, these pyroclastics are herein called Livingston igneous series. Comprises breccias, tuff-breccias, lapilli-tuffs, tuffs, vent agglomerates, tuffaceous sandstones, and volcanic conglomerates. Thickness at least 2,000 feet in Deer Creek headwaters region; thins to north and west to about 50 feet at Yellowstone River near Springdale, and wedges out southeast of Stillwater River, east of Nye, Mont. Overlies with slight angular unconformity the Eagle, Claggett, and Judith River formations as exposed along Main Boulder and East Boulder River valleys. Northward and northeastward, the gently dipping volcanic series is overlain conformably by Lance sediments; immediately overlying bed has been identified as Hell Creek member of Lance in some areas.

P. W. Richards and G. F. Prichard, 1950, Billings Geol. Soc. [Guidebook] 1st Ann. Field Conf., p. 49–55. Review of literature dealing with Livingston formation and data based on recent field work in Livingston Peak

15-minute quadrangle. Following conclusions presented: (1) Livingston composed largely of volcanic material, most of which was transported only short distance before being deposited in standing water; a wedge-like intercalation of coarse pyroclastics is in part conformable upon older beds in southern part of Crazy Mountain syncline and has very limited extent. (2) Thickness varies from area to area; maximum probably several thousand feet. (3) Equivalent in age to formations from lower part of Fort Union down to Eagle sandstone and, in some areas west of Crazy Mountain syncline, to "Dakota" of early geologists; Livingston is westward and southwestward facies of those formations. (4) Conglomerate wedge which contains water-worn pebbles of many types of sedimentary and volcanic rocks occurs along western edge of Crazy Mountain syncline; was included in upper part of Livingston by Weed and seemingly by Stone and Calvert (1910). This conglomerate may be Piedmont alluvial deposit in Fort Union similar in origin to Kingsbury conglomerate member of Eocene Wasatch along eastern flank of Bighorn Mountains, Wyo. (5) Formation overlain, probably conformably, in much of area by Fort Union formation, and separation of Cretaceous beds from Paleocene beds may be difficult at many places. (6) Member names, leaf beds, volcanic agglomerates, and Livingston conglomerates, given by Weed are not satisfactory in much of area.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, p. 1388 (table 1), 1407–1413, pls. 1, 7. Formation described in Bridger Range, where it is well exposed in eastern quarter of map area. Thickness up to 14,500 feet. Divided into five parts: lower 4,500-foot unit of tuffaceous or andesitic sandstone; finer grained valley-forming unit, about 3,500 feet thick, of siltstone, shale, some andesitic sandstones and fresh-water limestones; conglomerate and andesitic sandstone about 3,500 feet thick; andesitic sandstone about 2,000 feet thick; and upper conglomerate about 1,000 feet thick. Overlies Eagle sandstone (formation) with gradational contact; underlies Tertiary ash, sand, silt, and fanglomerate. In Maudlow basin, directly north of Bridger Range, contains Maudlow conglomerate lentil (new). Lower two units are Cretaceous. Exact position of Cretaceous-Paleocene boundary not known but taken to be boundary between shaly unit and overlying conglomeratic beds. Weed (1893) subdivided formation near Livingston into a lower dominantly andesitic sandstone, called leaf beds, and an upper purple shale and sandstone which graded upward into andesitic sandstone and conglomerate. Locally, in Boulder River area, southeast of Livingston, two major units are separated by series of agglomerates. Weed believed what is now called Eagle sandstone to be Laramie (uppermost Cretaceous) and that overlying beds were Coloradan and Montanan. He mentioned possibility that upper part of Livingston might be equivalent to Fort Union and assigned formation to Cretaceous(?). Units described by Weed correspond to lower three units of Livingston as delimited for area east of Bridger Range. The 2,000-foot sandstone unit and the 1,000-foot conglomerate unit of latter area are not present in vicinity of type locality. Plate 7 shows Livingston interfingers with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 419–422, pls. 34, 35, 36. Formation, in area east and southeast of Livingston, is about 7,000 feet thick and is divisible into five units although there are no sharp

contacts between them. Top of section. Overlies Virgelle sandstone and undivided younger rocks. Upper Cretaceous and Paleocene.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 38–40. Peale (1896) mapped volcanic rocks in Three Forks area and referred them to Livingston formation; he showed them unconformable on the Kootenai (Dakota formation of Peale). Alexander (1951, unpub. thesis) extended name Livingston into Whitehall area and included in formation more than 9,600 feet of andesitic flows and tuffs that are continuous with Elkhorn Mountains volcanics (new) of this report [southern Elkhorn Mountains, Jefferson and Broadwater Counties]. These, he says, are unconformable on folded and truncated Madison. Volcanic rocks in Whitehall area are herein assigned to Elkhorn Mountains volcanics. Although volcanic rocks of Elkhorn Mountains volcanics are partial age equivalents of and compositionally similar to Livingston formation of type area, their modes of origin are distinctly different, and separate formation names are needed. Rocks in the Elkhorn Mountains are largely volcanic outpourings; those of Livingston formation largely sediments composed of volcanic material, of which some—and perhaps most—was derived from erosion of Elkhorn Mountains volcanics.

U.S. Geological Survey currently classifies the Livingston as a group and designates the age as Late Cretaceous on basis of a study now in progress.

Typically developed in vicinity of Livingston, Park County.

Livingston Limestone Member (of Bond Formation)

Livingston Limestone (in McLeansboro Formation[1] or Group)

Livingston Limestone (in Wabash Formation)

Pennsylvanian: Southeastern Illinois and western Indiana.

Original reference: A. H. Worthen, 1895, Illinois Geol. Survey, v. 6, p. 11–19.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 19 (fig. 4), 27. In east-central Illinois, consists of two hard fine-grained light-gray limestones, massive or unevenly bedded, separated by a few feet of shale or clay; total thickness 20 feet or more. Southward shale or clay increases in thickness, coal and underclay appear; two cyclothems are represented which are provisionally termed Lower and Upper Livingston. McLeansboro group.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as limestone in Wabash formation in Indiana.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 83. Member of Bond formation (new).

Type locality: SE¼NW¼ sec. 6, T. 11 N., R. 11 W., Clark County, Ill. Named for Livingston.

Llajas Formation[1]

Eocene, lower and middle: Southern California.

Original references: H. G. Schenck, 1931, California Univ. Pubs. Geol. Sci., v. 19, no. 19, p. 455, footnote 50; J. H. McMasters, 1933, (abs.) Geol. Soc. America Bull., v. 44, no. 1, p. 217–218.

J. A. Cushman and J. H. McMasters, 1936, Jour. Paleontology, v. 10, no. 6, p. 74–77. Name Llajas was originally used informally to designate the series of conglomerate, fine sand, and sandy siltstone underlying Sespe formation and outcropping at and in vicinity of mouth of Las Llajas Canyon. It first appeared in literature in paper by Schenck (1931). McMasters (1933) designated typical exposures. Thickness at type locality, herein described for first time, 1,720 feet. Consists of conglomerate grading upward into oily silty sands which are overlain by 1,600 feet of sandy shales and siltstone. Overlies Santa Susana formation; underlies Sespe formation. Foraminifers described.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Lower and middle Eocene.

Type locality: Several short amphitheaters eroded in northwest side of north branch of Las Llajas Canyon, immediately northwest of mouth of latter, Ventura County. This north branch is locally known as Oil Canyon from presence in it of several small oil seeps.

Llanada Sandstone Member (of Marlife Shale)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Concretionary sandstone 840 feet thick. In upper half of formation. Name credited to D. W. Sutton (unpub. thesis).

Type locality: Moreno Gulch, Fresno County. Name derived from Llanada townsite, east center sec. 19, T. 15 S., R. 10 E.

Llanfair Sandstone Member (of Allegheny Formation)[1]

Middle Pennsylvanian: Southern central Pennsylvania.

Original reference: C. Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133.

Crops out in gorge opposite Henriette shaft No. 1, and exposed along tract near Llanfair shaft No. 2, about 2 miles south of Llanfair, Cambria County.

Llano Series[1]

Precambrian: Central Texas.

Original reference: C. D. Walcott, 1884, Am. Jour. Sci., 3d v. 28, p. 431–432.

Llano de Oro Formation[1]

Pleistocene (Wisconsin): Southwestern Oregon.

Original reference: P. J. Shenon, 1933, U.S. Geol. Survey Bull. 846–B.

F. G. Wells, P. E. Hotz, and F. W. Cater, Jr., 1949, Oregon Dept. Geology and Mineral Industries Bull. 40, p. 17. Described in Kerby quadrangle which includes area mapped by Shenon (1933). Consists of poorly sorted clay and sand with scattered pebbles and cobbles or thin lenses of gravel in sandy silt; commonly rusty red to buff. Maximum thickness 100 feet; commonly less than 50 feet. In some areas, formation has been tilted.

Named for exposures at Llano de Oro mine, Takilma-Waldo district. Well exposed in roadcuts along U.S. Highway 199, south of East Fork of Illinois River, Josephine County.

Llano Estacadan series[1]

Tertiary: New Mexico.

Original reference: C. R. Keyes, 1906, Am. Jour. Sci., 4th, v. 21, p. 298.

†Llano Estacado Formation[1]

Pliocene: Southeastern New Mexico and western Texas.

Original reference: R. T. Hill, 1892, Geol. Soc. America Bull., v. 3, p. 87–100.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 27. Panhandle formation [Panhandle beds] proposed by Gidley (1903) for pre-Clarendonian beds of Texas Panhandle, but commonly treated as Texas equivalent of Ogallala, is not in regular current use in either sense. If an unambiguous term, in the latter sense, is desired, Llano Estacado formation is available.

Plains on Panhandle of Texas and New Mexico.

Llao Rock Dacite Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 34, 36–37. Name applied to dacite flow on Llao Rock. Fills valley in rim of Crater Lake. Flow is more than a mile wide along crest and over 1,200 feet thick in middle, tapering to edges on both sides. On the northeast, tapers rapidly to an edge and ends in mass of pumice nearly 100 feet thick. Llao Rock eruption is younger than Grouse Hill flow (new). [See Sun Creek Dacite Flow].

J. E. Allen, 1936, Jour. Geology, v. 44, no. 6, p. 739–740. Llao flow filled glacial valley cut in northwest side of Mount Mazama and overflowed this valley on both sides. It is 1,200 feet thick at center (as exposed in crater walls) and 400 feet thick at south rim of valley. Extends south from rim of valley for three-quarters mile, thinning as it goes. Northward, steep side of filled glacial valley rises until flow is only 100 feet thick, but lava spreads out laterally for one-quarter mile beyond this point before it pinches out.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 30, 34, 35, 44, 47–49, 137, pl. 12. Thickest lava sheet on walls of Crater Lake. Llao lava escaped from vertical-sided vent on bottom of glacial valley, several thousand feet below former summit of Mount Mazama. Eruption of Llao dacite was preceded by explosions of dacite pumice. Beyond caldera rim, the lava is almost entirely concealed by blanket of pumice. Diller supposed that lava of Grouse Hill was older than Llao Rock flow because it seemed to have suffered more erosion and because it seemed to be partly overlain by same sheet of pumice that underlies dacite cliffs of Llao. First of these arguments is questionable, and second is invalid because pumice on top of Grouse Hill is part of same sheet that lies above Llao flow. There is no way of deciding which of the two flows is older. Probably, they are about same age. Probably erupted about same time as Llao flow.

Llao Rock forms high cliffs on north rim of Crater Lake.

Lloyd Sand Member (of Raritan Formation)

Lloyd Sand[1]

Upper Cretaceous: Southeastern New York and northern New Jersey.

Original reference: A. C. Veatch, 1906, U.S. Geol. Survey Prof. Paper 44, p. 21.

Wallace deLaguna, 1948, New York State Water Power and Control Comm. Bull. GW–17, p. 8 (table 1), 11–12, pl. 2. Raritan formation overlies the

bedrock over most of Long Island and much of Kings County; here consists of two members, an upper clay (unnamed) and lower known as Lloyd sand. The Lloyd consists of beds of coarse white quartz sand and gravel, separated by one, two, or in some places three thin clay partings. Thickness commonly 100 feet; as much as 250 feet on eastern part of island. Name "Lloyd sand", which is in common use, is misleading because it implies that the unit is either a formation or the equivalent of one; proper term is Lloyd sand member.

Named for occurrence in deep well at Lloyd Point, Lloyd Neck, Long Island.

Lobato Basaltic Lavas

Quaternary: North-central New Mexico.

H. T. U. Smith, 1938, Jour. Geology, v. 46, no. 7, p. 959. Named in a list of Quaternary formations in the area. Younger than Canones andesite and older than Puye gravel.

Occurs in Abiquiu quadrangle, Rio Arriba County.

Lobelville Shaly Limestone Member (of Brownsport Formation)[1]

Lobelville Formation (in Brownsport Group)

Middle Silurian: Western and central Tennessee.

Original reference: W. F. Pate and R. S. Bassler, 1908, U.S. Natl. Mus. Proc., v. 34, p. 410–432.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as formation in Brownsport group.

T. W. Amsden, 1949, Yale Univ., Peabody Mus. Nat. History Bull. 5, p. 25. In area of this report [western Tennessee], there does not appear to be any valid basis for subdividing Brownsport into three members or formations. Proposed that terms "Beech River", "Bob", and "Lobelville" be abandoned.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 264–266, figs. 2, 78. Lobelville formation included in Brownsport group. Conformably overlies Bob limestone; where Bob limestone is not typically developed, Lobelville and Beech River, locally in contact, cannot be separated lithologically; unconformably underlies Decatur limestone, a Devonian formation, or Chattanooga shale. In deeper part of structural saddle between Nashville dome and southeastern extension of Ozark dome, thickness averages 35 feet, locally being 40 or 50 feet. Distribution restricted to parts of Hardin, Wayne, Decatur, Perry, and Hickman Counties.

Named for exposures near Lobelville, Perry County. Only complete section is about 1 mile northeast of Lobelville.

Lobitos Mudstone Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1326. Thickness 450 feet. Overlies San Gregorio sandstone member (new); underlies Tunitas sandstone member (new).

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Lobo Formation[1]

Lower Cretaceous(?) or Tertiary(?): Southwestern New Mexico.

Original reference: N. H. Darton, 1916, U.S. Geol. Survey Bull. 618, p. 19, 39.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 109. Age of Lobo uncertain. According to Darton, it may be Permian, Triassic, Jurassic, or Cretaceous. Regional considerations appear to rule out presence of Jurassic rocks. Lobo does not resemble Triassic rocks of central New Mexico and therefore is probably either Permian or Cretaceous in age.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 24–26, 34 (fig. 3). In Cooks Range, Lake Valley quadrangle, formation is 80 to 150 feet thick and consists of reddish-brown sandstones and shales, and chert conglomerates with limestone matrix. Overlies Magdelena group undifferentiated; underlies Sarten formation. No definite proof of actual age. Herein classed as Permian(?).

Christina Lochman-Balk, 1958, Roswell Geol. Soc. Guidebook 11th Ann. Field Conf., p. 46 (fig. 1), 50 (fig. 4), 51–52. Lobo formation overlies Paleozoic section (top of which is Aleman formation) in Capitol Dome section, Florida Mountains. Formation known only in northern part of Florida Mountains where exposures start on northwest side of range, then cross range in southeasterly direction south of Arco del Diablo (Florida Peak) to Lobo Draw, the type locality. Formation overlaps bounding faults of Paleozoic fault block and rests with angular unconformity upon both Ordovician and Precambrian. Its areal distribution in range is same as overlying Tertiary volcanics. Thickness 250 to 350 feet. Age not known. No fossils have been found.

Probably named for occurrence at Lobo Draw on eastern slope of Florida Mountains, Deming region.

Lobster Lake Series[1]

Silurian: Western Maine.

Original reference: F. W. Toppan, 1932, Geology of Maine, Contr. Dept. Geol. Union Coll., Schenectady, p. 70–72.

Well exposed on shores of Lobster Lake [Lobster Pond?], Piscataquis County.

Locatelli Formation

Paleocene: Western California.

E. E. Brabb, 1960, Dissert, Abs., v. 21, no. 5, p. 1163. Oldest sedimentary rocks in area. Underlies Butano sandstone. Rests nonconformably on quartz diorite.

Report discusses Big Basin area, Santa Cruz Mountains.

Lockatong Formation (in Newark Group)[1]

Lockatong lithofacies (of Newark Group)

Upper Triassic: New Jersey and southeastern Pennsylvania.

Original references: H. B. Kummel, 1897, New Jersey Geol. Survey Ann. Rept. State Geologist 1896, p. 40–47; 1897, Jour. Geology, v. 5, p. 544–547.

D. B. McLaughlin and Bradford Willard, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 43. Interpretation of Newark group implies: (1) Brunswick and Lockatong were largely formed contemporaneously as red, torrential and nonred, paludal facies respectively; (2) Stockton and early Brunswick sedimentations were also to a degree contemporaneous; and (3) Newark is not a group of three distinct formations successively

deposited, but a series of interfingering, in part contemporaneously formed, continental facies.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook for Field Trips Atlantic City Mtg., p. 41–44, 51–52, pl. 1. Main body of formation is dark-gray argillite about 2,500 feet thick, with a few red argillite beds. Above this is alternating series of thick gray argillites separated by lesser thicknesses of red. Calculated thickness of southern belt 2,150 feet (plus faulted-out section of possibly 700 feet) as against more than 3,800 feet in northern belt. Distribution noted.

D. B. McLaughlin, 1959, Pennsylvania Topog. and Geol. Survey Bull. C–9, p. 77–91, pls. Lockatong lithofacies described in detail in Bucks County, Pa.

Named for Lockatong Creek, Hunterton. N.J. Crops out in three belts in New Jersey, but only two at Delaware River, owing to dying out of Hopewell fault. South belt less than 2 miles wide between Yardley and Washington Crossing; marginal fault with throw of several hundred feet has eliminated outcrop of lower part at West Trenton. Eastward formation passes under coastal plain sediments. Continues in Pennsylvania, widening in western Bucks County, then narrowing westward and disappearing by fingering out into red shale and sandstone of the Brunswick in Chester County. Northern belt 3 miles wide at the Delaware. East of there, strike curves northward, and full thickness passes through sandstone border facies into coarse fanglomerate at north border several miles northwest of Flemington, N.J. Cut off by east-west Chalfont fault near Bucks-Montgomery County line.

†Lockhart Formation (in Chester Group)[1]

Mississippian: Western Kentucky.

Original reference: F. J. Fohs, 1907, Kentucky Geol. Survey Bull. 9, p. 67.

Probably named for Lockhart, Livingston County.

Lockport Dolomite

Lockport Dolomite (in Niagara Group)[1]

Lockport Formation or Group

Middle Silurian (Niagara Series); New York and Michigan, and Ontario, Canada.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 289, 327.

Charles Butts, 1939, Geologie der Erde, North America, v. 1. p. 372–375. Discussion of Niagaran formations in Michigan, Wisconsin, and Illinois. Upper Niagaran prevails here as in New York; extension of name Lockport to this region to include post-Mayville Niagaran seems justified.

E. R. Cumings, 1939, Geologie der Erde, North America, v. 1, p. 596 (fig. 7), 597. Lockport dolomite at Niagara Gorge divided into (ascending) Gasport dolomite, Suspension Bridge dolomite (new), and Eramosa dolomite members. Thickness 77 feet. Underlies Guelph dolomite; overlies Decew waterlime.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Lockport formation in western New York comprises (ascending) DeCew waterlime, Gasport limestone, Goat Island (replaces

preoccupied Suspension Bridge), Eramosa, and Oak Orchard (new) members.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Group comprises (ascending) Gasport limestone, Goat Island limestone, Eramosa dolomite, Devils Hole dolomite (new), Oakfield limestone (new), and Oak Orchard dolomite. Lockport(ian) stage (new) and Lockport group have same stratigraphical limits—from base of Gasport to top of Guelph—in type section where about 210 feet of limestones and dolomites occur. East of Syracuse, Lockport group grades into dominantly shale for which name Illion is proposed. There is difference of opinion as to whether time break exists between Lockport group and underlying Rochester shale. Some claim that the Brownsport, Waldron, and Laurel fill this "gap." Evidence is not altogether conclusive inasmuch as apparent faunal differences may be due to ecological control. There seems to be physical break between Decew and Gasport in western New York, but no physical break can be seen from Rochester eastward. Decew is transferred to underlying Tonawanda stage (new). Underlies Salina group. Niagaran series. Middle Silurian.

Named for exposures at Lockport, Niagara County, N.Y.

Lockportian Stage

Middle Silurian: North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Niagaran series divided into four stages (ascending): Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian). Lockport stage and Lockport group have same stratigraphical limits—from base of Gasport to top of Guelph. Thickness 120 feet in type section.

Type section: Lockport Township, Niagara County, N.Y.

Loco Diorite[1]

Eocene: Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

At north end of Loco Mountain, Little Belt Mountains.

Locomotive Fanglomerate

Tertiary, middle(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 40–43, pl. 1; 1946, U.S. Geol. Survey Prof. Paper 209, p. 35–39, pl. 3 [1947]. Chiefly coarse alluvial-fan deposits, poorly sorted, with interbeds of tuff and breccia. Some sandstone and shale toward top and in southeasterly exposures. Maximum thickness between 6,000 and 12,000 feet. Interfingers with Ajo volcanics (new). Unconformably overlies Cardigan gneiss (new), Concentrator volcanics (new), and Cornelia quartz monzonite (new): unconformably underlies Sneed andesite (new).

Named from its characteristic exposure at Locomotive Rock, Ajo quadrangle, Pima County. Exposed widely in pediments and lower slopes south and southeast of main mass of Little Ajo Mountains. Small outlier occurs west of Chico Shunie fault.

Locust Grove Diorite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Near Locust Grove, Orange County.

Locust Grove Granite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Well exposed near Locust Grove, Orange County.

Locust Point Formation (in Borden Group)[1]

Lower Mississippian: Southeastern Indiana.

Original reference: P. B. Stockdale, 1931, Geol. Soc. America Bull., v. 42. no. 3, p. 708–716.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 77, 126–147. Includes following facies: Spickert Knob, Schooner Hill, Belmont, and Nelson Hill.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Shown on correlation chart in Borden group, Osage series; underlies Carwood formation; overlies New Providence shale.

Named from topographic prominence on Ohio River bluff, about 1 mile south of Floyd-Harrison County line south center sec. 12, T. 4 S., R. 5 E., and from nearby Locust Point post office, center SE¼ same section.

Lodgepole facies

See **Tongue River Member** (of Fort Union Formation).

Lodgepole Granite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 13, pl 1. Distinguishing features are coarse grain size, seriate texture, and distinct color difference of the two feldspars—potash feldspar is pinkish gray to salmon colored and sodic oligoclase is gray to white. Contact with Giant Forest pluton sharp, but, near south end of Lodgepole mass, scattered outcrops contain gradational types between the two varieties. In some respects, resembles Pear Lake quartz monzonite (new).

Named from exposures near Lodgepole Campground, Sequoia National Park. Granite crops out over about 7 square miles in an elongate body extending from Little Lake to south of Panther Peak.

Lodgepole Limestone (in Madison Group)[1]

Lower Mississippian: Southwestern Montana, northeastern Utah, and western Wyoming.

Original reference: A. J. Collier and S. H. Cathcart, 1922, U.S. Geol. Survey Bull. 736–F, p. 173.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 315–318, measured sections. Includes Paine member below and Woodhurst member above. Overlies Three Forks formation; underlies Mission Canyon limestone. Proposed that term Lodgepole be applied throughout Montana and Wyoming.

M. M. Knechtel, J. E. Smedley, and R. J. Ross, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2395–2411. Subdivided to

include Little Chief Canyon member (new) at base. Overlies Sappington sandstone member of Three Forks shale.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1710–1715, 1716 (fig. 8). Lower formation of Madison group. Thickness 584½ feet at Madison type section. Conformably underlies Mission Canyon limestone at type section of Madison; contact arbitrarily drawn, principally on basis of color change. Unconformably overlies Sappington sandstone at Sappington type section.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51–57. Basal formation of Madison group. Underlies Mission Canyon formation; overlies Sappington formation. Average thickness about 800 feet in western Wyoming; 200 feet in central and eastern Wyoming. Correlates with "Laminated limestones" of Peale (1893), the lower thin-bedded part of the Woodhurst of Weed (1899), lower unit of Madison group of Andrichuk (1955) and the "Madison" as used in most publications concerning the Mississippian of eastern Idaho, northern Utah, and western Wyoming.

W. J. Sando, J. T. Dutro, Jr., and W. C. Gere, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2745 (fig. 2), 2746–2747. Limestones underlying Brazer dolomite, mapped as Madison limestone by Richardson (1913, Am. Jour. Sci., 4th, v. 36, p. 406–416) here assigned to Lodgepole limestone of Madison group. Divided into three mappable members in Crawford Mountains. Thickness 773 feet in Brazer Canyon; 884 feet in Emma Canyon. Overlies "Three Forks" formation.

W. J. Sando and J. T. Dutro, Jr., 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 117–126. Corresponds roughly with Peale's (1893) "Laminated limestones" of Madison limestone. Lower formation of Madison group. Thickness as much as 733 feet. Underlies Mission Canyon limestone. Underlies Brazer dolomite at type section of Brazer; overlies Three Forks formation at Baldy Mountain and Brazer Canyon and Darby formation at Darby Canyon and Haystack Peak. Includes both the "Laminated limestones" and "Massive limestones" of Peale (1893). Coral zonation discussed.

Named for exposure in Lodgepole Canyon, Little Rocky Mountain region, Montana.

Lodgepole Rhyolite and Obsidian (in Gardiner River Rhyolite-Basalt Complex)

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1050, 1054–1055, pls. 1, 2. Term assigned to rhyolite flow that contributed to formation of Gardiner River rhyolite-basalt complex (new). Flow may have been extensive but no large masses uncontaminated by basaltic material have been found. Lithologically, least contaminated Lodgepole is normal gray to buff rock of lithoidal texture carrying abundant phenocrysts of orthoclase and quartz, grading at extreme east and west ends of complex into glassy and spherulitic rock. Relationships indicate that Lodgepole rhyolite, obsidian, and Cataract basalt (new) are younger than Meadow rhyolitic tuff (new).

Present on Gardiner River near Sevenmile Bridge, Yellowstone Park. Narrow zone of outcrops of contaminated rhyolite and obsidian extends southeasterly up river for about two-thirds mile.

Lodi Member (of Trempealeau Formation)

Lodi Shale Member (of St. Lawrence Formation)[1]

Upper Cambrian: Southern Wisconsin, Iowa, Michigan, and eastern Minnesota.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, p. 547.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236 (table 2). Table 2 shows various classifications of late Upper Cambrian strata in upper Mississippi Valley. According to Ulrich (1935, personal commun.) Lodi shale is member of Trempealeau formation; overlies St. Lawrence dolomite member and underlies Norwalk sandstone member. U.S. Geological Survey classification shows Lodi shale as uppermost member of St. Lawrence formation; overlies Mendota dolomite member; underlies Norwalk sandstone member of Jordan sandstone.

C. R. Stauffer, G. M. Schwartz, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1228 (table 1), 1238 (table 2); C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 28 (table 4), 30, 46. In proposed classification of St. Croixian of Minnesota, Lodi is upper member of St. Lawrence; overlies Nicollet Creek member (new); underlies Norwalk member of Jordan formation.

G. O. Raasch, 1939, Geol. Soc. America Spec. Paper 19, p. 96 (fig. 5), 97–113, 114 (fig. 14). Member of Trempealeau formation. Overlies St. Lawrence member; underlies Jordan member.

G. V. Cohee, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. chart 9. Member of Trempealeau formation in Michigan. Commonly white to buff dolomite which may be slightly sandy in part; purple dolomite may be present in basal part. Underlies Jordan sandstone member; overlies St. Lawrence member. Thickness 350 feet in Voss well, Washtenaw County.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 169 (fig. 2), 170 (fig. 3), 171, 173–176, 178, 179, 180, 181, 182. Term Lodi retained for dolomitic siltstone and sandstone member of St. Lawrence formation in upper Mississippi Valley. Occurs above Franconia formation and beneath Jordan formation. Vertically succeeds Black Earth member in basinward exposures; elsewhere, occurs beneath dolomite beds of Black Earth member as well as above it. At Arcadia, Wis., strata beneath the dolomite are regarded by Raasch (1952) as type Arcadia member of Trempealeau; except for presence of *Osceolia* fauna, on which basis they were designated Arcadia member, these beds do not differ from beds above the dolomite; these upper beds Raasch (1939) called Lodi, presumably because they contain the upper *Dikelocephalus* zone fauna. North of Arcadia, as at Ridgeland, the Lodi is continuous from the Franconia to the Jordan. Lodi shows facies change from basinward exposures to shoreward areas to the north. At Victory, Lodi is terminated by 6 feet of sandy dolomite, included in basal Jordan by Twenhofel, Raasch, and Thwaites (1935, Geol. Soc. America Bull., v. 46, no. 11, p. 1734), but here included in Lodi. Measured sections show thickness ranges from 2 to 43½ feet.

Presumably named for exposures at or near Lodi, Columbia County, Wis.

Lodo Formation

Paleocene and Eocene: Central California.

R. T. White. 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. Defined as disconformably overlying Moreno shale and conformably underlying Domengine formation. Includes Martinez(?) formation of Anderson and Pack (1915, U.S. Geol. Survey Bull. 603), plus a new member, Cerros shale, between Cantua sandstone member and Moreno shale. At type locality, Lodo formation is composed of 1,150 feet of claystone. Four miles south, the Cantua appears as lens in middle of unit. At this point and southward, the Lodo is divisible into (ascending) Cerros member, Cantua sandstone member, and Arroyo Hondo member. Eocene.

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1735–1745. Formation described in Coalinga district. Underlies Yokut sandstone (new). Thickness varies from zero, at north and south ends of its exposures, where it is overlapped by the Domengine, to more than 5,000 feet east of San Carlos Creek.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 208. Described in San Benito quadrangle as represented by about 300 feet bluish-gray foraminiferal clay-shale occurring in narrow belt along southwest side of Butts Ranch syncline. Overlies Big Oak Flat shale and sandstone member (new) of Panoche group. Underlies Yokut sandstone. Middle Eocene.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 15. Described in Fresno County in area of type Moreno. About 428 feet thick. Overlapped by Domengine.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. Described in Tumey and Panoche Hills, Fresno County, where it is 1,197 feet thick and includes (ascending) Cerros shale, Cantua sandstone, and Arroyo Hondo shale members. Overlies Moreno formation; underlies Yokut sandstone. Paleocene and Eocene.

Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 45, 46, 281–282.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 45, 46, 281–282. Term Lodo extended to include Mabury and Gredal formations of Van Couvering and Allen (1943) plus an unnamed unit beneath them. [Mallory states he proposed this change in 1953 and cites Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2781. This is an abstract in which Paleocene and Eocene stage names were proposed. No rock-stratigraphic terms were mentioned in this abstract.] Term Lodo further extended to south of Devils Den area to region of Temblor Hills and Media Agua Creek to be used for an unnamed lower Tertiary unit mapped by English (1921, U.S. Geol. Survey Bull. 721) as Cretaceous below Tejon formation. Lodo formation is included in Ulatisian stage. Acebedo member of Lodo mentioned on page 46.

Type locality: Lodo Gulch, about one-half mile south of junction of Panoche and Silver Creeks, in NE¼ sec. 29, T. 15 S., R. 12 E., in Tumey Hills, on west side of San Joaquin Valley, Fresno County.

Lodore Formation[1] or Shale[1]

Upper Cambrian: Northwestern Colorado, northeastern Utah, and south-central Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains: U.S. Geol. and Geog. Survey of Terr., 2d div., p. 41, 56, 58, 144–147.

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p. 689 (table 1). Formation described in Green and Yampa River Canyons. White to red coarse poorly sorted quartzitic and in part arkosic sandstones at top, middle, and base; middle part glauconitic; sandstone members separated by two layers of silty shale containing thin sandstone beds which are frequently somewhat glauconitic and fossiliferous. Thickness 350 to 400 feet. Unconformable below Madison formation and above Uinta Mountain group. Upper Cambrian.

Christina Lochman-Balk, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 29. Proposed that term Lodore be adopted for all thin wedge-edge sandstones of Upper Cambrian age in south-central Wyoming.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 22–24, pls. 1, 6. At type section in Dunn's Cliff (now known as Limestone Ridge), formation is 460 feet thick and consists of soft sandstone and shale with conglomerate at base. At section, 1 mile north of Hells Half Mile on Green River and 2 miles west of type locality, formation is about 440 feet thick. At this locality, lower 290 feet of tan to reddish sandstone is very feldspathic at base and grades upward into green micaceous sandy shale and sandstone 150 feet thick. In area of present report [Uinta River-Brush Creek area, Utah], formation consists of light-gray to pink coarse-grained massive to thick-bedded and cross-laminated, arkosic sandstone as much as 155 feet thick. Unconformably overlies Uinta Mountain group; underlies unnamed Mississippian limestone unit.

W. E. Hallgarth, 1959, U.S. Geol. Survey Oil and Gas Inv. Chart OC–59. At Cross Mountain, Colo., formation is exposed in canyon walls of Yampa River. Lower 150 feet consists of red and gray irregularly bedded crossbedded conglomerate and interbedded sandstone. Upper 100 feet consists of interbedded red and green, partly glauconitic shaly sandstone and sandy shale. Angular unconformities present at both base and top of formation.

Type locality: Dunn's Cliff (now known as Limestone Ridge). Named for Lodore Canyon, Moffat County, Colo.

Logan Fire Clay (in Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 713, 901.

Named for Logan, Hocking County.

Logan Formation[1]

Mississippian: Ohio and northeastern Kentucky.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 62, 76, 79, 80, 87.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 53–64. Three lithologic facies distinguished in formation: Vanceburg siltstone, Scioto Valley shale, and Pretty Run sandstone (new). In area of Vanceburg, facies includes (ascending) Buena Vista sandstone, Rarden shale, Vanceburg siltstone, Churn Creek siltstone and shale, and Vinton sandstone members; in Scioto Valley, facies includes (ascending) Buena Vista sandstone, Portsmouth shale, and Vinton sandstone mem-

bers; in Pretty Run, facies includes (ascending) Berne conglomerate, Byer sandstone, Allensville conglomerate, Vinton sandstone, and Rushville shale members. Overlies Cuyahoga formation; underlies basal Pennsylvanian Pottsville except in south-central part of State where, at a few places at easternmost outcrops of Mississippian, Maxville limestone lies between the Logan and Pottsville.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 25, 26–28. In Toboso, Granville, and Hocking Valley provinces, comprises (ascending) Byer, Allensville, and Vinton members; elsewhere not subdivided. Possibly a fourth member should be recognized; Andrews (1878) proposed Rushville for member at top of Logan. Included in Waverly series. [Facies as used by Holden not recognized in this report.] Editor's note stages that Hyde (1921, Ohio Geol. Survey Bull. 23) correlated Buena Vista sandstone, with Berne and lower part of Byer in discussing geology of Camp Sherman quadrangle; such a correlation would necessitate placing the Rarden, Vanceburg, Churn Creek, and most of Portsmouth shale in Logan formation.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 84). Shown on correlation chart as Osagean series.

Named for Logan, Hocking County, Ohio.

†Logan Group[1]

Mississippian: Ohio.

Original reference: E. Orton, 1880, Review Strat. Geology Eastern Ohio, p. 14.

Probably named for Logan, Hocking County.

Logan Limestone[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 787, 790, 805.

Crops out near Logan Furnace, Mifflin County.

†Logan Limestone or Flint (in Logan Formation)[1]

Mississippian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 900–901, pls. opposite p. 889, 900, 921, 933.

Probably named for occurrence in Logan formation, at Logan, Hocking County.

†Logan Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 178.

Named for Logan, Logan County.

Logan Shale[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 787.

Mifflin County.

Logana Member (of Lexington Limestone)

Logana Bed[1]

Logana Formation (in Lexington Group)

Middle Ordovician: Central Kentucky.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 9, 19.

G. G. Huffman, 1945, Jour. Geology, v. 53, no. 3, p. 169. Inasmuch as the Hermitage has its type locality in Tennessee and since the Hermitage of central Tennessee may contain strata of Curdsville age, retention of name Logana for strata immediately above the Curdsville of Kentucky is urged.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 12. A formation in Lexington group. Consists of thin-bedded fine-grained blue-gray argillaceous limestone with large amount of interbedded shale. Thickness about 35 feet. Overlies Curdsville limestone; underlies Jessamine limestone.

Named for Logana, Jessamine County.

Logan Branch Member (of Stonehenge Limestone)

Lower Ordovician (Canadian): Central Pennsylvania.

A. C. Donaldson, 1960, Dissert. Abs., v. 20, no. 9, p. 3693. Uppermost member; overlies Baileyville member (new). Characterized by oolitic fossiliferous calcarenites and calcirudites.

Type locality and derivation of name not stated.

Logan Hill Formation

Pleistocene, lower: Southwestern Washington.

P. D. Snavely, Jr., and others, 1951, U.S. Geol. Survey Coal Inv. Map C–8, sheet 1. Partly consolidated fluvial deposits of gravel and sand with minor amounts of silt and clay. More than 150 feet thick. Near Bucoda, formation rests on erosion surface that truncates Smith coal bed.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 67–72, chart 1, pls. 1, 4. Described in Centralia-Chehalis district. Deposited on old land surface of mature relief. Average thickness 75 to 100 feet; may exceed 200 feet in areas where old channels have been filled.

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (chart), 37–38, pl. 1. Described in Toledo-Rock Castle coal district where it is about 250 feet thick. Unconformably overlies Wilkes formation. Underlies alpine drift.

Type area: Roadcuts and canyons on Logan Hill, Thurston and Lewis Counties. Caps hills between Skookumchuck River and Hanaford Creek and flat-topped upland surface that forms Logan Hill.

Logansport Formation (in Midway Group)

Paleocene: Northwestern Louisiana and northeastern Texas.

Grover Murray, Jr., 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941–942. Consists of basal sand member, middle lignitic shale member, and upper calcareous member. Underlies Hall Summit formation (new); overlies Naborton formation (new).

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept., Conserv. Geol. Pamph. 3, p. 13. Includes (ascending) Dolet Hills, Cow Bayou, and Lime Hill members (all new).

G. E. Murray. Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 57–58. Includes all strata overlying Naborton beds and underlying Hall Summit formation; both contacts gradational. Type locality designated. Mapped in Texas. Paleocene.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 101–127. Described in De Soto and Red River Parishes. Includes (ascending) Dolet Hills, Cow Bayou, and Lime Hill members. Underlies Naborton formation; underlies Hall Summit formation. Midway group.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull. 34, p. 52. Term Logansport discontinued in Sabine Parish. Members raised to formational rank.

Type locality: Eastern side of Sabine River just above bridge at Logansport, De Soto Parish, La. Outcrop belt extends into Shelby and Panola Counties, Tex.

Logansport Limestone

Middle Devonian: North-central Indiana.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 259–260. Consists of 12 feet of light-colored granular limestone; fossiliferous in upper half. Overlies Silurian at type section. Previously correlated with Onondaga limestone.

Type locality: Pipe Creek Falls, 2 miles above junction of Pipe Creek and Wabash River, 7 miles above Logansport, Cass County.

Loggy Bayou Member (of Hall Summit Formation)

Paleocene (Midway): Northwestern Louisiana and northeastern Texas.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13, 14. Named in stratigraphic summary of Louisiana lignite district. Name credited to G. Murray, Jr.,

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 59; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 128, 129–130, pl. 10. Consists of massive to broken sands with subordinate amounts of sandy shale and clay-ball conglomerates; locally contains small amounts of glauconite; becomes lenticular and difficult to trace over northern half of Sabine uplift. Thickness 20 to 60 feet. Underlies Grand Bayou member; overlies Lime Hill member of Logansport formation; all contacts gradational. Type locality designated. Mapped in Texas. Paleocene.

Type locality: Exposures at and in vicinity of Yellow Bluff in NW¼ sec. 8 and SW¼ sec. 5, T. 14 N., R. 10 W., near junction of Love Lake and Loggy Bayou, Red River Parish, La. Reaches maximum development along escarpment west of Joaquin, Shelby County, Tex.

Log Springs Formation

Lower Pennsylvanian (Morrow): Northern New Mexico.

A. K. Armstrong, 1955, New Mexico Bur. Mines Mineral Resources Circ. 39, p. 5, 9–10, figs. 2, 4, 5, 6. Consists of shales, sandstones, and congolmerates. Basal shale is highly ferruginous, with numerous oolites of hematite, followed by medium-bedded series of deep-red shales, sand-

stones, and conglomerates. Sandstones tend to form small prominent ledges. Thickness of formation ranges from 10 to 75 feet. Unconformably overlies Mississippian strata in Sandia, Jemez, Nacimiento, and San Pedro Mountains; unconformably overlies Arroyo Penasco formation (new) at type section; underlies Sandia formation and in some areas unit referred to as Madera(?).

Type section: In Penasco Canyon, Nacimiento Mountains, NW¼SE¼ sec. 5, T. 16 N., R. 1 E. Name derived from Log Springs in Penasco Canyon.

Logtown Ridge Formation (in Amador Group)

Upper Jurassic: East-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283. Upper formation of Amador group at its northern type section. Consists of flows, tuffs, and fine to coarse augite andesite agglomerates; they are 2,700 feet thick along west side of Mother Lode Highway but thin and become finer in grain toward the west where they are several times repeated by folding. Overlies Cosumnes formation (new).

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 11–12, pls. 1, 2. Described in Angels Camp and Sonora quadrangles, Calaveras and Tuolumne Counties, where it consists predominantly of metamorphic rocks derived from coarse-grained generally mafic pyroclastics, mafic tuff, mafic flows felsic tuff, and a few thin beds of tuffaceous shale. Thickness 1,500 to 2,600 feet; in many parts of Sonora quadrangle, formation has been cut out by intrusive bodies and faults. Overlies Cosumnes formation; underlies Mariposa formation, and in some areas contact is depositional, in others it is unconformable. Age considered to be Middle or Upper Jurassic.

Type locality: At northern type section of Amador group on Cosumnes River, El Dorado and Amador Counties.

Lohali sandstones[1]

Jurassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 337.

Occurs near Lohali, Apache County, west of Chinle, and northwest of Fort Defiance.

Lohn Shale Member (of Thrifty Formation)[1]

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 408.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 122, 125–126. Drake gave name "Lohn bed" to coal-bearing shale overlying Speck Mountain limestone and underlying Chaffin limestone, near settlement of Lohn. Thickness of Lohn varies, partly because of unconformable relations that it bears to Parks Mountain sandstone, which in some places cuts it out, and partly because of another somewhat higher unconformable sandstone, which in places cuts into it. Thickness about 66 feet in Coleman County.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 72. Because Drake's descriptions apply chiefly to beds in vicinity of Colorado River and southward, his terminology may not apply perfectly to beds to the

north where differences exist in the stratigraphy. He described as one unit the shale and sandstone sequences overlying the Speck Mountain limestone member which extend up to next highest persistent limestone, the Chaffin member. He named the unit the Lohn bed. This terminology applies to sequences as they crop out south of Home Creek in southern Coleman County. He concluded that the Chaffin member splits into two beds north of Home Creek; his Lohn bed from there northward extends up to his lower Chaffin limestone bed. In present study, Drake's lower Chaffin was found to be Breckenridge limestone member, which does not extend south of vicinity of Home Creek. His Lohn bed includes thicker stratigraphic interval south of Home Creek than that north of creek. For that reason, name Lohn is discarded as stratigraphic name for use in eastern Coleman and northwestern Brown Counties.

Named for Lohn, McCulloch County.

Lohrville Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

†Lolo Series[1]

Precambrian (Belt Series): Central western Montana and Idaho.

Original reference: W. Lindgren, 1904, U.S. Geol. Survey Prof. Paper 27, p. 16, 34.

Near Lolo Pass, northern Bitterroot Mountains.

Loma Blanca Tongue (of Yegua Formation)

Eocene (Claiborne): Southwestern Texas.

W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1374–1375. Referred to as Loma Blanca oyster horizon of [F. C.] Owens.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 265–266. Suggests that F. C. Owens' Loma Blanca sandstone member be enlarged to include all of an upper sandstone tongue of the Yegua which lithologically cannot be subdivided on American side of Rio Grande. Locally there are several thin lenses of shale, sandy shale, and red streaks, but these are not easily traced. East of Falcon is 400 feet thick but east of Laredo has completely lensed out, having interfingered with a predominantly nonmarine section of red and green bentonitic shales.

Basal beds well exposed on Loma Blanca (white hill), Arroyo Clareno quadrangle.

Loma Plata Limestone

Cretaceous (Comanche Series): Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981; 1958, Texas Univ. Bur. Econ Geology, Geol. Quad. Map 22. Name applied to strata between cap rock of Benevides formation (new) and base of Grayson marl. Consists of lower nodular slope-forming limestone member, 340 feet thick, and an upper cliff-forming limestone member that is thick bedded, massive, light brownish gray, cherty and siliceous, rudistid bearing, and fine to medium crystalline. Total thickness 720 feet. Gradational into Grayson formation through an interval of 40 feet.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. In area of this report (Van Horn Mountains), the Loma Plata is restricted to southern half of area. Thickness 685 feet. Divided into two unnamed members. Overlies Benevides formation; underlies Eagle Mountains sandstone.

Type section for lower part is measured section 12 and for top is measured section 13, Pinto Canyon area, Presidio County.

Lombard facies (of Big Snowy Group)

Upper Mississippian: Central Montana.

O. D. Blake, 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 64 (fig. 1), 65–68. To south and west characteristic lithologies of Tyler, Heath, and Otter formations of group are blended into single unit to which term Lombard facies is applied. Thickness commonly 200 to 300 feet; more than 450 feet at Sawmill Creek in southern part of Castle Mountains. Lies above Kibbey formation and below Alaska Bench limestone or Amsden dolomite.

Named for exposures in vicinity of Lombard Station on Missouri River.

Lomita Marl Member (of San Pedro Formation)

Lomita Formation[1]

Lomita Marl

Pleistocene, lower: Southern California.

Original reference: U.S. Grant 4th and H. R. Gale, 1931, San Diego Soc. Nat. History Mem., v. 1, p. 42–43, 61.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 42–53, pls. 1, 13, 14. Described as Lomita marl formation. Occurs at base of lower Pleistocene deposits. In San Pedro where units are superimposed, the sequence is (ascending) Lomita marl, Timms Point silt, and San Pedro sand. Maximum exposed thickness 60 to 70 feet; computed thickness in San Pedro about 100 feet. Type region designated.

J. F. Poland, A. M. Piper, and others, 1956, U.S. Geol. Survey Water-Supply Paper 1109, p. 38 (table), 61, pl. 3. Rank reduced to member of San Pedro formation.

Type region: Near Lomita quarry, in western part of Gaffey syncline, Los Angeles County.

Lonaconing Sandstone (in Conemaugh Formation[1] or Group)

Pennsylvanian: Western Maryland and southwestern Pennsylvania.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 573.

W. O. Hickok, 4th, and F. T. Moyer, 1940, Pennsylvania Geol. Survey 4th ser., Bull. C–26, p. 98, fig. 21. Section northeast of Connellsville shows 20 feet of dark clay shale which contains plant fragments; near top of clay are several lenses of coal as much as 1 foot thick; coal lenses are inclined 10° to 15° to major bedding of the shale. Overlies Morgantown sandstone; underlies Clarksburg red shale. Included in Lonaconing subdivision of Conemaugh group.

Named for exposures along Georges Creek, south of Lonaconing, Allegany County, Md.

†Lone limestone[1]

Upper Silurian: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 37.

Lone quartzite[1]

Upper Cambrian: Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 8.

Well exposed in Lone Mountain, near Silver City, Grant County.

Lone Butte Limestone Member[1] (of Jefferson Limestone)

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 43.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4 (facing p. 1788). Age shown as Upper Devonian on correlation chart.

Type locality: On southeast side of southern spur of Lone Butte, in NE¼ sec. 26, T. 23 N., R. 13 W. Known only in five sections: Lone Butte, Spotted Bear Mountain, Pentagon Mountain, Prairie Reef-White Ridge, and Dearborn.

Lone Camp Group

Pennsylvanian (Strawn Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Beds between the Millsap Lake and Graford (restricted) groups herein divided into two groups, a lower Lone Camp group and an upper Whitt group with common boundary at disconformity between the Strawn and Canyon series. Lone Camp comprises Garner formation below and East Mountain shale above. Term Lone Camp limestone appeared in the Parker County, Tex., outcrop may in 1930, but did not come into common usage because this thin limestone had been named Dog Bend on Palo Pinto County outcrop map published in March, 1929.

M. G. Cheney and D. H. Eargle, 1951, Geologic map of Brown County, Texas (1:62,500): Texas Univ. Bur. Econ. Geology. Group includes named units (ascending) Ricker Station limestone, Ricker sandstone and Capps limestone. Underlies Whitt group.

Named from village of Lone Camp, 12 miles southwest of Mineral Wells, Palo Pinto County.

Lone Camp Limestone (in Mineral Wells Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: G. Scott and J. M. Armstrong, 1930, Geologic map of Parker County: Texas Univ. Bur. Econ. Geology.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 88. Term Lone Camp limestone appeared in the Parker County outcrop map in 1930. Name did not come into common usage because this thin limestone had been named Dog Bend limestone on Palo Pinto

County outcrop map published in March, 1929. Term Lone Camp is used in present report as a group term to include Garner and East Mountain formations.

†Lone Grove Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lv, 255–267, pl. 3.

Named for Lone Grove, Llano County.

Lone Mountain Dolomite

Lone Mountain Limestone[1] or Formation

Silurian: Eastern Nevada.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 262, 267.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 10–14. Lone Mountain limestone, as orignally defined, embraced deposits of both Ordovician and Silurian age. Unit is herein restricted, and name Lone Mountain formation retained for a discrete lithologic unit representative of the higher Silurian but possibly including in its upper 350 feet beds of Lower Devonian (Helderbergian) age. Name Hanson Creek formation applied to the Ordovician unit and Roberts Mountains formation to the fossiliferous Silurian unit. Thickness of restricted formation at type section 1,570 feet. Underlies Nevada formation (redefined).

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 37–80. Lone Mountain dolomite described in vicinity of Eureka, where it ranges in thickness from 1,500 to 2,200 feet. Overlies Roberts Mountains formation; underlies Beacon Peak dolomite member (new) of Nevada formation.

Type locality: Lone Mountain, about 18 miles north of Eureka, Eureka County.

Lone Oak Limestone Lentil (in Kincaid Formation)[1]

Eocene: Northeastern Texas.

Original reference: F. B. Plummer, 1933. Texas Univ. Bull. 3232, p. 536, 539, 553.

Well exposed at Lone Oak quarry west of Lone Oak, Hunt County.

Lonesome Formation

Upper Jurassic(?): East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 265–266. Consists of black shale with intercalated beds of massive blue-gray sandstone and conglomerate. In South Fork Valley, lower part of section shows three conglomeratic beds, each about 100 feet thick, alternating with black shale beds of equal thickness. Thickness of formation along South Fork River about 4,000 feet. Beds dip at angles of 80° to 90° in South Fork syncline and some are overturned. Unconformably overlies Trowbridge shale (new).

Type area: Extends from Spoon Creek region on Snow Mountain northeast across South Fork Valley along axis of a syncline which adjoins

the southeast side of Mowich anticline. Named for Lonesome Creek, a tributary of Lewis Creek, in South Fork Valley, Crook County.

Lone Star Formation[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 7.

Named for exposures on east slope of Lone Star Mountain, British Columbia.

†Lone Wolf Sandstone[1]

Permian: Southwestern Oklahoma.

Original reference: L. T. Patton, 1926, Am. Jour. Sci., 5th, v. 12, p. 194–196.

Named for development near town of Lone Wolf, Kiowa County.

Longarm Quartzite (in Snowbird Group)

Precambrian (Ocoee Series): Western North Carolina.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 954, 955 (table 1), 956 (fig. 3). Consists largely of clean feldspathic quartzite and arkose, dominantly light, medium bedded, and medium to very coarse grained; most layers current-bedded; interbedded with quartzite and arkose, especially in upper part, are many beds 1 to 3 feet thick of darker fine-grained sandstone. Thickness at type locality about 5,000 feet; thins and eventually pinches out a short distance southeast of Great Smoky Mountains. Conformably overlies Wading Branch formation (new) with contact gradational over several tens of feet; overlies and intertongues with Roaring Fork sandstone (new).

Type locality: Along Pigeon River at north base of Long Arm Mountain, which lies west of the Pigeon River about southeast of Waterville, Haywood County. Forms substantial part of group near Pigeon River and eastward, where it projects in ridges of intermediate height; appears in limited areas as far southwest as Cherokee.

Long Beards Riffs Sandstone[1]

Upper Devonian: Southwestern New York.

Original reference: D. D. Luther, 1902, New York State Mus. Bull. 52, p. 619.

Frederick Houghton, 1942, Hobbies, v. 22, no. 3, p. 48. Considered a lentil in the Wiscoy or in lower part of the Gowanda shale in which such sandstone layers are numerous.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Prelim. Chart 37. Abandoned. Field evidence indicates that sandstones at the riffle are similar in lithology to siltstones in basal part of the Dunkirk rocks on Wiscoy Creek. However, because identification of unit is open to question at any place other than the type exposure, it does not seem advisable to retain a name for such a local and indefinite unit.

Named from exposures on Genesee River in sides and bottom of river channel 1 mile south of Fillmore, Allegany County, where it forms "Long Beards riffs". Also exposed in north wall of ravine falls at Wiscoy.

†Long Beach sand[1]

Eocene: Eastern New Jersey.

Original references: S. Weller, 1905, New Jersey Geol. Survey Ann. Rept. 1904, p. 147, 157; 1905, Jour. Geology, v. 13, p. 76.

Long Canyon Member (of Las Posas Formation)[1]

Pleistocene: Southern California.

Original reference: E. D. Pressler, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, no. 13, p. 325–345.

Occurs in Long Canyon, on southern slope of South Mountain, Ventura County.

Long Canyon Sandstone (in Panoche Group or Formation)

Upper Cretaceous: Central western California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2), 993. Panoche group (or formation) is subdivided into 10 units. Long Canyon sandstone is second in sequence (ascending). Underlies Lower Waltham shale (new); overlies Curry Mountain shale (new). Long Canyon sandstone is assigned to Delevanian stage (new). Name credited to J. Q. Anderson.

Occurs in Alcalde Hills, Coalinga-Ortigalito area, San Joaquin Valley.

Long Creek Limestone Member (of Foraker Limestone)

Long Creek Limestone[1]

Long Creek Limestone Member (of Konawa Formation)

Permian: Southeastern Nebraska, northeastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 85, 88.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 103. Limestone member of Foraker limestone. Identifiable in southern Kansas and northern Oklahoma.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 168; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Alternating beds of yellow limestone and shale, or thin-bedded limestone, locally containing abundance of fusulines in northern part of outcrop area; in southern Kansas, light-gray limestone, more or less massive in upper and lower parts and sparsely fossiliferous. Thickness 5 to 8 feet. Overlies Hughes Creek shale member; underlies Johnson shale. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 83–85, pls. 1, 2, 3, 4. Persists as far south as T. 16 N., in southern Lincoln County. In northern Osage County, consists of shaly limestone and shale and minor amounts of chert. Ranges in thickness from 9.8 to 12 feet. In Pawnee County, consists of interbedded dense gray limestone and gray marly shale; no chert. Thickness as much as 25.3 feet; entire sequence seldom exposed at one place. Overlies Hughes Creek shale member; underlies Johnson shale.

A. E. West, 1960, Shale Shaker, v. 11, no. 3, p. 4–6. Described in Lincoln County, Okla., where it is classified as member of Konawa formation. Thickness 55 to 60 feet. Overlies Americus(?) limestone member; underlies Red Eagle limestone member.

Named for exposures on Longs Creek, at foot of bluff west of cemetery at Auburn, Nemaha County, Nebr.

Longdale Limestone[1] Member (of Lewistown Limestone)

Lower Devonian: West-central Virginia.

Original reference: R. J. Holden, 1920, (abs.) Geol. Soc. America Bull., v. 31, p. 137.

F. M. Swartz *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 69. Name Long Dale abandoned since Holden's data was never published and occurrences in type area was never described. Licking Creek limestone extended for use in area.

Probably named for Longdale, Alleghany County.

Long Draw Glacial Substage

Pleistocene (Wisconsin) : Southern Rocky Mountains.

L. L. Ray, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; Kirk Bryan and L. L. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 34–35; L. L. Ray, 1940, Geol. Soc. America Bull., v. 51, no. 12, pt. 1, p. 1862. Fourth of five glacial substages in southern Rocky Mountains. Followed Corral Creek substage and preceded Sprague substage.

Named for moraine in small valley tributary to Long Draw, sec. 17, T. 6 N., R. 75 W., approximately 4 miles upstream from moraines of Corral Creek substage, Cache la Poudre Valley.

Longfellow Limestone[1]

Upper Cambrian and Lower Ordovician: Southeastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. In stratigraphic section of rocks in southern Arizona.

Exposed in Longfellow incline and Longfellow mine, Morenci district.

Long Island Beds (in Ash Hollow Formation)

Pliocene, lower: Western Kansas.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 144. Mentioned in article on Tertiary prairie grasses from high plains. Rhinoceros Hill sands may belong in channel of same late Tertiary river system as Wray beds and Long Island beds and are probably nearly or quite contemporaneous with them.

Type locality and derivation of name not given.

†Long Island division[1]

Tertiary: Southeastern New York.

Original reference: W. W. Mather, 1843, Geology New York, pt. 1, p. 246.

In Oyster Bay and Hempstead quadrangles on Long Island.

Long Lake Gneiss[1]

Precambrian: New York.

Original reference: H. P. Cushing, 1907, New York State Mus. Bull. 115, p. 463–469.

Long Lake quadrangle, Adirondack Mountains.

Long Lake Series[1] or Stage

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 184.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 573. Long Lake series and its synonym, Presque Isle series or stage, are abandoned.

Probably named for Long Lake, in Presque Isle and Alpena Counties.

Longmeadow Sandstone[1]

Upper Triassic: Central Connecticut and central Massachusetts.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 451–456.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Name replaced by Turners Falls sandstone (new) in Greenfield and nothern part of Mount Toby quadrangle. Unit can not be traced into this area from its type area.

Robert Balk, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 496–497, pl. 1. Maximum thickness in Mount Holyoke quadrangle about 2,000 feet. Earliest beds older than Granby tuff, middle and upper parts younger than Granby.

Named for occurrence at Longmeadow, Mass.

Longmire Acid Breccias

See Keechelus Andesitic Series.

Long Mountain Granite

Upper Devonian: Northern New Hampshire.

R. W. Chapman, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2 p. 1187. Mentioned as a binary granite. Belongs to the New Hampshire magma series.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1079–1080, pl. 1. Described as light-gray medium-grained granite of uniform grain size. Locally porphyritic. Forms stocklike intrusion. Cuts Albee formation and is cut by narrow alkaline dike of the White Mountain magma series. Also locally intruded by small pegmatite dikes.

Type locality: Northern ridge of Long Mountain in northern part of Percy quadrangle, Coos County.

†Long Mountain Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lv, lvi, 255–267, pl. 3.

Named for Long Mountain, Llano County.

Long Savannah Formation

Middle Ordovician (Mohawkian): Southeastern Tennessee, Alabama, and northwestern Georgia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 75–76, chart 1 facing p. 130. Red dolomitic mudstone and interbedded buff earthy limestones. Basal layers contain detrital chert and some minor quartz sand. Thickness 50 to 175 feet. Underlies Mahan formation (new); overlies Lower Ordovician limestones and dolomites.

Type section: Exposed along Mahan Gap Road, Snow Hill quadrangle. Named from Long Savannah Creek just northeast of Snow Hill, Snow Hill quadrangle, Hamilton County, Tenn. Occurs in belts northwest of White Oak Mountain fault in southern Tennessee, Georgia, and Alabama.

Longs Peak Granite[1]

Precambrian: Central northern Colorado.

Original reference: M. B. Fuller, 1924, Jour. Geology, v. 32, p. 51–63.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 29. Included in Silver Plume granite in the Front Range area.

Named for Longs Peak, a large part of whose bulk is made of this granite.

Longs Peak-St. Vrain Granite

Precambrian: Central northern Colorado.

E. E. Wahlstrom, 1940, Econ. Geology, v. 35, no. 4, p. 480. Idaho Springs gneisses and Boulder Creek granite gneiss are cut by a younger granite batholith locally called Long's Peak-St. Vrain granite.

M. F. Boos, 1954, Geol. Soc. America Bull., v. 65, no. 2, p. 120. Chief granite of the Longs Peak-St. Vrain batholith.

At Camp Albion, Boulder County.

Long Spring Formation

Pliocene, upper, or Pleistocene: Southeastern Idaho.

Z. S. Merritt, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 119. Poorly sorted, well-consolidated conglomerate, consisting predominantly of pebbles, cobbles, and boulders of Paleozoic limestone and dolomite. Medium gray to gray buff. Individual limestone, dolomite, and shale fragments are angular and vary in size from small pebbles to boulders more than 2 feet in diameter, average about 3 inches in diameter. Interbedded with hard limestone conglomerate are lenses of softer dark- to yellow-brown or olive-green shale-breccia. Thickness varies from a few feet in upper Long Spring Canyon to about 200 feet in type area. Overlies Teewinot formation with angular unconformity in Alpine area.

Type section: In Grand Valley, 3 miles north-northwest of Alpine in secs. 21, 22, 27, and 28, T. 2 S., R. 46 E., Bonneville County. Outcrops in distinctive flat benches in bottom of canyon from which it derives its name.

Long Trail Shale Member (of Great Blue Limestone)[1]

Upper Mississippian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 53. Section of rocks of Chester age formerly included with Brazer (Williams, 1943; Williams and Yolton, 1945) are raised to group rank, consisting of (ascending) unit 3, Long Trail formation; unit 4, unnamed thin- to medium-bedded cherty limestone sequence; and unit 5, Manning Canyon formation. Units 1 and 2 are classed as members of the Brazer as defined in this paper.

R. P. Zeller, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 8, p. 1–36. Gilluly (1932) described Long Trail as a black carbonaceous shaly unit. In present study, it has been found that black

carbonaceous shales, though predominating at type area, are only minor constituent of member. Elsewhere shale-type rocks such as mudstone, siltstones, and claystones are prevalent along with thin interbedded carbonates. Intergradation, sediment size variation, and induration differences have resulted in large variety of units. Thickness 98 to 111 feet.

Named for exposures at head of Long Trail Gulch, in Ophir Canyon, Fairfield quadrangle.

Longview Limestone[1] **or Dolomite** (in Knox Group)

Lower Ordovician: Northern Alabama, eastern Tennessee, and southwestern Virginia.

Original references: E. O. Ulrich, 1924, Tennessee Dept. Ed. Div. Geology Bull. 28, p. 34; Bull. 31, p. 16.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim Map; C. R. L. Oder and W. H. Miller, 1945, Am. Inst. Mining Metall. Engineers Tech. Pub. 1818, p. 2. Underlies Kingsport formation (new).

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 22–25. Longview dolomite described in Lee Valley, Hawkins County, where it is 264 feet thick; underlies Kingsport limestone and overlies Chepultepec dolomite.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 23–26, pl. 1. Described in Jonesville district, southwestern Virginia, where it consists chiefly of light-gray to nearly white dolomite, some of which is medium crystalline and some fine crystalline. Thickness 98 to 272 feet. Underlies Kingsport dolomite; overlies Chepultepec dolomite; base of Longview not clear cut at all localities.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. In Shooks Gap quadrangle, Tennessee, Longview dolomite is about 250 feet thick; overlies Chepultepec dolomite and underlies Newala formation.

Named for fact that town of Longview, Shelby County, Ala., is located on a wide area of formation.

Longwall Sandstone Member (of Frontier Formation)

Lower Cretaceous(?): Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 1), 140–141. Medium-light-gray to white sandstone. Thickness 70 feet in western part of area; 100 feet, eastern part. Underlies Spring Canyon member (new); transitional contact with Aspen(?) shale.

J. M. Boutwell (1933, 16th Internat. Geol. Cong. [United States] Guidebook 17, Excursion C–1, p. 62) listed, but did not define, Longwall Sandstone in sequence between Kelvin Conglomerate and Aspen Shale. This may or may not be same unit defined by Hale, 1960.

Present in Coalville anticline, Summit County. Unit forms conspicuous white sandstone "wall" locally called the Longwall.

Longwood Shale[1]

Upper Silurian: Northern New Jersey and southeastern New York.

Original reference: N. H. Darton, 1894, Geol. Soc. America Bull., v. 5, p. 367, 382, 383.

Named for fact the most extensive exposures are along Longwood Valley east of Milton, Morris County, N.J.

Lonsdale Limestone (in McLeansboro Group)

Lonsdale Limestone Member (of McLeansboro Formation)[1]

Lonsdale Limestone Member (of Modesto Formation)

Upper Pennsylvanian: Central and western Illinois.

Original reference: A. H. Worthen, 1882, Econ. Geology of Illinois, v. 3, p. 258.

Chalmer Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as limestone in McLeansboro group.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 117–119, 194. Averages 6 to 8 feet; maximum 25 feet; locally only 2 or 3 feet. Where several feet thick, commonly consists of two parts: lower, dense to slightly crystalline, massive to thick bedded, fossiliferous, 3 to 7 feet thick; and upper, commonly composed of nodules of light-gray or mottled light- and medium-gray fairly pure limestone cemented with medium-gray limestone. Included in Gimlet cyclothem; where limestone cuts through underlying members of the Gimlet and Sparland cyclothems, it varies more in lithology and includes beds of limestone conglomerate. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 49 (table 1), pl. 1. Reallocated to member status in Modesto formation (new). Occurs above Gimlet sandstone member and below Exline limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Old Lonsdale quarries in N½ sec. 6, T. 8 N., R. 7 E., Glasford quadrangle, Peoria County.

Lookout Sandstone (in Pottsville Group)[1]

Lower Pennsylvanian: Northeastern Alabama, northwestern Georgia, and southern Tennessee.

Original reference: C. W. Hayes, 1892, Alabama Geol. Survey Bull. 4, p. 49–51.

V. H. Johnson, 1946, Coal deposits on Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map. Consists of two members, Gizzard below and Sewanee above. Underlies Whitwell shale; overlies Pennington shale.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 8, 10, 24, 31, 33, 45, 144. Terms Lookout and Walden were extensively applied in Tennessee for a time, but later were supplanted by term Lee, introduced from Virginia.

Named for exposures on Lookout Mountain, northeastern Alabama and northwestern Georgia.

Lookout Schist[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 634.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

Exposed on southeast shore of Lookout Lake, Medicine Bow Mountains.

Loomis Peak Dacites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, p. 71 (map).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 679. Cenozoic.

Occur in Mount Lassen region.

Loon Lake Granite[1]

Cretaceous: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 87, map.

U.S. Geological Survey currently considers Loon Lake Granite to be Cretaceous in age.

Named for exposures in vicinity of Loon Lake, Stevens County.

Loon Lake Quartz-Syenite Complex

Precambrian: Northeastern New York.

A. F. Buddington, 1948, Geol. Soc. America Mem. 28, p. 25. Loon Lake, Jennings Mountain, and Stark complexes are exposed on core of domes or anticlines which are either close-folded or isoclinally overturned.

A. F. Buddington, 1953, New York State Mus. Bull. 346, p. 71, 81–84. Consists of two members, phacoidal syenite, and phacoidal quartz-syenite and granite. Also referred to as Loon Lake series. Discussion of structure and origin of the complex and its relationship to Saranac complex.

Named for occurrence in vicinity of Loon Lake, Franklin County.

Lopez Fanglomerate[1]

Pleistocene or Recent: Southern California.

Original reference: M. L. Hill, 1930, California Univ. Pub., Dept. Geol. Sci. Bull., v. 19, no. 6, p. 141, 144.

B. F. Howell, 1954, California Div. Mines Bull. 170, map sheet 10. Referred to as Lopez alluvium. Thickness as much as 400 feet. An older higher fan than others in area except possibly Beehive Mesa alluvium (new). Pleistocene or Recent.

Named for exposures in Lopez Canyon, Los Angeles County.

Lorane Shale Member (of Spencer Formation)

Eocene: Western Oregon.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Myers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Name applied to basal shale and mudstone of Spencer formation (redefined). Thickness about 600 feet; figure varies due to thinning of member toward south and to local irregularities on surface of Tyee formation on which it was deposited. Intercalated sandstones, siltstones, shales, and mudstones at top of member gradually pass into typical sandstones of the formation.

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. Discussion of west-central border area of Willamette Valley. Uppermost exposed part of Tyee formation consists of thin-bedded siltstone and mudstone. Beds in an equivalent stratigraphic position in Eugene area were mapped as Lorane shale member of Spencer by Vokes and others (1951) who estimated thickness of sequence to be about 600 feet. Mapping in Corvallis-Monroe area indicates that Lorane

shale member is more closely related to Tyee formation than to Spencer formation.

Type locality: Valley of North Fork of Siuslaw River, in the S½ sec. 36, T. 19 S., R. 6 W., and sec. 1, T. 20 S., R. 6 W., north of Lorane, Lane County.

Loray Formation

Permian (Guadalupian): East-central Nevada and northwestern Utah.

J. S. Berge, Apr. 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, chart (strat. section). (Footnote on chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., 1960, p. 91, 106–107.) Named on stratigraphic section. Name credited to Grant Steele (unpub. thesis), who used term Loray for strata which writer [Berge] has included in Kaibab limestone.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 105 (pl. 6, fig. 2), 106–107. (Road logs dated Sept. 8–10). Formal proposal of name. Sequence of yellow-tan, gypsiferous silts and thin bioclastic limestones. At type locality, conformable with underlying Pequop formation (new) and overlain by Kaibab formation. Thickness 2,475 feet in central Butte Monntains, White Pine County; here rests on Upper Moorman Ranch member of Pequop and underlies Plympton formation. Identified at Ferguson Springs Mountain, Gold Hill, Cherry Creek Mountains, and Pequop Mountains. Probably equivalent to upper 300 to 400 feet of Hose and Repenning's (1959) measured Arcturus formation in Confusion Range, Utah.

Named for exposures at head of Loray Wash in Southern Pacific Railroad cut on southwest side of Montello Valley, SW¼NE¼ sec. 28, T. 38 N., R. 68 E., Elko County.

Lorette Beds

Lorette Formation[1]

Middle Ordovician: Quebec, Canada, and eastern New York.

Original reference: P. E. Raymond, 1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56, p. 257.

A. E. Wilson, 1936, Canada Geol. Survey Mem. 202, p. 10. Referred to as Lorette beds. Fine-grained conglomerate at base followed by thin-bedded blue-gray limestone, which becomes thick bedded and dark grey toward top. Thickness 90 feet at type locality, where it rests on Precambrian and is succeeded by typical middle Trenton beds.

Type locality: Just west of Quebec City, Quebec, Canada. Also exposed near Montreal.

Loretto Slate[1] Member (of Vulcan Iron-Formation)

Precambrian (Animikie Series): Northern Michigan.

Original reference: R. C. Allen, 1919, Ann. Inst. Min. Met. Engrs. Bull. 153, p. 2593.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Rank reduced and reallocated to Vulcan iron-formation where it forms upper member of formation and overlies Curry iron-bearing member.

Best developed on property of Loretto mine, Menominee district, Dickinson County.

Lorraine Shale

Lorraine Group[1]

Upper Ordovician: New York, and Ontario, Canada.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geology 2d dist., p. 119–123, 401, 429.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 286–287. Throughout New York-Ontario region, where sediments of post-Trenton age are preserved, they are of lower Cincinnatian Eden age and of clastic character. They comprise lower Lorraine sandy shales in New York and eastern Ontario, lower Dundas shales in central Ontario, and Sheguiandah shale of Manitoulin.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 137. Incidental mention in discussion of graptolites of Athens shale. Utica and Lorraine formations are represented in the upper Viola.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 9b, 19). As shown on correlation chart, Lorraine group in northwestern New York comprises Whetstone Gulf shale below and Pulaski shale above. Occurs above Utica shale and below Oswego sandstone. Group in Montreal lowland comprises Leclercville shale below and Nicolet River shale above.

Probably named for Lorraine, Jefferson County, N.Y.

Los Angelan Epoch[1]

Pleistocene: Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, p. 1–29.

Los Arrieros Shale Member (of Yegua Formation)

Eocene (Claiborne): Southern Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologist Bull., v. 26, no. 2, p. 259 (fig. 2), 266. Gray-green bentonitic locally sandy shale. Thickness approximately 110 feet. Uppermost member of formation; overlies Loma Blanca tongue; underlies Salineno sandstone tongue of Fayette formation. In some areas, underlies Rio Grande silts.

Named from village of Los Arrieros, located on bank of Rio Grande at north line of Roma quadrangle.

Los Banos Creek member (of "Quinto B" reef beds)

Upper Cretaceous: Central western California.

C. T. Smith, 1945, Jour. Paleontology, v. 19, no. 1, p. 38. Name appears in a sequence of Upper Cretaceous strata indicated by evolution of *Glycymeris veatchii.*

"Quinto B" reef beds are exposed on Los Banos Creek, west of Los Banos, Merced County.

Los Cerritos Beds[1] (in San Pedro Formation)

Pleistocene: Southern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, chart opposite p. 217.

See Deadman Island Beds.

Losee Gneiss

Losee Diorite Gneiss[1]

Precambrian: Northern New Jersey and western Pennsylvania.

Original reference: A. C. Spencer, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 49–50, pl. 5. Consists mainly of oligoclase and quartz, smaller amounts of orthoclase, bright-green diopside, with hornblende, hypersthene, biotite, apatite, magnetite, sphene, and locally zircon. Losee, Pochuck gabbro gneiss, and Byram granite gneiss grade into each other through intermediate types. With decrease in oligoclase, Losee phases pass into the Byram phases, and, with increase in pyroxene and hornblende, into phases of the Pochuck gabbro gneiss. Younger than Pickering gneiss and Franklin limestone.

Named for development around Losee Pond, Sussex County, N.J.

†Losee Pond Granite[1]

Precambrian: Northern New Jersey.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 439.

Named from exposures around Losee Pond, Sussex County.

Los Gatos Beds (in Panoche Group)

Los Gatos Sandstone

Los Gatos Stage

Upper Cretaceous (Chico Series): Northern California.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Incidental mention as beds in Panoche group.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 185 (fig. 69) [preprint 1941]. Shown as a stage, based on a faunal assemblage, in Panoche group.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Shown in list of subdivisions of the Panoche, as Los Gatos sandstone underlying Alcalde shale and overlying Waltham shale in Coalinga-Ortigalito area, San Joaquin Valley.

First mentioned as occurring in Diablo Range.

Losh Run Shale[1] Member (of Fort Littleton Formation)

Upper Devonian: Southern central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Proc. 1934, p. 123.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 215–216. Conmmonly dark-gray to brown shale which weathers rusty brown. Thickness about 10 feet. Underlies Trimmers Rock member. The Losh Run is a thin band, in some places a faunal zone, occurring chiefly in lower part of the Trimmers Rock but also represented in the underlying Brallier.

Named for stream in Perry County that enters the Juniata from the west about 5 miles north of Duncannon.

Los Medanos Formation

Pliocene, lower: Northern California.

B. L. Clark, 1943, California Div. Mines Bull. 118, pt. 2, p. 189, 191 [preprint 1941]. Shown on correlation chart as overlying "Lawler tuff."

Occurs on north side of Mount Diablo.

Los Muertos Creek Formation

Eocene, middle: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 205–206, 226 (fig. 5), pl. 3. A series of siltstones, fine-grained buff micaceous sandstones, clay-shales, and cherty shales. Thickness about 1,000 feet. Conformably overlain by Tres Pinos sandstone to southwest; overlapped by San Benito gravels to southeast; base is faulted out against Panoche group to northeast. Unit was assigned to Meganos formation by Kerr and Schenck (1925, Geol. Soc. America Bull., v. 36, no. 9), but that was before Capay stage had been separated in California Eocene.

Exposed 2 miles northwest of Los Muertos Creek, west of Brown Valley, in northeastern part of San Benito quadrangle. Out crop forms a narrow belt trending northwest for a distance of about 2 miles.

Losoya Creek Conglomerate (in Sabinetown Formation)[1]

Eocene, lower: Southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 575, 602.

On Losoya Creek, at bridge on South Flores Road south of San Antonio, Bexar County.

Lospe Formation

Miocene, lower(?) Southern California.

C. F. Tolman, 1927, Econ. Geology, v. 22, no. 5, p. 459. Named on stratigraphic column. Thickness, 2,700 feet. Consists of black shale, gray gypsiferous shale, gray sandstone, greenish-gray sandstone, red and green sandstone, conglomerate, and rhyolite tuffs. Underlies Monterey formation.

S. G. Wissler and F. E. Dreyer, 1943, California Div. Mines Bull. 118, pt. 2, p. 237, 238 [preprint 1941]. Described as 2,600-foot section of unfossiliferous, continental beds. Lower 650 feet consists of well-bedded maroon and greenish-gray sandstone and conglomerate; middle 1,000 feet composed of greenish-gray sandstone and sandy shale with two prominent 50-foot white and greenish tuff beds in upper 250 feet; upper 950 feet consists of gypsiferous gray and greenish-gray clay shale. Unconformably underlies Point Sal formation; unconformably overlies the Franciscan. Type area noted.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 11, 13–16, pls. 1, 3. Noted as resting on Franciscan or Knoxville; overlain without marked discontinuity by Point Sal formation or apparently overlapped by it. In type area, divided into two mapped but unnamed members.

Type area: Southwest slope of Mount Lospe, near western end of Casmalia Hills, approximately 2 miles south of Point Sal Landing and one-half mile north of Lions Head Beach (Guadalupe quadrangle).

Los Pinos Granite

Precambrian: Central New Mexico.

J. T. Stark and E. C. Dapples, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1936. Intrudes Sais quartzite (new), Blue Springs muscovite schist (new), White Ridge quartzite (new), and Sevilleta rhyolite (new). Granitization pronounced along its borders.

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1136–1138, pl. 1. In its least contaminated facies, medium-coarse-grained pink rock composed largely of microcline, orthoclase, albite, and quartz. Biotite most prominent dark mineral. Where biotite increases in amount to as much as 7 percent, it is intimately related to schist inclusions and adjacent formations. Comprises core of intruded granite grading outward through migmatitic facies into host rock.

Constitutes major part of Los Pinos Mountains. Forms steep western escarpment for 7 miles along central and southern parts of range.

Los Pinos Gravel

Los Pinos Formation

Los Pinos Member (of Hinsdale Formation)[1]

Miocene and Pliocene(?): Northern New Mexico and central southern Colorado,

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 185–192. Age of gravel given as Miocene and Pliocene(?). Flows mostly in Conejos quadrangle, Colorado, where they make up much of thick section of Chiquita Peak and Green Ridge, and no doubt were extruded by local volcano. Local flows also in northern part of New Mexico. Most material well bedded and individual beds mostly thick, but range from fraction of a foot to 100 feet or more. Overlies Treasure Mountain rhyolite in most places in Colorado but locally overlies Sheep Mountain quartz latite. Overlies Conejos quartzite latite or older rocks in New Mexico. Underlies Hinsdale formation.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 38, 43–51, pl. 1. Redefined as formation to include all rocks that overlie Treasure Mountain formation and unconformably underlie Cisneros basalt. In Tusas Valley, separated into four members (ascending): Biscara, Esquibel, Jarita basalt, and Cordito (all new). Biscara and Esquibel grouped together northwestward from point about 3 miles southeast of Tusas. Type locality designated.

Type locality: In canyon of Los Pinos Creek, near town of San Miguel, in extreme northern part of New Mexico, about 10 or 12 miles southwest of Antonito, Conejos County, Colo.

Los Puertos Limestone[1]

Los Puertos Member (of Naranjo Formation)

Oligocene or Miocene: Puerto Rico.

Original reference: B. Hubbard, 1920, Science, new ser., v. 51, p. 396.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85, sheets 1, 2. Unit formerly termed Los Puertos limestone included in Aymamón limestone (new).

E. A. Pessagno, Jr., 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 84. Member includes 0 to 2,300 feet of volcanic conglomerates and siltstones at base of Naranjo formation. Grades upward into Coamo Springs limestone member. Unconformably overlies Cretaceous units of Santonian age (Toa Vaca and Santa Ana formations). Naranjo formation considered early middle Eocene. Ponce-Coamo area.

First described in Lares district.

Lost Conglomerate Member (of Repetto Formation)

Pliocene, lower: Southern California.

C. J. Kundert, 1952, California Div. Mines Spec. Rept. 18, p. 9, pl. 2. A conglomerate with interbedded sandstone. Thickness 30 to 300 feet. Occurs in middle of formation.

Occurs in Whittier-La Habra area, south of Whittier fault, Los Angeles County.

Lost Brook Formation

Silurian(?): Central western Maine.

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Originally a pelitic, argillaceous quartz silty clay. Metamorphic grade of the pelitic and quartz-rich sediments restricted to chlorite and biotite zones of greenschist facies. Thickness about 7,000 feet. Underlies Johns Pond formation (new).

In Kennebago Lake quadrangle.

Lost Burro Formation

Middle and Upper Devonian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 18–20, pls. 1, 2, 3. Generally very light gray dolomite prominently striped with nearly black limestone and dolomite; lower part entirely dolomite; sandy beds that weather brownish gray mark base of formation; midway in section, conspicuous black limestone beds consist of masses of stromatoporoids, of which concentric cellular structure is sufficiently persistent to be considered a lithologic characteristic of that part of formation; spaghettilike outlines of masses of cladoporoids in several beds are another characteristic of the lithology; the combination of these two structures of organic origin occurs in none of the other formations and is excellent indicator of the formation. Thickness at type locality 1,525 feet; in Andy Hills about 2,245 feet. Underlies Mississippian Tin Mountain limestone (new); overlies Lower Devonian Hidden Valley dolomite (new).

J. F. McAllister, 1955, California Div. Mines Spec. Rept. 42, p. 9 (fig. 3), 12, pl. 2. Subdivided to include Lippincott member (new) at base.

B. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pubs., Geol. Sci., v. 38, no. 2, p. 92, 94 (fig. 4), 134–135, 136. Includes Quartz Spring sandstone member (new) in Quartz Spring area. Underlies Tin Mountain limestone. Late Devonian.

Type locality: On western side of Lost Burro Gap at southern entrance; extends from Hidden Valley dolomite at base of slope to Tin Mountain limestone near top. Named for Lost Burro Gap, through which road passes from Racetrack Valley to Hidden Valley, northern Panamint Range, Inyo County. Formation also widespread in region between Death Valley and Saline Valley.

Lost Cabin Member (of Wind River Formation)

†Lost Cabin Formation[1]

Eocene, lower: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1911, Am. Mus. Nat. History Bull., v. 30, p. 104–111.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 24, pl. 1. Referred to as member (or formation) of Wind River formation (or group). Is valid mappable lithologic unit. Overlies Lysite member. Wasatchian.

H. A. Tourtelot, 1948, Wyoming Geol. Soc. Guidebook 3d Ann. Field Conf., p. 113 (fig. 1), 114, 117–119. Although lithologic difference between rocks of Lost Cabin and Lysite units were described by Sinclair and Granger, most later workers considered the names to represent only faunal zones. Recent work has substantiated opinion of Wood and others that the units are lithologically separable as members of Wind River formation. Member typically consists of gray and grayish-green siltstone and claystone with yellowish-brown to orange sandstones deposited in sheets and channels; many sandstones conglomeratic. Thickness more than 400 feet between Badwater Creek and top of divide between Badwater and Poison Creeks, south of Lysite. Contact with Lysite member gradational; nature of distinguishing criteria for separating the two members suggests that the names should not be applied to lithologic units in places other than along southern margin of Big Horn Mountains. Report includes historical summary of usage of name.

Type area: East of Lost Cabin along Alkali Creek and on divide between Alkali and Poison Creeks, Fremont County.

Lost City Limestone Member (of Hogshooter Formation)

†Lost City Limestone[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: C. N. Gould, 1911, Oklahoma Geol. Survey Bull. 5, p. 179.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 44. Rank reduced to member status in Hogshooter formation. In Washington County, a 5-foot soft gray platy limestone bed is referred to Lost City member. Underlies Winterset member; overlies Stark or Canville; regarded as time equivalent of both Canville limestone and Stark shale members.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 61–62. Described in Tulsa County where thickness ranges from 3 feet at northernmost exposure to 50 feet south of Arkansas River.

Named from exposures near Lost City, near Sand Springs, Tulsa County.

Lost Creek Limestone[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F., p. xxvi.

In Lost Creek valley, Juniata County.

Lost Creek Limestone[1]

Lost Creek Limestone (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 304.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91; R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 22). A limestone in Breathitt formation.

Exposed along crest of ridge between Lost Creek and Big Branch of North Fork of Kentucky River, Buckhorn quadrangle, Breathitt County.

Lost Creek Shale Member (of Admiral Formation)[1]

Permian (Wolfcamp Series): Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 422.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley where it underlies Hords Creek member and overlies Coleman Junction limestone member of Putnam formation. Consists of yellowish-brown shale and thin platy sandstone. About 30 feet thick in south-central Coleman County.

Named for Lost Creek, Coleman County.

Lost Creek Trachyte

Miocene and (or) Pliocene: Southwestern Montana and northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Spec. Paper 6, p. 21–29, 78 (table 9), pl. 4. Silicified, tuffaceous, porphyritic trachyte with phenocrysts of orthoclase and scattered lithic fragments; light shades of brown, buff, green, gray, or white. Commonly mottled; massive in appearance. Because of resistance to weathering and erosion, and vertical jointing, most exposures are vertical cliffs. Weathers in plates that form characteristic talus.

Scattered patches of rock exposed in Yellowstone Valley, in northern part of Yellowstone National Park. Best and most accessible exposures in valley of Lost Creek, near Tower Falls Ranger Station. Derives name from this locality.

Lost Gulch Quartz Monzonite[1]

Upper Cretaceous or lower Tertiary: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, Econ. Geology, v. 49, no. 4, p. 363. Lost Gulch quartz monzonite intruded probably in late Cretaceous or early Tertiary time.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Mapped in Globe quadrangle, where it comprises two textural types— porphyritic quartz monzonite and quartz monzonite porphyry.

Occupies greater part of Lost Gulch and stretches northeast toward Horrell's Ranch, on Pinal Creek, Globe quadrangle.

Lost Jim Lava Flow

Quaternary: Central western Alaska.

D. M. Hopkins, 1953, (abs.) 4th Alaskan Sci. Conf. Proc., p. 237. Pahoehoe flow of olivine basalt, youngest of a series of basaltic lava flows compromising a lava plateau surrounding Imuruk Lake. Ranges in thickness from 10 to about 150 feet. Extends 17½ miles westward from its source cone (Lost Jim cone) and covers more than 60 square miles.

Around Lost Jim cone near Imuruk Lake, Seward Peninsula.

†Lostmans River Limestone[1]

Pliocene and Pleistocene: Southern Florida.

Original reference: S. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 222–225, table opposite p. 50.

Named for exposures on Lostmans River, Monroe County.

Lost Nation Group

Lost Nation Quartz Diorite

Upper Ordovician(?): Northern New Hampshire.

R. W. Chapman, 1935, Am. Jour. Sci., 5th ser., v. 30, no. 179, p. 404, 405. Mapped as quartz diorite. Intrusive into Albee formation. Tentatively assigned Upper Ordovician age.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 499. Belongs to Highlandcroft magma series.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1072–1074, pl. 1. Described as group consisting of quartz diorite with minor amount of diorite. Not possible to map these separately. Both types are dark gray, dark green, or black, medium grained and granular. Older than some intrusives of the White Mountain magma series. Pre-Silurian, probably Upper Ordovician. Derivation of name.

Named from typical occurrence at small community of Lost Nation in southwestern corner of Percy quadrangle, Coos County.

Lost Quarry Beds (in Ash Hollow Formation)

Pliocene, lower: Western Kansas.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 145. Mentioned in article on Tertiary prairie grasses from high plains. Occur higher in *Biorbia fossilia* zone than Rhinoceros Hill beds.

Quarry is in NW¼ sec. 1, T. 1 S., R. 38 W., Wallace County.

Los Trancos Formation

Miocene: Northern California.

H. C. Langerfeldt and L. W. Vigrass, 1959, *in* U.S. Congress, Joint Committee on Atomic Energy, Subcommittee on Research and Development, and Subcommittee on Legislation, Stanford Linear Electron Accelerator, Hearings: U.S. 86th Cong., 1st sess., app. D, p. 621. Divided into four members from base upward. Member A, loose to poorly cemented sand, 75 to 100 feet thick; Member B, volcanic rock including basaltic flows and fragmental volcanic material, 65 to 600 feet; Member C, coarse fragmental sandy limestone probably less than 50 feet; Member D, soft friable sandstone with some mudstone layers, thickness unknown. Overlies Searsville formation (new) with angular discordance.

Type locality and derivation of name not given. Area described is in Santa Clara and San Mateo Counties. Board on Geographic Names states that Los Trancos Creek forms boundary between San Mateo and Santa Clara Counties.

Los Trancos Member (of Topanga Formation)

Miocene, middle: Southern California.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. Consists mainly of dark-gray siltstone interbedded with light-gray medium-grained sandstone that is locally tuffaceous. Maximum thickness about 3,100 feet. Rests conformably on Bommer member (new); overlain with apparent disconformity by Paularino member (new); contact with Paularino is marked locally by andesite flow breccia that occurs in Paularino.

Typical exposures occur in area between Los Trancos Canyon and Bonita Creek in western part of San Joaquin Hills, Orange County. Named for

large canyon that originates at Signal Peak in San Joaquin Hills and empties into sea at Crystal Cove.

Lost River Chert (in Fredonia Member of Ste. Genevieve Limestone)

Lost River Chert[1]

Mississippian (Meramec Series): Southwestern Indiana.

Original reference: M. N. Elrod, 1899, Indiana Acad. Sci. Proc. 1898, p. 258–267.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 20, pl. 1. As originally defined by Elrod (1899), the Lost River chert was intraformational zone between "Paoli" and Mitchell limestones. Term Mitchell limestone abandoned, and Lost River chert included in Fredonia member of Ste. Genevieve limestone. Blue-gray chert 1 to 6 feet thick, commonly 10 to 20 feet above base of the Fredonia.

Named for occurrence on Lost River, near Orangeville, Orange County.

Lost Run Conglomerate

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., supp., p. 4–5, diagram. Traced eastward from Lewistown, the ridge-making member of Bald Eagle sandstone becomes conglomerate with pebbles of vein quartz, quartz-veined quartzites, cherts and jaspers, and, rarely, quartz-veined meta-argillites. Term Lost Run conglomerate is proposed for the conglomerate. Thickness about 350 feet in Lost Run area. Near Lewistown overlain by about 1,500 feet of Juniata red beds and underlain by about 300 feet of sandstone or graywacke, seemingly representative of lower part of Bald Eagle near Tyrone, than by sandy beds containing *Orthorhyncula stevensoni.*

F. M. Swartz, 1957, Pennsylvania Stat. Univ., Dept. Geology Contr. 3, 58 p. In vicinity of Tyrone Gap, interfingers with Spring Mount sandstone member (new) of Bald Eagle sandstone. At Lewistown and Lost Creek Gap, the Lost Run is overlain by 1,700 to 1,800 feet of red Juniata beds, including (descending), Run Gap, Plummer Hollow (new), and East Waterford (new) members. Underlain by 200 to 250 feet of greenish-gray Bald Eagle sandstone that appears to be representative, for the most part, of Centennial School sandstone and shale member (new) of Bald Eagle at Tyrone Gap.

Named for Lost Creek Gap, northeast of Lewistown, Mifflin County.

Lost Sheep Dolomite

Middle Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–330, p. 105; M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 26–28, pl. 1. Made up of two members: lower two-thirds—gray member—comprises three light- to medium-gray units and one thin black bed—149 to 159 feet thick; upper one third—cherty member—66 to 92 feet thick. Overlies Harrisite dolomite and underlies Thursday dolomite (both new).

Type section: About 2,000 feet southwest of Blowout mine in sec. 28, T. 12 S., R. 12 W., Juab County. Named for occurrence at Lost Sheep mine. Widely distributed on western side of Spor Mountain.

Los Vallos Member (of Yeso Formation)

Permian: West-central New Mexico.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Lower part consists of tan-brown friable siltstone, sandstone, and shale with several persistent thin limestone and thicker gypsum beds. In upper part, gypsum makes up about 50 percent of section. Constitutes bulk of Yeso formation. Thickness 820 to 1,020 feet. Overlies Meseta Blanca sandstone member (new); underlies San Andres formation.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 6, 7 (fig. 2), 10, pl. 1. Conformably overlies Abo formation and gradationally underlies Glorieta sandstone in Socorro County.

Underlies west Los Vallos and forms lower slopes of east face of Sierra Lucero in a long and broad belt extending from west edge of area in T. 5 N., into head of Carrizo Arroyo. Farther north forms floor and slopes of wide inner valley of Santa Fe Arroyo and head of Garcia Arroyo. Valencia and Socorro Counties.

Lothair Till

Pleistocene: Central northern Montana.

J. F. Smith, Jr., I. J. Witkind, and D. E. Trimble, 1959, U.S. Geol. Survey Bull., 1071–E, p. 134, 137–138, pl. 10. Light-tan till that weathers to buff; tightly cemented, very hard, and breaks with difficulty into irregular fragments with conchoidal surfaces. Consists of unsorted material ranging from clay-size particles to boulders as much as 3 feet in diameter. Clay and sand-size particles predominate. Lenses of sand and gravel intercalated in the till. Material of lenses is crossbedded. In many exposures, layers of light-yellow to buff even-bedded massive silt enclosed in the till; commonly forms lenses about one-half mile long and as much at 50 feet thick. Thickness of till commonly about 50 feet, but is as much as 310 feet in buried ancestral Marias River channel. Older than Pondera till (new).

Type locality: In NW¼ sec. 29, T. 30 N., R. 7 E., Liberty County. Covers much of the mapped Marias River area, Chouteau, Hill, and Liberty Counties. Named from town of Lothair in northwest corner of mapped area.

†Lott Chalk Member (of Taylor Marl)[1]

Upper Cretaceous: Northeastern Texas.

Original reference: C. H. Dane and L. W. Stephenson, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 52.

Crops out in vicinity of Lott, Falls County, and 1 to 3 miles north-northwest of Rogers, Bell County.

Lotus Formation

Cambrian: Southeastern California.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 380–382, figs. 1, 3. Proposed to designate a section of limestone and dolomitic limestone that crops out south and east of Lotus mine. Thickness at mine 4,800 feet (section incomplete); north of Wingate Pass 4,000 feet thick. Within mapped area, the Lotus is conformable with algal limestone

at top of underlying Wood Canyon formation; upper limit (not mapped) is determined by faults along east edge of Panamint Valley.

Named for Lotus Mine, Manly Peak quadrangle, southern Panamint Range, Inyo County.

Louann Salt

Louann Tongue (of Eagle Mills Formation)

Upper Permian to Upper Jurassic: Subsurface in Arkansas, Louisiana, and Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 4 (table 2), 8. Name Louann tongue applied to lower redbeds of Eagle Mills formation. Jurassic. Name credited to Shreveport Geological Society.

R. T. Hazzard, W. C. Spooner, and B. W. Blanpied, [1947], Shreveport Geological Soc. 1945 Ref. Rept., v. 2, p. 483, 484, 487–488, 489 (table 4), cross sections. Term Louann tongue as formerly used is synonymous with Werner formation as used in this report. Term Louann salt proposed for formation that overlies Werner and underlies Norphlet formation (new). Thickness in type well 857 feet; as much as 3,300 feet in Webster Parish, La. Permian. By inference, an unconformity is placed at base of Norphlet formation where it rests on Louann salt, and it is concluded that this is the Mesozoic-Paleozoic contact in Tri-State area.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. Assigned to Jurassic (Callovian).

D. I. Andrews, 1960, Gulf Coast Assoc. Geol. Soc. Trans., v. 10, p. 215–240. Report is comprehensive discussion of Louann salt and its relationship to Gulf Coast salt domes. Age of salt cannot be proved definitely. It is known to be older than Upper Jurassic, but believed no older than Upper Permian.

Type section: Gulf Refining Co.'s No. L. Werner Saw Mill Company well, Union County, Ark.

Loudoun Formation[1] (in Chilhowee Group)

Lower Cambrian(?): Virginia, Maryland, southern Pennsylvania, and West Virginia.

Original reference: A. Keith, 1893, as reported by G. H. Williams and W. B. Clark *in* Maryland, its resources, industries, and institutions, chap. 3, p. 68.

A. I. Jonas and G. W. Stose, 1939, Am. Jour. Sci., v. 237, no. 8, p. 575. Rocks of known Precambrian age in Virginia comprise an injection complex and a volcanic series. Both series occur in Catoctin Mountain-Blue Ridge and Mount Rogers anticlinoria. Injection complex comprises metamorphosed sedimentary rocks, intrusive diorite, granite, and injection gneisses. The granitic rocks were intruded during period of Precambrian folding and metamorphism. Volcanic rocks comprise both basalt and rhyolite, and, on west side of Blue Ridge uplift, are associated with series of slates and arkoses previously believed to be infolds of Loudoun formation but which are now believed to be rocks largely of tuffaceous origin interbedded with flows and lying at base of Catoctin metabasalt.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties, p. 31–34, fig. 5. Described in Frederick County, Md., where it crops out on slopes and in places on top of Catoctin and South Mountains. Formation is largely soft arkosic quartzite with beds of purer harder quartzite, quartzose conglom-

erate, and phyllite or slate. Some basal beds are red and green slate with scattered unassorted grains and small pebbles of quartz and feldspar; on west slope of Catoctin Mountain, basal beds contain bluish-gray and green tuffaceous slate which is overlain by thin quartzite and coarse arkosic quartzite containing pebbles. At High Knob, these basal beds are 200 feet thick. Upper beds are white to gray thin-bedded quartzite and purple banded arkosic quartzite which shows current bedding in places. Top of formation is placed below first prominent bed of purer vitreous quartzite of Weverton. Thickness variable; at Pine Knob on South Mountain about 200 feet; at High Knob on Catoctin Mountain about 310 feet. Overlies Catoctin metabasalt; in some areas, overlaps Catoctin and Swift Run tuff and rests on gneisses of injection complex at Potomac River. Some areas of quartzite formerly mapped at Loudoun are here included. Catoctin and South Mountains are synclinal in structure and lie on either side of anticlinal Middletown Valley.

H. P. Woodward, 1949, West Virginia Geol. Survey [Rept.], v. 20, p. 67–69. Term Loudoun normally applied to oldest sediments east of Blue Ridge, but in area west of Blue Ridge, including West Virginia, similarly located rocks have been separated into Loudoun and Weverton formations. Belt containing this western outcrop extends at least as far as Cloverdale, near Roanoke, Va., and ends in sharp summit known as Fullhardt Knob. Much confusion surrounds term "Loudoun," and it is here recommended that new or different nomenclature be adopted for sediments between Harpers shale and crystalline basement on inland flanks of Blue Ridge-South Mountain. None of the terms Loudoun, Weverton, or Unicoi seem adequate. Tentatively, joint name Loudoun-Weverton is used in this report.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 16–17, pl. 1. Included in Chilhowee group. Described in Elkton, Va., area, where it is as much as 200 feet thick. Consists of spotted purple or gray slate, probably representing altered volcanic tuffs and breccias; lava flows in some areas. Unconformably overlies Catoctin greenstone; underlies Weverton formation. Doubt exists as to whether Loudoun formation is valid unit. Original definition by Keith was ambiguous, no type locality was designated, and name was applied to beds in more than one stratigraphic unit. Some workers have interpreted the Loudoun that was supposed to overlie Weverton at type locality of latter as consisting of overturned post-Weverton beds. It is possible that terminology herein adopted may not prove satisfactory and further consideration may have to be given to a name for beds in Elkton area here termed Loudoun formation.

R. O. Bloomer, 1950, Am. Jour. Sci., v. 248, no. 11, p. 766. It appears that the Lynchburg and Loudoun in the respective type sections are approximately equivalent. According to the rule, name Lynchburg should be abandoned and replaced by older name Loudoun.

J. C. Whitaker, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 441–442. Studies of geology of Catoctin Mountain, Md. and Va., indicate that area is not syncline as previously interpreted but a tightly folded westward-dipping sequence which forms upper and eastern limb of South Mountain anticlinorium. It is here considered that original description of the Loudoun by Keith and description by Stose and Stose (1946) are invalid because they interpreted Catoctin Mountain as a syncline, overturned asymmetrically to west. As interpreted here, the Loudoun is exposed

only on western slopes of Catoctin Mountain where it overlies Catoctin metabasalt in normal sequence. Strata mapped as Loudoun on eastern slopes actually form a zone including basal part of the Harpers and the uppermost beds of Weverton quartzite. As described in this report Loudoun comprises two unnamed members, a basal phyllite, and an upper conglomerate.

Named for exposures in Loudoun County, Va.

Loughridge Formation (in Ancell Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 21, figs. 3, 12. Argillaceous, silty sandstone about 7 feet thick. Shown on columnar section as underlying Harmony Hill formation (new) and overlying Daysville formation (new).

Occurs in Dixon-Oregon area.

Louisenhoj Formation (in Virgin Island Group)

Upper Cretaceous: Virgin Islands.

T. W. Donnelly, 1960, Dissert, Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Lowermost unit in group. Consists of augite andesite breccias and tuffs with intercalated conglomerates (Cabes Point conglomerate lithofacies) containing pebbles and cobbles of Water Island formation (new). Eruptive center during Louisenhoj time was probably in Pillsbury Sound; in western St. John and eastern St. Thomas, formation consists of coarse cone debris, derived largely by gravitational sliding from small sub-aerial cone; in central St. Thomas, pyroclastics commonly showing laminar slumping are present; in western St. Thomas and on Culebra unslumped pyroclastics predominate. Thickness about 13,000 feet. Underlies Outer Brass limestone (new). Group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Louisiana Limestone[1]

Louisiana Formation

Louisiana Limestone (in Champ Clark Group or Fabius Group)

Lower Mississippian: Eastern Missouri, southwestern Illinois, and eastern Iowa.

Original reference: C. R. Keyes, 1892, Geol. Soc. America Bull., v. 3, p. 289.

E. B. Branson, 1938, Missouri Univ. Studies, v. 13, no. 3, pt. 1, p. 5. Louisiana limestone, Glen Park limestone, and Grassy Creek shale, which have been classed as Lower Mississippian by many geologists, are referred to Devonian in this study. Saverton shale included in Grassy Creek.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, chart 5; J. M. Weller, 1948, (abs), Am. Jour Sci., v. 246, no. 3, p. 150. Included in Fabius group (new). In standard section, overlies Saverton shale; underlies Maple Mill shale of Easley group (new). Devonian or Mississippian.

M. A. Stainbrook, 1950, Am. Jour. Sci., v. 248, no. 3, p. 208–209. Louisiana and McCraney are parts of same body of limestone. McCraney limestone not a member of Hannibal. Since name Louisiana has precedence, term McCraney may well be dropped.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 18–20. Reallocated to Champ Clark group

(new) proposed to replace Fabius group of Weller and others (1948). In this report, name Louisiana is used to designate lithographic limestone that in western Illinois normally overlies Saverton shale, or, where Saverton is absent, Grassy Creek shale. In Illinois, underlies Glen Park formation of Hannibal group. Thickness 3 to 5 feet. Mississippian or Devonian.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 30–34, pl. 1. Formation described in Bowling Green quadrangle where it is 0 to 40 feet thick. Sublithographic thin irregularly bedded gray- to pale-orange limestone with dolomitic mudstone partings. Conformably overlies Saverton formation; unconformably underlies Hannibal formation. Devonian-Mississippian.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., art. 5, p. 87–89, 98, 100 (fig. 3), 105. Unconformably underlies Cuivre shale (new) in Pike County, Mo.; elsewhere underlies Hannibal shale. In Missouri, unconformably overlies Saverton shale; in some places, rests directly on Grassy Creek shale. Age discussion. In this report, considered Upper Devonian.

Named for exposures at Louisiana, Pike County, Mo.

Louisville Limestone[1]

Silurian: North-central Kentucky and southern Indiana.

Original reference: A. F. Foerste, 1897, Indiana Dept. Geol. and Nat. resources 21st Ann. Rept., p. 217, 218, 232.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Gray-tan finely crystalline to dense dolomitic limestone. Thickness 0 to 10 feet. Overlies Waldron shale.

Named for exposures east of Louisville, Ky.

Louisville Limestone[1]

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 23.

Exposed at base of slope west of South Bend and in upper slopes eastward to Louisville, Cass County, Nebr.

†Louisville-Delphi Black Slate[1]

Upper Devonian: Indiana and Kentucky.

Original reference: J. Collett, 1872, Indiana Geol. Survey 3d and 4th Ann. Repts., p. 294, 306.

Probably named for occurrence from Louisville, Ky., to Delphi, Carroll County, Ind.

†Loup Fork Beds[1]

†Loup Fork Group[1]

Miocene, Pliocene, and Pleistocene(?): Eastern Colorado, Nebraska, South Dakota, and other western states.

Original reference: F. B. Meek and F. V. Hayden, 1862, Acad. Nat. Sci. Philadelphia Proc., v. 13, p. 415–435.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1269–1270. Names abandoned. Loup River is original name and Loup Fork was its synonym for many years.

Named for occurrences along Loup River, Nebr.

Loupian[1] (series)

Tertiary, middle: Nebraska.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

†Loup River Beds[1]

Tertiary: Nebraska.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 415–435.

Extends from Loup Fork of Platte River north to Niobrara River and south to unknown distance beyond the Platte.

Lousetown Formation

Lousetown Series or Andesite

Pliocene, upper, or Pleistocene, lower: Western Nevada.

T. P. Thayer, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1648–1650. Lavas of the series, in its type area, are all olivine basalts. They range from pale- or medium-gray porous lavas to fine-grained glassy dark flows. All types have a characteristic sheen on certain surfaces in hand specimen, owing to fluidal arrangement of feldspar laths. Prominent pyroxene phenocrysts rather common in coarser varieties. Related rocks in southern part of Comstock Lode district referred to as Lousetown pyroxene andesite and described as being more or less platy and in places with good columnar structure. Volcanics at the most are a few hundred feet thick. Overlies other volcanics of upper Miocene or lower Pliocene age.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 57–58, pl. 3. Formation ranges from fine-grained pyroxene andesite with basaltic habit and appearance to olivine basalt. Flows less than 50 feet thick, with vesicular tops. Commonly lies with marked angular unconformity on Truckee formation and older rocks. In Steamboat Hills, probably contemporaneous with or younger than Steamboat Hills rhyolite; elsewhere younger. Assigned late Pliocene or early Pleistocene age.

Type locality: In area east of Lousetown Creek, about 6 miles north of Virginia City, where lavas are best exposed and exhibit most variation.

Loutre Formation (in Cherokee Group)

Pennsylvanian (Des Moines Series): East-central Missouri.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 71–78, pl. 6. Green, light-gray to greenish-gray clay. Thickness at type locality 11½ feet. Underlies Tebo formation; overlies Cheltenham clay.

Type locality: Pit of the Laclede-Christy Clay Products Company, on east side of valley of Little Loutre Creek in SE¼NE¼ sec. 9, T. 49 N., R. 6 W., Montgomery County.

Louviers Alluvium

Pleistocene (early Wisconsin): Northeastern Colorado.

G. R. Scott, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1542–1543. Consists of reddish-brown pebbly facies along major streams and yellowish-brown silty facies along minor streams. At type locality, lies 60 feet above modern stream and 40 feet below older Slocum alluvium (new). Older than Broadway alluvium (new).

Type locality: Gravel pit along northeast edge of town of Louviers in SW¼SE¼ sec. 33, T. 6 S., R. 68 W., Kassler quadrangle, Douglas County.

Lovedale Gypsum Member (of Blaine Formation)[1]

Permian: Northwestern Oklahoma.

Original reference: Noel Evans, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 405–432.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1468. Occurs above Shimer gypsum and below Haskew gypsum. Thickness 1 to 8 feet.

Named for exposures near Lovedale, T. 26 N., R. 20 W., Harper County.

Lovejoy Formation or Basalt

Eocene, upper, or Oligocene, lower: Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Black blocky lava flows about 550 feet thick. Boulders of the basalt underlie Oligocene leaf-bearing beds at La Porte. Underlies Clover formation (new); unconformable above Eocene auriferous gravels; unconformity marked by faulting.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 166–167. At type section, herein stated, formation consists of nine flows of olivine basalt and is 500 feet thick; base of section not exposed. Flows vary in thickness from 10 to more than 50 feet. Overlies unit referred to as Auriferous gravels; underlies Ingalls formation (new). Locally underlies Penman formation. May be upper middle Eocene or upper Eocene.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 4, p. 193–218. Detailed discussion of origin distribution and age of formation. Age established as upper Eocene or lower Oligocene.

Type section: On Red Clover Creek in secs. 30 and 31, T. 25 N., R. 12 E., Blairsden quadrangle, Plumas County. Named for Lovejoy Creek, a tributary to Little Grizzly Creek, near Walker mine in secs. 8 and 17, T. 22 N., R. 12 E.

Loveland Loess[1] or Formation

Loveland Formation (in Sanborn Group)

Loveland Silt Member (of Sanborn Formation)

Pleistocene: Iowa, Illinois, Kansas, Kentucky, Mississippi, Nebraska, South Dakota, and Tennessee.

Original references: B. Shimek, 1909, Geol. Soc. America Bull., v. 20, p. 405; 1910, Science, new ser., v. 31, p. 75.

J. C. Frye and O. S. Fent, 1947, Kansas Geol. Survey Bull. 70, pt. 3, p. 42–45. Loveland loess was described from exposures in western Iowa and has been traced westward across Nebraska and southward from Nebraska as far as central Kansas. In this report stratigraphic equivalents of Loveland are designated Loveland silt member of Sanborn formation. Member includes eolian silts of the uplands and stratigraphically continuous colluvial silts on some slopes and fluvial-eolian silts of lower levels. Thickness 5 to 80 feet. Underlies Peoria silt member.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1947, Nebraska Geol. Bull. 15, p. 25–26. Overlies Crete formation (new). Thickness 8½ feet at type section of Crete. Underlies Peorian formation.

M. M. Leighton and H. B. Willman, 1950, Jour. Geology, v. 58, no. 6, p. 612, 616. Extended into southern Illinois and southward into Tennessee and Mississippi.

L. L. Ray, 1957, Jour. Geology, v. 65, no. 5, p. 543. Loveland loess described at Medora, Ky., near Louisville. Thickness 10 to 12 feet. Overlies gravel; underlies Farmdale loess:

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Included in Sanborn group. Overlies Crete formation; underlies Peoria formation.

R. B. Daniels and R. L. Handy, 1959, Jour. Geology, v. 67, no. 1, p. 114–118. Type locality of Loveland formation destroyed in 1957 when site was used as borrow pit for road construction. New cut adjacent to type locality is described; the exposure is recommended as new type section. Commonly dark brown. Thickness 18¾ feet. Overlies Kansan till; underlies Farmdale loess.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on correlation chart as Loveland formation. Above Crete formation and below Sangamon soil. [Kansas does not use term Sanborn group.]

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 59, 77–78, pl. 1. Geographically extended into Yankton area, South Dakota. Lies upon Illinoian till; overlain by Farmdale loess. Late Illinoian.

Type locality (Shimek): Sec. 3, T. 77 N., R. 44 W., Pottawattamie County, Iowa. Type section (Daniels and Handy): NW¼ sec. 3, T. 77 N., R. 44 W., Harrison County, Iowa.

Named for Loveland, Pottawattamie County.

Lovell Member (of Cloverly Formation)

Lower Cretaceous: Central southern Montana and central northern Wyoming.

R. M. Moberly, Jr., 1958, Dissert, Abs., v. 18, no. 1, p. 198. Proposed for youngest of three members of redefined Cloverly. Composed of three principal lithologies. Commonly at base is olive-gray and reddish-brown lithic wacke. Greatest part of formation [member] is variegated reddish- and yellowish-brown and gray kaolinitic claystone and mudstone, containing veinlets and hardpans of iron oxides. Quartz arenites which filled fluvial channels are laced through claystones. Overlies Little Sheep mudstone member (new); disconformably underlies Crooked Creek formation (new).

In Bighorn Basin.

Lovell Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 155. Name applied to relatively fine-grained unit overlying Kenyon member (new). Type section extends from depths of 2,850 to 2,975 feet. Thickness 65 to 190 feet. Underlies Mayfield member (new).

Type well: Wyman No. 1 (well 7), in NE¼NE¼SE¼ sec. 35, T. 41 N., R. 5 E., De Kalb County. Name derived from Lovell School three-fourths mile south of type well.

Lovelockian series[1]

Lower Jurassic: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 79.

Well exposed in Humboldt Range, east of Lovelock Station, Humboldt County.

Love Ranch Formation

Tertiary: Central southern New Mexico.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 2 (fig. 1), 6 (table 2), 13 (fig. 7), 63 (fig. 14), 69–71. Intercalated boulder-conglomerates and reddish siltstones that overlie Mancos-Eagle Ford beds with pronounced erosional unconformity. Total thickness uncertain because formation is involved in thrust faulting. May be as much as 2,100 feet thick at type locality; 100 feet and less in Organ Mountains.

Named for exposures northwest of Love Ranch, San Andres Mountains, Dona Ana County.

Lovingston Granite Gneiss[1]

Lovingston Formation

Lovingston Granite Gneiss (in Virginia Blue Ridge Complex)

Lovingston Quartz Monzonite Gneiss

Precambrian: Western and northern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim, ed, of geol. map of Virginia.

A. I. Jonas and G. W. Stose, 1939, Am. Jour. Sci., v. 237, no. 8, p. 589. Rockfish conglomerate at its type locality and elsewhere contains pebbles and boulders of granite gneiss and gneiss derived from Lovingston granite gneiss.

R. O. Bloomer, 1950, Am. Jour. Sci., v. 248, no. 11, p. 758, 759, 761. Lovingston gneiss, Marshall granite, and hypersthene granodiorite (delineated on Geologic Map of Virginia, 1928) represents widespread facies of the granitized complex. Lovingston gneiss comprises about two-thirds of the complex. It forms an irregular elongate mass about 12 miles wide at Rockfish River and 150 miles long from Roanoke River on southwest to Thornton River on northeast.

W. R. Brown, 1951, (abs.) Virginia Jour. Sci., new ser., v. 2, no. 4, p. 346; 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 90–92. Lovingston quartz monzonite gneiss grades into Reusens migmatite (new). Dark gneisses in migmatite resemble, in places, the overlying Lynchburg gneiss; this resemblance led earlier workers (Virginia Geol Map, 1928; Furcron, 1935, Geol. Survey Bull. 53) to conclude that Lovingston was intrusive into Lynchburg.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 582, pl. 1. In Blue Ridge area, central Virginia, Lovingston formation forms mappable body about 25 miles long and 8 miles wide. Across contact zone about 100 feet wide, rock grades into Marshall formation with changes in composition, granularity, and structure. To the southeast, unconformably overlain by Lynchburg gneiss. Other bodies as much as 3 miles long and 2 miles wide and elongated parallel to regional foliation are contained in Marshall formation. Gneiss and granite consist of quartz, potash feldspar, oligoclase-andesine and biotite; the gneiss is dark-gray medium grained rock with prominent biotite folia and porphyroblasts of potash feldspar as much as 4 inches in diameter. It surrounds the granite which is a granulose rock containing biotite as irregular, equidimensional aggregates a fraction of an inch in diameter and as randomly oriented grains.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull., 74, p. 9. Lovingston gneiss and granite included in Virginia Blue Ridge complex (new). Bloomer and Werner (1955) limited name Lovingston to gneisses with marked augen typical of this gneiss at type locality and to biotite granite surrounded by augen gneiss; to those rocks formerly called Lovingston but lacking prominent augen, they extend the name Marshall. Rocks of Lynchburg area, previously mapped as Lovingston gneiss, are generally without these prominent augen, so following usage of Bloomer and Werner they are called Marshall in this paper.

Named for occurrences around Lovingston, Nelson County.

Lovington Sandstone Member (of San Andres Formation)

Permian (Leonard): Subsurface in eastern New Mexico and western Texas.

J. M. Hills *in* R. L. Bates, 1942, New Mexico Bur. Mines Mineral Resources Bull. 18, p. 269–271. Name applied to 30-foot sandstone in San Andres formation. Occurs between depths of 4,705 and 4,735 feet in type well, 100 feet below top of formation.

Type section: Penetrated in Skelly No. 3–0 State, 660 feet from south line and 2,310 feet from east line of sec. 31, T. 16 S., R. 37 E., Lea County, N. Mex. Recognized in Gaines, Andrews, and Yoakum Counties, Tex.

Low Creek Beds[1]

Eocene: Eastern Texas and western Louisiana.

Original reference: A. C. Veatch, 1902, Louisiana Geol. Survey Rept. 1902, pt. 6, p. 127–128, pl. 37.

At Low's Creek, near Sabinetown, Sabine County, Tex.

Lowe Granodiorite[1]

See Mount Lowe Granodiorite.

Lowell Clay

Pennsylvanian: Northern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91. Lowell clay occurs at base of Pennsylvanian below La Salle third vein coal; a refractory clay.

Occurs at Lowell, La Salle County.

Lowell Coal Member (of Carbondale Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Jake Creek sandstone member and below Oak Grove limestone member. Coal named by Willman and Payne (1942, Illinois Geol. Survey Bull. 66). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼SW¼ sec. 8, T. 32 N., R. 2 E., La Salle County.

Lowell cyclothem (in Carbondale Formation)

Lowell cyclothem (in Carbondale Group)

Pennsylvanian: Northern Illinois.

H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 87, 102–107. Cyclothem containing eight stratigraphic units. Occurs above

Liverpool cyclothem and below Summum cyclothem. In Carbondale group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2). Included in Carbondale formation (redefined). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type exposure: In high bank on south side of Vermilion River, SE¼SW¼ sec. 8, T. 32 N., R. 2 E., one-half mile west of Lowell, La Salle County.

Lowell Formation (in Bisbee Group)

Lowell Limestone (in Allegheny Formation)[1]

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8–19, pl. 27. Series of alternating sandstones, shales, and limestones. Includes following members (new) in ascending order: Pacheta, Joserita, Saavedra, Cholla, Quajote, Perilla, and Pedregosa. Total thickness 1,104 feet. Overlies Morita formation; underlies Mural limestone.

Type locality: In Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction of Southern Pacific Railway, and southwest of Schlaudt ranch, Cochise County. Standard section also in Ninety One Hills.

Lowell Limestone (in Allegheny Formation)[1]

Pennsylvanian: Northeastern Ohio.

Original reference: J. S. Newberry, 1878, Ohio Geol. Survey, v. 3, p. 797–798.

Well exposed near Lowell, Mahoning County.

Lowell Mountain Formation[1]

Paleozoic: Northeastern Vermont.

Original reference: S. B. Keith and G. W. Bain, 1932, Econ. Geology, v. 27, no. 2, p. 173, 175.

Lowell Mountain, Irasburg quadrangle, Orleans County.

Lowell Park Member (of Platteville Limestone)[1]

Middle Ordovician: Northwestern Illinois.

Original reference: R. S. Knappen, 1926, Illinois Geol. Survey Bull. 49, p. 54–61, 65.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 113. Listed with upper Mississippi Valley formations not in general use.

Named for typical development in Lowell Park and along road north of Dixon quadrangle.

Lowellville Limestone (in Pottsville Formation)[1]

Lowellville limestone member

Pennsylvanian (Pottsville Series): Northeastern Ohio.

Original reference: G. F. Lamb, 1910, Ohio Nat., v. 10, p. 129.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 51, p. 50–52, geol. map. In Coshocton County, Lowellville limestone member of Pottsville series is thin fossiliferous limestone above Vandusen coal and about 58 feet below Lower Mercer limestone.

Well exposed near Lowellville, Mahoning County; also in Washington Township, Coshocton County; and in Madison and Hopewell Townships, Muskingum County.

Lower Brush Creek cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 107–111. I. C. White (1878) applied name Brush Creek to marine shale and limestone at the position of the Lower(?) Brush Creek limestone. Brush Creek is now applied to a series of different beds comprising two more or less complete cyclothems which are now designated Lower Brush Creek and Upper Brush Creek, respectively. Lower Brush Creek embraces interval between Mason cyclothem below and Upper Brush Creek cyclothem. Normal succession includes five members (ascending): Lower Brush Creek shale and (or) sandstone, Lower Brush Creek redbed, Lower Brush Creek underclay, Lower Brush Creek coal, Lower Brush Creek limestone. Thickness about 36 feet. In area of this report, Conemaugh series is discussed on a cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Members of cyclothem are present in Alexander, Athens, Dover, Lee, Trimble, Waterloo, and York Townships, Athens County.

Lower Brush Creek Limestone

Lower Brush Creek limestone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 91. Lower of two fossiliferous limestones in Ohio, at position of Brush Creek limestone which is exposed in Cranberry Township, Butler County, Pa.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 110. Lowest exposed marine member of Lower Brush Creek cyclothem in Athens County. Consists of varied beds of marine origin limestone, shale, or flinty chert, and at many places is combination of these different lithologies. Thickness about 6 feet. In some areas coalesces with Upper Brush Creek limestone member of Upper Brush Creek cyclothem.

Lower Brush Creek redbed member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 109. Member of Lower Brush Creek cyclothem in report on Athens County. At almost every locality where coal and underclay underlie Lower Brush Creek limestone, variegate claystone or shale underlies underlay in turn. It is possible that this claystone may belong to the claystone underlying Mason coal and underclay and, where separated from Lower Brush Creek limestone by shale or sandstone, the name Mason is generally applied, and where no shale or sandstone intervenes, the appellation is Brush Creek. Thickness of redbed member 5 to almost 16 feet.

Lower Brush Creek shale and (or) sandstone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 109. Member of Lower Brush Creek cyclothem in report on Athens

County. Average thickness of interval between Mason and Lower Brush Creek limestone is 18 feet. Most common type of rock occurring in this interval is stratified silty, sandy, and micaceous shale. Massive shale or clay shale occupies interval in some areas. Bedded fine to medium micaceous sandstone and interbedded sandstone occurs in some outcrops.

Lower Brush Creek underclay member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 109. Member of Lower Brush Creek cyclothem in report on Athens County. Thickness 4 inches to 4 feet.

Lower Freeport Clay (in Allegheny Formation)[1]

Pennsylvanian: Ohio and West Virginia.

Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 211, table 2. Clay above Lower Freeport limestone and below Lower Freeport or No. 6a coal. Thickness about 5 feet.

J. B. McCue and others, 1948, West Virginia Geol. Survey, v. 18, p. 16. Lower Freeport underclay present in West Virginia below Lower Freeport coal. Thickness 3 to 6 feet.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51, 53, table 1. Lower Freeport clay included in Lower Freeport cyclothem. Average thickness 4 feet. Directly underlies Lower Freeport coal. Commonly gradational with underlying Lower Freeport limestone. Area of report, Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 19. Lower Freeport clay member covered in Morgan County. Member has been recognized in Perry and Muskingum Counties. About 4 feet thick in Perry County and 5½ feet thick in Muskingum County. Zone may be as much as 5 feet thick in Morgan County. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 80–82. Lower Freeport underclay present in Athens County. Thickness varies from 6 inches to 5 feet 10 inches. Included in Lower Freeport cyclothem; occurs above Lower Freeport limestone member and below Lower Freeport coal member.

Name derived from town of Freeport, Armstrong County, Pa.

Lower Freeport cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 12, 14. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51–54, table 1, geol. map. Consists of (ascending) Lower Freeport shale and (or) sandstone, 25 feet; Lower Freeport limestone, 6 feet; unnamed shale, 4 feet; Lower Freeport clay, 4 feet; and Lower Freeport coal. Occurs below Bolivar cyclothem and above Middle Kittanning cyclothem. In area of this report, the Allegheny series is described on cyclothem basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 78–84. As early as 1858, Rogers used Freeport as group name for those strata between Lower Freeport and Lower Mahoning sandstones.

Strata in above interval now recognized as including three cyclothems which are (ascending) Lower Freeport, Bolivar, and Upper Freeport cyclothems. Bolivar cyclothem is minor, and most of thickness of Roger's Freeport group is occupied by the Freeport cyclothems. Lower Freeport members are (ascending) Lower Freeport shale and (or) sandstone. Lower Freeport limestone, Lower Freeport underclay, Lower Freeport coal, and Dorr Run shale. In area of this report [Athens County], the Allegheny series is described on cyclothemic basis; 13 cyclothems named. [For complete sequence see Brookville cyclothem.]

Name derived from town of Freeport, Armstrong County, Pa.

Lower Freeport Limestone Member (of Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2, p. xxviii.

N. K. Flint, 1948, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51, 53, table 1. Lower Freeport limestone included in Lower Freeport cyclothem. Average thickness 6 feet. Limestone lies between basal Lower Freeport sandstone and (or) shale member and Lower Freeport clay member. Area of report, Perry County.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 27. In early reports on geology of Pennsylvania, Lower Freeport limestone was called Middle Freeport in Cambria and Somerset Counties (Platt and Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2) and Butler limestone in Beaver County (White, 1878, Pennsylvania 2d Geol. Survey Rept. Q). Later, White (1877, Pennsylvania 2d Geol. Survey Rept. Q_2) changed name to Lower Freeport in his report on Lawrence County. This term has been generally accepted. Present report includes discussion of limestones of eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 80. Member of Lower Freeport cyclothem. Recognized at less than 10 localities in Athens County [this report]. In part, it seems to be replaced by a massive sandstone and, in part, to be absent due to lack of development—even where overlying underclay and coal are present. In many localities, the limestone and underclay between Lower Freeport and Lower Mahoning sandstones are interpreted as belonging to either Bolivar or Upper Freeport cyclothem. This is primarily because of the large thickness of Lower Freeport sandstone, possibly including Upper Freeport sandstone as well, and its general stratigraphic relationship to Lower Mahoning sandstone. Thickness of Lower Freeport limestone 8 inches to 8 feet. Underlies Lower Freeport underclay member; overlies Lower Freeport shale and (or) sandstone member. Allegheny series.

Name derived from town of Freeport, Armstrong County, Pa.

†Lower Freeport Sandstone (in Allegheny Formation)[1]

Lower Freeport sandstone and (or) shale member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K_3.

N. K. Flint, 1948, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51, 52, table 1. Lower Freeport sandstone and (or) shale included in Lower Freeport cyclothem. Thickness 15 to 40 feet. Includes interval between Middle Kittanning coal and Lower Freeport limestone. Area of report, Perry County.

See Lower Freeport shale and (or) sandstone member.

Name derived from town of Freeport, Armstrong County, Pa.

Lower Freeport Shale

Lower Freeport shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 118 (table), 160–177. Stratigraphic position of Lower Freeport shale is between Lower Freeport clay and Middle Kittanning coal. In various parts of the state, this interval includes in addition such local members as Washingtonville shale, Upper Kittanning coal and clay, and Lower Freeport sandstone. Lower Freeport shale crops out over belt extending from Mahoning, Columbiana, and Jefferson Counties, on east, to Lawrence County, on south. Average thickness about 36 feet. Lower Freeport sandstone partly or completely replaces Lower Freeport shale.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 79–80. Lower Freeport shale and (or) sandstone is lowermost member of Lower Freeport cyclothem. Thickness of member 39 feet. In the general absence of Washingtonville marine shale and Upper Kittanning member [of Kittanning cyclothems], the Lower Freeport shale and sandstone rest upon top of Middle Kittanning (No. 6) coal. Underlies Lower Freeport limestone member. Allegheny series. Area of report, Athens County.

Name derived from town of Freeport, Armstrong County, Pa.

Lower Kittanning Clay (in Allegheny Formation)[1]

Lower Kittanning clay or underclay member

Pennsylvanian: Western Pennsylvania, eastern Ohio, and West Virginia.

Edward Orton, 1893, Ohio Geol. Survey, v. 7, p. 65–66. Discussion of clays of Ohio. Position of the Kittanning clay is between the Ferriferous limestone and Lower Kittanning coal. Often occupies entire interval between these beds. In some sections where interval is unusually expanded, a sandstone occurs, and the clay and shale are reduced in extend. Thickness 8 to 30 feet. In some instances, the Kittanning clay proper merges with Middle Kittanning clay. Kittanning clay horizon proper is best exposed where it enters Ohio from Pennsylvania and where it leaves Ohio in its extension into Kentucky.

W. C. Phalen and Lawrence Martin, 1911, U.S. Geol. Survey Bull. 447, p. 27. Lower Kittanning clay member of Allegheny formation commonly underlies lower bench of Lower Kittanning coal from which it may be separated by a few inches of shale. In absence of lower bench of coal, the clay sometimes occurs below main coal itself, being separated from it by 3 to 4 inches of bone or shale. Overlies Kittanning sandstone member. Area of report, vicinity of Johnstown, Pa.

Wilber Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 268–269. Lower Kittanning clay lies on average about 22 feet above Vanport limestone and nearly 35 feet below Middle Kittanning coal. Thickness of clay 2 to 20 feet. [Report quotes from Orton, 1893.]

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 40. Lower Kittanning clay is basal unit of Kittanning formation in report on Brookville quadrangle. Thickness a few inches to 20 feet. Underlies Lower Kittanning coal; overlies Lower Kittanning sandstone of Clarion formation.

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 48. Ashley (unpub. ms.) proposed revision of Pennsylvanian system for Pennsylvania. He suggested base of Lower Kittanning clay in Kittanning member of Allegheny group as base of Allegheny group. Studies in western Pennsylvania reveal that Lower Kittaning coal is, regionally, most persistent coal in lower Allegheny group. It seems logical that this horizon should form lower limit of that group. Until final acceptance of Ashley's proposed reclassification, Brookville coal is considered a base of Allegheny group in present report [Smicksburg quadrangle].

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 46. Lower Kittanning clay included in Lower Kittanning cyclothem. Thickness 8 to 10 feet in Perry County. Overlies Kittanning shale and (or) sandstone member; underlies Lower Kittanning (No. 5) coal. Allegheny series.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. Survey Rept. Inv. 17, p. 15. Lower Kittanning underclay commonly occurs immediately below Lower Kittanning or No. 5 Block coal, but a foot or two of dark-gray or black shale locally intervenes between the coal and its underclay. Average thickness of underclay 3.7 feet.

Name derived from Kittanning, Armstrong County, Pa.

Lower Kittanning cyclothem

Pennsylvanian (Allegheny Series): Western Pennsylvania and southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 14. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 46–47, table 1, geol map. Includes (ascending) Kittanning shale and (or) sandstone, 6 feet; Lower Kittanning clay, 6 inches to 12 feet; Lower Kittanning (No. 5) coal; Hamden limestone. Occurs below Strasburg cyclothem and above Scrubgrass cyclothem. For purposes of this report, units of Lawrence cyclothem are treated as part of the Lower Kittanning. In area of this report, the Allegheny series is described on cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 60–64. Type area of the three (Lower, Middle, and Upper) Kittanning cyclothems is in vicinity of Kittanning, Pa. Rogers (1858, Geology of Pennsylvania, v. 2, pt. 1) called one of the coals in his Clarion group the Kittanning coal. Later, Lesley and White (1876, Pennsylvania 2d Geol. Survey map of southern Butler County) used term Kittanning group, and White's (1878, Pennsylvania 2d Geol. Survey Rept. Q) definition included those members from top of Upper Kittanning coal downward to top of Ferriferous ironstone. Exact correlation

between the several Kittanning cyclothems in Pennsylvania and the Kittanning cyclothems and the Lawrence and Strasburg cyclothems in Ohio and Athens County is still uncertain. Since Lawrence coal and Lower Kittanning shale and sandstone are seldom present, the underclays of these two cyclothems are commonly coalesced and extend along their outcrop belt in Ohio as single thick underclay known as Lower Kittanning or Number 5 clay. In present report [Athens County], shale and sandstone and underclay members of Lawrence and Lower Kittanning cyclothems are discussed as combined units rather than individually. Unnamed marine shale and limestone over Lower Kittanning coal has in recent years been described under name of Hamden, a name which should be used for nonmarine limestone and ironstone associated with Oak Hill underclay of Strasburg cyclothem.

Type area: Vicinity of Kittanning, on Allegheny River, in Armstrong County, Pa.

†Lower Kittanning Limestone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 303–305.

Lower Kittanning Marine Shale

See Kittanning Formation.

Lower Kittanning Sandstone (in Allegheny Formation)

Pennsylvanian: Pennsylvania and West Virginia.

C. K. Graeber and R. M. Foose, 1942, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 54, p. 40–41. Discussion of Brookville quadrangle. Lower Kittanning sandstone is uppermost unit in Clarion formation. Lies above Vanport sandstone and below Lower Kittanning clay of Kittanning formation.

M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 63. Discussion of Smicksburg quadrangle. Lower Kittanning sandstone is between Lower Kittanning coal and Vanport limestone.

R. L. Nace, and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22 (table 5). Lower Kittanning sandstone listed with recognized named members of Allegheny formation in Harrison County. Above Vanport limestone and below Lower Kittanning clay.

Name derived from Kittanning, Armstrong County, Pa.

Lower Kittanning Shale

Pennsylvanian: Eastern Ohio.

R. E. Lamborn, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 118 (table), 138–145. In previous reports of Ohio Geological Survey involving stratigraphy of Pennsylvanian rocks of Ohio, names have been used consistently for various coal, clay, limestone, iron ore, and sandstone beds, but little attention has been given to shale intervals. Shale beds in present report are given name of first prominent underlying coal, except where a prominent sandstone is found on same horizon as shale bed. In the latter case, the name of the sandstone is applied. Stratigraphic position of Lower Kittanning shale, as term is used in this report, is in interval between Clarion coal horizon below and Lawrence clay above. Massive sandstone fills part of this interval. Thickness of shale about

8 feet. Top of Lower Kittanning shale is clearly defined across Ohio as either Lawrence clay or overlying Lower Kittanning clay is invariably present on outcrop. Close above Clarion coal or clay are a limestone and an overlying iron ore, known as Vanport and Ferriferous respectively.

Name derived from Kittanning, Armstrong County, Pa.

Lower Little Pittsburgh cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 153–156. Embraces interval between Little Clarksburg cyclothem (new) and Upper Little Pittsburgh cyclothem (new). In normal sequence, includes five members (ascending): Connellsville shale and sandstone, Connellsville redbed, Lower Pittsburgh limestone, Lower Little Pittsburgh underclay, and Lower Little Pittsburgh coal. Thickness about 54 feet. Two Little Pittsburgh cyclothems underlie Pittsburgh (No. 8) coal in parts of northern Appalachian coal basin. In general, these two cycles are irregular and uncertain in development, and at many places most or even all members of one or both cyclothems seem to be missing. Hence, correlation of Little Pittsburgh members is often uncertain. In Athens County, only Connellsville sand and redbed members are well developed. In area of this report, Conemaugh series discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Alexander, Ames, Athens, Bern, Canaan, and Rome Townships, Athens County.

†Lower Little Pittsburgh Limestone[1]

Pennsylvanian: Western Pennsylvania, western Maryland, and northern West Virginia.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 305–308.

Lower Little Pittsburgh underclay member

Pennsylvanian: Eastern Ohio

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 1), 156. Member of Lower Little Pittsburgh cyclothem (new) in report on Athens County. Rests directly on top of Connellsville sandstone or more frequently on Connellsville redbed. Average thickness 11 inches. Lower Pittsburgh limestone commonly not developed in County. Conemaugh series.

Lower Mahoning limestone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 101–102. Lower Mahoning limestone member included in Mahoning cyclothem in report on Athens County. Thickness 1½ feet. Occurs above Lower Mahoning redbed member and below Thornton clay member. Conemaugh series.

Name derived from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Lower Mahoning redbed member

See Mahoning Red Bed (in Conemaugh Formation) and Mahoning cyclothem.

†Lower Mahoning Sandstone[1] (in Conemaugh Formation)

Lower Mahoning Sandstone (in Conemaugh Group)

Lower Mahoning sandstone and shale member

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1876, Pennsylvania 2d Geol. Survey Rept. L.

W. O. Hickok and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 89, fig. 21. Lowest sandstone in Conemaugh group. Rests directly on Upper Freeport coal bed or is separated from it by Uffington shale. At many places between Lower and Upper Mahoning sandstones is a shale interval which may contain up to three beds of coal, several beds of impure fire clay, one or two limestone horizons, iron ore, and a bed of red clay. Thickness of Lower Mahoning sandstone 30 to 40 feet in Fayette County [this report].

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 26–27. Lower Mahoning sandstone is basal member of Conemaugh series and includes shale and sandstone extending from top of Upper Freeport (No. 7) coal to base of Mahoning limestone. Where Mahoning limestone is absent, sandstone member extends upward into Thornton clay or to base of Mahoning sandstone. Area of report, Morgan County. Cyclothemic classification not used in this report.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 98–100. Lower Mahoning sandstone included in Mahoning cyclothem in report on Athens County. Average thickness 34½ feet. Lowermost member of cyclothem; underlies Lower Mahoning redbed member. Allegheny series.

Name taken from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Lower Mercer cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci [Guidebook] 24th Ann. Field Conf., p. 4, 8. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 29–31, table 1, geol. map. Includes (ascending) Lower Mercer shale and (or) sandstone 10 to 25 feet; Lower Mercer clay, 6 inches to 11 feet; Lower Mercer (No. 3) coal; and Boggs member, 1 inch to 4 feet. Occurs below Flint Ridge cyclothem and above Vandusen cyclothem; where entire Vanlusen cyclothem is missing, the shale and sandstone cannot be distinguished from Massillon shale of Bear Run cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.].

Exposed in northern and western Perry County.

Lower Mercer Fire Clay (in Pottsville Formation)[1]

Lower Mercer [fire] clay member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

N. F. Flint, 1951, Ohio Geol. Survey 4th ser., Bull., p. 30, table 1. Referred to as Lower Mercer clay member of Lower Mercer cyclothem in

report on Perry County. Thickness 3 to 6 feet. Directly overlain by Lower Mercer coal and underlain by either sandstone or shale. Pottsville series.

Lower Mercer Iron Shales (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

Lower Mercer Limestone (in Pottsville Formation)[1]

Lower Mercer limestone member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 33, table 1. Referred to as Lower Mercer limestone member of Middle Mercer cyclothem in report on Perry County. Youngest member of cyclothem. Thickness 1 to 12½ feet. Lies between Middle Mercer coal member and basal sandstone or shale member of Bedford cyclothem. Pottsville series.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 23. Lower Mercer limestone formerly called Blue limestone and Zoar limestone in early reports on geology of Ohio. In early writings of Geological Survey of Pennsylvania, this bed was called Mercer limestone (Rogers, 1858). White (1878, Pennsylvania 2d Geol. Survey Rept. Q_2) considered Lower Mercer more appropriate name for this member, and as a result latter term has come into general use in both Ohio and Pennsylvania. Lower Mercer is most prominent and widely distributed limestone member of Pottsville series. Thickness a few inches to 10 feet; average thickness about 2 feet. Position of Lower Mercer in Ohio varies from about 65 feet to 90 feet below base of Brookville coal which marks top of Pottsville series; occurs 15 to 40 feet below Upper Mercer limestone.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 53, p. 58–75. Lower Mercer limestone discussed in report on Coshocton County. Consists of dark bluish-gray to grayish-black stone containing profusion of fossils. Thickness a few inches to about 10 feet. Present about 27¼ feet below Upper Mercer limestone.

Named for Mercer, Mercer County, Pa.

Lower Mesa Formation or Gravels

Pleistocene: Southeastern Oregon and southwestern Idaho.

V. R. D. Kirkham, 1931, Jour. Geology, v. 39, no. 3, fig. 1 (p. 202), fig. 12 (p. 211), fig. 13 facing p. 212. Overlies Idaho formation. Name appears only on geologic map and on geologic cross-sections.

Mapped in Ada, Canyon, Owyhee, Payette, and Washington Counties, Idaho, and Malheur County, Oreg.

Lower Narrows Rhyolite[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121.

Occurs on north flank of syncline on both sides of Lower Narrows of Baraboo River, secs. 20, 21, 22, and 23, T. 12 N., R. 7 E., Baraboo district.

Lower Pittsburgh Limestone Member (of Conemaugh Formation)[1]

Lower Pittsburgh limestone and shale member

Upper Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: F. Platt and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 286.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 61–62, geol. map. Lower Pittsburgh limestone was named Summerfield limestone by Condit (1912, Ohio Geol. Survey Bull. 17) for exposures in Noble County, Ohio, and term was widely used in geological literature of state. Condit later retracted term Summerfield in favor of older term Lower Pittsburgh limestone (1923, U.S. Geol. Survey Bull. 270). Ohio Geological Survey recently abandoned term Summerfield. Lower Pittsburgh limestone not well represented in Morgan County [this report]. Lower Pittsburgh limestone and shale member of Conemaugh series occupies interval between Connellsville sandstone and shale member and Bellaire sandstone and shale member. Where best exposed in Morgan County, consists of 10 feet of yellowish-brown finely crystalline to dense nodular limestone with interbedded calcareous shales; limestone is separated from overlying Bellaire sandstone by 7 feet 5 inches of sandy clay shales.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 154–156. Lower Pittsburgh limestone member included in Lower Little Pittsburgh cyclothem (new) of Conemaugh series, in report on Athens County. Only representation of member in county consists of small limestone nodules and pellets in Connellsville redbed in Canaan Township.

Name for its occurrence with Pittsburgh coal in western Pennsylvania.

Lower Pittsburgh redbed member.

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 161. Member of Pittsburgh cyclothem (new) in report on Athens County. Average thickness about 17 feet. Typically gray to tan limonite-stained clay shale or claystone, with mottling of maroon, yellow, and red with some purple and orange. Above Lower Pittsburgh (Bellaire) shale and (or) sandstone member and below Upper Pittsburgh limestone member. Monongahela series.

Lower Pittsburgh Sandstone (in Conemaugh Formation)

Pennsylvanian: Pennsylvania and West Virginia.

[Original reference]: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 244.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 69 (fig. 4). Generalized columnar section for Pennsylvanian western Pennsylvania shows Lower Pittsburgh sandstone above Little Pittsburgh coal and below Upper Pittsburgh limestone. Conemaugh series.

Probably named for occurrence in vicinity of Pittsburgh, Pa.

Lower Pittsburgh (Bellaire) shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 161. Member of Pittsburgh cyclothem (new). Locally, lenses of shale and sandstone occupy part of interval of Lower Pittsburgh redbed. In Athens County [this report] these are uncommon but do occur locally and represent Lower Pittsburgh sandstone or Bellaire sandstone of Condit. Average thickness of lenses about 7 feet. Monongahela series.

Lowerre Quartzite[1]

Precambrian: Southeastern New York.

Original reference: F. J. H. Merrill, 1898, New York State Mus. 15th Ann. Rept., v. 1, p. 21–31.

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 676–683. So-called Lowerre quartzite, not valid name. Examination of all reported occurrences of the Lowerre showed only two localities where quartzitic-looking rocks are present, and detailed studies showed these pseudo-quartzites to be highly sheared phases of Fordham gneiss and related intrusives.

Named for exposures in southern Westchester County, near Lowerre Station in Yonkers at Hastings marble quarry and about one-half mile south of Sparta on shore of Hudson River.

Lower Sewickley cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 172–173, 174 (map 22). Embraces interval between Fishpot cyclothem (new) below and Sewickley cyclothem (new) above. Normal succession includes six members (ascending): Lower Sewickley shale and sandstone, Lower Sewickley redbed, Lower Sewickley limestone, Lower Sewickley underclay, Lower Sewickley coal (very local), and Lower Sewickley roof shale (if present is very thin and usually considered part of coal zone). Average thickness 19 feet. Terms Lower Sewickley coal and Lower Sewickley cyclothem will be used until further fieldwork demonstrates its true relation to Sewickley coal bed. [See Sewickley cyclothem.] In area of this report, Monongahela series is discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County.

Lower Sewickley limestone member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 172. Member of Lower Sewickley cyclothem (new) in report on Athens County. Occurs at only one locality and represents only recorded occurrence of fresh-water limestone in Fishpot to Sewickley coal bed interval. Thickness as much as 9 feet, but is interbedded with sandstone and redbeds. Occurs above Lower Sewickley redbed member and below Lower Sewickley underclay and coal members.

Name derived from Lower Sewickley cyclothem.

Lower Sewickley redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 172. Member of Lower Sewickley cyclothem (new) in Athens County. Occurs in normal sequence above Lower Sewickley sandstone member. Average thickness 5 2/3 feet.

Name taken from Lower Sewickley cyclothem.

Lower Sewickley roof shale member

See Lower Sewickley cyclothem.

Lower Sewickley Sandstone

Lower Sewickley sandstone and shale member

Pennsylvanian (Monongahela Series): West Virginia and eastern Ohio.

R. V. Hennen, 1912, West Virginia Geol. Survey [Rept.] Doddridge and Harrison Counties, p. 201–202. Buff fine-grained micaceous massive and arenaceous sandstone 25 to 30 feet thick. Lies 5 to 10 feet under Sewickley coal. Stratigraphically below Upper Sewickley sandstone.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56. p. 73. Lower Sewickley sandstone and shale member, as accepted by Ohio Geological Survey, occupies interval between Fishpot coal and Meigs Creek (No. 9) coal. Stratigraphic nomenclature of unit uncertain. It is the sandstone in interval designated as Fishpot sandstone by Lamborn (1930). In Lamborn's description of his Fishpot sandstone a probable correlation with Lower Sewickley sandstone of West Virginia was recognized. Writer [Norling] has not located original source of this latter term in West Virginia literature. Term probably resulted from recognition of position of Sewickley (No. 9) coal within long sandstone section and application of terms Lower and Upper to parts of that sandstone below and above the coal, respectively. Lower Sewickley member in Morgan County is sequence of sandstones and shales, 10 to 20 feet thick, which underlies Meigs Creek (No. 9) coal. Varies from sandy shale to massive sandstone sections.

M. T. Sturgeon, 1958, Ohio Geol. Survey Bull. 57, p. 172–173. In Ohio, the sandstone between Fishpot and Sewickley coal beds has been referred to as Lower Sewickley sandstone and Fishpot sandstone. Name Lower Sewickley, suggested by Hennen (1912), antedates name Fishpot proposed by Lamborn (1930) and is accepted terminology. Lower Sewickley shale and sandstone member of Lower Sewickley cyclothem (new) is 5 to 6 feet thick in Athens County [this report]. Occurs below Lower Sewickley redbed member of Lower Sewickley cyclothem. Name Lower Sewickley shale and sandstone member is used for lowest unit of Sewickley cyclothem (new) when its lower boundary rests on Fishpot cyclothem because it is proper term for this lithology in usual Fishpot to Sewickley coal bed interval and is continuous with Lower Sewickley shale and sandstone of Lower Sewickley cyclothem.

Mentioned by Hennen in section near Gore Station, Harrison County, W. Va.

Lower Sewickley underclay member

See Lower Sewickley cyclothem.

Lower Uniontown cyclothem

Pennsylvanian (Monongahela series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 181–182, 183 (map 24). Table shows Lower Uniontown as embrac-

ing interval between Arnoldsburg cyclothem (new) below and Uniontown cyclothem (new) above; however, text states Lower Uniontown is interposed within boundaries of Uniontown cyclothem. Succession includes six members (ascending): Arnoldsburg shale and sandstone, Ritchie redbed, Lower Uniontown limestone, Lower Uniontown underclay, Lower Uniontown coal (not observed in Athens County), and Lower Uniontown roof shale (not positively identified in Athens County). [See Uniontown cyclothem.] Thickness about 27 feet. In area of this report, Monongahela series discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Fairly consistent in Washington and Monroe Counties but of irregular occurrence and minor importance in Athens County.

Lower Uniontown roof shale member

See Lower Uniontown cyclothem.

Lower Uniontown shale and sandstone member

See Lower Uniontown cyclothem.

Lower Uniontown underclay member

See Lower Uniontown cyclothem.

Lower Washington Limestone Member (of Washington Formation)[1]

Lower Washington Limestone

Permian: Southwestern Pennsylvania, eastern Ohio, and West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 44, 50.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 39, 40. In Ohio, known distribution of Lower Washington on outcrop is confined to Belmont County, where it tends to be patchy and discontinuous. Thickness varies from a few feet to nearly 20 feet. Generally separated from underlying Washington coal by thin bed of arenaceous shale or shale and thin sandstone. Included in Washington series which, in Ohio, consists of following limestones (ascending): Elm Grove, Mount Morris, Lower Washington, Middle Washington, and Upper Washington.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness 0 to 8 feet.

Named for exposures near Washington, Washington County, Pa.

Lowes Grove Beds

Triassic: North-central North Carolina.

Grover Murray, Jr., 1938, Science, v. 87, no. 2261, p. 390. Fine white to brown yellow-mottled slightly metamorphosed shale containing *Estheria ovata* (Lea) and smooth-shelled ostracoda of the Cypridae family. Equivalent in age to Nelson beds (new).

Occurs in Durham Triassic basin along State Highway 54 about one-half mile west of Lowe's Grove, Durham County.

Low Gap Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 344.

Type locality: On Wolf Creek Mountain, Summers County, in public road slightly east of and above Low Gap School.

Low Gap Sandstone (in Cross Mountain Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19, pl. 2. Massive sandstone 45 to 70 feet thick. Overlies unnamed shale interval 35 to 140 feet thick that contains Grassy Spring coal; underlies shale interval 110 to 200 feet thick that contains the Cold Gap and Wild Cat coals and in turn underlies Tub Springs sandstone (new).

Type locality: Same as Cross Mountain group, which is on road leading to top of Cross Mountain, Lake City quadrangle, Anderson County. Named from exposures in Low Gap on crest of Redoak Mountain between Graves Gap and Cross Mountain.

Low Gap Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 334.

Type locality: On Wolf Creek Mountain, Summers County, W. Va., in public road slightly east of and above Low Gap School.

Low Gap Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 345.

Type locality: On Wolf Creek Mountain, Summers County, in public road slightly east of and above Low Gap School.

Low Hollow Limestone Member (of Maynardville Limestone)

Upper Cambrian: Southwestern Virginia.

R. L. Miller and J. O. Fuller 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76. Gray crypto-crystalline ribbon limestone in lower part and mottled limestone in upper part; interbedded fine-grained dolomite near top. Thickness 160 to 206 feet. Underlies Chances Branch dolomite member (new); overlies Conasauga shale.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 35–37; R. L. Miller and W. P. Brosagé, 1954, U.S. Geol. Survey Bull. 990, p. 15, 89, pl. 1. Further described. Thickness at type locality (herein given) 142 feet.

Type locality: Along Fourmile Creek at Virginia-Tennessee State line. Well exposed along road in Low Hollow 4½ miles south of Rose Hill and 1 mile south of Deans Store, Lee County.

Lowrie Sandstone Bed (in Wellington Formation)[1]

Permian: Central northern Oklahoma.

Original reference: J. M. Patterson, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 3, p. 243, 251.

Exposed a few miles north of Guthrie vertical bluffs on east side of Cimarron River, in central part of T. 17 N., R. 2 W. Named from railroad station of Lowrie, in sec. 16.

Lowville Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 74, 78–79, 83, 104, and map of Lowville quad.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 136, 137, 139. Includes finer grained modified border facies in Lake Bonaparte quadrangle.

Occurs in Lowville area.

Lowville Limestone (in Black River Group)[1]

Middle Ordovician: New York, Maryland, Pennsylvania, and western Virginia, and Ontario, Canada.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 179–191. Term Lowville-Moccasin used in this report [Appalachian Valley] because equivalent of upper three-fourths of Lowville in middle belt of valley is a red argillaceous limestone or calcareous mudrock facies which has received name Moccasin limestone, a name extensively used in southwestern Virginia and northern Tennessee. Lowville is bounded below by Athens shale or Ottosee limestone, or locally by Holston limestone. Overlain in some places by Eggleston limestone; in others by Trenton limestone or Trenton division of Martinsburg shale. In parts of the valley, a hiatus exists between Lowville-Moccasin and the Trenton due to absence of Chambersburg limestone, which in Franklin County, Pa., immediately overlies the Lowville.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, Va., subdivided into 29 distinctive zones. This study has revealed inconsistencies in use of stratigraphic names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Revised stratigraphic nomenclature proposed. Further use of terms Lowville and Lowville-Moccasin in Tazewell County and other parts of southwestern Virginia seems inadvisable. Witten limestone of revised classification corresponds to part, and locally to all, of Lowville limestone or Lowville limestone facies of Lowville-Moccasin formation as defined by Butts.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 46. Believed that names Tyrone and Lowville should not be used in central Tennessee as applied to definite units of limestone (name Carters has priority over New York name, Lowville, and Kentucky name, Tyrone). Name Carters should be restored to formational rank and be used as originally defined by Safford.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. In Saratoga Springs area, New York, previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland?, Hull, Sherman Fall representatives), and Canajoharie shale.

R. L. Miller and J. O. Fuller, 1954, Virginia Geol. Survey Bull. 71, p. 90–103, pl. 9. In Rose Hill district, Lee County, the Lowville is restricted to the pre-Moccasin beds, whose thickness amounts to about two-thirds of Lowville-Moccasin sequence (Butts, 1940). Consists of a lower redbed member and an upper platy member. Thickness 583 feet. Overlies Lenoir limestone; underlies Moccasin limestone. In Tazewell County, several new names have been proposed (Cooper and Prouty, 1943) for beds at least partly equivalent to those here described under Lowville but correlates between the two areas are not established, and Tazewell County names are not applied in Rose Hill district.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 47–56. Hurricane Bridge limestone, in Jonesville district, Virginia, is identical to the redbed member of Lowville limestone as mapped by Miller and Fuller. Woodway limestone is exactly equivalent to platy member of Lowville as mapped by Miller and Fuller.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 22–23. Name has been widely used in eastern United States and Canada as formation name, but such use should be discouraged outside New York, Ontario, and Quebec. Only in these latter regions can the formation be shown to be a laterally continuous unit. Elsewhere name has use only in facies sense for so-called dove limestones. In type section, formation is 34 feet thick. Overlies Pamelia formation; underlies Chaumont formation.

Well exposed at Lowville, Lewis County, N.Y.

Lowvillian (stage)

Ordovician (Black Riveran): New York.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 94 (table 3). Name used in list of stage names for middle division of Black Riveran series. Older than newly named Chamontian [stage]; younger than newly named Pamelian [stage].

Name probably derived from Lowville, Lewis County, for which Lowville limestone is named.

Loyal Creek[1] Member (of Utica Formation)

Middle Ordovician: Eastern New York.

Original reference: R. Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, p. 100.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 282–283. Loyal Creek member has been defined as the middle Utica or zone of *Dicranograptus nicholsoni* Hoplinson; black laminated shale; thickness about 130 feet on Loyal Creek near Fort Plain. Overlies Nowadaga member; underlies Holland Patent member.

Occurrence is in upper Mohawk Valley, westernmost Montgomery County.

Loyalhanna Limestone[1]

Loyalhanna Limestone Member (of Greenbrier Limestone)[1]

Mississippian: Western and central Pennsylvania, western Maryland, and West Virginia.

Original reference: C. Butts, 1904, U.S. Geol. Survey Geol. Atlas, Folio 115, p. 5.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Described in Hollidaysburg-Huntingdon area, Pennsylvania. Formation occupies

stratigraphic interval above Burgoon sandstone member of Pocono and below Mauch Chunk formation. Thickness about 40 feet.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 38–43. Member of Greenbrier limestone. At base of formation. Thickness 67 feet, excluding 8-foot covered interval at base. Underlies unnamed upper member of Greenbrier. Area of report, Garrett County.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000), Pennsylvania Geol. Survey, 4th ser. Mauch Chunk formation as mapped includes Greenbrier limestone in Fayette, Westmoreland, and Somerset Counties: Loyalhanna limestone at base in southwestern Pennsylvania.

Named for exposures in gorge in which Loyalhanna Creek flows across Chestnut Ridge is Westmoreland County, Pa.

Loyd Sandstone Member (of Mancos Shale)

Upper Cretaceous: Northwestern Colorado.

Kenji Konishi, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 69–70, pl. 1. Thick massive greenish-gray sandstone; fine to very fine grained, very calcareous, and nodular at certain horizons where it becomes quite fossiliferous; without prominent development of bedding planes; weathers to rounded lumplike masses; about 100 feet thick at type locality and apparently thins out eastward but keeps constant thickness southward and westward. Located about 60 feet below top of formation at type locality.

Type locality: Center sec. 36, T. 5 N., R. 92 W. Type section in Cliff on southeastern end of Iles Mountain, which is about 0.2 mile from Colorado Highway 13. Named for little town about 5 miles southwest of type locality.

Loysburg Formation[1]

Middle Ordovician: Central and central southern Pennsylvania.

Original reference: R. M. Field, 1919, Am. Jour. Sci., 4th, v. 48, p. 404, 410.

G. M. Kay, 1941, Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Formation comprises Clover member (new) 46 to 60 feet thick, in upper part and pre-Clover laminated magnesian and pure limestone, at least 400 feet thick. Underlies Hatter limestone (new).

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 193. Includes unnamed member and Clover member. Underlies Hatter formation which is subdivided into (ascending) Eyer, Grazier, and Hostler members. Chazyan series.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3 (fig. 2), 4–6, 7 (table 1). Loysburg formation was described as dark and impure dolomitic limestone lying between the Beekmantown and first "intraformational zone" of Carlim limestone. Clover limestone, classed as upper member of Loysburg, comprises 60 feet of relatively pure, sublithographic limestone overlying the "tiger-striped" lithology of interlaminated dark and buff-weathering ostracode-bearing limestone in type section [of Clover]. Inasmuch as the "first intraformational zone" is in the "tiger-striped" member, the Clover is added to original Loysburg. Carlim limestone included the "transition beds" or "tiger-striped", the Clover, and the Hatter formation in Tyrone district. Underlying magnesian beds were

classified as Bellefonte dolomite (Butts, Swartz, and Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. 96) and were considered Canadian age, but they may be a facies of the Loysburg, which has been considered "Stones River" or "Chazyan".

Named for village of Loysburg, Bedford County.

Luapelani Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 1, p. 1246 (fig. 1). Shown on map of recent lava flows.

On southwest side of Halekala.

Lucas Formation (in Detroit River Group)

Lucas Dolomite[1]

Middle Devonian: Ohio and southeastern Michigan, and western Ontario, Canada.

Original reference: C. S. Prosser, 1903, Jour. Geology, v. 11, p. 521, 540.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1456. Detroit River group revised. Oldest unit, Sylvania, is succeeded by Amherstburg dolomite, Lucas dolomite, and Anderdon limestone.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 1, 2 (fig. 2), 3–7. In order to apply outcrop terminology so far as possible to sediments of central part of Michigan basin, the Lucas is defined, in this report, as a formation that includes the thick evaporite sequence which overlies dolomite sequence, (Richfield member, new), downdip from outcrop area. Thickness (subsurface) 68 to 1,204 feet. Anderdon limestone, which overlies the Lucas in southeastern Michigan, not recognizable in subsurface; hence, the Lucas underlies Dundee formation.

G. M. Ehlers, E. C. Stumm, and R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northwestern Ohio: Ann Arbor, Mich., Edwards Bros., Inc., p. 8 (fig. 2), 9–10, 13. Thickness about 84 feet in quarries at Silica, Ohio, and in Detroit region 170 feet.

Named for exposures in Lucas County, Ohio.

Lucas limestone[1]

Middle Devonian: Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149; 1913, Iowa. Acad. Sci. Proc., v. 20, p. 205, 206.

Named for a locality in Johnson County.

Lucerne Granite

Age not stated: Eastern Maine.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Coarse-textured porphyritic biotite granite. Makes up large percentage of intrusive material in area mapped.

Report discusses parts of Hancock and Penobscot Counties.

Lucia Shale

Eocene: West-central California.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as underlying The Rocks sandstone and overlying Junipero sandstone (both new). Thickness 100 to 500 feet.

R. R. Thorup, 1943, California Div. Mines Bull. 118, pt. 3, p. 465. Described as greenish- to steel-gray thin-bedded nodular mudstone and shale. Lucia is gradational with both underlying Junipero sandstone and overlying The Rocks sandstone. Formerly considered part of Vaqueros which is herein stratigraphically restricted in its type area.

Type locality: NE¼ sec. 34, N½ sec. 35, SE¼ sec. 26, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County.

Lucien shale member[1]

Permian: Central northern Oklahoma.

Original reference: F. L. Aurin, H. G. Officer, and C. N. Gould, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, p. 786–799.

Named for exposures at Lucien, Noble County.

Lucile Series

Upper Triassic: Central western Idaho and northeastern Oregon.

W. R. Wagner, 1945, Idaho Bur. Mines and Geology Pamph. 74, p. 5, pl. 1. Comprises (ascending) graphitic schist and calcareous shale member, limestone member which has some intercalated tuffaceous lenses, and phyllitic and schistose member containing some volcanic flows. At Lucile, graphitic schist is gray to black fine-grained rock with well-developed schistosity; over 400 feet thick locally, but very lenticular, disappearing not more than 1 mile northwest of Lucile. Shale is white to light gray and pink; thin bedded, limy, and shows signs of flowage; about 100 feet thick one-half mile south of Cold Springs Lookout. Limestone is gray to bluish gray, except for some thin white to light-gray beds; thickness at Lucile 500 feet, and elsewhere ranges from 50 to more than 500 feet; at several points, beds of tuffaceous materials from few feet to over 50 feet thick and from 50 feet to over a mile long are intercalated with limestone. Phyllites and phyllitic schists are fine- to medium-grained light- to dark-brownish-gray micaceous rocks which show increase in grain size on approach to Idaho batholith to the east; thickness of more than 2,000 feet exposed at Riggins. Overlies Seven Devils volcanics.

Named for occurrence at Lucile, Idaho County, Idaho. Exposed in canyon walls of Salmon River from Lucile to Riggins and in canyons of Salmon and Little Salmon east and south of Riggins.

Luck-Sure Series[1]

Age(?): Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

Well developed in mineral claims formerly known as Lucky Cuss, Luck Sure, Wedge, Sunset, Knoxville (Stonewall), Anchor, and Grand Dipper, Tombstone district.

Lucky Bill Formation

Miocene(?): Southwestern New Mexico.

R. M. Hernon, W. R. Jones, and S. L. Moore, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 120. Listed in table of formations. Gravel, sand, and pumiceous tuffs; well-sorted and stratified in places. Thickness as much as 600 feet. Unconformably underlies unnamed rhyolite tuffs; overlies Rubio Peak formation (new).

In Santa Rita quadrangle.

Lucky Cuss Limestone[1]

Ordovician (?) : Southeastern Arizona.

Original reference: J. A. Church, 1903, Am. Inst. Mining Engrs. Trans., v. 33, p. 3–37.

Tombstone district.

Lucky S Argillite[1]

Upper Jurassic : Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Type locality: Forman Ravine, west end of Forman Ridge, Mount Jura. Named for Lucky S mine.

†Ludlow conglomerate member[1]

Devonian or Carboniferous : Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 202.

Ludlow Member (of Fort Union Formation)

Ludlow Formation (in Fort Union Group)

Ludlow Lignitic Member (of Lance Formation)[1]

Paleocene: Northwestern and northern South Dakota, northeastern Montana, and southwestern North Dakota.

Original reference: E. R. Lloyd and C. J. Hares, 1915, Jour. Geology, v. 23, p. 523-547.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 16–18. Formation described in southern Morton County where it is 17 to 49 feet thick, overlies Hell Creek formation and underlies and is in gradational contact with Cannonball formation which it replaces westward. Fort Union group. Paleocene.

N. H. Darton, 1951, Geologic map of South Dakota (1:500,000) : U.S. Geol. Survey. Ludlow formation mapped in northwestern South Dakota.

R. A. Brant, 1953, U.S. Geol. Survey Circ. 226. p. 1, 11, 12. Basal member of Fort Union formation in North Dakota. Equivalent to Tullock member and Lebo shale member in lignite fields of southeastern Montana. Underlies Tongue River member. In Marmarth lignite field, consists of 250 feet of alternating shale, sandstone, and lignite beds. Thins to the east and interfingers with Cannonball formation. Overlies Hell Creek formation. Paleocene.

P. R. May, 1954, U.S. Geol. Survey Bull. 995–G, p. 267–268. Member of Fort Union. Described in Wibaux area, where it crops out along banks of Yellowstone River in Dawson County, and on southwestern edge of area as far east as vicinity of Hodges, Mont. Thickness about 250 feet. Underlies Tongue River member; overlies Hell Creek formation. In most of older geologic reports, the Ludlow member and Hell Creek formation, which are similar in character, were not distinguished from each other but were referred to as Lance formation.

R. E. Stevenson, 1954, Areal geology of the Morristown quadrangle (1:62,500) : South Dakota Geol. Survey. Formation, in Morristown quadrangle, overlies Hell Creek formation and underlies Cannonball

formation. Thickness about 250 feet. Includes Shadehill coal facies at base and Hillen facies about 60 feet above Shadehill facies.

B. C. Petsch, 1956, Area geology of the Mouth of Bull Creek quadrangle (1:62,500): South Dakota Geol. Survey. Formation, in Mouth of Bull Creek quadrangle, overlies Hell Creek formation and underlies Tongue River formation. Includes Shadehill facies at base, Hillen facies near middle, and Giannonatti facies at or near top. Thickness about 250 feet.

Type locality: Vicinity of Ludlow, Harding County, S. Dak.

Ludlow Sandstone[1]

Middle Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1236–1237.

Perry County.

†Ludlowville Group[1]

Middle Devonian: New York.

Original reference: J. Hall, 1842, Am. Jour. Sci., 1st, v. 42, p. 57–62.

Well exposed along Cayuga and Seneca Lakes.

Ludlowville Shale (in Hamilton Group)[1]

Middle Devonian: Western and central New York.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 298.

Burnett Smith, 1935, New York State Mus. Bull. 300, p. 44–51. Formation, in Skaneateles quadrangle, subdivided into (ascending) Otisco, Ivy Point, Spafford, and Owasco members (all new). Restricted at base to exclude Centerfield member herein placed in Skaneateles formation.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 259. In Chenango Valley, Morrisville quadrangle, includes Stone Mill member (new).

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 361–372, pl. 1. Formation, in Batavia quadrangle, comprises (ascending) Centerfield, Ledyard-Wanakah, Tichenor, and Deep Run members. Overlies Skaneateles formation; underlies Moscow formation. Thickness about 113 feet.

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 3–7. Includes (ascending) Centerfield limestone, Ledyard, Wanakah shale, Tichenor limestone, and Deep Run members. In Cayuga Lake area, includes King Ferry member equivalent to Wanakah shale, Tichenor limestone, and Deep Run members to west. Hamilton group. Trepostomamous Bryozoa discussed.

Reference section: Sequence on Paines Creek at Aurora beginning with the Centerfield at Moonshine Falls and terminating with Portland Point beds at Black Rock, Erie County. Named for occurrence at Ludlowville, Tompkins County.

Lueders Limestone (in Wichita Group)[1]

Lueders Group

Permian: Central northern and central Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 94, chart opposite p. 96.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 94. Rank raised to group. Includes (ascending) Paint

Rock limestone, Maybelle limestone, and Lake Kemp formation. Overlies Belle Plains group (expanded); underlies Clear Fork group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as a formation where, in Runnels County, it is about 225 feet thick. Consists mainly of very even limestone beds, 1 foot or a little less to about 3 feet thick; in part of section, these beds succeed one another with only an inch or two of intervening shale; in other parts, shale or marl between the limestones ranges in thickness to about 5 feet; limestones characterized by fine algal pellets or particles of type called Osagia. Overlies Talpa limestone member of Clyde formation; underlies Arroyo formation. No basis was found for recognizing any limestone beds of the Lueders as corresponding to Maybelle and Lake Kemp beds, respectively. "Paint Rock" limestone is considered a synonym for Talpa limestone.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081-G, p. 276. In Brazos River valley, consists of persistent alternating beds of limestone and shale whose thickness ranges from 75 feet in northwestern Callahan County to 50 feet in west-central Throckmorton County. Separated from underlying Talpa limestone member by unnamed shale unit 30 to 70 feet thick. Underlies Arroyo formation of Clear Fork group. Wichita group.

Named for small town on Clear Fork of Brazos River, eastern Jones County.

Lueders Limestone Member (of Lueders Formation)[1]

Permian: Central northern Texas.

Original reference: M. M. Garrett, A. M. Lloyd, and G. E. Laskey, 1930, Texas Bur. Econ. Geology, geol. map.

In Jones and Taylor Counties.

†Lufkin Beds (in Claiborne Group)[1]

Eocene: Eastern Texas.

Original reference: W. Kennedy, 1892, Texas Geol. Survey 3d Ann. Rept., p. 45, 58.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, p. 885-904 [1940]. Discussion of Yegua problem. Terms Lufkin, Yegua, and Cockfield have been used for beds herein called Yegua. Although present writer [Stenzel] has retained name Yegua, he advocates use of Lufkin as name for these beds.

Named for Lufkin, Angelina County.

Lufkin Member (of Cook Mountain Formation)[1]

Eocene: Eastern Texas.

Original reference: B. C. Renick, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 531, 534.

Lufkin rhyolite[1]

Tertiary: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-monthly Bull. 19, p. 7-21.

Type locality: Lufkin Mountain, near Lake Valley, Sierra County.

Lugert Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

C. A. Merritt, 1958, Oklahoma Geol. Survey Bull. 76, p. 40–47, p. 1 Described in Lake Altus area as reddish medium-crystalline granite, locally containing xenoliths of gabbro, andesite, and aplite, as well as pebbles derived from an older granite conglomerate. Geographically restricted to rock of Taylor's type area, the Lugert region.

Occurs in vicinity of Lugert, Kiowa County.

Luisian Stage[1]

Miocene, middle: California.

Original reference: R. M. Kleinpell, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 3, p. 376–378.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 121–127. Superjacent to Relizian stage and subjacent to Mohnian stage. Comprises three zones: *Siphogenerina reedi*, lower; *Siphogenerina nufiformis*, middle; and *Siphogenerina collomi*, upper. Systematic catalogue.

Type locality: On Highland monocline about 4½ miles west of Indian Creek, San Luis Obispo County.

Lukachukai Member (of Wingate Sandstone)

Upper Triassic: Northeastern Arizona, western Colorado, northwestern New Mexico, and eastern Utah.

G. A. Kiersch, 1955, Mineral Resources, Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2, p. 5, fig. 1. Massive cliff-forming reddish-brown cross-stratified sandstone. Overlies Rock Point member (new). Name credited to Harshbarger and others (unpub. ms.).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 8 (fig. 5), 10–12, pl. 2. Pale reddish-brown fine- to very fine-grained sandstone at type locality. Lithology homogenous throughout Navajo country. Limestone lenses locally common in area between Chinle, Ariz., and the Four Corners State junction. Massive crossbedded sandstone that weathers into sheer cliffs above slope forming Rock Point member. Intertongues with Rock Point member in type area. Constitutes lower half of original Wingate sandstone as defined by Darton; underlies Entrada sandstone. Intertongues with Dinosaur Canyon sandstone member of Moenave formation in extreme southwestern part of Navajo country. Thickness about 300 feet throughout Navajo country. From Fort Wingate eastward, progressively thinner and pinches out within 30 miles south of Laguna, N. Mex. Thins and pinches out to west and south as well as to east of Navajo country. Northwestward along Ward Terrace it disappears between Chinle and basal member of Moenave formation. Type locality designated.

Type locality: Sandstone that forms vertical cliff on escarpment northeast of Lukachukai, Apache County, Ariz. Present throughout most of Navajo Indian Reservation.

Lukachukai sandstone[1]

Triassic(?): Northeastern Arizona and northwestern New Mexico.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 337.

Charles Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 63 (table). Underlies Nazlini shales.

Crops out in Lukachukai Valley, at north end of Chuska Mountains [northwestern New Mexico].

Luke Clay (in Allegheny Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 572.

Exposed in cut on B. & O. Railroad opposite Luke, Allegany County.

Luke Hill Formation[1] or Limestone[1]

Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 399. Contains as much as 1 foot of sandy rubble at base, followed by a few tens of feet of fine-grained crossbedded sandstone. Above are dark limestones, characterized by yellow-weathering interbeds which make up bulk of formation. Thickness 160 feet. Overlies Naylor Ledge formation. Underlies Solomons Corner formation. Phillipsburg series. Beekmantown.

Exposed from northern part of St. Albans quadrangle, Vermont, across international border for about 20 miles into Quebec.

Lukfata Sandstone

Cambrian(?): Southeastern Oklahoma.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 13–15, pl. 1. Consists of three unnamed members: lower made up mostly of interlaminations of thin-bedded limestone and shale; middle of interbedded platy sandstone and shale; and upper of more massively bedded sandstone which contains some laminae of shale. Thickness at least 145 feet. Underlies Collier shale.

Type sections: Lower member, at concrete high-water ford on Lukfata Creek near center of sec. 17, T. 5 S., R. 24 E., and locally within 400 yards upstream and downstream from this location; middle member, about 400 yards downstream from concrete ford; upper member, cliff section on west bank of Lukfata Creek, SE¼SE¼ sec. 8, T. 5 S., R. 24 E., McCurtain County. Occurrences are in core of Ouachita Mountains.

Lula facies (of Cow Bayou Member of Logansport Formation)

Paleocene (Midway): Northwestern Louisiana.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 112–114. Named as upper facies of member. Consists of 40 to 75 feet of gray to brown thin-bedded micaceous fine-grained argillaceous sands and silts with numerous limonitic sand laminae and disc-shaped limonitic concretions; characterized by well-preserved leaves and plant fragments. Transitional from underlying Benson facies.

Type locality: Exposures in roadcuts and gullies in the W½ sec. 11, T. 10 N., R. 14 W., along State Highway 747 from ½ to 1½ miles north of village of Lula, De Soto Parish.

Lulbegrud Clay[1]

Lulbegrud Conglomerate

Silurian (Niagaran): East-central Kentucky.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 50.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Lulbegrud conglomerate. Occurs below Waco limestone and above Oldham limestone.

Named for Lulbegrud Creek, Clark and Powell Counties.

Luman Tongue (of Green River Formation)

Eocene, lower: Southwestern Wyoming.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100, 101 (chart). Sequence of oil shale, fossiliferous calcareous sandstone, varved siltstone, and clay shale. Contains several tongues of low-grade oil shale. In north-central part of Great Divide Basin base of lowest oil shale tongue contains so-called pastel limestone marker bed. Thickness 180 feet at Luman Butte and thickens eastward to 270 feet in vicinity of Lost Creek Butte; about 200 feet at Tipton Station and about 390 feet at Frewen Station. Overlies Red Desert tongue (new) and underlies Niland tongue (new) of Wasatch formation. Intertongues with Battle Spring formation (new) to north.

Named for exposures on south slope of Luman Butte, sec. 34, T. 24 N., R. 97 W., Sweetwater County.

Lunasan series[1]

Lunasian series[1]

Carboniferous: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 8.

In Manzano Mountains.

Lunenburg Schist[1]

Upper Cambrian: Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 79–82.

Probably named for village or township of Lunenburg, Essex County.

Luning Formation[1]

Upper Triassic: Southwestern Nevada.

Original reference: S. W. Muller and H. G. Ferguson, 1936, Geol. Soc. America Bull., v. 47, p. 241–252.

S. W. Muller and H. G. Ferguson, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1594–1603. In most places, conformably underlies Gabbs formation; locally underlies Dunlap formation. Rests unconformably on Excelsior formation and in Shoshone Mountains overlies Grantsville formation (new).

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey Quad. Map GQ–45. Described in Mina quadrangle where six units are mapped. Thickness 8,000 feet at type locality, top not exposed (upper limestone 2,500 feet, slate and conglomerate 3,000 feet, lower limestone 2,500 feet); less in other ranges, no complete section.

N. J. Silberling, 1959, U.S. Geol. Survey Prof. Paper 322, p. 14–25, pls. Described in Union district, Shoshone Mountains, where approximately 3,000 feet is exposed in vicinity of West Union Canyon where top of section is obscured by Tertiary volcanic rocks. Four informal members recognized: clastic member, composed of siliceous conglomerate, sandstone, and argillite 600 feet thick; shaly limestone, 600 feet; calcareous shale, 550

feet; and carbonate member, composed of massive limestone and dolomite, at least 2,000 feet. Disconformably overlies Grantsville formation; underlies Gabbs and Sunrise formations undifferentiated.

Type locality: North slope of Pilot Mountains, about 12 miles southeast of Luning, Mina quadrangle, Mineral County.

Lupine Quartzite (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 563–565, pl. 28. Thin- to massive-bedded light-pinkish-brown vitreous to subvitreous fine-grained quartzite with many thin dusky-red purple argillite interbeds; becomes more vitreous and massive bedded higher in section. Brown-weathering grayish-pink dolomitic quartzite lenses 1 to 3 inches thick and several inches to several feet long are common and diagnostic. Some beds felspathic. Thickness about 3,000 feet. Overlies Spruce formation (new); underlies Sloway formation (new).

Type section (lower 2,750 feet): West side Blacktail Mountain, sec. 34, T. 17 N., R. 27 W., and sec. 4, T. 16 N., R. 27 W.; type section (top 300 feet): sec. 18, T. 16 N., R. 26 W., Named from exposures along Lupine Creek, a tributary of Trout Creek, near south edge of mapped area, sec. 33, T. 16 N., R. 26 W., St. Regis-Superior area, Mineral County.

Luquillo Formation[1]

Upper Cretaceous: Puerto Rico.

Original reference: H. A. Meyerhoff, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 279.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7). Thickness 2,500 feet. Overlies Río conglomerate; underlies Trujillo Alto limestone. Upper Cretaceous.

Named for exposures at town of Luquillo, Fajardo district, where it forms low but prominent cliffs both along shoreline and along banks of Río Sabana near its mouth. In this area, Río conglomerate, La Muda limestone, and Guaynabo formation are absent, and the Luquillo rests directly on Hato Puerco tuffs.

Lurich Formation or Group

Middle Ordovician (Chazyan): Virginia and West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 59 (fig. 2), 61, 63, 69–72. Top of lowest part of Ordovician limestone sequence is white-weathering calcilutite that contrasts sharply with siliceous cherty calcarenite. The calcilutite, of variable thickness passes down into beds having nodular black chert; these beds overlie impure dolomite. From Bolar southwestward, chert-pebble conglomerate zones are within and at base of dolomite. To the southwest, sequence is continuous upward from Blackford (Butts, 1942) [1940] chert-pebble conglomerate and dolomite to Elway (Cooper, 1951) *Dinorthis*-bearing calcilutite with black chert, to Five Oaks (Cooper and Prouty, 1943) calcilutite; these three units with younger formations formed Cliffield group (Cooper and Prouty, 1943) subsequently suppressed by Cooper (1951). Loysburg formation in Pennsylvania with Clover calcilutite at top is very like northern sections in the Virginias. In Appalachian Valley to east, term St. Paul group has been proposed for essentially same sort of sequence (Neuman, 1951). In area of this study, unit is designated Lurich formation, or Lurich group where separable into formations.

Thickness generally about 300 feet. Lies above Canadian series and below Lincolnshire formation (Chazyan).

Type locality: Lurich, Giles County, Va.

Lurichian Stage

Middle Ordovician (Chazyan): Virginia and West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 100. Name applied to older of two stages of Chazyan epoch in discussion of Middle Ordovician formations of eastern and southern West Virginia and western Virginia.

Name probably derived from Lurich, Giles County, Va., for which Lurich formation is named.

Lusk cyclothem (in Caseyville Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Caseyville group includes (ascending) Lusk, Battery Rock, and Pounds cyclothems.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 9, pl. 1. Includes Lusk shale. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. At base of Caseyville Formation (redefined). Below Battery Rock cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Tps. 12 and 13 S., R. 6 E., Pope County.

Lusk[1] (limestone)

Mississippian: Southeastern Illinois.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 39, no. 4, p. 320.

Derivation of name not stated but probably named for small village very near Golconda, Pope County.

Lusk Shale Member (of Caseyville Formation)

Lusk Formation (in Caseyville Group)

Pennsylvanian: Southeastern Illinois and western Kentucky.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36–37. Basal formation of group; occurs at base of Pennsylvanian throughout most of southern Illinois. Consists principally of sandy shale and shaly sandstone with more or less massive locally developed sandstones, one or more thin coals and zones of poorly preserved marine fossils. Maximum thickness 200 feet in Tps. 12 and 13 S., R. 6 E., and T. 12 S., R. 5 E.; commonly less than 100 feet. Underlies Battery Rock formation. Name Wayside was formerly applied to strata included in Lusk.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 30, 44 (table 1), 61–62, pl. 1. Rank reduced to member status in Caseyville formation (redefined). Occurs below Battery Rock sandstone member. Thickness 49 feet at type section of Caseyville; about 141 feet at reference section of Caseyville. Lusk and Drury shale members are composite units, but until subdivided names are useful and are retained. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Along Lusk Creek, Tps. 12 and 13, S., R. 6 E., Pope County, Ill.

†Luta Limestone (in Sumner Group)[1]

Luta Limestone Member (of Winfield Limestone)

Permian: Central and southern Kansas and northern Oklahoma.

Original reference: J. W. Beede, 1909, Jour. Geology, v. 17, p. 710–729.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 83, 85–88. Uppermost member of Winfield limestone. Overlies Cresswell member; underlies Odell shale. Formerly regarded as part of overlying Sumner group.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Shaly beds which have been called Luta limestone are included in Cresswell member of Winfield limestone.

Type locality: Five miles northeast of Marion, Kans., on Chicago, Rock Island, and Pacific Railroad. Named for Luta Brook, a tributary of Antelope Creek, just north of Marion, Marion County, Kans.

Luthers Mills Coquinite[1] (in New Milford Formation)

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 580, 583, 589, 592.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 279, 291, 297, 298. At top of New Milford formation. Uppermost New Milford beds are post-Chemung; in the east, they are continental and assigned to Catskill facies; in the west, they carry the marine Luthers Mills coquinite.

Named for crossroads east of Burlington, Bradford County, near which it is exposed along highway.

Lutie Member (of Theodosia Formation)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 25, 27–31, pl. 2. Lower member of formation. Underlies Blackjack Knob member (new); unconformably overlies Rich Fountain formation (new). Thickness as much as 170 feet. Includes Rockaway conglomerate beds at base, Hercules Tower sandstone near middle, and Pocket Hollow oolite near top. Top of member is slightly above midpoint between Pocket Hollow oolite bed and Gainesville sandstone bed of Blackjack Knob member.

Type section: Between post offices of Theodosia and Lutie in western part of Ozark County, Mo.

Lydia Granodiorite

Age not stated: Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 139. Hypersthene granodiorite separated from overlying Catoctin greenstone by about 400 feet of metamorphosed sediments.

Report discusses structure and stratigraphy of Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is overturned anticline, with axial plane dipping 28° to southeast, and a thrust fault bordering it on its western edge.

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†Lykens Series[1]

Pennsylvanian: Eastern Pennsylvania.

Original reference: D. White, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 755.

Lykins Formation[1]

Permian(?) and Triassic(?): Eastern Colorado.

Original reference: N. M. Fenneman, 1905, U.S. Geol. Survey Bull. 265.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 14 (fig. 3), 15 (table 1), 30–47. In Golden-Morrison area, subdivided into five members (ascending): Harriman shale, Falcon limestone, Bergen shale, Glennon limestone, and Strain shale. Thickness 410 to 463 feet. Underlies Ralston formation; disconformably(?) overlies Lyons formation. Permian-Triassic.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 34. Conformably overlies Lyons sandstone throughout eastern border of Front Range. Consists of poorly consolidated red sandy shales and siltstone with a few thin beds of limestone and gypsum. Thickness varies from about 200 feet in Castle Rock quadrangle to approximately 1,000 feet near Colorado Springs; average about 600 feet. In northern Colorado, unconformably underlies Jurassic Sundance; to the south Sundance wedges out and Lykins underlies Morrison formation. Permian(?) and Triassic(?).

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. In northern Colorado, near Wyoming boundary, includes the following members (descending): Red Hill shale (new), Park Creek limestone (new), Stonewall Creek shale (new), Poudre limestone (new), Livermore shale (new), Forelle limestone, Glendo shale, Falcon tongue of Minnekahta limestone, Harriman shale, and Blaine gypsum. Thickness about 1,000 feet; upper 750 feet consists of red clastics, and lower 250 feet consists of interbedded limestone, gypsum, and red clastic sediments.

Named for Lykins Gulch, about 9 miles north of Boulder, Boulder County.

Lyman Formation[1]

Silurian(?): Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Am. Jour. Sci., 3d, v. 7, p. 468–476.

Named for exposures over wide area around village of Lyman, Grafton County.

Lyman Series[1]

Silurian(?): Northwestern New Hampshire.

Original reference: F. H. Lahee, 1916, Jour. Geology, v. 24, p. 366–381.

Probably named for exposures over wide area around village of Lyman, Grafton County.

Lyme Granite Gneiss[1]

Pre-Triassic: Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 148, 152, and map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Unit referred to as granitic gneiss. Pre-Triassic.

Crops out in parts of town of Lyme, Old Lyme, and East Lyme, New London County.

Lynch Dolomite[1]

Middle(?) and Upper Cambrian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

J. C. Young, 1955, Utah Geol. and Mineralog. Survey Bull. 56, p. 20. Upper part of type Lynch dolomite considered early Ordovician in age.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1). Table of comparison of stratigraphic terminology applied in this report [southern Oquirrh Mountains and Fivemile Pass-northern Boulter Mountain area] and that applied by Gilluly (1932) shows (ascending) Bluebird dolomite, Cole Canyon dolomite, Opex dolomite, and most of Stansbury formation equivalent to Lynch dolomite. Term Lynch not extended into this area.

Named for exposures on Lynch Ridge, north of Ophir, Tooele County.

Lynchburg Gneiss[1]

Lynchburg Formation

Precambrian: Virginia and northern North Carolina.

Original reference: A. I. Jonas, 1927, Geol. Soc. America Bull., v. 38, p. 844, 845.

A. I. Jonas and G. W. Stose, 1939, Am. Jour. Sci., v. 237, no. 8, p. 575–593. Lynchburg was formerly considered equivalent to argillaceous sediments that are the basement rocks of the injection complex, but because the gneiss in places is underlain by Rockfish conglomerate, which is derived from the injection gneiss, the Lynchburg is now known to be younger than the injection complex and is believed to be equivalent to the younger Precambrian series which includes Catoctin metabasalt at top.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 409. Lynchburg gneiss and its equivalents in northern Virginia lie on east limb of Catoctin Mountain-Blue Ridge anticlinorium to a point about 20 miles southwest of Lynchburg; southwest of that point in Virginia and North Carolina, the Lynchburg has been thrust northwestward on Gossan Lead thrust fault over early Precambrian injection complex and overlying Lower Cambrian rocks of Holston Mountain block.

R. O. Bloomer, 1948, Am. Jour. Sci., v. 248, no. 11, p. 764–768. Lynchburg as shown on Geologic map of Virginia (1928) indicates two distinct formations: in vicinity of Rockfish River unconformably overlies granitized basement complex; west of Lynchburg and in vicinity of Bedford the formation grades into Lovingston facies of granitized complex. Thus, the Lynchburg in its type locality and northeast of Lynchburg is younger than the "Lynchburg" west of Lynchburg. The two formations resemble each other but older formation appears migmatitic. In this report, name Lynchburg refers to younger formation; older formation not named in this report. Also stratigraphy in Loudoun County appears confused. Keith (1894) evidently chose an exposure [Loudoun] near Aldie as unspecified type section of the Loudoun in preference to some locality along northwest side of Blue Ridge. The formation in the "type" locality seems to underlie the Catoctin and is thus equivalent to the Lynchburg, whereas the "Loudoun" along northwest side of the Blue Ridge overlies the Catoctin. Thus, it appears that the Lynchburg and

Loudoun in the respective localities are equivalent. According to the rule, name Lynchburg should be abandoned and replaced by older name Loudoun.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 140. In Albemarle and adjacent counties, underlies Johnson Mill graphite schist (new).

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 92. On southeast limb of Blue Ridge-Catoctin Mountain anticlinorium, Lynchburg gneiss, which locally has at its base Rockfish conglomerate, unconformably overlies Lovingston gneiss and Reusens migmatite; from the James River northeastward, it is overlain by Catoctin greenstone.

G. H. Espenshade, 1954, U.S. Geol. Survey Bull. 1008, p. 11–14, pl. 1. Discussed in James River-Roanoke River manganese district. Crops out in narrow strip bordering northwestern side of district and in three domal structures in southern part of district; these structures are bordered by rocks of Evington group. Along the western border of the district, rocks of Evington group are thrust over the Lynchburg. Late Precambrian age assigned to the Lynchburg by earlier workers is provisionally accepted here. Plate 1 shows age Precambrian(?).

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 63–72, pl. 1. Lynchburg gneiss described in Gossan Lead district. Includes several facies: staurolite schist, muscovite-garnet schist, biotite quartzite, ferruginous mica schist, and quartzite. No estimate of thickness made. Occurs in overthrust position on older Precambrian and Lower Cambrian; age cannot be determined from relations in this district. Considered same general age as Mount Rogers volcanic series.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 18–22. In Lynchburg quadrangle, Lynchburg gneiss, 10,000 feet thick, overlies Virginia Blue Ridge complex (new) and underlies Catoctin greenstone. "Late Precambrian".

R. V. Dietrich, 1959, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 134, p. 69–74, pl. 1. Formation described in Floyd County. Term formation used in preference to gneiss because unit in Floyd County may not be correlative with type locality Lynchburg and because unit contains schists, phyllites, amphibole-rich foliates, and other metamorphic rocks as well as gneiss. Overlies Little River gneiss (new) with transitional contact; in some areas overlies Willis phyllite (new) or includes Willis phyllite. Also includes Alum phylite (new). Top of Lynchburg not recognized in area.

Typically exposed at Lynchburg, Va.

Lynch Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 375.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 75. Sandy clay and shaly to massive sandstone. Overlies Bend division; underlies Burnt Branch bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units

of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for the upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Lynch Creek, west and northwest of Nix, Lampasas County.

Lyndon Gypsum Bed[1]

Silurian (Cayugan): Central New York.

Original reference: G. H. Chadwick, 1930, Geol. Soc. America Bull., v. 41, p. 81.

Occurs in old quarries at Lyndon, Syracuse region.

Lyndon Limestone[1]

Lyndon Limestone (in Bright Angel Group)

Middle Cambrian: Eastern Nevada, northwestern Arizona, southeastern California, and western Utah.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Mining Metall. Engineers Trans. 1647, p. 5; 1932, U.S. Geol. Survey Prof. Paper 171.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1158 (fig. 6), 1160. Thickness emended type section 345 feet. Underlies Chisholm shale; overlies Comet shale.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, p. 1794, 1816, pl. 1. Geographically extended into western Grand Canyon area, Arizona, where it is about 70 feet. Overlies Pioche shale; underlies Chisholm shale.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 31. Geographically extended into Wah Wah Range, Utah, and to Nopah and Resting Springs Ranges in California. In latter region, consists of member 5E of Hazzard's (1938 [1937], California Jour. Mines and Geology, v. 33, no. 4) Cadiz formation, is thinned to 35 feet, and underlies Tecopa shale (new).

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2), 2414. Generalized discussion of designation of stratigraphic units. Lyndon limestone is included in Bright Angel group and comprises (ascending) Tincanebits member, unnamed member, and Meriwitica member.

Typically exposed [type section] in Lyndon Gulch, Pioche region, Nevada.

Lynn Volcanic Complex[1]

Late Paleozoic: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.

Occurs north of Boston Basin.

Lynnfield Serpentine[1]

Precambrian or Cambrian: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.

Named for occurrence at Lynnfield, Essex County.

Lyon Series (Lyonian Epoch)

Permian(?): North America.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 229–235. Name proposed for American standard section of early Permian(?) rocks. Type Wolfcamp section is incomplete, and its basal contact is not well known. Kansas section of rocks of Sakmarian age is complete and well exposed over wide and accessible area, including parts of Oklahoma and Nebraska. Name Wolfcamp and time term Wolfcampian should not be used in Kansas, Oklahoma, and Nebraska. In Kansas, the series would include rocks from top of Brownville limestone to top of Herington limestone—that is, it would consist of Admire, Council Grove, and Chase groups. Faunally it would include the zone of *Pseudoschwagerina*, of primitive *Schwagerina*, and of advanced *Triticites*; the zone of *Peritrochia* and *Properrinites*. In Oklahoma, series would include, in Pawnee County, the seven mapped units of Chase group, eight of Council Grove group, and the Admire shale; in Lincoln County would include undivided shale and sandstone sequence below Fallis sandstone, Red Eagle limestone, Johnson shale, and Foraker limestone, and Admire formation.

Name derived from Lyon County, Kans., site of type localities of Admire group and Americus limestone. Council Grove is a few miles west of the county, and Chase County is adjacent on the west.

Lyon Mountain Granite Gneiss

Lyon Mountain Granite[1]

Precambrian: Northern New York.

Original reference: W. J. Miller, 1919, Jour. Geology, v. 27, p. 29; 1919, Econ. Geology, v. 14, p. 512.

A. W. Postel, 1951, Geology of the Dannemora quadrangle, New York: U.S. Geol. Survey Geol. Quad. Map [GQ–14]. Described and mapped as Lyon Mountain granite gneiss. Medium-grained foliated rock of complex composition, usually pink. Includes microperthite, microcline, plagioclase, and microantiperthite granite gneisses.

A. W. Postel, 1952, U.S. Geol. Survey Prof. Paper 237, p. 8, 10, 37. Miller described Lyon Mountain granite as including facies which he termed Hawkeye granite. In this report, Hawkeye granite gneiss is considered to be an older, separate unit.

Well exposed in and near village of Lyon Mountain, Clinton County.

Lyons Limestone[1]

Pennsylvanian(?): Central Oklahoma.

Original reference: A. I. Levorsen, 1928, Oklahoma Geol. Survey Bull. 40BB, p. 17, 43.

Lyons Sandstone[1]

Lyons Sandstone (in Cassa Group)

Permian: Central northern Colorado.

Original reference: N. M. Fenneman, 1905, U.S. Geol. Survey Bull. 265.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 3 (fig. 2), 6. Included in Cassa group (new). Underlies Opeche shale; overlies Owl Canyon formation (new).

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 34. Lies directly on Fountain formation south of Loveland but rests on younger and younger beds northward. Thickness 50 feet near Colorado-Wyoming boundary; approximately 200 feet at Morrison and Colorado Springs. Conformably underlies Lykins formation.

Well developed at Lyons, a few miles north of Boulder district.

Lyre Formation

Eocene, upper: Northwestern Washington.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 121, 123. Unconformably overlying unnamed sandy clay shale bed are more than 500 feet of firmly cemented massive medium- to coarse-grained conglomerate, which in southern limb of Clallam syncline are sufficiently resistant to erosion to allow a range of moderately high hills to exist parallel to and immediately north of the high basaltic ridge; conglomerates are persistent along northern border of Olympic Peninsula for more than 100 miles but decrease in thickness toward Cape Flattery. Above the conglomerates are approximately 4,120 feet of interstratified hard gray to grayish-brown coarse-grained massive sandstone with pebbly conglomerate layers, together with subordinate amounts of brownish-gray thinly bedded sandy shale. These sandstones and shales together with the lower thick conglomeratic member appear to constitute a lithologic unit, and for purposes of reference are referred to as Lyre formation. Thickness at type section (Lyre River Canyon), 2,200 feet; here includes 750 feet of conglomerate and massive sandstone and the lower 1,450 feet of the more firmly cemented gray sandstones and sandy shale. Conformably underlies 2,700-foot section of stratified concretionary sandstones and sandy shale. At type section, overlies Boundary shale (new) which forms uppermost part of middle Eocene Crescent formation. Intervening Cowlitz formation not present.

J. W. Durham, 1942, Jour. Paleontology, v. 16, no. 1, p. 86. In vicinity of Port Townsend, underlies Townsend shale (new).

J. W. Durham, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 106–107. In Quimper Peninsula area, Quimper sandstone overlies Lyre conglomerates, Townsend shale, and various parts of Eocene section.

R. D. Brown, Jr., P. D. Snavely, Jr., and H. D. Gower, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1, p. 94–107. Sequence of beds referred to by Weaver as basal 750 feet of conglomerate and massive sandstone is a distinctive and mappable lithologic unit. Name Lyre formation here restricted to this unit. At redefined type locality, formation is 1,270 feet thick and consists of two parts: an upper conglomerate 890 feet thick and a lower sandstone unit of which 380 feet are exposed. Throughout most of the mapped area, the Lyre is divisible into upper conglomerate facies and lower sandstone facies; contact between the two facies is gradational and is commonly marked by a zone in which the two types are intercalated. Overlain with erosional unconformity by strata containing Foraminifera of late Eocene age.

R. D. Brown, Jr., H. D. Gower, and P. D. Snavely, Jr., 1960, U.S. Geol. Survey Oil and Gas Inv. Map OM-203. In this report [Port Angeles-Lake Charles area], term used as restricted by Brown, Snavely, and

Gower. Rests conformably upon and, in places interfingers with, Aldwell formation (new). Thickness 0 to 3,280 feet.

Type section: Lyre River Canyon, Olympic Peninsula, Clallam County. As redefined, extends along Lyre River from point 2,850 feet south, 3,600 feet west NE cor. sec. 10, T. 30 N., R. 9 W., to point 950 feet south, 3,690 feet west, NE cor. sec. 10, T. 30 N., R. 9 W.

Lysite Member (of Wind River Formation)

†Lysite Formation[1]

Eocene, lower: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1911, Am. Mus. Nat. History Bull., v. 30, p. 104.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 24, 25, pl. 1. Referred to as member (or formation) of Wind River formation (or group). Valid mappable lithologic unit. Underlies Lost Cabin member. Wasatchian.

H. A. Tourtelot, 1948, Wyoming Geol. Soc. Guidebook 3d Ann. Field Conf., p. 113 (fig. 1), 114, 115–118. Although lithologic differences between rocks of Lysite and Lost Cabin units were described by Sinclair and Granger, most later workers considered the names to represent only faunal zones. Recent work has substantiated opinion of Wood and others that the units are lithologically separable as members of Wind River formation. Member consists of hard ledgy yellow to brown sandstone interbedded with brick-red, orange-red, tan, and gray sandy siltstone and claystone. Maximum thickness 660 feet, as exposed at west end of Cedar Ridge, Fremont County; this thickness includes at its base 385 feet of rocks considered to be possibly the same age as Gray Bull beds (Tourtelot, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 22). Overlaps older rocks, possibly of Cretaceous age, in Cedar Ridge, but relation of Lysite to earlier Tertiary rocks not known; contact with Lost Cabin gradational. Nature of distinguishing criteria suggests that names Lysite and Lost Cabin should not be applied to lithologic units in places other than along southern margin of Big Horn Mountains. Report includes historical summary of usage of name.

Type area: On Lysite and Cottonwood Creeks north of Lost Cabin, Fremont County.

Lytle Formation (in Dakota Group)

Lytle Sandstone Member (of Purgatoire Formation)[1]

Lower Cretaceous: Eastern Colorado.

Original reference: G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 19–24. Beds of sandstone, conglomeratic sandstone, and variegated claystone that make up lower part of pre-Benton Cretaceous sequence are correlated here with Lytle sandstone member of Purgatoire formation in south-central Colorado, and name Lytle, raised to rank of formation, is applied to them throughout northern Front Range foothills. In northern foothills, unit is characterized by abrupt lateral variation in local dominance of its sandstone or claystone fraction. At one extreme, consists almost entirely of sandstone and conglomerate and resembles its more consistently arenaceous southern equivalent, Lytle sandstone member of

Purgatoire. At other extreme, Lytle lacks conglomeratic beds and consists of approximately equal amounts of fine- to medium-grained sandstone and variegated claystone in alternating lenses. Thickness about 70 to 80 feet. No persistent mappable subdivision recognized in northern foothills. Underlies Plainview sandstone member of South Platte formation (both new). Morrison-Lytle contact indefinite in many places because conglomeratic beds are not persistently present at base of Lytle and rocks in upper part of Morrison are similar to those in the Lytle. Data on type locality; thickness at typical exposure 48 to 53 feet; underlies Glencairn member of Purgatoire formation.

Type locality: Lytle School, situated along Lytle Road just south of Turkey Creek in SW¼NW¼ sec. 2, T. 17 S., R. 67 W., Timber Mountain quadrangle. Finlay took name Lytle from small settlement of homes along Turkey Creek in southwestern part of old Colorado Springs 15-minute quadrangle.

Lytle Limestone Member (of Arroyo Formation)

Lytle Limestone[1] Member (of Clear Fork Formation)

Permian (Leonard): Central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 948, 949, pl. 9.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (chart). Shown on correlation chart as member of Arroyo formation. Lies below Standpipe limestone member and above Rainey [Rainy] limestone member.

Robert Roth, 1940, Geol. Soc. America and Affiliated Soc. 53d Ann, Mtg., Austin, Dec. 26–28, Excursions, p. 113 (table). Name Lytle is preoccupied.

Gayle Scott and others, 1941, West Texas Geol. Soc. [Guidebook] Spring Field Trip, May 10–11, p. 33. Lytle limestone and dolomites crop out on east bank of Lytle Lake.

Probably named for Lytle Creek, Taylor County.

†Lytton Formation[1]

Eocene: Central Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1902, U.S. Geol. Survey Geol. Atlas, Folio 76, p. 6.

Named for Lytton Springs, Caldwell County.

Mabb Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 132, 135, 136.

Exposed in old Mabb workings and dump, Houghton County, and along north line of sec. 6–55–33.

Mabb Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Mabury Formation

Mabury Member (of Lodo Formation)

Eocene, middle: Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Coarse tan sandstone about 315 feet thick. Underlies Credal formation (new); overlies undifferentiated Paleocene and Cretaceous rocks.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 281–282. Rank reduced to member status in Lodo formation. Overlies an unnamed member; underlies Credal member.

Occurs in Devils Den oil field district, northwestern Kern County, adjacent to Kings County line, about 40 miles from Paso Robles and about 60 miles northwest of Bakersfield.

McAlester Formation[1] or **Shale**[1] (in Krebs Group)

Pennsylvanian (Des Moines Series): Eastern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 437.

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 507–508. Formation (shale) includes four recognizable members (ascending): McCurtain shale, Warner sandstone, Lequire sandstone, and Cameron sandstone (all new). Upper Hartshorne coal occurs near base. Thickness 125 to 382 feet. Overlies Hartshorne sandstone; underlies Savanna sandstone.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 17, 26–44. Redefined; stratigraphically expanded below to include Lower Hartshorne coal and underlying shale; expanded above to include Tamaha sandstone and Keota sandstone members formerly included in Savanna formation. As thus redefined, includes (ascending) McCurtain shale, Warner sandstone, unnamed shale, Lequire sandstone, unnamed shale, Cameron sandstone, unnamed shale, Keota sandstone, and unnamed shale members. Thickness 700 to 2,000 feet; thinning is northward. Overlies Hartshorne sandstone; underlies Savanna formation. Des Moines series.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1526. Assigned Krebs group (new).

Named for exposures around McAlester, Pittsburg County, Okla.

McArthur Member (of Pottsville Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: H. Morningstar, 1922, Ohio Geol. Survey, 4th ser., Bull. 25, p. 116.

Named from typical exposures in vicinity of McArthur, Vinton County.

McBean Formation[1] (in Claiborne Group)

Eocene, middle: Eastern Georgia and central South Carolina.

Original reference: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 60, 237–284.

C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867, p. 55–72. Described in coast plain of South Carolina. Thickness about 100 feet. Includes unit termed Warley Hill phase by Sloan (1905). Overlies Tuscaloosa

formation or Black Mingo formation; unconformably underlies Santee limestone or Barnwell sand, both of Jackson age.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 22, 23–24. In historical summary of Congaree formation, authors state that Cooke and Shearer (1918, U.S. Geol. Survey Prof. Paper 120–C) supposed that all of their Congaree clay member was of Jackson age and transferred it to Barnwell formation under name of Twiggs clay member; later Cooke (1943, U.S. Geol. Survey Bull. 941) restored that facies consisting of thin-bedded or laminated sand and clay to McBean formation. The McBean is here restricted to include only the Cook Mountain equivalent, the *Ostrea sellaeformis* zone, of the Lisbon formation. This is represented at McBean, Ga., and in South Carolina by white sandy marl and massive yellow or red sand, which appears to be at least partly residual from sandy marl. Santee limestone, heretofore supposed to be of early Jackson age, represents the *Ostrea selaeformis* zone and seems to be offshore facies of restricted McBean. Warley Hill phase is raised to formation rank. Included in lower Claiborne.

Named for exposures at McBean and on McBean Creek, Richmond County, Ga.

McBryde Limestone Member (of Clayton Formation)

Paleocene: Southwestern Alabama.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 7–8. Proposed for the Nautilus rock of early authors. In type area, hard white fine-grained sandy limestone, 20 to 25 feet thick. Overlies Pine Barren member (new) and underlies calcareous tongue of Porters Creek clay; thin ledges of limestone similar to the McBryde are interspersed through several feet of the Porters Creek. To the east, in Butler County, thickens to about 100 feet, breaks up into shaly more sandy beds with concretionary layers; still farther east, passes into limestone of middle part of undifferentiated Clayton; westward, thins and becomes more argillaceous; loses its distinctive lithologic character in western Wilcox County.

Type exposures are in roadcuts along State Highway 100 in secs. 28 and 33, T. 12 N., R. 10 E., Wilcox County, about 3 miles west of McBryde Station.

McCann Sandstone[1]

Permian: Central northern Oklahoma.

Original reference: C. N. Gould, 1900, Kansas Univ. Quart., v. 9, p. 175–177.

Named for McCann's quarry, on Deer Creek, 20 miles southwest of Blackwell, Kay County.

McCarthy Shale[1] or Formation[1]

Upper Triassic: Central Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 426.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend; in Copper River region.

Typically exposed on McCarthy Creek, Nizina-Tanana region.

†McCarthy Creek Shale[1]

Upper Triassic: Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 426.

Well exposed on McCarthy Creek, Nizina-Tanana region.

McCartys Basalt Flow[1]

Recent: Northwestern New Mexico.

Original reference: R. L. Nichols, 1934, Geol. Soc. America Proc. 1933, p. 453.

R. L. Nichols, 1939, Am. Geophys. Union Trans., v. 20, pt. 3, p. 432–433. In an area approximately 2 miles long, there are about 100 collapse-depressions near terminus of McCartys flow.

Named in San Jose Valley, Valencia County.

McCaulley Dolomite[1]

McCaulley Dolomite (in Blaine Formation)

Permian: Central northern Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 26, pl. 1.

Gayle Scott and others, 1941, West Texas Soc. [Guidebook] Spring Field Trip May 10–11, p. 44–45. Reallocated to Blaine formation.

First described from occurrences near McCaulley, Fisher County.

McClearys Bluff Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), 82, pl. 1. Name applied to 3-inch coal bed that lies an estimated 50 feet above Friendsville coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NW¼SW¼SE¼ sec. 29, T. 2 S., R. 13 W., Wabash County. Named for McClearys Bluff.

McClearys Bluff Formation[1]

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

Original reference: Marshall Harrell, 1935, Indiana Div. Geology Pub. 133, p. 73 (chart).

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 94. A division of post-Alleghenian between Grayville above and Friendsville formation; these formations may not actually belong in sequence stated. Derivation of name given.

Named for exposures in McClearys Bluff on Wabash River, Wabash County, Ill.

McClellan Peak Olivine Basalt

Pleistocene: Western Nevada.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042-C, p. 59–60, pl. 3. Replaces preoccupied American Flat basalt of Gianella (1936). Described as flows and cinder cones of gray to black basalt with prominent yellowish-green olivine phenocrysts. Thickness 50 feet. Lies uncon-

formably on Alta formation, Hartford Hill rhyolite tuff, and pre-Tertiary rocks. Not directly overlain by younger rocks.

Remnants of flows are found on east slope of McClellan Peak, on American Flat, and in American Ravine, Virginia City quadrangle, Nevada.

†McCloud Formation[1]

Mississippian and Permian(?): Northern California.

Original reference: J. P. Smith, 1894, Jour. Geology, v. 2, p. 592–593.

Well developed in region of McCloud River, in Shasta County, and from which it receives its name.

McCloud Limestone[1]

Permian: Northern California.

Original reference: H. W. Fairbanks, 1894, Am. Geologist, v. 14, p. 29–30.

N. E. A. Hinds, 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 274; C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 163. Referred to as Lower Permian.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Consists of light- to dark-gray, medium- to thin-bedded, fossiliferous limestone. Thickness 1,600 feet in Bollibokka area. Conformably overlies Baird formation. Underlies Bollibokka group (new). Fossiliferous beds are dated as Wolfcampian and Leonardian.

Exposed along McCloud River, Redding region.

†McCloud Shales[1]

Permian: Northern California.

Original reference: H. W. Fairbanks, July 1894, Am. Geologist, v. 14, p. 30.

Occurs on east bank of McCloud River, about 20 miles north of U.S. Fisheries, Redding region.

McClure Sandstone Member (of Norton Formation)[1]

Lower Pennsylvanian: Southwestern Virginia.

Original reference: J. B. Eby, 1923, Virginia Geol. Survey Bull. 24, p. 63, 67.

Named for McClure River, Dickinson County.

McColley Canyon Member (of Nevada Formation)

Devonian: Northeastern Nevada.

Donald Carlisle and others, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2178 (fig. 2), 2180–2182. Well-bedded limestone, calcareous dolomite, and dolomite with no appreciable amount of quartz sand, excepting local quartzose facies at base. Thickness 420 feet at type section; thickens southward to 625 feet south of Bald Mountain; thins northward to approximately 200 feet. Underlies Union Mountain member (new): overlies Lone Mountain dolomite.

Type locality: McColley Canyon, Sulphur Springs Range, northern Mineral Hill quadrangle.

McCombs Limestone Member (of Bell Canyon Formation)

Upper Permian (Guadalupe Series): Western Texas and southern New Mexico.

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region Texas and New Mexico: San Francisco, W. H. Free-

man and Co., p. 15, 53. McComb limestone member lies between the Lamar limestone member above, and the Radar limestone member below.

P. B. King and N. D. Newell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 386–387. Unit had been described as flaggy limestone bed about 10 feet thick, lying about a third of the way up in 400-foot sandy interval between Rader and Lamar limestone members (King, 1948). McCombs limestone member of Newell and others (1953) is same as this flaggy limestone described by King. Derivation of name given, and type locality designated.

Type section: Bed 15, section 34, of King (1948), short distance southeast of McCombs Ranch and present route of U.S. Highway 62, near former route of highway as it existed before 1939, Culberson County, Tex. Strong persistent scarp-maker traceable for 30 miles or more southward from Guadalupe Mountains across Delaware Mountains.

McCormick Group

Lower and Middle Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 28–31, 44 (table 1), pl. 1, geol. sections. Lowest group in Pennsylvanian of Illinois. Includes Caseyville and Abbott (new) formations. As thus defined, includes strata formerly included in Caseyville group and lower part of Tradewater group. Underlies Kewanee group (new). Group is characterized by prominence of thick commonly massive relatively pure quartz sandstones that constitute 50 to 60 percent of strata; sandy shale and siltstone normally make up 40 percent or more of section. Coals are characteristically thin and limited in continuity; limestones uncommon to rare, although fossiliferous sandy beds or sandy limestones are present locally. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: Vicinity of McCormick, northwestern part of Pope County.

McCoy Formation[1]

Pennsylvanian or Permian: Northwestern Colorado.

Original reference: R. Roth, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 10, p. 1265–1267.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleontology Contr., v. 6, no. 4, p. 60–61, 68. Plant remains of McCoy formation are decidedly Permian in appearance and affinities. The plants are not proof of Permian or even late Pennsylvanian age but may be an early appearance due to conditions of environment. Contains *Walchia*-bearing bed.

H. F. Donner, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1220 (fig. 2), 1223–1228, pl. 1. Described in McCoy area where it is redefined to include over 3,500 feet of coarse arkosic sandstones and grits with interbedded shales and limestones. *Walchia* bed recognized as member of formation. As redefined, includes strata termed Weber(?), Maroon, and Rock Creek, which terms are abandoned in this area. Conformably underlies State Bridge siltstone; disconformably overlies Leadville limestone; north of the area, disappears within a few miles; 6 miles east of Yarmony Mountain, overlaps underlying formation and rests on Precambrian rocks. Early Pennsylvanian, probably Des Moines.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 823. On West side of McCoy area, separated from overlying State Bridge by Schoolhouse tongue of Weber sandstone.

Named for exposures at McCoy, Eagle County.

McCoy Mountains Formation

Upper Paleozoic or Triassic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 32, 49–52. Comprises metavolcanics, mainly original tuffs, together with some interbedded metasediments. Southwesterly dips of 30° to 50° prevail in southwestern part of McCoy Mountains and suggest a thickness many thousands of feet for formation. Cut by Coxcomb granodiorite (new).

Typical occurrence in southern part of McCoy Mountains, Palm Springs-Blythe area, Riverside County. Also covers about 15 square miles in southern part of Coxcomb Mountains.

McCoytown Sandstone[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F., p. xxvii.

Near McCoytown, in Tuscarora Valley.

McCracken Sandstone Member (of Elbert Formation)

Upper Devonian: Subsurface in southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

R. L. Knight and J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 56, 57 (fig. 1); J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 62 (table 1), 63. Consists predominantly of white, light-gray to red sandstone, fine- to medium-grained, some coarse, generally poorly sorted, commonly glauconitic, with a few streaks of sandy dolomite. Thickness of 112 feet in type well, between depths of 8,059 and 8,161 feet. Underlies unnamed upper member of Elbert formation with transitional contact; overlies Aneth formation (new) probably unconformably. Interfingers out into Elbert formation undifferentiated to the west.

Type locality: In Shell Bluff Unit No. 1 well on McCracken Mesa near town of Blanding, San Juan County, Utah. Location of Shell Bluff Unit No. 1 given as sec. 32, T. 39 S., R. 23 E. on page 56, and as sec. 32, T. 29 S., R. 22 E. on page 63.

Maccrady Shale[1]

Maccrady Series

Mississippian: Southwestern Virginia and western West Virginia.

Original reference: G. W. Stose, 1913, U.S. Geol. Survey Bull. 530, p. 233, 234.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 280–282, measured sections. Maccrady series, comprising beds between Greenbrier series and Pocono series, is distinct and well-defined stratigraphic division in area of this report. Consists of deep-red shale and weakly bedded sandstone. Thickest in southeast part of outcrop and thinnest in north and northwest. Estimated thick-

ness 250 feet in Caldwell section; about 60 feet near Pocahontas County line.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 350–354. Maccrady shale was named by Stose (1913) from village of Maccrady, 2 miles northeast of Saltville. This shale was also named Pulaski by Campbell (1894). Name Pulaski was preoccupied and was abandoned. Main body of rocks included in Maccrady of Stose is of Warsaw age and cannot be included with the red shale (Maccrady restricted) at its base which is of Osage age and closely related to Price formation. Hence, Maccrady is restricted to red beds at base of Maccrady as defined by Stose. In section published by Stose, the lower bed, 90 feet thick, seems to be based on an exposure at Broadford and includes all red rock of the Maccrady (restricted) and perhaps some of upper Price. The Maccrady directly overlies the Price. In Greendale syncline, including type locality, and in Big Stone area, the overlying formation is of Warsaw age. Near Duffield, Scott County, the Maccrady is 40 feet thick and underlies St. Louis limestone.

Paul Averitt, 1941, Virginia Geol. Survey Bull. 56, p. 18, 19 (fig. 2), 21. Shale in Scott and Washington Counties, Va., overlies Price sandstone and underlies Little Valley limestone (new). Thickness 50 to 100 feet.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38. In area of this report [southwestern Virginia, southern West Virginia, and eastern Kentucky], Greenbrier limestone rests unconformably on Maccrady shale which consists of red, green, and gray shales, siltstones, fine-grained to very fine-grained sandstones, and some andhydrite locally in subsurface. Buff to gray, sometimes greenish-buff, locally dolomitic, thin- to medium-bedded sequence of impure limestones is present in many places between top of Maccrady shale and base of Hillsdale member of Greenbrier. This sequence ranges in thickness from a few feet to 60 feet in this area but is thicker in Greendale syncline. It has been referred to as strata of Warsaw age, and strata in Little Valley, Scott County, Va., have been called Little Valley limestone. These strata are not named in this report.

Named for exposures at Maccrady, Smyth County, Va.

McCraney Limestone (in North Hill Group)

McCraney Limestone Member (of Hannibal Shale)

Mississippian (Kinderhook Series): Southeastern Iowa and central western Illinois.

R. C. Moore, 1928, Missouri Bur. Geology and Mines, v. 21, 2d ser., p. 20, 21, 22, 49, 58–59. [Original reference as McKerney limestone.]

M. A. Stainbrook, 1950, Am. Jour. Sci., v. 248, no. 3, p. 208–209. Lithologic and faunal similarity and apparently identical stratigraphic position of McCraney and Louisiana strata lead to conclusion that they are parts of same body of limestone. Therefore, McCraney is not member of Hannibal formation, and because Louisiana has precedence term McCraney should be dropped.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 28–30. Rank raised to formation in North Hill group. Basal formation of group. Conformably underlain by English River siltstone and seemingly gradational with it; conformably overlain by Prospect Hill siltstone with contact marked in outcrops by sharp change in lithology. Where Prospect Hill is not present (as at type local-

ity) McCraney is unconformably overlain by Burlington limestone of Osage age. Thickness 58 feet in Hancock and Adams Counties, Ill., thins eastward and westward; eastern edge lies along line of maximum thickness of English River, where basal Osage unconformity bevels the two formations.

Named from exposures in ravine in Mississippi River bluffs south of McCraney (misspelled McKerney in original reference) Creek, north of Kinderhook, Pike County, Ill.

McCune Limestone[1]

Middle Ordovician: Central eastern Missouri.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 61.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 51). Shown on correlation chart below Maquoketa shale and above Kimmswick limestone.

Named for exposures near McCune Station, Pike County.

McCurtain Shale Member (of McAlester Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 31–32. Described in Haskell County where it consists predominantly of shale but locally contains thick succession of sandstone beds many of which are massive. Thickness about 500 feet at south side of county; thins northward to about 200 feet. Lowest member of formation; underlies Warner sandstone member; overlies Hartshorne coal of Hartshorne formation.

Named for fact McCurtain, Haskell County, is built on this shale.

McCutcheon Volcanic Series

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 342–345, pl. 1. Succession of five lavas alternating with five tuffs, some of which contain sandstones, breccias, and fresh-water limestones. Aggregate thickness 1,500 to 1,700 feet. Divided into (ascending) Huelster formation, Star Mountain rhyolite, and Seven Springs formation. Base is lowest sandstone and conglomerate which overlie marine Upper Cretaceous; the top, the highest lava, is exposed along syncline crossed by Fort Davis-Toyahvale highway north of Star Mountain.

Name derived from Willis McCutcheon Ranch 7 miles south of Toyahvale, northwestern part of Barrilla Mountains, Reeves County.

McDermott Member (of Animas Formation)

McDermott Formation[1]

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

Original reference: J. B. Reeside, Jr., 1924, U.S. Geol. Survey Prof. Paper 134, p. 22–25.

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Reeside's (1924) typical section of McDermott in SW¼NW¼ sec. 19, T. 32 N., R. 11 W., subdivided as follows: lowest 95 feet of pebble-bearing sandstone and sandy shale is assigned to Kirtland formation: overlying 127 feet of purplish beds is

here termed McDermott member of Animas formation; top 106 feet is included in upper part of Animas.

C. H. Dane and G. O. Bachman, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–224. Formation mapped in San Juan basin and Zuni Mountains. Overlies Kirtland shale which, as mapped, includes an unseparated equivalent of McDermott formation in San Juan County; underlies Ojo Alamo sandstone.

Named for McDermott Arroyo, southwestern La Plata County, Colo.

MacDonald Formation[1]

Precambrian: Southern British Columbia, Canada, and northwestern Montana.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 2, 3.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1881. Correlated with Appekunny formation.

Named for fact it underlies extensive surface in MacDonald Range, British Columbia.

McDonald Shale or Shale Member (of Monterey Formation)

Miocene, upper: Southern California.

J. A. Cushman and P. P. Goudkoff, 1938, Cushman Lab. Foram. Research Contr., v. 14, pt. 1, p. 1. Referred to as McDonald shale, developed along west side of San Joaquin Valley.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1616–1617. Termed member of Monterey. Differentiated from underlying Devilwater-Gould member by its characteristic siltiness and massiveness; brownish gray and purplish gray. Thickness 2,250 feet. Conformably underlies Antelope shale member. Crops out in belt east of Devilwater-Gould member.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 13–14, pl. 1. Member described in Bitterwater Creek area, Kern County, where it is 1,200 to 3,000 feet thick and consists mostly of light-colored siliceous shales interbedded with variable amounts of sandstone and buff and rusty-brown colored limestone; diatomaceous in part. To the south of Bitterwater Creek, over 1,900 feet of the McDonald conformably overlies Gould-Devilwater member; in middle of McDonald section are 380 feet of friable fine-grained quartzose sandstone with streaks of silty shale, and this sandstone, although entirely within the McDonald, is considered to be the Twisselmann sandstone member (new); portion of the McDonald overlying the Twisselmann consists of about 600 feet of hard, gray to light-brown, siliceous and porcelaneous shale of uniform character. In Shale Hills area, disconformably overlies Eocene Point of Rocks sandstone.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, Road log, topog. profile, columnar section. McDonald shale member, in Chico Martinez Creek area, underlies Antelope shale member and overlies Devilwater silt member. Thickness about 2,300 feet. McDonald shale, Antelope shale, and Chico Martinez chert (new) members are equivalent to McLure shale member of Monterey.

First described in Crocker Flat landslide area, vicinity of Recruit Pass, east side of Temblor Range, San Luis Obispo County.

Macedonia cyclothem (in Abbott-Spoon Formation)

Macedonia cyclothem (in Tradewater Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Cyclothem in Tradewater group. In sequence, occurs above Delwood cyclothem and below unnamed cyclothem (Bald Hill coal).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. In sequence, occurs below Stonefort cyclothem and above Delwood cyclothem. Gives type locality of formation and cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), 55 (table 3). In Abbott-Spoon Formations (both new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NW sec. 27, T. 10 S., R. 6 E., Saline County. Name derived from school 6 miles south of Harrisburg.

Macedonia Formation (in Tradewater Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 39, 40. Consists of thick basal sandstone, here named Murray Bluff sandstone, and overlying series of shaly strata including several coals and one persistent marine limestone, the Curlew. Attains thickness of 100 feet or more. Underlies Stonefort formation; overlies Delwood formation (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Gives type locality of formation and cyclothem.

Type locality: NW¼ sec. 27, T. 10 S., R. 6 E., Saline County. Name derived from school 6 miles south of Harrisburg.

†McElmo Formation[1]

Upper Jurassic: Southwestern Colorado, northwestern New Mexico, and southwestern Utah.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 967–968. Coffin (1921, Colorado Geol. Survey Bull. 16) proposed term post-McElmo for beds between the McElmo and Dakota of southwestern Colorado. He stressed the fact that the beds could not be included with either the underlying or overlying beds without exceeding limits of type sections. Since Coffin's work, term McElmo has been abandoned, and because term Morrison has been applied liberally it now includes the post-McElmo as well as the McElmo.

Named for exposures on McElmo Creek, Montezuma County, Colo.

McElroy Formation (in Jackson Group)

McElroy Member (of Fayette Sandstone)[1]

Eocene, upper: South-central Texas.

Original reference: O. L. Brace, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 7, p. 779–781.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2628–2631. Ellisor (1933, Am. Assoc.

Petroleum Geologists Bull., v. 17, no. 11) divided the McElroy formation into Manning beds at top, Wellborn sands, and Wooleys Bluff clays. Ellisor considered the McElroy to extend upward to base of Dilworth sand member of Whitsett formation as she grouped these units. Renick (1936, Texas Univ. Bull. 3619) rejected name McElroy and considered the Manning a formation, including in it the Dilworth and Yuma sandstone members. Because name McElroy is in common use in south-central Texas area, it is believed that name McElroy should be retained but the formation expanded to include Dilworth sandstone and overlying Falls City shales of Ellisor (here renamed Conquista clay). McElroy, as redefined here, is practically equivalent to Manning formation of Renick (1936) and consists chiefly of bentonitic clays and tuffs with some interbedded sandstones. Includes (ascending) Manning clay, Dilworth sandstone, and Conquista clay members. Overlies Wellborn sandstone; underlies Whitsett formation. Jackson group. Exposures described. New type locality designated because locality given by Ellisor (1933) could not be located.

Type locality: Cuts along Farm Road 705, in southern Augustine County, about 8 or 10 miles west and southwest of McElroy; road connects Brookeland with State Highway 147 to San Augustine and traverses eastern edge of Angelina National Forest.

McGee Glaciation

McGee glacial stage[1]

McGee Till

Pleistocene: East-central California.

Original references: E. Blackwelder, 1930, Geol. Soc. America Bull., v. 41, p. 91–92; 1931, Geol. Soc. America Bull., v. 42, p. 865–922.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1289. Aeolian Buttes till (new) may be equivalent in age to McGee glacial stage but the Aeolian Buttes can be dated with respect to local volcanic and glacial events; McGee at its type locality 25 miles southeast cannot; therefore, new name is proposed.

W. C. Putnam, 1960, California Univ. Pubs., Geol. Sci., v. 34, no. 5, p. 233. Name Aeolian Buttes till considered invalid as representing an earlier Pleistocene, pre-Sherwin stage. Hence, glacial sequence on eastern slope of Sierra Nevada is McGee, Sherwin, Tahoe, and Tioga.

Name amended to glaciation in compliance with 1961 Code of Stratigraphic Nomenclature.

Exposed on high ridge west of McGee Peak, Mount Morrison quadrangle, Mono County.

McGhee Peak Formation (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 45–47, pl. 1. Lithic characteristics vary greatly vertically, and individual beds traced laterally for only short distances. Conglomerate and sandstone especially abundant; a few beds of shale and brown-weathering black limestone and some gray limestone in upper part of formation. In most areas, basal beds composed of ill-sorted conglomerate consisting of rounded cobbles and pebbles of quartzite, limestone, and chert in quartz-sand matrix. Conglomerate similar to basal beds occurs throughout formation, but percentage of limestone fragments increases in higher

beds. Abundance of limestone-pebble conglomerate characterizes formation. Basal part of formation formed by 75 feet of medium-grained white sandstone instead of usual conglomerate, sandstone overlain by 31 feet of conglomerate, above which is mostly sand. Sandstone of formation ranges from white to gray and red. Red sandstone, siltstone, and shale prominent locally. Thickness on McGhee Peak 370 feet; 546 and about 600 feet measured at other sections in range. Conformably underlies Carbonate Hill limestone (new); unconformably overlies several Permian limestones—on McGhee Peak it overlies Earp formation.

Named from exposures on McGhee Peak, which is midway between Granite Gap and Steins on crest of main ridge of Peloncillo Mountains, Hidalgo County. Crops out on top of peak and is exposed in northwest-trending belt on east side of main ridge of Peloncillo Mountains in vicinity of McGhee Peak, and elsewhere in mountains to south.

McGlone Limestone

Middle Ordovician (Bolarian): Western Virginia and eastern and southern West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, 64, 66, 78, 82–83. Name proposed for well-bedded calcilutite with variable quantities of calcilutite pebble conglomerate and laminated quartzose calcisiltite. Contains calcarenite with algal fossils at top southwest of Gap Mills. Metabentonite present in one section. Thickness 62 feet at type locality; thins to southeast. Underlies McGraw limestone (new) with sharp contact; overlies Benbolt limestone. Consists of beds previously referred to as Snyder in Virginia; use of that name has been criticized although unit is believed equivalent to Snyder limestone of Pennsylvania.

Type section: Near McGraw Gap, Alleghany County, Va. Named from McGlone in Turkey Cove, west of Gap Mills, Monroe County, W. Va.; beds are exposed along north flank of anticline to the east.

MacGowan Concretionary Bed (in Kevin Shale Member of Marias River Shale)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2795–2796; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 92. Thin resistant conglomerate bed. Consists of concretionary dolostone and limestone, weathering light-brown, orange-brown, or very dusky-red, which serve as matrix for abundant small pellets of light-olive-gray phosphatic siltstone of local concretionary origin, and of varying amounts of polished rounded granules and small pebbles of gray and black chert. This coarse material produces distinctive, easily recognized polka-dot pattern. Thickness 18 inches. In type section of Kevin member, the bed is about 314 feet below top of member, which is almost exactly at middle of member.

Named for exposures on the MacGowan lease in SE¼SW¼NE¼ sec. 4, T. 35 N., R. 3 W., Kevin-Sunburst oil field, Toole County.

McGrath Gneiss

Precambrian (early Algoman): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1014, pl. 1. Pink and black banded medium-grained foliated augen gneiss. Penetrates the Thomson formation lit-par-lit.

Largest exposures are 2 miles southwest of McGrath, Aitkin County.

McGraw Limestone

Middle Ordovician (Bolarian): Western Virginia and eastern and southern West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 63, 66, 78, 83–84. Name proposed for well-bedded heavy-ledged brittle, rather pure calcitite. Generally occurs at 6-inch to 1-foot ledges of dense calcitite broken into rectangular joint blocks; each ledge is irregularly laminated, has thin calcarenite lenses, and commonly has ramifying cylindrical fucoidal structures which are less resistant and leave holes upon weathering. Thickness 9 feet in type section; maximum over 40 feet with thinning to extinction southeastward. Underlies Nealmont limestone; contact is an erosional disconformity and rarely exposed. Overlies McGlone limestone (new) with sharp contact. Previously called Stover limestone, but extension of that name from Pennsylvania has been criticized.

Type section: In southeast end of Warm Spring Cove, northern Alleghany County, Va. Named from McGraw Gap southeast of the cove.

McGregor Limestone Member (of Platteville Formation)

McGregor Member (of Platteville Formation)[1]

Middle Ordovician: Northwestern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: A. C. Trowbridge, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 64, 70, 71, fig. 1.

A. F. Agnew and A. V. Heyl, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 9, p. 1585–1587. Underlies Quimbys Mill member (new).

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 759–763). Where typically developed, Carimona member (new) overlies McGregor member. Carimona occupies same stratigraphic interval as Quimbys Mill member, but the two are lithologically distinct and not known to overlap.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1030, 1031–1032. In southeasternmost Minnesota, the Platteville is composed of (ascending) Pecatonica, McGregor, and Carimona members. The McGregor is present throughout Fillmore County and lies directly on the Glenwood formation where the Pecatonica member is absent. Member is 20 feet thick in southeast, where it overlies the Pecatonica, and thins to about 16 feet in central part of county; about 25 feet thick in southwestern Wisconsin; 14 feet or less in vicinity of Rochester, and northwest of there changes in character until name McGregor is no longer applicable.

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 58 (table 1), 58–60. Constitutes major part of Platteville in southeastern Minnesota and northeastern Iowa. Rocks of McGregor member have at some times and places been classified as Magnolia and Mifflin members (Bays and Raasch, 1935; Bays, 1938). Although uppermost foot or two of McGregor in Fillmore County, Minn., appears smoother and thicker bedded than lower beds, the distinction is vague. In region south from Rochester, Minn., to McGregor, Iowa, there is virtually no evidence of the Magnolia and Mifflin members. However, in the Twin Cities, where interval is somewhat dolomitic, Majewske (1953, unpub. thesis) has shown that what in the past has been lumped together as McGregor is the Mifflin and Magnolia separated by hitherto unnamed member, Hidden Falls. McGregor

is used where special characters of Mifflin, Hidden Falls, or Magnolia are absent or insufficiently distinct to permit use of names.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 274–275. At reference section of Platteville, McGregor limestone member consists of lower unit (Mifflin of Bays, 1938), 15.1 feet thick and upper unit (Magnolia of Bays and Raasch, 1935), 15.8 feet thick; overlies Pecatonica dolomite member and underlies Quimbys Mill member.

Type section: Ravine south of highway, 1½ miles west of McGregor, Clayton County, Iowa.

McHale Slate (in Deer Trail Group)

Precambrian (Belt Series): Northeastern Washington.

Ian Campbell and J. S. Loofbourow, Jr., 1941, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as third of five formations in group. Younger than Edna dolomite (new); older than Stensgar dolomite.

Machegit Conglomerate Member (of Tagpochau Limestone)

Miocene: Mariana Islands (Saipan).

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1955, U.S. Army Corps of Engineers, *in* Military geology of Saipan, Mariana Islands: U.S. Army Corps of Engineers, Far East Command., v. 1, p. 9, pl. 2. Incidental mention.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 63, 71–72, chart 1, pl. 1. Well-rounded and deeply weathered cobbles and boulders of andesite in matrix of finer material of essentially same composition, the whole rather loosely consolidated. Average thickness 20 to 40 feet; type section 40 feet. Occurs above Donni member of transitional facies or is laterally equivalent to them. At type section appears to underlie inequigranular facies and overlie transitional facies.

Type section: Immediately east of southern part of Machegit cliff and just north of Adelug cliff, about 350 yards northwest of Donni Springs. Total areal extent about 65 acres.

McHenry Formation[1]

Pleistocene and Recent: Northeastern Maryland.

Original reference: P. R. Uhler, 1901, Maryland Acad. Sci. Trans., new ser., v. 1, p. 395–400.

Extends over parts of recent beaches of Patapsco River and Chesapeake Bay, and near Baltimore composes upper part of Fort McHenry Plateau.

Machias Formation (in Canadaway Group)

Machias Member (of Canadaway Formation)

Machias Shale[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 18–23. Machias formation in Wellsville quadrangle is limited by Rushford sandstones below, and Cuba formation above. Thickness about 400 feet.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 17. "Machias" is used here to designate the member between the Rush-

ford and Cuba members, of Canadaway formation, but the Rushford has not been traced far laterally and is not recognized in vicinity of the Machias which has never been assigned definite limits at its type locality.

Well exposed in Pierce quarry, west of Machias, Cattaraugus County.

Macho Member (of Tererro Formation)

Lower Mississippian: Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754–1756, 1760–1762, 1770, 1771, 1772, 1773. Composed of limestone breccia derived in large part from solution and collapse of cavernous parts of upper part of Espiritu Santo formation (new) and in minor part from collapsed parts of overlying Manuelitas member (new). Thickness 3 to 30 feet. In part, possibly as old as Devonian(?) and, in part, Early Mississippian.

Typically exposed on steeply sloping hill west of church at El Macho, north side of Macho Creek, west of confluence with Pecos River, 5.3 miles south of Tererro, San Miguel County.

Macho Pyroxene Andesites

Tertiary, lower(?): Southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39–40, pl. 1. Form fairly thick series of flows, flow breccias, and tuffs. Pyroxene andesite flows mostly dark-purple to purplish-gray porphyritic rocks. Breccias are purple to brownish red and contain fragments of pyrogene andesite flow rock in a groundmass similar to the flow rock except for color. Tuffs appear to form earliest part of series; they range from bright purple through chocolate brown to bright red and pale bluish gray. These rocks are mostly porphyritic. Tuffs often interbedded with white or green-gray magnetite-bearing sandstones and lenses of red conglomerate. Unconformably underlie late Tertiary volcanics. Thickness about 1,000 feet.

Named from Macho mining district at W½ sec. 20, T. 19 S., R. 7 W., Lake Valley quadrangle, Luna and Sierra Counties, where rocks form fairly thick series. Tuff exposed only in Old Hadley district.

McIntire Upper Conglomerate[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 45, 46, 48.

Well exposed along railroad, about one-half mile south of depot, and at many places around Scranton.

McIntosh Formation

Eocene, middle to upper: Southwestern Washington.

P. D. Snavely, Jr., and others, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1052–1061. Name proposed for sequence of dark-gray marine siltstone and claystone and interbedded arkosic and basaltic sandstone. Thickness 4,000 to 4,500 feet. Base of sequence not exposed; underlies volcanic rocks. Correlated with Mill Creek and Sacchi Beach beds of local usage and perhaps Burpee formation of Oregon.

P. D. Snavely, Jr., and others, 1951, U.S. Geol. Survey Coal Inv. Map C–8, sheet. 1. Underlies Northcraft formation (new).

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 12–22, pl. 1. Dark shale and arkosic sandstone described by Culver (1919) as part of

Newaukum series are mapped as McIntosh formation of this report [Centralia-Chehalis district]. Underlies Northcraft formation.

Type area: Central and southeastern parts of T. 16 N., R. 1 W., extending into northern parts of secs. 2 and 3, T. 15 N., R. 1 W. Named from McIntosh Lake near which formation is well exposed; Centralia-Chehalis district.

McKee Sandstone (in Simpson Group)

Middle Ordovician: Western Texas (subsurface).

Taylor Cole, C. D. Cordry, and H. A. Hemphill, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 279–281. Proposed for upper sandstone in Simpson group. Lies between depths of 5,228 to 5,281, in type well. Top occurs about 305 below first red shale break in the Simpson and about 840 feet above top of Ellenburger, though this interval varies somewhat in wide area. Occurs above Waddell sandstone (new).

Type well: Magnolia Petroleum Co.'s J. S. McKee No. 1–A, in sec. 24, Block 9, H and GN Survey, Pecos County.

Mackentire Redbeds Tongue (of Phosphoria Formation)

Mackentire Tongue (of Woodside Formation)

Permian: Northern Utah.

J. S. Williams, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 91–93. Concomitantly with the thinning of Rex member of Phosphoria, gray and red sandstones, siltstones, and shales appear between the calcareous sandstones and main body of Woodside shale. They are here named Mackentire red beds tongue of Phosphoria. Thickness as much as 100 feet.

H. D. Thomas, 1939, Am. Assoc. Petroleum Geologists Bull. v. 39., no. 8, p. 1249–1250. Discussion of Williams' paper. Proper designation should be Mackentire redbeds tongue of Woodside formation.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2855–2856. Complex problem of nomenclature of these beds discussed. Report follows Thomas (1939) and Thomas and Krueger (1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1) in designating rocks above the Franson in northeastern Utah as Woodside and in considering the Mackentire as tongue of Woodside. Thin beds of purple, greenish-gray, yellowish-orange, and gray shale and siltstone are present in Mackentire at type locality; east of Lake Fork, unit is dominantly greenish-gray and pale yellowish-orange siltstone, some redbeds commonly present. Thins north, east, and west of type locality.

Named for exposures at mouth of Mackentire Draw, a small tributary of West Fork of Lake Fork in sec. 27, T. 2 N., R. 5 W., Uinta Base and Meridian, Duchesne County.

McKenzie Lavas, Flows

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 46–51, 62. Discussion of Mount Multnomah ancient ancestor of the Three Sisters. Term McKenzie lava flows is applied to flood of lava which covered ancient McKenzie River valley.

McKenzie River valley is in eastern Lane County and western Deschutes County. Flows lie north of Scott Mountain, extend around west base of Black Crater and reach as far north as Mount Washington.

McKenzie Limestone or Formation

McKenzie Formation or Limestone (in Cayuga Group)[1]

McKenzie Member (of Mifflin Formation)

Middle Silurian: Western Maryland, central Pennsylvania, northern Virginia, and northeastern West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 522, 545, 591, pl. 28.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 116–145, measured sections. Formation described in West Virginia where it is as much as 290 feet thick. Overlies Rochester shale of Clinton group. Includes Rabble Run sandstone member. Underlies Williamsport sandstone. Middle Silurian, Niagaran series. This is "Niagara limestone" of earlier reports.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 74–77. Formation described in Maryland where it is included in Cayuga group. Includes Rabble Run sandstone member. Underlies Bloomsburg formation (also referred to as member of Wills Creek shale). Overlies Rochester formation, contact gradational. Thickness 100 to 240 feet.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 20, 23. Rank reduced to member status in Mifflin formation (new). Uppermost member of formation; overlies Rochester member; underlies Bloomsburg formation. Thickness at Mifflintown section 240 feet; at this locality the upper McKenzie has been incorporated with the Bloomsburg. In Mount Union area referred to as McKenzie formation. Thickness here 360 feet; has intraformational conglomerate at base. Underlies Bloomsburg formation; overlies Rochester formation. Silurian.

U. S. Geological Survey does not include the McKenzie in Cayuga Group.

Type locality: Nine miles southwest of Cumberland, Allegany County, Md. Named for McKenzie Station on Baltimore and Ohio Railroad.

McKenzie Hill Limestone[1] or Formation (in Arbuckle Group)

Lower Ordovician: Central southern Oklahoma.

Original reference: C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 23–24; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1318–1319, table 1. Formation divided into two members: Chapman Ranch below and McMichel (new) above. Thickness 674 to 1,122 feet in Arbuckles; 223 to 1,019 feet in Wichitas. Overlies Butterly formation (new); underlies Strange formation (new); or where the Strange is absent, underlies Cool Creek formation. Type section and derivation of name given.

Type section: Near top of McKenzie Hill on its western slope. Named for McKenzie Hill, a limestone hill about 7 miles northwest of Lawton and 1 mile south of Signal Mountain in secs. 8 and 9, T. 2 N., R. 12 W., Comanche County.

McKerney Limestone Member (of Hannibal Shale)[1]

See McCraney Limestone, correct spelling.

Mackinac Breccia

Mackinac Limestone[1]

Silurian and Middle Devonian: Northern Michigan.

Original reference: C. C. Douglass, 1839?, Michigan Leg. House Doc. 27, p. 97–111.

K. K. Landes and G. M. Ehlers, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 23, 33–34, 123–153. Douglass Houghton, first State Geologist of Michigan, named rocks of Mackinac Island and Straits the "Mackinac Limestone." In his handwritten journal (ms., Rare Book Room, Michigan Univ. Library) Houghton states: "For a distance of about half a mile west from Goose Island the bottom of the lake was seen to be composed of water-worn masses of white (Mackinac) limestone" (p. 167, Aug. 1, 1839). A few pages further, referring to shore line a short distance west of St. Ignace: "A naked point of Mackinaw limestone was noticed which attained an estimated altitude of about 180 feet" (p. 178, Aug. 14, 1839). The opposite page (179) contains map of "North Side of Lake Michigan" on which "Mackinaw L. Rock" is written across St. Ignace Peninsula. Apparently first published reference to Mackinac formation is in Fourth Annual Report of the State Geologist published in 1841 (Houghton, 1841, Michigan Senate Documents, v. 1, p. 486). A brief description of the Mackinac limestone is given on page 548 of same report in section by C. C. Douglass, Assistant Geologist. Houghton in his first use of the word in his journal spelled it "Mackinac," but elsewhere spelling "Mackinaw" is used. Douglass consistently wrote "Mackinac," the accepted spelling today. Present study has shown that this "formation" includes not only breccia but also sedimentary beds which range in age from Silurian to Mid-Devonian; and that pluglike extensions of the breccias penetrate rocks of varying ages. New formation names (Pointe aux Chenes, St. Ignace, Garden Island, and Bois Blanc) are given to the sedimentary units, and term Mackinac breccia is applied exclusively to breccias of the Straits region. Brecciated rocks range in age from within Pointe aux Chenes (Cayugan) through Detroit River group (Devonian).

Named for occurrence on Mackinac Island.

McKinney Basalt[1]

Recent: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho, compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30, 76–78, pl. 5. Thickness about 500 feet. Rests on Hagerman lake beds and Malad basalt. Pleistocene, but age difficult to determine.

U.S. Geological Survey currently designates age of McKinney Basalt as Recent on the basis of a study now in progress.

Type locality: McKinney Butte, from which the basalt issued, northwest of Gooding in Gooding County.

McKinney Knob Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 157, 162, 163, pl. 15. A cliff-forming siltstone about 30 feet thick at top of middle part of Brodhead formation, Liberty facies (new). Underlies Clementsville limestone member (new); probably correlative to Caney Creek mem-

ber (new) to the west; overlies New Providence formation, Junction City facies (new).

Type section: At small knob with prominent cliff, on a spur three-fourths mile southeast of McKinney in west-central Lincoln County.

McKissick Shale Formation[1]

Pennsylvanian: Southwestern Iowa and southeastern Nebraska.

Original reference: W. A. VerWiebe and W. R. Vickery, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 110.

Probably named for McKissick's Grove, 2 miles northeast of Hamburg, Fremont County, Iowa.

McKissick Grove shale (in Wabaunsee Group)[1]

Pennsylvanian: Southwestern Iowa and southeastern Nebraska.

Original reference: G. L. Smith, 1909, Iowa Geol. Survey, v. 19, p. 617, 631, 638, 645.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 30–31. Originally, strata comprising Root shale was included in McKissick Grove shale member of Wabaunsee formation by Condra (1927, Nebraska Geol. Survey Bull. 1, 2d ser.). Moore (1936, Kansas Geol. Survey Bull. 22) discarded name McKissick Grove and divided strata into 11 formations of which three, Friedrich shale, Jim Creek limestone, and French Creek shale are now classified as members of Root shale.

Named for McKissick's Grove, 2 miles northeast of Hamburg, Fremont County, Iowa.

†McKittrick Formation[1]

Pliocene and Pleistocene, lower(?): Southern California.

Original reference: R. Arnold, 1909, U.S. Geol. Survey Bull. 396, p. 22.

J. R. Schultz, 1938, Carnegie Inst. Washington Pub. 487, p. 115–215, pls. Discussion of a late Quaternary mammal fauna from tar seeps of McKittrick, Calif. Terms McKittrick brea, McKittrick asphalt, and McKittrick formation are used in various places in text.

W. E. Ver Planck, Jr., 1950, California Div. Mines Bull. 156, p. 224; 1952, California Div. Mines Bull. 163, p. 58. Report on gypsum makes incidental mention of McKittrick formation.

R. W. Pack (1920, U.S. Geol. Survey Prof. Paper 116) raised term McKittrick formation to group rank to include Etchegoin formation, probably including a representative of Jacalitos formation, and Paso Robles ("Tulare") formation. Terms McKittrick formation and group were abandoned by U.S. Geological Survey in 1940 when Woodring, Stewart, and Richards redefined the Etchegoin.

Named for exposures one-half mile south of McKittrick, Kern County.

Macksburg Sandstone[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Lovejoy, 1888, Ohio Geol. Survey, v. 6, p. 628, 635.

Probably named for Macksburg, Washington County.

Mackworth Slate (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Named for development on Mackworth Island, Casco Bay.

McLeansboro Group

McLeansboro Formation[1]

Upper Pennsylvanian: Illinois and western Kentucky.

Original reference: F. W. DeWolf, 1910, Illinois Geol. Survey Bull. 16, p. 181.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 6–9. Formation includes, in addition to coal units, the following members (ascending): Anvil Rock sandstone, Somerville limestone, Inglefield sandstone, St. Wendells limestone (new), Claypole Hills sandstone (new), Mumford Hills sandstone (new), Grayville limestone, Lawrenceville shale (new), New Haven limestone, Little Chain limestone (new), Little Wabash sandstone (new), and Henshaw or Dixon sandstone.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36. Caseyville, Tradewater, Carbondale, and McLeansboro, considered formations in previous publications, are now given group status.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 114–122. Group classified on cyclothemic basis. Includes (ascending) Sparland, Gimlet, Exline, and Trivoli cyclothems. Named members include Copperas Creek sandstone, Farmington shale, Gimlet sandstone, Lonsdale limestone, Exline limestone, Trivoli sandstone, and Trivoli limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 36–41, 48–51 (table 1), 71–84, pl. 1. Group includes (ascending): Modesto, Bond, and Mattoon formations (all new). Formation name originally applied to all Pennsylvanian strata above No. 6 coal as described from coreholes of two diamond drill holes near McLeansboro. As herein redefined group includes all strata above top of Danville (No. 7) coal. Maximum thickness about 1,200 feet in Jasper County, but more than 1,600 feet of McLeansboro reported from test hole in western Kentucky. Overlies Kewanee group (new). Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type locality: SE¼SW¼SW¼NE¼ sec. 25, T. 4 S., R. 5 E., McLeansboro quadrangle, Hamilton County, Ill. Named for town of McLeansboro.

McLish Formation[1] (in Simpson Group)

Middle Ordovician: Central southern Oklahoma.

Original reference: E. O. Ulrich, 1930, U.S. Nat. Mus. Proc., v. 76, art. 21, p. 73.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 68–77, charts 1, 2, fig. 1. Consists of two divisions: basal sandstone and an overlying section of thin sandstone, interbedded green shale, and variable limestones. Thickness about 200 feet at type locality; about 500 feet on West Spring Creek. Disconformable relationship with both underlying Oil Creek and overlying Tulip Creek. Ostracodal evidence indicates an age of Black River (possibly Lowville).

Type locality: On McLish Ranch, about 4 miles northwest of town of Bromide, Johnson County.

McLure Shale Member (of Monterey Shale)[1]

McLure Formation or Shale

Miocene, upper: Southern California.

Original reference: G. Henny, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 4, p. 403–404.

S. S. Siegfus, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 31–32. Reef Ridge shale is restricted at its type locality to exclude brown shales and silts in lower part of formation as originally defined because that part of the section had been previosly included in McLure shale by Henny (1930). Barbat and Johnson (1934, Jour. Paleontology, v. 8, no. 1) included within Reef Ridge formation the upper or No. 1 zone of Henny's type McLure. McLure consists of three units: lower silty sandy member, middle cherty member, and an upper silty member. Overlies Temblor formation; underlies type Reef Ridge shale(restricted).

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 122–125, pls. Rank reduced to member of Monterey shale. Thickness 552 feet on north slope of Reef Ridge. Overlies Temblor sandstone; underlies Reef Ridge shale.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496, 497 (fig. 211), 499 (fig. 213). Columnar section of Devils Den district shows McLure shale, 1,660 feet thick, above Alferitz formation (new) and below Jacalitos formation.

Umberto Young, 1943, California Div. Mines Bull. 118, pt. 3, p. 524 (fig. 224), 525. Underlies Belridge diatomite in Midway-Sunset area.

J. E. Kilkenny, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 12, p. 2260. Described as formation in Salinas Valley. Consists of siliceous and diatomaceous shales, mudstone, and silts with locally interbeded sands. Maximum thickness 700 feet. Overlies Santa Margarita sand on the Northeast fault block, to which it is confined in its outcrop; in Cholame Hills unconformable with overlying Poncho Rico formation.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook, May 9, p. 13. Chart of formations in Chico-Martinez Creek area shows Monterey formation comprises (ascending) Gould shale, Devilwater silt, McLure shale (equivalent to McDonald shale, Antelope shale, and Chico-Martinez chert), and Chico-Martinez (Belridge) diatomite.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 32–33, pls. 1, 2. McLure shale crops out in continuous belt along western border of Orchard Peak area. Thickness at least 1,700 feet. Includes Polonio sandstone tongue (new). Conformably overlies Temblor sandstone. Not overlaid by younger rocks in mapped area. Upper Miocene.

Type locality: In Canyon crossing Tent Hills south of Avenal Creek near west line of sec. 6, T. 24 S., R. 17 E., Fresno and Kings Counties. Borders McLure Valley.

McMenamy Limestone

Pennsylvanian (Desmoinesian): North-central Texas (subsurface).

H. H. Bradfield, 1959, *in* Petroleum Geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 68 (fig. 3), 71 (fig. 4), 72. Light gray to light brown, varying to dark gray or brownish gray,

finely crystalline to chalky or earthy. Average thickness 25 to 30 feet in northwestern Grayson County; thins eastward and disappears east of line drawn southward and slightly eastward from Big Mineral field; southward from Whitesboro area, increases to maximum of 70 feet near its southwestern termination; in its maximum development has biostromal characteristics. Occurs 250 to 400 feet above top of "Red Strawn." Produces at depth of 2,120 feet in Nortex No. 1 McMenamy in R. V. Banks Survey southwest of Macomb field.

First noted in well drilled on McMenamy land in 1937 by Denver Producing and Refining in J. Hartzog Survey, A–528, Grayson County.

McMichel Member (of McKenzie Hill Formation)

Lower Ordovician: Southwestern Oklahoma.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1319, table 1; 1939, Oklahoma Geol. Survey Circ. 22, p. 24, 44. Name proposed for upper member of formation. Overlies Chapman Ranch member (new). Consists of limestones both heavy bedded and thin bedded.

Named for McMichel Ranch, southwest of McKenzie Hill, in sec. 14, T. 2 N., R. 13 W., Comanche County.

McMicken Formation (in Eden Group)

McMicken Member (of Eden Formation)

McMicken Member (of Latonia Shale)[1]

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 10.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on correlation chart as uppermost formation in Eden group. Overlies Southgate formation; underlies Mount Hope formation of Maysville group. Consists of shale and limestone 60 to 80 feet thick.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030, 1031. Uppermost member of Eden formation. Overlies Southgate member.

Named for McMicken Avenue, Cincinnati, Ohio.

McMillan Formation (in Maysville Group)[1]

McMillan Formation (in Covington Group)

McMillan Group

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 10.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 26. McMillan group includes Bellevue, Corryville, and Mount Auburn formations as exposed in region around Cincinnati; in southern Blue Grass region the Tate, Gilbert, and Mount Auburn occupy the same interval.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1030. Uppermost formation in Covington group. Overlies Fairview formation; underlies Arnheim formation. Fairview and McMillan formations constitute standard for a medial Cincinnatian Maysville stage.

Named for McMillan Street in Cincinnati, Ohio.

McMonnigal Formation

Devonian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3). Named on cross section in report on Paleozoic continental margin in central Nevada. Overlies Masket formation (new).

Toquima Range, Nye County.

McNabb Limestone (in Senora Formation)

Pennsylvanian (Desmoinesian): Northeastern Oklahoma.

C. C. Branson, 1954, Oklahoma Geol. Survey Guidebook 2, p. 3, 5. Name appears in list of units included in Senora formation. Occurs in Croweburg coal cycle below underclay below Croweburg coal and above unnamed shale above Sequoyah coal.

Type locality and derivation of name not given.

McNairy Sand or Formation

McNairy Sand Member (of Ripley Formation)[1]

Upper Cretaceous: Western Tennessee, southeastern Illinois, western Kentucky, northern Mississippi, and southeastern Missouri.

Original reference: L. W. Stephenson, 1914, U.S. Geol. Survey Prof. Paper 81, p. 18, 22.

H. S. McQueen and others, 1939, *in* Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 70 (fig. 25), 71, 73 (fig. 26). McNairy formation, in Ardeola Hill section consists of (ascending) fine, white sand—10 feet; Zadoc member (new) about 29 feet; white sand—11 feet; brown micaceous clay with sand lenses—11 feet. Underlies Owl Creek formation.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 43; J. E. Lamar, 1948, Illinois Geol. Survey Rept. Inv. 128, p. 12. Referred to as formation. Probably attains thickness of about 300 feet in southern Illinois although maximum exposed thickness at any one place is 70 feet. Consists mainly of gray sand which is commonly oxidized in exposures to various shades of brown but may include pink or white bands. Underlies Clayton formation (sand).

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Mapped as sand member of Ripley formation.

L. W. Stephenson, 1955, U.S. Geol. Survey Prof. Paper 274–E, p. 98, 100, 101. Referred to as McNairy sand in Stoddard and Scott Counties, Mo., and Pulaski County, Ill. Thickness 173 feet in Stoddard County where it unconformably underlies Owl Creek formation. In Pulaski County unconformably underlies Clayton formation.

J. G. Grohskopf, 1955, Missouri Geol. Survey and Water Resources, 2d ser., v. 37, p. 19–20. Referred to as formation. In outcrop area, essentially a series of nonmarine micaceous sand, quartzite, sandy clay, and clay. Underlies Owl Creek formation.

Type locality: Cut on Southern Railway 1½ miles west of Cypress Station, McNairy County, Tenn.

†McNairy shell bed[1]

Upper Cretaceous: Western Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 156.

Named for McNairy County.

McNamara Argillite
McNamara Formation[1] (in Missoula Group)

Precambrian (Belt Series): Central western Montana.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 680, figs. 2, 3.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol, Survey Misc. Geol. Inv. Map I–296. In Bonner quadrangle, Montana, McNamara argillite overlies Bonner quartzite (new) and underlies Garnet Range quartzite.

Type section: Along Blackfoot River, in vicinity of McNamaras Landing [Missoula County].

McNulty Rhyolite[1]

Eocene: Western central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Geol. Atlas, Spec. Folio 48.

Occurs in McNulty Gulch, Tenmile district.

McNulty Gulch Rhyolite[1]

Eocene: Western central Colorado.

Original reference: W. Cross, 1886, U.S. Geol. Survey Mon. 12, p. 350.

Named for occurrence in one large and several small bodies at head of McNulty Gulch, which runs north and enters Tenmile River at Carbonateville, Summit County.

Macomb Granite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing, 1916, New York State Mus. Bull. 191, p. 13, 17, 18, 19, 25, 26.

R. V. Dietrich, 1954, Am. Jour. Sci., v. 252, no. 9, p. 513. Incidental mention in discussion of Fish Creek phacolith.

Occurs at Macomb, St. Lawrence County.

Macombs Dam gneiss[1]

Age(?): New York.

Original reference: R. P. Stevens, 1867, New York Lyc. Nat. History Annals, v. 8, p. 116–120.

Along southern shore of Spuyten-Duyvel Creek and Harlem River, Manhattan Island.

Macon City Shale[1]

Pennsylvanian: Northern Missouri.

Original reference: C. H. Gordon, 1893, Missouri Geol. Survey Sheet Rept. 2, v. 9, p. 60.

Named for Macon, Macon County.

Macoupin cyclothem[1] (in McLeansboro Group)

Macoupin cyclothem (in Modesto Formation)

Pennsylvanian: Southwestern Illinois.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 801–912.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 10, 12–13. In sequence, lies above Flannigan cyclothem (new) and below La Salle cyclothem (new).

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 21 (table), 38–41. In Carlinville quadrangle, underlies Shoal Creek cyclothem and overlies Burroughs beds, a succession of beds that do not seem to belong to either Macoupin cyclothem or underlying Carlinville cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Modesto formation (new). Below Shoal Creek cyclothem and above Carlinville cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: N½ center sec. 2, T. 9 N., R. 7 W., near Carlinville, Macoupin County.

Macoupin Limestone Member (of Modesto Formation)

Macoupin Limestone (in McLeansboro Formation[1] or Group)

Pennsylvanian: Southwestern and central western Illinois.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 804.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 21, 40. A limestone in Macoupin cyclothem, McLeansboro group.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 50 (table 1), pl. 1. Rank reduced to member status in Modesto formation (new). Occurs above Womac coal member (new) and below New Haven coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Center NE¼NW¼ sec. 2, T. 9 N., R. 7 W., Macoupin County.

McPherson Formation[1]

Pleistocene: Central Kansas.

Original reference: E. Haworth and J. W. Beede, 1897, Kansas Univ. Geol. Survey, v. 2, p. 287–296.

S. W. Lohman and J. C. Frye, 1939, (abs.) Econ. Geology, v. 34, no. 8, p. 942–943; 1940, v. 35, no. 7, p. 849–851. Term McPherson Equus beds was used by previous investigators to include all unconsolidated deposits in Harvey and McPherson Counties, and all these beds were held to be of Pleistocene age. Present investigation shows that although part of these deposits is Pleistocene in age, a large part appears to be Pliocene in age. Proposed herein to remove Pliocene beds from McPherson Equus beds of Haworth and Beede and to assign to them name Emma Creek formation. McPherson formation (restricted) is retained to include only fluvial deposits of Pleistocene age.

C. C. Williams and S. W. Lohman, 1949, Kansas Geol. Survey Bull. 79, p. 59–70, pls. 1, 7. Formation, as redefined in this report, includes all unconsolidated stream and slope deposits of Pleistocene age which occur in McPherson Valley and Arkansas River valley; includes Emma Creek formation at the type locality and much of the loess of Lohman and Frye (1940). In general, formation consists of early Pleistocene stream deposits, later and coarser Pleistocene stream channel deposits, and still

later Pleistocene silt, clay, and fine sand. Locally, conglomeratic bed 1 to 6 feet thick occurs at base formation; material in this conglomerate is similar to materials comprising so-called Abilene conglomerate. Volcanic ash present locally. Overlies Delmore formation (new).

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 94, 110. McPherson Equus beds included in list of units which are classed at least in part as Sanborn formation. Meade formation in [McPherson] Valley was formerly included within broadly inclusive McPherson formation.

Named for exposures in McPherson County, Kans.

McPherson Marble[1]

Middle Ordovician: Central eastern Missouri.

Original reference: B. F. Shumard, 1873, Missouri Geol. Survey Rept. 1855–1871, p. 307.

Named for McPherson's marble quarry, Jefferson County.

McRae Formation

Upper Cretaceous and Tertiary(?): Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14), 115–120. Comprises 100 to 200 feet of pebbly to bouldery conglomerate at base interbedded with shale or siltstone. Some beds are breccia. Above basal unit are many hundreds of feet of alternating shale and sandstone units. Conglomerate beds unusual and generally thin. Shale outcrops generally weather maroon, reddish brown, or purplish, and sandstone beds weather light gray or buff. Fresh exposures of sandstone are grayish green or pinkish. Thickness possibly more than 3,000 feet. Contact with underlying Mesaverde formation in different places appears to be transitional, disconformable, or sharp.

H. P. Bushnell, 1955, Compass, v. 33, no. 1, p. 11–17. Subdivided into lower, Jose Creek member, and upper, Hall Lake member.

Type locality: Crops out around base of Elephant Butte and along most of eastern shoreline of Elephant Butte Reservoir for several miles north of the dam. Named from old Fort McRae, located in eastern tributary to Rio Grande about 3 miles north of Elephant Butte.

McShane Formation

Upper Cretaceous: West-central Alabama and east-central Mississippi.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 37. Consists of more or less glauconitic crossbedded sand, gravelly sand, and laminated clay—marine deposits in contrast to preponderantly nonmarine beds of the underlying Tuscaloosa group. Thickness about 25 feet. Present in relatively small outliers in mapped region. Beds were formerly included in the Eutaw formation.

W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 204–207. Unconformably overlies continental Gordo; unconformably underlies marine Eutaw formation. Basal bed does not necessarily contain principal conglomerate of formation; at many places basal 6 to 20 feet of formation, consisting of laminated and rippled very fine-grained glauconitic sand lies abruptly on sand and gravel of Gordo formation and is in turn overlain by as much as 40 feet of gravelly sand. At designated type locality, beds are more

or less lenticular an intergradational. Thickness in type area about 200 feet; 240 feet in Warrior River valley but thinner to northwest; 57 feet in Itawamba County, Miss.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22, 26–30. Described in Prentiss County where it is about 28 feet thick; overlies Gordo formation and underlies Eutaw formation. In Mississippi, the McShane occupies a somewhat narrow irregular outcrop area which includes parts of Tishomingo, Prentiss, Itawamba, and Monroe Counties. In Prentiss County, is at surface only on lower slopes of creek branches in southeastern part of county. Thickness about 28 feet.

Type locality: A continuous series of roadcuts near middle of formation on Tuscaloosa-Columbus Highway (U.S. 82) in secs. 17 and 18, T. 19 S., R. 15 W., 1½ miles north of McShan, Pickens County, Ala.

McWain Sandstone Member (of Bond Formation)

McWain Sandstone (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

J. R. Ball, 1943, Illinois Acad, Sci. Trans., v. 36, no. 2, p. 151. Name applied to a channel sandstone about 10 feet thick in Carlinville quadrangle:

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 44–45, 89, 90, 91. Sandstone rests on upper strata of Macoupin cyclothem; it occupies normal position of basal sandstone of Shoal Creek cyclothem; however, similar material not observed elsewhere at base of Shoal Creek; hence, McWain is considered only a local sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Rank reduced to member status in Bond formation (new). Occurs above Shoal Creek limestone member and below Sorento limestone member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 25, T. 10 N., R. 7 W., Macoupin County. Named for occurrence on McWain Farms.

Macy Formation (in Plattin Group)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2058–2060. Named as uppermost formation in group. Fine-textured fucoidal calcite rock overlain by fossiliferous calcite rock with shaly partings and a widespread metabentonite near top. Thickness at type exposure 87 feet; approximately 125 feet thick in Perry County. Includes Hook member (new), at base, and Zell member (new). Underlies Decorah formation; overlies Hager formation (new).

Type exposure: Along Missouri Highway 25 in SE¼NE¼ sec. 27, T. 38 N., R. 8 E., 3 miles west of Macy, Ste. Genevieve County.

Maddox Limestone[1]

Silurian: West-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 565, 579.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 245. Foerste placed the Osgood and all of the Laurel exposed at Maddox Mill in Mad-

dox formation. This report, however, uses names Osgood and Laurel at Maddox Mill, as elsewhere.

Named for Maddox Mill, Hardin County.

Madera Diorite[1]

Madera Diorite and Granodiorite

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

E. D. Wilson, 1941, Arizona Bur. Mines Bull. 148, Geol. Ser. 14, p. 28, 29. Referred to as diorite and granodiorite. Intrudes Pinal schist.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ-41. Mapped as diorite in Globe quadrangle. Rock is gray medium-grained granodiorite, petrographically identical with Madera diorite of Pinal Mountain area.

Named for Mount Madera, one of the peaks of Pinal Range of which it occupies the crest; Globe quadrangle.

Madera Limestone[1] **or Formation** (in Magdalena Group)

Middle and Upper Pennsylvanian: Central and northern New Mexico and southern Colorado.

Original reference: C. R. Keyes, 1903, Ores and Metals, v. 12, p. 48.

M. L. Thompson, 1942, New Mexico Bur. Mines and Mineral Resources Bull. 17, p. 21–22. Keyes (1903) proposed name Madera for upper limestones of Pennsylvanian ("Upper Carboniferous") in region of Sandia Mountains. Keyes (1906, Jour, Geology, v. 14) used term Madera (Maderan) with reference to Permian limestones. Later workers have applied term Madera to different parts of the massive limestones of Pennsylvanian of central New Mexico, ranging in age from lower Des Moines series to upper Virgil series. Since term Madera was so poorly defined originally by Keyes and apparently used in so many different senses by Keyes and others, it is herein proposed that term Madera be dropped from Pennsylvanian nomenclature of New Mexico. Term Coyote sandstone member should be abandoned also.

C. B. Read and D. A. Andrews, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 8. In upper Pecos River and Rio Galisteo region, New Mexico, includes lower gray limestone member (0 to 700 feet) and arkosic member (0 to 1,300 feet). Overlies Sandia formation; underlies Sangre de Cristo formation.

C. B. Read and others, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map 21. In San Miguel, Santa Fe, Sandoval, Bernalillo, Torrance, and Valencia Counties, Madera limestone conformably overlies Sandia formation. Subdivided into lower gray limestone member and overlying arkosic limestone member. Lower member includes sequence of gray cherty limestones and calcareous shales and contrasts sharply with overlying member which consists of alternations of red or brown arkosic sandstones, arkosic limestones, and limestones that are chiefly light gray. Throughout much of area the contact between upper and lower members is gradational and there is much interfingering. Locally, there is an unconformity between the two members and at some places in the Sangre de Cristo Mountains the upper member overlaps the lower and rests directly on Precambrian basement rocks. Underlies red arkosic clastics of Permian(?) age. These strata are assigned to Abo formation in western part of area and to Sangre de Cristo in northeastern part of

area. At most places, contact of the Abo or Sangre de Cristo formations is gradational.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Divided into (ascending) Gray Mesa, Atrasado, and Red Tanks members in Lucero area. Thickness 1,600 to 2,000 feet. Underlies Abo formation; overlies Sandia formation.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Prelim. Map 61. Madera limestone, in La Joya area, Los Pinos Mountains, and northern Chupadera Mesa, divided into a lower gray limestone member and an upper arkosic limestone member. These units are approximately equivalent to Gray Mesa, Atrasado, and Red Tanks members of Lucero uplift. Lower member ranges in thickness from 80 feet in Joyita Hills to 830 feet in east-central Los Pinos Mountains. Upper member, not present in Joyita Hills, attains maximum thickness for area of 520 feet in southern Los Pinos Mountains. Overlies Sandia formation; underlies Permian Bursum formation (new).

R. L. Bates and others, 1947, New Mexico Bur. Mines and Mineral Resources Bull. 26, p. 17–20, 21–23, pl. 3. Term, as used in this report [Gran Quivira quadrangle], includes all strata between Sandia formation below and Bursum formation above. Divided into marine limestone member (665 feet) below and arkosic limestone member (437 feet) above.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 816–819, pl. 1. Geographically extended into Colorado. Includes Gray limestone member, arkosic limestone member, and Whiskey Creek Pass limestone member (new). Underlies Sangre de Cristo; overlies Clastic member of Sandia formation.

E. H. Baltz, Jr., and G. O. Bachman, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 99–100. Madera is Middle and Late Pennsylvanian (Atoka, Des Moines, and Missouri) in age in southeastern part of Sangre de Cristos; to the north, formation may be no younger than Des Moines in age because of lateral replacement of upper parts of arkosic limestone member by lower beds of Sangre de Cristo formation. Thickness 0 to 3,000 feet.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1904 (fig. 6), 1910–1918. In Sangre de Cristo Mountains between La Veta Pass and Westcliffe, Colo., about 3,068 feet thick. Divided into lower Gray limestone member, 533 feet thick; arkosic limestone member, 2,369 feet; and Whiskey Creek Pass limestone member, 166 feet. Overlies Deer Creek formation (new); at most places, underlies Sangre de Cristo formation; underlies Pass Creek sandstone (new). Grades northward into its equivalent, the Minturn. Name Madera replaces Hermosa and Rico formation as used by Goddard and Burbank (1937, Geol. Soc. America Bull., v. 48, no. 7) in south-central Colorado; at La Veta Pass, replaces Veta Pass limestone member of Sangre de Cristo conglomerate of Melton (1925).

Probably named either for the Madera area of Sandia Mountains or for village of La Madera, N. Mex.

†Madison Beds (in Richmond Group)[1]

Upper Ordovician: Indiana, north-central Kentucky, and southwestern Ohio.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 139.

Named for Madison, Jefferson County, Ind.

Madison Hornblendic Gneiss

Carboniferous(?), middle: South-central Connecticut.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 54, pl. 1. Described as hornblendic gneiss composed chiefly of oligoclase, biotite, quartz, and hornblende.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. and Nat. History Survey Bull. 86, p. 26. Replaced by term Haddam tonalite.

Mapped in towns of Madison, New Haven County, and Clinton, Middlesex County.

Madison Limestone,[1] Formation, or Group

Lower and Upper Mississippian: Montana, Colorado, Idaho, Wyoming, and Utah.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55. Madison limestone subdivided into (ascending) Paine shale, Woodhurst limestone, and Castle limestone. Overlies Monarch formation; underlies Quadrant formation. Thickness 1,300 feet. Carboniferous.

C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6. p. 45–48. Formation in northwestern Montana subdivided into (ascending) Silvertip conglomerate, Saypo limestone, Dean Lake chert, and Monitor Mountain limestone members.

H. W. Scott, 1935, Jour. Geology, v. 43, no. 8, pt. 2, p. 1023, 1030 (table 6). Name Big Snowy group applied to strata that occurs between Madison limestone and Amsden formation in central Montana.

C. C. Branson, 1937, Jour. Paleontology, v. 11, no. 8, p. 650–660. Madison limestone underlies Sacajawea formation (new) at type section of Sacajawea in Wind River Mountains, Wyo.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 305–335. Madison group in Montana comprises (ascending) Lodgepole limestone with Paine and Woodhurst members and Mission Canyon limestone. Overlies Three Forks formation; underlies Kibbey sandstone, Ellis formation, or Amsden formation. Lower Mississippian. Type section suggested.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 16–18, (fig. 5). Formation in Three Forks area, Montana conformably overlies Sappington sandstone (new). Underlies Amsden formation.

A. R. Glockzin and C. J. Roy, 1945, Geol. Soc. America Bull., v. 56, no. 8, p. 819–828. In Fremont County, Colo., basal beds of Fountain formation rest across truncated edges of Madison, Harding, and Manitou formations. Madison consists mainly of reddish-brown to cream-colored dolomitic limestone with local sandy facies. Maximum thickness 180 feet.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1141–1142. Madison limestone well represented along Logan Peak syncline, Utah, by about 850 feet of thin-bedded cherty, fossiliferous limestone, with minor shale member at base. Unconformably overlies Beirdneau sandstone member (new) of Jefferson formation; conformably underlies Brazer formation.

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p. 689 (table 1). Generalized columnar section of Green and Yampa River Canyons shows Lower Mississippian Madison

formation, 600 feet thick, unconformable above Lodore formation and separated from overlying Morgan formation by 185-foot unnamed interval of sandstone, conglomerate, and carbonaceous shale.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Lower part of beds previously called Madison limestone along Front Range of Colorado form lithologic unit bounded by two unconformities. This unit is herein named Hardscrabble limestone. Upper part of finely sandy and finely oolitic limestone beds of sequence previously called Madison in vicinity of Beulah are considered a formation in this report and named Beulah limestone.

M. E. Denson, Jr., and N. S. Morrisey, 1952, Wyoming Geol. Assoc. Guidebook 7th Ann. Field Conf., p. 37–43. As delimited in this report [Big Horn and Wind River basins, Wyoming], Madison group consists of continuous sequence of limestones and dolomites between overlying Amsden formation and underlying pre-Mississippian strata. Top of group is picked on basis of lithology and (or) erosional evidence at transition from calcareous to noncalcareous sediments. Base of Madison marked by unconformity which truncates beds ranging in age from Cambrian through Devonian. As delimited herein, group includes transitional strata of possible Meramec age. Comprises Lodgepole formation, Mission Canyon formation, and, locally between Mission Canyon and basal Darwin sandstone of Amsden formation, beds of unknown age designated "Upper Madison." Thickness of this unit varies from near 0 to 80 feet.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1723–1731. Madison limestone in northeastern Utah conformably overlies Leatham formation (new). Thickness 803 feet in Leatham Hollow, Logan, Utah, area. Underlies Brazer limestone.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 240, 241. Underlies Beaverhead formation (new), angular unconformity, near Armstead, Mont. At type section of Beaverhead, a plate of Madison limestone has been thrust over the Beaverhead.

A. B. Shaw and W. G. Bell, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 3, p. 333–337. New collections of fossils from lower part of Amsden formation at Cherry Creek, Wind River Mountains, Wyo., place Mississippian-Pennsylvanian boundary more than 48 feet and less than 63 feet above Madison limestone. Name Sacajawea formation rejected for Mississippian beds at Cherry Creek.

J. M. Andrichuk, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2170–2210. Discussion of Madison stratigraphy and sedimentation in Wyoming and southern Montana. Madison group includes entire Mississippian carbonate sequence. Group is divided into three units based on depositional environment as interpreted by lithic and faunal variations. Lower unit includes Lodgepole and lower part of Mission Canyon; middle unit includes part of Mission Canyon and lower part of Charles formation of Williston basin subsurface; upper unit includes upper part of Charles formation.

C. P. Abrassart and G. A. Clough, 1955, Intermountain Assoc. Petroleum Geologists Guidebook 6th Ann. Field Conf., p. 65, 70. In Juniper Mountain area, Colorado, Madison formation, about 270 feet thick, underlies Morgan formation and overlies Cambrian(?) beds. Mississippian-Pennsylvanian contact placed at base of lowest sandstone above thick series of limestone and dolomites of Madison formation.

V. R. Chamberlain, 1955, Billings Geol. Soc. Guidebook 6th Ann Field Conf., p. 78, 79. Group, as used in this report [Sweetgrass arch area], comprises (ascending) Exshaw-Bakken formation, Lodgepole formation, Mission Canyon formation, and Sun River dolomite (new). Sun River is considered equivalent to Charles formation.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 14–17. Name Madison limestone is preferred to name Gardner dolomite for rocks of Lower Mississippian age in East Tintic Mountains inasmuch as Gardner dolomite, as originally defined by Loughlin (1919), erroneously included some beds of Late Devonian age, and name was essentially restricted in its usage to East Tintic Mountains. Subdivided into two unnamed members. Lower member, 250 to about 350 feet thick, consists of eight distinctive lithologic units that are persistent throughout area; upper member, 450 to 550 feet thick, consists of two units. Overlies Pinyon Peak limestone; underlies Deseret limestone. Term Madison will be used as group name to include two new formations in report currently being prepared. Names have not been officially adopted by U.S. Geological Survey, hence are not used in present report.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 38. Alexander (1951, unpub. thesis) extended name Livingston formation into Whitehall area, and in formation there included more than 9,600 feet of andesitic flows and tuffs that are continuous with Elkhorn Mountains volcanics (new) of this report [southern Elkhorn Mountains, Jefferson and Broadwater Counties, Mont.]. These, he says, are unconformable on folded and truncated Madison formation. These volcanic rocks in Whitehall area are assigned to Elkhorn Mountain volcanics.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 40. Discussion of geology of Stansbury Mountains, Tooele County. Mississippian nomenclature is currently in state of flux. Recent work by U.S. Geological Survey in Tintic district has revised nomenclature there, but names have not been officially proposed. Because of this situation, nomenclature used in present report follows that established earlier, modified by Lovering and others (1949, Econ. Geology Mon. 1), for some units recognized within Stansbury Mountains are named only in Tintic district, even though some of these names are now being modified. In present report, term Gardner dolomite is used with two member subdivisions, in practically the same sense as applied by Lovering and others (1949) and includes all of Madison group of Morris (1957) except the upper cherty beds, herein mapped separately as basal unit of Pine Canyon formation.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 17–20, pls. Madison limestone, in Buffalo-Lake De Smet area, north-central Wyoming, overlies Bighorn dolomite and unconformably underlies Amsden formation. Consists of light-gray limestone, dolomitic limestone, and dolomite. Thickness 665 feet. Lower Mississippian.

W. J. Sando, J. T. Dutro, Jr., and W. C. Gere, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2746. Area of report is Randolph quadrangle, Utah. Limestones underlying Brazer dolomite, mapped as Madison limestone by Richardson (1913, Am. Jour. Sci., 4th, v. 36, p. 406–416) are herein assigned to Lodgepole limestone of Madison group.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 37–38, 41, 43, 45. Discussion of geology of southern Oquirrh Mountains and Fivemile Pass-Northern Boulter Mountain area, Tooele and Utah Counties. Gilluly

(1932, U.S. Geol. Survey Prof. Paper 173) used name Madison limestone for Lower Mississippian strata of Oquirrh Mountains. Total thickness of 462 feet of gray fossiliferous and in part cherty limestone was assigned to the Madison; an extensive faunal list provided by Girty evidently provided part of basis for using name Madison limestone. In Stansbury Mountains to west of Oquirrh Mountains, Rigby (1958) used name Madison group and referred Gardner dolomite to the lower formation and the overlying cherty unit of the Pine Canyon to upper part of group. Madison group at type locality and in many areas of outcrop in Montana contains distinct mappable lithologic formations. There the group consists of Lodgepole limestone, Mission Canyon limestone, and Charles formation. It seems unwise, however, to attempt to apply name Madison limestone to quite dissimilar lithic units in central Utah just because some faunal elements are common in both regions. Only a few beds of upper Gardner bear superficial resemblance to some strata of Lodgepole formation. It is believed that name Madison group (or formation) should be restricted to areal extent of typical Madison lithology. In present report, lower half of Gilluly's Madison is allocated to upper member of Gardner formation, and some upper strata of what Gilluly mapped as Madison are included in lower part of Pine Canyon limestone and, in reality, comprise its lower member.

W. J. Sando and Thomas Dutro, Jr., 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 117–126. Group at type section comprises Lodgepole limestone, 733 feet, and Mission Canyon limestone, 1,050 feet. The Lodgepole is believed to include both the "Laminated limestones" and "Massive limestones" of Peale (1893), a different interpretation from that of Holland (1952) and Strickland (1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf.). Intervals assigned to Paine and Woodhurst members of Sloss and Hamblin (1942) were identified in the section, but units are not recognized in present report because of difficulty in placing boundary between them in other sections studied. Preliminary studies of Mission Canyon faunas supported the possibility that beds of Meramec age are present. Writers [Sando and Dutro] agree with Andrichuk and Strickland that entire Mississippian carbonate sequence below Amsden in western Wyoming can be assigned to Madison group. However, Andrichuk's subdivisions of group rejected because they are not defined according to rules of stratigraphic nomenclature. Strickland's restriction of Mission Canyon and recognition of an "Upper Madison" unit of formational rank rejected. Strickland seems to have differentiated his "Upper Madison" from Mission Canyon mainly on basis that rocks allocated to "Upper Madison" are supposed to be separated from Mission Canyon by major unconformity. This apparently led Strickland to conclude that "Upper Madison" is of Meramec age. This concept of major unconformity separating Meramec from older rocks in Cordilleran region was originally suggested by Laudon (1948, Jour. Geology, v. 56, no. 4). Authors [Sando and Dutro] found no convincing evidence of major unconformity within Madison in western Wyoming or southwestern Montana. Breccias occur a hundred feet or more below top of group at many localities, but they are interpreted as collapse features and cave fillings related to extensive development of karst topography on top of Madison. Laudon's ideas concerning nature and significance of Meramec boundary have not been widely accepted. Although there is faunal evidence for Meramec equivalents in upper part

of Madison group, general rarity of fossils in this part of sequence makes it difficult to place Osage-Meramec boundary at most localities. Mission Canyon undoubtedly contains some beds younger than those present in its type section in central Montana, but this does not necessitate recognition of separate unit in uppermost Madison. If future work should support further subdivision of upper part of Madison, it is herein suggested that such new units should be recognized as member of Mission Canyon, rather than as separate formations. Coral zonation discussed.

Type section (Sloss and Hamblin): Exposed along Gallatin River at Logan, Mont. Named for Madison Range, central part of Three Forks quadrangle, Montana.

†Madison Sand (in Vicksburg Group)[1]

Oligocene, lower: Southwestern Mississippi.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 82.

Named for exposures near Madison and for Madison County.

Madison Sandstone[1]

Upper Cambrian: Southern Wisconsin.

Original reference: R. D. Irving, 1875, Am. Jour. Sci., 3d, v. 9, p. 442.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 44, p. 150. Sunset Point formation proposed to replace term Madison; application of term Madison to these strata has created confusion owing to widespread use of same name for Mississippian limestone in Montana and Wyoming.

Type locality: At Madison, Dane County.

†Madison Water Limestone (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana.

Original reference: D. D. Owen, 1859, Rept. geol. reconn. Indiana made in 1837, p. 28.

Named for Madison, Jefferson County.

Madisonic period[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46, p. 203.

Madison Valley Beds[1]

Madison Valley Formation

Miocene, upper: Central southern Montana.

Original reference: E. Douglass, 1903, Carnegie Mus. Annals, v. 2, p. 151–155.

H. E. Wood 2d, and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 25, pl. 1. Referred to as formation. Barstovian.

J. A. Dorr, Jr., 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1245. Formation is fluviatile deposit with occasional lacustrine lenses. Type locality mentioned. Very late Miocene (late Barstovian).

J. A. Dorr, Jr., 1956, Jour. Paleontology, v. 30, no. 1, p. 62–74. In past Madison Valley formation (Douglass, 1907, Carnegie Mus. Annals, v. 4, no. 2) has been variously called Bozeman lake beds, Loup Fork, Madison Valley beds, and Bozeman formation. It underlies and is locally exposed on high bench that declines gently eastward from eastern bluffs to Gallatin River valley. A fluviatile deposit with rare lacustrine lenses, the

Madison Valley formation overlies Miocene *Leuciscus turncri* lake beds (H. E. Wood 2d, 1941). Late Miocene mammals have been collected from formation from exposures in river bluffs, but localities and stratigraphic levels from which many came remain uncertain or are inexactly recorded. New collections from a gray volcanic ash channel fill in formation southeast of type locality have yielded faunule here named Ancency local fauna. Fossil horizon probably correlates with beds in upper quarter of type section. Latest Miocene.

Type locality: Eastern bluffs of lower Madison River valley south of Three Forks, Gallatin County.

Madisonville Limestone Member (of Lisman Formation)

Madisonville Limestone (in McLeansboro Formation)[1]

Upper Pennsylvanian: Western Kentucky.

Original reference: C. J. Norwood, 1878, Kentucky Geol. Survey, new ser., v. 4, p. 319–320.

E. J. Harvey, 1956, U.S. Geol. Survey Water-Supply Paper 1356, p. 64. Reallocated to member status in Lisman formation. In Henderson area is youngest member of formation; overlies Anvil Rock sandstone member.

Named for Madisonville, Hopkins County.

Madras Formation[1]

Pliocene: Central northern Oregon.

Original reference: E. T. Hodge, 1927, Geol. Soc. America Bull., v. 38, p. 163.

E. T. Hodge, 1940, Oregon State Coll. Studies in Geology Mon. 1 [map with text]. Conformably underlies Cascan formation; overlies Columbia River basalt. Upper Pliocene.

Howel Williams, 1957, Geologic map of the Bend quadrangle, Oregon, and a reconnaissance geologic map of the central portion of the high Cascade Mountains (1:125,000): Oregon Dept. Geology and Mineral Industries in cooperation with U.S. Geol. Survey. Pliocene and Pleistocene.

U.S. Geological Survey currently designates the age of the Madras as Pliocene on the basis of a study now in progress.

Formation exposed in vicinity of Madras, Jefferson County.

Madrid Formation

Age not stated: West-central Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Composed predominantly of calcareous quartzite with lime-silicate minerals in middle grade metamorphic zones. Contains only minor amounts of argillaceous rocks and calcareous beds; sulfides absent or inconspicuous. Quartzites grade upward into Dyer Hill member (new). Younger than Parmachenee formation (new).

I. E. Furlong, 1960, Dissert. Abs., v. 21, no. 4, p. 848. In Farmington quadrangle overlies Smalls Falls formation (new).

Present in Anson and Farmington quadrangles.

†Madrid Formation[1]

Upper Cretaceous: Central northern New Mexico.

Original reference: D. W. Johnson, 1903, School Mines Quart., v. 24, p. 338.

In Cerrillos Hills, Santa Fe County. Named for Madrid.

Madson Basalt[1] (in Snake River Group)

Pleistocene, upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30, 72–74, pl. 4. Thickness about 200 feet. Older than Malad basalt. Stratigraphically above Hagerman lake beds. Underlies McKinney basalt. Derivation of name.

U.S. Geological Survey currently classifies the Madson Basalt as a formation in Snake River Group on basis of study now in progress.

Named after Madson Spring, which issues from alluvium some distance below outcrops of basalt. Crops out directly above talus and beneath basalts in east wall of Snake River Canyon near Steele Springs, half a mile downstream from mouth of Big Wood River, Gooding County.

Magdalena Group[1]

Magdalena Limestone

Pennsylvanian and Permian; New Mexico and western Texas.

Original reference: C. H. Gordon, 1907, Jour. Geology, v. 15, p. 807–816.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 157–172. At Silver City, N. Mex., Magdalena formation [group] is divided into two formations, Oswaldo below, about 400 feet thick, and Syrena above, about 400 feet thick; unconformably overlies Lake Valley limestone. In northern end of Oscura Mountains, the Magdalena rests on Precambrian granite, and is about 1,000 feet thick. Increases northward to Taos region to about 3,000 feet. Southward from Oscura Mountains, in regions of San Andres and Organ Mountains, has thickness of about 3,000 feet and is composed almost entirely of limestone. In San Andres and northern end of Organ Mountains, overlies Lake Valley limestone; in southern end of Organ Mountains, apparently overlies Fusselman limestone. In Sacramento Mountains, overlies Lake Valley limestone. In Hueco and Franklin Mountains disconformable above the Helms. In Franklin Mountains, formation consists of (ascending) La Tuna, Berino, and Bishops Cap members. Underlies Abo sandstone.

G. F. Loughlin and A. H. Koschmann, 1942, U.S. Geol. Survey Prof. Paper 200, p. 16, 19–20, pls. 2, 8, 31. Group, in Magdalena mining district, New Mexico, comprises (ascending) Sandia formation and Madera limestone. Thickness about 850 feet. Overlies Kelly limestone; underlies Abo limestone.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 22–23. Presentation of new classification of Pennsylvanian in New Mexico. Term Magdalena seems to be essentially synonymous with systemic term Pennsylvanian. Term Magdalena not used in nomenclature of Pennsylvanian rocks in this report. Terms Oswaldo, Syrena, La Tuna, Berino, Bishops Cap, Madera, and Coyote sandstone are not used in this report. Term Sandia retained.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 674–677, 687. Northwest of Delaware basin, later Paleozoic rocks are divided into Magdalena and Manzano groups. Magdalena is marine deposit, containing many limestone beds, and is generally classed as Pennsylvanian.

Basal formation of Manzano is Abo sandstone. In previous reports, the Abo was considered approximately equivalent to Wolfcamp series, and supposed unconformity at its base was supposed to be same as that at base of Wolfcamp. It is herein suggested that Abo is mostly or wholly post-Wolfcamp and that equivalent of Wolfcamp series lies in upper part of Magdalena group as at present defined and mapped. In Sacramento, San Andres, and other mountains of New Mexico, the usual limestones and other marine sediments of Magdalena group pass upward into several hundred feet of interbedded limestones, red and gray shales, sandstones, and arkosic conglomerates. The limestones contain fusulinids and other invertebrates, and the shales contain fossil plants. This unit forms upper part of Magdalena group and no doubt will be classed as separate formation when further work is done. Future work may indicate desirability of shifting unit from Magdalena to Manzano group. Evidence suggests that upper unit of Magdalena group, as now defined, is traceable southward into Hueco limestone of Wolfcamp series.

R. E. King, 1945, New Mexico Bur. Mines Mineral Resources Bull. 23, p. 21. Thompson (1942) did not use term Magdalena in his Pennsylvanian classification. King (1942) referred to Hueco equivalent in mountains of southern New Mexico as "upper part of Magdalena group." He suggested that "future work would no doubt indicate desirability of shifting the unit to the Manzano group" (Abo, Yeso, and San Andres). Such change has not been made and name Magdalena has become more entrenched in recent geologic literature of U.S. Geological Survey, in which the Hueco is continued to be classed as Magdalena. Names Pennsylvanian and Hueco are fully adequate for designation of these strata. It is herein recommended that term Magdalena be permanently abandoned.

R. L. Bates and others, 1947, New Mexico Bur. Mines Mineral Resources Bull. 26, p. 17. On grounds of redundancy in stratigraphic nomenclature, New Mexico Bureau of Mines and Mineral Resources no longer uses term Magdalena.

C. B. Read and G. H. Wood, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 220–236. Term Magdalena group is applied to all marine beds between Mississippian below and Permian nonmarine Abo above. This usage is in rather close agreement with earlier definitions of the term. Upper limit of Magdalena group, as term is used here, is not a time line but represents limit of marine sedimentation in area.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. in Geology, no. 4, p. 88–97. In Caballo Mountains, Magdalena group is divided into (ascending) Red House, Nakaye, and Bar B formations (all new). Thickness 1,120 to 1,700 feet. Overlies Cutter formation, Upham dolomite, Cable Canyon sandstone, Percha formation, or Nunn member of Lake Valley limestone. Underlies Abo formation. Thompson's (1942) Pennsylvanian terminology rejected in this report.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Composite columnar section, Sacramento Mountains, shows Magdalena group comprises (ascending) Gobbler (new), Beeman (new), Holder (new), and Bursum formations. Bursum is Permian. Overlies Helms formation; underlies Abo formation.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 21–23, 34 (fig. 3). In Cooks Range, Lake Valley quadrangle, a section of 182 feet of Pennsylvanian sediments is referred to Magdalena group.

Unconformably overlies Lake Valley formation; unconformably underlies Lobo formation.

Named for exposures in Magdalena Mountains, Socorro County, N. Mex.

Magenta Member (of Rustler Formation)

Permian (Ochoa): New Mexico.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1600 (fig. 2), 1614. Name applied to a 30-foot gypsiferous dolomite about 30 feet below top formation. About 150 feet above a 35-foot bed of dolomite termed Culebra member. Name suggested by W. B. Lang, who (1938, New Mexico State Engineer 12th and 13th Bienn. Rept.) measured the section and divided Rustler into 11 units; unit No. 2 in this sequence (descending) is Magenta.

Occurs east of Pecos River, in central Eddy County.

Magnolia Member (of Platteville Limestone)[1]

Middle Ordovician: Southwestern Wisconsin, northwestern Illinois, northeastern Iowa, and southeastern Minnesota.

Original reference: C. A. Bays and G. O. Raasch, 1935, Kansas Geol. Soc. 9th Ann. Field Conf. Guidebook, p. 297–300.

C. A. Bays, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 269. Overlies Mifflin member (new).

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 58 (table 1), 60, 61–62. Rocks of McGregor member have at some times and places been classified as the Magnolia and Mifflin members of the Platteville (Bays and Raasch, 1935; Bays, 1938). In region south from Rochester, Minn., to McGregor, Iowa, there is virtually no evidence of Magnolia and Mifflin members. However, in Twin City area, where interval is somewhat dolomitic, Majewske (1953, unpub. ms.) has shown that what in the past has been lumped together as the McGregor is the Mifflin and Magnolia separated by hitherto unnamed member, Hidden Falls. McGregor is used where special characteristics of Mifflin, Hidden Falls, or Magnolia are absent or insufficiently distinct. From the Twin Cities, where it is about 8 feet thick, the Magnolia member extends eastward into Wisconsin and is 11 feet thick at River Falls. Member wedges out southward from Twin Cities, perhaps partly by gradation into lower Carimona member, and is not present at Cannon Falls and Fairbault.

Type exposure: On or near Highways 13 and 14, 1 mile south of Magnolia, in NW¼ sec. 26, T. 3 N., R. 10 E., Rock County, Wis.

Magoffin Beds[1]

Magoffin Limestone (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 301.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 94; R. C. Moore and others, 1944, Geol. Soc. America Bull. 55, no. 6, chart 6 (columns 21, 22, 23). Marine shale with large concretions of limestone in Breathitt formation.

Well exposed in Breathitt County. Can be traced through Knott and Breathitt Counties to North Fork of Kentucky River at Coplan.

Magog Conglomerate[1]

Lower Ordovician: Northeastern Vermont, and Quebec, Canada.

Original reference: J. A. Dresser, 1925, Royal Soc. Canada Proc. and Trans., 3d ser., v. 19, sec. 4, p. 116.

Magothy Formation[1]

Upper Cretaceous: Maryland, Delaware, New Jersey, Long Island and other islands of New England Coast.

Original reference: N. H. Darton, 1893, Am. Jour. Sci., 3d, v. 45, p. 407–419.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 248–250. Described along Chesapeake and Delaware Canal. Lowermost member is fine yellow iron-stained to buff micaceous compact sand containing variable proportions of clay of same color, plus additional small patches or lenses of black sticky clay; comprises more than half the thickness of formation. Middle member consists of white sand and clay. Upper member is black clay. Maximum thickness about 34 feet. Overlies Raritan formation; underlies Crosswicks clay of Matawan group.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 21–23, 27. Unconformably overlies Raritan in New Jersey. In outcrop reaches thickness of 150 feet at Raritan Bay and thins southwest where, in southern part of state, it is 25 feet thick. Maximum width in outcrop 4 miles. Underlies Merchantville member of Matawan formation. Southernmost exposures are near District of Columbia. Well exposed along Severn River in Maryland and along Chesapeake and Delaware Canal in Delaware. Thickness varies from about 25 feet along Delaware River to 15 feet in Prince Georges County, Md. Rests with disconformity on "Raritan" formation.

Gerald Meyer, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 98–99. Formation in Prince Georges County, consists essentially of light-gray crossbedded coarse sand containing small amount of glauconite and pyrite; particles of carbonaceous matter or lignite common throughout formation. In and near outcrop, thickness ranges from nearly nothing to about 60 feet. Farther down dip, it is at least 49 feet thick, and, so far as is known from well logs, it is nowhere absent. Overlapped by Monmouth formation.

Well exposed on Magothy River, Anne Arundel County, Md.

Magpie Dolomite Member (of Blaine Gypsum)[1]

Permian: Western Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bien. Rept., p. 42, 48.

Named for permanent camp of an Arapahoe chief of that name on Bitter Creek, Blaine County.

Mahala Sandstone and Conglomerate (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as overlying Peculiar shale (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Coarse conglomerate with minor sandstone and sandy shale; perhaps in part Pliocene. Thickness 30 to more than 115 feet. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon, in the southeastern Puente Hills, between Chino and Santa Ana River, San Bernardino County.

Mahan Formation

Middle Ordovician (Mohawkian): Southeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 76, chart 1 (facing p. 130). Name proposed for 200 feet of ribbon-banded to thick-bedded dove-gray calcilutite, lower half of which is characteristically studded with plates and nodules of black chert. Upper part is even-bedded calcilutite with numerous shaly interbeds. Overlies Long Savannah formation (new). Top defined at type locality by a red mudstone, one of several red intercalations in a thick succession of ribbon-banded limestones. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along Mahan Road, Snow Hill (TVA 112-NE) quadrangle, about 1,900 feet west-northwest of intersection with Tennessee Highway 60, Hamilton County.

Mahanoy Black Shale Member[1] (of Marcellus Formation)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Pal. Soc. Feb. 28, p. 202–203.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 173–174. Usually lithologically indistinguishable from Shamokin black shale member below unless intervening sandy members are present.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 4, 27. In Juniata, Mifflin, and Perry Counties the Marcellus is subdivided into (ascending) Shamokin shale, Turkey Ridge sandstone, and Mahanoy shale.

Named for Mahanoy Township, southwestern Northumberland County.

Mahantango Formation[1] (in Hamilton Group)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Pal. Soc., Feb. 28, p. 202, 205–223.

Bradford Willard, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 196, p. 274, 275, 276 (table 2). Formation is dominated by coarse sandstone, the Montebello member, in lower Susquehanna and Juniata Valleys.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 133–134, 176–194. Designation of Mahantango formation is retained for beds of Hamilton group above Marcellus formation in Pennsylvania even where the equivalents of the Moscow, Ludlowville, and Skaneateles formations of New York are more or less clearly recognized. Hence, Hamilton group of Pennsylvania has two formations: Mahantango above and Marcellus below; these in turn are locally analyzed into lesser units or facies; thus, Mahantango includes Skaneateles, Ludlowville, and Moscow facies.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3–4. Formation embraces that part of Hamilton group above Marcellus formation and below Susquehanna group. Correlative with Montebello and Sherman Ridge (new) formations in east-central Pennsylvania. Consists principally of greenish-gray thin- to medium-bedded slightly carbonaceous shale. Sporadic sandstone zones appear through-

out area and thicken eastward. In east-central Pennsylvania, the sandstones are well developed and form Montebello formation which overlies Marcellus.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Contains "Centerfield coral bed" in eastern Pennsylvania.

T. M. Kehn, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2018. Geologic mapping has revealed that, contrary to previously published reports and maps, there are two outcrop belts of Oriskany, Onondaga, and Marcellus formations between Schuylkill and Susquehanna Rivers. Mapped area is bounded on north by Second Mountain and on south by Blue Mountain. Marcellus is overlain by Montebello sandstone member of Mahantango formation, a buff to light-gray-brown coarse locally conglomeratic quartzitic sandstone about 800 feet thick at the Susquehanna and about 20 feet thick at the Schuylkill.

Named for exposures in valley, North Branch of Mahantango Creek, Snyder County.

Mahaska till[1]

Mahaskan glacial epoch[1]

Pleistocene: Iowa.

Original references: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 145; 1932, Pan-Am. Geologist, v. 58, p. 203.

Mahogany Member (of Ankareh Formation)

Lower Triassic: Northeastern Utah and western Wyoming.

Bernhard Kummel, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., fig. 1 facing p. 48; 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 17), 178 (fig. 21), 180. Name applied to red strata between the Gartra grit member above and Thaynes formation below. Interfingers with Thaynes. In Wasatch and Uinta Mountains.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 104. Kummel (1953) divided Ankareh formation into Mahogany, Gartra grit, and Stanaker members. All of these members are mappable units and deserve formational rather than member rank. "Mahogany" is an unnecessary synonym of Boutwell's Ankareh or at least Williams (1945) Ankareh (restricted).

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300. Lower Triassic. Extended into Wyoming.

Named after Mahogany Hill, north of Weber River, T. 1 S., R. 6 E., Summit County, Utah.

Mahomet Beds[1]

Pleistocene: Central eastern Illinois.

Original reference: E. J. Cable, 1921, Some phases of the Pleistocene of Iowa: Cedar Falls, Iowa, Wolverton Bros., p. 59.

Leland Horberg, 1953, Illinois Geol. Survey Rept. Inv. 165, p. 18 (footnote). Not same as Mahomet sand (Horberg, 1946). Cable's usage of "Mahomet beds" does not imply formal stratigraphic usage.

Located near Mahomet, Champaign County.

Mahomet Sand

Pleistocene (pre-Wisconsin): Northeastern Illinois (subsurface).

Leland Horberg, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1204. A fill of gravel and sand within the Mahomet (? Teays) bedrock valley.

Leland Horberg, 1953, Illinois Geol. Survey Rept. Inv. 165, p. 18–19. Defined as oldest deposit which underlies glacial till or clearly related outwash along Mahomet bedrock valley; known only from subsurface; well samples indicate deposit consists of sand and gravel in roughly equal proportions and is composed of a wide variety of rocks and minerals, dominantly of sedimentary origin. Not to be confused with "Mahomet beds" of Farmdale age exposed near same locality and referred to by Cable (1921); Cable's reference does not imply formal stratigraphic usage.

Named from village of Mahomet, Champaign County, where a number of borings penetrate the deposit and samples are available for its full thickness down to bedrock.

Mahoning Clay

Mahoning Fire Clay (in Conemaugh Formation)[1]

Pennsylvanian (Conemaugh Series): Northern West Virginia, western Maryland, and western Pennsylvania.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 309.

R. E. Lamborn, 1942, Ohio Geol. Survey, 4th ser., Bull. 43, p. 9, 23. A clay (in Conemaugh series) underlying Mahoning coal is referred to as Mahoning or Thornton clay.

First mentioned in Monongalia County, W. Va.

Mahoning cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 12. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 57–60, table 1, geol. map. Includes (ascending) Lower Mahoning shale and (or) sandstone, 35 feet; Mahoning limestone, 6 inches to 18 feet; Thornton clay, as much as 17 feet; and Mahoning coal. Occurs below Mason cyclothem and above Upper Freeport cyclothem of Allegheny series. In this report [Perry County] the Conemaugh series is described on cyclothemic basis; seven cyclothems are named (ascending): Mahoning, Mason, Brush Creek, Wilgus, Anderson, Barton, and Harlem; about one-half of the strata of the series are present in county.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94–95 (table 11), 97–102. Comprises (ascending) Lower Mahoning sandstone, Lower Mahoning redbed, Lower Mahoning limestone, Thornton (Mahoning) underclay, and Lower Mahoning coal members. In this report [Athens County], Conemaugh series is described on cyclothemic basis; 15 cyclothems are named (ascending): Mahoning, Mason, Lower Brush Creek, Upper Brush Creek, Wilgus, Anderson, Upper Bakerstown, Harlem, Ames, Gaysport, Duquesne, Elk Lick, Little Clarksburg, Lower Little Pittsburgh, and Upper Little Pittsburgh.

Named derived from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Mahoning Formation[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: G. H. Ashley, 1926, Pennsylvania Topog. and Geol. Atlas 65, p. 25–26, pl. 4.

Punxsutawney quadrangle.

Mahoning Limestone (in Conemaugh Formation)[1]

Mahoning limestone member

Pennsylvanian (Conemaugh Series): Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 477, 489.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 57, 59–60, table 1. Included in Mahoning cyclothem in Perry County. Thickness 6 inches to 18 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 27–28. Term Mahoning limestone was originally applied to a limestone in the Pottsville series by Rogers (1858). I. C. White (1879, Pennsylvania 2d Geol. Survey Rept. Q) renamed this lower Pennsylvanian bed the Upper Mercer limestone. White (1891, U.S. Geol. Survey Bull. 65) reapplied term Mahoning to limestone overlying lower part of massive Mahoning sandstone of Pennslyvania. Thus, in Ohio, Mahoning limestone member (Conemaugh series) is the limestone overlying Lower Mahoning sandstone and shale member; underlies Thornton clay. Poorly exposed in Morgan County.

Named from Mahoning River, Lawrence County, Pa.

Mahoning Red Bed (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 57; pl. 6.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 100–101, 106. Lower Mahoning redbed member included in Mahoning cyclothem. Upper Mahoning redbed member included in Mason cyclothem. Area of report is Athens County.

Name Mahoning taken from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Mahoning Sandstone Member (of Conemaugh Formation)[1]

Mahoning Sandstone (in Conemaugh Group)

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, western Virginia, and West Virginia.

Original reference: J. P. Lesley, 1856, Manual of Coal, p. 94, 97–98.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 97, 98, 104. Name Mahoning was first used in geologic literature by Lesley (1856) and has been applied primarily to sandstones lying between Upper Freeport (No. 7) coal and Lower Brush Creek limestone. Two Mahoning sandstones are commonly present, known as Upper and Lower Mahoning

sandstones. In present report, Lower Mahoning sandstone is included in Mahoning cyclothem, and Upper Mahoning sandstone is included in Mason cyclothem.

Carlyle Gray, and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in Conemaugh formation.

Name taken from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Mahopac granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1919, New York State Mus. Bulls. 225–226, p. 54–56.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 143. In place of Canada Hill, Reservoir, and Mahopac granites described by Berkey and Rice (1919), term Canada Hill granite phase of Hudson Highlands complex is used to include all rocks representative of granitic igneous activity in the Hudson Highlands after the Pochuck diorite phase and earlier than the Storm King granite intrusion.

Type locality: Along road running from Kent Cliffs to Mahopac mines, especially on fault scarp north of mines, in Putnam County.

Main Street Limestone (in Washita Group)

Main Street Formation (in Washita Group)

Main Street Limestone Member (of Denison Formation)[1]

Main Street Limestone Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Central and southern Oklahoma and central and northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 302, 303, 317, 328–331.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Chart shows Main Street limestone in Washita group; occurs below Grayson shale and above Pawpaw formation. Lower Cretaceous. [Denison formation abandoned.]

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 29, table 4. Foraminifera of Main Street formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Trip, p. 88, 93. In central Texas, considered uppermost member of Georgetown limestone. Approximately 25 feet thick in north-central Texas, thickens to 50 feet in Johnson and Tarrant Counties, thins southward to about 35 feet in McLennan County. Overlies Pawpaw shale member; underlies Del Rio clay. Predominantly nodular limestone with interbedded thin shales.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 34 (fig. 14), 35, 36 (fig. 15). Member of Denison formation. In Tarrant County, Tex., member is composed chiefly of alternating thickly bedded marly limestone and thin marl and marly clay beds. Thickens southward from about 20 feet to more than 40 feet at southern border of county. Overlies Pawpaw shale member; underlies Grayson marl member.

Named for occurrence on East Main Street, Denison, Grayson County, Tex.

Maitlen Phyllite

Lower or Middle Cambrian: Northeastern Washington.

C. F. Park, Jr., 1938, Econ. Geology, v. 33, no. 7, p. 713 (chart), 714 (fig. 2). Named on map and stratigraphic chart. Thickness about 5,000 feet. Underlies Metaline limestone and overlies Gypsy quartzite (both new).

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 15–17, pl. 1. Described as greenish gray, fine grained, and conspicuously banded; includes beds of limestone near top and platy quartzite near base. Gradational into Gypsy quartzite, contact placed at top of a prominent bed rich in fucoidal impressions where quartzite becomes subordinate in quantity to phyllite; underlies Metaline limestone, contact gradational Derivation of name given.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 606–608, 611, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for the Metaline quadrangle. The new names replace those given by Weaver (1920). Correlative with the Maitlen phyllite are parts of Weaver's Northport limestone, Boundary argillite, Deep Lake argillite, and all of the Cedar Creek argillite.

R. G. Yates and J. F. Robertson, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MS–137. Mapped in Leadpoint quadrangle, Stevens County. Consists of quartzite, schist, and phyllite. Underlies Metaline formation. Cambrian.

Named from valley of intermittently flowing Maitlen Creek, east of Ione, Pend Oreille County.

Majagua Formation

Oligocene, middle: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, pt. 4a, no. 29, p. 134 (correlation chart). Name appears on chart. Above David formation. Middle Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 338. Undefined name. Oligocene(?).

In Chiriquí Province. Río Majagua (presumed source of name) is one of numerous streams flowing southward from Volcan de Chiriquí, a tributary of Río David.

Makaino Basaltic Andesite (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 246–247, pl. 1. Nonporphyritic aa with poorly to moderately well-defined fluidal structure. Buried by Mossman picritic basalt, but erosion has reexposed it in small windows. Maximum exposed thickness 125 feet. Each member in series is unconformably underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 111. Pleistocene(?).

Named for exposures along Makaino stream. A single flow which filled a small gulch, east of present Hanawi Gulch, formed by erosion after extrusion of Waiaako lava.

Makalapa Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 111. Subaerial gray tuff, about 300 feet thick. Overlies Aliamanu tuff and Fort Shafter gravels; contemporary with Salt Lake tuff.

Named for Makalapa Crater, the vent from which it issued.

Makanaka Drift and Glaciation

Pleistocene: Hawaii Island, Hawaii.

C. K. Wentworth and W. E. Powers, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1942; 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1206–1207. Four stages of glaciation, presumably correlative with Ice Age elsewhere, occurred on Mauna Kea. These are (beginning with latest) Makanaka, Waihu, Pohakuloa, and pre-Pohakuloa stages.

H. T. Stearns, 1945, Geol. Soc. America Bull., v. 56, no. 3, p. 269–270. Of glacial stages and deposits described by Wentworth and Powers, only Makanaka can be accepted as definitely glacial. Makanaka deposits consist of outwash and drift.

Drift well exposed at 10,000 feet in amphitheater head of Pohakuloa Gulch. Fans of unconsolidated material lie at mouths of Waikahalulu and Pohakuloa Gulches on plain at 6,500 feet.

Makanda Sandstone Member (of Caseyville Formation)

Makanda Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: S. St. Clair, 1917, Illinois Geol. Survey Bull. 35, p. 48, pl. 4.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 35, 94. Reallocated to member status in Caseyville formation. Upper sandstone of the formation.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 30. Discontinued. Pounds sandstone member of Caseyville formation (redefined) extended in area to include strata formerly considered to be lower part of Makanda.

Named for town of Makanda, Jackson County.

Makapipi Basalts (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 231 (table), 241–243, pl. 1. A group of lavas stratigraphically between Big Falls picritic basalts (new) and Waiaaka basaltic andesite (new). Several separate lava flows present; surfaces of individual lavas marked by thin layers of red soil but show little evidence of erosion. Lavas are fine-grained olivine basalts tending toward basaltic andesites. Both pahoehoe and aa present with aa predominant. Some clinkers present. Average thickness about 75 feet; greatest measured thickness, 155 feet in test hole 27.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 112–113. Pleistocene(?).

Named for exposures along Makapipi Gulch. Well exposed along Hanaui Gulch from Waiaaka Stream to Hanawi Spring no. 1. Between Waiaaka and Waiohue Stream, lavas fill valley cut into Kula and Honomanu lavas.

Makasin Hill zone (in Negaunee Formation)[1]

Precambrian (middle Huronian): Northern Michigan.

Original reference: J. L. Adler, 1935, Jour. Geology, v. 43, no. 2, p. 113–132.

Type area: Makasin Hills, Marquette County.

Makawao Breccia[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 113. Dark-gray well-cemented generally unbedded breccia containing numerous blocks of Koolau lavas, some of which are more than 3 feet in diameter; elsewhere fine-grained laminated brown tuff. Thickness of breccia phase more than 200 feet. Breccia believed to fill vent blasted through Koolau volcanic series; tuff intercalated in alluvium underlying Ainoni volcanics. Extent noted.

Named for Makawao Stream in which, at 600 feet altitude, two beds of tuffaceous phase are exposed; typical breccia well exposed in Maunawili Ranch about 1¾ miles south and a little west of Olomana Peak. Main patch of breccia is one-half mile long and one-quarter mile wide, 1¾ miles south-southwest of Olomana Peak on northeast side of Koolau Range 8 miles northwest of Makapuu Head.

Makaweli Formation (in Waimea Canyon Volcanic Series)

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 2; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 113–114. Principally lava flows that accumulated in Makaweli graben on southwestern side of major shield volcano of Kauai. Lavas predominantly olivine basalt. Maximum thickness 1,500 feet; base not exposed. Includes Mokuone member (new). Later than Napali formation (new); approximately coeval with upper part of Olokele formation (new).

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 42–49, table facing p. 20, pl. 1. Along Waimea Canyon, the Makaweli is separated from Napali formation to west by scarp formed by erosion of fault scarp that bounded graben. Base not exposed, but believed to rest with erosional unconformity on Napali and Olokele formations. Locally overlain with erosional unconformity by rocks of Koloa volcanic series. Includes Mokuone member. Total thickness unknown; maximum exposed thickness, 1,500 feet. Coeval with upper part of Olokele formation; probably middle or late Pliocene.

Type localities: Western wall of canyon of Makaweli River, and eastern wall of Waimea Canyon between mouth of Omau Stream and confluence of Waimea and Makaweli Rivers. Occupies about 25 square miles in southwestern part of island.

Mak Hill Glaciation

Pleistocene: Southwestern Alaska.

E. H. Muller *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 2, 13 (table 1). Four major glaciations tentatively recognized in northern part of Alaska Peninsula. Mak Hill succeeded Johnston Hill and preceded Brooks Lake glaciations (new). Lateral moraines and glaciated bedrock surfaces of the glaciation are well preserved below summits of previously overridden hills and more than 600 feet above marginal deposits of subsequent advances. West of foothills, moraines, where preserved, characterized by partly filled kettle basins, incompletely integrated surface drainage and knobs, and ridges considered modified by subsequent mass wasting. Name credited to Abrahamson (unpub. dissert.).

Named for knoll composed of glacial till, 9 miles east of Naknek, northern Alaska Peninsula.

Makua Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1245, 1246, pl. 1, (fig. 2). Complex of several flows. Radiocarbon dating gives age of about 590 years.

On southwest side of Haleakala.

Malad Member (of Thousand Springs Basalt)

Malad Basalt[1]

Pleistocene, upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30, 74–75, pl. 4. Thickness about 400 feet. In some areas, rests on Hagerman lake beds. Wedges out between Madson and McKinney basalts. Older than Thousand Springs lava.

U.S. Geological Survey currently classifies the Malad as a member of Thousand Springs Basalt on basis of a study now in progress.

Exposed in Malad Canyon, Gooding County. Near Malad power plant it forms cliff over 400 feet high.

Malade Valley Group[1]

Pliocene(?): Southeastern Idaho and northeastern Utah.

Original reference: A. C. Peale, 1879, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 641.

Malade River valley.

Malaga Mudstone Member (of Monterey Shale)[1]

Miocene, upper: Southern California.

Original reference: W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 146.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 11 (fig. 3), 14 (table), 15 (fig. 4), 37–39, pls. 1, 14. Described as consisting chiefly, and in some areas almost entirely, of massive radiolarian mudstone or fine-grained siltstone; at

Malaga Cove includes laminated diatomite and diatomite and diatomaceous shale in thin streaks or in well-defined units several feet thick; limestone occurs as concretions and lenses in both massive mudstone and laminated diatomite; mudstone is light chocolate brown or olive gray when dry and almost black when wet. Thickness 300 to 600 feet. Overlies Valmonte diatomite member; underlies Repetto siltstone.

Type region: Malaga Cove, at northwest end of the hills (where lower and upper parts of member, but possibly not entire thickness, are exposed), Palos Verdes Hills area, Los Angeles County.

Malagan series

Paleozoic (Late Carbonic): New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 106 (chart). Comprises (ascending) Carlsbad, Hess, Maravilla, and Castile terranes.

Malam (Maremu) (Marem) Beds or Formation

Miocene: Caroline Islands (Kasaie).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 69, table 5 [English translation in library of U.S. Geol. Survey, p. 84]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 29. Malam (Maremu) beds or formation included in East Caroline beds (formation).

Malden Sandstones (in Kanawha Formation)[1]

Pennsylvanian: West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2A, p. 271, 425.

Occurs on both banks of Great Kanawha River in vicinity of Malden, Kanawha County.

Malheur Formation[1]

Recent: Northeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Malheur, Harney County.

Mallett Dolomite[1]

Mallett Member (of Dunham Dolomite)

Lower Cambrian: Northwestern Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 110.

W. M. Cady, 1945, Geol. Soc. American Bull., v. 56, no. 5, p. 528–529. Rank reduced to member in upper part of Dunham dolomite.

Named for fine exposures on shores of Mallett[s] Bay 5 miles north of Burlington, Chittenden County.

Malone Drift or Till

Malone Glaciation

Pleistocene: Northwestern New York.

Paul MacClintock, 1958, Glacial geology of St. Lawrence seaway and power projects: New York State Mus. and Sci. Service, p. 6–25. Older of two episodes of glaciation in area. Ice advanced from the north-

east toward the southwest. Followed by Fort Covington glaciation (new) wherein ice advanced from the northwest.

Named from Malone, Franklin County, in vicinity of which till is well exposed. Also exposed in Lawrence seaway excavations.

Malone Formation[1]

Upper Jurassic: Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 720–721, 736.

C. C. Albritton, Jr., 1937, Field and Lab., v. 5, no. 2, p. 48–50. Age of Malone fauna, described by Cragin (1905, U.S. Geol. Survey Bull. 266) has been subject of uncertainty. Chiefly on basis of ammonites, Cragin assigned entire sedimentary sequence in Malone Mountains and Hills to Upper Jurassic. Later workers agreed that while ammonites described by Cragin are Jurassic, some pelecypods proved existence of Cretaceous strata in Malone formation. Adkins (1933) proposed name Torcer for hypothetically Cretaceous fraction of the Malone, restricting the latter to include only beds of Jurassic age. Present study shows that interbedded limestone and gypsum constituting some 300 feet of basal part of Cragin's Malone are of Permian (Leonard) age. Previously these beds have been variously regarded as Permian, Jurassic, or Cretaceous. Malone formation, is herein again emended to include only beds of Jurassic age; unconformably overlies Permian strata. Consists of lower division of limestone, conglomerate, sandstone, sandy shale, and impure limestone, and upper division dominantly of impure limestone. Maximum thickness about 1,000 feet. Underlies Torcer formation redefined to include only Lower Cretaceous fraction of original Malone. Malone fauna, despite its misleading pelecypods, is Jurassic in age as Cragin maintained.

C. C. Albritton, 1938, Geol. Soc. America Bull., v. 49, no. 12, pt. 1, p. 1754 (fig. 2), 1758–1764. Overlies Permian Briggs formation (new); underlies Torcer formation. Thickness as much as 1,000 feet.

R. W. Imlay, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 11, p. 1485. Formation has been considered to include rocks in Malone Mountains and in hills north and east of Malone. Adkins and Albritton have restricted formation to include only rocks of Jurassic age. However, fossil evidence for Lower Cretaceous rocks in area defined is inadequate. Only positive evidence of age is furnished by late Upper Jurassic ammonites representing early middle Kimmeridgian and upper Portlandian stages. Until undoubted Lower Cretaceous fossils are found in Malone Mountains, it does not seem necessary to modify concept of Malone formation.

Named for Malone Mountain and hills north and east of Malone (now Torcer) Station on Southern Pacific Railway, Hudspeth County.

Maloney Metamorphic Series[1]

Ordovician: Central Washington.

Original reference: W. S. Smith, 1916, Jour. Geology, v. 24, p. 559–570.

Skykomish Basin.

Malpais Basalt[1]

Pliocene(?): Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 72.

Caps Malpais Mesa, southwestern part of Goldfield district.

Mamacoke Gneiss[1]

Precambrian: Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 150–152, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 60–61, pl. 1. Pre-Permian. Difficult to map since transitional into both Sterling orthogneiss and Monson orthogneiss. Same as Stonington gneiss of Martin (1925).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Largely medium-grained gray banded gneiss. In some belts, includes biotite gneiss and schist, quartzite, and hornblende gneiss and amphibolite; in others, gray and pink granitic gneiss. Pre-Triassic. Derivation of name stated.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 26. Not used on present map. A mixed zone of granite and Haddam tonalite.

Named for Mamacoke Island or Hill on west bank of Thames River in town of Waterford, New London County.

Mammoth Andesite[1]

Tertiary: Central Nevada.

Original reference: A. Knopf, 1921, U.S. Geol. Survey Bull. 725-H.

Well exposed on Mammoth claim, Cedar Mountains.

†Mammoth Limestone[1]

Lower, Middle, and Upper Cambrian and Lower Ordovician: Central northern Utah.

Original reference. G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 620, footnote.

Well exposed at and around Mammoth, Juab County.

Mammoth Cave Limestone

Mammoth Cave Series[1]

Mississippian: Western central Kentucky.

Original reference: A. M. Miller, 1919, Table of geological formations of Kentucky, p. 3.

A. C. McFarlan, 1954, Kentucky Geol. Survey Spec. Pub. 4, p. 11. Mammoth Cave limestone is a general term covering a number of Mississippian limestones including the St. Louis, Ste. Genevieve, and lower Chester. These are the limestones in which Mammoth Cave and other large Kentucky caves occur. Occurs below Beattyville shale and above Waverly formation.

Apparently named for Mammoth Cave, Edmondson County.

Mammoth Mountain Rhyolite

Mammoth Mountain Rhyolite (in Potosi Volcanic Series)[1]

Middle or late Tertiary: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

Named for Mammoth Mountain, Creede district.

Mamou Member (of Foley Formation)

Pliocene: Southwestern Louisiana (subsurface).

P. H. Jones, *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 60–61 Sequence of thin lenticular fine-grained beds containing pyrite, marcasite, and organic remains. Thickness about 1,200 feet. Overlies Steep Gully member (new) with contact gradational; underlies graveliferous deposits of early Pleistocene age.

Named for town of Mamou in Evangeline Parish, about 45 miles south of Alexandria, near which it occurs typically in deposits penetrated by a water-well test hole, in T. 5 S., R. 1 E.

Manana Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 114–115. Gray to brown palagonitized tuff, erupted from two vents and constituting the tuff cone of Manana Island. Highest point of island has altitude of 361 feet, but tuff extends unknown distance below sea level. On adjacent mainland, tuff unconformably overlies Koolau volcanic series and overlies reef believed to have been formed during the plus 25-foot (Waimanalo) stand of sea. Extent noted.

Forms Manana Island, a nearly circular island about 0.4 mile in diameter, 1½ miles northwest of Makapuu Head.

Manasquan Formation (in Rancocas Group)

Manasquan Marl[1]

Eocene, lower and middle: New Jersey.

Original reference: W. B. Clark, 1893, New Jersey Geol. Survey Ann. Rept. 1892, p. 205–208.

H. G. Richards, 1945, Geol. Soc. America Bull., v. 56, no. 4, p. 402. There is no evidence, faunal or stratigraphic, for an unconformity between Manasquan and Shark River formations (Eocene). It is more probable that these two formations represent a single unit.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 4 (fig. 2), 8 (fig. 4), 59–61. Originally described as separate formations, Manasquan and Shark River marls now thought to be equivalent. Manasquan-Shark River formation is reported to overlie conformably the Vincentown and dips on average about 15 feet per mile southeast. No good exposures of formation occur in which both upper and lower limits are exposed; hence, thickness is not known but is probably 25 to 30 feet. Since Manasquan and Shark River are equivalent, it is not known what part of the Manasquan the Shark River beds represent. Chart shows the Shark River-Manasquan stratigraphically below Kirkwood formation. Considered Wilcox in age.

H. W. Miller, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 733–735. Manasquan formation with its Shark River member is

definitely Eocene, but its position within the Eocene is doubtful. In view of its stratigraphic position, overlying lower Eocene Vincentown formation, and first appearance of several typical Eocene genera in section, it is writer's [Miller] opinion that the Manasquan is mid-Eocene Claiborne in age.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184. Rancocas group includes (ascending) Hornerstown sand, Vincentown formation, and Manasquan formation.

Named for exposure on Manasquan River, Monmouth County. Exposures chiefly from Asbury Park southwest to Marlton.

Manassas Sandstone (in Newark Group)[1]

Upper Triassic: Virginia.

Original reference: J. K. Roberts, 1923, Pan-Am. Geologist, v. 39, p. 185–200.

R. S. Young and R. S. Edmundson, 1952, (abs.) Virginia Jour. Sci., v. 3, new ser., no. 4, p. 329. A fresh-water limestone, 6 to 9 inches thick, occurs in the Manassas and is exposed in quarry along State Route 3 about 3½ miles east of Culpeper.

Extends in broken belts from a few miles south of Potomac River over all areas to Carolina border.

Manastash Formation[1]

Eocene: Central Washington.

Original reference: G. O. Smith, 1902, U.S. Geol. Survey 22d Ann. Rept., pt. 3, p. 485–486.

C. E. Weaver, 1937, Washington [State] Univ. Pub. in Geology, v. 4, p. 52–53. Massive quartzose sandstone containing interstratified layers of fine-grained brownish-gray shale containing seams of impure coal. Thickness 200 to 300 feet. Rests with basal conglomerate unconformably upon Easton schists; unconformably overlain by Yakima basalts and penetrated by diabase dikes. Formation does not lie in contact with other sedimentary rocks, thus making it difficult on purely stratigraphic grounds to place it definitely in Eocene sequence.

Named from occurrence near headwaters of Manastash and Taneum Creeks on south side of Yakima Valley about 20 miles west of Ellensburg, Kittitas County.

†Manatee River Marl[1]

Miocene, lower or upper: Southern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 125–126.

Occurs on right bank of Manatee River, a few miles above Braidentown, Manatee County.

†Manayunk Mica Schists and Gneisses[1]

Precambrian (Glenarm Series): Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. C_6, p. 27–28, map.

Extends along Schuylkill River from south of Mill Creek to mouth of Wissahickon Creek.

Manchester Group (in Newark Group)[1]

Upper Triassic: Central southern Pennsylvania.

Original reference: G. H. Ashley, 1931, Pennsylvania Topog. and Geol. Survey Bull. G_1, p. 77.

Occurs in Manchester Township, York County.

Manchester Schist

Manchester Formation (in Pine Mountain Group or Series)

Precambrian: Central western Georgia.

G. W. Crickmay *in* L. M. Prindle, 1935, Georgia Geol. Survey Bull. 46, p. 32–33. Formation made up mainly of mica schist and garnet-biotite gneiss. Includes quartzite member, 50 to 300 feet thick, about 850 feet above base. Overlies Hollis quartzite. In Pine Mountain series.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 29, pl. 1. Mica schist and biotite gneiss; in vicinity of Warm Springs contains enough graphite to mark paper; about 850 feet above base, contains persistent bed of quartzite that ranges from 50 to 300 feet in thickness. Overlies Hollis quartzite.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 6 (table), 14–23. In Thomaston quadrangle, referred to as formation in Pine Mountain group. Consists of three unnamed members (ascending): kyanite-muscovite schist and biotite schist, 1,200 to 3,000 feet; quartzite, 200 to 800 feet; and mica schist and feldspathic mica schist, 1,500 feet. Intruded by Jeff Davis granite (new). Precambrian(?).

Named for Manchester, Meriwether County. Exposed in two belts that extend generally northeast, one is north of Pine Mountain and the other south of Oak Mountain; area is south of Towaliga fault.

Manchester Shale[1]

Eocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 52, 188.

Named for exposures at Manchester Landing, near mouth of L'Eau Frais, Clark County.

Mancos Sandstone[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: R. D. Crawford, 1920, Colorado Geol. Survey Bull. 23, p. 11–15, map.

Name applied to sandstone about 350 to 400 feet above base of Mancos shale in Routt County.

Mancos Shale[1]

Mancos Group

Lower and Upper Cretaceous: Western Colorado, northeastern Arizona, northwestern New Mexico, eastern Utah, and southern and central Wyoming.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

W. T. Lee, 1912, Geol. Soc. America Bull., v. 23, p. 594–598. In central New Mexico, includes Tres Hermanos sandstone member, 150 feet thick, in lower part. Includes the rocks, mainly shale, above Dakota sandstone and below Mesaverde formation.

C. T. Lupton, 1914, U.S. Geol. Survey Bull. 541, p. 128. Mancos shale near Green River, Utah, includes Ferron sandstone member (new),

50 to 100 feet thick, about 400 feet above base. Overlies Dakota sandstone.

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota(?) sandstone in Henry Mountains, Gilbert (1877) applied local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," Tununk sandstone, and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation, "Masuk shale" with Lewis shale, and Masuk sandstone with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe entire succession corresponds to Mancos shale.

J. B. Reeside, Jr., 1924, U.S. Geol. Survey Prof. Paper 134, p. 9–13. Described in San Juan basin, New Mexico, where it is about 1,800 feet thick, overlies Dakota sandstone and underlies Point Lookout sandstone of Mesaverde group. Contains Tocito sandstone lentil (new) about 735 feet above base.

E. T. Hancock, 1925, U.S. Geol. Survey Bull. 757, p. 7 (table), 10–13. Thickness 5,000 feet in Axial and Monument Butte quadrangle, Moffat County, Colo. Includes Morapos sandstone member (new) about 800 feet below top. Overlies Dakota sandstone; underlies Iles formation (new) of Mesaverde group.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 436–440. Mancos shale, in southern part of Wasatch Plateau, comprises five members (ascending): unnamed lower shale, Ferron sandstone, middle unnamed shale, Emery sandstone (new), and upper unnamed shale. Grades upward into Star Point sandstone (new) of Mesaverde group. In Castlegate quadrangle, the middle unnamed shale member contains in upper part a lenticular sandstone named by F. R. Clark (unpub. ms.) Garley Canyon sandstone member of Mancos. Passes by gradual transition into basal formation of Mesaverde group, Star Point sandstone.

C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23 (table), 32, 36–38. In Book Cliffs region, Colorado, overlies Dakota(?) sandstone, underlies and interfingers with Mesaverde group. Anchor Mine tongue (new) of Mancos shale penetrates Sego sandstone of Mesaverde group. Buck tongue (new) of Mancos shale separates Sego and Castlegate sandstones of Mesaverde group. Upper Cretaceous.

J. D. Sears, 1934, U.S. Geol. Survey Bull. 860–A, p. 12–14. In southern part of San Juan basin, New Mexico, includes Mulatto and Satan tongues (both new).

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 40–45, pls. East of Mount Taylor, N. Mex., there are three prominent sandstones in lower 350 feet of Mancos shale to which name Tres Hermanos sandstone has been applied. Of these, sandstone No. 2, about 75 feet thick, is the most persistent. Main body of Mancos includes Mulatto tongue in

lower part, and Satan tongue in upper part. Overlies Dakota(?) sandstone; intertongues with Mesaverde formation.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 97–98 (table), 99–105. Discussion of Cretaceous geology of Uinta Basin. All strata between Dakota(?) sandstone and lowest member of sequence of sandstone mapped as Mesaverde undivided are designated as Mancos shale. Conformably overlies Dakota(?) sandstone throughout area but intertongues at upper boundary with Mesaverde group. Thickness varies from west to east; 800 feet at Currant Creek; more than 6,000 feet near Utah-Colorado line. Divided into five members (ascending): lower shale, Aspen shale, middle shale, Frontier sandstone, and upper shale. In Vernal region, underlies Asphalt Ridge sandstone formation (new) of Mesaverde group.

J. W. Huddle and F. T. McCann, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 75. In area of this report [Duchesne River area, Duchesne and Wasatch Counties, Utah], the Mancos, 2,900 to 3,700 feet thick, is dominantly marine formation that interfingers westward with nonmarine sandstone, shale, and coal. Includes lower shale member, 360 to 390 feet thick; Frontier sandstone member, 450 to 600 feet thick; and upper shale member, 1,800 to 2,600 feet thick. Overlies Dakota sandstone; underlies Mesaverde formation.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, 103 p., pls. Discussion of large-scale intertonguing between marine Mancos and nonmarine Mesaverde strata in New Mexico, Arizona, and southwestern Colorado. Mancos shale crops out in almost unbroken line southward from Mesa Verde along western margin for distance of 180 miles to near Atarque. In addition to Mulatto and Satan tongues as defined by Sears (1934) and Hunt (1936), the Mancos includes Twowells sandstone lentil, Pescado tongue, and Horsehead tongue (all new). Pescado tongue splits Gallup member of Mesaverde into upper and lower parts. Horsehead tongue overlies Atarque member (new) of Mesaverde formation. Suggested that name Tocito sandstone lentil be dropped because it is correlative of Gallup sandstone member of Mesaverde and part of Dilco member of Mesaverde. There is probability that Tres Hermanos sandstone is a tongue of Dakota(?) sandstone.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. In area of this report [eastern side of San Juan basin, Rio Arriba County, N. Mex.], the Mancos comprises the following members (ascending): Graneros shale, Greenhorn limestone, Carlile shale, Niobrara calcareous shale, and unnamed shale member. Thickness about 2,060 feet. Overlies Dakota sandstone; underlies Hosta sandstone member of Mesaverde formation. Upper Cretaceous.

W. B. Hoover, 1951, *in* C. T. Smith and others, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 46, 47, 79. Includes Sanastee sandstone member (new) in vicinity of Grants.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 605–610. Referred to as Mancos group. Comprises (ascending) Mowry shale, Lower Mancos shale, Frontier sandstone, and Upper Mancos shale. Lower and Upper Cretaceous. Area of report is Strawberry Valley quadrangle, Utah.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 37 (table), 79–85, pls. In Henry Mountains region, Utah, comprises five members (ascending): Tununk shale, 525 to 650 feet;

Ferron sandstone, 150 to 300 feet; Blue Gate shale, 1,500 feet; Emery sandstone, 198 to 257 feet: Masuk shale, 600 to 800 feet. Overlies Dakota sandstone; underlies Mesaverde formation. Gilbert (1877) used term Masuk sandstone for unit herein referred to as Mesaverde formation.

C. E. Stearns, 1953, Geol. Soc. American Bull., v. 64, no. 4 p. 466. In Tonque Valley, N. Mex., Cano sandstone member (new) of Mesaverde formation is interbedded in upper part of Mancos shale.

Dan Bozanic, 1955, Four Corners Geol. Soc. [1st] Field Conf., p. 91. Term Sanastee was apparently applied to unit which had earlier been named Juana Lopez by Rankin (1944).

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 97–110. In this report [Uinta River-Brush Creek area, Duchesne and Uintah Counties, Utah], Mancos shale, of Late Cretaceous age, is divided into three members (ascending) : Mowry shale, 30 to 120 feet, Frontier sandstone, 140 to 270 feet, and upper unnamed shale, 4,900 feet. Overlies Dakota sandstone; underlies Mesaverde formation. Term Mowry is used in preference to term Aspen; term Frontier is retained as a member although the unit may not be strictly equivalent to typical Frontier; term upper shale member is used in preference to continuing use of Hilliard shale in eastern Uinta Mountains.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 177–202. Discussion of sedimentary facies and intertonguing in Upper Cretaceous of Book Cliffs, Utah-Colorado. Dominantly continental deposits of Star Point, Blackhawk, and Price River formations pass eastward into lagoonal deposits which interfinger eastward with marine Mancos shale. As exposed in the cliffs, the Mancos is drab, gray, or slightly bluish; near the top are a few thin lenses of calcareous sandstone, limestone, a few concretionary beds. In central Utah, where it is separated from lower members by Emery sandstone, this upper part of the Mancos is called Masuk member, but, to the east, it is not readily separable. It is about 5,000 feet thick in central Utah and about 4,000 feet thick in western Colorado. However, exposed parts rarely exceed 600 to 700 feet. Upper part of Mancos grades into overlying littoral marine sandstone tongues, with which it interfingers. These tongues of sandstone thin eastward and grade into the shale. Above each sandstone tongue is a tongue of Mancos shale thinning westward. The two largest shale tongues are the Buck and Anchor Mine. This interfingering results in stratigraphic rise of upper boundary toward east, making upper part of Mancos increasingly younger from west to east.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 263–271. Mancos shale in Black Mesa, Ariz., represents only small part of type Mancos of southwestern Colorado. Marine shale of Mancos intertongues south and west of type locality with sandstone units of overlying Mesaverde group, the top of Mancos thereby lowering in age in those directions. Evidence on Black Mesa suggests also that base of Mancos rises in age in those directions from type locality. Result is pinch-out of the Mancos in those directions. Black Mesa is in intermediate position between Mancos at type locality and its pinch-out. Underlies Toreva formation (new) of Mesaverde group; overlies Dakota sandstone.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2149–2162. In revised nomenclature of Mesaverde group, San Juan basin, New Mexico, name Gallup sandstone as a formation in Mesaverde group will replace Gallup sandstone member, and in its northward extension, replace in its entirety the Tocito sandstone lentil of Mancos shale.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 19–20. In Puertecito quadrangle, New Mexico, underlies La Cruz Peak formation (new) of Mesaverde group. In this report, the Mancos is restricted to strata beneath the Tres Hermanos(?) sandstone which is assigned tentatively to Mesaverde group.

D. B. Givens, 1957, New Mexico Bur. Mines and Mineral Resources Bull. 58, p. 7–8, 10. In Dog Springs quadrangle, includes Tres Hermanos member. La Cruz Peak formation as mapped in area of this report differs from the La Cruz Peak as defined by Tonking (1957) in that the shale which he included at base of the formation in Puertecito quadrangle is here included in the Mancos.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 181–197. Report is reinterpretation of section of Cretaceous rocks in Alamosa Creek valley area, Catron and Socorro Counties, N. Mex. Winchester's (1920) Bell Mountain sandstone at top of his Miguel formation is upfaulted duplication of his Gallego sandstone member from which it was supposed to be separated by nearly 1,000 feet of beds. Winchester's names. Miguel formation, Chamiso formation (for Mesaverde rocks overlying the Miguel), and Bell Mountain sandstone member are abandoned and stratigraphic names used in San Juan basin are extended to units recognized in Alamosa Creek valley. The marine shale tongue of Mancos shale (Pescado tongue of Pike, 1947) underlying Gallego sandstone member, now of Gallup sandstone, is shown to be of latest Carlile age, although it contains some species heretofore regarded as indicative of Niobrara age. Name D-Cross tongue of Mancos is herein proposed for this marine shale unit, which may be a somewhat higher and younger tongue than Pescado tongue at its type locality. Lower part of Gallup sandstone tongues out into Mancos shale in southeastern part of Mount Taylor coal field.

R. G. Young, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 18 (fig. 1), 19 (fig. 2), 20 (fig. 3), 21–22, 23 (fig. 4); 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 159 (fig. 2), 176–180. In southwestern Colorado, disconformably overlies Naturita formation (new) of Dakota group. Because of intertonguing with underlying Dakota deposits, base of Mancos becomes progressively younger to west.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 41–43. Mancos shale in Yampa district, northwestern Colorado, is restricted to thick succession of shale, sandy shale, and thin-bedded sandstone overlying Niobrara formation and underlying Mesaverde group. Shales and sandstones of Mancos grade upward and interfinger with Tow Creek sandstone member of Iles formation. Includes Devils Grave sandstone member (new) in lower part and Hunt Creek sandstone member (new) in upper part.

Kenji Konishi, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 67–73. Discussion of Axial basin and Williams Fork area,

Moffat and Routt Counties, Colo. Mancos shale at type locality is 2,000 feet thick. In northwestern Colorado, section of Mancos above Frontier formation maintains thickness of about 5,000 feet. As indicated in the difference in thickness when compared with type locality, the Mancos in northwestern Colorado includes younger deposits than are included at type locality. Mowry shale and Frontier formation (within Mancos shale of older terminology) have been given formational status; that is, Mancos shale as herein used includes that part of original Mancos above Frontier formation. Mancos is oldest stratigraphic unit exposed in area; basal contact with underlying Frontier is in subsurface. Upper boundary with Mesaverde group (Iles formation) is gradational. Several mappable sandstone members and tongues recognized in upper 1,200 feet of Mancos. They are (ascending) Morapos sandstone member, "Second Mancos sandstone tongue," "First Mancos sandstone tongue," and Loyd sandstone member (new). Meeker sandstone member (new) occurs about 700 feet below Morapos sandstone member. Basal 600 to 700 feet of Mancos is distinguished from other parts of formation by its calcareous nature and its fauna.

U.S. Geological Survey currently classes the Juana Lopez Sandstone as a member of the Mancos Shale on the basis of a study now in progress.

Named for occurrence in Mancos Valley and about town of Mancos, between La Plata Mountains and the Mesa Verde, Montezuma County, Colo.

Mancosian series[1]

Cretacic: Arizona, Colorado, and New Mexico.

Original reference: Name credited to C. R. Keyes. [Original reference not located by present compilers.]

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 225 (fig. 11). Name given as Mancosan [apparently a lapsus for Mancosian]. Cretacic. Overlies Dakotan sandstone.

Mandan Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 177, 205, 206, 248, 409, 490, 491, figs. 23, 24, 25, 29, 34.

Named for occurrence in Mandan mine, Keweenaw County.

Mandan Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

H. R. Cornwall, 1951, Geol. Soc. America Bull., v. 62, no. 2, p. 161, 167, pl. 1. Typically ophitic basalt with pegmatitic layers in its upper part in Michigan copper district. Along the strike, thickness ranges from a few feet to 400 feet. Occurs about 300 feet stratigraphically below Greenstone flow.

In Houghton and Keweenaw Counties.

Mandanan series[1]

Tertiary(?): Western North Dakota and South Dakota.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist. v. 43, p. 135.

Probably named for exposures at and around village of Mandan, Morton County, N. Dak.

Mandata Formation (in Helderberg Group)

Mandata Member (of Helderberg Formation)

Lower Devonian: Central and south-central Pennsylvania and western Maryland.

F. M. Swartz, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1923; 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 65–69, 80–81. Formation consists of shale and chert. Comprises several rock units (ascending): thin-bedded shale with thin bed of impure limestone; thin-bedded gray shale and four interbedded layers of dark-gray finely crystalline limestone; thin-bedded dark-gray shale and few interbedded impure chert layers; medium-bedded impure dark chert and interbedded dark-gray shale, with thin bed of impure limestone; and thin-bedded unfossiliferous shale. Thickness 91 feet at type locality; thins westward. Underlies cherts of Oriskany age, Shriver chert in some areas; overlies cherty New Scotland limestone. In Perry County, overlies Falling Springs sandstone member (new) of New Scotland. Contacts not well exposed but appear sharp. Type locality designated. Geographically extended to Maryland.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 13. Referred to as member of Helderberg formation.

Type locality: On highway to Berrysburg, one-fourth mile south of Mandata (Bull Run of Millersburg topographic sheet), Northumberland County, Pa.

Manele Basalt[1] (in Lanai Volcanic Series)

Pleistocene(?): Lanai Island, Hawaii.

Original reference: C. K. Wentworth, 1925, Bernice K. Bishop Mus. Bull. 24, p. 39.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 114–115. Crater remnant that forms headland south and west of Manele harbor, including all basalt south of sandy neck of land at Manele. Unit of Lanai basalt included in Lanai volcanic series. Relationships to rest of Lanai basalt not given.

Type locality: Headland south and west of Manele Harbor. Exposed over about one-fourth square mile at south edge of Lanai.

Maness Shale (in Washita Group)

Maness Shale Member (of South Tyler Formation)

Cretaceous (Comanche Series): Northeastern Texas (subsurface).

T. L. Bailey, F. G. Evans, and W. S. Adkins, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 176–178, pl. 1. In type well, consists of faintly laminated to massive bronze or copper-colored and dark-gray somewhat calcareous clay shale and claystone. Underlies Woodbine formation; overlies Buda limestone. Occurs at depths of 4,705 to 4,766 feet.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 476. Included at base of newly defined South Tyler formation.

Type well: Shell Oil Co.'s Maness well No. 1, eastern Cherokee County.

Mangas quartzite[1]

Upper Cambrian: Southwestern New Mexico.

Original references: C. R. Keyes, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico. Des Moines, Robert Henderson, State Printer, p. 4, 9.

Exposed near Silver City, Grant County.

Mangum Dolomite Member (of Blaine Gypsum)[1]

Mangum Dolomite Member (of Dog Creek Formation)

Permian: Southwestern Oklahoma and central northern Texas.

Original reference: C. N. Gould, 1905, U.S. Geol. Survey Water-Supply Paper 148, p. 71.

T. S. Jones, 1953, Stratigraphy of the Permian basin of West Texas: West Texas Geol. Soc., p. 30 (fig. 9). Shown on correlation chart as member of Dog Creek formation. Underlies Guthrie dolomite member; overlies Shimer dolomite member of Blaine formation. Permian (Guadalupe).

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 25–26, pl. 1. In Carter area, Oklahoma, member of Blaine formation; consists of gray limy dolomite, about 1½ feet thick, typically weathering to honeycombed pattern. Overlies Collingsworth gypsum member; underlies Van Vactor gypsum member (new).

Named for Mangum, Greer County, Okla.

†Manhasset Boulder Bed[1]

Pleistocene: Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48.

Mapped along eastern side of Manhasset Neck, Long Island.

Manhasset Formation[1]

Pleistocene: Southeastern New York and southern New England islands.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, pl. 1, text.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Thickness 150 to 200 feet. Includes (ascending) Herod gravel, Montauk till, and Hempstead gravel members. Overlies Jacob sand. Fuller (1914) believed Manhasset formation to be of Illinoian age and that an interglacial erosional interval, the Vineyard stage, intervened between period of deposition of the Manhasset and that of younger Wisconsin drift. Recent workers feel that lack of any noticeable difference in weathering between the Manhasset and younger Wisconsin drift, and absence of any generalized interglacial deposits, preclude existence of interglacial stage; thus, the Manhasset is believed to be of Wisconsin age.

First described in vicinity of Manhasset Neck, Long Island. Present on Block Island, Nantucket, Marthas Vineyard, No Mans Land, and Cape Cod.

†Manhattan Beds[1]

Permian: Northern Kansas.

Original reference: Robert Hay, 1893, Kansas State Bd. Agric. 8th Bienn. Rept., p. 101.

Named for Manhattan, Riley County.

Manhattan Drift

Pleistocene (Wisconsin): Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 12 (fig. 4). Shown on columnar section of Pleistocene deposits as Manhattan-Rockdale drift. Occurs below Valparaiso drift and above Minooka drift.

Tills present in Joliet area.

†Manhattan Gneiss[1]

Precambrian: New York.

Original reference: D. S. Martin, 1888, Geol. map of New York City and vicinity.

†Manhattan Group[1]

Precambrian: Southeastern New York.

Original reference: R. P. Stevens, 1867, New York Lyc. Nat. History Annals, v. 8, p. 116–120.

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 673. Proposed that term Manhattan group be abandoned and unit comprised of Fordham gneiss, Inwood marble, and Manhattan formation (new) be renamed New York City group.

Type locality not stated. Term first applied to rocks on Manhattan Island.

†Manhattan Limestone (in Council Grove Group)[1]

Permian: Northern Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 37, 40–41.

Named for Manhattan, Riley County.

Manhattan Schist[1]

Manhattan Formation (in New York City Group)

Precambrian: Southeastern New York and western Connecticut.

Original reference: F. J. H. Merrill, 1890, Am. Jour. Sci., 3d, v. 39, p. 390.

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 673. Manhattan formation is uppermost unit in New York City group (new). Name Manhattan schist considered inappropriate. Formation is dominantly a garnetiferous quartz-biotite-plagioclase gneiss characterized by sillimanite and locally much muscovite. Overlies Inwood marble. Inwood is indistinguishable lithologically from marble layers occurring in Manhattan formation. Age of group not certain; may ultimately prove to be correlative of Cambro-Ordovician series north of Hudson Highlands.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 4, 21–26, geol. map. Formation mapped in Danbury quadrangle. Was called Becket gneiss on State geological map of 1906; and Balk (1936, Geol. Soc. America Bull., v. 47, no. 5). Term Manhattan formation used because of apparent physical continuity with type locality. Overlies Inwood marble.

Named for exposures on Manhattan Island, N.Y.

Manheim Formation (in Pocono Group)

Mississippian: Northern West Virginia.

J. L. Dally, 1956, Dissert, Abs., v. 16, no. 12, p. 2425. Named as lower unit in group in northern part of state. Underlies Burgoon formation.

Possibly named for Manheim, Preston County.

Manila Agglomerate or Andesite

Eocene(?): Mariana Islands (Rota)

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Manila andesite named on correlation chart. Eocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 48, table 4 [English translation in library of U.S. Geol. Survey, p. 57]. Referred to as Manila agglomerate. Correlated with Kagman andesite, Marino agglomerate, Baranos andesite, and Aimiliiki agglomerate. Eocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 43. Manila agglomerate forms basement complex of island. Consists of two pyroxene-, hypersthene-, common-augite-andesites and their agglomerates. Conformably underlies Mariiru limestone. Eocene(?). Refers to S. Sugawara (1939, unpub. ms.) and K. Asano (1939, Jubilee Pub. Yabe's 60th Birthday).

Type locality: Manila Hill, highest part of Rota Island.

Maniobra Formation

Eocene, lower and middle: Southern California.

J. C. Crowell and Takeo Susuki, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 581–592, pl. 1. Consists of interbedded siltstone, sandstone, and breccia along with sandy limestone and conglomerate. Total thickness about 4,800 feet. In thickest part, is differentiated into two mappable units which intertongue. One unit, consisting of coarse sedimentary breccia and conglomerate, in the main lies lower in the section; the other unit, composed of light-buff siltstone with conspicuous sandstone and grit layers, predominates high in section but extends also as lenses and tongues to within a few feet of the base. On east at base of section, large granitic boulders up to 30 feet in diameter lie along the unconformity with basement granite; these give way upward to thick lenses of coarse granitic conglomerate and breccia with interbeds of buff siltstone and arkosic sandstone; upper part of section on east consists of massive buff siltstone with sandstone and boulder beds. On west, section consists largely of interbedded siltstone and sandstone with conspicuous isolated boulders of granite. Type section lies between granitic basement on north and basal conglomerate of overlying unnamed nonmarine rocks on south.

Type locality: Just west of the valley herein named Maniobra Valley. Valley was part of maneuver area used during World War II by armored units from Desert Training Center. Since many of the topographic names in region have come from Spanish, maneuver is herein translated into the Spanish maniobra. Strata are exposed in northeastern Orocopia Mountains in Colorado Desert, Riverside County. Beds lie about 15 miles northeast of San Andreas fault zone and are preserved in broad east-west structural depression in border zone between Transverse Ranges and Basin and Range Province.

Manistee Limestone[1]

Mississippian: Western Michigan.

Original reference: C. C. Douglass, 1839?, Michigan Leg. H. Doc. 27, p. 97–111.

Occurs near Manistee River in T. 15 N.

Manistique Dolomite

Manistique Group

Manistique Series[1] or Formation

Middle Silurian (Niagaran Series): Northern Michigan and eastern Wisconsin.

Original reference: R. A. Smith, 1916, Michigan Geol. Survey Pub. 21, p. 152.

R. B. Newcombe, 1933, Michigan Geol. Survey Pub. 38, p. 23, 37. Manistique formation divided into Schoolcraft and Cordell members.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Manistique dolomite (Wisconsin and Michigan) includes Schoolcraft dolomite below and Cordell dolomite above.

G .M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 19–22, 31 (fig. 2). Rank raised to group, and members to formations. Overlies Burnt Bluff group; underlies Engadine dolomite. Thickness as much as 210 feet.

Named for exposures at Manistique, Schoolcraft County, Mich.

†Manitoban Substage[1]

Pleistocene: Great Lakes region.

Original reference: M. M. Leighton, 1931, Jour. Geology, v. 77, p. 51–53.

The name Manitoban is taken from province of Manitoba, Canada.

Manitou Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Manitou mine, Keweenaw County.

Manitou Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Manitou mine, Keweenaw County.

Manitou Limestone,[1] Dolomite, or Formation

Lower Ordovician: Eastern Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 4, p. 379–382. Representative type section designated in which name Manitou is restricted to Ordovician limestone lying between Cambrian Sawatch sandstone and Devonian limestone herein named Williams Canyon. Thickness 218 feet.

Q. D. Singewald and B. S. Butler, 1941, U.S. Geol. Survey Bull. 911, p. 8 (table 1). In London fault area, Mosquito Range, the Manitou is as much as 130 feet thick; overlies Peerless shale member of Sawatch quartzite; underlies Parting quartzite member of Chaffee formation.

J. H. Johnson, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 308 (table 1), 314–320. Ordovician sequence along Sawatch Range includes remnants of three formations: Manitou dolomite, Harding sandstone, and Fremont limestone. The Manitou consists of thinly bedded dolomites and dolomitic limestone; very siliceous in places. Thickness 100 to 370 feet.

Separated by unconformities from Sawatch quartzite below and Harding sandstone above. Lower Ordovician.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Restricted at base to exclude 8 to 14 feet of dolomite herein named Ute Pass dolomite. Thickness of restricted Manitou about 187 feet. Underlies Williams Canyon limestone.

Q. D. Singewald, 1951, U.S. Geol. Survey Bull. 970, p. 9 (table 1). In Blue River area, Summit County, consists of thin-bedded white to medium-blue mostly crystalline dolomite. Thickness about 70 feet. Overlies Peerless formation; disconformably underlies Parting quartzite member of Chaffee formation.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 893, 905–911. Manitou formation of this report [White River Plateau] includes a little more than upper half of Dotsero dolomite (Bassett, 1939). Term formation preferred to limestone because unit includes variety of rock types. Subdivided into (ascending) Dead Horse conglomerate and Tie Gulch dolomite members (both new). Thickness 80 to 155 feet. Overlies Clinetop algal limestone member (new) of Dotsero formation; underlies Parting member of Chaffee formation.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 11–12, pl. 1. Manitou dolomite described in Garfield quadrangle, Gunnison and Chaffee Counties. At most places, rests unconformably on irregular surface of Sawatch quartzite, but in southern part of Tomichi district, and in Monarch district, rests on Precambrian granite. Manitou dolomite is equivalent to the limestone below the quartzite in Tomichi limestone of Crawford's (1913) nomenclature. Thickness 175 to 250 feet. Manitou is characteristically bluish-gray crystalline well-bedded dolomite. Individual beds range in thickness from a few inches to several feet in thickness. Metamorphic processes, particularly those related to intrusion of Mount Princeton quartz monzonite, have locally changed the dolomite to marble. Unconformably underlies Harding quartzite.

R. R. Berg and R. J. Ross, Jr., 1959, Jour. Paleontology, v. 33, no. 1, p. 106–119. On basis of faunal correlations, unit termed Ute Pass at Williams Canyon is reassigned to lower part of Manitou. On bases of lithology and stratigraphic position, the Ute Pass of Missouri Gulch is correlated with Peerless formation and term Ute Pass dolomite abandoned. The Manitou consists of finely to coarsely crystalline limestone and minor amounts of dolomite that total 195 feet at type locality. Here section is sparingly fossiliferous and contains trilobite and brachiopod fauna in lower part and gastropod fauna above. To northwest in Manitou Park, formation consists chiefly of dense red dolomite as in vicinity of Missouri Gulch, and trilobites occur mainly in thin beds of limestone. South of Williams Canyon, the Manitou is massive dense unfossiliferous dolomite. Faunal evidence indicates that the Manitou slowly lapped southward over eroded pre-Ordovician surface. From north to south, formation rests successively on Peerless formation, Sawatch quartzite, and Precambrian rocks. Overlapped by Middle Ordovician Harding sandstone.

Type section: Measured on east side of canyon above the Narrows of Williams Canyon, north of Manitou, SW¼ sec. 32, T. 13 S., R. 67 W., El Paso County.

Manitou Series[1]

Precambrian: Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. and Nat. History Survey, v. 4, p. 297–298.

F. J. Pettijohn, 1937, Geol. Soc. America Bull., v. 48, no. 1, p. 166–170. Discussion of northern Lake Superior region. Manitou series is represented by granite-pebble-bearing conglomerates, arkose, quartzite, slate, and a little agglomerate and tuff. Mapped in six areas. Early Precambrian.

Named for exposures on Manitou River, Lake County.

Manitoulin Dolomite Member (of Cataract Formation)[1]

Manitoulin Dolomite (in Cataract Group)

Manitoulin Dolomite (in Medina Group)

Lower Silurian: Ontario, Canada and northern Michigan and western New York.

Original reference: M. Y. Williams, 1913, Ottawa Nat., v. 27, p. 37.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1981 (fig. 2), 1982 (fig. 3), 1989–1990. Discussion of stratigraphy of Medinan group in Ontario and New York. Manitoulin ranges in thickness from 50 feet at type locality to 4 feet along Niagara Gorge. Not positively identified east of gorge. Underlies Cabot Head shale. Overlies Whirlpool sandstone in Hamilton and vicinity; overlies Fish Creek shale (new) at DeCew Falls and in Niagara Gorge. Name Manitoulin has been applied to shale equivalent of the dolomite in Niagara Gorge, but this is not proper since it is a different lithologic unit. In west, the Manitoulin is light-gray irregularly bedded dolomitic limestone changing toward east so that in Niagara Gorge it is yellowish-gray sandy and silty phosphatic dolomite weathering pale buff. In restored stratigraphic cross section (fig. 2) of Medinan group, datum is Manitoulin-Cabot Head contact, the line along which dominant transgression changed to dominant regression; hence this contact closely approached a true time-line.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 4 (fig. 4), 5. Best exposures of Manitoulin dolomite in Michigan are on or near shore of Scott Bay on northwest side of Drummond Island, Chippewa County. Only two exposures are known west of Drummond Island; one of these is northwest shore Manistique Lake in Luce County where unit is about 9 feet thick. Basal formation in Cataract group; underlies Cabot Head shale. Alexandrian series.

Named for exposures on Manitoulin Island, Ont.

Manitoulin Limestone[1]

Silurian (pre-Niagaran): Michigan, and Ontario, Canada.

Original reference: J. J. Bigsby, 1824, Notes on geography and geology of Lake Huron, p. 199–204.

Manix Lake Beds[1]

Pleistocene: Southern California.

Original reference: J. P. Buwalda, 1914, California Univ. Pub., Dept. Geol. Bull.. v. 7, p. 444.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 45–46, pl. 2. Described in Alvord Mountain quadrangle, where beds occur chiefly between the 1,780- and 1,800-foot contours and mark approximate shoreline of Lake Manix in Pleistocene time. Mammalian vertebrate fossils and fossil birds collected from Manix Lake beds suggest a late Pleistocene age.

Well exposed along Mohave River 2 miles southeast of Manix, San Bernardino County, about 120 miles northeast of Los Angeles.

Mankato Stade, Drift

Mankato (Mankatoan) Substage[1] or Subage

Pleistocene (Wisconsin): Mississippi Valley.

Original references: M. M. Leighton, 1931, Jour. Geology, v. 39, no. 1, p. 51–53; 1933, Science, v. 77, p. 168.

W. E. Wright, Jr., and Meyer Rubin, 1956, Science, v. 124, no. 3223, p. 625–626. Radiocarbon dates discussed in this report suggest that surface drift at Mankato should be correlated with the Cary (pre-Two Creeks) rather than with Valders (post-Two Creeks). Use of term Valders is favored over term Mankato for last major substage of the Wisconsin. Adoption of this term would establish the several important intervals of the middle and late Wisconsin—Tazewell, Cary, Two Creeks, and Valders—as units of reference based on activity of a single ice lobe (Lake Michigan lobe).

M. M. Leighton, 1957, Science, v. 125, no. 3256, p. 1037–1038. Wright and Rubin (1956) expressed view that Mankato drift should be correlated with the Cary (pre-Two Creeks) rather than with Valders (post-Two Creeks). They favor term Valders over term Mankato for last major substage of the Wisconsin. Evidence cited to show that even though Mankato is older than Two Creeks it is still younger than Cary.

M. M. Leighton, 1957, Jour. Geology, v. 65, no. 1, p. 108–109. Wisconsin stage reclassified to include the following substages (ascending): Farmdale, Iowan, Tazewell, Cary, Mankato, and Valders. Mankato includes Port Huron and Manistee drifts.

R. V. Ruhe, Meyer Rubin, and W. H. Scholtes, 1957, Am. Jour. Sci., v. 255, no. 10, p. 671–689. New radiocarbon dates in Iowa permit a grouping of age values and raise new problems in stratigraphic correlation of late Pleistocene deposits in Iowa and adjacent regions. Older group of ages greater than 29,000 years dates Iowan substage and pre-Iowan deposits. Old group of ages of 22,900 to 25,100 years dates the Farmdale substage. Intermediate group of ages ranges 14,000 to 17,000 years. Parts of Des Moines lobe previously classified as Mankato are dated at 11,600 to 11,800 years and antedate Two Creeks interstadial.

R. J. Mason, 1958, Michigan Univ. Mus. Anthropology, Anthropol. Paper 11, p. 23, 27 (table 6). In Wisconsin sequence, the Two Creeks interstadial represents the period between end of Mankato retreat and next and last glacial advance (Valders). The Cochrane is not represented in Michigan [this report].

Meyer Rubin, 1960, Am. Geophysical Union Trans., v. 41, no. 2, p. 288–289. Discussion of changes in Wisconsin glacial stage chronology by C^{14} dating. Type Mankato till dated at approximately 12,000 years, making it older than Valders till of Thwaites at Two Creeks and actually placing it into Cary substage range of ages.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 3–4, 7. Presentation of revised time-stratigraphic classification of Wisconsinan stage of Lake Michigan lobe. Consists of (descending) Valderan, Twocreekan, Woodfordian, Farmdalian, and Altonian substages. Radiocarbon dates indicate that till in type area of Mankato is older than Valders till and Two Creeks forest bed of Wisconsin, rather than

equivalent in age to Valders till as previously correlated. Transposition of term Mankato within Lake Michigan lobe from the till above Two Creeks forest bed to till below Two Creeks forest bed introduces a complicating modification of both Mankato and Cary, produces an unneeded substage, and retains a name from outside of Lake Michigan Lobe. The Woodfordian includes that part of Cary that has been assigned to the Mankato (Leighton, 1957; Wright, 1957, Science, v. 125, no. 3256).

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Presentation of classification of Wisconsin glacial stage of north-central United States. Mankato glacial substage separated from older Cary glacial substage by Bowmanville intraglacial substage (new) and from younger Valders glacial substage by Two Creeks intraglacial substage. Author [Leighton] does not agree with classification recently proposed by Frye and Willman (1960). Mankato glacial substage was thought to have its greatest areal extent in Keewatin field; hence, its name was taken from that area. Substage was that of Leverett's (1933, Science, v. 77) Late Wisconsin. Recently it has been found by Ruhe (1952, Am. Jour. Sci., v. 250, no. 1; 1955, Jour. Geology, v. 63, no. 1; 1957, Am. Jour. Sci., v. 255, no. 10) that much of southern part of Des Moines lobe is of Cary age. Mankato, Minn., lies in an area of drift known to be younger than Cary and older than Valders. Hence, name of substage [Mankato] remains unchanged. Circular 285 (Frye and Willman) is confusing on this point. The circular also ignores stratigraphic relations and history of Mankato substage by placing it in the so-called "Woodfordian substage." To put all three substages, Tazewell, Cary, and Mankato, into the Woodfordian is to overlook two important intervals: the Tazewell-Cary (St. Charles) intraglacial and Cary-Mankato (Bowmanville) intraglacial intervals. In Keewatin field, a valley train issued from Mankato glacial lobe, recorded in terrace, remnants of Mississippi River valley. This is Festus terrace of Robertson (1938, St. Louis Acad. Sci. Trans., v. 29, no. 6). Present writer traced Festus terrace to outwash plain of Mankato drift in Dakota County, Minn. A low terrace below it, formerly called "Late Mankato" by Leighton and Willman (1949, Illinois Geol. Survey Field Conf., June 12–25) is now regarded by writer as Valders valley train.

Name amended to Mankato Stade to comply with stratigraphic code adopted 1961.

Name derived from Mankato County, Minn.

Mankomen Formation[1]

Permian: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 40, map.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–D, p. 104–108. Exposures in upper Chistochina Valley, north of Mankomen Lake looked on as type locality for the Permian (Mankomen formation) of upper Cooper River region. Stratigraphic section displayed in type locality not duplicated elsewhere. Type locality was place of dominant lime deposition.

Type locality: Upper Chistochina Valley north of Mankomen Lake, central Copper River region.

Manley Coal Member (of Abbott Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), pl. 1. Proposed for coal formerly called Babylon coal.

Overlies Babylon sandstone member; underlies Tarter coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: On west bank of Spoon River in NE¼NE¼ sec. 14, T. 7 N., R. 1 E., Fulton County. Name derived from small settlement of Manley 4 miles west of type outcrop.

Manlius Limestone (in Helderberg Group)

Manlius Limestone (in Cayuga Group)[1]

Manlius Limestone (in Keyser Group)

Lower Devonian: New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 5th Rept., p. 376.

Burnett Smith, 1929, New York State Mus. Bull. 281, p. 25–36. Manlius group subdivided into (ascending) Olney limestone, Elmwood beds, Clark Reservation limestone, Jamesville limestone, Pools Brook limestone, and Bishop Brook limestone.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1182–1184. Term Keyser group proposed to include Decker sandstone, Rondout limestone, and Manlius limestone. These formations replace Keyser limestone in northern area. Manlius limestone is equivalent to part of White's (1882) Stormville limestone and conglomerate.

G. H. Davis, 3d, 1953, New York State Mus. Circ. 35, p. 5–29. Transitional Manlius-Coeymans contact discussed in upper New York State. Manlius section measured at edge of town of Manlius. Unit names used for this section were proposed by Smith (1929); Jamesville and Pools Brook limestones represent upper two members of Manlius; Bishop Brook limestone is considered Coeymans in age.

1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 2, 3–4. Columnar section (page 2) shows Manlius group comprises (ascending) Cobleskill, Rondout, and Olney limestone members, and Elmwood beds. Overlies Salina group; underlies Clark Reservation and Jamesville limestone shown as transitional beds between Manlius group and Helderberg group. Pages 3 and 4 refer to Manlius formation comprising above named members.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Formation subdivided into (ascending) Thacher (new), Olney, Elmwood, Clark Reservation, and Jamesville members. The higher limestone members named by Smith (1929) pass laterally in Coeymans limestone of eastern New York and hence are undoubtedly of Devonian age. Overlies Rondout formation. Helderbergian series. Lower Devonian. Coeymans limestone of central New York, overlying Jamesville member of Manlius, is entirely younger than Coeymans of eastern New York. Name Deansboro proposed for this member of Coeymans.

L. V. Rickard, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1608. Westward from Helderbergs of eastern New York, Coeymans limestone thickens to nearly 100 feet at Cherry Valley. This thickened Coeymans splits into three parts—lower and middle parts grade laterally into Olney, Elmwood, Clark Reservation, and Jamesville members of type Manlius. Thus nearly all of Manlius of central New York is facies

of Coeymans of eastern New York and should be included in Lower Devonian. Manlius of eastern New York is entirely pre-Olney. It thins westwardly, is absent west of Jamesville, and is seemingly replaced by underlying thickening Rondout dolomite.

L. V. Rickard, 1956, Dissert, Abs., v. 16, no. 1, p. 102. West of Cherry Valley, the thickened Coeymans splits into three parts. Lower part, for which name Dayville limestone is proposed, grades laterally into Olney limestone of Syracuse area. Middle part changes into Elmwood, Clark Reservation, and Jamesville members of Manlius. For upper beds of Coeymans, which continue westward as far as Chittenango Falls, name Deansboro limestone is proposed. Bishop Brook limestone at Manlius is a reappearance of the Deansboro further west. Evidence indicates that entire type Manlius near Syracuse, central New York, is equivalent in age to Lower Devonian Coeymans and Kalkberg formations of eastern New York. So-called Manlius of eastern New York is entirely older; name Thacher limestone is proposed for this latter unit. Helderbergian series.

U.S. Geological Survey currently classifies the Manlius Limestone as a formation in the Helderberg Group on the basis of a study now in progress.

Named for occurrence at Manlius, Onondaga County.

Mannetto Gravel[1]

Tertiary(?) or Pleistocene(?): Southeastern New York and southeastern Massachusetts.

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1715, chart 12. Shown on correlation chart as Pliocene(?). Occurrence of Mannetto at altitude above 270 feet presumably excludes it from the marine Pleistocene.

Wallace de Laguna and N. M. Perlmutter, 1949, New York State Water Power and Control Comm. Bull. GW–18, p. 39–40. Age of Mannetto uncertain. It may be related to either the Jerseyan or so-called Illinoian glacial periods of New Jersey, but few facts are available and no correlation is possible. Or, it may be a late Tertiary deposit that has no relation to Pleistocene ice sheets; this seems unlikely since none of the Tertiary deposits of New Jersey resembles the Mannetto. Existing evidence strongly indicates that Mannetto gravel is early or mid-Pleistocene in age.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 145. Considered older than Jameco gravel on basis of degree of weathering. Gravel is oldest post-Cretaceous deposit on Long Island. Presumably Pleistocene glacial outwash, although some workers have suggested that it is of late Tertiary age. Restricted to Mannetto and Wheatley Hills areas; not observed in eastern part of island.

Named for Mannetto or High Hill south of Huntington, Long Island.

Mannie Shale (in Richmond Group)

Mannie Clay (in Richmond Group)[1]

Upper Ordovician: Western Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 39, 44.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 215–219, fig. 73. Mannie shale is, in general, a succession of greenish argillaceous limestone, calcareous shale, and shale. Thickness commonly 15 to 25 feet; in Marion County as much as 50 feet. Locally, shale is overlain by about 10 feet of fine-grained quartz sandstone referred to as Mannie sandstone member. Conformably overlies Fernvale limestone; both the Mannie and Fernvale grade into Sequatchie formation; unconformably underlies Brassfield limestone or Chattanooga shale and, possibly, the Osgood formation; in Wells Creek basin, occurs as a small block with Hermitage formation, surrounded by Devonian and Mississippian beds. Type section stated.

Type section: Northwest of Riverside, Lewis County. Named from exposures north of west end of railroad bridge across Buffalo River near mouth of Allens Creek (formerly Mannie Creek).

Manning Clay Member (of McElroy Formation)

Manning Beds[1]

Manning Formation (in Jackson Group)

Manning Member (of Fayette Formation)

Eocene, upper: Eastern Texas.

Original reference: E. T. Dumble, 1915, Geol. Soc. America Bull., v. 26, p. 462, 463.

C. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 22, 26–28. In Lee County, Fayette formation is divided into three members (ascending): Caddell clays and sands, Wellborn sandstone, and Manning beds.

H. B. Stenzel, 1953, Am. Assoc. Petroleum Geologists Guidebook Field Trips Houston Mtg., p. 45. Contains Plum bentonite (new).

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 165–172. Strata of Manning formation comprise sandstones, shales, and volcanic ash. Basal 100 feet contains greater percentage of lignite than is normal for rest of formation. At the top of this lower lignitic zone in Brazos and Grimes Counties is a sandstone herein named Goodbread. At the top of the Manning are two sandstones each from 5 to 50 feet thick. They are separated by a shale zone 30 to 60 feet thick. Upper sandstone was named Yuma by Renick. Lower sandstone named Dilworth by Renick on assumption that it was equivalent to Dilworth sandstone of Gonzales County. However, there is no conclusive proof of this equivalence, and lower sandstone is herein named Tuttle. Overlies Wellborn; underlies Whitsett.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2626 (table 1), 2629–2630. Rank reduced to member status in McElroy formation (redefined). Underlies Dilworth sandstone member; overlies Wellborn sandstone. Renick (1936, Texas Univ. Bull. 3619) considered the Manning a formation and included in it Dilworth and Yuma sandstones as members. He also included as much as 25 feet of clay above the Yuma sandstone member in the Manning. Manning formation of Renick is, with possible exception of his Yuma sandstone member, equivalent to McElroy formation as classified in present report, and Manning clay member of present report is equivalent to Manning beds of Ellisor (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11). Note on type locality.

Named for exposures at Manning Station on St. Louis & Santa Fe Railway, Angelina County. The railroad and town, formerly the site of a lumbermill, are now abandoned; so is Manning Church, shown on Angelina County map of Texas State Highway Department. Only one inhabited house, that of M. M. Flourney, remains at site of village and mill, which is on Farm Roard 844, 10.2 miles by road south-southwest of Huntington.

Manning Canyon Shale[1]

Manning Canyon Formation

Upper Mississippian and Lower Pennsylvanian: Northern Utah.

Original references: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 423 (table 1), 430–431 (name credited to Gilluly); J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

A. A. Baker, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 30. Manning Canyon shale, in vicinity of Provo in Wasatch Mountains, consists mainly of black to dark-brown shale with some interbedded gray limestone and thin beds of medium- to coarse-grained partly conglomeratic sandstone. Overall thickness in headwaters of Rock Canyon, near divide between Rock Canyon and Pole Canyon, is 1,645 feet. At this locality, the shale contains a prominent ledge of gray fossiliferous limestone near the middle. In vicinity of Provo, thickness of shale is about 500 feet greater than in Oquirrh Mountains. North of thrust fault in upper American Fork, Manning Canyon shale is either absent or is represented in thin shale and limestone unit that overlies Humbug formation in some areas. Overlies Great Blue limestones; underlies Oquirrh formation.

Walter Sadlick, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 50 (table 1), 53–54, 56. Discussion of Carboniferous formations of northeastern Uinta Mountains. Correlations of beds assigned in this paper to Manning Canyon shale have been problematical. Williams (1943) apparently included these beds in the Brazer. Thomas and others (1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 16) termed them lower member of the Morgan. Baker and others (1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7) are of the opinion that the beds in the Uintas correlate with a shale and limestone sequence, exposed in American Fork and Big Cottonwood Canyons, assigned to lower Great Blue limestone. Bissell (1950, Utah Geol. Soc. Guidebook 5) suggested a correlation with the Manning Canyon shale. Untermann and Untermann (1954, Utah Geol. and Mineralog. Survey Bull. 42) believe that the beds are Pennsylvanian and may correlate with upper part of Manning Canyon shale. Because the stratigraphic unit in question is essentially black shale and its fauna and its stratigraphic relationship to either the Great Blue limestone or the Manning Canyon shale are unknown, the term "Black shale unit" has also been applied to these beds. Sadlick (1954, Jour. Sed. Petrology, v. 24, no. 2; Jour. Paleontology, v. 28, no. 4) correlated this unit with Manning Canyon shale on paleontologic evidence. Manning Canyon of Uinta Mountains contains dark-gray to black shale and limestone, with minor amounts of sandstone. On western end of Uintas, formation is essentially shale with about 11 percent limestone. About midway along length of Uintas, although exposures are poor, formation appears to be black shale with a few dark argillaceous limestone beds. In eastern Uintas, silt and sand increase

progressively eastward at expense of shale and if carbonaceous shale were not present in these clastic beds, the Manning Canyon would be separated with difficulty from shore facies of underlying Humbug. Thickness about 545 feet in Sols Canyon. Overlies Great Blue limestone and underlies Oquirrh formation in Oquirrh basin; underlies Round Valley formation (new) in eastern and western Uinta Mountains. Manning Canyon shale of Uinta Mountains has average maximum thickness of about 500 feet. Strata about 170 feet below top contain fauna regarded as upper Chesterian and represent part of *Eumophoceras-Cravenoceros* zone. Beds higher in formation contain many undescribed species and a fauna Mississippian in total aspect although a few forms suggestive of Pennsylvanian are present. Uppermost 100 feet of Manning Canyon is relatively unfossiliferous and probably contains Mississippian-Pennsylvanian boundary because no distinct unconformity can be detected in field and boundary does occur in upper parts of Manning Canyon in Oquirrh basin.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 68–69. Gilluly (1932) described 16 units (1–16 descending) in Soldier Canyon section. Section was restudied in detail for present report, and 42 units were recognized with thickness of 1,324 feet. Contact between Manning Canyon shale and overlying Oquirrh formation is placed at base of unit 1 of Gilluly's section. So selected, the contact can be readily mapped on aerial photographs since overlying beds are typically like the gray limestone ledges of lower Oquirrh formation. In writer's Soldier Creek section of Manning Canyon shale, about 64 percent of the formation is shale (865 feet), limestone slightly more than 7 percent (96 feet), and remaining 29 percent is siltstone and mudstone (363 feet). By placing unit 1 of Gilluly in Oquirrh formation, his measured section of the Manning Canyon in Soldier Creek totals only 995 feet, or 370 feet less than the 1,324 feet measured by writer. Gilluly's units 15, 13, 9, 7, 4, 3, and 2 are similar to those of writer. Units 10 to 12 of Gilluly total 95 feet; corresponding units of writer total almost 400 feet. Writer's unit 6 is almost 75 feet more than Gilluly's unit 6. Although Gilluly reported thickness 750 to 1,140 feet, only latter figure was most reliable. At present, Mississippian-Pennsylvanian boundary cannot be located accurately in type section of Manning Canyon shale. Some geologists are not convinced that shale unit in Uinta Mountains is Manning Canyon shale but believe that the shale correlates with some part of Great Blue limestone of Oquirrh basin.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 15 (fig. 4), 22, pl. 1. In East Tintic Mountains, conformably overlies Great Blue limestone and underlies Oquirrh formation. Consists of three members: lower, composed of fissile brown-weathering fossiliferous black shale; limestone member that is blue gray, medium to massive bedded, fine grained, and essentially devoid of fossils; and upper member composed principally of black, brown-weathering shale that includes many beds of dark-gray to black limestone and several lenses of brown-weathering quartzite that intergrade along strike with pebble conglomerate. Thickness about 1,050 feet.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 48–49, geol. map. Formation described in Stansbury Mountains where it is 200 to 1,600 feet thick. Three units differentiated. lower black shale, medial

dark-gray predominantly limestone unit, and upper black shale and quartzite. Overlies Great Blue limestone; underlies Oquirrh formation.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Bull. 66, p. 20 (fig. 1), 23–25. Described in Daggett County, where it is 545 feet thick, underlies Round Valley limestone and overlies Humbug formation.

R. W. Moyle, 1959, Utah Geol. Soc. Guidebook 14, p. 59–92. Described in southern Oquirrh Mountains. Gilluly named formation for exposures in Manning Canyon but stated that section in Soldier Canyon was more representative of formation. In this report, Manning Canyon section is referred to as type locality and Soldier Canyon section as type section. Most data of this report deals with Soldier Canyon section. Thicknesses: Soldier Canyon, 1,559 feet; Ophir Pass, 1,327 feet; Manning Canyon (base faulted), 1,064 feet; West Canyon (top not exposed), 1,683 feet; and Lake Mountain (top not exposed), 1,910 feet. Overlies Great Blue limestone; underlies Oquirrh formation.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 97. Conformably underlies Hall Canyon member (new) of Oquirrh formation.

M. D. Crittenden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 63–74. In view of near identity of faunas and of apparent structural continuity from Wasatch to western Uinta Mountains, it is believed that the black shale of Uinta Mountains are direct lateral equivalent of Doughnut formation in Big Cottonwood Canyon. If this is the case, neither Great Blue nor Manning Canyon is an appropriate name, and extension of term Doughnut to Uinta Mountains is proposed.

Walter Sadlick, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 75–77. Strata assigned to Manning Canyon formation in Uinta Mountains has been so designated because lithologically and paleontologically they are similar to Manning Canyon formation of Oquirrh basin. However, there is a possibility that this unit is shaly facies of Doughnut formation described by Crittenden.

Type section: Soldier Canyon, which is on north side of nose of plunging Ophir anticline approximately 3 to 3½ miles east and south of Stockton. Creek has eroded nose anticline and exposed section which crops out at mouth of canyon and then trends east to ¼ to ½ mile west of mouth of South Fork where it passes under valley floor. Measured section is on north side of canyon about one-half mile above its mouth, sec. 33, T. 5 S., R. 4 W., Tooele County. Type locality: Manning Canyon, SW¼ sec. 4, T. 6 S., R. 3 W., Utah County.

Mannington Sandstone (in Washington Formation)[1]

Mannington Sandstone (in Washington Group)

Mannington sandstone and shale member

Permian (Washington Series): Western West Virginia, eastern Ohio, and southwestern Pennsylvania.

Original references: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 226; G. P. Grimsley, 1909, West Virginia Geol. Survey, v. 4, p. 440–441.

W. O. Hickok 4th, and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135, 148. Two sandstones, lower and upper Mannington, in Washington group, are separated by Waynesburg B coal. Lower

Mannington overlies Woodglen limestone (new) and lies 105 feet above Waynesburg coal (base of group); upper Mannington lies 120 feet above Waynesburg coal.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 93, geol. map. Mannington sandstone and shale member (Washington series) in Morgan County is 30 to 45 feet thick; in southern part of county, coalesces with stratigraphically lower Waynesburg sandstone to form a nearly solid sandstone section over 50 feet thick. Since Waynesburg "A" (No. 11–A) coal is nonpersistent and Little Washington coal is not recognized in county, both basal and top boundaries of the Mannington are indefinite.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 210–212. Sandstone and shale member of Little Washington cyclothem in report on Athens County. Thickness 31 to 52 feet. Often coalesces with overlying Washington sandstone and underlying Waynesburg sandstone to form massive cliffs up to 100 feet in height.

Named for Mannington, Marion County, W. Va.

Mansfield Beds

Mansfield Red Beds (in Chemung Formation)[1]

Upper Devonian: Central northern and northeastern Pennsylvania.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 45, 100, 108.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Correlation chart shows "Mansfield beds" in New York above Fall Creek conglomerate and below Blossburg red beds. Interfinger with Dunkirk shale.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 397. Dunkirk shale outcrops from Lake Erie to Mansfield County, Pa., where the facies interfingers with Mansfield beds which are continental. [Atlas does not show any Mansfield County in Pennsylvania; town of Mansfield is in Tioga County.]

Probably named for occurrence at Mansfield, Tioga County.

Mansfield Beds[1]

Pennsylvanian: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 188–191.

Mansfield area, Bristol County.

†Mansfield Formation[1]

Precambrian: Northwestern Michigan.

Original reference: H. L. Smyth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 114–115.

Crops out at Mansfield mine and north of it near Michigamme River, in T. 43 N., R. 31 W., Felch Mountain district. Named for Mansfield, Iron County.

Mansfield Formation

Mansfield Group

Mansfield Sandstone (in Pottsville Group)[1]

Lower and Middle Pennsylvanian: Southwestern Indiana.

Original reference: T. C. Hopkins, 1896, Indiana Dept. Geology and Nat. Resources 20th Ann. Rept. 1895, p. 186–213.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 87 (fig. 1), 88–89. Mansfield group includes Ferdinand and Fulda limestones (both new).

F. D. Spencer, 1953, U.S. Geol. Survey Circ. 266, p. 14 (fig. 4). Hindostan beds occur in lower part of Mansfield sandstone.

D. J. McGregor, T. C. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 2. Mansfield formation, which ranges from 250 to 300 feet in thickness, includes many rock types: crossbedded and wavy-bedded fine- to medium-grained sandstone, locally conglomeratic; gray, commonly silty shale that in many places carries ironstone concretions; thin discontinuous beds of coal and clay; and one thin bed of marine limestone and chert near top. Regional unconformity separates the Mississippian from the Pennsylvanian. Pre-Pennsylvanian erosion has removed progressively older Chester formations at increasing distances north of Ohio River. Because Mansfield directly overlies rocks of late Chester age near Ohio River in Perry County and rests directly on Ste. Genevieve limestone of late Meramec age in central Putnam County, base of Mansfield had descended through a stratigraphic interval of approximately 600 feet in distance of 125 miles. In southern part of area, Mansfield generally rests on Tar Springs formation; to the north, it is typically on Golconda formation; where it rests on a clastic formation in Chester series, distinction between rocks of early Pennsylvanian and Chester age is difficult. Outcrop belt extends in northwesterly direction from Ohio River to Warren County; strata have regional westerly and southwesterly dip of approximately 25 to 30 feet per mile, and main Mansfield outcrop lies immediately west of Chester outcrop belt. In Pottsville series.

F. E. Kottlowski, 1959, U.S. Geol. Survey Coal Inv. Map C–28. Designated formation since it is mappable unit containing large amounts of shale, thin beds of coal, underclay, and limestone and is only locally predominantly sandstone. Thickness about 60 feet. Underlies Brazil formation.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 22–29, pl. 1. Described in Huron area. As now defined, includes all rocks of Pennsylvanian age below Lower Block coal which forms base of overlying Brazil formation. Divisible into two parts designated as lower and upper. Boundary of lower and upper parts placed at top of Pinnick coal member (new) or at inferred equivalent horizon where coal is absent. Upper part, about 160 feet thick, includes Blue Creek coal member (new) about 100 feet above base. Lower part, 50 to 150 feet thick, includes Pinnick coal member at top and French Lick coal member (new) about 50 feet below top. Unconformably overlies Glen Dean limestone (restricted) of Stephensport group (redefined).

Named for Mansfield, Parke County.

Mansfield Group[1]

Mansfield Subgroup (of Sabine Group)

Eocene: Northwestern Louisiana and western Mississippi.

Original references: E. W. Hilgard, 1869, Am. Jour. Sci., 2d, v. 48, p. 340–341; 1869, Prelim, rept. geol. reconn. Louisiana, p. 8–9.

H. V. Howe and J. B. Garrett, Jr., 1934, Louisiana Dept. Conserv. Geol. Bull. 4, p. 9. Term Mansfield, used by Hilgard (1869) for lignitic beds in northwestern Louisiana, is proposed as a subgroup term of the part of the Sabine group below and the Wilcox equivalents.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 91. Midway group as redefined in Louisiana includes Mansfield subgroup of Howe and Garrett (1934).

C. O. Durham, Jr., and C. R. Smith, 1958, Louisiana Dept. Conserv. Geol. Pamph. 5, p. 10–12. Discussion of Louisiana Midway-Wilcox correlation problems and the validity of subdivisions of the lower Wilcox. Term Mansfield subgroup as used by Howe and Garrett (1934) is used informally for the lower Wilcox although it embraces the subdivisions Naborton, Logansport, and Hall Summit of Murray (1941; 1948). As a term, "Mansfield" allows one name to be assigned to a subgrouping of Wilcox formations which are predominantly continental but contain sufficient fauna to be assigned to the Paleocene. "Mansfield" thus comprises the thicker Louisiana counterpart of Naheola formation of Alabama. Use of the several formational names of Murray is voided in present report because recent work in Sabine, Red River, and Caddo Parishes has indicated need for their revision.

Named for exposures near Mansfield, De Soto Parish, La.

Mansfield Iron-Bearing Slate Member (of Hemlock Formation)

†Mansfield Formation or Slate[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: J. M. Clements, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 36–48, 62, pl. facing p. 84.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 36. Consists in part of chert-siderite iron-formation and in part of slate, with a maximum thickness of about 500 feet. Occurs within lower third of formation; thus, is stratigraphically below newly defined Bird iron-bearing member.

Named for Mansfield mine, Crystal Falls district, Iron County.

†Manti Beds[1]

Eocene, lower: Central Utah.

Original reference: E. D. Cope, 1880, Am. Nat., v. 14, p. 303–304.

Wasatchian: J. A. Dorr, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2.

Apparently named for Manti, Sanpete County.

Mantua Lentil (in Polecat Bench Formation)

Paleocene: Northwestern Wyoming.

G. L. Jepsen *in* W. B. Scott, 1937, A history of land mammals in the Western Hemisphere: New York, Macmillan Co., p. 99; 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 233–234, 238 (table). Proposed for massive sandstone, about 130 feet thick, at base of formation; contains diagnostic vertebrate fauna that correlates, approximately, with type Puerco. About 70 feet below Rock Bench quarry beds (new). Underlain by thin coal bed below which dinosaur bones, teeth, and tracks are preserved.

Type section: In sec. 31, T. 57 N., R. 98 W., Park County. Name derived from Mantua coal mines and railroad siding.

Manuelitas Member (of Tererro Formation)

Lower Mississippian: Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754–1756, 1760, 1762–1763, 1769–1770, 1771, 1772,

Crystalline limestone, limestone pebble and cobble conglomerate, and calcarenite. In many areas, beds were involved in collapse into large sink holes in Macho member (new) and Espiritu Santo formation (new). Thickness 45 feet at type locality; 25 feet in Pecos River Canyon; as much as 27 feet in southeastern part of Sangre de Cristo Mountains; and as much as 38 feet in north-central part of mountains. Unconformably underlies Cowles member (new). Fossils indicate Early Mississippian age.

Type locality: Gap in hogbacks on Manuelitas Creek 1.6 miles east of Lower Rociada, northwestern San Miguel County.

Manzanan series[1]

Pennsylvanian: New Mexico.

Original reference. C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

Derivation of name not given.

Manzanita Dacites[1]

Manzanita Lake Lavas

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 304–306, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 679. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2). Manzanita Lake is in northwestern part of Lassen Volcanic National Park. Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Manzanita Limestone Member (of Cherry Canyon Formation)

Permian (Guadalupe Series): Western Texas.

P. B. King *in* F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 92. Cherry Canyon formation is divided into (ascending) Getaway, South Wells, and Manzanita limestone members.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 580–581, 585 (fig. 7), pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 36–38, pl. 3 [1949]. Consists of buff earthy limestone in rather thick beds, with many geode cavities; beds weather to characteristic orange-brown color; intercalated are several beds of volcanic ash and each bed averages about a foot in thickness; locally the ash is altered to green chert resembling turquoise; southward near Long Point, member changes into lumpy, slabby dark-gray limestone containing beds of volcanic ash. Thickness 25 to 100 feet. Lies near top of formation about 100 feet above South Wells limestone member.

Type section: On Nipple Hill east of Manzanita Spring, near Frijole post office, Culberson County. Widely exposed in southern Guadalupe Mountains where it forms first prominent bed below limestone ledges of Hegler and Pinery members of Bell Canyon formation.

†Manzano Group[1]

Permian: New Mexico.

Original references: C. L. Herrick, 1900, Am. Geologist, v. 25, p. 337; Jour. Geology, v. 8, p. 112–126.

Christina Lochman-Balk, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 106. Recent mapping has recognized four or five forma-

tions (ascending): Bursum, Abo, Yeso, Glorieta sandstone, and San Andres limestone in this series of beds; term Manzano group has lapsed from usage and should be abandoned.

U.S. Geological Survey has abandoned the term Manzano Group.

Derivation of name not stated.

Map Beds or Formation

Miocene: Caroline Islands (Map and Yap).

Risaburo Tayama, 1935, Topography, geology, and coral reefs of the Yap Islands: Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 19, p. 30–36 [English translation in library of U.S. Geol. Survey, p. 26–32]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 61–62, table 4 [English translation in library of U.S. Geol. Survey, p. 72–73]. Consists of lower unit composed largely of breccia and an upper unit consisting of alternate layers of sandstone, shale, tuff, and marl with conglomerate at base; well bedded. Nonconformably overlies Yap formation.

Chiefly on Map Island, Yap group.

Maple Hill Limestone Member (of Zeandale Limestone)

Maple Hill Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, western Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 80.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42, 43, 44. Underlies Langdon formation and overlies Wamego shale (both new).

F. C. Greene and W. V. Searight, 1949, Missour Geol. Survey and Water Resources Rept. Inv. 11, p. vii, 21. Generalized section shows Maple Hill limestone present in Missouri. Overlies Wamego shale and underlies Langdon shale. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, and Nebraska, May 1947.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. Rank reduced to member status in Zeandale formation (new). Overlies Wamego shale member; underlies Pillsbury shale (new), which name replaces Langdon shale.

Well exposed in Maple Creek, about 2 miles southwest of Maple Hill, Wabaunsee County, Kans.

Maple Mill Formation (in Hannibal Group)

Maple Mill Shale (in Kinderhook Group)[1]

Lower Mississippian (Kinderhook): Southeastern Iowa and western Illinois.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 322.

L. A. Thomas, 1949, Geol. Soc. America Bull., v. 60, no. 3, p. 407–408. On basis of conodont assemblage, Maple Mill is redefined as uppermost Devonian shale. Underlies English River siltstone.

M. A. Stainbrook, 1950, Am. Jour. Sci. v. 248, no. 3, p. 209, 210, 211, 212. Not a member of Hannibal formation. Macrofauna is related to Mississippian rather than to Devonian fauna. Kinderhook succession in upper

Mississippi valley seems to be (ascending) Maple Mill shale, English River siltstone, Louisiana limestone, Hannibal shale and siltstone, and Chouteau limestone.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 23–27. In this report name Maple Mill is used for shale overlying the Glen Park, or where Glen Park is absent, the Louisiana, Saverton, or older rocks; overlain in apparent conformity by English River or Chouteau, and where these are absent, overlain unconformably by Osage. Local black shale facies in west-central part of state is differentiated Nutwood member. Thickness varies inversely with ridges and troughs in Glen Park siltstone; thickness of gray Maple Mill decreases abruptly where it grades laterally into black Maple Mill (Nutwood member); locally, interval between Glen Park and Osage is entirely black shale. Maximum thickness 64 to 70 feet; commonly less than 30 feet where it extends over Vandalia arch. Correlation of Maple Mill (as used in this report) with type Maple Mill in central Iowa uncertain; type section may include beds equivalent to Saverton of this report.

Type locality not stated. Maple Mill section described by Bain is in SE¼NW¼ sec. 4, T. 7 N., R. 8 W., Washington County, Iowa. Beds 1 and 2 of the section represent Maple Mill shales.

Maple Ridge Porphyry

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 41, 43 (map 2). Flow unit of dark biotite-augite andesite(?). Overlies Shoal Creek breccia (new). Stratigraphically below Cove Mountain formation (new). Maximum thickness 300 feet. Name credited to H. R. Blank (unpub. thesis).

Makes up most of Maple Ridge, in west-central part of Bull Valley district, Washington County.

Maple Summit Sandstone

Upper Devonian (Chautauquan): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 8–9. Name will probably be used, following more definitive study of area, for unit here termed Sandstone A and described as a member (or parvafacies) consisting of sandstones with a few interbedded shales. Both sandstones and shales are micaceous. Sandstones often coarse-grained; lenses of conglomerate containing both quartz pebbles and clay galls not uncommon. Channel fillings occur on bottom of sandstone layers. Thickness 386 feet in Youghiogheny Gorge through Laurel Hill. Conformably underlies Sandstone B (Youghiogheny sandstone); base not exposed.

Type exposure along cuts of Baltimore and Ohio Railroad about 1 mile west of Bidwell, Fayette County.

†Mapleton Granite[1]

Devonian: Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 105–106, 146–148.

Named for occurrence on low rounded hill in northeast corner of Mapleton Township, Aroostook County.

Mapleton Sandstone[1]

Upper Devonian: Northeastern Maine.

Original reference: H. S. Williams, 1899, Am. Jour. Sci., 4th ser., v. 8, p. 360, footnote.

W. S. White, 1943, U.S. Geol. Survey Bull. 940–E, p. 129. Upper Devonian.

Outcrop area includes eastern part of Mapleton Township, Aroostook County.

Maplewood Shale[1] (in Clinton Group)

Maplewood Shale Member (of Clinton Formation)

Middle Silurian: Western New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

R. M. Leggette, L. O. Gould, and B. H. Dollen, 1935, Ground water resources of Monroe County, New York: Monroe County Regional Plan. Board. p. 26, fig. 11. Geologic column of Monroe County, shows Maplewood shale overlies Thorold (Oneida) sandstone and underlies Brewer Dock (Bear Creek) shale. Thickness 18 feet. Member of Clinton formation.

T. G. Payne, 1938, Rochester Mus. Arts and Sci. Guide Bull. 5, p. 69. Formation in Clinton group. Overlies Thorold sandstone: underlies Brewer Dock shaly limestone member of Reynales formation. Thickness 21 feet.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 3. Correlation chart shows Maplewood shale at base of Clinton group. Niagaran series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Maplewood shale, Clinton group, included in Ontarian stage, Middle Silurian.

Well exposed in Genesee Gorge at Maplewood Park, Rochester, Monroe County.

Maquam Group

Middle Ordovician (Chazyan): Northwestern Vermont.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Named to include Carman quartzite and overlying Youngman formation. Overlies Beldens formation.

Named for Maquam Bay 6 miles south of type sections of both formations at Highgate Springs, Franklin County.

Maquinita Granodiorite

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 56–59, pl. 1. Gray to dark gray, homogeneous, well foliated, and strongly lineated. In some exposures, foliation is faint, but lineation is well marked in all the granodiorite. Locally rock is flaser (lenticular) granodiorite. Intruded Moppin metavolcanic series (new); contact with amphibolites of Moppin series appears to be sharp and parallel with schistosity of the wall rock. Emplaced earlier than Tres Piedras granite (new).

Type locality: In Maquinita Canyon, secs. 3 and 4, T. 28 N., R. 7 E., Las Tablas quadrangle, Rio Arriba County. Plutons lie between American and Cow Creeks, on part of lower north slope of Tusas Mountain, along west side of upper Tusas Valley southeast and northwest from Maquinita

Canyon, and along part of Duran Canyon. Small dikes in area from just north of Burned Mountain to Hopewell and Buckhorn Gulch.

†Maquoketa Series[1]

Ordovician: Upper Mississippi Valley States.

Original reference: F. W. Sardeson, 1897, Am. Geologist, v. 19, p. 330–336.

Maquoketa Shale (in Richmond Group)[1]

Maquoketa Group or Formation

Upper Ordovician: Eastern Iowa, western Illinois, southern Minnesota, eastern Missouri, and southwestern Wisconsin.

Original reference: C. A. White, 1870, Iowa Geol. Survey, v. 1, p. 180–182.

Samuel Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60 (table), 94–109. Maquoketa beds (or formation) divided into (ascending) Elgin shaly limestone, Clermont shale, Fort Atkinson limestone, and Brainard shale members (all new). Overlies Galena limestone; underlies beds belonging to Wapsipinicon stage of Devonian. Table (p. 60) refers to Maquoketa stage, Trenton series.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 90–93, measured sections. Formation in southeastern Minnesota comprises Dubuque member below and Wykoff member above. Overlies Stewartville member of Galena formation; in some areas, underlies Devonian Cedar Valley limestone; in some areas, covered by glacial drift.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 259. In zinc-lead district, Wisconsin, Illinois, and Iowa, Maquoketa shale (Upper Devonian) is commonly grayish dolomitic shale and dolomite. Thickness 110 feet in southern part of district; thickens northeast to 240 feet in locality 25 miles west of Madison, Wis.; thickens to northwest, 220 to 260 feet being common northwest of Dubuque, Iowa. Characterized by facies changes. Appears to lie conformably on the Galena; underlies Silurian dolomite.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1029 (fig. 1), 1042, pl. 1. In Fillmore County, Minn., Ordovician rocks above Dubuque formation are assigned to Maquoketa formation, which is not differentiated into members. Relation of these rocks to members of Maquoketa in Iowa is not known, and relation of Sardeson's (1892) Wykoff formation to body of Maquoketa is uncertain. Formation consists of about 70 feet of argillaceous dolomitic limestone that is massively bedded, generally microangular, grayish yellow, vuggy in lower part, and poorly fossiliferous except in streaks; at top is a thin bed with sand and abundant chert and quartz granules.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 9 (fig. 2), 12–15, pl. 1. Formation described in Bowling Green quadrangle, Pike County, Mo., where it is typically thin laminated shale which is interbedded with shaly limestone layers. Average thickness about 100 feet. Unconformably overlies Middle Ordovician Kimmswick formation; where Edgewood is absent, a phosphatic conglomerate of Grassy Creek formation lies immediately above Maquoketa. Upper Ordovician (Richmond).

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, p. 513–547. In this report, Upper Ordovician rocks in western Indiana

and eastern and southern Illinois are assigned to Maquoketa group, composed of (ascending) Eden shale, Cape limestone (new), and Orchard Creek shale. Upper Ordovician rocks in northwestern Illinois and eastern Iowa are assigned to Maquoketa shale.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 22–31, pls. 1, 3. Described in Dubuque South quadrangle, Iowa-Illinois. Divided into three lithologic units (ascending) brown shaly unit, Brainard member, and Neda member. Thickness 114 to 250 feet. Overlies Dubuque shaly member of Galena dolomite; underlies Mosalem member (new) of Edgewood dolomite. Upper Ordovician.

Named for exposures on Little Maquoketa River, Dubuque County, Iowa.

†Marais des Cygnes coal series[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 22–24.

Named for exposures on Marais des Cygnes River, Kans.

†Marais des Cygnes Shales[1]

Pennsylvanian: Kansas and Missouri.

Original reference: C. R. Keyes, 1900, Iowa Acad. Sci. Proc., v. 7, p. 84.

Named for Marais des Cygnes River, Kans.

Marathon Conglomerate[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 362.

Occurs in and near Marathon, Marathon County.

Marathon Limestone[1]

Lower Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066–1069, 1079.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 8–19, strat. sections. As measured in Marathon anticlinorium, limestone is between 840 and 890 feet thick. Divisible into three parts: Monument Spring dolomite member and beds above and below it. In Dagger Flat anticlinorium, limestone is intensely folded and faulted; no continuous section can be measured on northwest limb, and only a partial section on southeast limb. In Solitario and old Jones Ranch areas, Alsate shale is absent between characteristic limestones of Marathon limestone and Fort Pena formation; in its place is a white to buff quartzose sandstone 20 to 50 feet thick that is here named Rodriquez Tank sandstone. Graptolite faunas discussed. Tremadoc fossils found 25 feet above contact with Dagger Flat sandstone and 225 feet below contact. If Tremadoc belongs in Ordovician, as is now commonly considered, then, with exception of uppermost graptolite zone, Marathon is Early Ordovician. Top 30 feet is Whiterock (early Middle Ordovician) age.

Named for exposures in town of Marathon, Brewster County.

Marathon sandstone member[1] (of Ithaca facies subgroup)

Upper Devonian: South-central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Sandstone included in Ithaca shale.

Occurs in Ithaca region.

†Marathon Series[1]

Upper Cambrian and Lower and Middle Ordovician: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 37–38.

Marathon region.

Maravilla dolomite[1]

Permian: Texas.

Original reference: C. R. Keyes, Feb. 1936, Pan-Am. Geologist, v. 65, no. 1, p. 42, 49, 50.

Named for intermittent stream that flows by Marathon town to Rio Grande but heads in the Glass Range, where it is the drainage channel of the deep Gilliland Canyon.

Maravillas Chert[1]

Upper Ordovician: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 38–39.

J. L. Wilson, 1954, Am. Assoc. Petroleum Geologists Bull, v. 38, no. 12, p. 2458 (fig. 2), 2460 (fig. 3), 2462, 2463. In Marathon folded belt, West Texas, underlies Persimmon Gap shale (new); overlies Woods Hollow formation.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005. p. 6. 13, 27–31, 33–34, 36, 113–116. On basis of graptolite fauna, Maravillas chert represents late Middle Ordovician and all of Late Ordovician.

Named for Maravillas Gap, Brewster County.

Marble Limestone

Precambrian (Chuaran series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112–113. Limsetone bed, 15 feet in thickness, which occurs in midst of the great shales-section of this region. Top layer is characteristic *Stromatopora* zone. Underlies Final shales (new); overlies Venus formation (new).

Its name refers to its fine exposures in a deep side-canyon opening into Marble Canyon from the Nunkoweap Valley; Grand Canyon region.

Marble Cliff Limestone (in Columbus Limestone)[1]

Middle Devonian: Central Ohio.

Original reference: C. S. Prosser and W. C. Morse, 1915, Outlines of field trips in geology in central Ohio, p. 14, 17.

Well exposed in banks of Scioto River and at Marble Cliff, Franklin County.

Marble Falls Limestone (in Bend Group)[1]

Marble Falls Group

Lower and Middle Pennsylvanian: Central Texas.

Original reference: R. T. Hill, 1889, Am. Geologist, v. 3, p. 289.

N. H. Darton, L. W. Stephenson and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Lower formation in Bend group; underlies Smithwick shales.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 80. In this report, type Marble Falls beds are considered a group, being part of Morrow series. Underlies Big Saline group (new).

F. B. Plummer, 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 33, p. 3, 5, 6, 8. Marble Falls limestone includes [sequence not stated] Lemons Bluff (new), Big Saline, and Sloan (new) members.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 64–69. Consists generally of dark-gray and black siliceous fossiliferous limestones and black shales; upper limestones grade eastward into shales. Thickness 30 to more than 400 feet. Divided into four units (ascending): Lemons Bluff member, Big Saline member, Sloan member, and Gibbons conglomerate lentil (new). Underlies Smithwick shale; overlies Barnett formation in some places and in others the Ellenburger.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 181–183. Presence of fusiform fusulinids in Marble Falls limestone indicates that formation is post-Morrow in age. If Morrow beds are present at all in type Marble Falls, only a small part of lower part could be so classified, and, until some evidence of its Morrow equivalence is found, beds at Marble Falls should be regarded as post-Morrow in age. Term Marble Falls should be restored to its former meaning; that is, to include all beds at Marble Falls and equivalent beds in other parts of central Texas. Included in Atoka series.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142–146. Big Saline formation east of Cavern Ridge comprises (ascending) Gibbons conglomerate, Aylor oolite, Lemons Bluff spiculite, and Brister limestone members. Term Big Saline limestone as used east of Cavern Ridge includes the type section of the Marble Falls limestone and other sections of the Marble Falls limestone east of Cavern Ridge discussed by Thompson (1947, Jour. Paleontology, v. 21, no. 2, p. 147–164).

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 46–77. Group comprises Sloan formation below and Big Saline formation above. Underlies Smithwick formation.

Type locality: Exposure along banks of Colorado River from dam at Marble Falls to base of strata 1 mile below highway bridge at Marble Falls, Burnet County.

Marblehead Limestone Member (of Columbus Formation)[1]

Middle Devonian: Northwestern Ohio.

Original reference: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 75, 746–750, 758.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 276 (fig. 1). Underlies Venice member; overlies Bellpoint member.

Named for Marblehead Peninsula, near Sandusky, Erie County.

Marble Hill Marble (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana.

Original reference: D. D. Owen, 1859, Rept. geol. reconn. Indiana made in 1837, p. 28, 29.

Named for Marble Hill, near Madison, Jefferson County.

Marblemount Quartz Diorite

Pre-Mesozoic: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map). Sheared and partly metamorphosed to chloritic schist. Earlier than Mesozoic folding. Older than Skagit gneisses.

Marblemount is in Skagit County.

Marble Point Stage

Marble Point Till

Pleistocene: Southwestern Montana.

W. B. Hall, 1960, Billings Geol. Soc. [Guidebook] 11th Ann. Field Conf., p. 197–199. Discussion of multiple glaciation in Madison and Gallatin Ranges. Three stages recognized: Marble Point (oldest), intermediate, and Sawmill. Marble Point is most extensive episode in area. Marble Point till is present at elevation of more than 8,000 feet. Apex till (new) is present at average elevation of 9,000 feet. Believed that high-level glacial episode, represented by Marble Point and Apex tills, is either early Wisconsin in age or only slightly older.

Named for till deposit on Marble Point, secs. 4 and 9, T. 9 S., R. 4 E., Gallatin County.

Marburg Schist

Marburg Schist (in Wissahickon Formation)

Lower Paleozoic(?) (Glenarm Series): Western Maryland and southwestern Pennsylvania.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346–347. Blue and green muscovite-chlorite schist and chloritoid schist with infolded quartzite beds; probably in part equivalent to Ijamsville phyllite (new). Lies northeast, east, and southeast of area of Ijamsville phyllite, volcanic flows, and Wakefield marble (new). In York County, Pa., the Marburg lies northwest of albite-chlorite schist facies of the Wissahickon, and extends northeastward into area of McCalls Ferry quadrangle where it [Marburg] is much coarser in grain, contains abundant muscovite, and was included with the Wissahickson by Knopf and Jonas (1929). Glenarm series. Precambrian(?).

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Marburg schist mapped with Wissahickon formation. Probably Lower Paleozoic.

Named from Marburg, York County, Pa. Stratigraphically continuous into Carroll County, Md.

Marca Shale Member (of Moreno Formation)

Upper Cretaceous: Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1954; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 9, pls. 2, 3, 4, 5. White-weathering calcareous shale, 300 feet thick. Underlies Dos Palos shale member (new); overlies Tierra Loma shale member

(new). On basis of this mapping, it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch.

Type locality: Escarpado Canyon, secs. 7 and 8, T. 15 S., R. 12 E., Panoche Hills, Fresno County. Escarpado Canyon is 6 miles south of Moreno Gulch and 2 miles north of Panoche Creek. Named for Marca Canyon with mouth at center sec. 13, T. 14 S., R. 12 E.

Marcellon Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 519.

Occurs in sec. 7, town of Marcellon, Columbia County.

Marcellus Shale (in Hamilton Group)[1]

Marcellus Shale Member (of Romney Shale)

Marcellus Member (of Millboro Shale)

Middle Devonian: New York, western Maryland, New Jersey, Ohio, eastern and central Pennsylvania, Virginia, and West Virginia.

Original reference: J. Hall, 1939, New York Geol. Survey 3d Rept., p. 295–296; L. Vanuxem, 1840, New York Geol. Survey 4th Rept.

G. A. Cooper, 1930, Am. Jour. Sci., 5th ser., v. 19, no. 110, p. 129–134. Marcellus of this report [Hamilton group of New York] is used in same way as Vanuxem used it in 1840 and is placed in Hamilton group as formation correlative in rank with Skaneateles and other formations. Upper limit of Marcellus is base of Stafford and Mottville members of Skaneateles; lower limit is Onondaga. Following divisions recognized: Oatka Creek shale, Chittenango, Cherry Valley, Union Springs, Cardiff shale, Bridgewater, and Pecksport members.

G. A. Cooper, 1933, Am. Jour. Sci., 5th ser., v. 24, no. 156, p. 543–551. Marcellus, in region east of Schoharie contains Berne and Otsego members. Name Berne is used for shale that is equivalent in Berne quadrangle to Union Springs, Cherry Valley, and Chittenango members. In Schoharie Valley, the Panther Mountain shale and sandstone includes upper part of the Marcellus, the Skaneateles, and the Ludlowville, which cannot be separated lithologically. Suggested that name Panther Mountain be used in Susquehanna and Cherry Valley for interval between Solsville and Portland Point members where Pecksport and Mottville are lithologically indistinguishable and Skaneateles and Ludlowville cannot be separated on this basis.

Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 202–204. Formation, in central Pennsylvania, is 200 to 675 feet. Includes (ascending) Shamokin black shale, Turkey Ridge sandstone, Mexico sandstone, and Mahanoy black shale members. Underlies Mahantango formation; overlies Onondaga. Hamilton group.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 42–43. Member of Millboro shale. Thickness 100 to 150 feet. Overlies Naples member.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 308-317. Millboro shale used for mappable unit because Marcellus and Naples constituents cannot be readily separated and mapped. Includes only Marcellus and Naples (basal Portage) shales of original Romney.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 179–180; G. A. Cooper, 1943, *in* Winifred Goldring, New York State Mus. Bull. 332, p. 247–279. Includes Stony Hollow member (new) which is equivalent to Cherry Valley limestone. Beds hitherto classified as "Marcellus" shale (Bakoven of Chadwick) immediately underlie Stony Hollow member and are now proved to be equivalent of Union Springs member. The Stony Hollow underlies Mount Marion formation of Grabau at its type section; hence, the Mount Marion is interpreted as sandy facies of Chittenango black shale member of Marcellus overlying Cherry Valley to west.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Because of presence of *Paraspirifer* in the Mottville and its abundance below the Mottville in eastern New York, seems best to transfer the Mottville-Stafford to the Marcellus.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County Rept. 14, p. 87–88. Middle Devonian of Maryland is included in single formation, the Romney, which is divided into Onondaga, Marcellus, and Hamilton members. Thickness of Marcellus about 500 feet.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 27, pl. 1. In western part of trip area, relationship with underlying Onondaga is largely transitional; in Mifflin, Juniata, and Perry Counties, contact is sharp. Marcellus is typically dark-gray to black thin-bedded or laminated partly calcareous shale; numerous large limestone concretions present and pyrite common. In Juniata, Mifflin, and Perry Counties, Marcellus subdivided into (ascending) Shamokin shale, Turkey Ridge sandstone, and Mahanoy shale. Total thickness increases in this area, and formation apparently intertongues with overlying Montebello sandstone. Thickness 75 to 500 feet.

Type section (Cooper, 1930): Slate Hill, about 1 miles south of Marcellus. Complete section exposed in Jackknife ravine on northeast slope of hill. Named for exposures at Marcellus village, Onondaga County, N.Y.

Marcem Formation

Middle Ordovician (Mohawkian): Southwestern Virginia and northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 76–77, chart 1 (facing p. 130). Name applied to unit consisting of conglomerate at base with light-gray to pink massive calcarenite above. Minor parts of shale, mudstone, and calcilutite may be present. Thickness 120 to 300 feet. Underlies Lincolnshire formation. Name attributed to B. N. Cooper and G. A. Cooper.

Named from Marcem quarry 2 miles west of Gate City, Scott County, Va. Occurs along northwest base of Clinch Mountain west of Gate City.

Marcy Anorthosite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing, 1899, New York State Geologist 18th Ann. Rept.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 19–21, table 3, pl. 4. Discussion of Adirondack igneous rocks and their metamorphism. Main

massif of anorthositic rocks occupies about 1,200 square miles. Two facies of the anorthositic rocks have been defined, named, and differentiated on published geologic maps. One facies, the Whiteface, originally named by Kemp (1898), is almost wholly restricted to borders of anorthosite masses. Miller (1919 New York State Mus. Bulls. 213, 214) named the rock characteristic of the core of the anorthosite massif the Marcy anorthosite and described it as typically bluish-gray coarse- to very coarse-grained anorthosite with less than 10 percent dark minerals. Terms Marcy and Whiteface have thus been used in sense of formation names rather than of closely defined rock types, and it is with this significance that the terms are used in this report. Locally, there are belts of anorthositic rocks which do not fit the requirements for either the Marcy or Whiteface facies and term "transitional facies" is used to cover them. "Border facies" includes both the Whiteface and "transition" facies and in addition, as along exposed border of St. Regis-Marcy anorthosite, a facies which has coarse Marcy txeture but is commonly gabbroic anorthosite and contains garnet.

Named for exposures on Mount Marcy, Essex County.

Maremu (Marem) Beds or Formation

See Malam Beds or Formation.

†Mareniscan Series[1]

Precambrian: Michigan.

Original reference: C. R. Van Hise, 1892, U.S. Geol. Survey Bull. 86, p. 490.

Name derived from Marenisco Township, south of Gogebic Range, Gogebic County, where these rocks have a typical development.

Maretburg facies (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 212–214. Consists of (1) limestone, generally bedded, siliceous, dense, and in places massive; and (2) shale, in zones of various thickness up to 5 or 6 feet, distributed throughout formation, and in a basal member up to 18 feet thick, bounded by bands of glauconite. Thickness 35 to 60 feet. Contains Cummins Station member (new) at base. Merges with Steels Knob facies (new) on west and Hummel facies (new) on east. Underlies unclassified Upper Mississippian rocks; overlies Floyds Knob formation.

Type section: Along Louisville and Nashville Railroad and nearby hillsides, midway between Maretburg and Brodhead, one-half mile west of Cummins Station, Rockcastle County. Named for town of Maretburg, west-central Lincoln County.

Margeson Creek Gneiss

Precambrian: Northern Michigan.

J. E. Gair and K. L. Wier, 1956, U.S. Geol Survey Bull. 1044, p. 18–27, pl. 1. Consists mainly of banded gneiss of granodioritic to tonalitic composition and granitic rocks ranging in composition from granite to tonalite; granitic rocks are mainly inequigranular and well foliated; less common are equigranular nonfoliated and pegmatitic varieties. Unconformably underlies Randville dolomite. Rocks of the Margeson Creek gneiss were considered "Archean" in age by earlier workers. Present

study corroborates this conclusion although term "Archean" is not used. The gneiss is in a position analogous to lower Precambrian granitic and gneissic rocks of Dickinson County although it does not necessarily correlate with them.

Name derived from Margeson Creek along which there are many exposures in sec. 12, T. 44 N., R. 32 W.; secs. 6 and 7, T. 44 N., R. 31 W.; and sec. 31, T. 45 N., R. 31 W., Kiernan quadrangle, Iron County.

Maria Formation

Post-Cambrian (probably upper Paleozoic) : Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 25–28. Consists of crystalline limestone, gypsum beds, quartzites, and schists. In southern half of western area, the Maria is characterized by an escarpment 1,000 to 1,500 feet high. In the face of the escarpment, Maria beds strike northeast and dip 30° to 40° NW. Unconformably overlies Chuckwalla complex (new).

R. A. Hoppin, 1954, California Div. Mines Spec. Rept. 36, p. 8–15, 24. Described in connection with gypsum deposits in Palen Mountains. Lies in fault contact (may or may not be reverse) with sediments tentatively assigned to McCoy Mountains formation. Upper Paleozoic(?).

Named for typical occurrence in the Maria and Little Maria Mountains, Palm Springs-Blythe area, Riverside County.

Maria Plutonic Complex

Upper Paleozoic(?) : Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 29–32, pl. 4. Contains crystalline dolomitic limestones, quartzites, and schists, cut by dioritic and granitic rocks, usually in the form of sills, and by many pegmatite dikes; metasediments are granitized and locally injected lit-par-lit by pegmatitic granite. Both the diorite and the granite are younger than the Paleozoic Maria beds [formation]; hence, they may be late Paleozoic or even as young as late Mesozoic. They are tentatively assigned to late Paleozoic.

Covers an area of about 10 square miles in Maria Mountains, Palm-Springs-Blythe area, Riverside County.

Maria Creek Limestone Member (of Shelburn Formation)

Maria Creek Limestone

Upper Pennsylvanian: Southwestern Indiana.

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 125. Incidental mention as Maria Creek limestone.

F. E. Kottlowski, 1954, U.S. Geol. Survey Coal Inv. Map C–11. Formally named Maria Creek limestone member of Shelburn formation. Consists of a basal limestone unit 6 inches to 6 feet thick and an upper limestone unit 3 to 10 feet thick; limestones are separated by 2 to 11 feet of varicolored shale. Member varies both laterally and vertically, one or more units generally being absent locally. Thickness of member at type section 6½ feet. Separated from underlying Busseron member by a shale and sandstone interval that contains coal beds; overlain by gray sandy shale as much as 27 feet thick. Name credited to George Heap (unpub. thesis).

Type section: NE¼SE¼ sec. 9, T. 6 N., R. 8 W., Sullivan County. Named for exposures along Maria Creek, 4 miles east of Carlisle.

Mariana Limestone

Pliocene and Pleistocene: Mariana Islands (Tinian and Saipan).

Risaburo Tayama, 1936, Geomorphology, geology, and coral reefs of Tinian Island together with Aguijan and Naftan Islands: Tohoku Univ., Inst. Geology and Paleontology Contr. in Japanese Language no. 21, p. 26–27, 31 [English translation in library of U.S. Geol. Survey, p. 25–27, 31-32]. Coralline limestone with conglomerate at base; locally a *Halimeda* limestone. Unconformably overlies rocks older than Carolinas limestone.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 12–13. Consists of white to yellowish-white poorly stratified soft to hard porous limestone. Unconformably overlies Naftan limestone.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 78–84, pl. 2, chart 1. On Saipan includes: rubbly facies of impure fragmental limestones; *Acropora*-rich facies of calcareous clays and impure limestones; massive facies of mainly unbedded porous clastic to constructional limestones; and *Halimeda*-rich facies. Thickness ranges from featheredge to probably more than 400 feet thick, and perhaps 500 feet or more. Unconformably above Tagpochau limestone; older than Tanapag limestone. Naftan limestone of Tayama (1938) included in Mariana of this report; it is part of *Halimeda*-rich facies. Pleistocene. Standard reference section designated.

Reference section: Exposures in area known as Dandan (southeastern Saipan). This site refers to that part of Dandan included between Wallace Highway at north, Dandan Point at south, Laulau Bay at east, and Gonno Cliffs at west.

Marianna Limestone (in Vicksburg Group)[1]

Oligocene, middle: Western Florida, southern Alabama, and Mississippi.

Original reference: L. C. Johnson, 1892, Geol. Soc. America Bull., v. 3, p. 128–132.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1324–1329. Sediments included in formation consist of soft chalky limestone, locally called chimney rock; some local, hard limestone; tough to hard ledges in the chimney rock; sandy glauconitic limestone; marl; calcareous sand; lignitic clay. Thickness probably not more than 60 feet. In Mississippi and western Alabama, includes Mint Spring marl member in basal part. At Marianna, overlies Ocala limestone; in Mississippi and Alabama, Forest Hill sand and Red Bluff clay. Underlies Byram formation (Glendon limestone member).

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 75–81. In Mississippi and western Alabama, the Marianna is separated from Eocene formations by lower Oligocene Red Bluff clay, but, in Florida it lies directly on Ocala limestone. Seems probable that Marianna overlaps lower Oligocene deposits somewhere in Alabama and lies unconformably on Ocala in Florida. Underlies Byram limestone. Thickness about 30 feet at Marianna; as much as 80 feet in western Alabama. Not recognized east of Chattahoochee and Apalachicola Rivers, either in Georgia or Florida. Middle Oligocene.

Named for exposures at Marianna, Jackson County, Fla.

Marias River Shale (in Colorado Group)

Upper Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2793; 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90–91. Consists of 900 to 1,200 feet of dark gray shale. Comprises (ascending) Floweree, Cone calcareous, Ferdig shale, and Kevin shale members (all new). Underlies Telegraph Creek formation; overlies Blackleaf formation.

Named from excellent exposures along Marias River, which flows eastward across Sweetgrass arch between South arch and Kevin-Sunburst dome. Here, most of formation is exposed in Marias River saddle, along boundary between Toole and Pondera Counties. Forms bedrock on most of Sweetgrass arch and extends westward into Rocky Mountains.

Mariato formation[1]

Pleistocene(?): Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 261.

W. P. Woodring *in* R. Hoffstetter and others, 1960. Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 338–339. Poorly defined name for surficial deposits. Pleistocene(?).

Present on Mariato Plain, Veraguas Province.

Maricao Basalt (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 337–338. pl. 1. Lava and flow breccia with minor breccia and tuff occur above and as lenses in Yauco mudstone (new) in Las Vegas syncline and to lesser extent in Hormigueros syncline. Turonian to Maestrichtian.

Named for exposures on Río Maricao north of Maricao, Mayagüez area.

†Maricopa Shale[1]

Miocene, upper and middle: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2989. Saltos shale member (new) of Monterey shale was mapped by English (1916) as Maricopa shale and by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) as "Temblor".

Named for exposures west of Maricopa and Maricopa Flat, Kern County.

Marietta (in Carbondale Formation)[1]

Pennsylvanian: Northwestern Illinois.

Original reference: T. E. Savage, 1930, Illinois Acad. Sci. Trans., v. 22, p. 498.

Probably named for Marietta, Fulton County, just east of McDonough County line.

†Marietta Beds[1]

Lower Cretaceous (Comanche Series): Southern Oklahoma and northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, pl. 13, p. 302, 303, 328–337.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey. Name preoccupied. Beds or clays are now classified as Weno.

Named for Marietta, Love County, Okla.

Marietta Sandstone (in Dunkard Group)[1]

Marietta Sandstone (in Washington Formation)

Marietta sandstone member

Permian: Eastern Ohio, western Pennsylvania, and western West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 35.

R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 215–218, maps. Interval between Jollytown and Washington coals is often occupied in its lower part by sandstone ledges having total thickness of over 100 feet. These have been named Marietta sandstone by White (1891). In Marshall-Wetzel-Tyler area, these two ledges are termed Upper and Lower Marietta.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 149, 150, 151. In Fayette County, consists of three units referred to as Lower, Middle, and Upper Marietta. Unit herein named Davistown sandstone may have been included in Upper Marietta by Hennen (1909). In area where Middle Washington limestone is well developed, it seems preferable that the Upper Marietta be confind to the sandstone strata below this limestone and that the sandstone above it be given another name; hence, term Davistown.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). In Harrison County, middle and upper units of Marietta sandstone are included in Washington formation, Dunkard series.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 93–94. Lower part of Marietta sandstone member (Washington series) present in Morgan County. In this report, the Washington is considered a series, and term Dunkard is considered synonymous with Permian.

Named for Marietta, Washington County, Ohio.

Marigold Member (of Okaw Formation)

Marigold Oolite (in Chester Group)[1]

Mississippian (Chester): Southwestern Illinois.

Original reference: A. H. Sutton, 1934, Jour. Geology, v. 42, no. 6, p. 626, 627, 628.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 834. Many limestones in lower half of Okaw formation (restricted) are more or less oolitic, and one conspicuous oolite, the Marigold member, occurs about 75 feet above the base.

Occurs in area south of Marigold, Randolph County.

Mariiru Beds

Eocene: Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 49, table 4 [English translation in library of U.S. Geol. Survey, p. 59]. Chiefly limestone. Correlated with Nagas beds on Guam and Matansa beds on Saipan.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 45. Formation consists of sandy limestone, marl, limestone, and basal conglomerate. Conformably overlies Manila formation. Refers to S. Sugawara (1939, unpub. ms.) and K. Asano (1939, Jubilee Pub. Yabe's 60th Birthday).

Exposed at Mariiru, Hiirippo, Gargane, and Taihanom, Rota Island.

Marin Sandstone Member (of Franciscan Formation)

Marin Sandstone (in Franciscan Group)[1]

Jurassic and Cretaceous: Northern California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

U.S. Geological Survey currently classifies the Marin Sandstone as a member of the Franciscan Formation on the basis of a study now in progress.

Named for occurrence on Marin Peninsula, Marin County.

Marino Agglomerate or Andesite

Eocene: Mariana Island (Tinian).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]. Marino andesite named on correlation chart. Correlated with Hagman andesite on Saipan, Manila andesite on Rota, and Babelthaup agglomerate on Palau. Eocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 48, table 4 [English translation in library of U.S. Geol. Survey, p. 57]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 45. Referred to as Marino agglomerate.

Exposed on slope of Carolinas, or Lalo, Hill, and Shinminato Tableland, Tinian.

Marino Beds

Eocene: Mariana Islands (Tinian).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 51, table 4 [English translation in library of U.S. Geol. Survey, p. 61]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 45. Alternate layers of sandstone, shale, and liparitic tuff. Correlated with Fena beds on Guam and Densenyama beds on Saipan. Figure 40 (p. 51) shows Marino beds stratigraphically above Marino agglomerate.

Exposed in the Carolinas plateau and Banaderon Lemai, Tinian.

Marion Concretionary Limestone (in Chase Group)[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 772, 773, 780, 783, 797.

Named for Marion, Marion County.

Marion Flint (in Chase Group)[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 773, 779–786, 797.

Named for Marion, Marion County.

†Marion Formation (in Sumner Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 786–789.

Named for exposures in Marion County, Kans.

Marion Granite[1]

Precambrian (Laurentian): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 522.

Forms three low knobs in town of Marion, Waushara County.

Mariposa Formation

Mariposa Slate[1]

Upper Jurassic: Northern California.

Original reference: G. F. Becker, 1885, U.S. Geol. Survey Bull. 19, p. 18–23.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 90. Overlies Amador group (new).

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 12–14, pls. 1–4. Formation in Angels Camp and Sonora quadrangles. Lithology varies within mapped area, and in places slate is only a minor constituent; hence, term formation is used. In Sonora quadrangle, about two-thirds of the rocks assigned to formation are dark-gray to black slates and the rest are metamorphosed fine- to coarse-grained sandstone and grit, graywacke, pebble conglomerate, tuffaceous sandstone, and sandy to silty tuff. Believed to be in depositional contact with Logtown Ridge formation along east flank of Peoria Mountain and along flanks of Bear Mountain; in these areas, basal part of Mariposa consists of dark-lead-gray slate with subordinate sandy and pebbly layers. Formation is exposed in a partly fault-bounded northwest-trending belt that lies west of Mother Lode fault system. Major structure of belt east of Bear Mountain, in Angels Camp quadrangle, is not sufficiently known to warrant measurement of thickness of formation. In Sonora quadrangle and adjacent parts of Chinese Camp quadrangle, graded bedding shows top of formation is to east; here formation is about 3,000 feet thick. To the west, Mariposa unconformably overlies Logtown Ridge formation; to the east, it is cut off by Mariposa fault zone so that top of formation is not seen. No type section has been described.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 6. Potassium-argon dating of Rocklin granodiorite (new) from Rocklin pluton gave age of 131 million years. Pluton intrudes Mariposa formation.

Named for occurrence on Mariposa estate, in Mariposa County.

Mariposa Group[1]

Mesozoic: East-central California.

Original reference: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

Between Stanislaus River and Mariposa Creek, Tuolumne and Mariposa Counties.

Maris Rhyolite[1]

Miocene, upper, or later: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723, p. 50–51.

Exposed at Maris mine, Manhattan district.

Marjo Canyon Diorite

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 300–301, geol. map. Plutonic rock, medium to coarse grained, typically composed almost entirely of andesine and hornblende in ratio of about 3 to 1.

Named for its exposure at Marjo Canyon amphitheater SW¼ sec. 18, T. 1 N., R. 7 W., San Bernardino County. Also present on east side of San Antonio Canyon.

Marjum Limestone[1]

Marjum Formation

Middle Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 10.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1129–1132, 1141 (fig. 5), 1147. Thickness emended section 1,530 feet. Overlies Wheeler shale; underlies Weeks limestone. Middle-Upper Cambrian boundary lies at base of Weeks.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 41–42. Deiss (1938) redefined Marjum and Weeks limestones on nonlithologic and uncertain paleontologic basis and placed Marjum-Weeks contact at estimated position of Middle-Upper Cambrian boundary. As presently defined, these units are regarded invalid. Their present definition is comparable to Cadiz formation of California and Comet shale in Nevada.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 49–51, 149–150, pls. 1, 17. Described as formation in Sheeprock Mountains where it includes strata between Wheeler formation and Cole Canyon dolomite. Composed of carbonates and some shale. Thickness 1,193 feet. Middle Cambrian; because no fossils were found in upper half of formation, it is possible that part of the Marjum may straddle Middle-Upper Cambrian boundary.

Type locality: Cliffs on south side of Marjum Pass, House Range, Millard County. Emended section measured on spur which forms west side of Rainbow Valley.

Markgraf Member (of Joliet Formation)

Silurian (Niagaran): Northern Illinois.

D. L. Graf, 1952, Illinois Geol. Survey Rept. Inv. 161, p. 2, 3 (table 1). Dense fine-grained slightly argillaceous slightly silty dolomite.

Occurs in Chicago area. [Graf (p. 2) states that he obtained his samples from Willman. Willman (1943, Illinois Geol. Survey Rept. Inv. 90, p. 26–27) divides Joliet formation into five unnamed members, A to E; on p. 26 he [Willman] mentions Markgraf quarry in discussing member A but does not apply the name to any of his units.]

Markham Mill Formation (in Jackfork Group)

Mississippian (Meramecian and Chesterian): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 857, 884–886. Defined to include strata underlying Wesley formation (new) and overlying Prairie Mountain formation (new). Consists of basal siliceous shale followed by shales and thin sandstones; at Prairie Mountain, basal shale contains lenses of cherty sandstone conglomerate; conglomerate is coarser northward, becoming bouldery in frontal part of Ouachita Mountains. Thickness varies from 220 to about 500 feet; measured thickness at type locality 400 feet. Pushmataha series.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 43 (table 3), 54–55. In type area, consists of 400 feet of strata chiefly composed of sandstone which is thick bedded in lower part and thin bedded in upper part. Base marked by 15 to 20 feet of dark-gray siliceous shale which is most characteristic member of formation. Thickness 318 feet and 328 feet respectively in two sections in Kiamichi Range. Formation thins rapidly northward from type section into frontal Ouachitas. Overlies Prairie Mountain formation; underlies Wesley formation. Mississippian (Meramecian and Chesterian).

Type locality: NE cor. SW¼ sec. 21, T. 2 S., R. 14 E., Atoka County. Name taken from saw mill, Markham Mill. Second type locality was chosen in sec. 2, T. 2 S., R. 12 E., along Campbell Creek; this was first considered the type locality, but no name was available in area.

Markley Sandstone Member (of Kreyenhagen Formation)

Markley Sandstone[1]

Eocene, upper: Western California.

Original reference: B. L. Clark, 1918, California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

B. L. Clark and A. S. Campbell, 1942, Geol. Soc. America Spec. Paper 39, p. 1, 4 (fig. 3), 5, 9. Redefined and subdivided to include newly defined Sidney shale member which lies about 2,000 feet above base of formation. Stratigraphically overlies Kellogg shale (new) and, in some areas, a series of shales and sands locally referred to as "Nortonville shales"; underlies Kirker formation.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 59–64, 96, 130, 142, pls. 7, 8, 11–13. Described in area immediately north of San Francisco Bay region where it is most widely distributed Tertiary formation. In American Canyon (Carquinez quadrangle), formation is nearly 5,100 feet thick; includes newly defined Jameson shale member, 200 to 1,200 feet thick, about 1,400 feet above base. Wherever base is exposed, it rests on the Domengine; uncomformable beneath Cierbo formation; in some areas, overlapped by Wolfskill formation (new); in some areas, overlain by Putnam Peak basalt (new).

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Rank reduced to member status of Kreyenhagen formation. Underlies "Sidney" shale member; overlies Nortonville shale member.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1341. Here treated as a formation overlying Nortonville formation. Includes Sidney Flat shale member.

Named for exposures in vicinity of Markley Canyon, Mount Diablo region, about 35 miles east of San Francisco.

†Marks Head Marl[1]

Miocene, lower: Eastern Georgia and southern South Carolina.

Original reference: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, 19.

Extends from Mark's Head, on scarp of Savannah River Swamp, northwest of Porter's Landing, Effingham County, Ga., by Raysor's Bridge, S.C., and thence below Mount Hope on Santee River, S.C.

Marks-Mills Red Beds

Eocene, upper: Arkansas.

Original reference: G. D. Harris, 1894, Am. Jour. Sci., 3d, v. 47, p. 304.

Probably named from the red beds of Marks Mills Battlefield, Cleveland County.

Mark West andesite[1]

Pliocene: Northern California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 58–87.

Probably named for Mark West Springs, Sonoma County.

Marlboro Clay Member (of Nanjemoy Formation)[1]

Eocene, lower: Eastern Maryland and eastern Virginia.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene Volume, p. 65.

N. H. Darton, 1947, Econ. Geology, v. 43, no. 2, p. 154–155; 1951. Geol. Soc. America Bull., v. 62, no. 7, p. 753–754, 755, 757 (fig. 5), 760. Marlboro clay constitutes lowest member of Nanjemoy formation. Thickness at most places near 30 feet, but clay thins and thickens irregularly. Consists of pure clay, mostly pink, not "argillaceous sand," and some gray clay. Underlies dark green sand of Nanjemoy formation; unconformably overlies glauconitic sand or marl of Aquia formation. Marlboro clay member may have been coextensive with other members of the Eocene in Virginia, but it thins to the west; not far south of lat 38°15′ its western edge is buried under overlap of Miocene diatomaceous earth; clay passes below sea level a shore distance east of Chatterton.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 224. In York-James Peninsula, Va., the lower Eocene (Wilcox) part of Nanjemoy formation, the Potapaco clay member, truncates Aquia formation. Downdip from Fall Line, the Aquia formation and Potapaco member, as well as basal Marlboro clay member of Nanjemoy, have been truncated by transgressive sea of middle Eocene time.

First described from exposures near Upper Marlboro, Prince Georges County, Md.; also crops out across Anne Arundel and Charles Counties, and far south across coastal plain of Virginia.

Marlboro Formation[1]

Precambrian(?): Eastern Massachusetts and eastern Rhode Island.

Original reference: B. K. Emerson and J. K. Perry, 1907, U.S. Geol. Survey Bull. 311, p. 7, 8, 11, 13–36, map.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 9, 10. Abandoned in Pawtucket quadrangle, Rhode Island-Massachusetts, since Emerson's (1917) use in this area was based on an incorrect interpretation. Replaced by Blackstone series, which includes Westboro quartzite, formerly thought to underlie the Marlboro. Smithfield limestone member also abandoned in this area.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 8–14, pl. 1. Described in Maynard quadrangle, Massachusetts. Precambrian(?).

Named for Marlboro, Mass., where exposed along Main Street.

Marlboro Member (of Hudson River Formation)

Ordovician: Southeastern New York.

P. H. Bird, 1941, New York Acad. Sci. Trans., ser. 2, v. 3, no. 5, p. 113–114. Name applied to massive sandstone within Hudson River formation. Probably represents facies change from shale both to east and to west. Appears to be near top of formation, if not at top. Thickness well over 1,000 feet at center and may be as much as 2,000 feet. During deformation, behaved as competent member in comparison with the shale on both sides.

Exposed in tunnel of Delaware Aqueduct, which passes through Hudson River formation. Marlboro member occurs in vicinity of Marlboro Mountain [Ulster County]. In general, structure is asymmetrical syncline with low and gradually increasing dips in western limb and steep dips in eastern limb.

Marlbrook Marl[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas, northwestern Louisiana, and northeastern Texas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 84–86, 188.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Marlbrook marl shown on correlation chart above Annona chalk and below Saratoga chalk.

Typically exposed about 1 mile north of Saratoga, on road to Mineral Springs, Howard County, Ark. Also exposed along Marlbrook Creek in T. 10 S., R. 24 W., Hempstead County, Ark.

Marlife Shale (in Panoche Group)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists Pacific Section Guidebook Spring Field Trip. p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Red cobble conglomerate, lower brown shale, concretionary sandstone, and upper gray shale. Thickness 8,685 feet. Includes Carnerada conglomerate member (new) at base and Llanada sandstone member (new) in upper part. Overlies Ciervo shale (new); underlies Television sandstone (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: Moreno Gulch, Fresno County. Named derived from Marlife Plateau, secs. 17, 18, 19, 20, 29, and 30, T. 14 S., R. 11 E.

†Marlin Chalk Member (of Taylor Marl)[1]

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: C. H. Dane and L. W. Stephenson, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 51–55.

Typically exposed 0.4 to 0.9 mile south of courthouse at Marlin, Falls County, along edge of bottom lands of Brazos River, in a small scarp facing west.

Marlinton Formation (in Pocono Group)

Lower Mississippian: Southern West Virginia.

J. L. Dally, 1956, Dissert. Abs., v. 16, no. 12, p. 2425. Named as basal unit in group in southern part of state. Underlies Sunbury shale.

Possibly named for Marlinton, Pocahontas County.

Marlow Formation[1] (in Whitehorse Group)

Marlow Sandstone Member (of Whitehorse Formation)

Permian: Southwestern, central southern, and central Oklahoma and southern Kansas.

Original reference: R. W. Sawyer, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, no. 3, p. 312–320, map.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1815. In Kansas, Whitehorse sandstone can be divided into four members: Marlow, Relay Creek dolomite, an even-bedded sandstone member, and an upper shale member, the latter two representing the Rush Springs-Cloud Chief member of Oklahoma section. Thickness 110 feet. Overlies Dog Creek shale.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, formation includes Doe Creek sandstone member in northwestern Oklahoma and Verden sandstone member in southwestern Oklahoma.

C. C. Branson, 1955, The Hopper, v. 15, no. 12, p. 137. Doe Creek sandstone lies within the Marlow at higher level than Verden sandstone.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 24 (fig. 6), 40, pl. 1. In northwestern Oklahoma, Whitehorse group consists of Marlow formation at base and overlying Rush Springs sandstone. Thickness 350 feet. Guadalupe series.

Named for exposures at Marlow, Stephens County, Okla.

Marmaton Group[1]

†Marmaton Formation[1]

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

Original reference: C. R. Keyes, 1897, Iowa Acad. Sci. Proc., v. 4, p. 23–24.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 285–344. Group in Kansas comprises (ascending) Fort Scott limestone, Labette shale, Pawnee limestone, Bandera shale, Altamont limestone, Nowata shale, Lenapah limestone, and Memorial shale. Thickness about 250 feet. Overlies Cherokee shale; underlies Bronson group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2025 (fig. 3), 2027–2028. Strata from base of Fort Scott limestone (of Blackjack Creek limestone) to disconformity that marks upper limit of Desmoinesian series are designated as Marmaton group. Term Henri-

etta group used by Missouri Survey is abandoned by interstate conference, both because in common later usage it duplicated Marmaton and because formations overlying Pawnee limestone are not well developed near Henrietta. Overlies Cherokee group; underlies Pleasanton group. Kansas has suppressed term Bourbon group in preference to Pleasanton.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 19–47, pl. 1. In Kansas, Marmaton group includes strata from base of Fort Scott to disconformity which marks upper limit of Des Moines series. Marmaton of Oklahoma north of Arkansas River has same limits. For practical cartographic purposes, limits of Marmaton equivalents in area north of Arbuckle Mountain are base of Calvin sandstone below and base of Seminole formation above. In Tulsa County comprises (ascending) Fort Scott limestone, Labette shale, Oologah formation, Nowata shale, Lenapah limestone, and Holdenville (Memorial) shale. Underlies Skiatook group.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12. p. 2748 (fig. 1). As shown on northern midcontinent composite stratigraphic section, Marmaton group occurs above Cabaniss group.

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J, pl. 16. Group in southern part of Oklahoma coalfield comprises (ascending) Calvin sandstone, Wetumka shale, Wewoka formation, and Holdenville shale. Overlies Cabaniss group; underlies Skiatook group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 29–33, fig. 5. Sequence of thick shales and sandstones with thin limestones and coals extending from base of Blackjack Creek limestone to top of Cooper Creek limestone, is designated Maramaton group. Includes (ascending) Fort Scott, Labette, Pawnee, Bandera, Altamont, Nowata, and Lenapah formations. Overlies Cherokee group; underlies Pleasanton group. Classification of group used here is that agreed upon by State Geological Surveys in northern midcontinent region (Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11). Although Iowa is not entirely in agreement with this classification, it is used here for convenience of those who may be familiar with the grouping as used in other States of the region.

Named for exposures on Marmaton River, Vernon County, Mo., and Bourbon County, Kans.

Marmolejo Formation

Lower Cretaceous: West-central California.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 449, 458–469. Name proposed for Lower Cretaceous of Santa Lucia Range. Consists of 4,000 to 5,000 feet of dark shales with minor amounts of sandstone and conglomerate. Formation is strongly folded and faulted. Rests either disconformably or unconformably on Franciscan-Knoxville rocks. Unconformably underlies Jack Creek formation.

Type section: East of Marmolejo Flats, southern Santa Lucia Range. Base of section exposed, but top is cut off by fault.

Marmor Stage

Middle Ordovician (Mohawkian): North America.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 8 chart 1 (facing p. 130). Mohawkian series divided into five stages (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness. Marmor stage

includes Chazy group of rocks and its correlatives. Name credited to G. A. Cooper and B. N. Cooper.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 93, 94. Name replaced by Blackford stage (new) for use as a provincial stage in the Appalachians. Unit was based on formations in Tennessee, and type section is isolated from those of other Ordovician post-Canadian stages of the Appalachian region. Position of unit in Virginia sequence in dispute.

Reference section: Along railroad to the east of Marmor and extends to adjacent Louisville quadrangle. Named from Marmor just east of Friendsville on the Concord quadrangle, Tennessee.

Maromas Granite Gneiss[1]

Mississippian(?) or older: Central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 143, map.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Paleozoic(?).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic. Derivation of name.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619–620, 630–634, pl. 56. Discussion of pegmatites of Middletown area, Connecticut More than 300 concordant and discordant pegmatites were examined. Pegmaties cut metasediments of Bolton schist of pre-Mississippian(?) age and, in ascending order of sequence, mafic gneisses, Glastonbury granite gneiss, Maromas granite gneiss, and Monson gneiss. Position of these formations in stratigraphic column cannot be determined with accuracy; their maximum age is indicated by their relation to the pegmatites which have been dated by uranium- and thorium-lead ratios as about 260 million years old, presumably Mississippian. The Maromas is a gray-medium-grained biotite orthogneiss. Intrudes Bolton schist.

John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 19, 22, fig. 3. Unconformably underlies Collins Hill formation (new). Ordovician(?).

Named for Maromas quarries in town of Middletown, Middlesex County. Main body of gneiss occupies roughly elliptical area, 1 by 3 miles at first bend in Connecticut River east of Straits.

Maroon Formation[1]

Maroon Conglomerate[1]

Pennsylvanian and Permian: Western central Colorado.

Original reference: G. H. Eldridge, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 971–1009. Subdivided to include Coffman conglomerate, Chubb siltstone, and Pony Spring siltstone members.

C. F. Bassett, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1863–1864. Donner (1936, unpub. thesis) divided Maroon formation, in McCoy area, into Rock Creek conglomerate member below and State Bridge siltstone above. Overlies McCoy formation.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1375–1397. In Gore area, Eagle and Summit Counties, names Weber and Maroon are abandoned and term Battle Mountain proposed for the thick sequence of Pennsylvanian clastics.

K. G. Brill, Jr., 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 627–632, measured sections. In west-central and northwestern Colorado, overlies Belden shale; rank raised to formation. Consists of red, yellow, and brown shale, sandstone, arkose, and conglomerate with intercalated beds of gypsum and thin limestone. Thickness as much as 7,000 feet. Contact with Belden shale gradational; contact arbitrarily drawn where coarse clastics predominate over dark shale and limestone. Underlies Weber quartzite or Chinle formation. Most, if not all, of unit is Des Moines in age.

Ogden Tweto and T. S. Lovering, 1947, Colorado Mining Resources Board [Bull.], p. 380 (chart). Formation in Gilman district, is 4,500 to 6,000 feet thick. Overlies Leadville limestone. Pennsylvanian and Permian(?).

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 229–235. Name Maroon formation applied to all Pennsylvanian or Permian redbeds overlying Minturn formation in Gore and Mosquito Ranges. As so used, Maroon corresponds to Wyoming formation of Emmons (1898, U.S. Geol. Survey Geol. Atlas, Folio 48), to "upper unit" of Pennsylvanian and Permian(?) of Koschmann and Wells (1946, Colorado Sci. Proc., v. 15, no. 2), to upper half to three-fourths of Maroon as recognized by U.S. Geological Survey in recent years, and, in part, to uppermost part of Maroon as used by Brill (1944). Upper part probably includes beds equivalent to part of State Bridge formation of Brill (1944), but siltstone facies typical of State Bridge is poorly developed in Pando-Kokomo region. Formation in Pando-Kokomo region consists of unfossiliferous redbeds which, on Jacque Peak, on north edge of district, reach thickness of almost 2,000 feet. Overlies Jacque Mountain limestone member of Minturn; top of formation not preserved and original thickness unknown; unconformably underlies rocks.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 42–47, pl. 1. Formation, in South Park area, crops out over wide belt across western part of Park, from Mount Silverheels on north to beyond Antero reservoir on south; forms floor of valley west of Dakota hogback; south of reservoir, it continues along west side of Park, but outcrops are irregular as result of faulting. In southwestern area, includes Chubb siltstone member below and Pony Spring siltstone member above; thickness about 7,700 feet; undifferentiated in northern area where it is about 8,500 feet thick and consists essentially of red beds. Overlies Weber(?) formation, which contains Coffman conglomerate at top. Separated from overlying deposits by erosional unconformity; underlies Garo sandstone. Pennsylvanian and Permian.

N. W. Bass and S. A. Northrop, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1540–1551. In Glenwood Springs area, includes South Canyon Creek dolomite member (new) near top of formation. Underlies Chinle formation.

R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 552 (fig. 3), 553. Described in Crested Butte quadrangle where it overlies Gothic formation (new) and unconformably underlies Entrada sandstone. Thickness 1,189 feet at type section of Gothic formation; probable maximum thickness 3,500 feet within area.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 822–823. Described in paper on Permo-Pennsylvanian zeugogeosyncline, Colorado and New Mexico, where it crops out in northern part of trough and is

equivalent to Sangre de Cristo formation. Division between these two formations is placed arbitrarily at Fremont-Park County line. In this paper, Maroon formation includes those strata which overlie Jacque Mountain limestone or its equivalent and underlies Weber sandstone or younger strata. In middle of trough where Jacque Mountain limestone is absent or greatly altered in appearance, it is difficult to distinguish between Maroon and Minturn formation. Either Wolfcampian or late Pennsylvanian.

R. L. Langenheim, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1748–1779. Detailed description and discussion of correlation of formation in Crystal River valley, Gunnison, Pitkin, and Garfield Counties. Maroon formation as employed here includes all dominantly coarse clastic sediments above Gothic formation and below State Bridge siltstone. In Crystal River valley, three marine limestones are included in formation. Top of Maroon not well understood. In this area, State Bridge has been removed and Maroon is disconformably overlain by Jurassic rocks; hence, it is not difficult to select boundary. At Glenwood Springs, situation is complicated by Schoolhouse tongue of Weber sandstone and by South Canyon Creek dolomite. Other workers have recognized the Chinle, Shinarump, and other Triassic formations. If Schoolhouse tongue and South Canyon Creek dolomite were absent, all redbeds in that area could be referred to Maroon formation. Dry Park Ranch, Marion Creek, Thompson Creek, and Coal Creek sections of this report probably include lateral equivalents of these rocks [Schoolhouse tongue and South Canyon Creek dolomite].

H. F. Murray, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 55. Described in Maroon trough. Because top of Maroon is eroded in Gore and Mosquito Ranges, Tweto's definition must be modified to make term more applicable. About 18 miles west of Minturn, red sandstones and conglomerates of Tweto's Maroon are overlain by Weber sandstone which marks upper limit of red sandstones and conglomerates everywhere north and west from this point. South and east of Wolcott, the sandstones and conglomerates of the Maroon contrast with overlying red siltstones of State Bridge. In section along Eagle River between Wolcott and Minturn, typical siltstones of State Bridge are well developed above the Maroon near town of Minturn. Therefore, Tweto's Maroon probably does not contain State Bridge beds. As used in this report, the Maroon consists of sandstones and conglomerates between the top of Jacque Mountain limestone and the base of Weber sandstone, where it is present. Where Weber is absent, top is defined by siltstones and mudstones of State Bridge formation. Thus defined the Maroon is mappable unit throughout central and northwestern part of Maroon trough in both surface and subsurface.

John Chronic, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent regions, p. 62 (fig. 2), 63. In past, term Maroon has been used in north-central Colorado, while equivalent Sangre de Cristo formation has been restricted to mountain range of that name. Because lithologies and ages of the two formations are essentially the same, it is here proposed that name Sangre de Cristo be dropped and that prior name Maroon be applied to equivalent coarse redbeds, at least as far south as La Veta Pass.

Named for typical development on Maroon Creek in Aspen quadrangle.

Marquam limestone (deposit)

Oligocene: Eastern Oregon.

J. E. Allen, 1946, Oregon Dept. Geology and Mineral Industries G.M.I. Short Paper 15, p. 4 (pl. 2), 5–7. Limestone occurs as lenses in sandy tuffs, grits, and conglomerates, both massive and well bedded, which have low dips to south and southeast. Conglomeratic phases overlie lime lenses in two localities. Fossils, both foraminifera and megafossils, indicate Vaqueros age, correlative with Illahe-Mehama formation of Thayer (1939) and Butte Creek beds of Harper (1941, unpub. map of Molalla quad.). Marine sediments interfinger with and are overlain by continental Molalla formation to east.

Occurs in sec. 2, T. 6 S., R. 1 E., Clackamas County, 1 mile northeast of Marquam. Extensively quarried.

Marquette Granite[1]

Precambrian: Northwestern Michigan and Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no, 4, p. 426–428.

W. A. Seaman, 1944, Michigan Dept. Conserv. Geol. Survey Div. Prog. Rept. 10, p. 11, 12 (table 1). Shown on geologic column of Marquette Iron Range as Marquette granite, rhyolite, quartz porphyry, and so on. Older than Kitchi sediments.

Name first applied to granite in Wisconsin; area not stated.

Marquette Member[1] (of Belvidere Formation)

Lower Cretaceous (Comanche Series): Central Kansas.

Original reference: W. H. Twenhofel, 1924, Kansas Geol. Survey Bull. 9, p. 31–32.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Shown on correlation chart as member of Belvidere formation. Overlies Kiowa shale member; underlies Mentor sandstone members.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Dakota formation, as herein defined, includes stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Apparently named for exposures near Marquette, McPherson County.

Marquette Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 520.

Occurs near village of Marquette, Green Lake County.

Marquette Rhyolite[1]

Precambrian: Southeastern Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Occurs 1 mile southwest of village of Marquette, Green Lake County.

†Marquettian System[1]

Precambrian: Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept., p. 365.

Marquez Shale Member (of Reklaw Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 71–78. Chiefly even-bedded chocolate-colored shales; glauconitic sands or sandstones common in lower part. Thickness 50 to 60 feet. Overlies Newby sand member (new); boundary transitional and interfingering; underlies Queen City sand, contact transitional.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 78–83, 88, pl. 1. Described in Henrys Chapel quadrangle, Cherokee County, where it is 85 to 105 feet thick and gradationally underlies Arp member of Queen City formation.

Named for occurrences near Marquez, Leon County.

Marrowstone Shale

Oligocene: Northwestern Washington.

J. W. Durham, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 104 (fig. 2), 106. Name applied to the moderately well-bedded fossiliferous sandy shales that overlie Quimper sandstone on Marrowstone Islands.

Well exposed along eastern shore of Kilisut Harbor and on south side of Mystery Bay [Jefferson County]. Here outcrops are at water's edge, and any later Tertiary beds are concealed by glacial drift.

Marseilles Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 162–165. Largely till; gravel and sand present in kames and eskers, as deposits in subglacial channels, as outwash plains in front of moraine, as deltas in Lake Illinois and Lake Lisbon, and as deposits of the Fox River torrent. Till is gray to dark gray, with greenish cast; usually more clayey than other till in area. Thickness about 200 feet beneath the higher parts of the moraine north of Marseilles; in large part of moraine thickness is at least 100 feet; variations in thickness result from irregular top of drift. Overlies Bloomington and Chatsworth drifts. [Report lists six drifts in the Tazewell; for sequence see under Shelbyville.]

Named for town of Marseilles, La Salle County, which is situated at place where Illinois River cuts through moraine.

Marsh Formation (in Missoula Group)

Marsh Shale[1]

Precambrian (Belt Series): South-central Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Shale shown on map legend as part of Siyeh group.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 113. In parts of region around Helena, Marsh shale is sole representative of Missoula group.

Adolph Knopf, 1950, Am. Mineralogist, v. 35, nos. 9–10, p. 838–839. Marsh formation overlies Helena dolomite conformably, as shown in exposures on South Park Street in town of Helena. Here, it consists of maroon

mud-cracked shale (or argillite) and thin interbeds of mud-flake breccia and quartzite. It is 250 feet thick here and is overlain disconformably by Middle Cambrian Flathead quartzite. Type section is at mouth of Marsh Creek, just outside Marysville [this report] map area. Stratigraphic relations not well shown there. Barrell (1907, U.S. Geol Survey Prof. Paper 57) ignored type section in his report on Marysville district. According to Walcott (1899), Marsh formation is 300 feet at type locality and constitutes topmost formation of Belt terrane, and this characterization, though inadequate, has now done duty for 50 years. Formation thickens from Helena northwestward to 3,000 feet at Marysville. Here it underlies Greenhorn Mountain quartzite (new). Top of Marsh on north flank of Greenhorn Mountain is deep-maroon argillite, ripple marked and mud cracked and interbedded with thin quartzites 1 to 2 inches thick.

Type section: At mouth of Marsh Creek, north of Marysville, Lewis and Clark County. Town of Marysville is 20 miles northwest of Helena.

Marshall Diorite

Precambrian(?): Northeastern Washington and western Idaho.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 21–23, pl. 1. Medium-gray to almost black diorite that occurs mainly in sills which vary in thickness from 3 to 1,200 feet. Intrudes Bead Lake and Skookum formations (both new).

Named from Marshall Creek, Pend Oreille County, Wash.

Marshall Formation

Marshall Sandstone[1] or Group

Mississippian: Southern Michigan.

Original reference: A. Winchell, 1861, Michigan Geol. Survey 1st Bien. Rept. Prog., p. 80, 139.

G. V. Cohee, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 11. Sandstone consists of upper member, Napoleon sandstone, and lower unnamed member which consists in part of sandy shale. In some areas of Calhoun, Jackson, and Hillsdale Counties, lower member is separated from overlying Napoleon by shale, but where shale is absent, it is difficult to draw line between the two units. Thickness 200 to 250 feet north of outcrop area. Overlies Coldwater shale, and in many places grades down into it.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 80, 81). Shown on correlation chart as Marshall group below Michigan formation and above Coldwater shale. Kinderhookian-Osagean.

G. J. Stramel, C. O. Wisler, and L. B. Laird, 1954, U.S. Geol. Survey Circ. 323, p. 21, 23 (fig. 20). Referred to as Marshall formation.

Named from exposures in vicinity of Marshall, Calhoun County.

†Marshall Granite[1] or Formation

Marshall Gneiss (in Virginia Blue Ridge Complex)

Precambrian: Western central and northern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey Prelim. ed. geol. map of Virginia.

L. R. Thiesmeyer, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1963. Four major Precambrian granitic bodies representing extensive batholiths of western Piedmont in Virginia have been delineated; in

order of intrusion these are: Lovingston gneiss, hypersthene granodiorite, Crest Hill granite (new), and Marshall granite. [Author states Marshall granite is redefined. However, redefinition is not clear in this abstract and compiler was unable to locate any subsequent paper on this area by Thiesmeyer.]

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 582. Marshall formation comprises most of basement complex in the Piedmont. Formation is gray or green uniformly medium-grained gneiss consisting of quartz, potash feldspar, oligoclase-andesite, and biotite; quartzo-feldspathic bands that average about an eighth inch thick are separated by filmlike folia of bleached chloritized biotite. Grades into basement complex gneiss, Lovingston formation, and Pedlar formation (new).

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 9, 11–12, pl. 1. Rocks of Lynchburg area, previously mapped as Lovingston gneiss, are generally without prominent augen and are called Marshall gneiss in this report. Gneiss occupies belt 3½ miles wide in northwest corner of quadrangle, grades into Pedlar formation on northwest, and, with modifications, is intertongued with darker gneisses to form Reusens migmatite on southwest. Included in Virginia Blue Ridge complex (new). Precambrian.

Named for exposures around Marshall, Fauquier County.

Marshall Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Southeastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1934, Illinois Geol. Survey Bull. 61, p. 129–138.

C. O. Dunbar and L. G. Henbest, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 320. Should be considered as of Lansing age (Kansas and Nebraska) according to fusulinid evidence.

Occurs in Clark County.

†Marshall Shale[1]

Mississippian: Northwestern Arkansas and northeastern Oklahoma.

Original reference: J. C. Branner and F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. xiii, 26, 53–54.

Named for Marshall Mountain, just east of Marshall, Searcy County, Ark.

Marshall Creek Breccia

Upper Cretaceous(?): Southwestern Utah.

J. H. Mackin, 1947, Utah Geol. Soc. Guidebook 2, p. 9–12. Fanglomerate mudflow breccia. Occurs at disconformable contact between "Entrada" and quartzite conglomerate at base of Iron Springs formation (new). Breccia lenses irregularly, varying from 0 to more than 50 feet within short distances.

Occurs along western and southeastern parts of border zone of Three Peaks intrusion in Iron Springs district.

Marshall Hill Conglomerate[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 357.

Forms large part of broad upland known as Marshall Hill, about 6 miles north of Wausau, Marathon County.

Marshalltown Formation (in Matawan Group)[1]

Marshalltown Member (of Matawan Formation)

Upper Cretaceous: New Jersey and Delaware.

Original reference: G. N. Knapp, as reported by R. D. Salisbury, 1899, New Jersey Geol. Survey Ann. Report. State Geologist, 1898, p. 35, 36.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, pt. 6, p. 243 (fig. 32), 258–261, pl. 57. Formation extends from Sandy Hook Bay southwestward to Delaware River. Can be traced in banks of Chesapeake and Delaware Canal a distance of approximately 5 miles from 2,100 feet west of Summit Bridge to one-quarter mile east of St. Georges Bridge where it disappears beneath water level.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 30–32. Member of Matawan which is here reduced to formational rank. Underlies Wenonah member and overlies Englishtown member; both contacts conformable. Thickness 30 to 40 feet; dips about 25 feet to the mile southeast. Probably present in Chesapeake and Delaware Canal where it cannot be differentiated from Crosswicks clay. Beds in Canal called Marshalltown by Carter are believed to be Navesink and Mount Laurel.

M. E. Johnson and H. G. Richards, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2151 (table 1), 2156. Here considered of formational rank. Excellent exposure occurs in cut along New Jersey Turnpike at Fellowship, 2 miles south of Moorestown, Burlington County. Thickness about 14 feet. Here formation contains so little clay that it is water bearing.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Formation in Matawan group. Overlies Englishtown formation; underlies Wenonah sand. Average dip is southeast 35 feet per mile.

Named for occurrence near Marshalltown, Salem County, N.J.

†Marshalltown Shale[1]

Mississippian: Central northern Iowa.

Original reference: S. W. Beyer, 1897, Iowa Geol. Survey, v. 7, p. 211, 226–227.

Exposed near Marshalltown Flouring Mills, Marshall County.

Marshburg Clay

Marshburg Shale or Slates (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Northwestern and central northern Pennsylvania.

Original reference: C. A. Ashburner, 1885, Pennsylvania 2d Geol. Survey Rept. R_2, p. 307, 325.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 57, 103. Marshburg clay (Pottsville series) underlies Kinzua Creek (Kinzua) sandstone and overlies Olean conglomerate.

First described in Forest, Elk, and McKean Counties.

Marsh Creek Group[1]

Pliocene(?): Southeastern Idaho.

Original reference: A. C. Peale, 1879. U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 612, 641, 642.

Exposed on Marsh Creek above Red Rock Gap, Bannock County.

Marshfield Sandstone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 8, 42.

Mars Hill Conglomerate[1]

Silurian: Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 119, 134–136.

R. A. Bither, 1947, Maine State Geologist Rept. 1945–1946, p. 84. Mentioned in report on Aroostook limestone locations.

Named for development on Mars Hill, Aroostook County, on Maine-New Brunswick boundary.

Mars Hill Diabase[1]

Age(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 115, 177–179.

Named for occurrence on Mars Hill, Aroostook County.

Marsh Valley Group[1]

Pliocene(?): Southeastern Idaho.

Original reference: A. C. Peale, 1879, U.S. Geol. and Geog. Survey Terr. 11th Ann. Rept., p. 612, 641, 642.

Exposed on Marsh Creek above Red Rock Gap, Bannock County.

Marsland Formation

Marsland Formation (in Hemingford Group)

Miocene: Nebraska, Colorado, South Dakota, and southeastern Wyoming.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, p. 443, 444. Name applied to deposits which immedately overlie Arikaree group and which are faunally and lithologically distinct from typical Arikaree. Overlies Harrison formation (as defined by Hatcher); underlies Sheep Creek formation. Where best exposed, in region around Marsland, includes some 150 feet of buff and gray soft sandstones. Consists, in part, of valley fills and in some places mantles slopes of large valleys. On basis of fauna, should provisionally be considered as lower part of upper Miocene.

A. L. Lugn, 1938, Am. Jour. Sci., v. 36, 5th ser., no. 213, p. 226, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1253–1254, 1258, 1264 (table 1), 1266 (table 2). Included in Hemingford group (new). Thickness 125 to 200 feet. Separated from underlying Harrison formation by structural and erosional unconformity. Unit has been referred to as "Upper Harrison" but was not part of Harrison as defined by Hatcher; neither was it part of Scott's (1894) Nebraska beds as Hatcher believed, nor was it included in Darton's Arikaree.

R. C. Cady, 1940, Am. Jour. Sci., v. 238, no. 9, p. 663–667. Underlies Box Butte member (new) of Sheep Creek formation. [Lugn (1939) states that this unit has been included with and measured as part of Marsland formation on which it rests unconformably at most places, where no separating Sheep Creek valley fill deposits occur to reveal true relationship.]

H. J. Cook and J. T. Gregory, 1941, Jour. Paleontology, v. 15, no. 5, p. 549–552. Fauna described from "Upper Harrison" beds. These beds are distinct from overlying Marsland formation and contain fauna more closely related to Arikaree than to Marsland. Hence, Marsland as defined by Schultz includes two separable formations: the "Upper Harrison" beds and the higher previously unnamed deposits, exposed east of Marsland. Because of faunal distinctness of beds around Marsland from the "Upper Harrison", it seems desirable to restrict use of term Marsland to deposits at type locality described by Schultz. Restricted Marsland is equivalent to the "unnamed beds" between the "Upper Harrison" and Sheep Creek, shown in columnar section of region by Cook and Cook (1933, Nebraska Geol. Survey Paper 5, p. 44). Although acknowledging undesirability of term "Upper Harrison," authors do not propose name for these earliest deposits of Hemingford group which lie below restricted Marsland.

C. B. Schultz, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1990. Traced from type area into Colorado, South Dakota, and Wyoming. A distinct lithologic unit in Nebraska and Wyoming areas, and, although in Colorado and South Dakota these deposits are less typical, the faunas are equivalent.

R. C. Cady and O. J. Scherer, 1947, U.S. Geol. Survey Water-Supply Paper 969, p. 20, 26–32, pl. 1. Described in Box Butte County, Nebr., where it overlies Harrison sandstone and underlies Sheep Creek formation, in many areas the Box Butte member. Nebraska Geological Survey places Marsland and Sheep Creek formations in Hemingford group. This classification not used by U.S. Geological Survey.

Type area: Southwest of Marsland, along Niobrara River, in secs. 23 to 27, T. 28 N., R. 52 W., and secs. 19 and 30, T. 28 N., R. 51 W., Box Butte County, Nebr.

Marthaville Formation (in Wilcox Group)

Eocene, lower: Northwestern Louisiana and eastern Texas.

J. O. Barry, 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941. Sabine (Wilcox) subdivided into three faunal units (ascending): Marthaville beds and Pendleton and Sabinetown faunal units.

J. O. Barry and R. J. Le Blanc, 1942, Louisiana Dept. Conserv. Geol. Bull. 23, p. 20–23. Consists of basal sand member that passes transitionally upward into lignitic and calcareous clays; the characteristic fauna occurs in sparingly glauconitic silty calcareous concretionary layers in the clay and silts. Thickness about 250 feet. Overlies Midway formations; underlies a lithologic sequence referred to as the Pendleton faunal unit. The Marthaville has also been referred to as Marthaville faunal unit. Name Marthaville is credited to G. E. Murray (unpub. thesis).

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 181–195. Underlies Pendleton formation (new).

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 50 (fig. 4), 60–61. Expanded to include all beds above Hall Summit formation and below Pendleton formation. As thus defined, consists of three unnamed units or members: a basal sand member, a middle lignitic shale member, and an upper calcareous silt and clay member. Maximum thickness 300 feet.

H. V. Andersen, 1960, Louisiana Dept. Conserv. Geol. Bull., 34, p. 66–71. As mapped in Sabine Parish, includes two lithologic units: basal sand

member, 7 to 17 feet thick, and upper clay and argillaceous silt member, 15 to 30 feet thick. Members are separated by ½- to 4-foot fossiliferous zone characterized by *"Ostrea" thirsae* Gabb. Basal contact with underlying "Hall Summit" formation is mapped slightly lower in section than indicated by Murray (1948, Louisiana Dept. Conserv. Geol. Bull. 25). Underlies Pendleton formation. Upper contact as mapped herein is at least 50 feet lower in section than boundary established by Barry (1941). Type locality restricted and alternate reference section designated.

Type locality: Near railway depot at Marthaville, Natchitoches Parish, La. Units can be traced along strike from Red River-Bienville Parish line westward to vicinity of Mount Enterprise fault in Shelby County, Tex.

Type locality (restricted): Outcrop in Natchitoches Parish, 0.3 mile south of Marthaville, on State Highway 1217. Extends from road "Y" south along dirt road to top of hill in center of S½ sec. 28, T. 9 N., R. 10 W.

Reference locality: In Sabine Parish 3 miles south of Marthaville on State Highway. Extends from water level of unnamed tributary to Bayou Dupont southwestwardly to top of hill near Berry's Grocery Store (NE¼ SW¼ SW¼ sec. 5, T. 8 N., R. 10 W.)

†Martha Washington Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 169.

Forms the bluff at Rockport, Spencer County, known familiarly as "The Lady Washington."

Martin Limestone[1] or **Formation**

Middle and Upper Devonian: Central and eastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21.

Charles Keyes, 1942, Pan-Am. Geologist v. 77, no. 3, p. 225–228. In Bisbee region, no less than four good and valid geological formations incorporated in Martin limestone, each distiguishable lithologically and faunally, three of which are: Escacado limestone, Patagonia limestone, and Espinal formation. Martin limestone represents entire periodic sedimentation, and is merely synonymic with Devonic itself.

M. N. Short and others, 1943, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 27. In Superior district, restricted at base to exclude beds herein named Crook formation.

J. W. Huddle, 1948, Tulsa Geol. Soc. Digest, v. 16, p. 76. In northeastern Arizona, formation composed of three unnamed members (ascending): conglomeratic sandstone and dolomitic limestone member; sandstone and limestone member; and calcareous sandstone, sandy limestone and shale member. As traced from southeastern Arizona toward central Arizona, formation becomes increasingly sandy. Upper Devonian.

N. P. Peterson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 99, 100. Limestone disconformably overlies either Dripping Spring quartzite or small remnants of Troy quartzite and underlies Escabrosa limestone and Naco limestone in Globe-Miami district.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 26–29, pl. 5. Lithologically, the most variable formation of Paleozoic age of central Cochise County. In type section, in Bisbee quadrangle, formation dominantly limestone, with some pinkish shale in lower half; in Tombstone

Hills, shale with subordinate sandstone constitutes over half the formation; in Dragoon Mountains, sandstone still more conspicuous, and dolomite more abundant than limestone; and in Whetstone Mountains, more largely clastic than at Bisbee. Thickness ranges from 229½ to 340 feet, but variation in thickness not significant of regional thinning. Upper Devonian.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 523–528, pls. 45, 47. In Jerome area, limestone subdivided into four unnamed members which do not correspond to the three members farther east as recognized by Huddle. Middle(?) and Upper Devonian.

Type section: Bisbee quadrangle, southeastern Arizona. Named for Mount Martin, on Escabrosa Ridge, where formation is typically developed and well exposed.

Martin Bridge Formation[1] **or Limestone**

Upper Triassic: Northeastern Oregon.

Original reference: R. W. Chaney, 1932, 16th Internat. Geol. Cong. Guidebook 21, p. 4.

W. D. Smith and J. E. Allen, 1941, Oregon Dept. Geology and Mineral Industries Bull. 12, p. 6 (fig. 2), 8, 10–11, 13. Described in Wallowa Lake quadrangle. Unconformably overlies a unit termed the Lower Sedimentary Series, or where series is lacking, unconformably overlies Clover Creek greenstone. Grades upward into and is intercalated with Hurwal formation (new).

Named for locally well-known bridge on Eagle Creek, Wallowa Mountains region.

†Martin Canyon Beds[1]

Oligocene, upper, and Miocene, lower: Northeastern Colorado.

Original reference: W. D. Matthew, 1901, Am. Mus. Nat. History Mem., v. 1, pt. 7, p. 355–374, 444.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 18–20. Martin Canyon problem discussed. In this report, upper part of Matthew's Martin Canyon beds with its fauna is included in Pawnee Creek formation. It is difficult to determine whether or not Matthew's Pawnee Creek beds included upper Martin Canyon beds in other localities, but possibly they did at all points except in the Martin Canyon area. Term Martin Canyon should be abandoned as name for lithologic unit. Section did not exist as described; the lower part is assigned to White River formation, and lithologically the upper part cannot be distinguished from similar beds that grade into the Pawnee Creek. Fauna is Hemingfordian and not Arikareean in age.

Named for Martin Canyon of Cedar Creek, Logan County.

Martin Creek Limestone

Middle Ordovician: Northeastern Tennessee and southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Dark-gray and brown limestone with abundant chert nodules in lower part; tan cryptocrystalline limestone with chert nodules in some zones in upper part; locally has zone of coarsely crystalline fragmental limestone near base. Thickness 40 to 182 feet. Overlies Rob Camp limestone (new); underlies Hurricane Bridge limestone (new). Same as Lenoir limestone on U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 43–47. Unconformably overlies Rob Camp limestone, or where this is absent overlies Poteet limestone; conformably underlies Hurricane Bridge limestone. Equivalent to Lenoir limestone described by Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) in Lee County; relations to type Lenoir not established. Type section stated. Discussion of problems of correlation and summarizes nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Type section: Along county road that climbs bluff west of bridge across Martin Creek at its junction with Powell River, northwestern corner Hancock County, Tenn.

Martinez Formation[1]

Martinez Stage

Paleocene: Western California.

Original reference: W. B. Gabb, 1869, California Geol. Survey Pal., v. 2, p. xiii, as reported by J. D. Whitney from unpublished paper by Gabb, and footnote by Gabb on p. 129.

J. A. Cushman and J. D. Barksdale, 1930, Stanford Univ. Dept. Geology Contr., v. 1, no. 2, p. 55–73. Study of Foraminifera from shale below so-called Domengine at Martinez, and therefore within limits of Martinez formation (as previously mapped), shows definite relationship with Claiborne Eocene of Gulf Coastal Plain. Known relationship of fauna would seem to place Martinez formation definitely in Eocene of Claiborne age, or would seem to suggest possibility that Martinez formation needs to be redefined and upper part assigned to Meganos.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 854–856. West Coast Eocene comprises (ascending) Martinez, Meganos, Capay, Domengine, transition, Tejon, and Gaviota stages. For the Martinez, Capay, and Domengine, there is fairly good faunal evidence for general correlation. Deposits of the Martinez ("Paleocene") have limited distribution as compared to those of middle Eocene. Best known sections are in San Francisco Bay, Mount Diablo, and Simi Valley areas. "Martinez" of Cushman and Barksdale included in Capay stage.

R. T. White, 1938, Geol. Soc. America Proc. 1937, p. 256–257; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1735–1745. Lodo formation (new) in Tumey Hills on west side of San Joaquin Valley, Fresno County, includes "Martinez(?) formation" of Anderson and Pack (1915, U.S. Geol. Survey Bull. 603).

Boris Laiming, 1940, 6th Pacific Sci. Cong., v. 2, p. 535–568. Discussion of character and distribution of smaller foraminifera in marine Eocene deposits of California, and shows correlation of foraminiferal zones with faunal "stages" already established by paleontologists on basis of mollusca. Correlation chart shows 12 foraminiferal zones in Eocene as compared to six stages on basis of mollusca. Foraminiferal zone E correlates with Clark's and Vokes' (1936) molluscan Martinez stage, and zones C and D with "Martinez" of Cushman and Barksdale (1930).

E. A. Watson, 1942, Am. Midland Naturalist, v. 28, no. 2, p. 451–458. Formation, in Pacheco syncline, is 2,600 feet thick; overlies Chico formation and underlies "Tejon" formation. Lower part Paleocene; upper 1,000 feet of type Martinez are correlated with other California deposits of middle Eocene age.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 11, 21 (fig. 4). Cretaceous-Paleocene boundary discussed. In present report [California Tertiary marine mollusca], an arbitrary choice of boundary has been set, taking lower Martinez at its type area in Contra Costa County as representing base of Paleocene and, hence, base of Tertiary. Correlative formations are considered to be the lower glauconitic sands of the Lodo at its type section in Fresno County and the "Martinez marine member" mapped by Nelson (1925, California Univ. Pubs. Bull., Dept. Geol. Sci., v. 15, no. 11) in Simi area, Ventura County. Stratigraphers are urged to study this area and give formational name to this Martinez correlative for which the name "Martinez" is inappropriate because (1) at its type area the Martinez is both Paleocene and Eocene and (2) Paleocene faunule in Simi Hills contains relatively few species in common with that of type Martinez.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 48–52, pls. Formation described and mapped in Coast Ranges immediately north of San Francisco Bay region. Footnote on page 47–48 states that geologic map of Carquinez quadrangle and report were prepared prior to 1936 and do not represent changes of Eocene classification in Martinez area resulting from later investigations. Early Tertiary deposits in east and west limbs of Martinez syncline are mapped in Carquinez quadrangle as Martinez formation and Domengine sandstone. Martinez as mapped in west limb of syncline includes three stratigraphic units which, from recent paleontologic evidence, include Paleocene "glauconitic" sandstone, lower Eocene silty shales equivalent to the Capay, and silty sandstones and shales of Domengine age. Massive and thick-bedded gritty sandstones and overlying shales which are mapped as Domengine in west limb of Martinez syncline contain no molluscan fossils, but recent studies have furnished evidence of foraminiferal faunas indicative of late Eocene age. These gritty sandstones differ lithologically from upper Eocene Markley formation exposed elsewhere in Carquinez and Antioch quadrangles. Martinez as mapped in east limb includes Paleocene "glauconitic" sandstones and silty shales of Capay and possibly Meganos stages.

Peter Dehlinger, 1952, California Div. Mines Spec. Rept. 26, p. 5. East and northeast of mapped area [southern Ridge Basin] Martinez formation underlies Modelo formation, angular unconformity.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 1–20. Strata which were mapped in San Francisco Folio (Lawson, 1930) in east limb of Pacheco syncline as Martinez formation are designated in this report as Vine Hill sandstone and Las Juntas shale, and beds on west limb are designated as Vine Hill sandstone, Las Juntas shale, and Muir sandstone. Fossiliferous beds now referred to as Muir sandstone were considered in earlier reports as Upper Martinez. Rocks in Concord quadrangle between west limb of Pacheco syncline and Franklin fault were mapped in San Francisco Folio as Chico and Martinez formations. Recent work has shown that rocks exposed in hills just north of mouth of Franklin Canyon near north border of Concord quadrangle which were mapped as Martinez in San Francisco Folio belong to Chico series. These strata have been offset to northeast along Muir fault. Strata mapped as Martinez southeastward toward Walnut Creek include rocks classified in this report as Vine, Las Juntas, and Muir.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 27–29, pl. 1. Formation, mapped and described in Lower Lake quadrangle in Lake and Sonoma Counties where it is 2,200 to 4,200 feet thick. Consists of shale at top; conglomerate and sandstone, yellow feldspathic sandstone; white feldspathic sandstone at base. Rests with angular unconformity upon Knoxville and Cretaceous rocks; underlies Tejon formation.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–95. Formation, in Valyermo quadrangle, Los Angeles County, comprises two members: an upper, more than 3,000 feet thick, and a lower, more than 2,600 feet thick. The two members are not in normal contact. Present south of San Andreas fault.

B. Y. Smith, 1957, California Univ. Pub. Geol. Sci., v. 32, no. 3, p. 127–242. Discussion on history of usage of term Martinez. Term may have a number of meanings depending on interpretation of significance of contained fossils. Some workers consider that Martinez was defined on basis of age significance of contained fossils and believe that term is valid only as stage name and that some other term should be applied to lithogenetic unit. Many workers use term Martinez for cartographic, lithogenetic unit (formation) and prefer some other term for name of a Paleocene stage. Magnitude of Martinez within the cartographic, lithogenetic sense may vary. Term Martinez formation was used by Cushman and Barksdale for strata of entire Martinez group of Merriam's (1897, Jour. Geology, v. 5, p. 767) usage. Many recent workers prefer to limit term Martinez formation to that part of strata in Merriam's Martinez group that contains fossils of Paleocene age. Not until 1949 (Stewart, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34; also Weaver, 1953) did any worker who accepted restriction of term Martinez to Paleocene strata attempt to assign formal designations to formational units stratigraphically overlying them and within the Martinez group of earliest usage. In present report [Foraminifera from Contra Costa County], Weaver's (1953) terminology is used with no attempt at modification. However, since Pacheco syncline is generally accepted as type area for Martinez, it is difficult to follow Weaver's omission of that term, and it seems desirable that Weaver's new units, Vine Hill, Las Juntas, and Muir, be included either as members within Martinez formation or as formations within Martinez group.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 57–58, pl. 1. Martinez is stage name applied to rocks of Paleocene epoch in California. It is also commonly used, not quite properly, as formation name in many parts of state, where distinctive Martinez-stage fauna has been recognized. "Martinez formation" is generally understood to refer to a Paleocene sedimentary unit overlying Upper Cretaceous and underlying formations of lower Eocene Meganos stage. It is so used in this report [San Fernando quadrangle, Los Angeles County]. Formation crops out only in discontinuous narrow slivers along south side of San Gabriel fault for about 8 miles. Reaches maximum outcrop width of about 0.4 mile in southeastern quarter of quadrangle where exposed thickness is about 1,500 feet. Formation is faulted, sheared, and folded but determinable dips are, in most places, steep toward north. Predominantly coarse marine sediments, comprising dark-greenish-black sandstone, thin interbeds of shale, and thick massive well-cemented lenticular beds of pebble conglomerate.

Named for occurrences at Martinez and on north flank of Mount Diablo, Contra Costa County.

Martinez Marine Member[1] (of Martinez Group)

Eocene: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 11.

South of Simi Valley, Ventura County.

Martinian series[1]

Devonian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer.

Martin Lake Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 22.

Crops out around south and west sides of Martin Lake, 2 miles south of Bridgeport, Wise County.

Martin Ridge Schist

Pre-Ordovician(?): North-central Washington.

E. A. Youngberg and T. L. Wilson, 1952, Econ. Geology, v. 47, no. 1, p. 2–4, 12. Composed of alternating bands of argillaceous amphibole schists and quartzites varying in thickness from 1/32 of an inch up to more than 1 inch, and a bed of marble that occurs 20 to 25 feet above contact with Buckskin schist (new). Age sequence not clear; it would appear that Fernow unit (new) is older than the less metamorphosed Buckskin and Martin Ridge schists; this would require that beds be overturned because Fernow gneisses lie stratigraphically above schists.

Named for occurrence in vicinity of Martin Peak, near Holden, Chelan County.

Martinsburg Limestone (in Washington Formation)[1]

Permian: Southwestern Pennsylvania and eastern Ohio.

Original reference: E. V. d'Invilliers, 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2579.

Burned for lime on Bacon Street Run, Morgan Township, Washington County, Pa.

Martinsburg Shale[1]

Middle and Upper Ordovician: West Virginia, Maryland, New Jersey, southeastern Pennsylvania, Tennessee, and western Virginia.

Original references: H. R. Geiger and A. Keith, 1891, Geol. Soc. America Bull., v. 2, p. 156–163, pl. 4; A. Keith, 1894, U.S. Geol. Survey Geol. Atlas, Folio 10.

G. W. Stose, 1906, Jour. Geology, v. 14, p. 207 (table), 211. In South Mountain, Pa., and adjacent areas, calcareous strata of Chambersburg limestone (new) of Shenandoah group are followed by series of shales and soft sandstones previously called "Martinsburg shale" but herein called Martinsburg group. At the base are a few feet of dark calcareous shale and thin beds of carbonaceous limestone, transition beds, containing fauna regarded as Trenton in age. These are followed by dark to

gray platy shale, with *Leptobulus insignia, Triarthus becki,* and other Utica forms, including numerous graptolites, and is therefore named "Utica shale". It is intricately folded but thickness is estimated to be 1,000 feet. Above it is greenish to buff sandstone which is named Eden because it contains fauna referred by Ulrich to the Eden. It is about 500 feet thick.

H. B. Kummel, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161. Overlies Jacksonburg limestone in Franklin Furnace area.

G. W. Stose, 1909, U.S. Geol. Survey Geol. Atlas, Folio 170. In Mercersburg-Chambersburg district, Pennsylvania, Martinsburg shale is 2,000 feet thick. Overlies Chambersburg limestone; underlies Juniata formation.

E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, no. 8, p. 328. *Sinuites* bed referred to Martinsburg formation.

R. S. Bassler, 1919, Cambrian and Ordovician deposits of Maryland: Maryland Geol. Survey, p. 154–173. Generalized section of Martinsburg shale in southern Pennsylvania and Maryland shows Martinsburg comprises (ascending) Trenton and ? Utica division, about 1,100 feet thick, with granoscrystalline fossiliferous limestone and shale 2 to 10 feet thick, carrying *Sinuites* fauna; Eden division, about 1,000 feet thick; Lower Maysville division, 300 feet thick; Upper Maysville division, 150 feet thick, consists of unfossiliferous sandstone (Oswego sandstone). Overlies Chambersburg limestone; underlies Juniata formation of earliest Silurian or highest Ordovician age. Section along west slope of Tuscarora Mountain, southeast of McConnellsburg, Pa., describes Martinsburg (ascending) Trenton and Utica? black fissile shale, Lower Eden shales (not exposed), Middle Eden fossiliferous shale, Upper Eden shale and calcareous sandstone 400 feet, Maysville (Fairview) fossiliferous gray sandstone (*Orthorhynchula* bed at top) 300 feet, Oswego gray sandstone member 150 feet.

G. W. Stose and A. I. Jonas, 1927, Geol. Soc. America Bull., v. 38, no. 3, p. 505–536. Overlies Leesport limestone in southeastern Pennsylvania.

R. R. Rosenkrans, 1933, Washington Acad. Sci. Jour., v. 23, no. 9, p. 413–419. Six bentonite beds (Nos. 0–5) have been identified in basal Salona formation (late Black River or early Trenton age) in central Pennsylvania. A section of basal Martinsburg is exposed southwest of Strasburg, Va. Here Martinsburg contains six bentonite beds that are tentatively correlated with bentonite beds of the Salona of Pennsylvania.

R. L. Bates, 1936, Virginia Geol. Survey Bull. 46–M, p. 184–185. Described in Big A Mountain area where it consists chiefly of thin beds of highly fossiliferous limestone alternating with thinner beds of calcareous shale; near the top is buff sandy shale. Thickness about 1,600 feet. Martinsburg is divided, on basis of paleontology and to some extent also on lithology, into three parts: the Trenton, Eden, and Maysville. Only where there is good exposure of entire formation is this subdivision possible, and it is not feasible in area of present report. Trenton member (Upper Mohawkian) recognized in this area. Remainder of Martinsburg is Cincinnatian. Hiatus between Martinsburg and overlying Juniata indicated by absence of Oswego sandstone elsewhere 200 to 500 feet thick. Overlies Moccasin (Lowville). Term Sevier shale has been applied to Martinsburg in southwestern Virginia.

R. L. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1701–1702. In all published reports of the Jacksonburg both in New Jersey and Penn-

sylvania, it has been stated to pass upward into Martinsburg shales without disconformity. However, no continuous exposures from Jacksonburg into Martinsburg had been observed. One such exposure occurs in Hackettstown limestone lowland [New Jersey] where there is a disconformity between the two formations. Presence of hiatus raises question as to amount of time represented thereby and age of basal Martinsburg. Youngest fauna in Jacksonburg is of Sherman Fall age, so overlying Martinsburg cannot be older than later Sherman Fall.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 5–7. Martinsburg shale described in south-central Pennsylvania. Passes gradually over into Chambersburg or older limestone or is faulted against even older beds. Above, it may intergrade with "Oswego" sandstone, the Juniata red beds, or be in unconformable contact with Tuscarora sandstone. Usually called "shale", the Martinsburg is variable lithologic group. Often contains heavy sandstone, principal body of which is herein named West Fairview member. Also contains pebbly unit herein named Paxton Creek conglomerate.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1165–1198. Term Bald Eagle (Grabau, 1909) revived and used to replace term Oswego which has been misapplied in Pennsylvania. Bald Eagle is used herein as member of Juniata. This use of Bald Eagle restricts Martinsburg at top; this usage differs from Stose (1909) and Bassler (1919) who included the Bald Eagle ("Oswego") in the Martinsburg. The Fairview is treated as upper member of Martinsburg. Relationships of the Martinsburg, Bald Eagle, Juniata, and Tuscarora are all transitional. In Schuylkill Gap area, massive sandstone at top of Martinsburg is herein named Shochary sandstone member. Lithologically, stratigraphically, and faunally, appears to be correlate of Bassler's Fairview sandstone in south-central sections but is not traceable through. Based upon interpretation of sedimentary cycle, the Ordovician-Silurian boundary in Pennsylvania separates the Tuscarora or Shawangunk from underlying strata, whether these are Juniata, Bald Eagle, or Martinsburg. Tectonic evidence indicates Ordovician-Silurian line is at top of Martinsburg (Eden shale or one of its sandstone members—the Fairview or Shochary). By this procedure, the Bald Eagle and Juniata become basal Silurian.

Bradford Willard, 1939, Pennsylvania Acad. Sci. Proc., v. 13, p. 126–133. In Pennsylvania, Martinsburg "formation" or "shale" (group would be better term) normally rests on Chambersburg limestone west of the Susquehanna, the Leesport limestone in Schuylkill Valley. Between, it may be in fault contact with older formations, as the Beekmantown east of Harrisburg. Cocalico shale of Lancaster County is known to rest upon limestone with Chambersburg fossils and is partly or wholly the correlate of the Martinsburg. Overlain normally by Bald Eagle sandstone or conglomerate ("Oswego" of some authors) from Lehigh Valley. westward. At the Schuylkill, this sequence is interrupted because Martinsburg is faulted against Tuscarora of Medinan age. Martinsburg "formation" comprises (ascending) Cocalico shale, unnamed and undifferentiated dark shales, Jonestown beds (new), Fairview or Shochary sandstones. In Berks County, interval from top of Leesport to top of Shochary is probably of order of 4,500 feet; in Susquehanna Valley above Harrisburg, 2,500 to 3,000 feet, estimated. Age from early Trenton at least through early, perhaps, middle Maysville.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 201–213. At Martinsburg, W. Va., in Massanutten Mountain; at Strasburg, Shenandoah County; and just south of Draper Mountain, in Wythe and Pulaski Counties, the Martinsburg overlies Chambersburg limestone with no known break or hiatus between them. Where Chambersburg is absent, as northwest of Walker and Clinch Mountains in southwest Virginia, the Martinsburg overlies Lowville-Moccasin limestone. In some areas around south end of Massanutten syncline, the geologic map shows Martinsburg resting on Athens shale, but there is reason to believe that the Chambersburg limestone, or shale of equivalent age, is included in base of Martinsburg. In central Pennsylvania and for long distances, but not everywhere, along line of Little North Mountain in Virginia as far south as Brocks Gap, Rockingham County, and perhaps as far as Rawley Springs, *Orthorhynchula* zone in top of Martinsburg is Oswego sandstone. In Walker and Clinch Mountains and throughout entire northwest part of Appalachian Valley in Virginia, the *Orthorhynchula* zone is invariably overlain by Juniata formation. In Massanutten Mountain, both Oswego and Juniata are absent, and Martinsburg is succeeded by Massanutten sandstone, basal part of which is possibly Clinch or equivalent Tuscarora. Where Trenton limestone is clearly differentiated, it is treated as separate formation. Overlying shale, corresponding to Eden and Maysville parts of the Martinsburg, is likewise made a distinct formation, named Reedsville shale.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1963–1964. In Chambersburg area, overlies Greencastle formation which includes *Sinuites* zone at top.

Bradford Willard, 1943. Geol. Soc. America Bull., v. 54, no. 8, p. 1069–1075. Martinsburg group, as here used, includes Fairview and Shochary and Jonestown beds and Dauphin shale (new). Locally the Jonestown red beds, Eden and younger, are continental equivalents of marine Martinsburg with which they intergrade. The marine Martinsburg is twofold (shale below sandstone) and not threefold (shale, sandstone, shale) as sometimes stated. In northern New Jersey and at Otisville, N.Y., the Martinsburg is unconformably overlain by Shawangunk formation. Reedsville shale is partial coordinate of the Martinsburg.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 103–109, pl. 8. Formation described in Burkes Garden quadrangle. Roughly divisible into three parts, lowest, or Trenton, division composed of light-gray medium-grained shell limestones which are very dense and hard. Dark-gray shales occur as intercalations in the limestones and constitute about 25 percent of total thickness of division. Metabentonites occur in lowest 50 to 75 feet of formation. Thickness of Trenton division 650 to 750 feet. Eden division is composed of olive-drab and drab-gray fissile shales and slabby argillaceous limestones. Thickness as much as 500 feet. Maysville, or uppermost division, is 250 to 350 feet thick and except for uppermost 50 to 75 feet, closely resembles Eden division. Separation of upper Eden and lower Maysville made wholly on basis of fossils. Conformable with underlying Eggleston and overlying Juniata.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 86–89. Discussion of lower Middle Ordovician stratigraphy of Shenandoah Valley, Va. Martinsburg formation, 183 feet thick, overlies Oranda formation (new) at type section of Oranda. Contains *Sinuites* beds at

base. Overlies Collierstown limestone (new) at type section of Collierstown.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 742–746. Martinsburg shale succeeds Oranda formation in south-central Pennsylvania [this report]. Only lower few hundred feet included in this study. *Sinuites* zone consists of black muddy, rubbly to slabby limestone and forms the thin basal unit of Martinsburg. Sharp lithologic change succeeds *Sinuites* zone throughout most of area. Eighteen separate bentonite beds present in lower 220 feet of formation at composite Africa section, 1½ miles west of Mercersburg. Some metabentonites are correlated with metabentonite beds in Salona formation; lower part of Martinsburg formation is equivalent in Blacklog Valley to the part of Salona limestone succeeding metabentonites 1 and 2 and including metabentonite 6. Lower part of Martinsburg is quite fossiliferous. Lowest beds characterized by *Sinuites cancellatus* (Hall), *Cryptolithus tesselatus* Green, and *Leptobolus*? *ovalis* Bassler. Succeeding, more argillaceous beds contain *Cryptolithus tesselatus* Green and *Climacograptus* sp., and *Brongniartella trentonensis* (Collie) is present in Path and Blacklog Valleys where it is apparently restricted to beds between metabentonites 4 and 6. Presence of *Sinuites cancellatus* (Hall) and *Ecculiomphalus trentonensis* (Conrad) in upper part of type Jacksonburg in New Jersey suggests that it may contain beds corresponding to *Sinuites* zone of south-central Pennsylvania. Whether Jacksonburg contains equivalents of beds younger than *Sinuites* zone is not known. Term Greencastle formation abandoned in this report.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map 76. Martinsburg shale newly recognized in Shooks Gap quadrangle, Tennessee. Only lower beds present; overlies Bays formation.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2722. Overlies Ontelaunee formation (new) of Beekmantown group in Berks County, Pa.

C. E. Prouty, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–31, p. 29–30. Interval between Beekmantown group and Martinsburg formation, embodying essentially the Leesport in east-central Pennsylvania and, in a restricted sense, the Jacksonburg of eastern Pennsylvania and western New Jersey, divided into (ascending) Annville, Myerstown, and Hershey limestones. Basal contact of Martinsburg has been interpreted differently in various areas of Pennsylvania. One of the difficulties lies in lithologic versus faunal interpretations. *Sinuites cancellatus* zone, used by Ulrich (1911) as guide to basal contact was used by Craig (1949) in separating Martinsburg from Oranda in central belts. *Sinuites* zone is followed by graptolite-bearing dark shale. Latter zone is thought to represent graptolite zone recognized at Steelton in basal Hershey. Thick metabentonite below could then fit Salona 2 metabentonite which Craig placed at top of Oranda. Martinsburg base in central belts then has been placed lower stratigraphically than in eastern belts, and contact is drawn to include dark shaly limestone of general Hershey type within the Martinsburg. Eastward from Harrisburg, increased metamorphism has obliterated most of faunal evidence, and contact is drawn lithologically where carbonaceous limestones (Hershey limestone) yield stratigraphically higher into noncalcareous olive to brownish buff-weathering shale. Thus, basal Martinsburg contact as generally drawn eastward from Susquehanna River differs from contact westward by approximate inter-

val of Hershey limestone. This relationship extends eastward into New Jersey where contact is drawn at top of calcareous Jacksonburg. On basis of general lithologic comparisons with fossiliferous rocks in central Pennsylvania, it is likely that the Hershey-Martinsburg contact would represent roughly the upper Salona contact and therefore appoximates upper Sherman Fall-Trenton in age. Miller (1937) indicates that Jacksonburg deposition in western New Jersey must have continued well into Sherman Fall time, thereby inferring age of basal Martinsburg to be no older than late Sherman Fall. Basal Martinsburg could be younger than this, depending upon time represented by hiatus separating it from Jacksonburg.

Named for Martinsburg, W. Va.

Martinsville Formation

Pleistocene (Wisconsin): South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 18–19, pl. 1. Silt, sand, and gravel deposits on floodplains of present streams. Thickness less than 2 feet to 15 feet or more. Overlies every bedrock formation within Huron area at one place or another. Among unconsolidated materials, it probably overlies both facies of Atherton formation (new) and lower part of Prospect formation (new). Name credited to W. J. Wayne (in preparation).

Type locality and derivation of name not stated.

Martinville limestone[1]

Pennsylvanian: Illinois.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 39, no. 4, p. 320.

Martville Sandstone[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Type locality: Bentley's quarry between Martville, Cayuga County, and Hannibal, Oswego County.

Marvel Limestone[1]

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 309–310; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 355, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly in use in Death Valley region. Marvel dolomitic limestone underlies Surprise formation, here redefined as member of Kingston Peak formation. Precambrian.

Exposed along Marvel Canyon, southern part of Panamint Range, Inyo County.

Marvin Beds

See Marvin Quarry Bed.

Marvin Creek Limestone[1]

Marvin Creek Limestone Member (of Oswayo Formation)

Devonian: Central northern Pennsylvania and southern New York.

Original reference: C. A. Ashburner, 1880, Pennsylvania 2d Geol. Survey Rept. R, p. 68–69.

C. R. Fettke, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. M–21, p. 33, 34. Section of Oswayo formation near Knapp Creek, N.Y., shows Marvin Creek coquinite about 23 feet above base of section. This is probably the limestone which Ashburner called Marvin Creek. Caster (1934) renamed this limestone the Roystone, stating that Ashburner was not sufficiently exact in his definition of type locality and that limestone which Ashburner saw along Marvin Creek is one of the calcareous horizons in lower part of Knapp formation. Writer [Fettke] does not agree with this interpretation of Ashburner's use of the term and states reasons. Term Marvin Creek is used in this report [Bradford oil field, Pennsylvania and New York].

Well developed in Marvin Creek valley, McKean County, Pa.

Marvin Quarry Bed

Middle Devonian: Northeastern Michigan.

[G. M. Ehlers], 1938, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 8th Ann. Field Excursion, [fig. 2] after p. 8. Shown on columnar section as overlying Afton bed (new); top of section.

W. A. Kelly, 1940, Michigan Acad. Sci., Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion, [p. 1, figs. 4, 6, and 7], map 1. Lower beds consist of black argillaceous limestone with irregular shale partings and massive granular limestone with scattered crinoid columnals; includes biostrome consisting principally of heads of stromatoporoids and two varieties of *Prismatophyllum*. Upper half of section at Afton cannot be definitely correlated with section near Lake Huron, and provisional names, Afton beds, Marvin beds, and Beebe beds, are used in place of Alpena, Norway Point, Potter Farm, Partridge Point, and Squaw Bay, employment of which would imply stricter correlation than is justified.

Present in Black Lake-Afton area.

Mary Lake Granite

[Precambrian]: Northern Michigan.

L. T. Aldrich, 1958, Geol. Soc. America Bull., v. 69, v. 12, pt. 2, p. 1528. All the Rb-Sr ages of mica samples from Dickinson County, except those of the pegmatites, agree within the errors of measurement at 1,380 million years, indicating that all the micas analyzed from the metamorphic zones were formed at the same time as that of the Mary Lake granite.

In vicinity of Iron Mountain, Dickinson County.

Marys Creek Marl Member (of Goodland Formation)

Lower Cretaceous (Comanche Series): Northeastern Texas.

B. F. Perkins, 1957, Dissert. Abs., v. 17, no. 6, p. 1310; 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 15–19, 20. Proposed for lower interstratified marls and marly limestones of formation. At type locality, consists of 51 feet of interstratified blue marls, marly limestones, and several hard fossiliferous limestones. Underlies Benbrook limestone member (new). Basal part of member is gradational from Walnut marl;

contact between the two arbitrarily placed at top of uppermost resistant shell bed of the Walnut. Upper limit of member placed at top of interstratified sequence of thin marls and limestones and at base of thick limestone and marly limestone sequence of upper member. Widespread hard shell bed of *Gryphaea mucronata* Gabb in limestone matrix present about 6 feet below top of member.

Type section: Along Marys Creek for distance of 1½ miles from U.S. Highway 80–180 bridge southeastward to bluffs, on Rowan Ranch, Tarrant County.

Marysville Claystone Member (of Meganos Formation)

Marysville Formation[1]

Eocene, lower: Northern California.

Original reference: Howel Williams, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, p. 112, 121–124.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34, sheet 2. Restricted to beds of fossiliferous green claystone and siltstone; designated as claystone member of Meganos formation. Type locality designated.

Type locality: On west side of Marysville Buttes in Fig Tree Gulch near center W½ sec. 28, T. 16 N., R. 1 E. [Yuba County].

Marysville Sand Member (of Vashon Drift)

Pleistocene: Northwestern Washington.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 26, 27–28, pl. 1. Sand and gravel valley-train material more than 40 feet thick. Overlies Arlington gravel member (new).

Area: Snohomish County; contains Tps. 26 and 32 N. of the Willamette base line.

Maryville Limestone[1] (in Conasauga Group)

Middle Cambrian: Northeastern Tennessee, southeastern Kentucky, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 49–51. In eastern Tennessee, the Conasauga varies in lithology, and three phases are recognized; in central phase (between Knoxville and Morristown and north of Clinch Mountains), the Conasauga is considered a group consisting of six formations of which Maryville limestone is fourth in sequence (ascending). Underlies Nolichucky shale; overlies Rogersville shale. Thickness 250 to 650 feet.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Described and mapped as limestone in Conasauga group in Shooks Gap quadrangle, Tennessee. Thickness 670 feet.

Named for Maryville, Blount County, Tenn.

Mascall Formation[1]

Miocene, upper: Central northern Oregon.

Original reference: J. C. Merriam, 1901, California Univ. Pub. Bull. Dept. Geology, v. 2, no. 9, p. 305.

Theodore Downs, 1956, California Univ. Pub. Geol. Sci., v. 31, no. 5, p. 199–354, pls. Particularly in type area, includes wind-blown and water-

laid deposits of variable thickness. Believed to be transitional Hemingfordian (middle Miocene) and Barstovian (late Miocene) in age. No evidence for subdivision of formation or fauna. Fauna described.

T. P. Thayer, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Maps MF–49 and MF–50. Mapped in Aldrich Mountain quadrangle and in Mount Vernon quadrangle. Conformable on Columbia River basalt; underlies Rattlesnake formation with angular unconformity. Upper Miocene.

Type exposure near Mascall ranch, 4 miles below Danville.

Mascoma Group

Middle or Upper Devonian(?): West-central New Hampshire.

C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Consists of fine- to medium-grained white, gray, and pink weakly foliated granitoid rocks. Includes quartz diorite, granodiorite, quartz monzonite, and granite, Belongs to Oliverian magma series. Probably Upper Devonian.

C. A. Chapman, 1939, Geol. Soc. America Bull., v. 50, no. 1, p. 143, pl. 6. Name given to plutonic rocks of Mascoma dome. Granodiorite is most abundant type.

R. J. Bean, 1953, Geol. Soc. America Bull., v. 64, no. 5, p. 534–545, pl. 2. Middle(?) Devonian.

Occupies central part of Mascoma quadrangle.

Mascot Dolomite (in Knox Group)

Lower Ordovician: Eastern Tennessee and Virginia.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim. Map. Name appears on map legend. Occurs above Kingsport limestone (new).

C. R. L. Oder and H. W. Miller, 1945, Am. Inst. Mining Metall. Engineers Tech. Pub. 1818, p. 1, 2 (table 1). In Mascot-Jefferson City zinc district, consists of light- and dark-gray dolomite and limestone; moderately cherty; base marked by chert matrix sandstone; limestone most abundant in Jefferson City area. Thickness 500–700 feet. Overlies Kingsport formation. Name chosen jointly by Josiah Bridge and Oder.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 27–32. Described in Hawkins County where it consists typically of light-gray finely crystalline to compact well-bedded dolomite with intercalated layers of compact blue limestone near top; these limestone layers are not present along Copper Ridge. Base of formation is marked by bed of chert-matrix sandstone which is prominent in Mascot area; top is taken at unconformity at top of Knox group. Along Copper Ridge, formation is divided into two members, lower characterized by massive ledge-making beds of white chert and upper by compact well-laminated silty dolomite that underlies sink holes. Thickness 510 feet. Overlies Kingsport formation.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 28–30, pl. 1. Described in Jonesville district, southwestern Virginia, where it underlies Dot limestone and disconformably overlies Kingsport dolomite. Consists predominantly of light-colored to nearly white dolomite. Thick-

ness 169 to 462 feet; thinness may be due to erosion during hiatus between Mascot and Dot formations.

Josiah Bridge, 1956, Geol. Soc. America Bull., v. 66, no. 6, p. 727. In Douglas Lake area, underlies Douglas Lake member (new) of Lenoir limestone.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23. Term Mascot replaces "Cotter-Powell beds" as used by Oder, 1934. Jefferson City, Cotter, and Powell are names of formations exposed in Arkansas and Missouri; there is no possibility that they can be traced into Appalachian Valley.

Named for Mascot, Knox County, Tenn., near which several partial sections of formation are exposed.

Masefau Dike Complex and Breccia

Masefau Volcanics

Pliocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1286–1288, pl. 1. Hundreds of closely spaced dikes intruded into thin-bedded basalts. About 200 feet thick. Complex is truncated at top apparently by erosional unconformity and on northern side of fault(?) scarp. Above fault(?) plane is 20 to 100 feet of talus and firefountain debris and about 50 feet of Pago volcanic series.

G. A. Macdonald, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1336–1337. Masefau volcanics include olivine basalts, olivine-poor basalts, and olivine-free basalts.

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 180. Pliocene(?). No fossils.

Complex and breccia crop out on east side of Afono Bay, in Bartlett Island off Masefau Bay, and in promontory opposite island. Complex is named from latter locality which is near Masefau village.

Maskerchugg Granite (in East Greenwich Group)

Mississippian(?): Central Rhode Island.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Gray to light-tan fine-grained granite. Contains inconspicuous small phenocrysts and has well-developed flow structure. Appears to include Spencer Hill volcanics (new); intruded by unnamed granite porphyry and Cowesett granite (new). Unconformably underlies Carboniferous beds. Included in East Greenwich group.

Named for ledges near Maskerchugg River which flows through outcrop area in Kent County. Most characteristic outcrop is at intersection of First Avenue and Middle Road, East Greenwich.

Masket Formation

Silurian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt, 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in report on Paleozoic continental margin in central Nevada. Overlies Diana formation (new) or Gatecliff formation (new).

Toquima Range, Nye County.

Mason Clay (in Conemaugh Formation)[1]

Mason clay or underclay member

Pennsylvanian (Conemaugh Series): Eastern Ohio

[Original reference]: Wilber Stout and R. E. Lamborn, 1924, Ohio Geol. Survey, 4th ser., Bull. 28, p. 316, 317, 318.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 60, 61, table 1. Included in Mason cyclothem, Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 30. Mason clay member (Conemaugh series) occurs below Mason coal and above Upper Mahoning sandstone and shale member. In many areas in Morgan County, interval of Mason clay is occupied by sandstone and shales, which extend to base of Brush Creek limestone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 106. Underclay member of Mason cyclothem in report on Athens County. Average thickness about 7 feet. Occurs with Mason coal above Upper Mahoning shale and sandstone member. Conemaugh series.

First mentioned in Columbiana County. Probably named for association with Mason coal.

Mason cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 11, Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 60–61, table 1, geol. map. Includes (ascending) Upper Mahoning shale and (or) sandstone, 30 feet; Mason clay, 3 feet; and Mason coal. Occurs above Mahoning cyclothem and below Brush Creek cyclothem. In area of this report, the Conemaugh series is described on a cyclothemic basis; seven cyclothems are named. [For sequence see Mahoning cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 102–107. Described in Athens County. Occurs above Mahoning cyclothem and below Lower Brush cyclothem. Includes Upper Mahoning shale and (or) sandstone, Upper Mahoning redbed member, Mason underclay, Mason coal, and Mason marine shale member. In this report, the Conemaugh series is described on a cyclothemic basis; 15 cyclothems are named. [For complete sequence see Mahoning cyclothem.]

Name Mason was applied by White (1903) to an underclay, a coal, and a marine shale from type area at Mason on Elk River, Kanawha County, W. Va.

†Mason Series[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lvii, 276–281.

Probably named for Mason County.

Mason Shale (in Conemaugh Formation)[1]

Mason shale member

Pennsylvanian (Conemaugh Series): Southern West Virginia and eastern Ohio.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 281.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 182, 183, 185. In Ohio, Mason shale member (Conemaugh series) occurs below Brush Creek coal and above Mason coal. Commonly gray with some shaly sandstone. Thickness 10 to 32 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 107. Marine shale member of Mason cyclothem in report on Athens County. Thickness 10 to 12 feet. Overlies Mason coal and underlies Lower Brush Creek shale and (or) sandstone member of Lower Brush Creek cyclothem.

Named for Mason, on Elk River, Kanawha County, W. Va.

Mason City Dolomite Member (of Shellrock Formation)

Mason City Limestone or Dolomite[1]

Upper Devonian: Central northern Iowa.

Original reference: W. H. Norton, 1897, Iowa Geol. Survey, v. 6, p. 148.

A. H. McNair, 1942, Jour. Paleontology, v. 16, no. 3, p. 349–350. Referred to as Mason City dolomite member of Shellrock.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (table), 187. Shellrock consists of lithographic and dolomitic limestones and thin shales; includes (ascending) Mason City, Rock Grove, and Nora members.

Named for exposures at Mason City, Cerro Gordo County.

Mass Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart complied by M. G. Wilmarth).

Named for occurrence in Mass mine, Ontonagon County.

Mass Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Mass mine, Ontonagon County.

Massacre Volcanics[1]

(?)Pliocene, lower: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 32, 46–47, pls. 4, 6. A group of knobs of dense basalt. Rocks represent denuded feeder of an ancient volcano. Shown on stratigraphic section above Eagle Rock tuff and below Rockland Valley basalt.

The feeder dikes form Massacre Rocks, a group of knobs of diabase, in sec. 6, T. 9 S., R. 30 E., Power County.

†Massanutten Sandstone[1]

Silurian: Northeastern Virginia and western Maryland.

Original reference: H. R. Geiger and A. Keith, 1891, Geol. Soc. America Bull., v. 2, p. 156–163, pl. 4.

C. K. Swartz and F. M. Swartz, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2008–2009. Proposed to restrict term Massanutten to the Silurian beds.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 202. In Massanutten Mountain, overlies Martinsburg shale. Basal part of Massanutten is possibly the Clinch or equivalent Tuscarora.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 11 (table 1), 46–47. Term Massanutten sandstone, as used here, applies to the thick series of sandstones, quartzites, and conglomerates of Massanutten Mountain area, overlying unfossiliferous or sparsely fossiliferous sandstone at top of Martinsburg and lying below Bloomsburg red beds. Original definition by Geiger and Keith (1891) invalid because of misidentification (corrected by Keith, 1894). Darton (1899, U.S. Geol. Survey Geol. Atlas, Folio 61) used Massanutten sandstone to include Juniata formation, Tuscarora quartzite, and Cacapon sandstone. Thornton (1953, unpub. thesis) designated type section and gave thickness of 700 feet. Thickness 500 to 700 feet in Rockingham County [this report].

Type locality: At Burners Gap, 3 miles N. 25° W. of Hamburg, Page County. Named for Massanutten Mountain, in Rockingham, Shenandoah, and Page Counties, northeastern Virginia. Occurs only in Massanutten Mountain area where it is principal ridge-forming rock.

Massie Clay[1]

Massie Member (of Alger Formation)

Silurian (Niagaran) : Southwestern Ohio.

Original reference: A. F. Foerste, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 168.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 35, chart facing p. 46. Shown on generalized section of western Ohio as uppermost member of Alger formation. Thickness 5 to 6 feet. Overlies Laurel member; underlies Euphemia formation.

Well exposed on Massie Creek, a short distance west of Cedarville, Greene County.

Massie Creek Sandstone

Upper Devonian: Central Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 73–75. Highly calcareous fossiliferous sandstone that varies from light gray, or almost white, to medium gray and light yellowish brown on fresh exposures. Thickness about 7 feet at type locality; probably does not exceed 10 to 12 feet; average may be as little as 5 feet. Unconformable below Mississippian Bachelor formation (new); unconformable on beds ranging from Plattin to Holts Summit (new), including Kimmswick, Callaway, Snyder Creek, and Glen Park. Stratigraphic relations of Massie Creek and Bushberg are similar, and later evidence may show they are time equivalents. Recommended that both names be used unless and until the two are proven synonymous.

Type locality: Outcrop in NE cor. SW¼SE¼NW¼ sec. 24, T. 47 N., R. 4 W., Warren County. Exposed along Massie Creek and some of its tributaries.

†Massillon Sandstone (in Pottsville Formation)[1]

Massillon sandstone and shale member

Pennsylvanian (Pottsville Series) : Eastern Ohio.

Original reference: J. S. Newberry, 1874, Ohio Geol. Survey, v. 2, p. 131.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 24, 25–26, table 1. Included in Bear Run cyclothem. Name has been largely restricted to

massive sandstone; in this report, shale occurring at the same stratigraphic position is also called Massillon. Thickness 5 to 65 feet. Member thins, thickens, and changes from massive sandstone to interbedded sandstone and shale within short distances.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 53, p. 43–46, geol. map. Near Massillon, where thickness varies from 20 to 80 feet, Massillon sandstone (Connoquenessing) member (Pottsville series) closely overlies Massillon coal; locally replaces Quakertown coal. Eastward, sandstone is well developed on outcrop in Ohio and western Pennsylvania. In Beaver County, Pa., was described as Connoquenessing sandstone by White (1878), for exposures along Connoquenessing River. White (1878 [1879]) divided it into the Upper and Lower Connoquenessing sandstone with Quakertown coal between. Southwest from Massillon, sandstone is irregularly present but found close above Quakertown coal and thus corresponds in position to Connoquenessing sandstone of Pennsylvania. Locally the Massillon thickens replacing overlying and underlying units; at such localities, it extends from near base of Pennsylvanian to horizon of Lower Mercer limestone.

Named for Massillon, Stark County.

Mass Mountain[1] (Basalt)

Mississippian: Northern California.

Original reference: N. E. A. Hinds, 1930, Geol. Soc. America Bull., v. 41, p. 158.

Southern part of Klamath Mountains.

Masuk Member (of Mancos Shale)

†Masuk Shale (in Mancos Shale)[1]

Masuk Tongue (of Mancos Shale)

Upper Cretaceous: Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of the Henry Mountains: U.S. Geog. and Geol. Survey of the Rocky Mountain region, p. 4 [2d. ed. 1880].

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 16, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota (?) sandstone in Henry Mountains, Gilbert (1877) applied local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in the present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," Tununk sandstone, and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation, "Masuk shale" with Lewis shale, and Masuk sandstone with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe that entire succession corresponds to Mancos shale. Thickness of "Masuk shale" 500 to 700 feet.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8 (table). Generalized section of exposed sedimentary rocks in Henry Mountains shows Masuk shale member at top of Mancos shale. Thickness

700 feet. Overlies Emery sandstone member; underlies Mesaverde formation.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 36 (table), 85. Thickness of Masuk member 787 feet at Bitter Creek Divide, Henry Mountains. Overlies Emery sandstone member; underlies Mesaverde formation (referred to as Masuk sandstone by Gilbert, 1877).

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 180 (fig. 2). In central Utah where it is separated from lower members by Emery sandstone, upper part of Mancos is called Masuk member, but to east it is not easily separable and is herein referred to as Masuk tongue of Mancos. Present below Panther sandstone tongue of Star Point sandstone.

Named for occurrence in Masuk Plateau, Henry Mountains.

†Masuk Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of the Henry Mountains: U.S. Geog. and Geol. Survey of the Rocky Mountain region, p. 4 [2d ed. 1880].

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota(?) sandstone in Henry Mountains, Gilbert (1877) applied local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in the present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," Tununk sandstone, and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation, "Masuk shale" with Lewis shale, and Masuk sandstone with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe that entire succession corresponds to Mancos shale. Thickness of Masuk sandstone about 300 feet. Unconformable below Wasatch(?) formation.

H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164, pl. 5. Shown on correlation chart as Masuk sandstone member of Mesaverde formation.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 86. In Henry Mountains, Mesaverde formation is about 400 feet thick and consists entirely of sandstone. Gregory (1877) referred to the formation as Masuk sandstone.

In Masuk Plateau, Henry Mountains.

Masukian series[1]

Upper Cretaceous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 64–65, 280, 303.

Mata Chin Formation

Quaternary(?): Panamá.

R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 187–189. Black basic rounded igneous boulders. Thickness 110 feet in face of hill at Juan Grande; 100 feet south of Bas Obispo. Believed to be contemporaneous with basic igneous eruptions of Cretaceous and Eocene time.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 339. Considered informal name. Quaternary(?). Boulders may have weathered from conglomerate of Bohio formation or may be exfoliated masses weathered out of basalt. Name should be Matachin.

Matachin was a pre-Canal village on Río Chagres. Site is now flooded by Gatún Lake.

Matafao Trachyte and Breccia

Pleistocene(?) : Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 100, 105, 129–130. Trachyte plug penetrating massive basaltic breccia.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1286 (table 1), 1302–1303. Matafao trachyte plug is associated with Pago volcanic series. Where well exposed in Fagaalu Valley, plug is bordered by 10 to 25 feet of brecciated trachyte which grades into band of friction breccia 50 to 150 feet wide composed of trachyte and basaltic fragments. Pliocene and lower Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 181. Pleistocene(?).

Crops out on summit of Matafao Peak. Covers area of about 0.25 square mile.

Matalanim beds

See Metalanim Beds or Conglomerate.

Matansa Limestone

Eocene, upper : Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 52–53]. Referred to as Matansya beds. Lower part is andesite boulder conglomerate; middle, a succession of tuff beds; upper, well-stratified pink limestone 3 to 5 meters thick.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 11–12. Limestone unconformably overlies Sankakuyama rhyolite or Hagman andesite and underlies younger igneous and sedimentary formations of various ages. Upper Eocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 56–60, pls. 2, 8B, 17A, chart 1. Tayama applied name Matansya beds to part of rocks here called Matansa limestone. Includes three principal facies: basal transitional facies of dull-yellowish to red-brown tuffaceous to marly limestone and calcareous conglomerate; pink, highly foraminiferal clastic limestones; and white, sparingly foraminiferal clastic limestones. Thickness 200 to about 500 feet. Basal beds overlie or grade laterally to upper beds of Densinyama formation, contact transitional or locally unconformable. Beds that succeed Matansa in local column are the probably Oligocene volcanic rocks of Fina-sisu for-

mation (new), but direct contact not observed. In local succession, Matansa beds are actually overlain by Miocene or Quaternary deposits. Type section designated.

Type section: Succession of Eocene strata that extends up southern part of west-facing Papua cliffs, in southeastern part of Matansa district, about 300 feet south of roadside quarry.

Matansya Beds

See **Matansa Limestone.**

Matanuska Formation[1]

Lower and Upper Cretaceous: Central southern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 317–327, table facing p. 474.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 12, pls. 1, 2. Most complete section of formation exposed in gorge of Granite Creek about 2 miles east of Eska, where it has aggregate thickness of at least 4,000 feet. Assumed to overlie Arkose Ridge formation (new). Upper Cretaceous.

Arthur Grantz and D. L. Jones, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B347–B350. Mollusks can be grouped into assemblages of Albian, Cenomanian, Turonian, Campanian and Upper Campanian and Maestrichtian(?) ages.

In Matanuska Valley.

†Matanuska Series[1]

Jurassic, Cretaceous, and Tertiary: Alaska.

Original reference: W. C. Mendenhall, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 307–309.

Occurs near top of Limestone Gap and along upper course of Bubb Creek; also makes base of Castle Mountain. Matanuska River flows nearly along strike of series.

Matawan Group or Formation[1]

Upper Cretaceous: New Jersey, Delaware, and northeastern Maryland.

Original references: W. B. Clark, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 335–336; Jour. Geology, v. 2, p. 161–177.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 250–261. In New Jersey, group comprises (ascending) Merchantville clay, Woodbury clay, Englishtown sand, Marshalltown formation, and Wenonah sand. In Chesapeake and Delaware Canal area in Delaware and adjacent parts of Maryland, the Matawan has been mapped as an individual formation; previous investigators have not considered it practicable to subdivide it. Fresh exposures along canal have made it possible to subdivide the Matawan there, although it has not been deemed feasible to separate the Merchantville and Woodbury clay units, which are therefore treated as combined unit under old name Crosswicks clay; Wenonah sand is wanting.

R. A. Schmidt, 1948, Jour. Paleontology, v. 22, no. 4, p. 392 (table 1). Group in northern Delaware comprises (ascending) Crosswicks clay, Englishtown sand, and Marshalltown formation.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 23-39. Rank reduced to formation. Defined

as those beds above the Magothy and below the shell bed formed by *Exogyra*, *Gryphaea*, and *Belemnitella* in base of the Navesink. As thus defined, consists of six members (ascending): Merchantville, Woodbury, Englishtown, Wenonah, and Mount Laurel (previously included in Monmouth group). Overlies Magothy formation with slight disconformity; conformably underlies Monmouth formation.

M. E. Johnson and H. G. Richards, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2150–2160. Here Matawan is considered a group with Wenonah sand at top. Report is a discussion of paper by Spangler and Peterson.

Typically exposed on shore of Raritan Bay in vicinity of Matawan Creek and along banks of the creek, Monmouth County, N.J.

Matewan Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 199.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 94. Massive sandstone in Kanawha group.

Named for town in Mingo County.

Matfield Shale (in Chase Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: C. S. Prosser, 1902, Jour. Geology, v. 10, p. 714.

G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 36. Includes (ascending) Wymore shale, Kinney limestone, and Blue Springs shale members (all new).

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 164–165. Thickness 60 to 90 feet. Underlies Barneston limestone; overlies Wreford limestone.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 110–111. Matfield shale of this report extends upward from top of Wreford limestone to base of Fort Riley limestone. Prosser (1902) defined Matfield as 60 to 70 feet of shale and thin limestones overlying Wreford limestone and underlying Florence flint. This section has been divided into Blue Springs and Wymore shale members separated by Kinney limestone member. These members have been identified as far south as Kay County. South of this point, Kinney limestone is absent and shale members cannot be differentiated. Florence flint member of Barneston, which defines top of Matfield farther north, does not occur in Pawnee County. As used in this report, the Matfield is an undifferentiated section of red sandstones and shales and probably includes thin section in upper part that is equivalent to lower part of Barneston formation of Kansas. Thickness about 100 feet in Pawnee County.

Named for development in Matfield Township, Chase County, Kans.

Matilija Formation

Matilija Sandstone Member[1] (of Tejon Formation)

Eocene, or Eocene, upper: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1928, Geol. Soc. America Bull., v. 39, p. 1090.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 26–27, 38 (fig. 2), pls. 1–6. Described in Santa Ynez Mountains, Santa Barbara County,

as Matilija formation. Made up of a succession of beds, up to 25 feet thick, of massive medium-grained fairly hard bluish-white sandstone which weathers buff. Thickness as much as 2,000 feet. Underlies Cozy Dell shale; overlies Anita shale; where Anita shale buttresses out Matilija unconformably overlies the Cretaceous or Franciscan. Upper Eocene.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1756–1758. In Santa Barbara area, overlies Juncal formation (new).

Type locality: In canyon at Matilija Springs, Ventura County.

Matoaka Formation (in Pocono Group)

Lower Mississippian: Southern West Virginia.

J. L. Dally, 1956, Dissert. Abs., v. 16, no. 12, p. 2425. Named as uppermost unit in group in southern part of state. Overlies Sunbury shale.

Probably named for Matoaka, Mercer County.

Mattapan Volcanic Complex[1]

Devonian or Carboniferous: Eastern Massachusetts and northeastern Rhode Island.

Original reference: Laurence LaForge *in* B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 200–201, map.

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts (1:31,680): U.S. Geol. Survey Geol. Quad. Map [GQ–5]. Rhyolite dikes of Brockton quadrangle may be same age (Devonian or Carboniferous) as Mattapan volcanic complex exposed in Norwood quadrangle to northwest.

Named for exposures in Mattapan, Dorchester district of Boston, Mass.

Mattaponi Formation

Upper Cretaceous and Paleocene: Southeastern Virginia (subsurface).

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 17–22, pls. 1, 7. Name applied to 429 feet of sediments underlying Aquia formation in type well. Top 100 feet is glauconitic to some extent and remainder consists of brightly colored mottled clays, and gray, blue, red, and purple-brown clays. Overlies Potomac group. Occurs between depths of 235 and 654 feet in type well.

Type well: Municipality of Colonial Beach, Westmoreland County. Drilled by Virginia Machinery & Well Co., Inc.

Matteawan Granite[1]

Precambrian: Southeastern New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, pl. 18.

Probably named for occurrence in town of Matteawan, Dutchess County.

†Matthews Landing Group or Series (in Midway Group)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 57–60.

Named for exposures at Matthews Landing, on Alabama River, in Wilcox County.

Matthews Landing Marl Member (of Porters Creek Clay)

Matthews Landing Marl (in Midway Group)[1]

Matthews Landing Member (of Naheola Formation)

Paleocene: Southwestern Alabama and Mississippi.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 57–60.

F. S. MacNeil, 1946, U.S. Geol. Survey Strat. Minerals Inv. Prelim. Rept. 3–195, p. 5, 11–12. Reallocated to member status in Porters Creek clay and emended to include upper marls and limestones of Graveyard Hill section of Smith, Johnson, and Langdon (1894, Report on geology of Coastal Plain of Alabama: Alabama Geol. Survey) which is generally referred to as Blacks Bluff interval or Porters Creek. These changes made because top of Matthews Landing member is sharply defined, whereas, especially in central Alabama where it attains maximum development, there seems to be no definite line to separate it from beds represented in Graveyard Hill section. In central Alabama, member consists of glauconitic sandy marl, sand, and limestone, but west of Alabama River it becomes sandy glauconitic clay that on weathering forms concretionary limonite. West of Tombigbee River, member is 3 to 8 feet thick; east of river, thickens to about 100 feet in Wilcox County, Ala. If there are equivalent beds to the east, they are included in Clayton formation. Underlies Naheola formation.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 37, 42, pl. 3. Underlies Oak Hill member (new) of Naheola formation in Choctaw County, Ala.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 107–118, pls. 1, 5, 7, 9, 10. Described in Kemper County, Miss., as member of Porters Creek. Thickness 5 to 8 feet. Underlies Naheola formation and in some areas Fearn Springs member of Nanafalia formation. Historical summary of usage of name.

W. L. Roux, Jr., 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Referred to as member of Naheola formation.

Named from old Matthews Landing on Alabama River, in northern part of sec. 12, T. 12 N., R. 6 E., Wilcox County, Ala. Extends from Winston County, Miss., to eastern Butler County, Ala.

Mattoon Formation (in McLeansboro Group)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 39–41, 51 (table 1), pl. 1, geol. sections. Proposed for all Pennsylvanian strata above top of Millersville limestone member of Bond formation (new). Predominantly shale and sandstone. Maximum thickness 500 to 600 feet; more than 750 feet of Mattoon strata present in Union County, Ky. Members (ascending): central and southeastern Illinois—Friendsville coal, McClearys Bluff coal, Shelbyville coal, Opdyke coal, Trowbridge coal, Calhoun coal (new), Bonpas coal (new), Omega limestone, Shumway limestone, Effingham limestone (new), Bogota limestone (new), Greenup limestone (new), Gila limestone, Woodbury limestone (new), and Reisner limestone (new); and eastern Illinois—Cohn coal (new) and Merom sandstone. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is independent of rock-stratificatic classification.

Type locality: Outcrops in counties of deeper Illinois basin area of southeastern Illinois. Named for city of Mattoon which lies in general outcrop belt of formation.

Mauch Chunk Shale[1] or Formation

Mauch Chunk Group, Red Beds, or Series

Upper Mississippian: Pennsylvania, western Maryland, and northern West Virginia.

Original reference: J. P. Lesley, 1876, Pennsylvania 2d Geol. Survey Rept. L, App. E, p. 221, 222, chart.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 252, 254–266, measured sections. Mauch Chunk series, upper division of Mississippian, underlies Pottsville series and overlies Greenbrier series. Maximum thickness about 2,800 feet. Includes (ascending) Bluefield, Hinton, Princeton, and Bluestone groups.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 46 (fig. 14), 49–53. Series, in Fayette County, divided into three parts: lower, red and green shale and buff to olive micaceous sandstone that lies directly on Loyalhanna limestone; middle, dark fossiliferous limestone and interbedded gray shale; upper, predominantly bright-red shale with lesser amounts of green shale and buff micaceous sandstone. Includes Greenbrier limestone, 5 to 40 feet thick, in middle part. Thickness about 200 feet. Underlies Connoquenessing sandstone, Pottsville series. Age not well known, commonly thought to be Chester.

Ernst Cloos and C. H. Broedel, 1943, Geol. Soc. America Bull., v. 54, no. 9, p. 1379 (table 1). Referred to as Mauch Chunk red beds in discussion of reverse faulting north of Harrisburg, Pa. Thickness 2,000 to 3,000 feet.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Group, in Donegal quadrangle, composed of about 160 feet of alternating red and green argillaceous shales with interbedded greenish fine-grained thin to massive sandstones. Fossiliferous Greenbrier limestone, about 24 feet thick, present in lower part. Overlies Loyalhanna limestone; underlies Pottsville series, Connoquenessing sandstone.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 44–45, 48 (fig. 7). Formation described in Garrett County where it crops out on both flanks of Deer Park anticline and on flanks of Accident anticline. Consists of interbedded fine-grained sandstones, siltstones, and shales; shales are typically noncalcareous and red or green; sandstones are brown to green, micaceous, and thin bedded. Sections based on geologic map indicated thickness of 500 to 700 feet. Overlies Greenbrier formation; underlies Pottsville formation. Assigned to Chester series, though not believed to be everywhere the same age.

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2671, 2674 (fig. 3), 2683. Formation underlies Tumbling Run member (new) of Pottsville formation at type section and reference section of Pottsville. Thickness about 1,000 feet.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 1–2, 37, 39, fig. 9. Formation, of Late Mississippian and Pennsylvanian(?) age, rests conformably on Pocono formation and consists of from 2,000 to more than 8,000 feet of rock in southern and western parts of anthracite region. Absent in extreme northeastern part of region, and only a few feet thick in extreme northern part. Typically consists of red-brown and light-gray fine- to coarse-grained quartzose and impure quartz sandstone, red and olive-green siltstone and shale beds, and gray-olive-green and red-brown conglomerate beds. The light-gray quartzose and impure quartz sandstone is concentrated in the basal 500

to 600 feet of formation. The basal light-gray beds appear to be genetically related to underlying strata of the Pocono, and conglomerates in upper part are apparently tongues of Early Pennsylvanian Pottsville formation. Progressively younger red beds occur to north and west.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation includes Greenbrier limestone in Fayette, Westmoreland, and Somerset Counties; Loyalhanna limestone at base in southwestern Pennsylvania.

Type locality not stated but commonly assumed to be at Mauch Chunk, Carbon County, Pa.

Maud Chert Conglomerate Member (of Konawa Formation)

Permian: East-central Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 110–111. Name applied to the dark cherts occurring in the upper three-fourths of formation.

Well exposed at Dripping Springs School, in Pottawatomie County, northwest of Maud, sec. 29, T. 8 N., R. 5 E.

Maudlow Conglomerate Lentil (in Livingston Formation)

Paleocene: Southwestern Montana.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, p. 1410, pl. 7. Consists of andesitic volcanic conglomerate and conglomeratic, crystal-lithic tuff. Thickness 688 feet. Occurs about 300 feet above Eagle sandstone. Paleocene plant remains in upper part of lentil and 300 feet above it. Name credited to Klemme (unpub. thesis).

Occurs in vicinity of Maudlow, Gallatin County.

Maunawili Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 115. Nepheline basalt lava flow and remnants of associated cinder cone. Thickness at flow about 100 feet. Flow rests on soil which in turn rests on conglomerates in terrace graded to plus 95-foot (Kaena) stand of sea.

Named for Maunawili Ranch, on which it is exposed. Covers area of about 0.3 square mile on northeast side of Koolou Range, 7.5 miles northwest of Makapuu Head.

Maurice Formation

Maurice Member (of Boysen Formation and Gros Ventre Formation)

Upper Cambrian: Southern Montana and northwestern Wyoming.

Erling Dorf and Christina Lochman, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 276; 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 547–550. Consists of lower member of intercalated gray-green fissile shales and glauconitic limestone edgewise conglomerates with local development of lenses of dense gray algal(?) limestone (average 60 feet thick); upper member of massive-bedded oolitic limestone, mottled buff, gray, and pink, with a few flat pebble conglomerates and sandy limestones (average 100 feet thick). Thickness at type locality 150 feet. Underlies Snowy Range formation (new); overlies Park shale. Dresbach equivalent. Term Gallatin formation not applicable in this area [southern Montana].

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1094–1096, 1101 (fig. 3), 1104–1105. Rank reduced to member status in Boysen formation (new) in Wind River area, Wyoming. Thickness 182 feet in type section of Boysen. Underlies Snowy Range member; overlies Gros Ventre member of Depass formation.

V. E. Nelson and Victor Church, 1943, Jour. Geology, v. 51, no. 3, p. 145. Stratigraphic chart of Gros Ventre and Hoback Ranges shows member at top of Gros Ventre formation. Middle Cambrian.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 16. Dorf and Lochman introduced term Maurice for Pilgrim equivalent in Yellowstone Park area, and term has been applied in Logan area. Distinction between Maurice and Pilgrim is presence of mottled oolitic limestone in Maurice. Term Maurice considered unnecessary.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 399. In the area east and southeast of Livingston, Mont., name Pilgrim limestone is used in preference to Maurice because separation of the two units is difficult especially where they interfinger in basins between the outcrops where the formations are named.

Type locality: South side of valley of North Fork of Grove Creek, 5 miles south of Red Lodge, Carbon County, Mont. Named from Mount Maurice, prominent elevation on Beartooth front.

Maury Formation

Maury Glauconitic Member (of Ridgetop Shale)[1]

Maury Green Shale Member (of Chattanooga Shale)

Maury Shale

Lower Mississippian: Western and central Tennessee, Alabama, and Georgia.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 141, 143.

K. E. Born and H. B. Burwell, 1939, Tennessee Div. Geology Bull. 47, p. 48. Maury green shale is top member of Chattanooga shale.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 895–900. Maury shale, with its conspicuous phosphatic nodules, has been prominent in black-shale literature as a connecting link between the black shale and overlying strata. Its status as member of one or the other has been crucial to some of theories relating to the Mississippian succession. Proposed here to restrict term Maury to bed of shale containing phosphatic nodules, commonly less than 1 foot thick, Osage in age, which overlies Chattanooga. This definition excludes the Falling Run, and Eulie (both new) and the undifferentiated overlying beds, and limits the Maury to the time and conditions of formation of its most characteristic feature, phosphatic nodules. This restriction will necessitate restudy and differentiation of excessive thicknesses of shale [as much as 20 feet] usually assigned to Maury. Chattanooga shale is overlain disconformably by Maury, and Maury is shoreward facies, not seaward facies, or Chattanooga or any other formation to which it is related. Summary of usage.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 23–26, pl. 5. Maury formation of this report is "Maury green shale" of Safford and Killebrew, who proposed the term for beds between the "Black shale (Chattanooga shale)" and their Tullahoma formation. Lithologic charac-

teristics, stratigraphic position, and fauna of Glendale shale of Swartz (1924) are similar to those of Maury formation, and it is believed that these names refer to same lithologic unit. Name Maury is used in preference to Glendale in this report. Maury is well-defined lithologic unit wherever it is overlain by Ridgetop shale or New Providence shale. Generally 1½ to 3 feet thick and consists mostly of grayish-yellow, green, and greenish-gray glauconitic mudstones. In north-central Tennessee, nodule bed contains Late Devonian conodonts like those of Gassaway member of Chattanooga shale; elsewhere in central Tennessee, it contains early Mississippian (Kinderhook) conodonts. On basis of conodonts, Maury is considered biostratigraphic equivalent of lower part of New Providence shale. Beds identified as Big Stone Gap member and Olinger member of Chattanooga by Swartz (1927) are included in Maury as herein defined. No adequate exposure of formation was found in Maury County [where named by Safford and Killebrew] therefore standard exposure is designated.

Standard section: Along south side of road near top of west slope of Pull Tight Hill, 13½ miles southeast of Franklin and 1.2 miles east of Cross Key, Williamston County, Tenn.

Mauumae Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 42, 45.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 115–116. Pyroclastic material ranging from cinder and spatter to medium-textured black ash and associated lava flow of nepheline basalt. Thickness in drill hole more than 151 feet. Unconformably overlies Koolau volcanic series; underlies Diamond Head tuff and Kaimuki basalt.

Erupted from Mauumae. Exposed over about one-half square mile on south side of Koolau Range, 10 miles west of Makapuu Head.

Maverick Shale

Precambrian: Central Arizona.

E. D. Wilson, 1938, *in* Arizona Bur. Mines Bull. 145, Geol. Ser. 12, pl. 3; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118, 1123–1124. In type section, consists of thin-bedded locally rippled-marked fine-grained dense gray shale containing alternating thin sandy to quartzitic beds in upper part. In vicinity of North Peak, shale ranges from gray and dark gray to maroon with light-gray diffusion spots; south of North Peak, shale is prevailingly gray to pale greenish gray on fresh fracture, weathering dull gray or pale yellowish. Thickness 800 feet at Maverick Basin; thins to about 500 feet at North Peak; apparently thins greatly northward. Overlies Deadman quartzite (new) and underlies Mazatzal quartzite with conformable contacts.

Named from typical occurrence in Maverick Basin, in northwestern part of Mazatzal Mountains.

Maxfield Limestone[1]

Middle Cambrian: Central northern Utah.

Original reference: F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 107.

F. C. Calkins and B. S. Butler, 1943, U.S. Geol. Survey Prof. Paper 201, p. 14–18, pl. 5. Gray and white dolomite and gray- to buff-mottled limestone interbedded with shale. Thickness 570 feet. Overlies Ophir shale; underlies Jefferson(?) dolomite. Probably Middle Cambrian. Plate 5 shows Upper Cambrian.

A. E. Granger, 1953, U.S. Geol. Survey Circ. 296, p. 2. Crops out in City Creek Canyon (near Salt Lake City) where it is 1,039 feet thick, conformably overlies Ophir shale and conformably underlies Swan Peak(?) formation.

U.S. Geological Survey currently designates the age of the Maxfield Limestone as Middle Cambrian on the basis of a study now in progress.

Named for Maxfield mine at Argenta, near Salt Lake City.

Max Meadows (fault) Breccia

Upper Paleozoic: Southwestern Virginia.

B. N. Cooper and J. C. Haff, 1940, Jour. Geology, v. 48, no. 8, pt. 2, p. 945–974. Fault breccia, separating the sole and tread of Max Meadows overthrust, consists of three cataclastic zones: upper autoclastic breccia composed of large angular blocks and smaller tabular fragments of quartz sericite phyllite; lower autoclastic zone consisting of angular blocks and fractured masses of Elbrook limestone and dolomite; and intervening zone of crush conglomerate composed chiefly of rounded fragments of limestone, dolomite, and phyllite. Combined thickness of three zones about 75 feet; all fundamental relations of the breccia are seldom seen in a single exposure. Rome and Elbrook formations have been thrust over younger formations along two closely spaced low-angle overthrusts which are nearly parallel; lower and older of these faults is the Pulaski and the upper Max Meadows.

Occurs in Draper Mountain area situated in west-central Pulaski County and adjacent parts of Wythe County. All three zones are exposed along east bank of Cove Creek about 3 miles west of Max Meadows, Pulaski County.

Maxon Sandstone (in Trinity Group)[1]

Lower Cretaceous: Western Texas.

Original reference: P. B. King, 1930, Texas Univ. Bull. 3038, p. 91–93, map.

G. A. Kiersch and P. W. Hughes, 1952, Econ. Geology, v. 47, no. 8, p. 798 (fig. 2). Shown on geologic column of outcropping units, Reagan Canyon to Del Rio, Tex., as below the Walnut-Comanche Peak and above the Glen Rose limestone. Consists of buff- to reddish-brown medium-bedded sand and siltstone and gray-black medium- to thin-bedded argillaceous limestone. Thickness about 200 feet.

Type locality: Maxon Station, near point where Southern Pacific [Railroad] leaves Marathon basin, Brewster County.

Max Patch Granite[1]

Max Patch Granite Gneiss

Precambrian: Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 116.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 18–19; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Max Patch granite gneiss consists entirely of Max Patch granite as mapped by

Keith. Unit has been so completely metamorphosed that most of it has a gneissic to schistose structure, and little, if any, true granite remains unaltered; porphyritic variety of unit has been altered to augen gneiss, whereas the even-grained variety has been altered to gneiss or schist. Precambrian(?).

Named for Max Patch Mountain in Madison County, N.C. [This may be considered the type locality.].

Maxville Limestone[1]

Mississippian: Ohio and northeastern Kentucky.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 80, 84.

Wilber Stout, 1945, Ohio Geol. Survey, 4th ser., Bull. 45, p. 8 (table), 34. Maxville limestones were laid down on sandstones and shales of Logan formation, and then were cut away during a long cycle of erosion which left only small isolated areas. Such deposits are present at surface in Scioto, Jackson, Vinton, Hocking, Perry, and Muskingum Counties. Underlies Pottsville rocks.

Named for village of Maxville, Perry County, Ohio.

Maxwell Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: E. F. Lines, 1912, Illinois Geol. Survey Bull. 17, p. 89, 90.

Probably named for occurrence at or near Maxwell, Peoria County.

Maya conglomerate[1]

Tertiary: New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 9.

Derivation of name not stated.

Mayagüez Group

Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 329–340, pl. 1. Composed of bedded and massive fragmental limestone; thin- to medium-bedded foraminiferal tuffaceous mudstone, siltstone, and tuff, and andesitic and basaltic volcanic rock including massive tuff, lava, and breccia. Thickness about 780 meters near south and southwest coasts and as much as 3,800 meters near northeastern corner of area. Conformably overlies Río Loco formation, and, where Río Loco is absent, unconformably overlies Bermeja complex (new). Comprises seven lithofacies units of formational rank: Parguera, Brujo, and Melones limestones, Yauco mudstone, Maricao basalt, Sabana Grande andesite, and El Rayo volcanic rocks. In this classification, the Mayagüez group and Melones limestone are litologic units which correspond to time-stratigraphic units within Mayagüez area, whereas the other six formations are regarded as lithologic units or lithofacies, with no implications of position relative to one another. Youngest rocks are Maestrichtian; oldest are Turonian to Santonian.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p.

55–56. Mattson included rocks assignable to Río Yauco formation in his Mayagüez group. Inasmuch as the Río Yauco and Río Blanco formations interfinger, the Río Blanco should be included in Mayagüez group.

Named for Mayagüez map area. Comprises most of rocks in southwestern Puerto Rico.

Mayagüez Shales[1]

Tertiary: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 61.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 334. Berkey suggested this name for shales outcropping near Mayagüez. Name has not been used since but Meyerhoff and Smith (1931, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, no 2, pt. 3) suggested similarity between them and Fajardo shales.

Maybelle Formation (in Lueders Group)

Maybelle Limestone[1] Member (of Lueders Formation)

Permian (Leonard Series): Central northern Texas.

Original reference: A. S. Romer, 1928, Texas Univ. Bull. 2801, p. 74.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Given formational status in the Lueders herein designated as a group. Underlies Lake Kemp formation; overlies Paint Rock limestone.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Examination of type outcrops of Maybelle and Lake Kemp beds affords no satisfactory ground for classing the limestones as parts of the Lueders. No basis was found for recognizing any limestone beds of the Lueders in the Colorado River area [mapped in this report] as corresponding to Maybelle and Lake Kemp beds, respectively.

Derivation of name unknown.

May Creek Formation[1] or Schist

Devonian(?): Southwestern Oregon.

Original reference: J. S. Diller and G. F. Kay, 1924, U.S. Geol. Survey Geol. Atlas, Folio 218.

C. N. Schuette, 1938, Oregon Dept. Geology and Mineral Industries Bull. 4, p. 112. In Meadows mining district, unconformably underlies Umpqua formation.

Exposed for 3 miles along May Creek and beyond mouth of May Creek, Riddle quadrangle, Jackson County.

Mayes Formation[1]

Mayes Group

Mayes Limestone Member (of Fayetteville Shale)

Mississippian: Northeastern and central eastern Oklahoma and northwestern Arkansas.

Original reference: C. W. Shannon and L. E. Trout, 1915, Oklahoma Geol. Survey Bull. 19, pt. 1, p. 127–130.

W. H. Easton, 1942, Arkansas Geol. Survey Bull. 8, p. 17 (table), 19–20. Mayes limestone member of Fayetteville is recognizable lithologic unit in Arkansas.

E. L. Selk, 1948, Jour. Geology, v. 56, no. 4, p. 303–307. Mayes formation consists of those beds of Mississippian age underlain by Boone (Osagian) and overlain by Fayetteville (Chesterian) in outcrops in Mayes County, Okla., and is commonly considered to be equivalent in age to Moorefield and Batesville formations. Name was proposed by Snider (1915) and correlated as lower Chester. Buchanan (1927) applied name to dark argillaceous silty limestone of subsurface Mississippian and correlated lower part at least with Meramec series. Cram (1930) presented evidence that subsurface "Mayes" was facies of Boone and, therefore, of Osage age. Since that time, the name has persisted, as has the confusion and controversy. New evidence, by deep drilling in western and northwestern Oklahoma, supports general opinion of subsurface geologists that the "Mayes" of subsurface is of Osage age and is not a correlative of Mayes formation of outcrop in northeastern Oklahoma.

J. C. Barker, 1951, Tulsa Soc. Digest, v. 19, p. 173–176. Caney formation of Lawrence uplift has two characteristically developed facies, a lower calcareous siltstone phase and an upper black shale unit. Subsurface stratigraphers have referred to calcareous phase of lower Caney as the "Mayes". This calcareous phase is exposed in three localities and could not be mapped as separate unit. It is herein referred to as "Ada Mayes." The "Ada Mayes" unconformably overlies Welden limestone and grades into overlying shale of upper Caney.

M. K. Elias, 1956, *in* Petroleum geology of southern Oklahoma, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 60. Name Ahloso [Ahlosa] member is introduced for basal unit of Caney shale, commonly referred to as "Mayes" or "Ada Mayes". These terms reflect attempts of geologists to connect these rocks with lithologically similar "Mayes" of subsurface of east-central Oklahoma. This is shown by Selk (1948) to be largely Osage in age and, therefore, older than Snider's (1915) Mayes of northeastern Oklahoma outcrops. Term is inappropriate for formal nomenclature of Mississippian rocks of Arbuckle Mountains; hence, name Ahloso [Ahlosa] is proposed.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 47–65. Raised to group rank for surface units in northeastern Oklahoma. Includes Moorefield formation below and Hindsville above. Meramec and Chester.

K. C. Jackson, 1959, Fort Smith Geol. Soc. Guidebook 1st Field Conf., p. 56. Member occurs near base of Fayetteville. Consists of dark-gray to blue-black massive crystalline limestone. Throughout much of southwest Washington County, Ark., member is represented by large septarian-type concretions.

U.S. Geological Survey uses the term Mayes formation only in subsurface.

Named for Mayes County, Okla.

Mayfield Member (of Mount Simon Formation)

Upper Cambrian: Northern Illinois (subsurface).

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 153 (fig. 2), 154 (fig. 3), 155. Name proposed for a thick sequence of interbedded conglomeratic and nonconglomeratic sandstones overlying Lovell member (new). Type section extends from depths of 2,495 to 2,850 feet. Thickness 145 to 390 feet. Underlies Lacey member (new).

Type well: Wyman No. 1 (well 7), in NE¼NE¼SE¼ sec. 35, T. 41 N., R. 5 E., De Kalb County. Name derived from Mayfield Township, 5 miles west of type well.

Mayfield Hills Plagioclase Syenite

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Name applied to the plagioclase syenite occurring in Mayfield Hills stock.

Occurs in Wylie Mountain vicinity, Jeff Davis County.

Mayflower Amygdaloids[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Mayflower mine, Houghton County.

Mayflower Flows[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Mayflower mine, Houghton County.

Mayflower Schist[1]

Ordovician(?): Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Exposed in Mayflower Gulch, Manhattan district.

Maynardville Limestone[1] or **Formation** (in Conasauga Group)

Maynardville Limestone Member (of Conasauga Shale)

Maynardville Limestone Member (of Nolichucky Shale)

Upper Cambrian: Eastern Tennessee and southwestern Virginia.

Original reference: C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 5, p. 474–475, 494, 497.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 4. Name considered invalid.

John Rodgers, 1943, Geologic map of Copper district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim. Map; John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 11–12. Removed from Rome formation, and rank reduced to member in upper part of Nolichucky shale. Thickness 181 feet in Hawkins County. New standard section designated as old section is now covered by Norris Reservoir.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (2 sheets); R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 14, 15–17 geol. sections. In Jonesville district, Lee County, Va., Maynardville limestone is subdivided into two members. Low Hollow limestone below and Chances Branch dolomite. Thickness 250 to 350 feet. Underlies Copper Ridge dolomite. Maynardville is oldest formation exposed in district; present in discontinuous belts partially rimming Fleenortown and Town Branch fensters and in discontinuous belts on south side of Wallen Valley fault.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (pl.); pt. 2, p. 46 (fig. 3), 48, 49–53. In eastern Tennessee, the Conasauga varies in lithology, and three phases are recognized. In northwestern phase, Maynardville limestone is considered member of Conasauga shale. In central phase, the Conasauga is considered a group consisting of six formations of which the Maynardville is the uppermost; thickness 150 to 350 feet;

overlies Nolichucky shale. In southeastern phase, sequence is Honaker dolomite, Nolichucky shale, and Maynardville limestone.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Survey Geol. Quad. Map GQ–111. Referred to as formation in Duffield quadrangle, Virginia; more than one-half of unit is dolomite. Contains Chances Branch limestone member and Low Hollow limestone member which total about 200 feet in thickness. Overlies Nolichucky shale; underlies Copper Ridge dolomite.

J. M. Cattermole, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–126. Maynardville limestone mapped in Bearden quadrangle, Tennessee, where it is uppermost unit of Conasauga group. Thickness about 250 feet. Overlies Nolichucky shale; underlies Copper Ridge dolomite of Knox group.

New type section: Along State Highway 33, 7 miles northeast of Maynardville, between bridge over Cox Branch and south end of bridge across Norris Reservoir. Old and new type sections are about 3 miles apart along same belt of outcrop. Name taken from village of Maynardville, Union County, Tenn.

Mayne Creek Formation[1]

Mayne Creek Member (of Hampton Formation)

Mississippian (Kinderhookian): Central northern Iowa.

Original reference: F. M. Van Tuyl, 1925, Iowa Geol. Survey, v. 30, p. 52,92, 105, 108.

L. R. Laudon and B. H. Beane, 1937, Iowa Univ. Studies, v. 17, no. 6, p. 236, 237. Member of Hampton formation. Overlies Chapin member; underlies Eagle City member. [Spelled Maynes Creek.]

Named for exposures in north bluff of Mayne Creek, NE¼ sec. 21, Reeve Township, Franklin County.

May Pond Member (of Littleton Formation)

Lower Devonian: Southwestern New Hampshire.

M. T. Heald, 1950, Geol. Soc. America Bull., v. 61, no. 1, p. 45, 50–51, 55, pl. 1; 1950, The geology of the Lovewell Mountain quadrangle, New Hampshire: New Hampshire State Plan. Devel. Comm., p. 9, 14. Composed predominately of banded gneiss with some beds of well-stratified schist. In Lovewell Mountain quadrangle, the May Pond lies stratigraphically above and to east of Hubbard Hill member (new). In northern part of quadrangle, the two members are separated by a sill of Kinsman quartz monzonite. Underlies Dakin Hill member (new). Probable total thickness 5,000 feet.

Typical outcrops: Along roads leading to village of Marlow and on Route 31 in Washington, 600 feet south of bridge over Ashuelot River.

Maysville Group[1]

Maysville Formation (in Cincinnati Group)

Maysville or Maysvillian Stage

Upper Ordovician: Northern Kentucky, northwestern Georgia, southern Indiana, southwestern Ohio, and Tennessee.

Original reference: A. F. Foerste, 1905, Science, new ser., v. 22, p. 150.

R. H. Flower, 1946, Bulls. Am. Paleontology, v. 29, no. 116, p. 108–112. Discussion of Cincinnatian cephalopods of Cincinnati region. Maysville group includes Fairview beds below and McMillan formation above. Oc-

curs above Eden group and below Richmond subseries. In Covington subseries of Cincinnatian series.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 32–33. In full sequence, as at Cincinnati, Maysville formation is separated from the Trenton by Fulton and Eden shales. In Georgia, so far as is known, the Fulton and Eden are absent, and, where Maysville is present, the Trenton is also absent and the Maysville succeeds the Moccasin.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 10, 11, 44–45; 1949, Tennessee Div. Geology Bull. 56, p. 179–192. Group in central Tennessee includes Leipers formation. Overlies Nashville group (redefined and used to replace term Trenton group in Tennessee); underlies Richmond group. Eden group present locally between Nashville and Maysville groups.

Duff Kerr, 1951, Compass, v. 28, no. 2, p. 98 (fig. 3), 100–102. Group, in Cincinnati area, comprises Fairview and McMillan formations. Conformably overlies Eden group. Top of Mount Auburn member of McMillan formation marks top of Covington subseries, the lower half of the Cincinnatian series. Mount Auburn underlies Sunset member of Arnheim formation which is base of Richmond subseries of the Cincinnatian.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Generalized stratigraphic column of Ordovician and Silurian rocks exposed in Jefferson and Switzerland Counties shows Maysville group comprises (ascending) Mount Hope, Fairmount, Bellevue, Corryville, Mount Auburn, and Arnheim formations. Overlies Eden group; underlies Richmond group. Cincinnatian.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2. Correlation chart shows Maysvillian stage in Cincinnatian series above Edenian and below Richmondian stage. Maysville group comprises (ascending) Mount Hope shale and limestone, Fairmount shale and limestone, Bellevue shale and limestone, Corryville shale and limestone, and Mount Auburn shale and limestone. Above Eden group and below Richmond group.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 518–521. Formation included in Cincinnati group, are of Cincinnati arch (subsurface).

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1031. Fairview and McMillan formations constitute the standard for a medial Cincinnatian Maysville stage.

Named for exposures along railroad south of Maysville, Mason County, Ky.

Mayville Limestone[1]

Silurian: Southeastern Wisconsin.

Original reference: T. C. Chamberlin, 1877, Geology Wisconsin, v. 2, p. 336–345.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Mayville dolomite shown on correlation chart in Michigan and Wisconsin. Occurs below Burnt Bluff group. In Michigan, occurs above Manitoulin dolomite; in Wisconsin, is oldest Silurian. Albion series.

G. V. Cohee, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 33, sheet 2. Gray-buff to light-browish-gray dolomite and limestone; locally pink and red dolomite. More than 100 feet thick at type locality.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 3, 9. Name Mayville, which as been used for strata occupying position between Middle Silurian Burnt Bluff group and Richmond strata of Upper Ordovician age, is not used in this report. Highest *Virgiana decussata*-bearing strata of Mayville are here named Lime Island dolomite and placed in Burnt Bluff group.

Type locality: About 2 miles south of Mayville, Dodge County. Extends throughout eastern part of Wisconsin from Illinois border to Green Bay Peninsula; forms series of low cuestas at many places.

Maywood Formation[1]

Upper Devonian: Central western Montana.

Original reference: F. C. Calkins and W. H. Emmons, 1913, U.S. Geol. Survey Prof. Paper 78.

Christina Lochman and Donald Duncan, 1944, Geol. Soc. America Spec. paper 54, p. 16. In discussion of early Cambrian faunas of central Montana, Maywood formation tentatively assigned to Silurian by Calkins and Emmons is here regarded as highest Upper Cambrian.

Christina Lochman, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2202 (fig. 1), 2213. As used in this report, Maywood overlies Sage pebble conglomerate member (new) of Dry Creek shale (redefined). Consists of buff-orange dolomite, maroon-green dolomite, and mudstones 65 to 85 feet thick. Underlies Jefferson dolomite. Devonian. Most of the beds referred to in literature by Weed (1900, U.S. Geol. Survey 20th Ann. Rept. for 1898–1899, pt. 3), Deiss (1936, Geol. Soc. America Bull., v. 47, no. 8), and Lochman and Duncan (1944) as Dry Creek shale are actually the basal Devonian unit and beds of undetermined age of Sloss and Laird (1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8) and should be known as Maywood formation.

V. L. Freeman, E. T. Ruppel, M. R. Klepper, 1958, U.S. Geol. Survey Bull. 1042–N, p. 495–496, pl. 42. In area of this report [Townsend Valley, Mont.], Red Lion formation of Cambrian age and Maywood formation of Upper Devonian age are mapped as a unit although the two formations are separated by erosional unconformity.

Named for exposures on Maywood Ridge, west of Princeton, Philipsburg quadrangle.

Mazama Andesites, Lavas. Flows

See Mount Mazama Andesite, Dacites, Lavas, Flows.

Mazarn Shale[1]

Lower Ordovician: Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. D. Miser, 1917, U.S. Geol. Survey Bull. 660, p. 68.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 11 (fig. 2), 22–23, pl. 1. Described in Ouachita Mountains of Oklahoma where it has an estimated thickness of 600 feet. Lithologically resembles the older Collier shale. The locally interbedded limestones of the Mazarn are distinctive, but, in spite of this distinctive limestone, the position of Mazarn shale in sequence, above Crystal Mountain sandstone and below Womble shale, is only sure method of its identification. As defined here, the Mazarn underlies Womble shale although it is separated from it by a thin sandstone referred to as "Blakely" sandstone; this sandstone could be designated as a separate unit, but if so designated it should not be called "Blakely"

because of the findings of current fieldwork in the Blakely sandstone type area in Arkansas. Ordovician.

Named for Mazarn Creek, eastern Montogomery County, Ark.

Mazatzal Granite

Precambrian: Central Arizona and southwestern Colorado.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, pt. 2, p. 101. While Archean deformation was going on, granitoid magmas invaded crust in central Arizona and southwestern Colorado. Exposures show stocks and small batholiths of various sizes and composition. Since most of the rock is granite, it is all referred to as Mazatzal granite. Mazatzal orogeny discussed.

Mazatzal Quartzite[1]

Precambrian: Central Arizona.

Original reference: E. D. Wilson, 1922, Pan-Am Geologist, v. 38, p. 299–312.

Alexander Stoyanow, 1942, Geol. Soc. America Bull., v. 53, no. 9, p. 1259–1261. Mentioned in detailed succession of Paleozoic paleogeography of Arizona. Theories on age relationships reviewed.

E. D. Wilson, 1938, *in* Arizona Bur. Mines Bull. 145, Geol. Ser. 12, pl. 3; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118 (table 1), 1124–1126, pl. 10. Crops out in four different areas in central Arizona. Resting with apparent conformity on Maverick shale (new) and intruded in places by granite, it makes up the high main ridge of the northern half and the crest of Four Peaks at the southern end of Mazatzal Range. Along Pine Creek, lies unconformably on Red Rock rhyolite and is unconformably overlapped by Paleozoic and Tertiary beds. In northeastern Tonto Basin and in Christopher Mountain and vicinity, occurs faulted against Red Rock rhyolite and is unconformably overlapped by Apache, Paleozoic and Tertiary formations. Near Del Rio, in fault contact with metamorphosed shale of Alder series and unconformably overlapped by Cambrian, Devonain, and Tertiary beds. Thicknesses. 1,300 feet in Mazatzal Mountains; 3,800 feet on Pine Creek, 1,780 feet near Del Rio.

Named for development in Mazatzal Range.

Mazomanie Sandstone[1]

Mazomanie Sandstone Member (of Franconia Formation)

Upper Cambrian: Central Wisconsin and southern Minnesota.

Original reference: E. O. Ulrich, 1920, Washington Acad. Sci. Jour., v. 10, p. 73–78.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. 1, 2; 1953 Jour. Paleontology, v. 27, no. 4, p. 555. Rank reduced to member status in Franconia formation which is herein subdivided into five formations. Ulrich (1920) used term Mazomanie formation for nonglauconitic dolomitic sandstone in central Wisconsin that contains *Prosaukia* fauna; he believed Mazomanie was younger than Franconia. This sandstone represents a facies to the north and east of the more highly glauconitic Franconia sandstone, and name Mazomanie member is applied here to this nonglauconitic facies. Interfingers with and replaces glauconitic sandstones to north and east. Overlies Tomah member (new), interfingers with Reno member (new).

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 866–869, measured sections. Twenhofel, Raasch, and Thwaites (1935, Geol. Soc. America Bull., v. 46, no. 11) rejected name Mazomanie. From Mississippi River

eastward in Wisconsin, interbedded nonglauconitic sandstone in Franconia greensands thicken until in central Wisconsin entire Franconia above Tomah member is composed of nonglauconitic and dolomitic sandstone; revived name Mazonmanie is applied to facies that intertongues with Reno member. Member consists of two rock types: a crossbedded dolomitic sandstone dominant in type area, and a thin-bedded sandstone well exposed only in St. Croix Valley. The thin-bedded Mazomanie is a distinct type distinguished from the Tomah by absence of interbedded shale, but regional relationships between the two Mazomanie rock types cannot be distinguished in detail. Term Mazomanie has been expanded to include all sandstones that constitute nonglauconitic facies to north and east. In some areas, the Mazomanie overlies Birkmose member of Franconia. At type area, the Mazomanie constitutes more than three-fourths of Franconia thickness. Thickness at type locality 116½ feet. Measured sections show Mazomanie present in Minnesota.

Type area: At Ferry Bluff, SW¼ sec. 20, T. N., 9 R. 6 E., Sauk County, Wis. This is a locality mentioned by Ulrich (1920) and is situated across Wisconsin River from town of Mazomanie.

Mazourka Group

Mazourka Formation[1] (in Pogonip Group)

Lower and Middle Ordovician: East-central California.

Original reference: F. B. Phleger, Jr., 1933, Southern California Acad. Sci. Bull., v. 32, pt. 1, p. 1–6.

R. L. Langenheim, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2085–2091. Described in Mazourka Canyon area, Independence quadrangle. Consists of approximately 500 feet of limestone and shale. Overlies Pogonip dolomite; underlies Barrel Spring formation of Eureka group. In Pogonip group. Chazyan.

U.S. Geological Survey currently classifies the Mazourka as a group and designates its age as Lower and Middle Ordovician on the basis of a study now in progress.

Typically exposed in Mazourka Canyon between Barrel Spring Canyon and Lead Canyon Trial, Inyo Range.

Mead Limestone

Middle(?) Cambrian: Northwestern Arizona.

E. T. Schenk and H. E. Wheeler, 1942, Jour. Geology, v. 50, no. 7, p. 894–896, fig. 3, table 1. Light-gray to pink, fine-grained to dense laminated to thin-bedded (outcrops massive), somewhat mottled limestone. Thickness quite variable, 110 feet at type locality. Disconformably overlies Peasley limestone. Variation in thickness due to post-Mead disconformity which has completely removed formation short distance eastward.

Type locality: South wall of western Grand Canyon about 1½ miles east of Grand Wash Cliffs.

Meade Group

Meade Formation

Meade Gravel[1]

Pleistocene: Southwestern Kansas and northern Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado College Studies, v. 6, p. 53–54.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 108. Meade gravels of Cragin (1896) should be abandoned unless future work leads to an adequate understanding or nature of the beds.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, p. 399 (table), 411–419. Formation as herein redefined includes Meade gravels of Cragin (1896) at base; Cragin's (1896) Pearlette ash; Smith's 1940 Odee formation, *Equus niobrarensis* beds, Jones Ranch beds; and all other beds of Pleistocene age above Rexroad member of Ogallala formation and below Kingsdown silt. Thickness 50 to 150 feet. Type locality designated because original Meade type locality cannot be located accurately.

T. G. McLaughlin, 1946, Kansas Geol. Survey Bull. 61, p. 123–130. Term Meade formation is used in this report as defined by Frye and Hibbard except that Jones Ranch beds are considered a part of Kingsdown silt.

J. C. Frye, Ada Swineford, and A. B. Leonard, 1948, Jour. Geology, v. 56, no. 6, p. 520 (fig. 6), 521–523. Proposed to restrict Meade formation (Frye and Hibbard, 1941) to sediments at its type section, NW¼ sec. 21, T. 33 S., R. 28 W., Meade County, Kans., and equivalent deposits elsewhere, which signifies that this term should be used throughout Kansas to include the sediments of the Kansan cycle of fluvial sedimentation. Two members recognized: Grand Island below and Sappa above; latter includes Pearlette volcanic ash lentil.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleonotology Contr., v. 7, no. 4, p. 63–70. Formation redefined to include original deposits designated by Cragin as Meade gravels in area of old Vanhem post office. Formation is also defined to include the overlying silts and caliche exposed in section on tributary of Spring Creek, west of Crooked Creek. These upper beds are not present near Vanhem post office but occur below another gravel here included with Pearlette ash in Crooked Creek formation (new). Basal sands and gravels are herein designated Meade gravels member of Meade formation, thus retaining name and type locality given by Cragin in vicinity of old Vanhem post office. Type exposures are in Clark County in sec. 12, T. 30 S., R. 23 W., and secs. 7 and 18, T. 30 S., R. 22 S., on north side of Bluff Creek; Vanhem post office, in NW¼ sec. 13, T. 30 S., R. 23 W., was just to southwest of these exposures. Beds overlying the Meade gravels and below Crooked Creek formation are here named Missler member of Meade formation. Overlies Rexroad formation. Type locality of Meade redesignated to conform with new definition of formation proposed in this paper. Type locality of formation designated by Frye and Hibbard (1941) does not include Meade gravels as defined by Cragin. Thickness 29 feet at type locality.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 84–106. Report discusses conflicts in usage of term Meade and presents classification as currently used by Kansas Geological Survey. Type locality of Frye and Hibbard restudied; type locality (measured section) given as SE¼NE¼NE¼ sec. 21, T. 33 S., R. 28 W., Meade County. Here formation is 62 1/3 feet thick and includes Grand Island member below and Sappa member above. Sappa member includes Pearlette ash bed. Overlies Ogallala formation. Underlies Sanborn formation. Pleistocene (Kansan stage).

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 56. Group in northern Kansas, includes all Pleistocene deposits above base of David City formation and below Crete formation. In Meade County, group in-

cludes all deposits above the Rexroad formation and below Kingsdown formation. In southwestern Kansas, group comprises Ballard formation (new) below and Crooked Creek formation above. Elsewhere divided into two unnamed formations and underlies Crete formation of Sanborn group. Classification used in this report is in accord with agreement at Pleistocene conference held at Lawrence, Kans., June 1956.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 54–58. Discussion of history of usage of name. In Harper County, Meade group includes fluvial gravels, sands, and silts, and volcanic ash that lie above Pliocene Ogallala formation or above Permian Rush Springs, or Whitehosre group where Ogallala is missing. Thickness 0 to 70 feet. Ballard formation not recognized in Harper County, but Crooked Creek formation with Pearlette ash lentil is present.

Type locality (Frye and Hibbard) : Exposures along Crooked Creek valley in Meade Center Township south of city of Meade, and particularly Pleistocene beds exposed in sec. 21, T. 33 S., R. 28 W., Meade County, Kans.

Type locality (Hibbard, 1949) : Includes exposures along tributary of Spring Creek in SW¼ sec. 6, and in sec. 7, T. 32 S., R. 28 W., Meade County.

Type section (Frye, Swineford, and Leonard) : NW¼ sec. 21, T. 33 S., R. 28 W., Meade County.

Meade Peak Phosphatic Shale Member or **Tongue** (of Phosphoria Formation)

Permian: Eastern Idaho, southwestern Montana, eastern Utah, and western Wyoming.

V. E. McKelvey *in* V. E. McKelvey and others, 1956 , Am. Assoc. Petroleum Geologist Bull., v. 40, no. 12, p. 2832 (fig. 3), 2836 (fig. 4), 2845–2847. Phosphatic shale member of Richards and Mansfield (1912), formerly known also as B unit or member of Phosphoria in Montana and northwestern Wyoming and as middle shale member of Park City in Utah, is here named Meade Peak phosphatic shale member of Phosphoria formation. In its typical area, consists of about 200 feet of dark carbonaceous phosphatic and argillaceous rocks; mudstone and phosphorite are chief end-member rock types, and dark dolomite and limestone are subordinate types. In southeastern Idaho 125 to 225 feet thick; thickens southward to about 300 feet in central Wasatch Mountains, where it is split by tongue of Franson member (new) of Park City formation; thins toward the north, east, and southeast, and pinches out in southwestern Montana, western Wyoming, and eastern Utah; thins westward; in Cassia County, Idaho, about 80 feet thick; westernmost extent unknown. Overlies lower chert member (unnamed); underlies Rex chert member. In typical area, lower and upper contacts are defined, respectively, as base and top of sequence of dark carbonaceous or phosphatic beds.

V. E. McKelvey and others, 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 12–17, 36–37, pls. 2, 3. Overlies Grandeur member or tongue (new) of Park City formation.

Name derived from Meade Peak, about 2½ miles south of Phosphoria Gulch, Bear Lake County, Idaho.

†Meadow Limestone[1]

Pennsylvanian (Missouri Series) : Southeastern Nebraska, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 13, 22, 37.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33–34. Although unit was properly defined with relation to its position and sequence in the section its age and correlation has proved to be in error. Name has been in use for more than 30 years but is now dropped and name Merriam accepted by Nebraska Survey.

Type locality: In Keiwitz Quarry west of Meadow Station, Sarpy County, Nebr.

Meadow Marble Member (of Sevier Shale)[1]

Middle Ordovician: Central Tennessee.

Original reference: C. H. Gordon, 1924, Tennessee Dept. Ed., Div. Geology Bull. 28, p. 39–40, 63–65, map.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 78. Name applied to calcarenite lens near base of Sevier southwest Friendsville.

Named for exposures near Meadow Station, Loudon County.

Meadow Rhyolitic Tuff

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1052, 1059, pls. 1, 2. Crumbly rhyolitc tuff older than rocks of Gardiner River rhyolite-basalt complex (new). Underlies Cataract basalt (new); overlies Castle rhyolite (new).

Present in meadow near east end of First Cataract in Gardiner River, Yellowstone Park.

Meadow Canyon Member (of Oquirrh Formation)

Pennsylvanian (Derryan): Northwestern Utah.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 100–108, pls. 1, 2. Typically interbedded orthoquartzite, calcareous sandstones, arenaceous limestones and crystalline to bioclastic limestones. Thickness 945 feet. Conformably overlies Hall Canyon member and conformably underlies Cedar Fort member (both new).

Type locality: Meadow Canyon west of Lewiston Peak, in secs. 29 and 32. T. 5 S., R. 3 W., Tooele County. Measured section on spur directly north of Meadow Canyon.

Meadow Creek Sandstone Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 141. Incidental mention in discussion of Grass Creek member (new) of Frontier formation. Name credited to D. W. Trexler (unpub. thesis).

Coalville area, Summit County.

Meadow Creek Trachyte[1]

Tertiary, middle or upper: Northwestern Arizona.

Original reference: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743.

Occurs on north side of Meadow Creek, Oatman district.

†Meadville Group (in Pocono Group)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

Named for Meadville, Crawford County, Pa.

†Meadville (lower) Limestone (in Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

Named for Meadville, Crawford County, Pa.

†Meadville (upper) Limestone (in Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1880, Pennsylvania 2d Geol. Survey Rept. Q_3.

Named for Meadville, Crawford County, Pa.

†Meadville (lower) Shale (in Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

Named for Meadville, Crawford County, Pa.

†Meadville (upper) Shale (in Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

Named for Meadville, Crawford County, Pa.

Meadville Shale or Formation (in Cuyahoga Group)

Meadville Shale Member (of Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 83–90.

H. P. Cushing, Frank Leverett, and F. R. Van Horn, 1931, U.S. Geol. Survey Bull. 818, p. 52–54, 56. Cuyahoga, in its typical area, is elevated to group rank, and subdivisions (ascending) Orangeville shale, Sharpsville sandstone, and Meadville shale are treated as formations. Meadville in Cleveland area [this report] is 30 to 250 feet thick and consists of alternating blue shale, thin sandstone, and sandy limestone. Unconformably underlies Sharon conglomerate.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 52–53. Included in Tinker Creek facies of formation in Ohio. Lower part of member consists largely of blue-black argillaceous fissile shales and blue-gray thin-laminated arenaceous shales with some interbedded micaceous fine-grained sandstones; number and thickness of sandstones increase in upper part and make up as much of deposit as the shales. Thickness 100 to 200 feet. Overlies Sharpsville sandstone member; contact gradational. Lower Mississippian.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Eight members recognized in Cuyahoga formation (ascending): Orangeville, Sharpsville, Strongsville (new), Meadville, Rittman, Armstong, Wooster (new), and Black Hand. Field evidence indicates that Shenango sandstone and overlying Hempfield shale (new) are stratigraphic equivalents of upper part of Meadville member in Cuyahoga and Medina Counties. Meadville contains a mixed late Kinderhook-early Osage fauna.

Named for exposures near Meadville, Crawford County, Pa. Well exposed in Cuyahoga, Medina, and Summit Counties, Ohio.

Meadville Stage[1] or monothem[1]

Mississippian: New York, Ohio, and Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 129, table facing p. 61.

Hugo Greener, 1957, Yale Univ. Peabody Mus. Nat. History Bull. 11, p. 9, 59–60, fig. 1. Discussion of "*Spirifer disjunctus*": its evolution and paleoecology in Catskill delta. Collections were made from Meadville stage which (according to chart) includes Orangeville shale, Sharpsville sandstone, and Harvest Home shale.

Meagher facies (of Belt Series)

Precambrian: Western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Meagher facies includes the standard section of the series in the Belt Mountains and probably the Little Belt section; extends westward to Prickly Pear Creek. Distinguished by great thickness of Spokane and presence of Greyson member at its base.

In Belt and Little Belt Mountains.

Meagher Limestone[1]

Middle Cambrian: Central and southwestern Montana.

Original references: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55; 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 285–286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1276, 1277, 1314, 1330–1332. Weed designated the cap of Keegan Butte as principal locality for Meagher; because that cap is Dry Creek and Pilgrim, the Meagher technically has no status; however, name has been used consistently to designate limestone between Wolsey and Park shales and for this reason should be retained. At type locality, herein designated, and on Checkerboard Creek, Meagher limestone (emended) consists of three lithologic subdivisions: basal thin-bedded gray to green-gray limestone containing flakes and nodules of tan and buff sandy clay; middle, green to green-gray fissile micaceous shale, interbedded with a few gray and tan-gray thin-bedded banded fine-grained limestone; upper, mixed beds of fine- and coarse-grained thick- and thin-bedded limestone, which weathers gray and, in some sections, buff. Thickness at type locality 127 feet; maximum thickness 416 feet on Beaver Creek; 50 feet on Half Moon Pass; thickens from Big Snowy Mountains westward and southward and averages approximately 258 feet. Best exposed, most completely developed, and most fossiliferous section is in vicinity Nixon Gulch, Three Forks quadrangle. This is in area of Peale's (1893) section for Flathead and Gallatin formations. Here Meagher is 347 feet thick and is correlated with Peale's "Trilobite limestone" (at base of Gallatin), for which he gave thickness of 120 feet. [See Flathead Quartzite.]

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2142–2143. Present in southwestern Montana where it is as much as 550 feet thick. Overlies Wolsey shale and underlies Park shale.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 8–10, pls. 1, 2, 3. Five lowest natural Cambrian map units in southern Elkhorn Mountains are lithologically similar to Flathead sandstone, Wolsey shale, Meagher limestone, Park shale, and Pilgrim

dolomite of nearby areas, as redefined by Deiss (1936), and these formational names have been adopted. Meagher limestone comprises three units. Middle unit consists of medium-gray or medium-bluish-gray, indistinctly thick-bedded limestone. Upper and lower units are more thinly and more distinctly bedded carbonate rocks that are characterized by "black and tan" or "blue and gold" banding and mottling on weathered surfaces. Thickness 490 to 570 feet; typically intermediate unit accounts for about half the thickness of the formation and upper and lower units share the rest about equally.

Type locality: On south side and top of South Hill in Belt Park, center sec. 15, T. 14 N., R. 7 E., Little Belt Mountains quadrangle.

Means Trachyte (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21. Name proposed for dark-gray to black alkali-feldspar trachyte which forms most of outcrops on C. C. Means Ranch. Thickness at type locality 530 feet. Contains a breccia lentil 140 feet thick and a felsite lentil 115 feet thick. Overlies Fairbury trachyte (new); underlies Zopilote breccia (new).

R. K. DeFord and others, 1958, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Guidebook, Apr. 10, 11, 12, p. 31 (fig. 14). Generalized columnar section shows Means trachyte below Bell Valley andesite.

Type section: Adjacent to Bell ranch, Wylie Mountain area, Culberson County.

Mecca Formation

Miocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 24, 25 (fig. 2), pl. 2. Essentially a basal conglomerate of granitic and metamorphic debris that lies upon "basement" rocks and is overlain by Palm Spring formation in Mecca and Indio Hills; northwest of Painted Canyon, upper part of formation contains reddish sands and clays and in one exposure contains cobbles of sandstone with marine Eocene fossils; 3 miles southeast of Painted Canyon, Mecca consists of 600 feet of hard pinkish-gray sandstone and reddish clays; base not exposed. Thickness as much as 1,000 feet.

Type section: On Mecca Hills anticline at Painted Canyon, 5 miles northwest of Mecca, Imperial County.

Mechum River metasedimentary rocks

Late Precambrian and Lower Cambrian: North-central Virginia.

E. O. Gooch, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 569–674. Name applied to an infolded belt of rocks that includes metamorphosed conglomerates, sandstones, and siltstones that are intruded by metagabbro and diabase. Unconformably overlie Precambrian basement complex.

Named for exposures along Mechum River, Albemarle County. Belt is about 60 miles long and from one-half mile to 2 miles wide in northwestern Piedmont. Lies along or near axis of Catoctin Mountain-Blue Ridge anticlinorium about midway between the Late Precambrian-Early Cambrian formations in the Blue Ridge and Late Precambrian and possibly younger formations in the Piedmont. Belt is locally faulted, and infold is

overturned toward northwest in southwestern end but is open to the northeast.

Mechunck Limestone[1]

Cambrian: Central Virginia.

Original reference: W. A. Lambeth, 1901, Thesis presented to University of Virginia, p. 14.

Occurs in Monticello area, Albemarle County.

Meda Rhyolite[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 65.

Exposed in vicinity of Meda Pass and near to road south of Myers Mountain, Goldfield district.

Medford Diabase[1]

Upper Triassic: Northeastern Massachusetts.

Original reference: A. W. G. Wilson, 1901, Boston Soc. Nat. History Proc., v. 30, no. 2, p. 353–374, map.

W. H. Drennen, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 552, 553. Incidental mention in report on variations in chemical composition across igneous contacts.

Named for occurrence in Medford, Middlesex County.

Media Shale[1] Member (of Temblor Formation)

Miocene, lower: Central California.

Original reference: G. M. Cunningham and W. F. Barbat, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 4, p. 419–421.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 5 (table 2), 9–10, pl. 1. Described in Bitter Creek area, Kern County, as the Media shale member of Temblor formation. Lithologically ranges from tan platy silty shale to light-colored hard porcelaneous and siliceous shale. Thickness varies from 500 to 800 feet along McDonald anticline to as much as 2,300 feet on flank of Cedar Canyon syncline. Conformably overlies Carneros sandstone member; conformably overlain by "Button bed" sandstone.

Occurs in San Joaquin Valley.

†Medicine Beds[1]

Lower and Upper Cretaceous: Central southern Kansas.

Original reference: C. N. Gould, 1898, Am. Jour. Sci., 4th ser., v. 5, p. 169–174.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 154. Kiowa shale as herein defined probably contains stratigraphic units formerly called "Greenleaf sandstone," "Mentor beds," and others, and is in part equivalent to "Belvidere formation," "Medicine bed," "Elk River [Creek?] beds", and others.

Named for upper Medicine River, west of Belvidere, Kiowa County.

Medicine Flow

Recent: Northern California.

H. A. Powers, 1932, Am. Mineralogist, v. 17, no. 7, p. 276, 288, pl. 1. Composed of dacite lava. Thickness 100 feet at margins to 250 feet in center. Probably younger than Hoffman flow.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 373. Stony to glassy black dacite. Rests upon platy andesite, morainic deposits, Lake basalt, and lake deposits from former extension of Medicine Lake.

Occurs in Modoc Lava-Bed quadrangle.

Medicine Bow Formation[1]

Upper Cretaceous: Southern Wyoming and northwestern Colorado.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Prof. Paper 108, p. 228, 229.

Erling Dorf, 1942, Carnegie Inst. Washington Pub. 508, p. 4–21 [preprint 1938]. Redefined and stratigraphically restricted below to exclude approximately 400 feet of sediments which are termed Fox Hills. Base is considered to be lowest coal beds which separate underlying marine faunas from overlying fresh- and brackish-water faunas, and which also separates massive more persistent sandstones below from the thinner lenticular sandstones above. Thickness of restricted Medicine Bow in Wyoming 4,000 to 6,000 feet. Geographically extended into northwestern Colorado.

S. H. Knight, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 45–50. Thickness 3,200 to 4,000 feet in northern part of Hanna basin. Overlies Lewis formation; underlies conglomeratic sequence aggregating 13,500+ feet in thickness referred to as Ferris-Hanna formations. Upper Cretaceous (Lancian).

Well exposed along both sides of North Platte River at mouth of Medicine Bow River, Carbon County, Wyo.

Medicine Bow Peak Quartzite

Precambrian: Wyoming.

W. J. Kivi and R. W. Mallory, 1940, *in* Kansas Geol. Soc. Guidebook 14th Ann. Field Conf., p. 107. Incidental mention.

Medicine Bow Peak and high ridge to left are formed of the quartzite.

Medicine Lake Basalt

See Lake Basalt.

†Medicine Lodge Beds (in Cimarron Group)[1]

Permian: Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of Kansas.

Medicine Lodge Beds or Volcanics

Miocene(?): East-central Idaho and southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 369–370, table 1, pl. 1. Consist of shales, bentonitic clays, sandstones, pebble conglomerates, fanglomerates, rhyolites, and some lignite; thick vuggy fresh-water limestone at top. Thin to medium bedded, crossbedded, and jointed. White, gray, yellow, violet brown, and brown. Maximum thickness exceeds 5,000 feet. Overlie basaltic and andesitic lavas.

Occupy intermontane basin between Beaverhead and Tendoy Ranges, and a small plateau in Tendoy Range, Clark County, Idaho, and Beaverhead County, Mont.

Medicine Lodge Gypsum Member (of Blaine Formation)[1]

Medicine Lodge Gypsum (in Cimarron Group)[1]

Permian: Southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 27–39.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1468. In Canadian County, Okla., Medicine Lodge gypsum bed, 4 to 7 feet thick, is separated from overlying Shimer gypsum bed by Alabaster gypsum bed (new). All in Blaine formation.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1784, 1795, 1796 (fig. 6). Underlies Nescatunga member (new).

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 24 (fig. 6), 28–29. Overlies Flowerpot shale. Guadalupe series.

U.S. Geological Survey has abandoned the term Cimarron Group.

Named for Medicine Lodge River and town of Medicine Lodge, Barber County, Kans.

Medicine Peak Metaquartzite[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 632.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

Forms south end of Medicine Bow Peak Ridge, Medicine Bow Mountains.

Medill Sand

Pleistocene, upper: Southern California.

P. U. Rodda, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2481, 2487–2488, 2490–2491. Loosely consolidated fine to coarse sand and gravel. Maximum thickness 60 feet. Unconformably overlies Anchor sand (new).

Area is near hilltop on Overland Avenue, about 1,000 feet south of National Boulevard, and 1 mile southwest of Castle Heights area, in Cheviot Hills, Los Angeles. Named for exposures along and adjacent to Medill Place.

Medill volcanic zone (in Eagleford Formation)

Cretaceous: Northeastern Texas.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 138, 139, 143. A zone of crossbedded tuffaceous sand 11 to 20 feet thick that occurs near the top of the Eagleford. Top of zone is approximately 15 feet below base of Austin conglomerate in Medill-Woodland area. Separated from underlying Kanawha volcanic zone by interval of 80 to 90 feet of bluish-gray bedded clay shales.

Well exposed at Medill, Lamar County.

†Medina Group[1]

Lower Silurian: New York and Michigan.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 374, on 3d district.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 31–34. Confusion prevails in literature with reference to term Medina. In this report,

no attempt is made to revise or modify classification; term Medina group simply includes two members, Elkhorn shale and Clinton sandstone, which are correlative respectively with Queenston shale and Whirlpool sandstone of the New York (Niagara Falls) section.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 899–B, p. 70–91. Medina group as used in this report [southwestern New York] is assigned entirely to Silurian. Strata here designated Oswego and Queenston in lower part of group have been correlated with formations elsewhere that are assigned an Ordovician age in other U.S. Geological Survey reports. Group crops out in belt about 10 miles wide south of Lake Ontario, and Albion sandstone, at top of group, is exposed in gorge of Niagara River. Dipping southward, in conformity with regional structure, the group extends underground far beyond State boundary, and in southern Allegany County the gas sand lies more than 4,000 feet below sea level. Underlies Clinton group.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 533–534, chart 3. Medinan of Vanuxem and Hall was shown by Grabau and others to include, at its base, Queenston shale of Richmond age, here referred to Upper Devonian. Ulrich, Bassler, and New York Geological Survey use term in its original sense to include Queenston shale, which they consider to be Silurian. Many, following Grabau, restrict the Medinan to beds above the Queenston and below the Clinton. Clarke (in Ulrich, 1913) proposed the term Albion for Medinan beds lying above Queenston shale. This usage has been adopted by U.S. Geological Survey and is followed in this report. [Term Medina not used and terms Albion group and Albion series used instead.]

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Chart shows Medina group in Albion series. Brassfield is only unit listed in group.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1979–1996. Standardization of Silurian stratigraphic terminology (exclusive of the Cayugan) in southern Ontario and western New York, including type section in Niagara Gorge, shows that strata are suited to tripartite divisions, both faunal and physical. Hence, Silurian system is divided into Medina, Clinton, and Niagara groups, the three comprising Ontarian series. Medinan time includes an early short transgressive history represented by deposition of Whirlpool sandstone, Fish Creek shale (new), and Manitoulin dolomite, followed by longer regressive history represented by deposition of Cabot Head shale and Grimsby sandstone. Change from transgressive to regressive tendencies is marked by phosphatic zone in upper Manitoulin dolomite of Niagara Gorge; the Manitoulin-Cabot Head contact is essentially a time-line. Suggested that, for purposes of mapping, Grimsby-Thorold contact be retained as Medina-Clinton boundary. Recommended that names Albion, Alexandrian, Anticostian, Cataract, and Power Glen be suppressed and discontinued.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Group included in Lewistonian stage (new), Niagaran series. Includes Rumsy Ridge shale above Whirlpool sandstone and below Cabot Head shale. Name Rumsy Ridge replaces preoccupied name Fish Creek.

Named for occurrence in vicinity of Medina, Orleans County, N.Y.

Medinilla (Lower and Upper) Limestone

Aquitanian: Mariana Islands (Medinilla).

Risaburo Tayama, 1952, Japan Hydrog. Office Bull., v. 11, table 4. [In English translation (p. 65), limestone on Medinilla Island is described but formal name is not used.] Named on correlation chart. Consists of lower and upper limestone. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 46. Tayama referred name Medinilla limestone to the whole limestone mass of Medinilla Island which he subdivided as pink-colored massive limestone, thin sandy limestone, and well-bedded limestone in descending order. He correlated the massive limestone, sandy limestone, and bedded limestone with his Tagpochau, Donni, and Laulau formations respectively. Aquitanian.

Medora Amygdaloid[1] (in Portage Lake Lava Series)

Precambrian (Keweenanwa): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

H. R. Cornwall, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–51. Included in Portage Lake lava series.

Named for occurrence in Medora mine, Keweenaw County.

Medora Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Medora mine, Keweenaw County.

Medora Knob facies[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 237–239.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74. Includes Dry Creek sandstone and Brownstown Hills sandstone members of Edwardsville.

Name derived from Medora Knob of the Knobstone escarpment, crossed by U.S. Highway 50, 1 mile west of Medora, Jackson County.

Medorm Member (of Ngeremlengui Formation)

Eocene, upper, or Oligocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 45, 47–48, pl. 8. Volcanic breccia and lapilli tuff and highly altered and poorly exposed rocks of Karamado Bay complex. At type locality, ranges from coarse volcanic breccia near base to lapilli tuff near top, and varieties and relative proportion of fragments likewise change. Thickness at type locality about 700 feet. Thickness of the part of Medorm that composes Karamado Bay complex not estimated; if bay is caldera, as structure suggests; total thickness may exceed 1,000 feet. Middle member of formation; overlies Nghemesed number; underlies Arakabesan member.

Name derived from village of Medorm in central part of west coast of Babelthuap. Occurs in vicinity of Karamado Bay and region to south.

Medusa Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 10, 15A, 16. Limestone, dolomite; thickness as much as 11 feet. Shown on columnar section as underlying Oglesby member (new) and overlying New Glarus member (new). Where Oglesby member is absent, underlies Boarman member (new) of Mifflin formation.

Occurs in Dixon-Oregon area.

Meduxnekeag Granite

Age not stated: Northwestern Maine.

R. S. Houston, 1956, Maine Geol. Survey Bull. [7], p. 106, 107. Incidental mention.

Occurs in southern Aroostook County west of Houlton.

Meek Group

Pennsylvanian: Eastern Wyoming and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 22 (fig. 7), 28 (fig. 10). Consists mostly of limestones and silty limestones with some sandstone. Comprises lower 130 feet of Division II of Hartville "formation" (Condra and Reed, 1935). Thickness 119 to 130 feet. Underlies Wendover group (new); overlies Hayden group (new).

Type locality: Meek Cliff, sec. 22, T. 27 N., R. 66 W., Platte County, Wyo.

Meek Bend Limestone (in Millsap Lake Formation)[1]

Meek Bend Limestone Bed (in Hill Creek Member of Lazy Bend Formation)

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 15, fig. 3, pl. 1. Reallocated and rank reduced to status of bed in Hill Creek member of Lazy Bend formation. Fine- to medium-crystalline limestone. Commonly gray with some beds light mottled brown. Thin, flaggy to massive. Maximum thickness 12 feet. Separated from Dennis Bridge limestone bed (at base of Hill Creek) by unnamed interval of shale and sandstone. Underlies Steussy shale member. Type section established.

Type section: In scarp northwest of Hill Creek about 1½ miles southwest of mouth of Hill Creek. Limestone forms top of irregular scarp extending from Brazos River southwestward to Cretaceous rocks near southwest corner of Parker County. Limestones that crop out near Meek Bend are Brannon Bridge limestones higher in section. Named for Meek Bend of Brazos River.

Meeker Sandstone Member (of Mancos Shale)

Upper Cretaceous: Northwestern Colorado.

Kenji Konishi, 1959, Rocky Mountain Assoc. Geologists 11th Ann. Field Conf., Symposium, p. 67. Consists of sandstone, gray to brownish gray, very fine grained, and well sorted; very thin bedded with ill-defined undulatory bedding planes; strongly calcareous. Occurs about 700 feet below Morapos sandstone member. Term has been used by subsurface geologists working in northwestern Colorado.

Traceable on surface northward from Meeker, Rio Blanco County, into Yellowjacket area along western flank of Yellowjacket anticline and continues northward as steep hogback.

Meers Quartzite[1]

Precambrian: Southwestern Oklahoma.

Original reference: M. G. Hoffman, 1930, Oklahoma Geol. Survey Bull. 52, p. 26, 31, 45.

G. W. Chase, 1952, Oklahoma Geol. Survey Circ. 30, p. 11, 12 (table 3). Oldest rock in region [Wichita Mountains]. Black to nearly white medium-grained quartzite occurring as xenoliths in gabbro and Lugert granite.

Named for occurrence south of Meers townsite, Comanche County.

Meeteetse Formation[1]

Upper Cretaceous: Northern Wyoming.

Original reference: D. F. Hewett, 1914, U.S. Geol. Survey Bull. 541, p. 91, 102.

J. D. Love, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 81–82. In type area consists of light-colored tuffaceous sandstone, thin coal and carbonaceous shale beds, and yellowish to greenish bentonite beds. These overlie sandstone of Mesaverde formation. In Spread Creek Canyon, an exposure in center of syncline includes 166 feet of strata consisting of gray to chalky gray siltstone with large biotite flakes, white granular biotite tuff, carbonaceous claystone and shale, thin impure coal beds, and yellow to green bentonite beds. About 675 feet exposed on west limb of Spread Creek anticline. Younger Cretaceous rocks not observed in contact with Meeteetse. Stratigraphically below Harebell formation; contact not observed. Plant remains suggest Upper Cretaceous age.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2436–2437. Described in parts of Powder River, Wind River, and Big Horn basins. Consists of alternating thin beds of sandstone, siltstone, shale, tuffaceous siltstone or mudstone, carbonaceous shale, and lenticular coal beds. Maximum thickness 1,300 feet in western part of Big Horn basin; thins eastward, intertongues with Lewis shale, and is absent along southwestern part of Wind River basin; in southeastern part of Wind River basin, ranges in thickness from 700 feet in Rattlesnake Hills surface section to about 400 feet in Canal surface section. Underlies Lance formation, apparently conformable.

Named for town of Meeteetse on Greybull River, Park County.

Meetinghouse Slate

Meetinghouse Slate (in St. Francis Group)

Meetinghouse Slate Member (of Gile Mountain Formation)

Upper Silurian: East-central Vermont and west-central New Hampshire.

C. G. Doll, [1944], Vermont State Geologist 24th Rept. 1943–1944, p. 19. Described as gray and black micaceous slates often showing brownish stains. Very thin quartzite layers often interbedded. Excellent cleavage. Estimated thickness about 1,100 feet. Upper member of Gile Mountain schists. Devonian.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 17–19, pl. 1. Described as slate. Devonian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Geographically extended to New Hampshire. Middle Ordovician(?).

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 108, 111, 112, pl. 1. Member of Gile Mountain formation.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 24–25. Included in St. Francis group. The Meetinghouse may either overlie Gile Mountain formation and thus be at top of St. Francis group (thrust hypothesis of Monroe contact) and Devonian in age or correlate with Northfield slate, which is at base of St. Francis group (unconformity hypothesis of Monroe contact), and thus be Devonian or Silurian in age.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 34–36. Estimated thickness 0 to 2,700 feet in St. Johnsbury quadrangle. Overlies Gile Mountain formation. Most agree that age is Silurian and (or) Devonian but age is still open to question. Of the three possible sequences discussed, the author [Hall] prefers (ascending) Northfield slate, Waits River formation, Gile Mountain formation, and Meetinghouse slate.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pls. 1, 3. Assigned to Upper Silurian.

Named for Meetinghouse Hill in Stafford quadrangle, Vermont.

Meganos Formation[1]

Meganos Stage

Eocene, lower: Western California.

Original reference: B. L. Clark, 1918, Geol. Soc. America Bull., v. 29, p. 94, 281–296.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, no. 6, p. 853 (fig. 1), 856–858. Referred to as Meganos stage intermediate between Martinez stage below and Capay stage above. Clark (1921, Jour. Geology, v. 29, no. 2) described type section of Meganos formation, dividing it into ascending divisions A, B, C, D, and E. Molluscan fauna of this series as listed by Clark and Woodford (1927, California Univ. Pubs. Bull., Dept. Geol. Sci., v. 17, no. 2) comes from division D. This is important because it is possible that upper member, or division E, should be referred to Capay stage. Thus in discussing fauna of Meganos stage, present writers include only species from Division D, or lower. Fauna of stage incompletely known at present, only approximately 70 species described.

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 13 (table 1), 27–32. Strata north of Coalinga have been referred by various writers to the Martinez, Meganos, and Tejon stages, but no formational name has been formally assigned them. Name Arroyo Hondo formation has been suggested for them by E. R. Atwill and is here applied to these strata. Formation, which includes Meganos horizon, is included in Capay stage.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 205–206. In San Benito quadrangle, unit defined as Los Muertos Creek formation has been assigned to Meganos formation by Kerr and Schenck (1925, Geol. Soc. America Bull., v. 36, no. 9), but that was before Capay stage had been separated in California. Eocene.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 4, sheet 2. Includes Marysville claystone member.

Type section: Strip beginning about 1½ miles east and a little north of Clayton and ending in vicinity of Byron Hot Springs, Contra Costa County. Named for exposures on Meganos Ranch or land grant, southeast of Martinez.

Mehama Volcanics[1]

Oligocene: Northwestern Oregon.

Original reference: T. P. Thayer, 1933, Pan-Am. Geologist, v. 59, no. 4, p. 317.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull., v. 15, fig. 1. Described as terrestrial tuffs, lavas, and breccias which for most part were water laid. Contains fossil wood. Thickness as much as 600 feet. Underlies Stayton lavas. Comparable in age to Warrendale or Eagle Creek formation in Columbia River Gorge.

I. S. Allison and W. M. Felts, 1956, Geology of Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Geographically extended into Lebanon quadrangle. Tentative names Scio beds and Berlin volcanics used by Felts (1936, unpub. thesis) are abandoned. About 500 vertical feet of Mehama volcanics are exposed on sides of Prospect Mountain, Franklin Butte, and Hungry Hill. Formation in this part of quadrangle strikes N. 50° W. and dips about 6° NE. By projecting outcrop at Hungry Hill northeastward in direction of Prospect Mountain, total thickness exposed is estimated about 1,500 to 2,500 feet. Maximum thickness not known. The 500-foot section on Franklin Butte shows about 250 feet of sandstone, siltstone, and tuffs at top. Below this is Scio floral zone in about 100 feet of white bedded tuffaceous shale. At base of section are about 150 feet of micaceous sandstones in which fragment of marine fossil was found. Relation of Mehama volcanics to Eugene formation uncertain; Mehama volcanics may be in part terrestrial equivalent of marine beds to west. Upper part presumably overlies Eugene formation. Both are overlain unconformably by Stayton lavas. Oligocene or partly older.

Well exposed near crest of Mehama anticline, north and east of Mehama, Marion County.

Mehrten Formation[1]

Miocene and Pliocene: Northern California and western Nevada.

Original reference: A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 34 (table), 61–71, pl. 1.

G. H. Curtis, 1954, California Univ. Pub. Geol. Sci., v. 29, no. 9, p. 453–502. Piper and others (1939) proposed name Mehrten formation for fluviatile sediments of predominantly andesitic material occurring in area of Mokelumne River drainage, the type section being near Mehrten dam site. The authors did not make clear just what they intended the limits of the formation to be. It would appear that they restricted its limits to area of their geologic map, plate 1, which covers relatively small tract in lower part of Sierran foothills between Plymouth and Salt Springs. However, they stated (page 69) that "east of the Mokelumne area andesitic breccia and detritus that are equivalent to the Mehrten formation and that are similar to it in texture, bedding, and composition are widespread over the entire west slope of the Sierra Nevada and extend far to the north and south. In that area the andesitic rocks exceed 1,000 feet in thickness at many places and attain a maximum thickness of 2,000 feet on the north-

east side of Silver Lake, 40 miles northeast of Jackson. All these are the products of one epoch of volcanism." This being true, it seems reasonable to extend name Mehrten to these "equivalent" and "similar" deposits which are connected by more or less continuous outcrops with type section. Since deposits extend eastward beyond Silver Lake for many miles even beyond border of California into Nevada north of Topaz Lake, name "Mehrten formation" is used in present paper to apply to all deposits of clastic and pyroclastic material of predominantly andesitic composition deposited on the Sierra Nevada and contiguous terrain during this volcanic epoch. Extension of name will probably cause problems, especially in western Nevada, where similar deposits of earlier age have been identified (Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9) and possibly in northern Sierra, where source andesites of Oligocene Wheatland formation may occur. Deposition occurred in late Miocene(?) and early Pliocene.

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 18, pls. 1, 3. Described in Angels Camp and Sonora quadrangles as essentially andesitic or basaltic throughout and consisting of conglomerate, mudflows, agglomerate, breccia, and tuff. Composed chiefly of hornblende andesite. Maximum thickness about 300 feet (northeast part of Angels Camp quadrangle). Unconformably overlies Valley Springs formation. Miocene and Pliocene.

S. N. Davis and F. R. Hall, 1959, Stanford Univ. Pub. Geol. Sci., v. 6, no. 1, p. 9–10, 14–15. In eastern Stanislaus and northern Merced Counties, conformably underlies Turlock Lake formation (new); overlies Valley Springs formation. Maximum thickness 1,200 feet. Early to middle Pliocene.

Type section: Along Clements-Camanche Road about 1¼ miles east of the Mehrten dam site, in NE¼SW¼ sec. 5, T. 4 N., R. 9 E., San Joaquin County. Named for exposures in bluffs along Mokelumne River near Mehrten dam site, which is about 3½ miles upstream from Clements bridge.

Meigs Creek Clay Shale

Pennsylvanian (Monongahela): Southeastern Ohio.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 74. Meigs Creek clay and clay shale member (Monongahela series) is present between Lower Sewickley sandstone and Meigs Creek coal in many localities; in others, it is either absent or not recognized in the underlying shale sections of Lower Sewickley sandstone and (or) Fishpot limestone members. Consists of 1 to 5 feet of gray to tan semiplastic clay or clay shale.

Occurs in Morgan County.

†Meigs Creek White Limestone (in Monongahela Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: W. T. Griswold, 1902, U.S. Geol. Survey Bull. 198, p. 17–19.

Probably named for association with Meigs Creek coal.

Meister Member (of Devils Gate Limestone)

Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 49, 50–51. Greater part of member is thick-bedded

gray fine-grained limestone. Many beds are crowded with rounded algal growths or stromatoliths, and others are filled with colonies of coral. A few dolomites occur sporadically throughout member, most significant being those in 30-foot zone at top of unit. These are white-weathering dense dolomites or dolomitic limestones in beds 6 inches or so thick interbedded with darker limestone beds of same thickness. Thickness 410 feet on Newark Mountain. Contact with underlying Nevada formation gradational. In general, base of member was placed at lowest bed of dark-gray thick-bedded limestone. Upper contact marked by diagnostic bed of dark-gray oolitic ostracod-bearing limestone at base of overlying Hayes Canyon member (new).

Named from exposures in vicinity of Meister mine in Newark Mountain, near Eureka, White Pine County.

Melbourne bone bed[1] facies (of Pamlico Sand)

Melbourne Formation

Pleistocene: Florida.

Original reference: C. W. Cooke and S. Mossom, 1929, Florida Geol. Survey 20th Ann. Rept.

E. H. Sellards, 1940, Geol. Soc. America Bull., v. 51, no. 3, p. 381. Melbourne beds underlie Van Valkenburg beds (new).

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 25, pl. 1. Late Pleistocene formation.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 299–300. Regarded as facies of Pamlico sand.

Named for occurrence at Melbourne, Brevard County. Widespread—east coast, west coast, and interior.

Melette facies (of Arikaree Formation)

Melette Formation

Miocene: South-central South Dakota.

A. F. Agnew, 1957, Geology of the White River quadrangle (1:62,500): South Dakota Geol. Survey. Formation consists typically of three zones of fine-grained thin-bedded pinkish dense limestone, white-weathering and fossiliferous; lower two limestones, each 2 feet thick, are separated by 38 feet of red and grayish-pink uncemented tuffaceous sand; upper limestone, 7 feet thick, is separated from middle one by 19 feet of similar sand; above upper limestone, several feet of similar sand is exposed beneath cap of Pleistocene upland gravel. Thickness in mapped area at least 78 feet; 9 miles to south more than 150 feet thick. Conformably overlies Arikaree formation.

W. D. Sevon, 1959, Geology of the Okreek quadrangle (1:62,500): South Dakota Geol. Survey. Redefined as facies of Arikaree formation. Limestones vary from 1 to 3 feet in thickness and occur at about 150, 165, and 175 feet above base of formation.

Named for exposures near center of line between secs. 14 and 23, T. 41 N., R. 28 W., in small mesa containing Mellette triangulation station.

Mellen or High Bridge Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Melmont[1]

Eocene: Western Washington.

Original reference: W. F. Jones, 1914, Geol. Soc. America Bull., v. 25, p. 122.

Probably named for town of Melmont in northern part of Pierce County.

Melones Limestone (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; Geol. Soc. America Bull., v. 71, no. 3, p. 329, 335–337, pls. 1, 6. Name applied to dark argillaceous lenticular limestone with banded tuff or volcanic wacke and mudstone exposed in center of the Sierra Melones. Lowest part of unit is massive or thick-bedded dark argillaceous limestone or, where this is absent, thin fossiliferous medium-bedded mudstone. This grades upward into medium-bedded fossiliferous calcareous mudstone. Above are banded volcanic wacke, conglomeratic tuff or wacke, fragmental calcilutite, and more argillaceous limestone. Top of formation not exposed in this area; approximate minimum thickness 175 meters. In Teo syncline, occurs as lenses in El Rayo volcanic rocks. In Melones syncline, overlies Parguera limestone (new). Microfauna indicates a Campanian to Maestrichtian or possibly Maestrichtian age.

Named for exposures in the Sierra Melones, Mayagüez area.

Melozi Formation[1] (in Shaktolik Group)

Lower Cretaceous: Central western and central Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 395–412, chart opp. p. 474.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 246). Age given as Lower Cretaceous on correlation chart.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Marine formation included in Shaktolik group in Koyukuk geosyncline and Hogatza uplift areas.

Named for exposures on north bank of Yukon River from 8 to 20 miles below Melozi telegraph station. In Nulato-Norton Bay district, and Lower Yukon River and Koyukuk River regions.

Melrose Granite

Melrose granite facies (of Columbia Granite)[1]

Precambrian: Central Virginia.

Original reference: A. I. Jonas, 1932, Virginia Geol. Survey Bull. 38, p. 22–23, map.

H. E. LeGrand, 1960, Virginia Div. Mineral Resources Bull. 75, p. 13, pl. 1. Melrose granite described in report on Pittsylvania and Halifax Counties. Paleozoic or Precambrian.

Named for exposures around Melrose, Campbell County.

Melrose[1] (quartzite)

Carboniferous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Melville Formation (in Fort Union Group)

Paleocene: Central Montana.

G. G. Simpson, 1937, U.S. Natl. Mus. Bull. 169, p. 15 (table), 25, 55, pl. 1. Dark, greenish or gray, shales with numerous gray to yellow sandstones. Thickness at least 4,000 feet and possibly as much as 6,000 feet. Uppermost unit of group in Crazy Mountains. Overlies Lebo formation.

Named from town of Melville, Sweetgrass County, which is situated on these beds and is surrounded, within a few miles, by excellent and typical exposures of them.

Memorial Shale[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, eastern Kansas, and western Missouri.

Original reference: R. H. Dott *in* R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 58, 67.

R. H. Dott, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 8, p. 1591–1597. Formal proposal of name. Term is applied to strata above top of Lenapah (Eleventh Street) limestone and below base of Seminole formation. In latitude of Tulsa, it consists principally of clay shale with silty streaks and contains, near the middle, about 10 feet of sandstone in thin fine-grained to silty beds a few inches thick interspersed with sandy, silty shale and locally in the upper part, one or more fossiliferous limestone beds a few inches thick. Thickness at type locality 80 feet. Equivalent to upper part of Holdenville shale and to strata formerly mapped as upper Nowata in vicinity of Tulsa. Type locality stated.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 340–341. At top of Marmaton group. Overlies Idenbro limestone member (new) of Lenapah limestone; underlies Hepler sandstone. Thickness as much as 40 feet in Kansas.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 9. Marmaton shale above the Lenapah has been named Memorial shale, and the name is applied to shale at this position in Missouri. Underlies Hepler sandstone.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 42. Memorial shale, by definition, extends upward from top of Lenapah limestone to base of Seminole formation; likewise Holdenville shale extends upward from top of Wewoka formation to base of Seminole formation. Lenapah has been traced into uppermost Wewoka; hence, Memorial and Holdenville lie between same stratigraphic limits and are equivalent. Holdenville, the older and more commonly used term, takes precedence.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 101. Abandoned by Oklahoma Geological Survey.

Type locality: Near cemetery along west line of SW sec. 36, T. 19 N., R. 13 E., and in SE sec. 35, vicinity of Tulsa, Okla. Name derived from Memorial Park cemetery.

Memphis Loess[1]

Pleistocene: Southwestern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 162.

Named for occurrence at Memphis, Shelby County.

†Memphis Sandstone (in Peacock Formation)[1]

Permian: Central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 953, pl. 10.

Crops out near town of Northfield, in northern Motley County. Named from occurrence near Memphis, Hall County.

Memphremagog Formation

Memphremagog Slate[1]

Silurian or Devonian: East-central and northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 115, footnote.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1491, 1501, 1505. Beds mapped in central Vermont as "Memphremagog slates" by Richardson (1906) are, in general, represented by redefined Northfield slate. Stratigraphic relations of the former had not been clearly described. Lower Trenton age of "Memphremagog slates" is open to question.

C. G. Doll, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2014. Memphremagog quadrangle touching upon international boundary in northeastern Vermont is in large part underlain by relatively thin-bedded, metamorphosed sedimentary rocks of probable Ordovician age. These rocks compose Memphremagog formation and consist chiefly of slates, phyllites, impure limestones, and quartzites.

C. G. Doll, 1943, Am. Jour. Sci., v. 241, no. 1, p. 57. Memphremagog formation contains Waits River limestone as key member. Recent discovery of determinable fossil crinoid and cystoid calyces, and two gastropods in Waits River limestone at Westmore, shows Waits River limestone and intercalated rocks to be at least as young as Middle Silurian, and very possibly of Lower Devonian age.

C. G. Doll, [1945], Vermont State Geologist 24th Rept., p. 16–18, pls. 3, 4. Formation includes a great variety of rock types, arenaceous and micaceous dolomitic limestones and intercalated mica schists. Contains Waits River limestone member, also Standing Pond amphibolite member (new). Latter occurs either entirely in the limestones of the formation or along their contact with the mica schists. Coarse garnet schist is associated with this member. Thickness estimated about 8,000 feet. Age designated Middle Silurian; plate 4 shows age as probably Lower Devonian also.

Named for Lake Memphremagog located in northern part of Memphremagog quadrangle on Vermont-Quebec border.

Menan Tuff

Pleistocene: Southeastern Idaho.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 28 (table), pl. 4 (geol. map). Named on map. Described as tuff and unconsolidated lapilli interbedded with basalt.

J. C. Bayless, 1950, Michigan Acad. Sci., Arts and Letters, Papers, v. 34, p. 218. Menan Buttes cover 8 square miles and rise 500 feet above plain. They contain craters about one-half mile in diameter and 100 to 150 feet deep. Lower slopes are covered with weathered tuff and loess, beyond which black volcanic sand predominates. Snake River lava laps on west

and north sides of Menan Buttes and entirely surrounds tuff cone to north.

Mapped only in and near Menan Buttes, western Madison County.

Menard Limestone[1]

Menard Limestone (in Elvira Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, and western Kentucky.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 128.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136, 137; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 838. Assigned to Elvira group (new). In standard Mississippian section, underlies Palestine sandstone and overlies Waltersburg sandstone. In southwestern Indiana, may be represented by Siberia limestone and the underlying and overlying shale intervals.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Name Menard limestone extended into southern Indiana where it replaces term Siberia limestone. Local Indiana names of upper Chester are dropped, and formations given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Menard limestone shown on stratigraphic column of upper Chester in Indiana as 25 to 50 feet of blue-gray thin-bedded lithographic to fine-grained oolitic arenaceous limestone. Term Elvira group not used in Indiana.

Named for Menard, Randolph County, Ill., where it is well exposed southeast of State Hospital.

Mendenhall Gneiss

Precambrian: Southern California.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 21–29, pls. 1, 2, 3. Dark gneiss consisting of high percentage of blue quartz, thoroughly altered plagioclase, potash feldspars, and various proportions of ferromagnesian minerals. Main body of gneiss, oriented in west-northwest direction approximately parallel to San Gabriel fault, is overlapped by upper Miocene Mint Canyon formation which lies in depositional contact on gneiss at its west end; elsewhere gneiss is in contact with rocks of Precambrian anorthosite group, pre-Cretaceous diorite gneiss, and Cretaceous(?) granitic rocks; in some places contact is a clear-cut fault. Intruded by anorthosite-gabbro rocks and also by Upper Jurassic(?)-Lower Cretaceous(?) granitic rocks. Age of rocks of anorthosite group, determined by leadalpha measurements, is about 900 million years.

Type locality: Mendenhall Peak, San Fernando quadrangle, Los Angeles County. Crops out north of San Gabriel fault; underlies area of 9 square miles in belt 10 miles long and less than 2 miles wide.

Mendha Formation

Mendha Limestone[1]

Upper Cambrian and Lower Ordovician: Eastern Nevada.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Mining Metall. Engineers Trans. 1647, p. 7; 1932, U.S. Geol. Survey Prof. Paper 171.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., No. 34, p. 12 (fig. 2), 13. Interbedded limestone and dolomite with a few thin beds of intercalated shale. Composite thickness about 2,125 feet. Overlies Highland limestone (restricted).

Named for Mendha mine on west side of Arizona Peak, Pioche region, Lincoln County.

Mendon Schist[1]

Mendon Dolomite[1]

Mendon Formation

Precambrian: Northwestern and southwestern Vermont.

Original reference: C. L. Whittle, 1894, Am. Jour. Sci., 3d, v. 47, p. 347–355.

L. M. Prindle and E. B. Knopf, 1932, Am. Jour. Sci., 5th, v. 24, no. 142, p. 265. Over Mount Holly gneiss lies succession of mica schist and quartzite, including some limestone or dolomite with a prominent structure that strikes nearly due north. This assemblage was called by Whittle the Mendon "series". Because assemblage is chiefly schists, it is herein called Mendon schist. Dolomite belonging to Mendon schist unconformably underlies Paleozoic quartzite.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. Guidebook 34th Field Mtg., p. 8, 12. Mendon series includes lower graywacke, Mendon dolomite, and Nickwackett graywacke.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 12 (fig. 2), 13 (table 1), 14–16, pl. 1. Oldest rocks in autochthonous sequence of Castleton area belong to provisional Mendon series. Until true relations of these rocks to those above and below are understood, name Mendon series should be retained. Thickness about 2,000 feet. Underlies Cheshire quartzite.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 22 (table 2), 26–36, geol. map. Rocks immediately overlying Mount Holly complex at Mendon were named Mendon series by Whittle (1894). Under present stratigraphic usage application of term "series" to these rocks should be abandoned. Proposed here that Mendon series be emended to Mendon formation. Whittle described the "series" as including (ascending) "conglomerate-schist" member, "pebbly crystalline limestone" member, and "mica schist" member. The "pebbly crystalline limestone" will be referred to as Forestdale member (Keith, 1932) of Mendon, and the "mica schist" member will be referred to as Moosalamoo member (Keith, 1932) of Mendon. Forestdale member is about 600 feet above base of formation; Moosalamoo member is lenticular body of schist in upper part of formation. Thickness 800 to 1,800 feet. Underlies Cheshire quartzite. Lower Cambrian.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 29 (table 1), 30–34. Formation in Rutland area comprises (ascending) Nickwacket, Forestdale, and Moosalomoo members. Thickness as much as 1,750 feet. Underlies Cheshire quartzite; overlies Precambrian Wilcox formation (new), unconformity.

P. H. Osberg, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 47. In Coxe Mountain area, Vermont, Pinnacle forma-

tion underlies Forestdale dolomite. Names Mendon and Nickwacket have been used for rocks included in Pinnacle formation. However, name Mendon is not sufficiently definitive.

Well exposed in town of Mendon, 1 mile south of Mendon village, Rutland County. Formation crops out along upper part of western escarpment of Green Mountains and underlies summit and eastern slopes of Mount Moosalamoo. To the south, width of outcrop expands and includes area between Chandler Ridge and Romance Mountain.

Mendota Dolomite Member (of St. Lawrence Formation)[1]

Upper Cambrian: Southern Wisconsin.

Original reference: R. D. Irving, 1875, Am. Jour. Sci., 3d, v. 9, p. 441–442.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236 (table 2). Chart shows Mendota dolomite as middle member of St. Lawrence formation. Overlies unnamed shale and underlies Lodi shale member.

Named for occurrence on Lake Mendota, near Madison.

Menefee Formation (in Mesaverde Group)[1]

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

Original reference: A. J. Collier, 1919, U.S. Geol. Survey Bull. 691–K.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 92, 95, pls. 1, 11. Described in Fort Defiance-Tohatchi quadrangles where it underlies Tohatchi [Tohachi] formation and overlies Point Lookout sandstone. Thickness 1,200 to 2,290 feet. Lower 500 feet contain carbonaceous shales and thin coals and are equivalent environmentally of upper Gibson coal member of Sears (1934, U.S. Geol. Survey Bull. 860–A), and rest of section above is equivalent to Allison barren member of Sears (1925).

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956. Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156, 2157. Nomenclature of Mesaverde group, in San Juan basin, revised. Menefee formation includes, in southern part of basin, coal-bearing zone formerly called upper Gibson coal member, and above that zone bed formerly called Allison barren member. Unit formerly called upper Gibson coal member is here named Cleary coal member of Menefee.

Named for Menefee Mountain, Montezuma County, Colo.

Menominee Group

†Menominee Series[1]

Precambrian (Animikie Series): Northern Michigan.

W. S. Balyey, 1904, U.S. Geol. Survey Mon. 46, p. 38, 39, 175–488. The rocks of the Algonkian system in the Menominee district are divided into Lower Menominee and Upper Menominee series, equivalent to Lower Huronian and Upper Huronian elsewhere in Lake Superior region. Unconformity separates Lower Menominee from Upper Menominee. Lower Menominee includes (ascending) Sturgeon quartzite. Randville dolomite, and Negaunee formation; Upper Menominee includes (ascending) Vulcan formation (subdivided into ore-bearing Curry member, Brier slate, and ore-bearing Traders member), and Hanbury slate. Menominee is unconformable below Cambrian rocks and above Archean granites, gneisses and schists.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Reinstated and redefined as group in Animikie series. As redefined, covers only middle part of series as originally defined. In type locality, group consists of two formations: basal Felch formation, and Vulcan formation made up of (ascending) Traders iron-bearing member, Brier slate member, Curry iron-bearing member, and Loretto slate member. Unconformably underlies Baraga group (new); unconformably overlies Chocolay group (new).

Group is named for Menominee district of southern Dickinson County.

Mentasta Schist[1]

Pre-Devonian: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 26.

Upper Copper River region.

Menteth Limestone Member (of Moscow Shale)[1]

Menteth Formation

Middle Devonian: West-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 22.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 374–375, pl. 1. Discussion of stratigraphy of Batavia quadrangle. Menteth limestone, basal member of Moscow formation, has stratigraphic position 55 feet above Tichenor member of Ludlowville at Canandaigua Lake, but when traced westward, it approaches Tichenor horizon due to rapid thinning of Deep Run member of Ludlowville. May terminate in eastern part of quadrangle. Underlies Kashong shale member of Moscow.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454. Referred to as Menteth formation. Thickness 1 foot at Jacox Run near Geneseo. Overlies Deep Run formation.

Forms first falls at Tichenor Point and Menteth Point, on Canandaigua Lake, Ontario County.

†Mentor Formation[1]

Mentor Sandstone Member (of Belvidere Formation)

Lower Cretaceous (Comanche Series): Central Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 162.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Shown on chart as sandstone member of Belvidere formation. Overlies Marquette sandstone member; underlies Terra Cotta shale member (new) of Ellsworth formation (new).

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 154. Kiowa shale as herein defined probably contains stratigraphic units formerly called "Greenleaf sandstone," "Mentor beds," and others, and is in part equivalent to "Belvidere formation," "Medicine bed," "Elk River beds," and others.

Type exposure (Mentor beds): On east side of Smoky Hill River about 3 miles east of Mentor, Saline County.

Meramec Series

Meramec Group[1]

Upper Mississippian: Mississippi Valley region.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 110.

R. C. Moore, 1933, Historical Geology: New York, McGraw-Hill Book Co., Inc., p. 262–264. Valmeyer series (new) includes Osage group below and Meramec group above.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132–134. Meramec group, Valmeyer series, includes (ascending) Warsaw, Salem (Spergen), St. Louis, and Ste. Genevieve limestones. Overlies Osage group; underlies New Design group (new) in Chester series. Interpretations in this report are not necessarily in accord with current classifications recognized by Illinois and Missouri Geological Surveys.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 777–778. Iowa series includes (ascending) Kinderhook, Osage, and Meramec groups. This is classification used by Illinois Geological Survey; however, present authors [Weller and Sutton] believe that the Kinderhook should be raised to rank of series and the Valmeyer series, consisting of Osage and Meramec groups, should be recognized. Meramec group includes (ascending) Salem, St. Louis, and Ste. Genevieve limestones. Underlies New Design group of Chester series.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 98 (fig. 1), 99–100, chart 5. In this report, the Mississippian is subdivided into (ascending) Kinderhookian, Osagean, Meramecian, and Chesterian series. In standard section, Meramecian series comprises (ascending) Warsaw, Salem, St. Louis, and Ste. Genevieve limestones. Disagreement exists regarding boundary between Meramecian and Osagean series and current usage is not consistent. U.S. Geological Survey classes Warsaw formation in the Meramecian, and this practice is followed by Missouri Geological Survey. Indiana, Iowa, and Illinois Geological Surveys classify the Warsaw with the Osagean.

L. R. Laudon, 1948, Jour. Geology, v. 56, no. 4, p. 288–302. Discussion of Osage-Meramec contact. Problems concerning contact cannot be solved at type sections of either Osage or Meramec series because both sections are incomplete. At type section of Osage, the upper Burlington, Keokuk, Salem, and St. Louis formations are all missing. Upper Burlington and Keokuk beds are exposed at other places in west-central Missouri, Warsaw and Salem formations are not represented at all, and St. Louis formation is known from only one small area. At type section of Meramec series, beds of Osage age are not exposed. In vicinity, beds of Keokuk, Burlington, Reeds Spring, and Fern Glen age are exposed, but Warsaw formation is not represented. Evidence indicates major break at end of Osage epoch. Evidence also indicates desirability of retaining standard terms Kinderhook, Osage, Meramec, and Chester, and militates against any usage whereby Osage and Meramec rocks are classed together as unit.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 47–49. In Beardstown, Glasford, Havana, and Vermont quadrangles, Meramec group, Valmeyer series, includes Salem and St. Louis formations and unconformably underlies Pennsylvanian strata.

Named for Meramec Highlands and Meramec River, west of St. Louis, Mo.

Merced Formation[1]

Pliocene, upper, and Pleistocene(?) : Western California.

Original references: A. C. Lawson, 1893, California Univ. Pub. Dept. Geol. Bull., v. 1, p. 142–151; 1895, U.S. Geol. Survey 15th Ann. Rept., p. 459–463.

F. A. Johnson, 1943, California Div. Mines Bull. 118, p. 622–627. In Petaluma region, upper Pliocene Merced is represented by both marine and fresh-water sediments. Former consists chiefly of fine-grained generally massive quartz-feldspathic sandstone, conglomerate, and clay shale. Latter consists of fluvatile conglomerates and sandstones of varying coarseness accompanied in many places by siltstones and clays. Marine Merced, about 1,500 feet thick, rests unconformably upon the Franciscan over entire area, except in southeastern corner, where west of Penngrove and Petaluma it is apparently conformable upon Sonoma volcanics which, in turn, are unconformable upon Franciscan group and Petaluma formation. Fresh-water deposits occur north of Santa Rosa and rest in conformable depositional contact upon Sonoma volcanics represented here by basalt.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 92–94. In area of this report [Coast Ranges north of San Francisco Bay], the Merced is composed of marine sandstones and sandy shales usually less than 300 feet thick and probably equivalent to lower Merced of type section. South of Petaluma on west side of Burdell Mountain, Merced is interbedded with Sonoma volcanics. Pliocene.

W. K. Gealey, 1951, California Div. Mines Bull. 161, p. 11 (fig. 2), 23–25, pl. 1. In Healdsburg quadrangle, the limited exposures of Merced are light-gray massive- to thick-bedded uniformly medium-grained sandstone that weathers pale buff; not cemented. Grades upward into nonmarine Sonoma sands and gravels, contact not precisely located. Minimum thickness of 500 feet estimated for Wilson Grove area. In Wilson Grove area, Merced strata conformably overlie 200 feet of Sonoma tuff; they are in turn overlain conformably by Sonoma sandstone and conglomerate; thus Merced here is marine wedge interbedded with Sonoma group. Northeast of Rio Dell, overlies Franciscan with profound unconformity. Merced blankets Franciscan terrane west of Llano de Santa Rosa south of Russian River, and is preserved in structural lows along San Andreas rift at various points southward to Golden Gate. In Healdsburg quadrangle and adjacent areas to south, its eastern extent has been controlled by western flanks of coeval Sonoma volcanics.

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 26 (table 6), 38–47, pls. 1, 3, 4. Described in Santa Rosa and Petaluma Valley areas where it consists of medium- to fine-grained fossiliferous marine sand, sandstone, and silty clay, with minor interbedded gravel and pebbly beds; tuffaceous in part. Thickness 0 to about 2,000 feet. Interbedded with Sonoma volcanics and Glen Ellen formation. Includes part of Sonoma group of Gealey (1950 [1951]). In much of the area, unconformably overlies Franciscan and Knoxville, but, in western part of the area, is in fault contact with them. In some places, overlies Petaluma formation with marked angular unconformity. Pleistocene(?) and late Pliocene. In general, Merced time is believed to span time interval occupied by Sonoma volcanics of Pliocene age and Glen Ellen formation of Pliocene(?) and Pleistocene age.

William Glen, 1959, California Univ. Pubs. Geol. Sci., v. 36, no. 2, p. 147–198. Type Merced, approximately 5,000 feet thick, is mostly gray and

brown, soft, friable sandstone; largely deposited in a marine shallow water coastal embayment environment. Molluscan and crustacean species indicate deposition from middle Pliocene through early Pleistocene time. Fossils and lithology indicate that "Merced" formation of Pillar Point is of middle Pliocene age and part of Purisima formation. Only a small part may be correlative with type Merced.

Named from Lake Merced, which lies in structural or synclinal depression of Pliocene terrane, south of San Francisco. Exposed in sea-cliff which extends from Lake Merced, near San Francisco, to Mussel Rock about 8 miles south of Point Lobos at entrance to the gate. Thickness in cliff section, 5,834 feet.

Mercedita Lentil (in Ponce Limestone)

Oligocene, middle: Puerto Rico.

R. C. Mitchell-Thome, 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 138, 139 (table 1). Clastic fraction in lower Ponce. Maximum thickness about 75 meters.

Occurs between Quebrada and del Agua and central Mercedita.

Mercer coal group[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original references: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. xxi–xxxvi; H. M. Chance, 1880 Pennsylvania 2d Geol. Survey Rept. G_4.

Mercer Formation (in Pottsville Group)

Mercer Member (of Pottsville Formation)

Mercer Shale Member (of Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original references: J. P. Lesley (Mercer group), 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. xxi-xxxvi, 319–333; H. M. Chance (Mercer coal group), 1880, Pennsylvania 2d Geol. Survey Rept. G_4

Charles Butts, 1904, U.S. Geol. Survey Geol. Atlas, Folio 115. Pottsville formation, in Kittanning quadrangle, is composed of two sandy members, the Connoquenessing and Homewood sandstones, separated near the middle by stratum of shale 20 feet or more in thickness, bearing one or more thin seams of coal (the Mercer coal and shale).

Charles Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133. In the Ebensburg quadrangle, Pottsville formation is about 130 feet thick and is composed of two sandstone members separated by shale and fire clay. These are (ascending) Connoquenessing sandstone, Mercer shale and clay, and Homewood sandstone members. Mercer member consists of 6 feet of shale overlain by 9 feet of clay, at top of which, partly included in the Homewood, are small pockets of coal 2 inches thick. Small specimens of plants present in shale.

F. G. Clapp, 1907, U.S. Geol. Survey Geol. Atlas, Folio 146. In parts of Pennsylvania where it is exposed, the Pottsville consists of two massive members, Homewood and Connoquenessing sandstones, separated by thin bed of shale, which generally carries fire clay and coal beds. This shale is known as Mercer member.

W. C. Phalen, 1910, U.S. Geol. Survey Geol. Atlas, Folio 174. Pottsville formation, in Johnstown quadrangle, consists of (ascending) Connoquenessing sandstone, Mercer shale, and Homewood sandstone members. The Mercer consists of shale and clay, with which locally a coal bed is associated. Thickness and character of member vary. Thickness 8 to 13 feet.

M. R. Campbell, F. G. Clapp, and Charles Butts, 1913, U.S. Geol. Survey Geol. Atlas, Folio 189. In Barnesboro-Patton quadrangles, the Pottsville formation consists of a lower sandstone, the Connoquenessing, and an upper, the Homewood. These massive members are separated by shale of somewhat irregular thickness, which commonly contains bed of fire clay and in some places thin beds of coal. To this member, which has been recognized throughout most of western Pennsylvania and which contains fossil flora, name Mercer shale member has been applied from Mercer County where the coal beds and limestones are particularly well developed. The fire clay is known as Mount Savage fire clay in western Maryland. It seems to be persistent throughout most of western Pennsylvania, but it has not been observed in Barnesboro and Patton quadrangles.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 9). Correlation chart shows Mercer shale in Pottsville series.

R. M. Foose, 1953, Econ. Geology, v. 39, p. 563. Mercer shale member of Pottsville group consists mainly of thin-bedded shale and sandy shale, containing one, and in some places two or three coal beds which range from 3 to 30 inches in thickness. Uusually directly underlying lowest main coal bed there are 5 to 20 feet of clay. Clay commonly rests directly on Connoquenessing sandstone. Underlies Homewood sandstone. Thickness including clay, coals, and shale, as much as 53 feet.

R. C. Bolger and H. V. Gouse, 1953, Pennsylvania Geol. Survey, 4th ser., Bull. M–36, p. 4. In the Driftwood quadrangle, Mercer formation (Pottsville series) consists of shale, coal, sandstone, and claystone. Overlies Connoquenessing sandstone; underlies Homewood sandstone.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 68, 70 (fig. 5), 71, figs. 10, 18. Mercer formation contains Mercer coals, Mercer clay, and Homewood sandstone. Overlies Connoquenessing formation; in some areas, overlies Mississippian Mauch Chunk formation.

E. G. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 909, 910, (fig. 2). Throughout most of western Pennsylvania, the lower two-thirds of Pottsville group consists of massive sandstone (Connoquenessing formation) and upper one-third of highly variable sequence of clays, coals, shales. and sandstones (Mercer formation). As shown on generalized section, Mercer formation includes Mercer clay at base, Mercer coals and shales in middle part, and Homewood sandstone and shale at top. Underlies Clarion formation of Allegheny group.

Named for Mercer, Mercer County, Pa.

Mercer Limestone (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477.

See Lower Mercer Limestone and Upper Mercer Limestone.

Named for Mercer, Mercer County.

Mercersburg Formation

Middle Ordovician (Trentonian) : South-central Pennsylvania.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1964. Name proposed for beds formerly included in middle part of Chambersburg limestone. Dark-gray thin irregular and thick even-bedded limestone with base at bottom of drab cuneiform siltstone zone containing metabentonite. Thickness 500 feet. Underlies Greencastle formation; overlies Shippensburg formation (new). In western belts of outcrop in Cumberland Valley, converges with Greencastle formation; in that area it is separated from Shippensburg by Hatter limestone and Snyder member of Benner limestone.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 731–732. Redefined and subdivided. Stratigraphically extended by lowering of base to include beds from top of Shippensburg formation. Consists of dark-gray fine-grained, thin crinkly and thick evenly bedded, blue-gray-weathering limestone with an interval of tan to medium-gray, slabby, buff-weathering limestone at base. Five metabentonites recognized; not all present in a single section. In eastern belts, divided into Housum member below and Kauffman member above. Thickness 235 feet at type locality; thins uniformly to northeast. Disconformably underlies Oranda formation; contact marked by prominent basal calcarenite of the Oranda. Contact with underlying Shippensburg formation marked at type section by prominent irregular, partly silicified bedding surface. Type locality further described. Derivation of name given.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000) : Pennsylvania Geol. Survey, 4th ser. As mapped, Chambersburg formation includes dark-gray thin-bedded limestone (Oranda) at top; gray argillaceous limestone (Mercersburg) in the middle; and dark-gray cobbly and thin irregularly bedded limestone (Shippensburg) below. Occurs southwest of Susquehanna River only.

Type section: Along Cumberland Valley Railroad 2 miles southwest of Marion, Franklin County. Named for exposure along West Branch of Conococheague Creek 2.5 miles southeast of Mercersburg, Franklin County.

Merchants Amygdaloid[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in old Merchants mine, Ontonagon County.

Merchants Flow[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in old Merchants mine, Ontonagon County.

Merchantville Formation (in Matawan Group)

Merchantville Clay (in Matawan Group)[1]

Merchantville Member (of Matawan Formation)

Upper Cretaceous: New Jersey.

Original reference: G. N. Knapp, as reported by R. D. Salisbury, 1899, New Jersey Geol. Survey Ann. Rept. State Geologist 1898, p. 35.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 24–26. Member of the Matawan which is here reduced to formational rank. Gradational into overlying Woodbury member; overlies Magothy formation. Thickness about 35 feet in Monmouth County; 60 feet in Salem County; decreases in thickness southeastward toward Chesapeake and Delaware Canal. Exposed in cuts in Chesapeake and Delaware Canal where lithologically it can not be differentiated from the Marshalltown and Woodbury.

M. E. Johnson and H. G. Richards, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2150–2160. Here considered of formational rank. Report is discussion of paper by Spangler and Peterson (1950).

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Basal formation in Matawan group. Underlies Woodbury clay; overlies Magothy formation. Average dip southeast 40 feet per mile. Thickness 48 to 60 feet; thickens in outcrop to northeast.

Named for Merchantville, Camden County.

Mercury Limestone

Lower Mississippian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 356–357, pls. 32, 33. Consists of dark-gray buff-weathering cherty crinoidal limestone. Generally poorly bedded and forms resistant ledges. Thickness of incomplete section 115 feet. Overlies Narrow Canyon limestone (new); contact gradational. Upper contact not exposed owing to faulting.

Named from exposures on Mercury Ridge about 5 miles east of Camp Mercury, southeast margin of the Atomic Energy Commission Nevada proving grounds area, Nye and Clark Counties. Traceable northeastward for about a mile as prominent gray ledge but terminated in both directions by reverse fault.

Mercy Sandstone Lentil (in Tierra Loma Shale Member of Moreno Formation)

Upper Cretaceous: Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1954; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 14), 9, 24. Occurs 70 feet below top of Tierra Loma shale (new). Thickness about 190 feet. On basis of this mapping, it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch.

Type locality: Mercy Canyon, sec. 15, T. 16 S., R. 12 E., Panoche Hills, Fresno County. Named for Mercy Hot Springs.

Meredith Granite[1] (in New Hampshire Plutonic Series)

Meredith Porphyritic Granite (in New Hampshire Magma Series)

Upper Devonian(?): East-central New Hampshire.

Original reference: M. P. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, p. 83, map.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1892, 1893–1894. Porphyritic granite assigned to New Hampshire magma series in Belknap Mountains.

Alonzo Quinn, 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 476–478, pl. 1. Porphyritic granite further described.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Granite included in Kinsman quartz monzonite of New Hampshire plutonic series in Lake Winnipesaukee region.

Named for typical exposures in Meredith Township, Belknap County.

Meriden Ash Bed[1]

Meriden type[1]

Upper Triassic: Central Connecticut.

Original reference: B. K. Emerson, 1897. Geol. Soc. America Bull., v. 8, p. 66–67, 72–77.

Occurs 1 mile north of Meriden, New Haven County.

Meriden Formation (in Newark Group)

Triassic: Central Connecticut.

P. D. Krynine, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1919. Fine-grained lacustrine and paludal variegated and dark siltstone, shales, limestones, light feldspathic sandstones, subordinate coarse clastics, and three basaltic lava flows. Maximum thickness 2,800 feet. Underlies Portland formation (new): overlies New Haven arkose (new).

P. D. Krynine, 1950, Connecticut Geol. Nat. History Survey Bull. 73, p. 30–31, 32, 57–69. Subdivided from base upward: lower lava flow, lower sedimentary division, middle lava flow, upper sedimentary division, and upper lava flow. Thickness of sedimentary members varies from 1,150 feet near Meriden to 2,000 feet east of New Haven; lava sheets are from 450 to 850 feet thick. Sedimentary units occur in two facies: normal sedimentary, the most widespread, and Great Fault fanglomeratic facies, confined to eastern margin of outcrop area. Normal sedimentary facies is divided into two geographic facies. In south-central Connecticut, lower division includes coarse pink arkose, limestone, dark shales, and coarse pink or gray micaceous arkose with shaly lenses. Upper division contains fine-grained grayish arkose with a little sandy shale, red siltstones and fissile shales interbedded with black shales and gray feldspathic sandstones, dark shales with arkose and conglomerate lenses, and red fissile shales. In central Connecticut, lower division includes maroon fissile shales, dark laminated shales with limestone layers, and red fissile shales and siltstones. Upper division includes red fissile shales, siltstones and sandy siliceous shales; dark shales with arkose and limestone lenses; and red siliceous sandy shales. Assigned to Newark group. Two type localities designated: the lacustrine environment prototype for the lower division and the swamp prototype for the upper division.

John Rodgers and others, 1956. Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Lava flows named: Talcott lava member at base, Holyoke lava member in middle, and Hampden lava member at top.

E. P. Lehmann, 1959, Connecticut Geol. Nat. History Survey Quad. Rept. 8, p. 6–7, 8 (table 1). Term Meriden formation not used in this report [Middletown quadrangle]. Rock units involved are here given formational status as follows: Talcott basalt, Shuttle Meadow formation (new), Holyoke basalt, East Berlin formation (new), and Hampden basalt.

Type localities: For lower sedimentary division, outcrop on southern shore of Shuttle Meadow reservoir between Meriden and New Britain; for upper sedimentary division, quarry on a country road in Kensington, 1½ miles south of Berlin.

†Meridian Formation[1] or Buhrstone[1]

Eocene, middle: Southeastern Mississippi and southern Alabama

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 12th Ann. Rept., pt. 1, p. 413–415, 491.

James Turner, 1952, Mississippi Geol. Survey Bull. 76, p. 14–18. Formation described in Yalobusha County, Miss., where it is 40 to 125 feet thick. Unconformably overlies Ackerman formation; contact with overlying Tallahatta not well defined as Meridian sand is interlensed with Tallahatta sand and shale. In basal part of Claiborne.

Named for exposures in vicinity of Meridian, Lauderdale County, Miss.

Meridian Sand Member[1] (of Tallahatta Formation)

Meridian Formation (in Claiborne Group)

Eocene, middle: Southeastern Mississippi and western Alabama.

Original reference: E. N. Lowe, 1933, Mississippi Geol. Survey Bull. 25.

R. E. Grim, 1936, Mississippi Geol. Survey Bull. 30, p. 20. Basal member of Tallahatta formation; underlies Basic member.

F. S. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 46–47. Thickness of member 61 feet in Winston County. Underlies Basic member; overlies Hatchetigbee formation.

V. M. Foster, 1940, Mississippi Geol. Survey Bull. 41, p. 63–64, 68–72. Rank raised to formation. Lowe recognized probability of unconformity at top of [Meridian] sand and, in uncompleted manuscript, separated basal Claiborne sands as a distinct formation. Since it is now established that stratigraphic relations are disconformable both above and below and that sands constitute a stratigraphic unit which is different lithologically from overlying and underlying beds, the Meridian is now generally considered to be of formational rank. Thickness 70 to 100 feet in Lauderdale County. Overlies Hatchetigbee formation; underlies Tallahatta formation.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 16. Meridian is uppermost Wilcox. Reasons presented for this age designation.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, pl. 3. Correlation chart shows Meridian sand member present in Choctaw County and western Alabama.

T. W. Lusk, 1956, Mississippi Geol. Survey Bull. 80, p. 43–54. Formation described in Benton County about 100 to 150 feet thick. Commonly a very coarse to medium sand. On outcrop, usually reddish brown, but, where fresh and a few feet above its lower contact, characteristically banded light and dark brown. Disconformity at base of formation well exhibited; upper contact not so clear. As result of lateral change of Tallahatta formation from shale to sand, exact Meridian-Tallahatta contact can be determined at only few locations. Overlap of Meridian formation has added to confusion of age determination of Meridian as well as overlying Wilcox strata. Claiborne group.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 189, pls. 1, 5. Meridian sand member probably present at surface in southeastern corner of Kemper County. Sand might be included in either Wilcox or Claiborne group. Mississippi Geological Survey includes Meridian sand member in the Claiborne.

Named for exposures at and near Meridian, Lauderdale County, Miss.

Meriwitica Member (of Bright Angel Shale and of Lyndon Limestone)

Meriwitica Tongue [in Bright Angel Shale]

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 80–82. Tongue is rusty-brown-dolomite unit in Bright Angel shale of western Grand Canyon. Composed of crystalline dolomite. Thickness at Meriwitica Canyon 16 feet. Separated from base of Muav formation by member of Bright Angel shale about 100 feet thick composed of shales and limestone. Lateral equivalent of certain limestone beds found in area west of Grand Canyon that probably constitute a member of the Muav, which is lower than any member within the Grand Canyon. Younger than Tincanebits tongue (new); older than Elves Chasm tongue (new).

H. E. Wheeler and V. W. Mallory, 1953, Am. Assoc. Petroleum Geologist Bull., v. 37, no. 10, p. 2413 (fig. 2), 2414. In generalized paper on designation of stratigraphic units, mentioned that Meriwitica would be treated as member of Lyndon westward and as member of Bright Angel eastward in accordance with procedure recommended by present stratigraphic code.

In western Grand Canyon. Traced along walls of canyon for many miles and extends eastward at least as far as Meriwitica Canyon.

Merizo Limestone

Recent: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 58–59, table 4 [English translation in library of U.S. Geol. Survey, p. 69]; S. Hanzawa, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 46–47. A raised coral reef. Consists of two members separated by unconformity. Upper member is limestone consisting of erect corals; lower member is conglomerate consisting of coral gravels deposited horizontally. Merizo and Barrigada (Mariana) limestones are unconformable. Correlated with Tanapag limestone.

Typically exposed at Merizo, Guam.

Merkel Dolomite Member (of Choza Formation)

Merkel Dolomite Member (of Clear Fork Formation)[1]

Permian: North-central Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull., v. 1, p. 95, 96, 97, pl.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as member of Choza formation. Occurs above Bullwagon dolomite member of Arroyo formation and below San Angelo sandstone.

Named for exposures just west of Merkel, Taylor County.

Mermentau Member (of Le Moyen Formation)

Recent: Southeastern Louisiana (subsurface and surface).

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 90–94. Consists of dark-colored marine muds, beach deposits of sand and shell, organic clays of the coastal marsh, and sediments formed in lakes and bays—all complexly interlaminated; deposition of member continues today. Thickness in-

creases gulfward and eastward and thins out landward against emergent Pleistocene deposits. Upper surface is modern land surface. Base lies on eroded gulf-marginal surface of Prairie formation. Essentially contemporaneous with and merges into deltaic deposits of Lebeau member.

Named for deposits penetrated by water wells and bore holes in vicinity of Cameron, in T. 14 S., R. 9 W., in Cameron Parish.

Merom cyclothem (in McLeansboro formation)

Pennsylvanian: Central and southern Illinois.

J. M. Weller and W. A. Newton, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 329. Upper part of McLeansboro formation from Shoal Creek limestone up to highest Pennsylvanian strata, is divided into following cyclothems (descending): Merom, Shumway, Woodbury, Gila, Greenup, Newton, Upper Bogota, Lower Bogota, Cohn, LaSalle, Macoupin, Flannigan, and Shoal Creek.

Type locality not given, but type for Merom sandstone is in sec. 7, T. 7 N., R. 10 W., Sullivan County, Ind.

†Merom Group[1]

Pennsylvanian: Southwestern Indiana.

Original reference: G. H. Ashley, 1902, U.S. Geol. Survey 22d Ann. Rept., pt. 3, p. 273–277.

Named for Merom, Sullivan County.

Merom Sandstone[1]

Merom Sandstone Member (of Mattoon Formation)

Upper Pennsylvanian: Southwestern Indiana and eastern Illinois.

Original reference: J. Collett, 1871, Indiana Geol Survey 2d Rept., p. 199.

C. A. Malott, 1948, Indiana Acad. Sci. Proc., v. 57, p. 126 (fig. 1), 129–130. In Dicksburg Hills, Knox County, Ind., overlies Ditney formation (restored) and underlies Hazelton Bridge formation (new). Thickness about 40 feet in Hazelton locality.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1). Rank reduced to member status in Mattoon formation (new).

Type locality: Sec. 7, T. 7 N., R. 10 W. Named from exposures in Wabash River bluff at Merom, Sullivan County, Ind.

Merriam Limestone[1] **Member** (of Plattsburg Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 93, 97.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33–34. This is "Meadow" limestone named by Condra and Bengston (1915). Its type locality is in Kiewitz quarry west of Meadow Station, Sarpy County, Nebr. Although member was properly defined with relation to its position and sequence in the section, its age correlation has proven to be in error; although name has been in use for more than 30 years, it is now dropped, and name Merriam accepted by Nebraska Survey.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 81. Basal member of Plattsburg. Underlies Hickory Creek shale member; overlies Bonner Springs shale.

Named for exposures in town of Merriam, Johnson County, Kans.

Merrimac granodiorite

Late Jurassic(?): Northern California.

Anna Hietanen, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 583, 584, pl. 1. Shown on map and named in a petrographic discussion of rocks in the area.

Occurs in Merrimac area, Plumas National Forest, Butte and Plumas Counties.

Merrimac Rhyolite[1]

Precambrian (pre-middle Huronian): South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 130.

In Merrimac Township, on south flank of syncline near Merrimac, sec. 32, T. 11 N., R. 7 E., Baraboo district.

Merrimack Quartzite[1] or Group

Probably Ordovician and Silurian: Southeastern New Hampshire and northeastern Massachusetts.

Original reference: C. H. Hitchcock, 1870, New Hampshire 2d Ann. Rept. on Geology and Mineralogy, p. 34, geol. map.

L. W. Currier, 1952, *in* L. W. Currier and R. H. Jahns, Geol. Soc. America Guidebook for Field Trips in New England, p. 107. Age of quartzite is Devonian(?) or Carboniferous(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Group term used in New Hampshire. Subdivided to include (ascending) Kittery quartzite, Eliot formation, and Berwick formation. Probably Ordovician and Silurian.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 43–44, 99–105. Merrimack group of present report is used in much the same sense as by Hitchcock except that Rye formation is excluded. That part of Hitchcock's Rockingham mica schist lying southeast of Fitchburg pluton is included in Merrimack group. Group is equivalent of Eliot and Berwick formations. Thickness probably about 16,500 feet. Term Merrimack group as used in present report is more inclusive than Merrimack quartzite of Massachusetts (Emerson, 1917, U.S. Geol. Survey Bull. 597). Group includes following formations on Emerson's map: Merrimack quartzite, Oakdale quartzite, and gneisses of unknown age and origin. Tentatively assigned to Silurian.

Named for exposures on both sides of Merrimack River and near town of Merrimack, N.H.

Merriman Limestone Member (of Graford Formation)[1]

Upper Pennsylvanian: Central northern Texas.

Original reference: F. Reeves, 1922, U.S. Geol. Survey Bull. 736–E, p. 120.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 97. Name Merriman abandoned. Unit included in Winchell member (new) of Graford formation.

Crops out near Merriman Church, south of Ranger, Eastland County.

Merritt Sand[1]

Pleistocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

P. D. Trask and J. W. Rolston, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1082, 1103–1105. Thickness as much as 60 feet. Underlies Bay Mud formation (new); overlies Posey formation (new).

D. H. Radbruch, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–239. In Oakland West quadrangle, Merritt sand varies in thickness from a few inches to known maximum of 65 feet. Overlies Alameda formation; grades laterally into Temescal formation; underlies Bay Mud. Where exposed at surface forms low, rounded hills.

Named for occurrence on Lake Merritt, in city of Oakland.

Mesa Basalt[1]

Tertiary, upper: Northwestern Nevada and southeastern Oregon.

Original reference: J. C. Merriam, 1910, California Univ. Dept. Geology Bull., v. 6, no. 2, p. 21–53.

D. O. Cochran, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 10 (chart), 12. Mesa basalt listed with Cenozoic formations of Oregon. Overlies Thousand Creek formation.

Widespread over region of Virgin Valley and Thousand Creek, west of Denio, Humboldt County, Nev.

Mesa Formation[1]

Age(?): Arizona.

Original reference: W. P. Blake, 1899, Rept. Governor Arizona to Secretary Interior of U.S., p. 143.

Forms mesa on which University of Arizona at Tucson is located.

†Mesabi Gabbro[1]

Precambrian: Minnesota.

Original reference: N. H. Winchell, 1895, Am. Geologist, v. 16, p. 333.

In Mesabi district.

†Mesabi Series[1]

Pre-Cambrian (Huronian): Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 351–361.

Mesabi district.

Mesa Redondo Member (of Chinle Formation)

Upper Triassic: Northeastern Arizona.

M. E. Cooley, 1958, Plateau, v. 31, no. 1, p. 7–14. Comprises lower reddish-brown mudstone-siltstone slope-forming unit, medial conglomeratic ledge-forming unit, and upper mudstone-siltstone slope-forming unit. Thickness ranges from 95 to 160 feet. Maximum thickness on Cedar Ridge 5 miles southeast of St. Johns; 98 feet thick, 6 miles north of Concho, and 121 feet at type area. Grades upward or intertongues with lower part of Petrified Forest member; either lies unconformably on Moenkopi formation or overlies and intertongues laterally with Shinarump member of Chinle formation.

Type section: Along north side of Little Colorado River, 1 to 3 miles east of State Highway 260, and about 16 miles northwest of Concho, Ariz. Named from exposures, lying at base of Mesa Redondo, a prominent landmark 20 miles east of Snowflake, about 10 miles southwest of type section.

Mesa Rica Sandstone

Mesa Rica Sandstone Member (of Purgatoire Formation)

Lower Cretaceous: Northeastern New Mexico.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 62. White or brownish-buff crossbedded medium- or coarse-grained sandstone that is massive or cliff forming; locally lenses of quartz-pebble conglomerate at base. Overlies Tucumcari shale member; underlies Pajarito shale member (new). Originally included in Tucumcari beds.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2005 (fig. 2), 2007. Rank raised to formation; term Purgatoire abandoned in Tucumcari-Sabinoso area. Thickness 50 to 100 feet.

Type locality and derivation of name not stated. First described in northwestern Quay County.

Mesaverde Group[1] or Formation[1]

Upper Cretaceous: Western Colorado, Arizona, northwestern New Mexico, eastern Utah, and Wyoming.

Original reference: W. H. Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. for 1875, p. 245, 248, pl. 35.

N. M. Fenneman and H. S. Gale, 1906, U.S. Geol. Survey Bull. 297, p. 22–28, pl. 11. Formation, in Yampa coal field, Routt County, Colo., comprises (ascending) barren sandstone series, lower coal group, Trout Creek sandstone, middle coal group, Twentymile sandstone, and upper coal group. Thickness about 3,500 feet. Overlies Mancos formation; underlies Lewis shale.

W. T. Lee, 1909, U.S. Geol. Survey Bull. 341, p. 320 (table), 322–323. Formation, in Grand Mesa coal field, Colorado, comprises (ascending) Rollins sandstone, Bowie shale, and Paonia shale. Thickness 925 feet. Overlis Mancos shale. Montana group.

C. H. Wegemann, 1918, U.S. Geol. Survey Bull. 670, p. 20–23. Formation, in Salt Creek oil field, Wyoming, divided into (ascending) Parkman sandstone, unnamed member, and Teapot sandstone. Thickness about 845 feet. Represents in whole or in part the Mesaverde formation of Colorado and southern Wyoming. Overlies Steele shale; underlies Lewis shale.

A. J. Collier, 1919, U.S. Geol. Survey Bull. 691–K, p. 296–297, pl. 34. Group, in Montezuma County, Colo., comprises (ascending) Point Lookout sandstone, Menefee and Cliff House sandstone. Overlies Mancos shale.

E. T. Hancock, 1925, U.S. Geol. Survey Bull. 757, p. 7 (table), 13–20. Group, in Axial and Monument Butte quadrangles, Colorado, comprises (ascending) Iles and Williams Fork formations. Overlies Mancos shale; underlies Lewis shale.

J. D. Sears, 1925, U.S. Geol. Survey Bull. 767, p. 15–18. Formation, as exposed in Gallup-Zuni basin, comprises about 1,800 feet of alternating gray sandstone, drab clay shale, and coal beds. Subdivided into (ascend-

ing) Gallup sandstone, Dilco coal, Bartlett barren, Gibson coal, and Allison barren members. Overlies Mancos shale.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 440 (fig. 2), 441–448. In Wasatch Plateau, rocks designated as Mesaverde group are subdivided into (ascending) Star Point sandstone, Blackhawk formation, and Price River formation. Upper shale member of Mancos passes by gradual transition into basal formation of Mesaverde group; underlies Wasatch formation.

J. D. Sears, 1926, U.S. Geol. Survey Bull. 781, p. 16 (chart). Group, in Baxter Basin, Wyo., comprises (ascending) Blair formation, Rock Springs formation, Ericson sandstone, and Almond formation. Overlies Baxter shale; underlies Lewis shale.

C. E. Dobbin and others, 1929, U.S. Geol. Survey Bull. 806–D, p. 134 (table), 140–141. Formation, in Rock Creek oil field, Wyoming, is about 1,250 feet thick. Top is marked by Pine Ridge sandstone member which contains several beds of coal. Overlies Steele shale; underlies Lewis shale.

C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 22–23 (table), 31–53. In Book Cliffs coal field, Colorado, Mesaverde group comprises (ascending) Castlegate sandstone, Sego sandstone, Mount Garfield formation, and Hunter Canyon formation. Overlies Mancos shale; unconformable below Tertiary(?).

J. D. Sears, 1934, U.S. Geol. Survey Bull. 860–A, p. 14–19. Formation, in coal field from Gallup eastward to Mount Taylor, comprises (ascending) Gallup sandstone, Dilco coal, Dalton sandstone (new), Bartlett barren, Gibson coal, Hosta sandstone (new), and Allison barren members. Overlies Mancos shale.

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 45–50. Formation, in Mount Taylor coal field, comprises (ascending) Gallup sandstone, Dalton sandstone, Gibson coal, and Hosta sandstone members. Mulatto tongue of Mancos lies between Dilco coal and Dalton sandstone members. Satan tongue of Mancos splits Hosta sandstone member into a lower and an upper part. Gibson coal member is split by Hosta sandstone into a lower and an upper part. Higher formations of Upper Cretaceous absent in area.

C. H. Dane, 1936, U.S. Geol. Survey Bull. 860–C, p. 93–108, pl. 41. Formation, in La Ventana-Chacra Mesa coal field, New Mexico, comprises (ascending) Hosta sandstone, Gibson coal, Allison, La Ventana, and Chacra sandstone members. Overlies Mancos shale; underlies and interfingers with Lewis shale.

D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852, p. 9–10 (table), 12–20. Group, in Book Cliffs coal field, Emery and Grand Counties, Utah, comprises (ascending) Blackhawk formation and Price River formation which is subdivided into (ascending) Castlegate sandstone, Sego sandstone, Neslen coal-bearing, and Farrer non-coal-bearing members. Buck tongue of Mancos shale separates the Castlegate and Sego sandstone members. Overlies Mancos shale; underlies Tuscher formation.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. In Anthracite-Crested Butte coal district, Colorado, formation includes Rollins sandstone member below and Baldwin sandstone member (new) above. Name Baldwin replaces term Bowie as used in area by Lee.

P. J. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 93–130. Tabby Mountain region in western part of Uinta basin, Mesaverde group undifferentiated is 0 to 3,000 feet; overlies Mancos shale and unconformably underlies Currant Creek formation (new). In eastern part of Uinta basin, group is subdivided into (ascending) Asphalt Ridge sandstone (new), Rim Rock sandstone (new), and Williams Fork formation (contains more than type Williams Fork). Overlies Mancos shale; unconformably underlies Wasatch formation.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 9–11, 71. Discussion of large-scale intertonguing between marine Mancos and nonmarine Mesaverde strata in New Mexico, Arizona, and southwestern Colorado. At type locality, the Mesaverde is usually referred to as a group because of the three distinct lithologic subdivisions. To the south, it is usually considered a formation, and the less distinct subdivisions are treated as members. In Gallup area, base of Gallup sandstone, although conformable with underlying Mancos shale, marks abrupt change in lithology which Sears considered indicated Mancos-Mesaverde contact. At that time, he believed Gallup sandstone to be homogenetic equivalent of Point Lookout sandstone but recognized that it was much older. It is now known that all or most of Mesaverde near Gallup is older than any of Mesaverde of type locality. Several tongues of Mancos shale project into and wedge out between rocks of Mesaverde character. Southward from Gallup, the Gallup member thickens at expense of underlying Mancos shale to about 400 feet and becomes more nonmarine, and in Zuni Indian Reservation is divided into upper and lower parts by Pescado tongue (new) of Mancos shale. Still farther south near southern limit of Mesa Verde-Atarque area, rocks of Mesaverde facies come into section below Gallup member and are separated from it by Horsehead tongue (new) of Mancos shale. This unit is herein named Atarque member of Mesaverde. Winchester's (1920) Chamiso formation reduced to rank of member of Mesaverde.

L. B. Leopold and C. T. Snyder, 1951, U.S. Geol. Survey Water-Supply Paper 1110–A, p. 8, 9. In vicinity of Gallup, N. Mex., Gibson coal member of Mesaverde disconformably underlies Gamerco formation (new).

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 463 (fig. 2), 466–467. Formation, in Galisteo-Tonque area, New Mexico, includes Cano sandstone member (new) embedded in upper part of Mancos shale.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 87–96. Mesaverde group, in Fort Defiance-Tohatchi quadrangles divided into five formations with several members as follows: Gallup sandstone, 100 to 400 feet; Crevasse Canyon formation (new), 252 to 410 feet, which includes Dilco, Dalton sandstone, and lower Gibson members; Point Lookout sandstone, 0 to 365 feet, which includes Satan tongue of Mancos shale and Hosta sandstone tongue; Menefee formation, 2,300 feet; and Tohatchi formation, about 1,350 feet. Overlies Mancos shale; underlies Chuska sandstone.

H. E. Wright, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1831–1833. Group, in Chuska Mountains, unconformably underlies Deza formation (new).

M. W. Bodine, Jr., 1956, New Mexico Bur. Mines Mineral Resources Circ. 35, p. 4 (fig. 2), 5 (fig. 3), 6–8. In Capitan coal field, Lincoln County, Mesaverde group, undifferentiated, is about 400 feet thick, overlies Mancos shale and underlies Cub Mountain formation (new).

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 271–281. Mesaverde group in Black Mesa area, Arizona, comprises three formations (ascending): Toreva, Wepo, and Yale Point sandstone (all new). Group of Black Mesa, in its entirety, is older than Mesaverde at type locality in southwestern Colorado. Overlies Mancos shale; no younger sediments overlie Yale Point sandstone.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, 2149–2162. Mesaverde group substituted for Mesaverde formation, throughout San Juan basin, and formations of the type locality, Point Lookout sandstone, Menefee formation, and Cliff House sandstone, are also extended throughout the basin. Several names for units formerly called members of Mesaverde formation in southern part of basin are retained as names of tongues or members of the formations of Mesaverde group. Name Gallup sandstone replaces Tocito sandstone lentil of Mancos shale. Crevasse Canyon formation of Allen and Balk (1954) is accepted for that part of Mesaverde group between Gallup sandstone and Point Lookout sandstone with Gibson coal member restricted at its top. Name Cleary coal member of Menefee formation is proposed for beds formerly included in upper part of Gibson coal member of Mesaverde. Beds included in Chacra sandstone member by Dane (1936) appear to be about equivalent to combined upper two southward-extending tongues of Cliff House sandstone northeast of Newcomb. Name Cliff House sandstone will replace Chacra sandstone member.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 191, Chamiso member of Mesaverde abandoned in favor of Crevasse Canyon formation.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 6 (table 1), 7 (fig. 2), 18–22. Group described in Puertecito quadrangle. Includes La Cruz Peak and Crevasse Canyon formations as well as unit termed Tres Hermanos(?) sandstone at base. Thickness about 1,765 feet including Tres Hermanos(?) sandstone. Overlies Mancos shale; underlies Baca formation.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2426–2436. In Powder River basin, Mesaverde formation is divided into three members (ascending): Parkman sandstone, unnamed member, and Teapot sandstone. Parkman sandstone, as defined by Darton (1906), was treated as a formation and included all sandy strata correlative with what is herein referred to as Mesaverde formation. Within framework of regressive and transgressive deposition, as it is used in this report, the marine part of unnamed middle member in Power River basin appears to be a tongue of Pierre shale. Mesaverde is not subdivided in Big Horn Basin. Overlies Cody shale or Steele shale. Underlies Meeteetse formation or Lewis shale.

C. W. Brown, 1958, Dissert. Abs., v. 18, no. 1, p. 194. Mesa Verde group, in Yellowstone Park area, includes Bacon Ridge formation, "coaly sequence," "lenticular sandstone and shale sequence," "white sandstone sequence," and Harebell formation. Group is overturned southwest of Gardiner thrust fault and is in fault contact with Precambrian, Paleozoic, and Jurassic rocks.

J. M. Parker, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90, 98. As formation names Bearpaw and Claggett are used in part of basin [Powder River, Wyoming-Montana] and as age relationships of

these formations are rather well defined, it is preferable to use those names throughout basin. By using formation names Bearpaw, Parkman, Claggett, Eagle, Telegraph Creek, and Niobrara, it is possible to do away with names Lewis, Cody, Steele, and Mesaverde in this area. Lewis, Cody, Steele, and Mesaverde formations, as defined in their respective type localities, do not relate exactly in time or as continuous rock units with rocks that have been designated by those names in Powder River basin.

J. R. Donnell, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Ann. Field Conf., Symposium, p. 76–77. Formation, in Carbondale area, northwestern Colorado, is more than 5,000 feet thick in Thompson Creek area. Thins southward to about 2,800 feet. Overlies Mancos shale. Underlies Ohio Creek conglomerate.

J. A. Barlow, Jr., 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Ann. Field Conf., Symposium, p. 111–113. Total thickness of Mesaverde formation 2,644 feet on west flank of Rawlins uplift, Carbon County, Wyo. Overlies Steele formation; underlies Lewis formation.

J. R. Bergstrom, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 11th Ann. Field Conf., Symposium, p. 114. Informally named Mesaverde group in southeastern Wyoming is composed of Allen Ridge formation (new) and Pine Ridge sandstone. Overlies Steele formation; underlies Lewis formation.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 9–22, measured sections. Area of report, Book Cliffs in Carbon, Emery, and Grand Counties, Utah, and Garfield and Mesa Counties, Colo. Mesaverde group, because of its lateral changes in character and composition, is divided into three sets of units. In western cliffs, the Star Point formation is not present as such, and Blackhawk formation at base of group is overlain by Castlegate sandstone and Price River formation (restricted by removal of the Castlegate). In central cliffs, the much-thinned Blackhawk formation is overlain in succession by Castlegate sandstone, Buck tongue of Mancos shale, Sego sandstone, Neslen formation, Farrer formation, and Tuscher formation. In early reports, the Sego, Neslen, and Farrer formations have been considered members of Price River formation, and Tuscher formation was not included in Mesaverde group. In eastern cliffs, the Sego sandstone is basal unit, containing Anchor Mine tongue of Mancos shale; the Sego is overlain by Mount Garfield formation, containing in lower part "coal measures" with Rollins sandstone member and upper part "barren measures"; at top is Hunter Canyon formation. Relations between Mancos shale and overlying Mesaverde are not simple, for there is successive loss of sandstone along the outcrop from west to east by change into shale, such that in their larger aspects the two units overlap considerably—higher parts of Mancos shale were formed contemporaneously with lower parts of Mesaverde to west.

Names Haybro, Holderness, Milner, and Mount Harris Formations, all in Mesaverde Group, appeared in bold face in the Wilmarth Lexicon on the basis of Wilmarth's correlation chart. The names had been approved for use by M. R. Campbell. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used the names on the Cretaceous correlation chart

and cited the Wilmarth Lexicon. However, Campbell's report was not published. U.S. Geological Survey has abandoned the names.

Named from Mesa Verde, Colo.

Mescal Limestone (in Apache Group)[1]

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1915, Washington Acad. Sci. Jour., v. 5, p. 380–385.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Composed of distinct beds ranging from a few inches to 2 feet in thickness that have great diversity in character and composition, A few beds are relatively pure crystalline limestone, but most are cherty and dolomitic. Thickness in Globe quadrangle about 250 feet. Overlies Dripping Spring quartzite. Wherever top of Mescal is exposed, it is overlain by basalt of Apache group. Stratigraphically below Troy quartzite.

Named for exposures in Mescal Range, Ray quadrangle.

Mescaleran series

Paleozoic (Late Carbonic): New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 106 (chart). Comprises (ascending) Cornudas, Leonard, Limpia, and Eddy terranes.

Meseta Blanca Sandstone Member (of Yeso Formation)

Permian: Northwestern New Mexico.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Light orange or red tangentially crossbedded sandstone. Weathers to rounded and overhanging cliffs. Underlies San Ysidro member (new); overlies Abo formation in the south, tongues with Abo to the north, and then tongues into Cutler formation in vicinity of Senorito Canyon. In area from San Miguel Canyon north to Senorito Canyon, Meseta Blanca tongues with overlying San Ysidro member.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. In Lucero uplift, Valencia, Socorro, and Bernalillo Counties, underlies Los Vallos member (new). Thickness 0 to 250 feet. Coextensive with underlying Abo formation.

Type section: Near Canon, in sec. 3, T. 16 N., R. 2 E., Sandoval County, and area immediately north of this section in Canon de San Diego Grant.

Meshik Formation[1]

Miocene: Southwestern Alaska.

Original reference: R. S. Knappen, 1929, U.S. Geol. Survey Bull. 797, p. 198–201, map.

U.S. Geological Survey currently designates the age of the Meshik Formation as Oligocene or Miocene on the basis of a study now in progress.

Well exposed along sides of valley of Meshik River and Meshik Lake, Alaska Peninsula.

Mesillan series

Paleozoic (Mid-Siluric): Southern New Mexico.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 319. Name applied to Mid-Siluric rocks. Includes Fusselmann limestone.

Name taken from valley at foot of Franklin-Organ Mountains, north of El Paso.

†Mesnard Epidote[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680.

Named for fact it occurs in old Mesnard mine, Houghton County.

†Mesnard Formation[1]

Precambrian : Northwestern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 63–66.

S. A. Tyler and W. H. Twenhofel, 1952, Am. Jour. Sci., v. 250, nos. 1–2, p. 11 (table 1), 12–16. Lithology at type locality and adjacent areas, consists of basal conglomerate succeeded by clean quartzite followed upward by shaly quartzite which passes into shale; east of Teal Lake, basal quartzite is succeeded by interbedded shales and quartzites which pass upward into relatively clean white and pink quartzites. Van Hise and Bayley (1897, U.S. Geol. Survey Mon. 28) divided formation into four members: basal conglomerate, slate and quartzite, quartzite, and slate; Van Hise and Leith (1911, U.S. Geol. Survey Mon. 52) concluded there were three members: basal conglomerate, central quartzite, and upper slate. It is doubtful if any division as simple as either of these can be made because lithic sequence varies greatly from place to place. Total thickness cannot be determined. Underlies Kona formation; separated from underlying granites by unconformity.

Type section: Exposed on slopes and summit of Mount Mesnard south of Marquette.

Mesnard Quartzite[1]

Precambrian : Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 517.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1436 (table 1), 1455 (table 4), 1461. Palmer gneiss, previously considered pre-Huronian, consists of metamorphic Mesnard quartzite, Kona dolomite, Wewe slate, and Ajibik quartzite. Table 1 shows lower Huronian sequence in Marquette area (ascending) Mesnard, Kona, Wewe. Palmer gneiss not listed on this table.

Composes larger part of mass of Mount Mesnard, south of Marquette, Marquette County.

Mesquite Schist

Precambrian (?) : Southern California.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1). 14–15, pls. 1–3. Chlorite-quartiz-albite-sericite schist; dark steel gray when fresh, weathers to light silvery gray; prominently and thinly bedded; uppermost 500 feet contains many interbeds of fine crystalline limestone, some as much as 10 feet thick. Total thickness about 4,500 feet. Schist dips east under Garlock series (new) ; contact sharp, concordant; probably a disconformity. Columnar section shows Mesquite schist younger than Rand schist.

Exposed in Mesquite Canyon in El Paso Mountains, Saltdale quadrangle, Kern County.

Metacom Granite Gneiss

Devonian(?) or older: Eastern Rhode Island.

A. W. Quinn and G. H. Springer, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–42. Gray to pink medium-grained locally porphyritic granite. Characteristically lineated and locally foliated. Contains inclusions or relics of quartz muscovite schist and darker schists; in places is in gradational contact with the quartz-muscovite schist. Small dikes and irregular intrusive bodies of aplite also present.

Named for exposures along Metacom Avenue one-half mile south of summit of Jupiter Hill and eastward for one-quarter mile at eastern border of Bristol village, Bristol County.

Metalanim (Matalanin) Beds or Conglomerate

Miocene: Caroline Islands (Ponape).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 347 (correlation chart) [English translation in library of U.S. Geol. Survey]. Matalanim conglomerate named on correlation chart. Oligocene.

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 69, table 5 [English translation in library of U.S. Geol. Survey, p. 84]. Matalanim beds belong to East Caroline group, considered to be Miocene.

Metaline Limestone or **Formation**

Middle Cambrian: Northeastern Washington.

C. F. Park, Jr., 1938, Econ. Geology, v. 33, no. 7, p. 713 (chart), 714 (fig. 2). Named on map and stratigraphic chart. Thickness 3,000 feet. Underlies Ledbetter slate and overlies Maitlen phyllite (both new).

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 17–19, pl. 1. Described as limestone and dolomites with phyllite near base. Grades into Maitlen phyllite below. Derivation of name given.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 606–612, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for Metaline quadrangle. The new names replace those given by Weaver (1920). Correlative with Metaline limestone are most of Weaver's Northport limestone, Republican Creek limestone, Red Top limestone, and Deep Lake argillite, and part of Boundary argillite.

Named from cliffs near Metaline Falls, Pend Oreille County. Exposed in Pend Oreille Valley from Ione north to Canadian border.

Metamora Drift

Pleistocene (Wisconsin): Northern Illinois.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, pt. 1, p. 29. In Peoria area, Metamora drift is listed as older than Normal drift and younger than Bloomington drift.

Probably named for occurrence near Metamora, Woodford County.

Metcalf Phyllite (in Snowbird Group)

Precambrian (Ocoee Series) : Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 957. Represents Snowbird group in western part of Great Smoky Mountains. Characteristic rock of formation is lustrous thinly fissile gray-green or gray phyllite, but almost half the unit is more silty and resembles siltstone of the Pigeon except for its stronger cleavage; carbonate-bearing laminae uncommon; sandstone beds resembling those in the Pigeon and Roaring Fork are widely spaced and generally thin, but northwest of Schoolhouse Gap they constitute much of exposed section. In most places, Metcalf is faulted against other rocks and is highly foliated, contorted, and sheared; thickness indeterminable but may be thousands of feet. Relations to remainder of group uncertain; joins Pigeon siltstone at northeast end of its outcrop, but contact relations are obscure.

Named for Metcalf Bottoms on Little River, [Sevier County], where it is typically exposed along Tennessee Highway 73. Crops out between high ridges of Great Smoky Mountains and the cove areas on the northwest in belt extending from near meridian of Gatlinburg southwestward to Cades Cove.

Metchosin Volcanics[1]

Metchosin Volcanic Series

Eocene, lower(?) and middle: British Columbia, Canada, western Oregon and western Washington.

Original reference: C. H. Clapp, 1910, Canada Geol. Survey Summ. Rept. 1909, p. 89.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 26–40. Basaltic lavas, tuffs, and agglomerates with pillow structure and intercalated shales and cherts. Form basement Eocene rocks from Vancouver Island southwest to southern Oregon. On Olympic Peninsula, the volcanics overlie the Solduc (Soleduck) formation with angular unconformity.

C. E. Weaver, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1406 (table 6). Paleocene.

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 16 (fig. 5), 22–34, 70–79, pl. 1. In Cowlitz River-Willapa Hills area, series comprises central mass of Willapa Hills anticlinal uplift. Minimum exposed thickness 6,000 to 8,000 feet; total thickness probably exceeds 10,000 feet. Base of series not exposed in southwestern Washington; around borders of Olympic Peninsula, the series rests upon basal Tertiary or pre-Tertiary complex of closely folded sedimentary and metamorphic rocks. Along northern and eastern borders of Willapa Hills, upper flows of series are overlain conformably by Stillwater Creek member of Cowlitz formation; along southern boundary of mapped area, series is overlain with marked angular unconformity by basalt flows and sandstones of middle Miocene Astoria formation. Lower part of Metchosin is of unknown age, although volcanism may have been initiated in early Eocene time; upper part of formation is of upper middle Eocene. In recent years, several new names—Tillamook volcanic series, Siletz River volcanic series, and Coffin Butte volcanics—have been proposed for middle and lower(?) Eocene volcanic units in parts of northwestern Oregon; these units are correlative at least in part with each other, and all three

may be correlated with Metchosin volcanic series. Herein suggested that these formational names are unnecessary and that name Metchosin volcanic series be used for lower(?) and middle Eocene volcanics which constitute Tertiary "basement rocks" of western Oregon and Washington.

Type area: Southern Vancouver Island, British Columbia. Volcanics underlie area approximately 37 miles in an east-west direction and 5 to 7 miles in a north-south direction.

Meteor Granodiorite[1]

Upper Jurassic: Northeastern Washington.

Original reference: C. E. Weaver, 1913, Washington Geol. Survey Bull. 16, p. 20–30.

J. L. Marlow, 1958, U.S. Atomic Engery Comm. [Pub.] RME–2068, p. 9. Incidental mention in report on uranium occurrences in northern Ferry County. Late Jurassic.

Named for Meteor, Ferry County.

Methow Gneiss

Age uncertain (pre-Chelan batholith). Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 166–167. Distinctive "biotite-granite" gneiss. Has marked foliation emphasized in outcrop and hand specimen by clots of biotite some of which are as large as half dollar. Clots may be irregularly drawn-out ovoid areas of paper thinness or single ragged books of black biotite up to 2 millimeters in thickness. Outcrops paralleling schistosity have leopard-spot appearance. Gneiss shows concordance in structure with overlying Leecher metamorphics (new) north and east of Methow River.

Type locality: In narrow valley of Methow River from Carlton south through town of Methow, Methow quadrangle.

Metralla Sandstone Member (of Tejon Formation)

Eocene, upper: Southern California.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922. Listed as member of Tejon formation in type area of Tejon. Thickness 1,300 feet. Shown as underlying Reed Canyon siltstone member (new) and overlying Liveoak member (new).

J. G. Marks, 1943, California Div. Mines Bull. 118, pt. 3, p. 535, 536 (fig. 232), 537 (fig. 233). Consists of fine- to medium-grained sandstones uniformly gray in color, massive, and well indurated by calcareous cement; many spherical concretions up to 10 feet in diameter. Upper Eocene.

Type locality: Reed Canyon, Tehachapi Mountains, Kern County.

Mettawee Slate[1]

Mettawee Member (of Bull Formation)

Lower Cambrian: Southwestern Vermont and eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, p. 1084 (table 1), 1085–1086, 1091. In northern Taconic area, Mettawee slate overlies Bomoseen grit and underlies Eddy Hill grit. Keith's (1932) sequence is incompatible with sequence used in present report. Keith's Stilles phyllite, Hubbardton slate, and Bull slate are here included in Mettawee.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 47–49, pl. 2. Mettawee slate is widespread formation in western part of Castleton quadrangle. Several bands of Mettawee crop out in Poultney, Castleton, and Hubbardton quadrangles. In southern half of quadrangle, the Mettawee is confined to slate belt and does not crop out in Taconic Range. Kaiser (1945) mapped Mettawee in Taconic Range north of Castleton River. It is probable that the rock here mapped as Nassau contains some undifferentiated Mettawee. Thickness in Castleton area 100 to 300 feet. Top of Mettawee is fixed either at bottom of Eddy Hill grit or at lowest black slate or limestone of Schodack formation. Rests on Bomoseen grit, in many places a gradational contact between the two requires arbitrary definition.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 336–338. "Cambrian roofing slates" of Dale (1898, U.S. Geol. Survey 19th Ann. Rept., pt. 3B) were formally named Mettawee by Ruedemann (1914), although Dale had previously (1904) casually used name Greenwich slate for same beds. Keith (1932) subsequently proposed Bull slate for same interval. Mettawee slates occur in narrow synclinal belts, overturned westward, surrounding infolded Ordovician slates and shales. Bomoseen grit, which conformably and gradationally underlies the Mettawee, encloses these synclinal belts. Average thickness probably 125 feet.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Rank reduced to member status in Bull formation. Constitutes bulk of formation. Distinguished from underlying Biddie Knob formation by lack of chloritoid, which reflects primary compositional differences. In some areas, overlies Bomoseen greywacke member; in other areas the Bomoseen is within the Mettawee.

Named for Mettawee River, which drains region, rising in Pawlet quadrangle in southwestern part of Rutland County, Vt., and flowing northwest into New York.

Mexia Member (of Wills Point Formation)[1]

Paleocene: Northeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 559, 562.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 25. Lower member of Wills Point. Consists of dark thinly laminated or compact fossiliferous clay of fairly deep water marine facies. Constitutes about one-third of formation. Underlies Kerens member.

G. R. Kellough, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 153–155, 160. Thickness 85 feet in Tehuacana Creek section. Lower 36 feet contains abundant microfauna. Underlies Kerens member; overlies Tehuacana member of Kincaid formation.

Type locality: Clay pit at brickyard in west edge of Mexia, Limestone County.

Mexican sandstone[1]

Lower Cretaceous: Southeastern Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 129, 138, 139.

Named for Mexican Gulch, east of Bisbee, Cochise County.

Mexico Sandstone Member[1] (of Marcellus Formation)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Pal. Soc. Feb. 28, p. 202–203.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–19, p. 173, 174. Overlies Turkey ridge sandstone member; underlies Mahoney black shale member.

Well exposed in hill east of Mexico, Juniata County, and also at Blue Spring southwest of Mexico.

Meyersdale Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: Maryland Geol. Survey, v. 11, p. 59, 95, 110.

In Lower Youghiogheny Basin, Garrett County.

Meyersdale Red Shale (in Conemaugh Formation)[1]

Pennsylvanian: Southern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: C. K. Swartz, W. H. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 574.

M. T. Sturgeon and others, 1958, Ohio Div. Geology Bull. 57, p. 114–116. Swartz and others (1919) proposed name Meyersdale for redbeds above Buffalo sandstone and below Lower Bakerstown (Anderson or Thomas) coal. Flint's (1951) description of Buffalo shale in Perry County fits that of Meyersdale redbed rather than that of Buffalo member. Meyersdale is included in Wilgus cyclothem although it is not present in area of this report [Athens County]. It has been noted locally in Ohio. Conemaugh series.

Well exposed in cut of Western Maryland Railway east of Meyersdale, Pa.

Miami Oolite[1]

Pleistocene: Southern Florida.

Original reference: S. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 209, 211–214, table.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 256–260. Base of oolite is exposed only in Everglades and in southeastern part of Big Cypress Swamp. There it rests unconformably on Tamiami formation, of Pliocene age; locally limestone breccia or conglomerate, perhaps of early Pleistocene age, separates the Miami from the Tamiami. Presumably equivalent to Key Largo limestone; probably merges northwestward into Coffee Mill Hammock marl member of Fort Thompson formation.

Named for occurrence in vicinity of Miami.

†Michigamme Jasper[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: H. L. Smyth, 1894, Am. Jour. Sci., 3d, v. 47, p. 219–223.

Crops out in vicinity of Michigamme Mountain, in sec. 33, T. 44 N., R. 31 W. and sec. 3, T. 43 N., R. 31 W.

Michigamme Slate[1] (in Baraga Group)

Precambrian (Animikie Series): Northwestern Michigan and northeastern Wisconsin.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 598.

W. A. Seaman *in* A. K. Snellgrove, W. A. Seaman, and V. L. Ayres, 1944, Michigan Dept. Conserv. Geol. Survey Div. Prog. Rept. 10, p. 12. Chart shows Michigamme slate (or series) as underlying Sibley formation.

J. E. Gair and K. L. Wier, 1956, U.S. Geol. Survey Bull. 1044, p. 14 (table 2), 59, pl. 1. Described in Kiernan quadrangle, Michigan, where it is about 10,000 feet thick and unconformably overlies newly defined Fence River formation.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30, (table 1), 36, 37. Assigned to newly defined Baraga group. In Marquette district, Michigan, includes in the lower part Bijiki iron-formation member, Clarksburg volcanics member, and Greenwood iron-formation nember; in Iron and Dickinson Counties, Mich., overlies Fence River formation and underlies Badwater greenstone (new).

Named for exposures on islands of Lake Michigamme, Marquette district, Michigan.

Michigan Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in old Michigan mine, in Ontonagon County.

Michigan Formation[1] (in Grand Rapids Group)

Mississippian: Michigan.

Original reference: W. H. Taylor, chm., 1839, Michigan Geol. Survey Rept. State Geologist in re improvement of State salt springs, Michigan Leg. H. R. Doc. 2, p. 3.

G. M. Ehlers and W. E. Humphrey, 1944, Michigan Univ. Contr. Mus. Paleontology, v. 6, no. 6, p. 114–117. Discussion of history of nomenclature of Point au Gres limestone, Bayport limestone, and Grand Rapids limestone [group]. Reference is made to work of Lane (1893, 1895, 1899, 1900, 1909). Concluded that Point au Gres should be used instead of "Grand Rapids" or "Bayport".

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 80, 81). Shown on correlation chart as underlying Bayport limestone and overlying Napoleon sandstone of Marshall group. Osagean-Meramecian series.

Type locality and derivation of name not stated.

Midco Member (of Wellington Formation)

Permian: North-central Oklahoma.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1928. Thickness 255 feet. Overlies Otoe (redbed) member (new); underlies Billings member (new). Cyclic deposition is recognized in the Midco. Contains insect and crustacean fauna.

Type locality and derivation of name not stated.

†Middendorf Formation[1]

Middendorf Member (of Black Creek Formation)

Upper Cretaceous: Coastal Plain of South Carolina and Georgia.

Original reference: E. Sloan, 1904, South Carolina Geol. Survey, ser. 4, Bull. 1, p. 68, 72, 75–81.

C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867, p. 17. Local names Hamburg and Middendorf were applied by Sloan (1904) to clays and sands in South Carolina that were supposed to be of Lower Cretaceous age. Berry (1916, U.S. Geol. Survey Prof. Paper 84), on basis of fossil plants, transferred Middendorf beds to Upper Cretaceous under name Middendorf arkose member of Black Creek formation. Cooke (1926, U.S. Geol. Survey Prof. Paper 140–E) proposed to restore Middendorf to formation rank and to include in it the Hamburg beds. At that time, [Cooke] correlated the Middendorf with Tuscaloosa formation of Alabama but deemed local designation necessary, because beds having Middendorf aspect in Georgia might represent a period of time somewhat longer than that of the Tuscaloosa and might include all or part of Eutaw time. Recent work shows that Middendorf in Georgia is quite different from Eutaw formation but apparently identical with the Tuscaloosa. As local name for the beds in South Carolina and Georgia is unnecessary, older name Tuscaloosa is here substituted for name Middendorf formation.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2181–2184. In South Carolina, Middendorf member of Black Creek formation (herein revived as equivalent of upper part of Cooke's 1936 Tuscaloosa formation) has been shown to contain plant remains essentially equivalent to those of the lower Black Creek formation of North Carolina; lower part of Cooke's Tuscaloosa is herein referred to as Lower Cretaceous? (undifferentiated).

Named for exposures near Middendorf, Chesterfield County, S.C.

Middleburg Limestone Member (of Bader Limestone)

Middleburg Limestone (in Council Grove Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 20, 25.

R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River Valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 4, 7. Reallocated to member status in Bader limestone (new).

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 61; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. Uppermost member of Bader limestone. Overlies Hooser shale member; underlies Easly Creek shale. Wolfcamp series.

Type locality: On Easly Creek, 1½ miles south of Middleburg School, in E¼ sec. 36, T. 1 N., R. 13 E., in southwestern part of Richardson County, Nebr.

Middlebury Limestone

Middlebury Limestone (in Chazy Group)

Middle Ordovician: West-central Vermont.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 552–553, 554. Buff-streaked dark-blue-gray partly dolomitic limestone which is

somewhat nodular and granular, thin bedded and incompetent. Maximum thickness 600 feet. Underlies Orwell limestone (new); overlies Beldens formation (new) with gradational contact. Assigned Chazyan age, but may be partly Black River.

W. M. Cady and E-an Zen, 1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. Discussion of stratigraphic relationships of Lower Ordovician Chipman formation in west-central Vermont. Some of Cady's (1945) interpretations revised. Chipman formation comprises Beldens, Weybridge, and Burchards members in Cornwall village area and Bridport member in Bascoms Ledge area. All members of the Chipman underlie the Middlebury. The Bridport is as mapped by Cady at Bascoms Ledge, but Middlebury limestone is expanded westward and downward stratigraphically to top of Bridport and includes rocks that have been interpreted as "Crown Point limestone" and Beldens formation. Underlies Orwell formation.

Crops out over wide area west of Otter Creek at Middlebury village, Addison County. Well exposed in ledges on Middlebury College campus.

Middle Creek Conglomerate

Pleistocene: Northern Kentucky.

R. H. Durrell, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1751. Incidental usage only.

Occurs just to south of Commissary Corners, Kentucky.

Middle Creek limestone ledge (in Graneros Formation)

Cretaceous: Western South Dakota.

M. E. Wing, 1940, South Dakota Geol. Survey Rept. Inv. 35, p. 6, chart facing p. 10. Thin persistent limestone ledge in upper part of Graneros; approximately 200 feet below top of Greenhorn limestone.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 9. Preoccupied name Middle Creek abandoned; unit renamed Orman Lake limestone.

Caps escarpment trending northwest from Belle Fourche along northeast side of Middle Creek valley, Butte County.

Middle Creek Limestone[1] Member (of Swope Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85, 90, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 88; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. Middle Creek limestone member of Swope formation; underlies Hushpuckney limestone member; overlies Ladore formation. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28, fig. 5. Thin blue-gray to black dense fine-grained limestone. Not more than 1 foot thick. Basal member of formation; underlies Hushpuckney shale member; overlies Ladore shale.

Type locality: SW sec. 22, T. 18 S., R. 24 E., on Middle Creek at crossing of main highway 3 miles east of LaCygne, Linn County, Kans.

Middlefield Granite[1]

Carboniferous or post-Carboniferous: Western Massachusetts.

Original references: B. K. Emerson, 1898. U.S. Geol. Survy Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, pl. 34.

A small north-south mass in Middlefield Township, western part of Hampshire County.

Middle Freeport Limestone[1]

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1877, Pennsylvania Geol. Survey Rept. H_2, p. xxviii.

Name derived from town of Freeport, Armstrong County, Pa.

Middlegate Formation

Pliocene, lower: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 183–186, figs. 10, 11. Consists of three unnamed members (ascending): volcanics, conglomerates, and sedimentary breccias, with associated sandstones, clays, silts, and tuffs, white dacite tuff lense near Middlegate—thickness from a few feet to maximum of 300 feet; tan siliceous shale with interbedded clays and silts—thickness up to approximately 400 feet; sandstone, rhyolite breccias, silts, diatomite, conglomerate, grading northward to lake beds with siliceous sandstone and siliceous shale—thickness approximately 600 feet over most of area. Maximum aggregate thickness about 1,300 feet. Underlies Monarch Mill formation (new) with gradational contact; unconformably overlies Clan Alpine volcanics (new).

Named for exposures in southeastern foothills of Clan Alpine Range immediately east, north, and south of Middlegate, Churchill County.

Middle Kittanning Clay (in Allegheny Formation)[1]

Middle Kittanning underclay member

Pennsylvanian (Allegheny Series): Western Pennsylvania and eastern Ohio.

Wilber Stout and others, 1923, Ohio Geol. Survey, 4th ser., Bull. 26, p. 393–417. Middle Kittanning clay lies directly below Middle Kittanning coal. Position is nearly 31 feet above Lower Kittanning coal, 47 feet below Lower Freeport member and 95 feet below Upper Freeport stratum. Intervals vary from place to place. In many localities, separated from underlying Oak Hill clay by only a few feet of shale. Average thickness Middle Kittanning clay about 5 feet. Allegheny formation.

J. B. McCue and others, 1948, West Virginia Geol. Survey, v. 18, p. 16. Middle Kittanning underclay mentioned in report on clays of West Virginia.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 49, table 1. Included in Middle Kittanning cyclothem in report on Perry County. Average thickness 4 feet. Overlain by Middle Kittanning (No. 6) coal; at many places, underlain by sandstone or shale. Locally directly overlies Strasburg coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 70–72. Middle Kittanning underclay member of Middle Kittanning cy-

clothem in report on Athens County. Average thickness 1 or 2 inches. Allegheny series.

Name derived from Kittanning, Armstrong County, Pa.

Middle Kittanning complex

See Kittanning Formation.

Middle Kittanning cyclothem

Pennsylvanian (Allegheny Series): Western Pennsylvania and southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 12. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 48–51, table 1, geol. map. Includes (ascending) unnamed shale, Salem limestone, Middle Kittanning clay, Middle Kittanning (No. 6) coal, and Washingtonville shale. Occurs below Lower Freeport cyclothem and above Strasburg cyclothem. In area of this report [Perry County], the Allegheny series is described on a cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 68–76. Embraces interval between Strasburg cyclothem below and Upper Kittanning cyclothem above. Includes (ascending) Middle Kittanning shale and (or) sandstone, Snow Fork ironstone (Salem limestone), Middle Kittanning underclay, Middle Kittanning (No. 6) coal, and Washingtonville shale members. Thickness about 27 feet. In area of this report [Athens County], Allegheny series is discussed on a cyclothemic basis; 13 cyclothems are named. [For sequence see Brookville cyclothem.]

Named from Kittanning, Pa. Members outcrop in belt extending from Columbiana, Jefferson, and Mahoning Counties in eastern Ohio to Gallia and Lawrence Counties in southern Ohio. Outcrop extends across northwestern part of Athens County where exposures mostly occur in Waterloo and York Townships.

Middle Kittanning shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 69. Middle Kittanning shale and sandstone member included in Middle Kittanning cyclothem in report on Athens County. Interval between Strasburg-Oak Hill member of Strasburg cyclothem and Middle Kittanning coal or, in absence of Strasburg cyclothem, the interval between Lower and Middle Kittanning coals is largely occupied by shale and sandstone. Average thickness of shale and sandstone about 14 feet. Shale normally exceeds sandstone. Occurs below Snow Fork (Salem) limestone member. Allegheny series.

†Middle Mahoning Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: W. G. Platt, 1878, Pennsylvania 2d Geol. Survey Rept. H_4.

In Indiana County.

Middle Mercer clay member

See Middle Mercer cyclothem.

Middle Mercer cyclothem

Pennsylvanian (Pottsville Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 7. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 32–33, table 1, geol. map. Includes (ascending) Middle Mercer shale and (or) sandstone, 4 to 13 feet; Middle Mercer clay, 3 to 5 feet; Middle Mercer coal; and Lower Mercer limestone, 2 feet. Occurs below Bedford cyclothem and above Flint Ridge cyclothem. In area of this report, Pottsville series is described on a cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Exposed in Perry County.

Middle Mercer shale and (or) sandstone member

See Middle Mercer cyclothem.

†Middle Mercer Shales (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

Middle Park Formation[1]

Upper Cretaceous and Paleocene: Northwestern Colorado.

Original reference: W. B. Clark, 1891, U.S. Geol. Survey Bull. 83, p. 137.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 40, 42. Discussed under formations of Upper Cretaceous and Paleocene age. Equivalent to Arapahoe and Denver formations. Thickness exceeds 5,000 feet.

Occurs in Middle Park.

Middle Park Formation[1] (in Telescope Group)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 355, 365, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932, [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Murphy tentatively assigned all rocks above Panamint metamorphic complex to the Lower Paleozoic. South Park member (new) of Kingston Peak formation is a correlative of the Middle Park formation, Mountain Girl conglomerate-quartzite, and Wildrose formation of Telescope group. Precambrian.

Probably named for Middle Park Canyon in southern part of Panamint Range, Inyo County.

Middlesex Shale Member (of Sonyea Formation)

Middlesex Shale[1] (in Naples Group)

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 23, chart.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 11–12, pl. 3. Middlesex is unit of jet-black shale through greater part of area [Steuben, Yates, and parts of adjacent counties]. Sharply defined at base, where it overlies flagstones of the Standish, and at top where it underlies Cashaqua shale. Eastward and southward from southwestern part of Ovid quadrangle lithology of Middlesex changes abruptly. Massive flagstones come into upper half and virtually displace the shale; lower half, though it persists as exclusive shale unit changes to gray silvery shale.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54; Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2819. Clarke (1903) gave name Middlesex to black shale underlying his Cashaqua shale in vicinity of Middlesex, Yates County. This black shale is herein redesignated Middlesex shale member of Sonyea formation. Basal member of formation from Lake Erie eastward to Seneca Lake. Underlies Cashaqua shale member; in some areas, underlies Pulteney shale member (new); overlies West River shale. Standard reference section designated. Thicknesses: about 6 feet at mouth of Pike Creek on shore of Lake Erie; 63 feet at reference section; 75 feet on stream west of Chidsey Point on west shore of Keuka Lake and less than 5 feet in Watkins Glen, central Schuyler County.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 11, 12–13. Basal formation in Naples group. Underlies Sawmill Creek member (new) of Cashaqua formation. [Name Pulteney has priority over Sawmill Creek.]

Reference section: Gully on east side of West River valley, 0.8 mile southwest of center of Middlesex, Yates County. Named for exposures in town of Middlesex and in Middlesex Valley.

†Middleton Formation[1]

Eocene, lower: Western Tennessee, southern Alabama, and Mississippi.

Original references: J. M. Safford, 1892, Geol. Soc. America Bull., v. 3, p. 511–512; 1892, Am. Geologist, v. 9, p. 63–64.

Named for exposures at and near Middleton, Hardeman County, Tenn.

Middletown Clay[1]

Pleistocene, upper: Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

Underlies parts of northern Middletown Township, Middlesex County.

Middletown Gneiss[1]

Paleozoic(?): South-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 143, map.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Paleozoic(?).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Includes variety of rock types interbanded, generally with sharp contacts. Especially characterized by amphibolite and amphibole gneiss; also includes hornblendite, biotite gneiss and schist, feldspathic gneiss and granulite, quartzite and garnet granulite. Pre-Triassic.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 26, 34–46, 51–52, pls. 1, 2. Throughout most of area [Guilford and part of New Haven quadrangle] Middletown gneiss is in contact with Haddam tonalite, apparently grades stratigraphically upward into Bolton schist, but part grades along strike into lower Bolton schist. Pre-Triassic.

John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Survey Nat. History Bull. 84, p. 19, 21, fig. 3. Unconformably underlies Collins Hill formation (new). Ordovician(?).

Crops out in southeastern part of Middletown Township, Middlesex County.

Middle Washington Limestone Member (of Washington Formation)[1]

Middle Washington Limestone

Permian: Southwestern Pennsylvania, eastern Ohio, and West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 44, 48–50.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 39, 40. Middle Washington limestone is confined in its known distribution on the outcrop chiefly to Belmont County where it varies in thickness from 5 to 20 feet. Stratigraphic position is about 27 feet above Lower Washington limestone and about 54 feet above top of persistent Washington coal. Included in Washington series which, in Ohio, consists of the following limestones (ascending): Elm Grove, Mount Morris, Lower Washington, Middle Washington, and Upper Washington.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Middle Washington limestone in Washington formation shown on table of summary of stratigraphic sections of Dunkard group in Harrison County. Thickness 0 to about 30 feet. Occurs above middle Marietta sandstone and below Creston shale.

Named for exposures near Washington, Washington County, Pa.

Midland Sand[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: B. Willis and G. O. Smith, 1899, U.S. Geol. Survey Geol. Atlas, Folio 54.

Occurs in village of Midland, Puget Sound region.

Midnight Peak Formation

Upper Cretaceous: Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 173–174. Thick series of andesitic tuffs, breccias, and flows. Approximately 500 feet of red siltstone, tuffaceous sandstone, and pebble conglomerate form lowest member which is exposed in Bridge Creek. Breccias and flows above basal tuffs and sandstones are dark gray to green. Red tuffaceous sandstones and shales at base of formation named Ventura by Russell (1900). Unconformably underlies Pipestone Canyon formation (new) and overlies Winthrop sandstone. Thickness over 8,000 feet.

Occurs at Midnight Peak, the highest point on a northwest trending ridge lying between Twisp River and Canyon Creek, Methow quadrangle.

Midridge Limestone

Lower Mississippian (Kinderhook): West-central Utah.

C. S. Bacon, Jr., 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1032 (fig. 2), 1037. Crinoidal bed of upper Kinderhook age.

Lawrence Ogden, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 64 (fig. 2), 67, 70 (fig. 5). Massive cliff-forming dense medium- to dark-gray petroliferous calcitic limestone; basal bed is pink quartzite 1 foot thick; above is a 9-inch shale bed containing reworked material from underlying Devonian; another thin quartzite above shale grades upward into fossiliferous nodular limestone; rest of formation is mostly massive dark-gray limestone. Thickness 260 feet. Overlies unnamed Devonian rocks with angular unconformity; unconformably below Pennsylvanian rocks.

Present in Confusion Range. Forms prominent north-trending hogback which terminates southeast of Cowboy Pass, T. 17 S., R. 16 W., Millard County.

†Midway andesite[1]

Tertiary: Central Nevada.

Original references: J. E. Spurr, 1911, Min. and Sci. Press, v. 102, p. 560–561; 1911, Report on geology of property of Montana-Tonopah Mining Co.: Tonopah, Nev., published privately.

Named for Midway mine, Tonopah district.

Midway Group[1]

Midway Formation[1]

Midway Stage

Paleocene: Western Georgia to southern Texas, Arkansas, southwestern Illinois, Kentucky, southeastern Missouri, and western Tennessee.

Original references: G. D. Harris, 1894, Am. Jour. Sci., 3d, v. 47, p. 303–304 1896, Bulls. Am. Paleontology, v. 1, no. 4, p. 10–38.

C. W. Cooke, 1925, U.S. Geol. Survey Prof. Paper 140–E, p. 133–134. Group comprises Clayton formation, Sucarnochee clay, Porters Creek clay, and Naheola formation. Clayton is thickest in eastern Alabama and thins toward west; in western Alabama and in Mississippi, reduced to thin beds of limestone and, over considerable area of both states, overlapped by the Porters Creek or Sucarnochee clay. Porters Creek clay is thickest in Tennessee or Mississippi and pinches out entirely or is overlapped about midway across Alabama. Naheola extends across Alabama into Mississippi at least as far north as DeKalb. Underlies Wilcox group; overlies Cretaceous.

Julia Gardner, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 6, p. 744. In eastern Texas, includes Kincaid formation in lower part.

H. J. Plummer, 1933, Texas Univ. Bull. 3232, p. 555. Upper Midway named Wills Point formation.

R. H. Cuyler and A. W. Weeks, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 24. Near Mendoza, Texas, Midway formation contains Rosette bed (new), a mappable horizon as far northeast as Mexia region and beyond.

R. J. Le Blanc, 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941. Lower Eocene sediments below basal Sabine (Wilcox) *Ostrea thirsae* zone have surface thickness of about 800 feet in Sabine uplift of northwestern Louisiana. Upper 300 feet of sediments contain limited fauna. Lower 500 feet carry varied fauna which is older than Solomon Creek fauna of Texas (basal Wilcox or upper Midway in age) and correlated with upper Midway faunas of Alabama Naheola for-

mation and Kerens member of Wills Point formation of Texas. This correlation based on study of over 90 species from 15 previously undescribed localities in Sabine, Natchitoches, and De Soto Parishes.

Grover Murray, Jr., 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941–942. Midway sediments which crop out in northwestern Louisiana outline highest structural part of Sabine uplift. They are divisible on surface into three formations (ascending): Naborton, Logansport, and Hall Summit.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv., Geol. Pamph. 3, p. 13. Group includes (ascending) Naborton formation with Chemard Lake lignite lentil at top, Logansport formation with Dolet Hills, Cow Bayou, and Lime Hill members, and Hall Summit formation with Loggy Bayou, Grand Bayou, and Bisteneau members. Underlies Wilcox group.

M. W. Beckwith and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. Seguin formation, as originally defined, straddles boundary between Midway and Wilcox groups. Members of Seguin formation, Solomon Creek clays, and Caldwell Knob sands, are redefined so that base of Wilcox group is placed at disconformity marking top of Solomon Creek clays and base of Caldwell Knob sands. Solomon Creek member as defined herein apparently corresponds to upper part of Hall Summit unit of Barry and LeBlanc whereas Caldwell Knob member may be correlated with basal sand member of Marthaville unit and beds containing *Ostrea thirsae* in association with *O. multilirata.*

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour., v. 16, p. 41–42. Discussion of Midway-Wilcox contact in Alabama. Contact easily located in exposures on Chattahoochee River at Fort Gaines, Ga., where fossiliferous Wilcox (Nanafalia) beds lie on irregular surface of Midway limstone. Stratigraphic position of Midway-Wilcox contact in central and western Alabama has heretofore been indefinite. Stratigraphic interval consisting of 200 feet or more of beds of uncertain age separates uppermost fossiliferous Midway bed and lowermost fossiliferous Wilcox bed. These beds consist of laminated clay and sand, lignite, greensand, and crossbedded coarse sand. Heretofore, paleontological evidence has been insufficient for determining whether these beds should be assigned to Midway or Wilcox group. A fossiliferous greensand marl within this sequence has been discovered in Wilcox County. Microfossils, including diagnostic Midway species, occur in this bed and it has been assigned to Midway group. Midway-Wilcox contact has been placed above sequence of greensand beds at erosional unconformity beneath crossbedded coarse sand that underlies fossiliferous Nanafalia beds of Wilcox group. The crossbedded sand is absent in places, and fossiliferous Nanafalia beds lie directly on irregular surface of the Midway. Midway group comprises (ascending) Clayton formation Porters Creek formation (Sucarnooche), Naheola formation (with "Matthews Landing marl," "Oak Hill beds," and "Coal Bluff beds").

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 45–70. Group, in southern half of Sabine uplift, comprises (ascending) Naborton formation (with Chemard Lake lignite lentil at top), Logansport formation (with Dolet Hills, Cow Bayou, and Lime Hill members), and Hall Summit formation (with Loggy Bayou, Grand Bayou, and Bisteneau members). In northern half of uplift, comprises Logansport formation and Hall Summit(?) sand; Naborton for-

mation not exposed. Underlies Marthaville formation of Wilcox group. Paleocene.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 6–17. Group includes (ascending) Clayton formation with McBryde limestone, Pine Barren, and Chalybeate limestone members, Porters Creek clay with Tippah sand lentil and Matthews Landing marl member, and Naheola formation with Coal Bluff marl member, and Betheden formation.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1829–1833. Midway deposits (group) crop out in central Gulf Coast in crescentic belt across southern Alabama, northeastern Mississippi, and western Tennessee. Isolated exposures flank west side of Mississippi alluvial valley in Arkansas. Midway formations are (ascending) Clayton, Porters Creek clay (with Matthews Landing marl member), and Naheola. In western Alabama, the Naheola contains Coal Bluff marl. Naheola replaced by Betheden formation in northern Mississippi and southern Tennessee. Transitional between underlying Cretaceous Gulf series and overlying Eocene Wilcox group. Paleocene.

G. E. Murray, 1948, Louisiana Dept. Conserv., Geol. Bull. 25, p. 88–135. Group in Louisiana redefined to include all sediments stratigraphically below Marthaville formation of Wilcox group and above Arkadelphia formation of Gulf series. In this sense, it includes Mansfield subgroup of Howe and Garrett (1934), lower part of Wilcox group of Moody (1930, Pan-Am. Geologist, v. 54, no. 2), Midway black shale unit of numerous authors, and Kincaid formation. In De Soto and Red River Parishes, divided into (ascending) Kincaid, Porters Creek, Naborton, Logansport, and Hall Summit formations. Paleocene.

G. E. Murray, 1953, Mississippi Geol. Soc. [Guidebook] 10th Field Trip, p. 48–60; 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 5, p. 671–696. Controversy concerning term Wilcox, as well as term Midway, stems from usage of both terms in dual sense as (1) rock terms and as (2) time and time-rock terms. Proposed to use Wilcox strictly as rock unit term. Such usage of Wilcox permits retention of Midway as a time and time-rock term for all the time and rocks deposited during fluctuations of Paleocene sea in Coastal Plain province. Midway age (time) and stage (time-rock), therefore contain, respectively, all of the time, or rocks deposited in Coastal Plain province after Cretaceous and before early Eocene invasion as recorded by glauconitic fossiliferous sands of Nanafalia and Marthaville formations. Midway stage is used to include those deposits in Gulf and Atlantic Coastal Plain province formed during stand of early Tertiary sea prior to deposition of wide-spread *Ostrea thirsae*, *Ostrea multilirata* beds of east Texas, Louisiana, Mississippi, and Alabama and their equivalents. Type exposures of Clayton, Porters Creek, and Naheola formations are considered exemplary of the stage. Midway age embraces all time involved in deposition of these deposits. This is essentially the original usage of Midway as defined by Harris (1896). Sabine stage is suggested as time-rock term for post-Midwayan and pre-Claibornian deposits of Coastal Plain province. Wilcox group contains delineatable and mappable lithologic rock units, some of Midway age and some of Sabine age.

C. O. Durham, Jr., and C. R. Smith, 1958, Louisiana Dept. Conserv., Geol. Pamph. 5, p. 1–17. Discussion of Louisiana Midway-Wilcox correlation

problems. Evidence reviewed to show that Midway and Wilcox cannot be used in both a faunal and lithologic sense. Lithologic boundary drawn between Midway and Wilcox groups in Louisiana. [See Wilcox group, this reference.]

G. R. Kellough, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 147–160. Midway group of Texas, a predominantly shale, sandy shale, and sandy limestone section of Paleocene age, was deposited in open sea whose depth fluctuated between very shallow and deep. This concept based on study of samples from Tehuacama Creek, Limestone County. Sampled interval extends upward for 278 feet from Cretaceous-Paleocene contact. Foraminiferal content indicates that very lowest beds of Midway (Littig member of Kincaid) are marine, not littoral, probably mid- to outer neritic. Group includes Kincaid and Wills Point formations. Unconformably overlies Upper Cretaceous Navarro formation.

Named for exposures at Midway Landing and plantation, on west side of Alabama River, about 5 miles below Prairie Bluff, in Wilcox County, Ala.

†Midway Series[1] or Limestone[1]

Eocene, lower: Southern Alabama.

Original reference: E. A. Smith, 1886, Alabama Geol. Survey Bull. 1, p. 14.

Named for exposures at Midway Landing and plantation, on west side of Alabama River, about 5 miles below Prairie Bluff, in Wilcox County.

Midway Volcanic Group[1]

Oligocene and Miocene: Northeastern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map.

Probably named for Midway, British Columbia near international boundary.

Mier Sandstone Member (of Yegua formation)[1]

Mier Sandstone Tongue (of Yegua Formation)

Eocene, middle: Northeastern Mexico, and southwestern Texas.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1374, 1384.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 264–265. Tongue overlies La Perla shale member and underlies Jose shale member (both new). About 150 feet thick where it crosses into Starr County from Mexico; thins northward and wedges out before latitude of Laredo is reached.

Typically exposed Ciudad Mier, Tamaulipas, Mex.

Mifflin Formation

Silurian: Central Pennsylvania.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5–6, 23, 29–30. New name introduced to include McKenzie, Rochester, and Keefer formations of earlier authors. Older names are retained as members as they are locally separable. Thickness about 304 feet at Mifflinton [Mifflintown] section. Underlies Bloomsburg formation; overlies Rose Hill formation. Name credited to Miller (unpub. ms.).

Type locality and derivation of name not stated.

Mifflin Limestone (in Platteville Group)

Mifflin Limestone Member (of Platteville Formation)

Middle Ordovician: Southwestern Wisconsin, northern Illinois, and southeastern Minnesota.

C. A. Bays, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 269. Thinly bedded limestones which pass laterally to dolomitic limestones and dolomites. Thickness 17½ feet. Overlies Pecatonica dolomite member; underlies Magnolia member.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 10 (fig. 3). Geographically extended into Dixon-Oregon area, Illinois, where it is considered a formation in Platteville group. Consists of limestone or dolomite, alternately pure and argillaceous, noncherty, thin- to thick-bedded, with gray-green shale partings. Thickness about 25 feet. Includes (ascending) Brickeys, Boarman, Establishment, Hazelwood, and Briton members (all new). Underlies Grand Detour formation (new); overlies Pecatonica formation.

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 58 (table 1), 59, 60. Rocks of McGregor member have at some times and places been classified as Magnolia and Mifflin members of the Platteville (Bays and Raasch, 1935; Bays, 1938). In region south from Rochester, Minn., to McGregor, Iowa, there is virtually no evidence of Magnolia and Mifflin members. However, in Twin City area, where interval is somewhat dolomitic Majewske (1953, unpub. ms.) has shown that what in past has been lumped together as the McGregor is the Mifflin and Magnolia separated by an hitherto unnamed member, Hidden Falls. McGregor is used where special characteristics of Mifflin, Hidden Falls, or Magnolia are absent or insufficiently distinct. In Minnesota, Mifflin member is developed only from Twin City area eastward to Wisconsin and southward to Goodhue and Rice Counties. Thickness in Twin Cities about 11 to 13 feet; 7 feet at Afton; less than 4 feet at Faribault.

Named for exposures in roadcuts and stream banks of Pecatonica River at Mifflin, Iowa County, Wis., NE¼ sec. 34, T. 5 N., R. 1 E.

Mifflintown Limestone[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F., p. xxv–xxvi.

Crops out on west bank of Juniata River, near Mifflintown, Juniata County.

†Miguel Formation[1]

Upper Cretaceous: Southwestern New Mexico.

Original reference: D. E. Winchester, 1920, U.S. Geol. Survey Bull. 716–A.

C. H. Dane, A. A. Wanek, and J. B. Reeside, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 187. Abandoned because of its originally incorrect definition, and because of substantial duplication of beds as measured and mapped in the type area.

Named for Miguel Creek, which crosses beds in northwest part of area (Alamosa Creek valley), Socorro County.

Milam Chalk Member (of Anacacho Limestone)

Upper Cretaceous: Southwestern Texas.

R. T. Hazzard, 1956, San Angelo Geol. Soc. Guidebook March 16–17, p. 45 (chart), 58 (strat. section), 61 (strat. section), 121–122. Name applied to middle Anacacho member. Grayish-white chalk and marl. Basal 10 feet characterized by profusion of *Exogyra costata* var *spinosa* Stephenson. Numerous species of unidentified ammonites present in chalk above zone of *Exogyra costata* var *spinosa*. Large *Pachydiscus* numerous. *Exogyra ponderosa* present in yellowish-weathering marly zone above the grayish-white chalk; *Pcynodonta* (*Gryphaea*) *vesicularis* abundant in this marly zone and with it the ammonite *Bostrychoceras*. Pelecypod shells, which may be *Diploschiza cretacea*, present in marly zones. Thickness about 40 feet. Unconformably overlies an interval (of varying thickness) of thin-bedded brown limestones and brownish marly limestones without *Exogyra ponderosa*. Based upon field relationships and provisional interpretation of fossil sequences, Taylor-Austin contact is placed at base of Milam chalk with first appearance of *Exogyra costata* var *spinosa*, and some feet above, the ammonite *Bostrychoceras*.

Exposed on Turner and Milam Ranches at northeast end of Anacacho Mountains, Kinney County. Not recognized as lithologic unit on Anacacho Ranch in western part of Anacacho Mountains.

Milams Member (of Cook Mountain Formation)[1]

Eocene (Claiborne): Northwestern Louisiana and eastern Texas.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 87, 91–95, pl. 3. Stratigraphically restricted below to exclude lower 17 feet which are placed in newly defined Dodson member. As redefined, the Milams consists of about 50 feet of calcareous glauconitic shales, lignitic shales, and marl which occur above glauconitic fossiliferous sands of Dodson member and below fossiliferous ironstone zones of Saline Bayou member.

Type locality: NE¼ sec. 17, T. 13 N., R. 3 W., Winn Parish, La., which is one-half to three-quarter mile southwest of Milams, on Arkansas Southern Railway.

Milan Limestone Member (of Wellington Formation)

Permian: Southern Kansas.

G. H. Norton, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557. Milan limestone member at top of Wellington shale; conformably underlies Harper sandstone.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1757–1758. In following Wellington gray beds up section from type locality toward west and north, the break between gray beds below and redbeds above is so clear as to leave no doubt as to what Cragin (See Wellington formation) considered the contact. This is marked by a 1-foot bed of greenish to gray shaly platy dense limestone, strong enough to afford good outcrops, which are expressed in scarps and benches, characterized by an abundance of green copper carbonate. This bed is named the Milan limestone member. Three calcareous beds occur in top 8 feet of the Wellington, with the upper one ordinarily the most prominent as well as most cupriferous. Locally, there is thinning and weakening of topmost bed, together with corresponding strengthening and thickening of one of the lower beds, the 3-foot bed or the 8-foot bed below, with increase of copper content of these beds. Name Milan limestone member is intended

to include all three thin limestones. A thin bed of maroon shale commonly underlies the topmost bed, separated by a foot of gray shale, the color being typical of the Wellington rather than the brick red of over lying Cimarron redbeds.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 40. Milan limestone member, consisting of 1 foot of greenish-gray shaly limestone that on outcrop is characterized by bright-green copper carbonate, marks top of Wellington in comparatively large area.

Named for typical exposures on the 1-foot bed near SE cor. sec. 30, T. 32 S., R. 3 W., 2 miles north of Milan, and along south bank of Chikaskia River, Sumner County.

Milburn Shale (in Canyon Group)[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvi, pl. 3.

Named for Milburn, McCulloch County.

Miles Limestone Member[1] (of Falls City Limestone)

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 9.

Type locality: In high hill west of Miles Ranch, 2 miles southwest of Falls City, Richardson County.

Milesburg Formation[1]

Lower Devonian: Central Pennsylvania.

Original reference: C. Schuchert, 1916, Geol. Soc. America Bull., v. 27, p. 552.

In Tyrone Gap, Bald Eagle Mountain, Blair County.

†Milford Chlorite Schist[1]

Pre-Triassic: Southwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 100, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Includes local bands of serpentine and limestone. Pre-Triassic.

Mapped over large area in Milford Township, New Haven County.

Milford Granite[1]

Devonian(?): Eastern Massachusetts and northeastern Rhode Island.

Original reference: B. K. Emerson and J. H. Perry, 1907, U.S. Geol. Survey Bull. 311, p. 26–33, 45–47, 66, map.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* A. W. Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 15. Locally abandoned. Replaced by Esmond granite (new) in Pawtucket quadrangle, Rhode Island, where it is dissimilar to its type area.

Named for quarries in Milford, Mass.

Milford Silts

Pleistocene (Nebraskan): Western West Virginia.

D. P. Stewart, 1952, West Virginia Acad. Sci. Proc., v. 23, p. 113. Incidental mention in discussion of Barboursville silts (new). Deposited when preglacial Teays River was blocked by Nebraskan glacial ice.

Type locality and derivation of name not given.

Milk Creek Beds

Pliocene, lower: Central Arizona.

C. A. Reed, 1950, Plateau, v. 22, no. 4, p. 75–77. Has yielded numerous mammalian remains. Lower or middle Pliocene age.

C. S. St. Clair, 1957, Plateau, v. 30, no. 2, p. 36, 37, fig. 2. About 2,500 feet of fluviatile and lacustrine sediments containing siltstones, sandstones, conglomerates, and interbedded tuffs. Includes three members: lowest chiefly of conglomerate and conglomeratic sandstone, about 500 feet thick; middle of siltstone and sandstone with interbedded tuff, about 1,000 feet thick and uppermost of siltstone and sandstone with interbedded tuff, differing from middle member mainly by being locally crossbedded, about 700 feet thick. Upper 300 to 400 feet dated as lower Pliocene and underlying 2,000 feet or so of sediments assumed to be lower Pliocene, although it is possible that beds may in part span Miocene-Pliocene boundary.

On Milk Creek, a tributary of Hassayampa River, south of Prescott and within Prescott National Forest, Yavapai County. In Walnut Grove basin, west of Bradshaw Mountains.

Millard Formation (in Ophir Group)

Millard Limestone

Millard Member (of Howell Limestone)

Middle Cambrian: Western Utah.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 35–36, fig. 5. Eastward thinning and disappearance of Chisholm shale between Wah Wah and House Ranges bring the similar Lyndon and Peasley limetones into contact. In House Range, these two combined formations constitute valid lithologic unit, herein designated Millard limestone. As herein defined, consists of predominantly dark-gray fine- to medium-grained limestones that make up basal 281 feet of Howell limestone (Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7). Overlies Busby quartzite; underlies Burrows dolomite.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 11, 12, 14 (fig. 3). Included in Ophir group in Stansbury Mountains where it overlies Busby quartzite and underlies undivided shale and limestone sequence correlated with Dome, Burrows, and Burnt Canyon formations of Sheeprock and House Ranges. Thickness 190 to 280 feet. Base of formation placed at base of consistently pisolitic algal? limestone and top mapped at top of similar limestone. A few *Glossopleura* occur in shales of the formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12, (table 1), 35, 41–44, pl. 1, measured sections. In Sheeprock Mountains, name Millard formation substituted for Millard limestone of House Range. Divisible into three members: basal, 150 to 207 feet, pisolitic blue-gray medium-bedded limestone; middle, 50 to 120 feet, green shale, the *Glossopleura* zone of the Sheeprock Cambrian; upper, pisolitic lime-

stone averaging 40 feet in thickness. Conformably overlies Busby quartzite; underlies Burrows limestone. Included in Ophir group.

R. O. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50–51. Rank reduced to member status of Howell limestone (restricted). Proposed that Millard include *Girvanella* limestone facies of the Howell when other carbonate lithofacies are also represented. Upper member of Howell in House Range left unnamed at this time. Overlies Tatow formation. Name Burrows discontinued in House Range and Wah Wah Range.

Type section: In Marjum Canyon, House Range, Millard County.

Millbach Formation (in Conococheague Group)

Millbach Member (of Conococheague Formation)

Upper Cambrian: Southeastern Pennsylvania.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of the Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Limestone sequence that stratigraphically overlies Schaefferstown member (new); top is drawn at base of first medium-gray siliceous dolomite bed of overlying Richland member (new). Distinguished from Schafferstown member by presence of white to pinkish-gray crystalline limestone beds and less distinct shaly partings and bands in the medium-light-gray to medium-gray limestone beds; lithologically similar to Buffalo Springs member (new) and is distinguished principally by stratigraphic position; a few thin sandstones and sandy limestones or dolomites present; *Cryptozoon* reefs common. Width of outcrops suggests that thickness is in order of 500 to 550 feet; partial section (type) 112 feet; neither top nor base exposed, but good exposures of *Cryptozoon* present.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Upper Cambrian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Conococheague group.

Type section: Partial section measured in quarry about one-half mile southwest of Sheridan on south side of Mill Creek and 0.8 mile northeast of village of Millbach, Lebanon County. No satisfactory type section available in Lebanon County, but best partial section measured and used as type section.

Millboro Shale

Millboro Shale Member (of Romney Shale)

Middle and Upper Devonian: Western Virginia.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 42–44, pls. 1, 3. Proposed by C. Butts (unpub. ms. to replace term "Black shale of Devonian age" which was tentatively used to distinguish a Devonian black shale, composed of Marcellus and early Naples age, from Romney shale which includes beds of Onondaga and Hamilton age. In belts where name Millboro applies, the "black shale" contains no Onondaga and no beds of Hamilton, Tully, or Genesee age. Thickness 750 feet. Comprises two members, Marcellus below and Naples above. Underlies Brallier formation; overlies Onondaga formation.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 308–314. Term is applicable only in areas where the Hamilton is absent, as southwest of

Shenandoah County, Va. Shale is constant in its occurrence between the Onondaga and Brallier from Highland and Augusta Counties southwest to Tennessee. Thickness 200 to 1,000 feet. Type locality designated.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4, p. 1736–1737. Millboro may represent not only Marcellus but entire Hamilton.

F. G. Lesure, 1957, Virginia Polytech. Inst. Engineering Expt. Sta. Ser. 118, p. 19 (table 1), 20 (table 2), 55–57, pl. 1. Rank reduced to member status in Romney shale. In Clifton Forge district, conformably overlies and grades into Needmore shale member. Middle and Upper Devonian.

Type locality: Millboro Springs, Bath County.

Millbury Limestone[1]

Upper Carboniferous or post-Carboniferous: Eastern Massachusetts.

Original reference: B. K. Emerson and J. H. Perry, 1903, Geology of Worcester, with map.

Occurs at Millbury, Worcester County.

Mill City Glacial Stage

Mill City Till

Pleistocene: Northwestern Oregon.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 20, 21–23. Stage defined as time during which Mill City till was deposited. Thickness of till 25 to 30 feet.

Deposits exposed about 7½ miles along North Santiam River from Gates to a point almost 3 miles west of Mill City, Marion County.

Mill Creek beds

See **McIntosh Formation** and **Yamhill Formation.**

Mill Creek Limestone[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: C. A. Ashburner, 1886, 2d Pennsylvania Geol. Survey Ann. Rept. 1885, p. 443.

M. M. Chow, 1951, Pennsylvania Geol. Survey, 4th ser., Bull. G–26, p. 1–17. Summary discussion.

Crops out along north side of Mill Creek near Wilkes-Barre, Luzerne County, near breast of old Hallenback Dam, and about midway between River Street bridge and a bridge of Lehigh Valley Railroad which crosses creek at its mouth.

Miller Fire Clay[1]

Pennsylvanian: Northern Missouri.

Original reference: H. A. Wheeler, 1893, Missouri Geol. Survey Sheet Rept. 2, v. 9, p. 60–65.

Named for Miller Farm, 2½ miles south of Bevier, Macon County.

Miller Lava Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 14 (fig. 10), 60 (fig. 44), 80. Discussion of Mount Multnomah, ancient ancestor of the Three Sisters. Name applied to lava flow that issued from base of South Sister and flowed toward but did not entirely reach Devils Hill. Lava came to

surface, soaked through glacial moraine and debouched over glaciated surface. Covers about one-third square mile.

South Sister Mountain is on border of Lane and Deschutes Counties. Flow was named for Morrison Miller, a member of Hodge's party.

Miller Mountain Formation

Lower Cambrian: Southwestern Nevada.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–45. Lower part dominantly massive argillite with minor quartzite; upper part, alternation of thin-bedded slate, quartzite, and limstone, partly altered to diopside-garnet rock. Near top of exposed section is a bed of massive white crystalline dolomitic limestone about 500 feet thick. Thickness about 3,000 feet; neither top nor base exposed.

Type locality: South flank of Miller Mountain.

Miller Peak Argillite
Miller Peak Formation[1] (in Missoula Group)

Precambrian (Belt Series): Central western Montana, and southwestern Alberta, Canada.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 677–678, figs. 2, 3.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1901–1903. Basal formation of Missoula group. Comprises three members (ascending): Kintla, Roosville, and Mount Rowe (new). Underlies undifferentiated rocks of group; overlies Sheppard formation. Geographically extended into Alberta.

Charles Deiss, 1943, Geol. Soc. America Bulll., v. 54, no. 2, p. 211–215. Miller Peak argillite, in Saypo quadrangle, conformably underlies Cayuse limestone (new). Thickness 1,000 feet; base cut out by Lewis overthurst.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim Map 25. Mapped as basal formation of Missoula group. Underlies Hellgate formation.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Miller Peak argillite mapped in Bonner quadrangle, Montana, where it includes Hellgate quartzite member. Underlies Bonner quartzite (new); overlies Newland limestone of Piegan group.

Type locality: Upper part of south flank of Miller Peak, Bonner quadrangle, Montana.

Millers Sandstone[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1925, Geol. Soc. America Bull., v. 36, p. 457–464.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1752. Referred to as Millers Hollow member of Salamanca [apparently a lapsus for Millers sandstone (Caster, 1934)]. Upper Devonian.

First described in Erie County. Derivation of name not stated.

Millersburg Formation[1] or Group

Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84.

H. R. Wanless 1939, Geol. Soc. America Spec. Paper 17, p. 95. Millersburg group includes beds from base of Inglefield sandstone above to Millersburg coal. Name Millersburg formation was used to include strata from Somerville limestone above to Millersburg coal, about the lower half of Millersburg group.

Named for Millersburg, Elkhart County.

Millersburg Limestone Member (of Cynthiana Formation)[1]

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1914, Cincinnati Soc. Nat. History Jour., v. 21, no. 4, p. 112.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1641. Division of Cynthiana. Very fossiliferous, argillaceous, and characteristically rubbly limestone on eastern and northeastern flank of the dome. Marked at base by abundance of *Alonychia flanaganensis* in zone 6 to 8 feet thick. Underlies Nicholas limestone. More or less equivalent to Greendale limestone and similarly constitutes body of formation as Nicholas wedges out southward. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of Cynthiana. This includes lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

Named for Millersburg, Bourbon County.

Millers Cliff Conglomerate[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1489–1536.

Miller's Cliff is halfway between Lottsville and Wrightsville, Warren County.

Millers Hollow member (of Salamanca [formational suite])

See Millers Sandstone.

†Millers River Conglomerate[1]

Carboniferous: Northeastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 140, 156.

Occurs in valley of Millers River, in Cumberland, Providence County.

Millersview Limestone Member (of Grape Creek Formation)[1]

Permian: Central Texas.

Original reference: W. Kramer, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1579, 1581.

Crops out 4½ miles south-southwest of Millersview, Concho County.

Millersville cyclothem (in McLeansboro Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2); H. R. Wanless and Raymond Siever, 1956, Illinois

Geol. Suvery Circ. 217, p. 12, pl. 1. Listed as cyclothem at top of McLeansboro group.

Type locality: Secs. 28 and 34, T. 12 N., R. 1 W., Christian County.

Millersville Limestone Member (of Bond Formation)

Millersville Limestone (in McLeansboro Group)

Pennsylvanian: East-central Illinois.

E. F. Taylor and G. H. Cady, 1944, Illinois Geol. Survey Rept. Inv. 93, p. 22–26. Limestone called Millersville in this report [Moultrie, Coles, Shelby, and Cumberland Counties] is believed to be same as limestone exposed near Millersville, Christian County. In outcrops, limestone is gray to buff, crystalline, fossiliferous, with interbedded shales; near base of a porous coquina composed of aggregate of small spheroid-shaped particles with chalky incrustations and the numerous minute fossils of algae, fusulinids, and other foraminifera are important at some localities; thickness 5 to 6 feet. In this report, is known only from drill cuttings, is 30 to 50 feet thick and includes one or more prominent shale beds. Lies about 600 feet above Herrin (No. 6) coal bed and 40 to 50 feet below Upper Bogota limestone in vicinity of Louden pool. Bed has been variously called LaSalle, New Haven, Carthage, and Livingston limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 71. Rank reduced to member status in Bond formation (new). Top of formation in central and southwestern Illinois, where it overlies Coffeen limestone member (new). In southeastern and eastern Illinois, equivalent to Livingston limestone on east side of LaSalle anticline.

Type locality: Secs. 28 and 34, T. 12 N., 1 W., Christian County.

Millerton Formation[1]

Pleistocene: Western California.

Original reference: R. E. Dickerson, 1922, California Acad. Sci. Proc., 4th ser., v. 11, no. 19, maps.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 99–103, pls. Composed of conglomerates, brownish-gray soft sandy shales, and clayey sandstones with interbedded gravels. Beds moderately folded and faulted. Thickness about 60 feet. Overlain by Montezuma formation (new). Base not exposed at Millerton Head. Mason (1934, Carnegie Inst. Washington Pub. 415) considered Dickerson's Millerton and Tomales represented a single stratigraphic unit which he called Tomales.

Named for exposures in headland near Millerton Station, Marin County. Confined to area of Tomales Bay.

Millerville Green Schist[1]

Post-Carboniferous(?): Eastern Alabama.

Original reference: E. A. Smith, 1896, Alabama Geol. Survey Bull. 5, p. 118–125.

Well exposed at Millerville, Clay County.

Millett clay[1]

Miocene(?): Southeastern California and southwestern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 61, 79.

Named for old Millett borax camp, in Furnace Canyon, east of Death Valley, Inyo County, Calif.

Mill Hill slate

Paleozoic: Southeastern Pennsylvania.

Pennsylvania Geological Society, 1954, Pennsylvania Geologists 20th Ann. Mtg., p. 16, pl. 2; A. R. Geyer and Carlyle Gray, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 243, 244 (fig. 2), 245, 246. At Cornwall, a wedge of Paleozoic sediments lies above a dike at contact of Triassic diabase and Cambrian limestones. Sediments of the wedge include three mappable units: a limestone that apparently belongs to oldest member of Conococheague and is overlain by either of two units given local names of Mill Hill slate and Blue Conglomerate. Mill Hill is a hard dense light-brown to black banded hornstone. Believed to be outlier of Martinsburg shale which has been altered by diabase intrusion.

Present at Cornwall, Lebanon quadrangle, Lebanon County.

†Milliard limestone[1]

Cambrian: Utah.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 79.

Derivation of name and type locality not stated.

†Millican Formation[1]

Precambrian: Western Texas.

Original reference: G. B. Richardson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 194.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 148. Abandoned. Unit divided into two formations, Hazel sandstone above and Allamoore limestone below.

Named for Millican's Ranch, [Culberson County], 10 miles northwest of Van Horn.

Milligen Formation[1]

Devonian(?) and Mississippian: Southern central Idaho and southwestern Montana.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10, 24–29, map.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1771, chart 4. Devonian and Mississippian.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1112–1113. Described in Borah Peak quadrangle, Idaho, as mainly dark-gray to black carbonaceous shale. Thickness about 1,000 feet. Overlies Three Forks limestone; underlies Brazer limestone.

T. H. Kiilsgaard, 1950, Idaho Bur. Mines and Geology Pamph. 90, p. 40–41. In Warm Springs mining district, formation is more than 5,500 feet thick and possibly greater than 7,500 feet. Comprises three limestones referred to as lower, middle, and upper, and the Elkhorn limestones which are separated from lower limestone by several hundred feet of argillite. Some parts of formation mapped as undifferentiated. These parts are argillites, gradations of limy and siliceous argillites, and quartzites with boundaries too indefinite to map. Underlies Wood River formation.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2160–2161. Described in Beaverhead Range, Mont., as dom-

inantly dark-gray to black shales, limy shales, and shaly limestones that weather light or medium gray. Units of more massive limestone, also dark gray to black, form rugged cliffs 50 to 100 feet high. Thickness 2,291 feet in Nicholia Creek section. Relationships to underlying strata not exposed. Tentatively considered to be equivalent to all of Madison group, plus all or part of Big Snowy group.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. Discussion of late Paleozoic stratigraphy and paleotectonics of central and eastern Idaho. Milligen-Wood River contact is hiatus which is represented by Muldoon formation (new) deposited in Muldoon trough. Deposition was continuous from the Milligen into the Muldoon in the trough. Lower and Middle Paleozoic.

Named for exposure on Milligen Creek, Hailey quadrangle, 6 miles east of Ketchum, Idaho.

Milliken Sandstone Member (of Fox Hills Sandstone)[1]

Upper Cretaceous: Northeastern Colorado.

Original reference: J. Henderson, 1920, Colorado Geol. Survey Bull. 19.

J. D. Moody, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1457. Milliken in this report [upper Montana group of Golden area] is used to indicate basal sandstone member of Fox Hills formation as restricted by Lovering and others (1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 7).

Well exposed near Milliken Station, west of La Salle, Weld County.

Million Shale (in Eden Group[1] or Formation)

Upper Ordovician: Central Kentucky.

Original reference: J. M. Nickles, 1905, Kentucky Geol. Survey Bull. 5, p. 25.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Referred to as Million shale member of Eden formation.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 44). Shown on correlation chart as overlying Fulton shale and underlying Garrard siltstone.

Named for Million, Madison County.

Mill River Conglomerate[1]

Mill River Conglomerate (in Woods Corners Group)

Mill River Limestone Breccia

Middle Cambrian: Western Vermont.

Original reference: B. F. Howell, 1929, Vermont State Geologist, 16th Rept., p. 266–268.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1014–1015, 1047. Described as a local limestone breccia at base of Hungerford slate.

B. F. Howell, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1, column 70. Age designated Middle Cambrian on correlation chart.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 536, 537–539, pl. 1. Included in Woods Corners group (new). In St. Albans area, forms discontinuous lenses, commonly less than 200 feet long and no more than 35 feet thick. Overlies St. Albans slate; grades upward into Skeels Corners slate. Middle Cambrian.

Named for Mill River just east of which it is exposed about 2 miles southwest of St. Albans, one-quarter mile south of road running west from western foot of St. Albans Hill, Franklin County.

Mills Bed[1]

Eocene, middle: Southern Texas.

Original reference: F. M. Getzendaner, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 11, p. 1436–1437.

On O. A. Mills Ranch in Zavalla County.

Mills Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Listed as underlying Sites formation and overlying Golden Gate formation (both new).

J. M. Kirby, 1943, California Div. Mines Bull. 118, p. 606. Well-bedded dark- to greenish-gray clay shales. Derivation of name given and good exposures noted.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282 (footnote). Name preoccupied; replaced by Yolo formation.

Named from its proximity to Mills Orchard at mouth of Stone Corral Creek in sec. 35, T. 17 N., R. 4 W. Colusa County.

†Millsap division (in Strawn Group)[1]

Pennsylvanian (Allegheny): Central and central northern Texas.

Original reference: W. F. Cummins, 1891, Texas Geol. Survey 2d Ann. Rept., p. 361, 372–374.

Named for Millsap, Parker County.

†Millsap Limestone[1]

Lower Mississippian: Eastern Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

Named for Millsap Creek, Pikes Peak quadrangle.

Millsap Lake Formation (in Strawn Group)[1]

Millsap Lake Group

Middle Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106–108.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to group in Strawn series. Includes (ascending) unnamed subsurface formations, Dickerson, Lazy Bend, and Grindstone Creek formations. Underlies Lone Camp group (new); overlies Smithwick group of Lampasas series (new).

M. G. Cheney, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 163. Stratigraphically restricted below as Lampasas-Strawn boundary in Brazos River outcrop section is placed at base of conglomerate which rests on Dennis Bridge limestone member of Lazy Bend formation at Dennis Highway bridge in Parker County. As thus restricted, overlies Parks group (herein rank raised).

M. G. Cheney, 1947, Jour. Geology, v. 55. no. 3, pt. 2, p. 209. Thickness of Millsap Lake group (restricted) 1,400 feet. Overlies Kickapoo Creek group (new).

Type locality: Millsap Lake, Parker County.

Millsdale Limestone[1]

Upper Ordovician (Richmond) : Northeastern Illinois.

Original reference: J. R. C. Evans, 1929, Chicago Univ. Abs. Theses, Sci. ser., v. 2, p. 199–200.

Lithology and type locality not stated.

Mill Street Conglomerate

Upper Cambrian : Eastern Minnesota.

C. A. Nelson, 1951, Jour. Paleontology, v. 25, no. 6, p. 774. Incidental mention as Mill Street conglomerate.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 869–870. At Taylors Falls, Minn., Woodhill member of the Franconia has at base a boulder conglomerate containing *Elvinia* fauna. This is Mill Street conglomerate of Berkey (1897). [Berkey, 1897, Am. Geologist, v. 20, no. 6, p. 375, refers to two outcrops of conglomerate on Mill Street in Taylors Falls, and on p. 376 states that "the conglomerate at Taylor's Falls belongs stratigraphically to the lower part of the Franconia."]

Milltown Andesite[1]

Milltown Andesite Series

Tertiary : Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 47.

Fred Searls, Jr., 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 48, p. 8–12. Referred to as Milltown andesite series in discussion of Ransome's report. Dacite, which is most important rock in Goldfield, is believed to be a flow that may be grouped with Milltown andesite and not intrusive into it as believed by Ransome.

Named for settlement of Milltown, about 1 mile east of Goldfield, Esmeralda County.

†Milner Formation (in Mesaverde Group)[1]

Upper Cretaceous : Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell's report was not published. Name Milner Formation appeared in bold face in Wilmarth Lexicon on basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used name Milner Formation on Cretaceous correlation chart and cited Wilmarth Lexicon. The U.S. Geological Survey has abandoned the term Milner Formation.

Formation crosses valley of Yampa River in T. 6 N., R. 86 W., and is named for Milner, a small village in this valley.

Milo Tongue (of West River Shale)

Upper Devonian : West-central New York.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 65–66, 73. Name proposed for upper shales of West River shale in Keuka Lake valley. Consists of black and dark-gray fissile shale with interbedded light and blue-gray layers, limy bands, and spherical concretions. Shales are uniformly medium argillaceous siltstones. Very few thin flags pres-

ent. Thickness 90 feet. Underlies Middlesex shale; overlies Keuka flagstone lentil in Starkey tongue of Sherburne formation. Both contacts gradational. Unit has erroneously been called Standish formation.

Named for exposures in streams in Milo Township, Yates County. Type section is in Crosby Gully on east side of Keuka Lake, 7 miles south of Penn Yan.

Milton Dolomite[1]

Milton dolomite facies (of Clarendon Springs Dolomite)

Milton Limestone

Upper Cambrian: Northwestern Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 111–115.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 25. Referred to dolomite facies.

A. B. Shaw, 1951, Jour, Paleontology, v. 25, no. 1, p. 97. Limestone included in list of formations.

Best exposed in wide belt passing through town of Milton, about 3 miles west of Milton village, Chittenden County.

Milton Formation[1]

Triassic and Jurassic: Northern California.

Original reference: H. W. Turner, 1894, Am. Geologist, v. 13, p. 232–234.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 99–100. Near northern end of the Sierras, Triassic and Jurassic sediments and volcanics have been named Milton and Sailor Canyon formations but there is little doubt that they are equivalent. Since name Milton has priority, it is used here to include all Triassic and Jurassic rocks of higher parts of the Sierra Nevada, south of Taylorsville.

K. B. Ketner, 1959, *in* E. D. McKee and others, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, p. 17. About 200 feet of Milton is known to be Triassic. Partly Jurassic and partly Triassic.

Named for exposures in vicinity of Milton, an old stage station on Middle Fork of Yuba River, in Downieville quadrangle.

Milton Quartzite[1]

Cambrian(?): Eastern Massachusetts.

Original reference: M. Billings, 1929, Am. Jour. Sci., 5th, v. 18, p. 99, 101–103.

Exposed just north of the Quincy granite in town of Milton, Norfolk County.

Milwaukee Formation[1]

Middle Devonian: Southeastern Wisconsin.

Original reference: W. C. Alden, 1906, U.S. Geol. Survey Geol. Atlas, Folio 140.

G. O. Raasch, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 262 (fig. 207), 263, 264–266. Subdivided into (ascending) Berthelet, Lindwurm, and Northpoint members. Thickness 81 feet. Upper units not exposed. Overlies Thiensville formation. Data on type locality.

Type locality: Along Milwaukee River in Estabrook and Lincoln Parks, Milwaukee County; includes Milwaukee Cement quarries.

Mimbres Conglomerate

Miocene(?) to Pliocene: Southwestern New Mexico.

R. M. Hernon, W. R. Jones, and S. L. Moore, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 118 (map), 120. Listed in table of formations. Consolidated and deformed sand, gravel, silt, and clay, with interbedded basalt flows. Thickness about 1,000 feet. Unconformably underlies alluvium; unconformably overlies unnamed lava flows.

Mapped in northeast corner of Santa Rita quadrangle.

†Mimbres Limestone[1]

Ordovician and Silurian: Southwestern New Mexico.

Original references: C. H. Gordon, 1907, Science, new ser., v. 25, p. 824–825; 1907, Jour. Geology, v. 15, p. 91–92.

Named for Mimbres Mountains, western part of Sierra County.

Mimbresian series[1]

Ordovician: New Mexico.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259.

Mimbres Peak Rhyolite or Formation

Tertiary: Southwestern New Mexico.

F. J. Kuellmer and others, 1953, *in* New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 42 (map), 50 (map). Name Mimbres Peak rhyolite appears on legends for maps of part of southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 45–47. Formation described in Lake Valley quadrangle. Made up of several types of rhyolite—flows, perlite, minor pumiceous rhyolites, and their intrusive equivalents. Much of the rhyolite forms dome eruptions. Where rhyolite is encountered in sequence, it directly overlies Kneeling Nun welded rhyolite or Sugarlump series. Thickness about 200 feet.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 27–29, pl. 1. Formation described in Dwyer quadrangle. At typical section, consists of pink- and gray-banded flow rhyolite, massive gray spherulitic flow rhyolite, black perlitic flow rock, bedded pumiceous rhyolite tuffs, with fragments of silicified rhyolite, and bedded tuffs and tuffaceous sandstones. Thickness of formation about 450 feet. Overlies Kneeling Nun rhyolite; unconformably underlies Box Canyon rhyolite tuff (new). Derivation of name.

Typical section in sec. 3, T. 19 S., R. 10 W., Dwyer quadrangle. Name derived from hill located in sec. 8, T. 19 S., R. 10 W., Dwyer quadrangle.

Mina Grande Formation

Permian (Guadalupe): Southwestern Texas.

C. C. Rix, 1952, Geologic map of Chinati Peak quadrangle, Presidio County, Texas (1:48,000): Texas Univ. Bur. Econ. Geology, prelim. ed; 1953, West Texas Geol. Soc. [Guidebook] Spring Field Trip, May 28–30, p. 1, 5 (chart), 14, 20. Dolomitic reef limestone. Occurs above Ross Mine formation (new); unconformable below Cretaceous Presidio formation.

Type locality and derivation of name not stated.

Minaville Member (of Canajoharie Formation)

Middle Ordovician (Mohawkian) : East-central New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 268–270, pl. 4. Lower member of Canajoharie, Includes two lowest graptolite zones of the Canajoharie. Composed predominantly of black shales, somewhat silty in upper part, and a few metabentonites. Thickness about 750 feet; thins westward from type section. Underlies Fairfield member (new); overlies Shoreham limestone.

Type section: Along Chuctununda Creek between Amsterdam and Minaville. Named for Minaville, Florida Township, Montgomery County.

Minco division

Permian: Oklahoma.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1521–1525. Named as second of three time divisions of Permian in Oklahoma. Follows Wanette division and precedes Upper Red-Beds division. Extends from top of Herington limestone, or top of Stratford shale, to base of Marlow formation.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677–1678. Recommended that in Oklahoma term Minco be dropped in favor of Leonard series which in Oklahoma and Kansas extends from horizon near top of Herington limestone up to Dog Creek shale—that is, to base of Whitehorse group.

Reference locality, town of Minco, Grady County.

Mindego Formation

Oligocene, upper, and Miocene, lower (Zemorrian and Saucesian): Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Name given to at least 2,000 feet of calcarenites, arkosic sandstones, siltstones, mudstones, basalt flows, flow breccias and tuffs which lie disconformably or with slight angular nonconformity on San Lorenzo formation; conformably underlies Woodhams formation (new). Mindego is equivalent in age to some massive fossiliferous sandstones that have been called Vaqueros sandstone in nearby areas.

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

†Minden Formation (in Claiborne Group)[1]

Eocene, middle: Northern Louisiana.

Original references: J. W. Whittemore, 1927, Louisiana Dept. Conserv. Bull. 14, p. 6, 9, map; 1928, Bull. 16, p. 8; 1929, Bull. 19, p. 6.

Crops out around Minden, Webster Parish.

Mindi Hill Beds

Miocene: Panamá.

R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 180–181, 236 (table). Green sand marls of fine, uniform homogeneous texture and structure; no lamination; fossiliferous.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 339. Suppressed in favor of Gatún formation. Miocene.

Near Gatún, C. Z.

Mine Brook Formation

Middle Silurian: Central Connecticut.

G. P. Eaton and L. J. Rosenfeld, 1960, Internat. Geol. Cong., 21st. Copenhagen, pt. 2, p. 170 (fig. 1), 171 (table 1). Finely laminated biotit-calcite schists and gneisses; subordinate interbedded diopside-amphibolite granulites. Overlies Great Hill formation (new); underlies Camp Jenkins formation (new). Previous workers with the exception of Percival (1842, Report on the Geology of the State of Connecticut: New Haven), grouped the sequence of rocks from Collins Hill schist through Camp Jenkins schist as a single formation, and believed it to be intruded by Glastonbury, Maromas, and Haddom gneisses. Present work shows that these rocks represent four distinct formations, with unconformity separating Collins Hill from the others.

Mine Brook is in central part of Middle Haddam quadrangle, Middlesex County.

Mine Creek Shale Member (of Pawnee Limestone)

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 318–319, pl. 1. Name applied to shale unit between Myrick Station member (new) below and Laberdie member (new) above. Shale is mostly gray, more or less carbonaceous, and contains thin bed of limestone in upper part; toward the south black shale is most persistent part of member. Maximum thickness in Kansas about 16 feet.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 46. Noted as quite thin in Iowa.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 7. In Missouri underlies Coal City limestone member of Pawnee; term Coal City has priority over Laberdie and name Laberdie is suppressed.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31–32, fig. 5. In Appanoose County, member is composed of shale and clay that varies from light to dark blue gray and has persistent carbonaceous streak or coal smut about 3 feet from top. In Madison County, coal smut is about 4 inches from top and underlies gray fossiliferous shale; beneath coal smut is gray shale resting on 2-foot bed of gray sandy limestone that is locally conglomerate; underlying limestone is sequence of siltstone, sandstone, and shale. Aggregate thickness about 8 feet in Appanoose County: 21 feet in Madison County. Underlies Coal City member; overlies Myrick Station member.

Type exposure: Middle and south side sec. 23, T. 21 S., R. 25 E., on tributary of Mine Creek in Linn County, Kans. Identified as far south as 20 miles south Kansas-Oklahoma line.

Mine Hill Granite Gneiss

Paleozoic: Southwestern Connecticut.

R. M. Gates, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–121. Name used to replace preempted Roxbury granite gneiss (Rodgers and others, 1956). Lustrous white granite gneiss composed of microcline, albite, quartz, muscovite, and biotite. Muscovite forms foliation planes. Relative amounts of microcline and albite vary from layer to layer, and replace-

ment of microcline by albite is conspicuous in albite-rich layers. A semiconcordant, probably syntectonic intrusive into Hartland formation.

Named for typical outcrops on Mine Hill in west-central part of Roxbury quadrangle. Crops out in slablike cliff-forming layers of hogbacks 5 to 20 feet thick; outcrops are restricted to core of foliation dome in otherwise isoclinally folded Hartland formation.

Mineola Limestone[1]

Middle Devonian: North-central Missouri.

Original reference: E. B. Branson, 1920, Am. Jour. Sci., 4th, v. 49, p. 267–276.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 128–136. Formation is heterogeneous in composition and irregular in distribution. One typical phase is highly crystalline crinoidal limestone, almost white in color; another phase is made up of yellowish to pinkish-gray limestone which contains cavities produced by solution of fossils. In some places, lowest member is very sandy. The various phases are never present in one section. Overlies Jefferson City dolomite, St. Peter sandstone, Joachim dolomite, Plattin limestone, Kimmswick limestone, and Maquoketa shale; underlies Callaway limestone, Bushberg sandstone, and Chouteau limestone, though Callaway is commonest overlying unit.

A. G. Unklesbay, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 19, p. 3. Branson named Mineola as a formation, but relationships in Fulton quadrangle suggest that these beds should be considered facies of the Callaway.

Named for exposures 4 or 5 miles in extent, in vicinity of Mineola, Montgomery County.

Mineral Formation (in Cabaniss Group)

Mineral Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Missouri, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. Mineral formation (cyclothem), ninth in sequence (ascending), occurs below the Fleming and above the Scammon. Average thickness 12 feet. Includes coals locally known as Weir-Pittsburg, Lightning Creek, and Mineral. [For complete sequence see Cherokee group.]

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Mineral formation. Underlies Robinson Branch formation (new); overlies Scammon formation. Included in Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as a coal cycle in Senora formation, Cabaniss group, in Oklahoma.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 60–62. A formation in Cabaniss subgroup of Cherokee group. In southeastern Kansas the following divisions are differentiated (ascending): lower limestone bed, dark shale, underlimestone and sandstone, underclay, Mineral coal. Thickness in Crawford and Cherokee Counties averages about 23 feet; in northeastern Crawford County commonly less than 15 feet.

Named for association with Mineral coal. Succession is well exposed in strip-pit highwall in SE¼NW¼ sec. 24, T. 28 S., R. 25 E., Crawford County, Kans.

Mineral Bluff Formation

Cambrian: Central northern Georgia.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 55–56, pl. 1, map. Sequence of quartz-sericite schist, slate or phyllite, and small amounts of graphitic schist and talcose schist; quartz conglomerate and meta-arkose lenses occur 100 to 200 feet above base. Thickness 300 to 800 feet. Top of formation removed by erosion; contact with underlying Nottely quartzite gradational.

Occupies the trough of Murphy syncline. Well exposed in vicinity of Mineral Bluff, Fannin County.

Mineral Creek Andesite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures in south walls of Mineral Creek Canyon above Cooney mine, Mogollon district.

Mineral Fork Tillite

Precambrian: Central northern Utah.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 4–6, pl. 1. Black bouldery tillite interbedded with varved shale, dark-gray quartzite, and bouldery conglomerate. Thickness at Superior Peak about 1,000 feet. Thickens to northwest to at least 3,000 feet on east slope of Mill B South Fork. Underlies Mutual formation (new); overlies Big Cottonwood series.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 19. May be in part equivalent to Dutch Peak tillite (new).

Exposed in Superior Peak, covers almost entire upper basin of Mineral Fork, and extends over ridge to west onto east slope of Mill B South Fork.

Mineral King Beds[1]

Triassic(?): Southern California.

Original references: H. W. Turner, 1894, Am. Geologist, v. 13, p. 231; 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 451.

Exposed at old mining camp of Mineral King, about 15 miles southwest of Mount Whitney, at headwaters of Kaweah River, Tulare County.

Mineral Mountain Andesite Porphyry

See Keechelus Andesitic Series.

Mineral Wells Formation (in Strawn Group)[1]

Middle Pennsylvanian: Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 138.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 91–94. Includes Ricker sandstone and Capps limestone members.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87. Strawn-Canyon boundary falls within Mineral Wells for-

mation which name is here dropped. Units formerly included in Mineral Wells are reassigned to Lone Camp group (new) or Whitt group (new).

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 60. Strawn group is used in this report for all rocks in Colorado River valley between top of Smithwick shale of Bend group and base of Brownwood shale member of Graford formation of Canyon group. Term Mineral Wells formation is not used in this area because of marked range in thickness and lithology that occurs in the Strawn between the Brazos and Colorado River valleys.

Named for exposures in vicinity of Mineral Wells, Palo Pinto County.

Miners Castle Member (of Munising Formation)

Upper Cambrian: Northern Michigan.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Survey Div. Pub. 51, p. 6 (fig. 1), 95–109, fig. 70. Poorly sorted sandstone. Characteristically crossbedded. Size of sets of cross-strata is small; average between 4 and 6 inches thick. Thin lenses of blue shale separate sets of cross-strata in lower part of section. Upper units of pure sandstone and sorting is much better. Thickness at type locality and throughout most of exposure in the Pictured Rocks is 140 feet. Some slight thinning indicated to east and west of Pictured Rocks. Also thins to the south. Overlies Chapel Rock member (new); underlies Au Train formation (new).

Type locality: Miner's Castle in Pictured Rocks cliffs, on southern shore of Lake Superior, Alger County.

Minersville Shale Member (of Friedrich Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska and northeastern Kansas.

G. E. Condra and E. C. Reed, 1938, Nebraska Geol. Survey Paper 12, p. 9. Defined as basal member of formation. Underlies Palmyra formation (new).

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42. Overlies Morton limestone (new).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 14. Composed of red and grayish shales; locally sandy. Thickness 30 feet at Nebraska City and less southward in Nebraska and northeastern Kansas.

Type locality: In Missouri River bluffs near railroad station at Minersville, Otoe County, Nebr.

Minersville Tuff Member (of Needles Range Formation)

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Ann. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 99. Chiefly dark-gray to black devitrified tuff several hundred feet thick. Overlies Wah Wah Springs member (new); underlies Isom formation (new).

Named for occurrence in Minersville Canyon of Beaver River, Iron Springs district.

Mines Dolomite[1] (in Beekmantown Group)

Mines Dolomite Member (of Gatesburg Formation)

Lower Ordovician: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 527, 534, 537.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Included in Beekmantown group, Lower Ordovician. Underlies Larke dolomite; overlies Gatesburg formation. Thickness about 250 feet.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 282, 287, pls. 3, 4. Rank reduced to member status in Gatesburg formation. Consists of dark dolomite, siliceous oolite, and chert, much of it cryptozoon stromatolite. Separated from underlying Ore Hill member by interval, 650 to 700 feet thick, referred to as upper sandy Gatesburg member; upper contact not exposed, probably unconformably underlies Ordovician Larke dolomite or its limestone facies, Stonehenge formation. Upper Cambrian.

Named for old mining town of Mines, several miles southwest of Williamsburg, Blair County.

Minesota Coglomerate[1] (in Central Mine Group)

Precambrian (Keweenawan) : Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of the geology of Ontonagon County, pamphlet of 24 pages and map: Philadelphia, p. 20, map.

Copper district of Keweenaw Point.

Mineta Beds or Formation

Miocene(?), lower: Southeastern Arizona.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 59. Sequence of strata consisting of conglomerate, limestone, mudstone, and siltstone. Beds consist of three members (ascending): thin-bedded arkosic conglomerate about 1,300 feet thick; limestone member, about 50 feet thick, consisting of alternating marly algal limestone and shale; and detrital member, about 1,400 feet thick, consisting of thin-bedded siltstone, mudstone, and limestone. Beds cut by dikes and sills and overlain by flows of andesite porphyry. Strata exposed in complexly faulted block that is thrust over older metamorphosed rocks to west and is in normal fault contact with younger deposits to east. Probably equivalent to Pantano formation. Probably lower Miocene. Name credited to Chew (unpub. thesis).

W. D. Pye, 1959, Arizona Geol. Soc. Guidebook 2, p. 276. Thickness of formation over 3,000 feet. Type area cited.

Type area: Vicinity of Redington, on northeast side of Rincon Mountains, Pima County.

Minford Silt[1]

Pleistocene (pre-Illinoian) : Southern Ohio.

Original reference: Wilber Stout and D. Schaaf, 1931, Geol. Soc. America Bull., v. 42, no. 3, p. 663–672.

S. E. Norris and H. C. Spicer 1958, U.S. Geol. Survey Water-Supply Paper 1460–E, p. 215–225. Maximum thickness more than 80 feet. Commonly rests on fine sand or sandy silt which generally overlies the bedrock and which may represent part of original stream alluvium. Pre-Illionoian in age. Origin discussed.

Named for exposure in cut of Chesapeake & Ohio Railway at Minford, Harrison Township, Scioto County.

Mingo Formation (in Breathitt Group)

Mingo Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Northeastern Tennessee and southeastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 33, 38, 207, pl. 40–A.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 82–85. Overlies Hance formation; underlies Catron formation. Includes Fork Ridge sandstone member about 40 feet below Mingo coal. Thickness about 466 feet in Claiborne County, Tenn.; about 629 feet in Harlan County, Ky.

Named for Mingo Mountain, Claiborne County, Tenn.

Mingus Shale Member (of Garner Formation)[1]

Middle Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 25, 31; 1922, Texas Univ. Bull. 2132, p. 75, 76, charts.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 20–21, fig. 3. Total thickness (in Parker County) 210 feet measured in traverse from approximate base of member in bed of Rock Creek to base of Brazos River sandstone member in scarp west of Millsap; base not everywhere exposed. Includes thin coal seam which in this report is not considered to be Thurber coal as described by Plummer and Hornberger (1936). Overlies Goen limestone bed in Grindstone Creek formation.

Named for small mining town south of Mineral Wells, Palo Pinto County.

Mingus Mountain Tuff

Miocene, upper: North-central Arizona.

B. E. Sabels, 1960, Dissert. Abs., v. 21, no. 3, p. 596. Incidental mention in discussion of late Cenozoic volcanism in San Francisco volcanic field.

Minidoka Basalt[1]

Pleistocene: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 29, 83, pl. 4. Thickness about 30 feet. Deposited after Burley lake beds. Younger than Sand Springs basalt.

Named for Minidoka Dam. Probably issued from one of cones near Minidoka, Minidoka County.

Minitimi Limestone

Miocene, middle: Western Panamá.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 52. A coralline limestone which interfingers with Bastimentos shale at base of Gatún formation.

Occurs on Isla Colón (Columbus Island) and Isla Bastimentos (Provision Island).

Mink Creek Conglomerate (in Salt Lake Group)

Pliocene: Southeastern Idaho and central northern Utah.

R. D. Adamson, C. T. Hardy, and J. Stewart Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 2, 7–8. Upper member of Mink Creek formation (of Keller, 1952, unpub. thesis) is here elevated to status of formation and designated Mink Creek conglomerate. Consists of subrounded to angular cobbles and pebbles with some boulders. Matrix consists of light-gray sandy calcareous tuff and pale-yellow marl. Locally interbedded with

white tuff. Thickness approximately 3,435 feet. Conformably overlies Cache Valley formation.

Type section: About 1 mile west of Mink Creek, Cache Valley, Franklin County, Idaho.

Minneapolis Limestone[1] (in Beloit formation)

Middle Ordovician: Southern Minnesota.

Original reference: F. W. Sardeson, 1907, Geol. Soc. America Bull., v. 18, p. 185.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 113. Listed among upper Mississippi Valley formations not in general use.

Named for Minneapolis.

Minnechaduza Beds (in Ash Hollow Formation)

Pliocene: North-central Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 142. Name suggested for fragmentary layer at base of rim rock of Ash Hollow formation. Fauna from this layer was designated the Minnechaduza by Stirton (1939, Am. Jour. Sci., v. 237, no. 6, p. 433). Overlies Valentine sands at Valentine. Contains plant fossils.

Stirton designated type locality for Minnechaduza fauna on divide between Little Beaver and Crooked Creeks, SW¼SW¼ sec. 8, T. 34 N., R. 26 W., north pasture Niobrara Game Refuge, Cherry County; name taken from Minnechaduza Creek.

Minneiska Member (of Franconia Formation)

Upper Cambrian (St. Croixian): Southeastern Minnesota.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902. Named in a list of members of Franconia formation in Minnesota. Underlies Bad Axe member; overlies Taylors Falls member.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1239. Dropped in preference to name Hudson member.

Probably named for exposures near village of Minneiska, Wabasha County.

Minnekahta Limestone[1]

Minnekahta Limestone Member (of Goose Egg Formation)

Minnekahta Limestone (in Phosphoria Group)

Lower Permian: Western South Dakota, western Colorado, northwestern Nebraska, and eastern Wyoming.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 514.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, strat. sections. Included in Phosphoria group in Laramie Range, Hartville Uplift. Overlies Opeche shale; underlies Glendo shale (new).

H. D. Thomas, 1940, Kansas Geol. Soc. Guidebook 14th Ann. Field Conf., p. 124. Suggests that name Sybille tongue of Phosphoria be abandoned in favor of Minnekahta.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Falcon tongue of Minnekahta extends into Lykins formation from Horse Creek, Wyo.,

southward to Red Creek Canyon, between Colorado Springs and Canyon City, Colo.

Type locality: Region near the hot springs, South Dakota, originally known as Minnekahta by Indians.

Minnelusa Sandstone[1] or Formation

Pennsylvanian and Permian: Western South Dakota and northeastern Wyoming.

Original reference: N. H. Winchell, 1875, Black Hills of Dakota, by Wm. Ludlow, U.S. Eng. Dept. U.S. Army, p. 38, 65, map.

F. H. Brady, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 45–47, cross sections. Evaporite deposits in Minnelusa formation in Sundance-Beulah area, Crook County, Wyo., discussed. In this area, creeks have cut deep canyons through Minnekahta and Opeche formations and exposed strata not usually associated with Minnelusa. In these canyons, 383 feet of upper Minnelusa are exposed; of this exposure, 166 feet are local strata not present in formation outcrops in immediately surrounding area. Eighteen columnar sections measured, and section 8 in Sundance Canyon is considered type section. Here Minnelusa underlies Opeche and is 257 feet thick. Late Pennsylvanian to early Permian.

T. V. Jennings, 1959, Jour. Paleontology, v. 33, no. 6, p. 986–1000. Occurrence of Pennsylvanian upper Virgilian of lower Wolfcampian fusulinids described from Minnelusa formation in northern Black Hills.

Type section: Sundance Canyon in SW¼ sec. 10, T. 52, N., R. 61 W., Crook County, Wyo. Minnelusa is Sioux name for rapid water. Formation is exposed on Rapid River 4 or 5 miles above Rapid City, S. Dak.

Minnesotan series[1]

Ordovician: Minnesota.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 147–151.

Minnesota Valley Granite Series

Precambrian: Southwestern Minnesota.

E. H. Lund, 1953, Econ. Geology, v. 48, no. 1, p. 48. Term Minnesota River Valley granite series used to include number of masses of granite and granite gneiss in Minnesota River valley. Includes Morton granite gneiss.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482–1490. Formerly referred to as Minnesota River Valley granite series. Granites and granite gneisses that are younger than basic complex. Five rock types distinguished on basis of textural and structural characters. From southeast to northwest, they are the Fort Ridgely granite (new), Morton quartz monzonite gneiss, Sacred Heart granite (new), Montevideo granite gneiss (new), and Ortonville granite (new). Rocks may not be of same age, and limited outcrops make it difficult to establish their relations.

C. D. Walcott (1899, Geol. Soc. America Bull., v. 10, p. 22) used Minnesota River Valley gneiss and granite as descriptive term for basement rocks in southern Minnesota.

Exposed in Minnesota River Valley between New Ulm, Brown County, and Ortonville, Big Stone County.

Minnewaste Limestone Member (of Lakota Formation)

Minnewaste Limestone[1]

Lower Cretaceous: Western South Dakota.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 529.

W. J. Mapel and G. B. Gott, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–218. Rank reduced to member status in Lakota formation (redefined). Underlies Fuson member.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1091–B, p. 21, 27, 29, 31, 33, 45–46, 85–86. At reference section of redefined Lakota, Minnewaste consists of light-gray limestone with granulelike blebs of white limestone or calcite; locally sandy, containing parting of limy sandstone with a few black shale interbeds in middle part; bedding irregular, beds 0.5 to 3 feet thick. Thickness 36 feet. Thickness of Lakota above Minnewaste, 115 feet; thickness below, 310 feet. Discussion of history of stratigraphic nomenclature of Inyan Kara group.

First described in vicinity of Hot Springs, southeastern part of Black Hills. Minnewaste is Dakota Indian name for Cheyenne River. Composite section of redefined Lakota is in valley of Fall River in center W½NW¼ sec. 33, and N½NE¼ sec. 32, and adjacent parts of sec. 29, T. 7 S., R. 6 E., Fall River County, Hot Springs quadrangle, South Dakota. Minnewaste (unit 20) measured in river bluffs about 800 feet east of dam in center. E½W½NW½ sec. 33.

Minnith zone (in Powell Limestone)[1]

Lower Ordovician (Beekmantown): Central eastern Missouri.

Original reference: S. Weller and S. St. Clair, 1928, Missouri Bur. Geology and Mines, v. 22, 2d ser., p. 86–90.

Named for exposures at and near Minnith, Ste. Genevieve County.

Minong Breccia[1] (of Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1898, Michigan Geol. Survey, v. 6, pt. 1, p. 87, 101, 105, pl. 1.

Named for occurrence in Minong mine, Isle Royale.

Minong Porphyrite[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1898, Michigan Geol. Survey, v. 6, pt. 1, p. 141, 142, 159, 161, 170, 177, 200, 201, 209, 212, pls. 1, 2.

Named for occurrence in Minong mine, Isle Royale.

Minooka Drift

Pleistocene (Wisconsin): Northern Illinois.

D. J. Fisher, 1925, Illinois Geol. Survey Bull. 51, p. 17 (fig. 2), 69 (table 6), 76–79. Older than Rockdale drift and younger than Marseilles drift.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 4. Shown on columnar section of Pleistocene deposits below Manhattan-Rockdale drifts and above Marseilles drift.

Named from village of Minooka situated on drift about 3 miles south of southwest corner of Joliet quadrangle.

Minshall Limestone (in Brazil Formation)

Pennsylvanian: Southwestern Indiana.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96; R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). A marine limestone in Brazil formation above Minshall coal.

H. C. Hutchinson, 1960, Indiana Geol. Survey Bull. 16, p. 19–20. Name abandoned because stratigraphy at type locality has not been well understood and many miscorrelations have been made in tracing limestone along its outcrop. Name Perth limestone is applied to marine unit that closely overlies Minshall coal.

Type locality: Town of Minshall, Parke County.

Mint Canyon Formation[1]

Mint Canyon Series

Miocene, upper: Southern California.

Original references: W. S. W. Kew, 1923, Am. Assoc. Petroleum Geologists Bull., v. 7, p. 441–420; 1924, U.S. Geol. Survey Bull. 753.

R. H. Jahns, 1939, Am. Jour. Sci., v. 237, no 11, p. 818–825. Restricted to exclude basal 350-foot unit here named Tick Canyon formation. Name Mint Canyon formation retained for middle and upper beds. Name Mint Canyon series applied to strata as a whole. As restricted, formation comprises slightly more than 4,000 feet of gray sandstone and conglomerate, variegated siltstone and clay, and minor tuffaceous beds. Underlies marine beds containing uppermost Miocene invertebrate fauna.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 23 (fig. 3), 65–69, pl. 1. Name Mint Canyon formation was given by Kew (1923) to unit previously described by Hershey (1902, California Univ. Pub. Dept., Geol. Bull., v. 3) as Mellenia series, consisting of several thousand feet of nonmarine sedimentary rocks unconformably overlying Vasquez formation (Kew's Sespe(?); Hershey's 1902 Escondido series), and unconformably overlain by marine Modelo (Modelo? or Castaic) formation. Mint Canyon formation is most widely distributed formation of Soledad basin, covering about 45 square miles of northwestern and north-central part of San Fernando quadrangle [this report]. Lies in southwest-plunging folded and faulted syncline which is bounded on north, east, and south, respectively by the Sierra Pelona, Parker Mountain, and San Gabriel Mountains. Present north of San Gabriel fault. Thickness 4,500 feet. Overlies Tick Canyon formation; underlies Modelo formation. In Agua Dulce Canyon, unconformably overlies Vasquez formation; in extreme northwest corner of quadrangle unconformably overlies Pelona schist. In terms of invertebrate chronology, the Mint Canyon is probably early upper Miocene to middle Miocene in age.

Type locality: Mint Canyon, San Gabriel Mountains, Los Angeles County.

Minto Basalts or Lavas

Pliocene to Pleistocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 705–706, 709 (fig. 2), 713 (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig. 2), 1618, 1625, 1627–1629. High Cascade lavas are divided into four groups; in chronological order these are: Outerson basalts, Minto basalts, San-

tiam basalts, and Olallie lavas. Probable thickness of Minto basalts 4,000 feet. Where Outerson accumulations were high Minto lavas flowed around them; where Outerson deposits were thinner Minto lavas overrode them and lapped over onto Western Cascades. Basaltic cones of Minto series deeply dissected before extrusion of Olallie lavas.

Name derived from Minto Mountain, Jefferson quadrangle. Lavas formed shield volcanoes whose vents were near axis of present High Cascades.

Mint Spring Marl Member (of Marianna Limestone)[1]

Mint Spring facies (of Glendon Member of Vicksburg Formation)

Oligocene, middle: Southern Mississippi and western Alabama.

Original reference: C. W. Cooke, 1918, Washington Acad. Sci. Jour., v. 8, p. 187, 195–196.

F. F. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 26. Referred to as facies of Glendon member of Vicksburg formation. Note on derivation of name.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1326–1329. Consists chiefly of fossiliferous sand, sandy marl with numerous limestone concretions, and more rarely, concretionary ledges. Maximum thickness about 25 feet. Overlies Forest Hill sand and, in Alabama, Red Bluff clay.

Named from outcrop below water fall on Mint Spring Bayou, at National Cemetery, Vicksburg, Miss.

Minturn Formation

Pennsylvanian: Central Colorado.

Odgen Tweto, 1949, Colorado Sci. Soc. Proc., p. 152 (table 1), 194–198, 205–228. Name applied to series of clastic rocks about 6,000 feet thick lying between Belden shale and Maroon formation. Made up of lenticular beds of arkosic grit, shale, conglomerate, sandstone, and quartzite with a few relatively persistent beds of dolomite limestone. Includes (ascending) Wearyman dolomite (new), Hornsilver dolomite (new), Resolution dolomite (new), Robinson dolomite, Elk Ridge limestone, White Quail limestone, and Jacque Mountain limestone members. Pennsylvanian and Permian(?). Name Minturn is applied in preference to older names because none of these seems usable; Maroon is used for upper formation; Weber or Weber(?) has long been considered unsatisfactory; Battle Mountain introduced by Brill (1942) was in effect abandoned by him in 1944 when he proposed use of Maroon for same beds and Battle Mountain as defined does not correspond to divisions here recognized.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 820, 821. In South Park area, comprises Coffman conglomerate member, Chubb siltstone member, and lower part of Pony Spring siltstone; in Arkansas River section, includes Swissvale gypsum member (new).

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1919–1922. Described in Sangre de Cristo Mountains between La Veta Pass and Westcliffe, where it is at least 5,000 feet thick and consists chiefly of grayish to greenish sandstones, conglomerates, and shales or siltstones. Base is probably an unconformity; overlies Kerber formation at two localities but elsewhere rests unconformably on Mississippian or older rocks. Underlies Maroon or Sangre de Cristo formations, boundary imperfectly defined. Grades southward into its stratigraphic equivalent, Madera formation.

Named for extensive exposures in cliffs along east side of Eagle Valley near Minturn, Eagle County.

Minwah Limy Gneiss (in Tacoma Series)

Cambro-Ordovician(?) : Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations. Belongs to Tacoma series (new). Older than Sabattus garnet schist (new); younger than Hill Ridge biotite schist (new).

Occurs in Lewiston area, Androscoggin County.

Mira Basalt[1]

Miocene, upper : Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 69.

Caps Mira Mountain and underlies southern part of town of Goldfield, Esmeralda County.

Miraflores Basalt

Miocene, lower : Panamá.

[T. F. Thompson], 1943, Panamá Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 26. Consists of thick mass of dense hard dark-gray to blue-black rock that has intruded sedimentary rocks. Represents either laccolith or sill.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 339–340. Miocene.

Underlies site of Miraflores Locks and composes Cocoli Hill and Aguadulce Hill, Pacific side of Canal Zone.

Miraflores Pumice

Miocene(?) : Panamá.

R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 198–199, 206. Stratified; pink, salmon, and magenta. Term Panamá formation used to include analogous deposits of Barbacoas, San Pablo, and Miraflores.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 340. Considered informal name. Miocene(?).

In bluffs at Miraflores, C.Z.

Miraleste Tuff Bed[1] (in Altamira Shale Member of Monterey Shale)

Miocene, middle : Southern California.

Original reference: W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 125–129.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 19–20, pl. 1. Described as a thin tuff bed characterized by abundance of dark-brown pumice lapillae, commonly an inch or less in diameter, embedded in matrix of light-colored impure fine-grained volcanic ash. Generally 2 to 4 feet thick; maximum thickness 8 feet. Occurs in middle part of Altamira member.

Type region: Along west side of upper Agua Negra Canyon, Palos Verdes Hills area, Los Angeles County. Name derived from Miraleste residential district.

Miramar Member (of Naranjo Formation)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 71–73. Consists of volcanic conglomerate, calcareous siltstone, tuffaceous sandstone, and lenses of Coamo Springs limestone. Thickness 0 to 2,300 feet. Grades up into Coamo Springs member. Rests unconformably on units of late Santonian and early Campanian age.

Type locality: Base of cliffs located about 0.65 kilometer southeast of Miramar hacienda in southeastern part of Jayuga quadrangle.

Mirikattan Limestone

Recent (early Holocene): Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation table) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the south Seas: Japan Hydrog. Office Bull., v. 11, p. 58, table 4 [English translation in library of U.S. Geol. Survey, p. 69]. Named on correlation chart. Correlated with Tanapag limestone on Saipan, Dankuro [Dankuglo] limestone on Tinian, and Garukijokku limestone on Palau. Recent.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 47. A raised coral reef elevated 1 to 3 meters above sea level. Believed to be younger than raised-beach deposits. Early Holocene. Name credited to S. Sugawara (unpub. ms.).

Type locality: Rota Island. Exposed in belt surrounding island.

Misenheimer Shale[1]

Middle Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 169–178.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 15–60; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 26. Strata intervening between Grand Tower limestone (or Dutch Creek sandstone where Grand Tower is absent) and Mountain Glen shale (or Springville shale where Mountain Glen is absent) have been referred by Savage to Misenheimer shale and Lingle and Alto limestones. Restudy of area suggests that recognition of these formations may be neither stratigraphically logical nor practically feasible.

A. S. Warthin, Jr., and G. A. Cooper, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 10, p. 1523. In Jackson and Union Counties, a Hamilton age was formerly assigned to the Misenheimer. In this paper, term Misenheimer is not used because the Misenheimer is considered only a highly leached phase of Hamilton beds. Type Misenheimer is probably equivalent to part of St. Laurent limestone.

Well exposed in banks of Misenheimer Creek and tributaries in NE¼ sec. 34 and NW¼ sec. 35, Misenheimer Township, Union County.

Mission Argillite[1] (in Stevens Series)

Middle Cambrian(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 72, map.

Charles Deiss, 1955, U.S. Geol. Survey Bull. 1027–C, p. 122. Northport limestone restricted to the lower, thicker unit (main mass) of Weaver's Northport. As restricted underlies rather than interbeds with Weaver's Mission argillite. Age of Northport given as Middle Cambrian(?).

Probably named from town of Mission, Stevens County.

Mission Sandstone Member (of Tallant Formation)

Mission Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: M. I. Goldman and H. M. Robinson, 1920, U.S. Geol. Survey Bull. 686–Y, p. 362, 364.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 38–39, pl. 1. Reallocated to Tallant formation. Described as very fine grained, buff to light brown, thin bedded to massive. Occurs near top of formation. Interpreted as a channel deposit, possibly fluvial, but probably shallow marine.

Named for occurrence along Mission Creek, especially in secs. 13, 14, 23, 24 and 25, T. 28 N., R. 11 E., Osage County.

Mission Canyon Limestone (in Madison Group)[1]

Lower and Upper Mississippian: Montana.

Original reference: A. J. Collier and S. H. Cathcart, 1922, U.S. Geol. Survey Bull. 736–F, p. 173.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 315, 318, measured sections. Strata called Mission Canyon by Collier and Cathcart are lithologically and faunally identical with Weed's (1899) Castle limestone, but because latter has been discarded, it is proposed that terms Mission Canyon and Lodgepole be applied throughout Montana and northern Wyoming. Overlies Woodhurst member of Lodgepole limestone; underlies Amsden formation, Ellis formation, or Kibbey sandstone.

M. E. Denson, Jr., and N. S. Morrisey, 1952, Wyoming Geol. Assoc. Guidebook 7th Ann. Field Conf., p. 37–43. Formation, in Bighorn [Big Horn] and Wind River basins, Wyoming, consists of two unnamed members: lower, bedded siliceous limestone and dolomite, 140 to 160 feet thick; upper, massive limestone and dolomite, 80 to 155 feet thick. Overlies Lodgepole formation; underlies unit referred to as "upper Madison".

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51–57. Mission Canyon is middle unit of Madison group of this report. Overlies Lodgepole formation; underlies unit referred to as Upper Madison limestone. Thickness varies in western Wyoming due partly to pre-Meramec erosion but averages about 250 feet. Thickness at type section, herein stated, about 300 feet. Fossils indicate Osagean age. Mission Canyon correlates with the "massive limestones" of Peale (1893, U.S. Geol. Survey Bull. 110), upper part of Woodhurst of Weed (1899), lower Mission Canyon of Denson and Morrisey (1952), lower part of middle unit of Madison of Andrichuk (1955) and the Deseret of Utah.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 18–20, pls. 1, 2, 3. Mission Canyon, in area of this report [southern Elkhorn Mountains, Mont.], is composed of thick and indistinct beds of medium- to light-gray crystalline to granular lime-

stone with subordinate thinner and more distinct beds of darker gray limestone near top and bottom. Thickness 1,107 feet in Limestone Hills (just outside mapped area). Overlies Lodgepole limestone; underlies Amsden formation, erosional unconformity(?). Formation probably wholly late Mississippian in this local area.

W. J. Sando and J. T. Dutro, Jr., 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf. p. 117–126. In present report, Madison group comprises two formations Mission Canyon limestone (1,050 feet thick) and underlying Lodgepole limestone. Strickland's (1956) restriction of Mission Canyon and recognition of "Upper Madison limestone" of formational rank is rejected. Strickland seemingly differentiated his "Upper Madison" from the Mission Canyon mainly on the basis that rocks allocated to "Upper Madison" are supposed to be separated from Mission Canyon by major unconformity. In present study, no convincing evidence of major unconformity with the Madison in western Wyoming or southwestern Montana was noted. Mission Canyon in Wyoming undoubtedly contains some beds younger than those present in its type section in Montana, but this does not necessitate recognition of separate unit in uppermost Madison. If future work should support further subdivision of upper part of Madison, it is suggested herein that such new units be recognized as members of the Mission Canyon rather than separate formations. "Massive limestones" of Peale (1893) herein considered to be part of Lodgepole limestone and not part of Mission Canyon as suggested by Strickland. Coral zonation of Mission Canyon discussed.

Type section (Strickland): In canyon of St. Pauls Mission along west flank of Little Rocky Mountain uplift, Little Rocky Mountain region, Montana.

†Mission Creek Series[1]

Paleozoic, Cretaceous, and Tertiary: Southwestern Alaska.

Original reference: J. E. Spurr, 1896, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 153–183.

Well exposed at and named for Mission Creek, Yukon gold district.

Mission Creek Shale (in Deer Creek Limestone)[1]

Pennsylvanian: Northeastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 49, 50.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 53–54. Replaced by Burroak shale (new). Exposures on Mission Creek, Doniphan County, Kans., are correlative with Larsh shale of northern outcrops. In naming Mission Creek shale, Condra, (1927) miscorrelated the Rock Bluff and Ozawkie of Iowa Point section with Haynies and Rock Bluff, respectively, of Weeping Water Valley and Jones Point sections of Nebraska.

Named for exposures on Mission Creek, southeast of Iowa Point, Doniphan County, Kans.

†Missisquoi Formation[1]

Upper Cambrian: Northwestern Vermont.

Original reference: A. Keith, 1924, Vermont State Geologist Rept. 1923–24, p. 137.

C. Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1053. Beds termed Missisquoi by Keith (1924) are now referred to Gorge formation (new). Term Missisquoi preoccupied.

Exposed in gorge of Missisquoi River at Highgate Falls, Highgate village, St. Albans quadrangle, Franklin County.

Missisquoi Schist[1] or Group

Middle Ordovician: Northwestern Vermont.

Original reference: C. H. Richardson, 1919, Vermont State Geologist 11th Rept., p. 120–140.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1496. Rocks of Cram Hill formation (new) constitute upper part of Richardson's (1919) "Missisquoi schists" which he at first tentatively placed in Lower Cambrian but later (1927, Vermont State Geologist 15th Rept.) interpreted as Upper Cambrian. This is most recent age assignment made hitherto and was based mainly upon presence of "Missiquoi schists" (later termed "Missisquoi group") unconformably below "Memphremagog slates" (Richardson, 1916, Vermont State Geologist 10th Rept.; Richardson and Camp, 1919, Vermont State Geologist 11th Rept.) which were believed to be of lower Trenton to Deepkill (Beekmantown) age. Authors [Currier and Jahns] believe that the Cram Hill, and consequently upper part of "Missisquoi group," are probably Middle Ordovician and that lower Trenton age for "Memphremagog slates" is open to question.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Moretown formation in Montpelier quadrangle is subdivision of Missisquoi group of Richardson (1924).

Named for exposures in Missisquoi River valley in northern Vermont.

Mississinewa Shale[1]

Middle Silurian: Northeastern Indiana.

Original reference: E. R. Cumings and R. R. Shrock, 1927, Indiana Acad. Sci. Proc., v. 36, p. 71–84.

J. B. Patton, 1949, Indiana Div. Geology Prog. Rept. 3, p. 11. Lowest Silurian formation recognized at surface in Indiana. At most exposures, it is blue-gray argillaceous dolomitic silty massive limestone which has conchoidal fracture and weathers to small rectangular blocks; locally it is gray calcareous shale; interbedding of shale and limestone not common. Exposures of base not found. Normally overlain by Liston Creek limestone, but at Kokomo and Peru it is overlain by Kokomo limestone (Cayugan).

Named for exposures along Mississinewa, at or near river level, at Wabash and Largo, Wabash County.

†Mississippi Clays[1]

Miocene: Mississippi River basin.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 157, 330.

Developed in basin of Mississippi River.

†Mississippi Slate Series[1]

Precambrian: Minnesota.

Original reference: R. D. Irving, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 440–441.

Mississippi River region.

Missler Member (of Ballard Formation)

Missler Member (of Meade Formation)

Pleistocene: Southwestern Kansas.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 67–68. Name applied to beds overlying Meade gravels member (new) of Meade formation and underlying Stump Arroyo member of Crooked Creek formation (both new). Consists of reddish sandy silt. Thickness 17 feet.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 56. Reallocated to member status in Ballard formation (new). Overlies Angell member (new).

Type locality: Along tributary of Spring Creek in secs. 6 and 7, T. 32 S., R. 28 W., Meade County. Named for town of Missler on Rock Island Railroad, sec. 26, T. 31 S., R. 29 W.

Missoula Group[1]

Precambrian (Belt Series): Northwestern Montana and northern Idaho.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 677, figs. 2, 3.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1900–1901. Consists of argillites, quartzites, and sandstones, with minor beds of conglomerate, limestone, and calcareous shale. Ripple marks, mud cracks, salt crystal casts, and rain prints characteristic. Thickness 10,000 to 18,000 feet. Type locality given. In Glacier National Park, consists of Miller Peak formation below and about 4,800 feet of undifferentiated unnamed beds above. Overlies Sheppard formation of Piegan group (new). Term Missoula antedates and reduces to synonomy term Boulder Pass formation (Fenton and Fenton, 1931).

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 211. In Saypo quadrangle, Miller Peak argillite, Cayuse limestone (new), Hoadley formation (new), and Ahorn quartzite (new) are equivalent in age to lower and middle part of Missoula group of Clapp and Deiss (1931) in Sapphire and Garnet Ranges, Mont.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. In central western Montana, includes (descending) Sheep Mountain quartzite, Garnet Range formation, McNamara formation, Hellgate formation, and Miller Peak formation. Overlies Siyeh group.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 113. Group includes all of Belt series above Piegan group in all localities where the Piegan is recognizable. In northwestern Montana and adjacent parts of Idaho, group is represented by Striped Peak and Libby formations. In and near Glacier Park, the Shepard, Kintla, and other units are included in it. In vicinity of Missoula, group is described as containing 18,000 feet divided into five formations. In vicinity of Helena, Marsh shale is only representative of group, but to the north other units appear; in Saypo quadrangle, four formations [Miller Peak argillite, Cayuse limestone, Hoadley formation, and Ahorn quartzite] have been

distinguished. North Boulder group (new) may be equivalent to some part of Missoula group.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Group includes numerous named formations, most of which cannot be traced with confidence far from their type localities. Among these are Marsh shale in Helena region, Striped Peak, and Libby formations in northwestern Montana, five near Missoula, and others in and south of Glacier National Park.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 5. Group includes Striped Peak formation in northern Idaho.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Group, as mapped in Bonner quadrangle, Montana, comprises (ascending) Miller Peak argillite, Bonner quartzite (new), McNamara argillite, Garnet Range quartzite, and Pilcher quartzite (new). Overlies Newland limestone of Piegan group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 43–53, pls. 1, 2. In area of this report [Glacier National Park and Flathead region], base of group is redefined and placed at top of definitely calcareous beds of Siyeh limestone of Piegan group (redefined). The Siyeh is thus restricted to exclude a unit of greenish calcareous argillite, up to several hundred feet thick, now included in Missoula group. This places base of group in and near Glacier National Park stratigraphically lower than has been done previously. Argillaceous rocks above Siyeh limestone of present report correspond essentially to Spokane formation of Fenton and Fenton (1937) and to red and green argillite band in Siyeh of Clapp (1932, Montana Bur. Mines and Geology Mem. 4). However, the Spokane cannot be traced satisfactorily into Flathead region; hence, name "Spokane" is not here employed, and beds thus designated by the Fentons are regarded as unnamed parts of Missoula group. The argillaceous beds are overlain by Purcell basalt which in turn underlies Shepard formation. The Shepard can be mapped safely only where it is underlain by the Purcell. Greatest part of group consists of assemblage of grayish-, purplish-, and brownish-red and grayish-green dominantly argillaceous rocks that differ in details from place to place. No stratigraphic names are applied to main body of the group. Thickness of main body of group may be as much as 20,000 feet in Flathead region.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 560–569, pl. 28. In St. Regis-Superior area, Montana, divided into five formations (ascending): Spruce, Lupine quartzite, Sloway, Bouchard (all new), and unnamed feldspathic quartzite. Thickness about 16,000 feet. Overlies Wallace formation; underlies Paleozoic rocks.

Type locality: Slopes east and west of Rattlesnake Creek, northeast of Missoula, Mont.

Missoula[1] (limestone)

Carboniferous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Missouri Series

Missouri Group[1]

Upper Pennsylvanian: Iowa, Arkansas, Kansas, Missouri, Nebraska, and Oklahoma.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 114–116.

H. S. McQueen, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 25–29, pl. 5. Missouri series comprises (ascending) Pleasanton, Kansas City, Lansing, Pedee, Douglas, Shawnee, and Virgil series.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 657–706, chart 6. In upward order, Midcontinent time-rock divisions of the Pennsylvanian are designated as Morrowan, Lampasan, Desmoinesian, Missourian, and Virgilian.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 166–169. Chart shows classification and correlation of type Pennsylvanian section of eastern and western Pennsylvania with costandard sections of Appalachian and Midcontinent regions. Midcontinent region section comprises (ascending) Springer, Morrow, Lampasas, Des Moines, Missouri, and Virgil series. Missouri series is equivalent to Conemaugh series of Appalachian region and to most of Conemaugh of type section in western Pennsylvania. Upper Pennsylvanian. In south Ardmore basin, designated as reference section, beds of undoubted Missouri age, exceed 2,000 feet in thickness, or about 3,000 feet if full thickness of Hoxbar is included.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2020, 2021 (fig. 1), 2031 (fig. 4). For many years, all Pennsylvanian strata in northern Midcontinent area above so-called Des Moines group, or Lower Coal Measures, were known as Missouri group, or Upper Coal Measures. Boundary between these "groups" was drawn at base of Hertha limestone, or base of Kansas City formation of Missouri Geological Survey usage. Moore (1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.) relocated boundary to coincide with regional disconformity occurring 5 to 100 feet below Hertha limestone and classed redefined Des Moines as series. The former Missouri group, with addition of strata below and removal of beds above, was designated Missouri series. Studies prior to 1932 had revealed existence of widespread disconformity in middle part of old Missouri group and this seemed to rank in importance with other main time-rock boundaries in Pennsylvanian system. Deposits occurring between post-Desmoinesian disconformity and that in mid-part of Upper Pennsylvanian, are classed as belonging to Missourian series. This time-rock division comprises lower part of zone of *Triticites*. Missourian series, as recognized by State Geological Surveys in Midcontinent region, comprises (ascending) Pleasanton, Kansas City, Lansing, and Pedee groups. Underlies Virgilian series. Missouri Geological Survey restricts stratigraphic span of term so that future official usage in that State will conform to definition adopted in neighboring areas. Classification of Missourian strata in northern Oklahoma differs from interstate usage—in that terms Skiatook and Ochelata groups are used.

R. C. Moore and M. R. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 297. Approximately upper one-third of Pennsylvanian system belongs to Kawvian series (new). Kawvian rocks are divided into Missourian stage below and Virgilian stage above.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 78. Outcrop area of Missourian series in Kansas is a 20, to 40-mile wide belt, marked by east-facing escarpments, extending from Doniphan County to northeast Montgomery County in south. Thickness about 700 feet.

W. H. Bradley, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2284–2285. In Midcontinent region (including Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma) the U.S. Geological Survey uses following series subdivision of the Pennsylvanian: Morrow, Atoka, Des Moines, Missouri, and Virgil. Missouri series is late Pennsylvanian.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 23. In Iowa it is not possible to locate accurately unconformity separating Pedee group of Missouri series from Douglas group of Virgil series. If break in sedimentation exists, it may be above, within, or below sediments lying between Oread limestone of Shawnee group (Virgil series) and Stanton limestone of Lansing group.

Reference section: South Ardmore basin, Oklahoma. Named for development in northwestern Missouri and along Missouri River, Iowa.

Missourian Series or Stage

See **Missouri Series.**

†Missouri Mountain Formation[1]

Devonian and Pennsylvanian: Southwestern Arkansas.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557.

Missouri Mountain Slate or Shale[1]

Silurian: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 37.

B. H. Harlton, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 4, p. 781 (fig. 2), 787–788. In Ouachita Mountains, southeastern Oklahoma, approximately 100 feet thick and consists of green, hard siliceous shale, intercalated thin streaks of finely laminated chert, and locally lenses of conglomerate. Underlies Arkansas novaculite; unconformably overlies Polk Creek shale. Middle Silurian.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Silurian.

Named for exposures in Missouri Mountains, Polk and Montgomery Counties, Ark.

Mitchell Limestone[1]

Mississippian: Southern Indiana.

Original reference: C. E. Siebenthal, 1897, Indiana Dept. Geology and Nat. Resources 21st Ann. Rept., p. 296, 298.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 19. Abandoned by Indiana Geological Survey. Mitchell limestone was defined as overlying Bedford oolitic limestone (Salem), and its upper limit was not defined. Elrod (1899, Indiana Acad. Sci. Proc. 1888) restricted term to beds between Bedford oolitic limestone and Lost River chert. St. Louis group of Elrod contained Bedford oolitic limestone, Mitchell limestone, Lost River chert, and newly proposed Paoli limestone, which extended to the first Kaskaskia sandstone (now called Mooretown sandstone). Cumings (1922, Indiana Dept. Conserv. Pub. 21, pt. 4) returned to names St. Louis, Ste. Genevieve, and Paoli, but referred to them as divisions of the Mitchell limestone. Name Mitchell should have been discarded at this date.

Named for Mitchell, Lawrence County.

Mitchell Mesa Rhyolite (in Buck Hill Volcanic Series)

Mitchell Mesa Rhyolite (in Green Valley Volcanic Series)

Mitchell Mesa Welded Tuff (in Buck Hill Volcanic Series)

Oligocene and younger(?): Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Youngest unit in Green Valley series. Overlies Duff tuff (new).

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook], p. 13, 14 (table 1), 15, 17 (fig. 3), 21. Included in Buck Hill volcanic series (new) above Duff formation and below Tascotal formation (new). Consists of gray to pink rhyolite; thickness 37 to 150 feet. Youngest unit in series in Buck Hill quadrangle, although younger beds occur above the rhyolite in adjacent areas. [Authors make no reference to term Green Valley volcanic series.]

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1161–1162, pl. 1. Oligocene(?). Derivation of name given.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 543, 554–555, pl. 1. Described in Cathedral Mountain quadrangle. Renamed Mitchell Mesa welded tuff. Overlies Duff formation; underlies Tascotal formation. Suggested that units above Crossen trachyte are Oligocene and younger(?).

Named for Mitchell Mesa, northwestern Buck Hill quadrangle, Brewster County.

Mitchells Ferry Beds[1]

Eocene, upper: Eastern Texas and western Louisiana.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1317.

Named for exposures at Mitchell's Ferry, on Sabine River, Tex.

Mitten Black Shale Member (of Pierre Shale)[1]

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 107, measured sections. Thickness about 80 feet at Driscoll Creek, and about 75 feet a few miles north in sec. 5, T. 9 S., R. 56 E., Carter County, Mont. Thickens southward along west flank of Black Hills to about 500 feet near Thornton, Weston County, Wyo. Overlies Gammon ferruginous member.

H. A. Tourtelot, L. G. Schultz, and J. R. Gill, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B447–B448. Sharon Springs and Mitten black shale members of Pierre and Claggett shale are contemporaneous units of organic-rich black shale and beds of nonswelling bentonite. Silty and sandy beds overlying the Mitten along west side of Black Hills are 400 to 600 feet thick, and are eastward equivalents of nonmarine Judith River and Mesaverde formations of Montana and Wyoming.

Named for exposures along Driscoll Creek, locally known as Mitten Prong in sec. 22, T. 56 N., R. 68 W., Crook County, Wyo.

Mizpah Trachyte[1]

Tertiary: Central Nevada.

Original references: J. E. Spurr, 1911, Min. and Sci. Press, v. 102, p. 560–561; 1911, Report on geology of property of Montana-Tonopah Mining Co., Tonopah, Nev., published privately; 1915, Econ. Geology, v. 10, p. 713–769.

Named for Mizpah Hill, Tonopah district.

Moab Sandstone Member or Tongue (of Entrada Sandstone)[1]

Upper Jurassic: Central eastern Utah.

Original reference: A. A. Baker and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 8, p. 787, 799, 804, 805.

J. C. Wright and D. D. Dickey, 1958, Intermountain Assoc. Petroleum Geologists Guidebook 9th Ann. Field Conf., p. 173 (table 1), 178 (fig. 6), 179. In its central area, between Moab and Abajo Mountains, tongue joins with main mass of Entrada and displaces nearly entire Summerville formation. Thickness in this area about 150 feet and only a few feet of Summerville separates it from Morrison formation. Thins radially in all directions.

Named for exposures in Moab Valley.

Moat Volcanics[1]

Upper Permian: Central and southern New Hampshire.

Original reference: M. P. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, p. 89.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Extrusive phase of White Mountain plutonic-volcanic series of Mississippian(?) age. Includes flows, tuffs, and breccias composed chiefly of light-gray and red rhyolite, black basalt, and dark-gray andesite, also red trachyte.

U.S. Geological Survey currently designates the Moat Volcanics as Upper Permian on the basis of a study now in progress.

Type locality: On South Moat Mountain, North Conway quadrangle. Excellent section exposed from elevation 1,100 feet upwards on South Moat trail to Red Ridge.

Moberly Channel Sandstone[1]

Pennsylvanian: East central Missouri.

Original reference: C. F. Marbut, 1898, Missouri Geol. Survey, v. 12, pt. 2 (Sheet Rept. 12), p. 323, 324, 331–332, 350.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 28, p. 96–98, pl. 14. Near east edge of Stoutsville, Monroe County, the Moberly is in contact with Keokuk-Burlington cherty limestone; in sec. 28, T. 55 N., R. 9 W., where thickness is—80 feet, is in contact with Ardmore and Cheltenham formations: in some areas, may be in contact with the Warsaw.

Named from exposures at Moberly, Randolph County.

†**Mobile Formation**[1]

†**Mobile Bay Formation**[1]

Pleistocene: Southwestern Alabama.

Original reference: E. A. Smith, 1894, Am. Jour. Sci., 3d, v. 47, p. 285–296.

Borders Mobile Bay and extends up larger rivers to inland margin of coastal plain.

Mobridge Member (of Pierre Shale)

Upper Cretaceous: Central and southeastern South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 44–49, pls. 2, 3. A succession of highly calcareous shale, marl, and chalk beds which lie above Virgin Creek member (new) and below Elk Butte member (new). Thickness 90 to 230 feet.

A. L. Moxon, of O. E. Olson and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts. Tech. Bull., 2, p. 20, 25. Replaced by Interior member, which name has precedence.

J. P. Gries, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 34–35. Complete equivalence of all Interior beds to Mobridge member is in doubt; term Mobridge retained as originally defined.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 12 (table 1), 32 (table 3), 39. In Yankton area, member is as much as 18 feet thick, upper part removed by erosion. Overlies Virgin Creek member. Separated from sediments of post-Cretaceous age by Sharp unconformity. Commonly overlain by Ogallala formation of Pliocene age.

Type locality: Exposure above west end of highway bridge across Missouri River at Mowbridge. Exposure is in southeastern corner of Corson County opposite Mowbridge, Walworth County. Member extends from near North Dakota boundary to southern boundary of South Dakota.

Moccasin Limestone[1] **or Formation**

Middle Ordovician: Western Virginia, northwestern Georgia, and northeastern Tennessee.

Original reference: M. R. Campbell, 1894, U.S. Geol. Survey Geol. Atlas, Folio 12, p. 2.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 179–181. Name Lowville-Moccasin used in this report because equivalent of upper three-fourths of the Lowville in middle belts of Appalachian Valley is a red argillaceous limestone or calcareous mudrock facies, which has received name Moccasin limestone, a name extensively used in southwestern Virginia and northern Tennesse. Black River group.

B. N. Cooper, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1799–1800. Moccasin formation was originally described as a red argillaceous limestone with maximum thickness of 500 feet and was said to overlie blue flaggy Chickamauga limestone. Beds included in type Moccasin consist of 465 feet of red argillaceous limestone, calcareous mudrock, siltstone, and thin intercalations of bluish-gray calcilutyte. Type Moccasin is underlain by following stratigraphic zones (descending): 54 feet of fine-grained limestone containing *Camarocladia* cf. *C. gracilis*, 28 feet of coarse-grained limestone containing *Cryptophragmus antiquatus*, 40 feet of calcilutyte containing *Tetradium cellulosum*, 42 feet of red straticulate mudrock, and 5 feet of calcareous sandstone. Term Lowville-Moccasin has been used for a unit including all these zones. Gray limestone beneath body of red mudrock and above the red straticulate zone have been regarded as an intercalation of Lowville limestone within the Moccasin. *Camarocladia*-bearing limestones at top of so-called Lowville are undoubtedly part of blue flaggy Chickamauga limestone said by Campbell to underlie the Moccasin. Thus, the limestone which has been called Low-

ville, the red straticulate mudrock, and the sandstone were originally excluded from the Moccasin. So-called Lowville and Moccasin are not equivalent facies. Term Lowville-Moccasin should not be used.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, southwestern Virginia, is subdivided into 29 distinctive zones which are grouped into 8 formations. Detailed mapping led to recognition of inconsistencies in use of stratigraphic names, Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Name Lowville-Moccasin as used by Butts (1940) is not acceptable. In this paper, original usage of name Moccasin is revived and zones assigned to it are (ascending) red marble, red mudrock, and red siltstones (zones 26, 27, and 28). Thickness 328 feet. Overlies Witten limestone (new); underlies Eggleston formation.

Charles Butts and R. S. Edmundson, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1678. Includes Walker Mountain sandstone member (new) in upper part in Walker Mountain area, Virginia.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1176–1179. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Detailed sections measured along seven belts are compared with revised classification of Tazewell County, Va., (Cooper and Prouty, 1943). Blackford, Five Oaks, Lincolnshire, Thompson Valley (new), upper Peery, Benbolt, Wardell, Bowen, Witten, and Moccasin formations extend into northeast Tennessee. The Moccasin overlies Witten limestone and underlies Eggleston formation. Moccasin formation as herein defined is equal to upper part of Butts' "Lowville-Moccasin" in median and southeast belts. Butts included the red claystone of the Bowen in the Moccasin and the limestone intercalations in the "Lowville-Moccasin." The Moccasin is equivalent to "Bays" formation in its type area along Bays Mountain, southeast of Knoxville, Tenn. It is equal to the Bays as mapped in Knoxville folio (Keith, 1895) but not equivalent to the "Bays" of other folios in area, where it was mapped for the younger Juniata formation. Because Bays has been often misused and is not as widely used as Moccasin, it would best be discontinued. Commonly classed as Black River but may be earliest Trenton.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76. In Rose Hill oil field, Lee County, Va., includes Hardy Creek member (new) in upper part. Thickness 279 to 297 feet. Overlies Lowville limestone; underlies Eggleston limestone. Middle Ordovician.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 30–31, geol. map. Referred to as Lowville-Moccasin limestone. Moccasin and Lowville are facies of same general formation, the Lowville facies being bluish or dove-colored limestone and the Moccasin facies being predominantly red. Thickness 250 to 1,000 feet. Formation occupies strip on margin of belts (designated on map by symbol Oml), next to Stones River belt or to Knoxville dolomite. In complete sequence, as in McLemore Cove, Lowville-Moccasin succeeds Lebanon limestone. Where Newala limestone and Stones River group are absent, Lowville-Moccasin rests on Knox dolomite.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 83, pls. Moccasin limestone was named by Campbell (1894) for (Big) Moccasin Creek, Scott County, Va., northeast along strike of Clinch Valley belt. Rock is more limy shale and siltstone than limestone; hence, it is here

called Moccasin formation. As shown on present map, base is drawn below the lowest maroon and associated yellow shale and silty limestone. Campbell (1894, Folio 12; 1899, Folio 59) but not Keith (1896, Folio 27; 1901, Folio 75) drew base considerably higher, above a thick body of blue limestone, here included in lower part of Moccasin. Cooper (1942) prefers Campbell's original use, but for present map Keith's usage is more satisfactory. If necessary, name Moccasin as here used could be replaced by Bays formation. Equivalent to unit 3 of Chickamauga as mapped.

R. L. Miller and W P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104; 1954, U.S. Geol. Survey Bull, 990, p. 56–58. Replaced by Hardy Creek limestone and Ben Hur limestone (new) in Lee County, Va.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Referred to as formation Duffield quadrangle, Virginia. Present only in Copper Creek belt where it contains three members—lower red mudstone, middle limestone, and upper red mudstone. Overlies Witten limestone.

Named for occurrence on Moccasin Creek, Scott County, Va.

Moccasin Gap Member (of Unicoi Formation)

Lower Cambrian: Northeastern Tennessee.

H. W. Ferguson and W. B. Jewell, 1951, Tennessee Div. Geology Bull. 57, p. 11 (table 1), 22–23, pl. 1. A bed of coarse-grained quartzite about 50 feet thick that occurs about 1,000 feet or more from top of formation in parts of Del Rio thrust sheet. Commonly, the lower one of a group of quartzite beds in the formation; however, on northwest side of Yellow Springs Mountain at least two quartzite beds occur below the Moccasin Gap.

Well exposed at Moccasin Gap, Del Rio district, Cocke County.

Moccasin Springs Formation (in Bainbridge Group)

Middle Silurian: Southeastern Missouri and southern Illinois.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 16–18. Upper formation of Bainbridge group. Includes all Niagaran strata that overlie St. Clair formation in outcrop area in Cape Girardeau and Ste. Genevieve Counties, Mo., and Alexander and Union Counties, Ill. Directly underlies Fern Glen limestone in certain parts of Ozark border are in Illinois, in western St. Clair and Monroe Counties, and possibly in northwestern Jackson County. Consists predominantly of red and mottled red and gray to greenish-gray very fine grained silty argillaceous limestone and calcareous argillaceous siltstone; brick-red coloration is more prominent in basal part and purple mottling in upper. Thickness in Missouri outcrops 100 to 130 feet; over most of southern Illinois 160 to 200 feet; at type area, basal 5 to 15 feet not exposed. [Report deals with Niagaran reefs in Illinois and their relation to oil accumulation; much data relative to thickness and distribution of unit are based on subsurface studies.]

Type locality: In small box canyon in Mississippi River bluff in SE¼SE¼NW¼ sec. 24, T. 32 N., R. 14 E., Cape Girardeau County, Mo., (Jonesburg quadrangle) about 3 miles south of Moccasin Springs. [Locality described in detail by Ball, 1939, as type section of Bainbridge formation]. Formation crops out in Niagaran belts adjacent to the

Ozarks, but is partly or entirely replaced laterally by other rock types where Niagaran strata come to surface in Indiana, Kentucky, and Tennessee.

Modale sediments

[Miocene] (Luisian and Mohnian) : Southern California.

S. J. Kriz, 1955, Dissert. Abs., v. 15, no. 3, p. 393. Overlap other Miocene strata (Sespe, Vaqueros, Rincon) in area. Thins northeasterly and grades upward into strata that are probably nonmarine.

Area is Whitaker Peak-Reasoner Canyon in Ventura and Los Angeles Counties.

Modelo Formation[1]

Miocene, upper : Southern California.

Original reference : G. H. Eldridge, 1907, U.S. Geol. Survey Bull. 309.

Thomas Clements, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 2, p. 215–218. In Tejon quadrangle, underlies Ridge Route formation (new).

Peter Dehlinger, 1952, California Div. Mines Spec. Rept. 26, p. 5–6, pls. Term Modelo, as used in this paper [southern Ridge basin], denotes marine beds of upper Miocene age. This follows usage of Clements (1937) ; in recent years, name "Castaic formation" has also been applied but without adequate definition. Beds crop out in approximately three-quarters of area mapped. A conglomeratic member, ranging from a few feet to nearly 300 feet in thickness, lies at base of formation. Conglomeratic pecten bed, a few inches to about 8 feet thick overlies basal conglomerate and serves as excellent marker bed. Modelo section above pecten bed comprises alternating beds of sandstone, siltstone, and some shale. Thickness decreases markedly and uniformly in northerly direction. About 6,300 feet of lower part of formation is exposed in southern part of area where upper Modelo beds have been removed by erosion. In northern part of area entire thickness of formation is 2,000 feet. Underlies Ridge Route formation; overlies Martinez formation with marked angular unconformity east and northeast of area; southeast of area, overlies Mint Canyon formation, in some places conformable in other places unconformable. Modelo beds have been folded into asymmetrical northwestward plunging syncline, with gently dipping northeast flank and a much steeper dipping southwest flank. San Gabriel fault is parallel to synclinal axis, and lies about 1 mile west of it. Rocks exposed along eastern flank of syncline are chief subject of this report.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 6 (table 1), 24. Formation, in eastern part of Griffith Park area, Los Angeles County, lies unconformably on Feliz granodiorite (new) and on conglomerate of Hollycrest formation (new). Thickness about 1,000 feet. Consists of dark-gray organic and calcareous siltstone and shale, with lenses and thin beds of fine-grained argillaceous limestone; abundant wood fragments and fish scales; small basalt sill. Lithology not typical of rest of Modelo in Santa Monica Mountains nor of that in foothills east of Los Angeles River. Upper Miocene.

E. L. Winterer and D. L. Durham, 1954, California Div. Mines Bull. 170, map sheet 5. Along north slope of Santa Susana Mountains, underlies and interfingers with Towsley formation (new).

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. In Ridge basin area, beds formerly called Modelo are included in Castaic formation.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 69–74, pls. 1, 3. Formation crops out in two widely separated parts of San Fernando quadrangle, north and south of San Gabriel fault. South of fault, formation is 3,000 feet thick; overlies Topango(?) formation and underlies Elsmere member of Repetto formation. North of fault, formation is 500 feet thick, overlies Mint Canyon formation and underlies Repetto formation; in Bouquet Canyon unconformably underlies Saugus formation. Middle to upper Miocene.

E. L. Winterer and D. L. Durham, 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. On map accompanying this report [part of Ventura Basin in Los Angeles County], Modelo includes rocks in Santa Susana Mountains that Kew (1924) mapped as shale member of Modelo but does not include younger strata that he mapped as sandstone member of Modelo. These younger beds here included in Towsley formation. Modelo, as redefined in this report, is chiefly siltstone. Complete section is exposed near crest of Santa Susana Mountains in vicinity of Rice Canyon. Basal unit there is about 300 feet thick and consists of medium- to coarse-grained sandstone with lenses of pebble conglomerate. Overlying is sequence of beds about 2,700 feet thick consisting of gray to brown siltstone and mudstone that is commonly thin bedded. Light-colored silty to coarse-grained sandstone beds as much as several feet thick are sparingly interbedded with siltstone. Thickness increases westward from Newhall to at least 5,000 feet, but no wells have been drilled to base of formation in western part of area so its maximum thickness is not known. Underlies and interfingers with Towsley formation. Upper Miocene.

Well exposed in Hopper Canyon and head of Modelo Canyon, Ventura County.

Modesto Formation

Pleistocene, upper: Central California.

S. N. Davis and F. R. Hall, 1959, Stanford Univ. Pub. Geol. Sci. v. 6, no. 1, p. 6, 12, 20–22, pls. 2, 3. Consists of silt and sand; beds are lenticular and commonly crossbedded; composition and texture of formation suggest that it was deposited as thin series of coalescing alluvial fans. Overlies Riverbank formation (new); covered by Recent alluvium. Modesto and Riverbank formations together represent the Victor formation and can be traced northward into Mokelumne area.

Type section: NE¼SE¼ sec. 2, T. 4 S., R. 9 E., Ceres quadrangle. Exposed along private road which goes down south bluff of Tuolumne River in eastern Modesto. Crops out in area extending from slightly east of towns of Modesto and Turlock nearly to San Joaquin River; tongues of formation also extend eastward along streams of Sierran foothills.

Modesto Formation (in McLeansboro group)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 36–38, 48–50 (table 1), pl. 1, geol. sections. Includes all strata from top of Danville (No. 7) coal member of Carbondale formation to base of Shoal Creek limestone member of Bond formation (new). Predominantly gray shales with sandstones locally prominent. Commonly about 300 feet thick; maximum thickness more than 400 feet in

southeastern part of state; about 200 feet thick in local occurrences in northern Illinois. Members—southeastern Illinois—(ascending) Piasa limestone, De Graff coal (new), Pond Creek coal (new), Lake Creek coal (new), West Franklin limestone, Trivoli sandstone, Chapel (No. 8) coal and New Haven coal; southwestern Illinois—Piasa limestone, Rock Branch coal (new), Athensville coal (new), Scottville limestone, Trivoli sandstone, Chapel (No. 8) coal, Carlinville limestone, Burroughs limestone, Womac coal (new), Macoupin limestone, and New Haven coal; western and northern Illinois—Farmington shale, Gimlet sandstone, Lonsdale limestone, Exline limestone, Trivoli sandstone, Chapel (No. 8) coal, and Cramer limestone (new); eastern Illinois—Chapel (No. 8) coal and West Franklin limestone. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type locality: Sec. 16–17, T. 12 N., R. 9 W., Macoupin County. Named for town of Modesto.

Modin Formation[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. F. Sanborn, [1953], Stanford Univ. Abs. Dissert., v. 27, p. 436; 1960, California Div. Mines Spec. Rept. 63, p. 6, 8–14, pl. 1. In Big Bend quadrangle, subdivided into (ascending) Hawkins Creek, Devils Canyon, and Kosk members (all new). Overlies Brock shale; underlies Arvison formation (new). Estimated maximum thickness 5,500 feet. Upper Triassic.

Named for exposures near mouth of Modin Creek at its confluence with Squaw Creek in northeast part of Redding quadrangle, Shasta County.

Modoc Basalt[1]

Pleistocene and Recent: Northern California.

Original reference: H. A. Powers, 1932, Am. Min., v. 17, no. 7, p. 253, 273, map.

C. A. Anderson, 1941, California Univ., Dept. Geol. Sci. Bull., v. 25, no. 7, p. 367–372, geol. map. Described and mapped in Medicine Lake Highland area. Basaltic eruptions likely range in age from late glacial stage to within last few centuries.

Medicine Lake Highland area is in center of Modoc Lava Bed quadrangle.

Modoc Lavas[1]

Tertiary(?): Northwestern Nevada.

Origonal reference: R. W. Chaney, 1924, Geol. Soc. America Bull., v. 35, p. 162–163. Washoe County.

Modoc Limestone[1]

Lower Mississippian: Southeastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 136. Name applied locally to Mississippian strata in southeastern Arizona. Carries *Spirifer centronatus* fauna.

Exposed south of Modoc Mountain in Clifton-Morenci region.

Modoc Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: P. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 30–31.

Occurs in a single dike found in Modoc mine about one-half mile due north of Ward, Boulder County.

Moenave Formation (in Glen Canyon Group)

Upper Triassic(?): Northeastern Arizona and southern Utah.

G. A. Williams, 1954, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–440, p. 34. Overlies Wingate sandstone; underlies Kayenta formation.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2517, 2519. Includes two members: lower, sequence of sandstone and siltstone, Dinosaur Canyon sandstone; and upper, Springdale sandstone. Overlies Chinle formation (redefined); underlies Kayenta formation (redefined).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 12–18, 62, 63. At type locality, herein designated, is almost entirely sandstone and includes both Dinosaur Canyon and Springdale members. Thickness 20 to 385 feet. Basal Dinosaur Canyon intertongues with upper part of Lukachukai member of Wingate sandstone; Springdale member is gradational with overlying Kayenta.

R. A. Cadigan, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–700, p. 126 (fig. 26), 127. In St. George area, Utah, includes middle member, Whitmore Point.

Type locality: Near Moenave, 6 miles west of Tuba City, Coconino County, Ariz.

Moenkopi Formation[1]

Moenkopi Group

Lower and Middle(?) Triassic or Triassic(?): Arizona, California, Colorado, Nevada and southern Utah.

Original reference: L. F. Ward, 1901, Am. Jour. Sci., 4th v. 12, p. 401–413.

H. Bassler and J. B. Reeside, Jr., 1921, U.S. Geol. Survey Bull. 726–C, p. 90–92. Includes Virgin limestone member and Shnabkaib shale member (both new).

J. B. Reeside, Jr., and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 5, p. 797. Includes Sinbad limestone member (new) in San Rafael Swell.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 477–478. As Woodside, Thaynes and Ankareh (restricted) formations are traced eastward along south flank of Uinta Mountains each becomes thinner and Thaynes limestone tongue disappears completely. It is clear from these relationships that redbeds east of that point are in part equivalent to Ankareh (restricted) sandstone and shale, and in part to Woodside shale. Neither term alone can be appropriately applied to them. These beds are some times designated Moenkopi, but this name is not completely satisfactory because all of Moenkopi, at least in Zion area, is younger than Woodside shale. Since terms Woodside, Ankareh, or Moenkopi are not appropriate, these beds are herein named Red Wash formation.

H. E. Gregory and N. C. Williams, 1947, Geol. Soc. America Bull., v. 58, no. 3, p. 224–226, pl. 1. Formation described in Zion National Monument where it constitutes a regular north-south belt about 1 mile wide paralleling trend of Hurricane fault. Maximum thickness 1,452 feet. Six subdivi-

sions recognized (ascending): Timpoweap member (new), lower red member, Virginia [Virgin] limestone member, middle red member, Shnabkaib member, and upper red member. Overlies Kaibab limestone and underlies Shinarump conglomerate.

W. F. Scott, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1530. In central Wasatch Mountains, Thaynes formation thins and disappears to east and southeast where underlying Woodside and overlying Timothy join to constitute Moenkopi formation. Thus combined Woodside, Thaynes, and Timothy are recognized as constituting Moenkopi group.

E. D. McKee, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 85–88. Three members recognized in Little Colorado River valley (ascending): Wupatki (new), Winslow (new), and Holbrook. These do not correlate exactly with any of the six members of formation described by Gregory in southwestern Utah.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34, 35. In Muddy Mountains, Nev., 1,500 to 2,000 feet thick; disconformably overlies Kaibab limestone and underlies Chinle formation with Shinarump member at base. In Frenchman Mountain area, underlies Thumb formation (new) with angular unconformity.

S. J. Poborski, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1342; 1953, Plateau, v. 25, no. 4, p. 69; 1954, Geol. Soc. America Bull., v. 65, no. 10, p. 972. Virgin limestone member is herein given formational rank. Suggested that term Moenkopi group be used in St. George area for all lithologic units that have in past been known collectively as Moenkopi formation. Farther east, where Moenkopi is not readily divisible, name formation should be retained.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, 133p. Formation of Triassic age. Composed of series of deposits that form wedge thinning eastward from a maximum of about 2,000 feet in western Colorado, northeastern Arizona, and western New Mexico. Partly marine and partly continental in western sections; entirely continental in east. Invertebrate faunas indicate deposition began either during or preceding middle Early Triassic and continued into late Early Triassic and probably into Middle Triassic Time. Vertebrate faunas indicate an Early Triassic and probably, in part, Middle Triassic age. Three major transgressions and three regressions across southern Utah and northern Arizona are indicated. In southwestern Utah, subdivided into (ascending) Timpoweap, lower red, Virgin limestone, middle red, Shnabkaib, and upper red members. Present classification in Little Colorado River valley is (ascending) Wupatki, Moqui (new), and Holbrook members.

R. C. Robeck, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 10, p. 2499–2506. In San Rafael Swell, Utah, unconformably underlies Temple Mountain member (new) of Chinle.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 47–48, pl. 1. Formation described in Ivanpah quadrangle and mapped in San Bernardino County, Calif.

J. A. Momper, 1957, Four Corners Geol. Soc. [Guidebook] 2d Field Conf., p. 86 (chart), 91, 92. Stratigraphically extended to include Agua Zarca and Salitral members, units formerly included in Chinle.

M. E. Cooley, 1958, Plateau, v. 31, no. 1, p. 7–15. In Apache and Navajo Counties, Moenkopi unconformably underlies Mesa Redondo member

(new) of Chinle; Moenkopi incomplete in this area; includes Holbrook member at top.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 101–108. Discussion of stratigraphy of Triassic sequence in Wasatch and Uinta Mountains. Recommends use of name Moenkopi, Shinarump(?), and Chinle in eastern Uinta Mountains and considers revisions and introduction of new formational named by Williams (1945) and Thomas and Krueger (1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8) to be neither necessary nor desirable.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1835–1851. In salt anticline region of Utah and Colorado, formation is subdivided into (ascending) Tenderfoot, Ali Baba, Sewemup, and Pariott members (all new). Underlies Chinle; overlies Cutler. Wherever Hoskinnini or Tenderfoot is present, age of Moenkopi is Triassic(?) and Early and Middle(?) Triassic.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologist Bull., v. 43, no. 8, p. 1852–1868. Hoskinnini tongue of Cutler formation redefined as member of Moenkopi; laterally continuous with Tenderfoot member.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Lower and Middle(?) Triassic.

Named for Moenkopi Wash, Grand Canyon area, Arizona.

Moffett formation

[Upper Ordovician(?)]: Northern California.

F. G. Wells, G. W. Walker, and C. W. Merriam, 1959, Geol. Soc. America Bull., v. 70, no. 5, p. 645. States that name is preempted and name Duzel proposed for the phyllitic sequence. [Compiler was unable to locate earlier use of name.]

Area under discussion is northern Klamath Mountains.

Mogadore Till

Pleistocene (Wisconsin): Northern Ohio and northwestern Pennsylvania.

V. C. Shepps and others, 1959, Pennsylvanian Geol. Survey, 4th ser., Bull. G–32, p. 10 (fig. 3). 24, 29. Gray to bluish-gray weakly calcareous moderately pebbly sandy till deposited during Mogadore advance in Tazewell time. Mogadore advance preceded Kent advance.

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 3, 5. Thickness at type section 23 feet. Mogadore, especially on uplands commonly overlies bedrock. Where it does not form surface, it is unconformably overlain by Kent till. Type section designated.

Type section: South wall of shale pit of Universal Clay Products Co., Springfield Township, 1 mile west of center of Mogadore, Summit County, Ohio.

Mogollon Andesite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for prominent outcrops near town of Mogollon, Catron County.

†Mohave Formation[1]

Eocene: Southern California.

Original reference: J. H. Smith, 1900, Jour. Geology, v. 8, p. 455–456.

D. I. Axelrod, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1935. Eocene age considered definite on basis of floral fauna evidence.

Described as occurring on north slope of El Paso Range, between Mojave and Owen's Lake.

†Mohawk Group[1]

Lower and Middle Ordovician: New York.

Original reference: J. Hall, 1842, Am. Jour. Sci., 1st, v. 42, p. 52. Mohawk Valley.

Mohawk Lake Beds[1]

Pliocene-Pleistocene or Pleistocene: Northern California.

Original reference: H. W. Turner, 1891, Washington Philos. Soc. Bull. 11, p. 385–410.

Cordell Durrell, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 256 (footnote). Age believed to be Pleistocene. Generally accepted Miocene age is based upon plant fossils from beds overlain by andesite breccia and not Mohawk lake beds which are younger than the postandestic faulting which created the basin in which they are deposited.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Described as about 1,000 feet of lacustrine deposits. Unconformable above Warner basalt. Probably Pliocene and Pleistocene.

Cordell Durrell, 1959. California Univ. Pub. Geol. Sci., v. 34, no. 3, p. 180–182. Mohawk lake beds are Plio-Pleistocene or Pleistocene and not Miocene as formerly believed. Miocene Mohawk flora, thought to have occurred in the Mohawk lake beds, comes from Bonta formation.

Occurs in Mohawk Valley and vicinity, Plumas County.

†Mohawk Limestone[1]

Middle Ordovician: Eastern New York.

Original references: T. A. Conrad, 1839, Philadelphia Acad. Nat. Sci. Jour., v. 8, pt. 1, p. 228–235; 1839, New York Geol. Survey 3d Ann. Rept., p. 57–66.

Named for occurrence in Mohawk Valley.

†Mohawk Slate Group[1]

Upper Ordovician: Eastern New York.

Original reference: W. W. Mather, 1841, New York Geol. Survey 5th Ann. Rept., p. 91–94, 98–101, 129.

†Mohawk System[1]

Upper Cambrian, Ordovician, and Silurian: New York.

Original reference: T. A. Conrad, 1839, Philadelphia Acad. Nat. Sci. Jour., v. 8, pt. 1, p. 228–235.

Mohawkian Series[1]

Middle Ordovician: North America.

Original references: James Hall, 1842, Am. Jour. Sci., 1st, v. 42, p. 52; J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 876, 877.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1400–1404. Rocks younger than Canadian and Beekmantownian and older than Cincinnatian series are commonly referred to as Middle Ordovician, and placed in two series, Chazyan and Mohawkian. Proposed that latter be divided into Bolarian and Tretonian series. Mohawkian series originally included higher Black River Lowville ("Birdseye") and Chaumont

("Black River" restricted) limestones and Trenton limestone; older Pamelia limestone is part of defined Black River. Black River and Trenton formations in New York and Ontario lie with regional unconformity on Chazyan, Canadian, Upper Cambrian and Precambrian.

C. G. Winder, 1953 (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1493; 1955, Western Ontario Univ. Dept. Geology Contr. No. 9, p. 1–11, maps. Mohawkian sediments in New York, Ontario, and Ottawa-St. Lawrence Lowland have been interpreted for about 100 years as sequence of successively younger formations, and all have been named as such. Reconstruction of paleoecological conditions, based on recent study in Ontario, indicates that Black River and Trenton groups were deposited simultaneously. Each "formation" is a phase of deposition, of which lithology and fauna reflect the environment. Black River sediments are near shore equivalents of the Trenton sediments. Mohawkian was deposited in a transgressive sea, whereas repetition of Mohawkian phases in Cincinnatian in reverse order indicates a regressive sea. Similar environmental conditions during the transgressive and regressive stages of Middle-Upper Ordovician sea explain why Cincinnatian fauna is "recurrent" Mohawkian fauna. For Middle and Upper Ordovician, all time terms other than Mohawkian and Cincinnatian should be invalidated. Black River and Trenton groups are rock units—not time rock units.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7–9, correlation chart. Mohawkian series comprises (ascending) Whiterock, Marmor, Ashby, Porterfield, and Wilderness stages (all new). Terms Chazy and Black River discarded. Kay's (1948) term Bolarian considered unsatisfactory.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. Discussion of classification of Ordovician system in North America. The Chazyan, Blackriveran, and Trentonian succeed the Canadian in New York, and are classified as separate series, or as two series (Chazyan and Mohawkian), or as one (Champlainian).

Named for Mohawk River, N.Y.

Mohegan Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1921, New York State Mus. Bull. 225, 226, p. 29, 35, 40, 42, 43, 64.

D. H. Newland and C. A. Hartnagel, 1939, New York State Mus. Bull. 319, p. 93. Incidental mention as Mohegan yellow granite. Discussion of mining and quarry industries.

Named for exposures about Mohegan Lake, West Point quadrangle.

†Mohegan Bluff Beds[1] or Series[1]

Pleistocene: Rhode Island.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 978, table opposite p. 988.

Typically exposed in upper part of Mohegan Bluffs.

Moheganter Shales and Sandstones (in Hamilton Group)[1]

Middle Devonian: Eastern New York.

Original reference: A. W. Grabau, 1930, Sci. Quart, Nat. Univ. Peking, China, v. 1, no. 4, p. 14.

Moheganter Mountain.

Mohnian Stage[1]

Miocene, upper: California.

Original reference: R. M. Klienpell, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 3, p. 376–378.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 127–131, figs. 4, 14 (correlation chart). Spans interval between Luisian stage below and Delmontian stage above. Comprises three zones: *Bolivina modeloensis and Bulimina uvigerinaformus* in lower part, and *Bolivina hughesi* in upper part. Systematic catalogue. Type locality designated.

Type locality: Exposures along Topanga Canyon Road immediately north of Mohnian Spring, Los Angeles County.

Moingona till[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203.

Moingonan glacial epoch[1]

Pleistocene: Iowa.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44, p. 139–142.

Named after the old pre-glacial Moingona River, in a tributary deep gorge of which the till remnant is now revealed.

Mojado Formation

Lower Cretaceous: Southwestern New Mexico.

R. A. Zeller, Jr., 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 10 (chart). Name appears only on chart. Consists of interbedded sandstone, shale, and clay. Thickness over 5,000 feet. Underlies Tertiary fanglomerate; overlies U Bar formation (new).

Big Hatchet Peak quadrangle, Hidalgo County.

Mokapu Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper; Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 116. Nepheline basalt lava. Two outcrops described by Stearns (1935) who believed them to be part of single flow, probably from a cone subsequently destroyed by sea. Winchell (1947, Geol. Soc. America Bull. 48, no. 1) showed that lava of one outcrop contains melilite and the other does not; hence, the two outcrops are parts of different flows. He suggested that flow containing melilite may be part of same flow as Mokulea basalt, and and the other correlative with Ulupau tuff.

Named for Mokapu Peninsula. Exposed only in two small outcrops where it projects through emerged reef lmestone on Mokapu Peninsula on northeast coast of Oahu about 11½ miles northwest of Makapuu Head.

Mokelumne Formation

Permian: Northern California.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, pl. 1 facing p. 128. Shown on structure section across El Dorado County. Underlies or is in fault contact with Cosumnes formation.

Mokelumne Hill Quartz Diorite

Pre-Tertiary: Central California.

R. L. Rose, 1959, California Div. Mines Spec. Rept. 60, p. 12–13, 15 (fig. 3). Gray quartz diorite. At contact with Calaveras quartz-garnet-mica schist, intrusive rock is garnetiferous hornblendite.

Occurs in stock major part of which is east of Mokelumne Hill, Calaveras County. Well exposed in secs. 13 and 24.

Mokolea Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 116–117. Melilite-nepheline basalt lava flow remnant. Extent noted.

Named for Mokolea Rock in Kailua Bay which is composed of it. Exposed only in Mokolea Rock, a small stack about 1 mile east of Mokapu Peninsula and 10 miles northwest of Makapuu Head, and possibly a small outcrop on Mokapu Peninsula.

Moku Manu Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 117. An eroded remnant of tuff and cinder cone containing fill of nepheline basalt lava; tuff is brown and contains numerous angular blocks of basalt of Kailua volcanic series, and small amount of marine calcareous material. Thickness unknown; the two islets are 202 and 132 feet high respectively, but rocks extend below sea level. Advanced state of erosion suggests it is older than Ulupau tuff.

Named after the Moku Manu islets on which it occurs. Islets are three-quarters mile north of Mokapu Point and 12½ miles north-northwest of Makapuu Head.

Mokuone Member (of Makaweli Formation)

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 2; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 118. Sedimentary breccia and conglomerate beds intercalated with lavas of Makaweli formation, and breccia masses at contact of rocks of formation with older rocks. Maximum thickness of basal breccia 1,000 feet, and of conglomerate beds about 50 feet.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 47–49, table facing p. 20, pl. 1. Includes talus breccia at contact of Makaweli formation and layers of conglomerate interbedded with lavas of formation. At type locality, two layers of conglomerate are intercalated with lavas. In southeast wall of valley, 1.7 miles above junction of Mokuone and Makaweli Streams, bed of coarse conglomerate is exposed 75 feet above stream level; bed is about 25 feet thick; second bed of conglomerate, 10 feet thick, is exposed 25 feet higher in same wall.

Conglomerates can be followed along canyon walls in both directions; beds thicken upstream and thin seaward. Thickness about 1,000 feet.

Type locality: Along Mokuone Valley.

Molalla Formation

Pliocene, lower and middle: Northwestern Oregon.

E. M. Baldwin, 1950, Oregon Country Geol. Soc. News Letter, v. 16, no. 11, p. 92. Mentioned in discussion of Molalla leaf locality. Unconformably overlies platy andesite and Columbia River basalt in Molalla River valley.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 13–14, pl. 2. Formation comprises sandstone, conglomerate, and silt which are highly tuffaceous; sandstone and conglomerate occur in lower part of the section; beds show cut-and-fill structures and torrential bedding; sandstone is friable and contains fossil leaves; locally a massive basic volcanic breccia is interbedded with the conglomerate; light-colored tuffs in upper part of formation are nearly identical to and probably grade laterally into the Fern Ridge tuffs farther south. Conformably underlies Boring lava of Pliocene age; unconformably overlies Eocene basic lavas, breccias, and associated sediments. Chart shows Molalla as lower and middle Pliocene. Name was used by R. L. Nichols (1944) in unpublished report.

D. E. Trimble, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1667. Underlies Rhododendron formation. Middle Miocene.

Well exposed along Molalla River from a point below town of Molalla upstream to a point above Trout Creek, Clackamas County.

Molas Formation[1]

Pennsylvanian: Southwestern Colorado.

Original references: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120; 1905, Geol. Soc. America Bull., v. 16, p. 470–496.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2166–2168. Described in Paradox Salt basin. Divisible into three members. Lowest, varicolored claystone, predominantly red, containing solution-rounded limestone fragments of Mississippian age which appear to be limestone-chert regolith cemented by calcareous silty claystone; regolith fills depressions on karst surface developed in upper 10 to 100 feet of Leadville limestone. Middle, variable siltstone and shale with some intraformational conglomerate. Upper, not everywhere present, is marine red and green shale-sandstone sequence containing fossils of Des Moines age. Thickness, wedge-edge to 200 feet. Underlies Pinkerton Trail formation (new). Formation contains series horizons between Morrow and Atoka, and Atoka and Des Moines. This is section well exposed at type locality. Inasmuch as Molas shale was almost completely covered in areas where Hermosa formation was first studied, it was not described or included in original Hermosa section. It is now recognized that Molas is found only where Mississippian limestone is or was present beneath Pennsylvanian strata.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2056 (table), 2064–2065. In revised classification, Molas formation underlies Pinkerton Trail formation of Hermosa group; overlies Leadville limestone.

W. M. Merrill and R. M. Winar, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2107–2131. Includes three members, lowest of which is here named Coalbank Hill. Thickness as much as 140 feet. Overlies Leadville or Ouray limestone. Underlies Pinkerton Trail formation. Mississippian-Pennsylvanian boundary probably within Coalbank Hill member or overlying middle member.

Named for exposures on Molas Lake, Needle Mountains quadrangle, in San Juan Mountains on Durango-Silverton Highway.

Moleen Formation (in Ely Group)

Lower Pennsylvanian (Springeran-Atokan) : Northeastern Nevada.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2234–2243, figs. 2, 5. Thick widespread calcite limestone sequence, which is alternately very cherty and noncherty. Limestones principally light olive gray to grayish black, fine to coarse textured and weather light gray or bluish gray. Light-olive to medium-gray fresh colors predominate in type section. Calcarenite most prevalent with lesser amounts of calcilutite, calcirudite, and rare coquinite, fusulinal, and corraline beds. Calcarenites and calcirudites are clastic and detrital varieties. Divided into three members based on gross lithologic and faunal characters. Lower transitional member characterized by fossiliferous limestones with thin quartz-silty and sandy interbeds. Middle member of thick featureless cherty and noncherty limestone rather barren of good fossils and contains less silt, sand, and conglomerate impurities than others. Upper member contains slightly more clastic quartz and conglomerate and little less nodular chert than middle member and contains lowest abundant fusulinids. Thickness 1,270 feet in type section. Underlies Tomera formation (new) ; conformably overlies Tonka conglomerate (new) at several points. Moleen and Tomera together are practically equivalent to Ely limestone of east-central Nevada. Proposed to raise Ely to rank of group in Elko and north Diamond Ranges to include the Moleen and Tomera.

Type section: On west side of Grindstone Mountain, formerly Moleen Peak, NW¼ sec. 33, and on north end of Tomera Ridge, just east of that mountain, NE¼ sec. 34, T. 33 N., R. 54 E. Relation of top few units to overlying Tomera formation seen in Tomera Ridge. Named for Moleen Siding on Southern Pacific Railroad, 2 miles northeast of Carlin Canyon, SW¼ sec. 18, T. 33 N., R. 54 E.

Molly Gibson Formation (in Patagonia Group)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Composed of gray arenaceous limestone and brown clay. Younger than Hay Flat limestone (new).

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 30–31. Composed mainly, and especially in lower part, of brown, gray, chocolate, and red argillaceous and siliceous shales. In upper part of formation are bluish limestone beds; thin and soft varicolored arenaceous and argillaceous shales; and soft and crumbly, light-gray and pinkish arenaceous limestone beds. Thickness 1,000 feet. In fault contact with Paleozoic strata near Molly Gibson mine. Geographic area given.

Near Molly Gibson mine in Patagonia Mountains.

Mona Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1917, West Virginia Geol. Survey Rept. Braxton and Clay Counties, p. 191.

Probably named for Mona, Monongalia County.

Mona Schist[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 490.

W. T. Stuart, E. W. Brown, and E. C. Rhodehamel, 1954, Michigan Dept. Conserv, Geol. Survey Div. Tech. Rept. 3, p. 11 (table 3). Table of geologic formations shows Mona schist, Keewatin series, at base of section below Kitchi schist.

Named for exposures on Mona Hills, southwest of Marquette, Marquette County.

Mona Shale[1]

Oligocene: Panamá and Costa Rica.

Original reference: D. F. MacDonald and others, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 364.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 340. In original reference, name Mona shale, in expression "Watsi and Mona shales" appeared only on table, showing that shales overlie Sensori agglomerate and limestone [Sinosri formation] and underlie Tigre limestone. Fine-grained rocks for which MacDonald used name Mona shale underlie Tigre limestone in hills in Bocas del Toro area, about 15 kilometers southwest of mouth of Río Sixaola. Both underlying Tigre limestone and overlying Sinosri formation are considered of Oligocene age; therefore, Mona shale is assigned to Oligocene.

Mona Creek is local name for small stream flowing eastward into Cano San San, Bocas del Toro Province, Panamá.

Monacillo Formation

Upper Cretaceous: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 3), 10 (fig. 4), 19–20, pl. 2. Predominantly a continental deposit, ranging in texture from siltstone to conglomerate; commonly red to purple. Thickness near Trujillo Alto Road about 900 feet. Overlies Frailes formation (new); underlies Trujillo Alto limestone, contacts apparently conformable.

Named from Barrio Monacillo, southwest of Río Piedras.

Monahans Formation

Quaternary: Western Texas.

R. M. Huffington and C. A. Albritton, Jr., 1941, Am. Jour. Sci., v. 239, no. 5, p. 329–331. A dune deposit consisting of massive loose sand of gray to light golden color. Maximum observed thickness 6 feet; probably more than 30 feet in places. Overlies Judkin formation, contact sharp and irregular.

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Type locality: South side of Highway 80, 6½ miles northeast of Monahans, near Sand Hills, Ward County.

†Monarch Formation

Upper Devonian: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 55, no. 12, pt. 1, p. 1742. Listed with names not appearing on Devonian correlation chart. Heading of column reads Upper Devonian.

Mapped at and around village of Monarch, southwestern corner Fort Benton quadrangle.

Monarch Glacial Stage

Pleistocene (late Wisconsin): North-central Colorado.

R. L. Ives, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 75. Youngest of four ice advances recognized in Monarch Valley. Evidenced by terminal moraine. Younger than Arapaho glacial stage (new).

R. L. Ives, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1060, 1062. Time covered by deposition of Monarch moraine.

In Monarch Valley, Grand County.

Monarch Mill Formation

Pliocene, lower to middle: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 186–188, figs. 10, 11. Divided into six unnamed mappable units (ascending) tuffaceous clay, conglomerate, 1,350 feet; sandstone, 350 feet; rhyolite tuff and pumice, 275 feet; diatomite and tuffaceous silt, 200 feet; conglomerate, 100 feet; rhyolitic clay, pumice, sandstone, and silt, 300 feet. Aggregate thickness 2,575 feet. Overlies Middlegate formation (new) with contact gradational; unconformably underlies Quaternary deposits.

Exposed along U.S. Highway 50 in region from one-half mile east of Middlegate to 3 miles farther east, where it disappears under alluvial cover. Name taken from site of an old stamp mill which is in upper part of formation, 200 yards south of the highway, Churchill County.

Monastery Formation

Lower Cambrian: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 42–49. Dominantly pale-green quartz-chlorite-muscovite schist. Basal conglomerate and schistose sandstone unit is Tyson member (new); intermediate black graphitic quartz-muscovite schist is Battell member (new). Thickness 1,400 to 1,700 feet. Overlies Mount Holly complex with no structural discontinuity; underlies Granville formation (new).

Named from exposures on north-east slopes of Monastery Mountain. Exposed in wide north-south trending belt between Monastery Mountain and Pine Gap and between western slopes of Gillespie Mountain and eastern slopes of Burnt Hill, Rochester-East Middlebury area.

Mon Bluff Formation

Miocene, upper: Southern California.

Otto Hackel and K. F. Krammes, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 3–4, road log (p. 1, 6), geol. map. A unit about 50 feet thick that unconformably overlies Round

Mountain silt; underlies Kern River formation. In vicinity of Poso Creek, consists of sandy ash and forms conspicuous ledge; southward, in vicinity of Sharkstooth Hill, and along Kern River unit changes facies to a coarse conglomeratic white sand; here it has been called "Kern Park formation" or "Cottonwood Creek formation."

Present in Round Mountain area, Kern County. Probably named for occurrence in vicinity of Mon Canyon.

Monclova Sandstone[1]

Lower Devonian: Northwestern Ohio.

Original references: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 20; 1890, Ohio Geol. Survey, 3d Organization, 1st Ann. Rept., p. 24.

Named for Monclova, Lucas County.

Moncrief Member (of Wasatch Formation)

Moncrief Gravel

Eocene, lower: Central northern Wyoming.

R. P. Sharp, 1948, Jour. Geology, v. 56, no. 1, p. 1–14. Name Moncrief gravel applied to thick deposits of coarse bouldery gravel with interbedded silt, sand, and arkose layers that compose large piedmont ridges and spurs along east front of Big Horn Mountains. Consists predominantly of granitic rock fragments derived from Precambrian core of range. Thickness at least 1,200 feet on Clear Creek; 1,400 feet at Moncrief Ridge. Present topographic surface determines top of unit; base and lateral margins are gradational into finer grained "Wasatch" except where gravel lies with angular unconformity on Eocene Kingsbury conglomerate and older formations or is in fault contact with pre-Tertiary rocks of the mountains. May be coarse phase of the Wasatch. Demorest (1938, unpub. thesis) applied name Clear Creek gravels to these deposits; because name Clear Creek is preoccupied, name Moncrief is proposed.

J. D. Love and J. L. Weitz, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–122. Allocated to member status in Wasatch formation. Overlies Kingsbury conglomerate member.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 64–66. Described in Buffalo-Lake De Smet area, Wyoming, where it is as much as 1,400 feet thick and includes beds of conglomerate made up of cobbles and boulders of Precambrian crystalline rocks. Rests on Kingsbury conglomerate member with angular discordance near Bighorn Mountains; eastward both members grade laterally into a conformably, nonconglomeratic sequence of sandstone, shale, and coal that makes up Wasatch formation east of area.

Type locality: North face of Moncrief Ridge, secs. 34 and 35, T. 54 N., R. 84 W., Sheridan County.

Moneta Biotite-Hornblende Gneiss[1]

Moneta Gneiss (in Virginia Blue Ridge Complex)

Precambrian: Central western Virginia.

Original reference: A. A. Pegau, 1932, Virginia Geol. Survey Bull. 33, p. 2–26, 83, pl. 4.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 9, 13, 48. In this report [Lynchburg quadrangle], name Moneta gneiss is modified to include Reusens migmatite facies, Bloomer and Werner's

(1955, Geol. Soc. America Bull., v. 66, no. 5) "basement complex gneiss," and all other prevailingly nongranitoid rocks in region which are older than Marshall-Lovingston granitization. Moneta gneiss, granitized in part in development of Pedlar formation and Marshall gneiss, is possibly early Precambrian.

Named from Moneta, Bedford County.

Monitor Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1915, West Virginia Geol. Survey Rept. Boone County.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. In this report the Kanawha is considered a group.

Named for exposures at Monitor, Logan County.

Monitor (Lower) Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. D. Teets, Jr., 1919, West Virginia Geol. Survey Rept. Fayette County, p. 274.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 93. In this report the Kanawha is considered a group.

Occurs in Logan and Mingo Counties.

Monitor Butte Member (of Chinle Formation)

Upper Triassic: Southeastern Utah and northeastern Arizona.

G. A. Kiersch, 1955, Mineral resources, Navajo-Hopi Reservations, Arizona-Utah, v. 2: Tucson; Arizona Univ. Press, p. 4 (fig. 1), 5. Mostly siltstone and sandstone. Underlies Petrified Forest member; overlies Shinarump conglomerate.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 452–453. Claystone and clayey sandstone with interstratified lenses of sandstone; greenish-gray with some pale reddish-brown spots. Ranges in thickness from wedge-edge to 250 feet; commonly 100 to 150 feet. Underlies Petrified Forest member in southern part of southeastern Utah, and contact conformable and intertonguing; underlies Moss Back member in other parts of southeastern Utah, and contact is surface of erosion. Conformably overlies Temple Mountain member in San Rafael Swell; conformably overlies Shinarump member in most of southeastern Utah and unconformably overlies Moenkopi formation where Shinarump is absent. Member corresponds to division D of Chinle as described by Gregory (1917, U.S. Geol. Survey Prof. Paper 93).

Named for exposures in southeastern Utah near San Juan River south of Clay Hills area. Present in much of southeastern Utah; pinches out along a northwest line passing through northern part of Elk Ridge area and through southern part of San Rafael Swell. Also recognized in Monument Valley area, Arizona.

Monitor Mountain Limestone (in Hannan Limestone)

Monitor Mountain Limestone Member[1] (of Madison Limestone)

Mississippian (Meramecian): Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 48.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 38). Shown on correlation chart as the uppermost unit in Hannan limestone. Overlies Rooney chert. Meramecian.

Only known occurrence is in NE¼ sec. 18, T. 17 N., R. 7 W., on upper ridge and top of Monitor Mountain, Lewis and Clark County.

Monk Formation[1]

Cambrian(?): Southeastern British Columbia, Canada, and northwestern Idaho and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 6, 7.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (chart), 11–13, pl. 1. In Metaline quadrangle, Washington, consists of about 3,800 feet of schists, grits, and limestone. As defined here includes beds between Leola volcanics below and grits at base of Gypsy quartzite. As defined by Daly (1912), Monk did not include upper part of formation as used in this report. Near Sullivan Lake, top of formation is band of white sandy marble that grades upward into quartzite and grit; farther north, contact is placed arbitrarily so that dominantly quartzitic sediments are placed in Gypsy quartzite, and dominantly phyllitic sediments are referred to the Monk. Age unknown. Tentatively placed at base of Cambrian.

Named for exposures north of Monk Creek, British Columbia.

Monkey Hill Formation[1]

Miocene: Panamá.

Original reference: R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 176, 206–208.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 340. Suppressed in favor of Gatún formation. Miocene.

Exposed at Monkey Hill (Mount Hope), C.Z.

Monkton Quartzite[1]

Lower Cambrian: West-central Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 106.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525 (table), 530–532. Red quartzite in layers from a few inches up to 3 feet thick separated by beds of pink to gray dolomite. Thickness 0 to 800 feet. Overlies Dunham dolomite; underlies Winooski dolomite (revised).

Named for town of Monkton, Addison County.

Mon Louis Formation[1]

Pleistocene: Southwestern Alabama.

Original reference: E. A. Smith, 1894, Am. Jour. Sci., 3d, v. 47, p. 285–296.

Name derived from Mon Louis Island, on west coast of Mobile Bay.

Monmouth Group[1] **or Formation**[1]

Upper Cretaceous: New Jersey, Delaware, and northeastern Maryland.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 315, 331.

P. H. Jennings, 1936, Bulls. Am. Paleontology, v. 23, no. 78, p. 4, 5 (chart). Monmouth group as used in this report includes (ascending) Mount Laurel, Navesink, Red Bank, and Tinton formations.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 261–262. Along Chesapeake and Delaware Canal, only Laurel formation of group is present.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 40–52. Considered of formational rank and, as defined in this report, consists of beds lying below Hornerstown formation of Eocene age and above base of shell bed formed by *Exogyra*, *Gryphaea*, and *Belemnitella* which mark base of Navesink member. Includes also (ascending) Red Bank and Tinton members.

M. S. Carr, 1950, U.S. Geol. Survey Bull. 967, p. 32 (fig. 14), 33. Monmouth formation (erroneously called "Matawan" on some geologic maps) crops out east and southeast of Washington. In normal sequence follows Magothy formation but, locally, where Magothy is absent, lies on red clay of Raritan formation. Overlain by Aquia formation (Eocene), but to west, where Eocene deposits are absent is overlapped by Calvert formation.

R. R. Bennett and G. G. Collins, 1952, Washington Acad. Sci. Jour., v. 42, no. 4, p. 115. In Prince Georges County, Md., unconformably underlies Paleocene Brightseat formation (new).

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 8–19. Described in Prince Georges County. No complete section found; total thickness of outcropping Monmouth probably does not exceed 100 feet and may be as little as 40 or 50 feet; presumably thicker in Prince Georges County than farther seaward; dips toward southeast at estimated rate of 25 feet to mile. Unconformably overlies Patapsco formation. Unconformably overlain by beds of Paleocene age or, more commonly, by Aquia greensand or by Miocene Chesapeake group. Extends southward across county from vicinity of Priest Bridge on Patuxent River to Fort Washington on Potomac River; between Priest Bridge and Brightseat outcrop forms a band 2 to 3 miles wide; beyond Brightseat is narrower, crooked, and discontinuous.

J. J. Groot, D. M. Organist, and H. G. Richards, 1954, Delaware Geol. Survey Bull. 3, p. 26, 30 (table 3), 31. Group includes (ascending) Navesink, Mount Laurel, and Red Bank formations.

Named for Monmouth County, N.J.

Mono Limestone[1]

Upper Mississippian: Central northern Utah.

Original reference: S. G. Olmstead, 1921, Econ. Geology, v. 16, p. 438, 452, 453.

Probably named for Mono mine, Ophir district.

Mono series[1]

Monon series[1]

Lower Cambrian: California and Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 79.

Named from Mono County, Calif.

Mono Shale[1]

Upper Cretaceous: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 10, p. 350, 352, pl. 46, map.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1746. Upper Cretaceous. Disconformably underlies middle Eocene Sierra Blanca limestone at type locality of the Sierra Blanca.

Named for exposure in canyon of Mono Creek, at mouth of Roble Creek, Santa Barbara County.

Mono Craters Obsidian

Pleistocene: Eastern California.

W. C. Putnam, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1939. Listed as youngest stratigraphic unit in Pleistocene of area. Younger than Tioga terminal and lateral moraines.

Occurs in region about June Lake in the east-central Sierra Nevada.

Monongahela Formation[1] or Group

Monongahela Series

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, western Virginia, and West Virginia.

Original reference: H. D. Rogers, 1840, Pennsylvania Geol. Survey 4th Ann. Rept., p. 150.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 211–216. Series in Ohio crops out in narrow belt 5 to 15 miles wide that extends across southeastern part of the State from Jefferson and Belmont Counties on east to Lawrence and Gallia Counties on south. Thickness 240 to 270 feet. Composed of beds of shale, sandstone, limestone, clay, and coal with shale, sandstone, and limestone making up about 95 percent of group. Twenty-two members listed including coals. Includes strata from base of Pittsburgh coal to top of Waynesburg No. 11 coal. Overlies Conemaugh series.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100–127. Referred to as group. Described in Fayette County. Comprises Pittsburgh, Redstone, Sewickley, Uniontown, and Waynesburg divisions. Columnar section shows 22 units including coals. These are described as members of Monongahela formation. Overlies Conemaugh group; underlies Permian Washington group.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 48 (fig. 7), 65. In Maryland, formation is present only in Georges Creek and Upper Potomac basins. Overlies Conemaugh formation; underlies Dunkard group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 65–87, geol. map. Considered series in this report. Strata included extend from base of Pittsburgh (No. 8) coal to top of Waynesburg (No. 11) coal. Entire Monongahela present in Morgan County. Thickness 247 feet. Twenty-two members (including coals) described.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158–189. Series described in Athens County. Average thickness 270 feet. Limits of series are base of Pittsburgh cyclothem and top of Waynesburg (No.

11) coal bed. Twelve cyclothems described. [For sequence see Pittsburgh cyclothem.] Succeeded by Dunkard series of Permian.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 10. Referred to as series. Consists of tan and gray shales, a few shaly sandstones, clay, coal, and some nonmarine limestones. Thickness 200 to about 500 feet. Principal outcrops are to north and east of Dunkard series in central and western parts of State.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69, 71–72. Monongahela group at top of Pennsylvanian section averages about 375 feet in thickness. Contains Pittsburgh coal seam at base and base of this seam marks lower boundary of Monongahela. Top of Waynesburg coal marks upper boundary and separates Pennsylvanian rocks from overlying Permian(?) or Dunkard rocks. At this systemic boundary, there is no recognizable physical break, the subdivision being made on basis of fossil plants.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation consists of cyclic sequences of sandstone, shale, limestone, and coal; limestone prominent in northern outcrop areas; shale and sandstone increase southward; commercial coals present; base at bottom of Pittsburgh coal.

Named for exposures along Monongahela River, Pa.

†Monongahela River coal series[1]

Pennsylvanian and Permian: Western Pennsylvania and northern West Virginia.

Original reference: J. P. Lesley, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. xxiii.

†Monongahela River Series[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, Virginia, and West Virginia.

Original reference: J. J. Stevenson, 1873, Am. Philos. Soc. Trans., new ser., v. 15, p. 15–32.

Named for exposures along Monongahela River, Pa.

†Monroe Beds[1]

Pennsylvanian: Central southern Iowa.

Original reference: S. W. Beyer and L. E. Young, 1903, Iowa Geol. Survey, v. 13, p. 366.

Named for Monroe County.

†Monroe Beds,[1] Formation,[1] or Group[1]

Silurian and Lower Devonian: Southern Michigan and northern Ohio.

Original reference: A. C. Lane, as reported by M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66.

J. W. Wells, 1947, Ohio Jour. Sci., v. 47, no. 3, p. 121 (fig. 1). Report is paleoecological analysis of Devonian rocks of Columbus region. Columnar section shows Silurian Monroe formation underlying Bellpoint member of Middle Devonian Columbus formation

Named for exposures in Monroe County, Mich.

†Monroe Beds[1] or Slates[1]

Precambrian(?): Southern central North Carolina.

Original reference: H. B. C. Nitze and G. B. Hanna, 1896, North Carolina Geol. Survey Bull. 3, p. 36–37.

Monroe, Union County.

†Monroe Shales[1]

Middle Devonian: Southeastern New York and northern New Jersey.

Original reference: N. H. Darton, 1894, Geol. Soc. America Bull., v. 5, p. 367, 373.

At Monroe, Orange County, N.Y.

Monroe Creek Sandstone (in Arikaree Group)

Monroe Creek Beds[1]

Monroe Creek Formation (in Arikaree Group)

Monroe Creek Member (of Arikaree Formation)

Miocene, lower: Western Nebraska, southern South Dakota, and eastern Wyoming.

Original reference: J. B. Hatcher, 1902, Am. Philos. Soc. Proc., v. 41, p. 116.

C. B. Schultz, 1938, Am. Jour. Sci., 5th ser., v. 35, no. 210, p. 442–443. Proposed that Arikaree be continued as group name and that it include (ascending) Gering, Monroe Creek, and Harrison formations (the latter as Hatcher defined it). Monroe Creek, at type section, is characterized by horizontal dark-gray tubular or pipy concretions and uppermost partly by pseudo-pipes. Thickness about 300 feet.

R. C. Cady and O. J. Scherer, 1947, U.S. Geol. Survey Water Supply Paper 969, p. 20–22, pl. 1. Described in Box Butte County, Nebr., where it is referred to as sandstone. Much of unit is below level of Niobrara River.

S. G. Collins, 1959, Geology of the Martin quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Considered member of Arikaree formation in South Dakota. Consists of pink to medium-brown very fine well-sorted mostly quartzose noncalcareous sandstone which is uniform in composition and contains very little clay. Differs from exposures described in Nebraska in that no pipy concretions and very little conglomeratic material or torrential crossbedding are present. Thickness at least 250 feet. Underlies Harrison member with contact gradational and difficult to locate precisely.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Formation in Arikaree group. In area of this report, consists of 90 feet of compact buff silty and very fine grained sands that have many small isolated concretions and some fossil rootlets. Underlies Harrison formation; overlies Sharps formation (new).

S. G. Collins, 1960, Geology of the Patricia quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Formation in Arikaree group. Consists of medium-brown to light-pinkish-gray very fine well-sorted mostly quartzose noncalcareous sandstone which contains little clay. Contains two mappable facies that are tentatively correlated with Gering channel sand and Mellette limestone; these facies are not typical of the Monroe Creek as described above. Underlies Harrison formation; overlies Sharps formation. Contact with Sharps formation only approximately located, and practicality of separating the two units in future mapping farther to east is questionable.

Well exposed in north face of Pine Ridge, at mouth of Monroe Creek Canyon, 5 miles north of Harrison, Sioux County, Nebr. [This is referred to as type section by Schultz.]

Monserrate Member (of Augustinillo Formation)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 96–103; 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 85. Consists of thin- to massive-bedded black calcareous mudstones which alternate with buff- and gray-colored argillaceous limestones. Thickness 17,000 feet or more; base not exposed in Ponce quadrangle. Interfingers with Collores member (new).

Type locality: Near kilometer post K6H9 on Río Cerrillos Road (Route 139). Name derived for Hacienda Monserrate, Ponce quadrangle. Crops out in Ponce, Jayuya, Peñuelas, and Adjuntas quadrangles.

Monson Gneiss

Monson Granodiorite[1]

Mississippian(?) or older: Central Massachusetts, central Connecticut, and southwestern New Hampshire.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 15, 18, 41–45, 57–65.

W. G. Foye, 1949, Connecticut Geol. Nat. History Bull. 74, p. 51–52, pl. 1. Referred to as an orthogneiss. Shows large variations in texture and composition depending on position within batholithic masses. Includes Eastford, Glastonbury, and Haddam gneisses as originally mapped and also igneous part of Willimantic gneiss. Middle Carboniferous(?).

J. B. Hadley, 1949, Bedrock geology of the Mount Grace quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–3]. Termed a gneiss. Ranges in composition from granite to quartz diorite in Mount Grace quadrangle, Massachusetts. Upper Devonian.

J. M. Aitken, 1951, Connecticut Geol. Nat. History Survey Bull. 78, p. 49, 50. Gneiss considered granitized part of Hebron gneiss in eastern Connecticut.

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 20, 21. Devonian.

Norman Herz, 1955, Connecticut Geol. Nat. History Survey Quad. Rept. 5, p. 16. Resemblance to Glastonbury gneiss is only superficial; two are treated here as separate units.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–92. Mapped in Warwick dome in eastern part of Massachusetts part of Northfield quadrangle, Massachusetts-New Hampshire-Vermont. A border facies of the Monson is recognized, and large amphibolite masses in the gneiss are also mapped. Middle Paleozoic.

Frederick Stugard, Jr., 1958, U.S. Geol. Survey Bull. 1042–Q, p. 619, 634–636, pl. 56. In Middletown area, Connecticut, pegmatites cut metasediments of Bolton schist of pre-Mississippian(?) age and, in ascending order of sequence, mafic gneisses, Glastonbury granite gneiss, Maromas granite gneiss, and Monson gneiss. Position of these formations in stratigraphic column cannot be determined with accuracy; their maximum age is indicated by their relation to the pegmatites, which have been dated by

uranium- and thorium-lead ratios as about 260 million years old, presumably Mississippian. The Monson is a banded to massive medium-grained biotite granodiorite gneiss. East of Middle Haddam, Monson gneiss has indefinite contact with Hebron gneiss. Crops out in Middletown area in two localities: narrow belt along eastern edge of Middle Haddam quadrangle and in Killingworth dome in southern part of Middle Haddam quadrangle.

Named for occurrence at Monson, Hampden County, Mass. Crops out from Northfield southward through New Salem, Petersham, and Monson in Massachusetts, and across towns of Stafford, Tolland, Vernon, Bolton, Glastonbury, Marlboro, East Hampton, Haddam, Chester, and Saybrook in Connecticut.

†Montalban[1] (Formation)

Precambrian(?): New Hampshire.

Original reference: C. R. Van Hise and C. K. Leith, 1909, U.S. Geol. Survey Bull. 360, p. 87, 88.

Well exposed in White Mountains.

Mont Alto lignite[1]

Tertiary(?): Central southern Pennsylvania.

Original reference: J. P. Lesley, 1864, Mont Alto lignite and Appalachian erosion, p. 4, pls.

Montalto Quartzite Member (of Harpers Schist)[1]

Lower Cambrian: Central southern Pennsylvania.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 207.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as member of Harpers formation. Cambrian.

Forms Montalto Mountain, Franklin County.

†Montana Breccia[1]

Tertiary: Central Nevada.

Original reference: J. E. Spurr, 1911, Report on geology of property of Montana-Tonopah Mining Company: Tonopah, Nev., published privately.

Named for Montana mine, Tonopah district.

Montana Group[1] or **Formation**[1]

Upper Cretaceous: Montana, Colorado, Kansas, New Mexico, North Dakota, South Dakota, Utah, and Wyoming.

Original references: G. H. Eldridge, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 93; 1889, Am. Jour. Sci., 3d, v. 38, p. 313–321.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 50–63, pls. 1, 2. Group in Bighorn Canyon-Hardin area, Montana and Wyoming, comprises (ascending) upper part of Cody shale (with Telegraph Creek shale equivalent to Eagle sandstone, and Claggett shale members), Parkman sandstone, and Bearpaw shale. Overlies Colorado group; underlies Hell Creek formation.

Following formations included in Montana Group: Bearpaw Shale, Claggett Shale, Cody Shale (upper part), Eagle Sandstone, Fox Hills Sandstone, Horsethief Sandstone, Judith River Formation, Lennep Sandstone, Parkman Sandstone, Pierre Shale, Trinidad Sandstone, Two Medicine Formation, and Virgelle Sandstone.

Named for exposures in Montana, especially in upper Missouri River region.

†Montana Series[1]

Upper Cretaceous: Montana.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, no. 25, p. 1106–1108.

Montana Peak Formation

Cenozoic(?): Southern Arizona.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. RME–2009, p. 7, pl. 1. Consists of rhyolitic lavas, breccias, and tuffs, characterized by a general red or purple color. Thickness about 800 feet. Underlies Atascosa formation (new) generally conformably, with local disconformity; overlies Ruby Road formation (new).

Typically developed at Montana Peak, Ruby quadrangle, Santa Cruz County.

†Montara Granite[1]

Montara Quartz Diorite

[Cretaceous]: Western California.

Original references: A. C. Lawson, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 408; Am. Geologist, v. 15, p. 343–346.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Montara quartz diorite discussed in paper dealing with potassium-argon age determinations. Age given as 91.6 million years. Varies from quartz diorite to granite. Unconformably overlain by Miocene sedimentary rock; all other adjacent sedimentary rocks are in fault contact with the granite.

Constitutes mass of Montara Mountain, San Francisco Peninsula.

Montauk Till Member (of Manhasset Formation)[1]

Pleistocene: Southeastern New York and islands of southern New England.

Original reference: M. L. Fuller, 1905, Geol. Soc. America Bull., v. 16, p. 367–390.

Lawrence Weiss, 1954, U.S. Geol. Survey Prof. Paper 254–G, p. 146. Thickness 40 to 60 feet. Underlies Hempstead gravel member; overlies Herod gravel member. Manhasset believed to be of Wisconsin age.

Named for occurrence at Montauk Point, Long Island. Present on Block Island, Marthas Vineyard, Nantucket, No Mans Land, and probably Cape Cod.

Montchauve Group

Pennsylvanian: Central northern Wyoming.

T. W. Todd, 1959, Dissert. Abs., v. 20, no. 6, p. 2230. Includes [ascending] Sacajawea formation, Amsden formation, and Tensleep sandstone, all products of a marine transgressive-regressive cycle that took place on the Wyoming cratonic shelf as one phase in the development of the eastern Cordilleran geosyncline.

In Big Horn Basin.

Montebello Formatioln (in Hamilton Group)

Montebello Sandstone (in Hamilton Formation)[1]

Montebello Sandstone Member (of Mahantango Formation)

Middle Devonian: Central Pennsylvania.

Original reference: E. W. Claypole, 1885, Pennsylvania 2d Geol. Survey Rept. F_2, p. 67–68.

Bradford Willard, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 196, p. 274, 275, 276 (table 2). Mahantango formation is dominated by coarse sandstone, the Montebello member in lower Susquehanna and Juniata Valleys.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Montebello sandstone, a local development of sandstone in the Mahantango of Pennsylvania in Perry, Dauphin, and Northumberland Counties. Ranges in age from Skaneateles through Ludlowville and possibly into the Moscow.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 3–4. Formation in Hamilton group. Underlies Sherman Ridge formation (new).

T. M. Kehn, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2018. Geologic mapping has revealed that, contrary to previously published reports and maps, there are two outcrop belts of the Oriskany, Onondaga, and Marcellus formations between the Schuylkill and Susquehanna Rivers. Area mapped is bounded on north by Second Mountain and on south by Blue Mountain. The Marcellus is overlain by Montebello sandstone member of Mahantango formation.

Named for exposures at Montebello Narrows, on Little Juniata River, Perry County.

Monte Cristo Diorite[1]

Pre-Permian(?): Southeastern Alaska.

Original reference: W. C. Mendenhall and F. C. Schrader, 1903, U.S. Geol. Survey Prof. Paper 15, p. 33–37.

Named for exposure on Monte Cristo Creek, Nebesna and Chisana River region.

Monte Cristo Limestone[1] **or Dolomite**

Lower and Upper Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9–10, 17.

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 880–881, 883 (fig 2). Geographically extended into Nopah Range, Inyo County, Calif., where it consists of (ascending) Dawn limestone, Anchor limestone, Bullion limestone, and Yellowpine limestone members. Thickness 1,587 feet. Name Stewart Valley limestone is abandoned, and Mississippian beds previously ascribed to it are assigned to Dawn limestone member of Monte Cristo. Overlies Crystal Pass member of Sultan limestone; underlies Bird Spring formation.

Charles Deiss, 1952, U.S. Geol. Survey Bull. 973–C, p. 114–117, pl. 13. Described as Monte Cristo dolomite in Sloan district, Nevada, where it includes Dawn, Anchor, and Bullion members. Thickness 695 feet. Overlies Crystal Pass member of Sultan; underlies Bird Spring formation.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42, pl. 1. Described in Ivanpah quadrangle (California-Nevada) where it consists of

(ascending) Dawn limestone, Anchor limestone, Bullion dolomite, Arrowhead limestone, and Yellowpine limestone members. Thickness 350 to 700 feet.

Ben Bowyer, E. H. Pampeyan, and C. R. Longwell, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–138. Lower and Upper Mississippian.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Spring Mountains, Nev., underlies Illipah formation.

Named for exposures near Monte Cristo mine, Goodsprings quadrangle, Nevada.

Monte de Oro Formation[1]

Upper Jurassic: Northern California.

Original reference: H. W. Turner, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 548.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 976, chart 8C (column 90. Shown on correlation chart as Middle Jurassic. Stratigraphic position relative to other Jurassic formations of the Sierra cannot be determined because it is an isolated occurrence.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. Shown on paleotectonic map as Upper Jurassic.

Occurs near Oroville, just south of Monte de Oro, Butte County.

Montediablan Stage

Pliocene, early: California.

D. E. Savage, 1955, California Univ. Pubs., Geol. Sci., v. 31, no. 1, p. 19–24. A stage based on mammalian faunal assemblage, Deposits containing Montediablan stage are included in nonmarine Green Valley formation. Superjacent to Cerrotejonian stage (new). Contemporaneous with later part of North American Clarendonian age of Wood and others (1941).

Type section: In beds near base of Green Valley formation on south slope of Mount Diablo, Contra Costa County.

Monte Largo Granite

Precambrian: Central New Mexico.

J. T. Stark, 1956, New Mexico Bur. Mines Mineral Resources Bull. 34, p. 17–18, pl. 1. Mapped as Monte Largo granite. Described as a small stock-like mass of granite, quartz monzonite, and diorite, approximately 1½ miles square. Stock is coarse to medium coarse grained. Exposure bounded on south, east, and northeast by Blue Springs schist, by quartz reefs and Sais quartzite on the north, and by overlying pediment gravels on the west.

Between mouths of Monte Largo and West Bartalo Canyons in parts of secs. 26, 27, 34 and 35, T. 5 N., R. 5 E. [R. 4 E. from map], Valencia County.

Montell Sandstone (in Allegheny Formation)[1]

Pennsylvanian: Western Maryland and northern West Virginia.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 572.

West of Piedmont, W. Va. Named for its position above Montell coal.

Montello Granite[1]

Precambrian: Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 521.

Crops out in village of Montello, Marquette County.

Monte Neva Formation

Cambrian: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 159, 160. Lower half consists of thin-bedded very platy generally dark-gray limestone, siltstone, and shale grading upward into dark-gray silty limestone. Thickness at type section 594 feet. Overlies Eldorado limestone; underlies Raiff limestone (new).

Type section: Northern Egan Range in NW¼ sec. 33, T. 22 N., R. 63 E. on divide north of third large canyon north of Monte Neva Hot Springs. Monte Neva Hot Springs is in Steptoe Valley 5½ miles southeast of type section.

†Monterey Conglomerate[1] or Sandstone

Pennsylvanian: Northeastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 276, 277, 369–372, 374.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 146. Name locally applied to Bon Air (Newton) sandstone.

Named for occurrence at Monterey, Putnam County.

Monterey Group,[1] Shale,[1] or Formation

Monterey Stage

Miocene, middle and upper: Western California.

Original reference: W. P. Blake, 1856, Philadelphia Acad. Nat. Sci. Proc., v. 7, p. 328–331.

C. F. Tolman, 1927, Econ. Geology, v. 22, no. 5, p. 459. Overlies Lospe formation (new).

G. D. Hanna, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 10, p. 969–983. Discussion of Monterey shale at its type locality and summary of its fauna and flora.

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 127–149. In Palos Verdes Hills, includes Altamira shale member (new) with Portuguese tuff and Miraleste tuff beds (both new), Valmonte diatomite member (new), and Malaga mudstone member (new).

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 122–125. Study of history of name "Monterey" as affecting Coalinga and nearby regions reveals that it has been used: (1) as formation name for particular type of lithology without any definite chronologic implication other than Miocene; (2) as a formation name based on chronologic implication of varying value; and (3) as a group name. Proposed to abandon Monterey as group name including Vaqueros Sandstone and to treat Monterey shale as formation name for Miocene strata in Coast Ranges characterized by hard siliceous shale and soft shale containing microscopic siliceous fossils, regardless of varying chronologic relations of these strata within the Miocene. The proposal

results in abandonment of Salinas shale and Maricopa shale as synonyms of Monterey shale. In areas where units of formation rank are recognized within the Monterey, group usage is still retained. As mapping progresses, member names may be proposed for lithologic units within the Monterey or formations may be recognized, as has been done in San Francisco Bay region. In this report, unit designated McLure shale member of Monterey is only Miocene shale of Monterey type in Reef Ridge and Kettleman Hills section. According to principles advocated in this report, it would be proper to call it simply Monterey shale, as was done 30 years ago. Name McLure, however, has come into such wide usage that it seems undesirable to urge its abandonment. McLure is considered member of Monterey on grounds that it represents a particular type of Monterey lithology—porcelaneous mudstone.

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 204–205 (fig. 3), 216, 230–253. In full sections, the Miocene series of California is divisible on basis of coincident faunal and physical groupings into three equal major stages (ascending) Vaqueros, Temblor, and Monterey, commonly described as being, respectively, of lower, middle, and upper Miocene age. Monterey includes three named substages: Briones, Cierbo, and Neroly. At Caliente Mountain, a homoclinal section exposes about 1,100 feet of upper Oligocene(?), 4,500 feet of Vaqueros, 4,700 feet of Temblor, and 4,600 feet of Monterey strata.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958; 1943, California Div. Mines Bull. 118, pt. 3, p. 464 (fig. 190), 465 (fig. 192). Monterey shale, at type locality of Vaqueros formation, overlies Sandholdt formation (new). Fossils at base of Monterey are Luisian. Monterey, in this area, is restricted to lowermost occurring cherts and porcellaneous shales; lower argillaceous shales and sandstones of former definitions excluded.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1611 (fig. 2), 1616–1617. Formation, in Crocker Flat landslide area, Temblor Range, comprises (ascending) Devilwater-Gould, McDonald shale, and Antelope shale members. Overlies Temblor-Vaqueros formation; underlies Santa Margarita formation. Thickness about 6,500 feet. Middle and upper Miocene.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 220–222, 224 (fig. 3), pl. 4. Group, in San Benito quadrangle, is represented by fairly thin basal shale member overlain by considerable thickness of arkosic sandstone and conglomerate, which is interbedded toward top with diatomaceous shale. Thickness as much as 3,400 feet. Group is confined to Gabilan Range, southwest of Bear Valley fault. Basal shale rests depositionally (either conformably or disconformably) upon Pinnacles formation along Willow Creek; the arkose rests unconformably upon Pinnacles formation and Miocene rhyolite in southern part of quadrangle, and upon granite in northwestern part of area. Underlies alluvium. Upper Miocene.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1336–1337 (fig. 1), 1339, 1341 (table 1), 1345–1347; W. P. Woodring and others, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 14; W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 11 (table), 18–25, pls. In Santa Maria district, Monterey shale crops out in western Casmalia Hills, eastern Purisima Hills, and Foxen Canyon-Sisquoc River area.

In western Casmalia Hills, only region within mapped area where base is exposed, the Monterey overlies conformably Point Sal formation and has overlaps northward onto basement rocks. Comprises three unnamed members: lower, 200 to 900 feet, phosphatic shale, silty shale, somewhat porcelaneous shale; middle, 185 to 225 feet, chert, cherty shale, porcelaneous shale; upper, 600 to 1,000 feet, porcelaneous shale, laminated diatomite. Underlies Sisquoc formation, in some areas Todos Santos claystone member (new). Middle to upper Miocene.

M. N. Bramlette, 1946, U.S. Geol. Survey Prof. Paper 212, 57 p. Discussion of Monterey formation and origin of its siliceous rocks. Miocene strata that consist predominantly of highly siliceous rocks have received a number of names in different areas, but recent stratigraphic work indicates that most of these locally named stratigraphic units are essentially equivalent. Appears advisable to return to an early and convenient usage by extending term Monterey formation to include many of these locally named units. This report contains stratigraphic sections representing most of areas where local names have been applied, with their suggested correlation. Locality from which formation name was derived is unsatisfactory as type locality. At this area, near town of Monterey, in Monterey County, formation cannot be measured in any unbroken sequence, and complete succession can be worked out only by detailed mapping and by correlating several partial sections. A thick tuff bed forms basal part of formation in many places in San Luis Obispo and Santa Barbara Counties. It is herein named Obispo tuff member.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 67–75, pls. In area of this report [Coast Ranges immediately north of San Francisco Bay region], group comprises (ascending) Sobrante sandstone, Claremont shale, Oursan sandstone, Tice shale, Hambre sandstone, and Rodeo shale. Thickness about 4,250 feet. Overlies San Ramon sandstone; underlies Briones sandstone of San Pablo group. Differentiated divisions of the Monterey immediately south of Carquinez Strait in Mare Island and Carquinez quadrangles are well represented in south limb of San Pablo syncline. Their identity as individual units is lost in north limb of fold where strata are described as Monterey shale. Measured section of shale about 1,855 feet. Overlies Martinez formation; on Point Reyes Peninsula, overlies Laird sandstone (new).

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 34–42, pls. Monterey shale as used in this report [southwestern Santa Barbara County] includes all sediments lying above Rincon shale, and above Tranquillon volcanics (new) where present, and below Sisquoc formation. Term, as herein used, is same as Modelo formation of Ventura basin. Predominantly siliceous shales ranging in age from uppermost Saucesian to lower Delmontian of the Miocene. Shale herein includes Relizian Point Sal formation of northern Santa Maria basin as mapped by Woodring and others (1944) as this unit loses its identity as a formation and becomes inseparable from Monterey shale in Santa Ynez Mountains and southern Santa Maria basin. Throughout area the Monterey is divisible into two lithologic members, lower and upper. Upper Monterey as used in this report corresponds to the middle and upper members as mapped by Woodring and others (1944) in northern Santa Maria basin, Point Sal formation. Thickness about 1,700 feet in Santa Ynez Mountains; 1,800 to 4,500 feet in Santa Maria basin.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 11–14, pl. 1. Formation, in Bitterwater Creek area, Kern County,

consists of about 4,000 feet of shales and sandstones. Comprises (ascending) Gould-Devilwater shale, Twisselman sandstone (new), and McDonald shale members. Conformably overlies Temblor formation; unconformably underlies Tulare formation. Middle and upper Miocene.

T. W. Dibblee, Jr., 1951, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec. [Guidebook], Stop 2, p. 1–2. In Salisbury Canyon, underlies Bitter Creek sandstone (new).

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 37–39, pl. 1. Term Monterey formation is here applied [San Jose-Mount Hamilton area] to middle and possibly upper Miocene rocks characterized by abundance of siliceous sediments. They do not include same units mapped by Lawson (1914) who used Monterey group. Strata of formation mapped. Average thickness 500 feet. Overlies Temblor formation; underlies Briones sandstone. In some areas, faulted up against Briones and, in some areas, faulted down into the Cretaceous. On east limb of syncline, where it is overlapped by Briones sandstone; on Sierra Road, it is faulted out along Calaveras fault but appears in Alum Rock Canyon and in Arroyo Aguague where, though poorly exposed, forms thin bed between Briones and Berryessa (new) formations.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. In Hayward quadrangle, group comprises (ascending) Sobrante sandstone, Claremont shale, unnamed middle sandstone and shale, and Rodeo shale. Overlies Chico formation of Lawson with angular unconformity; underlies Briones sandstone with disconformity. Middle Miocene.

C. A. Hall, Jr., 1958, California Univ. Pubs., Geol. Sci., v. 34, no. 1, p. 17–18. In this report [Pleasanton area, Alameda and Contra Costa Counties], term Monterey formation and Monterey group are considered inappropriate for following reasons: (1) widely separate basins of deposition existed in Coast Range area during middle Miocene, and there is no indication that Monterey basin was connected with that in area under discussion; (2) Monterey shale or "formation" cannot be traced from type area to Pleasanton area or even into San Jose quadrangle, where it was mapped by Crittenden (1951); and (3) terms "Monterey formation" and "Monterey group", which have been used in adjoining area to comprise the Sobrante, Claremont, Oursan, Tice, Hambre, and Rodeo "members" or "formations," suggest that these units are related in some way to Monterey shale; they are distinct mappable units that can be traced from their type localities to Pleasanton and adjacent area, and their only relation to Monterey shale is that they may be in part correlated with it on faunal basis.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2975 (fig. 2), 2978–2979 (fig. 3), 2988–2991. In Caliente, La Panza, and Sierra Madre Mountains, the shale conformably above Painted Rock sandstone member (new) of Vaqueros formation and conformably below Santa Margarita sandstone is mapped as Monterey shale. Shale grades laterally eastward into sandstone unit mapped as Branch Canyon formation (new). Shale averages about 2,500 feet in thickness and comprises (ascending) Saltos shale and Whiterock Bluff shale members.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Formation, in La Honda and San Gregorio quadrangles, San Mateo County, is restricted to late Miocene (Delmontian?) brown siliceous mudstones and porcelanites

which lie unconformably upon older formation. Overlies Woodhams formation (new); underlies Purisima formation. Thickness 9,000 feet in west; thins to wedge in east.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, p. 13. Formation, in Chico-Martinez Creek area, comprises (ascending) Gould shale, Devilwater silt, McDonald shale, Antelope shale, and Chico-Martinez chert (new) members.

Y. T. Mandra, 1960, Dissert. Abs., v. 20, no. 11, p. 4370; 1960, Internat. Geol. Cong. Rept., 21st, pt. 6, p. 78, 79–81. Formation, near Bradley, southern Monterey County, includes Buttle diatomite member (new).

Typical section (Blake): About 2 miles southeast from center of town of Monterey, Monterey County. Forms part of hill 500 to 600 feet high which fronts the bay and rises on east side of stage road to San Francisco. Hanna (1928) stated that locality is on northwest side of long ridge which partly encircles the bay; exposure can be traced from line of Monterey-Salinas Highway to and a little across Monterey-Carmel Highway. This is a distance of about 4 miles east and west.

†Monterey Sandstone[1]

Lower Devonian: Northwestern Virginia and western Maryland.

Original reference: N. H. Darton, 1892, Am. Geologist, v. 10, p. 13, 15–16.

Named for Monterey, Highland County, Va.

Montesano Formation[1]

Pliocene: Southwestern and northwestern Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 173, 187–191. Unconformably overlies Astoria formation. Age given as Pliocene although invertebrate fauna shows characteristics of both upper Miocene and lower Pliocene.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 593, chart 11. Formation is a composite from numerous sections exposed in banks of Wynoochee and Wishkak Rivers and their tributaries. Maximum exposed thickness 2,800 feet. At certain localities, it is unconformable on the Astoria and Lincoln formations; its relation to the younger Quinault formation is concealed.

Named for Montesano, Grays Harbor County.

†Monte Sano Limestone[1] or Montesano Group[1]

Mississippian (Meramec-Chester): Northern Alabama, Illinois, Kentucky, and Tennessee.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 29.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 163, chart 5 (column 86) Tennessee Geological Survey finds name Monte Sano limestone useful as a designation for the undifferentiated Ste. Genevieve and Gasper.

Named for exposures at Monte Sano, Madison County, Ala.

†Montevallo Conglomerate[1]

Pennsylvanian: Northern central Alabama.

Original reference: J. Squire, 1890, Alabama Geol. Survey Rept. Cahaba coal field, pt. 1.

Probably named for exposures at Montevallo, Shelby County.

†Montevallo Formation[1]

Lower Cambrian: Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Chaba coal field, p. 148, map.

Named for Montevallo, Shelby County.

Montevideo Granite Gneiss (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482, 1484–1485, pl. 6. Pink, medium-grained, and contains a small amount of dark minerals, except where it is contaminated with gabbro gneiss which it intrudes. Distinguished from Morton gneiss primarily by its straightness of banding.

Typically developed in vicinity of Montevideo and forms extensive outcrops in Granite Falls vicinity, Chippewa and Yellow Medicine Counties.

Montezuma Formation

Pleistocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 103–106, pls. 6, 7, 9, 10. Composed of deposits of obscurely stratified gravels, sands, and clays that have been uplifted into terraces and dissected by steam erosion. Unconformably overlies Wolfskill, Huichica, and Glen Ellen formations (all new). Deposits may have once connected with gravel and sands of same age and lithologic composition which crop out along northern flank of Los Medanos Hills and south of Pittsburg from which place the formation was named and described by Tolman (1941) as Pittsburg formation; because this name is preoccupied, Montezuma is proposed.

Named from Montezuma Hills in Antioch quadrangle, Solano County.

Montezuma Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: H. B. Patton, 1909, Colorado Geol. Survey 1st Rept., p. 125, 126, 128, map.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 44, 123. Constitutes large porphyritic quartz monzonite stock which is nearly surrounded by Precambrian rocks, but for the western end which has invaded and baked Cretaceous shale.

Town of Montezuma, Summit County, is built on this rock.

Montezuma Schist[1]

Precambrian: Western North Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 4.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 29–30; J. L. Stuckey, 1958, Geologic map of North

Carolina (1:500,000): North Carolina Div. Mineral Resources. Occurs in association with Linville metadiabase. Flattop schist, and metarhyolite.

Named for Montezuma, Cranberry quadrangle, Mitchell County.

Montezuma shales[1]

Middle Jurassic: Southwestern Colorado and northeastern Arizona.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 65, no. 4, p. 303, 306.

Charles Keyes, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 314. Middle Jurassic.

Name derived from Montezuma County in southwestern Colorado.

Montgomery Bed (in Jackson Formation)[1]

Eocene, upper: Northwestern Louisiana.

Original reference: T. L. Casey, 1902, Science, new ser., v. 15, p. 716.

Named for exposures at Montgomery, Grant County.

†Montgomery Buhr,[1] Grits,[1] or Sandstone[1]

Mississippian: Virginia and West Virginia.

Original reference: W. B. Rogers, 1838, Virginia Geol. Survey Rept. 1837, p. 17.

Probably named for Montgomery County, Va.

†Montgomery Formation[1]

Silurian: Southwestern Ohio, southern Indiana, and northern Kentucky.

Original reference: A. F. Foerste, 1896, Cincinnati Soc. Nat. History Jour., v. 18, p. 189, 190.

Named for Montgomery County.

Montgomery Formation

Montgomery Member

Pleistocene: Central and southwestern Louisiana and Texas.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78, (fig. 6) 160–163. The series of Pleistocene deposits in Grant and La Salle Parishes is divided into four members, their names corresponding to the four distinct depositional terrace surfaces, Williana (oldest), Bentley, Montgomery, and Prairie. Montgomery member consists of clays and sands, the sandier materials predominating with depth; gravels common but are marginal deposits, reworked concentrations in form of large alluvial fans; highly oxidized plastic red-colored clays at surface grade downward at a depth of 2 feet into mottled red to yellow clays with thin lenses of silty sands; at depth of 20 feet, clays are generally replaced by a thin-bedded group of light-brown to yellow clays and sands which weather into "pinnacly clays;" slightly weathered clays are light brown to bluish gray and caryy carbonized wood fragments and leaf impressions. Thickness uncertain; wells drilled on terrace surface encountered as much as 115 feet of clays and sands. Overlies Miocene Catahoula formation.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 180–182, pl. 1. Rank raised to formation. Described in Rapides and Avoyelles Parishes where it underlies Prairie deposits and Recent alluvium.

G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 143–144. Geographically extended into eastern Texas. Thickness in southwesten Louisiana ranges from 85 to 125 feet.

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 71–74. In vicinity of Oakdale overlies Foley formation (new).

Named for exposures near Montgomery, Grant Parish, La. Well exposed at Waddel Bluff in sec. 8, T. 7 N., R. 4 W.

Montgomery Limestone[1]

Silurian: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Niagaran series above Grizzly formation (?) which may be Ordovician.

Named for occurrence on Montgomery Creek, 2⅓ miles south of Taylorsville, Plumas County.

Montgomery Creek Formation[1]

Eocene: Northern California.

Original reference: H. Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 215.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology, v. 35, no. 3, p. 228–231. Thickness at type locality more than 600 feet with base not exposed. Unconformably overlies Chico formation; underlies Tuscan formation.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6 (fig. 3), 16–17, pl. 1. In Big Bend quadrangle, is represented by nonmarine conglomerate, arkose, sandstone, and shale. Maximum thickness about 2,600 feet. Overlies Potem formation; underlies Pliocene(?) volcanic rocks.

Type locality: North side of Montgomery Creek, 2½ miles east-northeast of village of Montgomery Creek, Shasta County.

Monticello dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 150.

Probably named for Monticello, Jones County.

Monticello Rhyolites[1]

Precambrian: Central Virginia.

Original reference: W. A. Lambeth, 1901, Thesis presented to University Virginia, p. 11.

In Monticello area, Albemarle County.

Monticello Schist[1]

Precambrian: Central Virginia.

Original reference: W. A. Lambeth, 1901, Thesis presented to University Virginia, p. 9.

Probably named for Monticello, Albemarle County.

Montijo Conglomerate[1] or Formation

Oligocene(?) : Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 241.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 242. Referred to as formation; unconformably overlies Torio limestone (upper Eocene). Middle Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 341. Poorly defined name. Oligocene(?).

Exposed on west side of Azuero Peninsula, Veraguas Province.

Montosa limestone[1]

Pennsylvanian : New Mexico.

Original reference : C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 22. Keyes did not give source or definition of term Montosa limestone; therefore, the term is not considered established.

Derivation of name not given.

Montoya Dolomite

Montoya Limestone[1] or Group

Middle and Upper Ordovician : Western Texas and southern New Mexico.

Original reference: G. B. Richardson, 1908, Am. Jour. Sci., 4th v. 25, p. 476, 478–479.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 16–18. Referred to as dolomite. In Silver City area, subdivided into (ascending) Second Value, Par Value, and Raven members. Thickness 275 feet. Underlies Fusselman dolomite; overlies El Paso dolomite.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2201 (table). Stratigraphic table shows Montoya group comprises (ascending) Cable Canyon sandstone and Jornada limestone.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. in Geology 4, p. 31 (table), 56–66. In Caballo Mountains, divisions of Montoya proposed by Entwistle in Silver City area, can be mapped and identified in partial exposures. Also, these units, plus a basal sandstone, can be identified in other areas— San Andres, Organ, Santa Rita, Florida, Big Hatchet, and Sacramento Mountains. Therefore, Montoya is herein used as group term and Entwistle's units are given formational status. However, since type localites designated by Entwistle are not in continuous stratigraphic exposure and in addition are faulted and variously altered by mineralization, the Cable Canyon section opposite Sierrite mine, which offers continuous, unbroken, unaltered, and completely exposed outcrop, is used as new type locality. New names are applied to formations (ascending) Cable Canyon sandstone, Upham dolomite, Aleman, and Cutter, upper three correspond to Entwistle's units. Thickness as much as 450 feet. Overlies El Paso group; underlies Fusselman dolomite.

L. C. Pray, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1897 (fig. 2), 1898 (fig. 3), 1899 (fig. 4), 1900, 1902–1906. Formation described in Sacramento Mountains, N. Mex., where it is 209 feet thick; consists of

lower cherty member and upper solid chert member. Underlies Valmont dolomite (new); overlies El Paso formation.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 24–25, table 1. Limestone described in Peloncillo Mountains where it is as much as 100 feet thick; consists of medium- to dark-gray dolomite, with about 30 feet of alternating dolomite and black chert in beds 2 to 6 inches thick. Overlies El Paso limestone; underlies Percha shale.

L. C. Pray, 1958, Texas Geol. Soc. Guidebook Franklin and Hueco Mountains, p. 30–43. Group described in northern Franklin Mountains, Tex., where it is 429 feet thick and includes (ascending) Upham formation, Aleman formation, and Cutter dolomite. Underlies Fusselman formation; overlies El Paso formation. Age largely Upper Ordovician although lower part may be somewhat older. Type section suggested.

H. J. Howe, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 10, 2285–2330. Group divided into (ascending) Cable Canyon sandstone (replaced in Baylor Mountains by a St. Peter sandstone equivalent); Upham dolomite containing a Red River fauna, which is probably Upper Trenton or possibly lower Cincinnatian in age; Aleman formation with Maquoketa fauna, notably the coral *Paleophyllum thomi*, which crops out in marker bed for 140 miles; and Cutter formation with late Ordovician fauna near its base. Disconformably overlies El Paso formation.

Named for Montoya Station, on Santa Fe Railway, about 10 miles above El Paso, Tex.

Montpelier Sandstone[1]

Middle(?) Devonian: Southeastern Iowa.

Original reference: C. R. Keyes, 1893, Iowa Geol. Survey, v. 1, p. 40–46, pl. 2.

Named for Montpelier, Muscatine County.

†Montpelier Slate[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 95.

Extends from Montpelier to Northfield, Washington County.

Montreal Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, fig. 28.

Probably named for occurrence in Montreal mine, Keweenaw County.

Montreal Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Montreal mine, Keweenaw County.

Montrose Member (of Keokuk Limestone)

†Montrose chert (in Osage Group)[1]

Mississippian; Southeastern Iowa.

Original reference: C. R. Keyes, 1895, Iowa Geol. Survey, v. 3, p. 320, 341, 445.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 795. Referred to as member of Keokuk limestone. Thickness 30 feet. In lower part of Keokuk.

Named for exposures at Montrose, Lee County.

Montrose Redbeds

Montrose Red Shale (in Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 68, 115.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Montrose red beds; occur above Catawissa red beds and equivalent to Wellsburg shale and sandstone.

Type locality: Montrose, Susquehanna County.

Montrose Sandstone[1]

Upper Devonian: Northeastern Pennsylvania and southern central New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 381.

Probably named for town of Montrose, Susquehanna County, Pa.

Monument andesite[1]

Tertiary: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-Monthly Bull. 19, p. 7–21.

Type locality; Monument Peak, near Lake Valley, Sierra County.

†Monument Creek Group[1]

Eocene and Oligocene: Eastern central Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept. p. 39–40, 89.

Monument Creek quadrangle, Denver Basin region.

Monument Hill Bentonitic Member (of Pierre Shale)[1]

Upper Cretaceous: Northeastern Wyoming, southeastern Montana, and northwestern South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

W. A. Cobban, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 87. Thickness 165 feet. Overlies unnamed black shale member; underlies a 200-foot dark-gray shale member at top of formation. Area of this report is Crook County, Wyo., Carter County, Mont., and Butte County, S. Dak.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 110–111, measured sections. In Carter County, Mont., top of member is about 200 feet below base of Fox Hills sandstone and base is estimated to be about 450 feet above Mitten black shale member of Pierre and 1,500 feet above base of Pierre. In central Crook and Weston Counties, Wyo., rocks equivalent to Monument Hill

bentonite member apparently consists of dark-gray shale indistinguishable from dark shale of underlying Kara bentonitic member (new). Thickness 150 to 220 feet.

Named for exposures at Monument Hill, sec. 32, T. 56 N., R. 68 W., Crook County, Wyo.

Monument Spring Dolomite Member (of Marathon Limestone)[1]

Lower Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066–1069.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 10. Occurs 550 to 600 feet above base of Marathon and ranges from 40 to a maximum of 90 feet in thickness. Consists of oval lenses of blue-gray and yellow-mottled dolomitic limestone surrounded by black shale and thin-bedded, cross-laminated gray limestone. Underlies unnamed interval in upper part of Marathon gray limestone.

Typically exposed one-half mile west of Monument Spring, Marathon uplift, Brewster County.

†Monument Valley Shale[1]

Permian: Northeastern Arizona and southeastern Utah.

Original references: D. Hager, 1924, Mining and Oil Bull., v. 10, no. 2, p. 137; no. 4, p. 385, 423.

Named for exposures in Monument Valley, San Juan County, Utah, and Navajo National Monument, Ariz.

Moody Shale Member[1] (of Toledo Formation)

Eocene, upper: Northwestern Oregon.

Original reference: H. G. Schenck, 1927, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 12, p. 455, 456, 457, 459.

H. E. Vokes, Hans Norbisrath, and P. D. Snavely, Jr., 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 88. Dark to black hard tuffaceous mudstones, commonly intricately fractured, with occasional discontinuous, irregular, hard cemented limy bands a few inches thick; interbedded fine- and medium-grained sandstones containing glauconite and coarse pumiceous material occur at numerous horizons; carbonaceous material and plant fragments abundant in sandstones near base thickness 1,500 to 1,800 feet. Along Eckman Creek and south of Green Mountain, member becomes markedly tuffaceous and interfingers with volcanic rocks of the Toledo to south. Underlies an unnamed sandy member 1,000 to 1,200 feet thick; overlies Burpee formation. Upper Eocene.

Type locality (Schenck): Railroad cuts at Moody Station on Southern Pacific Railroad, between Yaquina and Toledo, Lincoln County. (Vokes and others): At Moody School, north bank of Yaquina River in sec. 30, T. 11 S., R. 10 W., Lincoln County.

Moody Ledge Granite[1] (in New Hampshire Magma Series)

Upper Devonian or Upper Carboniferous: West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 28, Moosilauke map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 509–510 pl. 12. Map bracket shows Moody Ledge granite in New Hampshire magma series above French Pond granite and below Pond Hill granite.

Mapped on and around Moody Ledge, Moosilauke quadrangle.

Moodys Marl (in Jackson Group)

Moodys Marl Member (of Jackson Formation)[1]

Eocene, upper: Mississippi and southwestern Alabama.

Original reference: O. Meyer, 1885, Am. Jour. Sci., 3d, v. 30, p. 435.

C. W. Cooke, 1939, Jour. Paleontology, v. 13, no. 3, p. 337–339. Gosport sand of Alabama, heretofore classified as topmost formation of Claiborne group (Eocene), and the only known formation of "upper Claiborne" age, proves to be nearly equivalent to Moodys marl of Jackson group. It is recommended that name Gosport be replaced by Moodys and that Claiborne group be restricted to formations heretofore classified as lower Claiborne.

F. S. MacNeil, 1946, Southeastern Geol. Soc. 4th Field Trip, p. 43. Replaced by Moodys Branch formation. Although not rigidly defined, name Moodys marl apparently was used in this area [southeastern Alabama] for "Scutella bed" and beds here referred to Gosport sand.

Named for exposures along Moodys Branch of Pearl River, in city of Jackson, Miss.

Moodys Branch Marl[1] or **Formation** (in Jackson Group)

Moodys Branch Member (of Jackson Formation)

Eocene, upper: Mississippi, southwestern Alabama, Georgia, and Louisiana.

Original reference: O. Meyer, 1885, Am. Jour. Sci., 3d, v. 30, p. 435.

H. N. Fisk, 1938, Louisiana Geol. Survey Bull. 10, p. 94–98. Moodys Branch marl extended into Louisiana where it is most fossiliferous unit zone in state. Consists of glauconitic sands transitional with lower lignitic silty clays of Cockfield formation and with overlying Yazoo clays. Jackson group.

F. F. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 16–18, 19 (fig. 4). Basal member of Jackson formation. Underlies Yazoo member; overlies Yegua silt (Lisbon). Thickness 30 to 45 feet.

Tom McGlothlin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 56–59. Moodys Branch is calcareous fossiliferous green sand ranging in thickness from about 10 to 50 feet. Author of this report is convinced that at least upper part and perhaps all of so-called "Gosport" of Hatchetigbee anticline is Moodys Branch. Political boundary separating Mississippi and Alabama was apparently given weight in not only changing name of Moodys Branch, but also the age. There is possibility that Jackson-Claiborne contact is located in approximate middle of "Gosport" of Hatchetigbee anticline. Jackson group includes Moodys Branch at base and Yazoo clay at top.

W. E. Belt and others; 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Jackson group, as mapped, includes Moodys Branch formation at base and Yazoo clay above.

F. S. MacNeil, 1946, Southeastern Geol. Soc. Guidebook 4th Field Trip, p. 33–42. Term Moodys Branch formation replaces term Moodys marl. Gosport sand and Claiborne-Jackson contact discussed. Writer has determined equivalence of lower part of Gosport, as originally defined, with uppermost part of Cockfield formation (Yegua), and upper part of Gosport with lower part of Moodys Branch, to his own satisfaction but acknowledges that there are others who would place base of Moodys Branch at both higher and lower levels. Main problem is not whether

lower part of Gosport is equivalent to Moodys Branch, but whether or not lower part of Gosport, and at least upper part of Cockfield, are Jackson rather than Claiborne. Practice of U.S. Geological Survey in classifying Gosport as Jackson was based on supposed equivalence of Gosport and Moodys Branch.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Moodys Branch formation comprises lower sand member and upper limestone member; lower sand member interfingers with "Scutella bed" which extends into Georgia. Formation underlies Yazoo clay and overlies Cockfield formation in Mississippi; hence, in Alabama and Georgia, underlies Ocala limestone.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 112 (table 9), 115–156. Moodys Branch formation in Florida is cream to white fragmental marine highly fossiliferous limestone composed of camerinid-rich limestone member, Williston (new), at top and echinoid-rich limestone member, Inglis (new), at base. It is approximately basal 80 feet of Ocala limestone of Cooke (1945). Underlies Ocala limestone (restricted); disconformably overlies Avon Park limestone.

L. D. Toulmin, P. E. LaMoreaux, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 120–121. Formation described in Choctaw County, where it maintains thickness of 10 to 18 feet. Basal formation in Jackson group; underlies Yazoo clay; overlies Gosport sand.

H. B. Stenzel, 1952, Mississippi Geol. Soc. [Guidebook] 9th Field Trip, p. 41. In Alabama, includes Dellett sand member (new).

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2, p. 130; 1957, Florida Geol. Survey Bull. 38, p. 29–30. Williston and Inglis, originally defined as members of Moodys Branch, are herein raised to formational rank. [This apparently abandons use of Moodys Branch formation in Florida].

H. V. Andersen, 1960, Type localities project Unit 1: Baton Rouge, La., Soc. Econ. Paleontologists and Mineralogists, Gulf Coast Sec., no pagination. Note on type locality. Reference section designated. Thickness 16 feet at reference section.

Type locality: At intersection of Peachtree Street and Poplar Blvd. in city of Jackson, Hinds County, Miss. Reference section: In Riverside Park, in city of Jackson, Miss. Named for exposures along Moodys Branch of Pearl River, in city of Jackson, Miss.

Moon Trachyte (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21. Name proposed for two trachyte lava units which are exposed on Moon Ranch. Lower unit, quartz trachyte member, consists of 45 feet of dark-red slabby to blocky aphanite; upper unit, platy trachyte member, consists of hard light-colored nonvesicular non-porphyritic highly platy alkali-feldspar trachyte about 70 feet thick. Underlies Means trachyte (new); overlies Pantera trachyte (new).

Type section: (Quartz trachyte) small cuesta on Halcon Draw; (Platy trachyte) high hill east of Esperanza well, in Coyote Hills, Jeff Davis County.

Moon Hill Quartzite Member (of Skookum Formation)

Precambrian: Northeastern Washington.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 13–14, pl. 1. Coarse-grained quartzite about 1,100 feet thick at top of Skookum formation (new). Top of Moon Hill quartzite concealed by Tertiary Tiger formation.

Forms crest of Moon Hill, Pend Oreille County.

Moon Lake Diorite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1934, New York State Mus. Bull. 296, p. 62.

Forms much of peninsula on south side of Moon Lake, Antwerp quadrangle, Jefferson County.

Moonlight Formation

Upper Cretaceous: Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3). 24–26, pls. 1, 2. Proposed for lithologic unit in Orchard Peak area which is equivalent to Pachydiscus silt or Ragged Valley shale of Coalinga area and elsewhere. Consists of two facies: a light-colored siltstone facies in Devil's Den and Sawtooth Ridge synclines and a dark-gray clay shale west of Sawtooth syncline; transition between the two facies occurs rather abruptly, near west end of Sawtooth Ridge syncline. Thickness at type locality 1,550 feet; 1.2 miles to southwest in Sawtooth Ridge syncline, thickness is about 375 feet, this suggests that the Moonlight may be a tongue which pinches out toward south. Except where faulted, formation conformably overlies Serpiente sandstone (new) and underlies Red Man sandstone (new). Contains *Baculites chicoensis, Liopistha,* and Foraminifera.

Type locality: Moonlight Valley which runs along south limb of Devil's Den syncline, just north of Avenal Ridge, northeastern Kern County.

Moonshine Conglomerate[1]

Middle Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, chart 8C. Shown on correlation chart above Mormon sandstone and below Hull agglomerate. Middle Jurassic.

Occurs on southwest slope of Mount Jura, Taylorsville area.

Moonstone Rhyolite

Tertiary: Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981. Named in a stratigraphic sequence as younger than Shely group (new) and older than Petan trachyte (new).

Moore Formation

Pennsylvanian (Atokan): Southern Oklahoma (subsurface).

R. H. Wheeler, 1947, World Oil, v. 127, no. 7, p. 156, 161. Name applied to subsurface limestone and shale sequence that underlies overlapping

Deese rocks and overlies successively truncated Mississippian formations from the Caney and Mayes to the Woodford shale. Consists of two members: an upper siliceous, glauconitic, dense brown limestone thickening southward from 50 feet in West Moore to a maximum of 150 feet, and a lower sandy black calcareous shale with a maximum thickness of 180 feet; variations in thickness of the members are due to truncation of the limestone and onlap of the shale.

Occurs in structurally low area centering in northern McClain County between down-faulted South and West Moore structures and the structurally high Lindsey area to the south. Has not been penetrated to north on Oklahoma City uplift.

Moorefield Formation

Moorefield Shale[1]

Upper Mississippian: Northern Arkansas and central eastern Oklahoma.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Prof. Paper 24, p. 26.

Mackenzie Gordon, Jr., 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1627–1631. Moorefield in Batesville district, Independence County, Ark., consists of lower member of black calcareous shale and limestone and upper member of dark fissile clay shale; lower member has been known as Spring Creek limestone (name preoccupied) and grades laterally into chert that has been mapped incorrectly as Boone chert. Recommended that name Moorefield formation be restricted to lower member, and that name Ruddell shale be erected for upper member.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 45, 49–61, pls. 1–4. Described on flanks of Ozark uplift in northeastern Oklahoma where it is divided into four facies of member rank (ascending) Tahlequah, Bayou Manard, Lindsey Bridge, and Ordnance Plant. Advisability of application of term Ruddell to rocks in Oklahoma is questionable at this time; hence, above terminology is applied to its probable equivalent. Unconformably underlies Hindsville formation; unconformably overlies Keokuk formation or, in some areas, the Reeds Spring formation or the Chattanooga shale.

Named for Moorefield, Independence County, Ark.

Moorehouse Member (of Onondaga Limestone)

Middle Devonian: New York.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 628–629, 637, 642. Medium-gray, very fine grained limestone beds separated by thin shaly partings in many places; chert common, more abundant in upper nonshaly half. In west-central New York, limestone is coarser and lighter colored than in central area and seems to contain fewer impurities. Thickness 20 to 25 feet in type area; maximum about 50 feet. Underlies Seneca member: overlies Nedrow member (new) with transitional contact.

Type locality: On southwest extremity of Moorehouse Flats at Onondaga County Prison quarry one-half mile south of County Penitentiary at Jamesville, Onondaga County. Not recognized east of Winfield quadrangle.

Mooretown Formation

Mooretown Sandstone (in Chester Group)[1]

Mooretown Sandstone Member (of Renault Formation)

Upper Mississippian: Southern Indiana and central and western Kentucky.

Original reference: E. R. Cumings, 1922, Handb. Indiana Geology, pt. 4, Sep. Pub. 21, p. 408, 515, chart.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig. 1), 269, 270, (fig. 3), 271, 272. In Meade, Hardin, and Breckinridge Counties, Ky., Mooretown sandstone is considered member of Renault formation. Underlies Beaver Bend limestone member; overlies an unnamed limestone member at base of formation. Maximum thickness 75 feet.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 825; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Considered member of Renault formation in Indiana.

C. A. Malott, 1952, Stratigraphy of Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich. The Edwards Letter Shop, p. 7, 12–13, 101. Renault formation of standard Chester column has triple expression in southern Indiana (ascending) Paoli limestone, Mooretown sandstone, and Beaver Bend limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves a name in its own right. Underlies Beaver Bend limestone; in Putnam County, overlapped by Pennsylvanian sandstone. At type locality, about 21 feet of Mooretown is exposed; exposure does not show overlying Beaver Bend.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6. Name Bethel formation here used in place of Mooretown sandstone. Bethel has priority and wider usage. Name Mooretown is incorrectly spelled and refers to village that no longer exists; formation is not dominantly sandstone and is not completely exposed at type locality designated by Malott (1952).

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 24, pl. 1. Mooretown sandstone in Indiana is 5 to 30 feet thick; characteristically about 15 to 20; maximum 65. Normal lithology is fine-grained friable tan to dark-brown iron-stained sandstone resting on Paoli limestone; *Stigmaria* common in this zone; dark-gray to black carbonaceous shale, constitutes upper part. Ratio of sandstone to shale ranges from none of either to equal parts of both. Underlies Beaver Bend limestone.

Type locality: SW¼SE¼ sec. 3, T. 3 N., R. 2 W., roadcut north side of State Road 60, about one-fourth mile east of old village site of Mooretown, Lawrence County, Ind.

Mooreville Chalk (in Selma Group)

Mooreville Tongue (of Selma Chalk)[1]

Upper Cretaceous; Northeastern Mississippi and western Alabama.

Original reference: L. W. Stephenson, 1917, Washington Acad. Sci. Jour., v. 7, p. 243–250.

H. R. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey; W. H. Monroe and D. H. Eargle, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 50. Rank raised to formation in Selma group. Includes Arcola limestone member at top. Unconformably

overlies Tombigbee sand member of Eutaw formation; underlies Demopolis chalk.

Named for exposures at Mooreville, Lee County, Miss.

Mooringsport Formation (in Trinity Group)

Mooringsport Member (of Rusk Formation)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, and Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 36–37, cross sections. Includes dominantly marine shale and limestone lying above Ferry Lake anhydrite and below red shales and sands of Paluxy formation. Corresponds to Upper Glen Rose formation. Thickness as much as 800 feet. Type section to be described in forthcoming paper.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2357–2359. Rank reduced to member status in Rusk formation (new). Redefined as that stratigraphic interval and its recognizable equivalent above Ferry Lake anhydrite and below top of first limestone bed within Trinity group in Mooringsport field area of Caddo Parish, La.

Representative section is in Union Producing Co.'s Noel Estate well No. 1–A, Mooringsport field, sec. 11, T. 19 N., R. 16 W., Caddo Parish, La. Top of member 825 feet below top of Trinity group.

Moorman Ranch Formation

Moorman Ranch Member (of Pequop Formation)

Permian (Leonardian to early Guadalupian): Eastern Nevada and western Utah.

J. S. Berge, April 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 11 (fig. 3). (Footnote and stratigraphic chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf.) Name appears on correlation chart credited to Steele (unpub. thesis). Overlies Pequop formation; underlies "Kaibab" limestone of Park City group.

Grant Steele, June 1960, Dissert. Abs., v. 20, no. 12, p. 4635. In eastern Great Basin. Leonardian to earliest Guadalupian marine limestone and dolomite sedimentation, modified by two episodes of evaporited precipitation, is represented by Moorman Ranch formation (new), the unnamed Summit Springs evaporite succession and Hermit and Toroweap formations.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). In Moorman Ranch area overlies Pequop formation.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 106. (Road logs dated Sept. 8–10.) Rank reduced to member status in Pequop formation. Referred to as lower and upper Moorman Ranch. In Moorman Ranch section, basal 1,750 feet of Pequop is referred to as Lower Moorman Ranch member. Lower member composed of grayish-orange to yellowish-tan micro- to fine-crystalline, thin- to medium-bedded limestone and thin interbeds of dark-yellowish-orange, fine-grained sandstone and silt; lower Leonardian age fusilinids present throughout unit. Disconformably underlies Upper Moorman Ranch member; conformably overlies Riepetown sandstone (new). Upper member is 1,050 feet thick with lower 850 feet assigned to upper Leonardian, and remaining 200 feet lower Guadalupian in age. Underlies Loray formation.

Moorman Ranch section is in T. 17 N., R. 59 E., White Pine County, Nev.

Moosalamoo Phyllite[1]

Moosalamoo Member (of Mendon Formation)

Precambrian: West-central Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 362, 395.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 28, 30, 34, 35. Reduced to member of Mendon formation. A lenticular body of schist in upper part of formation; absent in some areas. Thickness featheredge to about 900 feet. Grades upward into Cheshire quartzite. Lower Cambrian. This unit termed "mica schist" member of Mendon series (Whittle, 1894).

Named for thickest exposures on slopes of Moosalamoo Mountain, East Middlebury-Rochester area.

Moose Creek Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258.

Well exposed along Moose Creek, Lewis County.

†Moose Island Shale[1] or Series[1]

Silurian: Southeastern Maine.

Original reference: N. S. Shaler, 1886, Am. Jour. Sci., 3d, v. 32, p. 51, 58.

Named for exposures on Moose Island, southeastern coast of Washington County.

Moose Lake Conglomerate

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1038 (fig. 4). Shown on stratigraphic column and on map legend as occurring at base of Knife Lake series. Thickness 1,700 feet. Underlies Dike Lake slate (new); unconformable above Ely greenstone. [Text describes Saddlebag Lake conglomerate at this horizon.]

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1593. Greenstone conglomerate, called Moose Lake by Stark and Sleight (1939) and described by them as Saddlebag conglomerate, occurs in Twin Peaks area where it lies directly on [Ely] greenstone; farther north, gray and flinty slate lies directly on the same greenstone mass, because there is a fault between the slate and the greenstone conglomerate. In this report, the Knife Lake series is divided into 20 members. Table of approximate chronological sequence (ascending) shows Disappointment Mountain and Moose Lake greenstone conglomerates as unit 3 occurring above flinty slates and below Jasper Lake greenstone conglomerates.

Occurs in Kekequabic and Ogishkemuncie Lakes area [Cook County].

Moose River Group

Moose River Sandstone[1]

Lower and Middle Devonian: Western Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21–22, 88–92.

P. M. Hurley and J. B. Thompson, Jr., 1950, Geol. Soc. America Bull., v. 61, no. 8, p. 837, 838, pl. 1. Chiefly gray- or buff-weathering sandstone. Gray sandy slates interbedded with sandstones. Few thin beds of impure lime-

stone associated with slates. Age designated Lower Devonian in text, and Lower to Middle Devonian on geologic map (pl. 1).

Named for exposures near Moose River and Moose River settlement, Somerset County.

Moosic[1] (formation

Upper Devonian: Eastern Pennsylvania.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 104–105.

In Moosic Mountain, west of Pocono Plateau.

Mooyie Argillite[1] or Formation[1]

Precambrian: Idaho, and British Columbia, Canada.

Original reference: R. A. Daly, 1905, Canada Geol. Survey Summ. Rept. 1905, p. 96–100.

Named for its situation on Moyie [Mooyie] River, northeast Idaho and British Columbia.

Moppin Metavolcanic Series

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 1, 10, 14–21, pl. 1. Consists largely of greenschist and amphibolite with other less abundant rock types including conglomerate, phyllite, gneiss, and schist. Thickness from 1,000 to several thousand feet. Series is intruded by sills and dikes of Burned Mountain metarhyolite (new) and by sills, dikes, and plutonic masses of Maquinita granodiorite (new) and Tres Piedras granite (new). These rocks were called Hopewell series by Just (1937), but are herein renamed because Hopewell is preempted.

Named after exposures in upper Spring Creek just north of Moppin Ranch. Exposed in a northwest trending belt extending from Hopewell to Cow Creek, American Creek, and in part, the southeast part of Kiawa Mountain, Las Tablas quadrangle.

Moqui Member (of Moenkopi Formation)

Triassic: Northeastern Arizona.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, p. 18, 19. Siltstones and claystones, most of them shaly or fissile, and gypsum beds, lenses, nodules, and veins. Strata dominantly olive gray, though pale reddish brown locally common. Thickness, as shown on table, ranges from 20 to 144 feet. Generally light color in contrast to red brown of Wupatki member below and Holbrook member above. Units here called Wupatki and Moqui were referred to as Salt Creek by Hager (1922, Mining and Oil Bull., v. 8, no. 2).

In Poverty Tank-Concho area.

Mora sandstone[1]

Cretaceous: Central northern New Mexico.

Original reference: C. R. Keyes, 1909, Econ. Geology, v. 4, p. 368–369.

Named for Rio Mora, Santa Fe County.

Moraga Formation[1] **or Tuff** (in Berkeley Group)

Pliocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 143. Interbedded with overlying Siesta and interfingers with underlying Orinda. In Bald Peak syncline where Siesta thins to less than 50 feet, Moraga volcanics are almost in contact with Bald Peak lavas.

D. E. Savage, B. A. Ogle, and R. S. Creely, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1511 Included in sequence of formations (in west-central Contra Costa County) for which new group name is proposed [name not given] Sequence (ascending) Orinda, Moraga, Siesta, Bald Peak, and an unnamed formation. Unnamed unit is exposed east of Moraga fault system in fault contact with Siesta and Moraga formations: [See Contra Costa group.]

D. E. Savage and O. E. Bowen, 1955, *in* Geol. Soc. America Cordilleran Sec. [Guidebook] Apr. 28–30, Trip 2, p. 2, 3. Road log (between Oakland and Mount Diablo) mentions (1) flow contact of Orinda formation with lower member of Moraga volcanic series (lower member is also locally called Grizzly Peak basalt); (2) prominent, light-colored, water-laid tuff bed in Moraga volcanics; east-dipping bed is in west limb of synclinal structure; (3) depositional contact between east-dipping flows of Moraga volcanics and conformable lake beds of Siesta formation; (4) depositional contact between steeply west-dipping Siesta lake beds and lower member of Moraga volcanics on east limb of syncline; (5) reappearance of light-colored tuff bed in Moraga volcanics in west limb of syncline; (6) contact of Moraga volcanics with conglomerate of Orinda formation along crest of sharp, asymmetrical anticline, Moraga volcanics stand almost vertical whereas Orinda sediments dip east at angles around 45°.

Named for Moraga Valley, Contra Costa County.

Morales Member (of Santa Margarita Formation)[1]

Morales Formation

Miocene, upper: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

T. W. Dibblee, Jr., *in* Chester Stock, 1948, Southern California Acad. Sci. Bull., v. 46, pt. 2, p. 84. Section exposed in Apache Canyon, Ventura County, divided into (ascending) Caliente, Apache, and Morales formations. Morales consists of gray sand, conglomerate, and clays. Pleistocene.

D. E. Savage, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1845. Shown on chart of formations of Caliente Range, [Ventura County]. Thickness 1,000 feet. Nonfossiliferous. Overlies Quatal formation. Age probably Plio-Pleistocene.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, p. 2974 (fig. 1), 2978 (fig. 3), 2990 (fig. 8), 2996–2998. Rank raised to formation. At designated type locality, about 2,750 feet thick and consists of basal conglomerate 0 to 50 feet thick; alternating claystone, sandstone, and gravel about 1,300 feet; and sandstone and gravel about 1,400 feet. South of Cuyama River, lower part of Morales consists of about 1,300 feet of gray gypsiferous claystones of lacustrine origin (mapped as Santa Margarita by English, 1916, and as Pleistocene lake beds by Eaton and others, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) which are conformably overlain by 1,500 feet of sand and gravel (here mapped as Cuyama formation by English, 1916, and included in Pleistocene fans by Eaton and others, 1941). Along south margin of Cuyama Valley, between Castro and Santa Barbara

Canyons, as much as 1,000 feet of Morales sandstone, gravels, and claystone (mapped as Cuyama by English, 1916) are exposed and lie directly on Santa Margarita sandstone. In Cuyama Badlands, the Morales (here mapped as Santa Margarita by English, 1916) is approximately 4,200 feet thick and consists of an upper unit (2,200 feet) of coarse gray incoherent conglomerate made up of debris of granitic, gneissic, quartzitic rocks, schist, basalt, sandstone, and white shale; and a lower unit (2,000 feet) of pebble-conglomerate-sandstone with similar debris, and interbeds of gray sandy siltstone resting conformably on Quatal formation. Regionally, Morales is unconformably overlain by Pleistocene alluvial fans; in Cuyama Valley, unconformably overlain by Pleistocene fanglomerates; in northern Cuyama Badlands and Carrizo Plain, overlain by Pleistocene Paso Robles formation. Probably of Pliocene age.

Type locality: From Whiterock Bluff eastward through sec. 25, T. 11 N., R. 28 W., and sec. 30, T. 11 N., R. 27 W., Caliente Mountain quadrangle. Name derived from Morales Canyon.

Moran Formation (in Wichita Group)[1]

Moran Group

Lower Permian (Wolfcamp Series): Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 135–145.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 93. Rank raised to group. Includes (ascending) Dothan, Horse Creek, and Sedwick formations. Underlies Putnam group; overlies Pueblo group (redefined).

R. C. Moore *in* M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 13, sheets 3, 4. Formation includes (ascending) Watts Creek shale, Gouldbusk limestone (new), Santa Anna shale, and Sedwick limestone members.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley where it is about 100 feet thick. Overlies Pueblo formation; underlies Putnam formation. [Includes members as listed in above reference.] Wolfcamp age.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G. p. 270. Formation is 155 to 220 feet thick in Brazos River valley. Overlies Pueblo formation; underlies Putnam formation. Only upper member, Sedwick limestone, recognized in area.

Named for Moran, Shackelford County.

†Moran Limestone Member (of Moran Formation)[1]

Permian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Named for Moran, Shackelford County.

Morapos Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Northwestern Colorado.

Original references: E. T. Hancock, 1923, U.S. Geol. Survey Press Memo. 16037, with map; 1925, U.S. Geol. Survey Bull. 757.

Kenji Konishi, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 67–69. Consists of thin-bedded sandstone 15 to 75 feet thick, with well-defined top and poorly defined base that merges into

sandy shale. Forms conspicuous escarpment in Axial and Monument Butte quadrangles, where it is about 1,000 to 1,200 feet below Mancos-Mesaverde contact and about 1,000 to 1,100 feet above top of Meeker sandstone member (new). Separated from overlying Loyd sandstone member (new) by two sandstone tongues of Mancos.

Named for outcrops in vicinity of Morapos Creek, Routt County.

Moravian Heights Formation

Precambrian: Eastern Pennsylvania.

D. M. Fraser *in* B. L. Miller, D. M. Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 163 (fig. 30), 170–175, 182–183, pl. 1. Light-gray to light-greenish rocks which contain streaks of sericite and sillimanite. Thickness uncertain as in many areas unit contains much injected material. Considered to be approximately same age as Franklin limestone; in Chestnut Hill area, occurs in plot of irregular width adjacent to the Franklin; no contacts between the two observed but both are injected and altered by Byram granitic material. Conformable above Pochuck gneiss and both formations strike N. 50° E. and dip northwest at an angle of 59°. This superposition of Moravian Heights gives no indication of relative periods of origin as all Precambrian rocks have been extensively disturbed; the Pochuck may be older, younger, or interbedded with the Moravian Heights. Name credited to B. L. Miller and E. T. Wherry.

Occurs on south slope of Chestnut Hill north of Easton, Northampton County, in Fairview School ridge, south of Easton, and in other scattered areas through Precambrian area which extends toward Reading.

Moreau Gravels

Pleistocene (pre-Wisconsin): North-central South Dakota.

J. C. Mickelson and C. L. Baker, 1950, Areal geology of the Mouth of Moreau quadrangle (1:62,500): South Dakota Geol. Survey; J. C. Mickelson and A. D. Klein, Jr., 1952, Areal geology of the Cheyenne Agency quadrangle (1:62,500): South Dakota Geol. Survey. Fluvial sand and gravel terrace deposits in old Missouri River flood plain. Overlain by 0 to 20 feet of loess.

Mapped in Dewey and Walworth Counties.

†Moreau Sandstone[1]

Lower Ordovician (Beekmantown): Central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 370–375.

Named for Moreau Creek, Cole County.

Morehead facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 177–191. Constitutes northeastern outcropping phase of Brodhead formation. Dominant lithology is blue-gray, greenish-gray to drab siltstone. Thickness ranges from 195 feet, where it merges with Irvine facies (new) in Powell County, to 270 feet in northwestern Greenup County. Comprises Christy Creek siltstone, Frenchburg siltstone, Haldeman siltstone, Perry Branch siltstone, and Indian Fort shale members (all new) of Brodhead formation. Underlies Floyds Knob formation and overlies New Providence formation, Stanton and Bluestone facies (both new).

Type section: Along road leading to U.S. Forest Tower; bottom of section at intersection with Dry Creek road, 1½ miles southeast of Morehead; top of section at tower, 1½ miles east-southeast of Morehead, Rowan County. Named for Morehead, county seat.

Morehouse Formation

Pennsylvanian(?): Subsurface in Louisiana and Arkansas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 7–8, cross sections. Name selected by Shreveport Geological Society to designate 1,190 feet of marine silty shales and thin siltstones penetrated at depths of from 9,285 to 10,475 feet in type well. Underlies Eagle Mills formation apparently conformably and gradationally. Base not determined. Probably Jurassic.

R. W. Imlay and J. S. Williams, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1672–1673. Fauna indicates late Paleozoic age; probably not older than Pennsylvanian.

R. T. Hazzard, W. C. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 484 (table 1), 486. Morehouse, in this report, considered younger than Eagle Mills. Underlies Werner formation (new). Permian.

W. S. Hoffmeister and F. L. Staplin, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 1, p. 158–159. Middle to Upper Pennsylvanian. This determination made on basis of study of plant spores in interval from 10,243 to 10,253 feet in type well.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. Neither relation of Morehouse to overlying and underlying formations, nor its position relative to Eagle Mills formation is clear. Three interpretations suggested: Eagle Mills older than Morehouse; Morehouse older than Eagle Mills; units separated by fault of unknown dip and displacement. Second interpretation is followed in this report.

Type well: Union Producing Co. Tensas Delta No. 1–A well, sec. 8, T. 22 N., R. 4 E., Morehouse Parish, La.

Morehouse Quartzite[1]

Cambrian(?): Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

T. B. Nolan, 1943, U.S. Geol. Survey Prof. Paper 197–D, p. 152. In this report, Morehouse quartzite is assigned in part to the Silurian, but it is probably of Cambrian age.

Type locality: Morehouse Canyon, northwest of Frisco, Beaver County.

Morena Rhyolite[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 46.

Occurs on Morena Ridge, Goldfield district.

Morenci Shale[1]

Upper Devonian: Southeastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43.

Present in vicinity of Morenci and at other places in Clifton-Morenci region.

Moreno Formation[1] **or Shale**[1] (in Chico Group)

Moreno Group

Upper Cretaceous and Paleocene(?) : Southern California.

Original reference: R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603.

R. T. White, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 256–257. In Tumey Hills region, disconformably underlies Lodo formation (new).

F. M. Anderson, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1943. Regarded as group in Chico series.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1953–1954; 1951, California Div. Mines Spec, Rept. 9, p. 7–11, pls. 2–5. Subdivided in type area. Includes four members (ascending) : Dosados sand and shale, Tierra Loma shale (including Mercy sandstone lens), Marca shale, and Dos Palos shale (includes Cima sandstone lens). Members mapped as lithogenetic units for distance of 35 miles. On basis of mapping, it is concluded that Anderson and Pack (1915) show base of Moreno in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch. Thickness about 3,700 feet. Underlies Paleocene glauconitic sandstone; overlies Panoche formation.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 204–205. Described in San Benito quadrangle where it is exposed in a narrow belt along northeast side of Butts Ranch syncline. Thickness 300 to 650 feet. Conformably overlies Call sandstone member (new) of Panoche group; relationship to Big Oak Flat shale member (new) of Panoche not certain as the two are not in contact.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 31–33. Replaced by Moreno Grande formation (new) in Tesla quadrangle.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. Described in Tumey Hills region. Moreno-Lodo boundary discussed. Upper Cretaceous and Paleocene.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 28–29, pls. 1, 2. Formation, in Orchard Peak area, crops out only as single arctuate band of brown shale in Devil's Den syncline. This is southernmost surface exposure known. Not known which of Payne's members is represented at Devil's Den. Maximum exposed thickness, 900 feet, is on north limb of syncline. Formation thins southeastward to about 230 feet near eastern end of outcrop belt. Conformably overlies Red Man sandstone (new) ; underlies upper Eocene Canoas siltstone member of Kreyenhagen shale.

Typically exposed in Moreno Gulch on east flank of Panoche Hills, Fresno County. Moreno Gulch is 8 miles northwest of Panoche Creek.

Moreno Grande Formation

Upper Cretaceous: Central western California.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 472. Name proposed for original Moreno and part of underlying Panoche formation. Name credited to A. S. Huey (unpub. ms.).

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 31–33, pls. 1, 2, 3. Described as consisting of siliceous, argillaceous, and sandy shale, sandstone beds, limestone concretions, and locally, buff sandstone at top. Thickness as much as 650 feet. As defined, the Moreno Grande, north of

Pacheco Pass, comprises the Moreno as mapped by Anderson and Pack (1915); southward to Coalinga region, the formation comprises the restricted Moreno, Brown Mountain sandstone, and the Ragged Valley (*Pachydiscus* silt) as members. Unconformably underlies Tesla formation; overlapped by Cierbo formation on the north; contact with underlying Panoche not well exposed but appears to be conformable and gradational. Along southside of Corral Hollow, the Moreno Grande dips steeply northward at angles of 60° to 80° into a syncline.

Occurs in Tesla quadrangle which comprises about 240 square miles in parts of Alameda and San Joaquin Counties.

Moretown Formation

Middle Ordovician: Central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116. Name used only on correlation chart. Lower Cambrian. Underlies Cram Hill formation; overlies Stowe formation (new).

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Described in Montpelier quadrangle as chiefly granulite, quartzite, phyllite, and slate. Laminated quartz-albite-sericite-chlorite granulite, known as "the pinstripe," most characteristic. Underlies unnamed metamorphics in map area; in some areas, underlies Shaw Mountain formation; overlies Stowe formation, zone of transition as much as 500 feet. Is subdivision of Missisquoi group of Richardson (1924). Ordovician. Type locality given.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. In Hyde Park quadrangle overlies Umbrella Hill formation (new).

Named for typical occurrence in eastern Moretown Township on east slope of Northfield Mountains, Montpelier quadrangle.

Morgan Formation[1]

Morgan Formation (in Durst Group)

Morgan Sandstone

Middle Pennsylvanian: Northeastern Utah and western Colorado.

Original reference: E. Blackwelder, 1910, Geol. Soc. America Bull., v. 21, p. 519, 529–542.

K. G. Brill, Jr., 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 632–633. Name Morgan formation is applied to several hundred feet of red and white fine-grained sandstone with intercalated shale and crystalline marine limestone that lie between the Mississippian and the Weber quartzite in Moffat County, Colo. Thickness 941 feet near Elk Springs; more than 1,500 feet on Cross Mountain with top not exposed. Fauna indicates Morgan is of Des Moines age. Sediments have been referred to as "older Pennsylvanian" by earlier workers.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 832–833. Referred to as Morgan sandstone. At type locality herein noted, lies below type Weber quartzite and above Brazer limestone. Thickness about 1,000 feet at Round Valley.

A. A. Baker, J. W. Huddle, and D. M. Kinney, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1179–1182. In Uinta basin, Morgan formation, 400 to about 1,400 feet thick, consists of lower limestone unit and an overlying interbedded gray to red limestone and sandstone unit. Contains fusulinids of Lampasas or Morrow age in lower part and of Des Moines age in upper part. Overlies Mississippian; underlies Weber sandstone.

M. D. Crittenden, Jr., B. J. Sharp, and F. C. Calkins, 1952, Utah Geol. Soc. Guidebook 8, p. 10–11. Doughnut formation (new) includes parts of Morgan formation as defined by Calkins (1943, U.S. Geol. Survey Prof. Paper 201).

C. P. Abrassart and G. A. Clough, 1955, Intermountain Assoc. Petroleum Geologists Guidebook 6th Ann. Field Conf., p. 65, 67–70 [jointly with Rocky Mountain Association of Geologists]. Formaton, in Juniper Mountain area, Colorado, divisible into three mappable members: lower, predominantly sandstone, 66½ feet; middle, thick limestones, nodular limestones, and intercalated shales, 427 feet; upper, thick limestones, sandstones, and some shale and limestone conglomerate beds, 525 feet. Aggregate thickness about 1,019 feet. Section measured west to east, from west entrance of Yampa River Canyon. Overlies Madison formation. Lower Pennsylvanian.

Walter Sadlick, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 50 (table 1), 57–58. In Uinta Mountains, term Morgan formation stratigraphically restricted below to exclude lower member herein named Round Valley formation. As thus restricted, the Morgan essentially corresponds to definition of type Morgan. Underlies Weber sandstone. The Morgan pinches out eastward at expense of Hells Canyon formation. Thus, the Hells Canyon replaces the Morgan formation eastward.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 70, 71–75. Included in Durst group (new).

Type locality: In Round Valley, east of town of Morgan, Morgan County, Utah.

Morgan Series[1]

Lower Devonian: West Virginia.

Original reference: G. H. Ashley, 1923, Eng. and Mining Jour.-Press, v. 115, p. 1106–1108.

Probably named from Morgan County.

Morgan Corners Formation[1] or Dolomite

Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 397–398. Overlies Wallace Creek limestone; underlies Hastings Creek limestone. Thickness 150 feet. Phillipsburg series.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

Morgan Creek Limestone Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

Frederick Romberg and V. E. Barnes, 1944, Geophysics, v. 9, no. 1, p. 88, fig. 7 (geol. map); P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 149, 155, pl. 4 [1945]. Red limestone at base grading upward into gray limestone. Underlies Point Peak shale member (new); overlies Welge sandstone member (new). Name credited to Josiah Bridge and V. E. Barnes.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 114–115, pls. 1, 2. Consists of medium- to coarse-grained abundantly glauconitic well-bedded limestone; lower part commonly reddish, the red tones becoming less pronounced and grading upward into gray or greenish-gray limestone; in many sections, there is a shaly zone in upper part of member; in areas where limestone above this shale is thin, boundary is arbitrarily chosen; individual layers of limestone are from 4 inches to 1 foot or more thick, and thickness of any one bed is rather uniform. Thickness ranges from about 70 feet in Point Peak and Carter Ranch sections to about 160 feet in Salt Branch section; at type section about 110 feet.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 155, 188, 225, 254, 310 [1946]. Local stratigraphy described.

Type section: On the point just north of junction of north and south forks of Morgan Creek, Burnet County.

Morgan Ranch Formation (in Wassuk Group)

Pliocene, middle and upper (Hemphillian-Blancan): Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 33–36, 66–67, figs. 2, 3, 4. Consists of three mappable lithologic units (ascending): pumice—thickness 10 feet; sandstone and breccia—thickness 100 feet; fanglomerate—thickness 590 feet. Aggregate thickness 700 feet. In conformable contact with underlying Coal Valley formation (new). In fault contact with granitic basement which rims Coal Valley basin at the west. Further study may indicate desirability of retaining separate names for Morgan Ranch formation and Smith Valley beds (new), though they now appear to be facies of same basin of deposition.

Named for exposures in the region extending from one-half mile to over 4 miles south of Morgan's Ranch, Hawthorne quadrangle.

Morgantown Member (of Conemaugh Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Tpog. and Geol. Atlas 27.

Pittsburgh quadrangle.

Morgantown Red Bed (in Conemaugh Formation)[1]

Morgantown redbed member

Pennsylvanian: Western Maryland, western Pennsylvania, and eastern Ohio.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 6.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 151. Member of Little Clarksburg cyclothem in report on Athens County. Swartz (1922) called redbeds that are a facies of Morgantown sandstone the Morgantown redbed. Name should apparently be applied to redbeds below or at position of Morgantown shale and sandstone. It is possible that redbeds in stratigraphic position of Morgantown are a tongue belonging to Clarksburg redbed above. Where more or less continuous redbed lithology extends from or below Elk Lick member to Clarksburg members or even higher, name Clarksburg is used in this report. Thickness about 12 feet. Conemaugh series.

Morgantown Sandstone Member (of Conemaugh Formation)[1]

Morgantown Sandstone (in Conemaugh Group)

Morgantown sandstone and shale member

Pennsylvanian: Northern West Virginia, eastern Ohio, western Maryland, and western Pennsylvania.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 78, 97, fig. 21. Separated from overlying Clarksburg red shale by Lonaconing coal and clay; and from underlying Barton limestone by Barton coal. Thickness 50 to 80 feet in Fayette County. Included in Conemaugh group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 58–59, geol. map. In Morgan County, Morgantown sandstone and shale member (Conemaugh series) includes strata from Birmingham shales to base of Clarksburg limestone. Basal boundary indefinite because of absence of the Elk Lick member, and replacement, at least locally, of a part or all of the Birmingham by sandstone. Where Clarksburg limestone is absent, the Morgantown cannot be differentiated from overlying Connellsville sandstone. When Clarksburg and Birmingham members are present Morgantown member is 15 to 20 feet thick; in areas of sandstone development, thickness varies from 15 to 60 feet, depending upon how low stratigraphically the sandstone sequence begins.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 151. Shale and sandstone member of Little Clarksburg cyclothem in report on Athens County. Occupies position between Elk Lick and Clarksburg members and locally may be replaced by redbed. Sandstone which Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) assigned to Morgantown member is now believed to belong to Upper Grafton member. Average thickness of true Morgantown shale and sandstone about 21 feet. Conemaugh series.

Named for Morgantown, Monongalia County, W. Va.

Morita Formation[1] (in Bisbee Group)

Lower Cretaceous (Comanche Series): Sonora, Mexico, and southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 56, 63–65.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12, 13. Underlies Lowell formation (new).

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 70–73. Described in central Cochise County, Ariz., where it is present only in Mule Mountains. Thickness 715 feet; thickens southward into Mexico. Gradationally overlies Glance conglomerate; underlies Mural limestone.

Named for Morita Hills, just south of international boundary, between longs 109°45′ and 109°50′, in Sonora, Mex.

Mormon Sandstone[1]

Mormon Formation

Middle Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 976, chart 8C (column 92). Shown on correlation chart as underlying unnamed volcanic rocks and overlying Thompson limestone.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Mapped with Middle and (or) Lower Jurassic marine sedimentary and metasedimentary rocks.

Named for exposures at Mormon Station, an old stage route near Taylorsville, Plumas County.

Morning Glory Limestone Member (of Gold Hill Formation)[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Exposed near Morning Glory mine, Manhattan district.

Moroni Formation

Tertiary, middle or upper: Central Utah.

S. L. Schoff, 1938, Ohio State Univ. Abs. Doctors' Dissert. 25, p. 381–382. Consists of varied pyroclastic rocks (thought to be largely water-laid); metamorphosed tuff, breccia, volcanic conglomerate, green sandstones, and conglomerates. Thickness varies; maximum about 1,500 feet. Overlaps all older exposed formations: in places the relief on the unconformity amounts to 1,000 feet in less than 1 mile.

Named for the town of Moroni, with type locality at The Cliff, nearby.

Morovis Limestone

Eocene: Puerto Rico.

R. C. Mitchell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2971. Name applied to siliceous fine-grained limestones, intermingled with reddish brecciated limestones, and fine-grained dense blue-gray limestones at locality along Morovis-La Torrecilla Road. On lithologic ground, this Morovis limestone could be correlated with Corozal limestone. Kaye (1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1) suggests that Paleocene-Eocene boundary may pass through his Corozal exposures, the Eocene lying west of the northwest-striking outcrops, and thus the Morovis would be higher stratigraphically.

Described from locality along Morovis-La Torrecilla Road; paved road going south 2 kilometers before Torrecilla leading to Barrio Pasto.

Morphy[1]

Morphy Shale Member (of Canajoharie Shale)

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 118. Referred to as Morphy shale member of Canajoharie; lowermost member; underlies Sprakers shale.

Type locality and derivation of name not given but may have been named from Morphy Creek near Amsterdam in Montgomery County.

Morrill Limestone Member (of Beattie Limestone)

Morrill Limestone (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 234, 235, 237.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 166. Uppermost member of Beattie limestone. Overlies Florena shale member; underlies Stearns shale. Consists of brown to gray impure cellular limestone that, in northern part of outcrop area, contains a thin shale parting; in southern Kansas, thickens mainly as a result of algal accumulations in upper part. Thickness 2 to 8 feet. Wolfcamp series.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 76, pls. Thickness 3¼ to 7½ feet in Wabaunsee County, Kans. Overlies Florena shale member; underlies Stearns shale.

Type locality: West and one-half mile north of Morrill, Brown County, Kans.

Morris Granite[1]

Precambrian: New York.

Original reference: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2, p. 482, 510, 525, map.

Named for occurrence on west slopes of Mount Morris, Franklin County.

Morris Ferry Greensand[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas and southeastern Oklahoma.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 89.

Crops out near low-water line of river at Morris' Ferry on Little River, in northern edge of Little River County, Ark.

Morris Mountain Shaly Member (of Logan Formation)[1]

Mississippian: Northeastern Kentucky.

Original reference: Charles Butts, 1922, Kentucky Geol. Survey, ser. 6, v. 7, p. 46.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 229. "Morris Mountain shaly member of the Logan formation" of northeastern Kentucky, which has been regarded as topmost division of New Providence, is combination of an uppermost shale member, Indian Fort (new), of Brodhead formation (new) and a basal shale unit, Rothwell (new), of Muldraugh formation (new) with an intervening Floyds Knob horizon. "Morris Mountain shaly member" should be discarded as a single stratigraphic unit.

Named for Morris Mountain, about 4 miles north of Stanton, Powell County.

Morrison Formation[1]

Upper Jurassic: Colorado, Arizona, Kansas, Montana, New Mexico, Oklahoma, South Dakota, Utah, and Wyoming.

Original reference: G. H. Eldridge, 1896, U.S. Geol. Survey Mon. 27. [Formation was named by Eldridge in this monograph, within the area of which is its type locality; but Pikes Peak folio, by W. Cross, in which the formation was also described was published in 1894, before publication of the monograph.]

N. H. Darton, 1904, Geol. Soc. America Bull. v. 15, [no. 8], p. 388. Thickness of Morrison as much as 150 feet in Black Hills region. Absent to the southeast where its place apparently is represented by an unconformity

of erosion on surface of Unkpapa sandstone. Unconformably underlies Lakota sandstone. Formation has been known as "Atlantosaurus beds" and Beulah shale.

C. A. Fisher, 1909, U.S. Geol. Survey Bull. 356, p. 28–30, pls. 1, 7. Morrison formation, which is extensively exposed along Rocky Mountain Front Range in southern Montana and Wyoming, is also believed to occur along northern base of Little Belt Mountains. In previous investigations in this field by Weed and others, Morrison formation has not been recognized, and beds comprising it have been grouped with the Kootenai and included in "Cascade" formation. During fieldwork for present study, dinosaur bones provisionally regarded as of Jurassic age were found at several localities; at one exposure, sec. 3, T. 16, N., R. 2 E., about 30 feet below bone-bearing bed, a green shale containing fresh-water fauna later than Ellis formation was observed. These rocks, here provisionally regarded as constituting Morrison formation, consists of sandstone and bright-colored sandy shale with scattered layers of impure limestone, many of them lenticular in form. Lies with apparent conformity on the Ellis and overlain conformably by the Kootenai. Thickness 60 to 120 feet. Future investigation may prove that rocks here tentatively regarded as Morrison constitute in reality a basal member of the Kootenai.

W. R. Calvert, 1909, U.S. Geol. Survey Bull. 390, p. 22–24. Morrison formation has not previously been recognized in Lewiston coal field, although Weed and Pirsson (1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3) suggested that certain beds in Judith Mountain district might be equivalent of Morrison of Colorado and Wyoming. In area of present report, Morrison consists of shales, sandstones, and argillaceous limestones, all apparently of fresh-water origin. Greens and pinks are predominating colors. Thickness about 125 feet. Overlies Ellis formation; underlies Kootenai. No suggestion of unconformity noted at either base or top. Lines of delimitation somewhat uncertain, especially as regards upper limit. Top of Morrison is believed to be marked by persistent sandstone member 10 to 15 feet thick, in which bone fragments are found. Above this member, beds are distinctly arenaceous and are mapped as Kootenai on account of their lithology and of occurrence of Lower Cretaceous plants a short distance from their base.

G. W. Stose, 1912, U.S. Geol. Survey Geol. Atlas, Folio 186. Lowest formation exposed in Apishapa quadrangle, Colorado. Consists of red, green, and drab blocky shale or argillite, soft sandstone, and thin beds of limestone. Thickness about 120 feet. Underlies Purgatoire formation (new) which was formerly regarded as part of Dakota sandstone. Jurassic or Cretaceous.

G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203. In Colorado Springs quadrangle, formation consists of fresh-water marl that includes many lenticular bodies of limestone and thin beds of sandstone. Maximum thickness 245 feet, near Colorado City. Unconformably overlies Lykins formation, a relation that is not very apparent in Colorado Springs quadrangle but is evident elsewhere. Conformably underlies Lytle sandstone member (new) of Purgatoire formation. Jurassic or Cretaceous.

W. T. Lee, 1920, Am. Jour. Sci., 4th ser., v. 49. no. 219, p. 183–188. Type section of Morrison redefined. Strata originally assigned to Morrison include some that are equivalent to an older formation (Sundance of Jurassic) and others at top which contain fossil plants of Upper Cretaceous type. Section at Morrison comprises 10 units (numbered in descending

order 1–10). Units 1–5 are Dakota group, 265 feet thick. Units 6 and 7 are Morrison formation, 160 feet thick. Units 8–10 are Sundance formation, 17 feet thick. According to G. L. Cannon, who accompanied writer [Lee] and who assisted in work on Denver Monograph [27], Nos. 1–3 of section were regarded as the two sandstones of the Dakota and the shale as the "Dakota fire clay." Other geologists have followed this usage, and when the "lower Dakota" and shale above it a few miles farther south were correlated with Purgatoire, No. 3 of Morrison section was regarded as Lower Cretaceous. No. 4 (100 feet thick) of section is part of Morrison as originally defined yet it contains fossil plants which Knowlton described as belonging to "Dakota flora." Unit 5 (10 feet thick) is conglomeratic sandstone—Saurian conglomerate—containing dinosaur bones and pebbles of quartz and jasper; sharply separated from underlying shale.

W. T. Lee, 1927, U.S. Geol. Survey Prof. Paper 149, p. 17, pl. 1. At Morrison, Colo., type locality of Morrison formation, rocks were once assigned to this formation which do not belong there—at base 17 feet or more of orange sandstone which is now known to be unconformable with overlying Morrison and underlying Lykins, and at top nearly 200 feet of beds younger than Morrison. Reasons for revision of type section were given by Lee (1920), but thicknesses given in present paper should replace those previously published. Cretaceous(?).

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 81–82, measured sections. In San Rafael Swell, Utah, formation is 415 to 847 feet thick; includes Salt Wash sandstone member near base. Overlies Summerville formation of San Rafael group; underlies Dakota(?) sandstone. Lower Cretaceous(?).

W. S. Burbank, 1930, Colorado Sci. Soc. Proc., v. 12, no. 6, p. 171–173. Described in Ouray district, Colorado. Comprises the middle limestone and upper sandstone members of the "La Plata sandstone" of Cross and entire thickness of "McElmo" formation as these two formations are defined by Cross and Howe in Ouray folio. Thickness 700 to 750 feet. Comprises a basal limestone, sandstone, and shale member, herein named Wanakah, a middle sandstone member, and an upper shale member. Underlies Dakota(?) sandstone; overlies Upper(?) Jurassic sandstone. Lower Cretaceous(?).

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 9–10, 32–44, 58–63, charts. Discussion of correlation of Jurassic formations of parts of Utah, Arizona, New Mexico, and Colorado. Morrison formation is interpreted as including, besides the more usual variegated mudstones (McElmo formation of many authors), in New Mexico the Todilto limestone and beds heretofore called "Navajo" sandstone (Zuni sandstone of Dutton) and in Colorado beds formerly assigned to middle and upper La Plata sandstone by Cross and others. Age of Morrison has for many years been topic for debate, and literature bearing on it has been extensive. Mook (1916, New York Acad. Sci. Ann. Rept., v. 27) listed over 200 papers describing or discussing the formation, not including those of purely descriptive paleontology and considerable numbers have been added since 1916. Several writers have assigned to beds here included in Morrison formation an age widely different in one area from that assigned in another area. For example, the Morrison (of present report) of southeastern Utah has been called "early Jurassic", while the Morrison (of present report) of northeastern Utah has been called on a later page of same paper "late Jurassic." Present writers

see no basis for such separation but consider formation everywhere of essentially same age—late Upper Jurassic. Discussion of history of nomenclature.

H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 58–59, 36 (table), pls. Formation in San Juan country, Utah, subdivided into (ascending) Bluff sandstone, Recapture shale, Westwater Canyon sandstone, and Brushy Basin shale members (all new). Thickness as much as 1,415 feet. Overlies Summerville(?) formation of San Rafael group; underlies Dakota(?) sandstone. Upper Jurassic.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1751–1765. Formation in La Plata Mountains, Colo., comprises (ascending) Pony Express limestone, Bilk Creek sandstone (new). Wanakah marl (restricted), and Junction Creek sandstone (new) members. Overlies Entrada sandstone.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 951–992. Formation in and adjacent to Colorado Plateau currently includes diverse lithic units, many of which cannot properly be included if limitations of type section and relationships to other formations are considered. Todilto limestone, Bluff sandstone, Wanakah marl. Pony Express limestone, and Bilk Creek sandstone can be correlated with San Rafael group and dated as Upper Jurassic by the marine beds in the group. Salt Wash sandstone, Brushy Basin shale, Recapture sandstone, and Westwater Creek sandstone are considered equivalent to type Morrison and have yielded vertebrate remains which are almost certainly Jurassic. Succeeding these are two new formations, Buckhorn conglomerate, and Cedar Mountain shale, which have yielded no fossils but are tentatively classed as Lower Cretaceous.

W. A. Waldschmidt and L. W. LeRoy, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1097–1114. Revised type section proposed. Subdivided into six lithologic units. Basal sandstone unit, 7 feet of buff massive locally cross-bedded coarse- to medium-grained calcareous sandstone, conglomeratic in lower part; north from type locality unit thickens to at least 30 feet. Gray and red shale unit, represents lower 55 feet of Morrison. Gray clay and limestone unit, an interbedded series of gray clays and gray lithographic fresh-water limestones, 49¾ feet thick. Gray shale and sandstone unit, 51½ feet thick. Red shale unit 36¾ feet thick; most highly colored interval in formation. Sandstone and shale unit 76½ feet thick; variegated sandy shales, maroon most prevalent, constitute about 30 percent of interval. Formation, as herein described, is cartographic unit between Dakota sandstone as originally defined by Eldridge (1896) and strata assigned to probable Sundance by Lee (1920) which have in part been assigned to Ralston formation (new). Morrison, as defined in present report, is considered Jurassic. There has been controversy regarding position of Morrison-Dakota boundary. Lee (1920), in a somewhat confusing paper, redefined Morrison at its type locality. It appears that in his reconsideration he erroneously interpreted Eldridge's Morrison-Dakota boundary to be somewhat stratigraphically higher than Eldridge had originally indicated. Consequently, Lee proposed that the contact be lowered to Eldridge's original boundary. Later Lee (1927) reexamined Dakota and Morrison formations near Morrison, Colo. In this work, he designated the lowest Dakota unit as the "Lower Sandstone" (10 to 40 feet) and described it as "massive, conglomeratic." This boundary corresponds

to that proposed in present report. As herein defined, the Morrison lies with apparent disconformity below conglomeratic phase of Dakota as defined by Eldridge (1896) and Lee (1927) and overlies disconformably the red, sandy shales assigned by various workers to Lykins formation. At some localities, basal sandstone of Morrison is in juxtaposition with strata that have been correlated by Lee (1920) with Sundance (Jurassic) and which have been included in Ralston formation.

W. A. Cobban, R. W. Imlay, and J. B. Reeside, Jr., 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 4, p. 451–453. Morrison formation overlies Ellis formation at type section of Ellis. Here the Morrison is 110 feet thick.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1269–1270, 1290. In Sweetgrass arch, Montana, the Ellis is raised to group rank to include (ascending) Sawtooth, Rierdon, and Swift formations. Overlying Ellis group are continental beds of Upper Jurassic and Lower Cretaceous age. Thickness ranges from 348 feet in Flat Coulee oil field on north side of Sweetgrass Hills to about 1,300 feet along Rocky Mountain Front near Craig. Beds are divisible into three major rock units. Lowest unit consists chiefly of fine-grained rocks, largely clay shale and mudstone, dense gray limestone, and fine- to very fine-grained gray and brown sandstones. Dominant color greenish-gray. Unit is as much as 310 feet thick and rests conformably on Swift formation. Along Little Belt Mountains and west to Craig, top of unit is either coal bed or black carbonaceous clay and mudstone. Charophyte oogonia and ostracods from lower part of unit show definite Morrison (Jurassic) affinities. This unit is assigned to Morrison formation and the two overlying units to Kootenai. West of Kevin-Sunburst dome, the Kootenai rests unconformably on Morrison, Swift, and Rierdon formations. An understanding of this unconformity is important in interpretation of Morrison-Kootenai beds.

R. W. Brown, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 238–248. Discussion of fossil plants and Jurassic-Cretaceous boundary in Montana and Alberta, Canada. Cobban's (1945) studies demonstrate presence of erosional interval that marks unconformity between Morrison and older Jurassic formations and a basal sandstone or conglomerate of Kootenai formation in vicinity of Cut Bank, Mont. Extended southeastward toward Great Falls and Lewistown, this horizon corresponds with a level at or just above the coal bed that occurs in basal part of unit now known as Kootenai in Montana (originally named Yellowstone formation and then Dakota sandstone by Weed [1899, U.S. Geol. Survey Geol. Atlas, Folio 45]). This coal is 75 feet, more or less, above stratum that Fisher (1909) and Calvert (1909) considered to be top of Morrison, the 75-foot sequence consisting of unfossiliferous soft greenish or reddish sandy shale. In Montana, the Morrison (called Cascade formation by Weed, 1899), as defined by Fisher and Calvert, is practically barren of plant fossils throughout most of its sequence. Among lower and middle strata are beds of platy marly limestone that contains oogonia of alga, *Chara*. If the Morrison be enlarged to include the 75 feet, more or less, of basal beds hitherto referred to the Kootenai, that is, all the greenish shales and coal, with its associated dark shale, up to the unconformity of Cobban, then a small florule of ferns, cycads, and conifers becomes available for comparison with the flora found in the overlying strata. This enlarged Morrison is most likely equivalent in whole or in large part to Kootenay

of Canada; and Kootenai of the United States corresponds in large part with lower Blairmore of Canada.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1255–1293. Jurassic formations of western Uinta Mountains are (ascending) Nugget sandstone, Twin Creek limestone, Preuss redbeds, Stump sandstone, and Morrison formation. Eastward along mountains, the Nugget persists but is called Navajo on east, Twin Creek limestone intertongues with Carmel redbeds, Preuss redbeds grade into crossbedded Entrada sandstone, Stump sandstone grades into Curtis shales and limestones, and Morrison thins and becomes less conglomeratic.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1664–1667. Report is revised correlation of Jurassic formations of parts of Utah, Arizona, New Mexico, and Colorado. Todilto limestone is excluded from Morrison, and also the gypsum as being probably an evaporite related to withdrawal of Upper Jurassic sea. Massive sandstone above the Entrada at Todilto Park, at Navajo Church near Fort Wingate, at Lupton, and elsewhere in northern Arizona seems most probably a facies of Morrison formation.

J. W. Huddle and F. T. McCann, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 75. Formation, in Duchesne and Wasatch Counties, Utah, is 1,450 to 1,550 feet thick and consists of multicolored lenses of shale, sandstone, siltstone, conglomerate, and a few thin beds of fresh-water limestone. Overlies Curtis formation, contact appears conformable but not gradational. Underlies Dakota sandstone. Contact with overlying Cretaceous rocks concealed throughout area.

W. L. Stokes and D. A. Phoenix, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 93. Described in San Miguel and Montrose Counties, Colo., where it is about 350 feet thick and includes Salt Wash sandstone and Brushy Basin shale members. Underlies Burro Canyon formation (new).

E. B. Eckel and others, 1949, U.S. Geol. Survey Prof. Paper 219, p. 9 (table), 30. Morrison formation, in La Plata district, Colorado, is restricted to strata above Junction Creek sandstone which is herein given formation rank, and below Dakota(?) sandstone. As restricted, formation is 400 to 625 feet thick. The Wanakah, formerly included in Morrison is also given formation rank and includes Pony Express limestone and Bilk Creek sandstone as members. These latter units were considered members of Morrison by Goldman and Spencer (1941).

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 49–50, pl. 1. Described in South Park, Colo., where it is 250 to 360 feet thick. Along the Dakota Hogback, the formation rests unconformably upon Garo sandstone (new) and is in turn unconformably overlain by Dakota sandstone. Along eastern side of the park, the Morrison overlaps the Precambrian; near Hartsel overlaps the Garo, Maroon, and Precambrian.

C. T. Smith, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13; 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 15–18. In Thoreau quadrangle, McKinley and Valencia Counties, Morrison formation comprises (ascending) Chavez member (new), Prewitt sandstone member (new), and Brushy Basin shale member. Overlies Thoreau formation (new); underlies Dakota(?) formation.

K. G. Brill, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 828. Believed that unit termed Bullington conglomerate member of Magdalena by Ray and Smith (1941) is coarse-grained facies of Morrison.

Teng-Chien Yen and J. B. Reeside, Jr., 1952, U.S. Geol. Survey Prof. Paper 233–B, p. 22–25, pls. Report contains summary of stratigraphy of formation and systematic description of molluscan fauna.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 127–168. Morrison formation has been recognized over most of western interior of United States; except where removed by erosion, it is present over all of Colorado, eastern Utah, northwestern New Mexico, and part of northeastern Arizona. Over most of western interior, the Morrison has not been divided into members. In western Colorado, eastern Utah, northeastern Arizona, and northwestern New Mexico, formation can be separated into lower and upper part, each of which has two members. Arbitrary line separating undifferentiated Morrison of central Colorado from subdivided Morrison to the west extends irregularly from northwestern Colorado to south-central Colorado. This line is approximately the limit of recognizable Salt Wash member. Lower part consists solely of Salt Wash member in most of eastern Utah and western Colorado and solely of Recapture member in most of northeastern Arizona and northwestern New Mexico. These members interfinger and grade into each other over a broad area, in vicinity of Four Corners. Upper part of Morrison consists of Westwater Canyon and Brushy Basin members. Westwater Canyon member constitutes lower unit of upper part in southern part of region of study. Brushy Basin member is present over most of region of study. East of arbitrary line marking limits of recognizable Salt Wash the Morrison is undifferentiated. Area of undifferentiated Morrison includes all central and eastern Colorado and extends eastward into western Kansas to a subsurface pinchout of formation. This area includes type section of formation, near Morrison, Colo., where formation is nearly 300 feet thick (section described by Waldschmidt and LeRoy, 1944). Northward from type section into Wyoming, the Morrison can be divided roughly into three units: lower unit of thin-bedded gray shale and limestone with charophyte oogonia and ostracods, a medial unit of crossbedded sandstone and conglomerate with dinosaurian remains, and an upper unit of variegated shale. West of type section, in central Colorado basin, the Morrison consists of claystone beds with thin intercalated limestone and sandstone beds. Dense limestones are abundant in this area but are lenticular and cannot be correlated with type section. Formation thins over crest of Uncompahgre uplift. Base of Morrison defined in Colorado Plateau region as base of terrestrial fluvial Jurassic deposits overlying beds of marine or marginal marine San Rafael group. Detailed criteria for selecting contact vary from one area to another. Lower Cretaceous beds overlie Morrison in Colorado, eastern Utah, small area in northeastern Arizona, and northern New Mexico. In the past, these beds have been included in either Morrison formation or Dakota sandstone, depending on basis of their characteristics and affinities in different areas. In southeastern Colorado and northeastern New Mexico, the Purgatoire separates the Morrison and Dakota. In north-central Colorado, beds usually called Dakota probably contain equivalents of Lower Cretaceous Cloverly of Wyoming. In Four Corners area and northward through western Colorado and easternmost Utah, Burro Canyon formation has been recognized as separate formation of Early Cretaceous age. In central Utah, the Cedar Mountain formation (Stokes, 1944) forms widespread Lower

Cretaceous unit. No field evidence for major disconformity has been recognized at base of Lower Cretaceous strata.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 23–26. In northern Front Range foothills, Colorado, the Morrison underlies Lytle formation of Dakota group. Morrison-Lytle contact is indefinite in many places because (1) conglomeratic beds are not persistently present at base of Lytle, and (2) rocks in upper part of Morrison are similar to those in the Lytle. Both the new and the old type sections of Morrison have indefinite upper contacts. Not all six informal units recognized by Waldschmidt and LeRoy in new type section can be identified away from Alameda Parkway section, and a more generalized subdivision of the Morrison is necessary for northern Front Range foothills. Their [Waldschmidt and LeRoy's] two middle units make up most characteristic part of Morrison, a light- to greenish-gray marl and claystone with intercalated thin limestone beds and a few thin calcareous sandstone lenses. This zone occupies 100 feet or more of the Morrison throughout Front Range foothills and includes dinosaur-bearing beds as well as beds containing freshwater molluscan fauna (Yen, 1952, U.S. Geol. Survey Prof. Paper 233–B). Above these undoubted Morrison strata, the sequence locally consists of dominantly red variegated silty claystone with lenses of sandstone, the whole too variable laterally to permit division into useful subunits. At many localities, discontinuous lenses of conglomerate occur approximately at contact of the dominantly red variegated beds and the underlying greenish-gray beds. The Lytle is similar to upper dominantly red variegated zone of Morrison and differs only in its local predominance of sandstone and conglomeratic sandstone, in the somewhat lighter hues of its variegated bed, and in the composition of its conglomerates. Three principal types of stratigraphic relationships are present at Morrison-Lytle contact along Front Range. Most obvious is formed where a thick conglomeratic sandstone lens of the Lytle rests unconformably on greenish-gray claystone and marl of undoubted Morrison. Second type is formed by basal conglomeratic sandstone lens in the Lytle resting with obvious unconformity on some part of the dominantly red variegated clay and sandstone in the upper Morrison. Exposures of this type of contact are present on scarp of hogback south of Eldorado Springs, in Turkey Creek gap south of Morrison, on scarp of hogback north of Deer Creek, and at other places throughout hogback between Boulder and Indian Creek. Third type of contact is a variation of the second type in which the contact itself is obscure because entire sequence of beds between disconformity at top of Lytle and greenish-gray claystones of undoubted Morrison consists of alternating lenses of sandstone, or conglomeratic sandstone, and variegated claystone. Indefinite contacts can be seen in Denver and Salt Lake Railroad cut at Plainview, in Eldridge's type Morrison at Morrison, and in the new type Morrison exposure in Alameda Parkway roadcut. At Plainview, five massive sandstone units, four of them conglomeratic to varying degrees, lie between disconformity at top of Lytle and the greenish-gray Morrison. Lateral tracing from Eldorado Springs section, where base of Lytle is clear cut, indicates that second lens from top in Plainview cut is in the correct relative position to be basal lens of Lytle. Indefinite contact between the Morrison and Lytle in both old and new type sections of Morrison raises question of where its upper contact was originally placed. Eldridge's (1896) definition of Morrison did not include measured section and his description of upper limit has been interpreted in different ways. Lee's idea that Eldridge

included plant-bearing beds of the Dakota in his original description of the Morrison has been accepted by many geologists (Stokes, 1944; Reeside, 1952); others (Waldschmidt and LeRoy, 1944) contend that Lee misinterpreted Eldridge and that the Morrison-Dakota contact as defined by Eldridge is acceptable. Lee placed the Morrison-Dakota contact at base of ledge-forming sandstone capping the Dakota hogback at Morrison, a horizon above middle of gray shale-bearing part of Dakota group in this area. In terms of nomenclature introduced in present report, this horizon is base of Kassler sandstone member of South Platte formation (both new) of Dakota group. Comparison of the relative thicknesses of the units described by Eldridge demonstrates that he could not have included any of plant-bearing Dakota in his type Morrison. Eldridge gives average thickness of 200 feet for the Morrison; consequently the part of formation he refers to as "upper third" can be expected to be about 60 or 70 feet thick. In section measured by writer [Waagé] at Morrison, 65 feet of variegated clay and sandstone, including a weakly conglomeratic sandstone, lie between the dominantly greenish-gray Morrison and the probable base of the Lytle. Actually, the Morrison is about 270 feet thick at type locality, not 200, but even a third of this larger figure would not make the upper third of the Morrison more than 100 feet thick. If Lee's interpretation is applied to the section at Morrison, the "upper third" of the Morrison is 228 feet thick, and the formation as a whole is between 350 and 300 feet, about double Eldridge's figure. By Lee's interpretation, the overlying Dakota, said by Eldridge to be between 225 and 300 feet thick, is only 78 feet. Lee (1920) revised Eldridge's type Morrison section, placing upper contact under the so-called Saurian sandstone which marked base of upper third of Eldridge's Morrison. His stated reason for this revision was that "no obvious break was found in the section between the plant horizon and the Saurian conglomerate." In Turkey Creek section 1.8 miles south of the type Morrison, Lee (1927) placed his Morrison-Dakota contact at base of the Lytle, apparently unaware that the break he had chosen as the contact at Morrison lay some 98 feet stratigraphically below. Throughout the foothills region Lee (1927) confused the two conglomerates in zones in question and consistently placed his Morrison-Dakota contact at base of the most obvious conglomerate zone, apparently unaware that more than one zone existed. It is most likely that the Morrison-Lytle contact of present report corresponds to Eldridge's Morrison-Dakota contact. Waldschmidt and LeRoy (1944), in recommending a new type section for the Morrison, recognize that Lee (1920) misinterpreted Eldridge's Morrison-Dakota boundary. They believe that Lee corrected this error in a subsequent paper. Lee's 1927 work offers somewhat more accurate section than the estimated section presented in his 1920 work, but the two sections are obviously much the same and can be matched to show that Lee did not change the position of his Morrison-Dakota contact in his 1927 work. Consequently, the top of the Morrison as defined by Eldridge (1896) and as redefined by Lee (1927) is in different stratigraphic position, Lee's being at base of the conglomeratic zone in upper third of Eldridge's Morrison. New type section of Morrison is better exposed than Eldridge's type section, but upper contact is equally obscure. None of the many thin sandstone lenses between disconformity at top of Lytle and the greenish-gray claystones of the Morrison contain pebbles of chert and quartzite, Waldschmidt and LeRoy have chosen base of uppermost massive sandstone lens in the Lytle as top of their Morrison, but this ledge thins out into variegated

claystone a short distance north of the roadcut. Chert and quartzite pebble conglomerate, presumably at base of Lytle, crop out locally along hogback north of the parkway and, when followed laterally toward the roadcut, apparently grade into conglomeratic sandstone that lies between 35 and 55 feet below Morrison-Dakota contact chosen by Waldschmidt and LeRoy. Beds between the disconformity that marks the top of Lytle formation and the greenish-gray claystones of undoubted Morrison are highly lenticular and variable in thickness and lithology. They contain two horizons at which conglomeratic lenses are locally common. Upper one of these has the thicker and more persistent conglomeratic lenses, and the unconformity at their base is herein taken as Morrison-Lytle contact. It is believed that this contact corresponds to the Morrison-Dakota contact of Eldridge. Throughout most of northern foothills the local conglomeratic lenses at base of Lytle crop out near enough to one another so that position of Morrison-Lytle contact can be interpolated between them. Where it is not possible to recognize the contact over a large area, it is expedient to map the Lytle with the Morrison as an undifferentiated unit.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 51–55, strat. sections. In Mexican Water area, Arizona, formation comprises (ascending) Salt Wash, Recapture, Westwater Canyon, and Brushy Basin members; overlies Bluff sandstone of San Rafael group; underlies Dakota sandstone. In Fort Wingate area, New Mexico, formation comprises (ascending) Recapture, Westwater Canyon, and Brushy Basin members; overlies Cow Springs sandstone (new); underlies Dakota sandstone.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 40. At southern end of outcrop belt, Elkhorn Mountain volcanics (new) are in contact with Morrison formation.

K. M. Waagé, 1959, U.S. Geol. Survey Bull. 1081–B, p. 38–40, 50–52, measured sections. In Black Hills region, underlies Lakota formation. Measured sections show thickness 21½ to 111 feet. Position of Morrison-Lakota contact is a problem, at least locally, because of lack of persistent well-defined lithic change. At one place, contact suggests gradation and at another angular discordance. There is a possibility that beds called Morrison in Black Hills are equivalent to only part of sequence of beds embraced by type Morrison. At time Darton (1901) introduced term Morrison into Black Hills to replace Jenny's (1899) name Beulah clays, very little was known about detailed stratigraphy of the beds. In area of type Morrison, conglomeratic lenses occur chiefly at two horizons, suggesting hiatuses. One of these is at base of Lytle formation, the other at base of upper third of the Morrison. Top of Lytle is marked by the transgressive disconformity that also marks top of Lakota. Matching the breaks in the Front Range and Black Hills sequence leads to matching the Lytle with the upper Lakota and the upper third of the Morrison with the lower Lakota. This possibility is as tenable as the possibility that entire type Morrison is equivalent to Morrison in Black Hills region.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2003–2007. In Tucumcari-Sabinoso area, overlies Bell Ranch formation (new); underlies Tucumcari shale.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull. v. 71, no. 8, p. 1141–1145, 1151–1153, 1157, 1165. Morrison formation of Bighorn Basin, as here

restricted, includes the earliest formed nonmarine sedimentary rocks [of sequence studied], conformably overlying Sundance formation. Rocks are interlensed calcareous quartz sandstones, green mudstones and shales, and subordinate limestones, with locally conspicuous red-banded mudstones. Thickness 130 to 280 feet with thinner sections generally on western side of basin. Unconformably underlies Pryor conglomerate member (new), of Cloverly formation (redefined) in outcrops from Sykes Mountain northwestward to Red dome and at some exposures on west side of basin.

Type locality: Morrison, Jefferson County, Colo. Type section (Waldschmidt and LeRoy): Exposure along north side of West Alameda Parkway roadcut SE¼ sec. 23, T. 4 S., R. 70 W., Morrison quadrangle, Jefferson County, Colo., 2 miles north of Morrison.

†Morrison Sandstone[1]

Middle Jurassic: Northern California.

Original reference: O. H. Hershey, 1904, Am. Geologist, v. 33, p. 356–360.

Trinity and Shasta Counties.

Morristown Dolomite Member[1] (of Conococheague-Copper Ridge formation)

Upper Cambrian: Eastern Tennessee.

Original reference: C. R. L. Oder, 1934, Jour. Geology, v. 42, no. 5, p. 476–478, 493, 496.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 4, 18. Abandoned. Morristown dolomite and Bloomingdale limestone members (Oder, 1934) are parts of the Copper Ridge or Conococheague; use of these terms does not seem warranted.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 33. Oder's (1934) Morristown seems to correspond approximately to entire Copper Ridge as here delimited.

Type locality: Along U.S. Highway 25E, about 2 miles northwest of Morristown, Hamblen County.

Morrow Series

Morrow Group[1] or Formation[1]

Lower Pennsylvanian: Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 28, 109–113.

R. C. Moore and others, 1937 (abs.) Geol. Soc. America Proc. 1936, p. 93. Referred to as Morrow series.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 11–13. Referred to as Morrow subseries. Rocks of Morrow age are exposed in narrow belt along most of boundary between Mississippian and Pennsylvanian beds in northeastern Oklahoma but are not known to extend into Kansas. Unlike development of these deposits in type region, near Fayetteville, Ark., Morrow beds of Oklahoma consist almost entirely of limestone. At many places it is difficult to determine contact between limestones of Morrow age and underlying lithologically similar Pitkin limestone of Chester age. Paleontologic distinctions between these two divisions indicate that disconformity at base of Morrow strata is an important boundary. Underlies Des Moines subseries.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 853, 854 (fig. 1), 857–859, 861–864, 889–912. Bendian system (period) is subdivided into two series—the older, the Pushmataha (new), and the younger, the Morrow. In southern Ouachitas, the Morrow is subdivided into (ascending) Union Valley sandstone, Round Prairie formation (new), and Barnett Hill formation (new). In frontal Ouachitas and north of Arbuckles, includes (ascending) Union Valley sandstone, Primrose formation, Limestone Gap shale (new), Wapanucka formation, and Barnett Hills formation. South of Arbuckles, includes (ascending) Hale formation (Rod Club, Overbrook, Lake Ardmore), Primrose, Limestone Gap shale, Wapanucka, and Barnett Hill. As shown on chart, the Morrow comprises most of Springer group and the Dornick Hills group. Underlies Pennsylvanian Des Moines series.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 81–87. Proposed four-fold division series classification of Pennsylvanian (R. C. Moore, 1932, (abs.) Geol. Soc. America Bull., v. 43, p. 279–280) does not seem adequate nor applicable. Harlton (1938) placed Stanley and Jackfork groups of "Bendian system" of southern Oklahoma in new series which he called Pushmataha with maximum aggregate thickness of more than 9,000 feet beneath 2,000 feet of beds of Morrow series. A post-Morrow and pre-Strawn series between type Marble Falls and Strawn sediments also appears necessary. Name Lampasas series is here proposed for these beds.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 657–706, chart 6. In upward order, midcontinent time-rock divisions of the Pennsylvanian are designated as Morrowan, Lampasan, Desmoinesian, Missourian, and Virgilian.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 144–146. Chart shows classification and correlation of type section Pennsylvanian section of eastern and western Pennsylvania with costandard sections of Appalachian and midcontinent regions. Midcontinent region section comprises (ascending) Springer, Morrow, Lampasas, Des Moines. Missouri, and Virgil series. Springer is used in preference to Harlton's Pushmataha series. Morrow is equivalent to New River series of Appalachian region and to most of Middle Pottsville of eastern Pennsylvania. Reference section of Morrow designated.

R. C. Spivey and T. G. Roberts, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 181–186. Lampasas is not appropriate as series name because, in its type area, it is only partly exposed and because, as redefined by Cheney and others (1945) it includes beds of Des Moines age and excludes part of Marble Falls, which is post-Morrow in age. Proposed that Atoka formation be elevated to Atoka series and defined to include all beds from top of Wapanucka limestone, Morrow series, to base of Hartshorne sandstone, Des Moines series.

C. A. Moore, 1947, Oklahoma Geol. Survey Bull. 66; p. 22–49, pls. measured sections. Report is a detailed study of outcrops of Morrow series of rocks in northeastern Oklahoma, in an area lying generally north and east of Arkansas River and east of Neosho (Grand) River. Morrow series is basal Pennsylvanian in this area and is considered middle Pottsville in age. The Morrow should be defined to include beds between the Pitkin formation of Chester series (Mississippian), and Atoka formation of Des Moines series, upper Pottsville.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2019. Deposits of Morrowan age are exposed in northeastern Oklahoma and are recognized in subsurface of western Kansas. In terms of fusuline zonation, Morrowan deposits are defined as belonging to zone of *Millerella*. Probably throughout northern midcontinent area, including Pennsylvanian deposits north of latitude of Tulsa, lower boundary of Morrowan series, where rocks of this age are present, coincides with major unconformity that separates Pennsylvanian from older systems. Upper boundary is well-marked disconformity in most places, but in parts of subsurface there is indication that Morrowan strata are limited above by a disconformity or nonconformity. Superjacent rocks seem definitely assignable to Desmoinesian series in parts of region, but in other parts post-Morrowan-pre-Desmoinesian beds may be differentiated.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 286. Ardian series (new) comprises rocks assigned to Springeran and Morrowan stages.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1935–1945. Group comprises lower division of Pennsylvanian of Ozark Highlands in Arkansas and Oklahoma. Consists of limestone and clastic sediments. In Washington County, Ark., where it has its most complete development, it is 300 to 400 feet thick. Comprises Hale formation below and Bloyd shale above. Overlies rocks of late Mississippian age; underlies Atoka formation.

W. H. Bradley, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2284–2285. In midcontinent region (including Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma), U.S. Geological Survey uses the following series subdivision of the Pennsylvanian: Morrow, Atoka, Des Moines, Missouri, and Virgil. Morrow is early Pennsylvanian.

C. W. Tomlinson, 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 18–25. Morrowan series, as used in this report, includes strata between Springeran series and Atokan series. It is identical in Ardmore area with Morrow series as defined by Cheney and others (1945). It includes maximum of about 2,000 feet of strata, from base of Primrose sandstone to a horizon above Otterville limestone and below Bostwick conglomerates. This is sequence of strata which Harlton (1956) designated Golf Course formation.

O. B. Shelburne, Jr., 1960, Oklahoma Geol. Survey Bull. 88, p. 17 (fig. 2), 41–44, pl. 1. Basal part of Atoka formation in Boktukola syncline is Morrowan; middle and upper parts are Atokan and are equivalent to the Atoka formation of frontal Ouachitas.

Reference section: Ardmore basin, Oklahoma. Named for Morrow, Washington County, Ark.

Morrowan Series or Stage

See **Morrow Series.**

†Morrow Creek Member (of Green River Formation)[1]

Eocene: Southern Wyoming.

Original reference: W. H. Bradley, 1926, U.S. Geol. Survey Prof. Paper 140, p. 123, chart, map.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1074. Recognition of Wilkins Peak member (new) of Green River

formation and its equivalence to Cathedral Bluffs tongue of Wasatch formation forces recognition of equivalence of Morrow Creek member with Schultz (1920) type Laney shale member of Green River. Name Morrow Creek is abandoned and name Laney shale member substituted.

Named for exposures in valley of Morrow Creek, Rock Springs uplift.

Morse Creek Limestone[1]

Middle Devonian: Western New York.

Original reference: A. W. Grabau, 1917, Geol. Soc. America Bull., v. 28, p. 946.

Named from Morse Creek, near Athol Springs, Erie County.

Morses Line Slate

Middle(?) Ordovician: Northwestern Vermont, and Quebec, Canada.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Name used only on correlation chart. Underlies Highgate formation; overlies Gorge formation. Refers to Shaw (unpub. thesis, 1949).

A. B. Shaw, 1951, Jour. Paleontology, v. 25, no. 1, p. 98. Described as calcareous slate and limestone with intercalated limestone conglomerate. Includes Ordovician conglomerate previously known as "Corliss breccia" as local lens. Thickness at least 2,500 feet. Derivation of name given.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 553–554, pl. 1. Includes Corliss conglomerate as member. Estimated thickness of 2,500 feet is probably a minimum. Bounded, top and bottom, by thrusts. On the west, Morses Line slate is believed to be thrust over Highgate formation and older rocks along Gore thrust, whereas on the east formation is overridden by Oak Hill thrust. Only at St. Albans Hill does Morses Line appear to lie in sedimentary contact with Hungerford slate. Middle(?) Ordovician.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 572, pl. 3 (correlation chart). Geographically extended into Quebec. So extended, merges northward into Stanbridge slate.

Named for town of Morses Line which lies on international boundary in northwestern ninth of Enosburg Falls quadrangle.

Mortimer Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 33, fig. 3. Shown on columnar section as underlying Rivoli member (new) and overlying Fairplay member (new).

Occurs in Dixon-Oregon area.

Morton Granite Gneiss or Quartz Monzonite Gneiss (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

G. A. Thiel and C. E. Dutton, 1935, Minnesota Geol. Survey Bull. 25, p. 88–94, pl. 5. Composed of red feldspars and dark minerals which appear mostly in form of streaks and bands; feldspars constitute larger share of rock, both orthoclase and plagioclase being abundant. Because of attractive color tones has been given a variety of trade names such as "Rainbow," "Tapestry," "Antique," and "Imperial."

E. H. Lund, 1953, Econ. Geology, v. 48, no. 1, p. 46–52. Morton granite gneiss is most widespread of a number of masses of granite and granite

gneiss which are included in Minnesota River Valley granite series (new). Precambrian.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1477 (fig. 1), 1482–1483, pl. 1. Morton quartz monzonite gneiss is most widespread of the five rock types in Minnesota Valley granite series [formerly referred to as Minnesota River Valley granite series]. A hybrid rock formed by strewing out of basic inclusions in a granite magma. Characterized by highly contorted structure and great variety of textures and colors. Pink to dark gray, depending upon degree to which granite magma was contaminated by basic rock. Texture ranges from medium granitoid to very coarse pegmatite. Pegmatite phase does not consist of distinct veins or dikes but is dikelike in that in many places pegmatitic material cuts across earlier structure. Fort Ridgely granite (new), which occurs to the southeast, is probably a less contaminated and more massive facies of Morton gneiss. Sacred Heart granite (new) occurs to the northwest, but age relationship of the two units is not known. Sacred Heart appears to be younger.

Named for occurrence in vicinity of Morton, Renville County. Extends from near New Ulm, Brown County, to a point south of Sacred Heart, Renville County, a distance of about 50 miles.

Morton Limestone

Pennsylvanian (Virgil Series) : Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 41–42, 43. Dark-gray to yellowish or brownish locally irregular sandy to conglomeratic fossiliferous limestone. Thickness about 2 feet. First limestone above Dover formation in Nebraska and lies between Minersville shale member of Friedrich formation and what seems to be the Dry shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 14–15. Geographically extended into southwestern Iowa.

Named from outcrops at Morton stockyards in south Table Creek valley, southwest of Nebraska City, Otoe County, Nebr. Extends from near Thurman, Iowa, to northeastern Kansas but not as far as Kansas River valley.

Morton Loess

Pleistocene (Wisconsinan) : Northern Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 7, 11. Name applied to pro-Shelbyville loess, formerly called Iowan loess. Calcareous fossiliferous yellow-tan to gray massive silt. At type section, occurs in stratigraphic succession above Farmdale silt and below Shelbyville till. Name for Iowan loess as a rock-stratigraphic unit necessary because radiocarbon dates have demonstrated that Morton loess is at least 15,000 radiocarbon years younger than type Iowan of Iowa. Woodfordian substage.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 541. Presentation of classification of Wisconsin glacial stage of north-central United States. Paper also gives consideration to other classifications including one proposed by Frye and Willman. They proposed renaming Iowan loess, "Morton loess." Town of Morton is in central Illinois 100 miles away from where loess has its phenomenal expression at Iowan drift margin. Morton

loess is referred to by Frye and Willman as "pro-Shelbyville loess" without presentation of evidence. "Pro-Shelbyville" should imply that the valley train from which loess was blown came from advancing Shelbyville glaciers. This is not true. Wood from top of Iowan loess in Farm Creek sections averages 1,700 years older than wood from very base of Shelbyville till. Because Labradorean-Iowan came from same direction as Shelbyville glacier, it is possible that Iowan loess may be in part blown from a pro-Labradorean-Iowan valley train.

Type section: Farm Creek Railroad cut, center sec. 31, T. 26 N., R. 3 W., Tazewell County. Named for town of Morton approximately 6 miles southeast of type section.

Mosalem Member (of Edgewood Dolomite)

Lower Silurian: Northeastern Iowa.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 36–39, pl. 3. Proposed for basal member of Edgewood. Underlies Tete des Morts member (new). Unconformably overlies Neda member of Maquoketa shale. Thickness 4 to 94 feet. Member differs lithologically in areas of thin Edgewood from areas of thick Edgewood. This lithologic change is transitional, but for ease of description it is arbitrarily set where the formation is 40 feet thick. Member, where Edgewood is thick, comprises 30 to 94 feet of wavy-bedded argillaceous pale-grayish-orange to olive-gray dolomite and has chert nodules and pale-brown to olive-gray shale partings. Rocks become more argillaceous, have more shale, and are darker toward base.

Named for exposures along Niagara escarpment in Mosalem Township, Dubuque County. Due to the many variations in lithology and thickness no specific exposure can be called typical.

Mosby Sandstone Member (of Colorado Shale)

Mosby Sandstone Member (of Warm Creek Shale)[1]

Upper Cretaceous: Central northern Montana.

Original reference: C. T. Lupton and Wallace Lee, 1921, Am. Assoc. Petroleum Geologists Bull., v. 5, p. 263.

W. A. Cobban, 1953, U.S. Geol. Survey Prof. Paper 243–D, p. 45–54, pls. Member of Colorado shale. Chiefly light-gray fine to very fine grained calcareous sandstone that commonly has concretionary habit; ranges from massive to shaly in short distances and shows crossbedding and ripple marks. At recommended type section, consists of two sandstone beds 5½ feet thick separated by 11 feet of sandy shale. Member lies 743 feet below top of Colorado shale. Cenomanian ammonite fauna.

Type section: Measured east of Musselshell River from one-quarter mile east to one-half mile north of Mosby post office, in S½ sec. 2, and N½ sec. 11, T. 14 N., R. 30 E., Garfield County.

Mosca limestone[1]

Pennsylvanian: New Mexico.

Original reference: C. R. Keyes, 1906, Jour. Geology, v. 14, p. 147–154.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 22. Keyes did not give source or definition of term Mosca limestone; therefore, term is not considered established.

Derivation of name not given.

Moscow Shale (in Hamilton Group)[1]

Middle Devonian: Western and central New York and Pennsylvania.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 298–300.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 13, pl. 10. Discussion of Paleozoic section in Harrisburg area. In northern part of section above and perhaps including top of thinning Montebello sandstone, and below Portage is the Moscow. It consists of 50 feet or more of dark-gray nonfissile shale with abundance of fossils, and zone of *Vitulina pustulosa* near top.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 373–380, pl. 1. Formation includes (ascending) Menteth limestone, Kashong shale, Windom shale, and Leicester marcasite (new) members. Thickness 72 feet in Batavia quadrangle [this report]. Overlies Ludlowville formation; underlies Geneseo formation. Hamilton group.

A. J. Mozola, 1951, New York State Water Power and Control Comm. Bull. GW–26, p. 10 (table 3), 13, pl. 2. In Seneca County, overlies Ludlowville shale and underlies Tully limestone. Thickness about 140 feet.

Wallace de Witt, Jr., and G. W. Colton, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–30. Base of section in Silver Creek quadrangle; only Windom member exposed in area. Underlies Geneseo shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2816, 2827. Sutton's Leicester member is here considered a lenticular layer of pyrite and marcasite at base of Geneseo shale member of Genesee formation.

Named for occurrence at Moscow (now Leicester), Livingston County, N.Y.

Moseley Limestone Lentil[1] **or Limestone**

Eocene: Eastern central Texas.

Original reference: B. C. Renick and H. B. Stenzel, 1931, Texas Univ. Bull. 3101, p. 78, 91.

H. B. Stenzel, E. K. Krause, and J. T. Twining, 1957, Texas Univ. Bur. Econ. Geology Pub. 5407, p. 23. Term Moseley limestone no longer in good use. Unit is part of Stone City beds of present usage.

Named for old Moseley's Ferry site on the Brazos (bridge on the Giddings to Hearne branch of Southern Pacific Railroad), Burleson and Robertson Counties.

Moses Hill Beds

Upper Cambrian to Lower Ordovician (Ozarkian): Northeastern New York.

A. W. Grabau, 1936, Paleozoic formations in the light of the pulsation theory, v. 2, Cambrovician pulsation, pt. 1, Caledonian and St. Lawrence geosynclines: Peiping, China, Univ. Press, Natl. Univ. Peking, p. 517–518. These [shale and limestone] beds, which contain *Acrothele pretiosa* (Billings) the true *Obolella pretiosa* of Billings (*"Linnarssonis pretiosa"* as it appears in the Guide to the Quebec region), appear to belong to an overthrust Cambrian mass. Whether they are part of that series or belong to a lower series exposed perhaps as a fenster, as Ruedemann holds may be case for Schaghticoke and Deepkill exposures, is not determined. It is of course possible that both these [Moses Hill] and Upper or Lauzon

Sillery of Chaudriere River and Cap Rouge, Quebec, from which this species was first described, are of Levis age. Until this identification is verified, it is desirable to regard both the Upper Sillery (Lauzon) and the Moses Hill beds as more likely to belong to early part of the Cambrovician advance, that is, the Upper Cambrian—Tremadoc division (Ozarkian in the restricted sense).

Moses Hill is 2 miles west of North Greenwich near line between Schuylerville and Cambridge quadrangles, Washington County. Fossils mentioned above have been collected from shales 1 mile west-northwest of South Argyle in same region, and from limestone on north side of Bald Mountain, 2 miles northwest of Greenwich, Schuylerville quadrangle. These localities lie within east Adirondack part of St. Lawrence geosyncline.

Mosheim Member (of Lenoir Limestone)

Mosheim Limestone (in Stones River Group)[1]

Middle Ordovician: Eastern Tennessee, northern Alabama, northwestern Georgia, western Virginia, and West Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 413, 414, 538, 543, 544, 557, 636, pl. 27.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 135–139. Mosheim limestone immediately overlies Murfreesboro limestone in southwestern Virginia. In belts southeast of Clinch Mountain, where Murfreesboro is generally absent, Mosheim rests upon Beekmantown dolomite. Everywhere succeeded by Lenoir limestone. Maximum thickness about 100 feet. Extends southward along southeast side of Appalachian Valley to vicinity of Shelby, Ala. Also present at Bunker Hill and Martinsburg, Berkeley County, W. Va. Included in Stones River group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, Va., is subdivided into 29 distinctive zones that are grouped in 8 formations. Detailed tracing and mapping led to recognition of inconsistencies in use of terms Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Superposition of the Mosheim with respect to the Murfreesboro, as postulated by Ulrich and Butts, is based upon their study of section along Yellow Branch, Lee County, Va. At this locality, two zones of Mosheim-type limestone are present. One calcilutite overlies beds containing *Polylopia billingsi*, a supposedly Murfreesboro guide fossil. The other zone of calcilutite underlies the beds containing this fossil. Butts has not indicated reasons for identifying the calcilutite above the *Polylopia billingsi* as the Mosheim, rather than the calcilutite beneath the horizon of *Polylopia*. In Tazewell County, in exposures one-half mile west of Wittens Mills, two calcilutites are present in succession like that exposed along Yellow Branch, Lee County. The higher calcilutite west of Wittens Mills overlies the *Lophospira* zone which contains the Murfreesboro fauna. Butts identifies the lower calcilutite which underlies Murfreesboro fauna, as Mosheim. By tracing the calcilutites exposed at Wittens Mills, it was found that the calcilutite overlying the Murfreesboro fauna is same zone identified by Butts as Mosheim in exposures south of St. Clair Station, near Bluefield. In proposed revised stratigraphic nomenclature, Cliffield formation (new) includes beds which Butts has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 1–124. Revised classification proposed for lower Middle Ordovician in Shenandoah Valley, where names Stones River, Mosheim, Lenoir, Holston, Whitesburg, and Athens have been used without adequate evidence. Relationship of Mosheim and Lenoir discussed in their type areas. Type Mosheim occupies stratigraphic position of lowest division of type Lenoir. Probably type Mosheim is calcilutite facies representing substantial part of true Lenoir. Usage of name Mosheim for a pre-Lenoir stratigraphic division should not be extended hundreds of miles away from type locality when evidence that Mosheim underlies the Lenoir is lacking in critical localities. Precise equivalency of Shenandoah Valley Mosheim to type Mosheim of Tennessee has never been demonstrated. New Market limestone (new) is essentially the same as unit identified by Butts as Mosheim in most parts of northern Virginia.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1181. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Detailed measured sections compared with revised classification of Tazewell County, Va. Inasmuch as "Mosheim" has been applied to type of lithology occurring at different horizons within Cliffield group, it is of no significance as a definite formational name and should be abandoned.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 24–25, geol. map. Included in Stones River group in northwestern Georgia. Not extensively exposed. Varies from a few feet to 100 feet in thickness; smaller thickness prevails. Overlies Murfreesboro limestone and underlies Lenoir (Ridley) limestone.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104; 1954, U.S. Geol. Survey Bull. 990, p. 39–43. Rob Camp limestone (new) replaces Mosheim limestone as previously used in Jonesville district, Lee County, Va.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 69, pls. For the present map, the Mosheim is considered a member of the Lenoir that locally replaces lower part of formation.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 147, pl. 28. Mosheim member of Lenoir in Tellico-Sevier belt is identical ithologically with aphanitic limestone in Mosheim section. Stratigraphically above Douglas Lake member of Lenoir. Occurs below unnamed argillaceous limestone member. Middle Ordovician.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad Map 76; 1960, Map 126. In Shooks Gap and Bearden quadrangles, Tennessee, mapped as member of Lenoir. Middle Ordovician.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 78–79. Mosheim is a facies rather than a formation and has been widely misidentified as a formation. Name should be used only for calcilutites associated with restricted Lenoir formation in southwestern belts and their equivalents. At type section, formation overlies Knox dolomite but underlies Lenoir lithology. Northeast of Friendsville, Tenn., typical Mosheim appears between beds with typical Lenoir lithology. In town of Friendsville, the Mosheim is underlain by calcarenites with abundant typical Lenoir species. Thus, the Mosheim is a part of the Lenoir, but is discontinuous and appears at different levels in the Lenoir.

Named for exposures in railroad cut at Mosheim Station, Greene County, Tenn.

Mosherville Sandstone Member (of Gailor Dolomite)

Lower Ordovician: East-central New York.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 803, 806, 811. Name proposed for basal member of Gailor dolomite. Relatively pure typically massive white orthoquartzite with locally occurring porous crossbedded brown iron-stained sandstone. Locally represented by conglomerate of dolomite and calcilutite with sand matrix; grades laterally into coarse sandstone. Lithologically similar to older Potsdam sandstone for which it has been mistaken. Thickness 4 to 7 feet. Unconformably overlies Galway formation (redefined) at type locality; overlies Hoyt limestone and Ritchie limestone in other areas.

Type locality: Roadcut 2 miles southwest of village of Galway, Saratoga County, Other occurrences include field exposures one-half mile south of Mosherville, Saratoga County.

Moshup Till Member (of Jameco Formation)[1]

Pleistocene (Kansan): Southeastern Massachusetts.

Original reference: J. B. Woodworth and E. Wigglesworth, 1934, Harvard Coll. Mus. Comp. Zool. Mem., v. 52.

Occurs only on No Mans Land and at Nashaquitsa Cliffs, on south shore of Marthas Vineyard. Named for a "local god finding a place in aboriginal folk-lore concerning the origin of Gay Head."

Mosinee Conglomerate[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 364.

Occurs on upland area east and southeast of Mosinee, Marathon County.

Mosley Hill Formation (in Jackson Group)

Oligocene: Northern Louisiana.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 700–707. Name proposed for the dark-blue to brown lignitic and carbonaceous micaceous fossiliferous and arenaceous clays and mudstones which are, at least partly equivalent to the type Vicksburg. Thickness varies from less than 200 feet to more than 400 feet. Overlies Danville Landing or Shubata and underlies Chickasawhay or Catahoula formations. East of type locality, Mosley Hill changes facies and is replaced, in part, by calcareous sediments of Vicksburg stage.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 100–102. Delaney (1958, unpub. thesis) restudied Mosley Hill type locality. He reported presence of three mappable units (two silty clay units separated by a sand) between Danville Landing and Catahoula. He restricted Mosley Hill to basal unit (which is unit exposed at Mosley Hill); the overlying sand, he named Sandel formation; uppermost fossiliferous clays and siltstones between Sandel and Catahoula he named Rosefield formation. Mosley Hill as restricted by Delaney is nonfossiliferous gypsiferous interbedded clay and silty sand unit, estimated by Delaney to be 55 feet thick in eastern and central Sabine Parish. Sandel and Mosley Hill lie within transitional zone between Eocene and Oligocene and are difficult to date.

Delaney depicted Mosley Hill as interfingering with Danville Landing beds which carry Jackson fauna. Mosley Hill is herein included in Jackson group and Eocene-Oligocene boundary mapped at base of Sandel. Comparative outcrops of Mosley Hill in Sabine Parish cited by Murray (1952) restudied, and sediment exposed along U.S. Highway 171 in sec. 31, T. 5 N., R. 10 W., Sabine Parish, is redesignated as alternate type locality for Nash Creek formation (Oligocene). Bulk of sediments at North Lucius Branch (Murray, 1952) is equivalent to Mosley Hill formation as redefined by Delaney and herein considered to be upper Jackson.

Type exposure: Consists of those exposures on and around Mosley Hill in secs. 2, 3, 4, 9, 10, and 11, T. 8 N., R. 2 W., Grant Parish.

Mosquito Porphyry[1]

Eocene: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1886, U.S. Geol. Survey Mon. 12, p. 83.

Named for occurrence in North Mosquito Amphitheater, on north face of Mount Lincoln, north of Alma, Park County.

Moss Porphyry[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 44.

Moss mine, Oatman district.

Moss Back Member (of Chinle Formation)

Upper Triassic: Southeastern Utah and Southwestern Colorado.

J. H. Stewart and J. F. Smith, Jr., 1954, Intermountain Assoc. Petroleum Geologists [Guidebook] 5th Ann. Field Conf., p. 29, 30 (fig. 2), 31, 32. Moss Back sandstone unit of Chinle formation is typically yellowish-gray and very pale orange fine- to medium-grained sandstone, about 60 feet thick. Includes some conglomeratic sandstone lenses containing limestone, siltstone, quartzite, and quartz and chert pebbles; commonly contains carbonized and silicified wood. Crossbedded on medium scale and channels into underlying claystone and sandstone unit. In White Canyon, it is about 200 feet above base of Chinle; north of White Canyon, claystone and sandstone unit pinches out, and Moss Back rests directly on the Moenkopi. Has been mapped and referred to as Shinarump in many areas.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 453–457, 464–465. Described as member of Chinle. In northern limits, contains a silty facies which consists of abundant interstitial greenish silt and clay and interstratified lenses of greenish siltstone and claystone. Average thickness 60 feet; may be as much as 150 feet where it fills channels. Overlies Monitor Butte member along southwestern margin, overlaps Monitor Butte toward northeast and overlies Moenkopi along northeastern margin; locally overlies Cutler formation; conformably underlies either Petrified Forest member, Owl Rock member, or Church Rock member; in places, top contact is gradational and intertonguing and is arbitrarily placed at most conspicuous change in lithologic character of strata. Type locality designated and described in detail.

Type section: Measured 0.4 mile west and 0.2 mile south of northern tip of northwesternmost of four buttes that are located on or near divide

between Fry and Red Canyons, long 110°08′51″ W., and lat 37°34′46″ N., San Juan County, Utah. Ridge formed by westernmost three buttes is called Moss Back.

Moss Lake Formation (in Cataract Group)

Silurian (Alexandrian) : Northern Michigan.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 6–7, 8 (map). Proposed for gray and buff cherty and noncherty dolomites, and gypsiferous dark-greenish-gray and light-green shales that are underlain by Cabot Head shale and overlain by Lime Island dolomite (new) of Burnt Bluff group. Thickness 10 to 150 feet; at type section about 15 feet. Name Mayville not used in this classification. Highest beds of Mayville are placed in Lime Island dolomite.

Type section: In ditch on north side of road just west of SE cor. sec. 35, T. 41 N., R. 19 W., about 1½ miles west of Isabella, Delta County. Exposed along Moss Lake.

Mossman Picritic Basalt (in Hana Volcanic Series)

Pleistocene(?) : Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 247–249, pl. 1. Single widespread flow of pahoehoe, composed of numerous thin flow units; aa present in places but decidedly subordinate. Moderately vesicular but uniform in composition over entire area. Maximum thickness of 80 feet in test holes 50 and 78; elsewhere averages about 35 feet. Along highway overlies Makaino basaltic andesite (new); underlies Kuhiwa basaltic andesite (new) east of Makapipi Stream. In drill holes 48, 49, and 56 is underlain by olivine basalt not recognized elsewhere. East member of series is underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 118. Pleistocene(?).

Forms surface of most of area between Hanawi and Makapipi Streams and along coast of Nakiku. Named from Mossman Spring which issues from it.

Mossy Ridge Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson) : Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 101 (fig. 9), 103–104. Ranges upward from lignitic clays, through silty shales and sandy clays, leaf-bearing silts, and lignitic sands to typical beach deposits of massive fossiliferous sands. Thickness about 12 feet. Occurs in upper part of member at about same stratigraphic horizon as Zenoria lentil (new).

Typically exposed in highway cuts north of Montgomery, Grant Parish, NW¼ sec. 10, T. 8 N., R. 5 W.; and center of north line of sec. 18, T. 8 N., R. 3 W.

Mott Haven Limestone[1]

Precambrian : Southeastern New York.

Original reference : J. D. Dana, 1881, Am. Jour. Sci., 3d, v. 21, p. 431–432.

Occurs in vicinity of Mott Haven, Manhattan Island.

Mottville Member (of Marcellus Formation)

Mottville Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: B. Smith, 1916, Philadelphia Acad. Nat. Sci. Proc., v. 67, p. 561–566.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Reallocated to member status in Marcellus formation. West of Cayuga Lake the Mottville is believed to be continuous with Stafford limestone previously placed at base of Skaneateles. Stafford also reallocated to Marcellus formation. Underlies Delphi Station member of Skaneateles.

Named for occurrence at Mottville, Onondaga County.

Moulton Diorite[1] (in New Hampshire Plutonic Series)

Upper Devonian or Upper Carboniferous: Northwestern New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 27, map.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 26–28, pl. 1. Massive coarse-grained green and white metadiorite and finer grained greeen metadiabase. Map bracket shows Moulton diorite in lower part of New Hampshire plutonic series below Kirby quartz monzonite. Devonian.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 51–52, pls. 1, 2, 3, 4. Younger than Meetinghouse slate.

Typically exposed on Moulton Hill in northwestern corner of Moosilauke quadrangle.

Moulton Sandstone Member (of Oakville Formation)

Miocene: East-central Texas.

B. C. Renick, 1936, Texas Univ. Bur. Econ. Geology Pub. 3619, p. 77, 78–79, table 1. Crossbedded, thin-bedded to massive sandstone, fine to coarse grained; locally contains reworked Cretaceous fossils. Thickness about 10 feet; occurs in lower part of the middle Oakville.

Town of Moulton, northwestern Lavaca County, is located on outcrop.

†Mound Group[1]

Pennsylvanian: Central western Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on iron ores, pt. 2, p. 169, 196.

Named for occurrence in mounds of Johnson and Cass Counties.

Mound City Shale[1] (in Swope Limestone)

Mound City Shale Member (of Hertha Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas and northwestern Missouri.

Original references: J. M. Jewett, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 99, 100, 103; R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 90, 97.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 193. Middle member of Hertha limestone. Underlies Sniabar limestone member; overlies Critzer limestone member. Thickness as much as 14 feet; average about 6 feet.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11. The Hertha differs from previous usage of Missouri Survey by inclusion of Critzer limestone and Mound City shale member.

Type locality: Near Mound City, Linn County, Kans.

Mound Ridge Member (of Oneota Formation)

Lower Ordovician: Southwestern Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 86–87 (fig. 3), 92, Comprises number of distinctive strata which are (descending) rather massive dolomite characterized by broad-domed *Cryptozoon* occurring in masses several feet in diameter; at other localities massive cherty to noncherty dolomite occupies this position; dolomite stratum bearing *Cryptozoon* packed as columnar colonies 3 to 6 inches in diameter and rising full height of bed, chert commonly present; green-specked bed—dolomite, coarsely crystalline, vitreous, clean, gray or buff, studded with glauconite, zone of chitons commonly at base; *Cryptozoon* stratum packed with columnar colonies, 1 to 2 inches in diameter and rising to full height of bed; green-specked band like one above, chitons locally present; zone of abundant chitons, commonly associated with rather obscure cryptozoa. Thickness averages 13 feet, ranges from 10 to 17 feet. Underlies Genoa member (new); overlies Hickory Ridge member (new).

Type section: Quarry and Mississippi bluff in NE¼SE¼ sec. 32, T. 13 N., R. 7 W., Stoddard quadrangle, 1 mile south of Genoa, Vernon County.

†Mound Valley Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. I. Adams, 1896, Kansas Univ. Geol. Survey, v. 1, p. 23.

Caps row of hills, 120 feet high, northwest of Mound Valley, Labette County, and passing under surface at Cherryvale, Montgomery County.

†Mound Valley Shale[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 47, 102.

Named for Mound Valley, Labette County, Kans.

Moundville Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 520.

Crops out at head of Lake Buffalo, on line betweens secs. 8 and 5, T. 14, R. 9 E., Moundville, Marquette County.

Mount Aetna Quartz Monzonite Porphyry

Paleocene(?) to Oligocene(?): Central Colorado.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 30–31, pl. 1. Name changed from Etna quartz monzonite porphyry because former name was preempted. Spelling of Etna changed to Aetna to conform to that used on topographic base map of Garfield quadrangle. Rock is coarsest grained porphyry in quadrangle. Light, medium, or pinkish gray, and weathered surfaces generally dull gray with local buff to brown iron-stained areas. Large pink and white feldspar phenocrysts

especially conspicuous. Younger than unnamed quartz latite porphyry in area and older than unnamed volcanic breccia.

Type locality: On Mount Aetna, 3 miles north of Monarch, where rock occurs as an irregular stock extending about 3 miles northwest to headwaters of Tomichi creek, Garfield quadrangle, Chaffee and Gunnison Counties.

Mountain Bed[1] or Formation

Lower Cretaceous: Southwestern Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 730–731.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Mountain formation of Taff shown on correlation chart below Quitman formation of Taff.

El Paso County.

Mountain City Formation

Carboniferous: Northeastern Nevada.

A. E. Granger and others, 1957, Nevada Bur. Mines Bull. 54, p. 116, pl. 14. Dark siliceous schist, in part calcareous, with interbedded quartzite. Thickness at least 2,000 feet. Rocks metamorphosed adjacent to quartz monzonite intrusive. Overlies Nelson amphibolite (new).

Named for occurrence in vicinity of Mountain City, Elko County.

Mountain Cove Formation

[Miocene]: Southwestern Utah.

E. F. Cook, 1960, Geol. Soc. America Bull., v. 71, no. 11, p. 1710. Incidental mention in discussion of breccia blocks of Mississippian limestone. Name credited to H. R. Blank (unpub. thesis).

Area of report is Welcome Spring area.

Mountain Girl Conglomerate-Quartzite[1] (in Telescope Group)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 309–310, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 355, 365, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly in use in Death Valley region. South Park member (new) of Kingston Peak formation (Precambrian) is a correlative of three formations in Murphy's Telescope group: Middle Park formation, Mountain Girl conglomerate-quartzite, and Wildrose formation. None of these formations was recognized as mappable unit in Manly Peak quadrangle.

Probably named for exposures near Wildrose Canyon, Panamint Mountains, Inyo County.

Mountain Glen Shale[1]

Upper Devonian: Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 169–178.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 778. Mississippian (Kinderhook). Lies unconformably on Devonian limestone and attains maximum thickness of nearly 50 feet.

J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 16, 18–19; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 27. Consists of hard well-laminated black carbonaceous shale of Chattanooga type. Maximum thickness about 500 feet. Underlies Springville shale; overlies Alto limestone.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Upper Devonian.

Named for occurrence near Mountain Glen, Union County.

Mountain Home Shale[1]

Mountain Home Shale Member (of Syrena Formation)

Pennsylvanian: Southwestern New Mexico.

Original reference: H. Schmitt, 1933, Am. Inst. Min. and Met. Engrs. Contr. 39, p. 2, 4, 13.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. Term Mountain Home was used by Schmitt for convenience in mapping and listed in his succession of rocks but not discussed further. Information indicates that Mountain Home of Schmitt includes most of Missouri series. Term will not be used in this report on Pennsylvanian system of New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284. Geologic section shows Mountain Home shale as lower member of Syrena. Underlies Humboldt limestone member (Don limestone); overlies Oswald limestone.

Present in vicinity of Mountain Home mine, Santa Rita mining district.

Mountain Lake Member (of Bromide Formation)

Ordovician: Southern Oklahoma.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 120. Name suggested for the shaly sequence of lower Bromide. Occurs above basal sandstone of the formation. Thickness 194 feet. Underlies Pooleville member (new).

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 95. The Mountain Lake (in general) is the Cool Creek formation as established by Ulrich (1932).

Name taken from Mountain Lake, E½ sec. 22, T. 2 S., R. 1 W., near Woodford, Carter County.

Mountain Meadows Dacite Porphyry

Mesozoic(?): Southern California.

A. O. Woodford, J. S. Shelton, and T. G. Moran, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 23. Has an outcrop 5,500 by 2,500 feet. Intrudes gneissic bedrock. Dacite and bedrock are overlain unconformably by massive and fragmental volcanic rocks.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 517 (fig. 2), 520 (fig. 3), 523, 427. Described as a rock with phenocrysts of euhedral oligoclase and biotite, and less abundant partly resorbed quartz in a rather pale greenish or yellowish gray, ordinarily altered. Underlies Glendora volcanics. Derivation of name given.

Name derived from the largest exposed mass, 2,000 feet across, intrusive into basement complex at Mountain Meadow Country Club northwest of Pomona, Los Angeles County.

Mountain Spring Volcanics (in Amador Group)

Jurassic: East-central California.

G. R. Heyl, 1948, California Div. Mines Bull. 144, pt. 1, p. 51, 52, 53, pl. 7. A series of schists and greenstone in Newton mine area (near Jackson, Amador County), tentatively correlated with Jurassic Amador group described by Taliaferro (1942), is subdivided into four formations (descending) Mountain Spring volcanics, Dufrene slate, Newton Mine volcanics, and Sunnybrook volcanics, Mountain Spring volcanics consist of sequence of feldspathic chlorite schist, dark-blue-gray slate, and pale green slaty tuffs with thin intercalations of dark-blue-gray shale. Approximate thickness 560 feet. In absence of fossil evidence, wider regional studies will be necessary to determine definitely whether Mountain Spring volcanics and Dufrene slate should be considered uppermost Amador or part of Mariposa slate. Measured section, along Mountain Spring Creek from Mariposa slate eastward, dips steeply to east; relation of beds to Mariposa slate suggests section is overturned, and is on west limb of an overturned anticline or its faulted equivalent.

Named from exposures on Mountain Spring Creek, near Newton mine, Amador County.

Mount Airy Granite

Paleozoic(?): Northern North Carolina.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 22–23; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Light gray nearly white biotite granite of medium texture composed of orthoclase, plagioclase, quartz, biotite, and minor amounts of apatite, zircon, muscovite, chlorite, and epidote; on basis of feldspar content, it is best classed as a quartz monzonite.

Named for occurrences around Mount Airy, northeastern Surry County. Forms body approximately 8 miles long and 4 miles wide.

Mount Alto Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: P. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 34–35.

Occurs as a single dike about one-quarter mile north of Mount Alto Park and about 1 mile east of Gold Hill Station, Boulder County.

Mount Antero Granite

Paleocene(?) to Oligocene(?): Central Colorado.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 28–29, pl. 1. Granite is light gray to nearly white, and weathered surfaces are slightly glistening white, with local pinkish or brownish tones. Typically medium grained and composed mostly of feldspar and quartz, with subordinate small grains of biotite. Younger than Mount Pomeroy quartz monzonite (new), Mount Princeton quartz monzonite, and unnamed andesite in the area.

Type locality: On Mount Antero, the crest of which lies a few hundred feet east of the eastern boundary of Garfield quadrangle, Chaffee County. In

eastern part of Garfield County, the granite occurs as two stocks, several small outlying bodies, and dikes.

Mount Anthony Formation

Middle and Upper Ordovician (?) : Southwestern Vermont.

J. A. MacFadyen, Jr., 1956, Vermont Geol. Survey Bull. 7, p. 16, 28–29. Altered sandy green to gray argillite. Some of these beds had formerly been included in Taconic slate, but new name is advisable because of age and structural connotations of Taconic. Occasional limestone and dolomite lenses are present. Fine-grained sericite and chlorite schist on western margin grade toward east into chlorite-biotite schist. Maximum thickness 1,250 feet. Overlies Walloomsac slate unconformably.

Best exposed on Mount Anthony and its southern extension, Bennington area.

Mount Ascutney Granite[1]

Carboniferous : Southeastern Vermont.

Original reference: C. H. Hitchcock, 1884, Am. Mus. Nat. History Bull., v. 1, p. 178–179.

Occurs only at Mount Ascutney, Claremont quadrangle, Windsor County.

Mount Athos Formation[1] (in Evington Group)

Paleozoic (?) : Central Virginia.

Original reference : A. S. Furcron, 1931, Pan-Am. Geologist, v. 55, p. 317.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1), 93. Quartzite, commonly conglomeratic; mica schist; and white, gray, and pink marble. Marble in discontinuous lenses. Thickness 100 to 800 feet. Chronologic sequence of formations in James River synclinorium found to be reverse of that interpreted by Furcron. Underlies Slippery Creek greenstone (new); overlies Pelier schist (new) all in Evington group (new). Paleozoic (?).

G. H. Espenshade, 1954, U.S. Geol. Survey Bull, 1008, p. 15 (table 1), 17–19, pl. 1. Extended to include white marble previously placed in underlying Cockeysville marble. Overlies Archer Creek formation (new). Derivation of name given.

W. R. Brown, 1958, Virginia Div. Mineral Resources, Bull. 74, p. 8 (fig. 2), 35–37, pl. 1. Lower schist phase of Mount Athos formation (as defined by Furcron) separated and named Pelier schist. Age shown on columnar section as Lower Paleozoic (?).

Named for occurrence at Mount Athos, east of Lynchburg, along James River.

Mount Athos Greenstone[1]

Precambrian [?] : Southeastern Virginia.

Original reference: A. S. Furcron, 1935, Virginia Geol. Survey Bull. 39, pl. 1.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 93 (columnar section). Chronologic sequence of formations in James River synclinorium found to be the reverse of that interpreted by Furcron, and Mount Athos greenstone overlies Mount Athos formation instead of underlying it.

Extends over several counties east of Lynchburg, James River region.

Mount Auburn Shale Member (of McMillan Formation)[1]

Mount Auburn Formation (in Maysville Group or McMillan Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and northwestern Kentucky.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 85.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 11, 26, 27. In Kentucky considered a formation in McMillan group. In Cincinnati region, overlies Corryville formation; in southern Blue Grass region, underlies Sunset member of Arnheim formation and overlies Gilbert limestone; contact gradational. Thickness 10 to 35 feet.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on chart of Ordovician rocks, exposed in Jefferson and Switzerland Counties, as Mount Auburn formation in Maysville group. Consists of irregularly bedded rubbly argillaceous fossiliferous limestone. Thickness 3 to 20 feet. Underlies Arnheim formation; overlies Corryville formation.

K. E. Caster, E. A. Dalve, and J. K. Pope, 1955, Elementary guide to the fossils and strata in the vicinity of Cincinnati, Ohio: Cincinnati Mus. Nat. History, p. 12 (fig. 3), 18. Member of McMillan formation, Maysville group. Overlies Corryville member; underlies Arnheim formation, Richmond group. Thickness 15 feet.

Named for Mount Auburn, Cincinnati, Ohio.

Mount Baker Lava[1]

Mount Baker Andesitic Volcanics

Quaternary: Central northern Washington.

Original reference: G. O. Smith and F. C. Calkins, 1904, U. S. Geol. Survey Bull. 235, p. 35.

H. A. Combs, 1939, Geol. Soc. America Bull., v. 50, no. 10, p. 1494, 1499, 1501 (fig. 2). Volcanic rocks associated with Mount Baker are divided into three groups, oldest to youngest, Mount Baker lava, Black Buttes, and scattered flow remnants. Suggests Pleistocene to Recent age.

Peter Misch, 1952. The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 18. Mount Baker andesitic volcanics are younger than Hannegan volcanics (new). Shown on map as early Pleistocene.

Occurs on Mount Baker.

Mount Belknap Rhyolite

Mount Belknap Volcanic Series

Pliocene(?): Central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 438 (fig. 2), 440 (fig. 3), 442 (fig. 7), 447–449. Consists of two facies, not equally distributed; gray facies extends farther to west, south, and east than red tuffaceous facies. Entire mass forms lenticular body, and in conformity with regional structure, dips to west on west side, to north on north side, and to east on east side. Base is at altitude of over 11,000 feet in center of Tushar Mountains but reaches valley floor on either side. Each facies has maximum thickness of about 2,000 feet. Overlies Bullion Canyon volcanics; in contact with Dry Hollow latite (new), Joe Lott tuff (new), and Sevier River formation on east; on west underlies Joe Lott tuff. Tertiary.

P. F. Kerr and others, 1957, Geol. Soc. America Spec. Paper 64, p. 24–26, pl. 12. Referred to as Mount Belknap volcanic series. Petrographic discussion.

U.S. Geological Survey currently designates the age of the Mount Belknap Rhyolite as Pliocene(?) on the basis of restudy of Bullion Canyon Volcanics.

Composes crest of Tushar Mountain near northern end, and Mount Baldy and Mount Belknap Peaks, Marysvale region.

Mount Bennett Rhyolite[1]

Oligocene(?) : Southwestern Idaho.

Original reference: I. C. Russell, 1902, U.S. Geol. Survey Bull. 199, p. 42.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 33. A local name applied to volcanics along border of Snake River Plain.

Named for occurrence on Mount Bennett.

†Mount Bohemia Conglomerate[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: A. C. Lane, 1906, Mines and Minerals, v. 27, p. 204–206.

Named for fact it caps Bohemian Range, Keweenaw County.

Mount Carmel Sandstone[1]

Mount Carmel Sandstone Member (of Bond Formation)

Pennsylvanian: Southeastern and eastern Illinois.

Original reference: A. H. Worthen, 1875, *in* Geology and Paleontology, v. 6, p. 51–60, Illinois Geol. Survey.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Rank reduced to member status in Bond formation (new). Occurs above Shoal Creek limestone member and below Flannigan coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: W½ sec. 21, T. 1 S., R. 12 W., Mount Carmel quadrangle, Wabash County.

Mount Catherine Rhyolite

Eocene(?) : Central Washington.

R. J. Foster, 1957, Dissert. Abs., v. 17, no. 9, p. 1982; 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 114, pl. 1. Light-purple, light-orange, and light-blue-gray rhyolite flows, tuff, and breccia, most of which contain small clear quartz phenocrysts. Included in Guye formation by Smith and Calkins (1906). Outcrop pattern is crude oval, open to northwest. Overlies Guye formation with angular unconformity; rhyolite dips away from inside of arc at moderate to steep angles, and Guye formation dips steeply southeast, so that rhyolite is parallel with Guye on southeast side of arc but overlies it discordantly elsewhere. Underlies Naches formation, apparently concordant. Unfossiliferous. Probably Eocene.

Type area: Steep-walled canyon of Mill Creek, the southeasterly running creek just northeast of Mount Catherine, central Cascade Mountains.

Mount Champion Formation

Recent: Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, Correlation chart, geol. map. Formation consists of lower member, very weak soil, and an upper member. Overlies Lake Creek formation (new).

Twin Lakes area, Lake County, Colo.

Mount Champion Quartz Monzonite[1]

Precambrian(?): Central Colorado.

Original reference: J. V. Howell, 1919, Colorado Geol. Survey Bull. 17, p. 43.

Typically exposed on Mount Champion, Lake County.

Mount Clark Granite[1]

Probably Cretaceous: California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 128, map.

Named for the fact that it composes Mount Clark, Yosemite National Park.

Mount Deception Granite[1]

Precambrian(?): Northern New Hampshire.

Original reference: C. H. Hitchcock, 1877, Geology New Hampshire, pt. 2, p. 124.

Mount Deception, White Mountains.

Mount Eagle Volcanics

Mount Eagle Series[1]

Upper Cretaceous: St. Croix, Virgin Islands.

J. F. Kemp, 1926, New York Acad. Sci. Scientific Survey of Porto Rico and the Virgin Islands, v. 4, pt. 1, p. 49 (reprinted? from J. F. Kemp, 1923, Report to H. H. Hough, Captain, U.S.N., Governor, Virgin Islands. Printed at the Naval Station, St. Thomas). Mount Eagle series consists almost entirely of fragmental volcanic rocks. Steeply tilted; inclinations commonly from 60° to vertical, rarely below 45°. Overlain by Kingshill series (new).

D. J. Cederstrom, 1941, Am. Jour. Sci., v. 239, no. 8, p. 556. Referred to as Mount Eagle volcanics. Intruded by diorite. Upper Cretaceous. Underlies Kingshill marl.

D. J. Cederstrom, 1950, U.S. Geol. Survey Water-Supply Paper 1067, p. 16–19, pl. 1. In some areas, underlies Jealousy formation.

Kemp refers to Mount Eagle Range. Cederstrom shows Mount Eagle (1,165 feet) in northwestern part of island.

Mount Ebel Sandstone Member[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 251, 253, 258, 261, 270, 272.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74, 224; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 1. Included in Allens Creek facies of formation.

Type exposure: Along Smithville-Fairfax Road a short distance south of Mount Ebel Church, NE¼NW¼ sec. 23, T. 7 N., R. 1 W., 3 miles south of Smithville, Monroe County.

Mount Eden Formation[1]

Pliocene: Southern California.

Original reference: D. M. Fraser, 1931, Mining in California, v. 27, no. 4, p. 511–514.

D. I. Axelrod, 1938, Carnegie Inst. Washington Pub. 476, p. 128–219. Consists of red bed member about 1,800 feet thick and lower Mount Eden member about 1,500 feet thick. Underlies San Timoteo formation.

Named from Mount Eden, a hill in San Jacinto quadrangle. Well exposed south of Beaumont at western end of San Gorgonio Pass between San Bernardino and San Jacinto Mountains.

Mount Edgar Limestone

Lower Permian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 240. Listed as unconformably underlying Lower Triassic Moenkopi(?) and overlying Pennsylvanian Providence Mountains limestone (new). Thickness about 2,130 feet.

Occurs in Providence Mountains, near Kelso, San Bernardino County.

Mount Elden Formation

Upper Devonian: North-central Arizona.

Incidental mention: Louis Hussakof, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1988.

Louis Hussakof, 1942, Am. Mus. Novitates, no. 1186, p. 1–2. A series of strata of limestone, sandstone, etc., 148 feet in thickness. Locality cited.

Exposed on slopes of Mount Elden, near Flagstaff, Coconino County.

Mount Emmons Volcanics

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Agglomerate and interbedded lava flows. Name appears only on geologic map legend.

Mapped on summit of Mount Emmons in vicinity of Pavlof Volcano, Alaska Peninsula.

Mount Evans Quartz Monzonite

Precambrian: Western Colorado.

M. F. Boos and Esther Aberdeen, 1940, Geol. Soc. America Bull., v. 51, no. 5, p. 725, pl. 1. Name applied to coarsely crystalline quartz monzonite in Mount Evans batholith. Most of text discussion deals with batholith; Mount Evans quartz monzonite is shown on geologic map.

M. F. Boos, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1179. Falcon granite gneiss, Mount Evans quartz monzonite and quartz monzonite gneiss, Santa Fe Mountain pluton and fringing dikes, Rosalie lobe of Pikes Peak batholith, and Indian Creek plutons (Silver Plume type granite) invaded Idaho Springs and younger Precambrian formations in order named, probably in Algonkian time.

Mapped in vicinity of Mount Evans on eastern slope of Front Range west of Denver.

Mount Eve Granite

Precambrian: Northern New Jersey and southern New York.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 453–454. Light coarse-grained rock, mostly structureless, locally exhibits

banding. Intrudes marble and gneisses in vicinity of Glenwood syncline and in Mount Eve area in form of stocks which have dike- or sill-like apophyses. Occurs as thick sill-like mass near nose of anticline formed by Losee gneiss west of Glenwood syncline. At Mount Eve is a light medium-grained granitic gneiss considered to be border facies of Mount Eve granite, formed by reaction of granite with intruded gneisses.

In Franklin-Sterling area located in Sussex County, N.J., and Orange County, N.Y.

Mount Garfield Formation (in Mesaverde Group)[1]

Upper Cretaceous: Western Colorado.

Original reference: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 22, 33.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b, column 43. Shown on correlation chart in Mesaverde group below Hunter Canyon formation and above Anchor Mine tongue of Mancos shale.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187. Terms Mount Garfield and Hunter Canyon dropped; term Neslen facies adopted for coal-bearing rocks of Price River formation; and term Farrer facies adopted for noncoal-bearing rocks above Neslen facies.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 19. Formation ranges in thickness from 970 to 1,070 feet and contains most of coal beds in Book Cliffs of Colorado. Lower part, 305 to 666 feet, constitutes the "coal measures;" upper part, 405 to 665 feet constitutes "barren measures." In lower part, in vicinity of Colorado River, includes Rollins sandstone member, so designated because it is believed to be unit so named by Lee (1912, U.S. Geol. Survey Bull. 510) in Grand Mesa area. Southeast of Colorado River, beds of lower part of Mount Garfield below Rollins sandstone member pass into marine shales indistinguishable from Mancos shale, and Rollins becomes basal unit of Mesaverde group. Mount Garfield is conformable with underlying Sego sandstone and overlying Huuter Canyon formation. Upper part of the "coal measures" of the Mount Garfield and the "barren measures" are together equivalent to Bowie and Paonia shale members of the Mesaverde.

Named for Mount Garfield, about 3 miles northwest of Palisade. Recognized along Book Cliffs from Utah-Colorado State boundary as far as Grand Mesa.

Mount Garfield Porphyritic Quartz Syenite[1] (in White Mountain Plutonic-Volcanic Series)

Mississippian(?): West-central New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1935, Geology of Franconia quadrangle, New Hampshire, p. 15, map.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1025, 1030–1031. Age tentatively considered Mississippian, possibly Lower Pennsylvanian.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in White Mountain plutonic-volcanic series of Mississippian(?) age.

Named for Mount Garfield, Franconia quadrangle.

Mount Garfield Volcanic Formation

[Oligocene(?)]: Northwestern Washington.

R. C. Ellis, 1959, Dissert. Abs., v. 20, no. 3, p. 990. Similar in lithology to and may be correlative with Keechelus formation.

Report discusses geology of Dutch Miller Gap area.

Mount Gilead Sandstone (in Dixon Formation)

Mount Gilead Sandstone (in Henshaw Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 120.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. Mount Gilead Sandstone in Dixon formation. [Apparently so designated by Glenn, 1922.]

Occurs around and on ridge west of Mount Gilead School, Webster County.

Mount Gilead Shale (in Dixon Formation)

Mount Gilead Shale (in Henshaw Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference; L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 120.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96, Mount Gilead shale in Dixon formation. [Apparently so designated by Glenn (1922).]

Exposed near Mount Gilead School, Webster County.

Mount Givens Granodiorite

Cretaceous: Central eastern California.

D. G. Sherlock and Warren Hamilton, 1958, Geol. Soc. America Bull., v. 69, no. 10, p. 1254–1255, pl. 1. Typically light-gray biotite-hornblende granodiorite in which hornblende is in distinct small prisms and uniform over broad areas. Forms bedrock in southwest corner of area. Principal rock type in Mount Givens pluton that crops out in an area 10 miles wide and extends northwest (boundaries as yet unknown) for more than 30 miles.

Occurs in north half of Mount Abbott quadrangle, Sierra Nevada, Fresno County. Mount Givens pluton is named for occurrence around Mount Givens in Huntington Lake area.

Mount Glen Terrane[1]

Upper Devonian: Illinois.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 39, no. 4, p. 320 (table).

Mount Hague Volcanics

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Agglomerate and interbedded lava flows, one of which is Volcano Bay basalt (new). Name appears only on geologic map legend.

Mapped on summit and slopes of Mount Hague, Pavlof Volcano area, Alaska Peninsula.

Mount Hamilton Group

Upper Cambrian and Lower Ordovician: Northeastern Nevada.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 16–23. Name proposed to include all rocks which Hague (1877) originally placed in Pogonip formation. Divided into two formations: the Goodwin, represented by two members, and the Pogonip by four. Most pronounced lithologic change in group sequence is between the second and third members, second member being massive dolomite and third a thin-bedded shaly nodular limestone. Name Pogonip is restricted to four upper members, and the two lower members are designated Goodwin formation. Structure in area is complex, and no complete stratigraphic section of group was measured. Sequence presented is built up from a number of partial sections. Thickness about 3,700 feet. Overlies Dunderberg shale; underlies Eureka quartzite.

Named for exposures in Mount Hamilton area, White Pine mining district, White Pine County.

†Mount Harris Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: M. R. Campbell, 1931, Tentative correlation of named geologic units of Colorado, compiled by M. G. Wilmarth, U.S. Geol. Survey, separate chart.

Campbell's report was not published. Name Mount Harris Formation appeared in bold face in the Wilmarth Lexicon on the basis of Wilmarth's correlation chart. Cobban and Reeside (1952, Geol. Soc. America Bull., v. 63, no. 10) used name Mount Harris Formation on the Cretaceous correlation chart and cited the Wilmarth Lexicon. U.S. Geological Survey has abandoned the name Mount Harris Formation.

Crops out at Mount Harris, a coal mining town on Yampa River, Yampa coal field.

Mount Herman Sandstone[1]

Upper Devonian: Southwestern New York.

Original reference: J. M. Clarke, 1902, New York State Mus. Bull. 52, p. 525.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1742. Upper Devonian.

Well exposed in number of small quarries on Mount Herman, just south of Olean, Cattaraugus County.

Mount Hoffman Complex

Pleistocene to Recent(?): Northern California.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 365–367. Name applied to a complex characterized in large part by silicic lavas, which dominantly are perlitic rhyolites.

Occurs in vicinity of Mount Hoffman, Medicine Lake Highland, Modoc Lava Bed quadrangle.

Mount Hole Granodiorite

Cretaceous: Southern California.

E. S. Larsen, Jr., and N. B. Keevil, 1947, Geol. Soc. America Bull., v. 58, no. 6, p. 489–490. Named in a report on a study of the batholith of southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 89–90. pl. 1. An intermediate type of granodiorite. Intrudes Woodson Mountain granodiorite. Derivation of name given. [Spelled Mt. Hole in this reference.]

Named from its characteristic outcrops on Mount Hole, near Corona, Riverside County.

Mount Holly Complex

Mount Holly Gneiss[1]

Mount Holly Series

Precambrian: West-central Vermont.

Original reference: C. L. Whittle, 1894, Am. Jour. Sci., 3d ser., v. 47, p. 347–355.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull, v. 52, no, 5, p. 653, 654. Mount Holly series excluded from eastern flanks of Green Mountains; name replaced by Pico Peak series (new).

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 21–26, 44–48. Name emended to Mount Holly complex a more accurate term than Mount Holly series. Includes units lithologically similar to those of original Mount Holly series. In western sequence, Green Mountain anticlinorium underlies Mendon formation; in eastern sequence, underlies Monastery formation (new), but relation between the two units not clear.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 22–27, 29 (table 1), 42 (table 2). In western sequence, Rutland area, unconformably underlies Wilcox formation (new). In eastern sequence, unconformably underlies Saltash formation (new). Thickness in both areas about 7,000 feet.

Named for development in town of Mount Holly, Rutland County.

Mount Holly Conglomerate[1]

Pliocene(?): Southern New Jersey.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 271, 288.

Occurs on top of hill at Mount Holly, Burlington County.

Mount Hood Lavas

Pliocene, upper, and Pleistocene: Northwestern Oregon.

Name appears on chart only: W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2.

In Portland area.

Mount Hope Formation[1]

Pleistocene: Panamá.

Original reference: A. P. Brown and H. A. Pilsbry, 1913, Philadelphia Acad. Nat. Sci. Proc., v. 65, p. 493.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 341. Fossiliferous Pleistocene deposits. Contains numerous species of mollusks, nearly all of which are Recent.

Occurs in Black Swamp near Mount Hope, C.Z.

†Mount Hope Marl[1] or phase[1]

Eocene (Jackson): Southern South Carolina.

Original reference: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 17, 18.

Named for exposures at Mount Hope, on Santee River, Berkeley County.

Mount Hope Shale Member (of Fairview Formation)[1]

Mount Hope Formation (in Maysville Group)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and central northern Kentucky.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 75, 76.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on generalized stratigraphic column as Mount Hope formation in Maysville group. Occurs at base of group below Fairmount formation and above McMicken formation of Eden group. Thickness 25 to 45 feet.

Named for an exposure on southeastern slope of Price Hill, known as Mount Hope, at Cincinnati, Ohio.

Mount Houghton Felsite[1]

Mount Houghton Quartz Porphyry[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 83, 175–750.

Composes Mount Houghton, Keweenaw County.

Mount Jefferson Formation[1]

Pliocene: Central northern Oregon.

Original reference: E. T. Hodge, 1927, Geol. Soc. America Bull., v. 38, p. 163.

Forms Mount Jefferson and other mountains in Cascade Mountains.

Mount Jefferson Sandstone Member (of Rockfish Conglomerate)

Age not stated: Western Virginia.

H. B. Cooke, Jr., 1952, (abs.) Virginia Jour. Sci., v. 3, new ser., no. 4, p. 336. Rockfish conglomerate is divided into two members: Rockfish conglomerate (restricted) and Mount Jefferson sandstone.

Type locality and derivation of name not stated.

Mount Kate Series

Mount Kate Volcanics

Pliocene: Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299. Volcanics represented by lavas that cover large areas in neighborhood of Silver City. Thickness 1,500 feet.

R. R. Coats, 1936, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 4, p. 78, 79. Series consists of unconsolidated tuffs and breccias in Washoe district.

Exposed over large areas around Silver City and Virginia City.

Mount Lafayette Granite Porphyry[1] (in White Mountain Plutonic-Volcanic Series)

Mississippian(?): West-central New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1935, Geology of Franconia quadrangle, New Hampshire, p. 13, map.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1025, 1028–1030. Age tentatively considered Mississippian, possibly Lower Pennsylvanian.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in White Mountain plutonic-volcanic series of Mississippian(?) age.

Typically exposed on summit of Mount Lafayette, Franconia quadrangle.

Mount Laurel Sand[1] (in Monmouth Group)

Mount Laurel Member (of Matawan Formation)

Upper Cretaceous: New Jersey and Delaware.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 315, 333.

C. W. Carter, 1937, Maryland Geol. Survey, v. 13, p. 243 (fig. 32), 262–263. Geographically extended into Delaware where it is present along Chesapeake and Delaware Canal for a distance of 1 7/8 miles at its eastern end. At St. Georges Bridge, 8½ feet of formation is exposed above water level, full thickness probably not cut by canal. Only representative of group in immediate canal area. Unconformably overlies Marshalltown formation; unconformably overlain by Wicomico and Talbot formations (Pleistocene).

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 24, 36–39. Rank reduced to member status in Matawan formation. Uppermost member of formation; overlies Wenonah member; underlies Navesink member of Monmouth formation.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Basal member of Monmouth group. Underlies Navesink formation; overlies Wenonah formation of Matawan group. Average dip SE 35 feet per mile.

Named for Mount Laurel, Burlington County, N.J.

†Mount Lebanon Formation (in Claiborne Group)[1]

Eocene: Northwestern Louisiana.

Original reference: H. K. Shearer, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 4, p. 439–441.

Named for Mount Lebanon, Bienville Parish.

Mount Lowe Granodiorite[1]

Upper Jurassic or Lower Cretaceous: Southern California.

Original reference: W. J. Miller, 1926, (abs.) Geol. Soc. America Bull., v. 37, p. 149.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, table 4. Listed with Late Mesozoic rocks in San Gabriel Mountains. Younger than Wilson diorite.

Named because of typical occurrence on Mount Lowe and vicinity, San Gabriel Mountains, Los Angeles County.

Mount Mansfield Series

Age not stated: Northern Vermont.

E. C. Jacobs, 1935, (abs.) Geol. Soc. America Proc. 1934, p. 85. A series of schists and gneisses. On the west is in undetermined contact with Fairfax schist (new) of probable Precambrian age. Series extends across mountain massive to Hardwick where it is bordered by belts of, probably Ordovician, phyllites, and limestones. In Elmore, the Mansfield series is in contact with amphibolites.

Present in Green Mountain area.

Mount Marion Formation (in Hamilton Group)

Mount Marion Beds[1]

Middle Devonian: Eastern New York.

Original reference: A. W. Grabau, 1917, Geol. Soc. America Bull., v. 28, p. 954.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180. Stony Hollow member (new) of Marcellus formation underlies Mount Marion formation of Grabau at its type section; hence, Mount Marion is interpreted as sandy facies of Chittenango black shale member.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 11 (fig. 3), 15, pl. 2. In Albany County, Mount Marion formation overlies Bakoven shale and underlies Ashokan formation. Consists of argillaceous sandstones and sandy shales which are dark blue gray when fresh, and heavier sandstones; heavier sandstones predominate in higher horizons and entire formation tends to weather to brownish color. Thickness over 1,400 feet.

Well exposed at Mount Marion, west of Saugerties, Ulster County.

Mount Mazama Andesites, Dacites, Lavas, Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, 162 p. Geologic map of Crater Lake National Park maps Mount Mazama dacites and Mount Mazama andesites. Text uses terms Mount Mazama lavas, Mazama lavas, Mazama flows, Mazama andesites.

Diller and Patton (1902, U.S. Geol. Survey Prof. Paper 3) described following andesite areas: Castle Creek, Dutton Cliff, Eagle Crags, Munson Point, Round Top, Sentinel Rock, Steel Bay, Union Peak, Watchman and Wizard Islands, and several andesite dikes.

Mount Mazama Pumice

Pleistocene to Recent: Southwestern Oregon.

H. P. Hansen, 1942, Am. Midland Naturalist, v. 27, no. 2, p. 523–534. Name applied to pumice erupted from former Mount Mazama. Depth of pumice varies from more than 10 feet in vicinity of Crater Lake to several inches about 100 miles to north. Depth of peat profiles and rate of peat formation suggest that eruption of Mount Mazama occurred between 5,000 and 7,500 years ago.

I. S. Allison, 1945, Geol. Soc. America Bull., v. 56, no. 8, p. 789–808. Section of lake beds exposed in trench of Ana River below Ana Spring near northwest corner of Summer Lake basin, in Lake County, reveals near top at least six layers of pumice. Four of these appear to record eruptions of Mount Mazama which led finally to formation of Crater Lake; source of fifth is not known; sixth is attributed to eruption of Newberry Crater. Because certain layers in associated sediments imply shallow-water conditions, these eruptions must have occurred when last pluvial lake, formerly about 215 feet deep, had been reduced by evaporation to depth of about 85 feet, probably about 14,000 years ago. Data appear to extend back ages of Mount Mazama pumice, of Crater Lake, and of Paleo-Indian occupation of area by several thousand years. First layer of Mount Mazama pumice herein described would be a little more than 14,000 years old, age of main Crater Lake pumice layer would be about 500 years less than that. Eruption of Newberry pumice

took place about 3,000 years later or about 10,500 years ago.

H. P. Hansen, 1946, Am. Jour. Sci., v. 244, no. 10, p. 710–734. Discussion of post glacial forest succession and climate in Oregon Cascades. By correlating Pleistocene and post-glacial lake levels in Summer Lake basin with those of Lake Lahontan basin of Nevada, Allison (1945) dates eruption of Mount Mazama between 10,000 and 14,000 years ago. On the contrary, the thickness of bog sediments overlying Mount Mazama pumice, the stratigraphic position of interbedded pumice in relation to the warm, dry stages as interpreted from pollen profiles, and the correlation of many pollen profiles from the Pacific Northwest indicate that eruption of Mount Mazama took place between 8,000 and 10,000 years ago. [Geologic map (fig. 1) shows distribution of Mount Mazama pumice. This map is adapted from Williams (1942, fig. 16) which shows thickness and distribution of Crater Lake pumice.]

Mount Mazama was at present site of Crater Lake.

Mount Merino Member (of Normanskill Formation)

Middle Ordovician: Eastern New York.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 327, p. 23, 24. Incidental mention in discussion of Cambrian and Ordovician fossils.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 331, p. 89–101, geol. map [1946]. Referred to as chert and shale member. Thickness varies; 40 feet of chert exposed at south end of Mount Merino. Underlies Austin Glen member; overlies Deepkill shale.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 14). Shown on correlation chart as Mohawkian (Black River).

Well exposed on Mount Merino, Catskill quadrangle.

Mount Mesnard Quartzite[1]

Precambrian: Northern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. State Bd., 1891, 1892, p. 64–65.

Well exposed on Mount Mesnard.

Mount Moat Conglomerate[1]

Devonian(?): Northern New Hampshire.

Original reference: C. H. Hitchcock, 1873, Boston Soc. Nat. History Proc., v. 15, p. 304, 307.

Mount Moat, White Mountains.

Mount Morris Limestone Member (of Washington Formation)[1]

Mount Morris Limestone (in Washington Group)

Mount Morris limestone member

Pennsylvanian: Southwestern Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 39–40.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135, 147. In Fayette County, occurs in two beds separated by shale or sandstone. These limestones are here designated as lower and upper Mount Morris limestones; intervening sandstone is termed Mount Morris sandstone. In some areas, the lower Mount Morris limestone is cut out and Mount Morris sandstone lies on Waynesburg

sandstone. Upper Mount Morris limestone is separated from overlying Colvin Run limestone by Waynesburg A coal. Thickness of limestones with intervening sandstone about 27 feet. All units included in Washington group.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 40. In eastern Ohio, Mount Morris limestone member (Washington series) is local in its occurrence. Consists of nodules or thin layers of limestone, of fresh- or brackish-water type, embedded in argillaceous shales. Occurs 30 to 40 feet above horizon of Waynesburg coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 208. Mount Morris limestone named as member of Waynesburg "A" cyclothem in report on Athens County, although generally absent in county, but well developed in Monroe and Belmont Counties.

Named for exposures on north bank of Dunkard Creek at Mount Morris, Greene County, Pa.

Mount Morrison Formation

Precambrian: Central northern Colorado.

M. F. Boos, 1954, Geol. Soc. America Bull., v. 65, no. 2, p. 118–119, fig. 2, pl. 1. Finely gneissic quartz monzonite, migmatite, and injection gneiss with associated pegmatites and aplites. Chief rock is gneiss that occurs as imbricated sheetlike masses and stocks. Gneiss, medium-grained, and on fresh exposure gray to almost white or tan.

Type locality: On Mount Morrison where a large body of it is well exposed, Jefferson County, Denver Mountain Parks area. Large bodies well exposed on Santa Fe and Saddleback Mountains southeast of Idaho Springs. Composes most of Mount Falcon and small masses outcrop in Deer Creek drainage area.

Mount Olympus Granite[1]

Precambrian: Central northern Colorado.

Original reference: M. B. Fuller, 1924, Jour, Geology, v. 32, p. 51–63.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 28, 29. As used in this report, Cripple Creek granite of Pikes Peak quadrangle, and Longs Peak and Mount Olympus granites of Estes Park region are included in Silver Plume granite.

Named for peak and quadrangle over much of whose surface it is exposed.

Mount Ord Pyroxenite

Precambrian: Central Arizona.

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1128, pl. 11. Dense blackish porphyry. Typically pale greenish gray on weathered surfaces and black on fresh fracture, with phenocrysts of pyroxene up to 5 mm in diameter in dense groundmass. Forms stock intruding Alder series and in turn invaded by granite on its southeast. Many dikes of this rock, generally less than 75 feet wide and trending northeastward, intrude Alder series for about 3,000 feet from stock.

Crops out as belt ¾ mile to 2⅛ miles wide that extends northeastward across Mazatzal Range at Mount Ord.

Mount Ord Series

Mesozoic (Jura-Trias): California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Grouped under metavolcanics on map legend.

Mount Osborn Glaciation

Pleistocene: Central western Alaska.

D. M. Hopkins, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 11, 13 (table 1). Four Quaternary glaciations recognized on Seward Peninsula. Mount Osborn preceded by Salmon Lake glaciation (new). Deposits recognized on aerial photographs of the valley heading in west wall of Mount Osborn and in a few other valleys in Kigluaik Mountains. End moraines small sharp-crested ridges that enclose parts of valleys, in which talus accumulations are small and rock glaciers uncommon.

Recognized on Mount Osborn, southwestern part of Seward Peninsula.

Mount Osceola Granite[1] (in White Mountain Plutonic-Volcanic Series)

Mississippian(?): Central New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1934, Geology of Franconia quadrangle, New Hampshire, p. 15, map.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1031–1032, pl. 3. Age changed to Mississippian(?).

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Belongs to White Mountain plutonic-volcanic series.

Named for characteristic exposures on Mount Osceola, Franconia quadrangle.

Mount Pleasant Conglomerate[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 58–59.

Caps summit of hill at village of Mount Pleasant, Wayne County.

Mount Pleasant Phosphate[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 105, 127–128, 209–211.

Named for Mount Pleasant, Maury County.

Mount Pleasant Red Shale Member (of Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 59, 63.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 282–283. Highest red member of Catskill. White applied name to more than one unit, including a conglomerate and red shale under the one name. The Mount Pleasant is herein restricted to the shale and embraces beds from base of Pocono to top of Elk Mountain sandstone. This includes in Wayne County the highest redbeds below Griswolds Gap conglomerate which White thought probably were Devonian-Mississippian transitional strata, but they are here assigned entirely to Devonian. Thickness about 500 feet in type region.

Well exposed along road descending from village of Mount Pleasant, Wayne County. Town now called Pleasant Mount, but township is still Mount Pleasant and contains type locality.

Mount Pleasant Sandstone

Mount Pleasant Shales and Sandstones (in Chester Group)[1]

Upper Mississippian: Southwestern Indiana and central western Kentucky.

Original reference: W. N. Logan, 1924, Indiana Dept. Conserv. Pub. 42, p. 11, 125.

Norval Ballard, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 11, p. 1521 (table 1). Table gives age as Upper Mississippian.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Mount Pleasant sandstone replaced by Degonia sandstone. Local Indiana names of upper Chester are dropped, and formations given names of standard Chester column.

Named for exposure at Mount Pleasant, Perry County, Ind.

Mount Pomeroy Quartz Monzonite

Paleocene(?) to Oligocene(?): Central Colorado.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 23–24, pl. 1. Name changed from Pomeroy quartz monzonite because former name was preempted. Typically a pinkish-gray medium-grained rock, with weathered surfaces dull greenish gray or dull reddish brown. Hornblende, the most abundant mafic mineral, typically chloritized; this feature, combined with pinkish tone, is characteristic of most of the rock and helps to distinguish the Mount Pomeroy from other Tertiary intrusive rocks, particularly the Mount Princeton quartz monzonite. Older than both quartz latite porphyry in area and Mount Princeton quartz monzonite.

Type locality: On Pomeroy Mountain, Garfield quadrangle, Chaffee County.

Mount Princeton Quartz Monzonite[1]

Paleocene(?) to Oligocene(?): Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1935, Colorado Sci. Soc. Proc., v. 13, no. 8, p. 475, map.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 25–27, pl. 1. Generally fresh-appearing rock on weathered as well as newly broken surfaces. Typically gray and medium grained but locally light gray, pinkish, or rarely white. Texture ranges from even granular through lightly porphyritic to prominently porphyritic. Older than Mount Antero granite (new); younger than Mount Pomeroy quartz monzonite (new). Formerly designated the Princeton quartz monzonite. Paleocene(?) to Oligocene(?). Type locality designated. Mount Princeton quartz monzonite is one of largest bodies of Tertiary intrusive rocks in Colorado. It forms small batholith roughly circular in outline with maximum diameter of about 20 miles. Only southern part is present in Garfield quadrangle [this report]. The quartz monzonite lies chiefly east of Continental Divide. Many of highest peaks in quadrangle are composed of this quartz monzonite, especially those north and west of Chalk Creek.

Type locality: On Mount Princeton, the summit of which lies less than one-half mile east of northeast corner of Garfield quadrangle. Excellent exposures at type locality.

Mount Prospect Complex

Age not stated: Northwestern Connecticut.

E. N. Cameron, 1951, Connecticut Geol. Nat. History Survey Bull. 76, p. 1–2, 4, 8–37. Includes three major groups of widely differing rock types. Oldest includes metasedimentary mica gneisses, mica quartzites, and quartz-mica schists of Hartland and Berkshire formations; the Mount Tom hornblende gneiss; an assemblage of dioritic gneisses (previously known as Brookfield diorite) comprising bulk of complex; biotite pyroxenite and biotite hornblendite; and quartz monzonite porphyry. Second is a sequence of mafic igneous rocks, olivine norite, quartz norite, hypersthene pyroxenite, and dike rocks which intrude oldest group. The third consists of granites, aplites, and pegmatites which cut oldest group, but may be older than younger mafic intrusives. Complex lies along boundary between Berkshire and Hartland formations. Bedding and foliation in metasediments are parallel; foliation of dioritic gneisses is parallel to their layering and their contacts with the metasediments.

Named for Mount Prospect. Occupies an area of about 14 square miles around village of Bantam, Litchfield County.

Mount Rainier Lavas[1]

Mount Rainier Volcanics

Pleistocene: Western Washington.

Original reference: H. C. Culver, 1936, Washington Dept. Conserv. and Devel., Div. Geology Bull. 32, p. 21.

H. A. Coombs, 1936, Washington (State) Univ. Pubs. in Geology 3, no. 2, p. 172–190. Mount Rainier volcanics (or lavas) roughly divided into two groups; loose and crumbly pyroclastics, and compact flows. Pyroclastics are abundant on higher slope of mountain, and lava flows attain greatest development in basal parts of mountain although they also occur on higher slopes intercalated with the pyroclastics. Exact time of issuance of lavas unknown, but it is thought that greater part of volcano was formed during Pleistocene time. Paleobotanical evidence indicates post-Pliocene eruptions.

Lavas occupy approximately 100 square miles, of this amount about 45 square miles are covered by perennial snow and ice. Vertically lavas range from upland surface of Cascades, at an elevation of 6,000 feet, to crater at 14,408 feet.

Mount Rogers Volcanic Group

Mount Rogers Volcanic Series

Precambrian: Southwestern Virginia, northern North Carolina, and northeastern Tennessee.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 410–411. Volcanic series, which is 1,000 or more feet thick, consists of series of rhyolite flows underlain by tuff, arkose, and basalt flows, and overlain by a series of red tuff and arkose. Considered late Precambrian as it overlies, and is structurally discordant with, the injection complex and is overlain by Lower Cambrian Unicoi formation.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 48–49, pl. 1. In Gossan Lead district, comprises (descending) rhyolite, and Flat Ridge formation (new). Thickness near Comers Rock, Grayson County, about 800 feet. Derivation of name given.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 29–32, pls. In northern part of region [northeastern Tennessee],

Mount Rogers volcanic group wedges in between basement rocks and rocks of definite Paleozoic age. Group is sequence of silicic flows and tuffs and clastic sedimentary rocks many thousands of feet thick, which were probably laid down during latest Precambrian time.

Named for occurrence on Mount Rogers, highest peak in Virginia, located on Smythe-Grayson county line 16½ miles west of western boundary of Gossan Lead district.

Mount Rorah Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p 33, 45 (table), 64, pl. 1. Proposed to replace Bald Hill coal because of prior use of name Bald Hill. Thickness about 2 feet. Stratigraphically above Creal Springs limestone member (new) and below Wise Ridge coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 35, T. 10 S., R. 4 E., Williamson County. Name derived from Mount Rorah Church about 2 miles northwest of type outcrop.

Mount Rosa Granite[1]

Mount Rosa Quartzite

Precambrian: East-central Colorado.

Original reference: G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, pl. 6. Shown on columnar section as Mount Rosa quartzite and credited to Finlay, 1916.

Most extensively developed on slopes of Mount Rosa, Colorado Springs region.

Mount Rowe Member (of Miller Peak Formation)

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1902–1903. Red quartzites, in thin to thick beds, many of which show crossbedding, ripple marks, and mud conglomerates. Quartzites grade upward into rose-red argillites, which are thinly bedded and fissile. Thickness about 1,500 feet. Overlies Roosville member; underlies undifferentiated rocks of Missoula group.

Type locality: South crest of Mount Rose, near Akamina Pass, Waterton Lakes National Park, Alberta.

Mount Ruth Leucogranodiorite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 206–209, 235. Fine-grained light-colored rock with large scattered biotite crystals. Intrudes Bald Mountain tonalite (new).

Exposed on summit and upper part of Mount Ruth, Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Mount St. Helens Lavas

Quaternary: Southwestern Washington.

Jean Verhoogen, 1937, California Univ., Dept. Geol. Sci. Bull., v. 24, no. 9, p. 283–294. Name applied to lavas from Mount St. Helens. Lavas are mainly basic, rhyolites are lacking, dacites occur sparingly in pyroclastics; pyroxene andesites and olivine basalts are common rock with andesites more abundant than basalts.

Mount St. Helens occurs on western slope of Cascade Range, 40 miles north of Columbia River.

Mount Savage Fire Clay (in Pottsville Formation)[1]

Mount Savage Underclay (in Kanawha Member of Pottsville Formation)

Pennsylvanian: Western Maryland, central southern Pennsylvania, and northern West Virginia.

Original reference: C. A. Ashburner, 1878, Pennsylvania 2d Geol. Survey Rept. F.

J. B. McCue and others, 1948, West Virginia Geol. Survey [Repts.], v. 18, p. 18. Mount Savage clay occurs beneath Tionesta coal about 50 feet below top of the Pottsville. Thickness about 14 feet in Mineral County.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 23 (table 6). Listed as Mount Savage underclay in Kanawha member of Pottsville formation.

Named for occurrence at Mount Savage, Allegany County, Md.

†Mount Savage Group (in Pottsville Formation)[1]

Pennsylvanian: Central southern Pennsylvania and western Maryland.

Original reference: C. A. Ashburner, 1878, Pennsylvania 2d Geol. Survey Rept. F.

In southern part of Huntingdon County, Pa.

Mount Savage Sandstone (in Allegheny Formation?)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 572.

Allegany and Garrett Counties.

Mount Scott Lavas

Pleistocene: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 36, pl. 3. Lavas are pyroxene andesites rich in phenocrysts of feldspar and carry many basic inclusions. Lavas issued from Mount Scott, a parasitic cone not far above eastern base of former Mount Mazama. None of the lavas exposed on walls of Crater Lake came from Mount Scott. In that direction, the flows did not spread more than a mile from the vent. In other directions, the Mount Scott lavas were able to move farther. Eastward, they pass beneath flows and domes of later dacite. Mount Scott probably ceased to erupt before dacites of Llao Rock, Cleetwood Cove, and Red Cloud escaped from Northern Arc of Vents.

Mount Scott is highest peak in Crater Lake National Park.

Mount Selman Formation (in Claiborne Group)[1]

Eocene: Southern and eastern Texas.

Original reference: W. Kennedy, 1892, Texas Geol. Survey 3d Ann. Rept., p. 45, 52–54.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 260–261. Discussed in area between Laredo and Rio Grande City. About 1,000 feet of Mount Selman beds exposed. Lower 700 feet probably Queen City in age. Above Queen City are 300 feet of red and green shales with some sandstones of approximate age of the Weches. Base of section; underlies Garceno sandstone member (new) of Cook Mountain formation.

Formation includes (ascending) Reklaw, Queen City, Sand, and Weches Greensand Members.

Named for Mount Selman, Cherokee County.

Mount Simon Sandstone[1] (in Dresbach Group)

Mount Simon Member (of Dresbach Formation)

Upper Cambrian: Southwestern Wisconsin and Minnesota.

Original reference: C. D. Walcott, 1914, Smithsonian Misc. Colln., v. 57, p. 354.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1901–1902. Listed as basal member of Dresbach formation in Minnesota. Underlies Eau Claire member.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 33, measured sections. In much of Minnesota, member overlies Hinckley sandstone. Thickness 80 to 200 feet. Outcrops confined to Pine County. Encountered in deep wells in southwestern part of state. Underlies Eau Claire member of Dresbach. St. Croixian series.

J. S. Templeton, Jr., 1950, Illinois Acad. Sci. Trans., v. 43, p. 151–159. In subsurface in northern Illinois subdivided into (ascending) Crane, Kenyon, Lovell, Mayfield, Lacey, Gunn, and Charter members (all new). Unconformably overlies Precambrian basement; underlies Eau Claire. Thickness 400 to 2,120 feet.

Forms escarpment called Mount Simon near Eau Claire, Wis.

Mount Stuart Granodiorite[1]

Pre-Tertiary: Central Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

R. C. Ellis, 1959, Dissert. Abs., v. 20, no. 3, p. 990. Rocks of Mount Stuart block are exposed along east margin of Dutch Miller Gap area and consist of Hawkins greenstone, Ingalls peridotite (new), and Mount Stuart granodiorite.

Occurs on and in vicinity of Mount Stuart, Chelan County.

Mount Susitna Glaciation

Pleistocene: Central southern Alaska.

T. N. V. Karlstrom *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 3, 13 (table 1). At least four major Quaternary glaciations recognized in Upper Cook Inlet area. Mount Susitna, oldest glaciation in area, preceded Caribou Hills glaciation. Summit level of Mount Susitna and other high-level surfaces with apparent ice-scoured forms lie above truncated spurs and marginal deposits of subsequent glaciations and record oldest glaciation in area. Scattered boulders and thick veneer of unconsolidated material present on some of these high-level

surfaces. In general, unconsolidated deposits are intricately dissected and extensively modified by mass wasting.

Evidence on summit level of Mount Susitna in southern Susitna lowland, Upper Cook Inlet region.

Mount Tabor Shale Member (of Cook Mountain Formation)

Mount Tabor Shale Member (of Crockett Formation)

Eocene, middle (Claiborne): Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 151–154, 159. Name applied to uppermost member of Crockett formation. Consists of interbedded silts and shales in upper part and chiefly brown shales in lower part. Thickness varies from 45 feet at type locality to as much as 100 feet in eastern part of area. Overlies Spiller sand member (new) with contact transitional; underlies Yegua formation with boundary placed where sands become more abundant than shales.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, pt. 2, p. 859 [1940]. Includes Serbin sand lentil (new) at top.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, 1664, 1665, 1671 (fig. 3). Reallocated to member status in Cook Mountain formation.

Type locality: In east ditch of U.S. Highway 75, on slope north of Mount Tabor School, Madison County.

Mount Toby Conglomerate (in Newark Group)[1]

Upper Triassic: Central southern Massachusetts.

Original reference: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 452.

M. E. Willard 1951, Bedrock geology of Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Mount Toby conglomerate as originally defined by Emerson included, in addition to conglomerate above Deerfield diabase, those parts of Turners Falls sandstone (new) and Sugarloaf formation exposed in Mount Toby highland and coarse talus breccia on east face of Mount Toby that was named Leverett breccia by Reynolds and Leavitt (1927). Mount Toby as mapped in present investigation includes only coarse and fine conglomerate above Deerfield diabase and talus breccia (Leverett breccia).

Named for occurrence on Mount Toby.

Mount Tom Hornblende Gneiss[1]

Paleozoic: Western Connecticut.

Original reference: W. M. Agar, 1927, Connecticut Geol. Nat. History Survey Bull. 40.

E. N. Cameron, 1951, Connecticut Geol. Nat. History Survey Bull. 76, p. 2, 11–12. Assigned to Mount Prospect complex (new).

R. M. Gates, 1952, *in* R. M. Gates and W. C. Bradley, Connecticut Geol. Nat. History Survey Misc. Ser. 5, p. 21–25. Dark-greenish-black or mottled black and white rock composed essentially of hornblende and plagioclase. Coarse to fine grained, massive to foliated and lineated. Evidence in New Preston quadrangle for probable igneous origin.

R. M. Gates, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–121. Name Mount Tom hornblende gneiss is used in this report, as it applies pri-

marily to hornblende gneisses in general area of Litchfield, New Preston, and Roxbury quadrangles. Forms cluster of intrusive bodies in Hartland formation.

Forms Mount Tom, Little Mount Tom, and Mount Rat, Litchfield County.

Mount Tripyramid Complex

Carboniferous(?): East-central New Hampshire.

A. P. Smith and others, 1938, Geologic map and structure selection of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Includes dark-gray coarse- to medium-grained gabbro, gray-mottled medium-grained hypersthene diorite, very light gray medium-grained monzodiorite, light-gray medium-grained and pink moderately fine-grained monzonite, dark-gray fine-grained porphyritic quartz monzonite, and pink medium-grained quartz syenite. Included in White Mountain magma series.

Crops out around Mount Tripyramid in northwestern part of Mount Chocorua quadrangle.

†Mount Vernon Beds[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: W. H. Norton, 1895, Iowa Geol. Survey, v. 4, p. 130–135.

Named for Mount Vernon, Linn County.

†Mount Vernon Series[1]

Lower Cretaceous: Eastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 324.

First discovered about 1 mile below Mount Vernon mansion, directly underneath high bluff known as Rose's Delight, within former Mount Vernon estate.

†Mount Washington Series[1]

Cambrian and Ordovician: Southwestern Massachusetts and northwestern Connecticut.

Original reference: W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Named for occurrence on Mount Washington, Berkshire County, Mass.

Mount Wilson Quartz Diorite[1]

Late Mesozoic: Southern California.

Original reference: W. J. Miller, 1926, (abs.) Geol. Soc. America Bull., v. 37, p. 149.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 468, 469, table 4. Wilson quartz diorite shown on correlation chart in San Gabriel, Santa Monica, and San Bernardino Mountains. Text refers to Wilson diorite. Late Mesozoic.

Named for exposures on and near Mount Wilson.

Mount Zion Porphyry[1] (in Gray Porphyry Group)

Eocene: Central Colorado.

Original references: S. F. Emmons, 1883, U.S. Geol. Survey Atlas of Leadville dist., Colo.; U.S. Geol. Survey Mon. 12, p. 76.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 46. Mount Zion porphyry not recognized in immediate region [Mosquito Range] though it is possible that some of what is here mapped as Evans Gulch porphyry is actually Mount Zion porphyry.

Named for exposures on Mount Zion, north of Leadville, Lake County.

Mowich Formation

Mowich Group

Lower Jurassic: East-central Oregon.

F. L. Davis, 1937, Oregon Country Geol. Soc. News Letter, v. 3, no. 2, p. 14. Referred to as Mowitch formation.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 235–238. Mowich group consists of three formations (ascending): Robertson, Suplee, and Nicely black shale (all new). Total thickness less than 500 feet. Group steeply folded; in some localities, inclined more than 45° and in some places nearly vertical. Unconformably underlies Colpitts group (new); overlies Donovan formation (new). Type area and derivation of name given.

Type area: Along head waters of South Fork of Beaver Creek, 7 miles southeast of Suplee post office, in secs. 26, 27, 28, and 29, T. 18 S., R. 26 E., Crook County. Named for Mowich Mountain.

Mowich Hypersthene Basalt

See Keechelus Andesitic Series.

Mowitch Formation

See Mowich Formation, Group

Mowitza Shale[1]

Upper Devonian: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

Type locality: Mowitza shaft, Star district, southeast of Frisco district, Beaver County.

Mowry Shale (in Colorado Group)[1]

Mowry Shale Member (of Colorado Shale)

Mowry Shale Member (of Mancos Shale)

Mowry Shale Member (of Graneros Shale)

Lower Cretaceous: Wyoming, Colorado, Montana, western South Dakota, and Utah.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165, p. 4. Clay Spur bentonite bed occurs at top of Mowry siliceous shale member of Graneros shale.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Shown on correlation chart as Mowry shale; overlies Newcastle sandstone; underlies Belle Fourche shale. [Has been considered member of Graneros shale.] Upper Cretaceous.

H. L. Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1573–1577. Mowry shale in Gros Ventre River and Mount Leidy Highland areas is about 1,070 feet thick and consists of salt and pepper

sandstones, black and gray shale, bentonite, thin dolomites, and many porcellanite beds. Contact with overlying Frontier gradational. For mapping purposes, contact is placed at base of typical Frontier-type sandstone, above which no bentonite or porcellanite beds were observed. Contact with underlying Thermopolis gradational in most areas. Base of Mowry chosen at bottom of first salt and pepper sandstone.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 11–13; R. E. Stevenson, 1952, South Dakota Geol. Survey Rept. Inv. 69, p. 6, 7. Classified as member of Graneros shale. Underlies Belle Fourche shale member; overlies Newcastle sandstone member.

A. J. Crowley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 85 (table 1). Generalized stratigraphic section in Black Hills area shows Mowry shale member of Graneros shale underlies Belle Fourche member and overlies Newcastle sandstone member of Skull Creek group. Thickness about 200 feet.

W. A. Cobban and J. B. Reeside, Jr., 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1892–1893. Recently, uncrushed ammonites have been collected from Mowry shale and equivalent rocks at several localities in Colorado, Wyoming, and Montana. These collections show that impressions and crushed internal molds of ammonites previously assigned to Upper Cretaceous genera *Metoicoceras*, *Acompsoceras* and *Neocardioceras* (as *Kanabiceras*) belong to lower Cretaceous genera *Gastroplites* and *Neogastroplites*. Largest collection of *Neogastroplites* is from bed of concretions in Mowry shale near Cody, Wyo.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2179–2181. Formations that are equivalent to Colorado shale are Fall River sandstone, Skull Creek shale, New Castle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. Mowry, in northern Black Hills, consists of about 235 feet of light-gray-weathering siliceous shale containing abundant marine fish scales. Interbedded with creamy white layers of bentonite, with Clay Spur bentonite at top. In central Montana, these beds are less siliceous and more sandy, but thickness is little changed. Farther west, rocks of Mowry age thicken and become more sandy, and lower part passes into nonmarine sediments with conspicuous amount of tuff, bentonite, and bentonitic mudstone. Mowry is considered a formation in the Black Hills and a member of the Colorado shale in central Montana. Lower Cretaceous.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 98–102, pls. 1, 6. Basal member of Mancos shale in Uinta River-Brush Creek area, Utah. Consists of dark-gray hard fissile light-gray-weathering shale. Thickness 30 to 120 feet. Underlies Frontier sandstone member; overlies Dakota sandstone. Upper Cretaceous. Name Mowry preferred to name Aspen in this area.

M. M. Knechtel and S. H. Patterson, 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–36. Mowry shale includes Clay Spur bentonite bed in northern Black Hills district, Montana, Wyoming, and South Dakota.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 58–59. Mowry shale described in Johnson County, Wyo., where it is about 500 feet thick and consists of two major units which grade into each other; lower, about 150 feet thick, is soft grayish-black shale with several thin beds of bentonite; upper unit, 350 feet, consists of light-gray brittle laminated

siliceous shale, with several yellowish bentonite beds and a few thin sandstones. Overlies Newcastle sandstone; underlies Frontier formation. [Colorado group not used in this report.]

R. F. Walters, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks basin, Colorado, p. 85, 86. Generalized stratigraphic section for Independence Mountain area, North Park, Colo., shows Mowry formation, 205 feet thick, overlies Thermopolis shale and underlies Frontier formation.

Herbert Skolnick, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 787–815. Skull Creek shale, Newcastle sandstone, and lower part of Mowry shale are considered Lower Cretaceous in age, correlated by Foraminifera with rocks of Kansas, Oklahoma, and Texas. Newcastle sandstone is considered to be a member of the Skull Creek. Mowry shale, with its widespread distribution, distinctive lithologic features, and characteristic fauna, can be mapped in the field and should be considered a formation. Since, locally, the basal part of the Mowry in Black Hills area appears more closely related to underlying Skull Creek shale than to typical siliceous upper Mowry shale, it is probable that a redefinition of the Mowry will assign its basal part to Skull Creek shale.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 40–43. As described by Darton on eastern side of Bighorn Mountains, Mowry beds were middle unit of his Colorado formation and consisted of sequence of hard light-gray shale and thin-bedded sandstone that weathers light gray and forms ridges. These shale beds are separated from Newcastle sandstone by 150 to 200 feet of soft black shale which when occurring on western side of Bighorn Mountains, has in past been mapped as part of Thermopolis shale. Thompson, Love, and Tourtelot (1949) advocated that Mowry shale in central Wyoming be defined to include not only the black shale but also the underlying black shale. Mowry shale as used in this report [Buffalo-Lake De Smet area, Johnson and Sheridan Counties, Wyo.] follows usage advocated by Thompson, Love, and Tourtelot. It includes strata lying between Muddy sandstone member of (Newcastle sandstone of this report) of Thermopolis shale and Frontier formation. As thus used, the Mowry shale is equivalent to rock in Black Hills which Rubey (1930) included in Mowry shale. Thickness of Mowry about 525 feet in area of present report. Includes a lower nonresistant black shale member about 200 feet thick and an upper resistant light-gray siliceous member about 325 feet thick.

J. B. Reeside, Jr., and W. A. Cobban, 1960, U.S. Geol. Survey Prof. Paper 355, p. 2–9, measured sections. Some difference of opinion has existed, with respect to central and western Wyoming, as to where in sequence of rocks the boundaries of Mowry should be placed. In this area, the Mowry is overlain by Frontier formation and underlain by Thermopolis shale. In original definition of Thermopolis shale, Lupton (1916) described a "Muddy sand" near the middle. This later became known as Muddy sandstone member of the Thermopolis, which is the present classification of U.S. Geological Survey. Love (1948, Wyoming Geol. Assoc. Guidebook 3d Ann. Field Conf.) has pointed out that that part of the Thermopolis that overlies Muddy sandstone member grades upward into Mowry shale and that a satisfactory boundary cannot be determined either at outcrops or from well cuttings. Love and associates (Love, 1948; Thompson, Love, and Tourtelot, 1949; Love and others, 1951) favor elevating Muddy sandstone to formation rank and extending Mowry downward to top of

the Muddy. Foster (1947) placed boundary between Mowry shale and Thermopolis shale still lower and included Muddy sandstone in lower part of Mowry. Upper boundary has likewise been placed at different levels according to personal opinion. Love and associates place upper boundary in central Wyoming at base of medium- to coarse-grained soft porous bed of sandstone that contains numerous dark grains. This sandstone is overlain by widespread unit of white bentonite, tuff, and porcellanite. In southwestern Wyoming, a similar white tuffaceous unit lies in lower part of Frontier formation at its type locality. In Jackson Hole area, Foster (1947) included this tuffaceous unit in upper part of Mowry. It makes little difference for present purposes whether this tuffaceous interval is called Mowry or Frontier. Presumably the tuff represents one of latest eruptions in the series that contributed to formation of Mowry shale, and its assignment depends on the personal opinion as to whether Mowry shale should include only main mass of volcanic debris or all of it. Systematic description of fossils.

D. L. Eicher, 1960, Yale Univ., Peabody Mus. Nat. History Bull. 15, p. 5 (fig. 2), 6, 7, 8, 10–12, 26, 49. Overlies Shell Creek formation (new).

Named for Mowry Creek, northwest of Buffalo, Johnson County, Wyo.

Moxahala Clay (in Allegheny Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1884, Ohio Geol. Survey, v. 5.

Named for Moxahala, Perry County.

Moya Formation (in Keller Group)

Pennsylvanian (Virgil Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 70 (fig. 7), 71, 72–73. Term proposed for limestone between top of Del Cuerto formation (new) and base of Bruton formation (new) of Fresnal group (new). At type locality, formation is composed largely of massive to massively bedded limestone, with a few thin layers of irregularly bedded to nodular limestone; in some areas, sandstones and shales are interbedded with the limestones. Thickness at type locality 51 feet.

Type locality: Northeast side of Oscura Mountains, Socorro County. Name derived from Moya Spring on east slope of Oscura Mountains, about 8 miles south of north side of range.

Moyer Member (of Frankfort Formation)

Upper Ordovician (Cincinnatian): Central New York.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 66–67. Name proposed for uppermost member of formation. Composed principally of gray, somewhat arenaceous shale with beds up to 1 foot thick of finely cross-laminated sandstone like those in Harter shale member (new) at base of formation. Proportion of sandstone to shale decreases toward top. Thickness about 400 feet. Overlies Hasenclever sandstone member (new); disconformably underlies Oneida formation.

Typically exposed along lower course of Moyer Creek southwest of Frankfort, Herkimer County. Also well exposed along stream flowing north-northeast of Frankfort Hill into Ferguson Creek.

Moyers Formation (in Stanley Group)

Mississippian (Meramecian): Southeastern Oklahoma.

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B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856, 870–874. Proposed for a sequence of sandstones and shales overlying Tenmile Creek formation (new) and underlying Chickasaw Creek siliceous shale (new); includes a 20-foot fossiliferous siliceous shale at base. Aggregate thickness about 1,100 feet. Stanley group. Pushmataha series (new); Bendian period.

L. M. Cline and O. B. Shelburne, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas Geol. Soc. and Ardmore Geol. Soc., p. 179 (table 1), 182. Middle formation in Stanley group. Overlies Ten Mile Creek formation; underlies Chickasaw Creek shale. At type locality, consists of 1,110 feet of alternating sandstones and shales. Mississippian (Meramecian).

Type locality: At and north of village of Moyers, in T. 2 S., R. 16 E., Pushmataha County. Well exposed on flanks of Tuskahoma syncline in Tps. 1 and 2, R. 16 E.

Muav Limestone (in Tonto Group)[1]

Middle Cambrian: Northwestern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 2), 21–24, 80–110. Numerous excellent key beds which serve as time planes are developed in various parts of Muav formation. They clearly illustrate relation between facies distribution and time. Seven principal members recognized in formation are here named (ascending) Rampart Cave, Sanup Plateau, Spencer Canyon, Peach Springs, Kanab Canyon, Gateway Canyon, and Havasu. Newly named tongues are (ascending) Elves Chasm, Garnet Canyon, Lava Falls, Parashant, and Boucher. Thickness of formation as redefined varies from 136 feet near Little Colorado at eastern end of Grand Canyon to 827 feet along Grand Wash Cliffs at western end. Intertongues with Bright Angel shale to east.

Named for Muav Canyon, Grand Canyon district, in lower part of which formation is well exposed.

Mud Sandstone (in Bluestone Formation)[1]

Mud Shale (in Bluestone Formation)[1]

Mississippian (Chester Series): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 320–321.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 184. Lower Mud shale, Lower Mud sandstone, Upper Mud shale, and Upper Mud sandstone (Reger, 1926) grouped into single member and named Mud Fork member of Bluestone formation.

Exposed on Mud Fork of Bluestone River in Tazewell County, Va.

Muda Limestone[1]

Cretaceous(?): Puerto Rico.

Original reference: D. R. Semmes, 1919, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, p. 74.

Mudd Pond Member (of Bull Formation)

Lower Cambrian: Eastern New York and western Vermont.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1–2. White vitreous medium-grained orthoquartzite with

rare dolomitic pods, locally there are two quartzite beds separated by green slate. Thickness as much as 20 feet. Underlies Castleton conglomerate member (new); overlies Zion Hill member. Locally absent.

Type locality not stated.

Muddy Sandstone Member (of Thermopolis Shale)

Muddy Sand[1] or Sandstone

Lower Cretaceous: Surface and subsurface in central northern Wyoming and subsurface in central southern Montana.

Original reference: F. F. Hintze, Jr., 1915, Wyoming State Geol. Bull. 10, p. 20–21.

Helen Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1572. Muddy sandstone, which is good marker in other areas, has not been found in Gros Ventre River area. There is a possibility that it is represented by basal salt-and-pepper sandstone which is here included in the Mowry.

R. M. Thompson, J. D. Love, and H. A. Tourtelot, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 36; J. D. Love and others, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–43. Allocated to member status in Thermopolis shale. Overlies a lower black shale member and underlies a black shale member. Upper Cretaceous. Writers of this report prefer to consider Muddy as separate formation, but this classification is not accepted by U.S. Geological Survey.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. In subsurface, Montana, Thermopolis shale includes Muddy sandstone member.

M. M. Knechtel, 1959, U.S. Geol. Survey Bull. 1072–N, p. 740–741. In earlier publications dealing with area [Little Rocky Mountains, Mont.], unit herein called Cyprian sandstone member of Thermopolis was tentatively designated Muddy sand.

D. L. Eicher, 1960, Yale Univ., Peabody Mus. Nat. History Bull. 15, p. 5 (fig. 2), 11, 14–16, 25–26, strat. sections. Nomenclatorial problems of Thermopolis shale and Muddy sandstone discussed. Status of Muddy sandstone appears to be key to much of problem. Two concepts of Muddy sandstone are prevalent: (1) it consists of separate and discontinuous sandstone lenses or tongues of dubious correlation which lie isolated within and surrounded by thick body of black shale; this view would not encourage recognition of Muddy as a formation; and (2) it consists of a single, persistent unit of highly variable lithology which occupies a single stratigraphic interval and records an important historical episode of basin-wide deposition; this view would encourage recognition of Muddy as formation. However, there is popular resistance toward formally recognizing Muddy and establishing type section for it. In this report, Muddy sandstone is considered a formation. Term sandstone is misnomer because in many areas unit does not consist predominantly of sandstone. Thickness commonly 30 to 50 feet; locally more than 100 feet. Overlies Thermopolis shale (restricted); underlies Shell Creek shale (new). Reference locality suggested.

As corollary to action taken in regard to change in boundary between Upper and Lower Cretaceous series, age of Muddy Sandstone Member of Thermopolis Shale is considered Lower Cretaceous.

Reference locality: Exposure near Greybull, N½ sec. 36, T. 53 N., R. 93 W., Bighorn County, Wyo.

Muddy Creek Beds

Oligocene(?): Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 369, table 1, pl. 1. Tuff with some shales, conglomerates and fresh-water limestone; basal pebble conglomerate and sandstone in Muddy Hole Basin; some bituminous shales; color, mostly white, light gray and buff with some pink, red, brown, and black. Maximum thickness exceeds 1,000 feet. Unconformably overlies Paleozoic rocks and underlies andesites and basalts.

Restricted to the intramontane Muddy Creek and Muddy Hole Basins in the Tendoy Range, Beaverhead County.

Muddy Creek Formation[1]

Pliocene(?): Southeastern Nevada, northwestern Arizona, and southwestern Utah.

Original reference: Chester Stock, 1921, Geol. Soc. America Bull., v. 32, p. 147.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1419, 1423. Stratigraphically extended to include highly tilted strata near mouth of Bitter Spring Wash, Nev. These include breccia, gray sandstone, and peculiar green volcanic tuff in addition to clay and gypsum—all previously assigned to underlying Horse Spring formation. Overlies Black Canyon group (new), angular unconformity. Referred to early Pliocene(?).

C. R. Longwell, 1946, Am. Jour. Sci., v. 244, no. 12, p. 823, 834. More warrant for Miocene(?) than for Pliocene(?) age classification, and evidence of regional aridity favors upper Miocene assignment rather than one older.

F. B. Van Houten, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2810. Upper Miocene or lower Pliocene.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 39 (map legend), 45–48. In area of this report [Washington County] a time during which generally fine light-colored locally tuffaceous sediments were deposited in troughs and basins is represented by "Muddy Creek" formation. Correlation with known beds of the Muddy Creek in southern Nevada has not been established. Beds in Beaver Dam Wash regarded as "Muddy Creek" in mapping for present report have been called Muddy Creek by C. M. Tschanz (personal letter). Elsewhere in Washington County, the "Muddy Creek" as mapped includes Blank's Reservoir formation (1959, unpub. thesis) and Cook's Parunuweap(?) formation (1957, Utah, Geol. and Mineralog. Survey Bull. 58). Maximum thickness 1,400 feet. Rest in older rocks with marked angular unconformity. "Muddy Creek" of Washington County thought to be mainly Pliocene, but may include some early Quaternary sediments. Chart shows Muddy Creek formation stratigraphically above Ox Valley tuff (new) and equivalent to Flattop Mountain suite (new).

Exposed along southwest side of Muddy River, between villages of Overton and Logan [Logandale], Nev., and in Meadow Valley, approximately 80 miles south of Panaca, Nev.

Muddy Creek Volcanics

Oligocene: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 374–375, pl. 1. Name applied to rhyolitic

tuffs and lava flows interbedded with Tertiary sediments. Range from white and light gray to pink and buff. Water-laid origin.

In Muddy Creek and Muddy Hole basins, Beaverhead County.

Muddy Mountain Chert Member (of Madison Limestone)

Mississippian: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 25. Conspicuous chert sequence near middle of Madison formation. Chert is extremely compact but considerably brecciated by later folding and faulting. Dominant color is red brown but some black, blue, and white layers present. Bedding poor. Between 50 and 100 feet thick on Black Mountain. Underlies gray limestone; overlies coral bed in blue limestone.

Exposed on southeastern slope of Black Mountain and on southern flank of Owl Creek Mountains. Named for Muddy Mountain (Monument Peak), at head of Dry Creek, in central eastern part of area of this report [roughly the southeastern end of Absaroka Range, Fremont County].

Muddy Peak Limestone[1]

Middle Devonian and older(?): Southeastern Nevada, northwestern Arizona, and southwestern Utah.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th, v. 1, p. 46–53; 1928, U.S. Geol. Survey Bull. 798.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1773, chart 4. Upper Devonian.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 514, 515 (fig. 2), 516. Thickness 552 feet in section measured in North Virgin Mountains, Clark County, Nev. Truncates Pogonip(?) and all formations of Cambrian by transgressive overlap. Underlies Rogers Spring limestone. Upper Devonian.

C. T. Snyder, 1952, Utah Geol. Soc. Guidebook 7, p. 8. Present in Beaver Dam Mountains, Utah, and Virgin Mountains, Ariz.

Named for exposures in vicinity of Muddy Peak Basin, especially on north side of Muddy Peak, Muddy Mountains, Nev.

†Muddy Valley Beds[1]

Pliocene(?): Southeastern Nevada.

Original reference: C. Stock, 1921, Am. Jour. Sci., 5th, v. 2, p. 254–257.

Probably named for Muddy Valley.

Mud Fork Beds (in Bluestone Group or Formation)

Mud Fork Member (of Bluestone Formation)

Mississippian (Chester Series): Southwestern Virginia and southeastern West Virginia.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 184, pl. 15. Reger (1926) subdivided the 90-foot succession of red beds immediately above Glady Fork sandstone into four units which he named Lower Mud shale, Lower Mud sandstone, Upper Mud shale, and Upper Mud sandstone. The four units are herein grouped into single member named Mud Fork member of Bluestone formation. Thickness at type section 91 feet. Underlies Belcher member (new).

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 97, 98). Shown on correlation chart as Mud Fork beds in Bluestone group and formation.

Type section: Along Road 656 about 1½ miles north of Bailey, Burkes Garden quadrangle, Tazewell County, Va. Name derived from Mud Fork, a tributary of Bluestone River.

Mud Hill Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 120–121, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined. Mud Hill basalt is third in known sequence. Older than Bellisle Mountain and younger than Big Hill.

Mud Hill cone is in Dry Cimarron River drainage area, Union County.

Mud Hill Series[1]

Miocene to Pleistocene(?): Southern California.

Original reference: E. E. Free, 1914, Carnegie Inst. Washington Pub. 193, p. 22–23.

Named for occurrence in Mecca Mud Hills, Mecca, Riverside County.

Mud Springs Group

Pennsylvanian (Derry Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 31 (fig. 2), 33–34, 36–37. Term proposed for all strata between top of Green Canyon group (new) below and the base of Des Moines series above. Thickness about 113 feet. Includes (ascending) Hot Springs formation and Cuchillo Negro formation (both new). Underlies Armendaris group (new).

M. L. Thompson, 1948, Kansas Univ. Paleont. Contr. 4, Protozoa, art. 1, p. 73 (fig. 8), 74. Includes Fra Cristobal formation and Cuchillo Negro formation. Term Fra Christobal replaces preoccupied name Hot Springs.

Type locality: Near north end of Mud Springs Mountains at west end of Whiskey Canyon, SW¼ sec. 1, T. 13 S., R. 5 W., Sierra County.

Muir Sandstone

Eocene, middle: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 36–44, pls. 4A, 4B, 4C. Composed of brownish-gray medium- to fine-grained marine silty sandstone with interstratified thin layers of silty shale; shale layers commonly contain foraminifera, and nodular layers in sandstone yield molluscs and corals. Thickness at type locality 835 feet. Underlies Escobar sandstone (new); overlies Las Juntas shale (new). Strata mapped as Muir sandstone at Muir Station originally were considered as upper part of Martinez group by Merriam (1897) and others at time when the Eocene of California was classified only as Martinez and Tejon. Muir sandstone together with overlying Escobar sandstone in east limb of Pacheco syncline were mapped as Tejon group in San Francisco folio by Lawson (1914).

B. Y. Smith, 1957, California Univ. Pubs. Geol. Sci., v. 32, no. 3, p. 144–146, 147, pls. Since Pacheco syncline is generally accepted as type area for Martinez, it is difficult to follow Weaver's (1953) omission of that term as an appropriate designation for lower part of sequence, and it seems desirable that Weaver's new units, Vine Hill, Las Juntas, and Muir, be

included either as members within Martinez formation or as formations within Martinez group. Systematic description of Foraminifera.

Type section: In west limb of Pacheco syncline in cuts along county highway at Muir Station, south and parallel to Santa Fe Railway, near Martinez, Contra Costa County. Northward from type section Muir is offset by faulting.

Mukwa Granite[1]

Precambrian (Laurentian): Central northern Wisconsin.

Original reference: T. C. Chamberlin, 1877, Geology Wisconsin, v. 3, p. 248.

Occurs in SE¼NE¼ sec. 26 and NW¼SW¼ sec. 25, town of Mukwa, Waupaca County.

Mulatto Tongue (of Mancos Shale)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1934, U.S. Geol. Survey Bull. 860–A.

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 44–45, pls. Lies between Dilco coal member and Dalton sandstone member of Mesaverde formation. Thickness 250 to 400 feet in Mount Taylor coal field. Stratigraphically below Satan tongue of Mancos.

Named for exposures at mouth of Canyon Mulatto, in T. 14 N., R. 9 W., 9 miles northwest of San Mateo, Valencia County.

Muldoon Formation

Lower Mississippian to [Upper Mississippian or Pennsylvanian]: Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. A flysch series consisting of a pelitic facies of black limestones and mudstones, and a psammitic series of graded immature graywackes ranging from 1 millimeter to 43 feet thick. Graded limestones also present. Subdivided into four new members (ascending): Copper Creek, Garfield, Iron Mine, and Wildhorse. Thickness approximately 10,000 feet in Muldoon trough. Overlies Milligen formation; conformably underlies Wood River formation in Muldoon trough, but formations have unconformable relationship in western source area.

Deposited in Muldoon trough, alined N. 30° W., between western positive element, and slightly negative eastern shelf area.

Muldraugh Formation (in Borden Group)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 200–222, pls. 6, 15. Proposed for rocks which lie between Floyds Knob formation beneath and Harrodsburg (restricted) limestone or younger strata above. Thickness up to 95 feet. Differentiated into five lithologic facies (west to east): West Point calcareous, Steels Knob chert, Maretburg, Hummel, and Olive Hill. Includes Cummins Station shale member (new) in Maretburg facies, Rothwell shale member (new) in Olive Hill facies, and Wildie siltstone in Hummel facies. Occurs throughout entire Lower Mississippian belt of outcrop in Kentucky except where it is cut out by one of the unconformities—that at base of Ste. Genevieve limestone or major one at base of Pottsville unit.

Type section: Along secondary road leading up "Muldraugh Escarpment" for one-half mile south-southwest from road intersection one-half mile

south of Philipsburg, Marion County. Name derived from prominent scarp which rises from southern and western border of Lexington Plain to the Highland Rim, long known as Muldraugh (sometimes spelled Muldraw) Hill or Escarpment.

Mule sandstone[1]

Lower Cretaceous: Southeastern Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 125–140.

Type section: In Mural Hill, east of Bisbee, Cochise County. Name derived from Mule Mountains.

Mule Mountain Granite

Post-Devonian: Northern California.

I. E. Klein, 1960, Sacramento Geol. Soc. [Guidebook] Field Trip June, 3, 4, and 5, p. 11. Name applied to granite in Mule Mountain stock. Has complex intrusive and faulted relations with Devonian Balaklala rhyolite and Copley metavolcanics.

Present in Mount Shasta area.

Muleros sandstone[1]

Lower Cretaceous (Comanche): Western Texas and southeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 247, 250, 337.

Caps Cerro de Muleros, west of El Paso, Tex.

Muleshoe Porphyry

Tertiary: Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 81, 85. Quartz monzonite porphyry. Intrusive relation to Upper Cretaceous formations.

Located along a fault on west side of South Park, 3½ miles southwest of Antero junction; in sec. 10, T. 13 S., R. 77 W.

Mulford Formation[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

Probably named for Mulfordtown, Webster County.

Mulholland Formation (in Contra Costa Group)

Pliocene, lower to middle: Northern California.

C. K. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 3, 6 (fig. 3), 14–16, pl. 1. Blue-gray to maroon lacustrine shales, siltstones, argillaceous limestone, pebbly sandstone; tuff bands, bentonite stringers, and limestone lentils common. Thickness 800 to 5,000 feet. Overlies Pinole tuff; unconformable below Pleistocene terraces.

Exposures along upper reaches of Kaiser and Cull Creeks, in Las Trampas Ridge area, east Oakland.

Mulky Formation (in Cabaniss Group)

Mulky Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines): Southwestern Missouri, southeastern Kansas, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 19, 23; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group divided into 15 cyclic formational units. The Mulky, 15th in sequence (ascending), overlies the Bevier. Average thickness 65 feet. [For complete sequence see Cherokee group.]

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Mulky formation. Overlies Lagonda formation; underlies Excello formation. In Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as coal cycle in Senora formation in Oklahoma; underlies Excello shale; overlies Lagonda coal cycle. Includes Kinnison shale and Breezy Hill limestone members. Cabaniss group.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 31 (fig. 20), 38. Formation in Missouri includes Breezy Hill limestone at base, underclay, and Mulky coal bed. Separated from base of Marmaton group by Excello formation. Thickness about 19 inches in Vernon County. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 84–88, measured sections. Formation includes beds above Iron Post coal or its horizon and extending to top of Mulky coal bed after which formation was named. Thus defined, formation includes lower shale (Kinnison), restricted to northern Oklahoma, Breezy Hill limestone member, and underclay, and Mulky coal. Thickness 6 inches to about 10 feet. Overlies Lagonda formation; underlies Excello formation. Cabaniss subgroup of Cherokee group.

Mulky coal was named by Broadhead (1873, Preliminary report on the iron ores and coal fields from field work of 1872: Missouri Geol. Survey) from Mulky Creek, Johnson County, Mo.

Mullinix Formation

Upper Triassic(?): North-central Nevada.

R. R. Compton, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1388–1389, pl. 1. Sequence of laminated to massive (silty and sandy) phyllites. Thickness about 5,000 feet. Overlies Andorno formation (new) with contact gradational.

Named for exposures in hilly ground west of Tertiary volcanic rocks between Mullinix and Solid Silver Canyons, Santa Rosa Range, Winnemucca area.

Mumford Formation

Upper Pennsylvanian: Southwestern Indiana.

C. E. Wier, 1955, Dissert. Abs., v. 15, no. 12, p. 2515. Proposed for youngest Paleozoic rocks in Indiana.

Type locality and derivation of name not stated.

Mumford Hills Sandstone (in McLeansboro Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 7. Between Friendsville coal and Aldrich coal of Indiana is variable, but usually prominent sandstone, here designated Mumford Hills sandstone.

Derivation of name not given.

Muncie Creek Shale[1] Member (of Iola Formation)

Muncie Creek Shale Member (of Chanute Shale)

Pennsylvanian (Missouri Series): Northeastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 92, 97.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. Shown on chart as member of Chanute shale in Missouri.

E. H. Wenberg, 1942, Iowa Acad. Sci. Proc., v. 49, p. 339 (fig. 2). Name appears on stratigraphic column of Virgil and Missouri series in Iowa.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032. Muncie Creek shale member of Iola formation; underlies Raytown limestone member; overlies Paola limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. Muncie Creek shale had been treated as member of Chanute shale by Missouri Geological Survey.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 81–82. Described in Tulsa County where it is 15 to 30 feet thick; upper part locally interfingers with overlying Avant (Raytown) limestone member.

H. G. Hershey, 1960, Iowa Highway Research Board Bull. 15, p. 26. fig. 5. In Madison and Union Counties, composed of two contrasting shale beds. Upper, dark gray to green about 1 foot thick; lower, about 1½ feet thick is hard platy black shale containing conodonts. Underlies Raytown limestone member; overlies Paola limestone member.

Type locality: Named for Muncie Creek in southern part of Wyandotte County, Kans., east of town of Muncie.

Mundy Breccia[1]

Precambrian: Southwestern Texas.

R. L. Harbour, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1786 (fig. 1), 1788–1790. A black angular breccia as much as 250 feet thick. Unconformably overlies Castner limestone (new). Locally pinches out between Castner limestone and Lanoria quartzite. Thickness about 190 feet.

Type locality: One and one-half miles southeast of North Franklin Mountain and one-half mile northwest of point at which Fusselman Canyon issues from mountains. Name derived from Mundy's Spring, 2 miles northwest of type locality.

Munising Sandstone[1]

Munising Formation

Upper Cambrian: Northern Michigan.

Original reference: A. C. Lane and A. E. Seaman, 1907, Jour. Geology, v. 15, p. 680, 692.

F. T. Thwaites, 1943, Michigan Acad. Sci., Arts and Letters, Papers, v. 28, p. 501. Original Munising sandstone is the Franconia of Wisconsin.

W. K. Hamblin, 1958, Michigan Dept. Conserv., Geol. Div. Pub. 51, p. 6 (fig. 1), 71–114, pls. 1, 2, 4. Lane and Seaman (1907) applied name Munising to upper 250 feet of "Lake Superior sandstone." Formation discussed

in detail. Consists of (ascending) basal conglomerate—maximum thickness 15 feet; Chapel Rock member (new)—40 to 60 feet; Miners Castle member (new)—140 feet. Overlies Jacobsville with unconformity; underlies Au Train formation (new) with unconformity. Much of the confusion concerning correlation of the Munising results from inaccessibility of vertical Pictured Rocks cliffs, which constitute principal exposure of formation. Since section exposed in Pictured Cliffs is unfossiliferous and lithic units of Wisconsin cannot be traced into area, terminology of Cambrian of Wisconsin should not be used in northern Michigan.

Named for exposures in bluffs back of Munising, Alger County.

Munterville Limestone or cyclothem

Pennsylvanian: Eastern Iowa and western Illinois.

L. M. Cline and D. G. Stookey *in* J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1586 (fig. 1), 1587–1588. In Iowa, two thin but well-marked cyclothems are present in section equivalent to Seahorne cyclothem of Illinois. Name Munterville is introduced for lower of these two cyclothems and for limestone which is its most prominent member. Underlies Seahorne limestone; underlying strata not discussed.

Numerous outcrops occur within radius of 1½ miles of Munterville, Wapello County, Iowa.

Mural Limestone[1] (in Bisbee Group)

Lower Cretaceous (Comanche Series): Southeastern Arizona.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21, p. 56, 65.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8, 20. Overlies Pedragosa member of Lowell formation (both new); underlies Cintura formation. Light-gray limestone, in lower part bedded, with *Orbitolina texana* (Roemer) and *Lima muralensis*, n. sp.; upper part massive with rudistid reefs.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8 (table), 73–76, pl. 1. In central Cochise County, extends in a strip about 1,000 feet wide along eastern side of Mule Mountains from Abbot Canyon, where it disappears beneath alluvium of Sulphur Spring Valley, to south edge of quadrangle. Composed of three members: lower part, generally making up a little more than half of formation, composed of relatively thin-bedded limestone interbedded with preponderant shale and sandstone; middle member composed of massive limestone with very little clastic material; and upper member, thinner beds ranging from shale and sandstone to mudstone and limestone. Thickness about 650 feet. Overlies Morita formation; underlies Cintura formation.

Caps Mural Hill, Bisbee quadrangle.

Muralian series[1]

Lower Cretaceous: Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 125–140.

†Murat Limestone[1]

Murat calcarenite facies (of Lincolnshire Limestone)

Middle Ordovician: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 53–54, 76–77, 84 (fig. 6). The Murat, as originally defined, included cherty *Hesperorthis* beds as well as succeeding thick zone of light-gray calcarenite and associated cherty limestone with *Dinorthis atavoides*. Butts regarded the Murat as applicable only to the coarse-grained limestone and believed granular beds to be younger than any part of associated cherty limestone which was identifed with the Lenoir. Thus, the Murat, regarded as a synonym for Holston, ceased to be used. Butts presumably was not aware that cherty limestones with *Sowerbyites triseptatus* and *Dinorthis atavoides*, which he identified elsewhere as Lenoir, actually overlie the granular beds which he called Holston. Obviously, Holston is an inappropriate name for the granular beds because the Holston is supposed to be younger than the Lenoir. Holston should not be used as time-stratigraphic name. In Tennessee, as well as in Virginia, there are many Holston type beds at many different horizons in the Middle Ordovician. Therefore, Murat could be revived on grounds that original definition was misunderstood and also by reason of the fact that Holston is not strictly applicable. It is proposed herein to revive Murat and to use it for the name of a characteristic facies of clastic reefy limestone, which is an essential part of Lincolnshire limestone.

Well exposed along Buffalo Creek at Murat, Rockbridge County.

Murderian Stage

Upper Silurian (Cayugan): North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Cayugan series divided into Canastota(n) and Murder(ian) stages. Murderian rocks encompass those from the Falkirk (or Oatka?)-Fiddlers Green-Binnewater to top of Silurian. Thickness 65 feet at type section; 90 feet in central New York; 40 feet in Rosendale quadrangle.

Type section: Along Murder Creek in Akron Falls Park, Akron, Medina quadrangle, New York.

Murdock Breccia[1]

Tertiary: Northwestern Arizona.

Original reference: C. Lausen, 1931, Arizona Bur. Mines Bull. 131.

Near Murdock mine, Oatman district, Mohave County.

Murfreesboro Limestone (in Stones River Group)[1]

Middle Ordovician: West-central and eastern Tennessee, northwestern Georgia, and western Virginia.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 105, 125.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 120–135. Basal formation in Stones River group in Virginia. Includes two facies: St. Clair, purely limestone; and Blackford, a heterogeneous sequence of red shale, red mottled argillaceous dolomite, gray shale, gray clay, and gray magnesian limestone. Thickness 27 to 1,152 feet. Overlies Beekmantown formation; underlies Mosheim limestone. Chazyan series.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 861, 863–868. Lower Middle Ordovician succession in Tazewell County, Va., revised. Further use of terms Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Lowville-Moccasin in Tazewell County and other parts of southwestern Virginia seems inadvisable. Unit called Murfreesboro by Butts is included in Cliffield formation as herein defined.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1140–1191. Although revised classification of lower Middle Ordovician in Tazewell County, Va., is somewhat local in nature, it can be usefully applied through much of southwest Virginia and northeast Tennessee. Use of terms Murfreesboro, "Mosheim", "Holston", "Ottosee", "Heiskell", Lowville, and "Bays" should be discontinued as distinct formational names throughout this area. Typical Murfreesboro fauna of Central basin of Tennessee occurs chronologically above, rather than below, "Mosheim", Lenoir, and "Holston." Central basin Murfreesboro has then been erroneously correlated into Virginia and Tennessee sequence. Since greater part of type Murfreesboro is unexposed, direct correlation cannot be successfully made into the Valley sequence.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 22–24, geol. map. Geographically extended into northwestern Georgia where it is included in Stones River group. Underlies Mosheim limestone; overlies Newala formation or Knox dolomite.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 24–32. Described in central Tennessee where it is basal formation in Stones River group. Base not exposed in Central basin; approximately 70 feet exposed at several localities. Conformably underlies Pierce limestone. Safford and Killebrew did not designate type section. On basis of priority, section on Stones River 1 miles west of old Pierce's mill would be most logical type locality. However, at this section, contact with overlying Pierce limestone is not exposed. At old Pierce's mill, this contact and about 10 feet of Murfreesboro limestone are well exposed. On the basis of derivation of name, the section of Murfreesboro behind ice plant just south of where Bradyville Road leaves Murfreesboro-Manchester Highway on southern edge of Murfreesboro would deserve consideration as alternative type locality. Contact with overlying Pierce limestone not exposed at this locality.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Prelim. Map 104; 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 35. In Lee County, Va., name Murfreesboro is replaced by Dot and Poteet limestones (both new).

Name for Murfreesboro, Rutherford County, Tenn.

†Murfreesboro Stage[1]

Miocene, middle(?) and upper: Northeastern North Carolina and eastern Virginia.

Original reference: A. Olsson, 1917, Bulls Am. Paleontology, v. 5, no. 28.

Typically exposed at Murfreesboro, Hertford County, N.C.

Murphy Marble[1]

Murphy Series

Lower Cambrian: Western North Carolina, northern Georgia, and eastern Tennessee.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 5.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 286–291. Murphy marble is present only in Murphy syncline. Nottely quartzite is in contact with the marble only in main belt from Ellijay, Ga., northeastward. Murphy syncline is tightly compressed compound syncline and at most places is bounded by thrust faults; these faults cut off Murphy marble at northeast and at many places cut out both the marble and Nottely quartzite. In places in northeastern part of syncline, Valleytown formation is on both sides of the marble, apparently in fault contact; elsewhere the marble, and in places the Nottely, are in fault contact with Nantahala slate and Great Smoky quartzite. It is generally agreed that sequence (ascending) is Valleytown formation, Murphy marble, Andrews schist, and Nottely quartzite. Only locality where Valleytown was found to be in normal contact with overlying formations is in main syncline in northern Georgia where the Nottely dips 70° southeast to vertical and lies between the marble at the west and the Valleytown at the east; a coarse conglomerate on the east side of the quartzite is in contact with the Valleytown. The conglomerate suggests a coarse initial sediment at base of clastic deposits; if conglomerate is at base of the Nottely, that quartzite is overturned and overlies the Valleytown and underlies Murphy marble at west, and the stratigraphic order of conglomerate, quartzite, and limestone is the common order of sedimentary deposition. It is suggested that Murphy marble may represent the Lower Cambrian dolomite horizon, and Nottely quartzite the underlying Lower Cambrian quartzite and that the Andrews schist represents the iron- and manganese-bearing transition zone commonly present at top of Lower Cambrian formations and therefore overlies the Valleytown [Valleytown and Brasstown here are treated as one unit—the Valleytown].

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27, 29. Murphy marble included in Talladega series believed to be Precambrian.

A. S. Furcron, 1953, Georgia Geol. Survey Bull. 60, p. 32, 33 (map), 36–38. Referred to as Murphy series.

J. L. Stuckey and S. C. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 32; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Andrews schist and Murphy marble are mapped together as Lower Cambrian(?). Murphy marble passes by gradation into Andrews schist.

Name for the fact that town of Murphy, Cherokee County, N.C., is partly located on this marble.

Murphys Bluff Formation or Sandstone

Murphys Bluff Sandstone Member (of Shelburn Formation)

Upper Pennsylvanian: Southeastern Illinois and southwestern Indiana.

C. A. Malott, 1937, *in* K. A. Payne, Jour. Paleontology, v. 11, no. 4, p. 277, 278–279. Lowest formation in region. At type locality is massive sandstone 60 feet thick. In Dodds Bridge area, Sullivan County, Ind., consists of 10 feet of flaggy sandstones which become somewhat

calcareous in upper part. Separated from overlying Hayden Branch formation (new) by 4 feet of gray shale.

J. D. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 46 (table 8). Shown on chart as member at top of Shelburn formation. Occurs above Vigo limestone member.

Type locality: Murphy's Bluff, along Ashmore Creek, in Clark County, Ill.

Murphysboro Coal Member (of Spoon Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), pl. 1. Assigned to member status in Spoon formation (new). At base of formation below Vergennes sandstone member. Coal named by Worthen (1868, *in* Geology and Paleontology, v. 3, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 9, T. 9 S., R. 2 W., Jackson County.

Murray Shale (in Chilhowee Group)

Murray Shale Member (of Erwin Formation)

Murray Slate (in Chilhowee Group)[1]

Lower Cambrian: Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 272–273. Precambrian Big Butt quartzite (new), named from the Big Butt, northeast culmination of Bald Mountains, where massive white quartzite and interbedded green argillite and fine-grained arkosic quartzite are enclosed in syncline. Keith (1905, U.S. Geol. Survey Geol. Atlas, Folio 118) named the quartzite Nebo and the softer beds Murray shale, which are names that properly should be applied only to Lower Cambrian formations.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13 (table 3). Two sets of formation names for Lower Cambrian clastic rocks are in use in eastern Tennessee and western North Carolina (table 3). Northeast Tennessee names. Unicoi, Hampton, and Erwin, are used in this report for the same rocks which Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) and Stose and Stose (1947, Am. Jour. Sci., v. 245) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn. Hot Springs area lies midway between type localities for each group of names. Hampton formation as used here includes Murray shale.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 964. U.S. Geological Survey restricts beds classed as Cambrian to those for which paleontological data are available. Chilhowee group as a whole is classed as Cambrian and Precambrian(?). Helenmode formation at top of group is Cambrian and remaining unfossiliferous formations [including Murray shale] are termed Precambrian(?).

R. B. Neuman and R. L. Wilson, 1960. U.S. Geol. Survey Geol. Quad. Map GQ-131. Murray shale described in Blockhouse quadrangle, Tennessee, where it is 350 feet thick. Overlies Nebo quartzite; underlies Hesse quartzite. Lower Cambrian(?).

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28 (table), 43. In northeasternmost Tennessee, considered shale member of Erwin formation. Overlies Nebo quartzite member; underlies Hesse quartzite member. Lower Cambrian.

Named for Murray Branch of Walden Creek, Sevier County, Tenn.

Murray Bluff Sandstone Member (of Abbott Formation)

Murray Bluff Sandstone (in Macedonia Formation)

Murray Bluff Sandstone (in Tradewater Formation)

Pennsylvanian: Southern Illinois.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 39, 40. A sandstone at base of Macedonia formation. Underlies a series of shaly strata including several coals and one persistent limestone.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 27). Shown on correlation chart as Murray Bluff sandstone in Tradewater formation.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 45 (table 1), 62, pl. 1. Rank reduced to member status in Abbott formation (new). Occurs above Delwood coal member. Thickness about 52 feet in type section of Abbott. Type locality stated. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NE¼ sec. 35, T. 10 S., R. 5 E., Saline County. Named for hill in southwestern part Saline County.

Murry (formation)

Permian (Wolfcampian): Nevada.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Overlies Butte [formation] (new); underlies Pequop formation.

Present in Moorman Ranch area.

Muscatine sandstone

Pennsylvanian: Eastern Iowa.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 75, no. 1, p. 78. In view of fact that Illinois part of Pennsylvanian coal measures has no special formational title as yet, the Iowa beds may be termed Muscatine sandstones. Thickness 110 feet.

Named for exposures in Muscatine County.

Muskingum Conglomerate (in Washington Formation)[1]

Permian: Southeastern Ohio.

Original reference: J. P. Lesley, 1856, Manual of coal, p. 105.

Named for Muskingum River.

†Muskogee Group[1]

Pennsylvanian: Central eastern and central Oklahoma

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 7.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named for Muskogee County.

Mussey Brook Schist (in Blackstone Series)

Precambrian(?): Northeastern Rhode Island.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 10–11, geol. map; A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts. U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Chiefly a light- to medium-gray fine-grained mica schist, thin beds of which usually alternate with fine-grained quartzite. Contains thin beds, sills, and dikes of Hunting Hill greenstone (new). Also contains local beds or lenses of white, buff, and gray fine- to medium-grained marble and dolomitic marble which were formerly included in Smithfield limestone member of Marlboro formation. Maximum thickness about 1,400 to 1,600 feet. Apparently older than Westboro quartzite. Included in Blackstone series.

Well exposed where Mussey Brook leaves Handy Pond and in area to south, Pawtucket quadrangle, Providence County.

Mustang Andesite

Pleistocene(?): Central-western Nevada.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 59, pl. 3. Named for thick flows of fine-grained andesite with abundant large hornblende phenocrysts which are commonly partly replaced by magnetite. Flows generally from 100 to 200 feet thick; lie in part on Kate Peak formation, in part on Truckee formation, and in part on Lousetown formation.

Present only in northeastern part of Virginia City quardangle. Named for Mustang, 9 miles east of Reno on Truckee River.

Mustang Creek Formation

Upper Cretaceous: Southern California.

O. P. Jenkins, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 251 (fig. 1). Appears in list of Cretaceous units in California. Name credited to A. Bennison.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Bennison (1941, unpub. map of late Upper Cretaceous deposits south of San Luis Creek, Merced and Fresno Counties) established Mustang Creek formation which he extended as far southward as Ortigalita Creek, beyond which it loses its identity. Where best exposed in Ortigalita Peak quadrangle, the lower unit is massive concretionary sandstone forming low topographic ridge from Laguna Seca Ranch northwestward beyond limits of quadrangle. In this report [Ortigalita Peak quadrangle], the Mustang Creek is included with several other units (named by Bennison) in discussion of upper part of Panoche formation.

Best exposed at Los Banos Creek, Ortigalita Peak quadrangle. Extends from Laguna Seca Ranch northwestward beyond limits of quadrangle.

Muttleberry limestone[1]

Lower Jurassic: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 80.

Named for exposures in Muttleberry Canyon east of Lovelock, Humboldt County.

Mutual Formation

Mutual Quartzite (in Uinta Mountain Group)

Precambrian: Northeastern Utah.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 6, pl. 1. Medium- to coarse-grained red-purple, quartzites and variegated red and green shales. Formation has form of thin wedge whose south edge is near divide between Big and Little Cottonwood Canyons, and which thickens northward to 1,200 feet in area between Big Cottonwood Canyon and mountain front. Unconformably underlies Tintic quartzite; conformably overlies Big Cottonwood series in interval between mountain front and Mill "B" North Fork, and unconformably overlies Mineral Fork tillite (new) a little farther east.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2737–2738. Mutual quartzite is oldest unit of Uinta Mountain group, in western Uinta Mountains. Thickness 4,025 feet in upper part of Smith and Morehouse Canyons. In top of unit, at mouth of Box Canyon, is sequence of buff quartzitic sandstones and brown micaeous shales termed Box Canyon member (new). Underlies Red Pine shale (new).

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 34, 37 (fig. 2). In this report [Uinta-Wasatch Mountain junction and part of central Utah], Mutual formation and Red Pine shale are not included in Uinta Mountain group.

In area of Big and Little Cottonwood Canyons, Wasatch Mountains, east of Salt Lake City.

Myatt Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 149 (fig. 7), 161–163. A marine lentil characterized by a yellowish-brown bentonite bed and fossiliferous sand. Thickness near Caldwell-Catahoula Parish line about 34 feet. Occurs near middle of member and stratigraphically above Bayou Calamus lentil.

Well exposed at Myatt (Wyant) Landing on west bank of Ouachita River in NE cor. SW¼NE¼ sec. 4, T. 11 N., R. 4 E., Caldwell Parish.

Myers Shale[1] (in Pocono Group)

Lower Mississippian: Northeastern West Virginia and western Maryland.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 101). Shown on correlation chart as shale in Pocono group; underlies Pinkerton sandstone; overlies Hedges shale. Osagean series.

C. B. Read, 1955, U.S. Geol. Survey Prof. Paper 263, p. 10–11. On basis of paleobotanical studies, it seems that the age of post-Hedges formations should be restudied. Lithologic evidence favors correlation of the Myers with Mauch Chunk, and Pinkerton with basal Pennsylvanian, and flora of the Hedges indicates an upper Pocono age for that unit.

Named for exposures on the Myers place, in Meadow Brook valley, Berkeley County, W. Va.

Myers Hill Sandstone[1]

Upper Cambrian: Wisconsin.

Original reference: C. E. Resser, 1933, Geol. Soc. America Bull., v. 44, no. 4, p. 738.

Myerstown Limestone

Middle Ordovician: Southeastern Pennsylvania.

Carlyle Gray, 1952, Pennsylvania Geol. Survey Prog. Rept. 140, p. 4; 1952, Pennsylvania Acad. Sci. Proc., v. 26, p. 86, 88. Typically dark-blue to black dense thin-bedded graphitic limestone with occasional beds of calcarenite. Contains three or four metabentonites. Weathered outcrops frequently show fluted edges similar to fluting of underlying Annville limestone. Maximum thickness about 200 feet. Contact with Annville marked by one or more beds of black very graphitic shaly limestone succeeded by varying thickness of impure gray crystalline limestone; these beds grade upward into typical Myerstown lithology. Underlies Hershey limestone (new) which is less pure and darker in color. Was previously included in Leesport formation. Name credited to C. E. Prouty.

Carlyle Gray and C. E. Prouty, 1954, Pennsylvania Geologist Guidebook 20th Ann. Field Conf., p. 25, 28. Standard and typical sections described.

Standard section at roadcut in Millardsville [Lebanon County]. Typical section near covered bridge across Swatara Creek, Dauphin County. Not well exposed in Lebanon County; thickest in western Berks County. Probably named for Myerstown, Lebanon County.

Mynot Sandstone Member (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Sandstone, shale, and siltstone. Maximum thickness about 30 feet in southwestern Colbert County; thins eastward to a nonpersistent bed in eastern Colbert County by interfingering with the oolitic limestone of the underlying Sandfall member (new); underlies Green Hill member (new).

Named for exposure in stream bank just southeast of road at community of Mynot, SW¼NW¼ sec. 7, T. 5 S., R. 14 W., in southwestern Colbert County.

†Myrick Formation[1]

Eocene: Southern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Atlas, Folio 64, p. 2.

Named for Myrick's lower apiary, on Frio River, Uvalde County.

Myrick Station Limestone Bed (in Pawnee Limestone Member of Oologah Formation)

Myrick Station Limestone Member (of Pawnee Limestone)

Pennsylvanian (Des Moines Series): Western Missouri, southwestern Iowa, eastern Kansas, and northeastern Oklahoma.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26 (fig. 2), 37. Pawnee limestone splits into two limestone separated by shale as it is traced from Kansas into Missouri. Upper limestone split is Pawnee of current usage in west-central Missouri. It is to be regarded as member of Pawnee formation and name will be selected

from Kansas locality. Name Myrick Station is proposed for lower limestone member (Lexington cap rock of Missouri Survey terminology). Thickness in type area about 5½ feet.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, p. 316, 317–318, 319. In Kansas, Myrick Station is second member from base of Pawnee. Characteristically brownish gray, massive, and somewhat earthy in lower part. Average thickness about 4 feet. Overlies Anna shale member and underlies Mine Creek shale member (both new).

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 15, 16 (fig. 2). In Nowata County, Oologah formation consists of Pawnee limestone at base, the Pawnee consisting of (ascending) cap rock of Lexington coal, Anna shale, Myrick Station limestone, and Coal City limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 32, fig. 5. In Appanoose County, member consists of two limestone beds separated by a 1-foot bed of fossiliferous shale that is greenish gray above and brown to black below. Upper limestone is light gray, hard, nodular, and earthy; thickness 1 to 9 inches. Lower bed is blue gray, finely crystalline and dense; thickness about 2 feet. In Madison County, consists of upper bed of light-gray dense argillaceous limestone that grades laterally into overlying shale; thickness 0.3 foot. Lower bed bluish-gray dense massive limestone, 0.8 foot thick. Overlies Anna shale member; underlies Mine Creek shale.

Type section: Outcrops in ravines in south bluff of Missouri River near Myrick Station on Missouri Pacific Railroad, just west of Lexington, Lafayette County, Mo.

Myrtis Sand Member (of Queen City Formation)

Eocene (Claiborne): Northwestern Louisiana.

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2519–2522. Fine grained, massive to crossbedded, orange, pink, and red, with some stringers of light-gray silty clay up to 0.2 foot thick. Total thickness 68 feet (52 feet exposed and remainder from bore hole with elevation of 234 feet at top of hole). Overlies Omen member; underlies Weches formation.

Named for exposures in deep roadcuts along Vivian-Atlanta Road in SE¼ sec. 3 and NW¼ sec. 10, T. 22 N., R. 16 W., 1½ miles west of town of Myrtis and 3 miles northwest of Vivian in northwest Caddo Parish.

Myrtle Group

Myrtle Formation[1]

Upper Jurassic and Lower Cretaceous: Southwestern Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 71–112. Generally accepted correlations of the Jurassic of southwestern Oregon and California are: Galice and Mariposa, Dothan and Franciscan, Myrtle and Shasta. Dothan is said to be younger than Galice. Also, it has been stated that the Dillard, lower part of original Myrtle, is equivalent of the Franciscan. Since the Dillard unconformably overlies the Dothan and Galice, one or the other of these correlations must be erroneous. Evidence is presented to show that the Dothan is older than the Galice and cannot be same age as Franciscan. Dillard, as

originally defined, includes Knoxville (Upper Jurassic) and possibly infolded Lower Cretaceous, but bulk of Dillard is to be correlated with the Franciscan. Myrtle, as mapped and defined, includes beds of both Upper Jurassic and Lower Cretaceous age and at least one important unconformity. Name Myrtle should be redefined, restricted, or abandoned.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2770–2785. Myrtle formation of Diller, based on sequence exposed in valley of Myrtle Creek, is herein restricted and considered to be a group as proposed by Louderback (1905, Jour. Geology, v. 13, no. 6) because it includes two distinct formations herein named Riddle and Days Creek. Group does not include rocks of Late Cretaceous age, such as some of Whitsett limestone lentils of Diller's Myrtle formation, nor does it include any rocks older than Riddle formation, such as were mapped as part of Myrtle in Port Orford and Roseburg quadrangles. These older rocks, now referred to Galice, Rogue, and Dothan formations, do not occur in the Myrtle on Myrtle Creek. Thickness about 3,000 feet. Overlies Rogue or Dothan formation. Upper Jurassic and Lower Cretaceous. Report contains historical summary of use of term Myrtle and discussion of Louderback's (1905) report.

Well developed along Myrtle Creek, Douglas County. Diller did not specify type locality.

Myrtle Beach peat

Pleistocene: Coastal plain of South Carolina.

D. G. Frey, 1952, Am. Jour. Sci., v. 250, p. 212–225. Seaside peat deposit of uncertain stratigraphic relationship to Horry clay, although presumably younger, that dates from a glacial age. Evidence for this is high percentage of spruce among tree pollens present in the peat. The peat is more likely Wisconsin than Illinoian.

Named for occurrence near Myrtle Beach.

Myton Member[1] (of Uinta Formation)

Eocene: Northeastern Utah.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, p. 241–242.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 26, pl. 1. Chart shows Myton overlying Wagonhound member. Uppermost Uintan.

Named for typical exposures at and near Myton, Duchesne County.

Nabesna Limestone[1]

Upper Triassic: Southeastern Alaska.

Original reference: W. C. Mendenhall and F. C. Schraeder, 1903, U.S. Geol. Survey Prof. Paper 15, p. 33–37.

F. H. Moffit, 1943, U.S. Geol. Survey Bull. 933–B, p. 122–124, pl. 6. Consists of a lower thick-bedded member and an upper member of thin beds separated by shale partings. Exposed north of Nabesna River at White Mountain, where named in vicinity of Cooper Pass, and in valleys of Snag River and possibly of Baultoff Creek. At White Mountain, formation consists of 1,200 feet of massive light-gray dense or crystalline limestone and about 800 feet of overlying thin-bedded light-gray limestone. Upper Triassic.

Named for exposures at White Mountain north of Nabesna River. Occurs on upper Nabesna and Chisana Rivers, Upper Tanana River region.

Naborton Formation (in Wilcox Group)

Paleocene: Northwestern Louisiana and northeastern Texas.

Grover Murray, Jr., 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941–942. Oldest of three named divisions of Midway sediments that crop out in northwestern Louisiana and outline the highest structural part of Sabine uplift. Consists of basal sand member, middle lignitic shale member, and upper calcareous member. Underlies Logansport formation (new).

D. P. Meagher and L. C. Aycock, 1942, Louisiana Dept. Conserv. Geol. Pamph. 3, p. 13. Includes Chemard Lake lignite lentil (new) at top.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 48 (fig. 2), 56–57; G. E. Murray, 1948, Louisiana Dept. Conserv. Geol. Bull. 25, p. 94–101, pl. 10. Includes all strata between Midway Porters Creek black shale which is reached at about 100 feet in wells near Naborton and the overlying basal sand of Dolet Hills member of Logansport formation. Exposed thickness about 175 feet. Type locality designated.

Type locality: Exposures along a local road between Louisiana Highway 9 and Bethlehem Church (between Naborton and Goss) in secs. 3 and 4, T. 12 N., R. 12 W., De Soto Parish, La.

Nacatoch Sand (in Navarro Group)[1]

Upper Cretaceous: Southwestern Arkansas, northwestern Louisiana, and northeastern Texas.

Original reference: A. C. Veatch, 1905, Louisiana Geol. Survey Bull. 1, p. 84, 85, 87–88; 1905, U.S. Geol. Survey Water-Supply Paper 114, p. 180, 183.

L. W. Stephenson, 1941, Texas Univ. Bur. Econ. Geology Pub. 4101, p. 20–22. In Texas, consists mainly of gray massive more or less calcareous marine sand, subordinate parts of which are indurated to hard calcareous concretionary masses of various sizes as much as several feet in longest dimension. Thickness 100 to 200 feet. Narrow belt of outcrop lies immediately to east of, and parallel to, that of Neylandville marl and has been traced southward through Texas as far as northern Falls County, where it passes under transgressing Corsicana marl.

R. G. Drouant, 1960, Dissert. Abs., v. 20, no. 11, p. 4367–4368. Discussion of stratigraphy and Ostracoda of *Exogyra costata* zone which embraces Saratoga, Nacatoch, and Arkadelphia formations of southwestern Arkansas. Units were traced on surface from Little River in Hempstead County to Arkadelphia in Clark County. Nacatoch formation is restricted to include upper arenaceous member and lower glauconitic member. Glauconitic member is a concentrate above an angular unconformity developed upon the chalk and argillaceous-arenaceous member of the Saratoga. Argillaceous-arenaceous member of Saratoga formerly included in Nacatoch.

Typically exposed at Nacatoch Bluff, on Little Missouri River, in Clark County, Ark.

Naches Formation[1]

Eocene: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 45–46, 49–51. Intercalated with Kachess rhyolite. Swauk formation, Naches formation, and Kachess rhyolite are probably in part contemporaneous. Naches is covered by upper part of Keechelus lava series; Swauk and Naches formations rest with marked unconformity upon the older metamorphic and igneous formations.

R. J. Foster, 1957, Dissert. Abs., v. 17, no. 9, p. 1982. In central Cascade Mountains, tightly folded Naches overlies Mount Catherine rhyolite (new) and conformably underlies Keechelus andesite.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 114–118, pl. 1. Smith and Calkins (1906) believed that Swauk and Naches were of same age on basis of two fossil leaves found in both and that they were laid down in separate contemporaneous lakes. Recent evidence indicates that these rocks are fluviatile, and, in spite of fossil leaves, the complete lack of contemporaneous volcanic rocks in the Swauk suggests that they are of different ages. The two formations are not in stratigraphic contact. Smith and Calkins did show that both the Naches and Swauk unconformably overlie Easton schist. They also showed that, in southern part of Snoqualmie quadrangle, Keechelus volcanic rocks overlie the Naches unconformably. Rocks that are correlated with Naches formation herein were called Teanaway basalt, Guye formation, and Keechelus formation by Smith and Calkins. Naches is underlain with apparent conformity by Mount Catherine rhyolite and unconformably overlain by Keechelus andesite. Locally intruded by Snoqualmie granodiorite. Naches is composed of about 5,000 feet of interbedded basalt, sedimentary rock, and rhyolite. May be Eocene, but dating and correlation considered tentative until diagnostic fossils are discovered.

Well developed on north side of Naches River valley, Snoqualmie quadrangle.

Nachusa Formation (in Platteville Group)

Middle Ordovician: Northern Illinois.

J. W. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 37, fig. 3, 9. Dolomite or limestone, pure except for argillaceous unit in middle. Thickness about 18 feet. Comprises (ascending) Eldena, Elm, and Everett members (all new). Shown on columnar section as underlying Quimbys Mill formation and overlying Grand Detour formation (new).

Type locality: In abandoned quarry on east side of Illinois State Highway 2, south of Dixon.

Nacimiento Group[1] or Formation

Paleocene: Northwestern New Mexico.

Original references: C. R. Keyes, 1906, Science, new ser., v. 23, p. 921; Am. Jour. Sci., 4th, v. 21, p. 298–300.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Referred to as formation. Chiefly drab and gray clays and quartzose sandstones 600 to 1,000 feet thick; it is equivalent of the lithologically unseparated beds in southern part of San Juan basin that carry Puerco and Torrejon faunas of Paleocene age. Conformably overlies Ojo Alamo sandstone; grades northward into Animas formation.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 272. Because Puerco and Torrejon are not recognizable except as faunal zones, it would seem best to consider this part of stratigraphic sequence as a single formation, the Nacimiento, not divisible into Puerco and Torrejon formations but containing markedly different Puerco and Torrejon faunas. Underlies San Jose formation (new).

Harley Barnes, E. H. Baltz, Jr., and P. T. Hayes, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–149. Formation described in Red Mesa area, La Plata and Montezuma Counties, Colo., where it corresponds to Reeside's (1924) Torrejon formation. Overlies Animas formation (redefined); underlies unit referred to as Wasatch-type rocks. Paleocene.

Named for town of Nacimiento (also known as Cuba), Sandoval County.

Naco Limestone,[1] Formation, or Group

Pennsylvanian and Permian: Southeastern Arizona and southwestern New Mexico.

Original reference: F. L. Ransome, 1904, U.S. Geol. Survey Prof. Paper 21.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 521–523. Restricted to Pennsylvanian.

J. W. Huddle and Ernest Dobrovolny, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 10. In central and northeastern Arizona, formation ranges from 400 to 800 feet in thickness and consists of limestone, shale, and sandstone. At type locality, includes beds of Pennsylvanian and Permian age; only Pennsylvanian beds ranging in age from Lampasas to Virgil were identified in area of this report. Overlies Redwall limestone; underlies Supai formation with contact drawn above a sequence of gray limestone and shale and below a sequence of red sandstone, shale, and limestone.

W. G. Hogue, and E. D. Wilson, 1950, Arizona Bur. Mines Bull. 146, Geol. Ser. 18, p. 100 (fig. 31). Generalized columnar section Bisbee quadrangle, shows Naco limestone, 3,000 feet thick, above Escabrosa limestone and unconformably below Glance conglomerate.

N. P. Peterson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 100 (fig. 31). Columnar section in Globe-Miami district shows Naco limestone, about 500 feet thick, disconformable above Escabrosa limestone and unconformable below Whitetail conglomerate.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 90 (fig. 2). In Fossil Creek area, Arizona, underlies Packard Ranch member (new) of Supai formation; in Fort Apache area, underlies Amos Wash member (new) of Supai. Overlies Redwall limestone. Pennsylvanian.

E. D. Wilson, 1951, Arizona Bur. Mines Bull. 158, Geol. Ser. 19, p. 50. In Empire Mountains, Naco formation underlies Andrada formation (new) and overlies Escabrosa limestone. Thickness 1,200 feet.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 15–44. Rank raised to group and subdivided into (ascending) Horquilla limestone, Earp formation, Colina limestone, Epitaph dolomite, Scherrer formation, and Concha limestone (all new).

D. L. Bryant, 1955, Dissert. Abs., v. 15, no. 7, p. 1224. Group stratigraphically restricted above to exclude Scherrer formation and Concha limestone, which together with Rainvalley formation (new) comprises Snyder Hill group.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 36–44. Group comprises (ascending) Horquilla limestone, Earp formation, Colina limestone, and Epitaph dolomite; other formations not present in this area. Overlies Escabrosa limestone. Pennsylvanian and Permian.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 11 (table 2), 31–43, pl. 1. In central Peloncillo Mountains, N. Mex., group includes (ascending) Horquilla limestone, Earp formation, Colina limestone, Scherrer formation, and Chiricahua limestone (substituted for synonymous term Concha limestone). Overlies Paradise formation; underlies Bisbee group (McGhee Peak formation, new).

First described in Naco Hills, near west edge of Bisbee quadrangle, Arizona.

Nacogdoches Beds (in Claiborne Group)[1]

Eocene: Eastern Texas.

Original reference: E. T. Dumble, 1920, Texas Univ. Bull. 1869, p. 57, 65, 67, 79–101, 255.

Well exposed at Nacogdoches and along streams flowing southward into Angelina River in Nacogdoches County.

Nadeau Gravel

Pleistocene, upper(?): Southern California.

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Consists of gravel and schist fragments and interbedded micaceous sand; prevailingly dark color; unconsolidated or poorly consolidated. Deposit greatly dissected. Thickness commonly less than 50 feet. Some exposures not easily differentiated from those of Harold formation (new).

Roadcuts one-half mile north of San Andreas fault on Old Nadeau Road, Pearland quadrangle.

Nadine Limestone (in Conemaugh Formation)

Pennsylvanian: Western Pennsylvania.

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Relatively pure limestone, light to dark gray on fracture, 4 inches to 1½ feet thick. Occurs approximately 172 feet below Ames limestone, 32 feet above Cambridge limestone, and 170 feet above Upper Freeport coal. Name Nadine is applied to limestone described by Johnson (1929) under Woods Run limestone; in Pittsburgh region, it occurs approximately 8 to 17 feet below the Woods Run as described by Raymond (1910); the two strata have been referred to as Woods Run limestone or as Upper and Lower Woods Run limestone.

Type locality: On Allegheny River east of Pittsburgh, near Nadine, Allegheny County.

Naese Sandstone Member (of Lee Formation)[1]

Lower Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 35, 86.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 41–42, 146. Designated by Ashley and Glenn as top bed of Lee formation but is considered higher than strata referred to Lee in other areas. Should probably be referred to lower Briceville rather than upper Lee.

Named from Naese Cliff on Cumberland River, about 8 miles by road above Pineville, Bell County, Ky.

†Naftan Limestone

Pliocene-Pleistocene: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 69–71]. Consists of well-bedded limestone, commonly conglomeratic and pink or white. *Halimeda*-bearing. Unconformably underlies Mariana limestone; unconformably overlies Laulau limestone or Donny [Donni] beds.

Josiah Bridge *in* W. S. Cole and Josiah Bridge, 1953, U.S. Geol. Survey Prof. Paper 253, p. 12. Foraminifera from Naftan are practically identical with those of Mariana limestone, and both formations have been assigned to Plio-Pleistocene.

S. Hanzawa *in* Jacques Avias and others. 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 48. Pleistocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 80. Naftan limestone of Tayama is included in Mariana limestone of this report.

Area of outcrop confined to Naftan Point and to small area on east side of Hagman Point.

Nafutan Limestone

See Naftan Limestone.

Nagany Limestone

Middle Ordovician (Blackriveran): Pennsylvania.

R. S. Bassler, 1950, Geol. Soc. America Mem. 44, p. 12, 270. Incidental mention in faunal list.

Name may be derived from Naginey, Mifflin County.

Nagas Beds

Eocene: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 49, table 4 [English translation in library of U.S. Geol. Survey, p. 59]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 40. Marl and shale. Correlated with Mariiru beds on Rota Island and Matansa limestone on Saipan. Unconformably overlie Bolanos formation.

Type locality: Nagas, Guam.

Naha Formation

Quaternary, upper: Northeastern Arizona.

J. T. Hack, 1941, Geog. Rev., v. 31, no. 2, p. 262–263; 1942, Harvard Univ. Peabody Mus. Am. Archaeology and Ethnology Papers, v. 35, no. 1, p. 53–54, fig. 29. Composed mostly of loose sand with gravel lenses. Contains two members, which are evidence of an interruption of deposition by an epicycle of erosion. Contains many pottery fragments of Pueblo IV and Pueblo III age: also a firepit was found at top of formation. Dated between Pueblo III time (1100 to 1300 A.D.) and 1700 A.D. Overlies Tsegi formation.

Traced throughout Jeddito Valley. Naha Well is located in lower reaches of Jeddito Valley, western Navajo country.

†Nahant Gabbro[1]

Lower Paleozoic: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.

At Nahant, Essex County.

†Nahant Limestone[1]

Lower Cambrian: Eastern Massachusetts.

Original reference: J. H. Sears, 1891, Essex Inst. Bull., v. 22, p. 32.

Occurs on south side of Nahant Head, at the Shag Rocks, and extends about 300 yards to just beyond Bennetts Head on north.

†Nahant Schist[1]

Lower Cambrian: Eastern Massachusetts.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 9th Ann. Rept., p. 577–578.

Name probably derived from Nahant Head, Essex County.

Naheola Formation (in Midway Group)[1]

Paleocene: Southern Alabama and eastern Mississippi.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 57–60.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour. v. 16, p. 42. Formation comprises (ascending) "Matthews Landing marl," "Oak Hill beds," and "Coal Bluff beds." Uppermost formation of Midway group. Overlies Porters Creek formation; underlies Nanafalia formation of Wilcox group with disconformity.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3-195, p. 12–14. Restricted to sand and shale beds above Matthews Landing marl member of Porters Creek clay. Lower glauconitic sands and shales of Coal Bluff beds of Brantly (1920) are added to top as Coal Bluff marl member. Underlies Nanafalia formation. Thickness 10 to 160 feet in Alabama. May be equivalent to Betheden formation. Thickness 10 to 160 in Alabama.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 41–44. In Choctaw County, includes Oak Hill member (new) and Coal Bluff marl member. Overlies Matthews Landing marl member of Porters Creek clay; underlies Nanafalia formation. Thickness about 180 feet.

W. F. Roux, Jr., 1958, Dissert, Abs., v. 19, no. 5, p. 1056. Formation includes Matthews Landing, Oakhill, and Kemper (new) members. Coal Bluff is given formation rank.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 119–131, pls. 1, 5, 7, 10. Described in Kemper County where it is as much as 100 to 115 feet thick. Consists of dark-gray to black carbonaceous silty muscovitic clay shale, interlaminated gray and yellow-gray argillaceous silt and muscovitic fine sand. Unconformably overlies Matthews Landing marl member of Porters Creek clay; unconformably underlies Fearn Springs member of Nanafalia formation.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 22 (fig. 6), 79–92. Described in Wilcox County, where it includes Oak Hill member below and Coal Bluff marl member above.

Conformably overlies Matthews Landing marl member of Porters Creek formation; unconformably underlies Gravel Creek sand member (new) of Nanafalia formation.

Named from Naheola Bluff, on Tombigbee River in SE¼ sec. 30, T. 15 N., R. 1 E., Choctaw County, Ala.

†Naheola Marl[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1887, U.S. Geol. Survey Bull. 43, p. 57–60.

Named for exposures in lower part of section at Naheola, on Tombigbee River, in Choctaw County.

Naiad limestone[1]

Silurian(?): Southwestern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad., Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 10.

In Silver City region. Derivation of name not stated.

Naish Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 87, 97.

Derivation of name not stated.

Nakaibito Formation

Recent: Northwestern New Mexico.

L. B. Leopold and C. T. Snyder, 1951, U.S. Geol. Survey Water-Supply Paper 1110–A, p. 9–15. At type locality, consists of 22 feet of interbedded tan-brown sand and silt, including several thick layers of uncemented yet massive sand. The fill is irregularly crossbedded and contains occasional lenses of unconsolidated subrounded fine gravel, particularly near base. Contains potsherds. Disconformably overlies Gamerco formation (new).

Type locality: Mexican Springs Wash near Nakaibito, 18 miles north of Gallup. Nakaibito is Navajo word for Mexican Springs and is local name for immediate vicinity of experiment station headquarters building.

Nakaye Formation (in Magdalena Group)

Pennsylvanian: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 92–93, 254–255, figs. 2, 11. Consists dominantly of thick to massive ledges of limestone which often contain abundant bands, lenses, or nodules of chert. Limestone is medium gray to dark gray and very fine grained in most places. Many beds weather a light tan-brown and others weather light gray to medium gray. Thickness at type section 419 feet; unit thickens slightly southward or southeastward along the range. Comprises little more than middle third of group. Underlies Bar B formation (new) and overlies Red House formation (new) with conformable contacts.

Type section: Measured in Caballo Mountains at South Ridge, sec. 10, T. 15 S., R. 4 W., Sierra County. Named from Nakaye Mountain in southwestern part of area where formation forms most of ridge.

Nakimuan series[1]

Precambrian: Cordilleran region.

Original reference: C. R. Keyes, 1917, Iowa Acad. Sci. Proc., v. 24, p. 56.

Naknek Formation[1]

Upper Jurassic: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 169–171, 179, 181.

C. E. Kirschner and D. L. Minard, 1948, U.S. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Divided into (ascending) Chisik conglomerate member, 300 to 600 feet; siltstone member, approximately 700 feet on Iniskin Bay; Pomeroy member (new), 600 to 1,300 feet; and upper sandstone member, 1,000 to 3,000 feet. Siltstone is hard, dark gray to black, and thick bedded. Upper sandstone member is light-gray medium-grained arkose; includes youngest Jurassic strata exposed on Iniskin Peninsula; beds average 10 feet in thickness. As exposed on Iniskin Peninsula, formation approximately 3,500 feet thick. Overlies Chinitna siltstone.

A. S. Keller and H. N. Reiser, 1959, U.S. Geol. Survey Bull. 1058–G, p. 269–273, pls. 29, 32. Described in Mount Katmai area where it crops out in mountainous belt 20 to 38 miles wide which trends northeastward across entire area. On northwest side of its outcrop belt, formation is in fault contact with igneous rocks of Early and (or) Middle Jurassic age. In northeastern part of map area, it is overlain partly by rocks of Cretaceous age, and both here and over much of central part of map area it is overlain by volcanic rocks of Tertiary or Quaternary age. Comprises Chisik conglomerate member in lower part and an unnamed upper member, 6,000 to 9,000 feet thick, of marine sandstone, siltstone, conglomerate, and shale. Relationship to Upper Cretaceous Kaguyak formation (new) not discussed.

Crops out about halfway from mouth of Naknek Lake to head of Savonoski, also on Iniskin Peninsula, Cook Inlet region.

†Nampa Beds[1]

Miocene, Pliocene, and Pleistocene: Idaho.

Original reference: S. F. Emmons, 1890, Boston Soc. Nat. History Proc., v. 24, p. 432–433.

Nampa sediments

Pleistocene, upper: Southwestern Idaho.

C. N. Savage, 1958, Idaho Bur. Mines and Geology County Rept. 3, p. 20 (table 1), 27, 41, 48, figs. 3, 4. Clay, silt, sand, and gravel, nonconsolidated fluviatile chiefly, some caliche. Thickness as much as 50 feet. Underlies Caldwell sediments (new); overlies intermediate Snake River eruptives.

In Boise Valley, generally below 2,800 feet elevation, Ada and Canyon Counties.

Nanafalia Formation (in Wilcox Group)[1]

Eocene, lower: Southern Alabama, southwestern Georgia, and eastern Mississippi.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 51–57.

J. E. Brantly, 1920, Alabama Geol. Survey Bull. 22, p. 148–152. Formation, lowermost of Wilcox group, consists of from 125 to 150 feet of (ascending) lignite, massive and laminated sands and clays, crossbedded sands, highly fossiliferous greensand marl and kaolinlike laminated to thick-bedded clays, and thin highly fossiliferous indurated beds. Divisible into three divisions on basis of both lithology and fossil content. Lowest of three phases is referred to as Coal Bluff beds and two upper phases as Gullette Bluff beds. Smith used term Coal Bluff to apply to lignite at base of Nanafalia. In this report, name is extended to include all strata (42 to 70 feet) below Gullette Bluff fossiliferous marl. Overlies Naheola formation; underlies Tuscahoma formation.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour., v. 16, p. 42. Formation comprises (ascending) basal sand, "Nanafalia Landing (*Ostrea thirsae*) marl," and "Gullette Bluff beds." Basal formation of Wilcox group; underlies Tuscahoma formation; overlies Naheola formation of Midway group with disconformity.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 8. Formation extends across State of Alabama and lies disconformably on formations of Midway group—Clayton formation in eastern Alabama, and Naheola formation in central and western Alabama. Comprises three members: basal coarse crossbedded sandstone 30 feet thick, containing rounded pellets of clay in lower part; middle greensand marl member 35 to 80 feet thick, packed with shells of *Ostrea thirsae;* upper glauconitic sandy clay member indurated in central Alabama and called pseudobuhrstone, 50 feet or more thick, containing molds of *Turritella.* Basal sand is absent in some areas. Basal sand was included by Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2) in his Ackerman formation in Alabama.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim, Rept. 3–195, p. 20. Lowest formation of Wilcox group in Alabama. Upper coarse sand of Coal Bluff beds of Brantly are here included in Nanafalia as Fearn Springs sand member. Thickness of formation above Fearn Springs member ranges from about 25 to about 100 feet, and it is roughly divisible in western Alabama into two zones—upper predominantly sandstone, sandy claystone, and laminated clay (Grampian Hills rock or "pseudobuhrstone" of Smith, Johnson, and Langdon, 1894, Report on the geology of the Coastal Plain of Alabama: Alabama Geol. Survey), and lower loose to tough sand with ledges or concretionary zones of sandstone; this lower part is commonly referred to as *Ostrea thirsae* beds. Type locality exposes only a few feet of upper sandstone and claystone facies. In easternmost Alabama, formation consists of two sand and clay sequences.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 72. Mapped in southwestern Georgia.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84. p. 143–166, pls. 1, 5, 7, 9. Described in Kemper County, Miss., where it is about 230 feet thick and includes Fearn Springs sand member in lower part. Wilcox group. Overlies Naheola formation; underlies Tuscahoma sand. History of usage of name.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 95–111, pls. 2, 3. In Wilcox County, consists of three members (ascending): Gravel Creek (new), unnamed unit (*Ostrea thirsae* beds), and Grampian Hills. Name Fearn Springs sand member not used

in this report because boundary positions of Fearn Springs type locality are in dispute and stratigraphic relationships with section in Alabama are uncertain. Thickness 112 to 260 feet. Overlies Coal Bluff marl member of Naheola formation; conformably underlies Tuscahoma sand, top placed at base of lowermost bed of tan to greenish-gray fine-grained silty sand with fine-grained glauconite and prints of small fossils. Smith and Johnson (1887) separated Nanafalia into three divisions—lower division 80 feet, middle division "*Ostrea thirsae* beds," 70 to 80 feet, and upper division "pseudobuhrstone," 40 feet. Lower division of Smith and Johnson was named Coal Bluff beds by Brantly (1920). In present report, these beds, except for a coarse-grained crossbedded sand at top, constitute Coal Bluff marl member of Naheola formation, and the coarse-grained crossbedded sand is Gravel Creek sand member of Nanafalia. Middle and upper divisions of Smith and Johnson are equivalent to "Gullette Bluff beds" of Brantly (1920) and, in this report, comprise middle and Grampian Hills members of Nanafalia.

Named for exposures at Nanafalia Landing on Tombigbee River, in Marengo County, Ala.

Nanafalia Landing Marl (in Nanafalia Formation)

†Nanafalia Marl (in Wilcox Group)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1883, Alabama Geol. Survey Prog. Rept. 1881–1882, p. 256, 318–321.

L. D. Toulmin, Jr., 1940, Alabama Geol. Survey Bull. 46, p. 28–29. Formation as restricted by Cooke (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 2) is equivalent to "Gullette Bluff beds" of Brantly (1920). It consists of 50 to 80 feet of light-colored sands and greensand marls packed with *Ostrea thirsae* Gabb, overlain by 40 to 120 feet of gray clays and glauconitic sandy clays indurated in some regions and called "pseudobuhrstone." Conformably underlies Tuscahoma formation.

Lyman Toulmin, Jr., 1944, Alabama Acad. Sci. Jour., v. 16, p. 42. "Nanafalia Landing (*Ostrea thirsae*) marl" listed in Nanafalia formation. Overlies a basal sand and underlies "Gullette Bluff beds."

Named for exposure at Nanafalia Landing, on Tombigbee River, in Marengo County.

Nanaimo Group[1] or Formation

Upper Cretaceous to Eocene(?): Northwestern Washington, and southwestern British Columbia, Canada.

Original reference: G. M. Dawson, 1886, Canada Geol. Survey Rept. 1886, p. 10B; 1890, Am. Jour. Sci., 3d, v. 39, p. 181–183.

J. S. Bradley, 1950 (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1520. Namaimo sediments are predominantly conglomerate and graywacke; graywackes are normally crossbedded and contain conglomeratic layers. Conglomerates of Chuckanut formation, assigned to Eocene, on plant evidence, are indistinguishable from "Cretaceous" conglomerates immediately above Cretaceous faunal horizons; thus, group may be in part post-Cretaceous.

T. J. Etherington, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 191 (table). Named in list of formations of western Washington and described as sandstone and shale with some local conglomerate and

coal beds; thickness about 10,000 feet. Occurs stratigraphically above San Juan group and below Solduc formation.

First described on Vancouver Island. On northernmost San Juan Islands, strata occur in northwest-trending belt.

Nanjemoy Formation (in Pamunkey Group)[1]

Eocene, lower and middle: Eastern Maryland and eastern Virginia.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene Volume, p. 58.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Correlation chart shows age as lower and middle Eocene. Includes Potapaco clay member below and Woodstock greensand above. Overlies Aquia formation.

N. H. Darton, 1947, Econ. Geology, v. 43, no. 2, p. 154–155; 1951, Geol. Soc. America Bull., v. 62, no. 7, p. 753–754, 755, 757 (fig. 5), 760. Includes Marlboro clay member at base.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 24, 26–28, pl. 2. Lower Potapaco clay member of Nanjemoy is early Eocene; upper Woodstock greensand marl member is middle Eocene. Potapaco clay member truncates Aquia formation. Downdip, the Aquia formation and Potapaco member of Nanjemoy, as well as basal Marlboro clay member of Nanjemoy, have been truncated by transgressive sea of middle Eocene time during which upper part of Nanjemoy was deposited. Hence, eastward Woodstock member of Nanjemoy generally rests upon beds of Mattaponi formation (new) in subsurface. Underlies Chickahominy formation. Area of report is York-James Peninsula, Va. Report includes subsurface data.

Named for Nanjemoy Creek, Charles County, Md.

Nankoweap Group

Precambrian (Grand Canyon Series): Northern Arizona.

C. E. Van Gundy, 1934, Grand Canyon Nature Notes, v. 9, no. 8, p. 345–346; 1951, Geol. Soc. America Bull., v. 62, no. 8, p. 953–959, pl. 1. Thin-bedded brown well-indurated sandstone with interbeds of sandy shale, light gray, reddish, or purplish brown; also medium- to fine-grained massive quartzite, light-gray to white cross-bedded sandstones, and thin-bedded light-gray sandy limestone containing thin laminae of green shale. Includes lower member of Chuar group as described by Walcott and upper part of Walcott's Unkar group. Thickness at type section, 330 feet. Separated from both Unkar and Chuar groups by erosional unconformities. Algonkian.

Type section: In Basalt Canyon of Grand Canyon region, where complete and undisturbed section is well exposed. Complete section also exposed on north side of Nankoweap Valley. Partial sections in Unkar Creek, Comanche Creek, and west of Tanner Canyon.

†Nannie Basin Limestone[1]

Middle(?) Cambrian: Northeastern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geol. Mem. 6, p. 6, 36, and passim.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 38–39. Name Nannie Basin dropped and original Damnation and Nannie Basin limestones combined under Damnation limestone.

Type locality: Where the limestone forms the lower cliffs, which are rim of physiographic feature known as Nannie Basin.

Nansemond Formation

Pleistocene: Eastern Virginia.

W. E. Moore, 1956, Virginia Acad. Sci., Geology Sec., Field Trip Guidebook, no pagination. Deposited in tidal lagoon environment and includes a number of facies which range through clay, silt, sand, and peat; marine shell beds locally present. Residual material from Sedley formation (new) and lag gravels and cobbles from Kilby formation (new) underlie the Nansemond beneath westernmost parts of Dismal Swamp terrace. Underlies Dismal Swamp terrace and Princess Anne terrace. Terrace, as used here, refers to land form only and does not refer to or imply existence of any deposits genetically related to them.

Area discussed is south of James River.

Nantahala Slate[1]

Nantahala Schist

Precambrian(?); Western North Carolina, central northern Georgia, and eastern Tennessee.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio, 143, p. 4.

G. W. Stose and A. J. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233; 1949; Geol. Soc. America Bull., v. 60, no. 2, p. 272, 273, 282–285. Term Nantahala slate is used as defined by Keith (1907) but included in Ocoee series and age given as late Precambrian. Slate is present above Great Smoky quartzite in main syncline of Ocoee series in Bald Mountains, in Great Smoky Mountains in vicinity of Newfound Gap and southwestward, and on flanks of Murphy syncline from northeast corner of Nantahala quadrangle southwestward into northern Georgia. In deeper parts of the syncline, as in Bald Mountains and Murphy syncline, slate is overlain by Big Butt (Tusquitee) quartzite. Northwest of main syncline, from Little Tennessee River southward across southern Tennessee and North Carolina, slate is enclosed in minor synclines in Great Smoky quartzite.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27, 29. Nantahala schist included in Talladega series believed to be Precambrian.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 43–44, 45–47, pl. 1, geol. map. In Mineral Bluff quadrangle, Georgia, slate crops out in two belts, one on each limb of Murphy syncline. Thickness commonly 1,000 to 1,800 feet; less than 500 feet where thinned by faulting east of Weaver Creek. Underlies Tusquitee quartzite; overlies Dean formation (new) of Great Smoky group, formations appear to be gradational through a zone less than 20 feet thick, and concordant. Cambrian-Precambrian boundary placed at base of Nantahala.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 951, 953 (table 1). As defined in this report, top of Ocoee series is placed at base of Nantahala slate, and Nantahala is included in rocks of Murphy marble belt under heading Precambrian(?) and early Paleozoic(?):

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 36–37; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped

as Nantahala slate in Ocoee series. Upper Precambrian. Age designation of Nantahala questionable, but it is mapped in Ocoee series because present knowledge of formation in North Carolina does not warrant assigning it to Cambrian.

Named for exposures along Nantahala River in Nantahala quadrangle, Macon and Swain Counties, N.C.

Nanushuk Group

Nanushuk Formation[1]

Lower and Upper Cretaceous: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 247.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 162–164, fig. 3. Redescribed as group of Lower and Lower(?) Cretaceous age. In Colville River region, it includes shale, sandstone, conglomerate, and coal beds with little or no bentonite or tuff. Estimated thickness 5,750 feet in outcrop area; thins slightly northward. Includes two new intertonguing formations—Chandler (nonmarine) and Umiat (marine). Overlies Torok formation (new) with gradational contact; unconformably underlies Colville group. Type section indicated.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 233, figs. 2, 3. Group includes four formations: Tuktu (redefined-marine) at base, Grandstand and Ninuluk formations (new-marine), and Chandler (nonmarine) which intertongues with and grades into two upper marine formations. Early Cretaceous and early Late Cretaceous.

E. G. Sable, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2635–2637, fig. 3. Redefined in Utukok-Corwin area (western part of northern Alaska) where group consists of two formations: the Kukpowruk (new) and Corwin (redefined). Thickens southwestward from about 6,500 feet on lower Utukok River to more than 15,000 feet at Corwin Bluff. Kukpowruk and Corwin formations gradational and intertonguing; the same relationship exists between Kukpowruk and underlying Torok formation.

Type section: Belt of rocks beginning 5 miles north of junction of Colville and Anaktuvuk Rivers and extending south for 30 miles. Exposed along Nanushuk River where river cuts across Arctic Foothills province. Known to crop out throughout foothills north of Brooks Range from Sagavanirktok River west as far as Kukpowruk River.

Naomi Peak Limestone Member (of Langston Formation)

Middle Cambrian: Southeastern Idaho and northern Utah.

G. B. Maxey, 1955, Dissert. Abs., v. 15, no. 4, p. 558. Incidental mention.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 671, fig. 2. Light- to medium-neutral-gray finely crystalline arenaceous limestone with numerous lenses of coarsely crystalline very fossiliferous pure limestone. In many places, few thin beds of gray medium-grained brown-weathering calcareous or dolomitic sandstone occur near base of member. Thickness 32 feet in High Creek section. Thickens to 40 feet to the north and east. Not recognized in Left Fork of Blacksmith Fork, or in central or western Utah. Underlies Spence shale member and conformably overlies Pioche(?) shale.

Excellent section on north side of North Fork of High Creek, approximately 6½ miles northeast of Richmond, Utah. High Creek section considered "standard" for Cambrian of northeastern Utah and southeastern Idaho. Member extends from Left Fork of Blacksmith Fork River northward beyond Spence Gulch and Malad, Idaho, and from east side of Bear River Range to Wellsville Mountain.

Napali Formation (in Waimea Canyon Volcanic Series)

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 119. Thin lava flows and associated pyroclastic rocks that accumulated on flanks of major Kauai shield volcano, outside boundaries of caldera. Predominantly olivine basalt. Exposed thickness 2,700 feet; total thickness above ocean floor about 19,000 feet. Oldest unit of series. Separated from Olokele, Haupu, and Makaweli formations (all new) by eroded fault scarps bounding Olokele and Haupu calderas and Makaweli graben.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 23–32, table facing p. 20, pl. 1. Lava flows and associated pyroclastic rocks that accumulated on flanks of major Kauoi shield volcano, outside boundaries of the caldera. Constitutes major part of shield and extends to its base at ocean floor. Exposed thicknesses 2,400 to 2,700 feet. Separated from Olokele and Haupu formations by boundary of faults of calderas and from Makaweli formation by eroded fault scarps at edge of Makaweli graben. Exact age not known. Probably formed during Pliocene.

Type locality: West wall of Waimea Canyon. Named for exposures along Napali Coast, on northwestern side of island.

Napanee Member (of Rockland Formation)

Middle Ordovician (Mohawkian): Southern Ontario, Canada and northern New York.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 252, 255–256, pl. 2. Name proposed for upper member of formation. Described as terrace- and scarp-forming gray-blue medium-textured rather heavy ledged limestone with shaly partings common in lower part. Has few heavy ledges and is more shaly in New York. Thickness 34 feet at type locality. Overlies Selby member; underlies Hull formation. Overlaps lower beds along upper Black River valley.

Type section: One mile north of Napanee Station, along Selby Creek in Lot 22, Conc. III, Richmond Township, Lenox and Addington County, Ontario.

Napa Valley Series

Pliocene, lower: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Naples Member (of Millboro Formation)

†Naples Shale[1] or Group[1]

Naples Shale (in Portage Group)

Upper Devonian: Western to central New York and Virginia.

Original reference: J. M. Clarke, 1885, U.S. Geol. Survey Bull. 16.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 43–44. Upper member of Millboro shale (new). Overlies Marcellus member. Underlies Brallier formation. Consists of carrot-red to apricot-buff shales and fine-grained siltstone. Thickness not accurately determined because of drag folding and crumpling of beds, but probably 500 to 600 feet. Early Portage in age. Area of report, Draper Mountains.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1992. Naples shale in Portage group. Thickness 25 feet in Berkeley County; thickens westward to more than 300 feet in Mineral County. Rock is black fissile platy or slabby shale overlying Hamilton formation in northeastern counties, and coalescing with Marcellus black shale in more southerly regions. Underlies Brallier shale. Previously mapped as "Genesee." Discussion of Devonian of West Virginia.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 42, no. 12, pt. 1, chart 4. Shown on correlation chart as group comprising (ascending) Middlesex shale, Cashaqua shale, Rhinestreet shale, and Hatch sandstone; in Lake Erie area, includes Attica shale. Overlies Genesee group; underlies Grimes sandstone or Angola shale.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 410–411. Term Naples black shale as recently used (Price and Woodward) for the "Genesee" may be premature because it anticipates correlation that has not been confidently confirmed. Name Harrell used herein as an alternative to applying a new name.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 56. Group comprises (ascending) Middlesex black shale, Cashaqua formation, Rhinestreet black shale, and Hatch formation. Name Attica shale, formerly applied to Naples strata above Cashaqua formation in Lake Erie region, is herein abandoned, and term Rhinestreet black shale is applied westward to Lake Erie. Thickness increases from west to east; 169 feet at Lake Erie; 858 feet at Keuka Lake. Underlies Grimes sandstone; underlies Gardeau formation where Grimes is absent. Grimes and Gardeau are equivalent to Angola shale, in part, which overlies Rhinestreet black shales where Hatch formation is absent west of Attica. Overlies Genesee group.

Named for town of Naples, Ontario County, N.Y.

Napoleon Sandstone Member (of Marshall Sandstone)

Napoleon Sandstone (in Marshall Group)

Napoleon Sandstone[1] or Group[1]

Mississippian: Michigan.

Original reference: W. H. Taylor, 1839, Michigan Geol. Survey Rept. State Geologist in re improvement of State salt springs, Michigan Leg. H. R. Doc. 2.

G. V. Cohee, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 11. Napoleon sandstone member of Marshall sandstone is approximately 20 feet thick in outcrop at Napoleon. Overlies unnamed member.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 80, 81). Shown on correlation chart as Napoleon sandstone at top of Marshall group. Occurs below Michigan formation.

Exposed at Napoleon, Jackson County.

Napoleonville Stage

Miocene: Southeastern Louisiana (subsurface).

C. M. McLean, 1957, Gulf Coast Assoc. Soc. Trans., v. 7, p. 241, 242 (fig. 1), 243. A stage name, based on faunal assemblages occurring in sediments commonly termed "Upper" Miocene in subsurface of southeastern Louisiana. Clovelly and Duck Lake stages proposed as replacements for "Lower" and "Middle" Miocene respectively. Names were selected arbitrarily only because denoted fields demonstrate representative sections for each; nothing in way of principal producing horizons is implied.

Naptowne Glaciation

Pleistocene: Central southern Alaska.

T. N. V. Karlstrom, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 4, 13 (table 1). At least four major Quaternary glaciations recognized in Upper Cook Inlet area. Naptowne, the youngest, succeeded Swan Lake glaciation (new). Represented by conspicuous spatula-shaped end moraine and by similar morainal belts at mouth of Matanuska Valley and on margin of lowland in front of trunk valleys heading in glaciers of Alaska Range and Kenai Mountains. Along lower slopes of these trunk valleys, marginal moraines and fresh ice scour features occur nearly continuously about 1,000 feet below Swan Lake moraines. Moraines have little-modified knob and kettle topography, and kettle lakes are common.

D. B. Krinsley, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 6, 13 (table 1). In southwest part of Kenai Peninsula, Naptowne glaciation was followed by Nikolai Creek glaciation (new).

T. N. V. Karlstrom, 1957, Science, new ser., v. 125, no. 3237, p. 74. Chart of Alaskan glacial sequences shows sequence in Cook Inlet area (ascending): Swan Lake, Naptowne, and Alaskan (new).

T. N. V. Karlstrom, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B330–B332. Lower boundary of Naptowne glaciation is dated between 46,000 and 37,000 B.C. (about 45,000 B.C.). Upper boundary placed about 3,500 B.C. Naptowne records a major glacial cycle of about 40,000 years.

Spatula-shaped end moraine is crossed by the Stirling Highway near Naptowne on Kenai Peninsula, Upper Crook Inlet area.

Naranjo Formation

Triassic: Northeastern New Mexico.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Sequence of interbedded brownish-red sandstone, siltstone, and shale. Thickness 15 to 64 feet. Overlies Chinle formation; underlies Ocate sandstone (new). Jurassic.

R. L. Griggs and S. A. Northrop, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 134–135. In Sangre de Cristo Mountains, N. Mex., overlies Dockum group; unconformably underlies Ocate sandstone. Triassic.

Named for exposures in cutbank near village of Naranjo, about 2 miles east of Ocate, Mora County. Present also at Turkey Mountains, 12 miles southeast of Ocate.

Naranjo Formation (in Jacaguas Group)

Eocene, middle: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 70–94. Consists of 13,000 feet of marine sediments. Divided into four members: Miramar (new), Coamo Springs limestone, Río Descalabrado, and Guayo conglomeratic sandstone. In eastern part of Ponce quadrangle, interfingers with and is overlain by Augustinillo formation (new).

E. A. Pessango, Jr., 1960, Caribbean Geol. Conf.:, 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83, 84. Thickness 13,000 feet; maximum exposed. Divided into four members: Los Puertos (new) at base, Coamo Springs, Río Descalabrado, and Guayo conglomeratic sandstone (new). Interfingers with Augustinillo formation (new) in eastern part of Ponce quadrangle; also overlain in part by the Augustinillo in northeastern part of quadrangle. Footnote states that the Guayabal is currently called Jacaguas group.

Typically exposed along Camino Naranjo 1.1 kilometers east of Juana Díaz. Extends approximately from Salinas to somewhat west of the Río Guayo.

†Narcissa Sandstone (in Cherokee Shale)[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: S. Weidman, 1932, Oklahoma Geol. Survey Bull. 56, p. 24.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. Name inadvertantly given to unit termed Little Cabin sandstone.

Named for town in Ottawa County.

Narizian Stage

Eocene, late: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903. Named as one of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Includes interval between Fresnian [Fresnoian] stage above and Ulatisian stage below.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 55–72, 78–81, 96–98, fig. 7, tables. Redefined to include Fresnian stage. Composed of two zones, basal *Bulimina corrugata* and upper *Amphimorphina jenkinski;* a third zone may lie within predominantly arenaceous foraminifer faunules just subjacent to Refugian stage.

Type is taken at Point of Rocks, in sec. 2, T. 26 S., R. 18 E., in northwestern Kern County in Devils Den area—the typical Point of Rocks sandstone with possible exception of basal 75 feet, plus Welcome member of Kreyenhagen formation, to a point below superjacent Wagonwheel formation.

†Narragansett Basin Series[1]

Pennsylvanian and Permian(?): Rhode Island.

Original reference: G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, Geol. Ser., v. 8, no. 4, p. 99.

Narragansett Basin.

Narragansett Pier Granite

Upper Pennsylvanian or post-Pennsylvanian: Southern Rhode Island.

D. R. Nichols, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–91. Name proposed for granite whose composition varies from granite to quartz monzonite. Typically reddish, medium-grained. Massive to gneissic. Texture variable with irregular patches of pegmatitic and aplitic material dispersed through granite. Contains schist inclusions locally. Intrusive into metamorphosed Pennsylvanian sedimentary rocks, also into Scituate granite gneiss and other gneissic rocks. Previously termed Boston Neck granite; also had been included with Sterling granite gneiss.

Named from exposures along shore of Narragansett Bay south of Narragansett Pier, Washington County.

Narrow Canyon Limestone

Upper Devonian and Lower Mississippian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 356, pls. 32, 33. Consists of dark-gray silty limestone well defined in beds less than an inch thick. Weathers into thin buff-colored plates and forms talus-covered slopes. Thickness 175 feet at type locality. Conformably overlies Devils Gate(?) limestone in sharp contact; underlies Mercury limestone (new) with contact gradational.

Type locality: In Narrow Canyon at southeast margin of the Atomic Energy Commission Nevada proving grounds area, Nye and Clark Counties. Well exposed about one-half mile from mouth of canyon in narrow, northwestward-trending band and are characterized by buff-colored slope-forming appearance.

Narrows Chert (in Beekmantown Limestone)[1]

Lower Ordovician: Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 641–643.

Type locality: On low spur of Wolf Creek Mountain, west of Mill Creek, south of Wolf Creek and about 2.2 miles southwest of Narrows, Giles County, Va.

Nash Marble Series[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 636.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Exposed on west branch of Nash Fork, Medicine Bow Mountains.

†Nashaquitsa Series[1]

Pleistocene: Southwestern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 303–363.

At Nashaquitsa Cliffs, on south shore of Marthas Vineyard.

Nash Creek Formation

Oligocene, upper: West-central Louisiana.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 104 (fig. 18), 105 (fig. 19), 106–107. Proposed for gray to chocolate-brown carbonaceous and micaceous bentonitic clays containing fossil leaf impressions and occasional lenses of pure bentonite and sand which overlie Sandel formation. Thickness about 35 feet at type locality. Underlies Catahoula formation. Alternate type locality noted.

H. V. Andersen, ed., 1960, Type localities project unit 1: Baton Rouge, La., Soc. Econ. Paleontologists and Mineralogists, Gulf Coast Section, p. [40–42]. Upper Oligocene.

Type locality: Cut bank on west side of Nash Creek and adjacent K. C. S. Railroad cut near center of NE¼ sec. 6, T. 4 N., R. 10 W., Sabine Parish. Alternate type locality: Gully which heads on west side of U.S. Highway 171, 0.3 mile south of Hodges Gardens main entrance (NW¼SE¼ sec. 31, T. 5 N., R. 10 W.).

Nashoba Formation

Carboniferous: Eastern Massachusetts.

L. W. Currier and R. H. Jahns, 1952, Guidebook for field trips in New England: Geol. Soc. America, p. 106–108, 110. Name proposed for thick section of metamorphic rocks referred to by Emerson (1917) as Bolton gneiss and "gneisses and schists of undetermined age." Consists of biotite paragneiss and schist with amphibolite beds and marble lenses. Name credited to W. R. Hansen (unpub. ms.).

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 1, 31–39, pl. 1. Gneissic formation moderately to strongly feldspathized. Youngest metasedimentary rock in area. Grades downward into mica schist facies of Worcester formation through an amphibolitic transition zone. Outcrop breadth several miles; although breadth of outcrop may be due in part to multiple folding, the formation is probably at least 5,000 feet thick. Gospel Hill gneiss (new) may be granitized facies of Nashoba.

Named for exposures in valley of Nashoba Brook in Maynard and Westford quadrangles. Well exposed near town of Bolton.

†Nashua Marl[1]

Pliocene, lower: Northeastern Florida.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 128–133, table opposite p. 50.

Named for exposures on St. Johns River near Nashua, Putnam County.

†Nashville Group[1]

Middle and Upper Ordovician: Western, central, and eastern Tennessee.

Original reference: J. M. Safford, 1851, Am. Jour. Sci. 2d., v. 12, p. 353, 356–357.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 11 (footnote), geol. map. Nashville group of Safford (1851, 1856) is redefined to include strata of the Hermitage, Bigby, Cannon, and Catheys formations and to exclude strata of the Leipers, Arnheim, and Fernvale formations. Thus, name Nashville group will replace name Trenton group of New York, which has been used in general for these four formations. Underlies Maysville group; overlies Stones River group. Age given on map as Ordovician.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 43). Age shown on correlation chart as Trentonian-Edenian.

Named for Nashville.

†Nashville Slate[1]

Ordovician: Northwestern Georgia.

Original reference: W. Spencer, 1891, Georgia Geol. Survey 1st Rept. Prog., p. 112.

†Nasina Series[1] or Group[1]

Precambrian and Paleozoic: Eastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 465–467, 478, 483.

Occurs only on lower White River up to about mouth of Ladue Creek. [Nasina in Tanana native name for White River.]

Nassau Formation

Nassau Beds[1]

Lower Cambrian: Eastern New York and western Vermont.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 327, p. 59, 60. Nassau quartzite, as well as basal quartzite of older areas in Appalachian geosyncline, is unfossiliferous. Nassau beds have yieded only *Oldhamia*, a worm trail. It is probable that Nassau quartzite and all basal quartzites throughout Appalachian geosyncline are Precambrian south from Random quartzite in Newfoundland. Burden iron ore is definite horizon between Nassau beds and Schodack beds.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 38–46, pl. 2. Formation described in Castleton quadrangle where it is part of Taconic sequence. The 2,000- to 4,000-foot Taconic sequence crops out in Taconic Range and slate belt. Thick phyllite, quartzite, and grit that underlies Taconic Range was formerly considered Upper Ordovician and was called Berkshire schist. Because of its relation to Cambrian slates of slate belt and its similarity to Nassau formation of New York, it is here mapped as Nassau formation. Thickness at least 1,000 to 3,000 feet. Includes Bird Mountain grit as facies; main body of Bird Mountain is probably 500 feet thick. Presumably lies beneath Bomoseen grit. Recognized that Nassau formation of Castleton area probably includes, in addition to rocks equivalent to typical Nassau of eastern New York, strata not exposed but presumably underlying typical Nassau. Lowest beds in Nassau of Castleton area are probably those on eastern flank of Taconic Range. In general, it is thought that successively younger beds crop out in westerly direction until the Bomoseen and Mettawee are encountered. Probable that Nassau as mapped here includes younger rocks that are not sufficiently well exposed to be recognizable in the field. In addition to large mass of probable Normanskill formation differentiated on map in township of Middleton, there may be other undifferentiated strata of Normanskill age in the Nassau. Some Mettawee and Bomoseen have probably not been recognized in Nassau terrane. It is not likely that Nassau as mapped here includes Schodack, Eddy Hill, or Zion Hill strata. Probably late Precambrian.

Theodore Arnow, 1951, New York Water Power and Control Comm. Bull. GW–25, p. 8 (table 1), 9–11, pl. 2. Formation described in Columbia County where it consists chiefly of greenish or reddish and greenish shale, interbedded with thin layers of quartzite or grit; some massive greenish quartzite present. Thickness about 785 feet. Underlies Schodack formation. Lower Cambrian.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, p. 337–338. Nassau beds (Ruedemann, 1914) were first distinguished by Dale (1904, U.S. Geol. Survey Bull. 242) as divisions A to E of Rensselaer County. Ruedemann (1932, New York State Mus. Bull. 285) placed formation wholly beneath Bomoseen grit implying that Nassau was older than any Lower Cambrian unit in Washington County. Later Ruedemann (1942) suggested that the Nassau, which has yielded no fossils except controversial *Oldhamia* represented late Precambrian and that local superjacent Burden iron ore was residual soil which accumulated during Lipalian interval. Interpretation proposed here is that Nassau is facies of Mettawee and Bomoseen and Burden iron ore is post-Lower Cambrian regolith. It is anomalous that no Nassau has been reported in Washington County and no Mettawee south of that county. This led to supposition that underlying reason may lie in contemporaneity of the two units. Also likely that some of what has been mapped as Nassau may be red and green shale facies (equivalent to red slates of Washington County) of Middle Ordovician Normanskill formation which has been thrust westward.

Named for exposures in Nassau, Rensselaer County, N.Y.

Natapoc Formation[1]

Eocene: Central Washington.

Original reference: E. Houghland, 1932, Northwest Sci., v. 6, no. 2, p. 68.

Occurs about 11 miles north of Leavenworth, Chelan County, and about 15 miles east of crest of Cascade Mountains, Natapoc Mountain.

Natchez Formation[1]

Pleistocene, lower: Southwestern Mississippi.

Original reference: T. C. Chamberlin, 1896, Am. Geologist, v. 17, p. 108–109.

M. M. Leighton and H. B. Willman, 1950, Jour. Geology, v. 58, no. 6, p. 614. Natchez formation is a Pleistocene valley-train deposit as interpreted by Chamberlain (1896), and Chamberlain and Salisbury (1906, Textbook of geology, v. 3). It is separate from and younger than Lafayette-type gravel.

H. N. Fish, 1951, Jour. Geology, v. 59, no. 4, p. 337 (fig. 3), 341. Elevations show that Natchez formation has been uplifted approximately 250 feet with respect to alluvial plain. Leighton and Willman did not give evidence from their study which permitted them to call Natchez a Pleistocene valley train or the particular glacial stage during which the formation was deposited. In this report, "Natchez formation" is considered sand facies of Bentley formation and the uplift has taken place since Yarmouth time.

Named for occurrences near Natchez, Adams County.

Natchez Pass Formation (in Star Peak Group)

Middle and Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map

[GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Quad. Map [GQ–11]. Light- and dark-colored massive dolomite and limestone in varying proportions. About 200 feet of basic lava flow and volcanic breccia generally present about 400 feet above base. Locally massive dark-brown siliceous conglomerate with some siliceous massive slate about 200 feet below top. Thin lenses of clastic rocks in places. Thickness at type locality 1,650 feet; about 1,000 feet in Sonoma Range. Conformably overlies Prida formation (new); underlies Grass Valley formation.

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Upper formation in Star Peak group. In Buffalo Mountain quadrangle, comprises lower and upper members. Lower member, predominantly massive gray limestone and dolomite in basal part and altered andesitic volcanic flows, tuff, and breccia, including argillite and siltstone in upper part, is 1,000 to 1,500 feet thick. Upper member, thin- to thick-bedded impure limestone in basal part and massive gray limestone in upper part, is about 1,000 feet thick. Overlies Prida formation; underlies Grass Valley formation. Middle and Upper Triassic.

Type locality: Natchez Pass, East Range, Winnemucca quadrangle.

Natick Arkose[1]

Carboniferous: Eastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 253–256, 375–376, 383–385.

Exposed along steep hill face from Natick, Kent County, for 2½ miles northward into Cranston, Providence County.

Natick Granite[1]

Lower Paleozoic(?): Massachusetts.

Original reference: W. O. Crosby, 1880, Boston Soc. Nat. History Occasional Papers 3.

Natick, Middlesex County.

National Sandstone[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of the geology of Ontonagon County, pamph. of 24 p., with map: Philadelphia, 1863, p. 21, map.

Well exposed in creek on National Location, Ontonagon County.

Nation River Formation[1]

Pennsylvanian(?): Central eastern Alaska.

Original reference: A. H. Brooks and L. M. Prindle, 1908, Geol. Soc. America Bull., v. 19, p. 294.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 704, pl. 1. Largely terrigenous in origin.

Helmuth Wedow, Jr., 1954, U.S. Geol. Survey Circ. 316, p. 5, 6, pl. 1. Aggregate thickness of between 5,000 and 6,000 feet in Eagle-Nation area. Underlies Tankandit limestone.

Well exposed along Yukon River a few miles below Eagle and from Montauk Bluff to below mouth of Nation River.

Natsy Member (of Deese Formation or Group)

Pennsylvanian (Des Moines Series): Central Oklahoma.

C. W. Tomlinson, 1937, Ardmore Geol. Soc. [Guidebook] Field Trip, March 13, p. 1–2, geol. map; C. W. Tomlinson and William McBee, Jr., 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 35–36. Proposed to replace preoccupied name Hollis as used on map by Guthrey and Milner in 1933. Most distinctive bed of member comprises from 4 to 6 feet of impure silty ferruginous brown massive limestone; 40 to 50 feet above this bed is thinner bedded calcareous sandstone of similar thickness; at type locality, both units are partly conglomeratic, containing small variegated pebbles, chiefly of limestone. Overlies Williams member; underlies Confederate member of Hoxbar formation.

Type locality: On allotment of Natsy Noella in N½SW¼SW¼ and S½NW¼NW¼ sec. 27, T. 5 S., R. 2 E., Carter County.

Natural Bridge Limestone[1]

Age(?): New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, pl. 45.

Occurs from Monticello, Sullivan County, to Croton River near Bulls Bridge, Westchester County.

†Natural Bridge Limestone[1]

Middle and Upper Cambrian and Lower Ordovician: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

Natural Corral Member[1] (in Belvidere Formation)

Lower Cretaceous (Comanche Series): Central Kansas.

Original reference: W. H. Twenhofel, 1924, Kansas Geol. Survey Bull. 9, p. 31–32.

Exposed at Natural Corral, a box canyon about 5 miles southwest of Marquette, McPherson County, in NW¼ sec. 5, T. 18 S., R. 5 W.

Naturita Formation (in Dakota Group)

Lower to Upper Cretaceous: Southwestern Colorado.

R. G. Young, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 17, 21, figs. 2, 3; 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 156–194. Carbonaceous unit consisting of conglomeratic sandstone, carbonaceous mudstone, carbonaceous shale, coal, littoral marine sandstone, and thin tongues of Mancos shale. Throughout much of the area, basal unit is a white to light-gray (on fresh surfaces), buff (on weathered surfaces) thin (5 to 15 feet) conglomeratic sandstone which disconformably overlies Cedar Mountain formation. In much of the area, a similar sandstone, about 20 feet thick, occurs higher in formation above as much as 45 feet of carbonaceous deposits. Upper part of formation of gray to black silty carbonaceous mudstone with lenses of conglomerate, sandstone, shale, and coal, about 100 feet thick. All of the formation in eastern part of the area is of Early Cretaceous age, but upper part in western part of the area is of Late Cretaceous age. Underlies Mancos shale.

Named for exposures near Naturita in southwestern Colorado. In Grand Junction area, Garfield, Mesa, and Delta Counties.

Naugatuck Sandstone (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 163.

Named for Naugatuck, Mingo County.

†Naugus Head Series[1]

Age(?): Eastern Massachusetts.

Original reference: W. O. Crosby, 1877, Geol. map of eastern Mass.

Well developed on Naugus Head promontory on Marblehead shore, Boston region.

†Naushon Series[1]

Pleistocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 303–363, map.

Occurs on island of Naushon and also on Marthas Vineyard.

Navajo Sandstone (in Glen Canyon Group)[1]

Upper Triassic(?) and Jurassic: Northern Arizona, western Colorado, southeastern Nevada, northwestern New Mexico, and southeastern Utah.

Original reference: H. E. Gregory, 1915, Am. Jour. Sci., 4th, v. 40, p. 102, 112.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 5–6, pls. Overlies Kayenta formation, lower boundary arbitrary; underlies Carmel formation of San Rafael group. Forms wedge with thick part to southwest in Nevada and thin edge in western Colorado. Not known to enter New Mexico. Thickness more than 2,000 feet in southeastern Arizona and adjacent Nevada. Believed that typical Nugget is equivalent to the Navajo.

H. E. Thomas and G. H. Taylor, 1946, U.S. Geol. Survey Water-Supply Paper 993, p. 20, 23–24, table facing p. 18. Described in Cedar City and Parawan Valleys, Utah. In Coal Creek Canyon, section is 1,100 feet thick and overlies Chinle formation. Between the shaly sandstones and sandy shales that are typical of the Chinle and the massive beds that are clearly identifiable as Navajo, there is a transition zone several hundred feet thick which might doubtfully be included in either formation. This transition zone, represented in Coal Creek Canyon section by beds 26 to 30, is assigned to Chinle; although the lower strata (bed 26 and much of bed 27) are quite similar to typical Navajo, the intervening shaly beds are not acceptable as part of that formation. As identified in Coal Creek Canyon the Navajo is thinner than in other parts of southern Utah. Underlies equivalent of Carmel formation.

R. K. Grater, 1948, Am. Jour. Sci., v. 248, no. 5, p. 311–318. Described in Zion National Park where it is about 2,100 feet thick; overlies Kayenta formation and underlies Carmel formation. Includes Temple Cap member (new) at top. Believed that basal Navajo and uppermost 200 feet, Temple Cap member, had their origin in water. Middle Jurassic(?).

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 81–89. Described in Zion Park region where it is 1,200 to 2,200 feet thick. Overlies Kayenta formation with local unconformity, and unconformably underlies Carmel formation of San Rafael group. Consists of light-

creamy-yellow, white, pinkish, and buff, highly crossbedded sandstone; Temple Cap member present at top. Jurassic(?).

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 596–597, 598. In Strawberry Valley quadrangle, Utah, Navajo is 1,240 feet thick and underlies Twin Creek limestone. Unit can be mapped almost continuously from Duchesne River area into northeastern part of quadrangle. Jurassic.

S. J. Reber, 1952, Utah Geol. Soc. Guidebook 7, p. 105–106. Overlies Chinle in Beaver Dam Mountains, Utah.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 145 (fig. 2). On correlation chart of recommended revision of stratigraphic units in Great Basin, Navajo sandstone replaces Aztec sandstone in southeastern Nevada.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2520, 2521. Base redefined in Cedar City area, Utah. In this area, Navajo includes Shurtz sandstone tongue (new), which lies 410 to 720 feet below base of Navajo sandstone as mapped by Thomas and Taylor (1946) and as accepted in this report. In section along Coal Creek measured by Thomas and Taylor, the Shurtz is designated as units 26 and 27 in the Chinle. In the section as republished by Gregory (1950, Utah Geol. and Mineralog. Survey Bull. 37) tongue appears as units 21 and 22 in the Chinle. Although Thomas and Taylor's section shows the Shurtz tongue as a separate unit lying below base of Navajo, Gregory mapped base of Shurtz as base of Navajo but did not note the change on republished section. In Kanab area, Navajo includes Lamb Point tongue (new), a name applied to rocks classified as Wingate by Gregory (1950); hence, term Wingate is eliminated in Kanab area. In their respective areas of outcrop, Shurtz and Lamb Point tongues are overlain by complementary tongues of Kayenta—Cedar City tongue (new) in Cedar City area and Tenney Canyon tongue (new) in Kanab area. Jurassic and Jurassic(?).

Extensively exposed in Navajo country. First described on Navajo Indian Reservation, Ariz.

†Navajo shales[1]

Upper Cretaceous: New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257; 1915, Conspectus of geologic formations of New Mexico. Des Moines, Robert Henderson, State Printer, p. 2, 10.

In San Juan region.

Navarro Group[1] or Formation

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: B. F. Shumard, 1862, Boston Soc. History Proc., v. 8, p. 189.

L. W. Stephenson, 1941, Texas Univ. Bur. Econ. Geology Pub. 4101, p. 641, pls. Group comprises (ascending) Neylandville marl, Nacatoch sand, Corsicana marl, Kemp clay, and Escondido formation. Overlies Taylor marl; underlies Midway group. Discussion of larger invertebrate fossils of Navarro group.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 49–53. Restricted to exclude Neylandville marl which is reallocated to Taylor

group. As restricted group comprises (ascending) Nacatoch sand, Corsicana marl, Kemp clay, and Escondido clay. Foraminifera described.

Named for occurrence in Navarro County.

†Navasota Beds[1]

Miocene and Pliocene: Eastern Texas.

Original reference: W. Kennedy, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 9–15, 43–44.

Named for Navasota, Grimes County.

Navesink Formation (in Monmouth Group)

Navesink Marl (in Monmouth Group)[1]

Navesink Member (of Monmouth Formation)

Upper Cretaceous: New Jersey and Delaware.

Original references: W. B. Clark, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 336–337; 1894, Jour. Geology, v. 2, p. 161–177.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 40–49. Rank reduced to member status in Monmouth formation. In Monmouth County, N.J., attains thickness of 30 feet; in southern part of State only about 5 feet. Consists of black to green glauconite containing varying amounts of sand and clay. Base is marked by fossil zone which in places is distinctly divisible into three parts; an upper *Gryphaea*, a middle *Exogyra*, and a lower *Belemnitella;* at other places, zone is represented by a single bed. Toward the top, Navesink passes into darker layer which contains less glauconite and more sandy clay and is in some places micaceous. Transition into overlying Red Bank member gradual, though locally, top of Navesink is marked by conspicuous bed of large fossiliferous concretions. Stratigraphically above Mount Laurel member of Matawan formation. Geographically extended into Delaware where it is present in Chesapeake and Delaware Canal. It is believed that Carter (1937) identified Navesink beds as being Mount Laurel-Marshalltown in several of his sections in Canal.

S. K. Fox, Jr., and R. K. Olsson, 1955 [abs.] Jour. Paleontology, v. 29, no. 4, p. 736. Upper Cretaceous Navesink, Red Bank, and Tinton are formations with distinct microfaunas indicating time differences. Stratigraphic evidence indicates unconformity between Cretaceous and Tertiary formations. Hornerstown rests successively from northeast to southwest on Tinton, Red Bank, and Navesink.

H. W. Miller, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 722–736. Discussion of Cretaceous-Paleocene boundary in New Jersey. Presence of a "middle greensand" between Navesink (Cretaceous) and Hornerstown formation recognized; it is suggested that this is southwestward extension of Red Bank formation (Cretaceous).

R. K. Olsson, 1960, Jour. Paleontology, v. 34, no. 1, p. 2–3, 4 (fig. 2). Underlies Sandy Hook member of Redbank formation.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Formation in Monmouth group. Overlies Mount Laurel sand; underlies Red Bank formation. Average dip SE 35 feet per mile. Thickness 10 to 40 feet. Thickens in outcrop to northeast.

Extensively developed throughout Navesink Highlands, Monmouth County, in vicinity of village of Navesink and along north bank of Navesink River.

Naylor Ledge Formation[1] or Limestone

Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 399. Overlies Hastings Creek limestone; underlies Luke Hill limestone. Thickness 30 feet. Phillipsburg series. Beekmantown.

Exposed from northern part of St. Albans quadrangle, Vermont, across international border for about 20 miles into Quebec.

Nazlini shales[1]

Upper Triassic: Northeastern Arizona, Colorado, and Utah.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 337.

Charles Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 63 (table). Underlies Leroux limestones; overlies Lukachukai sandstone.

Typically exposed on Nazlini Creek, south of Chinle and northwest of Fort Defiance, Ariz.

Neabsco Run Diorite[1]

Precambrian(?): Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Crops out 1 mile northeast of Minnieville post office and 5 miles northwest of Dumfries, along Neapsco [Neabsco] Run, Prince William County.

Neahga Shale[1] (in Clinton Group)

Middle Silurian: Western New York, and Ontario, Canada.

Original reference: J. T. Sanford, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 194.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 34–36. Discussion of Clinton group of western and central New York. Neahga shale, in lower part of group, is about 6 feet thick at type locality. Upper 5½ feet consists of smooth slightly silty slightly calcareous green platy shale. Typical Neahga grades downward into silty sandy calcareous green shale. Overlies Thorold sandstone; underlies Reynales limestone. Was termed Furnaceville shale by Williams (1919).

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Ontarian stage, Niagaran series, Middle Silurian.

Exposed in Niagara Gorge. Term Neahga means Niagara River.

Nealmont Limestone or Formation

Middle Ordovician (Trentonian): Central and south-central Pennsylvania, western Virginia, and eastern West Virginia.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Name applied to a limestone in Trenton group. Includes type Rodman, Lemont, and Center Hall. Thickness 65 to 135 feet; maximum in type section.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 191, 192, 195. Uppermost unit is Rodman member. Much of unit was previously termed Lowville.

Part was included in Lemont member of Carlim limestone in Tyrone district.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, fig. 2; 1944, Jour. Geology, v. 52, no. 2, p. 97–109. Includes Oak Hall member (new) at base and redefined Center Hall member in middle. Two thick metabentonitic clays defining upper 20 feet of Oak Hall in western Penns Valley are only ones definitely placed in Nealmont of Pennsylvania. In type section, base is 3-foot ledge of dark coarse-textured impure limestone disconformably overlying Stover member of Benner limestone; top is thick ledge of dark-brown-weathering fossiliferous limestone underlying cobbly basal beds of Salona limestone. Upper contact is essentially conformable. Regional unconformity at base; unit overlies successively older units southeastward. In Bellefonte district, Oak Hall is absent and Center Hall fills channels in underlying Valentine member of Curtin limestone. Derivation of name.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 78, 87–89, 95, 97, 103. Geographically extended to West Virginia and Virginia. Grades directly into Moccasin formation southeastward. Changes from dominantly argillaceous Moccasin facies in southeast to typical Nealmont limestone facies in northeast. Formation underlies Onego member (new) of Salona formation in West Virginia.

Type section: At Union Furnace, Huntingdon County, Pa. Named for village of Nealmont in Blair County, Pa., 2 miles east of Tyrone.

Nealmontian Stage

Middle Ordovician (Trentonian): Eastern North America.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1412. Stage in lower Trentonian. Extends from base of Trentonian. Equivalent to Rocklandian and Kirkfieldian stages.

Marshall Kay, 1960, Internat. Geol. Cong., 21st Copenhagen, pt. 7, p. 30. Suggested that term Nealmontian stage be applied to Rocklandian and Kirkfieldian substages and that succeeding stage be called Shermanian to include Shorehamian and Denmarkian substages.

Name derived from Nealmont, Blair County, Pa., for which Nealmont limestone is named.

Nealranch Formation

Permian (Wolfcamp Series): Southwestern Texas.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 49, no. 9, p. 299, 300, 301; 1960, Cushman Foundation for Foraminiferal Research Contr., v. 11, no. 4, p. 120. Embraces upper part of beds originally called Wolfcamp by Udden (1917). Unconformably underlies Lenoxhills formation (new). In Wolf Camp Hills the Nealranch, 300 to 470 feet thick, unconformably overlies gray limestone and contains oldest *Schwagerina* and *Pseudoschwagerina* faunas thus far discovered in Glass Mountains. Boundary between Permian and Pennsylvanian systems is taken at this unconformity. [Name also spelled Neal Ranch.]

Type locality: In Wolf Camp Hills one-fourth mile west of Hill 5060, northeast of Marathon, Brewster County.

†Nebo[1] (Formation)

Lower Ordovician: Southern Oklahoma.

Original reference: C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1495.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Name preoccupied. Unit now termed Oil Creek formation.

Named for village in Murray County.

Nebo Quartzite or **Sandstone** (in Chilhowee Group)[1]

Nebo Quartzite Member (of Erwin Formation)

Lower Cambrian(?): Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 272–273. Precambrian Big Butt quartzite (new) is named from the Big Butt, northeast culmination of Bald Mountains, where massive white quartzite and interbedded green argillite and fine-grained arkosic quartzite are enclosed in syncline; Keith (1905, U.S. Geol. Survey Geol. Atlas, Folio 118) named the quartzite Nebo and the softer beds Murray shale, which are names that properly should be applied only to lower Cambrian formations.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12 (table 3). Two sets of formation names for Lower Cambrian clastic rocks are in use in eastern Tennessee and western North Carolina (table 3). Northeast Tennessee names, Unicoi, Hampton, and Erwin, are used in this report for same rocks which Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 90) and Stose and Stose (1947, Am. Jour. Sci., v. 245) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn. Hot Springs area lies midway between type localities for each group of names. Unicoi formation as used here includes Nebo quartzite.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1, pls. 8, 13; pt. 2, p. 29. Because of poor base map on which he had to work Hayes (1895, U.S. Geol. Survey Geol. Atlas, Folio 20) made error in tracing units from Hiwassee River to Ocoee River; what he mapped as Nebo sandstone near Hiwassee River, he mapped as Cochran conglomerate near Ocoee River. The small area that Hayes mapped as Starr conglomerate on Little Mountain and Sugar Loaf near Parksville is white *Soclithus*-bearing quartzitic sandstone and belongs to either Nebo or Hesse sandstone. Nebo sandstone (Cambrian) is mapped in present report.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 964. U.S. Geological Survey restricts beds classed as Cambrian to those for which paleontological data are available. Chilhowee group as a whole is classed as Cambrian and Precambrian(?). Helenmode formation at top of group is Cambrian and remaining unfossiliferous formations [including Nebo quartzite] are termed Precambrian(?).

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Nebo quartzite described in Blockhouse quadrangle, Tennessee, where it is 300 feet thick. Overlies Nichols shale; underlies Murray shale. Lower Cambrian(?).

P. B. King and H. W. Ferguson, 1960, US. Geol. Survey Prof. Paper 311, p. 28 (table), 33, 43. In northeasternmost Tennessee, considered basal member of Erwin formation. Consists of several beds of white or gray vitreous quartzite that, in most places, contain abundant *Scolithus*. In-

dividual beds, 10 to 100 feet thick, are separated by shale similar to those in overlying Murray member. Lower Cambrian.

Named for Mount Nebo Springs on Chilhowee Mountain, Blount County, Tenn.

†Nebraska Beds[1]

Miocene: Nebraska.

Original reference: W. B. Scott, 1894, Geol. Soc. America Bull., v. 5, p. 594–595.

Named for State of Nebraska.

†Nebraska Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 588, fig. 52.

Probably named for occurrence in old Nebraska mine (which later became the Caledonia mine), Ontonagon County.

Nebraska Till

Pleistocene (Nebraskan): Kansas.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 52 (fig. 2), 53, 55, 56–58. In Kansas, deposits of Nebraskan stage are classed in three formations: David City, Nebraska till, and Blanco (which includes Holdrege and Fullerton members). At Iowa Point section, Doniphan County, Nebraska till is 7 feet thick; overlies David City formation and underlies Kansas till. Nebraska till is earliest recognized glacial deposit in Kansas. Nebraska uses Nebraskan till for till of same age in Nebraska.

Nebraskan Glaciation

Nebraska(n) Drift,[1] Till

Nebraskan Stage, Age

Nebraskan stage of glaciation[1]

Pleistocene: Mississippi Valley.

Original references: B. Shimek, 1909, Geol. Soc. America Bull., v. 20, p. 408; 1910 Science, new ser., v. 31, p. 75–76.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24 (fig. 1), 34, 38, 52 (fig. 2), 53, 55. Nebraskan is earliest age (stage). Followed by Aftonian age (stage). In Kansas, deposits of Nebraskan stage are classed in three formations: David City, Nebraska till, and Blanco (which includes Holdrege and Fullerton members). Term Grandian as used in Iowa and Illinois includes the Nebraskan and Aftonian.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 128. Nebraskan stage poorly represented in area, Beardstown, Glasford, Havana, and Vermont quadrangles.

Name amended to Nebraskan Glaciation to comply with Stratigraphic Code adopted 1961.

Named for occurrence in Nebraska.

Nebraska City Limestone Member (of Wood Siding Formation)

Nebraska City Limestone[1]

Nebraska City Limestone Member (of Caneyville Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

Original reference: G. L. Smith, 1919, Iowa Acad. Sci. Proc. 1918, v. 25, p. 526.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 43. Reallocated to member status in Wood Siding formation (new); basal unit of formation. Kansas Geological Survey classifies the Nebraska City as basal member of Caneyville limestone.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Basal unit of Wood Siding formation. Underlies Plumb shale member (new); overlies French Creek shale member of Root shale (new).

Type section: Upper strata in brickyard shale pit, one-fourth mile south of Missouri River bridge at Nebraska City, Otoe County, Nebr.

Necedah Quartzite[1]

Precambrian (Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 523–524.

Occurs at foot of hill on which village of Necedah, Juneau County, is located.

Necessity Shale Member (of Graham Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 104, 113, 114.

Derivation of name not stated.

Neda Formation[1]

Neda Member (of Maquoketa Shale)

Upper Ordovician: Southeastern Wisconsin and northeastern Iowa.

Original reference: T. E. Savage and C. W. Ross, 1916, Am. Jour. Sci., 4th, v. 41, p. 187–193.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 50). Shown on correlation chart as shale member of Maquoketa formation; overlies Brainard member.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 28–31, pl. 3. Described in Dubuque South quadrangle, Illinois-Iowa, where it is rank reduced to member status in Maquoketa shale. Comprises interlayered grayish-red soft shale, dolomitic dark-reddish-brown limonitic oolite, and grayish-green shale. Thickness 3 to 5 feet. Overlies Brainard member; underlies Mosalem member (new) of Edgewood dolomite.

Named from exposures in ore pit near Neda, Dodge County, Wis.

Nedrow Member (of Onondaga Limestone)

Middle Devonian: New York.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 627–628, 636, pl. 1. Consists of thin-bedded and shaly limestones marked in lower part by abundant platyceratid gastropods; upper part is more massive limestone with sparse fauna; beds are medium gray, very fine grained, and argillaceous. Thickness 10 to 14 feet. Westward from type locality passes into cherty limestone; and eastward into coarse limestone. Overlies Edgecliff member (new) with contact sharp; underlies Moorehouse

member (new) with contact transitional. Onondaga in New York is generally considered lower Middle Devonian (Onesquethaw stage).

Type locality: One mile south of Nedrow, at Indian Reservation quarry, and U.S. Highway 11, just south of their intersection, South Onondaga, Tully quadrangle, Onondaga County.

Needle Mountains Group[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio. 131.

N. E. A. Hinds 1939, 6th Pacific Sci. Cong. Proc., v. 1, p. 290. Mentioned in discussion of Precambrian formations of western North America. Includes Vallecito conglomerate, 2,000 feet, overlain by Uncompahgran quartzite, 8,000 feet.

Named for occurrence in Needle Mountains, San Juan and La Plata Counties.

Needles Complex

Precambrian: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, p. 116–119, pl. 7. Chief constituents are diorite varying to metadiorite and more or less crudely foliated granite varying to granodiortie.

Outcrops occur in northwestern Mojave Mountains, and along and west of highway between 10 and 17 miles south of Needles, Riverside County.

Needles Range Formation

Eocene or Oligocene: Southwestern Utah and eastern Nevada.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 99–105. Consists primarily of crystal-rich ignimbrites. Commonly pink to dark red brown, but range widely from black in solidly welded vitrophyre phases that occur near base of some units to light gray in their almost incoherent uppermost parts. In many sections, formation includes two, and in some sections, three separate ignimbrites. At type locality, includes two members (ascending): Wah Wah Springs tuff and Minersville tuff (both new). Overlies Claron formation; underlies Isom formation (new). Thickness commonly less than 100 feet where formation overlies the Claron in Iron Springs district; in Wah Wah Range 1,000 to 1,500 feet where it lies on mature erosion surface cut in older rocks. Eocene or Oligocene, but cannot be dated closely in this span on basis of evidence available at present time. Discussion of ignimbrites of area.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 140 (fig. 4). In Grant Range, Nev., overlies Windous Butte tuff (new) and underlies Shingle Pass tuff (new). Thickness 100 to 125 feet. Consists of two thin lightly to highly welded biotite crystal ignimbrites.

Type locality: East side of Needles Range at and south of Garrison-Milford Highway, Iron Springs district, Utah.

Needmore Shale

Needmore Shale (in Onondaga Group)

Needmore Shale Member (of Romney Shale or Onondaga Formation)

Middle Devonian: Central and south-central Pennsylvania, Maryland, northern and western Virginia, and eastern West Virginia.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 141, 144, 148–150. Name proposed for dark- to medium-gray limy shale. Weathers greenish, olive, or olive drab. Limestone present as thin beds, lenses, and nodules; more plentiful in upper part. Contains Beaver Dam black shale member (new) near middle in western Mifflin County, Pa. Thickness generally 100 to 150 feet west of Susquehanna River. Disconformably overlies Oriskany group. Underlies Selinsgrove limestone with gradational contact and supplants it southward; distinguished from Selinsgrove by greater portion of argillaceous material. Assigned to Onondaga group. It is the Selinsgrove shale of White (1883).

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 278–306. Geographically extended to Maryland, Virginia, and West Virginia. In West Virginia, replaces "Selinsgrove (lower) shale" of previous reports. Thickness 83 to 207 feet. Overlies Ridgeley sandstone and underlies Marcellus shale.

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 118, p. 53, 54–55, pl. 1. Rank reduced to lower member of Romney shale in western Virginia. Conformably underlies Millboro shale member; overlies Ridgeley sandstone.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation as mapped includes Needmore shale member in central Pennsylvania.

Named for exposures in southern Fulton County, Pa., between Needmore and Warfordsburg.

Neeley Formation

Neeley Lake Beds[1]

Pliocene, middle: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 32, 43, pls. 4, 6. Thickness about 100 feet with base concealed. Younger than Pillar Falls mud flow. Older than Eagle Rock tuff. Lower Pliocene(?).

U.S. Geological Survey currently classifies the Neeley as a formation and designates age as middle Pliocene on the basis of a study now in progress.

Exposed in bluffs of Snake River in vicinity of village of Neeley, Power County, 5 miles southwest of American Falls.

Neelytown Limestone[1]

Upper Cambrian: Eastern New York.

Original reference: W. Horton, 1839, New York Geol. Survey 3d Rept., p. 148.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 338. Early workers did not agree on age. Type locality has not been restudied; hence, age is in doubt.

Crops out in the crossroad a few hundred feet east of Neelytown Station, Orange County.

†Nefsy Shale Member (of Graneros Formation)[1]

Upper Cretaceous: Northeastern Wyoming.

Original reference: A. J. Collier, 1922, U.S. Geol. Survey Bull. 736, p. 82, table.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 8. In Black Hills region, Graneros formation is divided into five members (ascending): Skull Creek shale, Newcastle sandstone, Nefsy shale, Mowry shale, and Belle Fourche shale. In area of this report [north part of Whitewood anticline], the Nefsy cannot be distinguished from the Mowry.

Named for fact that large part of Nefsy townsite at Osage is underlain by this shale.

Negaunee Iron-Formation[1]

Precambrian: Northern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 65–66.

A. K. Snelgrove, W. A. Seaman, and V. L. Ayres, 1944, Michigan Dept. Conserv. Geol. Survey Div. Prog. Rept. 10, p. 31, 32, 34. In Republic area, overlies Ajibik quartzite and conglomerate and unconformably underlies Goodrich quartzite. Middle Huronian.

S. A. Tyler and W. H. Twenhofel, 1952, Am. Jour. Sci., v. 250, no. 2, p. 128–138. In Marquette district overlies Siamo slate and underlies Goodrich formation. Thickness 0 to 1,000 feet.

Named for exposures at and south of Negaunee, Marquette County.

Negli Creek Limestone (in Chester Group)[1]

Mississippian: Southern Indiana and central western Kentucky.

Original reference: W. N. Logan, 1924, Indiana Dept. Conserv. Pub. 42, p. 11, 125.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Replaced by Kinkaid limestone. Local Indiana names of upper Chester are dropped and formations given names of standard Chester column.

Named for exposures along Negli Creek a tributary of Little Deer Creek, 4 or 5 miles east of Tell City, Perry County, Ind.

Negra clay[1]

Miocene(?): California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 61, 80.

Exposed in east wall of Furnace Canyon, beneath Mesa Negra, east of Death Valley, Inyo County.

Nehalem Formation

Eocene, upper, to Oligocene, lower: Northwestern Oregon.

M. L. Steere, 1955, Geol. Soc. Oregon Country News Letter, v. 21, no .10, p. 85. Variable sequence of sandstones, tuffaceous siltstone, mudstones, and one local basalt flow. Total thickness 500 to 600 feet. Beds were formerly considered to be in lower part of Keasey formation. Overlies Cowlitz formation. Name credited to R. J. Deacon (unpub. thesis).

Type locality: On Rock Creek about one-half mile downstream from Keasey Station, Columbia County.

Nehawka Limestone[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 6, 33.

G. E. Condra and O. J. Scherer, 1939, Nebraska Geol. Survey Paper 16, p. 5–6. Unconformity at base of what is supposed to be Stranger formation is marked by erosion extending locally through Weston shale and probably into upper part of Stanton formation. Iatan limestone, if it was deposited here, apparently was eroded. Nehawka limestone, a conglomeratic facies, which is thought to be correlative with Tonganoxie sandstone of Kansas Survey classification, lies on lowest eroded surface of this unconformity.

Exposed in bed of North Branch of the Weeping Water, 2 miles north of Nehawka, Cass County.

Neihart Porphyry[1]

Cretaceous(?): Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

Occurs on divide above Neihart, Cascade County, and on slopes drained by Snow and Mackey Creeks, Little Belt Mountains.

Neihart Quartzite[1]

Precambrian (Belt Series): Central western Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111, 112. Positively known only in its type locality (herein given), although name has also been applied to strata that underlie Prichard formation in Anaconda Range. Underlies Chamberlain shale and overlies gneiss at type locality.

Type locality: Near village of Neihart [Cascade County].

Nelagoney Formation[1]

Pennsylvanian (Virgil Series): Central northern and northeastern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 75.

U.S. Geological Survey has abandoned term Nelagoney. Members have been reassigned to other formations.

Type locality: Nelagoney, Osage County.

†Nelagoney Sandstone[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: L. C. Snider, 1911, Oklahoma Geol. Survey Bull. 7, p. 221.

Named for Nelagoney, Osage County.

Nelchina Limestone[1]

Lower Cretaceous: Central southern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 313–315, table opp. p. 474.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Occurs in several isolated areas, mostly small, on hilltops at headwaters of Nelchina River and of Billy Creek, Matanuska district, Cook Inlet region.

Nellie Bly Formation[1] (in Skiatook Group)

Pennsylvanian (Missouri Series): Northeastern and central Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 74.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62. Included in Skiatook group. Name is applied to shales and sandstones above Hogshooter formation and below Dewey limestone, or below unconformity at base of Chanute formation where Dewey is absent. Maximum thickness 180 feet. Type locality stated.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 64–68. In Okfuskee County, consists of 6 mappable sandstones and 7 mappable shales. Thickness 440 to 460 feet. Conformably overlies Hogshooter; conformably underlies Dewey formation.

W. F. Turner, 1956, Oklahoma Geol. Survey Bull. 74, p. 70–78, pls. 1, 2. In Seminole County, consists of shale, sandstone, siltstone, chert conglomerate, limestone and limestone conglomerate; only a single ledge, the basal (No. 1) sandstone, is continuous across county. Thickness 300 to 400 feet. Conformable above Coffeyville formation and below the Belle City; in northern part of county, apparently conformable below Hilltop formation; in Pontotoc County, truncated by Ada formation.

Type locality: On Nellie Bly Creek, in secs. 31, 32, 29, 28, T. 24 N., R. 13 E., Washington County.

Nellie Juan Granite[1]

Mesozoic(?): Southeastern Alaska.

Original reference: U. S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 37, 46.

Occurs in western part of Prince William Sound, on south shore of Port Nellie Juan.

Nelson Amphibolite

Carboniferous: Northeastern Nevada.

A. E. Granger, 1957, Nevada Bur. Mines Bull. 54, p. 116, pl. 14. Forms narrow band between Banner limestone and Mountain City formation (both new).

Type locality not stated. Text refers to Nelson mine near Mountain City. Geologic map shows Nelson Ranch also in Elko County.

Nelson Beds

Triassic: North-central North Carolina.

Grover Murray, Jr., 1938, Science, v. 87, no. 2261, p. 390. Incidental mention as equivalent to Lowes Grove beds (new).

Occurs in Durham Triassic basin, approximately three-fourths mile west of Nelson, Durham County.

Nelson Hill facies[1] (of Locust Point Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 145–146.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. In north to south direction, Locust Point formation comprises Belmont, Nelson Hill, Schooner Hill, and Spickert Knob facies.

Name derived from Nelson Hill which is crossed by State Highway 46 at boundary between Bartholomew and Brown Counties.

Nelson Mountain Quartz Latite (in Potosi Volcanic Group)

Nelson Mountain Quartz Latite (in Potosi Volcanic Series)[1]

Middle or late Tertiary: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

Named for fact it is cap rock on Nelson Mountain, Creede district.

Nemaha Formation, Member, or Subgroup (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, northwestern Missouri, and northern Oklahoma.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 8, 14, 26.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2036, 2037, (fig. 6); 1949, Kansas Geol. Survey Bull. 83, p. 177–179; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15–16; F. C. Greene, and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20. Subgroups named (ascending) Sacfox, Nemaha, and Richardson by Condra (1935) have been included in interstate classification agreed upon by the State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. As thus defined, Nemaha subgroup in standard section includes (ascending) Burlingame limestone, Soldier Creek shale, Wakarusa limestone, Auburn shale, Reading limestone, Harveyville shale, Elmont limestone, Willard shale, and Tarkio limestone. Nomenclature in the several States may deviate from this by combination or omission of terms where certain named rock units are not recognizable.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Nemaha-Richardson boundary lowered to base of Tarkio limestone herein reduced to member status in Zeandale formation (new). This change has been agreed to by the Nebraska and Kansas Geological Surveys which are chiefly concerned. As herein redefined, Nemaha subgroup comprises four formations (ascending): Bern limestone (with Burlingame limestone member at base), Auburn shale, Emporia limestone, and Willard shale.

Type locality: Big Nemaha Valley between south of Falls City and southeast of Rulo, Richardson County, Nebr.

Nemo Series[1] or System

Precambrian: Southwestern South Dakota.

Original reference: J. J. Runner, 1926, Chicago Univ. Abstracts of Theses, Sci. ser., v. 2, p. 229–234.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 3, 4. Oldest system of Precambrian sedimentary rocks described in Black Hills.

Occupies oval-shaped area of about 5 square miles extent to west of village of Nemo, Lawrence County. In Black Hills.

Nenana Gravel[1]

Tertiary: Central Alaska.

Original reference: S. R. Capps, 1912, U.S. Geol. Survey Bull. 501, p. 30–34.

F. F. Barnes and others, 1951, U.S. Geol. Survey Bull. 963–E, p. 146 (table), 152, pl. 18. In Healy-Lignite area, overlies unnamed coal-bearing formation. Thickness about 4,200 feet.

Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 11–12, pls. 1, 2, 5. Consists largely or poorly consolidated moderately well-sorted conglomerate and sandstone. Thickness 4,000 feet east of Healy. Fossils collected from gravel exposed along Alaska Railroad about 3½ miles north of Browne Station indicate Oligocene or Miocene age, more likely Miocene than Oligocene. Mapped as Tertiary. Geographic distribution given.

Named for exposures on east bank of Nenana River between mouths of Healy and Lignite Creeks.

Nenzel Rhyolite Breccia[1]

Middle(?) Triassic: Northwestern Nevada.

Original reference: A. Knopf, 1924, U.S. Geol. Survey Bull. 762.

H. E. Wheeler, 1939, Jour. Paleontology, v. 13, no. 1, p. 106 (table 1). Nenzel rhyolite breccia overlies Rochester trachyte in which species of *Helicoprion* has been found. Units are referred to Anthracolithic time, which includes all late Paleozoic from base of Diantian stage (Mississippian) upward.

Forms summit of Nenzel Hill, Rochester district, Pershing County.

Neodesha Sandstone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: Robert Hay, 1887, Kansas Acad. Sci. Trans., v. 10, p. 7, cross section.

Named for Neodesha, Wilson County.

Neosho Limestone[1]

Pennsylvanian: Central eastern Kansas.

Original reference: A. J. Smith, 1903 Kansas Acad. Sci. Trans., v. 18, p. 99.

Named for Neosho Rapids, Lyon County.

†Neosho Shale Member (of Garrison Shale)[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 764–771, 799–800.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 59. Terms Neosho and Garrison no longer used in Kansas stratigraphic nomenclature.

Named for outcrops in Neosho Valley, near Council Grove, Morris County, Kans.

†Neponset Conglomerate[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. W. Dodge, 1882 Boston Soc. Nat. History Proc., v. 21, p. 210–213.

Neroly Formation[1] or **Sandstone** (in San Pablo Group)

Neroly Stage or Substage

Miocene, upper: Central western California.

Original reference: B. L. Clark and A. O. Woodford, 1927, California Univ. Pubs. Geol. Sci. Bull., v. 17, p. 69.

K. A. Richey, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1885. Term Neroly has greater validity as faunal zone than as lithologic unit.

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 199–200. The Monterey comprises three substages (ascending): Briones, Cierbo, and Neroly. Substages can be recognized strandward by distinctive echinoderm faunas and by a number of more or less distinctive mollusks.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 42–47. Neroly formation of this report [Tesla quadrangle] was described as San Pablo formation by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603). Consists of lower part, 50 to 700 feet thick, of blue sandstone, andesitic conglomerates and tuff; upper part, about 2,000 feet thick, shales, blue sandstones, and tuffs. Overlies Cierbo formation; underlies Livermore gravels. In northeast part of quadrangle, unconformably overlies Panoche formation and unconformably underlies Tulare formation. Upper formation in San Pablo group.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18 (table 3), 80–85, pls. Neroly sandstone described in Coast Ranges immediately north of San Francisco Bay region. Uppermost formation in San Pablo group. Overlies Cierbo formation. Derivation of name stated.

J. W. Durham, 1954, California Div. Mines Bull. 170, chap. 3, p. 24 (fig. 2), 25 (fig. 3). Listed as a megafaunal "stage" between Cierbo below and Jacalitos above.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 27–28, fig. 2, geol. map. Thickness about 600 feet in Pleasanton area. Overlies the Cierbo with contact gradational. In some areas, underlies Livermore gravels with angular discordance. Upper Miocene. Considered advisable to revise term San Pablo formation and designate the Neroly and Cierbo as members. No type section of formation has been adequately designated or described except for mention of type area by Weaver (1949).

Name derived from Neroly Station on Southern Pacific Railway in extreme northwest corner of Byron quadrangle northeast of Mount Diablo.

Neruokpuk Formation

Neruokpuk Schist[1]

Upper Devonian(?) or older: Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103–105 map.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 163 (fig. 2). Age of formation shown as Precambrian(?) on columnar section.

M. D. Mangus, 1954, Geologic reconnaissance of the Kongakut River area [Alaska] *in* Preliminary geographical survey of the Kongakut-Firth River area, Alaska-Canada: U.S. Natl. Park Service, p. 52–53. In Kongakut River area, formation divided into two lithologic units; lower unit, thought to be pre-Middle Silurian to Middle Devonian, and upper unit, thought to be Upper(?) Devonian.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Name appears on map legend under Paleozoic rocks undifferentiated.

Typically developed on three sides of Lake Peters, also near forks of Canning River. Neruokpuk is Eskimo name for Lakes Peters and Schrader.

Nescatunga Gypsum Bed or Member (of Blaine Formation)

Permian (Leonard Series): Southwestern Kansas and northern Oklahoma.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1794–1795, 1797. Gypsum bed in the Blaine formation between the Shimer gypsum bed above and the Medicine Lodge gypsum bed below. Thickness 3 to 9 feet.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 44, pt. 4, p. 158. Member of Blaine formation. Underlies Shimer gypsum member; overlies Medicine Lodge gypsum member. Locally as much as 8 feet of red shale separates the gypsum from the next higher and lower gypsum beds.

Well exposed along lower reaches of Nescatunga Creek, Comanche County, Kans.

Neshoba Sand Member (of Tallahatta Formation)

Neshoba Sand (in Claiborne Group)

Eocene, middle: Southeastern Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 24–28, fig. 1, pl. 2, profile C. Name applied to section of non-glauconitic to sparingly glauconitic sand heretofore considered to be lower Winona. Sands are typically well sorted, fine grained, and micaceous; massive to irregularly bedded and to crossbedded. When fresh, sands are white, but on ontcrop they are commonly stained red, brown, yellow, purple, and mottled; gray clay abundant in form of pellets, partings, stringers, and lenses. Overlies Basic claystone member and is stratigraphic equivalent of part of type Basic claystone in Mississippi and of part of type Tallahatta section of Choctaw County, Ala. Overlain and underlain by typical Basic material in Newton and Lauderdale Counties. Neshoba and Basic facies are interlensed over wide area, and thickness of Neshoba fluctuates inversely with thickness of the Basic.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Mapped as Neshoba sand in Claiborne group. Not recognized southeast of Newton County or north of Yalobusha River.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Neshoba sand member at top of Tallahatta formation; overlies Basic City shale member; underlies Winona formation.

Type section: Above Basic claystone and below Winona greensand along highway through Neshoba, Neshoba County.

Neslen Formation (in Mesaverde Group)

Neslen Coal-Bearing Member (of Price River Formation)[1]

Neslen facies (of Price River Formation)

Upper Cretaceous: Central eastern Utah and central western Colorado.

Original reference: D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, pl. 1 facing p. 1011. Shown on correlation chart as formation

with three members (ascending): Bluecastle sandstone, Thompson Canyon sandstone and Sulphur Canyon sandstone.

Teng-Chien Yen 1954, U.S. Geol. Survey Prof. Paper 254–B, p. 59, 60, 64. Listed in fossil collection locality data both as formation and as member of Price River formation.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 187–188, figs. 2, 3. Since this is a facies development which laterally crosses time lines, the use of a formational name would be inconsistent with the delimitation of more or less contemporaneous members. Name used to identify the facies. Rocks, which are predominantly shale and sandstone, are coal bearing. Shales largely nonmarine and gray to black. Sandstones of two types: thin lenticular buff sandstones of lagoonal deposits and massive buff littoral marine sandstones which are traceable for many miles. These sandstones used to subdivide rocks of facies into five members (ascending): Castlegate, Sego, Corcoran (new), Cozzette (new), and Cameo (new). Castlegate member belongs to both Neslen and Farrer facies. Each member consists of one or more basal sandstone tongues and associated lagoonal and barrier bar deposits and can be distinguished only where littoral marine sandstones are present. Rocks of facies range in thickness from about 100 feet near Woodside to about 1,000 feet near Colorado-Utah line. Terms Mount Garfield and Hunter Canyon formations dropped. Term Neslen facies applies to all coal-bearing rocks of Price River formation, and term Farrer facies applies to the non-coal-bearing rocks above Neslen facies. Montana age.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11 (table), 17. Formation included in Mesaverde group in central Book Cliffs (Utah east of Green River). Includes Bluecastle sandstone member in upper part. Overlies Sego sandstone. underlies Farrer formation. Average thickness 350 feet. To the east, appears to be equivalent to part of Mount Garfield formation.

Named for Neslen Canyon, in which town of Sego is located, and near Thompsons, Utah. In Book Cliffs.

Nespelem Silt[1]

Nespelem Formation

Pleistocene: Northeastern Washington.

Original reference: J. T. Pardee, 1918, U.S. Geol. Survey Bull. 677.

F. C. Walker and W. H. Irwin, 1954, Am. Soc. Civil Engineers Proc., v. 80, Separate No. 515, p. 3–5. Referred to as a formation, predominantly a glacial-lacustrine deposit of varved clay type. Thickness about 800 feet at Grand Coulee Dam.

Present along Nespelem River and near village of Nespelem, Okanogan County.

Nesson Formation

Jurassic: Subsurface in North Dakota and Montana and Manitoba, Canada.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 104–106, fig. 2. Proposed for sequence of carbonates and evaporates which underlies Tampico shale member (new) of Piper formation in Williston basin area; over most of basin, unconformably overlies Triassic(?) Spearfish formation. Thickness 260 feet. Includes (ascending) Poe evaporite, Picard shale, and Kline members. Formation pinches out by nondeposition on west side of Bowdoin dome; wedges out north-

east of Big Snowy platform and has no equivalent in Piper type section on north flank of Big Snowy Mountains.

Typical section: Between depths of 5,730 to 5,990 feet in Amerada No. 1 Clarence Iverson well, center SW SW sec. 6, T. 155 N., R 95 W., Williams County, N. Dak. Named for development in Nesson anticline.

Nestucca Formation

Eocene, upper: Northwestern Oregon.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Name proposed for formation consisting of brackish water and marine tuffaceous siltstone and claystone, sandstone, and intercalated volcanic material. Estimated thickness 7,000 to 8,000 feet. Overlies Siletz River volcanics and Burpee formation with angular unconformity; unconformably underlies Yaquina formation. Lithologically and stratigraphically, the interbedded volcanics resemble the Goble volcanics; in area to the north, the Nestucca is equivalent to upper part of Tillamook volcanic series and Cowlitz formation as mapped by Warren and others (1945).

E. M. Baldwin and others, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–155. Described in Sheridan and McMinnville quadrangles where it unconformably overlies Yamhill formation (new). Here consists of more than 2,000 feet of tuffaceous shale and siltstone and thin-bedded sandstone with intercalated pillow basalt, breccia, and tuff.

Typically exposed along north bank of Salmon River from Otis to Three Rocks and in roadcuts along north side of Nestucca Bay, Tillamook County. Beds crop out along both eastern and western flanks of main anticlinal fold in area.

Neutral Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 21; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. The Neutral, second in sequence (ascending), occurs above the Riverton and below the Columbus cyclothem. Average thickness 26 feet. Includes coal here named Neutral. [For complete sequence see Cherokee Group.]

Type locality and derivation of name not given. Cherokee outcrop in Kansas covers an area of about 1,000 square miles and includes parts of Labette, Bourbon, Crawford, and Cherokee Counties.

Neva Glacial Stage

Pleistocene: North-central Colorado.

R. L. Ives, 1942, Geog. Review, v. 32, no. 3, p. 450 (table 1). Name appears only on table giving late Pleistocene chronology of Monarch Valley. Younger than Monarch glacial stage. Dated as 4,000 years pre-1900.

Monarch Valley, Grand County.

Neva Limestone (in Council Grove Group)

Neva Limestone Member (of Grenola Limestone)

Neva Limestone (in Wabaunsee Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original references: J. W. Beede, 1902, Kansas Univ. Sci. Bull., v. 1, p. 180; C. S. Prosser, 1902, Jour. Geology, v. 10, p. 709.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 47. Neva limestone member consists of four or five limestones separated by shales. Thickness 16 to 24 feet. Overlies Salem Point shale member; underlies Eskridge shale. Wolfcamp series.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol Survey. Mapped as Neva limestone in Council Grove group.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 94–100. In Kansas and Nebraska the Neva is defined as top member of the Grenola and is underlain in turn by Salem Point shale, Burr limestone, Legion shale, and Sallyards limstone members. Only Neva member of Grenola can be identified with assurance in Pawnee County. Consists of upper and lower limestone members separated by 13 to 22 feet of blue-gray shale. Overall thickness 17 to 40 feet. Overlies Roca shale; underlies Eskridge shale.

M. R. Mudge and R. H. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 13 (table 2), 66–69, pls. Described in Wabaunsee County, Kans., where it is classified as member of Grenola limestone. Thickness 13½ to 16½ feet. Overlies Salem Point shale member; underlies Eskridge shale. Note on type locality.

Type locality: Near Neva Station, Cottonwood River valley, Chase County, Kans. Neva Station has been moved since limestone was named. Limestone was named from exposures near junction of Diamond Creek and Cottonwood River valleys in Chase County.

Nevada Formation

Nevada Limestone[1]

Lower and Middle Devonian: Eastern Nevada.

Original references: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, map 4; Arnold Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 237–272; 1892, U.S. Geol. Survey Mon. 20, p. 63–84.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 14–16. Restricted to lower 2,448 feet of Devonian strata above Lone Mountain formation as exposed at Lone Mountain; upper 2,065 feet of Devonian strata exposed at Devils Gate and in Modoc Ridge are named Devils Gate formation. Lower limit of formation drawn at top of barren, more or less massive dolomites of Lone Mountain formation. Upper limit arbitrarily established at top of *Stringocephalus* zone. Lower and Middle Devonian. Type section designated.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 40–48. In vicinity of Eureka, subdivided into (ascending) Beacon Peak dolomite, Oxyoke Canyon sandstone, Sentinel Mountain dolomite, Woodpecker limestone, and Bay State dolomite members (all new). Overlies Lone Mountain formation; underlies Devils Gate limestone. Term was first used by King (1878 [1876]), but Hague provided better definition as result of mapping in Eureka district. In 1883, he in effect selected the entire State as type locality. Later (1892) he modified this broad designation by citation of Modoc Peak, Combs Peak, Atrypa Peak, Woodpeckers Peak, and Newark Mountain, all within area of original Eureka survey, as affording "typical sections." Merriam (1940) selected Modoc Peak, first of five localities cited by Hague, as suitable type locality. Preliminary observations made in present study, indicate that there is probably complete section of the Nevada exposed there. Section is cut by several minor faults and by at least

two intrusive masses. In view of apparent priority given by Hague and of Merriam's subsequent designation, it is probably best to retain Modoc Peak as type locality, but it would be well to supplement Modoc Peak section by other more representative sections in Oxyoke Canyon on east, and Lone Mountain on northwest.

Donald Carlisle and others, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2176–2177, 2178–2179 (fig. 2), 2180–2184. In Sulphur Springs and Pinyon Ranges, subdivided into (ascending) McColley Canyon, Union Mountain, and Telegraph Canyon members. Overlies Lone Mountain dolomite; underlies Devils Gate limestone.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 353–355, pls. 32, 33. Described in Atomic Energy Commission proving grounds. Total thickness 1,070 feet. Comprises three units, A through C in ascending order. Unit A consists of about 460 feet of dolomite, limestone, and quartzite. Unit B consists of about 260 feet of interbedded light-gray and black dolomite. Unit C is made up of about 350 feet of interbedded limestone and dolomite. Underlies Devils Gate(?) formation; overlies about 1,565 feet of undifferentiated Paleozoic dolomite. At Mine Mountains, the Nevada and overlying rocks have been thrust over Mississippian strata.

E. L. Winterer and M. A. Murphy, 1960, Jour. Geology, v. 68, no. 2, p. 134 (fig. 6), 135. In northern Simpson Range overlies Rabbit Hill formation (new).

Type section: Sequence exposed at Modoc Peak. Named for development in State of Nevada.

†Nevadan series[1]

Middle and Upper Devonian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 55, 80.

Neville Formation

Pleistocene, upper: Southwestern Texas.

C. C. Albritton, Jr., and Kirk Bryan, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. On basis of disconformities in valley-fill complex, the Quaternary (late Pleistocene) as been divided into (ascending) Neville, Calamity, and Kokernot formations.

C. C. Albritton, Jr., and Kirk Bryan, 1939, Geol. Soc. America Bull., v. 50, no. 9, p. 1430–1434, 1443, 1449, 1452. At type locality, consists of calcareous silt and conglomerate; materials are poorly sorted; silty beds contain quantities of clay, sand, pebbles, cobbles, phenoclasts of conglomerates are set in matrix of silty sandstone; contains large amounts of secondary calcite diffused as caliche and in form of white nodules; in some areas, formation is reddish-brown ferruginous and calcareous silty clay; contains mammoth remains. Thickness at type locality 11 feet. Disconformably underlies Calamity formation; northward from type locality, abuts against Tertiary igneous rock; to the south, intersected by younger alluvium.

C. B. Hunt, 1952, U.S. Geol. Survey Bull. 996–A, p. 6. Proposed Pleistocene-Recent boundary would be at unconformity between Neville and Calamity formations.

Type locality: West bank of Calamity Creek 1 mile northwest of Neville's ranchhouse, Brewster County.

Newala Limestone,[1] Formation, or Dolomite (in Knox Group)

Lower Ordovician: Northern Alabama, northwestern Georgia, and eastern Tennessee.

Original reference: C. Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 95, map.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 18, 19–22, 52, geol. map. Geographically extended into northwestern Georgia. Estimated thickness 250 to 300 feet. Overlies Longview limestone; underlies Murfreesboro limestone; locally underlies Rockmart slate. Newala of Georgia is basal member of typical Chickamauga limestone named by Hayes (1891).

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 55, 56 (table 5), pls. Geographically extended into Tennessee. Where Kingsport and Mascot formations cannot be separated they are classed together as Newala formation. Knox group.

J. M. Cattermole, 1960, U.S. Geol. Survey Geol. Quad. Map CQ–126. Newala formation as used in this report [Bearden quadrangle] includes all dolomite and limestone between Longview dolomite and unconformity at top of Knox group. In some parts of eastern Tennessee, strata included in Newala can be divided into Kingsport formation and Mascot dolomite. Subdivision into these formations depends upon recognition of chert matrix sandstone about 2 inches thick; this sandstone is difficult to locate. Approximate thickness 650 to 890 feet.

Named for Newala post office, Shelby County, Ala.

New Albany Shale[1]

Upper Devonian: Indiana and north-central Kentucky.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 150, 152, 158, 172.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 829–908. New Albany shale in Indiana consists of Devonian Blocher and Blackiston formations (both new), 90 feet thick, and Mississippian Sanderson, Underwood, and Henryville formations (all new), 11 feet thick. This classification is based on floral and faunal content. Underwood contains Hamburg oolite fauna. These divisions continue through Kentucky, Ohio, and Tennessee. In eastern Kentucky, the Trousdale, a correlate of the Blocher, is underlain by Tully Portwood formation (new), which contains three coeval facies; the Underwood and Henryville are replaced by the Bedford and Sunbury. In Ohio, the Blackiston was contemporaneous with the Chagrin, and the Sanderson is equivalent to the Cleveland as restricted. The Olentangy is basal Blackiston and Upper Devonian in age. The Chattanooga in central Tennessee contains equivalents of all the Indiana New Albany divisions. The Blackiston and Sanderson are represented in Alabama. In Indiana, New Albany shale rests on limestone of Hamilton age, and in Clark County, rests on different levels of the Silver Creek, Swanville, or Beechwood formation. Underlies Jacobs Chapel formation (new). Outcrops of the New Albany in southern tier of counties in central Kentucky are adjacent to outcrops of Chattanooga shale in central Tennessee and are treated as part of the Chattanooga. New names are proposed for some of the Chattanooga beds.

Named for exposures at New Albany, Floyd County, Ind.

New Arcadian Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in New Arcadian mine, Houghton County.

New Arcadian Flow[1]

Precambrian (Keweenawan): Northern Michigan

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in New Arcadian mine, Houghton County.

Newark Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Quarried in eastern part of Newark Township, Caledonia County.

Newark Group[1]

Upper Triassic: Massachusetts to North Carolina.

Original references: W. C. Redfield, 1856, Am. Jour. Sci., 2d, v. 22, p. 357; 1856, Am. Assoc. Adv. Sci. Proc., v. 10, p. 181.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 106–120. In southern Pennsylvania, the Newark is divided into New Oxford formation below and Gettysburg shale. This broad division can be recognized northeastward to eastern Pennsylvania southwestward into Maryland, but dividing line between them is more or less arbitrary and varies somewhat in stratigraphic position from one area to another.

D. B. McLaughlin and Bradford Willard, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 34–43. Newark group in Delaware Valley has been differentiated into Stockton, Lockatong, and Brunswick formations. If these units were a series in normal superposition, maximum thickness could be 14,600, the minimum 11,800 feet. As interpreted in this report, the Newark is not a group of three distinct formations successively deposited, but rather a series of interfingering, in part contemporaneously formed continental facies.

P. D. Krynine, 1950, Connecticut Geol. Nat. History Survey Bull. 73, p. 27–69. Includes (ascending) New Haven arkose, Meriden formation, and Portland arkose.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 40–42. Rocks of Newark group occupy two belts in North Carolina. One, commonly known as Deep River basin, lies along eastern edge of Piedmont Plateau and extends from Anson County on southwest to near Oxord [Oxford], Granville County, on northeast. Other belt lies in north-central part of Piedmont Plateau and consists of Davie County basin and Dan River basin. In Deep River basin, includes (ascending) Pekin, Cumnock, and Sanford formations.

E. P. Lehmann, 1959, Connecticut Geol. Nat. History Survey Quad. Rept. 8, p. 9–25. In Middletown quadrangle, Newark group comprises (ascending) New Haven arkose, Talcott basalt, Shuttle Meadow formation (new), Holyoke basalt, East Berlin formation (new), Hampden basalt, and Portland arkose.

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. In Avon quadrangle, Connecticut, the group includes (ascending) New Haven arkose, Talcott basalt, Shuttle Meadow formation, Holyoke basalt, East Berlin formation, Hampden basalt, and Portland arkose.

W. T. Parrott and R. S. Young, 1960, Virginia Acad. Sci. Geol. Field Trip May 14, geol. map. In Chesterfield County, includes Otterdale sandstone.

Named for occurrence at and around Newark, N.J.

Newark Canyon Formation

Lower Cretaceous: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 68–70. Proposed for beds of Lower Cretaceous age that include almost all strata mapped by Hague (1883, 1892), as Weber conglomerate. Lithologically heterogeneous to an extreme. Made up of fresh-water limestones, conglomerates that contain both siliceous and limestone boulders, silts, sandstones, and grits. These are dense porcellaneous rocks, with a high content of silt and locally of organic matter that weather to a light blue gray in most places, although locally brownish tints prevail. In some places, they contain small angular fragments of chert and grade into chert-pebble conglomerates. Silts, sandstone, and grits probably form greater part of sequence. The deep red-colored soil developed on formation is one of most characteristic features. Thickness 1,800 feet in Newark Canyon. Rests with angular unconformity on earlier formations from Pogonip group up to Carbon Ridge formation (new). Overlain unconformably by Tertiary(?) and Quaternary sediments and by volcanic rocks.

T. E. Eakin, 1960, Nevada Dept. Conserv. Nat. Resources Rept. 1, p. 26. In list showing generalized stratigraphy of Newark Valley and vicinity, Newark Canyon, Lower Cretaceous, occurs below Eocene Illipah formation (new) of Humphrey and above Permian Carbon Ridge formation.

Best exposures in Newark Canyon where they extend from above Hunter's Ranch to Newark Summit on west side of Diamond Mountains. Beds extensively developed in two main bands south and east of Eureka.

Newaukum Series[1]

Pre-Tertiary(?): Southwestern Washington.

Original reference: H. E. Culver, 1919, Washington Geol. Survey Bull. 19, p. 18–33.

P. D. Snavely Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 22–23. Dark shale and arkosic sandstone described by Culver (1919) as part of Newaukum series are mapped as McIntosh formation in this report [Centralia-Chehalis district]. The conglomerate, graywacke, and breccia in Culver's Newaukum series are probably equivalent to a part of Northcraft formation.

Typically exposed in channel of North Fork of Newaukum River, in sec. 19, T. 14 N., R. 1 E., Lewis County.

†New Bedford Gneiss[1]

Lower Paleozoic (pre-Devonian): Southeastern Massachusetts.

Original reference: E. Hitchcock, 1833, Rept. geol., min., bot., and zool. of Massachusetts, p. 389–390.

Occurs at New Bedford, Bristol County.

Newbern Shale (in Sumner Group)[1]

Newbern Shale Member (of Donegal Limestone)

Permian: Northeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12 (graphic section).

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 30. Term Wellington is used for section between top of Herington limestone and base of Ninnescah shale. Of the 10 subdivisions listed, Strickler limestone and Newbern shale members of Donegal limestone (Moore, 1936) are not very persistent; name Donegal limestone is not well founded.

Type locality and derivation of name not stated.

Newberry formation

Precambrian (Grand Canyon Series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 109–110. Amygdaloidal lava flow. Thickness about 100 feet. Overlies Hotauta conglomerate; underlies Bass limestone.

Name derived from Newberry Butte opposite which formation is best exposed; Grand Canyon region.

Newberry Lava Flow

Newberry Obsidian Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 37, 57–58, 60 (fig. 44), 62, 80 (fig. 64). Discussion of Mount Multnomah ancient ancestor of the Three Sisters. Flow on south slope of South Sister. Largest of recent trachytic flows. Covers 0.6 square mile. Named for J. S. Newberry who visited it in 1854–55.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 58, pl. 7(a), geol. map. Newberry obsidian flow mentioned in discussion of volcanoes of Three Sisters region. May be among youngest rocks of region.

South Sister Mountain is in eastern part of Lane County.

Newberry Pumice

Newberry Crater Pumice

Pleistocene: Southwestern Oregon.

B. N. Moore, 1934, Jour. Geology, v. 42, no. 4, p. 360 (fig. 1). Newberry Crater pumice shown on map showing distribution of pumice sheets of Crater Lake region.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 70 (fig. 16). Newberry pumice shown on map showing distribution and thickness of Crater Lake pumice.

I. S. Allison, 1945, Geol. Soc. America Bull., v. 56, no. 8, p. 789–808. On basis of lacustrine sedimentation, eruption of Newberry pumice took place about 10,500 years ago. Younger than Mount Mazama pumice and main Crater Lake pumice.

H. P. Hansen, 1946, Am. Jour. Sci., v. 244, no. 10, p. 713. Mentioned as Newberry pumice and Newberry Crater pumice in report on post-glacial forest succession and climate in Oregon Cascades. Newberry pumice is stratigraphically above Mount Mazama pumice.

H. P. Hansen, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1252. Position of Newberry pumic above Crater Lake pumice in Summer

Lake basin reveals that Newberry Crater erupted after Mount Mazama, but before late Wisconsin lakes had become entirely dissected. It is dated between 9,000 and 8,000 years ago.

Newberry volcano is north and east of Crater Lake.

New Bremen Granite (in Diana Syenite Complex)

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 84. A typical augen gneiss. Discussed under heading of Diana syenite complex.

Occurs near New Bremen, Lewis County.

Newburg Limestone[1]

Pennsylvanian: Western Kentucky.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, pl.

At Newburg, Henderson County.

Newburgh Limestone[1]

Lower Cambrian to Middle Ordovician: New York.

Original reference: W. W. Mather, 1840, New York Geol. Survey 4th Rept. of 1st district, p. 257.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329, 343. Name rejected. Synonymous with Stockbridge.

Occurs at Newburgh, Orange County.

New Burnside Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45 (table 1), 65, pl. 1. Name applied to member in lower part of Spoon formation (new) in southeastern Illinois. Overlies Bidwell coal member (new); stratigraphically below Curlew limestone member. Thickness 3 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent if rock-stratigraphic classification.

Type locality: SE¼SE¼SW¼ sec. 5, T. 11 S., R. 4. E., Johnson County. Upper of two coals mined in vicinity of village New Burnside.

Newbury Granite Gneiss[1]

Cambrian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for village or township in Woodsville quadrangle, eastern part of Orange County.

Newbury Volcanic Complex[1] or Formation

Upper(?) Silurian or Lower(?) Devonian: Northeastern Massachusetts.

Original references: B. F. McDaniel, 1884, Essex Inst. Bull., v. 16, p. 165; B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 105. Age of volcanics given as probably Upper Silurian or Lower Devonian.

U.S. Geological Survey currently designates the age of Newbury Volcanic Complex or Formation as Upper(?) Silurian or Lower(?) Devonian on basis of study now in progress.

Occurs in towns of Rowley and Newbury, Essex County.

Newburyport Quartz Diorite[1]

Precambrian or Upper Ordovician: Northeastern Massachusetts and southeastern New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 177–178, map.

M. P. Billings *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Guidebook for field trips in New England: Geol. Soc. America, p. 25, 29. Exposures in New Hampshire considered comagmatic with Salem-Dedham magma series in Massachusetts, but may possibly belong to New Hampshire magma series. Precambrian.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Precambrian or Upper Ordovician.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 45–46, 105–106. Age considered Precambrian or Lower Paleozoic.

Named for occurrence at Newburyport, Essex County, Mass.

Newby Formation

Triassic-Jurassic(?): Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 167–169. Series of black shales, tuffs, and breccias, and metalavas of andesitic and possibly basaltic composition. Lowest exposed part of formation composed of approximately 2,000 feet of marine black shale. Base of formation not recognized. Tentative total thickness 14,000 feet. In fault contact with Leecher and Methow gneisses (both new) in central part of quadrangle. Intruded by Chelan batholithic complex on southwest. Marked angular unconformity between Newby and overlying Virginian Ridge formation (new).

Type locality: Along Lookout Ridge from forest lookout tower west to Black Pine Lake, Methow quadrangle. Name taken from Newby Ridge, since the name Lookout is previously used.

Newby Glauconitic Sand Member (of Reklaw Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 65–71. In some areas, consists of light-yellow or pink and only slightly ferruginous friable sandstone with many layers of red-brown harder crinkly-bedded highly ferruginous glauconitic sandstone partings; elsewhere consists of alternating thin layers of slightly glauconitic sand, glauconitic brown shale, and brown clay-ironstone layers. Thickness about 20 feet. Gradationally underlies Marquez shale member (new); overlies Carrizo sand, boundary (in Leon County) placed where first highly ferruginous glauconitic and fossiliferous sandstones of Newby appear above less ferruginous nonglauconitic and nonfossiliferous sandstones of the Carrizo.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 34–78, pl. 1. Described in Henrys Chapel quadrangle.

First described in Leon County.

Newcastle Lens (in Newcastle Formation)

Upper Cretaceous: Northeastern Wyoming.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14–15. Composed of thick layers of sandstone interbedded with thin layers of shale, siltstone,

and bentonite. Has lateral extent of 25 miles along outcrop extending from Clifton where it is 2 feet thick, to Pedro, where it is 10 feet thick; maximum thickness 85 feet at Newcastle. A point in sec. 31, T. 46 N., R. 62 W., near Pedro, is arbitrarily taken as division between Newcastle and Osage lens (new).

Named for Newcastle, Weston County.

Newcastle Sandstone

Newcastle Sandstone Member (of Colorado Shale)

Newcastle Sandstone Member (of Graneros Shale)[1]

Newcastle Sandstone Member (of Omadi Formation)

Newcastle Sandstone Member (of Skull Creek Formation)

Lower Cretaceous: Northeastern Wyoming, southeastern Montana, western Nebraska, and western South Dakota.

Original reference: E. T. Hancock, 1920, U.S. Geol. Survey Bull. 716, p. 39, 42, 96.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Shown on columnar section as uppermost member of Omadi sandstone (new). Overlies Skull Creek member; underlies Graneros shale.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Rank raised to formation. Underlies Mowry shale; overlies Skull Creek shale. Upper Cretaceous.

A. J. Crowley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 83–107. Newcastle sandstone, formerly regarded as member of Graneros shale, is herein assigned to Lower Cretaceous. Table 1 shows Newcastle sandstone member in Skull Creek group, above Skull Creek shale and below Mowry shale. Area of report, Black Hills of Wyoming and South Dakota.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2196, 2197 (fig. 2). Formations in Black Hills that are equivalent to Colorado shale are Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. The Nawcastle of northern Black Hills consists of about 40 feet of lenticular sandstones, dark-gray shale, bentonite, and lignite. In central and northwestern Montana, equivalent rocks, 300 to 430 feet thick, are largely gray-weathering sandy shale, with numerous thin layers of bentonite. Greenish-gray glauconitic sandstone beds are conspicuous feature on Sweetgrass arch. Lower Cretaceous.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 5–44. Formation studied on west, north, and east flanks of Black Hills. Name Newcastle sandstone is misleading because unit referred to comprises a shale-siltstone facies and a sandstone facies; hence, term formation is used. Two phases of formation distinguished, a carbonaceous one on west and northwest flanks of Black Hills and a noncarbonaceous one on east flank. Formation changes laterally from a sandstone to a shale-siltstone facies. Formation is also lenslike in that its total thickness decreases in both directions along outcrop from points of maximum thickness. Thickens into lenses in both directions along outcrop from points of maximum thickness. Thickens into lenses in seven of areas studied. These lenses are named, in clockwise order, Newcastle, Osage, New Haven, Little Missouri, Tilford, Rapid City, and Hermosa; the first four are in Wyo-

ming, and the others are in South Dakota. Maximum thickness reported 86 feet; minimum 11½. Underlies Mowry shale; overlies Skull Creek shale. Upper Cretaceous.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 58. Newcastle sandstone, in Johnson County, Wyo., is about 40 feet thick. Overlies Skull Creek shale; underlies Mowry shale. In southern part of Powder River Basin and elsewhere, the unit has been called Muddy sandstone or Muddy sandstone member of Thermopolis shale.

Herbert Skolnick, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 787–815. Member of Skull Creek formation. Thicknesses: 93 feet at type section; about 12 feet, Butte County, S. Dak.; 16¾ feet, Custer County, S. Dak.; about 12 feet, Meade County, S. Dak. Lower Cretaceous. Faunal and mineralogical evidence indicates that physically and spatially the Skull Creek shale, Newcastle sandstone, and lower Mowry shale are sufficiently related to be considered one unit.

G. R. Wulf, 1959, Dissert. Abs., v. 20, no. 5, p. 1747. In eastern Montana and western North Dakota, a blanket type sand herein named Dynneson has been called Newcastle.

W. J. Mapel, C. S. Robinson, and P. K. Theobald, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–191. On northern and western flanks of Black Hills, Newcastle sandstone is 0 to 80 feet thick and consists of discontinuous beds of light-gray sandstone, siltstone, and dark-gray shale or claystone and a few beds of impure lignite and bentonite. Overlies Skull Creek shale; underlies Mowry shale. Lower Cretaceous.

W. A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc. v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

Type section (Skolnick): NW¼NW¼ sec. 28, T. 45 N., R. 61 W., exposed on northwest side of cut on U.S. Highway 85, 0.4 mile northeast of junction with U.S. Highway 16, 1 mile east of Newcastle, Weston County, Wyo.

New Chapel Chert Bed (in Silver Creek Limestone)[1]

Middle Devonian: Southeastern Indiana.

Original reference: G. I. Whitlatch and J. W. Huddle, 1932, Indiana Acad. Sci. Proc., v. 41, p. 363–371.

Guy Campbell, 1942 Geol. Soc. America Bull.. v. 53, no. 7, p. 1062. The two facies of upper bed of the Silver Creek more or less merge in central Clark County and contain layers of bedded chert and chert nodules. Name New Chapel chert bed (Whitlatch and Huddle, 1932) is only local and perhaps of secondary origin, and it does not identify bed as a whole or at all localities; therefore, term seems unnecessary.

Named from small country church in SW¼SE¼ sec. 37, Clark Grant, Clark County.

Newcomb Sandstone (in Slatestone Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes both massive and thin facies. Thickness as much as 60 feet; comonly 20. Occurs in upper part of group; overlies a shale interval 40 to 120 feet thick that in turn overlies Sand Gap sand-

stone (new); underlies shale and Jellico coal that underlie Indian Bluff group (new).

Named from Newcomb, Campbell County.

New Corydon Limestone[1]

Silurian (Niagaran): Northeastern Indiana and west-central Ohio.

Original reference: E. R. Cumings and R. R. Schrock, 1928, Indiana Dept. Conserv., Div. Geol. Pub. 75, p. 53, 54, 113–117.

D. A. Busch, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1976. New Corydon formation and underlying Huntington dolomite (restricted) are now known to extend into west-central Ohio.

J. B. Sangree, Jr., 1960, Dissert, Abs., v. 21, no. 6, p. 1528. Revision of Silurian stratigraphy of northern Indiana proposed. New Corydon and Liston Creek formations are tentatively considered cherty facies of Mississinewa formation.

Named for exposures in vicinity of New Corydon, Jay County, Ind.

New Design Group

Mississippian (Chester Series): Eastern and southern Illinois, northern Kentucky, and eastern Missouri.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 134. Name applied to lower part of Chester series in standard section of the Mississippian. Underlies Homberg group (new). In southern Illinois, includes (ascending) Renault limestone, Bethel sandstone, and Paint Creek formation; in Mississippi River counties, includes Aux Vases sandstone, Renault limestone, Yankeetown chert, and Paint Creek limestone.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull. v. 24, no. 5, p. 766 (fig. 1), 823–829. In Kentucky, includes Girkin limestone.

Named for New Design Township, Monroe County, Ill.

New Egypt Formation

Cretaceous-Eocene: Eastern New Jersey.

R. K. Olsson, 1959, Dissert Abs., v. 19, no. 8, p. 2063–2064. Five units were studied: Navesink, Redbank, Tilton, New Egypt, and Hornerstown formations. Of these, the New Egypt formation of outcrop area is a lateral equivalent of Tinton formation and in subsurface represents both the Tinton and Hornerstown. Cretaceous-Tertiary boundary is marked by spheroidal weathering at surface in northern part of outcrop area (Tinton and Hornerstown formations), but apparently lies within a lithic unit in the subsurface (New Egypt sand); deposition appears to have been unbroken here. Paleocene-Eocene boundary also lies within a lithic unit (Hornerstown and New Egypt formations).

Occurs in New Jersey Coastal Plain in area of New Egypt and Sewell.

Newett Limestone (in middle member of Belden Formation)

Newett Limestone Member (or Weber? Formation)[1]

Pennsylvanian: Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 973–1009.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 835. Newett limestone is in lower part of middle shale and limestone member of

Belden formation. Rocks of unnamed middle shale and limestone member formerly assigned to Weber(?) formation by Gould.

Named for abandoned town of Newett, in sec. 3, T. 14 S., R. 77 W., near which limestone is exposed. In Park and Chaffee Counties.

New Fork Tongue (of Wasatch Formation)

Eocene: Southwestern Wyoming.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 60, 61, 64. Composed of variegated red, brick-brown, purple, yellow-brown, green, and gray clay shales: fine arkosic conglomerates; and coarse-grained cross-laminated sandstones. Overlies Knight member; interfingers with Fontenelle member (new) of Green River formation. Thickness as much as 325 feet.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1072. Interfingers with Fontenelle, here considered tongue of Green River formation. New Fork and Fontenelle tongues are approximate stratigraphic equivalents of Cathedral Bluffs and Tipton tongues farther east.

Typically exposed in buttes overlooking Green River-New Fork River junction, Sublette County.

†Newfoundland Quartzite[1] or Grit[1]

Middle Devonian (Onondaga): Northern New Jersey and southeastern New York.

Original reference: E. C. Edkel, 1902, New York State Mus. 54th Ann. Rept., pt. 1, p. r148.

Named for occurrence at Newfoundland, Morris County, N.J.

New Galilee Clay Shale (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: F. W. DeWolf, 1929, Pennsylvania Topog. and Geol. Atlas 5, p. 30, 31, pl. 6.

Named for occurrence 1 mile east of New Galilee, Beaver County.

New Glarus Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 41, figs. 3, 10, 15A, 16. Thick-bedded limestone 3 to 6 feet thick. Shown on columnar section as underlying Medusa member (new) and overlying Dane member (new).

Occurs in Dixon-Oregon area.

New Hampshire Plutonic Series

New Hampshire Magma Series[1]

Upper Devonian(?): New Hampshire and east-central Vermont.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

M. P. Billings, 1935, Geology of the Littleton and Moosilauke quadrangles: Concord, New Hampshire State Plan. Devel. Comm., p. 26–28, geol. maps. Subdivided in Littleton and Moosilauke quadrangles, New Hampshire. New units named are Moulton diorite, Remick tonalite, Sugar quartz monzonite, French Pond granite, Moody Ledge granite, and Pond Hill granite.

R. W. Chapman, 1935, Am. Jour. Sci., 5th ser., v. 30, no. 179, p. [404], 405–406. Represented by Berlin gneiss and a quartz diorite in Percy area, New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1892–1894, pl. 1. Represented by Chatham group, Meredith porphyritic granite, and pegmatites in Belknap area, New Hampshire.

Katharine Fowler-Lunn and Louise Kingsley, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1368–1373, pl. 3. Concord granite assigned to series in Cardigan quadrangle, New Hampshire.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 377, 378, 400. Redefined Winnipesaukee quartz diorite included in series in Red Hill area, New Hampshire.

A. P. Smith, 1938, Geologic map and structure sections of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Map legend shows Tamworth granite (new) and Norway quartz monzonite (new) included in series. Age shown as post-Lower Devonian and probably Upper Devonian.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500): New Hampshire Highway Dept. Includes Haverhill granodiorite (new).

R. W. Chapman, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1187. Represented by Long Mountain granite (new) in Percy quadrangle, New Hampshire.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1075–1077, 1079–1081. Restricted. Berlin gneiss abandoned and now unnamed unit assigned to Oliverian magma series.

Katharine Fowler-Billings, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1265–1270, pl. 1. Occurs as large intrusive bodies in Monadnock region, New Hampshire. Oldest unit is Kinsman quartz monzonite, next youngest is Spaulding quartz monzonite (new), and youngest is Concord granite.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 464–467. Includes Exeter diorite, quartz diorite, quartz monzonite, binary granite, and microcline granite in Mount Pawtuckaway quadrangle, New Hampshire. Winnipesaukee gneiss no longer recognized in area.

W. S. White and M. P. Billings, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 662–667, pl. 1. Includes Ryegate granodiorite (new). Geographically extended to Vermont.

M. P. Billings, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, p. 25, 45. Ayer granodiorite assigned to series in southeastern New Hampshire. Newburyport quartz diorite in same area may possibly belong to series.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 53–65, 106–107, 125–129, 146–147, 186. Summary discussion of plutonic series. Characterized by presence of biotite and muscovite, generally gray color, less intense granulation than in Oliverian plutonic series, and white pegmatites. Upper Devonian(?); younger than Lower Devonian and older than Mississippian(?). Derivation of name.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 28, pl. 1. Map bracket shows plutonic series includes Moulton diorite and Kirby quartz monzonite (new) in Littleton quadrangle.

Type area: Littleton and Moosilauke quadrangles, New Hampshire. Named for extensive development in New Hampshire.

New Harmony Sandstone (in McLeansboro Formation)

Pennsylvanian: Southwestern Indiana and southeastern Illinois.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Illinois Univ., Abs. Thesis, p. 8. Massive sandstone. Unconformably overlies clayey shale above Lawrenceville shale (new); underlies New Haven limestone.

Well developed along Wabash River, just below New Harmony, Ind.

New Haven Arkose (in Newark Group)

Upper Triassic: Central Connecticut.

P. D. Krynine, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1919. Fluvial deposit. Underlies Meriden formation.

P. D. Krynine, 1950, Connecticut Geol. Nat. History Bull. 73, p. 30–31, 32, 37–57. At base is a light-gray conglomerate and conglomeratic arkose. Above, a lower and an upper division are recognized. In south-central Connecticut, lower division includes coarse white, gray, or mottled arkose with conglomerate and many fragments of metamorphic rocks; upper division includes coarse pink arkose with numerous conglomerate lenses forming two main horizons near base and top. In both divisions are subordinate layers of micaceous shaly sandstones and shales. In central Connecticut, the lower division west of Meriden consists of coarse grayish arkose with subordinate black shales; upper division includes fine-grained red micaceous feldspathic sandstone west of Meriden, and coarse pinkish-gray arkose with conglomerate layers east of Meriden. Maximum thickness about 7,500 feet. Newark group. More than one type locality designated because of facies variations.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 8 (table 1), 10, pl. 1. Oldest formation in Newark group. Underlies and is exposed in small area along central part of west margin of map [Middleton quadrangle]. Thickness about 10 feet where best exposed. Underlies Talcott basalt.

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Underlies most of western half of Avon quadrangle, Connecticut. Buried over nearly all of this area by deposits of glacial drift, talus, and alluvium. Thickness probably at least 5,000 feet. Upper contact exposed in three areas. In these exposures, the New Haven conformably underlies Talcott basalt.

Type localities: In south-central Connecticut: western slope of West Rock ridge, northern end of Whitney Avenue in Hamden, on Hartford Turnpike next to New Haven Country Club, and in quarries of Fair Haven. In central Connecticut: at Roaring Brook, and at Hanover Pond south of Meriden.

New Haven Clay[1]

Pleistocene, upper: South-central Connecticut.

Original reference: R. F. Flint, 1933, Geol. Soc. America Bull., v. 44, no. 5, p. 965–987.

P. D. Krynine, 1937, Am. Jour. Sci., 5th ser., v. 33, no. 194, p. 135–136. Described as red or brownish varved clay. Underlies buff or pink sand. Probably of lacustrine origin.

Occurs at and north of New Haven.

New Haven Coal Member (of Modesto Formation)

Pennsylvanian: Southeastern and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37. 50 (table 1), pl. 1. Uppermost member of Modesto formation (new). In

southeastern area, occurs above Chapel (No. 8) coal member (new); in southwestern area, occurs above Macoupin limestone member. Coal named by Kosanke (1950, Illinois Geol. Survey Bull. 74). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: NW¼ sec. 19, T. 7 S., R. 10 E., New Haven quadrangle, Gallatin County.

New Haven Lens (in Newcastle Formation)

Upper Cretaceous: Northeastern Wyoming.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 15. Entirely sandstone. Maximum thickness 44 feet near New Haven; 34 feet 3 miles south of New Haven.

Named for New Haven, Crook County.

New Haven Limestone (in McLeansboro Group)

New Haven Limestone Member (of McLeansboro Formation)[1]

Middle and Upper Pennsylvanian: Southeastern Illinois.

Original reference: A. H. Worthen, 1875, Illinois Geol. Survey, v. 6, p. 67.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as limestone in McLeansboro group; occurs below Flannigan cyclothem and above Trivoli limestone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 55 (table 3). Replaced by Shoal Creek limestone member of Bond formation (new).

Probably named for New Haven, Gallatin County.

Newkirk Limestone[1]

Permian: Central nothern Oklahoma.

Original reference: L. L. Hutchison, 1911, Oklahoma Geol. Survey Bull. 2, p. 205–206.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Exposed at Newkirk, Kay County.

Newland Limestone[1] or **Formation** (in Piegan Group)

Precambrian (Belt Series): Central western Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

Russell Gibson, W. F. Jenks, and Ian Campbell, 1941, Geol. Soc. America Bull., v. 52, no. 3, p. 371. Term Wallace instead of Newland used for formation younger than Ravalli and older than Striped Peak in Libby and Trout Creek quadrangles, northwestern Montana and northern Idaho.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Included in Siyeh group on map legend.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Newland limestone included in Piegan group. Dark-bluish-gray argillaceous dolomitic limestone with some argillite, locally schistose. In central and western Montana, Newland and Wallace formations have been treated as essentially synonymous terms by some authors.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. In Bonner quadrangle, Montana, Newland limestone underlies Miller Peak argillite. Piegan group.

Type locality: On Newland Creek, 10 miles north of White Sulphur Springs, Meagher County, between Big Belt and Little Belt Mountain.

New Lisbon Member[1] (of Tully Formation)

Middle Devonian: East-central New York.

Original reference: G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, p. 809.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1787, chart 4. Middle Devonian.

R. E. Stevenson, 1948, New York State Sci. Service Rept. Inv. 1, p. 2, 4. Further described as dominantly argillaceous sandstone with some interbeds of fine-grained storm-roller sandstone.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 29–30. Basal member of Tully. Consists of thin-bedded platy sandstone with some sandy shale. Underlies Laurens member.

Well exposed along first south tributary to Stony Creek, 1½ miles east of New Lisbon, Otsego County.

Newlon Limestone and Shale (in Kanawha Formation[1] or Group)

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1918, West Virginia Geol. Survey Rept. Barbour and Upshur Counties, p. 281.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. In lower part of Kanawha here considered a group.

Type locality not given but occurs east of Newlon, Upshur County.

New London Granite

New London Granite Gneiss[1]

Carboniferous, upper, or post-Carboniferous(?): Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 149, 152, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 61. Redescribed as granite, pink to light gray, fine grained to medium grained, and even grained.

Typical exposures in and about New London.

Newman Limestone[1] or Formation

Mississippian: Eastern Tennessee, eastern Kentucky, and southwestern Virginia.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 38.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 108–110, pt. 1, pls. Mississippian limestone sequence, here called Newman limestone, has been subdivided into five or six formations in southwestern Virginia, northwestern Georgia, and northern Alabama; the same units are certainly present in eastern Tennessee, but studies are not yet far enough advanced to make it feasible to show the units separately on present map. In general, limestone units equivalent to the Warsaw, St. Louis, and Ste. Genevieve, together with the lower part of Chester group, and the middle part of Chester group of Upper Mississippi Valley States can

be recognized. The Newman varies in character across area. Thickness 600 to more than 2,800 feet. Overlies Grainger formation; underlies Pennington formation.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. In Blockhouse quadrangle, Tennessee, rocks formerly referred to as Newman are renamed Greasy Cove formation.

Type locality: Newman Ridge, Hancock County, Tenn.

†Newman Sandstone Lentil (in Newman Limestone)[1]

Mississippian: Northeastern Tennessee.

Original reference: A. Keith, 1897, U.S. Geol. Survey Geol. Atlas, Folio 40.

Name derived from type locality of Newman limestone at Newman Ridge, Hancock County.

New Market Limestone (in St. Paul Group)

Middle Ordovician: Western Virginia, central Maryland, southern Pennsylvania, and eastern West Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 71–74. Proposed for succession of predominantly dense fine-grained limestone above the Beekmantown and below the dark-gray limestones of the *Dinorthis atavoides* zone (Lincolnshire limestone). Where typically developed, consists mainly of dove-gray high-calcium limestone. At type section, two divisions are recognizable: lower zone, composed mainly of thin-bedded dove-gray calcilutite in many places with a few feet of limestone- and dolomite-pebble conglomerate at base; and an upper zone which is thick to massive and nearly free of insoluble matter. Thickest and most characteristically developed on west side of Massanutten syncline where it has maximum thickness of 250 feet, 4 miles west of Edinburg; in most sections west of Massanutten Mountain, thickness is 75 to 100 feet. Thinner and locally absent east of Massanutten syncline; two-fold division less distinct, and average thickness considerably less than 50 feet. Thickness at type section 83½ feet. New Market is essentially same as unit identified by Butts as Mosheim in most parts of northern Virginia.

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 286–298, pl. 2. Included in St. Paul group (new). Geographically extended into Maryland, Pennsylvania, and West Virginia. Redescribed at type section, and thickness given as 144 feet; discrepancy between this and published 85 feet [83½] feet is due to inclusion of dolomitic beds intercalated with limestone at base of section; therefore, formation at type locality consists predominantly of dove vaughanite with some strata of darker fine-grained limestone, and includes beds of dolomitic and argillaceous limestone in lower part. Strata are traced continuously from type section into southern Pennsylvania. The New Market at Tumbling Run, Vaucluse, and Stephens City, Va., points intermediate between type section, and area of this report [Maryland], is underlain by Beekmantown dolomite and overlain by Lincolnshire limestone. From Winchester, Va., northward, formations that enclose New Market change; in absence of Lincolnshire, Edinburg or Chambersburg, limestone rests directly on New Market. Northeastward from Bessemer, W. Va., Row Park limestone (new) intervenes between Beekmantown and New Market. New Market thickens north of Martinsburg, W. Va., to maximum of 710 feet at Welsh Run, Pa. Maintains average thickness of 150 feet from Kernstown, Va.,

to Hainsville, W. Va.; in that distance, has minimum thickness of 90 feet at Kernstown and maximum thickness of 185 feet at Bessemer.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 79–80. To northeast of type section New Market thickens and its stratigraphy becomes complex. Neuman (1951) amplified New Market and identified the so-called "Lowville" underlying Chambersburg formation (Shippensburg of Craig) as New Market. Cooper and Cooper (1946, p. 69) identified the New Market underneath an 800-foot sequence of "Stones River" which immediately underlies the "Lowville." The New Market of Cooper and Cooper near Marion, Pa., fingers at the base with dolomites as it does at New Market. Newman named the 800-foot sequence of "Stones River" the Row Park formation. Cooper and Cooper (1946) had previously identified this sequence at Whistle Creek on basis of contained fossils. Below the New Market of Cooper and Cooper, Neuman discovered lime stone containing abundance of *Rostricellula*. The seemingly conflicting identification of New Market by Cooper and Cooper and Neuman can be interpreted as facies condition. It is postlulated here that both identifications of New Market are correct, but that the Row Park is a partial facies of the New Market and also the Whitle Creek. The New Market is sandwiched between *Rostricellula* beds of the Row Park at the base and the main body of the Row Park. It interfingers with main mass of Row Park and overlies it as it does near Marion, Pa.

F. M. Swartz and R. R. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 12–14. Overlies Brown Mills limestone member (new) of Row Park formation in Franklin County, Pa.

Type section: In Madden quarry, near New Market, Shenandoah County, Va.

New Mass Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: W. H. Weed, 1925, The Mines Handb., p. 1008–1049.

Occurs on property of Mass Consolidated Mining Co. in Ontonagon County.

New Mass Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

New Milford Formation (in Chemung Group)

New Milford Group (in Catskill Formation)[1]

New Milford parvafacies

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 68–70.

Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 588–593. Formation assigned to Chemung group. Includes (ascending) Kingsley red shale, Lanesboro, and Luthers Mills coquinite members (all new).

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 46. New Milford upper, middle, and lower sandstone (White, 1881) are included in Lanesboro formational suite. Wellsburg monothem; New Milford

lower sandstone is here named Drinker Creek sandstone member (of Lanesboro formational suite). Kingsley member of New Milford is classed as member of Wellsburg monothem. Figure 7 shows New Milford parvafacies as part of Chemung stage.

Named for exposures in New Milford part of Susquehanna County.

New Milford Sandstone[1] or Shale[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania Geol. Survey Rept. G_5, p. 68–70.

Well exposed in New Milford part of Susquehanna County.

New Oxford Formation (in Newark Group)[1]

Upper Triassic: Southern Pennsylvania and western Maryland.

Original reference: A. I. Jonas, 1928, Maryland Geol. Survey Carroll County, geol. map.

D. B. McLaughlin and R. C. Gerhard, 1953, Pennsylvania Acad. Sci. Proc., v. 27, p. 136–137. Termed subarkosic lithofacies in Lebanon and Lancaster Counties, southeastern Pennsylvania. Contains some beds of true arkose, much subarkose, and extensive interbeds of red sandstone poor in feldspar, as well as some red shale. Interfingers with Gettysburg sandstone lithofacies and is the southern, and to a considerable extent, lower and older unit. Transition marked by extensive interbedding of feldspathic and nonfeldspathic sandstones.

Named for exposures at New Oxford, Adams County, Pa.

†Newport Conglomerate[1]

Carboniferous: Southern Rhode Island.

Original reference: E. Hitchcock, 1861, Am. Jour. Sci., 2d, v. 31, p. 377.

Type locality: Purgatory Rocks, southern part of Narragansett Basin.

Newport Formation[1]

Pleistocene: Northwestern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 269.

Typically exposed at Newport, Lincoln County.

Newport Granite[1]

Devonian: Northeastern Vermont.

Original reference: C. H. Richardson, 1908, Vermont State Geologist 6th Rept.

Newport is in Memphremagog quadrangle, Orleans County.

Newport Group

Precambrian: Northeastern Washington and western Idaho.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (chart), 9, 19, pl. 1. Name applied to about 29,000 feet of argillaceous sandstones, argillite, quartzitic sandstones, quartzites, and carbonate rocks cropping out in area. Comprises (ascending) Bead Lake formation, No Name argillite, and Skookum formation. Neither base nor top of group observed in map area.

Named for exposures near Newport, Pend Oreille County, Wash.

Newport Limestone[1]

Upper Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1594.

Well exposed opposite furnace at Newport, Perry County, and 1 mile east, on bank of Juniata River.

Newport Shales and Sandstones[1]

Upper Devonian: Central southern Pennsylvania.

Original reference: F. Platt, 1881, Pennsylvania 2d Geol. Survey Rept. T., p. 28.

On Juniata River, Perry County.

Newport Neck Shale[1]

Precambrian: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 316–318, 383.

Occurs along west shore of Newport Neck.

New Providence Shale

New Providence Formation (in Borden Group)

New Providence Shale (in Osage Group)[1]

Lower Mississippian (Osage Series): Southern Indiana, eastern and northern Kentucky, and Tennessee.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 161.

C. W. Wilson, Jr., and E. L. Spain, Jr., 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 6, p. 805–809. In study of early Mississippian rocks of central Tennessee, Bassler (1912, U.S. Natl. Mus. Proc., v. 41, no. 1851) divided strata between overlying Fort Payne chert and underlying Maury shale member of Chattanooga shale into two formations; upper was correlated with New Providence shale and local type locality given as Whites Creek Springs, Davidson County; lower was named Ridgetop shale. In present report, local use of New Providence shale is accepted but strata designated as Ridgetop are considered a phase of the New Providence.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76–77, 79, 99–135, pls. 6, 8. New Providence formation is basal unit of Borden group in Indiana and Kentucky. In Indiana, overlies Rockford limestone or New Albany black shale and underlies Locust Point formation; in Kentucky overlies New Albany-Ohio black shale unit, except in northeastern part of outcrop belt where Bedford-Berea-Sunbury wedge separates it from Ohio shale and it rests directly on Sunbury; underlies Brodhead formation (new). Thickness in Kentucky ranges from 50 feet in Pulaski County to 350 feet at Kentucky-Ohio border. Misunderstanding exists regarding New Providence in Kentucky. This has arisen chiefly from claim by Butts (1922, Kentucky Geol. Survey, ser. 6, v. 7) that overlying Keokuk rocks thin rapidly from Jefferson County southeastward, eastward, and northeastward around outcrop belt that borders Lexington Plain and that New Providence gradually thickens to comprise entire clastic unit of shale and sandstone, over 550 feet

thick, between underlying Ohio shale, or Sunbury shale, and overlying Warsaw or younger beds. In this interpretation, Butts considered New Providence "group" of Kentucky equivalent to combined Cuyahoga and Logan formations of Ohio. Butts' usage of New Providence group for strata in Kentucky is abandoned. Present study indicates that New Providence consists of only lower part of clastic Mississippian strata of Kentucky and is equivalent only to Cuyahoga formation. Includes the following facies (in order of occurrence along outcrop belt around Lexington Plain from Indiana to Ohio): Silver Hills, Keith Knob, Junction City, Forbush Creek, Dicks River, Boone Gap, Stanton, Bluestone, and Vanceburg. Comprises the following members (not in sequence): Beaver Creek, Buena Vista siltstone, Churn Creek shale, Clay City siltstone, Farmers siltstone, Gum Sulphur siltstone, Henley shale, Kenwood sandstone, Rarden shale, and Vanceburg siltstone. Osage series.

J. E. Conkin, 1957, Bulls. Am. Paleontology, v. 38, no. 168, p. 110–124. Further subdivided in area of Silver Hills facies into (ascending) Coral Ridge (new), Button Mold Knob (new), and Kenwood sandstone members.

Named for New Providence, now Borden, Clark County, Ind.

New Richmond Sandstone[1] (in Prairie du Chien Group)

New Richmond Sandstone Member (of Prairie du Chien Formation)

Lower Ordovician: Central western Wisconsin, northern Illinois, northeastern Iowa, and southeastern Minnesota.

Original reference: L. C. Wooster, 1878, Wisconsin Geol. Survey Ann. Rept. 1877, p. 36–41.

G. M. Schwartz, 1936, Minnesota Geol. Survey Bull. 27, p. 41–42. Discussion of geology of Minneapolis-St. Paul area. Use of term New Richmond is continued here, but it is suggested that in eventual revision of nomenclature term be dropped for this area because the sandstone is thin and at places entirely missing.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 59–62. In southeastern Minnesota, term New Richmond is replaced by Root Valley sandstone (new). Importance of Root Valley horizon in stratigraphy cannot be ignored, even though interpretation of sandy beds commonly called New Richmond sandstone, or Root Valley horizon, remains unsatisfactory. Indications are that this sandy phase is basal part of Shakopee and probably a distinct member of that formation.

J. N. Payne *in* H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 59–60, pl. 18. Crops out more or less continuously along Fox River south of Sheridan from about center of sec. 5 to NE cor. sec. 18, T. 35 N., R. 5 E., LaSalle County. Appears to be conformable on Oneota dolomite below and with Shakopee formation which overlies it in normal sequence. However, major unconformity occurs above New Richmond along southwest limb of Kanakee arch in LaSalle and Kendall Counties and along narrow strips in Grundy and Livingston Counties where pre-St. Peter erosion removed Shakopee formation so that New Richmond is overlain directly by St. Peter sandstone. Thickness (based on well data) 160 to 190 feet. Prairie du Chien series. General classification of geologic time (p. 191, 192) discusses New Richmond stage of Prairie du Chien epoch.

H. B. Willman and J. S. Templeton, 1951, Illinois Acad. Sci. Trans., v. 44, p. 111 (fig. 2), 119–120. New exposure noted in Illinois. Overlies Oneota formation, also exposed in this area.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Field Conf., fig. 3. Columnar section for Dixon-Oregon area, Illinois, shows New Richmand sandstone in Prairie du Chien group above Oneota formation and below Shakopee formation.

R. L. Heller, 1956, Geol. Soc. America Guidebook Minneapolis Mtg.. Field Trip 2, p. 29–39. Rank reduced to member status in the Prairie du Chien herein considered formation. Member is represented by fine- to medium-grained quartzose sandstone and fine- to medium-grained light brownish-gray to buff arenaceous dolomite. Relatively thin throughout most of area. Locally, as at Martel, Wis., and in area around Fillmore, Houston, and Winona Counties, Minn., member is massive sandstone unit. Ranges in thickness from 5 feet in vicinity of type locality along Willow River in Wisconsin, to maximum of 45 feet at Lanesboro. Not well exposed in Minnesota River valley except at Mankato where it is about 8 feet thick. Overlies Oneota dolomite member; underlies Shakopee dolomite member. Studies indicate that New Richmond sandstone and Root Valley sandstone are same stratigraphic unit. Name New Richmond has priority and term Root Valley should be suppressed.

Named for exposures in vicinity of village of New Richmond, St. Croix County, Wis.

†New River coal series[1]

Mississippian: West Virginia.

Original reference: C. A. Ashburner, 1877, Am. Philos. Soc. Proc., v. 16, p. 519–560.

New River Formation (in Pottsville Group)

New River Group[1]

New River Series[1]

Lower Pennsylvanian: West Virgina and southwestern Virginia.

Original reference: W. M. Fontaine, 1874, Am. Jour. Sci., 3d. v. 7, p. 463.

David White, 1943, U.S. Geol. Survey Prof. Paper 197–C, p. 137. Referred to as New River formation in description of Lower Pennsylvanian flora.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (columns 11, 12). Shown on correlation chart as New River group, above Pocahontas group and below Kanawha group, Pottsville series. In southern West Virginia, includes strata from base of Fire Creek coal to top of Upper Nuttall sandstone; in northern West Virginia, extends from unconformity at base of Sharon conglomerate at top of Connoquenessing sandstone.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 144–145. Middle Pottsville has generally been referred to as New River formation or group in much of Appalachian region. Upper and lower boundaries are restricted and division defined as series. Division should extend from base of Lower Raleigh sandstone to base of Upper Nuttall sandstone of southern West Virginia. Correlative Sharon conglomerate, Olean conglomerate, Rockcastle conglomerate, Lower Caseyville conglomerate, and lower conglomerate of Lookout formation seem to mark natural boundary of

series in other parts of Appalachian region. Base of Lower Connoquenessing sandstone, Corbin conglomerate, Upper Caseyville conglomerate, and base of Upper Nuttall sandstone are interpreted as marking unconformity that serves as boundary between New River series and succeeding Kanawha series. In some reports, this middle Pottsville division has been called Sewell group.

C. B. Read and S. H. Mamay, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B381. Lower Pennsylvanian on basis of plant fossils.

Named for exposures along New River, W. Va.

†New River System[b]

Mississippian: Pennsylvania and West Virginia.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2, p. xxiii–xxx.

New Rochelle Serpentine[1]

Precambrian: Southeastern New York.

Original reference: F. J. H. Merrill, 1898, New York State Mus. 15th Ann. Rept., v. 1, p. 21–31.

Occurs at Davenport's Neck at New Rochelle, Westchester County.

New Salem Aplite[1]

Upper Carboniferous or post-Carboniferous: Northern central Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 244, map.

Extends up from Enfield through Prescott, Hampshire County, and New Salem, Franklin County.

†New Salem Serpentine[1]

Upper Carboniferous or post-Carboniferous: Northern central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 55.

Occurs on west slope of Rattlesnake Hill, Berkshire County.

New Scotland Limestone (in Helderberg Group)[1]

New Scotland Member (of Helderberg Limestone)

Lower Devonian: Eastern New York, western Maryland, Mississippi, New Jersey, eastern Pennsylvania, Virginia, and northern West Virginia.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

F. M. Swartz, 1930, U.S. Geol. Survey Prof. Paper 158–C. Includes Healing Springs sandstone member (new) in Virginia.

W. C. Morse, 1936, Mississippi Geol. Survey Bull. 32, p. 11, 14, 16, 17. Formation exposed in Tishomingo State Park. Upper 40-foot interval is massive hard gray limestone. Lower half of this 40 feet is very fossiliferous. Underlies Island Hill formation. Helderbergian series. Most of New Scotland will be submerged when Pickwick Dam is completed.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 55–62. In parts of Monroe County, eastern Pennsylvania, the New Scotland is similar to that of eastern New York. Composed largely of somewhat calcareous, fossiliferous shale. At base is impure siliceous

and argillaceous limestone which contains interbedded dark chert and corresponds in position to Kalkberg member in Hudson River valley. In central Pennsylvania, consists of finely crystalline gray limestone and interbedded chert, commonly in layers 2 to 4 or 6 inches thick. At Clarks Mill and Falling Springs, Perry County, cherty limestone is displaced by medium-bedded solid calcareous sandstone herein named Falling Springs sandstone member. Overlies Coeymans limestone and in some areas such as Monroe County, Stormville sandstone member. Underlies Becraft limestone in eastern Monroe County; sandstone of probable Oriskany age in Carbon County; Mandata shale and chert new in central Pennsylvania. Thicknesses: 160 feet at Nearpass quarries, New Jersey; 80 feet in eastern Monroe County; 40 feet near Palmerton; 10 to 30 feet in central Pennsylvania. Helderberg group.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 276–279. In areas where Helderberg limestone is best developed in Virginia, New Scotland limestone member succeeds Coeymans limestone member and is limited above either by Becraft limestone member or by Oriskany sandstone. Thickness 72 to 150 feet. In Bath and Alleghany Counties, includes basal sandstone named Healing Springs by Swartz.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg., Field Guide Leaflets, Trip A, C, and E; 1943, New York State Mus. Bull. 336, p. 44, 67, 71 [1946]. New Scotland beds comprise Kalkberg cherty limestone below and Catskill shaly limestone above. Underlies Becraft limestone; overlies Coeymans limestone.

H. P. Woodward, 1948, West Virginia Geol. Survey, v. 15, p. 82–95. Overlies Coeymans limestone; underlies Port Ewen limestone.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 83. In Maryland, New Scotland member of Helderberg consists of lower limestone containing several layers of white chert which replace the limestone, and an upper bed of drab soft fissile shale. Thickness 12 to 43 feet. Overlies Coeymans member; underlies Becraft member.

F. G. Lesure, 1957, Virginia Polytechnic Inst. Bull., Engineering Expt. Station Ser. 118, p. 48. Names New Scotland and Becraft limestones as used by Butts (1940) do not seem justified, and in this report [Clifton Forge iron district] term Licking Creek limestone is used to include all limestone beds above Healing Springs sandstone and below Ridgeley sandstone.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 4, 13. From top to bottom, the Helderberg members are Mandata shale, New Scotland limestone (notably cherty) and Coeymans limestone. Members are separable on faunal basis but not defined clearly enough for mapping purposes. Thickness of New Scotland member 8 feet at Bald Hill roadcut, 2 miles east of Hollidaysburg. Consists of gray to light-gray thick- to medium-bedded finely crystalline limestone containing diagnostic brachiopod *Eospirifer macropleurus*.

Named for exposures at town of New Scotland, Albany County, N.Y.

Newsom Shaly Clay[1] or Shale

Middle Silurian: Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

R. W. Morris and B. L. Hill, 1952, Bulls. Am. Paleontology, v. 34, no. 142, p. 5–16. Newsom shale, as exposed in vicinity of its type section, is a soft calcareous shale which upon weathering breaks down into a yellowish clay. Contains megafossil fauna which is closely related to that of Waldron shale of Indiana.

Named for Newsoms Station, Davidson County.

Newspaper Rock Sandstone (in Chinle Formation)

Upper Triassic: Northeastern Arizona.

H. R. Stagner *in* L. H. Daugherty, 1941, Carnegie Inst. Washington Pub. 526, p. 10, 11–12. Gray and quite massively bedded sandstone. Upper part finer in texture and more thinly bedded than lower part, and many layers have fine ripple foreset-type crossbedding, ripple marks, sun cracks, and fossil tracks. Upper part, greenish-gray on fresh surface, soon weathers to chocolate or reddish brown, and apparently hardens considerably in the process. Occasionally similar fine-bedded layers found within more massive lower part. About 30 feet thick at Newspaper Rock; thins southward at expense of its base and separated into from two to five or six beds by wedges of greenish-gray argillaceous very fine-textured shale. Lies between lower and upper bentonitic shale zone both in Chinle formation.

Typically developed at Newspaper Rock, sec. 16, T. 18 N., R. 24 E., from which it takes its name, Blue Forest area, Petrified Forest National Monument.

Newton cyclothem (in McLeansboro Group)

Newton cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 24–25. Occurs above Bogota cyclothem (new) and below Greenup cyclothem (new). Includes Newton limestones.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Included in McLeansboro group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Mattoon formation (new). Occurs above Woodbury cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Crooked Creek, in secs. 15, 16, 22 and 27, T. 7 N., R. 10 E., about 4 miles east and a little north of Newton, Jasper County.

Newton Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 24–25. A limestone in Newton cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 55 (table 3). Replaced by Reisner limestone member (new) of Mattoon formation (new). Name Newton preempted. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality (of cyclothem). Along Crooked Creek, about 4 miles east and a little north of Newton, Jasper County.

Newton Sandstone Member (of Crab Orchard Mountains Formation)

Newton Member (of Lee Group)

Newton Sandstone (in Crab Orchard Mountains Group)

Newton Sandstone (in Pottsville Group)[1]

Lower Pennsylvanian: Eastern Tennessee.

Original reference: W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33-A, p. 50–51.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvania geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4, 12–B. Assigned to Crab Orchard Mountains group (new). In type area, massive, medium grained, crossbedded, and locally conglomeratic; over most of outcrop area, fine to medium grained, massive, friable. Attains maximum thickness, 110 feet, in type area; thins abruptly along a northeast-southwest line. Underlies Vandever formation; overlies Whitwell shale, local unconformity. Conglomeratic phase of the Newton sandstone in southern Cumberland and northern Bledsoe Counties was the type "Herbert conglomerate" erroneously considered by Nelson (1925) to be older than the Newton; the shale thought to be between the sandstones and named "Eastland shale" is actually Whitwell shale. "Herbert conglomerate" and "Eastland shale" discarded.

U.S. Geological Survey currently classifies Newton Sandstone as member of Crab Orchard Mountains Formation on basis of study now in progress.

Type area: Vicinity of Newton, Cumberland County.

Newton Sandstone Member (of Everton Formation)[1]

Middle Ordovician: Northern Arkansas.

Original reference: E. T. McKnight, 1935, U.S. Geol. Survey Bull. 853.

E. E. Glick and S. E. Frezon, 1953, U.S. Geol. Survey Circ. 249, p. 4–6. Further described in Newton County. Overlies a sequence of limestone, dolomite, and sandstone, 245 feet thick in some areas, in lower part of formation; separated from overlying Jasper member by sequence of dolomite, sandy dolomite, and dolomitic sandstones about 90 feet thick. Middle Ordovician.

Named for prominent occurrences in northern Newton County.

Newton Creek Limestone (in Traverse Group)

Newton Creek Limestone Member (of Alpena Limestone)

Middle Devonian: Northeastern Michigan.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Brown, bituminous and crystalline limestone 25 feet thick. Underlies Alpena limestone.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 584–585. At type locality, underlies Alpena limestone (restricted to exclude unit now termed Newton Creek) and overlies Genshaw formation.

G. V. Cohee, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 28, footnote 23. Considered a member of Alpena limestone by Michigan Geological Survey.

Type locality: Quarry of Michigan Alkali Company SW¼ sec. 13, T. 31 N., R. 8 E., Alpena County. Exposed as far west as Afton, Cheboygan County.

Newton Hamilton Formation (in Onondaga Group)

Middle Devonian: Central Pennsylvania.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2860 (fig. 2), 2864 (fig. 3), 2865–2869. Proposed for widespread shaly facies of Onondaga group in central Pennsylvania. Typically greenish gray shale, weathering light gray in contrast to the sooty black, silvery-weathering Marcellus shales above. Thickness about 100 feet in Mount Union quadrangle, but because of poor exposures and possible shearing along western flank of Stone Mountain and Jacks Mountain precise thickness uncertain. Includes Hares Valley limestone and shale member (new) above and Beaverdam shale member (new) below. Overlies and parallels exposures of Ridgeley sandstone of Oriskany group.

Type section: Along Pennsylvania Railroad ½ to ¾ mile northeast and 1 mile west of Newton Hamilton, Mount Union quadrangle.

Newton Hills Sand

Pleistocene: Southwestern South Dakota.

J. K. Baird, 1957, (abs.) South Dakota Acad. Sci. Proc., v. 37, p. 116. Thick section of sand and clay. Considered by some early workers to be Tertiary in age and by others to be Pleistocene; probably interglacial. Present study indicates it is Pleistocene, interglacial.

Exposed in Big Sioux Valley bluffs from eastern boundary of Newton Hills State Park almost to Fairview, Lincoln County.

Newton Mine Volcanics (in Amador Group)

Jurassic: East-central California.

G. R. Heyl and J. H. Eric, 1948, California Div. Mines Bull. 144, pt. 1, p. 51, 52, 53, pl. 7. Series of schists and greenstone in Newton mine area (near Jackson, Amador County), tentatively correlated with Jurassic Amador group described by Taliaferro (1942) is subdivided into four formations (descending) Mountain Spring volcanics, Dufrene slate, Newton Mine volcanics, and Sunnybrook volcanics. Newton Mine volcanics consist chiefly of pale-green chlorite schist with lesser amounts of pale-green fine-grained bedded tuff, and blue-gray slate. Approximate thickness 752 feet. Measured section, along Mountain Spring Creek from Mariposa slate eastward, dips steeply to east; relation of beds to Mariposa slate suggests that section is overturned and is on west limb of an overturned anticline or its faulted equivalent.

Name derived from Newton mine, about 6 miles west of Jackson, Amador County.

†Newtonville Limestone[1]

Upper Mississippian: Central Ohio.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 93.

Named for Newtonville (now called White Cottage), Muskingum County.

New Ulm Conglomerate[1]

Cambrian(?): Southwestern Minnesota.

Original reference: F. W. Sardeson, 1908, Geol. Soc. America Bull., v. 19, p. 221–242.

Crops out on left side of Minnesota River opposite New Ulm, 1½ miles above Redstone, Brown County.

Newville Group

Upper Jurassic (Knoxville): Northern California.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint]. Shown as uppermost group in Knoxville series. Overlies Grindstone group (new); underlies Paskenta group of Shasta series.

F. M. Anderson, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 929–932. Described in type area as predominantly dark argillaceous shales that contrast greatly with sandstones and conglomerates of Grindstone group as found in its type district. Maximum thickness (near Chrome) about 4,000 feet, farther south, group diminishes in thickness, owing chiefly to an overlap on its eastern border by beds of Shasta series. Extends both longitudinally and laterally beyond limits of older Knoxville groups (Grindstone and Elder Creek) and rests unconformably upon pre-Knoxville terrains in distinct overlaps, which in many areas are emphasized by basal conglomerates. Strata of this group occur in many areas, both within and outside the Great Valley. A number of these areas are discussed.

Type area: Well exposed near Newville, Glenn County.

†New York System]

Cambrian, Ordovician, Silurian, and Devonian: New York.

Original reference: E. Emmons, 1842, Geology New York, pt. 2, div. 4, Geol. 2d dist., p. 99, 429.

New York City Group

Precambrian or Paleozoic (pre-Upper Devonian): Southeastern New York and western Connecticut.

D. M. Scotford, 1956, Geol. Soc. America Bull., v. 67, no. 9, p. 1158–1159, pl. 1. Poundridge area, Westchester County, is underlain by Poundridge and Siscowit granites and New York City group comprising Fordham gneiss, Inwood marble, and Manhattan formation. Group is a conformable sequence either of entirely Precambrian or Paleozoic (pre-Upper Ordovician) age. Name New York City group credited to J. J. Prucha (ms. in preparation).

J. J. Prucha, 1956, Am. Jour. Sci., v. 254, no. 11, p. 672–674. Proposed for sequence of metamorphic rocks consisting of (ascending) Fordham gneiss, Inwood marble, and Manhattan formation. Name Manhattan schist is considered inappropriate for highest formation of group because much of formation is not schist. Name Manhattan group has long been applied to these formations (Stevens, 1897; Merrill, 1890, Am. Jour. Sci., 3d, v. 39) although in late years term has been little used. It is convenient to retain a group name for these formations, but use of the same name for group as for formation within the group violates the code of American Commission on Stratigraphic Nomenclature. Although term Manhattan group was proposed before Manhattan as formation name, the latter use is more firmly established; therefore, it is proposed that term Manhattan group be abandoned and unit be

renamed New York City group. Age of New York City group has never been determined definitely. Recognition of Fordham gneiss as part of the group, and the nonexistence of "Lowerre quartzite" invalidate any correlation based upon presumed similarities in stratigraphic sequences between New York City group and Cambro-Ordovician series north of Hudson Highlands. It seems likely that a correlation will have to be made by way of Connecticut, Massachusetts, and Vermont rather than directly across the Highlands.

J. W. Clarke, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1812; 1958, Connecticut Geol. and Nat. History Survey Quad. Rept. 7, p. 4, 15–16, geol. map. Geographically extended into Danbury and Bethel quadrangles, Connecticut. To east and south of group is Hartland formation. In fault contact with units of Precambrian highlands which include gneissic granite and trondhjemite; hornblende gneiss and amphibolite; and Danbury augen granite.

Name proposed for area south of Hudson Highlands, in southeastern New York. Area includes Manhattan, Bronx, Westchester, and Putnam Counties.

Neylandville Marl (in Navarro Group)[1]

Neylandville Marl (in Taylor Group)

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: L. W. Stephenson and W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 488, 516.

L. W. Stephenson, 1941, Texas Univ. Bur. Econ. Geology Pub. 4101, p. 17–20. Consists of 150 to 300 feet of gray sandy, calcareous clay or marl that unconformably overlies Taylor marl, and underlies Nacatoch sand.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 48–49. Reallocated to Taylor group. Reallocation made on basis of Foraminifera, which are herein discussed.

Type exposures are along Bankhead Highway between Liberty School and Neylandville, 3 to 6 miles in airline northeast of Greenville, and in first cut of Texas Midland Railway, west of Neylandville Station, Hunt County.

Ngardok (Galdog) Beds

Ngardok Member (of Aimeliik Formation)

Eocene: Caroline Islands (Babelthuap)

Risaburo Tayama, 1935, Tohoku Univ. Inst. Geology and Paleontology in Japanese Language, p. 13, 17, 39–40 [English translation in library of U.S. Geol. Survey, p. 20, 46]; 1939, Japanese Jour. Geology and Geography Trans. and Abs., nos. 1–2, p. 29; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 64–65, table 4 [English translation in library of U.S. Geol. Survey, p. 76–77]. Thick complex of well-bedded greenish-colored tuffaceous shales and sandstones. Overlies Babelthuap formation with contact probably faulted.

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 44, 45, pls. 4, 8, 9. Uppermost member of Aimeliik formation. Andesitic-basaltic tuff, lapilli tuff, and volcanic breccia. Tuff is well bedded: beds range from 1 inch to 40 feet in thickness. Overlies Ngarsul member.

Exposed in vicinity of Nagardok Lake.

Ngarekeukl Limestone

Recent: Caroline Islands (Peleliu).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1951, Tohoku Univ. Inst. Geology and Paleontology Short Papers no. 3, p. 103, 105; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 67, table 4 [English translation in library of U.S. Geol. Survey, p. 80]. Ngarekeukl (Garukiyoku or Galkyoku) composed mainly of coral limestone with erect reef-building corals. Cannot be distinguished from older Pelelilu limestone on basis of lithology.

Typically developed on coast of Ngarekeukl, Peleliu.

Ngaremlengui Formation

See Almongui Agglomerate.

Ngarsul Member (of Aimeliik Formation)

Eocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 42–44, pl. 8. Consists of andesitic-basaltic volcanic breccia, tuff breccia, and tuff, including interbedded Galap tuff submember (new). Predominating rock types are light- to dark-colored fine to coarsely crystalline andesites and basalts. Constitutes greater part of formation which is about 2,000 feet thick (overlying Ngardok member probably not more than 500 feet thick). Overlies Babelthuap formation.

Occurs extensively in northeastern, eastern, and southern Babelthuap, and western part of Koror.

Ngeremlengui Formation

Eocene, upper or Oligocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 45–49, pls. 4, 8, 9. Consists of andesitic and dacitic volcanic breccia together with tuffs, flows, conglomerates, and related sediments. Thickness 2,000 to 4,000 feet. Consists of (ascending) Nghemesed, Medorm, and Arakabesan members (all new). Overlies Aimeliik formation; stratigraphically below Palau limestone.

Type locality: In Ngeremlengui municipality in vicinity of Rois Mlungi, 1½ miles north-northeast of Karamado Bay, Babelthuap.

Nghemesed Member (of Ngeremlengui Formation)

Eocene, upper, or Oligocene: Caroline Islands (Palau).

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands: U.S. Army Corps of Engineers, Far East, p. 46–47. Consists chiefly of volcanic breccia and flow breccias. Thickness about 350 feet at type location. Grades upward into Medorm member; overlies Aimeliik formation.

Type locality: At Nghemesed pier at east entrance to Karamado Bay.

Niagara Group,[1] Limestone,[1] or Dolomite[1]

Niagara Series

Niagaran Group, Series

Middle Silurian: New York, Illinois, Indiana, Iowa, Michigan, Ohio, and Wisconsin.

Original references: J. Hall, 1842, Am. Jour. Sci., 1st ser., v. 42, p. 52, 57–62; 1843, Geology of New York, pt. 4.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 26–101. From time of earliest State report, term Niagaran has been in every classification of New York Silurian, but its meaning has not been constant. At times it has been limited to single formation such as Niagara limestone or Niagara shale. In other instances, it has been enlarged to include whole Silurian section from base of Queenston to lowest layers of the Salina. According to Silurian classification by Hall (1843), name Niagara should be used as group term covering formations from top of Clinton to base of Onondaga salt group. In this report, term Niagaran series is used to include Lockport dolomite above and Clinton group (includes strata from base of Thorold sandstone to top of Rochester shale). Formations constituting series are a well-marked lithologic unit of limestones and shales, which are distinct from Medinan sandstones and sandy shales beneath and Cayugan salt and gypsum-bearing shales above. Niagaran is represented by fossiliferous shales and limestones of normal marine period. Thus, Niagaran is a lithologic, a stratigraphic, and a faunal unit.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 3. Silurian comprises (ascending) Albion, Niagaran, and Cayugan series.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1979–1996. Silurian system exclusive of Cayugan divided into (ascending) Medina(n), Clinton(ian), and Niagara(n) groups, the three comprising the Ontarian series. In New York, the Niagaran group includes the Lockport and Guelph interval.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. No. 1. New York Silurian, standard reference section for United States, is divided into two series Niagaran (older) and Cayugan. Niagaran series divided into four stages (ascending) Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian).

Named for exposures in Niagara County, N.Y.

†Niagara Limestone[1]

Silurian: New York.

Original reference: L. Vanuxem, 1839, New York Geol. Survey 3d Rept., p. 248.

†Niagara Sandstone[1]

Silurian: Western New York.

Original reference: T. A. Conrad, 1837, New York Geol. Survey 1st Rept., p. 166–172.

Developed in course of Niagara River.

†Niagara Shale[1]

Silurian: New York.

Original reference: T. A. Conrad, 1839, Philadelphia Acad. Nat. Sci. Jour., v. 8, pt. 1, p. 228–235.

Niagara Gulch Latite (in Silverton Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

Named for Niagara Gulch, east of Eureka, San Juan County.

Niakogon Tongue (of Chandler Formation)

Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour. v. 41, no. 5, p. 164, figs. 2, 3. Upper part of nonmarine Chandler formation (new). Thickness in southern part of outcrop area about 1,700 feet; wedges out northward. A persistent conglomerate bed, characterized by greater percentage of white quartz pebbles than is found in other conglomerates in region, forms top bed of tongue. Underlies Seabee member (new) of Schrader Bluff formation (new); overlies Topagoruk member (new) of Umiat formation (new). Lower(?) Cretaceous.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 240–241, figs. 3, 4, 5. Upper of two major nonmarine tongues of formation. Separated everywhere from Killik tongue (new) (formerly the Hatbox tongue) by at least a thin section of marine Ninuluk formation (new). Entire tongue grades northeastward into Ninuluk formation. Lithologically similar to Killik tongue [great abundance of thick-bedded sandstones], predominantly of "salt-and-pepper" type. Upper part of tongue contains considerable amount of yellow-red highly iron-stained sandstone. Thin stringers of conglomerate associated with some sandstone in upper part. Bentonite present in upper part. Siltstone, silt shale, and clay shale constitute about 50 percent of entire section. Referred to basal Upper Cretaceous.

Type locality: Niakogon Buttes, between Chandler and Anaktuvuk Rivers, in Northern Foothills section of Arctic Foothills province.

Nicely Shale (in Mowich Group)

Lower Jurassic: East-central Oregon.

R. L. Lupher, 1951, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 239, 242. Consists of fairly uniform dark-gray to black sandy shale with occasional spheroidal black calcareous concretions, some as much as 2 feet in diameter. Thickness 134 to 228 feet; pinches out beneath younger formations. Conformably overlies Suplee formation (new); overlain by Colpitts group (new) in type area and by Hyde formation (new) eastward in South Fork Valley.

Type area: Along headwaters of South Fork of Beaver Creek, 7 miles southeast of Suplee post office, in secs, 26, 27, 28, and 29, T. 18 S., R. 26 E. Named for old Nicely homestead on upper Beaver Creek, in sec. 29, T. 18 S., R. 26 E., Crook County.

Nicely Run Siltstone and Shale (in Kittanning Formation)

Pennsylvanian: Western Pennsylvania.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 73 (table 1), 87 (fig. 15), 88 (fig. 16). Shown on stratigraphic sections in Kittanning formation above what is termed Middle Kittanning complex. Includes Nicely Run coal at top. Overlies Middle Kittanning coal.

Exposed northeast of Hamilton, Jefferson County, and east of Luthersburg, Clearfield County.

Nicholas Limestone Member (of Cynthiana Formation)[1]

Middle Ordovician: North-central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1909, Denison Univ. Sci. Lab. Bull. 14, p. 209, 210, 294, 297.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1641. Division of the Cynthiana. Medium- to coarse-grained medium- to comparatively heavy-bedded quarry rock, typically developed in Nicholas County, Ky., where it is 35 feet thick, and overlies Millersburg limestone. Widespread facies and includes quarry rock at Cynthiana, River Quarry beds at Cincinnati, and probably upper and greater part of railroad cut at Greendale Station. On the south, grades into argillaceous rock. Underlies Rogers Gap and partly included in it. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of Cynthiana. This includes lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 260, 265. Suggested that lowest occurrence of *Cryptolithus tessclatus* marks base of Nicholas member; top of Nicholas is marked by first appearance of *Eridorthis nicklesi*. Beds below *Cryptolithus tessclatus* zone carry a typical Greendale fauna; it is suggested that name Greendale be applied to these beds. Cincinnati series should be extended downward to embrace Cynthiana formation.

Named for Nicholas County, Ky., where it is well exposed southwest of Pleasant Valley.

Nichols Shale
Nichols Slate[1] (in Chilhowee Group)

Lower Cambrian(?): Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 3.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, p. 628–629 (fig. 1). Included in Cochran quartzite in Hot Springs area, North Carolina.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13 (table 3), 18. Rocks mapped by Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) as quartzite lentil and lower part of Nichols slate as Cochran conglomerate are included in Unicoi formation in this report [Hot Springs Window area].

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 35 (table 3), 38–39; pt. 1, pls. Nichols shale described and mapped in eastern Tennessee where it is 800 to 1,000 feet thick. Overlies Cochran conglomerate; underlies Nebo sandstone. Keith (1895) called the unit Nichols shale but lated referred to it as slate. Lower Cambrian.

R. B. Neuman and R. L. Wilson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–131. Described in Blockhouse quadrangle, Tennessee, where it consists of gray fissile argillaceous siltstone and fine-grained sandstone 100 to 600 feet thick. Overlies Cochran formation; underlies Nebo quartzite. Lower Cambrian(?).

Named for Nichols Branch of Walden Creek at eastern end of Chilhowee Mountain, Sevier County, Tenn.

Nicholville Conglomerate Member (of Potsdam Sandstone)

Upper Cambrian: Northeastern New York.

A. W. Postel, A. E. Nelson, and D. R. Wiesnet, 1959, U.S. Geol. Survey Quad. Map GQ–123. Friable red quartz-pebble conglomerate with intercalated sand lenses; crossbedding and local unconformities common. Underlies and probably interfingers with unnamed upper member. Base not exposed; believed to unconformably overlie Precambrian.

Type section: Gorge of St. Regis River, at Nicholville, Nicholville quadrangle, St. Lawrence County. Crops out in a reentrant in Precambrian boundary.

Nickwacket or Nickwackett Graywacke

See **Nickwaket Graywacke.**

Nickwaket Graywacke[1]

Nickwaket Member (of Mendon Formation)

Precambrian: Western Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 362, 394.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. [Guidebook] 34th Ann. Field Mtg., p. 12, 13. Nickwackett graywacke included as uppermost formation in Mendon series in Castleton quadrangle.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 13, 15. Age of Nickwacket graywacke designated either Precambrian or Lower Cambrian.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 30, 33, 34. Nickwacket reduced to member status in Mendon formation. Overlies Forestdale member. Thickness 25 to 800 feet in Rutland area.

P. H. Osberg, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 47. Included in Pinnacle formation of this report [Coxe Mountain area, Vermont].

Well exposed on Nickwaket Mountain in southwestern corner Rochester quadrangle, Rutland County.

Nicollet Creek Member (of St. Lawrence Formation)

Upper Cambrian (St. Croixian): Southeastern Minnesota.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1239–1240. Glauconitic dolomite, probably 30 to 40 feet thick; includes shales and conglomerates below quarry beds at old type section of St. Lawrence formation. Underlies Lodi member; overlies Bad Axe member of Franconia. [Probably replaces name Judson member.]

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 30, 45. Type section designated.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 171. Term Black Earth dolomite used for basal member of St. Lawrence; this follows usage of Ulrich (1916). Examination of type section of Nicollet Creek shows that all but the upper 10½ feet is uppermost Franconia. Suggests that Nicollet Creek be abandoned on grounds of stratigraphy and priority.

Type section: Along Nicollet Creek which enters Minnesota River from north, nearly opposite village of Judson, Nicollet County.

Nigger Canyon Volcanics

Pleistocene: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 3, 9, 15, pl. 1. Series of tuffs, agglomerates, dikes, and flows. Thickness as much as 100 feet. Considered younger than Pauba formation (new).

Occurs near mouth of Nigger Canyon in Elsinore fault zone in western Riverside County.

Niguel Formation

Pliocene: Southern California.

J. G. Vedder, 1956, *in* Pacific Petroleum Geologist, v. 10, no. 2, p. 3. Incidental mention.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. In type area, composed mainly of light-gray friable micaceous sandstone with interbedded gray sandy siltstone; breccia and conglomerate locally present at or near base of formation; upper part of formation may be nonmarine in origin. Maximum thickness about 350 feet. Unconformably overlies both Capistrano formation and Monterey shale; underlies Quaternary terrace deposits.

Type area: Immediately west of Galivan Overpass on U.S. Highway 101 about 4½ miles north of San Juan Capistrano, Orange County. Named for Niguel land grant on San Juan Capistrano quadrangle.

Nikolai Greenstone[1]

Nikolai Formation

Permian and Triassic(?): Eastern Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 425–432.

H. E. Wheeler, 1939, 6th Pacific Sci. Cong. Proc., p. 374. Represents 4,000 feet or more of altered basic lavas in Mount Wrangell district. Permian.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

In Nizina-Tanana region

Nikolai Creek Glaciation

Pleistocene (late Wisconsin): Central southern Alaska.

D. B. Krinsley *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 6, 13 (table 1). Southwest part of Kenai Peninsula glaciated three or more times during Quaternary period. Nikolai Creek succeeded Naptowne glaciation. Prominent moraine is evidence of glacial advance. Drift of the glaciation is thin; till generally coarse grained and contains numerous granite boulders.

Moraine is near Nikolai Creek at Tustumena Lake and can be traced south along eastern flanks of Caribou Hills and southwest along northwest bluffs of Kachemak Bay to within 10 miles of Homer.

Niland Tongue (of Wasatch Formation)

Eocene, lower: Southwestern Wyoming.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100, 101 (chart), 102. Sequence of coal beds, clay shale, silt-

stone, sandstone, and low-grade oil shale. In type area, contains four coal zones (ascending) Kelley, Luman, Hay, and Bush. Thickness in type area about 400 feet; thins westward to about 325 feet in Luman Butte area. Underlies Tipton tongue and overlies Luman tongue (new), both of Green River formation, with conformable contacts. Intertongues with Battle Spring formation (new) to north.

Type area: SW¼ T. 24 N., R. 95 W., and SE¼ T. 24 N., R. 96 W., Sweetwater County. Named for rocks which crop out at southern margin of structural basin called Niland Basin and along north side of Lost Creek Flat. Named from Niland's Spring in sec. 23, T. 25 N., R. 96 W.

Niles Canyon Formation

Lower Cretaceous: Northern California.

C. A. Hall, Jr., 1956, Dissert. Abs., v. 16, no. 12, p. 2426. Incidental mention; overlies Claremont shale; underlies Del Valle formation (new).

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 8–11, fig. 2, geol. map. Consists of sandstone, sandy shale, and some conglomerate stringers. Two members are distinguishable at certain localities. Lower member, which comprises greater part of formation and is well exposed in Niles, Stonybrook, and Sinbad Canyons, is principally shale or siltstone with interbedded sandstone and a few lenses of conglomerate; interbedded sandstone is fine to coarse grained, well indurated, massive, but is commonly thinly bedded; massive beds are 10 or more feet thick, whereas thinly bedded sandstone is in layers 2 to 12 inches thick. Upper member lacks shale and siltstone and cannot be traced into Niles Canyon area. Thickness in question because of faulting, overturning, and folding; approximately 4,000 feet in Main-Pleasanton Ridge area; about 5,500 feet in Niles Canyon; north of Niles Canyon, a 7,500-foot section lies between eastern branch of Mission fault and Stonybrook fault. Conformably overlies Oakland conglomerate; underlies Del Valle formation in Sunol Ridge area; unconformably underlies Claremont shale in Niles quadrangle; underlies Briones and Sobrante sandstones with slight angular discordance. Rocks here referred to Niles Canyon formation were originally assigned to Chico formation by earlier workers. Crittenden (1951) stated that rocks in Pleasanton and San Jose quadrangles were not a part of Chico and renamed them Berryessa formation. Neither name is considered appropriate; hence, Niles Canyon is herein proposed.

Type locality: In Niles Canyon along Alameda Creek, between Niles and Stonybrook Road, secs. 15, 10, 11, T. 4 S., R. 1 W., Alameda County; neither stratigraphic top or base exposed. Formation has continuous northwest-southeast trend for approximately 8 miles along Walpert Ridge and other ridges to Niles Canyon: also exposed from Niles Canyon to border of area near Calaveras Reservoir.

Nilkoka Group[1]

Precambrian: Eastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 472, 480, 483.

Exposed on bluffs of lower Tanana River between Nilkoka Creek and Baker Creek.

Nimrod Limestone (in Cisco Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 136.

Named for exposures near Nimrod, Eastland County.

Nimrod Shale (in Pueblo Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. Bradish, 1929, Texas Bur. Econ. Geology, geol. map.

In Shackelford, Stephens, and Eastland Counties, Brazos River region.

Ninemile Formation (in Pogonip Group)

Lower Ordovician: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 27–28, pl. 2. Platy and thin-bedded fine-grained to porcellaneous limestone of medium-gray color, which, on fresh fracture, exhibits an olive-green or greenish-blue cast. Shale and limy-shale partings likewise show this distinctive color. Includes beds of light-gray crystalline sandy limestone and limy sandstone. Ranges in thickness from less than 200 feet to more than 500 feet in Antelope Valley area; about 540 feet thick at type locality. Contacts with overlying Antelope Valley limestone (new) and underlying Goodwin limestone are gradational.

Type locality: Mouth of Ninemile Canyon, where unit is well exposed and from which it gets its name, on west side of Antelope Range near its north end, vicinity of Eureka, Eureka County.

Nineveh Limestone Member (of Greene Formation)[1]

Permian: Eastern Ohio, western Pennsylvania, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22, 32–33.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as 8 feet of limestone. Separated from overlying Nineveh sandstone by 10 feet of shale and Nineveh coal; separated from underlying Fish Creek sandstone by Hostetter and Fish Creek coals.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic section of Dunkard group in Harrison County, W. Va. Underlies unnamed shale below Nineveh coal; overlies unnamed shale above Burton sandstone.

Type locality and derivation of name not given.

Nineveh Sandstone Member (of Greene Formation)[1]

Permian: Eastern Ohio, western Pennsylvania, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 22, 32.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as 52 feet of sandstone underlying Gilmore limestone and separated from underlying Nineveh limestone by Nineveh coal.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic section of Dunkard group in Harrison County, W. Va., as sandstone 20 to 25 feet thick.

Named for exposures near Nineveh, Greene County, Pa.

Ninnescah Shale (in Sumner Group)

Ninnescah Shale Member (of Harper Sandstone)

Permian: Southern Kansas and northern Oklahoma.

G. H. Norton, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1557. Basal member of Harper. Underlies Stone Corral member; overlies Milan limestone member of Wellington shale. Near Oklahoma line, lower three-fourths of Ninnescah shale, which totals 290 to 390 feet, grades irregularly and rapidly into sandstones and conglomerates of the Garber of Oklahoma.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1667–1773. Rank raised to formation. Constitutes basal formation of Cimarron redbeds. Composed largely of red shale; minor amount of gray shale beds and thin impure limestone beds, and beds of calcareous sandstone and sand, which maintain their lithologic character in a wide area; seven of these beds are scarp-forming. About 425 feet thick near Oklahoma line; thins to 280 feet 50 miles farther north. At northernmost outcrop, topmost bed is Runnymede sandstone (new).

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 159–160. Ninnescah shale assigned to Sumner group, Leonard series.

Named for exposures on both forks of Ninnescah River in south-central Reno and north-central Kingman Counties, Kans.

Ninole Tuff

Pliocene(?): Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 37–38, 134. Thickness 12 feet at type locality of Ninole formation where it occurs about 500 feet below top of a 1,000-foot exposure.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 119. Now included in Ninole volcanic series. Pliocene(?).

Interbedded with Ninole basalt on south slope of Mauna Loa.

Ninole Volcanic Series

Ninole Basalt'

Pliocene(?): Hawaii Island, Hawaii.

Original reference: H. T. Stearns, 1926, Geol. Soc. America Bull., v. 37, p. 150.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 62 (table), 64 (table), 65 (fig. 17), 66–68. Term Ninole volcanic series replaces older term Ninole basalt. Mostly basaltic lava flows, predominantly massive pahoehoe, with a few beds of aa, as much as 75 feet thick but mostly thinner; bed of plagonitic tuff 2 to 12 feet thick 500 feet below top. Thickness more than 2,100 feet; base not exposed. Overlain with erosional unconformity by Kahuku and Kau volcanic series (both new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956. Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 120. Pliocene(?).

Type section: In walls of Ninole Valley, at Puu Enuhe, north of Hilea in Kau district. Crops out in hills between Qaiohinu and Wood Valley, a distance of 15 miles, on southeast slope of Mauna Loa.

Ninos schist[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 10.

In Solitario Mountain region, northwest of Las Vegas, San Miguel County. Derivation of name not given.

Ninuluk Formation (in Nanushuk Group)

Upper Cretaceous: Northern Alaska.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 241–244, figs. 4, 5. Greenish gray siltstone, silt shale, and dark blue-gray clay shale constitute about 60 percent of sequence. Coarse clastics account for most of remainder. Several thick sandstone units present near top of formation. Stringers and lenses of grit-pebble conglomerate present at intervals throughout coarser clastic units. Sandstone grades from "salt-and-pepper" through various shades of gray and yellow-red. Most have distinct greenish cast. Thickness at type locality 657 feet, and in addition 261 feet of interfingering nonmarine Niakogon tongue of Chandler formation are well exposed in about middle of entirely marine Ninuluk formation. Unconformably underlies Seabee formation; conformably overlies Grandstand formation (new) and nonmarine Killik tongue (new) of Chandler formation.

Type locality. On right bank of Colville River at Ninuluk Bluffs 20 miles downstream from junction of Killik and Colville Rivers, lat 69°08′ N., long 153°18′ W.

Niobrara Formation,[1] Limestone,[1] Shale, or **Chalk** (in Colorado Group)

Niobrara Shale Member (of Mancos Shale or Cody Shale)

Upper Cretaceous: Nebraska, Colorado, Kansas, Minnesota, Montana, New Mexico, North Dakota, South Dakota, and Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Sci. Proc., v. 13, p. 419–422.

W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165. Subdivided into Sage Breaks shale and Beaver Creek chalky members.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 30–33. In Colfax County, N. Mex., formation is about 950 feet thick, conformably overlies Carlile shale and conformably underlies Pierre shale. Comprises Fort Hays limestone and Smoky Hill marl members. Fort Hays limestone believed to be equivalent to part of Timpas limestone of previous usage, and Smoky Hill marl approximately equivalent to Apishapa shale.

C. H. Dane, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 78. In Rio Arriba County, N. Mex., Niobrara is considered member of Mancos shale. Thickness about 600 feet. Overlies Carlile shale member; underlies an unnamed shale member at top of Mancos.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2170, 2187, 2192–2195, 2196–2198; W. A. Cobban and J. B. Reeside,

Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 1948–1949. Formations in Black Hills that are equivalent to Colorado shale of central and northwestern Montana are (ascending) Fall River sandstone, Skull Creek shale, Newcastle sandstone, Mowry shale, Belle Fourche shale, Greenhorn formation, Carlile shale, and Niobrara formation. In northern Black Hills, Niobrara consists chiefly of gray chalk marl that weathers creamy, pale yellow, or orange; thin layers of bentonite abundant; dark-gray noncalcareous shale partings present near base and top of formation. Sage Breaks shale reallocated to member status in Carlile shale.

As corollary to above action, U.S. Geological Survey has abandoned the term Beaver Creek chalky member of Niobrara; hence Niobrara in some areas is undifferentiated.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. In Hardin area, Big Horn and Yellowstone Counties, Mont., Niobrara is considered shale member of Cody shale. Thickness 409 feet. Underlies Telegraph Creek member; overlies Carlile shale member.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (column 21). In Raton region, New Mexico, formation includes (ascending) Timpas limestone and Apishapa shale members. Overlies Carlile shale and underlies Pierre shale.

A. B. Shaw, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basin, Colorado, p. 49 (fig. 1), 50. Correlation chart shows various relationships: North Park, Colo., Niobrara formation comprises lower unnamed shale member and Smoky Hill member; overlies Frontier formation; Laramie basin, formation comprises (ascending) lower shale member, lower chalky member, upper shale member, and upper chalky member; overlies Wall Creek sandstone member of Frontier formation; underlies Steel shale; northern Front Range, formation comprises Timpas limestone and Apishapa shale members; overlies Benton shale.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basin, Colorado, p. 53, pl. 1. Formation described in Red Dirt area, Grand County, Colo., where it is divided into Fort Hays and Smoky Hill members. Believed that names Fort Hays and Smoky Hill have priority over terms Timpas and Apishapa; use of former terms would help standardize Niobrara terminology in west-central Colorado.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 48–49. Described in Buffalo-Lake De Smet area, Johnson and Sheridan Counties, Wyo., where it is classified as member of Cody shale. Thickness 985 feet. Overlies Carlile shale member; underlies unnamed sandstone and shale member.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Chart shows Niobrara chalk in Colorado group comprises (ascending) Fort Hays limestone and Smoky Hill chalk members. Underlies Sharon Springs shale member of Pierre shale and overlies Codell sandstone member of Carlile shale.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 12 (table 1), 21–29, pl. 1. Formation described in Yankton area, South Dakota and Nebraska, where it is 182 feet thick and comprises Fort Hays limestone and Smoky Hill chalk members. Overlies Carlile shale; underlies Pierre shale.

Named for exposures along Missouri River near mouth of Niobrara River, Knox County, Nebr.

†Niobrara Group[1]

Miocene, Pliocene, and later(?): Northern Nebraska, eastern Colorado, and eastern Wyoming.

Original reference: O. C. Marsh, 1875, Am. Jour. Sci., 3d, p. 51–52, pl. 9.

Niobrara River cuts through typical strata for more than 200 miles.

Niobrara River Channel Sands (in Valentine Formation)

Pliocene: Northwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 137. Name applied to channel sands from which Niobrara fauna of Stirton and McGrew (1935, Am. Jour. Sci., 5th ser., v. 29, no. 170) was collected. Age of fauna is regarded as transitional from Miocene to Pliocene with some emphasis to Miocene relations; however, geologists and paleontologists of Nebraska prefer to place the Miocene-Pliocene boundary at base of Valentine formation.

Fauna was collected from the so-called Railroad quarries, on south side of Niobrara River, south of Valentine, Cherry County.

Niobrara River Formation[1]

Pliocene: Nebraska, Colorado, and Wyoming.

Original reference: H. F. Osborn, 1918, Am. Mus. Nat. History Mem., new ser., v. 2, pt. 1, p. 9, 23, 25.

P. O. McGrew and G. E. Meade, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 197–207. Discussion of bearing of Valentine area, Nebraska, in continental Miocene-Pliocene correlation. Evidence is presented which supports retention of names Niobrara River, Burge, and Valentine.

F. W. Johnson, 1938, Am. Jour. Sci., 5th, v. 36, no. 213, p. 215–219. Proposed to consider Fort Niobrara and Niobrara River as obsolete and incompatible to good geologic nomenclature. Name Valentine beds should be retained and applied to lower 175 to 225 feet of unconsolidated sands of Ogallala formation in Valentine area, Nebraska.

Type area: On Niobrara River, near Fort Niobrara, Cherry County, Nebr.

Nipper Formation

Upper Cretaceous to Tertiary: Southeastern Arizona.

F. F. Sabins, 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1323, 1325, pl. 1. Lower half of formation is thick conglomerate of mafic volcanic rocks. The poorly sorted well-rounded cobbles and boulders range up to several feet in diameter, and are tightly cemented in matrix of graywacke sandstone. Very dark purple and green dominant colors. South of Nippers, a 20-foot bed of Paleozoic limestone conglomerate is interstratified with this sequence. Light-weathering aphanitic andesite flows comprise much of upper part of formation. Underlies Faraway formation; overlies Bisbee group at some localities and unconformably overlies upper Paleozoic strata at others.

Type locality: At the Nippers and other hills south of Blue Mountain in southwest corner of Vanar quadrangle, Cochise County. Also forms ridge between Whitetail and Indian Creeks in sec. 20, T. 16 S., R. 30 E., and occurs southwest of Cochise Head, Cochise County.

Nippewalla Group

Permian: Southern Kansas.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1782–1793. Proposed for group of related formations (ascending): Harper sandstone (restricted), Salt Plain formation, Cedar Hills sandstone, and Flowerpot shale. Lies between Stone Corral formation below and Blaine formation above. Cimarron series.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 157–159. Includes (ascending) Harper sandstone, Salt Plain formation, Cedar Hills sandstone, Flowerpot shale, Blaine formation, and Dog Creek shale. Thickness approximately 930 feet. Overlies Sumner group; underlies Whitehorse sandstone. Leonardian.

Named for township of Nippewalla, T. 33 S., Rs. 11 and 12 W., Barber County.

Nipsachuck Gneiss

Precambrian(?): Northeastern Rhode Island.

G. M. Richmond *in* G. M. Richmond and W. B. Allen, 1951, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 4, p. 10, 11, pl. 1. Light-gray medium-grained equigranular gneiss. Thin quartzite layers locally interbedded. Maximum thickness 1,400 feet. Underlies Absalona formation (new), contact gradational.

Named from exposures on hills southwest of Nipsachuck swamp, Georgiaville quadrangle, Providence County.

Nishnabotna Sandstone[1]

Upper Cretaceous: Southwestern Iowa.

Original reference: C. A. White, 1867, Am. Jour. Sci. 2d, v. 44, p. 27, 31.

Named for East Nishnabotna River.

Nisky Limestone[1]

Middle Ordovician: Eastern Pennsylvania.

Original reference: E. T. Wherry, 1909, Science, new ser., v. 30, p. 416.

Quarried near Nazareth, Northampton County. Derivation of name not stated.

Nittany Dolomite (in Beekmantown Group)[1]

Lower Ordovician: Central Pennsylvania, western Maryland, Tennessee, and western Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 552, 658, pl. 27.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 25. Term Nittany limestone should be abandoned because the three formations constituting it—Longview, Jefferson City, and Cotter—are distinguishable. Middle and Upper Canadian.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 17–20, pls. 1, 3. In Draper Mountain area, formation is composed of light-gray limestone, dolomitic limestone, and dolomite. Consists of two distinct and persistent lithologic types, upon basis of which formation is divided into members: Oglesby marble below and Draper dolomite above. Thickness about 550 feet. Overlies Conococheague formation. In most places directly underlies Mosheim formation; in some areas, a thin representa-

tive of Bellefonte formation is present between Nittany and Mosheim. Canadian.

C. E. Prouty, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1607–1609. Discussion of Trenton and sub-Trenton stratigraphy of northwest belts of Virginia and Tennessee and use of terms Nittany dolomite and Longview limestone in this area. Longview is largely limestone in type region (Alabama). Northwest of Clinch Mountain, Longview equivalent is largely dolomite and has often been referred to Nittany dolomite. In Pennsylvania, Stonehenge limestone underlies and Axemann limestone overlies the Nittany. The Stonehenge, partially homotaxial with the Chepultepec, apparently becomes dolomitic southwestward and shows indefinite relationship with that formation. Presence of Axemann in Virginia and Tennessee has not been established. In Alabama, the Newala limestone overlies the Longview, and, though probably a partial equivalent of post-*Lecanospira* dolomites of Tennessee and Virginia, it has different lithologic characteristics and indefinite boundaries in latter area. Appears best to dispense with the term Nittany in areas where relationships with Stonehenge and Axemann (Bellefonte in local absence of Axemann) are indefinite and to dispense with term Longview where definite relationship with Newala is unknown. A new formation name is needed in northeast Tennessee and southwest Virginia since redefinition of Longview or Nittany in that area would not clarify relationships to type areas of these units. Thickness of Nittany 275 feet along Bird Creek, Norris Reservoir region, Tennessee.

Name for exposures in Nittany Valley, Centre County, Pa.

†Nittany Valley Limestone[1]

Ordovician: Central Pennsylvania.

Original reference: H. M. Chance, 1880, Pennsylvania 2d Geol. Survey Rept. G4, p. 17–24.

Exposed in Nittany Valley, Clinton County.

Niverton Shale (in Conemaugh Formation)[1]

Pennsylvanian: Southern Pennsylvania and western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 67, 114, pl. 6.

Well exposed on west bank of Castleman River, 1.3 mile south of Niverton, Pa.

Nix Porphyrite

Carboniferous: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Nizina Limestone[1]

Upper Triassic: Eastern Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt.2, p. 429, 431, 435.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

In Nizina Tanana region.

Noah Dolomite Member (of Bluebell Formation)

Silurian: Central Utah.

Paul Billingsley *in* J. M. Boutwell, 1933, 16th Internat. Geol. Cong. [United States] Guidebook 17, Excursion C–1, p. 110 (fig. 14). Name appears on stratigraphic column of Tintic district. Uppermost member of formation; overlies Dora member (new); underlies Victoria quartzite.

T. S. Lovering and others, 1949, Econ. Geology Mon. 1, p. 7 (table 1). Upper 70 feet massive blue-gray dolomite, lies on well-bedded gray and blue-gray dolomite containing shaly-bedded planes at base. Thickness 290 feet.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 144, 145. Noah dolomite of Bluebell formation is equivalent to Simonson dolomite. Proposed that term Simonson dolomite be used in central Utah.

Type locality and derivation of name not stated.

Noah Parker horizon[1]

Lower Cambrian: Northwestern Vermont.

Original reference: G. E. Edson, 1906, Vermont State Geologist 5th Rept., p. 133–135.

Type locality: On farm of Noah Parker, west of highway passing Chase's corners, in Georgia, Franklin County.

Noatak Sandstone

Noatak Formation[1]

Devonian and Mississippian: Northern Alaska.

Original reference: P. S. Smith, 1913, U.S. Geol. Survey Bull. 536, p. 55, 69, 74, map.

T. G. Payne and others, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–126, sheet 1. More than 5,000 feet thick on Arctic slope. Top 900 feet is black marine shale with ferruginous limestone at top, argillaceous limestone 150 feet below top, and 160 feet of ferruginous quartz sandstone at base. Of Mississippian age.

J. T. Dutro, Jr., 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1415. Subdivided into five units. Three of these formations occur in western Brooks Range: an Upper Devonian siltstone-shale, Noatak formation (restricted) (Upper Devonian and Lower Mississippian), and a Lower Mississippian ferruginous calcarenite. In central Brooks Range, Upper Devonian siltstone-shale is overlain by thick chert conglomerate, approximately equivalent to Noatak formation (restricted).

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Noatak sandstone appears on map legend under both Upper Devonian rocks and Mississippian rocks (lower part).

Type locality: Western part of Noatak Valley between Nimiuktuk and Kugururok Rivers. Occurs most extensively in central and western parts of Noatak Basin.

Noblesville Dolomite[1]

Silurian (Niagaran): Central Indiana.

Original reference: E. M. Kindle, 1904, Indiana Dept. Geology and Nat. Resources 28th Ann. Rept. 407.

Named for Nobleville Township, Hamilton County.

†Nodaway Limestone (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 53.

Named for exposures at Nodaway, Andrew County.

Noel Shale[1]

Noel Shale Member (of Chattanooga Formation)

Upper Devonian and Lower Mississippian: Southwestern Missouri, northwestern Arkansas, and northeastern Oklahoma.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines p. 24.

E. B. Branson, 1938, Missouri Univ. Studies, v. 13, no. 3, p. 8 (fig. 2). Correlation chart gives age as Devonian.

G. G. Huffman and J. M. Starke, Jr., 1960, Oklahoma Geology Notes, v. 20, no. 7, p. 159, 160–163. Geographically extended into northeastern Oklahoma. Assigned to member status in Chattanooga formation. Fissile carbonaceous pyritic bituminous black shale; thin bed of phosphatic sandstone present a few feet above base in some sections. Thickness ranges from few inches near Bunch to more than 65 feet near Spavinow. Conformably overlies Sylamore sandstone member; where Sylamore is absent, the Noel lies with unconformity upon beds ranging in age from Early Ordovician Cotter to Devonian Sallisaw. Equivalent to black shale member of Chattanooga of Tennessee, New Albany of Indiana and Kentucky, Woodford of Oklahoma, Ohio black shale, and the Antrim of Michigan. On basis of conodonts, appears to be Late Devonian and Early Mississippian.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 89–92. Includes Roaring River sandstone member (new) at base. In Missouri, from its maximum thickness of about 35 feet in McDonald County, the Noel thins rapidly toward north and east. Unconformably overlies Cotter dolomite in southwestern Missouri; in Barry County, over limited areas, overlies Middle Devonian Fortune formation. Unconformably overlain by Mississippian strata ranging in age from oldest Kinderhookian to early Osagean. Upper Devonian. Type locality designated.

Type locality: About one-half mile south of Noel, McDonald County, Mo.

†Nogal Formation[1]

Permian: Southeastern New Mexico.

Original reference: A. G. Fiedler and S. S. Nye, 1933, U.S. Geol. Survey Water-Supply Paper 639.

Named for occurrence in vicinity of Nogal Canyon, Roswell artesian basin.

No-Ho-Co Formation (in Hoxbar Group)

Pennsylvanian (Missouri Series): Oklahoma (subsurface).

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 210, 213 (fig. 3), 216–217, 218 (fig. 4). Proposed for formation at top of Hoxbar group. Composed of an upper and lower carbonate unit and shale and sandstone interbeds. Upper carbonate unit consists of black ostracodal limestone that is commonly underlain by 10 to 15 feet of fine to coarsely oolitic, sandy limestone: lower limestone, about 20 to 30 feet thick is fine to coarsely oolitic and sandy; intercalated sand-

stone body which occurs near middle of the two limestones is 20 to 100 feet thick and is mostly calcareous, with scattered very fine to fine brown oolites; locally interdigitates into finely oolitic, sandy limestone. Thickness 120 to 185 feet: locally less than 100 feet.

Name derived from Amerada's No-Ho-Co No. 1, in SW¼SE¼ sec. 2, T. 5 N., R. 10 W., Caddo County.

Noisy Brook Gneiss

Age not stated: West-central Maine.

Kern Jackson, 1953, Maine State Geologist Rept., 1951–1952, p. 53, 62–66. Includes two facies. Central zone consists of coarse-grained crudely banded gneiss. Gneiss grades into marginal facies of silvery blue-gray micaceous schist. Intruded by granite complex. Contains small bodies of aplite and pegmatite.

Named for exposures along Noisy Brook, a small tributary of Swift River 1½ miles north of village of Roxbury, Oxford County. Exposed almost continuously upstream from Highway 17 for 2 miles.

Noix Oolite Member (of Edgewood Limestone)[1]

Noix oolite facies (of Cyrene Member of Edgewood Formation)

Lower Silurian: Northeastern Missouri and southwestern Illinois.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 62.

T. J. Laswell, 1957, Missouri Geol. Survey and Water Resources Rept. Inv. 22, p. 18, 19. Rank reduced to facies of Cyrene member of Edgewood formation.

Named for exposures along Noix Creek at Louisiana, Pike County, Mo.

Nolans Limestone (in Chase Group)

Nolans Limestone (in Sumner Group)[1]

Permian: Northwestern Kansas.

Original references: R. C. Moore, 1936, Jour. Geology, v. 44, no. 1, p. 5–9; 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 89–91; R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Reallocated to Chase group. Reallocation made on basis of redefinition of Leonard-Wolfcamp boundary; base of Leonard in Kansas is arbitrarily placed at top of Nolans formation which is top of Herington limestone member. Formation includes (ascending) Krider limestone, Paddock shale, and Herrington limestone member. Underlies Wellington shale; overlies Odell shale. Wolfcamp series.

Name derived from Nolans, a railway siding near Emmons, Washington County.

Nolichucky Shale[1] (in Conasauga Group)

Upper Cambrian: Eastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 27, p. 2.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim. Map; John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 14–15. Thickness 790 feet in Hawkins County, Tenn. Includes Maynardville limestone member near top.

Overlies Maryville limestone; underlies Copper Ridge dolomite of Knox group.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 49–53. In eastern Tennessee the Conasauga varies in lithology, and three phases are recognized. In central phase, group consists of six formations of which Nolichucky is fifth in sequence (ascending). Underlies Maynardville limestone; overlies Maryville limestone. Thickness 400 to 750 feet. In southeastern phase, sequence includes (ascending) Honaker dolomite, Nolichucky shale, and Maynardville limestone.

J. M. Cattermole, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–115. In Knoxville quadrangle, consists of two phases: northeastward from Third Creek, mainly shale with thin limestone beds interlayered in lower part and two or three limestone lenses, 20 to 50 feet thick, in upper part of shale; southwest of Third Creek, lower part contains higher proportion of interbedded limestone, and upper part is almost entirely blue-gray limestone which thickens southwestward to a maximum development in adjacent Bearden quadrangle. Thickness 1,040 to 1,400 feet. Underlies Maynardville limestone; overlies Maryville limestone.

J. W. Bryan, 1960, (abs.) Virginia Jour. Sci., v. 11, new ser., no. 4, p. 214. The Nolichucky is largely limestone and dolomite in Virginia, and usage of term Nolichucky shale is somewhat misleading.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 55. Described in northeasternmost Tennessee where it is 200 to 250 feet thick. Overlies Honaker dolomite; underlies Conococheague limestone. Conasauga group.

Named for exposures along Nolichucky River, Greene County, Tenn.

Nome Group[1]

Lower Paleozoic or older: Northwestern Alaska.

Original reference: A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901, Reconn. Cape Nome and Norton Bay regions, Alaska, in 1900. U.S. Geol. Survey Spec. Pub., p. 29, map.

R. M. Moxham and W. S. West, 1953, U.S. Geol. Survey Circ. 265, p. 2, 3. Two units of group, in Serpentine-Kougarok area, of Ordovician and Silurian age (ascending) undifferentiated limestone, slate, and schist; and Port Clarence limestone, probably mostly Silurian in age.

Most typically developed to south of Kigluaik Mountains and Bendeleben Mountains, Seward Peninsula.

Nome River Glaciation

Pleistocene: West-central Alaska.

D. M. Hopkins, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 10, 13 (table 1). Four Quaternary glaciations recognized on Seward Peninsula. Succeeded Iron Creek glaciation (new); preceded Salmon Lake glaciation (new). End moraines found 1 or 2 miles beyond northern and western margins of Bendeleben Mountains and 5 to 10 miles beyond their south fronts. Glacial topography (valley and cirque walls and lateral and end moraines) thoroughly modified by subsequent frost-riving, creep, and stream erosion.

D. M. Hopkins, F. S. MacNeil, and E. B. Leopold, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 4, p. 46–57. Discussion of coastal plain at Nome. Three marine stratigraphic units (Submarine Beach, Third Beach-Intermediate Beach, and Second Beach) record at least three

distinct intervals during which sea level stood as high or higher than at present and during which sea temperatures were warmer than at present. A fourth interval of high sea level may be representd by "Fourth Beach" at inner edge of coastal plain. Glacial drift of the Iron Creek (Nebraskan or Kansan) glaciation and of Nome River (Illinoian) glaciation separates the three units. Outwash, alluvium, colluvium, windblown silt, and peat that accumulated during Wisconsin and Recent time cover the glacial drift and youngest of marine sediments.

Deposits distributed widely and studied in detail in Nome River valley, southwestern part of Seward Peninsula. Most valleys in York, Kigluaik, Bendeleben, and Darby Mountain were occupied by ice. Glaciers also were present in cirques throughout uplands south and west of Kigluaik Mountains.

Nomlaki Tuff Member (of Tehama and Tuscan Formations)[1]

Nomlaki Tuff

Pliocene, upper: Northern California.

Original reference: R. D. Russell and V. L. Vander Hoof, 1931, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 20, no. 2, p. 12–15.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology, v. 35, no. 3, p. 243–247, pl. 3. Referred to as both Nomlaki tuff and Nomlaki tuff member of Tehama formation. Interbedded with both Tuscan and Tehama formations. Exposed for a distance of 40 miles along west side of Sacramento Valley; southerly exposure is in Stone Valley, NE cor. T. 20 N., R. 5 W., [Glenn County], where it is 15 feet thick. Thickness 42 feet at type locality, base not exposed; as much as 300 feet thick in Redding quadrangle where it unconformably overlies Chico formation. Upper Pliocene. Type locality noted.

Type locality: At former headquarters of old Nomlaki Indian Reservation about 6 miles northeast of Paskenta, Tehama County.

Nonada Sandstone Member (of Domengine Formation)

Eocene: Central California.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 3, 15, 21, 22–23, pl. 4. Friable gray fine-grained sandstone; on northeastern flank of Panoche Hills includes two calcareouss fossiliferous pebble "reefs." Thickness about 68 feet. Underlies Capita shale member (new); unconformably overlies Lodo formation in some areas and in others, as Chaney Ranch Canyon, unconformably overlies Laguna Seca formation (new).

Spanish word meaning low and flat (Nonada) is given to hill 200 feet north and 800 feet west of SW cor. sec. 13, T. 14 S., R. 11 E., Fresno County.

No Name Argillite (in Newport Group)

Precambrian: Northeastern Washington.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 11–13, pl. 1. Predominantly dark-gray argillite with occasional argillaceous sandstone beds and limestone lenses. Thickness about 4,200 feet. Gradationally underlies Skookum formation (new), transition zone about 400 feet thick; gradationally overlies Bead Lake formation (new), transition zone about 200 feet thick.

Named after No Name Peak, Pend Oreille County.

Nonesuch Shale (in Oronto Group)[1]

Precambrian: Northern Michigan and northeastern Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 221–224, pls. 17, 18.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474. Nonesuch shale lies stratigraphically above and is continuous with Outer conglomerate.

W. S. White and H. R. Cornwall, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Described in Ahmeek quadrangle, Michigan, where it overlies Cooper Harbor conglomerate and underlies Freda sandstone.

W. S. White and J. C. Wright, 1954, Science, v. 119, no. 3089, p. 354. At White Pine Copper deposit, Ontonagon County, Mich., Nonesuch is about 600 feet thick and composed largely of gray siltstone. Overlies Copper Harbor conglomerate.

Named for occurrence at Nonesuch mine, Gogebic County, Mich.

Nonewaug Granite

Paleozoic: Western Connecticut.

R. M. Gates, 1953, New England Intercollegiate Geol. Conf. [Guidebook] 40th [Ann. Mtg.] Field Trip B, p. 4–6. One of several intrusives in Hartland formation. A lenticular, east-west trending body in northern third of Woodbury quadrangle and southeastern part of Litchfield quadrangle. Characterized by fine- to coarse-textural-layering, graphic granite crystals locally in great quantity which range up to 2 feet across in a matrix of relatively fine-grained granite, and plumose muscovite in plumes up to 18 inches long.

R. M. Gates, 1954, Connecticut Geol. Nat. History Survey Quad. Rept. 3, p. 3, 6–7, 15–19, geol. map. Nonewaug granite was originally included with Thomaston granite by earlier workers. It has also been called Woodbury granite. Change to Nonewaug was made to avoid confusing it with Woodbury granite in Vermont.

Named for Nonewaug River in Woodbury and Bethlehem, Litchfield County.

Nooksack Formation or Group

Upper Jurassic and Lower Cretaceous: North-central Washington.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175, p. 2, 5 (table 2). In thick conformable sequence of predominantly dark siltstone in northern Cascade Mountains, fossils have been found that date part of these marine beds as Kimmeridgian and possibly Oxfordian. Peter Misch has named these rocks the Nooksack formation, the highest part of which is early Cretaceous.

W. R. Danner, 1958, Dissert. Abs., v. 18, no. 1, p. 195. Referred to as Nooksack group.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1533, chart 10e (column 57). Nooksack group shown on correlation chart. Term was proposed by Peter Misch in letters to Vernon Swanson, dated November 15, 1954. Term was published by McKee and others, 1956. Misch notes that lower 4,000 feet of group contains Late Jurassic megafossils, and upper 1,000 feet contains Early Cretaceous fossils of probable Valanginian age.

Exposed in Nooksack River area north of Mount Baker, Whatcom County.

Noonday Dolomite

Precambrian: Southern California.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 279 (fig. 3e), 300–301. A light creamy-gray to cream-colored algal dolomite which weathers to a pale creamy-buff color. Thickness 1,500 to 2,000 feet. Basal Cambrian of region; separated by marked angular unconformity from rocks of Archean and Algonkian age; underlies Johnnie(?) formation.

D. F. Hewett, 1948, California Div. Mines Bull. 129, p. 199. Described in Kingston Range, San Bernardino County, where it is about 2,000 feet thick near the iron deposits; decreases in thickness steadily eastward and is not known east of Mesquite Valley. On northwest slope of range, is nearly conformable with underlying Pahrump series, Kingston Peak formation, but on northeast and east slopes is highly unconformable. North and east of Kingston Range the dolomite is overlain successively by Prospect Mountain quartzite and Pioche shale of Cambrian age and Goodsprings dolomite of Upper Cambrian to Devonian(?) age.

C. R. Longwell, 1952, Washington Acad. Sci. Jour., v. 42, no. 7, p. 212. Suggestion made that Johnnie formation, Noonday dolomite, Deep Springs formation, and Reed dolomite of Inyo region be carried under heading "age unknown" because there is no firm basis for drawing a lower boundary of Cambrian in Death Valley region.

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 369–372, 379 (fig. 7), fig. 3. Described in Manly Peak quadrangle, Death Valley region, where it ranges in thickness from 800 to 1,000 feet. Underlies Johnnie formation; overlies Kingston Peak formation with disconformity or slight angular unconformity. Considered correlative of Sentinel dolomite, Radcliff formation, and Redlands dolomite limestone of Murphy's (1932 [1933]) Telescope group. Algal structures, common in lower part of Noonday in Manly Peak quadrangle, were noted by Hazzard (1937) in type area; algal structures occur in Sentinel dolomite described by Murphy as exposed in Sour Dough Canyon above Panamint City; no other fossils have been found in Noonday and its equivalents. Murphy tentatively assigned all rocks above Panamint metamorphic complex to Lower Paleozoic. All other published reports on Death Valley region equate base of Cambrian with unconformable base on Noonday. In this report base of Cambrian is defined faunally; since base of Noonday is 9,000 feet stratigraphically below frst occurrence of *Olenellus* entire formation is regraded as late Precambrian.

Well exposed in extreme southern portion of Nopah Range, cropping out in a belt of variable width which extends from about 1¼ miles north of Gunsight mine to nearly 2 miles southeast of Noonday mine, Nopah-Resting Springs area, Inyo County.

Nopah Formation

Upper Cambrian: Southeastern California and western Nevada.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 276 (fig. 3b), 320–322. Consists principally of dolomite, light gray, gray, or creamy buff. Thickness 1,740 feet. Shown on columnar section as underlying Pogonip(?) dolomite and overlying Cornfield Springs formation.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 9–10, pls. 1, 2. Described in Quartz Spring area where it is 1,600 feet thick and

conformably overlies Racetrack dolomite (new) and conformably underlies Pogonip formation.

A. L. Brown, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1235. Geographically extended into Nye County, Nev. In Cambrian sequence, underlies Highland Peak formation.

A. R. Palmer and J. C. Hazzard, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2494–2513. Paleontologic evidence shows that names Cornfield Springs and Bonanza King were misapplied in Nopah Range by Hazzard (1937). Units formerly designated by these names in Nopah Range should be considered as unnamed upper and lower divisions, respectively, of Bonanza King formation. Hence, Nopah formation overlies Bonanza King formation in this area.

H. R. Cornwall and F. J. Kleinhampl, 1960, U.S. Geol. Survey Field Studies Map MF–239. Mapped in Bare Mountain quadrangle, Nye County, Nev., where it overlies Bonanza King formation and underlies Pogonip group. Upper Cambrian.

Named for exposures in northern half of Nopah Mountains, Inyo County, Calif.

Nora Limestone[1]

Nora Member (of Shellrock Formation)

Upper Devonian: Central northern Iowa.

Original reference: A. O. Thomas, 1913, Science, new ser., v. 37, p. 459.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (table), 187. Shellrock formation consists of lithographic and dolomitic limestones and thin shales; includes (ascending) Mason City, Rock Grove, and Nora members.

Named for exposures in an abandoned quarry near Nora Junction, Floyd County.

Nordheimer Formation[1]

Carboniferous(?): Northwestern California.

Original reference: O. H. Hershey, 1906, Am. Jour. Sci., 4th, v. 21, p. 58–66.

Nordheimer Creek valley, Klamath Mountains.

Norfleet Limestone Member (of Lenapah Limestone)

Pennsylvanian (Des Moines Series): Eastern Kansas, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 337, 338–339, pl. 1. Defined to include all limestone and shale beds of the Lenapah below Perry Farm shale member (new). Where best developed, member comprises a few inches of dark-bluish-gray dense limestone overlain by shale which is mostly black and has maximum thickness of about 5 feet; locally upper part is very calcareous but also black and platy; at top of member is a limestone which is a few inches to about 3 feet thick. Overlies Nowata shale.

J. M. Jewett, 1945, Kansas Geol. Survey Bull. 58, p. 69. Discussed as cyclothem in Lenapah megacyclothem.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v. (fig. 1), 9. Geographically extended into northwestern Missouri where it underlies Perry Farm shale member and overlies Warrenburg sandstone member of Nowata formation.

C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 134, 135. Geographically extended into northeastern Oklahoma.

Type exposure: On Norfleet Farm along Pumpkin Creek in SE¼ sec. 35, T. 32 S., R. 18 E., northeast of Mound Valley, Labette County, Kans.

†Norfolk Formation[1]

Pliocene(?) and Pleistocene: Southeastern Virginia.

Original reference: W. B. Clark and B. L. Miller, 1906, Virginia Geol. Survey Bull. 2, pt. 1, p. 20.

Named for Norfolk County, Va., where the deposits have been recognized in deep cutting in Dismal Swamp Canal.

†Norfolk Basin Series[1]

Carboniferous: Southeastern Massachusetts.

Original reference: G. R. Mansfield, 1960, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, Geol. ser., v. 8, no. 4, p. 91–271.

Normal Drift

Pleistocene (Wisconsin): Northern Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 212. Incidental mention.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, pt. 1, p. 29. In Peoria area, Normal drift is listed as younger than Metamora drift.

Probably named for occurrence near Normal, McLean County.

†Norman division[1]

Permian: Central Oklahoma.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 43.

Occurs on east slope of Gypsum Hills.

Norman Sandstone[1]

Permian(?): Central Oklahoma.

Original reference: C. T. Kirk, 1904, Oklahoma Dept. Geology and Nat. History 3d Bienn. Rept., p. 10.

Well exposed on hilltops 6 miles southeast of Norman, Cleveland County, and on bluffs at Purcell, Indian Terr. (now McClain County).

Normandy Limestone[1]

Middle and Upper Ordovician: Central Tennessee.

Original reference: M. R. Campbell, 1899, U.S. Geol. Survey Geol. Atlas, Folio 53, p. 2.

Named for Normandy, Bedford County.

Normanskill Shale[1]

Middle Ordovician: Eastern New York, northwestern Massachusetts, and southwestern Vermont.

Original reference: R. Ruedemann, 1901, New York State Mus. Bull. 42, p. 489–568.

D. M. Larrabee, 1939, Eng. Mining Jour., v. 140, no. 12, p. 48 (fig. 2), 49 (fig. 3), 51–52. Near Poultney, Vt., Normanskill consists of grits, graywacke, red slate, quartzite, and chert. "Calciferous" shale referred to by Dale, (1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3) not noted in

this area, and the Normanskill overlies Zion Hill quartzite. Thickness about 1,500 feet. Zion Hill quartzite placed at base of Ordovician.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 331, p. 88–116. Formation, usually termed shale, consists of chert, grit, and shale, the first predominating. In Catskill quadrangle, two belts present: western grit belt and eastern chert belt. Comprises two members: Mount Merino chert and shale and Austin Glen grit and shale. Eastern part of chert belt adjoins Lower Cambrian belt, and western grit belt adjoins Snake Hill formation, north and south of Catskill quadrangle. Where Deepkill shale is exposed, it is either infolded with Mount Merino beds, as at Mount Merino, or found in strips between the Mount Merino bed and Schodack beds as west of Blue Hill on iron ore ridge, or west of Bingham Mills and southeast of Viewmonte.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1079–1098. Rocks in Taconic thrust sheet called Normanskill are characterized by marked banding, medium grain, generally calcareous cement, and hardness. Beds of ferruginous calcareous quartzite common. Thickness about 300 feet. Overlies Zion Hill quartzite.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 60–62. Discussion of range of Normanskill graptolites. There is no longer any reason to regard the Normanskill as Chazyan. It can no longer be assumed that all Appalachian formations below the supposed Lowville are necessarily Chazyan or older.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 38 (table 2), 55–57. In Castleton quadrangle, Normanskill beds are certainly exposed, but presence of underlying Schagticoke shale and Deepkill shale is problematical. No fossils from Ordovician of area have been found, and all rocks above Cambrian are herein mapped as Normanskill. Several rock types are recognized, and all are in lenticular bodies. In a few places, one type grades into another. No stratigraphic succession can be established. Isoclinal folding of the Normanskill does not facilitate interpretation. Dale's figure (1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3) for thickness of Normanskill, 1,250 feet, is accepted here. Nearly half of this thickness is made up of grit; red and green slates are probably 100 feet thick; remainder of Normanskill is dark slate, chert, and quartzite with aggregate thickness of 500 feet or more. Unconformity separates Normanskill from Zion Hill quartzite which in this report is Cambrian. Black River-Trenton(?).

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 33–34. Bulk of formation consists of shale, but grit, sandstone, chert, arkose, and conglomerate, ranking in order named, are present. Estimated thickness about 2,000 feet. Includes Mount Merino chert and shale member below and Austin Glen grit and shale above. Underlies Rysedorf conglomerate. Porterfield-Wilderness stages.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 56. In Taconic sequence, Thorn Hill and Granville quadrangles, unnamed Normanskill graywackes and black shales overlie Indian River formation.

J. G. Elam, 1960, Dissert. Abs., v. 21, no. 6, p. 1524. Discussion of Troy South and East Greenbush quadrangles, New York. Stratigraphic section divided into four groups, and previously described dominant formational names elevated to group status. Groups are Bull (Lower Cambrian),

West Castleton (upper Lower Cambrian-Upper Cambrian), Poultney (Lower Ordovician), and Normanskill (Middle Ordovician).

Normans Kill, a tributary entering Hudson River just south of Albany at Kenwood.

Norphlet Formation

Norphlet Tongue (of Eagle Mills Formation)

Jurassic: Subsurface in Arkansas, Louisiana, and Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 4 (table 2), 8. Name Norphlet tongue applied to upper red beds in Eagle Mills formation. Jurassic. Name credited to Shreveport Geological Society.

R. T. Hazzard, W. T. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945 Reference Rept., v. 2, p. 483, 484, 488, 490 (table 5). Term Norphlet tongue, as formerly used, is replaced by Norphlet formation. In type well, underlies Smackover formation; overlies Louann salt. Consists of red clays, gray clays, reddish and gray sands, with or without gravel. Maximum thickness about 150 feet. By inference, an unconformity is placed at base of Norphlet where it rests on Louann salt, and it is concluded that this is the Mesozoic-Paleozoic contact in Tri-State area. Jurassic.

Type section: Gulf Refining Co.'s No. 49 L. Werner Saw Mill Co. well, Union County, Ark.

Norrie Ferruginous Chert Member (of Ironwood Iron-Formation)[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501, 504.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Underlies Pence member; overlies Yale member. Thickness (taken from drill holes), 115 and 117 feet.

Named for Norrie mine, east of Ironwood, Gogebic County, Mich.

Norris Basic Flows

Tertiary: Southwestern Montana.

D. B. Andretta and S. A. Alsup, 1960, Billings Geol. Soc. 11th Ann. Field Conf., p. 187. Consists of several basic flows. Finely crystalline, almost glassy rock. Maximum thickness of flow 50 feet. These flows are listed as "Tertiary volcanics" on Montana State Geological map and apparently rest on both Precambrian rock and mid-Cenozoic strata.

Flows cap hills in vicinity of Norris, Madison County.

Norris Limestone (in Allegheny Formation)[1]

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889, 897, pls. opposite p. 889, 900, 912, 921.

In Hocking Valley. Named for proximity to Norris coal.

Norristown Sandstone (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: E. V. d'Invilliers, 1883, Pennsylvania 2d Geol. Survey Rept. D_3, v. 2.

Montgomery County.

†Norristown Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: B. S. Lyman, 1893, Pennsylvania Geol. Survey geol. and topog. map of Bucks and Montgomery Counties; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

Named for exposures at Norristown, Montgomery County.

†Norristown Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51–52.

Probably named for Norristown, Pope County, Ark., just across river from Dardanelles.

North Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

North Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

†North Amherst Granite[1]

Late Carboniferous or post-Carboniferous: Central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 323.

Named for occurrence in hills southeast and west of North Amherst Station, Hampshire County.

North Boulder Group or Formation

Precambrian (Belt Series): Southwestern Montana.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111, 113. Proposed for heretofore unnamed components of Belt series in isolated exposures near Jefferson River, southeast of Butte. Relations between this group and units farther north not clear. Group is believed to rest directly on pre-Belt complex of metamorphic rocks; lies without angular discordance beneath Middle Cambrian Flathead quartzite. Has coarse conglomerate at base, with arkose, some conglomerate, and sandy and silty strata above. Total thickness 6,000 feet or more. May include three or possibly four subdivisions of formational rank. May be equivalent in age to some part of Missoula group or to part of that group and part of Piegan group.

Strata extend eastward along and north of Jefferson River from vicinity of North Boulder to point southeast of Sappington.

Northbrae Rhyolite[1]

Pliocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

Named for occurrence in Northbrae district, near Berkeley, Alameda County.

Northbridge Granite Gneiss[1]

Precambrian: South-central Massachusetts and northwestern Rhode Island.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

A. W. Quinn, 1953, New York Acad. Sci. Trans., ser. 2, v. 15, no. 8, p. 266. Older gneisses of Georgiaville quadrangle, Rhode Island, include, from oldest to youngest, Nipsachuck gneiss, Absalona formation, and Woonasquatucket formation. In part, they may be correlated with Northbridge granite gneiss of Massachusetts.

Named for occurrence at Northbridge, Worcester County, Mass.

North Butler Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for its occurrence north of Butler.

North Butler Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Northcraft Formation

Eocene, upper: Southwestern Washington.

P. D. Snavely, Jr., and others, 1951, U.S. Geol. Survey Coal Inv. Map C–8, sheet 1. Name proposed for series of lava flows, pyroclastic rocks, breccia, and tuffaceous sedimentary rocks approximately 700 to 1,000 feet thick. Conformably overlies McIntosh formation; unconformably underlies Skookumchuck formation (new).

P. D. Snavely, Jr., and others, 1954, Science, v. 119, no. 3091, p. 419. Andesitic flows of Northcraft formation extruded during early part of late Eocene.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 22–26, pl. 1. Culver (1919) described sequence of rocks consisting of conglomerate, breccia, graywacke, and black siliceous shale which crops out along Newaukum River. He named these beds Newaukum series and considered them to be pre-Puget and probably pre-Tertiary in age. Dark shale and arkosic sandstone described by Culver are mapped as McIntosh formation in this report [Centralia-Chehalis district]. Conglomerate, graywacke, and breccia in Culver's Newaukum series are probably equivalent to part of Northcraft formation. Overlies McIntosh formation; underlies Skookumchuck formation. Late Eocene.

E. A. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (table), 13–14, pl. 1. Northcraft is oldest unit exposed in Toledo-Castle Rock coal district. Thickness about 200 feet; base not exposed. Underlies Cowlitz formation.

Typically exposed in vicinity of Northcraft Mountain and along road that parallels Salmon Creek in sec. 2 and the NW¼ sec. 1, T. 15 N., R. 1 W., Willamette meridian, Thurston County.

North Creek Formation

Tertiary-Quaternary: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 160, 163, 165. Comprises conglomerates unconformably overlying Kalamazoo volcanics (new). Apparently grades upward into present-day alluvium. Maximum thickness not known; may be greater than 1,000 feet.

Recognized only in Duck Creek valley, Schell Creek Range, Ely quadrangle.

North Creek Member (of Yazoo Clay)

Eocene, upper: Eastern Mississippi and western Alabama.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839 (footnote). North Creek (clay) member proposed for an average of 40 feet of green or gray slightly glauconitic, fossiliferous clay, underlain by Moodys sand and overlain by Pachuta marl member (new) or Cocoa sand.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Special Rept. 21, p. 121, 124, pl. 3. In Choctaw County, Ala., consists of greenish-gray plastic calcareous sparsely fossiliferous clay with white lime nodules and thin white sand streaks; base marked by a calcareous sandstone 2 to 12 inches thick. Thickness 50 to 60 feet.

Type locality: Exposures on west side of North Creek in SW¼ sec. 1, T. 3 N., R. 12 E., Jasper County, Miss., 2 miles southwest of Rose Hill on State highway to Gridley and Turnersville.

†North Denison Sand[1]

Lower Cretaceous (Comanche Series): Northeastern Texas and southeastern Oklahoma.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 302, 303, 328–330, 334, pl. 13.

Named for exposures in northern half of Denison, Grayson County, Tex.

Northeast Shale[1]

Northeast Shale Member (of Canadaway Formation)

Upper Devonian: Northwestern Pennsylvania and western New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 32; 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 16. Uppermost member of Canadaway formation. Thickness about 470 feet. Overlies Shumla siltstone member; underlies Dexterville member of Chadakoin formation. Girard shale (White, 1881) here included in Northeast member.

Named from township in Erie County, Pa.

Northfield Conglomerate[1]

Lower Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1919, Vermont State Geologist 11th Rept.

Northfield Township, Washington County.

Northfield Slate[1]

Middle Silurian: Central and northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 95.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1492, 1501–1506. Redefined to include, in general, beds previously mapped in central Vermont as "Memphremagog slates." Is mainly light- to dark-gray slate with scattered lenses and very thin beds of dense bluish-gray limestone and dolomitic limestone. Contains conglomerate at base ("Northfield conglomerate" of Richardson). Thin platy limestone beds above the conglomerate and two prominent zones of small siliceous nodules occur in lower part. Thickness 450 to 2,300 feet. Conformably underlies Waits River limestone; overlies Shaw Mountain formation (new) unconformably. Ordovician(?). Derivation of name given.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Middle Ordovician.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Silurian(?).

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 551, pl. 3. Discussion of stratigraphic and geotectonic relationships in northern Vermont and southern Quebec. Where Shaw Mountain formation is absent, Northfield slate lies directly, and to all appearances conformably, on Moretown formation. Middle Silurian.

Named for village of Northfield, Barre quadrangle, near which slate was formerly extensively quarried.

North Fork Shale (in Pottsville Group)[1]

North Fork Shale (in Pocahontas Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 239.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 96. Thin marine shale in Pocahontas group.

Exposed in N. & W. Railway grade at North Fork, McDowell County.

North Haven Greenstone[1]

Cambrian(?): Central southern Maine.

Original reference: G. O. Smith, 1896, Geology of Fox Islands, Maine, p. 12, 13–19.

Named for development on North Haven Island, Penobscot Bay.

North Hill Formation

North Hill Group

North Hill Member[1] (of Hampton Formation)

Mississippian (Kinderhook Series): Southeastern Iowa and northwestern Illinois.

Original reference: L. R. Laudon, 1931, Iowa Geol. Survey, v. 35, p. 344, 347, 366–371.

L. R. Laudon, 1935, Kansas Geol. Soc. 9th Ann. Field Conf. Guidebook, p. 246. North Hill member excluded from redefined Hampton. [This apparently makes North Hill a formation although Laudon did not so state.]

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 28. Considered a group in northwestern

Illinois. Includes (ascending) McCraney limestone, Prospect Hill siltstone, and Starrs Cave limestone (new).

Named for exposures on North Hill in city of Burlington, Des Moines County, Iowa.

North Hogback Tongue (of Point Lookout Sandstone)

Upper Cretaceous: Northwestern New Mexico.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144, sheet 1. A northeasterly thickening wedge of Point Lookout sandstone overlies a correspondingly thinning wedge of basal Menefee formation for a distance of about three-fourths mile along the outcrop. Contacts are relatively sharp. As a result of this intertonguing, the top of Point Lookout sandstone is about 65 feet high stratigraphically to the north. This sandstone wedge is here named the North Hogback tongue.

Observed only in secs. 10 and 11, T. 30 N., R. 16 W., San Juan County.

North Horn Formation

Upper Cretaceous and Paleocene: Central Utah.

S. L. Schoff, 1938, Ohio State Univ. Abs. Doctors' Dissert. 25, p. 379. Name applied to variegated beds with reptile and mammal remains between Price River formation and Flagstaff limestone. Rocks identified as North Horn underlie large areas in west-central and northern parts of Cedar Hills and consist of varied assemblage of nonmarine sandstones, conglomerates, shales, and fresh-water limestones. Maximum thickness 6,700 feet. Upper and lower contacts conformable, involving intertonguing of lithologic types. Name credited to E. M. Spieker.

C. L. Gazin, 1941, U.S. Natl. Mus. Proc., v. 91, no. 3121, p. 6. Name should have been restricted to either Cretaceous or Paleocene beds and not both. Since U.S. Geological Survey has adopted the more inclusive definition for North Horn, the name Joes Valley is proposed as member to include Paleocene part of formation.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper, 205–D, p. 132–134. Thickness 1,650 feet at type locality; four units recognized; unit 1 and 3 show characteristics of lake deposits; unit 2 and 4 are typical flood-plain and channel deposits. Grades downward into Price River formation; passes transitionally upward into Flagstaff limestone. In Green River Canyon, underlies Colton formation and overlies Tuscher(?) formation. In western Wasatch Plateau, formation consists of former lower Wasatch exclusive of basal conglomerate which is now placed in Price River formation.

Type locality: On North Horn Mountain, in Tps. 18 and 19 S., R. 6 E., Salt Lake meridian, Wasatch Plateau.

North Keys Sand

Miocene(?): Southern Maryland.

J. T. Hack, 1955, U.S. Geol. Survey Prof. Paper 267–A, p. 8–10, pl. 1. Bed of fine yellowish-orange sand which rests conformably on top clay bed of Calvert formation, and in Brandywine area, underlies gravel of Brandywine formation. Sand similar to the North Keys in some places is interbedded with the Brandywine; in others, the Brandywine is separated from the North Keys by sharp, irregular erosional contact; the top of the North Keys is placed at base of lowest gravel

in local sequence. Thickness in Brandywine area 20 to 60 feet; maximum thickness in central part of area near Baden. North Keys sand is lithologically unlike Choptank formation as it is exposed in Calvert Cliffs, where it contains sandy clay and clay beds at several horizons; either North Keys represents an overlap of sandy beds of the Choptank, on eroded Calvert formation, or it [North Keys] becomes younger to south and overlaps Choptank as well as Calvert. Unit has been mapped as part of overlying formations and in Brandywine area has been included in Brandywine and Sunderland formations.

Type locality: Vicinity of North Keys, a hamlet on road from Brandywine to Naylor, in Prince Georges County. Crops out on eastern flank of upland, caps many hills between the upland and Patuxent River, and is exposed in many roadcuts.

North Lake zone (in Negaunee Formation)[1]

Precambrian (middle Huronian): Northern Michigan.

Original reference: J. L. Adler, 1935, Jour. Geology, v. 43, no. 2, p. 113–132.

Type locality not stated, but map shows it around North Lake, Marquette County.

North Leon Limestone Member (of Graham Formation)[1]

North Leon Formation (in Graham Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: F. Reeves, 1922, U.S. Geol. Survey Bull. 736–E, p. 117.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1); R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 38). Shown on correlation chart as formation in Graham group; occurs below Bunger formation and above Gonzales formation.

Exposed on North Fork of Leon River, Eastland County.

North Meadow Creek Flows

Tertiary: Southwestern Montana.

D. B. Andretta and S. A. Alsup, 1960, Billings Geol. Soc. 11th Ann. Field Conf., p. 187. Name applied to large mass of volcanic rocks that crop out south of North Meadow Creek. Rests on Precambrian rocks.

North Meadow Creek flows through Madison County, area of this report.

North Mound Conglomerate and Quartzite[1]

Precambrian (upper Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Natl. History Survey Bull. 16, p. 371.

Forms North Mound about 5 miles northwest of Babcock, Wood County.

North Park Formation[1]

Miocene, upper, and Pliocene(?): Northern Colorado and southern Wyoming.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, Map 1.

John de la Montagne and W. C. Barnes, 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Park Basins, Colorado, p. 56–59. In North Park basin, occupies center of North Park syncline. About 400 feet thick at west end of syncline but increases to about 1,800 feet at Owl Mountains. Overlies White River

(used here as equivalent of Chadron) formation of early Oligocene age. Formation fills Saratoga Valley, a structural trough that continues northwest trend of North Park basin for distance of 75 miles. North of Saratoga, Wyo., more than 1,300 feet thick. Conformably overlies Browns Park formation of middle Miocene age at north end of Saratoga Valley but unconformably overlies Precambrian through Paleocene rocks throughout most of area. Late Miocene.

T. A. Stevens, 1960, U.S. Geol. Survey Bull. 1082–F, p. 336 (table 1), 352–354, pl. 12. Described in Northgate district, Colorado, where it consists of impure silts, sands, and stream gravels. Unconformably overlies White River formation. Pliocene(?) and Miocene.

W. J. Hail, Jr., and G. E. Lewis, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B259–B260. Probably late Miocene. Age determination made on basis of fossil vertebrates found at type locality of formation. Beekly's (1915 U.S. Geol. Survey Bull. 596) redefinition of the North Park has generally been followed by subsequent workers. In type area south of Walden, Jackson County, Colo., formation is at least 2,000 feet thick and at different places lies on White River formation of Oligocene age and on Coalmont formation of Paleocene and Eocene age. Formation of type area is not continuous with rocks mapped as North Park 20 to 30 miles farther north in Saratoga basin of northern Colorado and southern Wyoming (McGrew, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf.; Montagne and Barnes, 1957). In Saratoga basin area, the North Park lies on rocks as old as Precambrian.

Named for occurrence in North Park, northern Colorado.

North Peak Porphyritic Syenite

Age not stated: Central Montana.

R. N. Miller, 1959, Montana Bur. Mines and Geology Mem. 37, p. 22, 23. Name applied to porphyritic syenite which characterizes North Peak. Moderate brownish gray to dark brownish gray on weathered surfaces. Dense stony matrix; dark gray to moderate black on fresh surface. Abundant light-gray phenocrysts of sanidine, and lesser amounts of pale-yellow tabular feldspar altering to a clay mineral. No quartz or ferromagnesian minerals discerned megascopically.

Named for occurrence on North Peak in South Moccasin Mountains, Fergus County.

North Point Member[1] (of Milwaukee Formation)

Middle Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. 9th Ann. Field Conf., p. 262, 263, 266.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. North Point member shown on correlation chart above Lindwurm member.

Type locality: North Point, Intake Tunnel, Milwaukee County.

Northport Limestone[1]

Middle Cambrian(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 75, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 611. Remapping of northeastern Stevens County and discovery of Cambrian

and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for Metaline quadrangle. Part of Weaver's Northport limestone is correlative with Metaline limestone and part is correlative with Maitlen phyllite.

Charles Deiss, 1955, U.S. Geol. Survey Bull. 1027–C, p. 122, 126, pl. 14. Restricted to lower, thicker unit (main mass) of Weaver's Northport. As restricted, underlies rather than interbeds with Weaver's Mission argillite. In mapped area, Northport is all dolomite, about 629 feet thick, and is intruded by at least nine dikes of medium-grained trachytic lamprophyre.

Occurs near Marble, Stevens County. Dolomite is part of southwest limb of anticlinorium that extends northeastward along valley of Columbia River from Marble to beyond Northport.

North Ridge Agglomerate[1] or Formation

Upper Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, chart 8C (column 93). Shown on correlation chart as North Ridge formation above Hinchman formation and below Foreman formation.

Occurs on Hinchman Ridge and Ravine, north ridge of Mount Jura.

Northrip Member (of Yegua Formation)

Eocene: Southern Texas.

H. D. McCallum, 1947, South Texas [Geol. Soc. Guidebook] 14th Ann. Mtg. Field Trip, p. 5. Noted on road log as in contact with Christine member (new).

Type locality not stated but Christine member occurs near Christine, Atascosa County.

North Shore Volcanics or Volcanic Complex (in Keweenawan Group)

Precambrian: Northeastern Minnesota.

H. M. Gehman, 1958, Minnesota Univ. Center for Continuation Study, Gen. Ext. Div., Inst. of Lake Superior Geology, Apr. 21–22, p. 1. North Shore volcanic complex is intruded by gabbros of Beaver Bay complex. On basis of A^{40}/K^{40} dating (Goldich and Nier, p. 11, this report), group is considered middle late Precambrian. Middle Keweenawan.

F. F. Grout, R. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 13 (table 1), 30–40. Described in Cook County as North Shore volcanics in Keweenawan group. Volcanic group comprises rocks which consist predominantly of basalt and rhyolite flows with interbedded tuffs, shales, conglomerates, and breccias. Flows and associated rocks occupy about one-half of Cook County. Principal belt lies between coast of Lake Superior and upper contact of Duluth gabbro complex.

Occurs in Lake and Cook Counties.

North Star Conglomerate[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 80, chart.

Named for occurrence in old North Star mine, Houghton County.

†North Valley Hill Sandstone[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 79, 165, 166.

Crops out through Chester and Montgomery Counties. Exposed for miles along North Valley Hill, Chester County.

North Vernon Limestone[1]

Middle Devonian: Southeastern Indiana.

Original reference: W. W. Borden, 1876, Indiana Geol. Survey 7th Ann. Rept., p. 148.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 41, pl. 1. Term North Vernon includes entire Hamilton sequence. Name Sellersburg in its original sense was nearly in synonymy with North Vernon, although its author failed to account for lowest rocks of Hamilton age. Names North Vernon and Sellersburg can both be used to advantage in describing Hamilton rocks in southeastern Indiana. Sellersburg, as defined by Kindle (1899) and modified by later workers, is present in Clark County and southern Scott County—that is, throughout area where Hamilton rocks are readily divisible into Beechwood, Silver Creek, and Speed lithologies—but is not applicable in Bartholomew and Jennings Counties and most of Jefferson County. A name other than Sellersburg is useful where reference is made to undifferentiated limestones of this area. Name North Vernon as set forth by Borden (1876) is meaningful when applied to relatively homogeneous Hamilton limestones of Bartholomew, Jennings, and Jefferson Counties. If only one name is to be retained, it should be North Vernon on grounds of both priority and inclusiveness. At present, Indiana Geological Survey uses both terms North Vernon and Sellersburg as formation names that include all limestones of Hamilton age of southeastern Indiana outcrop.

Named for North Vernon, Jennings County.

Northview Shale[1]

Northview Formation (in Chouteau Group)

Northview Member (of Chouteau Formation)

Mississippian: Southwestern Missouri.

Original reference: S. Weller, 1901, Jour. Geology, v. 9, p. 140.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 184 (fig. 28), 193–196. Rank reduced to member status in Chouteau formation. Overlies Compton member; underlies Pierson member. Seems to be about middle of Lower Mississippian.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2154–2157. Formation ranges in thickness from a trace to 77 feet, which was observed in vicinity of Northview, Webster County. Present throughout central part of area of present report [southwestern Missouri]. In most of area of occurrence, conformably overlies Chouteau limestone. The Chouteau pinches out southward before the Northview. Thus, in southern part of area of its occurrences, the Northview unconformably overlies Sylamore sandstone or rocks of Ordovician age. Conformably overlain by Sedalia dolomite.

E. L. Clark and T. R. Beveridge, 1952, Kansas Geol. Soc. Guidebook 16th Field Conf., p. 71, 72 (fig. 1), 74, 77 (reprinted as Missouri Geol. Survey and Water Resources Rept. Inv. 13). Top formation of the Chouteau, herein redefined as group. Where formation is thick, consists of two members: upper predominantly siltstone interbedded with subordinate shales and lower predominantly shale with minor siltstone lenses. Underlies Pierson formation; at type section, overlies Compton formation. North of type section lower Northview changes facies laterally and becomes Sedalia formation of west-central Missouri; uppermost Northview is attenuated as thin bed of shaly siltstone which overlies Sedalia as far north as Missouri River and eastward into Cooper and Howard Counties; southward to Arkansas-Missouri line, Northview persists as thin limey shale. Top of Northview is considered top of Kinderhook series. Type locality proposed.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1958, Deutsche Geol. Gesell. Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Northview shale shown on chart below Boone formation. Thickness 0 to 20 feet.

Type section: A composite of section along old and new lanes of U.S. Highway 66, 2 miles northwest of Northview, Webster County. Entire Northview with exception of uppermost beds is exposed along old or south lane of U.S. Highway 66 in SW¼SW¼SW¼ sec. 23, and S½ SE¼SE¼ sec. 22, T. 30 N., R. 19, W. Contact with overlying Pierson is exposed in cut in relocated or north lane in NE¼SW¼SE¼ sec. 22, T. 30 N., R. 19 W.

North Warren Shale Member[1] (of Cattaraugus Formation)

North Warren Shale Member (of Venango Formation)

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 203.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 14, 243. Member of Venango. Overlies Bimber Run conglomerate member; underlies Pope Hollow conglomerate member. The three units comprise Salamanca formational suite of Caster (1934). Upper Devonian.

Named for occurrence between Asylum quarries at North Warren and Tanner's Hill quarries (now Warren reservoir) on Tanner's Hill, at Warren, Warren County.

Northwestern Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Min. Journal-Press, v. 115, p. 793–799, 836–843, maps.

T. A. Dodge, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 563. In Lead district, unconformably underlies Flag Rock formation (new) and overlies Ellison formation. Thickness as much as 4,000 feet.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 6, 13. In Galena-Roubaix district, overlies Ellison formation and underlies Garfield formation.

Named for exposures in cuts of Chicago and Northwestern Railroad between Lead and Blacktail, Lawrence County.

Norton Formation

Norton Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southwestern Virginia and southeastern Kentucky.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 34.

J. B. Eby, 1923, Virginia Geol. Survey Bull. 24, p. 63, 67. Includes McClure sandstone member near middle.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 69–72, 147. Underlies Gladeville sandstone; overlies Lee formation; includes several named coals from Norton (at top) to and including Tiller at base. Formation is discussed under heading "strata of Briceville age in Virginia".

Named for Norton, Wise County, Va.

Norton Limestone Member (of Tribes Hill Formation)

Lower Ordovician: East-central New York.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938. Named as member of Tribes Hill.

R. R. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518, 522, 523. Basal unit of formation in Champlain and Hudson Valleys. Described at Whitehall as mottled dolomitic limestone with uncertain amount of crossbedded sandstone at base. Thickness about 45 feet. Underlies Fort Ann limestone member; overlies Skene dolomite member of Whitehall formation. Represents division C–2 and upper part of C–1 of Brainerd and Seely's "Calciferous" (1890, Geol. Soc. America Bull., v. 1, p. 501–506).

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 74. Name preoccupied. Subdivisions of Tribes Hill formation in Champlain Valley poorly defined and can not be used in Mohawk Valley.

Occurs at Whitehall and Fort Ann, Washington County.

†Norton zone (in Niobrara Formation)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6. p. 51.

Named for Norton and Norton County.

Nortonville Shale Member (of Kreyenhagen Formation)

Nortonville Shale

Eocene, upper: Western California.

P. P. Goudkoff, 1943, California Div. Mines Bull. 118, pt. 2, p. 248 (fig. 99a) [preprint 1941]. Correlation chart of west side of San Joaquin Valley oil fields shows Nortonville claystone, 15 to 50 feet thick, in Coalinga oil field. Occurs below Kreyenhagen shale.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Rank reduced to member status in Kreyenhagen formation. Foraminiferal and radiolarian shale about 300 feet thick. Underlies Markley sandstone member. Type locality stated.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 137. Upper Eocene in Bay region is divided into three units: Domengine sand, at base, Nortonville shale, and Markley formation. In central Napa County, along Conn Creek northeast of Rutherford, are small downfaulted remnants of Nortonville shale. These have maximum thickness of 600 feet and are either vertical or stand at high angles.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull. 65, no. 12, pt. 2, p. 1341. Formation, at type section, is tripartite lithologic unit composed of two chocolate-brown marine silty clay shales with an intervening argillaceous feldspathic sandstone lentil. Underlies Markley formation. Upturned edges of these two formations are exposed in lenticular, elongate outcrop striking northwest with regional dip to northeast. Faunules correlated with Ulatisian and Narizian stages.

Type locality: In roadcuts and along ridge between Nortonville sand mine on Kirker Creek and Somersville cemetery, north of Mount Diablo, Contra Costa County.

Norwalk Sandstone Member (of Jordan Sandstone)[1]

Upper Cambrian: Western Wisconsin and southeastern Minnesota.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, no. 7, p. 547.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236 (table 2). Table shows Norwalk as basal member of Jordan sandstone; underlies upper unnamed sandstone member. Overlies Lodi shale member of St. Lawrence formation.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902; 1939, v. 50, no. 8, p. 1238 (table 2), 1240. Underlies Van Oser member (new).

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 48–49. Described in southeastern Minnesota where it is about 55 feet thick in type section of Jordan sandstone. Underlies Van Oser member; overlies Lodi member of St. Lawrence formation.

Well exposed at Norwalk, Monroe County, Wis.

Norway Limestone[1]

Precambrian: Northern Michigan.

Original reference: C. Rominger, 1881, Michigan Geol. Survey, v. 4, pt. 2, p. 182.

Menominee iron region.

Norway Quartz Monzonite (in New Hampshire Magma Series)

Upper Devonian(?): East-central New Hampshire.

A. P. Smith and others, 1938, Geologic map and structure sections of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Medium- to coarse-grained pink quartz monzonite, usually gneissic. Belongs to New Hampshire magma series whose age is post-Lower Devonian and probably Upper Devonian.

A. P. Smith, Louise Kingsley, and Alonzo Quinn, 1939, Geology of the Mount Chocorua quadrangle, New Hampshire: Concord, New Hampshire State Plan. Devel. Comm., p. 6, 15. Older than Tamworth granite and younger than Kinsman quartz monzonite. Type locality cited.

Type locality: Rapids on Avalanche Brook in northwestern corner of Mount Chocorua quadrangle.

Norway Point Formation[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 589–590. Described in Thunder Bay

region where it underlies Potter Farm formation and overlies Four Mile Dam formation. Thickness at type section about 34 feet; neither top nor bottom visible. Included in Traverse group.

Type section: Exposures on banks and in bed of Thunder Bay River below Norway Point Dam, NE¼ sec. 12, T. 31 N., R. 7 E., Alpena County. This dam is also known as Six Mile or Seven Mile Dam.

Norwich Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of geology of Ontonagon County, p. 17–18, map.

Exposed at Norwich mine, Ontonagon County.

Norwood Shale

Middle Devonian: Northern Michigan.

[G. M. Ehlers], 1938, Michigan Acad. Sci., Arts, and Letters Sec. Geology and Mineralogy [Guidebook] 8th Ann. Field Excursion, p. 3,[figs. 1–3] after p. 8. Top of section. Shown to overlie Squaw Bay.

Occurs in Alpena district.

Norwood Tuff

Norwood Tuff (in Salt Lake Group)

Oligocene: Central Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 845–846, pl. 1; 1955, Utah Geol. Soc. Guidebook 10, p. 38, fig. 9. Dominantly light-colored tuff with lenses of volcanic conglomerate. Inlaid in Knight(?) formation of lower East Canyon and Morgan Valley and in Henefer formation (new) of Little East Canyon. Separated by unconformity from underlying beds. Rests in synclinal valley (Morgan Valley) on beds of Wasatch group and in anticlinal valley (Little East Canyon) on Henefer formation. Has yielded vertebrate fossils. Lower Oligocene. Probably contemporaneous with Park City volcanics (new). Included in Salt Lake group by Hayden (1869).

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., p. 75 (fig. 2). Composite stratigraphic column shows Norwood tuff at base of Salt Lake group. Stratigraphically below Collingston conglomerate (new). Thickness 50 to 2,000 feet. Lower Oligocene.

A. J. Eardley, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 167. Term Norwood abandoned and name Fowkes applied to all Norwood outcrops.

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 137. Although Norwood tuff was referred to Oligocene by Eardley (1944) as result of vertebrate fossils identified as *Allops marshi* and *leptomeryx* sp., a lower jaw belonging to upper Eocene agriochoerid *Protoreodon* cf. *pumilus* has been found in these beds in Norwood Canyon. Possibly two horizons are represented. In any case, the Norwood Canyon specimen is not likely as young as Oligocene.

Named for exposures in Norwood Canyon, Morgan County.

Nosoni Formation[1]

Nosoni Formation (in Bollibokka Group)

Permian: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. H. Coogan, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1821. At type locality Nosoni formation consists of 16,200 [6,200] feet of basic pyroclastics, flows, and interbedded sediments. Lowest member, conformably overlying McCloud limestone, is about 150 feet of black, medium-bedded chert. Second member is 1,495 feet thick and is primarily of bedded green tuff, tuffaceous conglomerate, and sandstone. Third member is 3,265 feet of purple medium-bedded or massive tuffaceous conglomerate, tuffaceous sandstone, tuff breccia, fissile red shale, and black fossiliferous shale. Fourth member is 1,440 feet and consists largely of black medium-bedded silty shale, which is richly fossiliferous in places. Andesitic flows occur throughout formation. Underlies Dekkas formation. As originally mapped much of type Dekkas is lateral equivalent of type Nosoni. Fossils show formation to be of early Guadalupian age.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Described in Bollibokka area where it is lower unit in Bollibokka group (new). Name was given to basic tuff, tuffaceous conglomerate, flows, and associated partly fossiliferous sedimentary rocks conformably overlying McCloud limestone. The Nosoni thus includes the McCloud shales of Fairbanks (1894) and at least part of the Carboniferous shales of Smith's (1894, Jour. Geology, v. 2) Pitt formation. Formation is more than 6,200 feet thick. Lower part consists of green and red, bedded, lithic crystal lapilli tuff, tuff breccia, tuffaceous conglomerate, sandstone, and shale. Interbedded with these rocks are andesite basalt and scattered beds of chert. Above the lower pyroclastic sequence, as well as sparsely interbedded with it, are black shale and slate, locally rich in fossils. There is no easily recognizable division between Nosoni and Dekkas. In Bollibokka area, contact is placed at top of highest black shale unit below the first massive green tuff breccia. In Bollibokka area, consists of four units characterized by different dominant lithologic components. Diller (1906) mapped a "Nosoni sediments" member of the formation in Bollibokka area. His usage and mapping are not followed in present study because unit is inconsistently defined. At Chatterdown Creek, it equals dominant sedimentary Member Four, but on Nosoni Creek it includes Member Four and about half of dominantly volcanic Member Three.

Named for exposures on Nosoni Creek, Shasta County.

Notch Peak Limestone[1]

Upper Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1084, p. 9.

H. E. Wheeler and Grant Steele, 1951, Utah Geol. Soc. Guidebook 6, p. 32 (fig. 5). Thickness 1,490 feet. Overlies Orr and Weeks formations. Underlies Chokecherry(?).

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 12. Underlies House limestone (new) of Pogonip group (restricted and redefined).

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 24–25, pls. 1, 2. Described in area from Wah Wah Range northward to Silver Island Range where it overlies Dunderberg shale, geographically extended. Thickness 978 to 1,939 feet. Chokecherry dolo-

mite is divided into two distinct lithic types separated by major time boundary; proposed here that Cambrian part of Chokecherry be renamed Notch Peak.

D. K. Powell, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 1, p. 21–25, geol. map. Described in southern House Range. Walcott's and Wheeler-Steele's stratigraphic section of Notch Peak amended on basis of lithology, fauna, and redefinition of Cambrian-Ordovician contact. Amended Notch Peak 1,939 feet thick; conformably underlies House limestone; conformably overlies Dunderberg shale. However, it is believed that thickness may be as much as 2,700 feet.

Type locality: Upper part of main mass of Notch Peak, House Range, Millard County.

Nottely Quartzite[1]

Lower Cambrian: Western North Carolina, central northern Georgia, and eastern Tennessee.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 5.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 286–290. Nottely quartzite is thin but prominent ridge-making quartzite which occurs in contact with Murphy marble only in main belt from Ellijay, Ga., northeastward; from Mineral Bluff, Ga., northeastward to Tomotla, N.C., it is exposed continuously for more than 24 miles. Quartzite dips steeply southeast to vertical; in places it is folded with the marble, but for most part it lies southeast of the marble and northeast of Valleytown formation. Where Nottely quartzite is not present and Murphy marble lies adjacent to Valleytown formation, as in Tate area, Georgia, it is assumed that the Nottely is absent because of nondeposition. Locally in Murphy syncline, the Nottely is cut out by faults and in some areas is in fault contact with Nantahala slate and Great Smoky quartzite. Cambrian(?). Discussion of structural relationships of area in detail.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Included in Talladega series believed to be Precambrian.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 54–56. In Mineral Bluff quadrangle, underlies Mineral Bluff formation (new); contact gradational.

Named for exposures along Nottely River, Cherokee County, N.C.

Nounan Limestone[1]

Nounan Dolomite

Middle and Upper Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1109–1116, 1117 (fig. 4), 1122–1123. Walcott's Blacksmith Fork section redescribed. Consists of light-gray and some dark-gray dolomite; lower part contains more than 150 feet of white-gray cliff-forming limestone. Thickness 900 feet. Overlies Bloomington limestone, base arbitrarily drawn at base of cliffs above upper slope of Bloomington; underlies St. Charles formation. May be late Middle or early Upper Cambrian in age, but evidence not conclusive; considered Middle Cambrian as stated by Walcott.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 651, 660, 673 (fig. 3). Overlies Calls Fort shale member (new) of Bloomington formation.

U.S. Geological Survey currently considers Nounan Limestone to be Middle and Upper Cambrian in age.

Type locality: East slope of Soda Peak, west of Nounan, Bear Lake County, Idaho. Nounan Canyon cuts through formation.

Nova Formation

Miocene, upper, or Pliocene, lower: Southern California.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 414–415. Beds of Tertiary fanglomerate with intercalated layers of volcanic material. At least 3,000 feet thick. Unconformably overlies Precambrian and Paleozoic basement; contact poorly exposed, but in Nemo Canyon fanglomerate lies with depositional contact upon Precambrian. Fanglomerate and lava dip to east and southeast.

C. W. Jennings, 1958, Geologic map of California Death Valley Sheet (1:250,000): California Div. Mines. Mapped with Plio-Pleistocene nonmarine sedimentary units.

Occurs on west flank of Panamint Range, between Wildrose Canyon and Towne's Pass, Death Valley region, Inyo County. Well exposed in Nova Canyon, whence the name.

Novato Conglomerate

Cretaceous(?): Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18 (table 3), 45, pl. 10. Thick-bedded conglomerate composed of well-rounded cobbles and pebbles of quartzite, quartz porphyry, quartz diorite, and white quartz. Thickness about 1,300 feet. Surrounded by alluvium except for about a mile along west boundary where it rests on serpentine associated with Franciscan group and is in fault contact with Sonoma volcanics; has been downthrown along east side of Burdell Mountain fault for an undetermined distance.

Exposed in Petaluma quadrangle on west side of San Pablo Bay just west of mouth of Petaluma Creek, in Coast Ranges north of San Francisco Bay. Confined to elongate area of about 3½ square miles.

Nowadaga[1] Member (of Utica Formation)

Ordovician: Eastern New York.

Original reference: R. Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 282. Nowadaga shale has been defined by Ruedemann and Chadwick (1935) as lower Utica or zone of *Climacograptus typicalis* (Hall) and includes black hard somewhat calcareous mud shale of typical Utica appearance that directly overlies the Canajoharie. Underlies Loyal Creek member. Thickness 200 feet on Nowadaga Creek; 500 feet in Otsquago Creek section near Fort Plain.

Well exposed on Nowadaga Creek, Herkimer County.

Nowata Shale[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southwestern Iowa, southern Kansas, and western Missouri.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 23.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 292, 335. Includes Walter Johnson sandstone member (new). Overlies Altamont limestone; underlies Lenapah limestone. Thickness 600 feet near Tulsa; 175 feet at Nowata; about 50 feet at Kansas-Oklahoma line; thins rapidly northward. Marmaton group.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 33–36, pl. 11. In type locality, lies between Altamont limestone member of Oologah formation below and Lenapah limestone above. Locally, south of type locality, overlain unconformably by Seminole formation. Maximum thickness about 200 feet. Owing to failure to recognize unconformity at base of Seminole formation and to assumption by Ohern that Dawson coal is southward equivalent of Lenapah limestone, term Nowata has unwittingly been made to include lower part of Seminole formation from south part of T. 25 N., southward, and in addition Holdenville (Memorial) shale and Lenapah limestone from latitude of Tulsa southward. As result, the Nowata has been erroneously assigned thickness of 600 feet or more in latitude of Tulsa.

J. R. Faucette, 1944, Tulsa Geol. Soc. Digest, v. 23, p. 247–248. Section of Nowata at type locality incompletely exposed; more complete section suggested for type section. Thickness at this section approximately 100 feet.

W. B. Howe, 1959, Missouri Geol. Survey and Water Resources Rept. Inv. 9, p. 8–10, strat. sections. Geographically extended into western Missouri. Overlies Altamont formation; underlies Norfleet member of Lenapah formation. Average thickness between 10 and 15 feet. Includes Walter Johnson sandstone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30, fig. 5. Section of shales and sandstones beneath Cooper Creek limestone of Lenapah and above Worland limestone of Altamont is here called Nowata although it may include part of overlying Lenapah as used in Missouri. In Iowa, there is no obvious break in sedimentation that would justify differentiation. Thickness in Madison County about 50 feet.

Type locality: T. 26 N., R. 16 E., latitude of Nowata. Type section: SW¼ sec. 10, T. 27 N., R. 16 E., Nowata County. Section measured on south bank of Verdigris River. Named from Nowata, Nowata County, Okla.

Nowood Member (of Phosphoria Formation)

Permian: Northern Wyoming.

J. J. McCue, 1955, (abs.) Wyoming Univ. Pubs., v. 19, no. 2, p. 82. Incidental mention.

Present in southeastern part of Big Horn Basin.

Noxie Sandstone Lentil or Member (of Chanute Formation)

Pennsylvanian (Missouri Series): Northern Oklahoma and southern Kansas.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 40, 43, 104. Sandstone lentil forming base of Chanute shale in Chautauqua arch area. Underlies Thayer coal.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 61, pl. 1. Has maximum thickness of 60 feet in vicinity of Noxie. Consists of massive

coarse-grained crossbedded buff to reddish brown sandstone. Upper part overlaps Nellie Bly beds along south side of pre-Chanute erosion channel.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 190. Commonly fills channels that extend as low as Stark shale or lower; locally contains limestone conglomerate at base. Average thickness 40 feet; in southern Kansas, may be as much as 100 feet, locally. Underlies unnamed clay shale; disconformable above Drum limestone.

Named for outcrops in vicinity of Noxie, NW cor. sec. 30, T. 29 N., R. 15 E., Nowata County, Okla.

Noxubee Sand

Eocene (Wilcox): Mississippi.

F. F. Mellen, 1950, Mississippi Geol. Survey Bull. 69, p. 9, 10–11. Lower Tertiary stratigraphy shows cyclic sedimentation to prevail. Normal cycle consists of basal transgressive sand member, median clay or shale member of inundated phase, and superior regressive silt or fine sand member. Second cycle of the Wilcox, Ackerman formation, is most conspicously developed cycle in lower Tertiary. Its basal sand exhibits evidence of orogenic developments in region by coarseness of its grain, sporadic presence of pebbles, cobbles, and boulders (up to 905 pounds) of quartz and quartzite, local concentration of large muscovite flakes, its thickness (up to 475 feet in subsurface, Jasper County) and its widespread lateral extent. Name Noxubee is applied to this basal sand.

Type locality and derivation of name not stated.

Nugget Sandstone[1]

Lower Jurassic: Southwestern Wyoming, southeastern Idaho, and northeastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56, p. 56, chart, map.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 14. Nugget sandstone has been included in Chugwater formation by some geologists; in Lost Soldier district and in Steamboat Butte field where oil was found in it [Nugget], it is called lower Sundance sand. This sandstone is called Wyopo formation by some geologists. Nugget sandstone, as here defined [central Wyoming], is the red and gray massive to coarsely bedded sandstone overlying Popo Agie member of Chugwater and underlying a Middle Jurassic sequence of gypsum, red shale, and dolomite beds throughout most of Wind River basin except in southeastern part. There the gypsiferous rocks are absent and the Nugget is overlain by younger fine-grained gray marine sandstones and green shales. Thickness 500 feet at southwest margin of Wind River basin, thins to north and east, and is absent in most places north of Owl Creek Mountains and along eastern margin of basin.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1273, 1275, strat. sections. In western Uinta and central Wasatch Mountains, overlies Stanaker formation (new) which includes some strata classed as Nugget by Boutwell (1912, U.S. Geol. Survey Prof. Paper 77). Underlies Twin Creek limestone. Thickness 1,183 to 1,293 feet. Nugget persists eastward but is called Navajo beyond Whiterocks Canyon.

J. D. Love and others, 1947, Wyoming Geol. Survey Bull. 38, p. 23, 33, 34, 43–44, 50–51, 59. Stratigraphic sections in central Wyoming show Nugget underlying Gypsum Spring formation and overlying Popo Agie member of Chugwater.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 35–36, pl. 1. Described in Ammon and Paradise Valley quadrangles, Idaho, where it is estimated to be 1,000 to 1,500 feet thick. Overlies Wood shale; underlies Twin Creek limestone. Lower Jurassic.

G. N. Pipiringos, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 36 (chart), 37, correlation chart. Expanded at base to include 50 feet of strata formerly included in Jelm as originally defined.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 47–48. In northwestern Wyoming, overlies Deadman limestone or upper Popo Agie beds; unconformably underlies Gypsum Spring formation. Thickness 54 to 354 feet.

G. N. Pipiringos, 1957, Wyoming Geol. Survey Bull. 47, p. 8–10, 12 (table 2), 13, 17–19, pl. 5. Type Nugget, 1,900 feet thick, overlies the Thaynes and underlies the Twin Creek. It is divided into two members which Veatch (1907) mapped separately. Boutwell (1907) applied name Ankareh to a 1,300-foot sequence in Park City mining district, Utah, whose stratigraphic position is identical to that of original Nugget (resting on Thaynes and overlain by Twin Creek). Subsequent workers [see bibliography this report] in adjacent and intervening areas have tried to retain both names, not as equivalents, but by restricting name Ankareh to basal redbed unit of original Ankareh and Nugget formations, and by restricting name Nugget to the overlying thick sandstone unit. These workers did not agree as to where Nugget-Ankareh boundary should be drawn; hence, there is little agreement as to what names to use for subdivisions in sequence overlying the Thaynes and underlying the Twin Creek. Presumably Nugget sandstone (upper member of Nugget formation of Veatch) is similar to Nugget of central Wyoming as described by Love and others (1945, 1947). Term Nugget sandstone is here applied [Laramie basin] to those rocks overlying Jelm formation and underlying Sundance formation. Sandstone grades, within a few feet, downward into upper conglomeratic member of Jelm and is overlain by Canyon Springs member of Sundance. The Nugget of this paper constitutes upper part of original Jelm formation and is here correlated with upper part of Nugget sandstone of central Wyoming and with so-called Entrada of northern part of Colorado Front Range. Thickness 40 to 110 feet.

R. E. Skinner, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 129–130. Stratigraphically restricted above to exclude unit here named Kendall sandstone member of Gypsum Spring formation.

Named for Nugget Station on Oregon Short Line, Lincoln County, Wyo.

Nulato Formation[1] (in Shaktolik Group)

Lower Cretaceous: Central western and central Alaska.

Original referenee: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 247, 276, 331, pl. 3.

R. M. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 facing p. 246. Age given as Lower Cretaceous on correlation chart.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Marine formation included in Shaktolik group in Koyukuk geosyncline and Hogatza uplift areas.

Typically exposed in northwest bank of Yukon for 2 to 10 miles above village of Nulato. In Nulato-Norton Bay district, Lower Yukon River region, and Koyukuk River region.

Nulhegan Quartz Monzonite

Age not stated: Northwestern Vermont.

B. K. Goodwin, 1959, Dissert. Abs., v. 20, no. 5, p. 1740. Granitic rocks occupy about two-thirds of map area. Three major granitic bodies are present. Averill granite, Nulhegan quartz monzonite, and Echo Pond granitic complex (new). Nulhegan is comparatively uniform.

Report discusses geology of Island Pond area, located between Green Mountain anticlinorium and Connecticut River.

†Nunda Group[1]

Upper Devonian: New York and Pennsylvania.

Original reference: L. Vanuxem, 1842, Geology New York, pt. 3, p. 172.

Named for exposures along banks of Genesee River in district formerly included in town of Nunda, now Portage, Livingston County, N.Y.

Nunda Sandstone Member (of West Falls Formation)

Nunda Sandstone[1]

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1908, New York State Mus. Bull. 118, p. 61.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 15, pl. 3. Underlies Pipe Creek shale member of Wiscoy sandstone; overlies West Hill formation. Name used in place of High Point sandstone.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 37. Underlies Pipe Creek shale herein reallocated to member status in Hanover shale; interfingers with upper part of Angola shale.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Chart OC–55. Nunda sandstone of Clarke and Luther (1908) redesignated as sandstone member of West Falls formation (new). Thickness 2 to 225 feet; in western Wyoming County occupies interval of 28 feet but is divided into two parts by tongue of Angola shale member. In Genesee River valley-Letchworth Park area, overlies West Hill member and underlies Hanover shale (Pipe Creek member); in Naples-Hammondsport area, overlies West Hill member and underlies Wiscoy sandstone.

Exposed in town of Nunda, Livingston County.

Nunkoweap sandstone (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 114. Massive sandstones. Highest beds exposed in Protozoic section. Thickness 200 feet. Overlies Walhalla formation (new).

Grand Canyon region.

Nunn Member (of Lake Valley Formation)

Mississippian (Osage): Southwestern New Mexico.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11, 13, 28, 61, figs. 4, 29. Soft blue-gray marls and nodular crinoidal limestone beds. Thickness varies from 100 feet in Santa Rita area to 1 foot in Sacramento Mountains. Rapid lateral variation in thickness common in Sacramento Mountains where biohermal structures occur. Absent in southern part of range because of nondeposition. Overlies Alamogordo member (as redefined); underlies Tierra Blanca member (new). Beds previously included in Alamogordo member.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 31, 83–84, fig. 3. Thin-bedded nodular light-gray- to pinkish-gray-weathering crinoidal limestone and shale unit as much as 30 feet thick in Caballo Mountains, where it unconformably overlies Percha formation or rests on Alamogordo member and unconformably underlies limestone of Magdalena group.

Type section: On Apache Hill at type section of Lake Valley formation near Lake Valley, NE¼NW¼ sec. 21, T. 18 S., R. 7 W., Sierra County. Named for Pryor Nunn Ranch on Tierra Blanca Creek where there are excellent exposures.

Nushagak Formation[1]

Miocene or Pliocene: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 173–174, 184.

Forms eastern shore of Nushagak Bay and around Cape Etolin to Bristol Bay.

Nussbaum Formation[1]

Pliocene(?): Eastern Colorado.

Original reference: G. K. Gilbert, 1897, U.S. Geol. Survey Geol. Atlas, Folio 36.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 19, pl. 1. On plains, just east of Front Range, Mount Morrison surface underlies gravels of Nussbaum formation, whose age is probably Pliocene.

Named for Nussbaum Spring, east of Pueblo, Pueblo County.

Nuttall (lower) Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western parts of Mercer and Summers Counties, p. 112, 139, 210, 330, 355.

Nuttall Sandstone Member (of New River Formation)

Nuttall Sandstone (in New River Group)

Nuttall Sandstone Member (of Sewell Formation)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 77.

R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 180–183. Nuttall (Dotson) sandstone, 110 feet thick at type locality, is divided into two ledges in Wyo-

ming and McDowell Counties. Each ledge attains thickness of over 100 feet. Upper ledge holds name Nuttall and basal member is designated Lower Nuttall sandstone. Upper stratum seems to correlate with Dotson sandstone and Bearwallow conglomerate of Campbell 1897 [1898]. The two ledges are separated by the Douglas coal. Lower Nuttall overlies Douglas shale (new). Sandstone is topmost member of New River group.

R. V. Hennen and others, 1919, West Virginia Geol. Survey Rept. Fayette County, p. 295–298. Nuttall sandstone of Campbell, constituting top member of New River group at type locality of latter, in area of this report, and coalesced into one cliff rock just below Hawks Nest, 175 to 200 feet thick, is generally represented in Fayette County by two separate ledges of practically same thickness, generally separated by 5 to 20 feet of dark, sandy shales and sometimes a thin—6 to 18 inches—coal bed (Iaeger "B"). In this report, name Upper Nuttall sandstone is applied to upper ledge and Lower Nuttall sandstone to lower ledge. The former occurs from a few inches to 15 feet below Lower Douglas coal. It appears now that Panther sandstone or conglomerate, originally described on pages 185–186 of Wyoming-McDowell report, correlates with Upper Nuttall ledge, instead of the latter representing Dotson sandstone.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 223–224. In Greenbrier County, Upper Nuttall sandstone is 50 to 70 feet thick, and Lower Nuttall is about 30 feet thick.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). Correlation chart shows Lower and Upper Nuttall sandstones in New River group.

U.S. Geological Survey currently classifies Nuttall Sandstone as member of New River Formation on basis of study now in progress.

Named for Nuttallburg, Fayette County, W. Va.

Nutwood Member (of Maple Mill Formation)

Mississippian (Kinderhook Series): West-central Illinois.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 27, pl. 1. Proposed for a dark-brown to black facies of the Maple Mill formation. A silty slightly calcareous to noncalcareous dark-brown to black sporanites-bearing shale; grades laterally and vertically into Maple Mill gray shale; locally replaces gray shale entirely and is directly overlain by Chouteau limestone. Thickness varies from featheredge to as much as 40 feet, somewhat inverse to variations in thickness of underlying Glen Park formation. Where Glen Park is absent, directly overlies some unit of Champ Clark group (new).

Named from exposures along creek that flows through "The Narrows" just northeast of Nutwood in SE¼NE¼ sec. 33 and SW¼NW¼ sec. 34, T. 8 N., R. 13 W., and in bluff behind Tenneriffe School, NW cor. sec. 9, T. 7 N.. R. 13 W., Jersey County. Occupies limited area on Ozark uplift and Vandalia arch, extending northeastward from Mississippi River to Christian County.

†Nutzotin Series[1]

Carboniferous and older and Jurassic: Southeastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 359.

Probably named for Nutzotin Mountains.

Nuuanu Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 120–121. Lava flows and associated cinder cones and palagonitized tuff. Upper flow is columnar jointed melilite-nepheline basalt 17 to 22 feet thick; next lower flow, commonly a little more than 50 feet thick, is nepheline basalt with only a little melilite. Additional flows interfingering with alluvium and cinder appear to be present deeper in section. Overlies weathered alluvium resting on Koolau volcanic series.

Named for occurrence in Nuuanu Valley. Exposed over about 2 square miles along valley behind and in city of Honolulu, on southside of Koolau Range 12 miles west of Makapuu Head.

Nuwok Formation

Pliocene: Northern Alaska.

W. H. Dall, 1919, Report of the Canadian Arctic expedition 1913–1918, v. 8, pt. A, p. 26A. Briefly mentioned as the Pliocene formation which in Alaska underlies Gubik sand in many places.

F. S. MacNeil, 1957, U.S. Geol. Survey Prof. Paper 294–C, p. 100–101. Name appears on original field labels accompanying both Martin's and Leffingwell's fossil collections, but never formally adopted by U.S. Geological Survey. Name used only for fossiliferous beds making up upper 266 feet of an estimated 7,000-foot thick section containing silty shale, sandstone, and mudstone.

Occurs along, and in county adjacent to Carter Creek near Camden Bay.

Nye Mudstone

Nye Shale[1]

Miocene, lower: Northwestern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 269.

H. E. Vokes, Hans Norbisrath, and P. D. Snavely, Jr., 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 88. Described in Newport area as sequence of approximately 2,500 feet of black massive mudstones. Disconformably overlies Yaquina sandstone; unconformably underlies Astoria formation.

Type locality: (Schenck, 1928) At town of Newport and Nye Beach, in NW¼ sec. 5, T. 11 S., R. 11 W., Lincoln County.

Oacoma Beds or zone (in Sully Member of Pierre Formation)

Upper Cretaceous: Central South Dakota.

W. V. Searight, 1937, South Dakota State Geol. Survey Rept. Inv. 27, p. 23, pls. 2, 3. Medial zone in Sully member (new). Consists of banded bentonite shales with manganese-iron concretions.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2341, 2343. Abandoned. Agency-Oacoma zones redefined as DeGrey member of Pierre shale.

Exposed along Missouri River below the Great Bend and southward. Town of Oacoma is in Lyman County.

Oak Creek Beds[1]

Lower Cretaceous: Northeastern Wyoming and western South Dakota.

Original reference: W. P. Jenney, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 593, fig. 122, map.

Occur along Oak Creek, Crook County, Wyo.

Oak Creek Formation

Pliocene: Central southern South Dakota.

Original reference: E. L. Troxell, 1916, Am. Jour. Sci., 4th, v. 42, p. 345–348.

J. T. Gregory, 1942, California Univ., Dept. Geol. Sci. Bull., v. 26, no. 4, p. 315. Name Oak Creek formation, proposed by Troxell for these deposits [Pliocene] in South Dakota, is preoccupied. Relationship of these deposits to recently named Valentine and Ash Hollow formations of Nebraska is not clear (time range of both being indicated in South Dakota without corresponding changes of lithology). Hence, it is inadvisable to attempt to extend these formations into this area [Big Spring Canyon]. Therefore these beds [Oak Creek] are referred to Ogallala group without formal formational designation.

Named for Oak Creek, eastern part of Mellette County.

Oak Creek Member (of Supai Formation)

Pennsylvanian: East-central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 88, 91, figs. 2 and 3. Shown on figure as member of Supai formation, consisting of siltstone and mudstone. Overlies Packard Ranch member (new) and underlies Big "A" sand facies of Supai. Westward it grades into sandstone of Supai and eastward it intertongues with a limestone.

At Fossil Creek.

Oak Creek Quartz Latite Tuff

[Tertiary?]: Southwestern New Mexico.

A. M. Alper and Arie Poldervaart, 1957, Econ. Geology, v. 52, no. 8, p. 954, 963, 965. Slightly older than intrusive rocks of Animas stock. Thins away from stock in all directions, from a maximum of 1,500 feet or more.

Surrounds and partly roofs the Animas stock, which is about 4 miles long and from less than one-fourth mile to over 2½ miles wide, located in the Animas Range in north-central part of Walnut Wells quadrangle, Hidalgo County.

Oak Creek Sandstone (of Iles Formation)

Upper Cretaceous: Northwestern Colorado.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 43–44, fig. 3. Light-gray medium-grained crossbedded sandstone which forms prominent ledge 100 feet thick and 920 feet above base of formation. Has relatively smooth well-defined top and gradational base.

Forms prominent ledge on west side of Oak Creek near Haybro.

Oakdale Quartzite[1]

Carboniferous: Central Massachusetts, northeastern Connecticut, and south-central New Hampshire.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 59, 60–62, 76–78.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 487–488. Discussion of stratigraphy and structure of Mount Pawtuckaway quadrangle, New Hampshire, and correlation problems with other areas. Previous correlation could be in error. Worcester phyllite which overlies Oakdale, may be Pennsylvanian; but the Oakdale may be older and an unconformity may separate the two formations. Possibility that the Oakdale may be considerably older than the Worcester furnishes best possibility of setting up correlation that would fit evidence from other areas.

Named for village of Oakdale in township of Sterling, Worcester County, Mass., where it is well exposed.

Oakfield Limestone or Dolomite

Middle Silurian (Lockportian), Western New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Proposed for dolomitic limestone with normal type Lockport fauna. Underlies Oak Orchard dolomite; overlies Devils Hole dolomite (new).

Type section: Along Oak Orchard Creek, at Shelby, Orleans County.

Oak Grove Limestone Member[1] (of Carbondale Formation)

Oak Grove Beds (in Carbondale Group)

Pennsylvanian: Northern, central, and western Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 90 (fig. 36), 91–94, 197. Oak Grove beds consist of series of thin marine limestone and shale beds, each characterized by more or less distinctive lithology and fauna; 14 members have been differentiated, and some are given informal names. Overlie Jake Creek sandstone; underlie Purington shale. Included in Liverpool cyclothem. Type section and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 55 (table 3), 66–67, pl. 1. Limestone member of Carbondale formation (redefined). Occurs above Lowell coal member and below Purington shale member. Replaces name Oak Grove beds. Complex unit consisting of interbedded limestone and shale but designated as limestone because most distinctive elements are limestone and it occurs at position in cyclical sequence normal for limestone. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Small ravine north of Oak Grove School, SW¼SE¼ sec. 6, T. 5 N., R. 3 E., Havana quadrangle, Fulton County.

Oak Grove Sand Member (of Shoal River Formation)

Oak Grove Sand (in Alum Bluff Group)[1]

Oak Grove facies (of Alum Bluff Stage)

Miocene, middle: Northwestern Florida.

Original reference: W. H. Dall and J. S. Brown, 1894, Geol. Soc. America Bull., v. 5, p. 166, 170.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 137, 169, 173. Rank reduced to member status in Shoal River formation. Type locality stated.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 26–27. Facies in basal part of Shoal River facies of Alum Bluff stage.

Type locality (member): Bed and bank of Yellow River, 400 feet below bridge at Oak Grove in secs. 16 or 17, T. 5 N., R. 23 W., Okaloosa County.

Oak Hall Member (of Nealmont Limestone)

Middle Ordovician (Mohawkian): Central Pennsylvania.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 3 (fig. 2); no. 2, p. 97, 101 (table 7). Columnar section shows Oak Hall as basal member of Nealmont formation. Underlies Centre Hall member; overlies Valentine member of Curtin formation. Heavy ledged limestone, with metabentonites 18 feet from top and at top. Thickness up to 60 feet.

Type section: Along Highway 322, 1 mile west of Tusseyville, 3 miles south of Centre Hall, and 6 miles east of Oak Hall. Named from Oak Hall, a village east of State College, Centre County.

Oak Hill Clay (in Allegheny Formation)[1]

Oak Hill clay or underclay member

Pennsylvanian (Allegheny Series): Southeastern Ohio.

Original reference: Wilber Stout, 1916, Ohio Geol. Survey, 4th ser., Bull. 20, p. 19, 27, 252.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 47, 48, table 1. Member of Strasburg cyclothem, Allegheny series. In Perry County, underlies Strasburg coal; overlies nonpersistent Hamden limestone; where Hamden is missing, is either in contact with Lower Kittanning coal or separated from it by shale and (or) sandstone. Thickness 3 to 10½ feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 66–68. Oak Hill underclay member of Strasburg cyclothem in report on Athens County. Thickness 4 to about 10 feet. Occurs above Hamden limestone member and below Strasburg coal member. Allegheny series.

Named for occurrences in vicinity of Jackson County.

Oak Hill Member (of Naheola Formation)

Oak Hill Beds (in Naheola Formation)

Paleocene: Western Alabama.

Lyman Toulmin, Jr., 1944, Alabama Acad Sci. Jour., v. 16, p. 42. Naheola formation comprises (ascending) "Matthews Landing marl," "Oak Hill beds," and "Coal Bluff beds."

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 42–45, pl. 3, geol. map. Predominantly gray laminated carbonaceous clay, sandy clay, and micaceous silt, alternating with crossbedded sand; locally sandy clay is thin bedded; at some localities member contains massive beds of very fine-grained micaceous sand, generally silty or clayey enough to be compact and tough; laminated sand and shale contains, at top, one or more lignite beds as much as 5 feet thick. Thickness 100 to 125 feet. Unconformably underlies Coal Bluff member; overlies Matthews Landing marl member of Porters Creek formation.

W. F. Roux, Jr., 1958, Dissert. Abs., v. 19, no. 5, p. 1056. Naheola formation in west-central Alabama and Mississippi comprises (ascending) Matthews Landing, Oakhill, and Kemper (new) members.

Type locality: In roadcut on State Highway 10, one-half mile west of Oakhill post office, Choctaw County.

Oak Hill Slate[1] or Series

Precambrian(?) and Lower Cambrian: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1931, Geol. Soc. America Bull., v. 42, no. 1, p. 225–226.

T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 4, 6, 9, 10. Includes (ascending) Call Mill slate, Pinnacle graywacke, White Brook dolomite, Western Sutton slate, Gilman quartzite, Dunham dolomite, Oak Hill slate, Scottsmore quartzite, Sweetsburg slate, and Vail slate. Series is in Oak Hill slice bounded on the west by Oak Hill thrust. Overlies Precambrian Tibbitt Hill schist. Geologic map (fig. 2) shows extension into Vermont.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135–1151. Oak Hill slate of Clark is herein designated as Parker slate.

Type locality: Oak Hill, Sutton quadrangle, Quebec.

Oakland Conglomerate

Oakland Conglomerate Member (of Chico Formation)[1]

Upper Cretaceous: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 31–33, pl. 1. Described in San Jose-Mount Hamilton area. Thickness 3,000 to 7,000 feet. Underlies Berryessa formation (new); overlies Knoxville. Name Oakland conglomerate is applied following usage of Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193) who mapped conglomerates of identical character in Hayward and Concord quadrangles. Name as used by Lawson was "Oakland conglomerate member" of Chico formation. This designation not adopted here because fossil evidence suggests Lower Cretaceous age and because term "Chico" has been so broadly applied that it no longer has reasonable stratigraphic significance. Lithologic identity of conglomerates in San Jose and Oakland areas seems sufficient to warrant use of Lawson's term, whatever the stratigraphic significance may ultimately prove to be.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Described in Hayward quadrangle as Oakland conglomerate. Locally 1,000 feet thick, but commonly thinner and in many places missing. Overlies Knoxville; underlies Chico formation restricted to exclude Oakland. Lower Cretaceous.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 7–8, fig. 2, geol. map. Oakland conglomerate occurs along eastern side of Pleasonton-Main Ridge, in an isolated outcrop about 1 mile north of Calaveras Reservoir on west side of Calaveras-Alameda Creek, north of town of Niles. Average thickness of conglomerate beds approximately 400 feet. Southwest of Dublin, conglomerate crops out as three belts separated from one another by 200 to 450 feet of siltstone. This intervening siltstone unit is here included as part of formation. Conglomerate-siltstone unit generally dips steeply to west and has maximum thickness of about 1,400 feet, unless faulting has exaggerated it. Conformably underlies Niles Canyon formation (new); contact gradational; north of Niles unconformably underlies Claremont shale; overlies Knoxville(?)

shale. Lawson (1914) mapped 100 to 1,000 feet of conglomerate as basal member of Chico formation. Term "Chico" is not used in present report, and rocks previously referred to as "Chico formation" are recognized as constituting Niles Canyon and Del Valle formations.

Named for type exposure at city of Oakland.

Oakland Limestone[1]

Oligocene: Southwestern Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

Occurs in three small areas, one a mile north of Oakland, another at head of Green Valley, and third on Starr's Ranch, about 4 miles northeast of Umpqua Ferry, Roseburg quadrangle.

Oak Orchard Dolomite (in Lockport Group)

Oak Orchard Member (or Lockport Formation)

Middle Silurian: Western New York.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 33–34. Name proposed to replace preoccupied name Shelby of Clarke and Ruedemann (1903). Uppermost member of formation. Overlies Eramosa member. Represents limited and discontinuous dolomite facies within formation. Described as fine-grained light-gray limestone at Rochester. Termed formation on plate 1.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. No. 1. Referred to as Oak Orchard dolomite in Lockport group. Overlies Oakfield limestone or dolomite (new).

Named for outcrop along Oak Orchard Creek in western part of Orleans County.

Oakridge Sandstone[1]

Jurassic(?): Western California.

Original reference: C. F. Tolman, Jr., 1915, Nature and science on Pacific Coast: San Francisco, Elder and Co., p. 45.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 15. Incidental mention in discussion of Franciscan formation in San Jose-Mount Hamilton area.

Occurs at Corral Hollow near Livermore, Alameda County.

Oaks Shale Bed (in Hamlin Shale Member of Janesville Shale)

Oaks Shale[1] Member (of Hamlin Shale)

Permian: Northeastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore and G. E. Condra, Oct. 1932, Revised classification chart of Pennsylvanian rocks of Kansas and Nebraska.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 50 (fig. 12). Permian.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Rank reduced to bed in Hamlin shale herein reduced to member status in Janesville shale (new). Wolfcamp series.

Type locality: Oak Farm southwest of Salem, NE¼ sec. 9, T. 1 N., R. 15 E., Richardson County, Nebr.

Oak Spring Group

Oak Spring Formation

Eocene to Pliocene or younger: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 367–369, pls. 32, 33. White and light-colored tuff with interbedded and capping layers of dark-colored rhyolite, dacite, latite, and basalt. Few sedimentary rocks near base which include some fanglomeratic deposits, well-cemented gravels, and cream to light-gray marly limestone beds. Thickness at Oak Spring Butte about 2,000 feet; thicker sections to south.

C. M. Tschanz, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B293–B295. Upper part of basal limestone of Oak Spring in Nye County contains fossil fish, *Fundulus*, that is restricted to Pliocene and Quaternary. The fish occurs 150 feet above base of exposed sequence. Lower part of this limestone is similar to Miocene limestone in Lincoln County and contains poorly preserved gastropods which have been dated as late Tertiary, possibly Miocene. This suggests that limestone of Oak Spring may be partly Miocene and partly Pliocene and that lower part is correlative with widespread Miocene limestone in Lincoln and Clark Counties.

U.S. Geological Survey currently classifies the Oak Spring as a group and designates age as Eocene to Pliocene or younger on basis of study now in progress.

Named from exposures at Oak Spring Butte, Atomic Energy Commission Nevada proving grounds area, Nye and Clark Counties.

Oakville Sandstone[1]

Oakville Formation (in Fleming Group)

Miocene: Southwestern Texas.

Original reference: E. T. Dumble, 1894, Jour. Geology, v. 2, p. 556–559.

B. C. Renick, 1936, Texas Bur. Econ. Geology Pub. 3619, p. 75, 80, table 2. Formation consists of lower Oakville, 65 feet thick, and middle Oakville, 20 to 60 feet thick, with Moulton sandstone member (new) at base. Overlies Catahoula formation.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1722–1724. Formation included in Fleming group. Unconformably overlies Catahoula formation; unconformably underlies Cuero formation (new). Miocene, probably upper.

J. H. Quinn, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 14, p. 5–6. Fauna apparently Arikareean.

Named for Oakville, Live Oak County.

Oat Gulch Shale

Upper Cretaceous: Western California.

L. I. Briggs, 1953, California Div. Mines Bull. 167, p. 31. Mentioned in discussion of Panoche formation in Ortigalito Peak quadrangle. Name credited to Bennison (1941, unpub. map of late Upper Cretaceous deposits south of San Luis Creek, Merced and Fresno Counties).

Oberlin Formation

Pleistocene: Southwestern Louisiana.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1830–1831. Name given to the Pleistocene formation, intermediate in age between the Lissie and Eunice (new). Unit has been referred to as the lower Beaumont.

Covers surface of physiographic unit extending northeastward from Kinder, through Oberlin and Oakdale, La., to edge of Red River Valley.

Obispo Breccia[1]

Age(?): Panamá.

Original reference: E. Howe, 1908, Am. Jour. Sci., 4th, v. 26, p. 213.

Obispo Limestone[1] or Formation

Oligocene: Panamá.

Original reference: E. Howe, 1907, Isthmian Canal Comm. Ann. Rept. 1907, p. 108–138.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 894 (chart), 898 (table). Thickness of formation 2,500 feet in Gatun Lake area where it underlies Las Cascadas formation and base is not exposed. Underlain by Gatuncillo formation west of Madden basin only.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 31. Volcanic rocks now included in Bas Obispo formation and Las Cascadas agglomerate were named Obispo formation or breccia by Howe (1907). Emendation to Bas Obispo formation and splitting off of younger part as Las Cascadas agglomerate were proposed by MacDonald (1913, Isthmian Geology, Isthmian Canal Comm. Ann. Rept. 1913, App. S., p. 564–582).

Northern Gaillard Cut area, Canal Zone.

Obispo Tuff Member (of Monterey Formation)

Miocene, lower: Southern California.

M. N. Bramlette, 1946, U.S. Geol. Survey Prof. Paper 212, p. 22–23, pl. 2. Name applied to tuff bed forming basal part of the Monterey in San Luis Obispo and Santa Barbara Counties. Tuff, which is several hundred feet thick, is composed chiefly of vitric shards. Overlies a dark mudstone (Rincon formation?).

Well exposed on east side of San Luis Obispo Creek about 4 miles south of San Luis Obispo, San Luis Obispo County.

Obregon Formation (in Thrifty Group)

Pennsylvanian (Cisco Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Name applied to the 125 feet (more or less) of shales with lenticular limestone, sandstone, conglomerate, and coal members underlying Pennsylvanian-Permian boundary (herein placed at disconformity in Harpersville formation above Waldrip-Newcastle coal zone and below *Schwagerina*-bearing "Waldrip limestone No. 3") and overlying Chaffin formation redefined. "Harpersville" beds below systemic boundary are assigned to Obregon and Chaffin formations of Thrifty group and those above boundary to Saddle Creek formation of expanded Pueblo group.

Named from Obregon Switch on the Gulf, Colorado, and Santa Fe Railroad, 6 miles east of Santa Anna, Coleman County.

O'Brien Creek Formation

Eocene(?): Northeastern Washington.

Hunting Geophysical Services, Inc., 1960, *in* Washington Div. Mines and Geology Rept. Inv. 20, p. 5, 6. Formation is what Umpleby (1910, Washington Geol. Survey Bull. 1) called dacite flow conglomerate and Calkins and others (1959, U.S. Geol. Survey open-file map) called tuffaceous

shale, sandstone, and conglomerate. In many places tuffaceous sandstone contains black argillite chips; some conglomerate contains granodiorite boulders presumably from Cretaceous(?) batholith. Calkins and others (1959) have assigned Eocene(?) age to this formation. Republic quadrangle and part of Aeneas quadrangle were mapped by Muessig and Quinlan (1959, U.S. Geol. Survey open-file map).

Report discusses parts of Okanogan and Ferry Counties.

Observatory Hill Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 519.

Occurs 6 miles north of outcrop of Marcellon quartz porphyry, in SE¼ sec. 7, town of Buffalo, Marquette County.

Oatka Beds[1]

Oatka Shale or Waterlime (in Bertie Group)

Upper Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Oatka shale, or waterlime, is basal formation of Bertie group. Underlies Falkirk dolomite; overlies Camillus shale. Eastern equivalent of Oatka waterlime not certain. Shown on chart as representing more calcareous and dolomitic phase of upper Camillus though it is equally as probable that the Oatka may be facies of the Fiddlers Green. Should latter relationship prove correct, the Oatka should form base of Murderian stage (new). Note on occurrence.

Known only from Murder Creek at Akron, Tonawanda Creek at Indian Falls (Medina quadrangle), Black Creek at Morganville (Albion quadrangle), and Oatka Creek at North Leroy (Bergen quadrangle).

Oatka Creek Shale Member (of Marcellus Shale)[1]

Middle Devonian: Central and western New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 130–131.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 357–358, pl. 1. Named by Cooper as upper member of Marcellus from Cayuga Lake westward to Seneca Lake, being overlain by Mottville member of Skaneateles shale, and underlain by Cherry Valley limestone member of Marcellus. To west of Seneca Lake, comprises all of Marcellus. In Batavia quadrangle only upper part of member is exposed. Underlies Stafford limestone member of Skaneateles.

Type section: Below Main Street bridge over Oatka Creek at LeRoy, Genesee County.

Oatman Andesite[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 31, map.

Exposed north of Oatman, Mohave County.

Oatman Creek Granite[1]

Precambrian: Central Texas.

Original reference: H. B. Stenzel, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 144.

V. E. Barnes, [1952?], Geologic map of the Hilltop quadrangle, Gillespie, Llano, and Mason Counties, Texas (1.31,680) : Texas Univ. Bur. Econ. Geology. Granite provisionally classed at Oatman Creek crops out in northeastern part of quadrangle and has been intruded between Packsaddle schist and Town Mountain granite.

Virgil Barnes, Frederick Romberg, and W. A. Anderson, 1954, Internat. Geol. Cong., 19th, Algiers 1952, Comptes rendus, sec. 9, pt. 9, p. 153. Town Mountain granite invaded already deformed metasediments [Valley Spring gneiss and Packsaddle schist] and was followed by Oatman Creek granite, Siximile granite, and Llanite, latter being youngest.

Occurs on Llano uplift, Mason County.

†Ocala Group[1]

Eocene: Florida and Georgia.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 331. Type locality: Ocala, Fla.

Ocala Limestone[1] (in Jackson Group)

Ocala Group

Eocene, upper: Northern and northwestern Florida, southern Alabama, and southern and western Georgia.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 103, 157, 331.

C. W. Cooke and H. K. Shearer, 1918, U.S. Geol. Survey Prof. Paper 120–C, 51–56. Includes Tivola tongue.

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1683–1686. Two-fold faunal division recognized. Upper member is typical Ocala seen at outcrop on Ocala uplift. Lower member, not known on outcrop, is light cream-colored limestone, commonly harder than upper member, generally highly calcitic and ordinarily composed of molds of small miliolids. Overlies Avon Park limestone (new). Upper Eocene.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 56. Ocala transgresses beveled surface of Avon Park, Tallahassee, and Lake City limestones. Top of Ocala was land surface before younger marine deposits were laid down. Ocala is overlain by Marianna limestone, Byram limestone, and Suwannee limestone, or Hawthorn formation.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 156–171. Restricted by separation of thickness of about 80 feet from base, which is Moodys Branch formation. Underlies Suwannee limestone. As restricted in this report, includes marine limestone of peninsular Florida of upper Jackson age that contains high percentage of specimens of larger foraminifers, *Lepidocyclina*, *Heterostegina*, and various camerinids, as developed in Polk and adjacent counties in well penetrations. Base of this interval is exposed at type locality where formation is massive coquina. Thickest exposure is at Crystal River Rock Co., quarry in SW¼ T. 19 S., R. 18 E., Citrus County, where minimum of 107.9 feet of unit is exposed.

W. C. Holland, L. W. Hough, and G. E. Murray, 1952 Louisiana Dept. Conserv., Geol. Bull. 27, pl. 13. Ocala group used on diagram to include Moodys Branch and Ocala (restricted) of Vernon.

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2 p. 130. Rank raised to group. Includes all calcareous sediments of Jackson stage in

Florida. Comprises (ascending) Inglis, Williston, and Crystal River (new) formations.

H. S. Puri, 1957, Florida Geol. Survey Bull. 38, 248 p. Group comprises (ascending) Inglis, Williston, and Crystal River formations. Because "Ocala limestone" at type locality has been quarried and type section destroyed and exposures in vicinity of Ocala represent only about 40 feet of sediments (basal section in most pits belongs to Williston member) cotype locality is herein designated. Thickness about 70 feet at cotype locality. Foraminifera described. Faunizones listed.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321, 323, 327, 329-336. Described in Georgia where it is basal unit of Jackson group. Underlies Barnwell formation. In this report, Tivola is classed as a member of the Ocala.

W. J. Carr and D. C. Alverson, 1959, U.S. Geol. Survey Bull. 1092, p. 8–9. Ocala limestone, as used in this report, includes all rocks of late Eocene age in west-central Florida. Average thickness on outcrop 150 feet.

Type locality: Ocala, Marion County, Fla. Cotype locality: Zuber pit of Cummer Lime and Manufacturing Co., in SE¼NW¼ sec. 11, T. 14 S., R. 21 E., Marion County, Fla.

O'Carroll Member (of Martin Limestone)

Devonian: West-central Arizona.

S. L. Tainter, 1948, U.S. Bur. Mines Rept. Inv. 4293, p. 5. Referred to only as the O'Carroll bed, lowest member of Martin limestone.

In Banner mining district, T. 4 S., R. 16 E., southwestern corner of Gila County.

†Ocate Sandstone

Jurassic: Northeastern New Mexico and southeastern Colorado.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Gray medium to massive somewhat cross-laminated sandstone about 50 feet thick; overlies Naranjo formation (new). Underlies Wanakah formation.

G. H. Wood, Jr., R. B. Johnson, and G. H. Dixon, 1957, U.S. Geol. Survey Bull. 1051, p. 15–16. Geographically extended into Las Animas County, Colo. Thickness 30 to 60 feet in Sangre de Cristo Mountains. Conformably overlies Sangre de Cristo formation; underlies Wanakah(?) formation.

R. B. Johnson, 1959, U.S. Geol. Survey Bull. 1071–D, p. 95. Name abandoned in northeastern New Mexico and southeastern Colorado. Name Entrada used for unit throughout area.

Named for exposures on Ocate Creek about 1½ miles east of Octate, Mora County, N. Mex.

Occoquan Granite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Exposed on Occoquan Run, from Occoquan village to forks of Bull Run, Prince William County.

Oceana Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 164.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 62, 97. In lower part of Kanawha group.

Exposed one-half mile north of Oceana, Oceana district, Wyoming County.

†Ocheesee Beds[1]

Miocene, lower: Western Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 105, 112, 157, 158, 331.

Well developed at Ocheesee, Jackson County.

Ochelata Group

Ochelata Formation[1]

Ochelata Member[1] (of Ramona Formation)

Pennsylvanian (Missouri Series): Northeastern, central northern, and central Oklahoma.

D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 38, table, geol. map. Term Ochelata is applied to middle member of Ramona formation. Consists largely of shale, but persistent sandstone, varying in thickness from 5 to 12 feet, lies somewhat above middle of shale. Average thickness about 85 feet. Overlies Dewey limestone member; underlies Avant limestone member.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Trip, p. 40 (table), 42–43. Name Ochelata was introduced as stratigraphic term by Ohern (1910) for beds between Dewey and Avant limestones; subsequent usage (Gould, 1925, Oklahoma Geol. Survey Bull. 35) has extended its application to include all strata above Dewey and beneath Nelagoney formation. Since base of Nelagoney coincides with Missouri-Virgil boundary, Ochelata beds comprise upper Missouri deposits of northern Oklahoma. Term Ochelata is here used as group, and its application extended slightly into Kansas on north and to northeastern flank of Arbuckle Mountains on south. Lower boundary defined at base of Chanute shale, which corresponds to top of Drum limestone where this rock is present; in places where Drum is absent, basal Chanute sandstone may extend downward a varying distance below Drum horizon. Upper boundary is defined to coincide with Missouri-Virgil disconformity. Disconformable above Skiatook group.

M. C. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 718 (fig. 3), 720 (table 1), 725–730. In Oklahoma, group comprises (ascending) Chanute shale, Iola formation, Wann formation (revived, restricted, redefined), Torpedo sandstone, shale, Birch Creek limestone, and strata tentatively referred to Weston shale of Kansas section. Overlies Skiatook group.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 74–95, pl. 1; 1959, Oklahoma Geol. Survey Bull. 81, p. 28–42. Group includes (ascending) Chanute formation, Iola formation, Wann formation, Barnsdall, and Tallant formations. It was clearly the intent of Moore and others (1937) that Ochelata group extend up to base of Virgil series, wherever that might be. Specifically, they extended it up only to base of Nelagoney formation, whose basal member, according to Gould (1925), is Bigheart sandstone, and base of Bigheart was then thought to be base of Virgil series in northern Oklahoma. Recent studies have shown that base of Virgil is higher in section, and Bigheart sandstone is here included in Ochelata group as basal member of

Tallant formation. Tallant formation is unconformably overlain by basal Virgil rocks. Across Osage County, Tallant is overlain by Cheshewalla sandstone, basal member of Vamoosa formation.

Named for Ochelata, Washington County.

Ochoa Series

Upper Permian: New Mexico and Texas.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1676–1677. Proposed for fourth and uppermost division of Permian. Series is designated to include all upper Permian sediments of post-Guadalupe age. Consists largely of evaporites and attains subsurface thickness of more than 4,000 feet. Four subdivisions recognized: Lower Castile, Upper Castile, Rustler, and Dewey Lake. Lower Castile is confined to Delaware basin, where it rests on Delaware Mountain sandstone. Basal conglomerate present in places. Outside Delaware basin, upper Castile overlaps onto and rests unconformably on beds of Guadalupe age.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 662–663, pl. 2. Tessey limestone included in Ochoa series.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1596–1625. Formations included in Ochoa are (ascending) Castile, Salado, Rustler, and Dewey Lake.

G. V. Cohee, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 9, p. 1578–1579. U.S. Geological Survey has adopted a two-fold subdivision of the Permian (Lower and Upper series and Early and Late epochs). These subdivisions coincide as nearly as possible with those recognized in type Permian and are drawn according to existing concepts of biotic correlation with type sequence. Reference sequence for United States is Permian outcrops of northwestern Trans-Pecos Texas where approximate faunal boundary is taken as that between Cherry Canyon and Bell Canyon formations which are encompassed by Guadalupe series. Boundary also falls between Word and Capitan formations as recognized in Glass Mountains area. Ochoa series is Upper Permian.

Named for Ochoa post office in T. 24 S., R. 34 E., Lea County, N. Mex. Outcrops of beds of Ochoa age are found in Eddy County, N. Mex., and Culberson County, Tex.; these outcrops are not representative of thick sequence found in subsurface type locality. Type section has been penetrated by many wells.

Ochoco Formation, Andesites or Lavas

Pliocene, upper, or later: Central Oregon.

W. D. Wilkinson, [1939], Geologic map of Round Maintain quadrangle (1:96,000): Oregon Dept. Geology and Mineral Industries. Name used to designate series of lava flows which lie disconformably above Rattlesnake(?) formation. Described as andesites and gray olivine basalts. Lavas were poured out over Columbia River basalts, Mascall and Rattlesnake(?) formations.

E. T. Hodge, 1940, Oregon State Coll. Studies in Geology, Mon. 3, p. 21–22. Thickness 10 to 50 feet.

Occurs throughout eastern and northeastern part of Round Mountain area, Crook County, and in Dayville quadrangle along flank of Wolf Mountain.

Ochre Mountain Limestone[1]

Upper Mississippian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 135, chart 5 (column 30). Meramecian and Chesterian. Occurs above Woodman limestone and below Manning Canyon shale.

H. R. Cramer, 1954, Dissert. Abs., v. 14, no. 10, p. 1681. Discussion of coral zones in Mississippian of Great Basin area. Great Blue limestone, which is stratigraphically and lithologically similar to more properly though later named Ochre Mountain limestone, is dropped.

As originally defined included Herat Shale Member.

Named for exposures on Ochre Mountain, Gold Hill region.

Ocoee Series

Ocoee Group[1]

Precambrian: Eastern Tennessee, northwestern Georgia, and western North Carolina.

Original reference: J. M. Safford, 1856, Geol. reconn. Tennessee, 1st Rept., p. 149, 151–152.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 401–416. Ocoee series, as interpreted in this paper, forms continuous belt which extends from southwest end of Buffalo Mountain, Tenn., southwestward across southern Tennessee, North Carolina, and Georgia. Length of belt to Alabama State line is about 250 miles. It varies in width from 2½ miles at northeast end to maximum of 25 miles in area southeast of Chilhowee Mountains. Talledega series of Alabama is correlated with entire belt of Ocoee series as defined in this paper. Late Precambrian.

G. W. Stose and A. J. Stose, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1233; 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 267–320. Ocoee series divided into four major units which are correlated from northern North Carolina to western Georgia, with a fifth formation present only in Murphy syncline. Units are (ascending) Hurricane graywacke (new), Great Smoky quartzite, Nantahala slate, Big Butt quartzite, and Valleytown formation. Series does not resemble Lower Cambrian Chilhowee group which it overrides nor any other Lower Cambrian facies. Series is stratigraphically overlain by Lower Cambrian Unicoi formation and is late Precambrian.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 8, p. 627, 629 (fig. 8), 631 (table 4), 632–643. Series was named by Safford (1856). Keith, in his subsequent folio work in area did not use term and preferred to speak of sequence in terms of component formations. However, term Ocoee is desirable, because whole unit is more distinctive than its component parts and because it differs greatly in its gross features from adjacent rock units. In this report, Ocoee is classed as a provincial series, probably belonging to late Precambrian. It is comparable to such other Precambrian provincial series as Keweenawan, Belt, and Grand Canyon. Can be subdivided locally into a number of formations. Tentative interpretation of sequence in northeast part of Great Smoky Mountains includes (1) fine-grained sandstone, with interbedded siltstone and slate; (2) Great Smoky conglomerate; (3) Nantahala slate (in mountain area) and Pigeon siltstone (north of mountains); and (4) Sandsuck shale. Base not exposed in Great Smoky Mountains; equivalent beds near Big Pigeon River rest on Max Patch granite and Cranberry gneiss. Underlies Chilhowee group of which Cochran conglomerate is lowest formation.

Pigeon siltstone is here used for Stose and Stose's term Hurricane graywacke.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 9, p. 947–966. Series, in Great Smoky Mountains, is probably 30,000 feet or more thick. Lies unconformably on basement of earlier Precambrian granitic and gneissic rocks, and on northwest side of mountains is overlain by Cochran formation, or basal unit of Chilhowee group, which is of Cambrian and Precambrian(?) age. South of mountains, series is overlain by rocks of Murphy marble belt; here, top of series is placed tentatively at base of Nantahala slate. Series is divisible into three broad units of regional extent and contrasting lithologic character, which are herein designated groups and named Snowbird, Great Smoky, and Walden Creek (new). Groups consist of local intergrading and intertonguing formations and have complex stratigraphic and structural relations. Series is split by major thrust faults into three sequences, a southern, central, and northern, none of which contains more than two groups of the series. Series also includes unclassified formations, Cades sandstone, Rich Butt sandstone (new), and rocks of Webb Mountain and Big Ridge.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 32–37; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Series in North Carolina divided into (ascending) Snowbird formation, Great Smoky conglomerate, Nantahala slate, and Sandsuck shale. Age designation of Nantahala questionable, but it is mapped in Ocoee series because present knowledge of formation in North Carolina does not warrant assigning it to Cambrian.

Named for exposures along narrows of Ocoee River, Polk County, Tenn.

Oconee Creek zone[1]

Precambrian: Northwestern South Carolina.

Original reference: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908 in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 6, 8, 12.

Named for exposures on Oconee Creek.

Ocotillo Conglomerate

Pliocene, upper, or Pleistocene, lower: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 23 (fig. 2), 24, pl. 2. Composed of gray granitic-pebble conglomerate. Overlies Borrego lacustrine clays, and, together with Brawley lake bed facies into which the conglomerate grades, forms youngest unit of Cenozoic in Imperial Valley. At type section, about 800 feet thick and conformable upon Borrego clays; near Ocotillo and eastward on south flank of San Felipe Hills anticlinorium, about 1,000 feet thick and conformable upon Borrego clays; northeastward from Ocotillo, overlaps Palm Spring and Imperial formations. In Mecca Hills south of San Andreas fault conglomerate ranges in thickness from knife edge to 900 feet and is unconformable on older formations; west of fault, about 2,500 feet thick and overlies Palm Spring red beds; in Indio Hills, about 2,100 feet thick and lies unconformably on Canebrake (new), Palm Spring, and Imperial formations and shows northwestward overlap.

Type section: In northern part of Borrego Badlands northeast of Borrego, Imperial County. Named for exposures near Ocotillo.

Ocotillo Silt Member (of Tansill Formation)

Permian (Guadalupe): New Mexico and Texas.

West Texas Geological Society, 1940, West Texas Geol. Soc. Guidebook Fall Field Trip, Sept. 1940, p. 7, 14, fig. 2; R. K. DeFord and G. D. Riggs, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1717, 1718, 1719, 1722. Consists of sand marl, buff-gray magnesium limestone, and silt in upper part of formation. Thickness 13½ feet at type locality of Tansill.

Named from Ocotillo Hills, prominent topographic feature northwest of Carlsbad, N. Mex. Member traceable over long distance on surface and in subsurface.

†Ocoya Creek Beds[1]

Miocene, middle: Southern California.

Original references: H. W. Turner, 1894, Am. Geologist, v. 13, p. 239; 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 461.

Occur on Ocoya or Pose Creek, Kern County.

†Octoraro Schist[1] of Phyllite

Paleozoic(?): Southeastern Pennsylvania.

Original reference: F. Bascom, 1909, U.S. Geol. Survey Geol. Atlas, Folio 162.

E. H. Watson, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 158, 161, 164. Wissahickon (Octoraro) phyllite is here considered probably Paleozoic.

Named for exposures in banks of Octoraro Creek between Lancaster and Chester Counties.

Oddie Rhyolite[1]

Pliocene(?): Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 49, map.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1953, Geology of Coaldale quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–23]. Described in Coaldale quadrangle where it consists of intrusive masses, dikes, and flows of rhyolite, quartz-latite, and dacite approximately contemporaneous with Esmeralda formation. Thickness of flows nowhere over a few hundred feet. As used here, formation includes Brougher dacite of Spurr. Lower Pliocene(?).

H. G. Ferguson and S. H. Cathcart, 1954, Geology of the Round Mountain quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–40]. Described in Round Mountain quadrangle, where it consists of rhyolite and quartz latite intrusive into sediments of Esmeralda formation and flows overlying Esmeralda. In Manhattan report (Ferguson, 1924, U.S. Geol. Survey Bull. 723), intrusive rhyolite cutting the Esmeralda was described as Maris rhyolite and quartz latite flow conformably above the sediments as uppermost member of Esmeralda, but, because these accord closely in lithology and age relations with Oddie rhyolite (including Brougher dacite) of Tonopah district (Spurr, 1905), older name is retained. Pliocene(?).

Makes up Mount Oddie and Rushton Hill, Tonopah district.

Odee Formation

Pleistocene: Southern Kansas and northern Oklahoma.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 100–108. Composed principally of silt and clay, or of their indurated equivalents; numerous thin beds of fine sand are present, some locally cemented to form a hard rock, and fewer beds of sand and gravel; contains a single bed of diatomaceous marl. Maximum exposed thickness about 300 feet; thickness at typical exposure in sec. 35, T. 34 S., R. 29 W., 94 feet, beds are essentially horizontal and undisturbed and base in concealed. Formation seems to represent alluvial or lacustrine fill in an irregular basin, partly erosional partly deformational, in the Ogallala. Underlies Quaternary beds, locally with angular unconformity with dips as steep as 27°

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, p. 413. Odee formation has not proved to be satisfactory unit for field mapping and is here included in Meade formation (redefined).

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 77–79. Restricted to scattered deposits of basin filling of local origin; study of vertebrate fossils from these deposits indicates age is post-Crooked Creek. Smith did not state type locality; hence, it is here designated.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Included in list of locally named units which are properly classed at least in part as Sanborn formation.

Type locality: In sec. 35, T. 34 S., R. 29 W., Cimarron Township, Meade County, Kans. Also exposed along Cimarron Valley in northern Beaver County, Okla.

Odell Shale (in Chase Group)

Odell Shale (in Sumner Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp. 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 59.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 163. Reallocated to Chase group. Underlies Krider limestone member of Nolans limestone; overlies Cresswell limestone member of Winfield limestone. Thickness 20 to 40 feet, average 30 feet. Wolfcamp series.

Type locality: Ravines and highway cuts one-eighth mile south and 2¼ miles east of Odell, Gage County, Nebr.

Odenville Limestone[1]

Lower Ordovician: Northern central Alabama.

Original reference: Charles Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 99, map.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 41). Shown on correlation chart above Newala limestone and below Mosheim limestone.

Well exposed on north side of Seaboard Air Line Railway about one-third mile east of Odenville, St. Clair County.

Ogallala Formation[1]

Ogallala Group

Pliocene: Western Nebraska, northeastern Colorado, western and central Kansas, eastern New Mexico, western Oklahoma, northwestern Texas, and southeastern Wyoming.

Original reference: N. H. Darton, 1898, U.S. Geol. Survey 19th Ann. Rept., pt. 4, p. 732–742.

F. W. Johnson, 1936, Am. Jour. Sci., 5th, v. 31, p. 467–473. Formation divisible into "cap rock bed," Burge sands, and Valentine beds.

A. L. Lugn, 1938, Am. Jour. Sci., 5th, v. 36, no. 213, p. 220–227. Group in Nebraska comprises (ascending) Valentine formation, 175 to 225 feet; Ash Hollow formation, 100 to 250 feet; Sydney gravel, 15 to 50 feet; Kimball formation (new), 30 to 40 feet. Unconformably overlies Hemingford group (new). Pliocene.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 39–94. Unit herein named Rexroad has been mapped as Ogallala, and some beds are indistinguishable from Ogallala.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, pt. 13, p. 404–410. Formation is 60 to 375 feet thick in Meade basin. Overlies Laverne formation; underlies Meade formation. Middle Pliocene. Beds called Rexroad by Smith (1940) are herein designated Rexroad member of Ogallala.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 20. Formation, in Kansas, comprises (ascending) Valentine, Ash Hollow, and Kimball members. Maximum thickness 350 feet. Overlies Pierre shale; underlies Meade formation in some areas and in others Sanborn formation.

J. C. Frye and A. B. Leonard, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 32, p. 7–20; 1959, Texas Univ. Bur. Econ. Geology Rept. Inv. 39, p. 443. In Texas High Plains, Armstrong and Howard Counties, Pliocene Ogallala formation consists of fluviatile deposits, predominantly of sand but with some silt and local lenses of coarse gravel, resting on erosional topography with several hundred feet of relief, developed on bedrock. Distinctive fossil seeds permit correlation of floral zones as far south as Howard County with subdivisions (Valentine, Ash Hollow, and Kimball) recognized to north in Kansas and Nebraska. Formation becomes thin and discontinuous to south where upland surface of High Plains merges with Edwards Plateau, broken by remnants of still higher surface developed on Cretaceous limestones. Formation is distinguished at top by complex "Caprock" limestone. Unconformably underlies Blanco formation. Neogene.

A. J. Myers, 1959, Oklahoma Geol. Survey Bull. 80, p. 51–54. Formation, in Harper County, consists of beds of moderately well-sorted to poorly sorted sand and gravel, some of which are partly cemented by calcium carbonate. Thickness 0 to 35 feet. Overlies Laverne formation, but in no place is it in contact; underlies Meade group. Middle (Hemphillian) Pliocene.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 43–45, pl. 1. Formation in Yankton area is as much as 125 feet thick in Knox County, Nebr., but north of Missouri River is commonly less than 10 feet thick. Divided into two subunits: lower consists chiefly of sand, fine gravel, and

orthoquartzite; and upper is composed chiefly of silty clay. Overlies Mobridge member of Pierre shale; separated from overlying deposits of Pleistocene age by sharp unconformity.

Named for exposures around Ogallala, Keith County, Nebr.

Ogan Clay (in Allegheny Formation)[1]

Ogan underclay member

Pennsylvanian (Allegheny Series) : Southeastern Ohio.

Original reference: Wilber Stout, 1927, Ohio Geol. Survey, 4th ser., Bull. 31, p. 175–181.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40, 42. Included in Ogan cyclothem (Allegheny series). Not present in area of this report, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 55. Underclay member of Ogan cyclothem in report on Athens County. Poorly exposed. Thickness about 1 foot. Occurs above Ogan shale and (or) sandstone member and below Ogan coal and below Zaleski marine member. Allegheny series.

Named for exposure on Ogan farm, sec. 14, Elk Township, Vinton County.

Ogan cyclothem

Pennsylvanian (Allegheny Series) : Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40, 42. Includes (ascending) Ogan shale, clay and coal, and Zaleski flint. Occurs below Winters cyclothem and stratigraphically above Brookville cyclothem. Occurs in Ohio column, but not present in area of this report, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 53–56. Cyclothem, although poorly exposed consists of (ascending) Ogan shale and (or) sandstone, Ogan coal and underclay, and Zaleski marine members. Occurs above Brookville cyclothem and below Winters(?) cyclothem. In this report, Allegheny series is described on cyclothemic basis; 13 cyclothems are named. [For complete sequence see Brookville cyclothem.]

Stout (1927) named Ogan coal and underclay from exposure on Ogan Farm in sec. 14, Elk Township, Vinton County.

Ogan shale and (or) sandstone member

Pennsylvanian (Allegheny Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 53–55. Member of Ogan cyclothem in report on Athens County. Where best exposed, consists of about 29 feet of gray silty to sandy micaceous fairly evenly bedded shale that occupies full interval between Putnam Hill member of Brookville cyclothem and Zaleski marine member of Ogan cyclothem.

Stout (1927) named Ogan coal and underclay from exposure on Ogan Farm, sec. 14, Elk Township, Vinton County.

Ogden Flint[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1894, Geol. Soc. America Bull., v. 6, p. 48.

Occurs near Ogden, Riley County.

†Ogden Quartzite[1]

Lower and Middle Cambrian: Northeastern Utah.

Original reference: C. King, 1876, Am. Jour. Sci., 3d, v. 11, p. 477–479.

J. D. Forrester, 1937, Geol. Soc. America Bull., v. 48, no. 5, p. 638. Conformably overlying Ophir shale in Uinta Mountains is so-called Ogden (Ordovician) quartzite of Weeks (1907, Geol. Soc. America Bull., v. 18, p. 437). This unit, believed to be of Cambrian age, is here termed Pine Valley quartzite.

Named for development in Ogden Canyon.

Ogdensburg Formation[1]

Ogdenburg Member (of Tribes Hill Formation)

Lower Ordovician: Northern New York.

Original reference: G. H. Chadwick, 1915, Geol. Soc. America Bull., v. 26, p. 289, 291.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Rank reduced to member.

R. R. Wheeler, 1946, Harvard Univ. Summaries of Theses 1942, p. 144. Uppermost member of formation in St. Lawrence Valley. Has more faunal similarity to Tribes Hill than to upper Beekmantown beds with which it has been correlated. Overlies Bucks Bridge member.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1552. Limestone is about 120 feet thick in Thousand Islands region where it is of late Beekmantown age.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2, column 19. Shown on chart as a dolomite unit overlying Tribes Hill dolomite.

Typical sections near Ogdensburg, St. Lawrence County.

Ogima Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Ogima mine, Ontonagon County.

Ogima Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Ogima mine, Ontonagon County.

Ogishke Conglomerate (in Knife Lake Group)

Ogishke Conglomerate Member (of Knife Lake Slate)[1]

Ogishke Granite Pebble Conglomerate (in Knife Lake Series)

Precambrian: Northeastern Minnesota.

Original reference: A. Winchell, 1887, Minnesota Geol. Nat. History Survey 15th Ann. Rept., p. 149, 179.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1034–1035. Ogishke conglomerate or group (in Kekequabic and Ogishkemuncie Lakes area) consists of three mappable facies. Each shows some lateral gradations into the other two, but there is

also rude vertical range with Peebles or granite facies at base, overlain by West Gull or jasper facies, and Zeta Lake or granite porphyry facies at top. Thickness 4,800 feet. Group is unconformable above Dike Lake slate (new); underlies Knife Lake slate. Included in Knife Lake series.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 1), 1597–1601. Term Ogishke granite pebble conglomerate is herein used. Ogishke conglomerate should not be used in sense of basal conglomerate as was done in past. Clements (1903, U.S. Geol. Survey Mon. 45) included all conglomerates in Knife Lake series under term Ogishke. Stark and Sleight discuss belt only at type locality; there divisions are local and cannot be differentiated on map. In present report, Knife Lake series is divided into 20 members not necessarily all different chronologically; conglomerates appear at many horizons in series. Ogishke granite pebble conglomerate is listed as member 6 and rests on member 3—Disappointment Mountain and Moose Lake conglomerate.

Well exposed on southwest shore of Ogishkemuncie Lake, Vermilion district.

Oglesby Marble Member (of Nittany Formation)

Lower Ordovician (Canadian): Western Virginia.

B. N. Cooper, 1939, Jour. Geology, v. 47, no. 5, p. 511 (footnote). Name applied to lower member of formation; underlies Draper member (new). Thickness 155 feet.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 17–18, pls. 1, 3, 6A. Formally proposed as Oglesby marble member. Composed of very fine grained vaughanitic limestone of various colors, pinkish- and bluish-gray being the predominant and persistent types. Thickness at type locality 90 to 115 feet; here too, there is approximately 80 feet of chert, dolomite, and limestone (also of Nittany age) below Oglesby member; on the geologic map these are included in the Oglesby. Type locality stated.

Type locality: In Draper Mountain area near Oglesby School, on lane leading south from Lee Highway at Pulaski-Wythe County line.

Oglesby Member (of Pecatonica Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 3. Shown on columnar section as underlying Brickeys member (new) of Mifflin formation and overlying Medusa member (new) of Pecatonica formation.

In copy of guidebook used by compiler, a handwritten note states that Brickeys member of Mifflin formation overlies Boarman formation. Thus, the sequence would be (descending) Boarman, Oglesby, Medusa.

Occurs in Dixon-Oregon area.

Oglethorpe Formation

Precambrian: North-central Georgia.

A. S. Furrcon and K. H. Teague, 1945, Georgia Geol. Survey Bull. 51, p. 35–36, pl. 3. Thick massive layers of biotite gneiss; medium- to thin-bedded fine-grained even-granular biotite gneiss, graywacke, and arkose. Overlies Amicalola gneiss (new) in northern part of area; terminated westward by coarse blue quartz conglomerate. As defined here, the Oglethorpe is that part of Ocoee series between Amicalola gneiss and blue quartz conglomerate.

Well exposed along road between Jasper and Connahaynee Lodge and Mount Oglethorpe [Pickens and Dawson Counties] where a large syncline in these rocks forms top and western sides of the mountain.

Ogontz Beds or Limestone

Ogontz Member (of Stonington Beds)[1]

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Univ. Michigan Mus. Geol. Contr., v. 2, p. 113–150.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 52. States that Ogontz beds lie above the Stonington but also that "this member" was deposited under relatively clear water conditions.

W. H. Twenhofel, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 46). Shown on correlation chart as Ogontz limestone; underlies Big Hill limestone; overlies Bay de Noc limestone.

Outcrops 6 miles northwest of Ogontz, Delta County, on farm of Andrew Barbeau, and at other places along east shore of Little Bay de Noc for 6½ miles north of Lighthouse Point.

Ohara Limestone

†Ohara Limestone Member[1] (of Ste. Genevieve Limestone)

Mississippian (Chesterian Series): Western Kentucky, southern Illinois, and central Tennessee.

Original reference: E. O. Ulrich and W. S. T. Smith, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24, 41.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 161–162, chart 5 (columns 85, 86). Ohara limestone shown on correlation chart as occurring in Kentucky and Tennessee. Overlies Ste. Genevieve Limestone. Type Ohara consists of Levias member of Ste. Genevieve and Renault formation; type Gasper appears to consist of both Renault and Paint Creek; thus the names overlap.

Named for Ohara, Caldwell County, Ky. The post office was for many years known as Cedar Hill or Cedar Bluff.

Ohia Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 95–96, pl. 20–B. Medium- to dark-gray olivine basalt with scattered phenocrysts of feldspar. Below altitude of 600 feet lava was confined to eastern side of Keanae Valley and filled small gulch in older alluvium along west edge of Pauwalu lava (new); near highway flowed through gap in spur between Keanae and Wailuanui Valleys and spread across fan of older alluvium to mouth of Wailuanui Stream. Exposed overlying alluvium in sea cliff along west side of Wailuanui Bay; one branch reaches sea between Pauwalu Point and Keanae village.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 121. Pleistocene(?).

Named for Ohia Spring, which issues from it in Keanae Valley, east Maui.

Ohio Shale[1]

Upper Devonian: Ohio and north-central Kentucky.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 62.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 859–879. Black shale of Kentucky has been treated as part of New Albany, Chattanooga, or Ohio shale by different workers. Although it is continuous with all three, the shale above the Trousdale east of Cincinnati arch more nearly conforms to characters of Ohio shale. Formations of Ohio represented within limits of the New Albany are Olentangy, Huron, Olmsted, Cleveland, Bedford, Berea, and Sunbury. Lower Blackiston, upper Blackiston [Blackiston new in this report], and Sanderson (new) are equivalent to Huron, Olmsted, and Cleveland respectively. Olentangy is basal member of Huron.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 14–16, pls. Ohio shale represents practically continuous deposition of black mud throughout much of Late Devonian time. It crops out in wide belt from Cuyahoga County, in northern Ohio, to Pulaski County, in southern Kentucky. In northern Ohio, this black shale is divided into two units, Cleveland and Huron members. Separation of Cleveland from Huron is difficult and contact is arbitrarily drawn. In western Lorain County, between Cuyahoga and Huron Counties, Cleveland and Huron members are separated by western edge of Chagrin shale. Thins southward; more than 500 feet in southern Huron County, Ohio; 250 feet near Vanceburg, Lewis County, Ky; 95 feet near Irvine in Estill County, Ky. In vicinity of Irvine, the Ohio merges with Sunbury shale of Mississippian age at southern limit of Bedford and Berea rocks. Contact of Ohio shale with overlying Bedford shale is generally well defined from Berea, Ohio, to Irvine, Ky.

K. V. Hoover, 1960, Ohio Geol. Survey Circ. 27, p. 5–6, 7 (fig. 2). Discussion of Devonian-Mississippian shale sequence in Ohio. In northern Ohio, Ohio shale is regarded as consisting of three members (ascending): Huron, Chagrin, and Cleveland. The Cleveland is considered by some writers to have a "member" called the Olmsted. Stratigraphically, Cleveland shale is considered by all investigators to be top member of Ohio shale. Stratigraphic position of other two members has been disputed, some researchers regarding the Huron as basal member and others the Chagrin. Some workers have considered Ohio shale as a facies deposit. For all practical purposes, black shales of central and southern Ohio should not be split lithologically into members.

Named for Ohio River hills.

Ohio Creek Formation

Ohio Creek Conglomerate[1]

Paleocene: Western Colorado.

Original reference: W. Cross, 1892, Am. Jour. Sci., 3d, v. 44, p. 21–23.

V. H. Johnson, 1948, Geology of the Paonia coal field, Delta and Gunnison Counties, Colorado (1:62,500): U.S. Geol. Survey Prelim. Map. Described in Delta and Gunnison Counties, where it rests on Mesaverde formation and is separated from it by irregular unconformity, and unconformably underlies Wasatch ("Ruby") formation. Consists of light-colored sandstone, locally containing abundant pebbles of chert, jasperoid quartz, and

several kinds of igneous rocks. Erratic and locally absent, though in places as much as 200 feet thick. Tertiary age.

C. B. Hunt, 1956, U.S. Geol. Survey Prof. Paper 279, p. 19. Probably Paleocene.

J. R. Donnell, 1959, Rocky Mountain Assoc. Geologists [Guidebook] 13th Ann. Field Conf., Symposium, p. 76, 77. In Carbondale area, overlies Mesaverde formation. Probably Paleocene.

First described in Gunnison County.

Ohio River Formation[1]

Paleocene: Southern Indiana and northern Kentucky.

Original reference: G. H. Ashley, 1903, Indiana Dept. Geology and Nat. Resources 27th Ann. Rept., p. 68.

A. P. Pinsak, 1956, Indiana Geol. Survey Bull. 9, p. 7, 12–13, 52. Composed largely of unconsolidated but well-compacted sand that exhibits irregular, haphazard crossbedding; color ranges from red to white. Formation reaches its maximum thickness at Tip Top, Hardin County, Ky., where four units are represented: an upper red, upper medial white, lower medial tan, and lower white. Unconformably overlies Salem limestone in Clarke County and St. Louis limestone in Harrison County. If Highland Rim peneplane was developed during Pliocene time, Ohio River formation is Pliocene in age.

W. J. Wayne, 1960, Indiana Geol. Survey Bull. 21, p. 7–32, pl. 1. Formation is body of poorly consolidated medium- to fine-grained quartz sand in southern Indiana and northern Kentucky. It overlies limestones of middle Mississippian age in narrow belt from near Salem, Ind., to south of Fort Knox, Ky. Although regarded as a "ridge top" sand, formation does not cap the highest hills; formation was beveled along with surrounding rocks during late Tertiary cycle of erosion. Remnants of formation range from a few inches to more than 80 feet in thickness. Paleocene. Ashley did not designate type section but evidently considered exposures in Harrison County east and southeast of Elizabeth to be equivalent of a type area. Type section and reference sections herein designated.

Type section: Exposure 2 miles southeast of Elizabeth, in SW¼SE¼ sec. 3, T. 5 S., R. 5 E., Harrison County, Ind. Reference sections: SE¼NW¼ sec. 20, T. 1 S., R. 5 E., Clark County; SW¼SW¼ sec. 15, T. 5 S., R. 5 E., Harrison County.

Ohlson Ranch Formation

Pliocene, middle to upper(?): Northern California.

C. G. Higgins, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 3, p. 199–232, map. Marine sandstone, siltstone, and conglomerate; includes fluviatile(?) conglomerates. Thickness 0 to 300 feet; uneven basal contact makes estimate of thickness uncertain. Patchy, poorly exposed, 500 to 1,700 feet above sea level on hilltops; unconformably overlies Franciscan formation. No identifiable traces of formation found west of San Andreas fault-zone trace. Invertebrate fauna.

J. H. Peck, Jr., 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 4, p. 233–242, pl. 21. Paleontology discussed.

Type locality: Ernest Ohlson Ranch, 5½ miles east of Stewarts Point, N½ sec. 3, T. 9 N., R. 13 W., M. D., Annapolis quadrangle, Sonoma County.

Outcrop area is structural-topographic trough about 23 miles long, 4 miles wide, parallel to and 2 miles east of coastline.

Oil Creek Formation[1] (in Simpson Group)

Middle Ordovician: Central southern Oklahoma.

Original reference: C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1494, 1495, 1496. Name credited to E. O. Ulrich.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 61–68, charts 1, 2. Decker (1930) published correlation chart credited to Ulrich (and U.S. Geological Survey) as of 1928, in which Oil Creek was designated as lowermost of three Simpson formations: Oil Creek, Bromide, and West Spring Creek (with Criner member). Decker also presented chart which Ulrich reportedly presented from manuscript before Geological Society of America in meeting at New York City in 1928. In this second chart of Ulrich, basal Simpson was termed Joins Ranch (not Oil Creek), overlain by Nebo (not Bromide). Ulrich (1929 [1930], U.S. Natl. Mus. Proc., art. 21) published chart in which basal Simpson was designated Joins, with overlying Oil Creek in substitution for preempted term Nebo. Later stratigraphers have adopted last-mentioned nomenclature. In both surface and subsurface section, formation is divisible into two members: basal sandstone, and upper member of interbedded limestones and shales. Basal sandstone member predominates in eastern end of Arbuckles, whereas limestones predominate in central and western parts. Disconformably overlies Joins formation; in cases of overlap, rests unconformably on Arbuckle limestone or dolomite; disconformably underlies McLish formation. Thickness about 678 feet in West Spring Creek section; about 650 feet in U.S. Highway 77 section. Note on type locality. Chazyan.

Type locality: Along Oil Creek, which traverses formation in sec. 17, T. 3 S., R. 4 E., approximately 14 miles southeast of Sulphur, Murray County. Formation occurs throughout length of Arbuckle Mountains and crops out in Criner Hills.

Oil Creek Lake Group[1]

Upper Devonian and Mississippian: Northwestern Pennsylvania.

Original reference: J. P. Lesley, 1895, Pennsylvania 2d Geol. Survey Final Rept., v. 3, pt. 1, p. 1767.

Occurs at Oil Creek Lake, 14 miles northwest of Titusville, Crawford County.

Oil Lake Group[1] or Series

Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 91–98.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 52 (fig. 9). Oil Lake series shown on generalized "facieological" diagram of Upper Devonian strata in northern Pennsylvania. Oil Lake series, which is Mississippian contains Knapp stage.

First described at Oil Creek Lake, Crawford County.

Oil Springs[1]

Upper Triassic: Western Wyoming.

Original reference: W. C. Knight, 1901, Eng. Mining Jour., v. 72, p. 359.

Wind River Mountains.

Ojo Alamo Sandstone[1]

Ojo Alamo Formation or Group

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: B. Brown, 1910, Am. Mus. Nat. History Bull. v. 28, p. 267–274.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 27, pl. 1. Formation or group. Upper Cretaceous. Underlies Puerco formation.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Sandstone described in San Juan basin. Overlies Kirtland shale. Underlies Nacimiento formation.

C. D. Di Giambattista, 1952, Geological Symposium of the Four Corners region: Four Corners Geol. Soc., p. 6 (correlation chart), 8. Correlation chart shows Ojo Alamo sandstone as Paleocene. Overlies McDermott, angular unconformity; underlies Nacimiento formation. May be early Eocene. Southwestern Colorado and northwestern New Mexico.

R. Y. Anderson, 1960, New Mexico Bur. Mines and Mineral Resources Mem. 6, p. 2–4, 13. Discussion of Cretaceous-Tertiary palynology of eastern side of San Juan Basin, N. Mex. Ojo Alamo sandstone is of Montanan age from vertebrate evidence but Tertiary as determined from a few fragmentary plant fossils. Basal Ojo Alamo florule has only four forms in common with overlying or underlying florules and could be either Cretaceous or Paleocene. Middle florule has nine forms in common with overlying Nacimiento florules, suggesting Tertiary affinity.

Named for occurrence near Ojo Alamo, San Juan County, N. Mex.

Ojo Bonito Porphyry[1]

Cretaceous(?): Western Texas.

Original reference: C. L. Baker, 1929, Texas Univ. Bull. 2901, p. 73–74, 79–82.

Crops out in valley of Cibolo Creek, at eastern foot of main mass of Chinati Mountains.

Okaldakoochee Marl Member (of Fort Thompson Formation)

Pleistocene (Wisconsin): Southern Florida.

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 192 (table 1). Table shows Fort Thompson formation divided into Okaldakoochee marl member below and Coffee Mill Hammock marl member above; occurs above Ayers Landing member (new) of Caloosahatchee marl.

J. R. DuBar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 136 (fig. 4), 145. All Fort Thompson deposits that underlie Coffee Mill Hammock marl are grouped into Okaldakoochee marl; these include all fresh-water beds information at type locality and also lower marine unit here called "X, Chlamys bed".

Occurs in Caloosahatchee River area.

Okanogan glaciation

Okanogan[1] (till)

Pleistocene: Washington.

Original reference: C. R. Keyes, 1927, Pan-Am. Geologist, v. 47, p. 353.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 69, no. 2, p. 129 (table). Referred to as glaciation. Preceded by Bowian and followed by Vashon.

Originated in Cordilleran center.

Okaw Formation[1]

Okaw Formation (in Homberg Group)

Upper Mississippian (Chester Series) : Southwestern Illinois.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 127.

J. M. Weller *in* Stuart Weller and J. M. Weller, 1939, Illinois Geol. Survey Rept. Inv. 59, p. 12. As originally defined, Okaw included all beds between the Ruma below and Menard sandstone above. Main part of this interval consists principally of limestone, but at top there is considerable thickness of shaly and sandy strata. These two parts were termed Upper and Lower Okaw by Weller (1913) ; Ulrich (1917) applied name Plum Creek beds to upper division. Lower and Upper Okaw were for many years correlated with Golconda and Glen Dean formations, but it has been shown that both of these formations are actually included in Lower Okaw and that Upper Okaw is equivalent to Tar Springs, Vienna, and Waltersburg formations. Because Okaw, as originally defined, includes beds of both middle and upper Chester age and because its two divisions are separated by an unconformity and are separately mappable units, name Okaw is herein restricted to lower division and name Baldwin formation is proposed for Upper Okaw or Plum Creek beds. As thus redefined, Okaw crops out in several isolated areas entirely surrounded by Pennsylvanian beds in southwestern St. Clair County, southeast of Millstadt; its belt of continuous outcrop begins on Prairie du Long Creek 6 miles east of New Design and extends southeastward to Kaskaskia (Okaw) Valley, and then southward to the Mississippi; it occurs in Mississippi bluffs from a point 2 miles southeast of Modoc nearly to Marys River. Attains thickness of about 200 feet and consists principally of more or less heavy-bedded limestone separated by layers of shale.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136; J. M. Weller and A. J. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 833–834. Included in Homberg group (new).

Named for Okaw or Kaskaskia River, southwestern Illinois, whose valley is entirely excavated in these rocks.

Okay Limestone Lentil (of Pawhuska Formation)[1]

Pennsylvanian (Virgil Series) : Northeastern Oklahoma.

Original reference: K. C. Heald, 1918, U.S. Geol. Survey Bull. 686–E, p. 28–32.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 104. About 10 feet highest bed of Elgin sandstone. Probably equivalent to part of Lecompton limestone.

Named for exposures on and in neighborhood of O. K. Ranch, in sec. 31, Osage County.

†Okefenokee Formation (in Columbia Group)[1]

Pleistocene: Georgia Coastal Plain.

Original reference: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 60, 424–434.

Named for Okefenokee Swamp, a great swampy tract covering part of Charlton, Ware, and Clinch Counties.

Okesa Sandstone Member (of Barnsdall Formation)

Okesa Sandstone Member (of Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: O. B. Hopkins, 1918, U.S. Geol. Survey Bull. 686-H, p. 76–77, pl. 12.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 120; W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 30–32. Reallocated to member status in Barnsdall formation (new). Okesa thickens southward at expense of two unnamed shale members of formation and includes, as its basal bed, limy sandstone that is equivalent to Birch Creek limestone.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 37, 39–40. In Creek County, Okesa overlies Wann formation. In T. 19 N., R. 9 E., contains two sandstone units and intervening sandy to silty shale unit with combined thickness of 90 feet in north part and 80 feet in south part. In T. 18 N., has total thickness of 120 to 170 feet. Tps. 14 and 15 N., Rs. 8 and 9 E. is single sandstone unit which thins southward from 160 feet to 85 feet. As mapped in this area, rests on Iola limestone as far south as south side of sec 20, T. 14 N., R. 9 E., and rests on Chanute formation farther south where Iola is absent.

Named for exposures east of Okesa, T. 26 N., R. 11 E., Osage County.

Oketa Shale Member (of Barneston Limestone)

Oketo Shale (in Chase Group)[1]

Permian: Central Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook p. 12 (fig. 4), 69 (fig. 45).

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 76–77. Member of Barneston. Blue and gray shale, calcareous, and locally contains one or more beds of limestone. Thickness as much as 17 feet. Underlies Fort Riley limestone member; overlies Florence limestone member. Wolfcamp series.

Name derived from Oketo, Marshall County.

Oklahoma Series[1]

Permian: Oklahoma.

Original reference: G. H. Ashley, 1923, Eng. and Min. Jour-Press, v. 115, p. 1106–1108.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. Name preoccupied by Oklahoman series (Keys, 1896).

Oklahoman series[1]

Permian: Oklahoma.

Original reference: C. R. Keyes, 1896, Am. Geologist, v. 18, p. 22–28.

Named for Oklahoma.

Oklan Series or Epoch

Middle Pennsylvanian; North America.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 284, 286, 288–289 (fig. 1), 292–297. Analysis of physical characters and paleontological features of Pennsylvanian rocks

in North America leads to conclusion that stratigraphic cleavage at two positions within system has paramount significance. Three series recognized: Ardian-Lower Pennsylvanian; Oklan-Middle Pennsylvanian; Kawvian-Upper Pennsylvanian. Oklan series includes all Pennsylvanian deposits between Morrowan and Missourian rocks. Boundaries marked by disconformities which are clearly distinguished at many places but obscure in others. In some areas, Oklan formations rest disconformably or nonconformably on pre-Pennsylvanian rocks ranging in age from Mississippian to Precambrian. Divisible into two stages: Atokan (or Derryan) and Desmoinesian. Rocks of Oklan series are more widespread than those of either older or younger divisions of Pennsylvanian. Series contains several faunal zones which have world-wide distribution and which are readily identified. Time equivalent is Oklan epoch.

Name Oklan is based on abbreviation of State of Oklahoma and refers to the thick fossiliferous succession of Middle Pennsylvanian deposits in east-central and northwestern Oklahoma.

†Oklune Series[1]

Late Carboniferous(?), Mesozoic, and Tertiary: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 163–169, 181.

Exposed where Kanektok River emerges from Oklune Mountains and along the Kanetok on western side of mountains in Kuskokwim region.

Okmok Volcanics

Okmok Ash

Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaska Volcano Inv. Rept. 2, pt. 3, p. 28, pl. 3. Rocks of Okmok ash chiefly of 1- to 10-foot beds of well-sorted ash, lapilli, and fragments of accessory materials. Consolidated bed of agglomerate, 5 to 20 feet thick and composed largely of bombs, occurs near base of Okmok beds exposed in wall of caldera and in gullies around outer slopes of volcano. Bombs 1 to 2 feet long abundant in this bed; bombs and accessory fragments as much as 3 feet long occur locally. Bed about 20 feet below top of ash on northern outer slope consists of flattened disc-shaped bombs; individual bombs 1 to 4 inches thick and 4 to 12 inches across. A few lava flows, 20 to 50 feet thick, and a few beds of tuff-breccia, poorly sorted are interlayered with ash beds. In caldera walls, thickness of ash ranges from a few feet to more than 300 feet and averages 170 feet. On outer slope, thickness decreases rapidly with increasing distance from caldera; less than 5 feet thick along Bering Sea coast. Overlies Tanak volcanics (new) and Tulik basalt (new).

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 314–323, pl. 41. Okmok volcanics includes Tanak volcanics and Okmok ash of Byers and others (1947). Maximum thickness about 400 feet at type locality; thins outward to as little as 20 feet. Younger than Crater Creek basalt. Recent.

Type locality: North Rim of Okmok Caldera, Umnak Island.

Okmulgee Group[1]

Pennsylvanian: Kansas and Oklahoma.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named for city and county in Oklahoma.

Okpikruak Formation

Lower Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 159–160, fig. 2. Predominantly fine-grained greenish-gray sandstone of graywacke type, dark clay, and silt shale with minor amounts of conglomerate near base. On Siksikpuk River, formation characterized by rhythmic alternation of fine-grained sandstone, silt shale, and clay shale. Alternation not well developed along Okpikruak River. Thickness about 2,400 feet at type locality, 1,850 feet on Siksikpuk River. Unconformably underlies Torok formation (new); rests on Jurassic or Triassic rocks with little or no angular discordance.

W. W. Patton, Jr., *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 215, 220, fig. 2. Overlies Tiglukpuk formation (new), in some places with angular discordance; locally underlies Fortress Mountain formation (new).

Type section: In middle of a major syncline and exposed on small tributary of Okpikruak River at about lat 68°34′30″ N. and long 153°38′ W. Crops out in southern part of Arctic Foothills province from Itkillik River west to Kukpowruk River. Typically exposed along Okpikruak River.

†Oktibbeha Tongue (of Selma Chalk)[1]

Upper Cretaceous: Northeastern Mississippi.

Original reference: L. W. Stephenson, 1917, Washington Acad. Sci. Jour., v. 7, p. 243–250.

Named for Oktibbeha County.

Olaa Agglomerate

Pleistocene, upper(?) and Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 39–40. An accumulation of detrital material in mounds 5 to 25 feet high underlying Glenwood tuff.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 121. Now known to be fragmental tops of irregular aa flows of Kau volcanic series.

Occurs on east slope of Mauna Loa, inland from Olaa and Camp Two, on Waiakea Plantation Railroad.

Olallie Lavas

Pleistocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 706, 709 (fig. 2), 713; (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig. 2), 1617, 1618, 1631, 1632. High Cascade lavas are divided into four groups; in chronological order these are: Outerson basalts, Minto basalts, Santiam basalts, and Olallie lavas. Olallie lavas and Santiam basalts not in contact hence relative ages unknown. Extruded on dissected surface of Minto lavas.

Mapped in vicinity of Olallie Butte, Jefferson quadrangle. Olallie Butte is dissected cone typical of many built up on eroded Minto series.

Olathe Limestone Member[1] (of Stanton Limestone)

Pennsylvanian: Central eastern and northeastern Kansas.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans., [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, pt. 1, p. 76–79.

Type locality: At western edge of Olathe, secs. 34 and 35, T. 13 S., R. 23 E., Johnson County.

Olcese Sand[1]

Olcese Sand Member (of Temblor Formation)

Oligocene, upper, and Miocene, lower: Southern California (subsurface and surface).

Original reference: A. Diepenbrock, 1933, California Oil Fields, Div. Oil and Gas, v. 19, no. 2, p. 14, pl. 2.

A. M. Keen, 1943, San Diego Soc. Nat. History Trans., v. 10, no. 2, p. 26 (fig. 1), 28 (fig. 2), 29, 30. Mapped as Olcese sand in Kern River area around Round Mountain; considered member of Temblor. Underlies Round Mountain silt member; overlies Jewett silt member. Note on type locality.

Type locality: At west edge of Mount Poso oil field, northeast of Bakersfield, Kern County, in Ohio Oil Co. well No "Glide" 1, sec. 13, T. 27 S., R. 27 E.

Old Bridge Sand Member (of Raritan Formation)

Upper Cretaceous: East-central New Jersey.

H. C. Barksdale and others, 1943, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 67–101. Commonly a fine- to medium-grained sand, locally quite coarse; crossbedded, slightly micaceous; occasional small beds of clay. At outcrop, practically free of pyrite and lignite, but samples from boreholes show that downdip these substances are fairly common; dry sand is white or yellow. Thickness 80 to 110 feet (data based on surface exposures and from wells). Unit is No. 3 sand of previous reports. Occurs near top of formation below Amboy stoneware clay and above South Amboy fire clay, both of which are considered informal economic terms. Separated from Sayreville sand member (new) by South Amboy fire clay. Most of discussion of unit deals with its relationship to ground-water supply.

Named for outcrops in and near Old Bridge village, Middlesex County. Crops out or is exposed beneath Pleistocene deposits in irregular band that extends from Raritan Bay near South Amboy to and probably beyond Jamesburg.

Old Colony Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Old Colony mine, Houghton County.

Old Colony Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Old Colony mine, Houghton County.

Old Colony Sandstone[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, Geol. Ser. 4, p. 304, 375, 421, 445, fig. 37.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Included in Portage Lake lava series.

Named for occurrence in Old Colony mine, Houghton County.

Old Crow Gypsum[1]

Permian: Northwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 363.

Named for Old Crow crossing of Canadian River, Blaine or Dewey County.

Old Dominion Limestone[1] (in Stevens Series)

Lower Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 66, map.

V. J. Okulitch, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1540. Faunal evidence indicates Lower Cambrian age of limestone. Overlies Addy quartzite.

Probably named for exposures near Old Dominion Mountain, Stevens County.

Old Gregory Formation

Miocene, upper: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 135, 137–138, figs. 6, 7, 8, 9. Made up chiefly of light greenish to white rhyolite tuffs and breccias regularly characterized by lapilli, which are partly devitrified. Some of the pyroclastic section appears to be subaerial in origin. Tuffs regularly show graded bedding and are often associated with cream to tan siliceous shales of lacustrine origin. Shale units range from 10 to as much as 70 feet think. Total thickness approximately 2,700 feet. Probably rests on undifferentiated metamorphic and granitic rocks. Underlies Chloropagus formation (new).

Named for exposures in area about Old Gregory Camp, which lies a mile southeast of Red Mountain.

Oldham Limestone[1]

Lower or Middle Silurian: East-central Kentucky.

Original reference: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 47.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Oldham limestone below Lulbegrud conglomerate and above Plum Creek conglomerate. Silurian (Niagaran).

E. B. Branson and C. C. Branson, 1947, Jour. Paleontology, v. 21, no. 6, p. 550 (fig. 1). Table shows Oldham limestone overlying Plum Creek member of Brassfield formation. Lower Silurian (Medinan).

Named for Oldham Branch between Panola and Brassfield, Madison County.

Old Lassen Mud Flows

Age not stated: Northern California.

Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 5, geol. map.; no. 8, geol. map. Shown on geologic map on east side of Mount Lassen.

Lassen Volcanic National Park.

Old Ocean Shale

Oligocene: Southern Texas (subsurface).

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1618, 1630 (fig. 5), 1631 (fig. 6), 1634. Name suggested for Oligocene marine shale wedge that occurs in subsurface above unit here named Van Vleck sands and below unit named Pierce Estate sands or Flour Bluff sand. Wedge is more than 3,400 feet thick, thins northward, and disappears in well No. 7 (Danciger, Raver No. 1) in southeast corner of Colorado County.

Typically displayed in well No. 24 (Harrison and Abercrombie, Bernard River Land Development Company No. 4), in Old Ocean field, Brazoria County.

Old Pewabic Amygdaloid[1] (in Ashbed Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1 pt. 2, p. 86, chart.

Named for occurrence in an old mine on Pewabic property, in Keweenaw County.

Old Pewàbic Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in an old mine on Pewabic property, in Keweenaw County.

Old Rag Granite[1]

Precambrian: Northern central Virginia.

Original reference: A. S. Furcron, 1934, Jour. Geology, v. 42, no. 4, p. 400–410.

Edward Steidtmann, 1945, Virginia Geol. Survey Bull. 64, p. 27. Mentioned in report on commercial granites in Virginia.

Named from exposures in Old Rag Mountain, east of Old Ray post office, Madison County.

Oldsmar Limestone

Eocene, lower: Northern and central Florida (subsurface).

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1681, 1698–1701. 1751 (fig. 36). Name applied to limestone facies of lower Eocene in northern Florida and peninsula.

Defined to include interval that is marked at top by abundant specimens of *Helicostegina gyralis* Barker and Grimsdale and that rests on Cedar Keys limestone. Lithologically similar to overlying Lake City limestone (new). Thickness in type well 925 feet; 1,200 feet in Monroe County; 740 feet in Levy County.

Named from Oldsmar well, sec. 18, T. 28 S., R. 17 E., Hillsborough County. Samples from well are filed at Florida Geological Survey under No. W–8.

Old Woman Sandstone

Tertiary: Southern California.

R. L. Shreve *in* J. F. Richmond, 1960, California Div. Mines Spec. Rept. 65, p. 45–46, pl. 1. Massive reddish-buff conglomerate arkose devoid of marble casts. Sandstone becomes finer grained, more massive, and less conglomeratic stratigraphically upward and geographically northward. Thins rapidly northward; in Blackhawk Canyon, thickness decreases from estimated 600 feet near Voorhies fault to measured 200 feet near mouth of canyon 4,500 feet to north. Rests in depositional contact on deeply weathered gneiss; bedding in sandstone generally dips northward about 10° more steeply than contact with underlying gneiss. Overlain by terrace deposits.

Type locality: Lower Blackhawk Canyon, San Bernardino Mountains, north of Big Bear Lake, San Bernardino County. Forms typical badlands topography.

Olean Conglomerate Member (of Pottsville Formation)[1]

Olean Conglomerate

Lower Pennsylvanian: Western New York and northwestern Pennsylvania.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 89, 96.

Henry Leighton, 1941, Pennsylvania Geol. Survey, 4th ser., Bull. M–23, p. 57, 103. Referred to as Olean conglomerate, Pottsville series. Thickness 55 feet in McKean and Elk Counties, Pa. Underlies Marshburg coal and clay which in turn underlies Kinzua Creek sandstone.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 67–68. Olean conglomerate does not crop out in area of this report [Wellsville quadrangle] but occurs just one-half mile to west elevation at 2,500 feet and has been useful in working out relationship of beds in Wellsville quadrangle. Data suggests unconformity with underlying Mississippian(?) Oswayo(?) formation.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6. chart 6 (column 9). Correlation chart shows Olean conglomerate below Sharon shale in northwestern Pennsylvania and southwestern New York. Pottsville series.

Bradford Willard, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 781–796. Marine Mississippian of northwestern Pennsylvania meets and merges in north-central Pennsylvania with continental Mississippian spread from northeast. At their junction, the two facies are confined between overlying Olean or Pottsville spheroidal-pebble conglomerates of basal Pennsylvanian and underlying Devonian. Latter is represented by Mount Pleasant red shale of continental Catskill facies to east and youngest marine Devonian, Oswayo formation, to west.

Typical outcrop at Olean Rock City, 6 miles south of Olean, Cattaraugus County, N.Y.

Olean Drift

Olean Substage

Pleistocene (Wisconsin): New York and Pennsylvania.

Paul MacClintock and E. T. Apfel, 1944, Geol. Soc. America Bull., v. 55, no. 10, p. 1145 (fig. 1), 1153–1155, pl. 1. Based primarily on lithologic differences, three Wisconsin drift sheets are recognized (ascending): Olean, Binghamton, and Valley Heads. Olean drift is composed dominantly of sandstones, siltstones, and shales from bedrock constituting the plateau; contains only 2 to 3 percent limestone and very little igneous material. This contrasts with Binghamton drift which normally contains 12 to 20 percent limestone and 5 to 7 percent igneous material.

L. C. Peltier, 1949, Pennsylvania Geol. Survey, 4th ser., Bull. G–23, p. 4 (table 1), 16 (fig. 5), 20–26, table 5. Referred to as Olean substage in discussion of glacial geology of Susquehanna River terraces. Also discussion of Olean till, silt, sand, and gravel. Underlies Binghamton drift.

Well exposed in vicinity of Olean, Cattaraugus County, N.Y.

†Olean Shale[1]

Pennsylvanian: Western New York.

Original reference: J. M. Clarke, 1902, New York State Mus. Bull. 52, p. 525.

Olean quadrangle.

Olentangy Shale[1]

Olentangy Shale Member (of Blackiston Formation)

Upper Devonian: Central Ohio.

Original reference: N. H. Winchell, 1874, Ohio Geol. Survey, v. 2, p. 243, 287.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 46, no. 9, p. 859, 861, 865–866, 868–870, 876, pl. 1. New Albany shale in Indiana consists of Devonian Blocher and Blackiston formations (both new), 90 feet thick, and Mississippian Sanderson, Underwood, and Henryville formations (all new), 11 feet thick. These divisions continue through Kentucky, Ohio, and Tennessee. Olentangy shale is basal Blackiston and Upper Devonian in age. In Kentucky, Olentangy overlaps Silurian beds from Ohio River to Olympian Springs, the Portwood (new) to Indian Fields, and the Trousdale to Crab Orchard. Thickness 17½ feet at Fox Springs; 8½ feet at Rice Station; pinches out at Crab Orchard.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 8–16. Stratigraphic position and correlation of Olentangy shale discussed in detail. Difference of opinion arises from fact that a shale unit and a limestone unit lie between Huron shale and Delaware limestone of northern Ohio (or Dundee limestone of northwestern Ohio) and so hold generally the position occupied by Olentangy in central Ohio. Limestone in northern part of state is the Prout. It is described as immediately underlying Huron (Ohio) shale. Subjacent to this limestone is Plum Brook shale. Names "Silica formation" and "Ten Mile Creek dolomite"

are assigned to disputed shale unit and carbonate unit, respectively, in northwestern Ohio. Problem of correlation revolves around relationship of Olentangy in central Ohio to Prout limestone-Plum Brook shale of northern Ohio and Silica shale-Ten Mile Creek dolomite of northwestern Ohio. At various times and by different authors, Plum Brook shale has been correlated with Olentangy, and so-called Prout limestone has been regarded as member of Olentangy shale. Dating these rocks in the three geographic regions under consideration remains controversial matter. It is here suggested that Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek are stratigraphically correlatable with reservation that Olentangy is probably Upper Devonian. Top limit of Olentangy in central and southern Ohio is uppermost gray shale bed in contact with a black shale layer. In area of Prout limestone and Ten Mile Creek dolomite outcrop, contact between them and overlying black shale presents no problem. Disconformable relationship exists between underlying older formations and base of Olentangy. In northern Delaware County, Olentangy disappears beneath glacial drift. Devonian rocks next crop out in Huron County to north or Lucas County to northwest. Undisputed Olentangy is not present in these areas; rather Olentangy stratigraphic interval is represented by Prout limestone and Plum Brook shale (northern Ohio) or Silica shale and Ten Mile Creek dolomite (northwestern Ohio). Undisputed Olentangy is variable in thickness. In type area averages 28 feet. In southern Ohio ranges from 0 to 58 feet.

Named for exposures on Olentangy River, Delaware County.

Olequa Formation[1]

Eocene: Southwestern Washington.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Philos. Soc. Proc., v. 52, p. 566, 568.

Type locality not stated.

Olequa Creek Member (of Cowlitz Formation)

Eocene, upper: Southwestern Washington.

D. A. Henriksen, 1954, Dissert. Abs., v. 14, no. 12, p. 2316. Named as member of Cowlitz. Underlies Goble volcanics member; overlies Pe Ell volcanics member (new).

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 37, 48–49, pl. 1. Comprises two lithologic facies: (1) brackish water, shallow marine, and nonmarine consisting of massive to crossbedded fine-grained arkoses, feldspathic sandstones, and thin-bedded sandy siltstones, with intercalated beds of coal, bone, and carbonaceous siltstone and claystone; (2) near-shore marine consisting of massive to well-bedded mudstone, siltstone, and silty sandstones, in part carbonaceous, micaceous, glauconitic, and limy. Minimum thickness 800 feet. Thickness at type locality 2,500 feet; thickens toward southeast; along Cowlitz River may be as much as 5,000 feet or more. Conformably overlies Stillwater Creek member; contact gradational. Unconformably overlain by Oligocene sediments along contact line which trends northeastward from Cowlitz River to Chehalis River north of Pe Ell; in southeastern part of area member is overlain with marked angular unconformity by basalt flows and interbedded sediments of Astoria formation.

Type section: Along Olequa Creek from its confluence with Cowlitz River northward to Oligocene contact south of Winlock, and along Stillwater Creek from Brim Creek to Olequa Creek, Lewis County.

Oley Valley Slates[1]

Precambrian: Southeastern Pennsylvnaia.

Original reference: E. V. d'Invilliers, 1883, Pennsylvania 2d Geol. Survey Rept. D_3, v. 2, p. 47, 158, 180.

Berks County.

Olinger Gray Shale Member (of Chattanooga Shale)[1]

Mississippian (Kinderhook): Southwestern Virginia and southern Tennessee.

Original reference: J. H. Swartz, 1927, Am. Jour. Sci., 5th, v. 14, p. 485–499.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 193, chart 5 (columns 93, 94, 97). Age shown on chart as Mississippian (Kinderhookian series).

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 26. Thin gray mudstone bed at type locality of Chattanooga shale, which Swartz identified as his Olinger member of Chattanooga, is placed in Maury formation as herein defined. Assignment made because its lithologic character more closely resembles that of Maury formation than that of underlying grayish-black Chattanooga shale.

Well exposed at Olinger, Lee County, Va.

Olive Hill facies (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 217–222, pl. 16. Easternmost facies of formation. Essential feature is Rothwell shale member (new) at base, which, at some places, is sole representative of formation. Above Rothwell shale are beds of argillaceous limestone with shaly partings, essentially like those of Hummel facies to southeast. Thickness about 50 feet. Unconformably underlies Upper Mississippian rocks—in some areas St. Louis limestone and in other areas Ste. Genevieve limestone. Overlies Floyds Knob formation.

Type section: Along U.S. Highway 60, at steep hill 2¾ miles west-southwest of Olive Hill, Carter County. Name derived from town of Olive Hill, western Carter County.

Olive Hill Fire Clay (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Kentucky.

Original reference: A. F. Crider, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 2, between p. 594 and 616.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 97. Of Pottsville age; commonly at very base of Pennsylvanian.

Named for Olive Hill, Carter County.

Olive Hill Formation[1] (in Linden Group)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci. 4th, v. 46, p. 738.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280–281, fig. 2. In this report [pre-Chattanooga stratigraphy of central Tennessee], Dunbar's 1919 (Tennessee Div. Geology Bull. 21) classification of Lower

Devonian is modified. Units formerly included in Olive Hill are reclassified, and term Olive Hill is considered unnecessary.

Named for exposure in bluff on Indian Creek at Olive Hill, Hardin County.

Oliverian Plutonic Series

Oliverian Magma Series[1]

Middle or Upper Devonian(?): New Hampshire and southeastern Vermont.

Original reference: M. P. Billings, 1934, Science, new ser. v. 79, p. 55–56.

Katharine Fowler-Lunn and Louise Kingsley, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1374, pl. 3. Represented by Smarts Mountain granite in Cardigan quadrangle, New Hampshire. Devonian.

C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Includes Mascoma group, Smarts Mountain group, Croydon group, and Lebanon group. Upper Devonian(?).

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mt. Cube quadrangle (1:62,500): New Hampshire Highway Dept. Includes Baker Pond gneiss.

C. A. Chapman, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 897. Represented by Unity and Croydon groups in Claremont-Newport area, New Hampshire.

R. W. Chapman, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1075–1079. Extended to include quartz diorite formerly termed Berlin gneiss of New Hampshire magma series in Percy quadrangle, New Hampshire.

G. E. Moore, Jr., 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1635–1639, pl. 1. Geographically extended to southeastern Vermont.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Plutonic series includes Whitefield gneiss and Lebanon granite. Middle or Upper Devonian(?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 48–53, 106–107, 122–125, 147–148, 186–187. Summary discussion. Characteristics include pink color of many rocks, common foliation and (or) lineation, granoblastic texture, and evidence of deformation.

Named for Oliverian Brook in southwestern corner of Moosilauke quadrangle, New Hampshire.

†Oljeto Sandstone Member[1] (of Moenkopi Formation)

Upper Permian, Lower Triassic, and Upper(?) Triassic: Southeastern Utah.

Original reference: E. G. Woodruff, 1912, U.S. Geol. Survey Bull. 471, p. 80, 87.

Forms cliffs in Moonlight Valley, at Oljato (now Oljeto), San Juan County.

Olmos Formation (in Navarro Group)[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: L. W. Stephenson, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, p. 10, 14.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull. v. 53, no 3, chart 9. Shown on correlation chart below Escondido formation and above San Miguel formation. Basal member of Navarro group

Named for flag station of Olmos, Maverick County, which is located on outcrop of formations, and also for Olmos Creek (now generally called Elm Creek), which follows strike of formation near center of belt of outcrop from point, 7 or 8 miles north of Eagle Pass to junction of creek with Rio Grande.

Olmos Sand[1] (in Whitsett Formation)

Eocene (Jackson): Southeastern Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1316.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2634. Overlies Fashing clay member of Whitsett but not included in Whitsett in this report. Apparently overlapped by Catahoula in southeastern Atascosa, western Karnes and northern Live Oak Counties. Name is preempted but substitute name is not recommended in this report.

Named for Olmos Creek near Whitsett, Live Oak County.

†Olmsted Shale Member (of Cleveland Shale)[1]

Upper Devonian or Mississippian: Northeastern Ohio.

Original reference: H. P. Cushing, 1912, Am. Jour. Sci., 4th, v. 33, p. 583.

U.S. Geological Survey currently classifies the Cleveland Shale as a member of the Ohio Shale; hence, the name Olmsted Shale Member has been abandoned.

Named for exposures at Olmsted Falls, Cuyahoga County.

Olney Member (of Manlius Limestone)

Olney Limestone[1] (in Manlius Group)

Lower Devonian: Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 26, 27.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Manlius formation subdivided into (ascending) Thacher (new), Olney, Elmwood, Clark Reservation, and Jamesville. The higher limestone members all named by Smith (1929) pass laterally into Coeymans limestone of eastern New York and hence are undoubtedly Devonian in age.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. When traced westward from the Helderbergs, Coeymans formation thickens to nearly 100 feet at Cherry Valley. Further west this thickened Coeymans splits into three parts. Lower part, for which name Dayville is proposed, grades laterally into Olney limestone of Syracuse area.

Type section: One and three-fourths miles east of Olney Station, on Auburn and Syracuse Electric Railroad, at old quarry at Split Rock, Onondaga County.

Olokele Formation (in Waimea Canyon Volcanic Series)

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 2; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 121–122. Massive lava flows and associated pyroclastics that accumulated within boundaries of principal caldera of Kauai shield volcano. Lavas predominantly olivine basalt. Maximum thickness 2,600 feet; base not exposed. Younger than

most or all of Napali formations (new); probably coeval with Haupu formation (new).

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 32–42, table facing p. 20, pl. 1. Lava flows and associated pyroclastic rocks that accumulated within boundaries of major caldera of Kauai shield volcano. Total thickness not known; base not exposed; exposed thickness 2,000 to 2,600 feet. Separated from Napali formation by buried fault scarps marking edge of ancient caldera, and locally by masses of talus breccia that accumulated along fault scarp before it was buried. Separated from Makaweli formation in part by fault scarp at head of Makaweli graben. Upper part coeval with Makaweli formation. Believed to have been formed during Pliocene.

Type section: Walls of upper Olokele Canyon, and of Poomau, Koaie, and Waialae Streams, tributaries of Waimea River.

Olomoana Volcanics

Pliocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1286 (table), 1288–1289. Chiefly olivine basalts capped with andesitic basalts and perforated by plug of trachyte. Thickness about 1,074 feet. Pliocene and lower Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 187. Appear to be overlapped by Alofau volcanics. Pliocene(?); no fossils; age assignment made on basis of weathering and erosion.

Cover about 1½ square miles at eastern end of island surrounding Olomoana Peak.

Olpe Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 51–52.

Named for exposures at Olpe, Lyon County.

†Omadi Sandstone (in Dakota Group)

Cretaceous: Eastern Nebraska.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7), 18–19. Since the time Dakota group was named it has been separated into three formations, upper one of which is yet called Dakota sandstone, a usage conflicting with the name of the group. Omadi sandstone is herein proposed for so-called Dakota formation to include section between Fuson and Graneros shales. Includes (ascending) Fall River, Skull Creek, and Newcastle members. Thickness about 147 feet.

Type section: In Missouri River bluffs extending through Omadi Township, Dakota County. Term Omadi relates to an abandoned town, Omaha Creek, and the Omaha Indians.

Omega cyclothem (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145. In list of cyclothems in the McLeansboro the Omega occurs above upper Newton cyclothem and below Gila cyclothem.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by Ekblaw in south-central Illinois led to tentative recognition of six cyclothems in

which Omega is fourth in sequence (ascending)). Occurs below Shelby (new) and above Effingham (new). Subsequent attempts to set up single standard section based on assumption that Omega and Greenup limestones are equivalent resulted in series of 13 cyclothems, of which the Omega or Greenup are tenth in sequence (ascending), occurring below the Gila and above the Newton. If the Greenup and Omega are not equivalent, the section includes 14 cyclothems with Omega ninth in sequence, below Shelby and above Effingham. If this sequence is correct, or nearly so, it is probably incomplete, and other cyclothems may occur both above and below the Omega.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12. Type locality stated.

Type locality: List Fork and Bee Branch, secs. 18, 19, and 30, T. 3 N., R. 4 E., Marion County.

Omega Limestone Member (of Mattoon Formation)

Omega Limestone (in McLeansboro Formation[1] or Group)

Pennsylvanian: Southeastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1934, Illinois Geol. Survey Bull. 61, p. 135.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1 (column 6). Shown on correlation chart as limestone in McLeansboro group. Occurs below Shumway limestone; separated from Millersville limestone by Trowbridge and Shelbyville coals. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), 81–82, pl. 1. Rank reduced to member status in Mattoon formation (new). Occurs above Bonpas limestone member (new) and below Shumway limestone member. Thickness about 10½ feet at type exposure. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois.

Type locality: NW¼NW¼NE¼ sec. 30, T. 3 N., R. 4 W., Salem quadrangle, Marion County.

Omen Glauconitic Sandstone Member (of Queen City Formation)

Omen Member (of Mount Selman Formation)[1]

Eocene, middle: Northwestern Louisiana and eastern Texas.

Original reference: E. A. Wendlandt and G. M. Knebel, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 10, p. 1355–1356.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 10 (fig. 3), 95–99, 110, 113, pl. 1. Described in Henrys Chapel quadrangle as glauconitic sandstone member of Queen City formation. Thickness 22 feet. Underlies an unnamed sand member; overlies Arp member.

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2520. Geographically extended into Caddo Parish, La., where it is about 22 feet thick. Overlies Arp member; underlies Mytis sand member (new).

Well exposed near Omen and Arp in eastern Smith County, Tex.

Onaga Limestone[1]

Pennsylvanian: Northeastern Kansas.

Original reference: F. F. Crevecoeur, 1903, Kansas Acad. Sci. Trans., v. 18, p. 124, 125.

Occurs in vicinity of Onaga, Pottawatomie County.

Onaga Shale (in Admire Group)

Permian: Northeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Defined to include strata between Falls City limestone above and Wood Siding formation below. Thickness ranges from about 12 to 140 feet. Comprises (ascending) Towle shale, Aspinwall limestone, and Hawxby shale members.

Type section: In east-west roadcut and ditch in SW¼SW¼ sec. 2, T. 8 S., R. 10 E., Pottawatomie County. Name derived from town of Onaga in northern part of county.

Onalaska Clay[1]

Onalaska Member (of Catahoula Formation)

Miocene: Eastern Texas.

Original reference: E. T. Dumble, 1915, Geol, Soc. America Bull., v. 26, p. 466.

F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530 (chart), 715, 717 (fig. 48). Catahoula in east Texas divided into Onalaska above and Chita member (new) below. Dumble gave name Onalaska to strata above his basal sandstone member (now called Chita) and below base of Fleming (now called Lagarto and Oakville). Beds consist of tuffaceous shales, sandy clays, and crossbedded lenticular sandstones in places cemented opal. Type locality stated. Chart, p. 30, shows Onalaska member; figure 48 shows Onalaska tuff.

Type locality: Exposures in Rocky Creek, east of Onalaska, Polk County.

O'Nan Coal Member (of Spoon Formation)

Pennsylvanian: Northern Kentucky and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 45 (table 1), pl. 1. Proposed to replace Curlew coal in order to retain name Curlew for underlying limestone; stratigraphically above New Burnside coal member (new) and below Granger sandstone member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: At Indian Hill, near Curlew, Union County, Ky. Name derived from Dennis O'Nan Ditch, which flows across north tip of Indian Hill, DeKoven quadrangle.

Onate Formation

Middle Devonian: Central southern New Mexico.

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 222–227. Variable and intergradational series of shale, siltstone, fine sandstone, and limestone. Lateral transitional changes, such as gradations from shale to siltstone to arenaceous limestone in a distance of a few hundred feet. Gray brown. Flagstone bedding accompanied by fucoids(?), and worm trails are prevalent characteristics of unit. Greatest thickness of 86 feet 4 inches at type locality; thins to north and absent north of Rhodes Pass (Can-

yon). Averages 35 feet in Sacramento Mountains. Has relatively less shale and more massive beds than overlying Sly Gap formation. Disconformably overlies Fusselman limestone in Sacramento Mountains and Fusselman and Montoya in San Andres Mountains.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 77–78. Units such as Onate and Sly Gap not distinguishable lithologically, and hence are not mappable in New Mexico. These are no more than faunal zones at best, and prior and well established term Percha formation should be retained and applied widely to this lithologically and topographically distinct unit in New Mexico.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 28–29. Upper 45 feet of type section appear more closely related to, and should be placed in Sly Gap formation.

Type section: On north slope of San Andres Canyon, near an abandoned lead mine, in sec. 18, T. 18 S., R. 4 E., San Andres Mountains, Dona Ana County. Named from Onate Mountain, a ridge north of San Andres Peak. Limited in outcrop to Sacramento Mountains and southern and central parts of San Andres Mountains.

Onawa Granite

Age not stated: Maine.

R. S. Houston, 1956, Maine Geol. Survey Bull. [7], p. 12, 105. Composes Onawa pluton. Similar to felsic intrusion near town of Ludlow which is described as grading from coarsely granular biotite microcline granite near center of intrusion to finer grained more mafic phases along border.

Occurs in southern Piscataquis County.

Oneco Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: W. H. Weed, 1925, The Mines Handb., p. 1061.

Named for occurrence in Oneco mine, Houghton County.

Oneco Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Oneco mine, Houghton County.

Onego Limestone Member (of Salona Limestone)

Middle Ordovician (Trentonian): Western Virginia and eastern West Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 68, 69, 70, 71, 73, 88 (fig. 6), 89, 103. Occurs in lower part of formation. Includes argillaceous calcilutite and argillaceous calcisiltite, shaly calcitite, metabentonite. Thickness 32 to 70 feet. Overlies Nealmont formation. Believed to correspond approximately to lowermost Salona of Pennsylvania, though it probably extends a little lower, to Oranda of Shenandoah Valley, and to all but lowest part of Eggleston in New River region. Has been called Oranda by Kay (1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8).

Type section: In hillside north of Blue Grass, Highland County, Va. Named from Onego, Pendleton County, W. Va., a few miles northwest of type section.

One Horse Gypsum[1]

Permian: Northwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 363.

Exposed in brow of bluffs on south side of Canadian River in D County. Named for One Horse Ford of Canadian River, Blaine or Dewey County.

†Oneida Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of the geology of Ontonagon County, pamph. of 24 pages, map: Philadelphia, 1863, p. 21, map.

Ontonagon County.

Oneida Conglomerate[1]

Oneida Conglomerate (in Clinton Group)

Silurian: New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 374.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4 chart 3. Shown on correlation chart as basal formation in Clinton group. Occurs above Grimsby sandstone and below Sauquoit beds. Albion and Niagaran series.

Named for exposures in Oneida County.

O'Neill Formation

Upper Triassic: North-central Nevada.

R. R. Compton 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1387, pl. 1. About 2,000 feet of interbedded dark quartzites and phyllites. Characteristic rock is black or dark-gray brown-weathering micaceous quartzite that forms bed 1 to 6 feet thick; this quartzite is less abundant than the phyllites and thin quartzites, but it crops out much more prominently. Overlies Winnemucca formation, contact drawn at top of highest calcareous slate or phyllite in dominantly calcareous and thin-bedded sequence that characterizes Winnemucca. Underlies Singas formation (new).

Type area: Ridge between Wash O'Neill Creek and Provo Canyon, Santa Rosa Range, Winnemucca region.

Oneonta Sandstone[1]

Upper Devonian: Eastern and central New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 381.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 273. Continental red beds of Catskill front and northern Helderberg area were long regarded as Oneonta beds of Ithaca age. It is now known that in Catskill front the Ithaca is to be looked for in "Catskill" beds. This report [Coxsackie quadrangle] uses term Kiskatom beds.

Named for exposures on upper part of hill at Oneonta, Otsego County.

Oneota Dolomite (in Prairie du Chien Group)[1]

Oneota Dolomite Member (of Prairie du Chien Formation)

Lower Ordovician: Northwestern Iowa, northwestern Illinois, southern Minnesota, and southwestern Wisconsin.

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 11th Ann. Rept., pt. 1, p. 331, 332.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 55–59. In southeastern Minnesota, Oneota dolomite underlies Root Valley sandstone (new) and overlies Jordan sandstone. In some areas, separated from underlying Jordan by Kasota sandstone which in turn is overlain by thin unit referred to as Blue Earth siltstone. Thicknesses: about 45 feet at Mankato, 70 feet at Minneapolis, 150 feet at Dresbach, 197 feet at Lewiston. Beekmantownian.

H. B. Willman and J. S. Templeton, 1951, Illinois Acad. Sci. Trans., v. 44, p. 110 (fig. 1), 111 (fig. 2), 117–119. Most of formation in northern Illinois consists of light- to blue-gray uniformly coarsely crystalline dense cherty dolomite in massive beds as much as 15 feet thick. Total thickness 116 to 180 feet. Overlies Gunter formation; underlies New Richmond formation; contacts appear conformable. Lower Ordovician.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 150. In central and southern Wisconsin overlies Sunset Point formation (new) which name is proposed to replace term Madison.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 85–95. Formation, in Stoddard quadrangle, Wisconsin, subdivided into (ascending) Hickory Ridge, Mound Ridge, Genoa, and Stoddard members (all new). Thickness about 180 feet. Unconformably overlies Cambrian Sunset Point formation; underlies Lower Ordovician Shakopee (or Willow River) dolomite, from which it is separated by limited thickness of sandstone strata (New Richmond sandstone). In Prairie du Chien group.

R. L. Heller, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 29–36. Rank reduced to member status in the Prairie du Chien which is herein redefined as formation. Lowermost member of formation; underlies New Richmond sandstone member; overlies Jordan sandstone. Consists predominantly of fine- to medium-grained light-brownish-gray to buff compact to vuggy thin- to thick-bedded dolomite. Lower part of member (0 to 15 feet) commonly arenaceous, with lower few feet grading downward into dolomitic sandstone. Thickness probably less than 70 feet in northern part of outcrop area; basinward, as in southern Minnesota and northern Iowa, thickness is 170 feet. In Stillwater, Minn., area, temporary nondeposition near beginning of Ordovician time could account for relatively thin Oneota section and sharp lithologic break observed at Cambrian-Ordovician boundary. Preliminary studies in Minnesota River valley suggest that Kasota sandstone and Blue Earth siltstone should not be considered as formations but rather as a sandstone and siltstone facies of the Oneota.

Named for exposures on Oneota River, Allamakee County, Iowa. Oneota is former name for Upper Iowa River.

Onesquethaw Stage or Group

Lower or Middle Devonian (Ulsterian): North America.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. Devonian is subdivided into 10 stages of which Onesquethaw is third in sequence (ascending). Succeeds the Deerpark and is followed by the Cazenovia. [For complete sequence see Helderberg stage.] Includes sediments of the Esopus, Schoharie, and Onondaga and their correlates elsewhere on the continent.

Charles Schuchert, [1943], Stratigraphy of the eastern and central United States: New York, John Wiley and Sons, Inc., p. 85. Should be abandoned. Covers identical formations of Ulsterian stage.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv., Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 35 (table 1). Used as group in Mackinac Straits region, Michigan, where it includes Bois Blanc formation (new). Overlies Deerpark group; underlies Detroit River group. Ulsterian.

J. M. Dennison, 1960, Dissert. Abs., v. 21, no. 3, p. 593. Discussion of stratigraphy of Devonian Onesquethaw stage in West Virginia and Maryland. Top of stage in type region in New York not precisely defined. Top of Tioga bentonite proposed as upper boundary. This permits direct physical correlation of New York and central Appalachian sections. Tioga bentonite is present in subsurface between the two regions and crops out in New York in addition to 45 known localities in West Virginia, Virginia, and Maryland. Remainder and majority of stage consists of three formations or facies: Needmore shale, Huntersville chert, and Onondaga limestone.

Type section (stage): In Helderberg Mountains west of Clarksville and facing valley of Onesquethaw Creek in Albany County, N.Y.

Onion Creek Marl[1]

Pleistocene: Central Texas.

Original reference: R. T. Hill and T. W. Vaughan, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 252–254, 277.

Named for Onion Creek, Hays County.

Ono Formation

Lower Cretaceous: Northern California.

M. A. Murphy, 1956, (abs.) Jour. Sed. Petrology, v. 26, no. 2, p. 209; 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2101 (fig. 2), 2105–2112. Approximately 4,200 feet of mudstone, siltstone, conglomerate, graywacke, and limestone. Gradationally overlies Rector formation (new); underlies unnamed conglomerate units. Includes Huling and Roaring River tongues (both new). Horsetown stage.

M. A. Murphy and P. U. Rodda, 1960, Jour. Paleontology, v. 34, no. 5, p. 835. Conformably underlies Bald Hills formation (new).

Type section: Along North Fork of Cottonwood Creek from Ono to confluence of North Fork with Huling Creek. Named for village of Ono, Shasta County.

Onondaga Limestone[1]

Onondaga Formation (in Hamilton Group)

Onondaga Group

Middle Devonian: New York, western Maryland, Pennsylvania, Virginia, and West Virginia, and Ontario, Canada.

Original references: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 293–309; L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 378.

Bradford Willard, 1936, Jour. Geology, v. 44, no. 5, p. 578–603. Because of close faunal and stratigraphic affiliation with overlying beds, Onondaga

formation in Pennsylvania is assigned to position of lowest formation of Hamilton group. In central Pennsylvania, comprises lower shale member (called Selinsgrove shale by White, 1883) and noncherty limestone (called Selinsgrove lower limestone by White, 1883). In eastern Pennsylvania, comprises lower member, Esopus shale (called Post-meridian by Rogers, 1858, Geology of Pennsylvania; and Caudi-galli by White). Middle Devonian.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 141–160. Group as defined in Pennsylvania includes all stratigraphic units between top of preceding Oriskany group and succeeding Marcellus formation of Hamilton group. In central Pennsylvania, comprises (ascending) Needmore shale (new) and Selinsgrove limestone; in eastern Pennsylvania, comprises (ascending) Esopus shale and Buttermilk Falls limestone.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 41–42, pl. 3. In Draper Mountain area, Onondaga formation (chert) is 10 to 70 feet thick, overlies Becraft(?) sandstone and underlies Millboro shale (new).

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 294–303. At different localities in Virginia, the Onondaga is underlain by one or another of following formations: Oriskany sandstone, Becraft limestone, Cayuga beds of Wills Creek age, Keefer sandstone, undivided Clinton, Clinch sandstone, Juniata formation, and, as along low ridge between Walker Mountain and Marion, Smyth County, by *Orthorhynchula* zone of Martinsburg shale. Average thickness 50 to 100 feet. Underlies Romney shale.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, 1744–1745, chart 4. Onondaga, Schoharie, and Esopus and their equivalents are included in Onesquethaw stage (new). In western New York, two faunas recognized in Onondaga. Lower one has many Schoharie and Camden elements and is characterized by *Amphigenia* and many corals and is best developed on southern peninsula of Ontario. Schoharie elements include *Centronella*, *Strophonella ampla*, *Cyrtinaella biplicata*, *Calymene platys*, and *Tetraspis*. Camden elements are *Eodevonaria* and *Anoplia*. Overlying *Amphigenia* fauna is one characterized by *Paraspirifer acuminatus* occurring at top of Onondaga in New York. In central New York, a third division of Onondaga, the Seneca limestone which underlies the Marcellus contains an abundance of *Chonetes lineatus*, *Dalmanites selenurus*, and large coiled cephalopods. Lower or Middle Devonian.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 255–308. Onondaga group of this report includes all formations in West Virginia between top of Ridgeley sandstone and base of Marcellus shale. Has same constitution as Onondaga group of Pennsylvania as defined by Willard (1939) but has no relation to "Onondaga group" of New York or "Onondaga salt group" of early New York State geologists. Includes Huntersville chert and Needmore shale.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 226–235, geol. map. Limestone shown on map legend (Coxsackie quadrangle) above Schoharie grit and limestone and below Bakoven shale. Contact with Bakoven not noted in field.

R. E. Stevenson, 1949, New York State Sci. Service Rept. Inv. 3, p. 3 (table 1), 6–7. Onondaga group, central New York, comprises (ascending) Esopus, Carlisle Center, Schoharie, and Onondaga formations. Onondaga

formation includes (ascending) Springfield Center member (new), Babcock Hill member (new), and unnamed upper member.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 621–652. Onondaga limestone extends from Ontario, Canada, south to West Virginia, and its "equivalents" extend west to Mississippi. Some age variation over this large area is probable. In New York, formation is generally considered lower Middle Devonian (Onesquethaw) and is overlain by Marcellus black shale of Hamilton group. Conformably underlain by Schoharie grit, Esopus shale, and Oriskany sandstone in eastern New York; rests unconformably on Helderberg and Upper Silurian limestones in central and western New York. In central New York, subdivided into (ascending) Edgecliff, Nedrow, Moorehouse, and Seneca members (all new). All members are present in western New York section, but only Edgecliff member extends into eastern New York section. No complete exposures known from which exact thickness can be determined. Estimates of thickness range from 50 to 200 feet. Thickness about 70 feet near Syracuse. Hall did not designate type section. Chadwick (1944) stated that type locality was Split Rock but gave no reason for the designation; since only lowest member is fully exposed there, it is not adequate, and type locality should remain in "Onondaga County" where nearly whole formation is exposed at various places south of Syracuse.

W. A. Oliver, Jr., 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1441–1474. Discussion of Onondaga in eastern New York. Four members recognized by Oliver (1954) in central New York. In Onondaga County, type area, each member is divisible into two or more zones, which are more or less continuous as far east as Sangerfield quadrangle. Eastward zones gradually become indistinct, and horizontal facies changes are of greater interest. East of Cherry Valley, Seneca member grades laterally into Union Springs black shale which overlies Onondaga. Moorehouse and Edgecliff members recognizable, although greatly changed, as far southeast as Port Jervis. Lower Edgecliff grades into Schoharie formation in southeastern New York. Buttermilk Falls limestone of eastern Pennsylvania equated in time with Moorehouse member of southeastern New York and Nedrow and Moorehouse members of central New York.

F. M. Swain, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2858–2891. Group, in Mount Union area, Pennsylvania, includes Newton Hamilton formation (new). Disconformably overlies Ridgeley sandstone of Oriskany group and underlies Marcellus black shale of Hamilton group.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 26. Formation comprises Needmore shale below and Selinsgrove limestone above members. At East Waterford section, Onondaga is about 70 feet thick. Overlies Ridgeley member of Oriskany and underlies Shamokin member of Marcellus formation.

Named for exposures in Onondaga County, N.Y.

†Onondaga Limestone Series[1]

Devonian: New York.

Original reference: T. A. Conrad, 1837, New York Geol. Survey 1st Rept., p. 178–181.

Quarried near Auburn and on Onondaga Hill, near Syracuse, Onondaga County.

†Onondaga Saliferous Group[1]

Silurian and Lower Devonian: New York.

Original reference: J. Hall, 1839, New York Geol. Survey 3d Rept., p. 290–293, 304.

†Onondaga Salt Group[1]

Silurian (Cayugan): New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 375–376, 378.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Geol. Survey Div. Pub. 44, Geol. Ser., 44, p. 24, 27. Hall (1851), Geological Reports *in* pt. V. of Foster and Whitney report on Geology of Lake Superior Land District, U.S. Senate, Spec. Ses. March, 1851, Ex. Doc. no. 4) assigned marls, gypsum and vesicular, and gashed limestones of Mackinac Island, the St. Martin Islands, and mainland north of St. Ignace to Onondaga salt group, which is typically exposed in New York. Most of strata of Onondaga salt group are now included in what is known as Salina group. The marls, chiefly green and red shales, and gypsum noted by Hall are included in Pointe aux Chenes formation (new). Rominger (1873, Geology of the Upper Peninsula: Michigan Geol. Survey, v. 1, pt. 3) used term Onondaga salt group for dolomite and green and red variegated shale with some gypsum overlying Middle Silurian "Niagara group" (Niagaran series). In this usage, he followed terminology of Hall. Strata of Rominger's Onondaga salt group are assigned to Pointe aux Chenes formation.

Ontarian Series[1]

Silurian: Ontario, Canada, and New York.

Original reference: J. D. Dana, 1890, Geol. Soc. America Bull., 1, p. 40–41.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1979–1996. Standardization of Silurian stratigraphic terminology (exclusive of Cayugan) in southern Ontario and western New York, including type section in Niagara Gorge, discloses that strata are suited to tripartite division, both from faunal and physical standpoint. Silurian system is herein divided into Medina(n), Clinton(ian), and Niagara(n) groups, the three comprising the Ontarian series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., No. 1. New York Silurian, the standard reference section for United States, is divided into two series, older Niagaran and younger Cayugan. Term "Ontario(an)" used as stage name for lower and middle parts of Clinton group.

Ontarian Stage

Middle Silurian (Niagaran): North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Niagaran series divided into four stages (ascending) Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian). Ontario stage includes lower and middle parts of Clinton group. Ontarian rocks thicken eastward from about 18 feet in Niagara Gorge, 60 feet in Genesee Gorge, 90 feet along Salmon Creek (Palmyra quadrangle) to over 135 feet near Oneida Lake.

Type section: In Genesee River Gorge at Rochester, N.Y.

†Ontario Group[1]

Silurian: New York.

Original reference: E. Emmons, 1842, Geology New York, pt. 2, div. 4, geology 2d dist., p. 100–101, 429.

Ontario Series[1]

Silurian: New York.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, p. 1106–1108.

Ontelaunee Formation (in Beekmantown Group)

Lower Ordovician: Southeastern Pennsylvania.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2716 (fig. 3), 2720–2721. Proposed for the dolomite and interbedded limestone and chert lying above Epler formation (new) and underlying either Annville limestone, Jacksonburg argillaceous limestone, or Martinsburg shale. Formation is 675 feet thick near type locality and is divided into three members: upper interbedded limestone and dolomite member, middle dolomite member, and lower interbedded chert and dolomite member. Thins to 150 to 250 feet near Reading. Contact with Epler is placed at top of first limestone beneath lowest chert bed of Ontelaunee; contact zone gradational; line demarcating contact in Berks County is placed 100 feet below lowest chert bed of Ontelaunee.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Described in Lebanon County where it is uppermost formation of Beekmantown group and underlies Annville limestone (probably unconformable). Minimum thickness 500 feet.

Type section: Along east bank of Schuykill River 1 mile southeast of Leesport, Berks County.

Onteora Formation

Onteora Red Beds[1]

Upper Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1933, Am. Jour. Sci., 5th, v. 26, p. 480 (chart), 483, 484.

G. H. Chadwick, 1940, New York Geol. Soc. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. List of formations of Catskill region shows Onteora redbeds above Twilight Park conglomerate and below Stony Clove sandstones (new). Thickness 1,060 feet.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 125–129, 135, 136, geol. map [1946]. Redbeds described in Catskill and Kaaterskill quadrangles. Thickness about 1,150 feet. Underlies Stony Clove sandstone (also referred to as Stony Clove member of Katsberg); overlies Kaaterskill sandstones. Onteora redbeds differ little from Kiskatom redbeds except for incoming of substantial conglomerates especially at base (these conglomerates are Twilight Park conglomerate of Prosser, 1899).

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW–20, p. 8 (table 1), 15. Formation present in Albany County where it overlies Kiskatom formation and underlies glacial deposits.

J. M. Berdan, 1950, New York State Water Power and Control Comm. Bull. GW–22, p. 10 (table 2), 20. Formation is youngest consolidated rock exposed in Schoharie County. Composed of red and green shales and gray sandstones. Probably over 2,000 feet thick in eastern part of county; probably not over 800 feet in western part of county. Interfingers with Gilboa formation; underlies glacial deposits.

Type section: Vicinity of Haines Falls, Greene County; up sides of Kaaterskill "High Peak" and "Round Top" Mountains. Up the opposite slope is Onteora Park.

Oologah Limestone[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma.

Original reference: N. F. Drake, 1897, Am. Philos. Soc. Proc., v. 36, p. 377.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 28–32, pl. 1. Term Oologah has heretofore been applied to thick limestone formation which extends from vicinity of Broken Arrow, Tulsa County, to locality about 4 miles northeast of Oologah where it bifurcates. Term is here extended to Kansas-Oklahoma line to include (ascending) Pawnee limestone, Bandera shale, and Altamont limestone members. South of Broken Arrow, Oologah equivalents were included in beds called Broken Arrow formation. Thickness about 40 feet north of Broken Arrow, thicker northward to maximum of about 100 feet in latitude of Catoosa, Rogers County, and progressively thinner farther north; about 60 feet thick in type locality near Oologah; at Kansas-Oklahoma line its three northern members have combined thickness of about 165 feet. Conformably overlies Labette formation; conformably underlies Nowata formation. Marmaton group.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 14–15, 16 (fig. 2). Name Oologah here used for sequence of beds between base of cap rock of Lexington coal and top of Altamont limestone in Nowata County and for equivalent sequence of limestones not yet subdivided in vicinity of Tulsa. In Nowata County, the Oologah consists of Pawnee limestone at base, the Pawnee consisting in upward sequence of cap rock of Lexington coal, Anna shale, Myrick Station limestone, and Coal City limestone. Middle part of the Oologah is Bandera shale which thins southward from more than 100 feet at Kansas line to 2 feet near Tulsa. Upper Member of Oologah is Altamont limestone, which in turn has been subdivided into Amoret limestone below and Worland limestone above, with shale interval between. Overlies Labette shale; underlies Nowata shale.

Named for Oologah, Rogers County.

Ooltewah Formation

Middle Ordovician (Mohawkian): Southeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 80–81, chart 1 (facing p. 130). Ribbon-banded limestone with numerous intercalations of red Moccasin-type mudstone and fewer interbeds of buff shaly limestone. Lower half contains thin shaly layers. Thickness 250 to 600 feet. Underlies Bays formation; overlies Long Savannah formation (new). Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along Mahan Gap road, and extends for a quarter mile or more on either side of State Highway 60, Snow Hill (TVA 112–NE) quadrangle, Hamilton County.

†Oostanaula Shales[1] or Series[1]

Cambrian: Northwestern Georgia.

Original reference: J. W. Spencer, 1893, Georgia Geol. Survey, Paleozoic group, p. 34, 37, 77, 87, 99, 108, 112, 115, 119, 123, 130.

Named for exposures on Oostanaula River.

Opdyke Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), pl. 1. Assigned member status in Mattoon formation (new). Occurs above Shelbyville coal member and below Trowbridge coal member. Coal named by Cady and others (1952, Illinois Geol. Survey Bull. 78). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Coal in vicinity of village of Belle Rive and Opdyke, T. 3 S., R. 4 E., Jefferson County.

Opeche Formation[1] or Shale

Opeche Shale Member (of Goose Egg Formation)

Opeche Shale (in Phosphoria Group)

Lower Permian: Western South Dakota, southeastern Montana, northwestern Nebraska, and Wyoming.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 513.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 6, 10, 12, 14. Opeche shale included in Phosphoria group. Basal formation in Phosphoria group, in Laramie Range. Thickness about 70 feet. Underlies Minnekahta limestone; overlies Owl Canyon formation of Cassa group (both new).

J. D. Love, N. M. Denson, and Theodore Botinelly, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 92. Opeche shale in Glendo area, Wyoming, consists of about 25 to 75 feet of bright-red silty shale with lesser amounts of shaly yellow to red sandstone near base; thin purple limestone partings present in upper part; at top is persistent purple limy shale about 10 feet thick; locally lens of white gypsum about 5 feet thick. Underlies Minnekahta limestone; overlies Hartville formation. No fossils.

Billings Geological Society, 1951, Billings Geol. Soc. Guidebook 2d Ann. Field Conf., p. 8 (chart). Correlation chart shows Opeche present in southeastern Montana.

Typically developed on Battle Creek, Custer County, S. Dak. Opeche is Indian name for Battle Creek.

Open Door Limestone (in Gallatin Group)

Upper Cambrian: Southwestern Wyoming.

A. B. Shaw and C. R. DeLand, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 38, 39 (fig. 1), 40 (fig. 2), 41. Proposed for upper Gallatin limestone and flat-pebble conglomerates, without regard to their age. Name is used here in preference to any of many names proposed for Upper Cambrian of Wyoming because there is need for name for lithic unit that is upper Gallatin limestone. Names previously applied have been based on a knowledge of age of unit described (for

example, Grove Creek and Snowy Range formations, Saga pebble conglomerates, and others). Reliable faunal evidence is not invariably available, and in its absence these names are not applicable. Therefore, name Open Door is meant to designate upper part of Gallatin group, regardless of its age, based solely on its recognition as lithic unit. Includes Dry Creek shale member at base. Overlies Du Noir limestone. Surface of erosion evident between Open Door and Lander sandstone member of Big Horn dolomite.

Type section: On east wall of Granite Canyon in Gros Ventre Mountains, just below topographic feature known as the Open Door, Teton County.

Opex Formation

Opex Dolomite[1]

Upper Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 8–9. Formation described in East Tintic Mountains. Stratigraphically restricted to exclude lower dolomite member as originally defined by Loughlin; this lower unit now included in underlying Cole Canyon dolomite. Consists of alternating thin and thick beds of shaly oolitic limestone flat-pebble conglomerate, medium- and coarse-grained brown-weathering sandstone, and dusky blue-gray dolomite; one or more thick beds of red and green shale present locally at top of formation. Thickness 150 to 350 feet; about 250 feet near Eureka. Conformably underlies Ajax limestone. Upper Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 7 (table 1), 23–24, 28 (fig. 4), geol. map. Described in Stansbury Mountains, Tooele County, where it is 450 to 500 feet thick; overlies Cole Canyon dolomite and underlies Dunderberg shale. Two members differentiated on geologic map; these correspond roughly to upper and lower Opex as mapped by Loughlin (1919) whose terminology is followed in this report.

C. B. Bentley, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 18–19. At Tintic, stratigraphically restricted to exclude uppermost shale and limestone of Lindgren and Loughlin (1919); this shale and limestone designated as Dunderberg.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 53–57, pls. 1, 7. Formation described in Sheeprock Mountains where it is principally limestone and about 938 feet thick. Overlies Cole Canyon dolomite; underlies Ajax formation; fault at top of Cole Canyon has cut out unknown thickness of basal Opex. Crops out in belt about 2,600 feet wide in southern end of East and West Lookout Hills.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 26–27, 29 (fig. 9), pl. 1. In southern Oquirrh Mountains, underlies Standsbury formation and overlies Cole Canyon dolomite. Thickness 175 to 185 feet. Gilluly (1932, U.S. Geol. Survey Prof. Paper 173) mapped these rocks as upper beds of Lynch dolomite.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 132–135. In Boulter Mountains, consists of interbedded mottled limestones, brown sandstones, and mottled dolomite. A mottled dark-blue-gray to maroon limestone containing large oolites is present within 25 feet of basal beds; cross-bedded dolomite and flat-pebble conglomerates near middle of formation;

upper dark shaly limestone present about 25 feet below top of formation. Overlies Cole Canyon dolomite; underlies Ajax limestone.

Named for Opex mine, one-half mile northwest of Mammoth, Tintic district.

Ophir Formation[1] or Shale

Ophir Group

Lower and Middle Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107, p. 25–27.

J. D. Forrester, 1937, Geol. Soc. America Bull., v. 48, no. 5, p. 638, pls. 2, 3. In Uinta Mountains, conformably underlies Pine Valley quartzite (new).

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 7. In Wasatch Mountains, east of Salt Lake City, Ophir shale overlies Tintic quartzite and underlies Maxfield limestone. In a three-part unit about 400 feet thick. Cambrian.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2735–2739. In western Uinta Mountains, Ophir and Pine Valley formations, heretofore assigned to Cambrian and thought to be conformable, are separated by a 20° angle of discordance. Rocks earlier mapped as Ophir(?) formation of Cambrian age lie beneath the unconformity and are assigned to Precambrian and are here named Red Pine shale. Probable that true Ophir shale is represented in western Uinta Mountains by thin bed of shale at top of Tintic quartzite in South Fork basin; this shale is not sufficiently widespread or thick enough to serve as mappable unit.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 4–6, pl. 1. In East Tintic Mountains, formation is 275 to more than 400 feet thick and consists of lower shale member, middle limestone member, and upper shale member. Conformably overlies Tintic quartzite; conformably underlies Teutonic limestone. Middle Cambrian.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 664, 669. In discussion of Lower and Middle Cambrian stratigraphy in northern Utah and southeastern Idaho, beds formerly assigned to upper part of Ophir formation and to Maxfield formation are here assigned to Langston formation.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 11–13. Rank raised to group. In Stansbury Mountains, includes Busby quartzite, Millard limestone, Dome, Burnt Canyon, and Burrows equivalents, and Condor formation. Underlies Teutonic limestone; overlies Pioche shale. Refers to Cohenour (unpub. thesis) for use of group.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 32–35, pl. 1. Proposed that Ophir shale and Ophir formation be restricted to areas in which they have been applied. Ophir group as used in this report [Sheeprock Mountains] comprises following formations or their equivalents: Pioche shale, Busby quartzite, Millard limestone, Burrows limestone, Burnt Canyon limestone, Dome limestone, and Condor formation.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 13–16. Group as used in this report [southern Oquirrh Mountains] overlies Pioche shale and underlies Teutonic limestone of Hartmann group. Unit not subdivided into formations in this area.

T. S. Lovering and others, 1960, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–230. Formation mapped in East Tintic district. Consists of lower shale member, 175 feet thick; middle limestone member, 145 to 160 feet thick; upper shale member 70 to 90 feet thick. Overlies Tintic quartzite; underlies Teutonic limestone. Lower and Middle Cambrian.

Named for exposures at Ophir, eastern Tooele County.

Opohonga Limestone[1]

Lower Ordovician: Central Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 9–10, 11 (fig. 3), pl. 1. Repetitious sequence of medium- to fine-grained thin-bedded light-blue-gray argillaceous limestone and flat-pebble conglomerate that is streaked with thin layers and veinlets of siliceous clay which weather buff, yellow, and red. Base marked by bed of brown-weathering limy sandstone or sandy limestone; limestone beds immediately above sandstone bed enclose large nodules of white chert. Thickness 400 to more than 1,000 feet. Conformably overlies Ajax limestone; disconformably underlies Upper Ordovician Fish Haven dolomite. Term Fish Haven dolomite is currently applied in East Tintic Mountains to lower third of Bluebell dolomite of Loughlin (1919).

L. F. Hintze, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 46–53. Discussion of regional relationships in north-central Utah and adjacent areas. Believed that one set of names for Ibex basin and another set for northern Utah is sufficient for Lower Ordovician terminology in Utah. Recommended that terms Chokecherry dolomite and Oponhonga limestone in Gold Hill and Tintic mining districts be abandoned and standard nomenclature used; that is, Garden City formation (which may be subdivided) and Pogonip group which comprises six formations.

Named for Opohonga mine, about one-half mile southeast of Mammoth, Tintic district, Juab County.

Oppello Breccia[1]

Middle Cretaceous(?): Central northern Arkansas.

Original references: C. Croneis and M. Billings, 1929, Jour. Geology, v. 37, p. 543, 551; 1930, Arkansas Geol. Survey Bull. 3, p. 155–158.

Crops out on farm of W. J. Sadler, about 1 mile west of Oppello (Oppelo), Conway County.

Oquirrh Formation[1]

Oquirrh Group

Oquirrh Series

Lower Pennsylvanian to Lower Permian: Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173.

H. J. Bissell, 1936, Iowa Acad. Sci. Proc., v. 43, p. 239–243. Suggested that term Oquirrh be elevated to rank of series to include all beds from lower to upper Pennsylvanian and that lower facies be named Kelly formation and upper facies Hobble formation.

A. A. Baker and J. S. Williams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 623 (fig. 4), 625–626. In Utah County, underlies Kirkman limestone (new).

A. A. Baker, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 30. Described in Wasatch Mountains in vicinity of Provo where it has total thickness of about 26,000 feet. Preliminary study of some of fusulinids has shown presence of forms ranging in age from Morrow(?) in basal limestone, through Atoka, Des Moines, Missouri, and Virgil to middle or upper Wolfcamp and possibly Leonard. Formation may therefore include strata representative of nearly all the Pennsylvanian, and also may include at top some strata of Permian age.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 581–587. Described in Strawberry Valley quadrangle. Thickness 11,100 feet. Upper 9,800 feet considered Permian (Wolfcampian). Systemic boundary placed on basis of fusulinids. Overlies Weber sandstone; underlies Kirkman limestone.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 23–25. Exposed in northern and southern parts of East Tintic Mountains; neither area includes complete or unfaulted section. Thickness about 15,000 feet. Overlies Manning Canyon shale; underlies Diamond Creek(?) sandstone. Pennsylvanian and Permian.

A. E. Disbrow, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–131. Mapped in Fivemile Pass quadrangle where the lower 4,440 feet are exposed. Divided into five units, four limestone and one basal coquina limestone. Overlies Manning Canyon shale.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 49–51, 53 (fig. 7). In Stansbury Mountains, at least 15,000 feet thick. Overlies Manning Canyon formation; underlies North Horn(?) formation.

P. W. Nygreen, 1958, Utah Geol. and Mineralog. Survey Bull. 61, p. 1–67. Near Logan includes West Canyon member (new) in basal part.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 93–127, pl. 1. In southern part of Oquirrh Mountains and contiguous Fivemile Pass quadrangle, subdivided to include (ascending) Hall Canyon, Meadow Canyon, Cedar Fort, Lewiston Peak, and Pole Canyon members. These are referred to the Pennsylvanian. Thickness of the five members, 6,166 feet. Overlies Manning Canyon shale. Definitive Wolfcamp strata not mapped in area.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Suggested that Oquirrh formation be raised to group status and carried into Wells formation area, the Wells being dropped or retained as formation within group.

Named for occurrences in Oquirrh Range.

Oquirrh quartzite[1]

Carboniferous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 37.

Derivation of name not stated.

Orabai sandstone[1]

Upper Cretaceous: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 337.

Well exposed at Orabai Mesa, north of Winslow, Apache County.

Oracle Granite

Precambrian: Southeastern Arizona.

N. P. Peterson, 1938, Arizona Bur. Mines Bull. 144, Geol. Ser. 11, p. 8–9. Prevailingly a coarse-grained porphyritic biotite granite with large pink

or salmon-colored feldspars 1¼ to 1½ inches across that give rock a pink or gray mottled appearance on fresh surfaces. Composition suggests that rock should be classed as quartz monzonite rather than granite. Surface exposures of light-buff color. Oldest rock exposed in Mammoth area. Unconformably underlies Apache series.

In Mammoth Mining camp area, 3 miles southwest of village of Mammoth. Mapped area almost entirely in W½ sec. 26 and E½ sec. 27, T. 8 S., R. 16 E., on east flank of Black Hills. Also in area of village of Oracle on northern slope of Santa Catalina Mountains, Pinal County.

Ora Loma Formation

See Oro Loma Formation.

Oran Sandstone Lentil (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Texas Univ. Bull. 2132, p. 96, 97, 99, 100.

Probably named for Oran, Palo Pinto County.

Oranda Formation

Middle Ordovician: Western Virginia, south-central Pennsylvania, and southeastern West Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 86–89. Proposed for the 30-foot zone, characterized by occurrence of *Reuschella "edsoni"* and its associates, which overlies the Edinburg and directly underlies *Sinuites* beds of the Martinsburg. Composed mainly of very argillaceous limestone with metabentonitic clays, shales, and ledge-making siltstones. Unit is important as zone of reference below which the facies changes in Edinburg (new) are observable between Lacey Spring and Winchester. Corresponds to *"Christiania"* [*Bimuria*] bed of Chambersburg limestone of southern Pennsylvania.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1402 (chart). Chart shows Oranda present in southeastern West Virginia, Cumberland Valley, Pa., and Shenandoah Valley, Va.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 738–742. In south-central Pennsylvania, name Oranda is applied to beds formerly termed Greencastle; *Sinuites* zone is referred to base of Martinsburg. Throughout most of the area, formation consists of dark-gray to black fine-grained slabby to massive blue-gray to white-weathering limestone; in easternmost outcrops, consists of black argillaceous buff-weathering limestone with prominent shale partings. Thickness 17 feet south of Fannettsburg; over 158 feet northeast of Plainfield; 149 feet on Turnpike northeast of Newville. If present in Maryland, probably quite thin. Overlies Kauffman member (new) of Mercersburg or beds thought to be equivalent; underlies *Sinuites* zone of Martinsburg.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Chambersburg formation includes dark-gray thin-bedded limestone (Oranda) at top; gray argillaceous limestone (Mercersburg) in middle; dark-gray cobbly and thin irregularly bedded limestone (Shippensburg) below.

Type section: Along State Highway 55 about 2.7 miles S. 40° W. of Oranda and somewhat less than one-half mile west of U.S. Route 11 in north environs of Strasburg, Shenandoah County, Va. Name derived from Oranda, a hamlet about 3½ miles northeast of Strasburg.

Orange Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Named for Orange Township, Orange County.

†Orange Phyllite[1]

Pre-Triassic: Southwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Bull. 6, p. 86, 101–102, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,400): Connecticut Geol. Nat. History Survey; John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Bull. 84, p. 36–37. Includes dark-gray lustrous phyllite, commonly interbedded with finely laminated sericite-quartz phyllite or sericitic quartzite. Coarser toward the west where it is fine-grained mica-quartz-garnet schist. Beds of medium-crystalline micaceous limestone occur at several places. Few bodies of hornblende schist or amphibolite. Derivation of name stated.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 12–14, pl. 1. Mica quartzites just east of Prospect gneiss, previously included in Orange phyllite, are here included in Hartland formation. Thus, Orange phyllite is restricted to rocks between Milford chorite schist and Hartland formation.

Named for town of Orange, New Haven County.

†Orangeburg Formation[1]

Eocene, middle: Western and central South Carolina and southern Georgia.

Original references: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 344, chart facing p. 334; published in 1897 as House Doc. 5, 55th Cong., 2d sess.

Typical locality in old Orangeburg district (Lang Syne plantation, near Fort Motte, now in Calhoun County), S.C.

Orange-Martin Limestone[1]

Mississippian: Indiana.

Original reference: D. D. Owen and R. Owen, 1862, Rept. of geol. reconn. of Indiana, p. 126–127.

Named for occurrence in Orange and Martin Counties.

Orangeville Shale (in Cuyahoga Group)[1]

Orangeville Shale Member (of Cuyahoga Formation)[1]

Mississippian: Northeastern Ohio and northwestern Pennsylvania.

Original reference: I. C. White, 1880, Pennsylvania 2d Geol. Survey Rept. Q_3, p. 63.

H. P. Cushing, Frank Leverett, and F. R. Van Horn, 1931, U.S. Geol. Survey Bull. 818, p. 48–50, 57. Cuyahoga formation raised to group rank in its typical area, and its subdivisions (ascending) Orangeville shale, Sharpsville sandstone, and Meadville shale are raised to formation rank. In Cleveland district, Ohio [this report], Orangeville is very homogeneous except that it carries fairly persistent sandstone member, the Aurora, from 6 to 10 feet thick, 10 feet or less above base. This bed is absent in some sections, as at Berea. The few feet of shale below this

sandstone is on the horizon of Sunbury shale of central and southern Ohio. In Cleveland district, this shale zone is not easily separable from Cuyahoga beds. Thickness about 125 feet. In some areas, underlies Sharon conglomerate.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172. Included in Tinkers Creek shale facies (new) of Cuyahoga formation.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Orangeville, at its type locality on Pennsylvania-Ohio State line, consists of about 75 feet of gray to brown hard semifissile clay shale containing a few thin flagstones. Traced eastward into vicinity of Titusville, the flags in the Orangeville increase in number, and the Orangeville merges into Sharpsville sandstone. In northeastern Ohio, the Orangeville has a basal carbonaceous shale member, the Sunbury, which can be traced throughout Ohio. In Cuyahoga and Geauga Counties, Ohio, Aurora sandstone and Chardon sandstone members are present.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1362–1366; J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 10, 13, 18, 41, 42–45, pl. 4. Following members recognized: Sunbury, Aurora siltstone, Chardon siltstone, Bartholomew siltstone (new), and Hungry Run sandstone (new). Overlies Shellhammer Hollow formation (new).

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Named for village of Orangeville, on Ohio-Pennsylvania line in Trumbull County, Ohio. Basal member of Cuyahoga. Underlies Sharpsville member. In this report, the Cuyahoga is subdivided into eight members.

Orca Group[1]

Upper Mesozoic(?): Central southern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 404, 413.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–E, p. 236, 247–275. Workers who have studied sedimentary deposits of Prince William Sound region have accepted rocks around Port Valdez as typical of Valdez group and have agreed in assigning basaltic flows and intrusives, or greenstones as they are commonly called, and massive conglomerate beds of Ellamar district to Orca group. Aside from these points held in common, there is no generally accepted definition of what constitutes Valdez and Orca groups, what are their limits, and what are stratigraphic and structural relations of the beds included in them. Notwithstanding the similarities of the two groups, the Orca, when compared with the Valdez, shows greater diversity in kinds of rocks composing it. Consists dominantly of slate and graywacke. Type locality cited. Many or all of the sedimentary rocks exposed in islands and on mainland of southeastern part of Prince William Sound area, including type locality of Orca group, probably of Late Cretaceous age.

Type locality: Includes rocks of the mainland, adjacent to Orca Inlet and Orca Bay, and on Hawkins Island, southeastern Prince William Sound region.

Orcas Group[1]

Middle Devonian, Lower and Middle Pennsylvanian, Middle and Upper Permian and Upper Triassic: Northwestern Washington.

Original reference: R. D. McLellan, 1924, Am. Jour Sci., 5th, v. 8, p. 217–222.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, pt. 1, p. 1775. Part of this group is dated as Devonian by an identification of *Atrypa reticularis* reported by Schuchert. These seem to be Middle or Upper Devonian types rather than Silurian forms (McLellan, 1924).

W. R. Danner, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2055–2056. Orcas group, originally designated as Devono-Mississippian, is now known to contain rocks of Middle Devonian, Early and Middle Pennsylvanian, Middle and Late Permian, and Late Triassic. No diagnostic Mississippian fossils found.

Named for exposures on Orcas Island.

Orchard Gneiss[1]

Precambrian: Northeastern New York.

Original reference: J. F. Kemp, 1898, Am. Inst. Mining Engrs. Trans., v. 27, p. 178, map, secs.

Occurs near Port Henry, Essex County. Probably named for Orchard Pit.

Orchard Creek Shale[1]

Orchard Creek Shale (in Maquoketa Group)

Lower Silurian: Southwestern Illinois and southeastern Missouri.

Original reference: T. E. Savage, 1909, Am. Jour. Sci., 4th, v. 28, p. 515.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 56. Savage draws Ordovician-Silurian boundary at base of Orchard Creek shale, although there is no doubt that this formation is southward continuation of some part of Maquoketa shale which is generally conceded to be Upper Ordovician.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, pt. 1, p. 518 (table 2), 524. In area where Cape limestone (new) can be identified, Upper Ordovician rocks are referred to Maquoketa group which is composed of (ascending) Orchard Creek shale, Cape limestone, and Eden shale.

Named for Orchard Creek, 2 miles south of Thebes, Alexander County, Ill.

Orchard Point Conglomerate Member (of Blakeley Formation)

Oligocene, middle, or Miocene, lower: Northwestern Washington.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 114. Consists of approximately 1,800 feet of conglomerate at base of formation. Underlies 4,800-foot section of massive and stratified sandy shales and thick units of interstratified conglomerate. Middle Oligocene.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1341. At type section, lowermost Blakeley consists of 845 feet of well-bedded hard marine gray sandstones and massive conglomerates, the Orchard Point member. Orchard Point underlies approximately 4,000 feet of marine, interbedded siltstone, sandstone, and shale herein named Restoration Point member. Based on foraminiferal assemblages contained, the Blakeley, as herein restricted, is best correlated with Zemorrian stage [lower Miocene] of California.

Named for occurrence at Orchard Point near entrance to Bremerton Inlet, Kitsap County.

Orcutt Formation[1] or **Sand**

Pleistocene, upper: Southern California.

Original reference: H. W. Hoots and S. C. Herold, 1935, *in* Geology of natural gas: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 156.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1336 (fig. 1), 1340 (table 1), 1359–1360. In Santa Maria district, reddish-brown sand and gravel resting discordantly on Paso Robles and older formations are designated Orcutt sand. Maximum outcrop thickness between 50 and 100 feet. Considered oldest and most extensive terrace deposit in district; tilted as much as 12 degrees in flanks of anticlines. In type region, has maximum thickness of 50 feet and overlaps formations down to and including the Sisquoc. Upper Pleistocene.

G. F. Worts, Jr., 1951, U.S. Geol. Survey Water-Supply Paper 1000, p. 33–36, pl. 3, table facing p. 23. Described as formation consisting of two conformable members: an upper fine-grained sand member which corresponds to that part of formation exposed at type locality, and lower coarse-grained member. Woodring's term seems to apply only to upper member. Thickness as much as 225 feet.

Type region: On north flank of Casmalia Hills immediately west of Orcutt, Santa Barbara County.

Ord Mountain Group

Triassic(?): Southern California.

D. L. Gardner, 1940, California Jour. Mines and Geology, v. 36, no. 3, p. 266–267. Consists of two major units, andesitic flows, tuffs, and breccia, and hypabyssal intrusive rocks with a porphyritic habit. Intruded by Jurassic(?) plutonics.

Occurs on Ord, East Ord, and Kane Mountains, and southern flank of Bessemer Mountains, San Bernardino County.

Ordnance Plant Member (of Moorefield Formation)

Mississippian (Chesterian): Northeastern Oklahoma.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 57–61, pls. 1–5. Consists fundamentally of three parts (ascending): platy blue to yellow siltstone 9 feet thick; heavy-bedded blue fine-grained dense calcareous siltstone which weathers yellow, silty, and into concentric elements of concretionary nature 15 feet thick; and sequence of brown to black platy siltstone and shale 10 feet thick. Maximum thickness 35 feet. Northward from type locality, member loses upper and part of middle phase until only one or two of heavy ledges can be carried through; southward, the heavy-bedded siltstone development thins by convergence, and entire sequence passes into thin platy silty shale with occasional ledges and concretions of dense blue limestone. Believed to rest conformably upon Lindsey Bridge member (new) or in its absence upon Bayou Manard member (new); locally overlaps onto "knobs" of Boone chert; unconformably overlain by Hindsville limestone and northward from Pensacola is truncated by it.

Type locality: Along Pryor Creek within Oklahoma Ordnance Plant area and in west end of Low Water Dam, secs. 11 and 14, T. 20 N., R. 19 E., where all but uppermost beds are exposed in quarry, Mayes County. Uppermost beds well developed along west side of Grand River below its confluence with Pryor Creek in sec. 27, T. 20 N., R. 19 E.

Oread Limestone (in Shawnee Group)

Oread Limestone Member (of Vamoosa Formation)

Oread Limestone or Limestone Member (of Douglas Group or Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northern Oklahoma.

Original reference: E. Haworth, 1894, Kansas Univ. Quart., v. 2, p. 123, 124.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2034–2036; 1949, F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey Rept. Inv. 11, p. vii (fig. 3), 16–17. Shawnee group was defined by Moore (1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf.) as extending from base of Oread formation to top of Topeka formation. This classification of the Shawnee is now recognized by interstate agreement. Oread formation comprises (ascending) Toronto limestone, Snyderville shale, Leavenworth limestone, Heebner shale, Plattsmouth limestone, Heumader shale, and Kereford limestone members. Overlies Lawrence formation; underlies Kanwaka formation.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 26. Nebraska Geological Survey uses term Weeping Water limestone in preference to Toronto for basal member of Oread.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 52–54, pl. 1. Member of Vamoosa formation in Oklahoma. At type locality, Oread is composed of four limestones and three shales. Leavenworth member (No. 2 limestone, counting from bottom) is Middle Oread of this report [Osage County]; Upper Oread is Plattsmouth member (No. 3 limestone). Basal limestone does not crop out in Oklahoma. Middle Oread is a thin limestone, decreasing from about 4 feet near Kansas line to about 4 inches in sec. 15, T. 26 N., R. 9 E. South of this point, it is a calcareous zone, approximately 15 feet above top of Upper Wyona sandstone and perhaps 30 feet below overlying Elgin sandstone. Near Kansas line where member is well developed, it lies between 15 and 90 feet below Upper Oread limestone and approximately 100 feet above top of Jonesburg sandstone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 21, fig. 5. Basal formation in Shawnee group. Comprises (ascending) Toronto limestone, Heebner shale, Plattsmouth limestone, Heumader shale, and Kereford limestone members. Kereford missing in some localities. Where Toronto is missing, base of formation is indeterminate, and Snyderville shale cannot be separated from underlying Douglas group. Thickness 42 to 52 feet.

Named for fact it caps Mount Oread, at Lawrence, Douglas County, Kans.

Oreana shale[1]

Jurassic: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 80.

Occupies west flank of Humboldt Range southward from Oreana Station, Pershing County.

Oreapolis Limestone[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 6, 10, 19, 34.

Named for Oreapolis, Cass County.

†Oregon Beds[1]

Oligocene(?) and Miocene: Central northern Oregon.

Original reference: E. D. Cope, 1879, Am. Nat., v. 13, p. 333.

Named for State of Oregon.

Oregon Limestone[1] (in High Bridge Group)

Oregon Member (of High Bridge Limestone)

Middle Ordovician: Central Kentucky.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 13.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 12; D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 40–41. Middle formation of High Bridge (Highbridge) group. Underlies Tyrone limestone; overlies Camp Nelson limestone.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 18. Referred to as member of High Bridge limestone.

Named for Oregon, Mercer County.

Oregonia Member (of Arnheim Formation)

Oregonia division (in Arnheim Formation)[1]

Upper Ordovician (Richmond): Southwestern Ohio and north-central Kentucky.

Original reference: A. F. Foerste, 1910, Denison Univ. Sci. Lab. Bull. 16, p. 18.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as upper member of Arnheim; overlies Sunset member; underlies Fort Ancient member of Waynesville formation. Richmond series.

Named for Oregonia, Warren County, Ohio.

Ore Hill Limestone Member (of Gatesburg Formation)[1]

Upper Cambrian: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 527, 534, 537.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 282, 283–287, pls. 1, 3. Redefined to include nonarenaceous dark crystalline dolomite of the Gatesburg found at stratigraphic position of Butts' Ore Hill limestone from Williamsburg, Pa., northward through Tyrone and Bellefonte quadrangles. Thickness 130 to 213 feet: at Williamsburg and Birmingham, about 160 feet. Separated from overlying Mines dolomite member by interval, 650 to 700 feet thick, referred to as upper sandy Gatesburg member, and from underlying Stacy dolomite member by 400-foot interval referred to as lower sandy Gatesburg member. Type section designated.

Type section: Ore Hill quarry about 300 yards northeast of crossroads of Pennsylvania State Highway 686 and road leading east to Ore Hill Station, Bloomfield Township, Bedford County. Named for Ore Hill, Blair County.

Orejon Andesite[1]

Eocene: Southern New Mexico

Original reference: K. C. Dunham, 1935, New Mexico School Mines Bull. 11, p. 53, 54.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14). Age given as Eocene on chart showing nomenclature of Tertiary formations in Caballo Mountains and adjoining areas. Older than Cueva [rhyolite]; younger than Soledad [rhyolite].

Named for Orejon mine, Dona Ana County, in which it occurs as hanging wall of main fault.

Orella Member (of Brule Formation)

Oligocene, middle: Western Nebraska and southwestern Wyoming.

C. B. Schultz and T. M. Stout, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1921; 1941, Guide for a field conference on the Tertiary and Pleistocene of Nebraska: Nebraska Univ. State Mus. Spec. Rept., p. 4 (table 1), 37, fig. 8. Proposed for lower or *Oreodon* zone part of Brule formation. Thickness about 150 feet. Disconformably underlies Whitney member (new).

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 41–44, figs. 3, 10, table 1, 2. Four divisions distinguished. Chiefly silty clay, massive to laminated; commonly brownish-buff; locally greenish-gray. Thickness about 170 feet in Scottsbluff and Torrington areas, western Nebraska and eastern Wyoming; 184 feet in Crawford area, Nebraska. Overlies Chadron formation.

Type locality: About 2½ miles southwest of Orella Station in vicinity of Toadstool Park in sec. 8, T. 33 N., R. 53 W., Sioux County, Nebr.

Orellan Age

Oligocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 11, pl. 1. Provincial time term, based on Orella member of Brule formation, type locality, Orella, Nebraska. Includes the old term "*Oreodon* beds" used in the most extended sense. Covers interval between Oligocene Chadronian (older) and Whitneyan ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Type area: Northwestern Nebraska, southwestern South Dakota, and eastern Wyoming.

Ore Mountain Diorite

Pre-Upper Devonian: Central Maine.

S. S. Philbrick, 1936, Am. Jour. Sci., 5th ser., v. 31, no. 181, p. 9–10, 39. Incidental mention. Older than Onawa intrusive which is probably Upper Devonian in age.

Crops out between Katahdin Iron Works and Big Houston Pond in southern Piscataquis County.

Orestimba Group

Upper Cretaceous (Chico Series): Northern California.

F. M. Anderson, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. Chico series subdivided into Pioneer, Panoche, and Orestimba groups. Maximum thickness of Orestimba 5,000 feet.

F. M. Anderson, 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 395 [1939]. Orestimba group, Chico series, covers closing stages of Cretaceous. Crops out only in San Joaquin Valley. Overlies Panoche group along its eastern margin. Group begins with stratigraphic unit of unique

character, as described by Anderson and Pack (1915), who termed it "Moreno formation." This shaly unit has thickness of 2,000 feet and in district of Orestimba Creek is overlain by 3,000 feet or more of sandy formation, termed the Garzas.

R. D. Reed, 1943, California Div. Mines Bull. 118, pt. 2, p. 109 (table 6) [preprint 1941]. Shown on table as overlying Panoche group and comprising Volta, Garzas, Quinto, and Moreno formations.

Occurs in outer foothills of Diablo Range. Named for fact it lies across Orestimba Creek, Stanislaus County.

Orfordville Formation

Middle Ordovician(?): Western New Hampshire and eastern Vermont.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500); C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Consists of black to dark-gray mica schist, quartz-mica schist, feldspathic quartzite, staurolite schist, and staurolite-kyanite schist in middle grade metamorphic zone. Ottrelite schist or black schistose graphitic quartzite locally; also lenses of biotite gneiss in upper part. Dark-gray slate in lower grade zone. Includes Post Pond volcanic member (new) at base, Hardy Hill quartzite member (new) near middle, and Sunday Mountain volcanic member (new) at top. Underlies Albee formation.

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 119–124. Thickness about 5,000 feet.

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 108, 113–116, pl. 1. Stratigraphic revision. Includes (ascending) schists, Hardy Hill quartzite member, schists, and Post Pond volcanic member. Sunday Mountain volcanic member is considered equivalent of Post Pond member and is not mapped separately.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Members are Hardy Hill quartzite, Post Pond volcanic member, and Sunday Mountain volcanics.

Crops out in belt trending southwestward from Orfordville in New Hampshire part of Mount Cube quadrangle. Extends into Vermont.

Organ Rock Tongue or **Member** (of Cutler Formation)[1]

Permian: Southeastern Utah and northeastern Arizona.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1420, 1422, 1423, 1441, 1443, 1446.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 39 (table), 40 (fig. 7), 41, 42–44. Described in Henry Mountains region where it consists of red evenly bedded micaceous and shaly sandstone; grades northward into white crossbedded sandstone like White Rim or Cedar Mesa members. Thickness 265 to 400 feet. Conformably overlies Cedar Mesa sandstone member; conformably underlies White Rim sandstone member. In Monument Valley region, underlies De Chelly sandstone member.

G. K. Elias, 1957, *in* Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 10. Correlation chart shows Organ Rock present in northeastern Arizona.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1855 (fig. 2), 1857 (fig. 3), 1862. Underlies Hoskinnini (herein reallocated to member status in Moenkopi formation) in most of southeastern Utah.

Named for fact that the beds compose natural monument known as Organ Rock, south of San Juan River, between Moonlight and Copper Creeks, San Juan County, Utah.

Oriana Gypsum Member (of Peacock Formation)[1]

Permian: Central northern Texas.

Original reference: L. T. Patton, 1930, Texas Univ. Bull. 3027, p. 47.

Well exposed in valleys of Double Mountain Fork and Salt Fork Rivers, Stonewall County., and near station of Oriana, on Stamford & Northwestern Railroad.

Orient Formation

Paleozoic: North-central Utah.

B. F. Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 271, pl. 1. Brown well-crystallized quartzite, 15 feet thick, overlies 250-foot unit of dense greenish-brown shale. These will be referred to collectively as Orient formation and specifically as Orient quartzite and Orient shale.

R. E. Cohenour, 1959, Utah Geol. and Min. Survey Bull. 63, p. 75. Proposed that names Orient formation and its subdivisions, Orient shale and Orient quartzite, be supplanted by Kanosh shale and Swan Peak quartzite. Beds above Orient quartzite have been recognized to be units of Fish Haven dolomite.

Traced from Orient mine south and westward across Bates Gulch, West Tintic Mining District [Juab County].

Orient Gneiss[1]

Precambrian(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 85, map.

J. L. Barlow, 1958, U.S. Atomic Energy Comm. [Pub.] RME-2068, p. 7. Discussion of uranium occurrences in northern Ferry County. Oldest rocks in district are biotite-amphibole schists, gneisses, limestones, and quartzites, which Weaver (1920) designated Orient gneiss and tentatively assigned Precambrian age. Houghland (1933, unpub. thesis) subdivided this sequence and assigned name Rockcut formation to include two lower quartzite and limestone members of Lower Paleozoic(?) age. He also used term amphibole schist to include all basic medium- to fine-grained more or less metamorposed rocks in area. These schists are interbedded with the Rockcut.

Well exposed in railway cuts at town of Orient, Stevens County.

Orient Granite Porphyry

Tertiary: North-central Utah.

B. F. Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 275, pl. 1. Dense, buff colored, and massive. Phenocrysts of quartz, biotite, and feldspar; never predominate over groundmass.

Northeast of Orient mine, West Tintic Mining District, [Juab County].

Orienta Sandstone (in Bayfield Group)[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. Hist. Survey Bull. 25, p. 41.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 145 (fig. 8), 147, 150. Critical examination of evidence on which Thwaites (1912) established his Chequamegon formation reveals that his Chequamegon brownstone formation is none other than Port Wing brownstone member of Orienta formation, repeated by faulting. [Thwaites' 1912 general section referred to Upper brownstone (of Port Wing); thickness 500 to 700 feet.] It is suggested that Bayfield sediments are of Middle and possibly also Early Cambrian age laid down in structural basins formed at or after close of Algonkian.

Named for exposures near Orienta, Bayfield County.

Orinda Formation[1]

Orinda Formation (in Contra Costa Group)

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pubs., Dept. Geol. Bull., v. 2, p. 371, map.

B. L. Clark, 1936, Geol. Soc. America Bull., v. 46, no. 7, p. 1035, pl. 88. Stratigraphic sequence on south side of Riggs Canyon fault zone, Mount Diablo area, shows Orinda formation, 3,060 feet below Moraga tuff and above Jacalitos(?).

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 91–92, pl. 11. Described in Mare Island quadrangle where it occupies less than 1½ square miles and is exposed just east of Pinole Point; beds lie in shallow syncline whose axis passes beneath San Pablo Bay. Near Rodeo, Orinda overlies Neroly sandstone.

D. E. Savage, B. A. Ogle, and R. S. Creely, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1511. Included in sequence of formations (in west-central Contra Costa County) for which new group name is proposed (name not given). Sequence (ascending) Orinda, Moraga, Siesta, Bald Peak, and unnamed formation. Unnamed formation formerly mapped as Orinda, but separate formational name is warranted so that structural and stratigraphic relationships of rocks of area may be demonstrated.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 41–42, pls. 1–3. Described in San Jose-Mount Hamilton area. Formation is exposed in center of Tularcitos syncline; beds are tightly folded, overturned in part, and rest unconformably on the Briones. Consists of loosely consolidated red, maroon, or greenish conglomerate, sandstone, and clay. Thickness 750 to 2,000 feet. Miocene-Pliocene. Older than Packwood gravels.

C. K. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 6 (fig. 3), 14–16, pls. 1, 2. Described in Las Trampas Ridge area where it is basal formation in Contra Costa group (new). In some localities, overlain by Pinole tuff; in others by Mulholland formation (new) although the two cannot always be differentiated.

1955, Geol. Soc. America Cordilleran Sec. [Guidebook] Apr. 28–30, Trip 2, p. 2. Road log (between Oakland and Mount Diablo) mentions contact of Moraga volcanics with conglomerate of Orinda formation along crest

of sharp asymmetrical anticline. Moraga volcanics stand almost vertical; Orinda sediments dip east at angles around 45°.

C. A. Hall, Jr., 1958, California Univ. Pub. Geol. Sci., v. 34, no. 1, p. 29–30, fig. 2, geol. map. Occurs mainly in northern part of Pleasanton area where it reaches thickness of 9,000 feet. In southern part of area in Tularcitos syncline, formation is 2,000 feet thick. Overlies Neroly sandstone; overlies Briones formation in Tularcitos syncline. Underlies Leona rhyolite in some areas and Livermore gravels in other areas. Age of Orinda has been in question for about 40 years, and no new evidence was discovered in this study to clarify situation. Pliocene.

Named for exposures at Orinda, Contra Costa County.

Oriskany Formation,[1] Sandstone,[1] or Group[1]

Lower Devonian: New York, western Maryland, Pennsylvania, Virginia, and eastern West Virginia.

Original reference: L. Vanuxem, 1839, New York Geol. Survey 3d Rept., p. 273.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8. Oriskany treated as group in area of this report [south-central Pennsylvania]. Comprises Shriver chert below and Ridgeley sandstone above. Maximum thickness about 50 feet. Overlies Helderberg group; underlies Onondaga formation. Lower Ordovician.

Bradford Willard, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–11, p. 6 (fig. 3), 14. In Delaware Water Gap area, the Oriskany group, undifferentiated, is about 135 feet thick; overlies Port Ewen-New Scotland shale of Helderberg group and underlies Esopus shale of Onondaga group.

A. B. Cleaves *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 92–130. Group in Pennsylvania includes all stratigraphic units between overlying Onondaga group (including Esopus shale in eastern Pennsylvania) and underlying Helderberg formations. Faunally distinct although possessing Helderbergian affinites. Includes Ridgeley formation above and Shriver formation below.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 195–204, geol. map. In Coxsackie quadrangle, Oriskany loses its sandstone character, and becomes fossiliferous cherty limestone, sometimes interbedded with shaly phases. South of Saugerties, contains Glenerie limestone at top. In Rondout region, limestones are underlain by basal pebble conglomerate, 18 to 20 feet thick, Connelly conglomerate. Overlies Port Ewen limestone; underlies Esopus shale.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 127–149. Although an "Oriskany group" is recognized, there is only one formation in West Virginia to which name Oriskany can be applied. This is Ridgeley sandstone. "Shriver chert" formerly assigned to Oriskany is now allocated to earlier position; Huntersville chert, previously described as Oriskany in age, is herein established as an Onondaga formation.

Charles Schuchert, 1943, Stratigraphy of the eastern and central United States: New York, John Wiley & Sons, Inc., p. 85. Littoral shore phase of typical or upper Oriskany might be distinguished as Oriskany Falls member, 0 to 20 feet thick.

J. M. Berdan, 1950, New York State Dept. Conserv., Water and Power Control Comm. Bull. GW–22, p. 10 (table 2), 17. Oriskany sandstone overlies Becraft limestone and underlies Esopus siltstone in Schoharie County. Thickness 6 to 12 feet.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 85–87. Formation in Maryland consists of black cherty shale in lower part and calcareous sandstone or arenaceous limestone in upper part. Comprises Shriver chert and Ridgeley sandstone members. Overlies Helderberg formation; underlies Onondaga shale member of Romney shale.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh, Mtg., p. 4, 13, 26. Formation comprises Shriver and Ridgeley members. Thickness as much as 200 feet. Overlies Helderberg formation; underlies Onondaga formation.

T. M. Kehn, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2018–2019. Recent mapping has revealed that, contrary to previously published reports and maps, there are two outcrop belts of Oriskany, Onondaga, and Marcellus formations between Schuylkill and Susquehanna Rivers. Area is bounded on north by Second Mountain and on south by Blue Mountain. In these belts, the Oriskany formation, 0 to 20 feet thick, is milky-white to brown medium- to coarse-grained locally conglomeratic quartzitic sandstone. Disconformably overlaps Bloomsburg red beds of Silurian age from east to west. Underlies Onondaga formation.

Named for occurrence at Oriskany Falls, Oneida County, N.Y.

Oriskany Falls Member (of Oriskany Sandstone)

Lower Devonian: New York.

Charles Schuchert, [1943], Stratigraphy of the eastern and central United States: New York, John Wiley and Sons, p. 85. Name applied to littoral shore phase of typical or upper Oriskany sandstone. Thickness 0 to 20 feet. From eastern New York, littoral clean sand phase overlaps westward, passing into younger beds.

Type locality and derivation of name not given.

Orlando Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 147.

Exposed at Orlando, Lewis County.

Orleans Phyllite[1]

Ordovician: Northeastern Vermont.

Original reference: E. C. Jacobs, 1923, Vermont State Geologist Rept. 1921–1922, p. 93–108.

Extends north and south across eastern part of Orleans County.

Orman Lake Limestone Member (of Greenhorn Formation)

Orman Lake Limestone Bed (in Belle Fourche Member of Graneros Formation)

Upper Cretaceous: Western South Dakota.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 9–10. Flaggy limestone near middle of Belle Fourche member. Replaces preoccupied name Middle Creek limestone (Wing, 1940). Upper part

of Belle Fourche member above Orman Lake, has been included in Greenhorn formation on west side of Black Hills.

W. A. Cobban and J. B. Reeside, Jr., 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 61 (fig. 2). Shown on correlation chart as member of Greenhorn formation.

Named for exposures on south and west side of Orman Lake, Butte County, S. Dak.

Oro Blanco Conglomerate

Mesozoic: Southeastern Arizona.

G. M. Fowler, 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 121, 122, pl. 32. Consists of angular coarse fragments. Difficult to classify rock as it combines characteristics of conglomerate and breccia. Fragments range between 1 inch and 12 inches in diameter. Small gravel present only in sufficient quantity to fill interstices. Reddish and grayish color with some dark-hued greenish fragments giving mass variegated appearance in some places. Rests on weathered quartz monzonite surface under Montana mine workings.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. [Pub.] RME–2009, p. 8. In Ruby quadrangle overlies Pajarito lavas (new).

Covers large area in western part of Santa Cruz County, and is exposed in and around Montana mine, which is in Oro Blanco mining district, Santa Cruz County, 5 miles north of Mexican boundary and about 30 miles west of Nogales. Named for the mining district.

Orocopia Schist

Precambrian: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 21, pl. 2. Consists of well-bedded metasediments, largely mica-schist. In Orocopia Mountains, in fault contact with Chuckwalla complex, considered older.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, Chap. 2, p. 25. In eastern Mecca Hills, overlapped by Canebrake conglomerate (new).

Named for exposures in northwestern part of Orocopia Mountains, 5 or 6 square miles of which consist of the schist within Palm Springs-Blythe area, Riverside County.

Orocovis Limestone

Upper Cretaceous: Puerto Rico.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 47, 48 (table 4). Limestone occurring in San Juan district and tentatively correlated with Guayama limestone in Coamo-Guayama district.

Orofino Series[1]

Precambrian (Belt Series): Northern Idaho.

Original reference: A. L. Anderson, 1930, Idaho Bur. Mines and Geology Pamph. 34.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 5. Orofino series cannot be correlated with any part of Belt series farther north and must either be older than that series or belong to part of Prichard formation not exposed to north. Orofino series includes banded micaceous and hornblendic quartzite, schist, and gneiss with intercalated beds of marble.

Well exposed in Clearwater Canyon, near Orofino, the lower 11 miles of Orofino Creek in lower Canyon walls, and along lower course of North Fork between Elk Creek and Ahsahka.

Oro Grande Series[1]

Carboniferous: Southern California.

Original reference: O. H. Hersey, 1902, Am. Geologist, v. 29, p. 273–290.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 503, table 4. Late Paleozoic strata (Mississippian?) are represented in Victorville area by Oro Grande metasediments comprising thousands of feet of crystalline limestones and quartzites. Some poorly preserved fossils in the limestones. Locally interbedded with Sidewinder Valley metavolcanics.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 23–34, pls. 1, 2, 3, 4, 6, 7, 8. Hersey's type section measured and described in detail. At type section, an unknown thickness has been eroded out or faulted off so that total thickness of 2,450 feet is not representative of true thickness; maximum thickness of 9,670 feet is in Shadow Mountain section; aggregate thickness 1,200 feet in Sidewinder Mountain where series consists of three members separated by probable unconformities. Unconformably underlies Permian Fairview Valley formation; intruded by Waterman gneiss (new). Miller believed the Oro Grande to be interbedded with Sidewinder Valley metavolcanics, but present study does not support this view. Carboniferous.

Type section: East slope Quartzite Mountains, 1 mile east of Oro Grande, San Bernardino County.

Oro Loma Formation

Pliocene, lower or middle: Southern California.

F. F. Davis and D. W. Carlson, 1952, California Jour. Mines and Geology, v. 48, no. 3, p. 212. Ora Loma formation consists of deep reddish-colored poorly consolidated silts, sands, and gravels. Stratigraphically between San Pablo and Tulare formation. Name credited to L. I. Briggs, Jr. (unpub. paper).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 46–48, pls. 1, 2, 3. Described in Ortigalita Peak quadrangle. Anderson and Pack (1915, U.S. Geol. Survey Bull. 603) included in their Tulare(?) formation beds overlying San Pablo formation along front of Laguna Seca Hills which [beds] dip beneath valley alluvium at angles up to 40°, and flattish beds bordering Little Panoche Creek. Name Oro [Ora] Loma is given to the strata of Laguna Seca Hills. Oro Loma beds are folded with bedrock series, and Tulare strata extensively overlap all these units. Maximum thickness of about 300 feet occurs in vicinity of Oro Loma Creek. Type section designated; derivation of name given.

Type section: Along Oro Loma Creek, Ortigalita Peak quadrangle, which is mostly in Merced County. Continuously exposed for about 6 miles south of Rattlesnake Canyon.

Oronoco Formation

Precambrian or Cambrian: Central Virginia.

R. O. Bloomer and R. R. Bloomer, 1947, Jour. Geology, v. 55, no. 2, p. 94, 95. Variable thickness of both metamorphosed and unmetamorphosed

conglomerate sandstone, tuff, and andesite. Underlies Catoctin formation; unconformably overlies Precambrian crystalline basement complex.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 311. In central Virginia, a series of flows, tuffs, and arkoses has been described as Oronoco formation. At its type locality, this formation overlies the injection complex, is overlain by Catoctin basalt, and is equivalent to Swift Run tuff which had previously been named and mapped as far south as this part of Virginia. New name for formation is not warranted.

R. O. Bloomer, 1950, Am. Jour. Sci., 248, no. 11, p. 768–771. Name should be abandoned in favor of Swift Run which is its equivalent and has priority.

Occurs in northeastern part of Buena quadrangle. Named from Oronoco post office, Amherst County.

Oronto Group[1]

Precambrian: Northwestern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 48.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1474–1479. Group revised to include (ascending) Outer conglomerate, Nonesuch shale, and Freda sandstone. Underlies Bayfield group. Thickness as revised 13,550 feet. Thwaites (1912) included Eileen sandstone and Amnicon formation in Oronto group. Revision made on basis of lithological and heavy mineral evidence which suggests that Eileen sandstone belongs above Amnicon and includes beds on Middle River and Fish Creek sections which Thwaites classed as lower Orienta (in Bayfield group). Eileen sandstone, which resembles Bayfield group of sandstones, is probably basal Orienta, and Amnicon arkose is upper Freda. Thickness of Amnicon given by Thwaites—5,000 feet—is included in his estimate of thickness of Freda, and the 2,000 feet assigned to the Eileen is included in Orienta. Hence, 7,000 feet is eliminated from Thwaites' estimate of the section.

Named for exposures on Oronto Bay, Iron County.

Oro Plata Granite Porphyry

Tertiary: North-central Utah.

B. F. Stringham, 1942, Geol. Soc. America Bull., v. 53, no. 2, p. 275, pl. 1. Dense, buff, and massive. Phenocrysts of quartz, biotite, and feldspar never predominate over groundmass.

Near Oro mine, West Tintic Mining District [Juab County].

Oroville Beds[1]

Upper(?) Jurassic: Northern California.

Original reference: W. M. Fontaine, 1900, U.S. Geol. Survey 10th Ann. Rept., pt. 2, p. 342.

Occur near Oroville, Butte County.

Orr Formation[1]

Upper Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 10.

C. B. Bentley, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 6, p. 14–17, 40–42, 44–45, 48–50. In Wah Wah, Fish Springs, and House Ranges, divided into two formations, lower composed predominantly of limestone and in some places dolomite, and upper of shale and alternating shale and limestone. Name Orr retained for lower formation; name Dunderberg (extended from Nevada) applied to upper formation. Thickness 711 to 1,299 feet. Overlies Weeks formation and in some areas not distinguished from it.

Type locality: Orr Ridge, spur extending from main mass of Notch Peak, on south side of Weeks Canyon, House Range.

Ortega Formation

Tertiary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Grades from talus breccia to conglomerate and sandstone; well-indurated: brick-red. Maximum thickness about 200 feet. Younger than Chicoma volcanic formation (new); older than Abiquiu tuff (new).

Occurs in Abiquiu quadrangle, Rio Arriba County.

Ortega Quartzite

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 11, 13 (table 1), 21–22, 43, pls. 2, 3. Divisible into quartzitic and quartz-muscovite schistose phases. Essentially quartzite which is typically white to bluish gray. Includes Petaca schist phase, local conglomeratic phases, and several of Vallecitos rhyolites (new) in Petaca area, and Rinconada schist phase (new), and some of Picuris basalts particularly near base in Picuris area. Ranges from 2 to 5 miles in thickness. Lies above Hopewell series. Succeeded by Hondo slate in Picuris area.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 6–21, pl. 1. Formation consists of three members: quartzite member which has no exposed base, Rinconada schist member, and Pilar phyllite member (new). Estimated thickness in Picuris Range 6,600 feet.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 10 (table 2), 11–14, pl. 1. Redefined to include only quartzite that is stratigraphically equivalent to quartzite in Ortega Mountains (cited as Just's type area) and to overlying quartzite that extends up to, but does not include Big Rock conglomerate (new). Petaca schist mapped separately.

Widely exposed in Petaca area, including Ortega Mountain type area, and in Picuris area, Rio Arriba and Taos Counties.

Ortigalita Sandstone Member (of Ciervo Shale)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Brownish-green sandstone 570 feet thick. Occurs 600 feet below top of Ciervo formation (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: Papanatas Canyon, Fresno County. Name derived from Ortigalita Peak, in south-central sec. 18, T. 13 S., R. 10 E.

Ortigalita Creek Conglomerate

Upper Cretaceous: Western California.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Mentioned in discussion of Panoche formation in Ortigalita Peak quadrangle.

Orting Glaciation, Drift

Orting Gravel[1]

Pleistocene: Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 15, pl. 1. Described in Kitsap County. Subdivided into two members, lower (unnamed) and Kitsap clay. Thickness about 500 feet. Unconformably overlies Admiralty drift; underlies Puyallup sand.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 384–397. Restudy of Pleistocene deposits in Puget Sound lowland resulted in refinement and expansion of sequence described by Willis (1898). Willis' sequence of two glaciations (Admiralty and Vashon) and single interglacial interval (Puyallup) is replaced by four glaciations separated by nonglacial intervals. Stratigraphic section consists of Orting drift (oldest), Alderton formation (nonglacial), Stuck drift, Puyallup formation (nonglacial), Salmon Springs drift, and Vashon drift. Section of Orting drift designated as typical by Willis restudied and redescribed. Thickness measured section A is more than 165 feet; measured section B is more than 138 feet. Orting drift overlies deeply weathered sedimentary and volcanic rocks.

Typical section: SE¼SE¼ sec. 29, T. 19 N., R. 5 E., on east bank of Carbon River, at Orting, Pierce County.

Orton Gravels

Pleistocene: Central South Dakota.

B. C. Petsch and E. J. Bolin, 1950, Areal geology of the Fort Bennett quadrangle (1:62,500): South Dakota Geol. Survey; E. H. Stevens and J. M. Wilson, 1952, Areal geology of the No Heart quadrangle (1:62,500): South Dakota Geol. Survey. Sands and gravels of western origin containing considerable white chert and broken agate.

Mapped in Stanley County.

Ortonville Granite (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482, 1485. Variable in texture, color, and structure. Commonly red but locally pinkish gray. Texture ranges from medium granitoid to coarse porphyritic with aligned phenocrysts; pink pegmatites present in many areas. Crops out northwest of Montevideo granite (new).

Term Ortonville granite was used as trade name for dark-red granite quarried near town of Ortonville, Minn. (*See* E. F. Burchard, 1910, U.S. Geol. Survey Bull. 430; O. Bowles, 1918, U.S. Geol. Survey Bull. 663).

Principal outcrops lie between Odessa and Ortonville, Big Stone County. Same rock type crops out over large area southeast of Milbank, S. Dak.

Orwell Limestone

Middle Ordovician (Black River-Trenton): West-central Vermont.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 556–557. Massive heavy-ledged rather fine-textured black limestone, weathering light dove gray, cut through by innumerable white calcite veins. Discontinuous black chert beds occur in the limestone. Maximum thickness over 50 feet. Underlies Glens Falls limestone; overlies Middlebury limestone (new).

Named for extensive outcrops in southeastern part of Orwell Township, Addison County.

Osage Lens (in Newcastle Formation)

Upper Cretaceous: Northeastern Wyoming.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 15. Predominantly shale and siltstone. Maximum thickness 70 feet near Osage. A point in sec. 31, T. 46 N., R. 62 W., near Pedro is arbitrarily taken as division between Newcastle lens (new) and Osage.

Named for exposures near Osage, Weston County.

†Osage Limestone[1]

Lower Ordovician (Beekmantown): Central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 366, 375.

Named for Osage Bluff, Cole County.

†Osage Limestone (in Shawnee Formation)[1]

Pennsylvanian: Eastern Kansas.

Original reference: J. G. Hall, 1898, Kansas Univ. Geol. Survey, v. 3, p. 71.

Named for exposures at Osage City, Osage County.

Osage Series

Osage Group[1]

Lower Mississippian: Mississippi Valley region.

Original reference: H. S. Williams, 1891, U.S. Geol. Survey Bull. 80, p. 169.

R. C. Moore, 1933, Historical Geology: New York, McGraw-Hill Book Company, p. 262–264. Valmeyer series (new) includes Osage group below and Meramec group above.

K. E. Born, 1936, Tennessee Div. Geology, Resources of Tennessee, 2d ser., p. 33. Osage series in Tennessee includes (ascending) New Providence formation, Grainger shale, and Fort Payne chert.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132–133. Osage group, Valmeyer series, includes (ascending) Fern Glen limestone, Keokuk limestone, and Burlington limestone. Underlies Meramec group; overlies Kinderhook series.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 771, 777–778. Iowa series includes (ascending) Kinderhook, Osage, and Meramec groups. Osage group comprises (ascending) Fern Glen, Burlington, Keokuk, and Warsaw. This classification follows Illinois Geological Survey usage. Authors favor raising Kinderhook to rank of series and including Osage and Meramec groups in Valmeyer series.

L. R. Laudon, 1948, Jour. Geology, v. 56, no. 4, p. 288–302. Discussion of Osage-Meramec contact. Problems concerning contact cannot be solved at type sections of either Osage or Meramec series because both type sections are incomplete. At type section of Osage, the Upper Burlington, Keokuk, Salem, and St. Louis formations are all missing. Upper Burlington and Keokuk beds are exposed at other places in west-central Missouri, the Warsaw and Salem formations are not represented at all, and the St. Louis is known only from one small area. At type section of Meramec series, beds of Osage age are not exposed. In the vicinity, beds of Keokuk, Burlington, Reeds Spring, and Fern Glen age are exposed, but the Warsaw is not represented. If distribution of Osage rocks is compared with distribution of Meramec rocks, an important break between the two series is suggested. Analysis of ranges of fossils within Mississippian rocks reveals one of most remarkable faunal breaks in whole Paleozoic sequence at end of Osage series.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 98 (fig. 1), 99–100, chart 5. In this report, the Mississippian is subdivided into (ascending) Kinderhookian, Osagean, Meramecian, and Chesterian series. In standard section, Osagean comprises (ascending) Fern Glen, Burlington, and Keokuk. Occurs above Easley group (new) of Kinderhookian series. Disagreement exists regarding boundary between Meramecian and Osagean, and current usage is not consistent. Indiana, Iowa, and Illinois Geological Survey classify the Warsaw with the Osagean, while U.S. Geological Survey and Missouri Geological Survey include it in the Meramecian. Uncertainty also exists regarding Osagean-Kinderhookian boundary. This question involves consideration of three formations: Fern Glen, Sedalia, and Gilmore City.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2157–2171. At time Williams introduced term Osage, no geographic location was given for derivation of name. Keyes (1893, Iowa Geol. Survey, v. 1) stated that Williams suggested title "Osage" from name of river in southwestern Missouri which cuts through some of lower Carboniferous series in St. Clair County. Keyes also stated that most typical section of Osagian rocks is exposed at Osceola, in St. Clair County. Osceola is in deepest part of an east-west structural basin, and maximum Osage section along Osage River is present. Lower two-thirds of Burlington limestone is only part of Osagian represented in Osceola area. Most complete section is at Hunt-Bullard quarry about 1 mile west of town in NE¼NW¼SE¼ sec. 18, T. 38 N.. R. 25 W. Lowest beds are exposed in railroad cut in town of Osceola 2 blocks east of dam across Osage River. No rocks of Keokuk age are present in Osceola area. Hence type section was not well chosen. Nevertheless, term Osagian has gained wide acceptance and should continue to be used. Area south of Osage River in southwestern Missouri, northwestern Arkansas, and northeastern Oklahoma contains nearly complete sequence of Osagian rocks. St. Joe and Reeds Spring limestones occur below Burlington limestone, and are now referred to Osagian series. Keokuk and Warsaw formations above the Burlington are included in Osagian series. No single locality in this area exhibits complete sequence of all five formations.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1). In some areas Osage group, Valmeyer series, occurs above North Hill group of Kinderhook series.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 28 (fig. 9), 44–47. In Beardstown, Glasford, Havana, and Vermont quadrangles, Osage group,

Valmeyer series, comprises Burlington, Keokuk, and Warsaw formations. Overlies Hannibal group of Kinderhook series; underlies Meramec group.

Named for Osage River, Mo., along which Burlington limestones are exposed in vicinity of Osceola, St. Clair County.

†Osage City Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: J. G. Hall, 1896, Kansas Univ. Geol. Survey, v. 1, p. 104.

Crops out 6 miles southeast of Burlingame, Osage County.

†Osage City Shale (in Shawnee Formation)[1]

Pennsylvanian: Eastern Kansas.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 278, pl. 20; 1895, Am. Jour. Sci., 3d, v. 50, p. 461–462.

Named for exposures at Osage City, Osage County.

Osagian (Osagean) Series, Stage

See **Osage Series.**

†Osborne Limestone[1]

Upper Cretaceous: Central northern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 51.

Named for exposures at Osborne and in Osborne County.

Oscar Sandstone[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 11.

Exposed at and near town of Oscar, Jefferson County.

Osceola Amygdaloid[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1894, Lake Superior Min. Inst. Proc. 2d Ann. Mtg., p. 79–96.

H. R. Cornwall, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–34. Included in Portage Lake lava series.

Named for occurrence in Osceola mine, Houghton County.

Osceola Clay[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

Occurs in bluffs which form northern bank of Carbon River, 2 or 3 miles below Carbonado, Pierce County.

Osceola Flow[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Included in Portage Lake lava series.

Occurs in Osceola mine, Houghton County.

†Osceola Glacial Drift[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: Bailey Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

D. R. Crandell and H. H. Waldron, 1954, (abs.) Soc. America Bull., v. 65, no. 12, pt. 2, p. 1337. Unit termed Osceola till by Willis (1898) is now believed to be Recent mudflow.

Named for occurrence in vicinity of Osceola, near Mt. Rainier.

Osceola Mudflow

Recent: Western Washington.

D. R. Crandell and H. H. Waldron, 1956, Am. Jour. Sci., v. 254, no. 6, p. 349–362. Osceola till of Willis (1898) is herein redefined as Osceola mudflow. Flow is of Recent age and is restricted in geographic distribution to Mount Rainier and adjoining part of Puget Sound lowland in vicinity of White River. Thickness 75 feet at typical section. Maximum thickness 350 feet. Overlies stratified drift of Vashon age.

Typical section: In gully in northeast valley wall of White River about 3½ miles west of Enumclaw. Gully is in NE¼SE¼ sec. 29, T. 20 N., R. 6 E., and is about 0.2 mile west of intersection of Wilson Road and Barker Road.

Oscuro limestone[1]

Pennsylvanian: New Mexico.

Original reference: C. R. Keyes, 1909, Iowa Acad. Sci. Proc., v. 16, p. 159–163.

In Rio Grande region. Derivation of name not stated.

Osgood Formation[1] or Shale[1]

Osgood Formation (in Clinton or Wayne Group)

Osgood Limestone Member (of Bainbridge Formation)

Osgood Member (of Alger Formation)

Middle Silurian: Southern Indiana, west-central Kentucky, southeastern Missouri, and central Tennessee.

Original reference: A. F. Foerste, 1896, Cincinnati Soc. Nat. History Jour., v. 18, p. 191–192.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 35, table facing p. 46. In Ohio, considered member of Alger formation. Underlies Laurel member; overlies Dayton formation. Thickness 10 to 80 feet; average 45. Blue-gray calcareous shale with layers of dolomite.

J. R. Ball, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 7–9. Osgood limestone geographically extended into southeastern Missouri where it is considered member of Bainbridge formation; underlies Laurel member. Argillaceous limestone in thin to medium beds.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 244–248. Osgood formation included in Wayne group. Unconformably overlies Brassfield limestone and conformably grades into overlying Laurel limestone. Composed largely of gray sometimes bluish and sometimes greenish calcareous shale; locally may contain one or more beds of almost silt-free limestone; in western valley, basal few feet are red, and locally entire formation is red. Thickness 10 to 20 feet.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. In Indiana Osgood formation underlies Laurel formation and overlies Brassfield formation. Consists of tan

dense argillaceous limestone, and light-gray calcareous shale. Thickness 13 to 23 feet. In Clinton group.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci. Geology Sec. Guidebook 35th Ann. Field Conf., p. 17. Silurian section in Yellow Springs region shows Osgood shale, 25 feet thick, above Dayton limestone and below Laurel dolomite.

Named for Osgood, Ripley County, Ind.

Osgood Mountain Quartzite

Lower Cambrian(?): North-central Nevada.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]; 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. White quartzite, somewhat micaceous, in upper part interbedded with quartz mica schist. Thickness at type locality 5,000 feet. Base not exposed. Underlies Preble formation (new). In thrust contact with other Paleozoic formations.

Type locality: Osgood Mountains, Golconda quadrangle.

Oshawanan series[1]

Lower Mississippian: Southern Illinois.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 45, 50, 222.

Named for "the old name Oshawano Mountains, which was once applied to the easternmost folds of the Ozark uplift, on the flanks of which the complete section reclines."

Osier Mountain Welded Tuff Member (of Treasure Mountain Rhyolite)

Miocene, upper: Northwestern New Mexico.

W. R. Muehlberger and others, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 100, 101. Rhyolite near quartz latite in composition. Light gray to medium light gray at top; grades to pale red at base. Thickness 54 feet. Overlies Lagunitas clastic member (new). Name credited to E. L. Trice (unpub. thesis).

Crops out in Chama area, northern Rio Arriba County.

Osila Sand

Cretaceous or Eocene(?): Southern California.

F. C. Hodges and E. R. Murray-Aaron, 1943, California Oil Fields, v. 29, no. 1, p. 14, pl. 6. Shown as both surface and subsurface on structure section of Aliso Canyon oil field. Surface section occurs above Santa Susana fault. Wells have found approximately 400 to 1,900 feet of Osila depending on structural position.

C. E. Leach, 1948, *in* Structure of typical American oil fields: Tulsa, Okla., Am. Assoc. Petroleum Geologists, v. 3, p. 34. There is definite evidence for age of Osila above fault block, but its lithologic character and its position in stratigraphic section are similar to undifferentiated Eocene and Cretaceous section below fault.

Aliso Canyon field is in eastern part of Santa Susana Mountains, approximately 30 miles northwest from center of Los Angeles.

Oskaloosa Shale Member (of Deer Creek Limestone)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and northwestern Missouri.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc. Wichita, Kans. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 12.

F. G. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv., p. vii, 17. Columnar section shows Oskaloosa shale member above Ozawkie limestone member and below Rock Bluff limestone member. [Text does not discuss unit in Missouri.]

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 65. Consists of bluish- or yellowish-gray shale in northern Kansas and sandy micaceous shale containing red zone and some nodular limestone in southern part of state. Thickness ranges from minimum of 3 feet to maximum of about 50 feet locally in Osage County. Overlies Ozawkie limestone member; underlies Rock Bluff limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18, fig. 5. Greenish-gray blocky 6-foot interval in quarry south of Pacific Junction, E½NW¼NW¼ sec. 15, T. 71 N., R. 43 W., Mills County, has been identified as Oskaloosa shale. Not recognized over greater part of area if this report [southwestern Iowa]. Underlies Rock Bluff limestone member; overlies Ozawkie limestone member.

Type locality: Vicinity of Oskaloosa, Jefferson County, Kans.

Oso beds (in Chuaran series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Sandstones and shaly sandstones. Thickness 500 feet. Underlie Venus formation (new); overlie Jupiter shales (new).

Crop out prominently in Oso Gorge, a side-canyon reaching from Marble Canyon into Kwagunt Valley; Grand Canyon region.

Oso Member (of Capistrano Formation)

Miocene, upper, and Pliocene, lower: Southern California.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. Consists mainly of white friable coarse-grained feldspathic sandstone and grit, which are massive and poorly bedded. Member represents coarse sandy facies of Capistrano formation and grades laterally into typical sandy siltstone of Capistrano south of Arroyo Trabuco. Attains thickness of about 1,500 feet along Serrano Creek. Between Agua Chinon Wash and Borrego Canyon, the Oso rests conformably on Soquel member of Puente formation and is unconformably overlain by Niguel formation (new). Between Oso Creek and Arroyo Trabuco, the Oso rests unconformably on Monterey shale and is overlain by and interfingers with typical lithology of Capistrano.

Type area: Between Agua Chinon Wash and Oso Creek, approximately 2½ miles east of village of El Toro. Named for creek that lies between Aliso Creek and Arroyo Trabuco.

Osobb Formation

Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Quartzitic sandstone, shale, and some lenses of limestone and

dolomite. Sandstone markedly crossbedded; some limestone and dolomite of bioclastic origin. Exposed thickness about 2,000 feet. Conformably overlies Cane Spring formation (new).

Type locality: Southwest slope of Augusta Mountain in north end of Dixie Valley (Osobb Valley of Fortieth Parallel survey).

Osos Basalt[1]

Jurassic(?): Western California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey. Atlas, Folio 101.

Named for outcrops in Los Osos Valley, San Luis Obispo County.

Osoyoos Granodiorite[1]

Mesozoic: North-central Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

A. C. Waters and Konrad Krauskopf, 1941, Geol. Soc. America Bull., v. 52, no. 10, pl. 1. Mapped in north-central Washington. Roughly contemporaneous with Colville batholith. Mesozoic.

Occurs in vicinity of Osoyoos Lake. Extends across international boundary.

Ost Limestone Member (of Tecumseh Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska and southwestern Iowa.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 47, 52.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23. Thickness 2 to 4 feet. Underlies Rakes shale member; overlies Kenosha shale member. Does not persist very far into Kansas.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Recognized near Thurman, Fremont County, where it consists of two limestone beds separated by greenish-gray argillaceous shale that is about 1½ feet thick. Upper limestone is light gray, with fossil fragments of *Osagia*, and is little more than 1 foot thick; lowermost bed is brownish gray and massive and about 2.5 feet thick. Underlies Rakes Creek shale member; overlies Kenosha shale member.

Type locality: On Ost Farm on South Branch, Weeping Water Creek, 3½ miles east of Avoca, Cass County, Nebr.

Ostrander Member (of Dakota Formation)

Lower Cretaceous: Southeastern Minnesota.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 103–104, 148. Consists of gravel, sand, clay and iron conglomerate; gravels commonly yellow-stained and poorly sorted; sands vary from coarse to fine; crossbedding common. Thickness at type locality about 21½ feet. Overlies post-Devonian erosion surface; underlies glacial drift. In Minnesota, replaces name Windrow formation, type locality of which is in Wisconsin.

G. W. Andrews, 1958, Jour. Geology, v. 66, no. 6, p. 599. Unit termed Ostrander member of Dakota formation by Stauffer and Thiel (1941) is here defined as East Bluff member of Windrow formation.

Type locality: Carthog gravel pit in SE¼ sec. 29, T. 102 N., R. 13 W., at south end of village of Ostrander, Fillmore County; supplementary locality: On the Frank Farnhill Farm, SE¼ sec. 20, Bloomfield Township, Fillmore County.

Oswaldo Formation (in Magdalena Group)[1]

Pennsylvanian: Southwestern New Mexico.

Original reference: A. C. Spencer and S. Paige, 1935, U.S. Geol. Survey Bull. 895.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 23. Studies in Silver City-Santa Rita area show that Oswaldo and Syrena formations each include parts of at least two series of Pennsylvanian and not useful as stratigraphic units.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 281 (fig. 3), 283 (fig. 5), 284. Discussed in report on hydrothermal alteration at Santa Rita. Divided into (ascending) Parting shale, Middle Blue limestone, and Upper Blue limestone members. Overlies Hanover limestone here included in upper part of Lake Valley limestone. Underlies Mountain Home shale, lower member of Syrena limestone.

Named for Oswaldo patented mining claim, about 1 mile south of Hanover post office, Santa Rita district.

Oswayo Formation[1]

Oswayo Formation (in Conewango Group)

Oswayo Formation (in Susquehanna Group)

Devonian: Southwestern New York and northern Pennsylvania.

Original reference: L. C. Glenn, 1903, New York State Mus. Bull. 69, p. 978–989, map.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 63–67. Formation (or monothem) described in Wellsville quadrangle. Thickness about 150 feet. Base is about 200 feet above Salamanca conglomerate member of Cattaraugus.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33. Described in Chautauqua County, N.Y., where it is middle formation of Conewango group. Overlies Cattaraugus formation; underlies Knapp formation. Thickness about 100 feet. Upper Devonian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Unit mapped as Oswayo in western part of State consists of greenish-gray to gray shales, siltstones, and sandstones becoming increasingly shaly westward; considered equivalent to type Oswayo. Overlies Cattaraugus formation. In central and eastern part of State, consists of brownish- and greenish-gray, fine- and medium-grained sandstones with shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Oswayo not proved. Overlies Catskill formation. Included in Susquehanna group. Upper Devonian.

Named for exposures in vicinity of Oswayo Creek, Cattaraugus County, N.Y.

†Oswegatchie Series[1]

Precambrian: Northern New York.

Original reference: C. H. Smyth, Jr., 1894, New York State Mus. 47th Ann. Rept., p. 687–692.

Oswegatchie River flows through these rocks for many miles in St. Lawrence and Jefferson Counties.

†Oswego Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 105–107, 116.

Named for Oswego, Labette County.

Oswego Sandstone[1]

Upper Ordovician: New York, Pennsylvania, and Virginia, and Ontario, Canada.

Original reference: C. S. Prosser, 1888, Am. Inst. Mining Engineers Trans., v. 16, p. 946. Emmons and Vanuxem referred to unit as "Gray sandstone of Oswego" (see Wilmarth Lexicon); hence Prosser's term is first formal usage.

Charles Butts and E. S. Moore, 1936, U.S. Geol. Survey Bull. 855, p. 45–47, pls. 1, 3. In Bellefonte quadrangle, Pennsylvania, Oswego sandstone is nonfossiliferous formation of thick-bedded greenish-gray iron-speckled somewhat arkosic sandstone. Thickness 800 feet. Overlies *Orthorhynchula* zone at top of Reedsville shale; underlies Juniata formation.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1174. Term Oswego has been misapplied in Pennsylvania. There is probably little or no true Oswego in the state. For beds commonly referred to as Oswego, the term Bald Eagle is revived and treated as basal Juniata.

H. B. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 376–387. Crops out in West Virginia in two belts: (1) eastern outcrop in Berkeley, Morgan, Hampshire, and Hardy Counties, and (2) western belt in Grant and Pendleton Counties. Fails to reach surface of Mineral County and is absent in all geologic sections elsewhere in State. As described herein, the Oswego is considered to be of late Ordovician (Maysville or Richmond) age. Oswego of this report has been called "Gray Medina sandstone" by West Virginia Geological Survey. Thickness as much as 350 feet. Not certain that term Bald Eagle sandstone, revived for use in Pennsylvania by Willard and Cleaves, is appropriate for use in West Virginia.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 11 (table 1), 41–42. Described in Rockingham County, where it is 300 to 600 feet thick; underlies Juniata formation and overlies Martinsburg shale. In some areas, in fault contact with Martinsburg. Upper Ordovician.

Named for Oswego County, N.Y.

Otero Formation[1]

Tertiary(?): Southeastern New Mexico.

Original reference: C. L. Herrick, 1904, Am. Geologist, v. 34, p. 179, 186.

Derivation of name not stated, but report in which it is described is on Lake Otero, ancient salt-lake basin in southeastern New Mexico between Sacramento and San Andres Mountains.

Otero limestone[1]

Permian: Western Texas.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 39, 42, 46.

In Guadalupe Mountains. Derivation of name not stated.

Otero Mesa Member (of Yeso Formation)

Lower Permian (Leonard Series): Central southern New Mexico.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 696 (fig. 4), 698. At type section, consists of 168 feet of red to maroon shale and resistant ledges of reddish-brown to tan cross-laminated sandstone. Lies conformably on poorly exposed sequence of gypsum, gray shale, and thin-bedded dolomite about 50 feet thick, which is designated as basal part of formation. Overlain by poorly exposed sequence of gypsum, pink shale, and fine-grained sandstone. Unit has been considered part of Abo sandstone by various workers.

Type section: In westward-facing cuesta in S½ sec. 17, T. 21 S., R. 11 E., about 5 miles south of Culp Canyon, Otero County. Named for exposures at base of Otero Mesa.

†Otis Limestone[1]

Precambrian: Massachusetts.

Original reference: B. K. Emerson, 1899, U.S. Geol. Survey Bull. 159, p. 54, 57.

Exposed at Otis and vicinity, in eastern Berkshire County.

Otis Limestone[1] Member (of Wapsipinicon Formation)

Middle Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1894, Iowa Acad, Sci. Proc., v. 1, pt. 4, p. 22–24.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 38 (fig. 1), 41–42. Term Otis is applied to some thin- to medium-bedded limestones and dolomites that occur between Coggon belowand Kenwood members. Not exposed north of Linn County; in Fayette County, has been cut off by overlap and Spring Grove member rests directly on Silurian. Age shown on chart as Middle Devonian(?).

Named for railway junction of Otis, east of Cedar Rapids, Linn County.

Otisco Member[1] (of Ludlowville Formation)

Middle Devonian: Central New York.

W. A. Oliver, Jr., 1951, Am. Jour. Sci., v. 249, no. 10, p. 708, 709–713, fig. 6 (facing p. 724). Includes two named coral beds: Staghorn Point submember in lower part and Joshua submember (new) in upper part. Coral beds interfinger laterally with surrounding shale; upper and lower contacts sharply defined except in fringing areas where complete gradation into normal shales may occur. Overlies Centerfield member.

Type section: In Millers Place ravine on west side of Otisco Lake, 1 mile northwest of the causeway, Skaneateles quadrangle.

Otisville Shale Member (of Shawangunk Formation)[1]

Silurian: Southeastern New York.

Original reference: C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, p. 651, 652, 656, 660.

At Otisville, Orange County.

Otoe Member (of Wellington Formation)

Permian: North-central Oklahoma.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1928. Thickness 115 feet. Underlies Midco (lacustrine) member (new); overlies 190-foot anhydrite sequence.

Type locality and derivation of name not stated.

Otoe Shale Member (of Friedrich Formation)

Pennsylvanian (Virgil Series): Northeastern Kansas and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1938, Nebraska Geol. Survey Paper 12, p. 9. Defined as uppermost member of formation. Overlies Palmyra limestone member (new).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 14. Consists of shale, grayish above and reddish below. Thickness about 7½ feet.

Type locality: In ravine tributary to South Table Creek, 2½ miles southwest of Nebraska City, NW¼SW¼ sec. 20, T. 8 N., R. 14 E., Otoe County, Nebr.

Otsego Member (of Marcellus Shale)[1]

Middle Devonian: Eastern New York.

Original reference: G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544, 548.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Otsego shale and sandstone shown on correlation chart above Mount Marion shale and sandstone and below Ashokan sandstone.

Type section: In "Dugway" on east side of Otsego Lake, Berne quadrangle.

Otselic Shale and Sandstone[1]

Upper Devonian: Central New York.

Original references: J. M. Clarke (Otselic flags), 1899, New York State Geologist Ann. Rept. 1896, p. 35; 1903, New York State Mus. Handb. 19, p. 24, chart.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 72. Ithaca is divided into Otselic member below and Cincinnatus member by Clarke (1903) from vicinity of De Ruyter eastward to Chanango [Chenango] Valley. The projected Genesee group includes the beds to top, or nearly so, of Otselic division in this area.

Well exposed along Otselic River in Chenango and Cortland Counties.

Otsquago Sandstone[1]

Silurian: East-central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 8, 10, 13, fig. 1. Overlies Oneida formation; occurs 25 to 30 feet below Bryman shale.

Typically exposed in and near Otsquago Creek below Vanhornsville, Herkimer County.

Ottauquechee Formation[1]

Ottauquechee Group

Middle Cambrian: East-central and west-central Vermont.

Original reference: E. L. Perry, 1927, Vermont State Geologist 15th Rept., p. 161.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 655 (fig. 2), 656. Referred to as group. Occurs above Pinney Hollow schist and below Bethel schist and Missisquoi group.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 61–65, geol. map. Formation described in eastern sequence in Green Mountain anticlinorium near Rochester and East Middlebury. Overlies Pinney Hollow formation; underlies Stowe formation (new). Approximate thickness ranges from 1,800 to 2,500 feet.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 42 (table 2), 50–51. Formation, in Rutland area, overlies Pinney Hollow formation and underlies "Bethel" formation [schist] (Richardson, 1924). Thickness about 3,500 feet.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. In Montpelier quadrangle, overlies and intergrades with Camels Hump group (new); underlies Stowe formation.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. In Hyde Park quadrangle, overlies Belvidere Mountain amphibolite of Camels Hump group.

Type exposures: On Ottauquechee River in Bridgewater, Windsor County.

Ottawa Limestone [1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth, 1894, Kansas Univ. Court., v. 2, p. 121–122, 124.

Quarried at Ottawa, Franklin County.

Otter Formation (in Big Snowy Group)

Otter Shale Member (of Quadrant Formation)[1]

Upper Mississippian: Central and eastern Montana.

Original reference: W. H. Weed, 1892, Geol. Soc. America Bull., v. 3, p. 307.

H. W. Scott, 1935, Geol. Soc. America Proc. 1934, p. 367; 1935, Jour. Geology, v. 43, no. 8, pt. 2, p. 1027–1028. Included in Big Snowy group (new).

E. S. Perry, 1937, Montana Bur. Mines and Geology Mem. 3, p. 16. In type locality, Big Snowy group comprises (ascending) Kibbey, Otter, and Heath formations. The Otter, about 600 feet thick, consists of gray to vivid green shale with some anhydrite and gypsum, and thin beds of limestone and sandstone.

L. R. Laudon, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 210. Kibbey, Heath, Otter, and Amsden are believed to represent shore facies of various parts of early Pennsylvanian seas.

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 333 (fig. 2), 334 (fig. 3), 340–341, 346–347. Thickness 374 feet in composite standard section for revised Big Snowy group. Otter is used in this report as defined and delimited by Scott (1935).

Named for exposures along Otter Creek in Little Belt Mountains.

Otter Creek Granite[1]

Precambrian: South-central Wisconsin.

Original reference: J. T. Stark, 1932, Jour. Geology, v. 40, no. 2, p. 120, 121, 133.

Crops out on both sides of Otter Creek, Sumpter Township, SE¼ sec. 32 and SW¼ sec. 33, T. 10 N., R. 6 E., a short distance north of old Myers mill, Baraboo district.

Otter Creek Sandstone Member (of Cloverly Formation)

[Cretaceous]: Wyoming.

Arthur Mirsky, 1960, Dissert. Abs., v. 21, no. 4, p. 850, 851. White sandstone that forms lower part of Cloverly. Underlies unit referred to as mudstone member of Cloverly. Contact between Otter Creek member of Cloverly and Morrison formation appears to represent hiatus, but does not necessarily represent Jurassic-Cretaceous boundary.

Area of report is southern Big Horn Mountains.

Otterdale Sandstone (in Newark Group)[1]

Upper Triassic: Eastern Virginia.

Original reference: N. S. Shaler and J. B. Woodworth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 435–436.

W. T. Parrott and R. S. Young, 1960, Virginia Acad. Sci. Geol. Field Trip, May 14, geol. map. Shown on map legend above Vinita sandstones and shales and below diabase dikes.

Well exposed north, south, and west of Otterdale, Chesterfield County.

Otterville Member (of Golf Course Formation)

Otterville Limestone Member (of Dornick Hills Formation)[1]

Pennsylvanian (Morrow Series): Central southern Oklahoma.

Original reference: W. L. Goldston, Jr., 1922, Am. Assoc. Petroleum Geologists Bull., v. 6, p. 8.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 138, 139. Reallocated to member status in Golf Course formation (new). Best developed at West Velma, in Harrisburg trough, where it is about 870 feet thick and consists of dark gray generally calcareous and carbonaceous shale, or silty very fine sandy carbonaceous marly shale to marl, and argillaceous fine-grained calcareous sandstone to fine sandy fossiliferous limestone. Member may contain oolitic limestone with typical Morrow ostracods, brachiopods, and Bryozoa. Overlies Limestone Gap shale member; underlies Bostwick member of Lake Murray formation (new).

C. W. Tomlinson and William McBee, 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 20–21. Member of Golf Course formation. Includes 25 feet or more of limestone. Along southwest limb of Caddo anticline, northwest of Lake Ardmore, it is single resistant unit. Elsewhere it comprises two to four separate ledges with intervening tan shales occupying 100 to 400 feet of stratigraphic section. South of Ardmore, about 800 feet of black shale with sideritic layers intervene between underlying Jolliff conglomerates and Otterville limestone. Above Otterville are 100 to 500 feet of light-colored shale with a few ledges of thin calcareous sandstone and sandy limestone, which become conglomeratic southward. Otterville member was named by Goldston (1922) from village of that name not now in existence but shown on early maps in NW¼SW¼ sec. 3, T. 3 S., R. 1 W. Roth (1937, personal commun.) discovered fusulinids in limestone which Goldston had mapped as Otterville at that locality. These fusulinds proved limestone to be younger (possibly as young as Lester) than those mapped as Otterville elsewhere through Ardmore basin, including both localities from which Girty and Roundy (1923, Am. Assoc. Petroleum Geologists Bull., v. 7, no. 4) made their collections of prolific Otterville fauna. Name Otterville is here retained

for those limestone from which these collections came and not for one vanished village of Otterville. New type locality suggested for redefined Otterville.

Type locality: Girty and Roundy's (1923, p. 343) Station 4062, 250 feet southwest of NE cor. sec. 6, T. 6 S., R. 2 E., Love County, together with adjacent exposure 650 feet south of that corner in draw at east side of road in sec. 5. Named from village of Otterville.

Ottosee Shale or Limestone

Ottosee Shale or Limestone (in Blount Group)[1]

Middle Ordovician: Eastern Tennessee, northwestern Georgia, and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 453, 538, 539, 551, 555, 556, 557, pl. 27.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 170–178. Ottosee included in Blount group. Normally, Ottosee is limited below by Tellico sandstone and above by Lowville-Moccasin (Bays) limestone, but in Virginia Ottosee is bounded below by Athens shale in Rich Valley and generally southeast of Clinch Mountain, by Holston limestone in the two belts next northwest of Clinch Mountain, and by Lenoir limestone still farther northwest, as in Rye Cove, Scott County, and at south base of Big A Mountain in Russell County. Thickness 100 to 595 feet. Underlies Lowville-Moccasin limestone of Black River group.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, southwestern Virginia, is subdivided into 29 distinctive zones grouped into eight formations. Study has revealed inconsistencies in use of names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. In proposed revised nomenclature, Cliffield formation (new) includes beds which Butts (1940) has called Murfreesboro, Mosheim, Lenoir, Holston, and Ottosee.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1182–1183. Discussion of lower Middle Ordovician of southwest Virginia and northeast Tennessee. Measured sections compared with revised classification of Tazewell County, Va. Term Ottosee should be discontinued as definite formational name.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 27, 29. Geographically extended into northwestern Georgia where it is included in Blount group. Referred to as Ottosee (Sevier) shale. Overlies Holston marble.

John Rodgers, 1952, Geology of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map [GQ–19]. Ottosee shale in Athens quadrangle was formerly called Sevier shale, but typical Sevier appears to be of different age. Lower part of formation contains "marble" lenses. Upper part of member contains layers of red, semicrystalline and crystalline limestone, some of them quartzose, interbedded with layers of shale. Thickness about 1,000 feet. Overlies Holston limestone. Middle Ordovician.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 68–76, pls. Rocks in belt between Saltville fault and Knoxville and Rocky Valley faults divided into (ascending) Lenoir and Holston formations, Ottosee shale, and Bays formation. This sequence is here considered as standard

of reference, and the belt is referred to as standard belt. In this belt, the Ottosee consists of blue yellow-weathering limy shale and slabby siltstone, with lenses of crystalline limestone ("marble") some of which are mappable. Near base of formation are beds of shaly and sandy limestone packed with bryozoans; these beds grade down into red quartz-bearing lime-sandstone, all interbedded with calcareous shale. Thickness about 1,000 feet in standard belt.

B. N. Cooper, 1953, Geol. Soc. America Mem. 55, p. 4. Discussion of trilobites of Appalachian Valley. Ottosee formation as previously recognized in southwestern Virginia and eastern Tennessee, is facies of limestone which ranges as low as Lincolnshire limestone and as high as middle Black River.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16) mapped as Sevier shale rocks in Shooks Gap quadrangle herein called Ottosee. Thickness about 1,850 feet. Overlies Chapman Ridge sandstone (new). Underlies Bays formation. Name Chapman Ridge applied to strata formerly called Tellico.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145. Believed that Rodgers' introduction of terms Ottosee shale and Holston formation and continued use of Athens shale give these terms time-stratigraphic rather than rock-unit status. Sevier formation is used in present report in preference to Ottosee shale as used by Rodgers.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

J. M. Cattermole, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–126. Strata identified as Ottosee in this report [Bearden quadrangle, Tennessee] were mapped by Keith (1896, U.S. Geol. Survey Geol. Atlas, Folio 25) as Sevier shale in Middle Ordovician belts south of Saltville fault, as Chickamauga limestone and Sevier shale in belt around Dead Horse Lake, and as Chickamauga limestone north of Beaver Valley fault. Thickness about 1,100 feet. Underlies Moccasin formation; main body of Ottosee overlies and interfingers with Chapman Ridge sandstone; lower tongue of Ottosee underlies the Chapman Ridge.

Named for exposures at Ottosee Lake, in park at Knoxville, Tenn.

Ottumwan Epoch[1] or Series[1]

Pleistocene (Kansan and Yarmouthian) : Iowa and Illinois.

Original reference: G. F. Kay, 1931, Geol. Soc. America Bull., v. 42, no. 1, p. 449–452.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 38. In Iowa and Illinois, Pleistocene is classed as a Period (System) and four Epochs (Series) are used to include glacial-interglacial pair each. These are Grandian (Nebraskan and Aftonian), Ottumwan (Kansan and Yarmouthian), Centralian (Illinoian and Sangamonian), and Eldoran (Wisconsinan and Recent). Of these units, each of the first three essentially coincides with a glacial cycle; present data indicate that the youngest (Eldoran) includes two distinct cycles, each of which is complex within itself. These terms have not been adopted for official use in Kansas partly because of this inconsistency and partly because retention of Quaternary as System-Period with Pleistocene as its contained Series-Epoch would necessitate erection of new category of names to include these terms and thus produce further complication of classification system.

Named for Ottumwa, Iowa, where both Kansan and Yarmouth stages are well developed.

†Ouachita Shale[1]

Lower and Middle Ordovician: Southwestern Arkansas.

Original reference: A. H. Purdue, 1909, Slates of Arkansas: Arkansas Geol. Survey, p. 30, 33.

Named for Ouachita Mountains.

Oumalik Formation

Lower Cretaceous: Northern Alaska (subsurface).

F. M. Robinson, F. P. Rucker, and H. R. Bergquist *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 223, 225–229, figs. 2, 6. Divided into two units in type section: upper shale unit, 4,410 feet thick; and lower sandy shale, 1,610 feet thick. Upper unit is monotonous section of clay shale, medium dark gray to dark gray, slightly micaceous, carbonaceous, and pyritic. Lower unit made up of 40 percent siltstone and sandstone, in addition to clay shale of type found in unit above. Contact between upper and lower units is gradational but is placed at top of first sandstone of appreciable thickness. Sandstone and siltstone are medium light gray, hard, massive, silty, and very fine to fine grained. Formation approximately 6,000 feet thick, thins rapidly northward. Gradational into overlying Topagoruk formation in vicinity of type locality, angular unconformity between two formations in other areas. Overlies Lower Cretaceous(?) and Upper Jurassic(?) rocks undifferentiated.

Type locality: From 4,860 to 10,880 feet in Oumalik test well No. 1, on Oumalik anticline about 100 miles south of Barrow, Alaska, lat 69°50′18″ N., long 155°59′24″ W.

Ouray Limestone[1]

Upper Devonian: Southwestern Colorado, eastern Arizona, and southeastern Utah.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60, p. 8.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 489. On Pinal Creek, north of Globe, Ariz., lower Ouray limestone, 54 feet thick, overlies Martin limestone and underlies Escabrosa limestone. Devonian.

W. S. Burbank, 1941, U.S. Geol. Survey Bull. 906–E, p. 194, 196 (chart). In Uncompahgre district, term Ouray limestone is restricted to dolomitic limestone beds of Devonian age. Thickness 65 to 70 feet. Underlies Leadville limestone, name introduced in this area for beds containing Mississippian fossils; overlies Elbert formation.

J. C. Cooper, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 63. Thickness 0 to 238 feet in Four Corners area. Consists of massive dense argillaceous limestone, ranging from buff, tan, cream to gray in color, with some thin streaks of waxy gray-green clayey shales. In Utah, limestone is locally slightly sandy and in places basal part carries sandstone. Brachiopod and crinoid fragments occur in some wells. Unconformably underlies Mississippian Madison formation; overlies Elbert formation, probable unconformity.

R. L. Knight and D. L. Baars, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2275–2283. Ouray limestone extends from surface in San Juan Mountains of Colorado into subsurface of much of Colorado Plateau province. Since typical Ouray limestone fauna has both Mississippian and Devonian aspects and formation contacts are gradational, it is suggested that unit is transitional between Upper Devonian, Elbert formation, and Lower Mississippian, Leadville limestone.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 87. Ouray formation of current usage is restricted to extreme northwestern part of area. For purposes of this paper [southern and western San Juan basin], it has been included in Leadville formation.

Named for prominent occurrence in vicinity of Ouray, Ouray County, Colo., at junction of Canon Creek with Uncompaghre River.

Oursan Sandstone (in Monterey Group)[1]

Miocene, middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. E. Weaver, 1949, Geol. Soc. America Mem. 39, p. 17 (table 3), 69 (table 14), 70, pl. 12. Described in Coast Ranges immediately north of San Francisco Bay area. Fine-grained light-gray tuffaceous sandstone; marine. Thickness about 400 feet. Lies conformably upon Claremont shale and beneath Tice shale; dips northward at low angles. Where exposed in axis of Rodeo anticline is overridden by shales of Chico formation along thrust fault. South of San Pablo Bay passes unconformably beneath Pleistocene terrace deposits.

C. A. Hall, Jr., 1958, California Univ. Pubs., Geol. Sci., v. 34, no. 1, p. 18–19, fig. 2, geol. map. Oursan sandstone, in Pleasanton area, Alameda and Contra Costa Counties, is 250 to 500 feet thick. Overlies Claremont shale; underlies Tice shale. Term Monterey group not considered appropriate in this area.

Named for exposures on Oursan Ridge, Concord quadrangle, Contra Costa County.

Outer Conglomerate (in Copper Harbor Group)[1]

Outer Conglomerate (in Oronto Group)

Precambrian: Northern Michigan and Wisconsin.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 186, pls. 17, 18.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1472, 1474. Basal unit of Oronto group. Underlies Nonesuch shale. Thickness about 1,200 feet.

Named for fact that at Keweenaw Point, Mich., it is the outer conglomerate, the supposedly thicker Greater conglomerate, being the inner conglomerate.

Outer Brass Limestone (in Virgin Island Group)

Upper Cretaceous: Virgin Islands.

T. W. Donnelley, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Thin-bedded graphitic silicified radiolarian limestone, with small amount of tuffaceous material. Thickness 200 to 600 feet. Overlies Louisenhoj formation and un-

derlies Tutu formation (both new). Virgin Island group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Outerson Basalts or Series

Pliocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 705, 706, 709 (fig. 2), 713 (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig 2), 1617–1618, 1627, 1633. High Cascade volcanic rocks consist of at least four structurally distinct series separated by pronounced erosional unconformities In chronological order: Outerson series, Minto lavas, and two probably nearly equivalent series, Olallie lavas, and Santiam basalts. Outerson series consists chiefly of basaltic lavas with minor tuffs and lapilli beds with steeply dipping bedded agglomerates in lower parts. Thickness as much as 3,000 feet. Where Outerson accumulations were high, Minto lavas flowed around them; where Outerson deposits were thinner, Minto lavas overrode them. Rest with marked unconformity on Breitenbush series (new).

Named for occurrence in vicinity of Outerson Mountain, Marion County.

Outlaw Formation

Lower Cretaceous: Southeastern Arizona.

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1217. Discussion of sequence of rocks in Chiricahua National Monument. Chiricahua limestone is succeeded by thick section of Lower Cretaceous Bisbee group with recognizable Glance conglomerate at base, and in turn, by section of what appears to be Morita formation. This sequence of Lower Cretaceous rocks is apparently similar to Outlaw formation (Raydon, unpub. thesis) described from area east of Paradise. Above Bisbee group is a 300-foot sequence of red beds and associated tuff named Bonita Park formation (Waller, unpub. thesis).

Described from area east of Paradise, Cochise County.

Outlet Tunnel Quartz Latite[1] (in Alboroto Group)

Miocene: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 93 (table 18). Alboroto rhyolite described in San Juan district. Lower part consists of tridymite rhyolite which includes Campbell Mountain and Willow Creek rhyolites and probably Outlet Tunnel quartz latite [all included in Alboroto group] of Creede district.

Named for development at Outlet tunnel, Creede district.

Oveja formation (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Consists of sandstone, massively bedded in middle, but more or less shaly towards bottom and top of section. Thickness 175 feet. Underlies Solitude limestone (new); unconformably overlies Final shales (new).

Named from longitudinal ridge that separates Colorado River Canyon from Chuar Valley, must below mouth of Little Colorado River, Grand Canyon region.

Overall Limestone Member (of Admiral Formation)

Permian (Wolfcamp Series) : North-central Texas.

R. C. Moore, 1947, *in* A. K. Miller and Walter Youngquist, Kansas Paleont. Contr. 2, Mollusca, art. 1, p. 1 (footnote). Incidental mention.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Limestone was called "Bed No. 5" by Drake (1893, Texas Geol. Survey 4th Ann. Rept., pt. 1) and included at top of Fisk formation by Cheney (1940). Comprises normally two or more subdivisions of gray limestone weathering yellowish brown, each a few feet thick, separated by thin shale. Thickness 20 to 40 feet; average near Colorado River about 30 feet. Overlies Wildcat Creek shale member; underlies Jim Ned shale member of Belle Plains formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 272. Moore (1949) divided Admiral into four members in Colorado River drainage area. In Brazos River drainage area, the Admiral cannot easily be distinguished from underlying Putnam and overlying Belle Plains formations.

Named for exposures near Overall switch on Gulf Coast and Santa Fe Railway, about 4 miles east of Valera, Coleman County.

†Overbrook Granite Gneiss[1]

Precambrian : Southeastern Pennsylvania and Maryland.

Original reference: F. Bascom, 1904, Am. Jour. Sci., 4th, v. 17, p. 143.

Occurs at and around Overbrook, Philadelphia region, Pa.

Overbrook Sandstone (in Springer Group)

Overbrook Sandstone Member (of Springer Formation)[1]

Lower Pennsylvanian: Central southern Oklahoma (subsurface and surface).

Original reference (subsurface) : R. Roth, 1928, Econ. Geology, v. 23, p. 45, 53.

C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 46, p. 17. Surface outcrop noted. Derivation of name given.

R. C. Moore and others, 1944, Geol. Soc. America Bull. v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as Overbrook sandstone; here Springer is considered a group. Lower Pennsylvanian.

C. W. Tomlinson and William McBee, 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 11. Overbrook sandstone is 800 to 1,000 feet above Rod Club sandstone. Thickness 45 to 105 feet. Typically medium fine grained, white and massive, varying to slabby or thin bedded, some outcrops devoid of shale partings. From 500 to 700 feet below Lake Ardmore formation (redefined). Springer group.

Named for outcrop across middle of N½ sec. 6, T. 6 S., R. 2 E., half a mile east of Overbrook, at north edge of Love County.

Overland Mountain Granite (in Pikes Peak Group)

Precambrian : North-central Colorado.

J. M. Bray, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 768 (fig. 1), 770. Overland Mountain granite, classed by Lovering and Goddard (1939, Geologic map of the Front Range mineral belt, Colorado: U.S. Geol. Survey) is here given local name, following Goddard's original idea (U.S. Geol. Survey, unpub. rept.). Younger member of Pikes Peak group. Gneissic border closely resembles Boulder Creek granite. The rock, very coarse grained, feldspathic, and containing microline phenocrysts in coarse

groundmass of andesine, quartz, and biotite, is like a fine-grained pegmatite.

In Jamestown district, central Boulder County, 35 miles northwest of Denver.

Overton Fanglomerate[1]

Cretaceous(?) or Tertiary(?): Southeastern Nevada.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th, v. 1, p. 52; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 931, 933–935, table 1. Stratigraphically restricted to exclude about 3,800 feet of coarse conglomerate, clays, and sandstones at base of unit in northern Muddy Mountains, Nev., now dated as Cretaceous and put in Willow Tank formation (new) and Baseline sandstone (new). Consists of extremely coarse fan debris with some interbedded lenses of silt. Deposition of coarse Overton debris followed violent disturbance of the stratigraphic section by an overriding thrust plate. Thickness ranges from 20 to 3,000 feet. Overlies Baseline sandstone with angular unconformity; underlies Horse Spring formation. Age shown on table as Late Cretaceous or Early Cenozoic.

Exposures indicate deposit once covered practically every part of Muddy Mountains area, Clark County.

Ovid Formation or Limestone

Upper Cambrian: Southeastern Idaho and central northern Utah.

C. D. Walcott, 1925, Smithsonian Misc. Colln., v. 74, no. 3, p. 96, 104, 105. Ovid formation mentioned in description of fossil locality in Oneida County, Idaho.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 25. Limestone is the Mons limestone equivalent which has been removed from St. Charles formation, Wasatch Range, Utah.

On north side of Two Mile Canyon, 2 miles southeast of Malad, Oneida County, Idaho.

Owasco Member[1] (of Ludlowville Formation)

Middle Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 11, 50.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Uppermost member of Ludlowville; overlies Spafford member; underlies Portland Point limestone.

Probably named for outcrops on west side of Owasco Lake valley in Edgewater Ravine at a level about 200 feet above Owasco Lake and just below new cement road, Skaneateles quadrangle.

Owego shale member (of Cayuta monothem)

Upper Devonian: Pennsylvania.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 47. Member of Cayuta monothem. Thickness about 112 feet. Below Starruca [Starrucca] shale member and above Cascade Creek sandstone member.

Type locality and derivation of name not given.

Owen Limestone Member (of Lime Creek Formation)

Owen Substage or Beds[1]

Upper Devonian: Central northern Iowa.

Original reference: W. H. Norton, 1897, Iowa Geol. Survey, v. 6, p. 148.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182 (fig. 1), 187. Uppermost member of Lime Creek formation. Overlies Cerro Gordo member. Consists of dolomitic fossiliferous limestone about 40 feet thick.

Named for exposures on Owen Creek, Cerro Gordo County.

Owens Valley Formation

Permian: Eastern California.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4 (table 1), 6 (table 2), 7–12. Name proposed for highly diverse marine strata of Permian age which occupy large area on western slope of Inyo Mountains near Owens Valley border. Comprises interbedded silty and sandy limestone, fairly pure biogenic limestone, argillaceous shale, siltstone, sandstone, and conglomerate. In areas of plutonic intrusion, formation has been altered to argillite, minor quartzite, and calc-hornfels. Rocks previously classified as Diamond Peak quartzite (Kirk, 1918) are in considerable part considered altered middle and lower Owens Valley. Diamond Peak formation, and Upper Mississippian unit in central Nevada (Nolan and others, 1956) has not been traced into Inyo Mountains. Includes Reward conglomerate member (near top) and Owenyo limestone member. Thickness at type locality about 1,800 feet; in Darwin quadrangle, thickness may increase to about 3,000 feet. Formation folded and faulted. Rests with angular unconformity upon Keeler Canyon formation (new); underlies beds of early Triassic age.

W. E. Hall and E. M. MacKevett, 1958, California Div. Mines Spec. Rept. 51, p. 7 (table 1), 10–11, pl. 2. Described in Darwin quadrangle where it is about 3,200 feet thick and consists of three unnamed members: lower limestone, middle shale, and upper limestone-conglomerate member. Overlies Keeler Canyon formation; underlies Cretaceous quartz monzonite.

Type locality: In foothills between Union Wash and Reward mine, about 9 miles southeast of Independence, between Owenyo and Kearsarge, southern Inyo Mountains.

Owenyo Limestone Member (of Owens Valley Formation)

Owenyo Limestone[1]

Permian: Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 8, 10. Reduced to member status in Owens Valley formation (new).

Named for exposures about 3½ miles north of Owenyo Station on Southern Pacific, between Union Wash and Reward mine, Inyo Mountains.

Owl Canyon Formation (in Cassa Group)

Permian: Northeastern Colorado, southwestern South Dakota, and eastern Wyoming.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 5, 6–7, 19, 45. To the south, formation consists of red shales and sands which grade northward into red sands and some shale. Thickness 90 to 275 feet. Comprises that part of Cassa group (new) below Lyons sandstone.

Type locality: Lower part of Owl Canyon, NW¼ sec. 1, T. 9 N., R. 70 W., Larimer County, Colo.

Owl Creek Formation[1] (in Selma Group)

Owl Creek Sandy Clay Member or Tongue (of Ripley Formation)

Upper Cretaceous: Northeastern Mississippi, southeastern Missouri, and southwestern Tennessee.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric. Rept., p. 79, 84–91, 102.

Willard Farrar and Lyle McManamy, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., App. 6, p. 17, 21. Geographically extended into Stoddard County, southeastern Missouri, where it is referred to as Owl Creek sandy clay member or tongue of Ripley formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Assigned to Selma group.

L. W. Stephenson, 1955, U.S. Geol. Survey Prof. Paper 274–E, p. 97–137. Formation, in Crowleys Ridge area, Missouri, consists of 11 feet of clay and sand. Unconformably overlies McNairy sand; unconformably underlies Clayton formation. Fossils described.

C. W. Wilson, Jr., 1958, Tennessee Div. Geology Rept. Inv. 5, p. 4 (fig. 3). Chart of Cretaceous, Tertiary, and Quaternary strata of west Tennessee refers to Owl Creek tongue of Ripley formation.

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 4, 5, 22–25. Formation described in Tennessee and Mississippi where it consists characteristically of dark silty sand and subordinate amounts of clay, which are glauconitic, micaceous, and highly fossiliferous. Thickness commonly 30 to 40 feet; thickest in southern area of outcrop where it merges into Prairie Bluff chalk. In Hardeman County, Tenn., formation is overlapped by Midway group; southward along outcrop belt, it can be traced until it interfingers with Prairie Bluff chalk in Pontotoc County, Miss. Owl Creek lies within bounds of *Exogyra costata* zone; it is unconformably overlain by Clayton formation and lies with unconformity on Ripley formation. In some areas, overlies NcNairy sand member of Ripley and in other areas Keownville limestone member (new) of Ripley.

Named for exposures on Owl Creek, 3 miles northeast of Ripley, Tippah County, Miss.

Owl Mountain Glacial Substage

Owl Mountain Till

Pleistocene (pre-Wisconsin): North-central Colorado.

D. F. Eschman, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1380. Time of earliest of four glacial advances in area. Represented by deeply weathered till of patchy distribution, for most part found in front of mountains or high on valley walls. Preceded Gould glacial advance.

D. F. Eschman, 1955, Jour. Geology, v. 63, no. 3, p. 201–203, fig. 2. Deposits of substage mapped as Owl Mountain till. Till weathered and stained with limonite from top to bottom. In many places on surface of deposits, there is a scattering of weathered erratics which range to 8 feet in diameter.

Deposits found on northeast flank of Owl Mountain, and in several other areas of Michigan River basin, North Park.

Owl Rock Member (of Chinle Formation)

Upper Triassic: Northeastern Arizona, west-central New Mexico, and southeastern Utah.

G. A. Kiersch, 1955, Mineral resources, Navajo-Hopi Reservations, Arizona-Utah, v. 2: Tucson, Univ. Arizona Press, p. 4 (fig. 1), 5. Comprises alternating beds of siliceous limestones and siltstones. Overlies Petrified Forest member.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 458. Pale-red and pale-reddish-brown structureless siltstone interstratified with thin to thick beds of limestone. Thickness as much as 450 feet; commonly 150 to 250 feet. Conformably overlies Petrified Forest member, or Moss Back member where Petrified Forest is absent. Conformably underlies Church Rock member or disconformably underlies Wingate sandstone in places where Church Rock member is absent. Intertongues with overlying Church Rock member and absence of member in San Rafael Swell and Moab areas is probably due to lateral replacement of Owl Rock member by Church Rock member. Corresponds to Division B of Chinle formation described by Gregory (1917, U.S. Geol. Survey Prof. Paper 93) Name credited to I. J. Witkind and Rex. E. Thaden.

J. P. Akers, M. E. Cooley, and C. A. Repenning, 1958, New Mexico Geol. Soc. Guidebook 9th Field Conf., p. 93–94. At type section, consists of 131 feet of interbedded limestone and calcareous siltstone. Limestone is mottled pale blue and grayish pink and contains chert nodules and mud pellets; locally silty; bedding within siltstone is irregular and lenticular. Extends over entire Navajo country. About 300 feet thick along southwest-trending line between Round Rock and Castle Butte; thins northwestward and southeastward from this line.

Type section: Owl Rock in Monument Valley, Navajo County, Ariz.

Owls Head Granite[1]

Middle or Upper Devonian (?): West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 26, 34, Moosilauke map.

L. R. Page, 1940, Geologic map and structure sections of the Rumney quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Upper Devonian(?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 48. Included in Oliverian plutonic series of Middle or Upper Devonian(?) age.

Occurs on and around Owls Head Cliff in southwestern corner of Moosilauke quadrangle.

Owyhee Basalt[1]

Miocene: Southeastern Oregon.

Original references: K. Bryan, 1929, U.S. Geol. Survey Water-Supply Paper 597–A; B. C. Renick, 1930, Jour. Geology, v. 38, p. 494.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Bros., Inc., p. 108. Maximum thickness about 1,500 feet. Unconformably overlies Payette tuffs and rhyolites; unconformably underlies Pinnacle Point beds (new), tentatively considered to be late Miocene.

Named for occurrence in bluffs along lower part of Owyhee River, in Malheur County.

Owyhee Rhyolite[1]

Tertiary-Quaternary: Southwestern Idaho.

Original reference: V. R. D. Kirkham, 1931, Jour. Geology, v. 39, no. 6, p. 579.

C. N. Savage, 1958, Idaho Bur. Mines and Geology County Rept. 3, p. 21 (table 1), 24–25, 35, 49 (table 2). Unconformably overlies Payette formation.

Well exposed in Owyhee County.

Oxbow Dolomite (in Bertie Group)

Upper Silurian (Murderian) : Central New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Overlies Forge Hollow shale; underlies unnamed dolomite. Name credited to L. V. Rickard, Fieldwork has not demonstrated lateral continuity of Williamsville and Oxbow as shown on present chart. Thick glacial deposits conceal these units in area where they may merge. For present, distinct names are used in western and central New York.

Type locality and derivation of name not given.

Oxbow Creek Basalt

Miocene and (or) Pliocene : Northwestern Wyoming.

A. D. Howard, 1937, Geol. Soc. America Special Paper 6, p. 77–79. Olivine basalt. Thickness from 15 to 20 feet where Tower Falls road passes through cut on west side of Oxbow Creek valley, about 0.7 miles west of stream crossing. Terminates everywhere in scarp, from 15 to 20 feet high.

An exposure of basalt 4 miles long and one-half mile wide, which forms gentle, northwestward-sloping surface west of Oxbow Creek, Yellowstone National Park.

Oxbow Mountain Rhyolite

Precambrian : East-central Arizona.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 1), 1506. Grayish-white welded rhyolite tuff. Consists of coarse phenoclasts and welded glass shards. Over 1,250 feet thick. Overlies Haigler formation (new). Name given on table to Oxbow Mountain rhyolite but unit described in text as rhyolite of Oxbow Mountain.

Best exposures on southwest corner of Oxbow Mountain, in northeastern corner of Diamond Butte quadrangle.

†Oxford Gneiss[1] or type[1]

Precambrian : Northern New Jersey.

Original reference: F. L. Nason, 1889, New Jersey Geol. Survey Ann. Rept. 1889, p. 30.

Occurs in Van Nest Gap Tunnel of Delaware, Lackawanna & Western Railroad at Oxford Furnace, Warren County.

Oxford Gravel[1]

Pleistocene : Southwestern Colorado.

Original reference: W. W. Atwood and K. F. Mather, 1932, U.S. Geol. Survey Prof. Paper 166.

Covers lowlands surrounding village of Oxford, La Plata County.

Oxford Member (of Whitewater Formation)

Ordovician (Richmond) : Southwestern Ohio.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110, 114, chart facing p. 108. Listed on page 110 as member of Whitewater; sequence (ascending) Weisburg, Saluda, Oxford. Stratigraphic chart and page 114 shows Whitewater sequence (ascending) Lower Whitewater, Saluda, Upper Whitewater.

Type locality and derivation of name not given.

Oxford Schist[1]

Carboniferous : Eastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 60–68, map.

Named for town of Oxford, Worcester County.

†Oxmoor Sandstone and Shales[1]

Mississippian: Northern Alabama.

Original reference: E. A. Smith, 1880, Alabama Geol. Survey Rept. on Cahaba coal field, p. 155–157, p. 162, map, section.

Named for Oxmoor, Jefferson County.

Ox Valley Tuff

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 45, maps 1 and 2. Lightly to moderately or highly welded rhyolitic vitric-crystal tuff about 400 feet thick in thickest measured section. Light grayish blue to pink or purple. Lies above Cove Mountain formation (new). Underlies unit referred to as "Muddy Creek" formation. Name credited to H. R. Blank (unpub. thesis).

Ox Valley is in Bull Valley district, Washington County.

Oxyoke Canyon Sandstone Member (of Nevada Formation)

Lower and Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 43, pl. 2. Consists mainly of light-olive-gray thick-bedded sandstone or quartzite that commonly weathers to shades of brown. Beds are commonly several feet thick and many of them exhibit crossbedding. There are a few beds of Beacon Peak member type dolomite in lower part of member and more abundant thicker beds of a coarsely granular dolomite in upper part. Ranges in thickness from 430 to 450 feet. Gradational contacts with underlying Beacon Peak dolomite member (new) and overlying Sentinel Mountain dolomite member (new).

Type section: In canyon along southwest slope of Beacon Peak where old wood road along bottom of canyon provides excellent exposures. Name taken from Oxyoke Canyon where member is exposed in several fault blocks, vicinity of Eureka.

Oyster Ridge Sandstone Member (of Frontier Formation)[1]

Upper Cretaceous: Southwestern Wyoming and northeastern Utah.

Original reference: A. C. Veatch, 1906, U.S. Geol. Survey Bull. 285, pl. 12.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped in upper part of Frontier formation.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 140, 141. Overlies Allan Hollow shale member (new); unconformably underlies Dry Hollow member (new). Basal Oyster Ridge is 45 to 80 feet thick with 150 to 200 feet of interbedded green to brown shale and sandstone comprising upper part of member.

Forms Oyster Ridge, Uinta County, Wyo.

Ozan Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas and southeastern Oklahoma.

Original reference: C. H. Dane, 1926, U.S. Geol. Survey Press Bull. 8823, Sept. 10, 1926.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in southeastern Oklahoma.

Named for exposures along middle fork of Ozan Creek and for town of Ozan, Hempstead County, Ark.

†Ozark Group[1]

Mississippian : Mississippi Valley region.

Original reference : H. S. Williams, 1922, Pan-Am. Geologist, v. 37, no. 1, p. 36–40.

Named for prominent development of formations constituting group on southern and western margins of Ozark uplift.

†Ozark Marble[1]

Upper Cambrian : Southeastern Missouri.

Original reference : G. C. Broadhead, 1889, Am. Geologist, v. 3, p. 7–8.

Named for Ozark uplift.

†Ozark Sands[1]

Pleistocene : Southern Alabama.

Original reference : E. A. Smith, 1892, Sketch of geology of Alabama : Birmingham, Ala., Roberts and Son, pamph. of 36 pp.

Cover 2,000 square miles in Henry, Dale, Geneva, Covington, Escambia, Mobile, and Baldwin Counties. Derivation of name not stated but probably suggested by presence of sands at Ozark, Dale County.

Ozark Sandstone[1]

Pennsylvanian : Western Arkansas.

Original reference : A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Ozark, Franklin County.

†Ozark Series[1]

Upper Cambrian and Lower Ordovician : Southeastern Missouri.

Original reference : G. C. Broadhead, 1891, Am. Geologist, v. 8, p. 33.

Named for development of the rocks in Ozark Mountains.

†Ozarkian[1]

Pliocene and Quaternary : North America.

Original reference : O. H. Hershey, 1896, Science, new ser., v. 3, p. 620–622.

Ozarkian System[1] or Series

Cambrovician : Southern Appalachians and Mississippi regions.

Original reference : E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 627–647, pl. 27.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Paleocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines : Peiping, China, Univ. Press, Nat. Univ. Peking, p. 10–11, 12–14. Ulrich's definition of term Ozarkian, that is limited below by disconformity which separates it from Nolichucky or older formations, and above by base of Stonehenge limestone, is exact equivalent of Upper Cambrian as used in this report. Term Ozarkian is herein extended to cover entire transgressive series, that is, Upper Cambrian as well as Tremadoc equivalent or Stonehengian (new). Ozarkian series and overlying Shenandoan series (redefined) comprise Cambrovician in southern Appalachian region.

Earl McCracken, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 60–61. Two classifications of formations below the St. Peter have been used in Missouri. The one which disregards Ulrich's Ozarkian

and Canadian systems, places base of Ordovician at base of Gunter sandstone. The other classification, that of Ulrich, places those formations above the Gasconade and below the St. Peter-Everton in Canadian system and those formations below the Roubidoux and above the Derby-Doerun in the Ozarkian system. Whether the Lower Ordovician and Cambrian should be broken up to make the Ozarkian and Canadian as separate systems has been subject of controversy for many years. An area so small as Missouri should not be determining factor in this controversy. Ultimate correlation should be used on regional evidence. In Missouri, greatest break is at base of Roubidoux formation. Beneath the Roubidoux, the Upper Gasconade is entirely removed, and the Roubidoux rests on Lower Gasconade in parts of western Missouri. Recent work in Missouri, however, does not substantiate the regional break at the base of the Ozarkian.

Typical exposures occur in Ozark region of Missouri.

Ozaukee Formation[1]

Middle Devonian: Southwestern Wisconsin.

Original reference: E. R. Pohl, 1929, Pub. Mus. City Milwaukee Bull., v. 11, p. 7–8.

Ozaukee and Milwaukee Counties.

Ozaukee Member[1] (of Lake Church Formation)

Devonian: Southeastern Wisconsin.

Original reference: G. O. Raasch, 1935, Kansas Geol. Soc. Rept. 9th Ann. Field Conf., p. 260, 262, 263.

Named for Ozaukee County.

Ozawkie Limestone Member (of Deer Creek Limestone)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and northwestern Missouri.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans. [Am. Asoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 12.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii, 17. Columnar section shows Ozawkie limestone member at base of Deer Creek limestone. [Text does not discuss unit in Missouri.]

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 66. Consists of brownish-gray brown-weathering massive limestone. Fusulines and other marine fossils locally abundant. Commonly thickness is about 5 feet but ranges from about 1 to 20 feet. Underlies Oskaloosa shale member; overlies Tecumseh formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18, fig. 5. Identified only in quarry south of Pacific Junction, E½NW¼NW¼ sec. 15, T. 71 N., R. 43 W., Mills County. Here it is 0.4 foot of light-gray fine-grained limestone overlying 1½ feet of dark-gray arenaceous shale which in turn overlies buff sandy limestone bed about 1 foot thick. Where not recognized, the Ozwakie and overlying Oskaloosa shale member may be included in upper part of Tecumseh shale.

Type locality: In roadcut in NE¼ sec. 31, T. 9 S., R. 18 E., near Ozawkie, Jefferson County, Kans.

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Part 3, P-Z

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Paakea Basalt (in Hana Volcanic Series)

Pleistocene(?) : Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 251–252, pl. 1. Single aa flow; locally interflow clinker may indicate two flow units. Platy jointing rare; columnar jointing well developed. Sparsely vesicular with scattered phenocrysts of olivine in microcrystalline groundmass. Exposed thickness at mouth of Paakea Gulch approximately 150 feet; 1½ to 5 feet where tongues cross highway at Kapaula Gulch; 41 feet in test hole 12. Fills shallow valley cut in Kapaula lava (new). Each member of series is underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 102. Pleistocene(?).

Named for occurrence along Paakea Gulch. Flow entered area from southwest and divided into two branches which advanced to coast along valleys of Kapaula and Paakea, east Maui.

Pablo Formation

Permian(?) : South-central Nevada.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. Consists largely of greenstone and chert but contains small proportion of sedimentary rocks, chiefly slate and conglomerate. Contains also flows of felsitic lavas similar to intrusive Darrough felsite (new). Thickness probably exceeds 5,000 feet. Overlies Diablo formation; intrusive contact with Darrough felsite.

N. J. Silbering, 1959, U.S. Geol. Survey Prof. Paper 322, p. 6–10, pls. 10–11. Pablo formation is base of sequence in Union district, Shoshone Mountains, Nev. Three local members recognized. Lowest is coarse- and fine-grained sedimentary rocks interstratified with andesitic volcanic rocks; relatively thin limestone member; thick greenstone member composed of altered andesitic flows and volcanic breccia. Thickness about 2,450 to 3,450 feet. Base not exposed. Underlies Grantsville formation, little if any angular discordance.

Type locality: Pablo Creek, Toyabe [Toiyabe] Range.

Pabst Member (of Tyler Slate)[1]

Precambrian : Northwestern Michigan and northwestern Wisconsin.

Original reference: W. O. Hotchkiss, 1919, Eng. and Min. Jour., v. 108, p. 501–506.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Described from drill holes at Pence, Wis., as conglomerate and chert-carbonate rock. Thicknesses 16 feet and 30 feet.

Named for Pabst mine, east of Ironwood, Gogebic County, Mich.

Pacheco Group

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 130–132, pl. 2 [preprint 1941]. Upper Cretaceous of central Coast Ranges divided into Pacheco group, below, and Asuncion, above. The groups are separated by Santa Lucian orogeny. In Pacheco Pass quadrangle, group consists of 7,000 to 8,000 feet of gray sandy shales, sandstones, and conglomerates which are either vertical or dip eastward at high angles; beds extend both north and south of quadrangle as continuous belt and also occur west of belt on El Puerto Creek in western Stanislaus County. Less widely distributed in central Coast Ranges than Asuncion group, but reverse may be case in northern Coast Ranges. Overlies Shasta group; in southern part of Diablo Range, Pacheco beds rest on Franciscan; to the north, they rest on Paskenta; to the east of Priest Valley and Waltham Creek, Pacheco conglomerates, grading upward into sandstones and shales, rest unconformably on Paskenta, Knoxville, and Franciscan in turn.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 475–484. Name Jack Creek formation proposed as formational name for representative of Pacheco group in Santa Lucia Range.

F. M. Anderson, 1958, Geol. Soc. America Mem. 71, p. 15–30. Discussion of subdivisions of Pacific Coast Upper Cretaceous. Taliaferro's terms Pacheco and Asuncion groups used. Age of Pacheco ranges from latest Albian to close of Turonian time.

Named for development of beds in Pacheco Pass quadrangle especially on Quinto and Garzas Creeks.

Pacheta Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12, 14–15, pl. 27. Consists of following units (ascending): Lancha limestone (new), yellow dolomite, streaked and crossbedded sandstone with fragments of silicified trees, Tusonimo limestone (new), Cienda limestone (new), Black Knob dolomite (new), and Black Knob quartzite (new). Thickness 97 feet. Underlies Joserita member (new); overlies Morita formation.

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Pachuta Marl Member (of Yazoo Clay)

Eocene, upper: Eastern Mississippi and western Alabama.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1830 (fig. 6), 1839 (footnote). Pachuta (marl) member of Yazoo clay (or formation) proposed for 6 to 25 feet of buff, gray, or white, partly indurated generally glauconitic fossiliferous marl, overlain by Shubuta (clay) member (new) and underlain by Cocoa sand member or North Creek clay member (new).

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 122, 126, pl. 3. In Choctaw County, Ala., consists of yellow sandy hard limestone with prints of fossils and light-gray

almost white chalky marlstone irregularly indurated and containing white lime nodules; thins gradually from about 10 feet at Mississippi-Alabama line to about 5 feet in south-central part of county.

Type locality: Exposures on south side of Pachuta Creek, 1¼ miles south and southeast of Pachuta in SW¼ sec. 8, T. 2 N., R. 14 E., Clarke County, Miss.

Pacific muck

Pleistocene and Recent: Panamá.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 23–24. Series of low wave-cut benches and raised-beach or shallow-water bay deposits occurs at certain localities on Pacific side of Isthmus, above elevations attained by present tides. Locally similar to Atlantic Pleistocene deposits. Near city of Panamá, soft silt and clay-muck blanket covers underlying older agglomerates and tuffs. This layer deposited in late Pleistocene embayment and contains well-preserved fossils.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 341. Pleistocene. Informal name.

Pacific Quartz Latite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for outcrops near Pacific mine, in western part of Mogollon district.

†Pacific Sandstone[1]

Lower Ordovician: Central eastern Missouri.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 79.

Named for Pacific, Franklin County.

Packard Quartz Latite

Packard Rhyolite[1] or Rhyolite Series

Eocene, middle: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, map.

P. D. Proctor and others, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–45. Referred to as Packard quartz latite. Flows, tuffs, and breccias as much as 400 feet thick.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 30–32, pl. 1. Packard quartz latite subdivided into four units: basal tuff, a few inches to as much as 100 feet thick, locally absent; lower vitrophyre, a few feet to more than 700 feet thick, locally absent; massive quartz latite a few feet to more than 2,300 feet thick; and upper vitrophyre. Packard and Fernow quartz latites are apparently parts of same volcanic series which have been separated geographically by overlying latite volcanic rocks.

D. R. Cook, 1957, Utah Geol. Soc. Guidebook 12, p. 65 (fig. 6). As shown on chart, Packard rhyolite series underlies Laguna latite series (new) and overlies Humbug formation.

J. M. Foster, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 4, p. 35–36, pl. 4. Packard rhyolite series was followed by Laguna latite sequence.

Named for exposures on Packard Peak, Tintic district.

Packard Ranch Member (of Supai Formation)

Pennsylvanian: East-central Arizona.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 88, 89, figs. 2, 3. Arenaceous at type locality, becomes more calcareous eastward. Packard Ranch member of Oak Creek and Fossil Creek appears to intertongue with Naco formation to southeast. Underlies Oak Creek member (new) and overlies Naco formation.

Has optimum expression and development at Sycamore Canyon, and is recognizable both at Oak Creek Canyon and at Fossil Creek.

Pack Creek Substage

Pleistocene (Wisconsin): Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Section [Guidebook] 2d Ann. Field Trip, correlation chart. Substage of Pinedale stage. Occupies Cary-Mankato interval between Cary sub-age and Mankato sub-age.

Twin Lakes area.

†Packer Clay[1]

Pleistocene (late Illinoian): Southeastern Pennsylvania.

Original reference: E. H. Williams, Jr., 1894, Geol. Soc. America Bull., v. 5, p. 281–288.

Occurs between Easton and Topton divide and below level of 500 feet with exception of part of Saucon Valley west and south of Hellertown, Northampton County. Name derived from glacial lake named Packer.

Packsaddle Schist[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvii, lviii, 276–281, pl. 3.

V. E. Barnes, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. [1945] Intruded by Big Branch gneiss.

Virgil Barnes, Frederick Romberg, and W. A. Anderson, 1954, Internat. Geol. Cong., 19th, Algiers 1952, Comptes rendus, sec. 9, pt. 9, p. 152–153. Oldest Precambrian rocks in Llano uplift are most light colored, highly feldspathic metasediments, named Valley Spring gneiss, followed by dark-colored metasediments; including amphibolite, mica schist, graphite schist, and some marble, all of which are included in Packsaddle schist. These rocks are highly folded, and during folding it is believed the igneous rocks were intruded which were metamorphosed into Red Mountain gneiss and dioritic Big Branch gneiss. Date of intrusion of perioditic rocks, now serpentized into Coal Creek serpentine, in relation to Big Branch gneiss not satisfactorily determined. Town Mountain granite invaded the already deformed metasediments and was followed by Oatman Creek granite, Sixmile granite, and Llanite, the latter being the youngest.

Named for Packsaddle Mountain, Llano County.

Packsaddle Mountain Granodiorite[1]

Probably Jurassic or Cretaceous: Northern Idaho.

Original reference: J. L. Gillson, 1927, Jour. Geology, v. 35, no. 1.

Named for fact it composes Packsaddle Mountain, Bonner County.

Packwood Gravels

Pliocene to Pleistocene: Central California.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 42–43, pl. 1. Consists of poorly consolidated gravel, pebbly sandstone, silt, and clay. Estimated minimum thickness 500 feet. Reconnaissance indicates homoclinal dip to east of 10° to 30°, yielding a thickness of at least 3,000 feet with neither base nor top exposed. Underlies Santa Clara formation; overlies Orinda formation. Name credited to C. F. Tolman (unpub. rept.).

Sediments crop out in lower part of Packwood Creek, Morgan Hill quadrangle, where they occur in a block which has been dropped down between the Silver Creek and Calaveras fault zones. Area of study is in central Coast Ranges, about 50 miles southeast of San Francisco.

Pacoima Formation

Pleistocene, middle: Southern California.

G. B. Oakeshott, 1952, Petroleum World, v. 49, no. 1, p. 21 (map), 22. About 1,000 feet of poorly sorted gravels and fanglomerate. Unconformably overlies Saugus formation; unconformably underlies oldest terrace deposits. Fanglomerate [formation] has been distinctly folded along Little Tujunga syncline, and crystalline rocks have been thrust over it along Hospital fault.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 85–87, pl. 1. Formal proposal of name. Thickness 500 to 1,000 feet, south of San Gabriel fault; 200 feet, north of fault. In both areas, overlies Saugus formation and underlies terrace deposits; both contacts angular unconformities. Overlaps Elsmere member of Repetto near Olive View. Probably deposited in middle to early upper Pleistocene.

Type locality: At mouth of Pacoima Canyon one-half mile below Pacoima Dam, near eastern end of Sylmar 6-minute quadrangle, San Fernando quadrangle, Los Angeles County.

Paddock Shale Member (of Nolans Limestone)

Paddock Shale (in Sumner Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 61.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Member of Nolans limestone. Underlies Herington limestone member; overlies Krider limestone member. Thickness 7 to 10 feet in northern part of Kansas and about 30 feet in southern part. Leonard series.

Type locality: Roadcut one-fourth mile south of Krider, Gage County, Nebr. Named for Paddock Township, southern Gage County.

Paducah Formation[1]

Pleistocene: Western Kentucky.

Original reference: F. J. Fohs, 1907, Kentucky Geol. Survey Bull. 9, p. 67.

Probably named for Paducah, McCracken County.

Pagan Limestone

Pleistocene(?) or Recent: Mariana Islands (Pagan).

Risaburo Tayama, 1952, Coral reefs in the South Seas; Japan Hydrog. Office Bull., v. 11, table 4 [English translation in library of U.S. Geol.

Survey, p. 56]. Composed chiefly of reef-building corals; situated 1 to 2 meters above the reef flat and roughly 0.5 meter above the high-water mark. Covered with agglomerate. Recent.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 51–52. Pleistocene(?).

Forms outer caldera wall of island.

Page Ranch Formation

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. Mineralog. Survey Bull. 58, p. 18, 20, 21, 61–63. Consists of two units: a lower gray to gray-brown poorly bedded rough-textured tuff-breccia which contains occasional subangular boulders to 6 feet in diameter in a matrix of smaller lithic fragments and broken mineral crystals; and an upper crystal biotite dacite ignimbrite, moderately welded, gray brown to purplish brown, containing sparse lithic fragments. Only in mountain northwest of Page ranch are two units together, where they appear to be conformable; elsewhere either one or the other missing. Maximum thickness at least 600 feet. Overlies Rencher formation (new).

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig 2), 97–98. Subdivided into (ascending) Irontown and Kane Point tuff members. Kane Point has zircon age of 19 million years. This suggests that Rencher-Page Ranch period of extrusive-intrusive igneous activity is late Oligocene or early Miocene.

Mapped in northern half of Pine Valley Mountains, Washington and Iron Counties. Named for exposures capping mountain northwest of Page Ranch.

Pageton Sandstone[1]

Mississippian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 243.

Quarried at Pageton, McDowell County.

Pago Volcanic Series

Pliocene and Pleistocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1), 1290–1299, pl. 1; G. A Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 187–188. Includes extra-caldera lavas, dikes, plugs, cinder cones, vitric tuffs, lithic tuffs, and breccias; and intra-caldera lavas, dikes, plugs, cones, tuffs, and breccias. Intra-caldera volcanics, about 2,141 feet, include massive aphanitic and porphyritic basaltic and andesitic lava flows, and cinder cones, associated with three trachyte plugs; and interbedded lithic-vitric tuff member is 50 to 500 feet thick. Extra-caldera unit, about 1,609 feet thick, consists of lower member of thin-bedded primitive olivine basalts, associated thin dikes, and thin beds of vitric and lithic tuff having aggregate thickness of more than 1,000 feet; upper member consists of basalts, basaltic andesites, andesitic basalts, and andesites, associated with five plugs. Flows are massive and have maximum thickness of 500 feet.

Forms entire central part of island. Type locality of intra-caldera tuff and breccia member is head of Pago Pago Valley on north side of trail to Fagasa.

Pagoda Limestone

Pagoda Oolite[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 37.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1075, 1085, 1090 (fig. 2). Termed Pagoda limestone. Underlies Pentagon shale; overlies Dearborn limestone. Thickness type section 364 feet. Middle Cambrian.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 40–41, measured sections. Underlies Steamboat limestone in central and southern sections. Detailed measured sections.

Type locality: On east side of peak lying N. 20° E. of top of Pagoda Mountain in SW¼ sec. 3, T. 22 N., R. 13 W. Named for Pagoda Peak, but not present on peak that forms very top of mountain.

Pahala Ash (in Kahuku Volcanic Series)

Pahala Basalt[1]

Pleistocene: Hawaii Island, Hawaii.

Original reference: W. O. Clark, L. F. Noble, and H. S. Washington, 1923, Am. Jour. Sci., 5th, v. 6, p. 119.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 62 (table), 64 (table), 67 (table), 68, 69, 71–76. Pahala basalt replaced by Kahuku volcanic series (new). Name Pahala here restricted to top ash member; as thus restricted it is the persistent ash formation, derived from several sources, which caps Hilina volcanic series on Kilauea, Kahuku volcanic series on Mauna Loa, and Hamakua volcanic series on Mauna Kea. Also overlies Hilina, Hawi, and part of Hualalai volcanic series; underlies Kau, Puna, and Laupahoehoe volcanic series. Includes Waiau tuff described by Wentworth. Thickness as much as 50 feet.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 122–123. Pahala ash, as used by Stone (1926, Bernice P. Bishop Mus. Bull. 33), included ash deposits on Mauna Loa and Kileau, but did not definitely include those on Mauna Kea. Wentworth (1938, Hawaiian Volcano Observatory, 3d Spec. Rept.) used term Pahala tuff in same general sense. Stearns and Clark (1930, U.S. Geol. Survey Water-Supply Paper 616) included the ash as upper member of Pahala basalt. Present usage follows that of Stearns and Macdonald (1946).

Named for town of Pahala on south slope of Mauna Loa. Crops out about 450 square miles, chiefly on Mauna Kea and Mauna Loa.

Pahasapa Limestone[1]

Lower Mississippian: Western South Dakota and northeastern Wyoming.

Original reference: N. H. Darton, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 509.

E. P. Rothrock, 1955, North Dakota Geol. Soc. Guidebook Black Hills Field Conf., p. 76. Mississippian system represented in South Dakota by formations of Madison group, called Englewood and Pahasapa, where they outcrop, and Bakken, Lodgepole, Mission Canyon, and Charles where encountered in wells.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000) : U.S. Geol. Survey. Mapped in northeastern Wyoming.

Name is Dakota [Sioux] Indian name for Black Hills

Pahranagat limestone[1]

Ordovician : Nevada.

Original reference : C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 80.

Named for Pahranagat Mountains, north of Las Vegas, Clark County.

Pahrump Series

Pahrump Group

Precambrian : Southern California.

D. F. Hewett, 1940, Washington Acad. Sci. Jour., v. 30, no. 6, p. 239–240; 1956, U.S. Geol. Survey Prof. Paper 275, p. 25–28, pl. 1. Comprises about 6,500 feet of sandstone, conglomerate, quartzite, shale, and dolomite. Unconformably overlies Precambrian granite gneiss; unconformably underlies sedimentary rocks that probably represent basal formation of Paleozoic rocks. Lower Cambrian in age. Divided into (descending) Kingston Peak formation, Beck Spring dolomite, and Crystal Spring formation.

D. F. Hewett, 1948, California Div. Mines Bull. 129, p. 197. In Kingston Range, San Bernardino County, underlies Noonday dolomite.

L. A. Wright, 1952, California Div. Mines Spec. Rept. 20, p. 7, 8 (fig. 4). In Superior Talc area, Death Valley region, all three formations of Pahrump series exposed in a relatively undeformed section; this is only known locality west of Kingston Range where all units occur in virtually complete thicknesses. Series more than 5,500 feet thick, composes a north-trending structural block forming Saratoga Hills; block is about 2 miles long and dips eastward at moderate to steep angles.

D. H. Kupfer, 1954, California Div. Mines Bull. 170, map sheet 19. Referred to as Pahrump group.

D. H. Kupfer, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 188–194, pls. 1, 2. Name changed to group. In Silurian Hills [this report], exposed part is more than 11,000 feet thick and can be subdivided into 35 mappable members. Because of rapid facies changes in group, these members may not be recognized in other areas, and hence, are not given formal names but numbered (ascending) 1 to 35. Correlation of these members with Hewett's formations are uncertain. The 35 members may all be part of Crystal Spring formation, or they may represent all of Hewett's formations and a younger, previously unrecognized formation. Coarse clastic sediments dominate group; sandstone, generally orthoquartzite, is most common rock type; beds of carbonate rock, mainly dolomite, occur throughout section. Nonconformable on older metamorphic rocks; in measured section, top not exposed. Intruded by granitic rocks of two or more ages. Thrust faulting and chaos structure of area discussed.

Occurs in Kingston Range, Ivanpah quadrangle. Name derived from valley that borders Kingston Range on the north. Silurian Hills in San Bernardino County are 15 miles southeast of Death Valley.

Paicines Formation[1]

Pliocene: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 476, map.

Probably named for extensive development west of Paicines, San Benito County.

Paine Shale Member (of Lodgepole Limestone)

Paine Shale Member (of Madison Limestone)[1]

Lower Mississippian: Central northern, central southern, and southwestern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 315, 317–318, 319, 320, 321, 322, 323, 324. Reallocated to member status in Lodgepole limestone. At type locality and throughout southwestern part of state, characterized by thin-bedded dense limestones in units averaging 5 inches thick separated by almost equal amounts of calcareous shale and shaly limestone; chert lenticules common. In Big Snowy Mountains, member is highly massive. Eastward from Bridger and Gallatin Ranges, thins progressively and is missing in Pryor and Big Horn Mountains. Thickness 56 to 331 feet. Underlies Woodhurst member; overlies Three Forks limestone.

L. R. Laudon and J. L. Severson, 1953, Jour. Paleontology, v. 27, no. 4, p. 509 (fig. 2a). Columnar section Fairy Lake area, Bridger Mountains, shows Paine member overlying Sappington formation.

First mapped at and around Paine Gulch, southwestern corner Fort Benton quadrangle, Little Belt Mountains.

Paint Slate[1]

Precambrian: Northwestern Michigan.

Original reference: R. C. Allen, 1910, Michigan Geol. and Biol. Survey Pub. 3, geol. ser. 2, p. 100–101.

R. H. Nanz, Jr., 1953, Jour. Geology, v. 61, no. 1, p. 53, 55. Incidental mention in discussion of chemical composition of Precambrian slates.

Named for Paint River, Iron County.

Paint Creek Formation[1] or Shale

Paint Creek Formation (in New Design Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, western Kentucky, and southeastern Missouri.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 125.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig. 1), 269, 270 (fig. 2), 275–277. Paint Creek used here to include group of formations above Sample sandstone and below Cypress sand-

stone between Ohio River and southern end of Hardin and Breckinridge Counties, Ky. Includes three distinct formations: basal limestone 30 feet thick, central sandstone and shale 20 to 40 feet thick, and upper limestone member about 8 feet thick. Aggregate average thickness 62 feet near Lodiburg. These formations have been lumped together as upper Gasper; this name inadequate because it was originally used to describe a local phase in a restricted territory. The three formations of Paint Creek are correlatives of the Indiana formations (ascending), Reelsville limestone, Elwren sandstone and shale, and Beech Creek limestone. Names Reelsville and Elwren here proposed for the two lower members of the Kentucky formation; descriptive term *Productus inflatus* zone, first used by C. Butts, is here used in same manner.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 827–828. Assigned to New Design group (new). In standard Mississippian section, overlies Bethel sandstone and underlies Cypress sandstone. In Monroe and Randolph Counties, Ill., and northern Perry County, Mo., uniformly consists of calcareous shale and interbedded limestone with a conspicuous dark-red nonlaminated clay 12 to 15 feet thick about 10 feet above base; in lower part, shale predominates and limestone beds are argillaceous and separated by numerous bluish shaly partings; in upper part, limestone layers are more massive, purer, and crystalline, and at top is limestone bed about 10 feet thick. In areas where Bethel sandstone is absent, Renault and Paint Creek formations cannot be separated. In Meade, Breckinridge, Ohio, and parts of Hardin and Grayson Counties, Ky., Paint Creek consists of five variable members; three of these, the lowermost, middle, and uppermost, are largely shale, and the two intermediate are somewhat massive limestone. From Todd County to Grayson County, Ky., where Bethel sandstone is absent, Renault and Paint Creek formations together form limestone unit that cannot be easily subdivided; these beds are now known as Girkin limestone. In Indiana, formation comprises three members (ascending): Reelsville limestone, Elwren sandstone and shale, and Beech Creek limestone.

O. E. Wagner, Jr., *in* L. W. Currier, 1944, U.S. Geol. Survey Bull. 942, p. 17–18. Referred to as Paint Creek shale in Fluorspar area of Hardin County, Ill.

Elwood Atherton and D. H. Swann, 1948, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 32, no. 2, p. 300. Lower Chester formations are correlated in western Illinois, subsurface of southeastern Illinois basin, Hardin County, Ill., and Indiana. Paint Creek of southern and western Illinois is divided into three members: upper limestone and shale zone, named Ridenhower member and correlated with "Paint Creek" of southeastern Illinois; middle sandstone and shale zone, correlated with Bethel sandstone of southeastern Illinois; and a lower "pink crinoidal limestone" correlated with upper part of "Renault" formation and called Downeys Bluff member in southeastern Illinois. Correlations credited to F. E. Tippie (unpub. ms.).

A. H. Sutton and W. A. Oesterling, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1786. Paint Creek was named by Weller (1913) from exposures in southwestern Illinois. Name Ridenhower was applied by Butts (1917) to same part of Chester section, the shale between the Bethel and Cypress sandstones in the Fluorspar district.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Paint Creek formation of standard Chester column has triple expression in southern Indiana (ascending): Reelsville limestone, Elwren sandstone, and Beech Creek limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves name in its own right.

Named for Paint Creek, Monroe County, Ill. Typically developed in tributary of Paint Creek about 5½ miles northeast of Prairie du Rocher.

†Painted Desert Formation[1]

Jurassic and older(?): Northern Arizona, northwestern New Mexico, and southwestern Utah.

Original reference: L. F. Ward, 1901, Am. Jour. Sci., 4th, v. 12, p. 401–413.

Named for Painted Desert, Coconino County, Ariz.

Painted Hill Formation

Pliocene, lower or middle: Southern California.

C. R. Allen, 1954, California Div. Mines Bull. 170, map sheet 20. Typically unconsolidated gray conglomerate, locally contains white sandstone, fresh-water limestone, and interlayered flows of olivine basalt. Thickness about 3,400 feet. Underlies Quaternary gravels; overlies Imperial formation with essential conformity although Imperial beds pinch out to north.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 324 (fig. 2), 325 (table 1), 328–329, pls. 2, 3. Name Painted Hill formation herein applied to continental beds that conformably overlie Imperial formation east of Painted Hills. Bramkamp (1934, Ph.D. thesis, Univ. California, Berkeley, p. 15) termed the unit Indio because its stratigraphic position is similar to that of Indio formation in the Indio Hills. North of point where Imperial formation pinches out, Painted Hill lies directly on Coachella fanglomerate with marked angular unconformity. Probably early or middle Pliocene.

Named for Painted Hill, San Gorgonio Pass area, Riverside County.

Painted Rock Formation

Painted Rock Sandstone Member (of Vaqueros Formation)

Miocene, lower: Southern California.

T. W. Dibblee, Jr., 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Econ. Geologists guidebook, Joint Ann. Mtg., Los Angeles, p. 82, 86. Marine sandstone and siltstone, 5,500 feet thick. Underlies Monterey marine shale and associated lava flows and sills; overlies Soda Lake formation (new). Outcrops noted on road log.

I. T. Schwade, 1954, California Div. Mines Bull. 170, map sheet 1. Noted as occurring in hanging-wall block of Morales fault, Cuyama Valley. Here consists of about 50 percent sandstone.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2978 (fig. 3), 2986–2987, 2988 (fig. 7). Rank reduced to member status in Vaqueros formation. At designated type locality, consists of a sequence of sandstones and siltstones with minor amounts of shale; thickness about 5,430 feet; in vicinity of Painted Rock, about 6,000 feet. Overlies Soda Lake

shale member; underlies Monterey clay shale; both contacts gradational. Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) included upper 900 feet of section as part of their Temblor and called the rest, from which they report occurrence of *Turritella inezana*, "Vaqueros"; this separation was based on faunal content and not on lithology; because this predominantly sandstone section is lithologically inseparable throughout its areal extent, term Painted Rock sandstone member is applied. Top of sandstone at Caliente Mountain is stratigraphically about 800 feet lower than it is in northwestern Caliente Range. In southeastern Caliente Range, Painted Rock thins, and upper part grades laterally eastward into basal beds of nonmarine Caliente formation.

Type locality: Caliente Mountain and Midway Peak Southwest quadrangles. Name derived from Painted Rock, a sandstone knob on which Indian pictographs are preserved, sec. 17, T. 32 S., R. 20 E., Caliente Range. Range is an anticlinal uplift developed in thick series of Tertiary sediments and is partially overturned and thrustfaulted southwestward toward Cuyama Valley.

†Painterhood Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: F. C. Schrader and E. Haworth, 1905, U.S. Geol. Survey Bull. 260, p. 447.

Named for Painterhood Creek, Elk County.

Paint Lick Limestone (in Eden Group)[1]

Upper Ordovician: East-central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 10, 19, 212, 215.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 24. In central Kentucky, divisions of Eden include Fulton, Million, and Paint Lick. Paint Lick constitutes lower and massive part of Garrard sandstone of Campbell (1898).

Probably named for Paint Lick Creek, Madison and Garrard Counties, Ky.

Paint Pot Crater Flow

Recent: Northern California.

C. A. Anderson, 1941, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 7, p. 371. Name applied to a basalt flow from Paint Pot Crater. Considered older than Burnt Lava flow.

Occurs on western flank of Medicine Lake Highland near Little Glass Mountain, Modoc Lava Bed quadrangle.

Paint River Greenstones (in Quinnesec Schist)

Precambrian (Huronian): Northern Michigan.

H. M. Martin, 1936, The centennial geological map of the northern peninsula of Michigan (1:500,000): Michigan Dept. Conserv., Geol. Survey Div. Pub. 39, Geol. Ser. 33. Shown on map legend. Occurs in Crystal Falls and Iron River districts.

Paint River Group

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 37. Uppermost of four groups in the series; younger than Baraga group. Comprises (ascending) newly defined Dunn Creek slate, Riverton iron-

formation, Hiawatha graywacke, Stambaugh formation, and Fortune Lakes slate. In previous reports, these strata were considered part of the Michigamme slate. Iron River-Crystal Falls district is a deep tightly folded major synclinal structure incompletely bounded by Badwater greenstone; east of Crystal Falls, greenstone is absent and strata of the district proper rest directly on Michigamme slate. Recognition of stratigraphic position of Badwater greenstone formed basis for definition of Paint River group.

Named for Paint River which drains northern and eastern part of district, Iron and Dickinson Counties.

Paint Rock Bed (in Wichita Group)[1]

Paint Rock Limestone (in Lueders Group)

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 428.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Lueders here given group status. Underlies Maybelle limestone; overlies Talpa formation.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Type "Paint Rock" in Concho County has been traced into type exposure of Talpa limestone; "Paint Rock" is a synonym for Talpa limestone and preference in nomenclature is given latter term.

Named for Paint Rock, Concho County.

Pajarito Lavas

Mesozoic(?): Southern Arizona.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. RME–2009, p. 8, pl. 1. Consists principally of massive coarse-grained rhyolite, with abundant pink feldspar phenocrysts. Underlies Oro Blanco conglomerate.

Well developed in Pajarito Mountains in southeast section of Ruby quadrangle, Santa Cruz County.

Pajarito Shale

Pajarito Shale Member (of Purgatoire Formation)

Lower Cretaceous: Northeastern New Mexico.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 62. Member consists of soft brown sandstone alternating with gray shale that contains *Ostrea quadriplicata;* on basis of this fossil, believed to be Washita in age. Overlies Mesa Rica sandstone member (new) or, where Mesa Rica is absent, Tucumcari shale member.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2005 (fig. 2), 2007. Rank raised to formation; term Purgatoire abandoned in Tucumcari-Sabinoso area. Thickness 50 to 60 feet.

Type locality and derivation of name not stated. First described in northwestern Quay County.

Pakoon Limestone

Permian (Wolfcampian): Northwestern Arizona.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 515 (fig. 2), 524–525. Dolomitic limestones. Thickness 688 feet at type section; 305 feet in Grand Wash Cliffs. Overlies Callville limestone; under-

lies Queantoweap sandstone (new). Wedges out some distance west of termination of upper Callville member.

Grant Steele, 1960, Dissert. Abs., v. 20, no. 12, p. 4635. Overlies Ferguson Springs formation (new).

Type section: On west face and crest of Pakoon Ridge, northwest of Pakoon Spring, Mohave County, approximately T. 35 N., R. 16 W.

Pala Conglomerate[1]

Pleistocene: Southern California.

Original reference: A. J. Ellis, 1919, U.S. Geol. Survey Water-Supply Paper 446.

Occurs in valley of San Luis Rey, in vicinity of Pala, San Diego County.

Palafox Sandstone Member (of Mount Selman Formation)[1]

Eocene, middle: Southern Texas, and Tamaulipas, Mexico.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1370, 1371, 1377, 1381, 1385.

Forms a high cliff down the east bank of Rio Grande from mouth of Espada Creek to bluffs east of Palafox, Webb County, Tex. Can be traced from Rio Grande to Rio San Juan, Tamaulipas, Mex.

Palao Limestone

See Palau Limestone.

Palatine Bridge Limestone Member (of Tribes Hill Formation)

Lower Ordovician (lower Canadian): East-central New York.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 85–87. Name proposed for thin-bedded fucoidal arenaceous dolomilutite with many intercalations of shaly calcilutite. Described as fine- to medium-grained light-blue-gray rock with "glassy" appearance on fresh fracture. Pebble calcarenite layers common near top; pyrite abundant in uppermost few feet. Maximum thickness 56 feet; much variation. Conformably underlies Wolf Hollow member (new); overlies Fort Johnson member (new) with gradational contact in exposures west of Cranesville and unconformably in those to the east. Represents part of original "Calciferous" which was termed "Fucoidal Layers."

Type locality: Quarry 0.5 mile west of Palatine Bridge, Montgomery County.

Palau Limestone

Miocene to Pleistocene: Caroline Islands (Babelthuap)

Risaburo Tayama, 1935, Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 18, p. 13, 14–15, 37–39 [English translation in library of U.S. Geol. Survey, p. 16–17, 43–44, 45–46]. Consists of basal tuffaceous sand and gravel which contains andesite blocks and coral masses; an *Acropora* bed, about 10 meters thick; massive coral limestone which carries Nullipore and Foraminifera. Overlies Babelthuap agglomerate. Resembles Mariana limestone and may be contemporaneous with it.

U.S. Army Corps of Engineers, 1956, Military geology of Palau Islands, Caroline Islands:

U.S. Army Corps of Engineers, Far East, p. 39 (table 5), 55–59, pls. 4, 8, 9, 10, 11. Maximum thickness probably 750 feet or more. Age ranges from Miocene to Pleistocene; Miocene age indicated only at two localities.

Chart and plates show Palau older than Peleliu limestone and younger than Ngeremlengui formation.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 52. Pleistocene.

Well developed along southern shore of Babelthuap; widely distributed in islands south of Babelthuap.

Palestine Sandstone[1]

Palestine Sandstone (in Elvira Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, and western Kentucky.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 128.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136, 137; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 838. Assigned to Elvira group (new). In standard Mississippian section, underlies Clore limestone and overlies Menard limestone. Generally thin bedded and flaggy and contains much sandy shale. More massive beds occur locally as in Pope County, Ill., and northern Christian County, Ky. Within short distance beyond latter locality, formation becomes shaly and loses its identity in Leitchfield shale. In southwestern Indiana, probably represented by thin Bristow sandstone.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 6. Name Palestine sandstone extended into southern Indiana where it replaces term Bristow sandstone. Local Indiana names of upper Chester dropped, and formations given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Palestine sandstone shown on stratigraphic column of upper Chester in Indiana as gray to brown flaggy sandstone and green-gray shale. Thickness 5 to 40 feet. Term Elvira group not used in Indiana.

Named for Palestine Township, Randolph County, Ill., where formation is well developed along some tributaries of Tindall Creek.

Pali Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T.. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 123–124. Lithic tuff, cinder, agglomerate, vent breccia, and a lava flow and dike of nepheline basanite containing dunite inclusions. Maximum thickness of cinders about 40 feet; lava flow more than 20 feet. Uncomformably overlie Koolau volcanic series; also overlie Kaneohe, Nuuanu, and Aliamanu volcanics; underlie Salt Lake tuff. Pali cinders interbedded with alluvium in terraces-probably graded to the plus 95-foot (Kaena) stand of sea.

Crops out along road down the Nuuanu Pali, for which it is named. Exposed over about 0.2 square mile on face of Nuuani Pali (cliff) on northeast side of Koolau Range about 10 miles northwest of Makapuu Head.

Palikea Formation (in Koloa Volcanic Series)

Pleistocene: Kauai Island, Hawaii.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 3; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 124; G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 20, 75–84, pl. 1. Sedimentary breccias and conglomerates intercalated with volcanic rocks of Koloa series and lying between Koloa lavas and eroded rocks of Waimea Canyon series. Thickness at type locality 700 feet; elsewhere not over 200 feet.

Type locality: Palikea Ridge, 3.2 miles southeast of Kawaikini Peak, on eastern side of central mountain massif of Kauai. Crops out as narrow bands along edge of central massif of Kauai and intercalated with Koloa lavas over eastern two-third of island.

†Palisade Andesite (in Potosi Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13.

Palisade Diabase[1]

Upper Triassic: Northern New Jersey and eastern New York.

Original reference: N. H. Darton, 1889, Am. Jour. Sci., 3d, v. 38, p. 134–139.

N. M. Perlmutter and Theodore Arnow, 1953, New York State Water Power and Control Comm. Bull. GW–32, p. 9 (table 2). Predominantly a medium- to coarse-grained dark-gray rock of intrusive origin consisting chiefly of plagioclase, augite, and hypersthene. Occurs as intrusive bodies in Newark group.

Forms the Palisades of the Hudson.

†Palisade Porphyry[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 262–268.

Forms the Great Palisades of Minnesota coast of Lake Superior.

Palisade Canyon Rhyolite

Miocene, upper, or Pliocene, lower: Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1198. Consists of several flows, some of which are more than 200 feet thick. Rock is brownish red and weathers dark brown. Maximum thickness 500 feet. Flows thin out and disappear toward the east. Unconformably overlies Raine Ranch formation (new); underlies Carlin formation (new).

Forms cliff 500 feet high in Palisade Canyon, vicinity of Carlin. Separates Carlin basin from Pine Valley. Folded into open syncline in which Humboldt River flows and into an anticline that determines a ridge 1,000 feet high west of the river.

Palisades Conglomerate[1]

Pleistocene(?): Southwestern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3.

A. J. Eardley, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 323, 338. Pleistocene(?).

On left bank of Yukon, about 35 miles below mouth of Tanana, at base of cliffs, 150 feet high, that have been named the Palisades, Yukon gold district.

Palisades Flow, Andesite

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 32, 62, 134. Thick andesitic flow forming Palisade Point. Rests on glacial moraines. Top is irregular, having monolithic crags and deep steep-sided fissures. Lies to west of Roundtop flow (new). In sections northwest of the Wineglass, white lump pumice and tuffaceous dacite [Wineglass welded tuff] cover Palisades flow. Was part of main andesitic cone of former Mount Mazama.

The Palisades are on northeast rim of Crater Lake.

†Palm Beach Limestone[1]

Pleistocene: Southern Florida.

Original reference: S. Sanford, 1909, Florida Geol. Survey 2d Ann. Rept., p. 209–211, table opposite p. 50.

Typically exposed in T. 45, R. 41, 12 miles west of Lantana, Palm Beach County.

Palm Canyon Complex

Paleozoic and (or) Mesozoic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 12, 21–25, 36, 37, 38, pl. 1. A metasedimentary-igneous complex consisting largely of crystalline limestone, quartzites, and mica schists of phyllites, cut and locally injected by dioritic, granitic, pegmatitic, and silexitic material; highly deformed. Intruded by Bradley granodiorite (new), usually in form of sills.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 530. Paleozoic and (or) Mesozoic; wholly or partly correlative with Diamond Valley complex (new).

Named for typical exposures on the east side of lower Palm Canyon [south of Palm Springs], Riverside County. Exposed for 12 or 14 miles southeast of Palm Springs.

Palmer Gneiss[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 514.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1436 (table 1), 1455 (table 4), 1461. Palmer gneiss, previously considered pre-Huronian, consists of metamorphic Mesnard quartzite, Kona dolomite, Wewe slate, and Ajibik quartzite. Table 1 shows lower Huronian sequence in Marguette area (ascending) Mesnard, Kona, Wewe. Palmer gneiss not listed on this table.

Typical exposures west of Palmer Lake, Marquette district.

Palmer Volcanics[1]

Tertiary(?): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 103, map.

Occurs west of Palmer, Stevens County.

Palmerton Sandstone (in Onondaga Group)

Palmerton Sandstone Member (of Onondaga Formation)

Middle Devonian: Southeastern Pennsylvania.

F. M. Swartz, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 16, 52 (fig. 17), 108, 153. In area east of Schuykill River to Carbon County, Oriskany sandstone is overlain by Bowmanstown chert and Palmerton sandstone; latter has for many years been mistaken for the Oriskany. Thickness 120 to 145 feet. Overlies Bowmanstown chert; underlies Esopus. Onondaga group. In eastern Monroe County and northwestern New Jersey, Esopus is believed to be contemporaneous with Bowmanstown chert and Palmerton sandstone.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1148, 1150, 1153, 1156, 1177. Description of a number of measured sections. Derivation of name given. Middle Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Lower or Middle Devonian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Onondaga formation, as mapped, includes Palmerton sandstone in Lehigh Gap area.

Named from exposures on ridges and in quarries north of Palmerton, Carbon County.

Palmetto Formation[1]

Lower and Middle(?) Ordovician: Southwestern Nevada.

Original reference: H. W. Turner, 1902, Am. Geologist, v. 29, p. 261–272.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. Mapped in Round Mountain quadrangle. Includes beds equivalent to Mayflower schist, Zanzibar limestone, and Toquima formation of Manhattan district. Slates carry graptolites of Chazy and Normanskill age, the former only from one locality in Toyabe Range. Estimated thickness 5,000 feet in Toquima Range and 2,500 feet or more in Toyabe Range. Map bracket shows Ordovician.

H. G. Ferguson, S. W. Muller, and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–45. Thickness in Mina quadrangle about 4,000 feet, base concealed. Tertiary volcanic rocks cover contact between Cambrian Miller Mountain formation (new) and Palmetto. Underlies Diablo formation.

B. M. Page, 1959, Nevada Bur. Mines Bull. 56, p. 15–18, 19 (fig. 7), pl. 7. Oldest rocks exposed in Candelaria mining district. Isoclinally folded and cut by numerous faults. Thickness 87 to 167 feet, although total thickness unknown; neither top nor base exposed. Upper part eroded prior to deposition of Diablo formation; in some areas, in fault contact with Candelaria formation.

Type locality: Palmetto Mountains, Silver Peak quadrangle, Esmeralda County.

Palmetto (type) granite

Paleozoic (epi-Paleozoic): Northeastern Georgia.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 40, 44. Porphyritic biotite granite that closely resembles Stone Mountain type except that it includes many phenocrysts of feldspar, generally microcline. In Greene

and Elbert Counties, gradational into Stone Mountain type, and one appears to be but a phase of the other. In Greene County porphyritic type predominates, and in Elbert County equi-granular type is most common.

Named for exposures south of Palmetto, Fulton County.

Palm Park Formation

Oligocene: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14), 120–121. In southern part of Caballo Mountains, a sequence of clastic rocks which is probably older than McRae formation (new) and which underlies Santa Fe beds of Miocene-Pliocene age. Sequence has generally high content of volcanic debris as well as a few flows, all of which range from rhyolitic to basaltic in composition. Sequence divisible into lower dark-colored unit termed Palm Park formation and upper light-colored unit termed Thurmond formation. Generally has reddish-brown hue in outcrop. In some places, consists in large part of coarse bouldery conglomerate. At Palm Park where upper part is exposed, formation contains much reddish, grayish, and purplish-brown latitic to andesitic breccia and tuff. Reddish-brown tuffaceous clay and silt commonly intercalated with the tuff and breccia. Thickness probably at least 1,000 feet. Complete section nowhere exposed. At type locality, lower part of formation dropped below surface along Palm fault. Elsewhere, lower or upper boundaries may be covered by younger pediment-capping sediments. Base exposed along Apache Canyon where it stands steeply but in near conformity with underlying Magdalena beds. In this locality, upper beds are faulted beneath Thurmond formation.

Named for valley widely known as Palm Park located along southeastern edge of Caballo area, Sierra County.

Palms Granite

Precambrian: Southern California.

W. J. Miller, 1938, Geol. Soc. America Bull., v. 49, no. 3, p. 419 (fig. 1), 421–423. Typically a true granite, varying locally to a quartz monzonite, mostly medium grained, light gray, medium gray, and pinkish gray. Structure ranges from massive to highly foliated. Considered younger than Gold Park gabbro-diorite (new). Cut by White Tank monzonite (new).

Named from its typical and extensive development in Forty-nine Palms Mountain, Riverside County.

Palms Quartzite[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: C. R. Van Hise, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 338.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 85 (table 1). Included in Animikie series. Underlies Ironwood iron-formation; unconformably overlies Bad River dolomite.

Named for exposures just south of Palms mine, on Palms property, near Bessemer, Mich.

Palm Spring Formation[1]

Miocene, middle or upper: Southern California.

Original reference: W. P. Woodring, 1931, Carnegie Inst. Washington Pub. 418, p. 10.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1782. Noted as overlying Imperial formation and underlying Borrego formation (new).

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22, 23, 25, pl. 2. Described in Imperial Valley as a series of land-laid arkosic sandstones and red clays of Pliocene age. Thickness at type locality 4,800 feet; attains maximum thickness of 7,100 feet in Borrego Badlands; thins eastward to 6,800 feet on north flank of San Felipe Hills anticlinorium and to 3,600 feet or less on east-plunging nose and south flank of structural feature. In southwestern Imperial Valley, grades downward into marine Imperial formation and westward into Canebrake conglomerate (new); in Borrego Valley, grades upward into Borrego lacustrine beds; on Mecca anticline, unconformably overlies Mecca formation (new).

Named for spring on lower part of Vallecito Creek, a southwestward-flowing tributary entering Carrizo Creek about 1 mile above old stage station. Dibblee (1954) refers to type locality as south side of Carrizo Valley [Imperial and San Diego Counties].

Palmyra Limestone Member (of Friedrich Formation)

Pennsylvanian (Virgil Series): Northeastern Kansas and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1938, Nebraska Geol. Survey Paper 12, p. 9. Defined as middle member of formation. Underlies Otoe shale member (new); overlies Minersville shale member (new).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 14. Consists of one or two light-gray limestones containing *Triticites*. Thickness 1 to 3 feet.

Type locality: In cut-bank of Little Nemaha River, southeast of railroad station at Palmyra, Otoe County, Nebr.

†Palo Dur Beds[1]

Pliocene: Western Texas.

Original reference: W. B. Scott, 1894, Geol. Soc. America Bull., v. 5, p. 594–595.

Named for Palo Duro Canyon, western part of Panhandle of Texas.

Palolo Valley Mud Flow

See Kaau Mud Flow.

Palomas Gravel[1]

Pleistocene: Southwestern New Mexico.

Original references: C. H. Gordon, 1907, Science, new ser., v. 25, p. 824–825; 1907, Jour. Geology, v. 15, p. 91–92.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14), 123. Shown on correlation chart of formations in Caballo Mountains and adjoining areas. Occurs above Santa Fe formation, and appears to be both Pliocene and Pleistocene.

Named for exposures on Palomas River, Sierra County.

Palomasan series[1]

Quaternary: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 10.

Palo Pinto Limestone (in Canyon Group)[1]

Palo Pinto Limestone (in Whitt Group)

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Reallocated to Whitt group (new). Expanded above to top of Wiles limestone and below to base of subjacent sandstone above Keechi Creek formation (redefined). Canyon series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 63. Recommended that name Palo Pinto be abandoned in Colorado River valley, and that beds called Palo Pinto with question by Nickell (1938, Texas Univ. Bur. Econ. Geology Pub. 3801) and shale unit between the beds and Capps limestone member be included in Brownwood shale member of Graford formation, in accordance with general current usage in Texas.

Named for Palo Pinto, Palo Pinto County.

Palos Verdes Sand[1]

Pleistocene, upper: Southern California.

Original reference: A. J. Tieje, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 5, p. 502–512.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 53 (fig. 1), 56–59, pl. 1 Restricted to the marine deposits in Arnold's upper San Pedro series, that is, to deposits on the lowest (youngest) of 12 terraces. Consists of a thin veneer on terrace platform which bevels formations ranging in age from lower Pleistocene to Miocene. Composed of coarse-grained sand and gravel with silty sand and silt; limestone cobbles common in gravel. Thickness ranges from a few inches to 15 feet; average less than 10 feet. Type region designated as original type locality no longer exists.

Type region: Water front and adjoining region in San Pedro, Los Angeles County.

Palouse Formation[1]

Palouse soil

Pleistocene: Southeastern Washington, Idaho, and Oregon.

Original reference: R. C. Treasher, 1925, Science, new ser., v. 61, p. 469.

V. E. Scheid, 1940, Northwest Sci., v. 14, no. 3, p. 56–57. Discovery of fossil horse tooth from formation at Moscow, Idaho, raises question of age of formation.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 12. Formation appears to be correlative with Ringold formation and, if so, is of late Pliocene or Pleistocene age.

H. H. Waldron and L. M. Gard, Jr., 1954, U.S. Geol. Survey Geol. Quad. Map GQ–48; 1955, U.S. Geol. Survey Geol. Quad. Map GQ–56. Formation described in Hay and Penawawa quadrangles, Washington, where it mantles most of plateau upland surface and is a few inches to more than 200 feet thick.

Named for occurrence in Palouse Hills, southeastern Washington.

Paluxy Sand[1] **or Formation** (in Trinity Group)

Lower Cretaceous (Comanche Series): Eastern Texas, southwestern Arkansas, and southeastern Oklahoma.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 2, 42 (table 6), 43 (table 7). Overlies Mooringsport formation (new). Crops out in Little River and Hempstead Counties, Ark.

F. E. Lozo, 1949, Shreveport Geol. Soc. Guidebook 17th Ann. Field Trip, p. 85–92. Paluxy sand, heretofore generally considered as uppermost formation of Trinity group is indicated to be lateral equivalent of Walnut formation, in part, of central Texas. Paluxy sand, from type locality southward into central Texas, is more properly placed in Fredericksburg group on basis of sedimentary history.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 102, 109. Described in Llano region where it is uppermost formation in Trinity group. Extends in narrow band around east and northeast border of region and across central Burnet and north-central Lampasas Counties; occurs at base of Cretaceous outliers north of region. Commonly less than 10 feet thick. Overlies Glen Rose limestone; underlies Walnut clay of Fredericksburg group.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2334, 2335. Paluxy not included in Trinity group as defined in this report. Term Paluxy formation is restricted to those sandstones and shales which are time-stratigraphic equivalent of, and are laterally continuous with, part of the Walnut which is lowest formation of Fredericksburg group. Rusk formation occupies stratigraphic interval formerly termed Upper Glen Rose formation and Paluxy formation. Sandstones and red shales of upper part of Trinity group are time-stratigraphic equivalents of upper part of Glen Rose formation and are referred to in this report as "Paluxy-like" lithology.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 26–31. Paluxy sand described in McCurtain County where it is exposed as an east-trending belt about 8 to 10 miles wide which covers most of T. 6 S., Rs. 21 to 27 E. Thickness 0 to 880 feet. Conformably overlies De Queen limestone; unconformably underlies Goodland limestone.

Named for town and creek in Somervell County, Tex.

Palzo Sandstone Member (of Spoon Formation)

Palzo Sandstone (in Carbondale Group)

Pennsylvanian: Southern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 10, 15 (fig. 2) [1943]. Sandstone at base of Carbondale group; overlies DeKoven coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 46 (table 1), 63, pl. 1. Rank reduced to member status in Spoon formation (new). Occurs at top of formation above DeKoven coal member. Maximum thickness 40 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼ sec. 16, T. 10 S., R. 4 E., Williamson County. Named for exposures at Palzo, 10 miles north of Marion.

Pamelia Limestone[1] (in Black River Group)

Middle Ordovician: Northern New York.

Original reference: H. P. Cushing, 1908, Geol. Soc. America Bull., v. 19, p. 155.

F. P. Young, Jr., 1943, Am. Jour. Sci., v. 241, no. 3, p. 144–155. Basal formation of Black River group. Underlies Lowville. Consists essentially of dolomitic and shaly limestones with maximum thickness of 150 feet in Watertown region. Southeastward along Black River valley, it thins and disappears; westward, in Ontario, it retains its characteristic lithology but thins to 30 feet at Marmora, Hastings County.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 22–23. Greatest thickness, 150 feet, is in Jefferson County. Consists of lower division of about 70 feet composed of basal conglomerate and arkosic sandstones, dark-gray fossiliferous rock, and sublithographic limestone interbedded with gray dolomitic limestone. Upper division, about 80 feet thick, is light-gray or whitish earthy limestone interbedded with gray magnesian and sublithographic limestone. In both divisions, the dolomitic and earthy limestones weather to buff or yellowish-brown hue and are easily distinguished from overlying Lowville. Formation thins to east and west of its area of greatest thickness. Thins to disappearance in Oneida County to the east. Age and affinities of the Pamelia have been subject of debate, but it is generally conceded now that it has strongest ties with the Lowville rather than Chazy group.

J. H. Johnsen and G. D. Toung, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 1898. Exposure of formation reported east of Frontenac axis in New York. Thickness 3⅔ feet in quarry southeast of village of Chazy, Clinton County. Overlies Valcour formation; underlies Lowville limestone. Black River group (Lower Mohawkian).

Named for exposures at Pamelia, Jefferson County.

Pamelian (stage)

Ordovician (Black Riveran): New York.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 94 (table 3). Name used in list of stage names for lowest division of Black Riveran series. Older than newly named Lowvillian [stage].

Name probably derived from Pamelia, Jefferson County, for which Pamelia limestone is named.

Pamlico Formation[1] **or Sand** (in Columbia Group)

Pleistocene: Atlantic Coastal Plain from Delaware to Mississippi.

Original reference: W. B. Clark, 1910, Geol. Soc. America Bull., v. 20, p. 651.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 74–75. Geographically extended into Florida where it includes all marine Pleistocene deposits younger than Anastasia formation. Consists chiefly of sand. Thickness ranges from featheredge to about 50 feet. Generally lies at altitudes of less than 25 feet above sea level on east, south, and west coasts.

G. F. Brown and others, 1944, Mississippi Geol. Survey Bull. 60, p. 60–61. Pamlico sand underlies Pamlico plain along north shore of Mississippi Sound. Much of outer edge of sand is capped by Recent beach and dune

deposits from which it cannot readily be separated. Thickness on southeast bank of Wolf River 15 feet.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 50–51. In Prince Georges County, Md., and in District of Columbia, is entirely fluvial and estuarine. Thickness does not exceed 30 feet. Lies on valley floors cut in crystalline rocks and in sedimentary deposits ranging in age from Cretaceous Potomac group to Miocene Chesapeake group; may locally lie unconformably on Pleistocene Wicomico formation. Where it does not form the surface, overlain unconformably by Recent sediments. Formation accumulated during third cycle of downcutting and subsequent drowning of Potomac River; presumably this epoch is in later Pleistocene; it began during third glacial stage (Illinoian) and continued and was completed during third interglacial stage (Sangamon).

J. R. Dubar, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 133 (table 1), 135, 136 (fig. 4), 146, 147, 149 (fig. 13), 150, 154. In southwestern Florida, forms an almost continuous blanket of sand at elevations less than 25 feet above sea level. Generally rests with apparent unconformity on a member of the Fort Thompson, Caloosahatchee, or Tamiami formations. Between La Belle and Ortona Locks, commonly overlies Coffee Mill Hammock marl and may be overlain by Lake Flirt marl or lie exposed at surface; downstream from La Belle as far as Fort Denaud, rests, in many places, directly on Caloosahatchee formation, sometimes on upper shale bed and sometimes unconformably on Bee Branch member (new).

Named for Pamlico Sound, eastern North Carolina.

Pampa Schist

Jurassic or older: Southern California.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 18–22, pls. 1, 2, 3. Dark-gray mica schists; chiastolite-mica schists; chlorite greenstone schists. About 8,000 feet thick. Crops out within granitic rocks as linear inclusions with vertical or near-vertical attitudes. May be a phase of Kernville series, but its relationship to Kernville is obscured by granitic invasions.

Prominently exposed in Cottonwood Canyon drainage area west of Pampa Peak, Breckenridge Mountain quadrangle, Kern County.

Pamunkey Group[1]

Eocene, lower and middle: Eastern Virginia and eastern Maryland.

Original reference: N. H. Darton, 1891, Geol. Soc. America Bull., v. 2, p. 431–450, map.

N. H. Darton, 1951, Geol. Soc. America Bull., v. 62, no. 7, p. 752–759. Group includes Aquia and Nanjemoy formations.

R. R. Bennett and G. G. Collins, 1952, Washington Acad. Sci. Jour., v. 42, no. 4, p. 114–116. In Prince Georges County, Md., Aquia greensand, lower unit of group, overlies Paleocene Brightseat formation (new).

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361. Aquia formation is early Eocene; Nanjemoy formation is early and middle Eocene.

Named for exposures on Pamunkey River, Va.

Panaca Formation[1]

Pliocene: Eastern Nevada.

Original references: C. Stock, 1921, Geol. Soc. America Bull., v. 32, p. 146–147; 1921, Am. Jour. Sci., 5th, v. 2, p. 252–257.

D. A. Phoenix, 1948, Nevada State Engineer Resources Bull. 7, p. 34–38, 45–46, pl. 2. Described in Meadow Valley Wash drainage area; where best exposed, composed of terra-cotta to light-brown silts and fine sands and locally some diatomite and volcanic ash. Beds dip gently from both sides of Meadow Valley and are cut by faults of small displacement. Full thickness not known; where best exposed and most deeply dissected, estimated thickness at least 1,400 feet. Covered by Quaternary alluvium. Overlies Miocene(?) volcanic rocks. Pliocene.

Named for exposures near village of Panaca, Lincoln County.

Panama Conglomerate Lentil (in Cattaraugus Formation)

Panama Conglomerate[1]

Panama Conglomerate Member (of Venango Formation)

Panama Member (of Cattaraugus Formation)

Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. I_3, p. 58, 60, 70, 124.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2317, 2318. Reallocated to member status in Venango formation. Underlies Cherry Creek member (new). Upper Devonian. Area of report, Cherry Creek quadrangle, New York.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33. Basal member of Cattaraugus formation. Underlies Amity member; overlies Chadakoin formation of Arkwright group (new). Thickness 30 feet in Chautauqua County.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 19. Panama and Wolf Creek conglomerates and sandstones are contiguous. Panama has priority; name Wolf Creek abandoned.

Named for exposures at Panama, Chautauqua County, N.Y.

Panamá Formation[1]

Panamá Tuff

Miocene, lower: Panamá.

Original reference: R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull. 28, no. 5, p. 200–202.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart); W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 242, 246 (fig. 2); W. S. Cole, 1952, U.S. Geol. Survey Prof. Paper 244, p. 2 (fig. 1). Referred to as Panamá tuff.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 12, 39–42, 51 (fig. 4), pl. 1. Formation proper includes tuff, tuffaceous sandstone, tuffaceous siltstone and agglomerate. They evidently represent nonmarine, essentially fine grained tuff and tuffaceous strata that interfinger with and overlie La Boca marine member and Pedro Miguel agglomerate member. Estimated thickness at least 300 meters. Geologic map suggests that formation proper overlaps part of Caimito formation, but that relation needs confirmation. La Boca marine member apparently overlaps

Cucaracha and Culebra formations. La Boca member and presumably entire Panamá formation is not much younger than the Culebra formation and like the Culebra is considered early Miocene. Entire succession above Los Cascadas agglomerate (Culebra, Cucaracha, and Panamá formations) is believed to represent early half of early Miocene time; that is, the disputed Oligocene or Miocene.

Type area: Exposures along water front in city of Panamá, Panamá Province.

Panamint Metamorphic Complex[1]

Precambrian: Southeastern California.

Original reference: F. M. Murphy, 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 403. This investigation has supported suggestion made by earlier workers that Murphy's Panamint metamorphic complex is Archean.

Occurs in southern part of Panamint Range, Inyo County.

Panamintan series[1]

Lower Cambrian: Eastern California, western Nevada, and Utah.

Original reference; C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 80.

Named for Panamint Mountains, eastern California.

Pancho Rico facies (of San Ardo Group)

Pliocene: Western California.

T. A. Baldwin, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1986 (fig. 6), 1988. Diatomaceous and silty mudstones which bear a fauna similar to Reed Ridge, Sisquoc, and Purisima formations. Pancho Rico is lowermost of three overlapping facies in group. Underlies and interfingers with sands of Etchegoin facies. Overlies Santa Margarita sand.

Exposed on slopes of Pancho Rico Canyon and the nearby gulches which drain westward to the Salinas River near San Ardo, Monterey County.

Pandermitan series[1]

Lower Cambrian: Nevada and Utah.

Original reference: C. R. Keyes, 1927, Pan-Am. Geologist, v. 48, p. 68.

Derivation of name not stated.

Pando Porphyry

Tertiary, lower: Central Colorado.

Ogden Tweto, 1951, Geol. Soc. America Bull., v. 62, no. 5, p. 510. Quartz latite porphyry composed of scattered quartz and plagioclase phenocrysts and grains of altered biotite in light-gray or buff dense groundmass. Weak linear orientation detected in most chilled Pando porphyry, but planar orientation is indiscernible. Forms persistent sill or zone of sills in Pennsylvanian shale just above Leadville limestone; also in small sills in pre-Pennsylvanian quartzites and dolomites and in few dikes. Cut by Elk Mountain and by Eagle River porphyries.

Main sill persistent for several miles along upper Eagle River, from East Fork northward beyond Gilman, and crops out boldly on slope just east of Pando. In southern part of Gore Range, Eagle and Summit Counties.

†Panhandle Beds[1]

Panhandle Formation

Pliocene: Northwestern Texas.

Original reference: J. W. Gidley, 1903, Am. Mus. Nat. History Bull., v. 19, p. 634–635.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 27. Formation, proposed by Gidley, for pre-Clarendon beds of Texas Panhandle but usually treated as Texas equivalent of Ogallala, not in regular current use in either sense. If unambiguous term in latter sense is desired, Llano Estacado formation is available.

G. L. Evans, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 617, Cummins (1890, Texas Geol. Survey 1st Ann Rept.) did not attempt to subdivide Cenozoic of Texas, and his Blanco beds are practically a synonym for what is now known as Panhandle formation, which includes all of plains Cenozoic in Texas except Recent surface sands.

G. L. Evans, 1949, West Texas Geol. Soc. Guidebook Field Trip 2, Nov. 6–9, p. 5–6. Names Couch and Bridwell formations proposed for Pliocene units exposed along eastern side of plains in Lubbock, Crosby, and Floyd Counties. Terms Ogallala and Panhandle have been applied to most of High Plains Cenozoic beds.

May be named for the Panhandle of Texas or for town in Carson County where beds are exposed.

Paniau Volcanic Series

Pliocene(?): Niihau Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 90–91; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 12, p. 17 (table), 18–19, 42–45; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 125. Thin-bedded vesicular olivine basalts, both aa and pahoehoe, and correlative dikes and plugs. Total exposed thickness 1,281 feet. Separated from overlying Kiekie volcanic series (new) by erosional unconformity.

Type locality: East side Paniau Hill. Comprises central highland part of island.

Panoche Formation[1]

Panoche Group

Upper Cretaceous: Southern California.

Original reference: R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603.

F. M. Anderson, 1937, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1612. Upper Cretaceous Chico series subdivided into Gaines group (new), western Shasta County; Panoche group, Diablo Range; and Moreno group, Diablo Range. Panoche group, including Chico Creek and Los Gatos beds, has characteristic faunas in its upper one-third, but lower and major part is barren.

F. M. Anderson, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. Chico series subdivided into three major groups: Pioneer (new), Panoche, and Orestimba (new). Panoche group is best exposed on west border of San Joaquin Valley, where it has average thickness of 14,200 feet on flanks of Diablo Range.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1954–1955; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 7, 8 (fig. 4), 12 (fig. 6). Formation underlies Dosados sand and shale member (new) of Moreno formation in type area of Moreno.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 130–134 [preprint 1941]; 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 472. In 1915 term Panoche was introduced for Cretaceous along west side of San Joaquin Valley north of Coalinga. Later work has shown that Panoche, as mapped at that time, includes Knoxville, Paskenta, and Horsetown and extends across several disconformities. Recently term Chico series has been used to include all Upper Cretaceous and Panoche as upper group of series. This usage is unfortunate because it makes the Chico include beds separated by a disconformity which locally becomes pronounced unconformity. Two group names proposed: Pacheco below and Asuncion above, the two separated by Santa Lucian orogeny. As originally defined and mapped, Panoche formation includes not only a part of present Asuncion group and all of Pacheco group but also Shasta and Knoxville. Use of Panoche as group name would cause confusion. Panoche formation should be used for sediments, chiefly sandstones above the Pacheco and below the Moreno.

F. M. Anderson, 1943, California Div. Mines Bull. 118, p. 185–186 [preprint 1941]. Panoche group, Chico series, subdivided into (ascending) Yolo, Butte, Joaquin, and Los Gatos faunal stages.

I. F. Wilson, 1943, California Jour. Geology and Mines, v. 39, no. 2, p. 199–204, 226 (fig. 5). Group, in San Benito quadrangle, exposed on both limbs of Butts Ranch syncline for distance of about 9 miles. The two belts continue to southeast beyond limits of quadrangle and are overlapped to northwest by San Benito gravels. To the southwest, belt is 7,000 to 9,000 feet thick; northeast, belt is 5,000 to 6,000 feet. A separate mass of Panoche beds, with exposed thickness of more than 4,000 feet, occurs in northwest part of quadrangle, in Browns Valley region, where it is in fault contact with the Franciscan to north and Eocene Los Muertos Creek formation (new) to south. On northeast side of Butts Ranch syncline, divided into (ascending) Paynes shale and sandstone, Call sandstone, and Butts Ranch shale members (all new); on southwest limb, divided into (ascending) Paynes shale and sandstone, Call sandstone, and Big Oak Flat shale and sandstone (new) members. On northeast flank of Butts Ranch syncline, group is in contact with Franciscan; this contact is a fault as far east as Chemise Ridge, but east of that point appears to be depositional; on southwest side of syncline, group rests on Knoxville and Paskenta formations. Underlies Moreno shale.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Correlation chart shows that Panoche group, Coalinga-Ortigalito area, comprises (ascending) Curry Mountain shale, Long Canyon sandstone, lower Waltham shale, Juniper Ridge sandstone, upper Waltham shale, Los Gatos sandstone, Alcade shale, Joaquin Ridge sandstone, Ragged Valley shale, and Brown Mountain sandstone.

Ralph Stewart, 1946, U.S. Geol. Survey Prof. Paper 205–C, p. 85–88, pl. 9. Formation. in Reef Ridge area, Coalinga district, is 7,000 feet thick; unconformably overlies Franciscan formation and unconformably underlies Avenal sandstone.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 24–31. Formation was first mapped across northern part of Tesla quadrangle by

Anderson and Pack. They recognized that formation, as they mapped it locally, included strata of Lower Cretaceous age (Horsetown of this report), which by more detailed mapping could be differentiated from Panoche proper. In recent years, there has been tendency to divide Panoche into different formations or establish new limits for it. Except for differentiation of Horsetown beds, the sense in which Panoche was orignally mapped in this area is retained in this report. Maximum thickness about 10,000 feet. Formation is in fault contact with Franciscan and Horsetown formations; overlain gradationally by Moreno Grande formation (new); overlain unconformably by Oursan(?), Cierbo, and Neroly formations and by Livermore gravels.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 24–32, pls. 1, 2, 3. Formation described in Ortigalita Peak quadrangle where it is most widespread formation unit of map area and underlies about 100 square miles of area mapped. Maximum thickness measured 30,000 feet. East of Ortigalita Peak, overlies Wisenor formation (new) with angular discordance. Elsewhere, Upper Cretaceous sediments are in fault contact with Franciscan formation or contact is obscured by Quaternary deposits. Contact with overlying Moreno formation is gradational. Taliaferro and Anderson proposed divisions of Panoche group wherein Anderson's Pioneer group is approximately the equivalent of Taliaferro's Pacheco group and Anderson's Panoche and Moreno groups are inclusive of Taliaferro's Asuncion group. In present report, both the Pacheco and Asuncion groups of Taliaferro or Pioneer and Panoche groups of Anderson are represented though they have not been satisfactorily separated.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, Apr. 15–16, p. 4, 5 (fig. 3), 6 (fig. 4), 6 (fig. 5), 13 (fig. 6). Panoche group, in type area, subdivided into (ascending) Redil shale, Benito sandstone, Ciervo shale, Marlife shale, Television sandstone, and Uhalde sandstone and shale members (all new). In fault contact with underlying Franciscan; underlies Moreno shale.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 15). Includes Center Peak conglomerate member (new) at base.

Named for development in Panoche Hills, Fresno County.

Panola Formation[1]

Silurian and Devonian: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 2.

Named for Panola, Madison County.

Panola Granite

Age not given: Northwestern Georgia.

L. A. Herrmann, 1954, Georgia Geol. Survey Bull. 61, p. 85. Shows no visible structure but has pronounced porphyritic texture formed by small phenocrysts of microcline. Unlike Stone Mountain granite or Lithonia gneiss in structure, texture and composition.

Located near southeastern part corner of DeKalb County where it forms a small prominence known as Hog Mountain south of Panola. Of limited areal extent.

Pansy Lee Conglomerate

Upper Cretaceous or Tertiary, lower: Northwestern Nevada.

Ronald Willden, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2381 (table 1), 2391–2394. Basal unit, poorly sorted pebble to boulder conglomerate with about one-half to two-thirds of clastics being exotic chert and quartzite, and remaining one-half to one-third locally derived. Conglomerate becomes better sorted upward and amount of locally derived material decreases. Coarse-grained sandstone interbedded with pebble conglomerate through most of section. Chert clasts light to dark gray, green, and a few red or reddish brown. Quartzite clasts dark gray to almost white, well sorted, fine to medium grained, and clean. Thickness 200 to 500 feet. Underlies assorted unnamed volcanic and sedimentary rocks; unconformably overlies King Lear formation (new).

Type locality: In sec. 1, T. 36 N., R. 36 E., and sec. 6, T. 36 N., R. 37 E., just north of Pansy Lee mine on north side of low hills between Blue Mountain and Winnemucca Mountain about 10 miles northwest of Winnemucca. Also exposed in Jackson Mountains on northeast flank of King Lear Peak and on east side of south end of Trout Creek Spur.

Pantano Formation

Miocene, lower: Central southern Arizona.

R. E. King, 1939, Geol. Soc. America Bull., v. 50, no. 11, p. 1692. Incidental mention as a conglomerate, the Pantano, near Tuscon. Age not stated. Name credited to C. F. Tolman (unpub. ms.).

D. J. Brennan, 1957, Dissert. Abs., v. 17, no. 7, p. 1533. Consists of 13,762 feet of conglomerate, sandstone, and mudstone, with three andesite flows intercalated with the sediments. Underlies younger sediments and thrust block of older rocks. Probably lower Miocene.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 59. Probably equivalent to Mineta beds which are in part lower Miocene.

At Cienega Gap, Pima County.

Pantera Trachyte (in Garren Group)

Tertiary: Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Hard brownish-gray nonvesiculary andesine trachyte porphyry. No complete section exposed. Thickness about 350 feet in vicinity of type section. Overlies Hogeye tuff; disconformably underlies Moon trachyte.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Traced from type section in Wylie Mountains through the Van Horns and into northern Sierra Vieja; crops out west of Green River along eastern flank of Indio Mountains. Pinches out in center of Colquitt syncline. About 40 feet of Pantera intercalated with Chambers tuff in northern Sierra Vieja. Underlies Hogeye tuff.

Type section: South face of Pantera Peak, Wylie Mountains area, Culberson County.

Panther Conglomerate or Sandstone (in Pottsville Group)[1]

Panther Sandstone (in New River Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 185.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 97. Massive conglomeratic sandstone included in the New River group.

Exposed at Panther, McDowell County.

Panther Tongue (of Star Point Sandstone)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 180 (fig. 2). Underlies Storrs tongue of Star Point sandstone and separated from it by tongue of Mancos shale; overlies Masuk tongue of Mancos shale. A conspicuous cliff former at Helper. Can be traced from front of Wasatch Plateau, where it is 125 feet thick, to short distance east of Soldier Canyon, where it disappears in Mancos shale.

Exposed in Panther Canyon, southeast of Castlegate, Carbon County.

Panther Canyon Formation

Middle Triassic: North-central Nevada.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]; 1951, Geology of the Mount Moses quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–12]. Red shale, sandstone, conglomerate, and impure pink dolomite, weathering rusty brown. Total thickness about 700 feet in Mount Moses quadrangle. Thickness at type locality 300 feet; elsewhere, thins to 100 feet. Underlies Augusta Mountain formation; overlies China Mountain formation (new).

Type locality: Head of Panther Canyon, between Grass and Pumpernickel Valleys, Winnemucca quadrangle.

†Panther Creek Limestone Member (of Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: P. V. Roundy, K. C. Heald, and G. B. Richardson, 1922, U.S. Geol. Survey Bull. 686–Z, p. 397, pl. 55.

M. C. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 728; 1940, Oklahoma Acad. Sci. Proc., v. 20, p. 105. Abandoned; identical with Birch Creek limestone.

Named for Panther Creek in southwest part of T. 26 N., R. 12 E., Osage County, where it is well exposed along valley rim to east and west.

Panther Mountain Shale and Sandstone[1]

Middle Devonian: Eastern New York.

Original reference: G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544, 550.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Panther Mountain sandstone shown on correlation chart below Portland Point limestone and extending downward to Solsville sandstone in some areas and to base of Otsego shale and sandstone in other areas. Middle Devonian.

Type section: In face of Panther Mountain, Hamilton County, along towpath about ½ mile south of Fultonham and up Panther Creek to its head, where the Portland Point is exposed on property of T. Wayman, 3½ miles east of Summit.

Panther Seep Formation

Pennsylvanian (Virgilian) : South-central New Mexico.

F. M. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 7 (table 2), 9 (fig. 3), 42–47, pl. 1. Silty brown shales, dark carbonaceous shales, dark argillaceous limestones, massive biostromal limestones, silty calcarenites, and silty calcareous sandstones; near Ash Canyon, two gypsum beds in upper part; near Rhodes and Hembrillo Canyon, numerous biohermal reefs. Thicknesses: 800 feet, Mocking Bird Gap; 1,458 feet, Rhodes Canyon; 1,825 feet, Hembrillo Canyon; and 2,390 feet, Ash Canyon. Underlies Bursum formation and locally Hueco formation; overlies unnamed sediments of Missourian age. Correlative to most of Holder formation of Sacramento Mountains, to upper part of Bar B formation of Caballo Mountains, and to Keller and Fresnal groups as measured by Thompson (1942) in Oscura, Mud Springs, and Robledo Mountains.

Type section: In or near Rhodes Canyon. Also well exposed in Bearden Canyon. Panther Seep is in Bearden Canyon, 4.1 miles from mouth of canyon where latter joins Rhodes Canyon, San Andres Mountains. Can be mapped from Mockingbird Gap to southern end of San Andres Mountains; upper part exposed in Franklin Mountains.

Paola Limestone Member (of Iola Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 92, 97.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 68–69. Member, in Oklahoma, is 3 to 5 feet of massive calcareous sandstone and comprises three lenticular phases, which grade into each other, both laterally and vertically. Basal member of Iola; underlies Muncie Creek shale member; overlies Chanute formation.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 12, 13. Basal member of Iola formation as redefined for Missouri. Missouri Geological Survey had included Paola in Chanute formation.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Basal member of Iola. A light-gray sublithographic massive limestone with shale partings; fossiliferous. Thickness about 1 foot. Underlies Muncie Creek shale member; overlies Chanute shale.

Named for Paola, Miami County, Kans.

Paoli Limestone[1]

Paoli Limestone (in Blue River Group)

Paoli Member (of Renault Formation)

Upper Mississippian: Southern Indiana and central northern Kentucky.

Original reference: M. N. Elrod, 1899, Indiana Acad. Sci. Proc. 1898, p. 258–267.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 825; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Considered member of Renault formation in Indiana.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Michigan, The Edwards Letter Shop, p. 7, 12. Renault formation of standard Chester column has triple expression in southern Indiana (ascending): Paoli limestone, Mooretown sandstone, and Beaver Bend limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves a name in its own right. Paoli limestone rests on Aux Vases sandstone or directly on Bryantsville breccia at top of Ste. Genevieve; underlies Mooretown shale or sandstone. Present from Ohio River to about 5 miles northwest of Greencastle, Putnam County, where it is cut off and overlapped by Pennsylvanian Mansfield sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 23, pl. 1. Thickness of Paoli limestone in Indiana 2¼ to 39 feet. Commonly light-gray, gray, tan, or light-brown dense finely granular semioolitic limestone with some crystalline beds; gray or greenish-gray calcareous shale occurs in middle of formation. Overlies Aux Vases formation; underlies Mooretown sandstone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 49–50, pl. 1. Uppermost formation in Blue River group (new). Redefined to include unit formerly known as Aux Vases formation in Indiana, and term Aux Vases is rejected in Indiana. Thickness (as redefined) 29 to 38 feet. Overlies Ste. Genevieve limestone; underlies Bethel formation of West Baden group (redefined).

Named for Paoli, Orange County, Ind.

Paoli Limestone[1]

Pennsylvanian: Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

See **Paola Limestone Member** (of Iola Limestone) correct spelling.

Paonia Shale Member (of Mesaverde Formation)[1]

Upper Cretaceous: Central western Colorado.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 341, p. 320 (table), 323.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. In Anthracite-Crested Butte quadrangle, sequence of Mesaverde formation is (ascending) Baldwin sandstone (new), Rollins shale, Paonia shale, and Upper Mesaverde members.

Named for Paonia, Delta County.

Papanatas Conglomerate Member (of Redil Formation)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Red boulder conglomerate 0 to 950 feet thick at base of Redil formation (new). In fault contact with Franciscan. Name credited to D. W. Sutton (unpub. thesis).

Type locality: Papanatas Canyon, secs. 23 and 24, T. 14 S., R. 10 E., Fresno County. Name derived from Papanatas Canyon.

Papatele Trachyte

Pleistocene(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 106–108, 129–130. Small body of trachyte, probably volcanic neck, perhaps communicating

with pipe through which Pioa trachyte welled up to fill main crater. Pioa rhyolite, Matafafao, Papatele, Afono, and Vatia trachytes were erupted contemporaneously or nearly so.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285–1286 (table 1), 1302. Papatele trachyte plug is associated with Pago volcanics (new). Pliocene and early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 189. Pleistocene(?).

Crops out in Papatele summit, about 0.05 mile southeast of Pioa Peak, east of Pago Pago Bay. Covers about 0.02 square mile at Papatele Peak.

Papel Blanco Shale (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as underlying Blanco sandstone (new) and overlying middle Puente(?).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Platy siliceous shale with some chert. Thickness about 330 feet. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon, in southeastern Puente Hills between Chino and the Santa Ana River, San Bernardino County.

Paperville Formation

Middle Ordovician (Mohawkian): Northeastern Tennessee, northern Georgia, and western Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 82–83, chart 1 (facing p. 130). Thick succession of gray siltstones, black graptolitic shales and interbedded black limestones, and brown-weathering calcareous sandstones which were mapped as Athens in southeastern belts of Appalachian Valley in Tennessee. Beds form lower division of a buff-weathering shale-siltstone-sandstone succession totaling several thousand feet in thickness and overlying thin Fetzer formation [Fetzer tongue]. Underlies sandstones of "Tellico" formation. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Along Steele Creek, near Paperville, for which it is named, near Bristol, Bristol (T.V.A. 206–SW) quadrangle, Tennessee.

Papoose Volcanics

Tertiary: Northwestern Wyoming.

R. D. Krushensky, 1960, Dissert. Abs., v. 21, no. 4, p. 849. Consist chiefly of water-laid volcanic sandstones and conglomerates and some volcanic breccias. Oldest of five layered volcanic units in area. Underlie Squaw flows (new).

Hurricane Mesa area, Park County.

†Parachucla Marl[1] or Shale[1]

Miocene, lower: Southern Georgia and southwestern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 15–16, 18; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 435, 464, 466.

Named for exposures along Savannah River in vicinity of Parachucla, a locality in southeastern Georgia.

Parachute Creek Member (of Green River Formation)[1]

Eocene: Northwestern Colorado and northeastern Utah.

Original reference: W. H. Bradley, 1931, U.S. Geol. Survey Prof. Paper 168.

D. C. Duncan and N. M. Denson, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 94. Described in Garfield County, Colo., where it is essentially black-brown and gray marlstone including oil shale units; some beds of altered tuff, analcite, and chert; tongues of sandstone near base. Thickness 700 to 1,230 feet. Underlies Evacuation Creek member; overlies Garden Gulch member. Parachute Creek, Garden Gulch, and Douglas Creek members interfinger with a unit referred to as lower sandy member of Green River. Eocene.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 102, 108. Member typical only of Piceance Creek basin of western Colorado and extreme eastern part of Uinta Basin. Age of Green River given as Middle Eocene.

J. R. Donnell, 1953, Rocky Mountain Assoc. Geologists Guidebook Field Conf. May 14, 15, and 16, chart (facing p. 16). Overlies Anvil Points member (new) and underlies Evacuation Creek member in area between Rifle and De Beque Canyon, Colo. Thickness about 1,125 feet.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 407–413. Described in Duchesne, Uintah, and Wasatch Counties, Utah. Most widespread, distinctive, and continuous phase of Green River formation of Colorado and Utah. Phase extends uninterruptedly from vicinity of summit of Wasatch Range in central Utah eastward across the Green River to Evacuation Creek area near Utah-Colorado State line. As herein extended, characteristically contains thin extensive beds of oil shale and ranges in thickness from 435 to 500 feet. Underlies Evacuation Creek member.

W. B. Cashion and J. H. Brown, Jr., 1956, U.S. Geol. Survey Oil and Gas Inv. Map OM–153. In Bonanza-Dragon oil-shale area, Uintah County, Utah, and Rio Blanco County, Colo., the Parachute Creek member overlies Douglas Creek member in part of the area and Garden Gulch member elsewhere. Thickness 360 to 735 feet.

Named for exposures in vicinity of Parachute Creek, Garfield County, Colo.

Paradise Conglomerate[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 295–298.

Forms east side of Eastons Point terminating northward at Sachuest Beach near Newport, Newport County, and farther north forms Paradise Rocks.

Paradise Formation[1]

Upper Mississippian: Southeastern Arizona and southwestern New Mexico.

Original reference: A. A. Stoyanow, 1926, Am. Jour. Sci., 5th, v. 12, p. 316–320.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 29–30, pl. 1. Mapped in Peloncillo Mountains of southwestern New Mexico. In Big Hatchet Mountains and in Chiricahua Mountains, upper part of formation consists of continental deposits, but in Peloncillo Mountains no evidence of continental beds observed.

Originally described from occurrence on east face of Chiricahua Mountains, not far from Paradise, an abandoned mining camp 45 miles northeast of Bisbee, Ariz., and 10 miles west of New Mexico line.

†Paradise Limestone[1]

Silurian (Niagaran): Northeastern Utah.

Original reference: E. Blackwelder, 1910, Geol. Soc. America Bull., v. 21, p. 517–542.

Northern Wasatch Mountains.

Paradise Spring Complex

Upper Paleozoic(?): Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 504, 531–532. Mentioned in discussion of age of Hinckley Valley complex. Paradise Spring contains crinoidal segments of presumably Late Paleozoic age.

Type locality and derivation of name not given. Area discussed is Barstow quadrangle.

Paradox Formation[1]

Paradox Member (of Hermosa Formation)

Paradox Formation (in Hermosa Group)

Middle Pennsylvanian: Western Colorado and southeastern Utah.

Original reference: A. A. Baker, 1933, U.S. Geol. Survey Bull. 841.

N. W. Bass, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 7, accompanied by paper on Paleozoic stratigraphy as revealed by deep wells in parts of southwestern Colorado, northwestern New Mexico, northeastern Arizona, and southeastern Utah. Rank reduced to member of Hermosa formation. Overlies and underlies unnamed parts of formation. On basis of fusulinids, believed to be Lampasas and Des Moines in age.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2169–2173. In this report [stratigraphy of Paradox Salt basin], the Paradox is termed a formation. Comprises three unnamed members: lower member, 0 to 200 feet, is predominantly anhydrite, gypsum, black shale, and minor dolomite; middle member, chiefly Paradox salt; and upper member, 200 to 500 feet, black silty calcareous shale, grayish-brown finely crystalline argillaceous dolomite, white anhydrite, gray to white finely crystalline gypsum, and brown argillaceous fine-grained limestone. Maximum depositional thickness probably not over 5,000 feet; present thickness in anticlines ruptured by salt flowage may exceed 12,000 feet. Overlies Pinkerton Trail limestone (new); underlies Hermosa formation. Results of study prove Paradox to be entirely of Cherokee age.

George Herman and C. A. Barkell, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 5, p. 867–872. Member, as used in this paper [stratigraphy and productive zones in Paradox Salt basin], includes not only the complex evaporitic sequences with minor carbonate and black shale interbeds but also overlying, underlying, and adjacent carbonates deposited in a restricted marine environment. Lies entirely within Hermosa formation and its equivalents, horizontally interfingering with and vertically grading into open marine sediments. Member is evaporite megacyclothem composed of discrete sedimentary sequences which are complete or partial cyclothems. Contact with lower (unnamed) Hermosa member

gradational, the separation being made where open marine carbonates are overlain by either evaporites or carbonates deposited in a penesaline environment; underlies an upper Hermosa member.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2055 (fig. 3), 2056, 2065–2075. Formation in Hermosa group. Divisible into three mappable members. Lower member is penesaline complex of buff arkosic granulite, greenish-gray sandy siltstone overlain by gypsum along edge of San Luis uplift; interbedded black shale, dark-gray siltstone, gypsum, and dolomite in central part and along southwest shelves of Paradox basin; and dark-gray shales, gray porous dolomite, and gray cherty limestone higher on southwest Paradox sedimentational shelf. Middle member, or "salt member," grades shelfward into penesaline gypsum, anhydrite, and dolomite, and biohermal-biostromal dolomitic limestones. Upper member, similar to lower member, grades from penesaline strata shelfward into biostromal-biohermal dolomitic limestone, gray shale, and silty dolomite. Depositional thickness more than 4,000 feet along axis of Paradox basin. Underlies Honaker Trail formation, name introduced to replace previously used phrase upper Hermosa. Results of this study establish existence of important datum (the "P" datum), which is top of Paradox formation and, over great part of Four Corners region, is a disconformity which marks end of Paradox penesaline deposition and is mappable surface critical in evaluation of sedimentational and structural history of Paradox geosyncline.

N. W. Bass, 1958, Rocky Mountain Assoc. Petroleum Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 92, 93. In southern half of White River uplift, Colorado, name Paradox formation is applied to sequence 1,500 to 1,900(?) feet thick, that is dominated by thick beds of gypsum and interbedded black shale and underlies redbeds of Maroon formation. Overlies Belden formation.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1843, 1845. Tenderfoot member (new) of Moenkopi overlies Cutler formation and, locally, Paradox member of Hermosa formation with angular unconformity. In Sinbad Valley and Fisher Valley, Ali Baba member (new) of Moenkopi overlies the Paradox.

Type locality: Paradox Valley, Montrose County, Colo.

Parashant Tongue (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 98–99. Consists chiefly of fine- and uniform-grained dolomite which appears steely gray on fresh surfaces and weathers rusty brown. Usually contains much glauconitic and ferruginous material both as disseminated grains and in lenses. Strongly cross-laminated at Toroweap. Average thickness about 10 feet. Older than Boucher tongue (new); younger than Lava Falls tongue (new).

Thin but persistent and conspicuous unit in Cambrian sequence of Grand Canyon, extending from vicinity of Granite Park eastward at least as far as Toroweap.

Parguera Limestone (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 199; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 329–331, 333–335, pl. 1. Buff to gray

medium-bedded calcilutite and medium-bedded to massive fragmental limestone (microcoquina) with less than 15 percent tuff and a slightly smaller amount of calcarenite. Slodowski (1956, unpub. thesis) described the Parguera as part of Ensenada formation. Mitchell (1922) described exposures at Ensenada as Ensenada shale, his term for medium-bedded calcareous material. Unit redefined because Ensenada formation of Slodowski includes limestones and volcanic rocks here placed in San Germán formation. In southern structures the Parguera lies probably conformably on Río Loco formation, or where that is absent, unconformably on Bermeja complex (new). Where top is exposed, probably disconformably overlain by Melones limestone (new).

Type area: Range of hills north of fishing village of La Parguera, Mayagüez area.

Pariott Member (of Moenkopi Formation)

Middle(?) Triassic: Southwestern Colorado and southwestern Utah.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1838–1839, 1842, 1847–1848. Consists of red-brown to purplish-brown sandstone and chocolate-brown, orange, and red mudstone, siltstone, and shale. Thickness at type section 134 feet; 252 feet in Sinbad Valley, Colo.; thickens abruptly toward the west and is several hundred feet thick where it dips beneath the surface beyond northwest end of Castle Valley, Utah, where it is overlain by a lens of gray silty conglomeratic sandstone assigned by Baker (1933, U.S. Geol. Survey Bull. 841) to Shinarump conglomerate and by Dane (1935, U.S. Geol. Survey Bull. 863) to Chinle formation. Overlies Sewemup member (new); unconformably underlies Chinle formation and in some areas truncated by it.

Type section: South side of Pariott Mesa, sec. 5, T. 25 N., R. 23 E., Grand County, Utah.

Paris Formation[1]

Middle Ordovician: Central Kentucky.

Original reference: J. M. Nickles, 1905, Kentucky Geol. Survey Bull. 5, p. 15.

Named for Paris, Bourbon County.

†Paris Shale[1]

Pennsylvanian (Allegheny): Western Arkansas.

Original reference: A. J. Collier, 1907, U.S. Geol. Survey Bull. 326, p. 12, 20–21, map.

Named for Paris, Logan County.

Parita Formation[1]

Recent(?): Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 263.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat. v. 5, Amérique Latine, fasc. 2a, p. 342. Poorly defined name for surficial deposits. Recent age implied. Note on derivation of name.

Present in Coclé Province. Hershey mentioned head of Bay of Parita. There is also town of Parita, 10 kilometers northwest of Chitré.

Park Granite[1]

Tertiary: Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Occurs on northern spurs of Park Mountain, British Columbia or Washington.

Park sandstone[1]

Carboniferous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 37.

Derivation of name not stated.

Park Shale[1] or Argillite

Park Shale (in Gros Ventre Group)

Park Shale Member (of Gros Ventre Formation)

Middle Cambrian: Western Montana and northwestern Wyoming.

Original references: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55; Folio 56; 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1281, 1332–1333. Park shale, as herein emended, lies between Meagher limestone below and Pilgrim limestone above (both emended). Thickness at emended type section, 212 feet, base not exposed; maximum thickness (estimated) 330 feet on Keegan Butte, Little Belt Mountains. Dominantly green-gray, extremely fissile, nearly unfossiliferous, slightly micaceous shale. Weed did not designate type section. [See Flathead Quartzite].

Erling Dorf and Christina Lochman, 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 548. In southern Montana, underlies Maurice formation (new).

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2143–2144. Shaly beds resting conformably and transitionally on Meagher limestone in southwestern Montana are assigned to Park shale named by Weed from Little Belt Mountains and emended by Deiss (1936). Thickness 125 feet on north flank of Arrowhead Mountain, Centennial Range. Underlies Hasmark formation.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Considered uppermost formation in Gros Ventre group. Overlies Death Canyon limestone; underlies Du Noir limestone of Gallatin group.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 12 (table 1), 13. Park shale considered member of Gros Ventre formation. Overlies Death Canyon limestone member; underlies Boysen limestone. Thicknesses: 121 feet, Gros Ventre Range; 108 feet, Teton Range; 158½ feet, Snake River Range.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 10, pls. 1, 2, 3. Five lowest natural Cambrian map units in southern Elkhorn Mountains, Mont., are lithologically similar to Flathead sandstone, Wolsey shale, Meagher limestone, Park shale, and Pilgrim dolomite of nearby areas, as redefined by Deiss (1936). These formational names have been adopted. Thickness 215 feet, exclusive of andesite sills. Underlies Pilgrim dolomite; overlies Meagher limestone.

Type section (emended): On north side of Dry Wolf Creek, on eastern side of Little Belt Mountains. Emended section measured on spur east of eastern small unnamed creek which heads on Big Baldy Mountain and north of Dry Wolf Creek; locality lies in sec. 14, T. 14 N., R. 9 E. Name Big Park, referred to by Weed, is unknown to present inhabitants of Dry Creek valley, Montana.

Park City Formation[1] or Group

Permian: Northeastern Utah, northwestern Colorado, eastern Idaho, southwestern Montana, and central and eastern Wyoming.

Original reference: J. M. Boutwell, 1907, Jour. Geology, v. 15, p. 439–458.

A. A. Baker and J. S. Williams, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 623 (fig. 4), 624–625. In Diamond Fork area, Utah, overlies Diamond Creek formation (new); underlies Woodside shale.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 477. Unconformably underlies Red Wash formation (new).

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2840–2844. At type locality, formation consists of upper member (Franson, new), and lower members, composed mainly of carbonate rock, separated by Meade Peak phosphatic shale tongue of Phosphoria. Tongues of formation extend into eastern Idaho, southwestern Montana, central and eastern Wyoming, and northwestern Colorado. Lower member defined as the interbedded carbonate rock, cherty carbonate rock, carbonatic sandstone, and carbonatic siltstone that overlie Weber quartzite in Utah, Wells formation (as restricted in this report) in Idaho, Tensleep sandstone in Wyoming, and Quadrant quartzite in Montana and that underlies Meade Peak tongue of Phosphoria. Beds that Thomas (1934) called Phosphoria in Wind River Mountains are herein designated as Park City, and Ervay tongue is considered member of Park City. Intertongues with Shedhorn sandstone (new).

T. M. Cheney and others *in* V. E. McKelvey and others, 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 12–15. Unit referred to as "lower member" is here named Grandeur member; not well exposed in type section of Park City.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2178. Rank raised to group in Confusion Range. Includes (ascending) Kaibab limestone, Plympton formation (new), and Gerster limestone. Overlies Arcturus formation; underlies Thaynes formation. Group considered correlative with Park City formation in other areas.

Named for Park City district, Utah.

Park City Volcanics

Oligocene, lower: North-central Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 846; 1955, Utah Geol. Soc. Guidebook 10, p. 38, fig. 9. Chiefly andesitic. Norwood tuff (new) is fluviatile and lacustrine facies.

Present in Morgan Valley.

Park Creek Limestone Member (of Lykins Formation)

Permo-Triassic: Northern Colorado and eastern Wyoming.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Underlies Red Hill shale member (new); overlies Stonewall Creek shale member (new).

Extends northward beyond Horse Creek, Wyo., and as far south as Lykins Gulch, Colo.

Parker Formation[1]

Parker Limestone (in McLeansboro Group)

Parker Limestone (in Wabash Formation)

Pennsylvanian: Southeastern Illinois and southwestern Indiana.

Original reference: M. M. Fidlar, 1933, Indiana Acad. Sci. Proc., v. 42, p. 137, 139.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as limestone near base of Wabash formation.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart as limestone in McLeansboro group.

May or may not be same unit referred to as Parkers Formation by Malott 1947.

First described in Knox County, Ind.

Parker Quartz Diorite[1]

Upper Jurassic(?): Southern California.

Original reference: W. J. Miller, 1934, Univ. California at Los Angeles, Pub. in Math. and Phys. Sci., v. 1, no. 1, p 37–65, 83, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p 517, table 4 Listed under late Mesozoic intrusives.

Typical occurrence in Parker Mountain, west of Acton, San Gabriel Mountains.

Parker Slate[1]

Parker Shale

Lower Cambrian: Northwestern Vermont.

Original reference: Arthur Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 371.

C. E. Resser and B. F. Howell, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 202–203. Unit termed a shale.

A. B. Shaw, 1954, Geol. Soc. America Bull., v. 65, no. 11, p. 1038–1044, 1045. Lower and Middle Cambrian.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1136, 1151. In Oak Hill sequence, northwestern Vermont, the Parker slate, 25 to 100 feet thick, overlies Dunham dolomite and underlies Rugg Brook formation. Lower Cambrian. Unit herein designated Parker slate is the Oak Hill slate of Clark (1934, Geol. Soc. America Bull., v. 45, no. 1).

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 528–531, pl. 1. Parker slate described in St. Albans area. Thickness about 250 feet in southwestern part of area where it is poorly exposed; thickens to maximum of 1,000 to 1,200 feet north of Fonda quarry. Overlies Dunham dolomite with erosional unconformity; underlies Rugg Brook dolomite. Lower and Middle Cambrian. Unit might properly be called Georgia

slates, for Walcott's (1886, U.S. Geol. Survey Bull. 30) original Georgia shales began at Parker's ledge, the type locality of Parker slate, but older name has not been retained because of its confused history.

Named for exposures on old Parker farm and around sides of Parker Cobble, 2 miles northwest of Georgia Center, Milton quadrangle, Franklin County.

Parker Hill Sandstone Member (of Stanley Shale)

Pennsylvanian: Southwestern Arkansas.

N. H. Stearn *in* J. M. Hansell and J. C. Reed, 1935, Am. Inst. Mining and Metall. Engineers Trans., v. 115, p. 245. Name applied to a sandy zone about 175 feet thick, that occurs about 700 feet stratigraphically below the Gap Ridge member (new).

N. H. Stearn, 1936, Econ. Geology, v. 31, no. 1, p. 4 (fig. 2), 15–16. Thickness about 200 feet. Beds vertical. Pennsylvanian.

Named from Parker Hill mine, an important mining development in that horizon. Mine is in SE¼SW¼ sec. 1, T. 7 S., R. 26 W., Pike County.

Parker Hill Schist[1]

Pre-Devonian(?): Northwestern New Hampshire.

Original reference: F. H. Lahee, 1916, Jour. Geology, v. 24, p. 366–381.

Probably named for the Parker Hill in northwest corner of Moosilauke quadrangle.

Parkers Formation

Upper Pennsylvanian: Southwestern Indiana.

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 131–132, 133 (fig. 2), 138. Consists chiefly of shales with thin sandy beds near base, two thin coals with one near the top capped by a black sheety shale; this upper coal is the Parkers coal. Contains Rabens Branch bed (new) about 20 feet below Parkers coal and black sheety shale. Thickness 25 to 30 feet. Overlies Dicksburg Hills sandstone; underlies St. Wendells sandstone. Name is a variation of the name Parker, used for the coal, black sheety shale, and limestone of upper part of the formation by Fuller and Clapp (1904) in Patoka folio of the U.S. Geological Survey.

Name derived from Parkers Settlement in eastern Posey County, about 8 miles northwest of Evansville on State Road 66.

Parkhead Sandstone Member (of Jennings Formation)[1]

Parkhead Sandstone (in Portage Group)

Upper Devonian: Western Maryland, central Pennsylvania, and northeastern West Virginia.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 16. Geographically extended into south-central Pennsylvania where it is referred to as Parkhead sandstone at top of Portage group. Occurs above Trimmers Rock sandstone.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 91. In Washington County, Md., consists of shale interbedded with massive conglomeratic sandstone; commonly three conglomerate horizons in east—at base, in middle, and near top; lower sandstone is highly fossiliferous, and upper one very massive near Parkhead; toward the west, sandstones grade laterally into shales

that can scarcely be distinguished from overlying Woodmont shale; underlies Chemung sandstone.

Named from exposures at Parkhead Station, Washington County, Md.

Parkman Sandstone (in Montana Group)

Parkman Sandstone Member (of Claggett Formation)

Parkman Sandstone Member (of Judith River Formation)

Parkman Sandstone Member[1] (of Mesaverde Formation)

Upper Cretaceous: Northern Wyoming and southern Montana.

Original reference: N. H. Darton, 1906, U.S. Geol. Survey Prof. Paper 51, p. 13, 58.

C. H. Wegemann, 1918, U.S. Geol. Survey Bull. 670, p. 21–22. Lowermost member of Mesaverde formation. Consists of basal sandstone, 170 feet thick, a capping sandstone, 110 feet thick, and an intervening series of shale, carbonaceous shale, and coal beds, 190 feet thick. Separated from overlying Teapot sandstone member by unnamed shale interval 325 feet thick. Overlies Steele shale.

W. T. Thom, Jr., and others, 1935, U.S. Geol. Survey Bull. 856, p. 53–58, 128. At type locality, Parkman consists of conspicuous cliff-forming basal sandstone 70 feet thick, overlain in order named, by 120 feet of shale, 10 feet of white fine-grained sandstone, 75 feet of shale, and 5 feet of white sandstone. Aggregate thickness 280 feet. North of Parkman, top of sandstone is overlain by coal bed. Formation thickens northward and westward to maximum of 350 feet in northwestern part of Big Horn County, Mont. [this report], where it contains thick beds of shale. South of Crow Indian Reservation, sandstones of Parkman can be traced definitely, though not in continuous outcrop, from Parkman to Salt Creek and other localities in central Wyoming. Overlies Claggett shale; underlies Bearpaw shale. Montana group.

G. R. Downs, 1947, Wyoming Geol. Assoc. Guidebook 2d Ann. Field Conf., p. 139. Referred to as sandstone member of Claggett formation.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 63. Described in Hardin area, Montana-Wyoming, where it consists of about 250 feet of sandy shale and sandstone. Overlies Claggett shale member of Cody shale; underlies Bearpaw shale. Montana group.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 64, pl. 6. Parkman sandstone described in Johnson County, Wyo., where it is dominantly yellowish-gray sandstone, lower half of which contains large moderate-brown ellipsoidal concretions. Thickness as much as 720 feet. Overlies Cody shale; underlies Bearpaw shale. Parkman sandstone of mapped area referred to as Mesaverde formation 15 miles south of mapped area. There Mesaverde is divided into three units: Parkman sandstone member at base, unnamed member just above the middle, and Teapot sandstone member at top. The white to very light gray 8-foot sandstone at top of the Parkman in area of present report is probably equivalent to the Teapot sandstone member of Mesaverde, but lower members of Mesaverde cannot be recognized as distinct units in mapped area.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 12 (fig. 3), 14, pl. 1. Mapped in Hardin district, Montana and Wyoming, as lower member of Judith River formation. Underlies unnamed member; overlies Claggett shale member of Cody shale. Thickness about 350 feet.

J. M. Parker, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90–102. Type Parkman was originally described as a 300- to 500-foot sandstone containing harder, darker concretions. Later work in Crow Indian Reservation (Thom and others, 1935) defined Parkman formation to include sandy unit between Bearpaw shale and Claggett shale. Type Teapot sand was also named in the basin [Powder River]. Present subsurface and outcrop control makes it possible to show that type Teapot is part of original Parkman, as first described near town of Parkman and as later defined on Crow Indian Reservation. Thus, to conform to usage in the north and west-central parts of basin and to remain with original definition, the Parkman should be treated as formation with Teapot sandstone as uppermost member and the so-called Parkman of southwest Powder River basin should be designated as lower Parkman member. Hose (1955), in surface mapping in Johnson County, Wyo., considered Teapot sandstone to be upper member of his "Parkman" formation. By using formation names Bearpaw, Parkman, Claggett, Eagle, Telegraph Creek, and Niobrara, it is possible to do away with terms Lewis, Cody, Steele, and Mesaverde in this area.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2427–2428. Parkman sandstone member of Mesaverde formation, as used in this report, includes basal near-shore marine sandstone of the Mesaverde overlying Cody shale and underlying unnamed middle member of Mesaverde. A massive sandstone containing discontinuous shale lenses near base and top. Thickness 500 feet in southwestern part of Powder River basin; about 50 feet in southeastern part of Wind River basin.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 57–59, pls. Parkman sandstone described in Buffalo-Lake DeSmet area, Johnson and Sheridan Counties, Wyo., where it is about 720 feet thick. Grades into underlying Cody shale through transition zone as much as 150 feet thick. Underlies Bearpaw shale. Passes northward into nonmarine Judith River formation of central Montana.

Named for exposures near Parkman, Sheridan County, Wyo.

Parks Formation (in Kickapoo Creek Group)

Parks Formation (in Smithwick Group)

Parks Group

Pennsylvanian (Lampasas): North-central Texas (subsurface).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 84 (fig. 3), 86–87. Named as uppermost formation of Smithwick group. Includes limestones and sandstones that lie at depths of 3,626 to 3,820 feet in type well. Overlies Caddo Pool formation (new); underlies unnamed subsurface formations of Millsap Lake group.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 163. Rank raised to group. Typically consists of a variable sequence of dark shales, limestones, and sandstones between the black shales, gray, black and siliceous limestones of Smithwick group and an unconformity at the base of the conglomerates, sandstones, blue shales, and limestones of the Strawn series; in Brazos River outcrop section, this unconformity is placed at base of chert conglomerate overlying Dennis Bridge limestone at Dennis, Parker County. Near here, drilling indicates a thickness of about 1,600 feet for Parks group.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, p. 209. Kickapoo Creek group used in preference to Parks group. Parks retained as formation in Kickapoo Creek group.

Type well: Anza Oil Corp. Graham No. 1, central Young County. Named for town of Parks on Parks lease, central Stephens County.

Parks Creek Limestone (in Pottsville Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 72–73. Seville limestone was originally designated Parks Creek limestone by Savage (1927), apparently a typographical error for Barker Creek near Seville.

Derivation of name not stated but probably a creek in Fulton County.

Parks Mountain Sandstone Member (of Thrifty Formation)[1]

Parks Mountain Sandstone Member (of Chaffin Formation)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 410.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 126–127. The member called "Parks Mountain bed" by Drake is an unconformable deposit whose base on east side of Parks Mountain south of Whon cuts out Thrifty beds to a horizon within 10 feet of *Bellerophon* limestone (Drake, 1893) and whose top on account of poor outcrops is not exactly determinable, though it is at or near top of Lohn shale as defined by Drake. Interval from top of Lohn shale to lowest observed beds of Parks Mountain deposits is 99 feet, but there is reason to believe that top of Parks Mountain member lies a short distance below top of Lohn as defined by Drake. Parks Mountain may prove to lie within limits set by Drake for Lohn shale and may be represented in Brazos River area by one of the sandstone lentils below the Blach Ranch limestone. Speck Mountain limestone is cut out by Parks Mountain sandstone at south end of Parks Mountain, and 2½ miles south of Whon almost entire Thrifty formation is missing. Underlies Chaffin limestone member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Chaffin formation. Thrifty group. Cisco series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 74, pl. 27. Member of Thrifty formation. Underlies Chaffin limestone member; overlies Breckenridge limestone member. Parks Mountain was termed Avis sandstone by Bullard and Cuyler (1935) because that name had been applied to the first conglomeratic sandstone bed above the Wayland shale of Plummer and Moore (1921 [1922]) in Brazos River valley and because this conglomerate holds same relation to the Wayland along the Colorado River. The Avis of Plummer and Moore has been shown by Wallace Lee and others (1938) to have originated before the Ivan limestone member [of Graham formation] was deposited, and therefore name Avis of Bullard and Cuyler cannot be correctly applied to the stratigraphically higher Parks Mountain sandstone.

Named for Parks Mountain, Waldrip quadrangle, Coleman County.

†Parkville Limestone (in Kansas City Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 51.

Named for exposures at Parkville, Platte County.

†Parkville shale[1]

Pennsylvanian: Northwestern Missouri and southwestern Iowa.

Original reference: C. R. Keyes, 1898, Am. Geologist, v. 21, p. 349.

Named for exposures at Parkville, Platte County, Mo.

Parkwood Formation[1]

Upper Mississippian: Northern Alabama.

Original references: C. Butts, 1910, U.S. Geol. Survey Bull. 400, p. 15, 20; 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 8.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 166, chart 5 (column 90). Formation, recognized only in small area in east-central Alabama, at various places overlies Pennington shale, Bangor limestone, or Floyd shale. Relations of these formations not clear; Pennington shale may grade laterally into either or both the Floyd and Parkwood; Floyd and Parkwood may also be gradational.

H. E. Rothrock, 1949, Alabama Geol. Survey Bull. 61, pt. 1, p. 18–19, fig. 2. Traced from outcrop in vicinity of Birmingham to southeast side of Shoal Creek valley. In this area, conformably overlies Floyd shale and underlies Shades sandstone member of Pottsville formation. Gray or olive-brown claystone and siltstone with fine-grained sandstone at base and tough black claystone at top. Thickness 460 feet. Mississippian.

R. B. Morton, 1949, Mississippi Geol. Soc. Guidebook 7th Field Trip, p. 37, 38, 40. Includes Little Shades sandstone (new) in basal part.

W. H. Robinson, J. B. Ivey, and G. A. Billingsley, 1953, U.S. Geol. Survey Circ. 254, p. 51. In Birmingham area, consists of about 2,000 feet of sandstone and shale, shale generally predominating.

Named for exposures at Parkwood, Jefferson County.

Parma Sandstone[1]

Pennsylvanian: Southern Michigan.

Original reference: A. Winchell, 1861, Michigan Geol. Survey 1st Bienn. Rept. Prog., p. 112, 138.

G. V. Cohee, Carol Macha, and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Basal formation of Pennsylvanian of Michigan. Thickness commonly less than 100 feet; attains maximum thickness of 150 feet in northeastern Clare County. Underlies Saginaw formation; overlies Bayport limestone.

Named for exposures at Parma, Jackson County.

Parmachenee Formation

Silurian(?): Central western Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19, no. 10, p. 2577. Thinly bedded gray phyllites, impure biotite quartzites, and black limestone. Contains notable amounts of pyrite and pyrrhotite. Older than Madrin formation (new); younger than Perry Mountain formation (new).

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Carbonaceous argillaceous quartz silts in Kennabago Lake quadrangle. Thickness about 2,000 feet. Silurian (?).

In Anson and Kennebago quadrangles.

Parrish Limestone Bed (in Cashaqua Shale Member of Sonyea Formation)

Parrish Limestone Lentil (in Cashaqua Shale[1] Member of Sonyea Formation)

Upper Devonian: West-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 31–32.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 12, 13. Lentil overlies Rock Stream flagstone member (new) of Cashaqua shale. Underlies Rhinestreet shale.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 17–18, 53, 55, figs. 2, 5. Rye Point member (new) of Cashaqua formation includes red and green nodular limestone bed known as Parrish limestone lentil (Clarke and Luther, 1904).

U.S. Geological Survey currently classifies the Parrish as a bed in Cashaqua Shale Member of Sonyea Formation.

Well exposed in Parrish Gully at Parrish, Ontario County.

†Parsons Formation (in Pleasanton group)[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams, 1903, U.S. Geol. Survey Bull. 211, p. 33.

U.S. Geological Survey has abandoned the term Parsons Formation because the following members are now treated as separate formations: Lenapah, Nowata, and Altamont.

Named for Parsons, Labette County.

Parsonsburg Sand

Pleistocene (late Wisconsin): Southeastern Maryland (subsurface and surface).

W. C. Rasmussen and T. H. Slaughter, 1955, Maryland Dept. Geology, Mines and Water Resources Bull. 16, p. 114 (table 17), 118–119. Composed predominantly of medium-grained sand but is poorly sorted. Materials range from size of small boulders (rare), through cobbles, gravel, very coarse to very fine sand, silt, and clay. In color, it is buff, tan, orange, or brown. Thickness in reference locality 25 feet; elsewhere ranges from a fraction of a foot to as much as 33 feet. In different places, rests unconformably on each of the earlier Pleistocene deposits. In reference locality, overlies the Walston silt (new). Overlain only by soils, alluvium, and peat of Recent series.

Reference locality is test hole Wi–Bg 11 at Melson, at north end of Parsonsburg Ridge. Named for Parsonsburg, a village 6 miles east of Salisbury.

Parting Member (of Chaffee Formation)

Parting Quartzite Member (of Chaffee Formation)[1]

Upper Devonian: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1883, U.S. Geol. Survey Leadville Atlas; 1886, U.S. Geol. Survey Mon. 12.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 170–174. Described in Pando area where it is 45 to 57 feet thick, underlies Dyer dolomite member, and unconformably overlies Harding quartzite.

I. H. Mackay, 1953, Colorado School Mines Quart., v. 48, no. 4, p. 22, 27, 28. Described in Eagle and Pitkin Counties where it is 104 to 114 feet thick, underlies Dyer dolomite member, and disconformably overlies Manitou dolomite.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 907. In White River Plateau region, Parting member of Chaffee formation overlies Tie Gulch dolomite member (new) of Manitou formation (redefined). Top section in this area.

Named for exposures on Parting Spur, the spur that extends northwest from Dyer Mountain toward West Dyer Mountain, Lake County, east of Leadville.

Parting Shale

Parting Shale Member (of Oswaldo Formation)

Lower Pennsylvanian: Southwestern New Mexico.

Harrison Schmitt, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 780 (table), 781. Rests disconformably on Hanover limestone, the contact marked locally by thin conglomerate which is in places mainly white chert derived from underlying Hanover limestone. Where unmetamorphosed, the shale contains abundant plant remains. Some layers should be classified as fine-grained sandstone which, near main intrusive in area, is metamorphosed to quartzite. Thickness 18 feet. In lower Magdalena; underlies middle blue limestone.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284. Basal member of Oswaldo formation. Thickness 18 to 20 feet.

Central Mining district, in vicinity of Hanover, Grant County.

Partridge Formation

Partridge Slate[1]

Upper Ordovician (?): Central and southern New Hampshire.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Formation described. Chiefly dark-gray slate in chlorite metamorphic zone; includes thin-bedded light-gray quartzite and buff soda-rhyolite tuff at base. Is a gray mica schist in staurolite and sillimanite metamorphic zones. Age shown as Upper Ordovician (?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 19–21, 98. Maximum thickness 2,000 feet. Discussion of age; may be Middle Ordovician.

Named for Partridge Lake, Littleton Township, Grafton County.

†Partridge Point Formation[1]

Middle Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin, Jr., and G A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 593. Name Partridge Point should be abandoned in favor of Thunder Bay limestone.

Type locality: East shore of Partridge Point, 3 miles south of Alpena, Alpena County.

Parunuweap Formation

Pliocene(?): Southwestern Utah.

H. E. Gregory, 1945, Jour. Geology, v. 53, no. 2, p. 110–115. Includes conglomerates and alluvial or lacustrine silts. In Virgin and Parunuweap Valleys, conglomeratic phase consists chiefly of angular slabs of gray sandstone 1 to 4 feet in length, partly worn pebbles of limestone, elongated iron concretions 1 to 12 inches in diameter, and rounded pebbles of quartz, quartzite, and chert. In Kanab Valley, conglomerate includes angular blocks of basalt and many mud balls. In Coal Valley, chief components are slabs of pink and red limestone, gray sandstone, and rhyolite 1 to 3 feet in diameter, angular and rounded pebbles of quartzite, and chips of chalcedony. Along branches of Paria River, coarse gravels have consolidated into caliche mass that forms caps of mesas 50 to 70 feet above stream bed. Thickness 30 to 80 feet. Overlies Triassic, Jurassic, and Cretaceous formations; unconformably underlies sheets of basalt, talus, stratified sand, and gravel of very recent age.

Named for typical exposures in Parunuweap Valley—Kane, Washington, and Iron Counties.

Par Value Member (of Montoya Dolomite)

Upper Ordovician: Southwestern New Mexico.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 17. Composed of alternating bands of red chert and gray dolomite. Proportions are about one-third chert and two-thirds dolomite. Thickness at type locality 65 feet. Underlies Raven member (new); overlies Second Value member (new).

Typically developed on Par Value claim, Boston Hill mining district, Grant County.

Pasadena Formation[1]

Miocene: Southern California.

Original reference: R. Arnold and A. M. Strong, 1905, Geol. Soc. America Bull., v. 16, p. 188.

Flanks San Rafael Hills on south and underlies southern part of city of Pasadena, Los Angeles County.

Pasamonte Flow

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 138 (table 5), 139, 145. Oldest flow on east side of Don Carlos Hills.

Don Carlos Hills are in southwestern Union County.

Pasayten Andesite[1]

Lower Cretaceous: Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map. 4.

Pasayten River, British Columbia and Washington, crosses this mass.

Pasayten Formation[1]

Pasayten Group

Lower Cretaceous: Central northern Washington, and southern British Columbia, Canada.

Original reference: G. O. Smith and F. C. Calkins, 1904, U.S. Geol. Survey Bull. 235.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1533–1534, chart 10e (column 60). Shown as Lower and Upper Cretaceous on correlation chart. Includes red beds at top. Stratigraphically above Dewdney Creek formation. Age limits uncertain.

Term Pasayten group is used in Canadian publications.

Named for occurrences in Pasayten River valley.

Pasayten Volcanic Formation[1]

Lower Cretaceous: Central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 14.

Occurs in only one part of boundary belt, on densely thicketed slopes of Pasayten River valley.

Pascagoula Clay[1] **or Formation**

Miocene, upper: Mississippi, southwestern Alabama, and Louisiana.

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 12th Ann. Rept., pt. 1, p. 409.

G. F. Brown and W. F. Guyton, 1943, Mississippi Geol. Survey Bull. 56, p. 30–50. In area of Camp Van Dorn, formation includes Homochitto member below and Fort Adams member above (both new). Overlies Hattiesburg formation; underlies Citronelle formation and younger terrace deposits. Report deals mostly with ground-water supply.

Named for exposures along Pascagoula River, in Jackson County, Miss.

Paskenta Formation[1]

Paskenta Group

Paskenta Stage

Lower Cretaceous (Shasta Series): Northern California and southern Oregon.

Original reference: F. M. Anderson, 1902, California Acad. Sci. Proc., 3d ser., Geology, v. 2, no. 1, p. 43–47.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 38 (table 1), 41–61. Name Paskenta was suggested by writer (Anderson, 1902) for lower part of Shasta series, as since defined, in belief then prevalent that it formed representative part of Knoxville series. Later investigation has shown that Knoxville is distinctly Jurassic, whereas Paskenta group has chronological range strictly within the Cretaceous-Berriasian-Valanginian and is distinct from Knoxville. Paskenta forms lower part of Shasta series and underlies Horsetown group. In its type district (Elder Creek to Thomas Creek and southward), group begins at south with massive lenses of conglomerate, above which it is prevailingly sandy with alternating beds of sandstone and sandy shales. Group has been identified stratigraphically and faunally on both sides of delta area—that is, in

its type area and in Cottonwood district. Thickness 11,000 feet in axial area of delta; 8,000 feet on Middle Fork of Cottonwood; about 4,000 feet on Roaring River; and 5,300 feet in type district. In most sections, line of division between Paskenta and Horsetown has been determined faunally although in some places separation is aided by lithological changes. Includes several faunal zones.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 184 (fig. 68) [preprint 1941]; 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 916. Overlies Newville group (new) of Knoxville series.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 458–459. Discussion of Cretaceous of Santa Lucia Range. In northern California, the Lower Cretaceous has been divided into two groups, Paskenta and Horsetown. It is believed that names Paskenta and Horsetown should be used as approximate faunal stages rather than group terms. Name Marmolejo formation is proposed for Lower Cretaceous of Santa Lucia Range.

F. G. Wells, 1955, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–38. Paskenta formation of Anderson (1902) mapped in southern Oregon.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2101 (fig. 2), 2103. Term Paskenta is used as stage name for lower part of Shasta series; occurs below Horsetown which is redefined as stage and discussed in detail. Rocks included in Anderson's "Horsetown group" and uppermost strata of his "Paskenta group" in vicinity of Ono have been subdivided into Ono and Rector formations (both new), the boundaries of which are not coincident with Anderson's group.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Franciscan group is widely held to be restricted to Late Jurassic age, the Knoxville to be an upper shaly phase of Franciscan group, and the two to be overlain unconformably by detrital strata of Cretaceous age. Paleontologic evidence indicates this view to be incorrect. Franciscan group seems mainly to have been deposited contemporaneously with the Knoxville, Paskenta, Horsetown, and lower Upper Cretaceous.

W. D. Wilkinson and others, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 16. Paskenta formation listed in catalog of pre-Tertiary formations of Oregon. The 4,000 feet of dark or yellowish Cretaceous clay shales forming upper part of Knoxville of previous reports. Contains typical subtropical fauna with abundant *Aucella*.

Type district (Anderson, 1938): Immediately above village of Paskenta in western Tehama County, Calif., extending northward beyond Elder Creek, and southward toward Newville.

Paso Robles facies (of San Ardo Group)

Pliocene: Western California.

T. A. Baldwin, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1986 (fig. 6), 1988. Marine and nonmarine pebble beds, silica-cemented sands, and fresh-water clays, in part equivalent to original Paso Robles formation. Paso Robles is uppermost of three overlapping facies in group. Overlies and grades laterally into Etchegoin facies.

Exposed on slopes of Pancho Rico Canyon and nearby gulches which drain westward to Salinas River near San Ardo, Monterey County.

Paso Robles Formation[1]

Pliocene and Pleistocene(?): Western California.

Original reference: H. W. Fairbanks, 1898, Jour. Geology, v. 6, p. 565–566.

R. G. Frame, 1938, California Oil Fields, v. 24, no. 2, p. 27–47. Described in Santa Maria oil district as interbedded unconsolidated fine- to coarse, bluish- to buff-colored sands and gravels, and beds of bluish-colored clay. Unconformably underlies surface alluvium and gravels; overlies Foxen formation. Thickness 250 to 500 feet (determined from well records).

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1336 (fig. 1), 1340 (table 1), 1358–1359. Conformably overlies Careaga sandstone; unconformably underlies Orcutt sand. Maximum exposed thickness about 2,000 feet. Upper Pliocene to lower Pleistocene(?).

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 39 (fig. 3), 47–50, pls. 1–5. Described in southwestern Santa Barbara County as a series of terrestrial gravels, sands, and clays of probable uppermost Pliocene and lower Pleistocene age conformably overlying Careaga sand. Extensively exposed in San Rafael foothills where it attains a maximum thickness of 4,500 feet; thins to southwest to about 2,000 feet in vicinity of Los Alamos Valley and to about 700 feet under Santa Rita Valley. Underlies Orcutt sand; discordance.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 49–51. Maximum exposed thickness 2,000 feet in Santa Maria district. Underlies Orcutt sand; overlies Careaga sandstone. Late Pliocene and early Pleistocene(?). Type region designated.

W. E. Ver Plank, 1952, California Div. Mines Bull. 163, p. 40. Discussed in connection with gypsum deposits in San Benito County. Contains lenses of gypsum 3 to 6 feet thick and up to 300 yards in diameter.

Type region: Salinas Valley in Coast Ranges northwest of Santa Maria district.

Paspotansa Greensand Marl Member (of Aquia Formation)[1]

Eocene, lower: Eastern Virginia and eastern Maryland.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene Volume, p. 58, 62–64.

R. A. Schmidt, 1948, Jour. Paleontology, v. 22, no. 4, p. 390, 392 (table 1), 393. Paspotansa greensand marl member (above) and Piscataway indurated marl member (below) are present at type locality of Aquia formation. They cannot be distinguished on basis of their ostracods. Lower Eocene.

Named for Paspotansa Creek, which enters Potomac River from Virginia bank, a mile below Potomac Creek.

Passaconaway Syenite

Carboniferous(?): East-central New Hampshire.

A. P. Smith and others, 1938, Geologic map and structure sections of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Passaconway [Passaconaway] syenite described as coarse- to medium-grained green syenite. Belongs to White Mountain magma series.

A. P. Smith, Louise Kingsley, and Alonzo Quinn, 1939, Geology of Mount Chocorua quadrangle, New Hampshire: Concord, New Hampshire State Plan. Devel. Comm., p. 8, 18. Referred to as Passaconaway syenite.

Crops out in area bounded roughly by Mount Passaconaway, Mount Whiteface and Hibbard Mountain in northern part of Mount Chocorua quadrangle.

Pass Creek Sandstone

Pennsylvanian and (or) Permian: South-central Colorado.

D. W. Bolyard, 1956, Rocky Mountain Assoc. Geologists Guidebook to geology of the Raton Basin, Colorado, p. 52, 55–56; 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1904 (fig. 4), 1918–1919. Nonfossiliferous, greenish-gray to grayish-green medium- to light-gray, and pink sandstones, with a few interbeds of dark gray to black shale, siltstone, and limestone; lamination, cross-lamination, and crossbedding common. Thickness about 1,000 feet. Overlies Madera formation; underlies Sangre de Cristo formation. Contact with Sangre de Cristo obscured by faulting. Brill (1952) included these beds in Sangre de Cristo.

Named from exposure about 1½ miles south of Pass Creek Pass on U.S. Highway 160, Sangre de Cristo Mountains, between La Veta Pass and Westcliffe.

Pass Peak Conglomerate

Eocene, middle: Northwestern Wyoming.

A. J. Eardley and others, 1944, Hoback-Gros Ventre-Teton Field Conf. [geologic map]. Privately printed. Coarse red and gray conglomerates that grade into sandstone and shale toward basin. Thickness 1,000 to 5,000 feet. Unconformable below Camp Davis conglomerate (new); unconformable above Hoback formation (new).

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 74–75. Locally rests with angular unconformity on Hoback formation along eastern border of Hoback Range and near head of Little Granite Creek; in upper Horse Creek and Cache Creek drainages rests on Frontier formation. Derivation of name given.

J. A. Dorr, Jr., 1958, Geol. Soc. America Bull., v. 69, no. 10, p. 1218 (fig. 1). Early(?) Eocene.

Named from Pass Peak, a high point on Hoback basin-Green River divide about 4 miles north of point where U.S. Route 287 crosses divide.

Pasto Andesite

Eocene, pre-middle(?): Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 109–112, geol. map. Light- to medium-gray hornblende andesite that contains abundant phenocrysts of hornblende and common xenoliths of amphibole or hornblendite. Intrudes Ildefonso formation (new) and Robles formation, does not intrude Eocene Jacaguas group (new).

Typically exposed at Pasto in southwestern part of Barranquitas quadrangle. Crops out largely in Coamo, Barranquitas, and Río Descalabrado quadrangles.

Pastoria Sand Member (of White Bluff Formation)

Eocene (Jacksonian): Southeastern Arkansas.

L. J. Wilbert, Jr., 1953, Arkansas Div. Geology Bull. 19, p. 39, 40–56. Name applies to one of three marine facies of formation. Includes the more clastic elements of the formation. Typically argillaceous sand containing glauconite and molluscan remains. At type locality, estimated thickness is

about 65 feet, base not exposed; thins northward to about 20 to 25 feet at South Red Bluff. Stratigraphically equivalent with Caney Point marl member; underlies Rison clay member and, in some areas, the Redfield formation; contact with underlying Claiborne gradational.

Type locality: White Bluff on Arkansas River, 3½ miles east of Redfield, Jefferson County. Name is derived from Pastoria quadrangle.

Patagonia Group

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Contains Molly Gibson formation (new). Older than Santa Cruz group (new); younger than Bisbee group.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 30–31, 53. Sequence composed mainly of dark shales sporadically interbedded with arenaceous strata and volcanics and, in the upper third, with bedded arenaceous limestones (Molly Gibson formation). Geographic area given. Total thickness about 5,850 feet.

In Patagonia Mountains.

Patagonia limestone

[Upper Devonian] (Tombstonian): Southeastern Arizona.

[C. R.] Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 227, 228 (table). Name applied to the great median sector of the Martin limestone of Ransome (1904). Thickness 250 feet. Underlies Espinal formation (new); overlies Escacado limestone (new).

Name derived from well known mining camp in Santa Rita Mountains north [west-northwest] of Bisbee.

Patapsco Formation (in Potomac Group)[1]

Upper Cretaceous: Delaware, eastern Maryland, and eastern Virginia.

Original reference: W. B. Clark, 1897, Maryland Geol. Survey, v. 1, p. 156, 191.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 7–8. Patapsco is of Upper Cretaceous age because it lies between Arundel clay, which contains reptiles having Upper Cretaceous affinities, and Monmouth formation, which carries large marine fauna of late Upper Cretaceous. Presumably occupies position well down in series because it seems more closely related to Arundel than to Monmouth, from which it is separated by a gap representing several marine and nonmarine formations (Matawan, Magothy, and Raritan). Estimated thickness 200 or 300 feet.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2169 (fig. 1), 2173–2177. Lower Cretaceous. Assignment is made on basis of both floral and faunal evidence. Detailed discussion of problem.

Named for occurrence in valley of Patapsco River, Md.

Patillas Quartz Monzonite[1]

Age(?): Puerto Rico.

Original reference: C. R. Fettke, 1924, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 161.

Pato Red Member (of Vaqueros Formation)[1]

Miocene, lower: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 41. Mentioned in discussion of gypsum deposits in Ventura County. Gypsiferous zone occurs in the middle Miocene Caliente red beds which English designated the Pato member of the Vaqueros formation.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2995. These beds are here considered a part of Caliente formation.

Named for exposures in Pato Canyon, Cuyama Valley.

Patrick Greenstone[1]

Cretaceous(?) : Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, no. 1–2, p. 134, map.

J. C. O'Brien, 1952, California Jour. Mines and Geology, v. 48, no. 4, p. 265. Mentioned in report on mineral resources of Del Norte County.

Occurs in Del Norte County. Map shows Patrick Creek cutting across the greenstone.

Patriot Limestone (in Conemaugh Formation)[1]

Pennsylvanian : Eastern Ohio.

Original reference : D. D. Condit, 1909, Ohio Nat., v. 9, p. 484.

Probably named for Patriot, Gallia County.

Patterson Limestone Member (of Shady Dolomite)[1]

Lower Cambrian : Southwestern Virginia.

Original reference: Charles Butts, 1933, Virginia Geol. Survey Bull. 42, p. 3, map legend.

G. W. Stose and A. I. Jonas, 1939, Virginia Geol. Survey Bull. 51–A, p. 14–15, pl. 1. Name Patterson, given by Butts (1933) to lower ribboned blue dolomite and limestone of Shady, is appropriate for these beds in main part of Great Valley north of Gleaves Knob overthrust because Patterson, the type locality, is located on these rocks. Name Patterson will be used in this sense in this report (Wythe and Carroll Counties) with understanding that it is not appropriate for the lower part of the Lower Cambrian rocks south of Gleaves fault, where sequence is different. Thickness about 620 feet. Underlies an unnamed massive white saccharoidal dolomite, 200 feet thick in upper part of the Shady; overlies Erwin quartzite.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 41–42. In Wythe and Pulaski Counties, Patterson underlies Austinville dolomite member (new).

Type locality: Patterson, Wythe County, where more than 100 feet is exposed in bluff on west side of Little Reed Island Creek.

Patterson Point Formation

Quaternary : Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 180–181, pl. 23. Dacitic ash and pumice and dacitic and andesitic pyroclastic debris. Upper unit 10 to 15 feet thick consists of light-grayish-white to bluish-gray, firmly consolidated ash and pumiceous lapilli. Lower unit as much as 25 feet thick consists of salmon-pink to grayish-white, very firmly consolidated or welded dacitic glass and pumice. Deposit several hundred feet thick. Generally massive. Overlies Double Point dacite (new).

Type section: In stream cut north of the 1,980 foot mountain at lat 51°57'40'' N., long. 178°30'50'' E., Little Sitkin Island, in Rat Islands group of Aleutian Islands. Extends 2 miles northwestward from Little Sitkin volcano toward Patterson Point.

Patterson Ranch Group

Ordovician: South-central Oklahoma.

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 153–155. Name proposed for limestone-shale series of formations—Viola, Fernvale, and Sylvan. Overlies Simpson group; underlies Silurian formations.

Name taken from Patterson Ranch on south edge of Arbuckle Mountains on east side of U.S. Highway 77. Formations are characteristically exposed on ranch and extend from highway eastward across it.

Pattiway Formation

Eocene(?): Southern California.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2977–2981. At type locality, formation unconformably underlies Simmler formation, but base is unexposed. Total exposed thickness 3,680 feet. Upper 3,300 feet composed predominantly of light-gray to buff, hard medium-grained arkosic sandstones with minor interbeds of dark-gray carbonaceous siltstone; upper part of this sandstone unit contains several lentils up to 30 feet thick of brown conglomerate made up of rounded cobbles of quartzite and granitic and dark porphyritic rocks; sandstone series grades downward into dark-gray micaceous silty shale containing carbonaceous materials; approximately 380 feet of this shale crops out and forms lowest exposed part of Pattiway. Overlies unnamed Upper Cretaceous sandstones and conglomerates. Age of formation not known definitely because it is generally unfossiliferous; lower shale of Caliente Range section has yielded a foraminiferal fauna suggesting an Eocene or Cretaceous age; lithologically unlike Cretaceous strata of region, and field relations indicate an Eocene age as most probable.

Type locality: Extreme southeastern end of Caliente Range, T. 10 N., R. 25 E., east of Cuyama Ranch and Ballinger Canyon quadrangles. Name derived from former settlement of Pattiway, a few miles east.

Patton Limestone (in Greenbrier Limestone[1] or Series)

Middle Mississippian (Meramecian): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450, 480.

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 903. Denmar formation (new) includes Sinks Grove and Patton limestones of Reger (1926). Age of Denmar Middle Mississippian (Meramecian series).

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1910–1912. The Patton and Sinks Grove do not represent a single stratigraphic unit; in Monroe County, where they were named, they are separated by 10 to 20 feet of plant bearing shale [Patton shale]. Use of term Denmar for these two units is without merit. Middle Mississippian.

Type locality: On south side of Second Creek just south of Patton, Monroe County, W. Va.

Patton Shale (in Greenbrier Limestone)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450, 483.

Type locality: Northeast of Union, Monroe County, along Pickaway-Hillsdale road 0.8 mile southeast of Pickaway. Named for association with Patton limestone.

Patton Shale Member (of Pocono Formation)[1]

Patton Formation or Shale

Mississippian: Western Pennsylvania.

Original reference: M. R. Campbell, 1904, U.S. Geol. Survey Geol. Atlas, Folio 110.

P. A. Dickey, R. E. Sherrill, and L. S. Matteson, 1943, Pennsylvania Geol. Survey, 4th ser., Bull. M–25, p. 14–15. Mississippian strata of Oil City quadrangle are classified (ascending) Cussewago group, Berea group (including Corry sandstone), Cuyahoga group, Shenango formation, and Patton formation. The Patton consists of light-bluish-gray clay shale with included layers or lenses of poorly bedded soft red and green shale and fine- to medium-grained greenish-gray argillaceous sandstone. Thickness 60 to 70 feet.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227, p. 13. Member of Pocono formation. In Hollidaysburg-Huntingdon area underlies Burgoon sandstone member. Thickness about 40 feet.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 160, chart 5 (columns, 82, 106). Column 82, northwestern Pennsylvania, shows Patton shale above Shenango formation; in Osagean series. Column 106, subsurface southwestern Pennsylvania, shows Patton shale above Second gas sand and below Squaw sand; Kinderhookian series. According to text explanation of column 82, beds termed Patton consist largely of shale and include red beds. There is little or no evidence that these beds are of equivalent age at different places, and the Patton of northwestern Pennsylvania might as readily be correlated with part of the Maccrady of West Virginia or even part of Mauch Chunk of eastern Pennsylvania.

B. N. Cooper, 1948, Jour. Geology, v. 56, no. 4, p. 259 (footnote). Name Patton shale, which appears on Mississippian correlation chart (Weller and others, 1948) is invalid by reason of prior use of Patton for an older shale of Pocono age in western Pennsylvania.

R. C. Bolger and C. E. Prouty, 1953, Pennsylvania Acad. Sci., v. 27, p. 125. In Cameron County, Patton formation, about 60 feet thick, directly underlies Burgoon sandstone.

Named for outcrops on Redbank Creek, at Patton, near west line of Jefferson County.

Patuxent Formation (in Potomac Group)[1]

Lower Cretaceous: Eastern Maryland, Delaware, and eastern Virginia.

Original reference: W. B. Clark, 1897, Maryland Geol. Survey, v. 1, p. 156, 190.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Water Resources Bull. 10, p. 2–4, 5. Oldest formation of Coastal Plain in region of Prince Georges County and lies directly on crystalline rocks. Formation contains many unconformities, and there is presumably one at top separating it

from overlying Patapsco formation. Locally, in District of Columbia, underlies red gravel thought to be the Bryn Mawr (Pliocene?). Unconformably underlies Arundel formation here considered Upper Cretaceous.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2173–2177. Reanalysis of Potomac group floras substantiates views expressed by earlier workers (especially Berry and Seward) that Patuxent and Arundel floras are essentially similar associations comparable in age and composition with Wealden flora of England, which at present is considered of Neocomian age. Detailed discussion of problem.

Named for development in upper valleys of Little and Big Patuxent Rivers, Md.

Pauba Formation

Pleistocene, upper: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 3, 9, 13–14, pl. 1. Series of coarse fanglomerates and interbedded sands and silts about 500 feet thick. Unconformably underlies Dripping Springs formation (new); overlies Temecula arkose (new) with angular unconformity.

Occurs in Elsinore fault zone in western Riverside and northern San Diego Counties. Named from Pauba Rancho, east of Temecula, Riverside County.

Paularino Member (of Topanga Formation)

Miocene, middle: Southern California.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. Consists primarily of a poorly exposed sequence of interbedded sandstone, siltstone, and breccia. Estimated maximum thickness 1,275 feet. Unconformably underlies Capistrano formation of late Miocene to early Pliocene age and unnamed sandstone of Pliocene and early Pleistocene(?) age. Overlies Los Trancos member (new) with probable disconformity.

Type area: North of Bonita Reservoir on Bonita Creek at northwest edge of San Joaquin Hills, Orange County. Name taken from Paularino Avenue near northwest margin of map.

Paulian glaciation

Paulian till[1]

Pleistocene (Wisconsin): Central Minnesota.

Original references: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203, 217; 1933, v. 60, p. 55.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 69, no. 2, p. 108 (fig. 2), 129. Referred to as glaciation.

Paulina Peak Rhyolites

Pleistocene: Central Oregon.

Howel Williams, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 261, 265–266, 281. Discussion of history of Newberry volcano. Paulina Peak rhyolites consist of as many as 12 flows with total thickness of at least 1,000 feet. Earliest rhyolites are pale gray, porphyritic and platy lavas, some are so vesicular as to be almost pumiceous. Platy rhyolites are succeeded by dense flows in which banding is less pronounced, and these by black pitchstones overlain by finely laminated flows. Near summit are many varieties of obsidian.

The rhyolite flows form girdle of cliffs that rise to Paulina Peak and the high shoulder running toward southwest.

Paupack Sandstone (in Catskill Formation)[1]

Paupack parvafacies (in Shohola facies group)

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 59, 68, 169, 170, 199, 200.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7). Shown as a parvafacies in Shohola facies group.

Named for Paupack Falls on Wallenpaupack Creek, Palmyra Township, Pike County.

Paupack Shales (in Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 68.

Name derived from Paupack Falls, Pike County.

Pauwalu Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 94, 95 (table). Oldest Hana lava in Keanae Valley. Dense fine-grained olivine aa basalt, jointed in columns 6 inches to 2 feet in diameter, with layer of clinker at top. Exposed thickness in sea cliff 130 feet; at Piinaau Falls, about 175 feet exposed, separated into two distinct layers by bed of clinker.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 125. Pleistocene(?).

Named after Pauwalu Point, where it is exposed in sea cliff, filling valley cut into older alluvium. Valley is about 2,000 feet wide at coast and extends to unknown depth below sea level.

Pavant Flow

Pliocene, upper, or Pleistocene, lower: Central Utah.

G. B. Maxey, 1946, Am. Jour. Sci., v. 244, no. 5, p. 328, pl. 1. Oldest flow in area. Lava beds are horizontal, underlie Pleistocene lake beds and Recent deposits, and were extruded probably in late Pliocene or early Pleistocene. Underlies Tabernacle flow (new).

P. E. Dennis, G. B. Maxey, and H. E. Thomas, 1946, Utah State Engineer Tech. Pub. 3, p. 28, pl. 1. Thickness about 1,800 feet. Base not exposed.

Extends from southern end of Pavant Valley to Pavant Butte at northern extremity of valley, Millard County. More than 5 miles wide.

Pavlof Volcanics

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Agglomerate and interbedded lava flows. Name appears only on geologic map legend.

Mapped on summit and flanks of Pavlof Volcano, Alaska Peninsula.

Pavlof Sister Volcanics

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, pl. 2. Agglomerate and interbedded lava flows. Name appears only on geologic map legend.

Mapped on flanks of Pavlof Sister Volcano, Alaska Peninsula.

Pawhuska Limestone[1] or Formation[1]

Pennsylvanian (Virgil Series): Northeastern and central northern Oklahoma.

Original reference: J. P. Smith, 1894, Jour. Geology, v. 2, p. 199.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 98–99. Pawhuska formation does not crop out in Seminole County. Mentioned here because it has been mapped or traced across much of county by many geologists. Beds so mapped are ledges 9, 11, and 12 in upper part of Vamoosa formation. Pawhuska is truncated in or near sec. 20, T. 11 N., R. 7 E., in western Okfuskee County by overlying Ada formation.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 48–51, pl. 1. Formation is about 150 feet thick in northern Osage County and comprises (ascending) Lecompton, Plummer, Deer Creek, Little Hominy, Pearsonia (new), and Turkey Run members. Of these six members, only the Lecompton at the base and Turkey Run at top continue across Pawnee County and into Creek County. Formation thins southward to 56 feet in southern Pawnee County. In Creek County, formation is 60 to 75 feet thick from north line to south part of T. 16 N., but is 20 feet thick at one locality near middle of T. 15 N. Farther south, Turkey Run limestone member could not be found; Lecompton limestone member at base, 5 to 10 feet thick, and about 30 feet of shale and sandstone belonging to formation could be mapped in sec. 6, T. 14 N., R. 7 E. Lecompton member continues to south line of Creek County and is only part of Pawhuska that Ries (1954, Oklahoma Geol. Survey Bull. 71) could map in Okfuskee County. Conformable with Vamoosa formation below and conformable with younger rocks above as far south as middle of T. 15 N. It seems that Turkey Run member was not deposited farther south. The Lecompton has been mapped southward across Okfuskee County to surficial deposits associated with North Canadian River, but no representative of Pawhuska has been recognized farther south, where Pawhuska was probably completely removed by post-Vamoosa, pre-Ada erosion. Ada formation rests on rocks older than Vamoosa on north flank of Arbuckle Mountains, truncates Vamoosa, and probably truncates the Lecompton beneath surficial deposits associated with North Canadian River. Intergrades laterally with Vanoss formation. Name credited to Herbert C. Hoover (unpub. ms.).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 37–44, pl. 1. Formation described in Pawnee County where it is included in Douglas-Shawnee group. Recent usage has placed bottom and top of formation at base of Lecompton limestone and top of Turkey Run limestone, respectively. Pawhuska can presumably be traced from Kansas-Oklahoma line southward into Creek County where one or both of bounding limestones pinches out. However, extent, correlation, and even status of the Pawhuska is open to question. In Kansas and northern Osage County, Okla., interval occupied by Pawhuska formation contains as many as 12 limestones separated by shale and a few thin coals and limestones. The lime-

stones and coals thin and pinch out southward, and percentage of sandstone in section increases. Only Turkey Run and Lecompton limestones, which delimit formation, extend as far south as Pawnee County. No question has arisen on correlation of lower limit, but recent work has cast doubt on validity of upper correlation. According to Shannon (1954, unpub. thesis) and Carter (1954, unpub. thesis), Turkey Run limestone in Osage County is poorly developed and cannot be mapped; therefore, Moore's (1949, Kansas Geol. Survey Bull. 83) correlation of Turkey Run with Coal Creek limestone may be erroneous. South of Pawnee County, Lecompton member is thought to be equivalent to "Pawhuska" formation of Okfuskee County (Ries, 1954) which grades into basal part of Ada formation. An alternate theory by Tanner (1956, Oklahoma Geol. Survey Bull. 74) postulates that the "Pawhuska" is overlapped southward by Ada formation of Okfuskee County. Recent work has cast doubt on all these correlations. Some workers are of the opinion that the "Pawhuska" of Okfuskee County is southward extension of Bird Creek limestone of Wabaunsee group. Base of "Pawhuska" defines top of Vamoosa formation (Ries, 1954). If Pawhuska formation of Okfuskee County is in reality Bird Creek, Vamoosa formation extends upward into Wabaunsee group to base of Bird Creek and contains Pawhuska formation of Pawnee County. If such is the case, a difficult problem of subdivision and classification is posed. In Pawnee County, the Pawhuska rests conformably on Kanwaka shale of Vamoosa formation and is overlain conformably by Severy shale of Wabaunsee group.

Type locality: About 3 miles northwest of Pawhuska, formerly spelled Pawhuski, Osage County. Formation crops out in band 1 to 3 miles wide from Kansas-Oklahoma line, T. 29 N., Rs. 8 and 9 E., across Osage County and eastern Pawnee County; across west side of Creek County to middle of T. 15 N., R. 7 E., and representatives continue along west side of Creek County and west side of Okfuskee County to North Canadian River in T. 11 N., R. 7 E.

Pawling Gneiss[1]

Precambrian: Southeastern New York.

Original reference: T. N. Dale and L. M. Prindle, 1904, New York State Mus. 23d Ann. Rept., map; text by F. J. H. Merrill.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329. Listed with names rejected by virtue of synonymy and (or) lack of usage.

Occurs in part of Pawling Township, Dutchess County.

Pawnee Limestone[1]

Pennsylvanian(?): Central northern Oklahoma.

Original reference: N. F. Drake, 1897, Am. Philos. Soc. Proc., v. 36, p. 326–387.

Named for Pawnee, Pawnee County.

Pawnee Limestone[1] (in Marmaton Group)

Pawnee Limestone Member (of Oologah Limestone)

Pawnee Limestone (in Henrietta Group)

Pawnee Limestone Member (of Henrietta Formation)[1]

Pennsylvanian (Des Moines Series): Eastern Kansas, southwestern Iowa, western Missouri, and northeastern Oklahoma.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 24–25.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, no. 11, p. 312–321. Subdivided into (ascending) Anna shale (new), Myrick Station limestone, Mine Creek shale (new), and Laberdie limestone (new) members. Thickness at type exposure, herein designated, 30 feet. Overlies Labette shale; underlies Bandera shale. Included in Marmaton group.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 37. Subdivided into two members. Lower member named Myrick Station; upper member to be named with type locality in Kansas. Included in Henrietta group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 6–7; L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 7–15, columnar sections and measured sections. Formation, as recognized in Missouri, includes beds from base of Anna shale to top of Coal City limestone member. Term Coal City has priority over Laberdie, and Laberdie is suppressed in favor of Coal City. Marmaton group.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 29. Term Oologah is extended to Kansas-Oklahoma line to include (ascending) Pawnee limestone, Bandera shale, and Altamont members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 31–32, fig. 5. In southwestern Iowa, comprises (ascending) Anna shale, Myrick Station limestone, Mine Creek shale, and Coal City limestone members. Marmaton group.

Type exposure: Near center N½S½ sec. 7, T. 27 S., R. 24 E., Bourbon County, Kans. Named for exposures on Pawnee Creek, near village of Pawnee (now Anna), Bourbon County.

†Pawnee limestone series[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 24–25.

Probably named for Pawnee Creek, near village of Pawnee, Bourbon County.

†Pawnee Creek Beds[1]

Pawnee Creek Formation

Miocene, middle, to Pliocene, lower: Northeastern Colorado.

Original reference: W. D. Matthew, 1900, Am. Mus. Nat. History Bull., v. 12, p. 24–25.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 14 (fig. 4), 15 (fig. 5), 18–19, 20–21, 22, 23, 24, 25, 26, 27 (fig. 8). Matthew did not designate type section for Pawnee Creek beds. [See this report for discussion of problem.] Pawnee Creek formation used in this paper as a mapping unit for known Miocene beds in Logan and Weld Counties. As used here, term includes Matthew's Pawnee Creek beds and Pawnee Creek fauna and upper part of his Martin Canyon beds with its fauna. This is an expedient to avoid further confusion in use of term Martin Canyon and to avoid introduction of new term prior to solving stratigraphic and correlation problems in area. It is difficult to determine whether or not Matthew's Pawnee Creek beds included upper Martin

Canyon beds in other localities, but possibly they did at all points except in Martin Canyon area. Formation is represented in northeastern Colorado by series of valley fills. Oldest deposits are in bottoms of canyons cut into Oligocene surface and consist of massive silt or fine consolidated sand in thin layers; capping the silts is widespread coarse rubble bed; overlying channel rubble are beds of massive, sandy silts containing layers of nodular concretions, gravel lenses, and thin channel sandstone; locally rubble is overlain by olive-gray silt followed by massive silts, and in still other localities rubble seems to be replaced by olive-gray silt in the depositional sequence. Thickness at type section herein designated 144 feet. Underlies Ogallala formation; overlies Cedar Creek member or Vista member (new) of White River formation.

Type locality: At Eubanks ranchhouse, Pawnee Buttes, NE¼ sec. 1, T. 10 N., R. 59 W., Weld County. Named for Pawnee Creek, Logan and Weld Counties.

Pawpaw Formation (in Washita Group)

Pawpaw Sandy Member (of Denison Formation)[1]

Pawpaw Shale Member (of Denison Formation)

Pawpaw Shale Member (of Georgetown Limestone)

Lower Cretaceous (Comanche Series): Northeastern and central Texas and central southern Oklahoma.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 302, 303, 328–335.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Chart shows Pawpaw formation in Washita group. Occurs above Weno limestone and below Main Street limestone. [Term Denison formation abandoned.] Lower Cretaceous.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 28–29, table 4. Foraminifera of Pawpaw formation described.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 32–34. In Tarrant County, Tex., name Pawpaw is applied to shale sequence between Weno marly limestone member and Main Street limestone member of Denison formation. Consists chiefly of gray and bronze calcareous shale with few thin sandstone partings and several ironstone layers. Thickness 12 to 30 feet.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Conf., p. 88, 92. In central Texas, termed shale member of Georgetown limestone. Overlies Weno limestone member; underlies Main Street limestone member. In north Texas, composed predominantly of sandstone, which changes to marl near Waco. Marl is relatively soft, thinly bedded, with shale partings. Recognized as a 7-foot receding zone consisting of two shale beds separated by a 4-foot limestone.

Named for Pawpaw Creek, in southern and eastern part of Denison, Grayson County, Tex.

Pawtuckaway Complex (in White Mountain Magma Series)

Mississippian(?): Southeastern New Hampshire.

C. J. Roy and Jacob Freedman, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 908–914. Includes a variety of rocks ranging from gabbro to syenite, principal constituents being diorite and monzonite. Rocks become progressively less mafic from earlier gabbroic intrusion to latest monzonite and

syenite. Structural character is best accounted for by cauldron subsidence mechanism of emplacement.

Named for occurrence in Pawtuckaway Mountains in Deerfield and Nottingham Townships, Rockingham County.

†Pawtucket Formation[1]

Pennsylvanian: Eastern Rhode Island.

Original reference: C. H. Warren and S. Powers, 1914, Geol. Soc. America Bull., v. 25, p. 439–475.

Named for Pawtucket, R.I.

Pawtucket Shale[1]

Pennsylvanian: Eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 159–164.

Well exposed in banks of Blackstone River on Division Street, Pawtucket, and at Valley Falls, Providence County.

Paxton Quartz Schist[1]

Carboniferous: Central Massachusetts, northern Connecticut, and south-central New Hampshire.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 73, 74, pl. 1. Discussed together with Hebron schist under heading of Hebron, or Paxton quartz schist. Probably early Paleozoic.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Refers to Woodstock (Paxton) quartz schist phase of Hebron gneiss of pre-Triassic age.

Named for development at Paxton, northwest of Worcester, Mass.

Paxton Creek Conglomerate (in Martinsburg Shale)

Ordovician: South-central Pennsylvania.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, ser. 4, Bull. G–8, p. 5, 6. Name proposed for a pebbly unit in the Martinsburg shale in the Harrisburg area. Consists of ill-sorted, poorly rounded white quartz pebbles and shale chips in a muddy matrix. Very hard rock; in places, true conglomerite.

Named for outcrop near Paxton Creek in Harrisburg, Dauphin County.

Payette Formation[1]

Miocene and Pliocene(?): Southwestern Idaho, northeastern Nevada, southeastern Oregon, and northwestern Utah.

Original reference: Waldemar Lindgren, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 632–634.

D. W. Scharf, 1935, Carnegie Inst. Washington Pub. 453, p. 99. Future geologic mapping may show that Sucker Creek beds (new) are an integral part of Payette formation.

B. N. Moore, 1937, U.S. Geol. Survey Bull. 875, p. 67–71, 97–100, pls. 8, 11. Subdivided into six unnamed members in Harper district, Malheur County, Oreg.: lower agglomerate and tuff member, 100 to 200 feet; lower diatomite member, 450 feet; gray ash member, 60 to 150 feet; upper diatomite member, 0 to 175 feet; rhyolite porphyry member, 0 to 10 feet; and yellow tuff member, 100 to 500 feet. Overlies flows of olivine

basalt and hypersthene andesites correlated with Columbia River lava; capped by basalts. Only four members recognized in Otis Basin to the west. On basis of vertebrate fossils, upper member considered lower Pliocene; remainder of formation generally assigned to Miocene.

J. C. Bayless, 1950, Michigan Acad. Sci., Arts, and Letters, Papers, v. 34, p. 214–215. Term Camp Davis formation used in Snake River Plains, Idaho, in preference to term Payette formation, although term Payette has priority. Conglomerates are lithologically similar to those of Camp Davis formation of western Wyoming, and on that basis name Camp Davis is retained.

H. E. Corcoran, 1954, The Ore-Bin, v. 16, no. 12, p. 79–84. Lindgren did not designate type section; name apparently was suggested by exposures along Payette River in western Idaho. Because fossil leaves used by Knowlton (1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3; 1902, U.S. Geol. Survey Bull. 204) for original dating were found in vicinity of Marsh post office, it is proposed here that this locality be used as type section. Kirkham (1931, Jour. Geology, v. 39, no. 3) found that Payette and Idaho formations in Idaho, as well as in adjacent areas of Oregon, are separated by great thicknesses of rhyolite and basaltic lavas. He measured a maximum thickness of Payette of about 1,200 feet in vicinity of Lindgren's leaf locality near Marsh post office and a thickness of Idaho formation on south side of downwarp along Little Squaw Creek of 7,275 feet and on north side along Little Willow Creek of 18,633 feet. He reported fossil leaves of Miocene from Payette and flora and fauna of Pliocene or later age from Idaho. Recent study in Vale-Buchanan area, Oregon, shows that lake beds in area dip gently northeast into Snake River downwarp and that these sediments are separated from another underlying unit of terrestrial lake beds, which crop out farther to west, by series of lavas at least 5,000 feet thick. Upper lake beds assigned to Idaho formation and lower to Payette formation. Payette formation dated as middle to upper Miocene.

F. B. Van Houten, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2811. In Goose Creek area of northwesternmost Utah, and adjacent Idaho and Nevada, a 2,000-foot sequence characterized by carbonaceous and brittle bituminous shale and petroliferous limestone has been assigned to upper Miocene Payette formation. These deposits are well exposed on east flank of Goose Creek Range (T. 13 N., R. 18 W.) 8 to 10 miles north-northeast of village of Grouse Creek, Utah, as well as in scattered outcrops on west flank of Grouse Creek Range (S½, T. 12 N., R. 17 W.), several miles east of Grouse Creek.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 16–17. Rocks shown on Idaho State map (Ross and Forrester, 1947) as Payette and related strata include beds that, although having many resemblances, have considerable range in age. Rocks so grouped have affinities to Payette formation (commonly regarded as Miocene), Latah formation (middle or upper Miocene), and Idaho formation (Pliocene). Payette formation and related strata exposed principally along border of western part of Snake River Plain but continue at intervals and in relatively smaller masses into northern Idaho. Lack of adequate information led to somewhat arbitrary separation in which the unit that includes Payette formation is mostly west of 114° West longitude, and unit that includes Salt Lake formation is east of that meridian. This corresponds practically to current usage but some components of the two

assemblages are nearly equivalent to each other. Early concept that Payette and Idaho formations represent two successive stages of large lake, with division between them at some horizon not definitely fixed, within sedimentary succession above Columbia River basalt (Lindgren, 1898) is so much at variance with facts now known that it must be abandoned. Kirkham (1931, Jour. Geology, v. 39, no. 3) desired to restrict the Payette to sedimentary rock that generally occurs interbedded with Columbia River basalt, commonly about 600 feet below top of the basalt unit—a suggestion that has much to commend it in areas in which he worked. He mapped the Payette on this basis in area in southwestern Idaho comprising T. 1 S., to T. 13 N., R. 5 W. to R. 1 E., inclusive, and the area within bend of Snake River northwest of Weiser. Evidence now available suggests that there is much local variation in stratigraphic positions of sedimentary rocks associated with Columbia River basalt and that in places it is still difficult to distinguish these from similar but younger rocks nearby. Uncertainty remains as to precise stratigraphic relation between strata of Payette age and those in northern Idaho that contain Latah flora. In general way, term Idaho formation is applied to those Cenozoic rocks in and near western part of Snake River Plain that have broad lithologic and genetic resemblances to Payette formation but are younger.

W. J. Mapel and W. J. Hail, Jr., 1959, U.S. Geol. Survey Bull. 1055–H, p. 221 (chart 1), 224–229. In Goose Creek district, rocks similar in many respects to Payette formation are herein designated Payette(?) formation. Thickness of Payette(?) in Cassia County, Idaho, 855 feet. Underlies Salt Lake formation.

Type section (Corcoran): Vicinity of Marsh post office, Boise County, Idaho. Named for exposures along Payette River in western Idaho.

Payne Sandstone[1]

Permian: Central Oklahoma.

Original reference: C. T. Kirk, 1904, Oklahoma Dept. Geology and Nat. History 3d Bienn. Rept., p. 9–11.

Named for Payne County.

Payne Branch Sandstone (in Hinton Formation[1] or Group)

Mississippian (Chesterian): Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey [Rept.] Mercer, Monroe, and Summers Counties, p. 296, 352.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 98). Shown on correlation chart as Payne Branch sandstone in Hinton group, Mauch Chunk series. Underlies Avis limestone; stratigraphically above Stony Gap sandstone.

Type locality: On north side of Payne Branch of Fivemile Creek, 0.8 mile southwest of Caperton School and 2.2 miles north of Hatcher, Mercer County.

Payne Branch Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 353.

Type locality: On north side of Payne Branch of Fivemile Creek, 0.8 mile southwest of Caperton School and 2.2 miles north of Hatcher, Mercer County.

Paynes Shale and Sandstone Member (of Panoche Group)

Upper Cretaceous: Northern California.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 201–202, 226 (fig. 5), pl. 3. Consists largely of interbedded dark-colored clay-shales, greenish sandstones, and limestones. In Browns Valley area, a conglomeratic layer about 150 feet thick occurs in middle of section. Thickness at type locality 2,100 feet; 5,200 to 8,500 feet thick on southwest limb of Butts Ranch syncline. Basal member of group; underlies Call sandstone member (new); overlies Paskenta and Knoxville formation, undifferentiated.

Type locality: Along Paynes Creek, on northeast side of syncline, 2½ miles north of Butts Ranch, San Benito County.

Paynes Creek Basalt[1]

Pleistocene, late, or Recent: Northern California.

Original reference: H. Hamlin, 1921, Dept. Int., U.S. Reclamation Service in cooperation with State of California and Iron Canyon Project Association, App. 1, p. 47, 50, 58, pl. 2.

Probably named for Paynes Creek, Chico quadrangle.

Paynes Hammock Sand

Miocene: Alabama and Mississippi.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1346–1354. Name applied to unit termed Upper Chickasawhay member (Blanpied and others, 1934). At type locality, consists of about 13 feet of greenish sand containing one indurated limestone ledge; sand is faulted against Marianna limestone in small side fault to main Jackson fault. Overlies Chickasawhay limestone (Lower Chickasawhay member of Blanpied and others). Intertongues at west with nonfossiliferous beds referred to Catahoula sandstone. Basal Miocene.

Type locality: Along branch entering Tombigbee River at Paynes Hammock, Ala., in SW¼ sec. 16, T. 5 N., R. 2 E. Recognized as far west as Keys Mill, Smith County, Miss.

Payson Drift

Payson Substage

Pleistocene (Illinoian): Illinois.

M. M. Leighton and H. B. Willman, 1949, *in* Itinerary State Geologists Field Conf. on late Cenozoic Geology of Mississippi Valley, p. 9 (table 1); 1950, Jour. Geology, v. 58, no. 6, p. 602 (fig. 2). Illinoian stage is divided into (ascending) Loveland, Payson, Jacksonville, and Buffalo Hart substages.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 125 (fig. 50), 136–137, geol. sections 46, 58, 59, 64, 66, 68. Till plain in area outside Jacksonville and Buffalo Hart moraines is referred to as Payson drift. It is surface drift of northwestern and west-central parts of Beardstown quadrangle and approximately western one-fourth of Vermont quadrangle. Generally less than 20 feet thick over Pleasanton Ridge; at least 140 feet thick in vicinity of Bader where it obliterates pre-Illinoian Valley of Sugar Creek; 110 feet thick in sec. 34, T. 6 N., R. 1 W., Vermont quadrangle where it obliterates a pre-Illinoian Valley. Derivation of name given.

Named for Payson, Pike County, which is on outermost Illinoian moraine.

Payton Ranch Limestone Member (of Gazelle Formation)

Upper Silurian: Northern California.

Michael Churkin, Jr., and R. L. Langenheim, Jr., 1960, Am. Jour. Sci., v. 258, no. 4, p. 259 (fig. 1), 260–266. Fairly continuous limestone layer, dissected by erosion and repeated by faulting; present in upper part of formation. Base of member thin-bedded and with thin interbeds of shale. Above basal part, limestone is poorly stratified, very thick bedded, fairly pure calcium carbonate; excepting local intraformational conglomerate and brecciated recrystallized areas along faults, limestone is finely crystalline or microcrystalline. Sparsely fossiliferous. Thickness at type locality 188 feet; other measured sections 85 to 134 feet. Over 600 feet of shales, sandstone, bedded chert, conglomerate, and scattered lenses of similar limestone occur below member; upper contact is everywhere either an erosional surface or a fault contact.

Type locality: On east side of high peak (elev. 4,320 feet) in NE¼SW¼ sec. 6, T. 42 N., R. 6 W., Yreka quadrangle, Siskiyou County.

Peabody Granite[1]

Late Paleozoic(?): Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Massachusetts.

U.S. Geological Survey has revived the term Peabody Granite on basis of a study now in progress.

In Peabody Township, Essex County.

†Peaceable Sand[1]

Pleistocene(?): Central Oklahoma.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 439.

C. C. Branson, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. The name Gerty sand is contemporaneous and is the established name.

Named for exposures along Peaceable Creek, Pittsburg County.

†Peace Creek Beds[1]

Pliocene, lower: Southern Florida.

Original reference: W. H. Dall, 1891, Philadelphia Acad. Nat. Sci. Proc. 1891, p. 120.

Named for exposures on Peace Creek, De Soto County.

Peace Valley Beds

Pliocene, middle: Southern California.

J. C. Crowell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 8, p. 1625 (fig. 4), 1629 (fig. 5), 1631–1632. Name applied to about 4,000 feet of soft gray-green sand, siltstone, and shale intercalated with thin-bedded buff and white sandstone. Underlies Hungry Valley formation (new). Base of section not exposed. In northeastern part of area, Peace Valley beds abut against the quartz monzonite basement.

Occurs in Hungry Valley area which is in Transverse Ranges about 55 miles northwest of Los Angeles.

Peach Bottom Slate[1]

Ordovician(?): Southeastern Pennsylvania and western Maryland.

Original reference: J. P. Lesley and P. Frazer, Jr., 1880, Pennsylvania 2d Geol. Survey Rept. C_3, map of Lancaster County.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 96–103, 106. Removed from Glenarm series. Ordovician(?).

S. L. Agron, 1950, Geol. Soc. America Bull., v. 61, no. 11, p. 1265–1306. Detailed discussion of structure and petrology of Peach Bottom slate which lies in center of Peach Bottom syncline. Underlain by Cardiff conglomerate and Peters Creek schist.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Named for exposures at Peach Bottom, York County, Pa.

Peach Lake Diorite[1]

Age(?): Eastern New York.

Original reference: R. Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, pl. 1.

Dutchess County.

Peach Orchard Sandstone (in Pottsville Formation)[1]

Peach Orchard Sandstone (in Breathitt Formation)

Pennsylvanian: Northeastern Kentucky.

Original reference: L. C. Robinson, 1927, Kentucky Geol. Survey, ser. 6, v. 26, p. 239.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 93, 97, 106. Three sandstones in Breathitt formation: Lower Peach Orchard, Upper Peach Orchard, and Peach Orchard (sometimes called Upper Peach Orchard). All occur in Lawrence and Martin Counties.

First described in Morgan County. Type locality not stated. Peach Orchard is in Lawrence County.

Peach Springs Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 99–101. In area of type locality, consists of thin-bedded gray limestone, some of which is aphanitic and some fine grained. Much mottled with brown siltstone. This locality apparently relatively near margin of limestone facies because in sections to north and west the rock is more aphanitic, medium to dark gray, much less mottled with brown siltstone, and thicker bedded. Thicknesss uniform in central Grand Canyon between Fossil Rapids and Toroweap; westward is slightly thicker; ranges from 42 to 90 feet. Older than Kanab Canyon member (new); younger than Spencer Canyon member (new).

Type locality: Approximately 8 miles south-southwest of mouth of Diamond Creek in Peach Springs Wash. Unit extends from vicinity of Fossil Rapids westward through the Grand Canyon.

†Peacock Formation (in Double Mountain Group)[1]

Permian: Central northern Texas.

Original reference: L. T. Patton, 1930, Texas Univ. Bull. 3027, p. 45.

U.S. Geological Survey has abandoned both the Peacock Formation and Double Mountain Group.

Named for exposures at town of Peacock, Stonewall County.

Peale Formation[1]

Mississippian: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic Map of California Westwood sheet (1:250,000): California Div. Mines. Mapped with Mississippian marine-sedimentary and metasedimentary rocks and Paleozoic metavolcanic rocks. May include some Pennsylvanian rocks.

Well exposed on trail from Wards Creek to Peale diggings, Taylorsville region.

Peanut Peak Member (of Chadron Formation)

Oligocene, lower: Southwestern South Dakota.

John Clark, 1954, Carnegie Mus. Annals, v. 33, art 11, p. 197. Designated as upper member of formation. Overlies the Crazy Johnson member (new). Author previously described unit as "Upper Member" of Chadron.

Type locality: At standard section of Chadron formation in Big Badlands on south fork of Indian Creek, Pennington County, sec. 34, T. 3 S., R. 12 E. Named from prominent butte in southern part of sec. 10, T. 4 S., R. 12 E.

Pearce Volcanics

Miocene or Pliocene: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 9, 116–118, pl. 5. At west end of hill in north center sec. 1, T. 18 S., R. 25 E., hornblende andesite forms basal member and rests unconformably on Bisbee formation. Within a few hundred feet toward the east, however, andesite is overlapped by rhyolite which rests on Bisbee formation. In most other exposures of formation, rhyolites either overlie the andesites or are in fault contact with them. Andesitic parts of volcanics mostly normal flows, with subordinate flow breccias and a few thin water-laid andesitic tuffs. Flows are light pinkish gray to dark gray and weather to rather dark brown. Rhyolites include thick, massive flows, flow breccias, agglomerates, and tuffs, with fragmental rocks probably predominant. Flows range from light pinkish gray through pink to purplish and weather dark brown commonly glassy, with spherulites and lithophysae as much as 8 centimeters in diameter present in some of them. A few flows are lithic, and some are porphyritic black obsidian. In Sulphur Hills, 3,000 feet is probably minimum thickness for formation. Base exposed only in hills east and northeast of Township Butte. Upper limit of formation throughout map area is simply overlap of alluvium, and because the volcanic rocks have been highly deformed, it is impossible to estimate maximum orginal thickness.

Form a group of conspicuous isolated hills rising above alluvium of Sulphur Springs Valley in neighborhood of Pearce, from which name is derived. Six Mile, Pearce, and the Sulphur Hills, Township and Three Sisters Buttes, and Turkey Creek Ridge are all composed of these rocks. Central Cochise County.

Pearisburg Limestone[1]

Lower and Middle(?) Ordovician: Southwestern Virginia.

Original reference: R. S. Bassler, 1907, Mineral resources of Virginia by T. L. Watson, 137–138.

At Pearisburg, Giles County.

Pearl Shale (in Sumner Group)[1]

Pearl Shale Member (of Wellington Formation)

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: J. W. Beede, 1909, Kansas Acad. Sci. Trans. v. 21, pt. 2, p. 255.

W. A. VerWiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 5. Included in Willington formation. Thickness 43 feet.

Named for exposures at Pearl, Dickinson County, Kans.

Pear Lake Quartz Monzonite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 13, pl. 1. Light-colored coarse-grained rock that contains prominent pink potash feldspar, as well as white calcic oligoclase, gray quartz, and minor amount of biotite. In some respects resembles Lodgepole granite (new). Relation to other named plutonic rocks of area not determined.

Well exposed around Pear Lake in eastern part of area, Sequoia National Park.

Pearlette Ash Member (of Sappa Formation)

Pearlette Ash[1] Member (of Crooked Creek Formation and Meade Formation)

Pleistocene: Southwestern Kansas, Nebraska, Oklahoma, southeastern South Dakota to northwestern Texas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 53, 54.

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, pt. 13, p. 411. Cragin's Pearlette ash included in Meade formation (redefined).

C. W. Hibbard, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 742. Referred to as member of Meade formation.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1947, Nebraska Geol. Survey Bull. 15, p. 22, 23, Pearlette ash has wide occurrence in Nebraska, Kansas, South Dakota, Iowa, and is perhaps best horizon marker in the Pleistocene. In Kansas, occurs between Upland and Crete (new) formations. Iowa places the volcanic ash exposed northeast of Little Sioux, Harrison County, in Loveland formation.

J. C. Frye, Ada Swineford, and A. B. Leonard, 1948, Jour. Geology, v. 56, no. 6, p. 501–523. Ash lentils, collectively called Pearlette, can be differentiated petrographically from other late Cenozoic ash deposits of Plains region and have been studed at localities extending from southeastern South Dakota to northwestern Texas. Associated molluscan fauna possesses a great degree of uniformity and stratigraphic significance. Pearlette ash and faunal zone occurs above Kansas till and below Loveland loess and Iowa till in Missouri Valley region and is judged to be early Yarmouthian in age.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 69 (fig. 1), 71. Reallocated to member status in Crooked Creek formation (new). Thickness about 7 feet.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1950, Nebraska Geol. Survey Bull. 15–A, p. 22–24. Pearlette ash, thickness 15 feet, occurs in Sappa formation.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 14–15. Bed in Sappa member of Meade formation.

J. C. Frye and A. B. Leonard, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 32, p. 8 (fig. 2), 22. Included in Tule formation in western Texas.

C. W. Hibbard, 1958, Am. Jour. Sci, v. 256, no. 1, p. 55 (fig. 1), 58. Lentil in Atwater member (new) of Crooked Creek formation.

Named for old post office of Pearlette, Meade County, Kans.

Pearl Harbor Series[1]

See Pearl River Series.

Pearl River Series[1]

Pleistocene and Recent: Oahu Island, Hawaii.

Original reference: C. H. Hitchcock, 1900, Geol. Soc. America Bull., v. 11, p. 31–34.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p 125–126. Series of stratified rocks, about 1,000 feet thick, consisting of interbedded coral limestone, lagoon marl, poorly sorted terrigenous clays, silts, sands, and conglomerates, and beds of tuff. Locally interbedded with flows of Honolulu volcanic series. Overlies lavas of Koolau and Waianae volcanic series. Same as Pearl Harbor series (Hitchcock, 1912). Neither name (Pearl River series or Pearl Harbor series) now used.

Named after Pearl River, which drains into Pearl Harbor on south side of island.

Pearsall Formation (in Trinity Group)

Lower Cretaceous (Comanche Series): Southern Texas (subsurface).

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1441–1449. Defined for a sequence of dominantly shaly beds lying above the Sligo formation and below the Glen Rose limestone and representing the subsurface equivalents of the Travis Peak formation of the outcrop area. Type section extends from depths of about 8,835 to 9,360 feet, is 525 feet thick, and divisible into three members (ascending): Pine Island shale, 100 feet thick; Cow Creek limestone, 85 feet thick; and Hensell shale, 340 feet thick.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2340–2350. In this study, defined as a sequence of dominantly shaly beds stratigraphically above the Sligo formation and below the base of either the Glen Rose limestone or the Rodessa formation. Divisible into three members (ascending): Pine Island, Cow Creek or James limestone, Bexar shale. Undifferentiated where neither the James nor the Cow Creek member is recognized.

Type well: Amerada Petroleum Corp.'s Halff and Oppenheimer No. 8, in Pearsall field about 10 miles southwest of Pearsall, Frio County.

Pearson Glauconite Member (of Sabinetown Formation)

Eocene, lower (Wilcox): Western Louisiana and northeastern Texas.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 182 (footnote). Term Pierson glauconite was first used in field notes of Justin Rukas as a name for glauconite sands (first marine sand of

Sabinetown faunal unit) cropping out near railway station of Pierson, north of Natchitoches, La. Name is applied in this paper to westward extension of bed into Sabine County, Tex.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 63. Rank raised to member status in Sabinetown formation (restricted). Typically a fine-grained greensand or glauconitic sand which commonly contains considerable concretionary ironstone; fossiliferous. Thickness 32 feet. Reaches maximum development in Sabinetown area, thinning both northeastward and northwestward along strike. Underlies an upper unnamed member of the Sabinetown; overlies High Bluff member of Pendleton formation; in most exposures both upper and lower contacts are conformable and gradational.

First described from occurrence in Natchitoches Parish, La.

Pearsonia Limestone Member (of Pawhuska Formation)

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49. Name applied to member of Pawhusk. Overlies Little Hominy member; underlies Turkey Run member. Name credited to J. A. Carter (unpub. thesis) who applied name to "red" limestone of Heald (1918, U.S. Geol. Survey Bull. 691–C).

Type locality and derivation of name not stated. Map shows town of Pearsonia in northern Osage County. The limestone extends only to sec. 28, T. 26 N., R. 8 E., Osage County.

Pease River Group

Permian (Leonard Series): Western Texas.

H. C. Fountain, 1939, *in* Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 764. Name applied to the series of stratigraphic units from base of San Angelo up to base of Custer group. In tracing group northward to Mangum, Okla., it was demonstrated that it contained a part if not all of the Duncan sandstone, all of the Flowerport shale, Blaine, and Dog Creek shale up to base of Marlow or Custer group in Oklahoma and Kansas. Type exposure given.

Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412, 1413. Rocks of Leonard age that overlie the Clear Fork group have been designated varyingly as San Andres group, El Reno group, Pease River group, and "Blaine of Texas". Pease River is adopted here because its upper and lower limits are easily recognized over much of east side of Permian basin. Includes beds from base of San Angelo sandstone up to base of Custer group which is 10 to 30 feet below base of Childress limestone. Average thickness 870 feet. Disconformable at base and regional unconformity at top.

Robert Roth, 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 893–907. Includes San Angelo, Flowerpot, Blaine, and Dog Creek formations as exposed in Texas. Correlation with Cherry Canyon formation (Guadalupe series) suggested. Thickness 874 feet at type locality which is herein stated.

Type exposure (Fountain): Along Pease River in Hardeman and Cottle Counties.

Type locality: South Fork of Wichita River and Little Croton Creek in King and Knox Counties, about 40 miles south of Pease River.

Peasley Member (of Highland Peak Formation)

Peasley Limestone

Middle Cambrian: Southeastern Nevada and western Utah.

H. E. Wheeler, 1940, Nevada Univ. Bull., Geology and Mining Ser., no. 34, p. 12 (fig. 2), 14, 17–27. Chiefly dark-gray (carbonaceous) medium-grained thickly bedded to massive limestone commonly with numerous calcite veinlets in areas of appreciable deformation; topmost strata variable in character in consequence of differential erosion during post-Peasley hiatus. Thickness at type section about 120 feet; in Ely Range 150 feet. Unconformably overlies Chisholm shale; unconformably underlies Burrows dolomite (new). This is unit "A" of Highland Peak limestone as described by Wheeler and Lemmon (1939); Burrows dolomite is unit "B" and Highland Peak is herein restricted to exclude these units.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 33–35, fig. 5. Recognized from Groom, Nev., to Wah Wah Range, western Utah. Chisholm shale thins out and disappears between Wah Wah and House Ranges, thus bringing similar Lyndon and Peasley limestone into contact. In House Range, their combined counterpart is herein named Millard limestone.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 508. Thickness of Peasley given as 791 feet in section measured in Virgin Mountain, Clark County, Nev.; overlies Chisholm shale; underlies unnamed dolomitic limestone (Middle and Upper? Cambrian).

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 339, 340. Name Jangle limestone (new) substituted for Peasley limestone of Wheeler (1940) in Pioche and Groom districts.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 50 (fig. 4). Chisholm formation, as redefined in Wah Wah Range, includes Peasley limestone as used in that area by Wheeler (1948).

U.S. Geological Survey currently classifies the Peasley as a member of Highland Peak Limestone on basis of a study now in progress.

Type locality: On northwest spur of Comet Peak, on west side of Highland Range, Pioche district, Nevada. Spur forms secondary divide immediately south of Peasley Canyon.

Peavy Pond Complex

Peavy Complex

Precambrian: Northwestern Michigan.

R. W. Bayley, 1956, Dissert. Abs., v. 16, no. 8, p. 1427. Composed of gabbro with minor ultrabasic parts and fringed with intermediate and acid differentiates and hybrids. Intruded Hemlock and Michigamme formations during late middle Precambrian orogeny and metamorphism.

R. W. Bayley, 1959, U.S. Geol. Survey Bull. 1077, p. 10, 75–80, 82–92, pl. 1. Peavy Pond complex as designated here includes all intrusive rocks exposed on shores and islands of Peavy Pond. Cuts Hemlock and Michigamme formations in south part of Lake Mary quadrangle.

On shores and islands of Peavy Pond in secs. 14–17, 19–22, and 27–30, T. 42 N., R. 31 W., Iron County.

Peay Sandstone Member (of Frontier Formation)[1]

Upper Cretaceous: Southern Montana and northern Wyoming.

Original reference: F. F. Hintze, Jr., 1915, Wyoming Geol. Survey Bull. 10, p. 21.

J. H. Heathman, 1939, Wyoming Geol. Survey Bull. 28, p. 7 (table 2), 13. On south and east sides of Bighorn Basin, consists of concretionary sandstone about 87½ feet thick in lower part of formation.

Named for Peay Hills, Big Horn County, Wyo.

Pecan Gap Chalk Member (of Taylor Marl)[1]

Pecan Gap Chalk (in Taylor Group)

Upper Cretaceous: Northeastern Texas.

Original reference: L. W. Stephenson, 1918, U.S. Geol. Survey Prof. Paper 120–H, p. 156.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 38, 39 (fig. 4), 42–43 [1939]. Rank raised to formation in Taylor group. Bluish-white hard massive; partly sandy chalk and bluish-gray soft pliable sandy and chalky marl. Average thickness in Leon County wells 150 feet. Lies above Wolfe City sand and below unit referred to as upper Taylor marl.

J. T. Rouse, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 525–527. Detailed surface mapping in belt of outcrop from Collin County eastward into Red River County, shows that Pecan Gap chalk thins and disappears north and east and that Wolfe City sand, which underlies Pecan Gap, is to be correlated with Annona chalk (previously correlated with Pecan Gap).

H. R. Blank, N. L. Stoltenberg, and H. H. Emmerich, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 12, p. 5, 10 (table 1), 12–15. Member described in Blacklands experimental watershed, near Waco. Consists of lower chalk, 8 to 25 feet; lower highly calcareous marl, 90 to 100 feet; upper chalk, about 13 feet; and upper highly calcareous marl (not known how much of this should be included in member). Overlies Wolfe City member with unconformity; underlies upland gravel (Ulvade formation).

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 45–46, table 4. Pecan Gap chalk (Taylor group) has been considered tongue of Annona chalk, with lower marl and Wolfe City sand being lateral equivalents of lower part of Annona chalk (the interpretation accepted here). Alternative hypothesis has been presented: that the chalk is transgressive formation, younger than the marl and sand units. Foraminifera described.

Typically exposed in cut of Gulf, Colorado, and Santa Fe Railway, one-half mile east of Pecan Gap, Delta County, Tex.

Pecatonica Dolomite Member[1] (of Platteville Formation)

Pecatonica Formation (in Platteville Group)

Middle Ordovician: Southern Wisconsin, northwestern Illinois, northeastern Iowa, and southeastern Minnesota.

Orginal reference: O. H. Hersey, 1894, Am. Geologist, v. 14, p. 175.

C. A. Bays, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 269. Underlies Miffin limestone member (new) of Platteville formation.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 11 (fig. 3). In Dixon-Oregon area, Illinois, considered a formation in Platteville group. Consists of about 30 feet of dolomite and limestone, relatively pure, locally cherty, finely crystalline, and thick bedded; slightly argillaceous and has weak shale films in middle. Subdivided into (ascending) Hennepin, Chana, Dane, New Glarus, Medusa, and Oglesby members (all new). Underlies Mifflin formation; overlies Harmony Hill formation (new) in Ancell group (new).

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 275, 277–279. At designated type outcrop, Pecatonica dolomite member is 20 feet thick. Overlies Glenwood shale member; underlies McGregor limestone member.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1030–1031. Pecatonica member ranges in thickness from about 7 feet east of Mabel, Minn. to featheredge about 20 miles northwest; thickens as it continues into Iowa, Wisconsin, and Illinois; about 1 foot thick at Minneapolis.

Type locality: Bluff along Pecatonica River at Lattice Bridges, NW¼NW¼ sec. 21, T. 1 N., R. 6 E., Green County, Wis.

Pecatonica glaciation

Pecatonica till[1]

Pleistocene (pre-Wisconsin) : Illinois.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203, 217.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 69, no. 2, p. 129. Referred to as glaciation.

Peckham Formation

Pleistocene, upper: Central California.

C. J. Leith, 1949, California Div. Mines. Bull. 147, p. 12 (fig. 2), 26–27, pls. 1, 2. Name proposed for nonmarine silts, sands, gravels, and limestone occurring near center of Quien Sabe quadrangle. Maximum thickness 300 feet. Formation flat lying and rests with as much as 90° angular discordance upon the Franciscan and as much as 25° upon Miocene [Quien Sabe] volcanics.

Name derived from Peckham Ridge, an eastward trending spur of Diablo Range which marks northern limit of exposures, Quien Sabe quadrangle, about 90 miles southeast of San Francisco.

Pecksport Member[1] of Marcellus Formation)

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 134, 219.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Solsville member and below Mottville member.

Type section: Livermore Gully, 1 mile east of railroad switch at Pecksport, Madison County.

†Pecos Formation[1]

Permian: Southeastern New Mexico.

Original reference: A. G. Fiedler and S. S. Nye, 1933, U.S. Geol. Survey Water-Supply Paper 639.

Named for exposures east of Pecos River, Roswell artesian basin.

Pecos shale[1]

Permian(?): New Mexico.

Original reference: C. R. Keyes, 1909, Iowa Acad. Sci. Proc., v. 16, p. 159–163.

Rio Grande Valley.

Pecosan series[1]

Pecosian series[1]

Tertiary, upper: Eastern New Mexico and western Texas.

Original reference: C. R. Keyes, 1907, Iowa Acad. Sci. Proc., v. 14, p. 223–228.

Llano Estacado region.

Pecos Canyon Sandstone[1]

Permian: Northeastern New Mexico.

Original reference: J. K. Knox, 1920, Am. Assoc. Petroleum Geologists Bull., v. 4, p. 99–101.

In Santa Rosa-Tucumcari region.

†Pecos Valley Red Beds[1]

Permian and Triassic: Southeastern New Mexico.

Original reference: J. W. Beede, 1910, Am. Jour. Sci., 4th, v. 30, p. 131.

Crop out along foot of eastern flank of Sacramento Mountains and underlie alluvium in lower Pecos Valley. Well developed in walls of Rocky Arroyo, 20 miles west of Carlsbad, Eddy County.

Peculiar Shale (in Puente Formation)

Miocene, upper: Southern California.

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363. Shown on structure section as underlying Mahala sandstone and conglomerate (new) and overlying Hunter sandstone and conglomerate (new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 521. Micaceous sandy shale with poor stratification. Thickness 657 feet. Upper part of Puente. Measured section noted.

Exposed in Slaughter Canyon in southeastern Puente Hills, between Chino and Santa Ana River, San Bernardino County.

Pecursian series[1]

Picursian series[1]

Precambrian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 10.

Pedee Group[1]

Peedee Group[1]

Pennsylvanian (Missouri Series): Northwestern Missouri and eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 93, 97.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, v. 25, 2d ser., p. 28. Pedee recognized in northwestern Missouri where it includes Weston shale and Iatan limestone members.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 295. Term Pedee dropped from Iowa nomenclature. Weston shale and Iatan limestone included in Lansing group. Later work may warrant reestablishment of Pedee as independent group.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 78. Pedee is topmost division of Missourian rocks; includes Weston shale below and Iatan limestone above and possibly a few feet of sandy and clayey shale above the Iatan. Occurs between Stanton limestone of Lansing group and disconformity that defines top of Missourian series. Average thickness 90 feet.

Named from stream near Weston, Platte County, Mo., opposite Leavenworth, Kans., on Missouri River.

Pedernal Chert Member (of Abiquiu Tuff)

Miocene(?) : North-central New Mexico.

F. S. Church and J. T. Hack, 1939, Jour. Geology, v. 47, no. 6, p. 618, 620, 622. Thin veneer of remarkably pure chert that overlies the broad plateaulike surface which forms summit of San Pedro Mountain in many places. It passes laterally, without losing continuity, into poorly consolidated conglomerate, sandstone, shale, and tuff, which, in Cerro Pedernal, are obviously part of Abiquiu tuff.

Mapped on San Pedro Mountain, and its horizon followed eastward into the high mesas of northern part of Jemez Mountains. Named after Cerro Pedernal, a mountain whose Spanish mame means "flint" It [the mountain] presumably was so named from outcrops of chert long quarried by the Indians.

†Pedernales Dolomite Member (of Wilberns Formation)

Upper Cambrian : Central Texas.

Frederick Romberg and V. E. Barnes, 1944, Geophysics, v. 9, no. 1, p. 88, fig. 7. Gray to pinkish gray dolomite. Overlies San Saba member; underlies unnamed dolomite at base of Ellenburger formation. Name credited to Josiah Bridge and V. E. Barnes.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 148, 150, 155–156, pl. 4 [1945]. Uppermost member of formation; lies between San Saba limestone member below and Tanyard formation of Ellenburger group above. Grades downward and laterally into San Saba, an essentially equivalent facies if considered in regional sense. In type area, lower 86 feet is fine grained and evenly bedded, contrasting sharply with overlying massive coarse-grained part; coarse-grained dolomites are predominantly light gray and silvery gray with occasional intervals of yellowish gray or nutria; fine-grained dolomite is yellowish gray to beige; entire section speckled to mottled with dull dark reddish purple in varying degrees; glauconite, common elsewhere, is present only in basal few feet of member; some chert present, mostly near top of fine-grained part. Thickness in type area 187 feet; in Cherokee area 70 to 150 feet. Dolomites here named Pedernales were formerly included in Ellenburger limestone. Type section designated.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 121–123, pls. 1, 2. Dolomite facies of upper part of Wilberns developed mostly in eastern part of Llano uplift. Commonly replaces and is equivalent to variable part of San Saba limestone member, which is characteristic of upper Wilberns in western part of uplift. In western Blanco County, replaces entire San Saba and includes beds

equivalent to most of Point Peak shale member as well. Base extends lower in section in type area than at other places in uplift, but thicker sections have been measured elsewhere; this variation in thickness probably due to pre-Ordovician truncation of upper beds of Pedernales in vicinity of type section. Thickness on Backbone Ridge, Burnet County, 224 feet; at the Tanyard, Burnet County, 277 feet. Pedernales is that part of former Ellenburger limestone which Dake and Bridge (1932, Geol. Soc. America Bull., v. 43) called the Potosi and Eminence equivalents, and its removal from revised Ellenburger group and inclusion in Wilberns formation necessitated redefinition of Ordovician and Cambrian beds above and below systemic boundary (Cloud, Barnes, and Bridge, 1946 [1945]).

V. E. Barnes and W. C. Bell, 1954, San Angelo Geol. Soc. [Guidebook] March 19–20, p. 35, 36. Name Pedernales dolomite dropped.

Type section: Along Pedernales River from 1½ to 3 miles up stream from bridge on Johnson City-Marble Falls Highway 1 mile north of Johnson City, Blanco County.

Pedlar Formation (in Virginia Blue Ridge Complex)

Precambrian: Central Virginia.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 582, pl. 1. Assemblage of granitic, granodioritic, syenitic, quartz dioritic, anorthositic, and unakitic rocks undifferentiable in the field. A green, white, or red coarse-grained granulose rock. Unconformably overlapped by sequence of Late Precambrian and Early Cambrian formations.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 9–11, pl. 1. Included in Virginia Blue Ridge complex (new). Prevailing facies in Lynchburg area is gray to gray-green massive medium- to coarse-grained hypersthene or hornblende quartz monzonite. Typical exposures cited.

Typical exposures found along upper reaches of Pedlar River of northwestern Amherst County. Named from the river. Forms most of the basement complex of the Blue Ridge northeast of Roanoke and many masses surrounded by the Marshall and Lovingston formations in the Piedmont.

Pedregosa Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 8–9, 17–18, pl. 27. Consists of (ascending) buff sandstone, white platy sandstone, gray and buff limestone, calcareous sandstone, white and yellow shale, greenish sandstone, and thin layers of argillaceous limestone, sandstone, and shale. Thickness 182 feet. Overlies Perilla member (new); underlies Mural limestone.

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated at Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Pedro Bentonite Bed (in Gammon Ferruginous Member of Pierre Shale)[1]

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

C. S. Robinson, W. J. Mapel, and W. A Cobban, 1959, Am Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 106. Present at base of member in vicinity of Osage, Weston County, Wyo. Thickness 30 feet in Weston County. Thins laterally and a few miles north is less than 1 foot thick or is absent.

Named for exposures near Pedro, sec. 5, T. 45 N., R. 63 W., Weston County, Wyo.

Pedroian[1]

Pleistocene, lower: California.

Original reference: J. E. Eaton, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, p. 138.

Pedro Miguel Agglomerate

Pedro Miguel Agglomerate Member (of Panama Formation)

Miocene, lower: Panama.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 17–18. Pedro Miguel agglomerate proposed for extensive occurrence of this rock type in vicinity of Pedro Miguel Lock and its approach channels. In this area, associated with Cucaracha formation; in La Boca region, occurs near base of La Boca sediments (new) which are considered to be slightly younger than the Cucaracha.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 242, 246 (fig. 2). Lens of pyroclastics formerly referred to Las Cascadas agglomerate. In type region, pyroclastics overlie Cucaracha formation, but lower part apparently equivalent to upper part of Cucaracha sections. Farther south, pyroclastics occur as tongue in basal part of La Boca formation. Thickness varies; maximum averages about 300 feet.

W. P. Woodring, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–1; 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 40–41. Rank reduced to member status in Panama formation.

Type region: Pedro Miguel area. Recognized along and near Panama Canal from Pedro Miguel area to Pacific terminus.

Peebles Dolomite[1]

Silurian (Niagaran): Southwestern Ohio.

Original reference: A. F. Foerste, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 168–169.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart below Greenfield dolomite and above Cedarville dolomite of Durbin group.

Type section: Between Peebles, Adams County, and base of Greenfield dolomite, several miles east.

Peebles granite facies (of Ogishke Conglomerate)

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1034–1035. One of three facies in Ogishke conglomerate. Contains a wide assortment of pebbles in which 36 rock types have been recognized. Thickness 2,100 feet. Underlies West Gull facies; unconformably above Dike Lake slate.

Described in Kekequabic-Ogishkemuncie area.

Peedee Formation[1]

Upper Cretaceous: Eastern South Carolina and eastern North Carolina.

Original reference: E. Ruffin, 1843, Agric. Survey South Carolina, 1st Rept., p. 6–7, 24–27.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 44; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped in North Carolina where it crops out in a belt extending from Tar River at Greenville, Pitt County, southwest to South Carolina line. Near Greenville, only 3 or 4 miles wide, but to the southwest reaches maximum width of more than 25 miles. Variable gray to green argillaceous sands and impure limestones; locally, massive marine clays and interbedded sands. [Spelled Pee Dee.]

Named for exposures on Great Peedee River, S.C., the exposure at Burches Ferry, on west side of Peedee River in Florence County, being a typical one.

†Peedee Marl[1]

Miocene, upper: Northeastern South Carolina.

Original reference: E. Ruffin, 1843, Agric. Surv. South Carolina 1st Rept., p. 28.

Named for exposures in Peedee River region from Darlington to Allisons Ferry, Darlington and Florence Counties.

†Peedee River Marls[1]

Upper Cretaceous: Eastern South Carolina.

Original reference: F. S. Holmes, 1870, Phosphate rocks of South Carolina, p. 12, 13.

Peekskill Diorite Gneiss[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1921, New York State Mus. Bull. 225–226, p. 28.

Type locality: Along Peekskill Creek, Westchester County.

Peekskill Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1907, New York State Mus. Bull. 107, p. 377.

D. T. O'Connell, 1937, Geological excursions in New York City and vicinity Trip II: New York City Coll. Dept. Geology, p. 23. Considered to be acid differentiate of Cortlandt series.

Type locality: About 3 miles east-northeast of Peekskill, Westchester County.

Peekskill Norite[1]

Age(?): Eastern New York.

Original reference: R. Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, pl. 1.

Dutchess County.

Peekskill Phyllite[1]

Ordovician: Southeastern New York.

Original reference: C. R. Fettke, 1914, New York Acad. Sci. Annals, v. 23, p. 245–257.

Well exposed on northwest side of Peekskill Creek valley, Peekskill region.

Peekskill Creek Limestone[1]

Lower Cambrian to Middle Ordovician: New York.

Original reference: C. R. Fettke, 1914, New York Acad. Sci. Annals, v. 23, p. 201.

Peekskill Creek region.

Pe Ell Volcanics member (of Cowlitz Formation)

Eocene, upper: Southwestern Washington.

D. A. Henriksen, 1954, Dissert. Abs., v. 14, no. 12, p. 2316. Named as member of Cowlitz. Overlies Stillwater Creek member and underlies Olequa Creek member (both new).

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 38, 46–48, pl. 1. Series of lapilli tuffs, agglomerates, breccia, and thin interbedded tuffaceous siltstones intercalated with lower part of Stillwater Creek member. Attains maximum thickness of 1,200 to 1,500 feet at type locality; thins eastward wedging out at surface about 4 miles southeast of Pe Ell.

Type locality: In banks of Chehalis River in sec. 4, T. 12 N., R. 5 W., and secs. 33 and 34, T. 13 N., R. 5 W., W. M., Lewis County.

Peerless Formation

Peerless Shale Member (of Sawatch Formation)[1]

Upper Cambrian: Central Colorado.

Original reference: C. H. Behre, Jr., 1932, Colorado Sci. Soc. Proc., v. 13, no. 3, p. 58.

Q. D. Singewald, 1947, Preliminary geologic map and section of the upper Blue River area, Summit County, Colorado (1:31,250): U.S. Geol. Survey; 1951, U.S. Geol. Survey Bull. 970, p. 9 (table). Rank raised to formation. In Summit County, consists of two parts. Lower, equivalent to "Transition shale" at Leadville; basal quartzite is purple to nearly black, faintly crossbedded, and 2 to 10 feet thick; middle part, 10 to 12 feet thick, is brownish weathering dolomite in beds 3 inches to 3 feet thick; upper 10 to 20 feet is green platy shale with intercalated thin dolomites, highest of which contain red casts. Upper part equivalent to basal "White limestone" at Leadville; thin-bedded drab-weathering to brownish-weathering dolomite; uppermost beds slightly shaly and locally contain partings of thin layers of green shale. Thickness about 60 feet on North Star Mountain (composite section); 85 feet south side Spruce Creek. Underlies Manitou limestone, upper boundary indefinite; overlies Sawatch quartzite, hiatus.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 161–165. Formation described in Pando area where it is 35 to 112 feet thick and consists of thin-bedded, buff, green, purple, and pink sandy dolomite and dolomitic sandstone. Conformably overlies Sawatch quartzite; unconformably underlies Harding quartzite.

I. H. Mackay, 1953, Colorado School Mines Quart., v. 48, no. 4, p. 8, 13–14, 15, 16, pls. Peerless member described in Thomasville-Woods area, Eagle

and Pitkin Counties. Term "shale" is misnomer because unit here consists chiefly of thin-bedded gray to buff fine- to coarse-crystalline dolomites with numerous partings and stringers of arenaceous material, sandstones, and some shale. Thickness 50 to 102 feet. Basal part of formation. Upper part of formation; underlies Manitou dolomite.

R. R. Berg and R. J. Ross, Jr., 1959, Jour. Paleontology, v. 33, no. 1, p. 106–108. On basis of lithology and stratigraphic position, unit termed Ute Pass dolomite (Maher, 1950) in Missouri Gulch area is correlated with Peerless formation, and term Ute Pass is abandoned.

Typical occurrence on northwestern slope of Peerless Mountain, 6 miles east-southeast of Leadville.

Peerless Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Rept. Kanawha County, p. 281, 282.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 98. Considers the Kanawha a group.

Named for its association with the Peerless coal which was named for a mining village (now abandoned) on south side of Kanawha River just east of Lewiston, Kanawha County.

Peers Spring Formation[1]

Peers Spring Formation (in White Pine Group)

Peers Spring Formation (in White Pine Shale)

Lower Mississippian: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 20, map.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 25). Shown in Osagean series on correlation chart.

R. L. Langenheim, Jr., and J. H. Peck, Jr., 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1833; 1959, Cahiers Géol., no. 56, p. 537–548. At Dutch John Mountain, formation consists of basal calcareous siltstone unit (about 140 feet thick), middle black fissile shale unit (about 420 feet thick) which includes ledge-forming limestone, and an upper poorly exposed silty shale unit (about 460 feet thick). These units, except the limestone, are present at Peers Spring, but faulting prevents satisfactory mesurement. Middle unit of the Peers Spring resembles the bulk of Chainman shale at Ely, Nev., but all three units together are lithologically similar to White Pine shale at Hamilton, Nev. Single specimen of *Cravenoceras hesperium* and single specimen of *Rayonnoceras* were collected from lower Peers Spring unit at Dutch John Mountain. *C. hesperium* fauna, including *Brachycycloceras*, present in rocks of presumed similar stratigraphic position at Peers Spring. Westgate's report of Lower Mississippian fossils in Peers Spring apparently based on collections from fault block of Bristol Pass limestone at Peers Spring. Available paleontologic evidence suggests Upper Mississippian age for Peers Spring and biostratigraphic correlation with White Pine, Chainman, and Perdido formations. Underlies Scotty Wash quartzite at Dutch John Mountain.

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pubs., Geol. Sci., v. 38, no. 2, p. 108 (fig. 5), 110. Discussion of Quartz Spring

area, Inyo County, Calif. Formations, Tin Mountain limestone, Perdido formation, and Rest Spring shale as defined by McAllister (1952) are utilized in discussion and description of rocks in area. On the other hand, Joana limestone, Peers Spring formation, and Chainman shale, with somewhat different limits, are formations to which these same rocks would be assigned in regional discussion of Mississippian stratigraphy in Great Basin. For purposes of expressing regional stratigraphic relationships, many already proposed names are redundant. Figure 5 presents a condensed set of already proposed names as restricted and applied to units of regional significance. Names Peers Spring formation and Chainman shale are retained for formational units within a White Pine group, although these three names have frequently been employed in a synonymous sense.

R. L. Langenheim, Jr., and others, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 151. Rank reduced to member status in White Pine shale. Constitutes lower 50 feet of formation; underlies Chainman member. Age of White Pine shale, Upper Mississippian. Report is on geology of Ely No. 3 quadrangle.

Named for occurrence in hills east and north of Peers Spring, 3 miles northwest of Bristol Pass, Pioche district, Lincoln County.

Peery Limestone (in Cliffield Group)

Peery Limestone Member (of Cliffield Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper and C. F. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 830–832, 863–864, 884 (fig. 3). In Tazewell County, strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into 29 zones (ascending). Name Peery limestone member of Cliffield formation is applied to zones 8 and 9. The lower zone is dark-bluish-gray to black fine-grained argillaceous limestone containing *Lophospira;* upper zone is a succession of thick-bedded taupe- and dove-gray, rather pure calcilutites. Thickness about 50 feet; locally, as at Maxwell, Cliffield, and Gratton, the calcilutite alone exceeds 100 feet. Overlies Ward Cove member (new); underlies Shannondale limestone member of Benbolt limestone (both new).

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 68–69, pl. 8. In area between Brushy and Walker Mountains, the Peery is considered a formation in Cliffield group. In this area, the Peery overlies Athens formation. Thickness 10 to 18 feet.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 83. On southeast side of Clinch Mountain, overlies Rich Valley limestone (new) and underlies Benbolt shale.

Type locality: At south end of Peery Lime Co.'s quarry near State Highway 61, about three-fourths mile east of railroad station at North Tazewell, Tazewell County, Va.

Pegram Limestone[1]

Pegram Formation

Middle Devonian: Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 400, 425.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as part Lower or Middle Devonian and part Middle Devonian.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 312–315. Pegram formation varies in thickness from featheredge to maximum of 30 feet in Cheatham County. Unit referred to as sandstone, limestone, shale, and so on, depending upon phase of occurrence of lithologic type. Unconformably overlain by Chattanooga shale. Major overlapping unit in central Tennessee; at the Whirl of Buffalo River and at Standing Rock Creek, rests on Camden limestone, on Mill creek, it is on Beech River; in Davidson and Cheatham Counties, rests on the Lego, Dixon, Bob, Beech River, and Bledsoe(?) formations; in Trousdale and Sumner Counties, overlies the Laurel.

Named for exposures at Pegram, Cheatham County.

Pejepscott Gneiss

Pejepscot Formation

Cambrian(?): Southwestern Maine.

L. W. Fisher, 1938, (abs.), Geol. Soc. America Proc. 1937, p. 81. Incidental use of term Danville-Pejepscot series of gneisses. Middle Silurian.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 113–115, pl. 1, table 1 (facing p. 112). Formation described. Consists of three phases: coarse-grained quartz-feldspar-biotite gneiss, fine-grained quartz-biotite schist, and amphibolite. Maximum thickness approximately 10,000 feet. Underlies Taylor Brook formation. Cambrian(?). Type locality given.

V. E. Shainin, 1948, Maine Geol. Survey Bull. 5, p. 10–11. Referred to as gneiss.

Type locality: Roadcut one-half mile west of village of Pejepscot, Sagadahoc County.

Pekin Formation (in Newark Group)[1]

Upper Triassic: Central North Carolina.

Original reference: M. R. Campbell and K. K. Kimball, 1923, North Carolina Geol. and Econ. Survey Bull. 33, p. 20–25.

J. A. Reinemund, 1955, U.S. Geol. Survey Prof. Paper 246, p. 28–31, pl. 1. Lowest of the three Triassic formations in Deep River basin; lies unconformably on pre-Triassic metamorphic and igneous rocks at bottom of the Triassic sedimentary wedge and crops out in a belt along northwest side of basin; underlies Cumnock formation. Rocks vary greatly from place to place but in general consist of gray conglomerate, red or brown coarse-grained sandstone, red or brown siltstone and claystone in lenticular beds, gray coarse-grained sandstone, and gray siltstone. Thickness 1,750 to 1,800 feet in northern part of Sanford basin; 3,000 to 4,000 feet in western part of basin.

Named for exposures at Pekin, Montgomery County. Outcrop ranges in width from 3/5 of a mile to 3½ miles in Sanford basin and attains width of 4½ miles in Colon cross structure and southern part of Durham basin.

Peleliu (Pelilieu) Limestone

Pleistocene to Recent: Caroline Islands (Peleliu, Ngemelis, and Angaur).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation table) [English

translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 67, table 4 [English translation in library of U.S. Geol. Survey, p. 80]. Raised coral reef limestone. Consists primarily of *Halimeda* limestone and secondarily of coral limestone. Older than Ngarekeukl limestone. Pleistocene.

U.S. Army Corps of Engineers, 1956, Military geology of Palau, Caroline Islands: U.S. Army Corp of Engineers, Far East, p. 59–60, pls. 4, 10, 11. Estimated thickness 100 feet; upper surface commonly at an altitude of 30 feet or less. In many areas overlie Palau limestone. Pleistocene to Recent. Has been called Angaur limestone on Angaur.

Crops out on Peleliu, Ngemelis, and Angaur in southern part of Palau Islands.

†Pelham Granite[1]

Upper Carboniferous or post-Carboniferous: Central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 48.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–92. Name abandoned for rocks of the Pelham dome gneissic complex. These now subdivided and termed Dry Hill granite gneiss and Poplar Mountain gneiss.

Crops out in Pelham Township, Hampshire County.

†Pelham Limestone[1]

Ordovician: Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 152, section opposite p. 162, map.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 83. Broad name that is nearly equivalent to Chickamauga limestone as it embraces interval from top of Knox to Clinton. Name long neglected while Chickamauga was becoming entrenched in the literature. Neither name now has any value because Chickamauga sequence of Georgia and Pelham of Alabama can be divided into several formations ranging in age from Marmor to Trenton or higher.

Named for Pelham, Shelby County.

†Pelham Quartzite[1]

Upper Carboniferous or post-Carboniferous: Western central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18, pl. 34, map.

Crosses Pelham Township, Hampshire County.

†Pelham Saxonite[1]

Late Carboniferous or post-Carboniferous: Western central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 47–55, pl. 34, map.

In Shutesbury Township, Franklin County and Pelham Township, Hampshire County.

Pelier Schist (in Evington Group)

Lower Paleozoic(?): South-central Virginia.

W. R. Brown, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1547. Incidental mention.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, 91 (fig. 1). Tan sericite-quartz schist. Contains thin quartzites. Biotite porphyro-

blasts characteristic. Cloritoid facies common. Thickness 400 feet. Underlies Mount Athos formation and overlies Arch Marble (new), all in Evington group (new) of Paleozoic(?) age. Type locality designated.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 29, 34–35, pl. 1. Proposed that schist phase of Mount Athos formation be separated and named Pelier schist. Age shown on columnar section as Lower Paleozoic(?).

Type locality: Railroad cuts at Six Mile Bridge ½ mile northwest of Mt. Pelier Church, 4½ miles east of Lynchburg, Campbell County. Lynchburg quadrangle.

Pella Beds[1]

Mississippian: Central southern and southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 318.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 815. Beds consist of a thin basal sandstone, overlain by 5 feet of shale and 25 feet of compact thin-bedded limestone which grades into shale to the northwest. Unconformably overlie Verdi member of St. Louis formation.

Named for exposures near Pella, Marion County.

Pellisier Granite[1]

Middle or Late Mesozoic: Central eastern California.

Original reference: G. H. Anderson, 1935, Pan-Am.Geologist, v. 64, no. 1, p. 66.

G. H. Anderson, 1937, Geol. Soc. America Bull., v. 48, no. 1, p. 8–11. The granites [Pellisier and Boundary Peak] are probably equivalent in age to the Sierra batholith—middle or upper Mesozoic. Derivation of name given.

Typically exposed on a surface of low relief, designated as Pellisier Flats, which occupies large area along the crest of Inyo Range.

Pelly Gneiss[1]

Precambrian: Central eastern Alaska, and Yukon Territory, Canada.

Original reference: A. J. Collier, 1903, U.S. Geol. Survey Bull. 218, p. 16.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Mapped as Lower Precambrian in Tanana region.

Named for exposures on Pelly River.

Pelona Schist[1]

Precambrian(?): Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub. Dept. Geol. Bull., v. 3, pl. 1, map.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Mapped in Valyermo quadrangle where it is overthrust by Pleasant View complex (new). Age relations of the two units unknown.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 49–50, pl. 1. In San Fernando quadrangle, Pelona schist is present only north of San Gabriel fault. Thickness about 7,500 feet. Many workers have suggested a probable Precambrian age for the Pelona, and others have considered age to be more likely Mesozoic than Precambrian. Age of schist must be

considered in doubt because none of evidence presented to date has been entirely satisfactory. Map bracket shows pre-Cretaceous.

Named for Sierra Pelona, Los Angeles County.

†Pelton Basalt Member (of Deschutes Formation)[1]

Miocene, Pliocene, or Pleistocene, lower: Central northern Oregon.

Original reference: H. T. Stearns, 1931, U.S. Geol. Survey Water-Supply Paper 637, p. 139.

Exposed in Deschutes Canyon from line between Tps. 12 and 13 S., R. 12 E., to northern boundary of area; forms bench nearly one-quarter mile wide on both side of Deschutes River in northern part of T. 11 S., R. 12 E., and extends north and underlies former railroad station of Pelton.

Pembroke Formation[1]

Silurian: Southeastern Maine.

Original references: E. S. Bastin and H. S. Williams, 1913, Maine Water Storage Comm. 3d Ann. Rept., p. 168; 1913, Geol. Soc. America Bull., v. 24, p. 378, 379.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Assigned to Cayugan series [Upper Silurian].

Named for exposures near Pembroke, Washington County.

Pemigewasset Series[1]

Devonian or Carboniferous: Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1877, Geology New Hampshire, pt. 2, p. 142–148, 257–261.

Exposed over large areas along Pemigewasset River.

Pena Blanca Marls[1]

Oligocene: Panamá.

Original reference: E. Howe, 1907, Isthmian Canal Comm. Ann. Rept. 1907, App. E, pl. 147.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 343. In original reference, name appeared only on map explanation. That it was not intended as formal name is indicated by expression "marls of Pena Blanca" in text (p. 113). Strata at Pena Blanca are presumed to represent part of Caimito formation. Notes on locality.

Pena Blanca was village on Rio Chagres at site off northwest end of present Barro Colorado Island. Site is now submerged by waters of Gatun Lake, C. Z.

Pen Argyl Beds (in Martinsburg Shale)[1]

Upper Ordovician: Southeastern Pennsylvania.

Original references: C. H. Behre, Jr., 1926, Jour. Geology, v. 34, p. 485–487; 1927, Pennsylvania Geol. Survey, 4th ser., Bull. M9, p. 33, 104–107, maps.

Exposed at Pen Argyl, Northampton County.

Penasco quartzite[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 10.

Exposed near Pecuris, north of Santa Fe, Santa Fe County. Derivation of name not stated.

Pence Ferruginous Slate Member (of Ironwood Iron-Formation)[1]

Precambrian (Animikie Series): Northwestern Wisconsin and northwestern Michigan.

Original reference: W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501, 505.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Underlies Anvil member; overlies Norrie member. Thicknesses (taken from drill holes) 102 and 122 feet.

Named for Pence mine, west of Hurley, Iron County, Wis.

Pendejo Tongue (of Hueco Formation)

Permian (Wolfcampian): Southeastern New Mexico.

L. C. Pray, 1954, New Mexico Geol. Soc. Guidebook 5th Field Conf., p. 93. Appears only on columnar section. Shown as tongue of thin bedded limestone and gray shale between unnamed tongues of arkose, and red mudstone of the Abo formation.

In southern part of Sacramento Mountains, Otero County.

Pendleton Formation (in Wilcox Group)

Eocene, lower: Eastern Texas and western Louisiana.

Richard Wasem and Louis J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 182–195. Proposed for lower Eocene sediments cropping out around southern margin of Sabine uplift in Louisiana and Texas which have been referred to previously as Pendleton faunal unit. Sediments are mainly nonmarine with a few interbedded shallow-water marine fossiliferous sands. Thickness 275 to 300 feet. Typically developed along Sabine River. Best exposed over wide area drained by two Louisiana tributaries Bayou Lenann and Slaughter Creek; in this region, subdivided into (ascending) Bayou Lenann, Slaughter Creek, and High Bluff members. Overlies Marthaville formation and underlies the Pearson (Pierson) glauconitic sand of the Sabinetown faunal unit. Pendleton faunal unit of earlier reports.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 50 (fig. 4), 56 (footnote), 61–63. Underlies Sabinetown formation (restricted). Term Pendleton is preoccupied. If in future it is considered advisable to abandon Tertiary name Pendleton, term Pendleton Ferry is suggested since the type locality is the old Pendleton Ferry Landing.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 71–81. Recent subsurface studies indicate that Wasem and Wilbert's 275- to 300-foot thickness for Pendleton is grossly underestimated and that their mappable lithologic sequences, or members, as these sequences were designated, cannot be recognized in subsurface. There are 17 glauconite units ranging from 1 to 18 feet thick in the 975 feet of Pendleton sediment Wilcox core (obtained by Carter Oil Co.) which could alter their biostratigraphic zones appreciably.

Type locality: At old Pendleton Ferry, Sabine County, Tex. Formation has been traced westward across Sabine County, Tex., and eastward to Red River in Natchitoches Parish, La.

Pendleton Sandstone[1]

Pendleton Formation

Middle Devonian: Eastern Indiana.

Original reference: E. T. Cox, 1879, Indiana Geol. Survey 8th, 9th, and 10th Ann. Repts., p. 62.

G. A. Cooper and others, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Lower or Middle Devonian.

A. H. Sutton, 1944, Illinois Geol. Survey Bull. 68, p. 166–167. All beds at Pendleton considered as a unit, the Pendleton formation; regarded as essentially equivalent to lower Geneva and Jeffersonville, a third lithologic facies of same stratigraphic unit. Conclusion based on similarity of fossils and on paleographic considerations which seem to make correlation with Schoharie untenable.

Exposed at Pendleton, southern Madison County.

Pendleton Ferry Formation

Eocene (Midway): Northeastern Texas and northwestern Louisiana.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 56 (footnote). Term Pendleton is preoccupied by Pendleton sandstone of middle Devonian of Indiana. If, in future, it is considered advisable to abandon the Tertiary name Pendleton, the name Pendleton Ferry is suggested since the type locality of Pendleton is the old Pendleton Ferry Landing.

Old Pendleton Ferry Landing is in Sabine County, Tex.

Pendola Shale

Upper Cretaceous: Southern California.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1729 (fig. 2), 1733 (fig. 3), 1734 (fig. 4), 1743–1744. Consists chiefly of dark-gray to greenish-gray silty thin-bedded shale with irregularly interbedded layers of dark-gray limestone or fine calcareous sandstone. Thickness 440 feet at type locality; 1,000 feet 1 mile north of type locality; sections are incomplete, top having been eroded. Unconformably overlain by Juncal formation (new), which overlaps it on south; overlies Debris Dam formation (new) with contact possibly unconformable.

Type locality: On nose of Agua Caliente anticline 1.8 miles northeast of Pendola Guard Station in small canyon tributary to Agua Caliente Canyon, Santa Barbara County. Base of section is 9,100 feet N. 50° E. of guard station and eroded top of section is 10,200 feet N. 55° E. of guard station.

Pend Oreille Andesite

Pend Oreille Valley Andesite

Miocene(?): Northeastern Washington.

M. C. Schroeder, 1949, (abs.) Northwest Sci., v. 23, no. 1, p. 39–40. Pend Oreille Valley andesite proposed for volcanics consisting of valley flows of dark-gray trachytic andesite.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (chart), 24–25. Described as Pend Oreille andesite. Occurs as flows in an old valley that has been cut into the metamorphics of Newport group (new). Thickness about 1,100 feet. North of Skookum Creek unconformably underlies Tiger formation.

Crops out 1½ miles north of Furport along eastern edge of Pend Oreille River valley and forms valley wall for distance of 7 miles to Skookum Creek valley, Pend Oreille County.

Pend Oreille Group[1]

Carboniferous(?) and older(?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: O. E. Le Roy, 1912, Canada Geol. Survey Summ. Rept. 1911, p. 142.

Pend d'Oreille River empties into Columbia River just north of Washington-British Columbia boundary.

Penholoway Formation (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: (Penholoway terrace): C. W. Cooke, 1925, Georgia Geol. Survey Bull. 42, p. 24–26.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 75–77, pls. 2, 3. In southern Florida, Talbot, Penholoway, and Wicomico formations comprise conformable sequence of deposits whose differentiation is based mainly on location of their respective shore lines, namely 42, 70, and 100 feet above present sea level. Presumably Penholoway everywhere merges downward into deposits of Wicomico age, and Talbot into Penholoway and Wicomico successively. Sequence unconformably overlies Caloosahatchee marl and is likewise separated by a stratigraphic break from the Pamlico formation, which fringes around it.

Name derived from Penholoway Creek, Wayne County, Ga. Well exposed in Florida along Highway 18, the Childs-Okeechobee Road and west of Lake Okeechobee.

†Peninsular Limestone[1]

Eocene, upper: Northern Florida.

Original reference: W. H. Dall, 1903, Wagner Inst. Sci. Trans., v. 3, pt. 6, p. 1554.

Named for development in peninsular Florida.

Peñitas Formation

Pliocene(?): Panamá.

H. N. Coryell and R. W. Mossman, 1942, Jour. Paleontology, v. 16, no. 2, p. 233. Believed to correlate with Charco Azul formation.

In Burica Peninsula, Chiriquí Province.

Penman Formation

Pliocene, lower(?): Northeastern California.

Cordell Durrell, 1957, Pacific Petroleum Geologist, v. 11, no. 3, p. 3. Hornblende andesite mudflow breccia and volcanic conglomerate. Thickness 1,350 feet. Unconformable below Warner basalt; rests unconformably on Bonta formation (new) and all older rocks; unconformities marked by faulting.

Cordell Durrell, 1959, California Univ. Pubs. Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 174–177. Consists of three members. Lower, hypersthene andesite tuff with biotite dacite obsidian, pumice, and flow-banded lithic rocks, 150 feet thick. Middle, white-weathering hornblende andesite breccia, 250 feet thick. Upper, hornblende andesite mudflow breccia, volcanic conglomerate

and fanglomerate, some volcanic sand and tuff, 950 feet thick. Rests directly on Calaveras formation in southwest corner of Blairsden quadrangle; in eastern part of quadrangle, rests across faults between older units, so that in different fault blocks it lies on granitic rocks, the Ingalls, Delleker, and Bonta formations; elsewhere rests on the Lovejoy; unconformably underlies Warner basalt. Lower Pliocene.

Named for Penman Peak in south-central part of Blairsden quadrangle.

†Pennell sandstone[1]

Upper Cretaceous: Eastern Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 64, 65.

Named from Mount Pennell.

Pennington Shale,[1] Formation,[1] or Group

Upper Mississippian: Southwestern Virginia, northern Alabama, northwestern Georgia, eastern Kentucky, and eastern Tennessee.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 37.

Paul Averitt, 1941, Virginia Geol. Survey Bull. 56, p. 11–14, pls. 1, 2. Greater part of formation in Scott and Washington Counties, Va., is nonfossiliferous shale and sandstone. Full thickness not known because top is concealed by Saltville overthrust block, but about 2,250 feet is exposed. Overlies Cove Creek limestone.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 172–180. Formation described in Burkes Garden quadrangle. Comprises (ascending) Stony Gap sandstone, Avis limestone, and Falls Mills sandstone members. Thickness 1,000 to 1,700 feet. Overlies Bluefield shale and underlies Bluestone formation, both contacts conformable. Reger (1926, West Virginia Geol. Survey [Rept.] Mercer, Monroe, and Summers Counties) subdivided the Pennington [Hinton] into 45 units of which only three can be recognized with certainty in area of present report.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 166 chart 5 (column 90). Chart shows Pennington formation overlies Floyd shale and underlies Parkwood formation in east-central Alabama. Text states that relations of these formations are not clear and Pennington may grade laterally into either or both the Floyd and the Parkwood.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1, pls.; pt. 2, p. 110–112. Formation mapped and described in eastern Tennessee where it is heterogeneous and varicolored, including red, purple, and green clay shale, pink, red, green, and brown (normally calcareous) sandstone, and yellow shaly or silty fossiliferous limestone. Limestone is everywhere minor in amount; proportions of shale and sandstone vary widely. Overlies Newman limestone. Upper contact in northwestern belts not clearly defined except northeast of Jacksboro fault, where base of Pennsylvanian system is drawn at base of thick layer of pebbly white sandstone, which may be disconformable on Mississippian rocks. Elsewhere contact is drawn in transitional zone between red clay shale with scattered fossiliferous limestone beds and gray or brown sandy and silty shale with scattered coal beds. Contact thus records change from marine to nonmarine deposition, but it may not be drawn at same level everywhere, and possibly some beds included in Pennington northeast of Jacksboro fault are equivalent to some included in Pennsylvanian farther southwest.

Hence, thickness is not consistent; 200 feet or less near Chattanooga; 450 feet near Dayton; 150 feet at Cumberland Gap.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 64–67. Formation, in Madison County, composed of about 80 to 100 feet of red, green, and purple earthy shales interbedded with thin layers of limestone; a massive bed of hard fossiliferous light-gray crystalline limestone about 20 feet thick occurs near top of formation. Overlies Bangor limestone and underlies Pottsville formation. In Alabama, name Pennington has not been used widely in older publications; rock units now designated as Pennington formation have been included in Bangor limestone.

K. J. Englund, 1957, U.S. Geol. Survey Coal Inv. Map C–39. Formation, in Pioneer quadrangle, Scott and Campbell Counties, Tenn., consists of fine-grained gray to buff sandstone interbedded with grayish-green and grayish-red shale. Thickness about 650 feet. Overlies Newman limestone; underlies Lee formation.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Because term Pennington has been extensively used and is still accepted in Tennessee and Kentucky, it is proposed to raise Pennington to rank of group to include Hinton, Princeton, and Bluestone formations. Overlies Bluefield formation. Wilpolt and Marden's work (1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38) indicates that the Pennington in Big Stone Gap area contains lithologic equivalents of Hinton formation, Princeton sandstone, and Bluestone formation of West Virginia. Wilpolt and Marden used these West Virginia names at both type locality and type section of the Pennington shale of Campbell, thus abrogating use of Pennington as formation name.

K. J. Englund and H. L. Smith, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2015. Upper part of Pennington formation and lower part of Lee formation intertongue in their type area of outcrop, Lee County, Va., and in adjacent areas of Kentucky and Tennessee. The contact between these formations, which has been interpreted as an unconformity between Mississippian and Pennsylvanian systems, is transitional as result of intertonguing and lateral gradation between marine and nonmarine facies. Pennington-Lee contact, as determined lithologically in field, rises stratigraphically northward in this intertonguing sequence. According to literature, marine invertebrate fossils indicate Late Mississippian age of Pennington; plant fossils have been reported to show that Lee formation is of Early Pennsylvanian age. Intertonguing of Pennington and Lee formations suggests that these formations are partly contemporaneous.

Named for Pennington Gap, Lee County, Va., about 40 miles northeast along strike from Cumberland Gap.

Penn Yan Shale Member (of Genesee Formation)

Penn Yan Tongue (of West River Shale)

Upper Devonian: West-central New York.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 64–65. Name Penn Yan tongue proposed for lower shales of West River shale. Lower part consists of interbedded black and blue-black shales, blue-gray shales and thin limy argillaceous beds; unfossiliferous flags interbedded in dark shales. In upper part, shales generally lighter colored and more fossiliferous. Concretions plentiful; marcasite nodules present. Thickness about

140 feet in type area; thins eastward. In type region, contact with underlying Geneseo shale is difficult to determine but is placed at base of sequence of dark limy shales and interbedded shaly limestone layers. Top is placed arbitrarily at base of Crosby lentil of Starkey tongue (new), although Starkey-type flags being lower.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2817 (fig. 4), 2818. In vicinity of Canandaigua Lake, a 50- to 60-foot sequence of dark-gray shale and mudrock containing thin beds of black shale, many layers of nodular limestone and calcareous nodules, and a few very thin beds of siltstone overlies Geneseo shale member of Genesee and underlies *Stylio-lina*-bearing Genundewa limestone member of Genesee. Traced eastward to Keuka Lake, this sequence of dark shaly rocks is Grossman's Penn Yan tongue of West River shale. Unit is here redesignated Penn Yan shale member of Genesee formation, because it is not a tongue of the West River. In its type area, the Penn Yan underlies Crosby sandstone of Torrey and others (1932), which can be traced westward into Genundewa limestone member. In type area, overlies Geneseo member and underlies Ithaca member. About 170 feet thick near Penn Yan; thins westward to Lake Erie where it is 9 inches thick. In Cayuga Lake area, underlies Sherburne flagstone member. Thickness about 105 feet near Ithaca.

Named from outcrops in streams along south side of Keuka Lake outlet near town of Penn Yan, Yates County. Well exposed in middle gully of three draining north into outlet at Seneca Mills.

Penobscot Formation[1]

Cambrian(?): South-central Maine.

Original reference: G. O. Smith, E. S. Bastin, and C. W. Brown, 1907, U.S. Geol. Survey Geol. Atlas, Folio 149, p. 3.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in area of Rockland quadrangle, Knox County, is (ascending) Islesboro formation containing Coombs limestone member at top; Battio quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, a siliceous limestone member above the quartzite, and Rockport limestone member at top.

R. S. Houston, 1956, Maine Geol. Survey Bull. [7], p. 59. Upper Cambrian.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. In Hancock and Penobscot Counties, appears to be overlain by Bucksport formation (new).

Named for exposures along western shore of Penobscot Bay, especially between Belfast Bay and Sandy Point, Waldo County.

Penobscot Bay Granite[1]

Upper Silurian or Lower Devonian: Maine.

Original reference: F. W. Toppan, 1932, Geology Maine, Dept. Geol. Union Coll., Schenectady, p. 44.

†Penokee Series[1]

Precambrian (upper Huronian): Northwestern Wisconsin and northwestern Michigan.

Original reference: E. T. Sweet, 1876, Wisconsin Acad. Sci., Arts, and Letters Trans., v. 3, p. 40–45.

Penokee region, Wis.

Penon Blanco Volcanics (in Amador Group)

Upper Jurassic: East-central California.

Original reference [Penyon Blanco agglomerate]: N. L. Taliaferro, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 149.

N. L. Taliaferro, 1943, California Div. Mines Bull. 125, p. 283, 284. Assigned to Amador group. In Merced River section, Penon Blanco volcanics underlie Agua Fria formation and overlie Hunter Valley cherts. Thickness about 9,000 feet. Age of Amador group believed to be upper Middle to lower Upper Jurassic.

Present in southern type section of Amador group along Merced River.

Pensauken Formation (in Columbia Group)[1]

Pleistocene: New Jersey and northern Delaware.

Original reference: R. D. Salisbury, 1894, New Jersey Geol. Survey Ann. Rept. State Geologist 1893, p. 57–60, 67–72.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Correlation chart shows Cape May (part) and Pensauken (part) as Sangamon and Pensauken (part) and Bridgeton (part) as Yarmouth.

H. G. Richards, 1945, Geol. Soc. America Bull., v. 56, no. 4, p. 401–402. Correlation chart discussed. Writer does not agree with the combining of Cape May (part) and Pensauken (part) in the Sangamon interglacial nor with the combining of the Pensauken (part) with the Bridgeton (part) in the Yarmouth interglacial. Evidence indicates that Cape May is of late Pleistocene age, whereas Pensauken is mid-Pleistocene or older. There is no unconformity within the Pensauken nor any field evidence of a hiatus within the Cape May. Lithologically, the Pensauken and Bridgeton are practically inseparable although the latter has been more eroded and occurs at higher elevations; they are regarded as Pensauken-Bridgeton complex of early Pleistocene, probably Nebraskan to Yarmouth.

W. C. Rasmussen and others, 1957, Delaware Geol. Survey Bull. 6, pl. 3. Mapped in northern Delaware. Sand and clay on margin of Piedmont, forming terrace deposits at altitudes of less than 180 feet.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in eastern Pennsylvania. Illinoian stage.

Named for exposure at mouth of Pensauken Creek, at Hylton's pits [Burlington County], New Jersey.

Pentagon Shale[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 38.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, 1074–1075, 1089, 1090 (fig. 2); 1939, Geol. Soc. America Spec. Paper 20, p. 42–45. As here defined, overlies Pagoda limestone and underlies Steamboat limestone. Thickness at type locality 290 feet. Middle Cambrian.

Type locality: On Continental Divide, in NE¼ sec. 24, T. 25 N., R. 12 W., Lewis and Clark Range. Named for Pentagon Mountain which lies approximately 2 miles northwest of type locality.

Penters Chert[1]

Lower or Middle Devonian: Central northern Arkansas.

Original reference: H. D. Miser, 1920, U.S. Geol. Survey Bull. 715–G.

D. M. Kinney, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 611–612. Discovery of fossils in a thin gray argillaceous limestone in Penters chert confirms the earlier suggested Lower or Middle Devonian age for the Penters. The Penters is unfossiliferous at its type locality.

Named for exposures at Penters Bluff Station, Izard County.

Pentoga Greenstones (in Quinnesec Schist)

Precambrian (Huronian): Northern Michigan.

H. M. Martin, 1936, The centennial geological map of the northern peninsula of Michigan (1:500,000): Michigan Dept. Conserv., Div. Pub. 39, Geol. Ser. 33. Shown on map legend. Occurs in Iron River district.

Peñuelas Shale[1]

Upper Cretaceous: Puerto Rico.

Original reference: G. J. Mitchell, 1922, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 3, p. 251.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7). Thickness 2,000 feet. Underlies Coamo tuff limestone; overlies San Germán limestone.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 55. Mitchell (1922) used name Peñuelas shale for rocks correlated with Rio Yauco formation of this report.

Typically exposed along military road from Ponce to Peñuelas at kilometer 67+ (10+ by old numbers), Ponce district.

Penutian Stage

Eocene, lower: Western and southern California.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 18 (fig. 3), 34–40, 76, 93, fig. 7. Replaces stage name Juniperan. Change made to avoid confusion with Junipero sandstone in Reliz Canyon area. In sequence, the Penutian includes interval between the younger Ulatisian and the older Bulitian stages. Type includes the 20 feet of olive to greenish-gray siltstone and shale whose lower part constituted the type of the Bulitian stage and the 25-foot sandstone "reef" containing orbitoidal foraminifera and megascopic fossils, in the NE¼ sec. 21, T. 28 S., R. 19 E., in vicinity of Media Agua Creek, Kern County. Comprises two zones, *Plectofrondicularia kerni* below and *Alabama wilcoxensis* above.

Represented on Santa Barbara coast, in Simi Valley, along west side of San Joaquin Valley, vicinity of and north of San Francisco Bay area. Name refers to a linguistic stock of northern California Indians. The Yokut Indians, who occupied territory around Media Agua Creek, were of this linguistic stock.

Penyon Blanco Agglomerate[1]

See **Penon Blanco Volcanics.**

Peorian Loess[1]

Peoria(n) Formation

Peoria Formation (in Sanborn Group)

Peoria Silt Member (of Sanborn Formation)

Pleistocene: Illinois, Iowa, Kansas, and Nebraska.

Original reference: Frank Leverett, 1898, Jour. Geology, v. 6, p. 244–249.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 6. Shown in stratigraphic section as Peorian formation (loess). Overlies Loveland formation; underlies Recent. Thickness 5 to 80 feet. Some dune sand of Peorian age.

G. B. Schultz and T. M. Stout, 1945, Am. Jour. Sci., v. 256, p. 55 (fig. 1). Peorian loess underlies Bignell formation (new).

G. E. Condra, E. C. Reed, and E. D. Gordon, 1947, Nebraska Geol. Survey Bull. 15, p. 25, 31–33; 1950, Nebraska Geol. Survey Bull. 15–A, p. 25, 32–33. Peorian formation, as exposed at type locality of Crete formation, consists of light-brownish-gray to buff loess in upper part, medium-light-gray in middle part, and light-gray to brownish, partly iron-stained in lower part. Thickness, including soil at top, 11 feet. Overlies Loveland formation. Peorian loess of middle to late Wisconsin age deposited to variable thickness widely on Loveland loess in Nebraska and other areas and on exposed areas of Todd Valley sand, and older formations. However, term Peorian, as now used, represents time interval between the Iowan and Mankato substages in Iowa and should not be applied formationally where this interval includes both till and loess substages, as in Illinois and parts of South Dakota. Contact with Bignell loess indicated by buried soils.

J. C. Frye and O. S. Fent, 1947, Kansas Geol. Survey Bull. 70, p. 45–50. Peorian loess has been described in western Illinois and Iowa and is exposed unconformably above Loveland loess in Missouri Valley area of Iowa and Nebraska. Unit has been traced westward from Missouri Valley across Nebraska and southward as far as central Kansas. Since term Peorian is now generally used in time sense, adjectival ending dropped for stratigraphic unit here called Peoria silt member of Sanborn formation. Member in upland areas may be a complex of loesses of slightly different ages, at a few places separated by feebly developed soils. Its lithologic continuity in Kansas and Nebraska warrants inclusion of the complex of loesses, associated colluvial silts on some slopes, and fluvial-eolian silts on lower levels within a single member. Buried soil on Peoria silt member has been named Brady. Peoria silt occurs extensively in northern tier of Kansas counties in upland areas and on slopes, overlain by deposits of Bignell silt above Brady soil. Thickness more than 100 feet at type locality of Sanborn. Overlies Loveland silt member.

R. L. Schreurs, 1956, U.S. Geol. Survey Water-Supply Paper 1358, p. 14 (table), 23. Peorian loess, in Buffalo County and adjacent areas, Nebraska, consists of wind deposits of grayish-yellow silty clay (loess), locally grading into dune sand; contains several buried soils. Thickness 0 to 75 feet. Overlies Todd Valley formation; underlies post-Iowan terrace deposits.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, p. 55 (fig. 1). Rank raised to formation in Sanborn group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Peoria formation shown on correlation chart in Bradyan stage [Kansas does not use Sanborn group.]

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 7, 10, 12, 13. Beyond limit of Shelbyville till the Peoria loess serves as a supplementary type for Woodfordian substage (new). Peoria loess has been called Peorian, but it is here used as rock-stratigraphic rather than time-stratigraphic unit and adjectival ending is dropped. Stratigraphically overlies Farmdale silt; overlies Roxana silt (new) of Altonian substage (new). Thickness 15 to 25 feet.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 536. Frye and Willman's (1960) type section of "Roxana silt" reinterpreted. "Roxana silt" is Peorian loess (basal part Iowan). Thickness 43 feet. Occurs above Farmdale loess. Unit termed Peoria loess by Frye and Willman is possibly Bignell loess.

Named for exposures in vicinity of Peoria, Tazewell County, Ill.

†Peorian Stage[1] (of deglaciation)

Pleistocene: Midcontinent.

Original reference: Frank Leverett, 1898, Jour. Geology, v. 6, p. 244–249.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1714. Under previous usage by U.S. Geological Survey, the Iowan drift was regarded as representing a distinct stage of glaciation separated from the Wisconsin by Peorian stage of deglaciation. Geological Survey now classifies the Iowan drift as representing an early substage of the Wisconsin stage, and name Peorian is not used either for a distinct stage or substage.

Named for exposures near Peoria, Tazewell County, Ill.

Pepino Formation[1]

Miocene: Puerto Rico

Original reference: R. T. Hill, 1899, Natl. Geog. Mag., v. 10, p. 109.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latrine, fasc. 2b, p. 336. Term no longer used.

Forms Pepino Hills in northern Puerto Rico.

Pepper Shale Member (of Woodbine Formation)

Pepper Formation[1]

Upper Cretaceous (Gulf Series): Eastern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 417–422.

L. W. Stephenson, 1953, U.S. Geol. Survey Prof. Paper 242–E, p. 57–66. Rank reduced to member of Woodbine formation. Thickness 23½ feet. Unconformably underlies Eagle Ford shale; unconformably overlies Grayson marl (formerly Del Rio clay). Mollusks described. Fossil evidence confirms conclusion that Pepper shale is southward extension of the Woodbine and probably an extension of Lewisville member.

Type locality: Exposure on small branch of Pepper Creek south of Belton-Temple Highway, Bell County, and 1.6 miles east of easternmost of two passes of highway under Santa Fe Railway.

Peppersauce Sandstone[1]

Peppersauce Canyon Sandstone[1]

Upper Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 476–477, 480, 481, 482.

D. L. Bryant, 1952, Arizona Geol. Soc. Guidebook for Field Trip Excursions in Southern Arizona, p. 37. Thickness of 20 feet in Peppersauce Canyon.

In Peppersauce Canyon, Santa Catalina Mountains.

†Pequanac Shale[1]

Middle Devonian: Northern New Jersey.

Original reference: H. B. Kummel, 1908, U.S. Geol. Survey Geol. Atlas, Folio 161.

Well developed along upper Pequanac River.

Pequawket Breccia[1]

Devonian(?): Northern New Hampshire.

Original reference: C. H. Hitchcock, 1877, Geology New Hampshire, pt. 2, p. 235, 239, 262, 675, pl. 11.

On southern slope of Mount Pequawket, now North Moat Mountain, North Conway quadrangle, White Mountain.

Pequop Formation (in Carbon Ridge Group)

Permian (lower Leonard to lower Guadalupe): Northeastern Nevada and northwestern Utah.

Grant Steele, 1959, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1105. Purplish-gray irregularly bedded platy silty limestones with interbedded fusuline coquinas. Thickness 1,525 feet at type section. Lower contact placed at red silt member, which overlies massive Wolfcampian limestones (unnamed formation), and upper contact placed at base of unnamed massive dolomite sequence, which is overlain by Phosphoria formation.

J. S. Berge, Apr. 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 5, p. 10 (fig. 2), 11 (fig. 3), 27–29, pl. 4, chart (strat. section). (Footnote on chart refers to Steele's article in Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf.) Formation, in Ferguson Mountain area. Elko County, consists of interbedded calcareous quartzite and silty limestones. Thickness 681½ feet. Overlies Ferguson Mountain formation (new): underlies Kaibab limestone of Park City group. Correlation chart, in column credited to Steele (1959, unpub. thesis) shows Pequop formation overlies Ferguson Springs formation (new): in column credited to Bissell (1960), the Pequop overlies Carbon Ridge formation and underlies Moorman Ranch formation. Leonardian.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on correlation chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. In Utah, underlies the Kaibab and overlies Arcturus; in Moorman Ranch area, Nevada, underlies Moorman Ranch formation and overlies Murry [formation] (new); in Ferguson Mountain area, overlies Ferguson Mountain formation and underlies Plympton.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann Field Conf., v. 93 (chart 1), 106. (Road logs dated Sept. 8–10). Formal proposal of name. Overlies Ferguson Springs formation and in some areas Riepetown sandstone (new); underlies Loray formation. Includes Moorman Ranch member and Summit Springs evaporite member (new). Included in the Carbon Ridge herein raised to group status.

Type section: Sec. 3, T. 33 N., R. 65 E., Elko County, Nev. Section measured 1½ miles north of Jasper Railroad Tunnel in central part of Pequop Mountains.

Percha Shale[1]

Percha Formation

Upper Devonian: Southern New Mexico, southeastern Arizona, and southwestern Texas.

Original references: C. H. Gordon, 1907, Am. Jour. Sci., 4th, v. 24, p. 58–64; Science, new ser., v. 25, p. 824–825; Jour. Geology, v. 15, p. 91–92.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 163 (fig. 3). Overlies progressively, Fusselman limestone and Canutillo shale from Silver City, N. Mex., to El Paso, Tex.

L. R. Laudon and A. L. Bowsher, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 12, p. 2122, figs. 21, 22. Formation unconformably underlies Caballero formation (new) in Sacramento Mountains, N. Mex.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 95. Shale subdivided into lower Ready Pay member and upper Box member. Box member confined to Mimbres Mountain regions, whereas Ready Pay member believed to occur throughout southern New Mexico.

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 241–244. Neotype section designated. Shale overlies Sly Gap formation in San Andres Canyon, N. Mex.

M. A. Stainbrook, 1947, Jour. Paleonotology, v. 21, no. 4, p. 297–302. Two members recognized in Percha by Keyes (1908). Basal black shale termed Silver and upper lighter colored shales termed Bella. There is little doubt that these names were proposed for identical divisions of Percha named Ready Pay and Box by Stevenson (1944), and there is little reason to replace earlier names. Early Mississippian. Shale recognized near top of Mount Martin, at Bisbee, Ariz.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pub. Geology 4, p. 72–78. fig. 8. In Caballo Mountains, N. Mex., Percha has several lithologies not all of which occur in every outcrop. Predominantly gray-weathering calcareous claystone, olive-drab-weathering shale, and rusty-weathering sandstone and siltstone. Thin limestone lentils and beds irregularly distributed. Thickness ranges from thin edge to 105 feet. Although dominantly a shale unit at type locality, it includes more than shale elsewhere and would be more usefully termed Percha formation. Proposed units such as Onate and Sly Gap are not distinguishable lithologically, and hence are not mappable in New Mexico. These are no more than faunal zones at best, and the prior and well-established term Percha formation should be retained and applied widely to this lithologically and topographically distinct unit as it crops out in New Mexico. Does not rest everywhere on same formation. In most places, as along main scarp of Tim-

ber Mountain, it rests on the Fusselman, in other places rests on dolomite of Montoya group. Commonly overlain by beds of Magdalena group, but in southern end of mountains, Lake Valley rocks intervene. Includes beds of Devonian (Middle and Upper) and Mississippian (Kinderhook) age.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines and Mineral Resources Mem. 1, p. 31. Beds of Percha aspect overlie a thin "Three Forks" zone in Rhodes Canyon and are probably the beds above the Contadero in Hembrillo Canyon. In Rhodes Canyon, the Percha formation is pale- to dark-olive-gray calcareous silty micaceous shale, with a few lenses and nodules of medium-gray or olive-gray calcareous micaceous siltstone. Beds referred to Percha are 75 feet thick in Rhodes Canyon including a basal 18 inches of possible Three Forks equivalent. Thickness 67 feet in Hembrillo Canyon. Formation thins north of Rhodes Canyon and is absent at Sly Gap.

Neotype section: In SW¼SW¼SE¼ sec. 14, T. 16 S., R. 7 W., 2½ miles southeast of Hillsboro, Sierra County, N. Mex. This exposure approximately one-half mile south of narrow canyon called "The Box," through which Percha Creek flows eastward into Rio Grande.

Perchan series[1]

Devonian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines. Robert Henderson, State Printer.

Perdido Formation

Mississippian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 22–25, pls. 1, 2, 3. Consists of siltstone, shale, limestone, chert, and conglomerate; pale red to dark gray weathering reddish brown, brown, or gray; siltstone predominant in upper part, limestone predominant in lower part, characterized also by bedded chert. Lithology is greatly diversified within one section and also from place to place so that heterogeneity is an outstanding characteristic. Thickness about 610 feet at type locality; 220 feet in canyon below Ubehebe mine, west of Quartz Spring area. Underlies Pennsylvanian(?) Rest Spring shale (new); overlies Tin Mountain limestone (new).

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pub. Geol. Sci., v. 38, no. 2, p. 97–99, 137–140. In Quartz Spring area, consists of a lower limestone member and an upper siltstone member. Thickness about 424 feet (section incomplete). Overlies Tin Mountain formation. Late Mississippian.

Type locality: Extending south from Perdido Canyon, Inyo County. In the canyon, a fault between Perdido and Rest Springs formations cuts out uppermost part of Perdido, but this segment is well exposed south of Rest Spring. Type locality is supplemented by a second locality, about 3,000 feet south of Rest Spring. Named for Perdido Canyon, where formation is exposed from foot of southern wall, about 9,000 feet southeast of Quartz Spring, over hill to underlying Tin Mountain limestone.

Pereira Shale Member (of Alhambra Formation)

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 55–56, pl. 4A. Lowermost part consists of interbedded silty shale

and silty sandstone which grades up from Roop sandstone (new) with no sharp break near middle of lower third of exposed section brownish-gray silty shales are replaced by thinly stratified light-gray to white shale with occasional thin layers of interbedded silty gray sandstone. Exposed basal part is 290 feet thick; approximately 200 feet of higher beds are concealed.

Type section: West limb of Pacheco syncline, in Santa Fe cuts and ditches east of Muir Tunnel, near Martinez, Contra Costa County.

Perilla Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 9, 17, pl. 27. Consists of (ascending) friable light-yellow shale, brown crystalline limestone, light-yellow shale and argillaceous limestone, and brown crystalline limestone. Thickness 251 feet. Underlies Pedregosa member (new): overlies Quajote member (new).

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Perini Hill Flows (in Clear Lake Volcanic Series)

Quaternary: Northern Califonrnia.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 36, 41, pls. 1. 7. Andesitic flows bearing xenocrysts of quartz and xenoliths of aluminous rocks. Thickness 100 to 500 feet. Shown on columnar section above olivine basalt and below Boggs Mountain flows (new), but age relations of individual units of series are imperfectly know because some units are isolated and contacts of contiguous flows are commonly obscured by sliding.

Located on Perini Hill, about 3 miles southwest of Lower Lake. Lower Lake quadrangle, in Coast Ranges, about 70 miles north of San Francisco.

Perkasie Member (of Brunswick Formation)

Perkasie Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania and northwestern New Jersey.

Original references: B. S. Lyman, 1893, Geological and topographical map of Bucks and Montgomery Counties: Pennsylvania Geol. Survey; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

M. E. Johnson and D. B. McLaughlin *in* Erling Dorf, ed., 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 46, 50. Rank reduced to member status in Brunswick formation. Geographically extended to New Jersey where it consists of about 145 feet of red and dark-gray shale. Probably extends almost to western Montgomery County, Pa., but for part of extent is merged with thick hornfels aureole beneath large diabase sills and is indistinguishable.

Occurs near Perkasie Tunnel, Montgomery County, Pa.

Perkins Canyon Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in re-

port on Paleozoic continental margin in central Nevada. Underlies Gatecliff formation (new).

Toquima Range, Nye County.

Perkinsville Formation

Pliocene(?) to Pleistocene(?): Central Arizona.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 563–566, pls. 45, 47. Sedimentary rocks and intercalated lava flows. Sedimentary rocks primarily of coarse to fine gravel, but sand, silt, and some limestone also present. Gravel is increasingly coarse toward source areas north and south of Verde River. Bedding less evident to north and south, away from river. Lava is normal olivine basalts—except for one flow which is andesite. Basalt flows generally holocrystalline and porphyritic. Lava flows spread over part of Clarkdale quadrangle with uniform thickness of about 50 feet. Thickness of formation about 300 to 500 feet. Unconformably overlies all older formations in quadrangle; underlies Quaternary terrace gravel beds along Verde River at Perkinsville. Tentatively correlated with Verde formation.

Named from exposures on north side of Verde River near Perkinsville, Clarkdale quadrangle, Yavapai County.

Permenters Farm Beds (in Choctawhatchee Formation)

Miocene, middle: Western Forida.

H. R. Smith, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 269–274. Proposed to designate beds that lie above the *Arca* zone beds in Walton County. Lie below *Ecphora* zone and had been included in *Ecphora* by earlier workers. At type locality, consists of about 25 feet of fossiliferous marl. About 80 feet thick in well at Niceville.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 31. Choctawhatchee redefined as stage to include all Miocene sediments of post-Alum Bluff age in Florida panhandle and their equivalents in Central and Western Gulf States. In Florida panhandle, four biofacies, *Yoldia*, *Arca*, *Ecphora*, and *Cancellaria*, are recognized. Beds referred to as Permenters Farm beds are included in *Arca* facies. Recommended that term Permenters Farm beds be dropped.

Type locality: Roadcut on east bank of Alaqua Creek in sec. 17, T. 1 N., R. 19 W., Walton County.

Perote Member (of Providence Sand)

Upper Cretaceous: Eastern Alabama and western Georgia.

D. H. Eargle, 1948, Southeastern Geol. Soc. [Guidebook] 6th Field Trip, p. 44, 51–53; 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 105; 1955, U.S. Geol. Survey Bull. 1014, p. 70, 71 (fig. 11), 72. Consists chiefly of fine sand and silt which is carbonaceous and highly micaceous. Conformable with a coarser unnamed upper member. At type locality, approximately 150 feet thick and constitutes about half of entire Providence section. Overlies Ripley formation. Merges westward into Prairie Bluff chalk. Thins eastward, and at type locality of Providence (in Georgia) member is about 40 feet thick.

Type locality: Along U.S. Highway 29 in vicinity of village of Perote, southern Bullock County, Ala.

Perris Quartz Diorite[1]

Late Mesozoic(?): Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 501, map.

E. F. Osborn, 1939. Geol. Soc. America Bull.; v. 50, no. 6, p. 926. Noted as being the same as Val Verde tonalite (Wilson, 1937).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. Described as massive to moderately gneissoid with some irregularly distributed basic inclusions or schlieren arranged roughly parallel to the foliation. Listed in plutonic series, Perris and Estell quartz diorite (Val Verde tonalite) are older than Lakeview quartz monzonite and younger than Virginia quartz norite. Cuts Box Springs complex (new). Late Mesozoic.

Richard Merriam, 1948, California Div. Mines Bull. 177, p. 14. Considered equivalent to Bonsall tonalite.

U.S. Geological Survey considers the Perris Quartz Diorite as Late Mesozoic(?).

Occurs in Perris fault block, in parts of Elsinore and Corona quadrangles, Riverside County.

Perry Formation[1]

Middle Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Final Rept., v. 2, p. 1236–1237.

In Perry County.

Perry Formation[1]

Upper Devonian: Southeastern Maine, and southwestern New Brunswick, Canada.

Original reference: C. H. Hitchcock, 1861, Maine Board Agr. 6th Ann. Rept., p. 247–256.

D. H. Amos, 1958, Dissert. Abs., v. 19, no. 5, p. 1053. Discussion of geology of Calais and Robbinston quadrangles, Maine. Youngest stratified unit is Upper Devonian Perry formation. Consists of thick sequence of coarse clastic sediments containing interbedded basalt flows. All diorites and granites in area were emplaced in post-Silurian-pre-Upper Devonian interval because they exhibit intrusive contacts toward rocks of Upper Silurian age and have contributed detritus to Perry formation.

Named for development at Perry, Washington County, Maine, and elsewhere in Perry Basin.

†Perry limestone[1]

Silurian and Devonian: Eastern Missouri.

Original reference: C. R. Keyes, 1896, Missouri Geol. Survey, v. 11, p. 41.

Named for Perry County.

Perry Branch Siltstone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 179, 188, pl. 16. Uppermost member of Brodhead formation, Morehead facies (new). Thickness 25 to 40 feet. At type section underlies Floyds Knob formation and overlies Haldeman siltstone member (new) of Brodhead formation.

Type section: Along U.S. Highway 60 at spring 1½ miles west-northwest of Olive Hill; at hill along west side of Perry Branch, Carter County.

Perry Farm Shale Member (of Lenapah Limestone)

Pennsylvanian (Des Moines Series): Eastern Kansas, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 337, 338, 339, 340, pl. 1. Includes calcareous fossiliferous shale above Norfleet limestones member (new) and below Idenbro limestone member (new). Maximum thickness in Kansas about 10 feet; at type locality of Lenapah (Oklahoma) about 15 feet.

J. M. Jewett, 1955, Kansas Geol. Survey Bull. 58, p. 69. Discussed as a cyclothem in Lenapah megacyclothem.

Type locality: NW¼NE¼ sec. 7, T. 34 S., R. 18 E., Labette County, Kans.

Perry Mountain Formation

Silurian(?): Central western Maine.

A. R. Cariani, 1959, Dissert. Abs., v. 19. no. 10, p. 2577. Well-bedded quartzites intercalated with sandy biotite-muscovite schists and staurolite schists. Oldest formation in Anson quadrangle—underlies Parmachenee formation (new).

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Composed of basal conglomerates grading into cyclical argillaceous quartz siltstones in Kennebago Lake quadrangle. Thickness about 5,000 feet. Overlies Johns Pond formation (new). Lower part(?) of formation dated as Middle Silurian (Clinton).

In northwest corner of Anson quadrangle and in Kennebago Lake quadrangle.

Perrysburg Formation

Upper Devonian: Western and west-central New York.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Proposed for sequence between top of Hanover shale and base of Laona sandstone of Hall (1841). Clarke (1903) and Luther (1903) divided sequence into Dunkirk below and Portland above. Chadwick (1919) renamed upper part Gowanda beds as name Portland was preoccupied. Although Dunkirk and Gowanda can be traced from place to place in general way, they intergrade vertically to such an extent they cannot be mapped separately; hence, new name is proposed. In western New York, rocks of Perrysburg comprise wedge of Upper Devonian deltaic sediments that thickens to south and east; in this wedge, lithology varies from interbedded black and gray shales containing siltstones in area bordering Lake Erie to massive siltstones and sandstones containing some gray shale in vicinity of Pennsylvania-New York State line. Thickness at type locality 416 feet; in Chautauqua County 330 feet. Comprises seven members (described from northwest to southeast—the direction of increasing grain size and clastic content): Dunkirk shale. South Wales (new), Canaseraga sandstone, Gowanda, Hume shale (new), Caneadea, and Canisteo shale (new). Contact at base sharply defined wherever exposed; top of formation recognized with certainty only as far east as Laona sandstone of Hall can be identified. From Franklin Gulf eastward overlies Wiscoy sandstone.

Wallace de Witt, Jr., and G. W. Colton, 1953. U.S. Geol. Survey Geol. Quad. Map GQ–30. In Silver Creek quadrangle, includes Dunkirk shale, South Wales, and Gowanda members. Thickness about 400 feet.

L. V. Rickard, 1957, New York Geol. Assoc. 29th Ann. Mtg. Guidebook, p. 15 (footnote). In western New York, all recognized rock units present in interval between base of Dunkirk shale and base of Laona sandstone have been considered members of one encompassing unit, Perrysburg formation. Inasmuch as Laona or its correlate has not been traced eastward into Wellsville region, term Perrysburg cannot be applied to rocks of this interval in latter area.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1935 (fig. 2). Overlies Hanover shale member of Java formation (new).

Type locality: On Big Indian Creek in Perrysburg Township, Cattaraugus County.

Perryville Limestone

Perryville facies (of Benson Formation)

Perryville Formation[1]

Middle Ordovician: Central Kentucky.

Original reference: J. M. Nickles, 1905, Kentucky Geol. Survey Bull. 5, p. 15.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 989–996, pl. 1. Formation unconformably overlies the Lexington; unconformably underlies Cynthiana.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1635. Referred to as facies of Benson limestone.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41 (fig. 2), 42. Perryville limestone in Lexington area consists of gray crystalline limestone ranging in thickness from 15 feet to knife edge, being thinnest or absent along crest of Cincinnati arch in Fayette County. Underlies Cynthiana formation; overlies Woodburn limestone.

Named for Perryville, Boyle County. Best developed on western and southern flanks of Jessamine dome.

Perseverance Slate[1]

Triassic or older: Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 93–94.

Named for Perseverance Camp, just east of Juneau.

Persimmon Gap Shale

Upper Ordovician: Southwestern Texas.

J. L. Wilson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 12, p. 2458 (fig. 2), 2462, 2470. Greenish and drab, light-brown and pink-weathering siliceous and gypsiferous shale. Thickness at type locality 28 feet; in sections in the Solitario 40 feet. In all sections of older Paleozoic southeast of Marathon region and in the Solitario, overlies Maravillas chert and underlies Caballos novaculite.

W. B. N. Berry and H. M. Nielsen, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2254–2259. Van der Gracht published table of formations in the Solitario (furnished by Baker) in which name Solitario

formation was applied to 15 to 20 feet of bright-green siliceous and argillaceous shale between Maravillas and Caballos formations. Sellards (1932) described a green shale, 25 or 50 feet thick, overlying Maravillas chert in the Solitario. King (1937) mentioned a few feet of dark-green shale between the Maravillas and Caballos in the Rough Creek exposure. Wilson (1954) proposed name Persimmon Gap shale for shale between Caballos and Maravillas formations. Thus, Solitario formation of Baker and Sellards and Persimmon Gap shale of Wilson are same rock unit. Caballos novaculite is herein restricted to the two lower members as described by King (1937), and term Santiago revived and applied to upper three members of King's Caballos novaculite; hence, there is no need for names Persimmon Gap shale and Solitario formation.

Well exposed three-fourths of a mile up gulch east of road and ranger station at Persimmon Gap entrance to Big Bend National Park, Brewster County.

Perth Limestone Member (of Brazil Formation)

Middle Pennsylvanian: Southwestern Indiana.

H. C. Hutchinson, 1960, Indiana Geol. Survey Bull. 16, p. 19–21, pl. 16. Name proposed for marine unit that closely overlies Minshall coal. Numerous references have been made to this limestone and Wanless (1939) referred to it as Minshall limestone. Name Minshall herein abandoned. At type locality, limestone is gray, hard, argillaceous, and fossiliferous; weathers brown. Thickness 6.3 feet. Member lies 0.2 foot to 15 feet above Minshall coal and 3 to 15 feet below Coal II, which lies near top of Brazil formation.

Type locality: Abandoned strip mine of G. & F. Corp. in SW¼NE¼ sec. 3, T. 13 N., R. 7 W., Clay County, one-half mile northwest of town of Perth.

Peru Beds[1]

Pleistocene: Northeastern Illinois.

Original reference: C. O. Sauer, 1916, Illinois Geol. Survey Bull. 27.

Occurs along sides of valley, west of Peru, near western line of La Salle County.

Peru Limestone[1]

Middle Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F, p. xix.

Occurs for several miles east and west of Peru, Juniata County, in Tuscarora Valley.

Peru Sandstone[1]

Lower or Middle Devonian: Central Pennsylvania.

Original reference: J. P. Lesley, 1878, Pennsylvania 2d Geol. Survey Rept. F, p. xix.

Occurs at Peru, Juniata County.

†Pescadero Series[1]

Upper Cretaceous, Eocene and Miocene: Western California.

Original reference: G. H. Ashley, 1895, Jour. Geology, v. 3, p. 435–439.

Named for exposures at Pescadero Point and near Pescadero, San Mateo County.

Pescado Tongue (of Mancos Shale)

Upper Cretaceous: Northwestern New Mexico.

W. S. Pike, Jr., 1947, Geol. America Mem. 24, p. 9, 34–35, fig. 2. Consists mostly of gray marine shale; underlain by a regular massive cliff-forming sandstone 35 feet thick. Splits Gallup member of Mesaverde into upper and lower parts. Tongue is 50 feet thick in area of typical exposure, and its lower contact occurs 209 feet above top of main mass of Mancos shale.

Named from typical exposures on north side of valley of Pescado Creek, below Pescado village, in sec. 32, T. 11 N., R. 17 W., and sec. 5, T. 10 N., R. 17 W., McKinley County.

Peshastin Formation[1]

Pre-Tertiary: Central Washington.

Original reference: G. O. Smith. 1903. U.S. Geol. Survey Prof. Paper 19.

C. E. Weaver, 1937. Washington [State] Univ. Pubs. in Geology, v. 4, p. 19. Peshastin formation consisting of black slate and lenses of limestone and bands of chert has been mapped in both Mount Stuart and Snoqualmie quadrangles and was considered by Smith (1903) as of probable Jurassic age. Later investigations by W. S. Smith (1916, Jour. Geology, v. 24, no. 6) indicate that, on basis of fossil evidence, Peshastin rocks exposed in mountains at headwaters of south fork of Skyhomish River are of Ordovician age.

R. M. Pratt, 1959, Dissert, Abs., v. 19, no. 12, p. 3278. Oldest rocks in Mount Stuart area are Chiwaukum schist and Peshastin slate. Peshastin slate and Hawkins formation form an apparently conformable sequence.

Named for canyon of Peshastin Creek, near mouth of Negro Creek, Mount Stuart quadrangle.

Peshastin Glacial Stage

Pleistocene: Central Washington.

B. M. Page, 1939, Jour. Geology, v. 47, no. 8, p. 785, 787–795. Oldest of three successive stages of valley glaciation in Leavenworth area. Characterized by deposition of Peshastin till and Peshastin outwash. Followed by Leavenworth glacial stage (new).

Petaca Schist

Petaca schist phase (of Ortega Quartzite)

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 43, pl. 3. Minor quartz-muscovite schist phase of Ortega quartzite. Locally contains quartzite members, some places conglomeratic, and in other places quite feldspathic. Along strike grades into typical Ortega quartzite.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 34–36, pl. 1. Typical Petaca schist is light-gray schistose slabby to massive slightly muscovite quartzite. Represents altered parts of the Ortega quartzite, part of the lower Kiawa Mountain formation, and many layers of Burned Mountain metarhyolite. Mapped separately from Ortega quartzite.

Nearly restricted to Mesa la Jarita, Las Tablas quadrangle, Rio Arriba County.

Petaluma Formation[1]

Pliocene, lower: Northern California.

Original reference: R. E. Dickerson, 1922, California Acad. Sci. Proc., 4th ser., v. 11, no. 19, map.

F. A. Johnson, 1943, California Div. Mines Bull. 118, p. 623 (fig. 276), 624 (fig. 277), 625. In Petaluma region, consists chiefly of clays with some interbedded sandstone and rare bodies of thin beds and lenses of clayey limestone. Thickness about 4,000 feet. Unconformable beneath Sonoma volcanics and Merced formation. Middle Pliocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 85–91, pls. 6, 10, 11. Described in area immediately north of San Francisco Bay where it is exposed in four areas. Largest exposure trends S. 40° E. from vicinity of Penn Grove into Tolay Creek valley where it abuts against sandstone of Franciscan group or is covered by sand and gravels of Merced formation; exposed thickness here about 4,000 feet. Northeast limits of formation (north of Petaluma Valley) lie along an irregular contact with the Sonoma volcanics; folded and beveled Petaluma beds are unconformable beneath Sonoma volcanics. Base not exposed at any locality investigated.

R. A. Stirton, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 2011–2025. Discussion of vertebrate remains in Petaluma. Fossil equine specimens indicate an age transitional between middle Pliocene (Hemphillian) and late Pliocene (Blancan).

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 26 (table 6), 32–35, pl. 1. Described in Santa Rosa and Petaluma Valleys where it is composed of strongly folded continental and brackish-water clay, shale, sand, and sandstone and contains some conglomerate and nodular limestone. Exposed thickness probably exceeds 3,000 feet. May be in depositional contact with Franciscan group, but only fault contacts are mapped. Unconformably overlain by Sonoma volcanics, Merced formation, and alluvium. Table 6 shows age middle or early Pliocene; map bracket shows Pliocene. Includes Orinda formation of Johnson (1934, unpub. thesis). Exposures largely confined to belt 1 to 2 miles wide along southwestern flank of Sonoma Mountains, extending from north of Penn Grove to near mouth of Tolay Creek.

Apparently named for exposures in vicinity of Petaluma, Sonoma County.

Petan Trachyte or Basalt (in Vieja Group)

Tertiary: Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981. Named in a stratigraphic sequence as younger than Moonstone rhyolite (new) and older than Chinati Mountain (emended).

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 28. Uppermost formation Vieja group redefined. Consists of trachyandesite porphyry, dark greenish-gray to brownish-gray on fresh exposures. Maximum thickness about 300 feet. Appears as erosion remnants in form of small hills on Brite ignimbrite (new); discordantly underlies post-volcanic gravel.

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. Described in Pinto Canyon area where it overlies Brite rhyolite and underlies rocks of Chinati Mountain group. Type locality designated.

Type locality: Steep hill on which is Cleveland triangulation station. Named from Petan Ranch which occupies Capote Rim and Capote Draw from south fence of Brite Ranch to head of Pinto Canyon, Rim Rock country, Presidio County.

Pete terrane[1]

Cretaceous: Kansas.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

Derivation of name not stated.

Petersburg Formation[1]

Middle Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84, p. 2.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1. Described in Clay, Greene, and Sullivan Counties. Petersburg formation, as used by Cumings (1922, Indiana Geol. Survey Spec. Pub. 21), included rocks between unconformity at top of Coal IV and unconformity at top of Coal VII. Formation here restricted to rocks in interval between unconformity above Coal IV and unconformity above Alum Cave limestone member which is above Coal V. Restricted Petersburg includes Coals IVa and V and averages 115 feet thick. Consists of 95 to 125 feet of sandstone, shale, limestone, and coal. Interval from unconformity above Coal IV and base of Coal IVa is composed of 30 to 50 feet of sandstone and shale which grade into each other laterally and vertically. Overlies Linton formation (new); underlies Dugger formation.

Named for Petersburg, Pike County.

†Petersburg Granite[1]

Late Paleozoic: Eastern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. of geol. map of Virginia.

R. O. Bloomer, 1939, Virginia Geol. Survey Bull. 51, p. 141–145. In Richmond area, Petersburg granite consists of three facies: most common is gray to pink, medium-grained granite; a blue, relatively fine-grained facies (just west of Richmond); and a porphyritic facies occurs in a belt which extends north and south along eastern margin of Triassic basin. Intrudes Wissahickon gneiss; contact forms a zone of apophyses approximately 1 mile wide. Underlies Triassic sediments. Late Paleozoic.

First described from occurrences near Petersburg, Dinwiddie County, Va. Petersburg granite is a batholithic intrusion that extends from Hanover County, Va., southward into North Carolina.

Peters Creek Breccia

Middle Mississippian: West-central Indiana.

C. L. Bieber, 1959, Indiana Acad. Sci. Proc., v. 68, p. 265–267. Intraformational limestone breccia in Middle Mississippian limestone. As exposed at waterfall in small branch valley of Peters Creek, bed is nearly 6 feet thick. Bedding is indistinct, but associated limestones above and below are well bedded and nearly horizontal except for local rolls and arches. Over 90 percent of blocks (phenoclasts) in matrix are limestone. Base of breccia is in sharp contact with a wavy laminated layer of limestone 4 inches thick. Based mainly on lithology and sequence, age of breccia is believed to be early St. Louis.

Well exposed in SW¼NW¼ sec. 36, T. 16 N., R. 5 W., southwest of Fincastle, Putnam County.

Peters Creek Quartzite

Peters Creek Schist[1] or Formation

Lower Paleozoic(?) (Glenarm Series): Southeastern Pennsylvania, northern Maryland, and northeastern Virginia.

Original reference: A. I. Jonas and E. B. Knopf, 1921, Washington Acad. Sci. Jour., v. 11, p. 447.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 90–91. Peters Creek quartzite described in York County, where it underlies a belt 6 miles wide that covers most of southeastern corner of area. Divided into two parts by narrow area underlain by Cardiff conglomerate and Peach Bottom slate. At its northwestern boundary, in contact with Wissahickon formation. No estimate of thickness made. Major structure of the Peters Creek is synclinal. Intruded by Sykesville granite. Precambrian(?).

G. W. Stose and A. J. Stose, 1948, Am. Jour. Sci., v. 246, no. 7, p. 405, 408. Quartzose mica schist beneath Arvonia slate should be called Peters Creek formation. If Peters Creek formation belongs in Taconic sequence, it is part of a series that ranges in age up to Lower Trenton.

S. L. Agron, 1950, Geol. Soc. America Bull., v. 61, no. 11, p. 1267–1268. Peters Creek is series of interbedded chlorite-sericite and quartz-albite schists which underlies and encloses Peach Bottom syncline. Peters Creek lies above the Wissahickon schist and underlies Cardiff conglomerate.

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1029 (table 1). Formation included in Glenarm series which is considered pre-Silurian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Named for exposures along Peters Creek which enters Susquehanna River at Peach Bottom, Lancaster County, Pa.

Peters Mountain Sandstone (in Pocono Formation)[1]

Mississippian: Central Pennsylvania.

Original reference: B. Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 573.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 18. Platy gray sandstone with some pebble beds. Overlies Second Mountain member and underlies Cove Mountain member (both new).

Named for Peters Mountain, Dauphin County.

Peterson Limestone (in Gannett Group)[1]

Lower Cretaceous: Southeastern Idaho and western Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98–G, p. 76, 82.

R. E. Peck, 1941, Jour. Paleontology, v. 15, no. 3, p. 285–286. Considered Lower Cretaceous on basis of faunal studies.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 42–43, pl. 1. Described in Ammon quadrangle, Idaho, where it is chiefly massive dark dense limestone, underlies Bechler conglomerate and overlies Eph-

raim conglomerate. Locally in juxtaposition with Twin Creek limestone. Involved in folds and faults. Thickness appears to be about 200 feet. Lower Cretaceous.

C. A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 65 (table 1), 66–67. In Gannett Hills region, Wyoming, consists of about 125 feet of gray compact sublithographic limestone with a few conglomeratic and brecciated zones. Overlies Ephraim conglomerate; underlies Bechler formation.

W. L. Stokes, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 80, 81 (fig. 1). Thickness along Idaho-Wyoming boundary about 200 feet; wedges out eastward.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 56, pl. 21. Described in Jackson Hole area as limestone member of Gannett group. Light- to medium-blue-gray and sublithographic. Thickness about 135 feet on Fall Creek; 113 feet in Snake River Bluff near mouth of Dog Creek. Overlies Ephraim conglomerate member; underlies Bechler "conglomerate" member.

Named for exposures east of Peterson's Ranch, along Tygee Creek, sec. 34, T. 7 S., R. 46 E., Boise meridian, Freedom quadrangle, Bannock County, Idaho.

Petersville Shale[1]

Mississippian: Northeastern Kentucky.

Original reference: W. C. Morse and A. F. Foerste, 1912, Kentucky Geol. Survey Bull. 16, p. 24.

Named for Petersville, Lewis County.

Petes Summit Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3). Discussion of Paleozoic continental margin in central Nevada. Clipper Canyon sequence comprises (ascending) Charcoal Canyon, Petes Summit, Sams Spring, and Joes Canyon formations (all new). Clipper Canyon sequence is isolated by surrounding Tertiary volcanic rocks.

Clipper Canyon, Toquima Range, Nye and Lander Counties.

Petoskey Limestone[1] (in Traverse Group)

Middle Devonian: Northern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 201, 210.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1776, chart 4. Contains several faunas of different age; at base is an assemblage suggestive of the Norway Point of Alpena County; above is a fauna resembling the Potter Farm formation; this is followed by an assemblage containing an element of the Thunder Bay fauna.

Probably named for exposures at Petoskey.

Petrified Forest Member (of Chinle Formation)

Upper Triassic: Northern Arizona, southeastern Nevada, west-central New Mexico, and southern Utah.

G. B. Maxey, 1946, Am. Jour. Sci., v. 244, no. 5, p. 337. Incidental mention in discussion of geology of Pavant Range, Millard County, Utah. Name credited to H. E. Gregory.

H. E. Gregory, 1947, Geol. Soc. America Bull., v. 58, no. 3, p. 223 (table 1), 228. Upper part light-red and brown, irregularly bedded sandstones and sandy, argillaceous, carbonaceous, and calcareous shales widely variable in composition; lower part brilliantly variegated friable shales of various composition and degrees of hardness, which weather into badland forms; contains fossil wood. Thickness 300 to 400 feet. Underlies Springdale sandstone member (new); overlies unnamed sandstone in basal part of formation.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 52 (table), 66, 67–68, strat. sections. Described in Zion National Park region where it is 650 to 800 feet thick. Derivation of name stated.

G. A. Kiersch, 1955, Mineral resources Navajo-Hopi Indian Reservations Arizona-Utah: Tucson, Univ. Arizona Press, v. 2, p. 4 (fig. 1), 5. In Navajo country, underlies Owl Rock member (new) and overlies Monitor Butte member (new). Locally overlies Shinarump conglomerate. Predominantly claystone but contains sandstone (Sonsela beds) in eastern part.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 457–458. Described in southeastern Utah where it conformably underlies Owl Rock member and in most areas conformably overlies Monitor Butte member; conformably overlies Moss Back member in part of White Canyon and Elk Ridge areas. Thickness in Monument Valley area 500 to 700 feet; 100 feet in White Canyon area and southern part of Elk Ridge area; north of these areas 70 feet or less. Near junction of Green and Colorado Rivers, loses identity probably by intertonguing and intergrading with Owl Rock member. Corresponds to "C" division of Chinle formation described by Gregory (1917, U.S. Geol. Survey Prof. Paper 93) in northeastern Arizona. Geographically extended into Nevada and New Mexico.

R. F. Wilson, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. As result of this study, the Chinle is redefined to include only lower part of Petrified Forest member.

Named for fact that it contains band of fossil wood closely resembling dominant rock in Petrified Forest of Arizona. Present in all of northern Arizona and southern Utah, extends into southeastern Nevada and west-central New Mexico. In most of these areas, forms thickest and most characteristic part of formation.

Petros Sandstone (in Slatestone Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Two sandstones separated by a shale break that includes Petros coal. Thickness 50 to 60 feet in type area; 45 feet in Cross Mountain section. Underlies a shale interval 40 to 170 feet thick that includes Blue Gem coal and in turn underlies Sand Gap sandstone (new); overlies a shale interval 40 to 190 feet thick that contains Coal Creek coal and in turn overlies the Stephens sandstone (new).

Named from town of Petros, Morgan County.

Pewabic Amygdaloid[1] (in Ashbed Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. Pumpelly, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 21–25, 28.

T. M. Broderick, C. D. Hohl, and H. N. Eidemiller, 1946, Econ. Geology, v. 41, no. 7, p. 678 (fig. 1). Name appears on geologic section of Michigan copper district.

Named for occurrence in Pewabic mine, Houghton County.

Pewabic Flow[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (Chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

Pewabic Quartzite[1]

Precambrian (Huronian) : Northeastern Minnesota.

Original reference: N. H. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept., p. 79, 86.

Occurs in region of Gunflint Lake to Ogishke Muncie Lake. Named for Chippewa word meaning iron.

Pewabic West Conglomerate[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan) : Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 82, chart.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Included in Portage Lake lava series.

Probably named for occurrence in old Pewabic West mine, Houghton County.

Pfeifer Shale Member (of Greenhorn Limestone)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: N. W. Bass, 1926, Kansas Geol. Survey Bull. 11, p. 32.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Chalky shale and chalky limestone in alternating layers, "Fencepost limestone bed" at top; blue gray, weathers to light tan. In Hamilton County, Pfeifer shale member and the underlying Jetmore chalk member are thicker than farther east; they cannot be distinguished and have been together designated the Bridge Creek limestone member. Thickness of Pfeifer shale typically 19 to 21 feet in Ellis and Russell Counties. Includes Fencepost limestone bed. Underlies Fairport chalky shale member of Carlile formation.

Named for exposures 2½ miles northwest of Pfeifer, Ellis County.

Phalen Lake Volcanics[1]

Tertiary(?) : Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 101, map.

Forms steep escarpment overlooking west side of Phalen Lake, Stevens County.

Phantom Flows, Lavas

Pleistocene: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 30, pl. 6. Oldest of visible lavas of former Mount Mazama seems to have issued from vent close to the Phantom Ship, on south wall of caldera. How high

Phantom cone rose is impossible to tell; after activity ceased, summit was eroded and buried by flows and other ejecta from central vents of Mount Mazama. Unconformity separates Phantom flows from those of Mazama proper.

Phantom Ship, probably remnant of Phantom Cone, is on south wall of caldera of Crater Lake.

Phantom Migmatite

Precambrian: Northern Arizona.

Ian Campbell and J. H. Maxson, 1937, 17th Internat. Geol. Cong. Abs. of Papers, p. 65 (1939, Rept., v. 2, p. 260); 1938, Carnegie Inst. Washington Year Book 37, p. 363. Mentioned in discussion of Archean rocks of Grand Canyon.

Type locality: Phantom Creek, Grand Canyon area.

Phantom Canyon Quartzite

Precambrian (Algonkian): South-central Colorado.

J. D. Martinez, 1959, Dissert. Abs., v. 20, no. 3, p. 995. Incidental mention only.

In vicinity of Canyon City.

Phelan Limestone

Carboniferous(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Consists of coarse to finely crystalline, light blue-gray, massive-bedded limestone, locally cherty. Thickness 1,000 to 1,500 feet. Overlies newly named Wardlaw shale.

In Ashbrook mining district on west side of Goose Creek Range.

Phelps Sandstone[1]

Lower Mississippian: Southwestern Missouri.

Original reference: E. M. Shepard, 1898, Missouri Geol. Survey, v. 12, pt. 1, p. 49, 77–82.

E. B. Branson and M. G. Mehl, 1939, (abs.) Missouri Acad. Sci. Proc., v. 4, no. 6, p. 167. Bushberg is equivalent to the Phelps and should be called Phelps. The Phelps is basal Mississippian.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 71–72. Phelps sandstone as defined by Shepard has not proven useful unit in stratigraphic studies except, perhaps, as a subsurface catchall. In light of uncertainty of stratigraphic connotation of Phelps, it is here recommended that term be dropped from list of names in Missouri columnar section.

Named for Phelps mines, Greene County.

Phi Kappa Formation[1]

Lower Ordovician and later(?): Central Idaho.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10, 18.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 8. Phi Kappa formation, largely argillaceous quartzite, and the unnamed argillite beneath it are together probably broadly equivalent to Ramshorn slate, Kinnikinic quartzite, and Saturday Mountain formation.

Named for exposures along Phi Kappa Creek, Hailey quadrangle.

Philadelphia Brick Clay[1]

Pleistocene: Southwestern New Jersey and southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. History Sci. Proc., v. 32, p. 258–272, 296–309.

Philadelphia is in part built on this clay.

†Philadelphia Mica Schist and Gneisses[1]

Precambrian (Glenarm Series): Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. C_6, p. 28–31, map.

Extends from Delaware River at Trenton westward across Schuylkill River into Delaware County.

Philadelphia Red Gravel[1]

Pleistocene: Southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc., v. 32, p. 258–272, 296–309.

Well exposed near University of Pennsylvania in Philadelphia.

†Philipsburg Formation[1]

Lower Ordovician: Eastern New York and northwestern Vermont.

Original reference: R. P. Whitfield, 1890, Am. Mus. Nat. History Bull., v. 3, p. 25–28.

Philipsburg Series[1]

Lower Ordovician and older(?): Southern Quebec, Canada, and northwestern Vermont.

Original reference: W. E. Logan, 1863, Canada Geol. Survey, p. 273–280, 844–854.

Named for village of Philipsburg, Quebec, where lower formations of series are well exposed.

Philson Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: F. and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 286, 292.

Probably named for exposures at or near Philson, Somerset County.

Phipsburg Limestone[1]

Age(?): Maine.

Original reference: C. T. Jackson, 1838, Rept. on geology of Maine, v. 2, p. 61–62.

Phipsburg Basin.

Phoenix Beds[1]

Cretaceous: Oregon.

Original reference: F. M. Anderson, 1902, California Acad. Sci. Proc., 3d ser., v. 2, p. 1–62.

Southern part of Oregon Basin.

Phoenix Limestone Lentil (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 44, map, sections.

Crops out at mouth of Phoenix mine, Bingham district.

Phoenix Volcanic Group[1]

Mesozoic(?) and older(?): Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps.

The town of Phoenix is in midst of this large though interrupted area of basic volcanics.

Phoenix or Schroeppel Shale[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

D. W. Fisher, 1959, New York State Mus. Sci. Service Map and Chart Ser. No. 1. Gillette (1947) in his detailed study of Clinton group ignored Chadwick's (1918) Phoenix and Schroeppel shales, probably because they were so loosely defined. Instead he introduced name Willowvale for the green fossiliferous shale beneath the Herkimer and above the Kirkland. Gillette's view is followed in present report.

Type locality: At Phoenix, Schroeppel Township, on Oswego River, Oswego County.

†Phoenix Mine Group[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 175–178. Exposed in Phoenix mine in Keweenaw County.

Phoenix Park Quartz Latite[1] (in Alboroto Group)

Tertiary, middle or late: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 93 (table 18). Alboroto rhyolite described in San Juan district. Upper part is biotite-hornblende latitic rhyolite; includes Equity and Phoenix Park quartz latites [both part of Alboroto group] of Creede district.

Named for development about Phoenix Park, Creede district.

†Phoenixville Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: B. S. Lyman, 1894, Am. Philos. Soc. Proc., v. 33, p. 197–215.

At Gwynedd and Phoenixville tunnels, Bucks and Montgomery Counties.

Phosphoria Formation[1]

Phosphoria Group

Permian: Idaho, western Montana, northeastern Utah, and western Wyoming.

Original reference: R. W. Richards and G. R. Mansfield, 1912, Jour. Geology, v. 20, p. 683–689.

H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1655–1697. Marine limestone and sandstone tongues extend southeastward from the Phosphoria and Dinwoody formations of Wind River Mountains and Owl Creek Mountains, interfingering with red shales in base of Chugwater formation in central and southeastern Wyoming. Intercalated marine beds and red shales constitute the red-bed "Embar" of central Wyoming. Phosphoria includes Sybille tongue (new), Forelle tongue, and Ervay tongue (new).

G. E. Condra E C. Reed, and O. J. Scherer, 1940, Nebraska Geol Survey Bull. 13, p. 2, 6, 9; 1950, Nebraska Geol. Survey Bull. 13–A, p. 2, 3, 6, 9. Group comprises (ascending) Opeche shale, Minnekahta limestone, Glendo shale (new), Forelle limestone, and Freezeout shale. Overlies Cassa group (new); underlies Dinwoody formation or Spearfish formation (redefined). Permian.

N. D. Newell, 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1056 (fig. 2), 1057. In Confusion Range, Utah, Phosphoria formation, 4,555 feet thick, overlies the Kaibab and underlies Woodside.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 241. Beaverhead formation (new) unconformably overlies Cretaceous Kootenai, Triassic Dinwoody, and Permian Phosphoria.

J. J. McCue, 1955, (abs.) Wyoming Univ. Pubs., v. 19, no. 2, p. 82. In southeastern part of Big Horn Basin includes Nowood member (new).

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2844–2852; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 20–31. Phosphoria formation consists of chert, carbonaceous mudstone and phosphorite in its typical area in southeastern Idaho. These rocks intertongue with, and pass laterally into, sandstone in south-central Montana and northwestern Wyoming, carbonate rock in west-central Wyoming, and carbonate rock and subordinate sandstone in northeastern Utah; thin tongues of phosphatic and cherty rocks persist over all of these areas. Carbonate rocks in turn intertongue with, and pass laterally into, greenish-gray and red beds in eastern Wyoming, southeastern Montana, eastern Utah, and northwestern Colorado. Plan of nomenclature developed to describe these rocks has following elements: (1) retains name Phosphoria formation for chert-mudstone-phosphorite facies and identifies as tongues of the Phosphoria rocks of these lithologic types that interfinger with sandstone and carbonate rock along fringe of phosphate field; (2) retains name Park City formation for sequence of carbonate rock and sandstone in Utah, restores this name for similar carbonate rock in west-central Wyoming, and identifies as tongues of the Park City formation beds of carbonate rock that interfinger with other formations in Idaho, western Wyoming, and Montana; (3) introduces name Shedhorn sandstone, for sandstones of Phosphoria age in northwestern Wyoming and southwestern Montana. Three members recognized at type locality—Meade Peak phosphatic shale, Rex chert, and cherty shale. Three other members—the lower cherty member (laterally continuous with lower beds of Meade Peak), Retort phosphatic shale member, new, (laterally continuous with the cherty shale member), and Tosi chert member, new, (laterally continuous with upper part of the Retort and cherty shale member)—are not present in broader area of typical development of the Phosphoria. Eastward, parts of Phosphoria grade laterally into sandstone of Shedhorn and carbonate rock of Park City formations, but other parts extend as tongues over most of field. Thickness at type locality 250 to 450

feet; thickens to about 1,300 feet in south-central Idaho. Underlying formations: Quadrant quartzite, Montana; Tensleep sandstone, Wyoming; Wells formation, Idaho; Weber quartzite or sandstone, Utah and Colorado.

Named for typical exposures in Phosphoria Gulch, which joins Georgetown Canyon, 2½ miles northwest of Meade Park, Idaho.

Piasa Limestone Member (of Modesto Formation)

Piasa Limestone (in McLeansboro Formation)[1]

Piasa Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern and southwestern Illinois.

Original reference: H. E. Culver, 1925, Illinois Geol. Survey Coop. Min. Ser. Bull. 29, p. 20.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 21 (table), 30–31. Included in Sparland cyclothem, McLeansboro group. Overlies Danville (No. 7) coal; underlies unnamed shales.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 48 (table 1), pl. 1. Rank reduced to member status in Modesto formation (new). In southeastern area, occurs below De Graff coal member (new); in southwestern area occurs below Rock Branch coal member (new), Piasa limestone, De Graff coal, Pond Creek coal, and Lake Creek coal members may be included in complex West Franklin limestone member in eastern part of area. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: E½ sec. 25, T. 8 N., R. 10 W., Jersey County. Named for Piasa Creek.

†Picacho Limestone[1]

Permian: Southeastern New Mexico.

Original reference: A. G. Fiedler and S. S. Nye, 1933, U.S. Geol. Survey Water-Supply Paper 639.

Named for Picacho, Lincoln County, in vicinity of which lower part is well exposed.

Picacho de Calera Formation[1]

Upper Devonian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 485, 488.

W. D. Pye, 1959, Arizona Geol. Soc. Guidebook 2, p. 277. Age given as Upper Devonian in catalog of formation names in southern Arizona and northern Sonora.

In Picacho de Calera Hills, 25 miles northwest of Tucson.

Picard Shale Member (of Nesson Formation)

Jurassic: Subsurface in Montana and North Dakota, and Manitoba, Canada.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 104, 105, fig. 2. Shale unit that conformably overlies Poe evaporite member (new) and underlies Kline member (new). In type section, consists of 40 feet of dark-red shale which is slightly silty in part and

contains masses or thin interbeds of white earthy gypsum in lower half of unit. Thins laterally toward margins of Williston basin.

Type section: Interval 6,610 to 6,650 feet in Deep Rock Oil Corp. No. 1 Picard well, center NW NE sec. 6, T. 29 N., R. 52 E., Roosevelt County, Mont.

Picayune Formation (in Silverton Volcanic Group)

Picayune Quartz Latite (in Silverton Volcanic Series)

Picayune Volcanic Group (in Silverton Volcanic Series)[1]

Tertiary, middle and upper: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 76–77, pl. 1. Picayune quartz latite made up of interlayered flows, tuffs, breccias, and agglomerates of a quartz latite of intermediate silica content, in San Juan region. Rocks chiefly dark-purple or greenish quartz latites grading into rhyolites on one hand and into darker quartz latites on the other. Thickness 1,800 feet.

Pickens Sandstone[1]

U.S. Geological Survey currently classifies the Picayune as a formation in Silverton Volcanic Group and designates the age as middle and late Tertiary on basis of a study now in progress.

Small exposures in Animas Valley and in its minor tributary, Picayune Gulch, from which unit takes its name.

Pickaway Limestone (in Greenbrier Limestone)[1]

Mississippian (Meramecian): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450–473.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 272–277; J. M. Weller and others, 1948. Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Limestone in Greenbrier series. Underlies Union limestone; overlies Taggard formation [shale]. Meramecian series.

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1910–1912. Discussion of paper by Wells (1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5). Butts (1927, Oil and gas possibilities at Early Grove, Scott County, Virginia) ignored writer's [Reger] previous terminology. He used names Cove Creek limestone and Fido sandstone for certain stages of Mauch Chunk and assigned everything between the Gasper (Upper Union) and St. Louis (Hillsdale) to the Ste. Genevieve. Use of Cove Creek and Fido was violation of custom because writer's names were already in print. Butts' classification of rocks to the Ste. Genevieve was merely an avoidance of Pickaway, Taggard, Patton, and Sinks Grove.

Type locality: Along State road between Pickaway and Union, Monroe County, W. Va.

Pickens Sandstone[1]

Pennsylvanian: Northern West Virginia.

Original reference: J. A. Taff and A. H. Brooks, 1896, U.S. Geol. Survey Geol. Atlas, Folio 34.

Named for Pickens, Randolph County.

Pickering Gneiss[1]

Precambrian: Eastern Pennsylvania and New Jersey.

Original references: B. L. Miller, 1912, Econ. Geology, v. 7, p. 767; 1925, Pennsylvania Geol. Survey, 4th ser., Bull. M_7, p. 61–66; F. Bascom, 1932, U.S. Geol. Survey Geol. Atlas, Folio 223.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 12–45, pl. 5. Area of report is Delaware Water Gap and Easton quadrangles, New Jersey and Pennsylvania. There is in the Highlands a series of schists and gneisses which are different from predominating gneisses of district and which at many places are evidently closely associated with Franklin limestone and at some places apparently grade into the limestone. They are regarded as sedimentary. Their relations to Pochuck, Byram, and Losee gneisses are not clear, but, because the Pochuck, Byram, and Losee are believed to be intrusive in the limestone, it is inferred that they are also intrusive in sedimentary gneisses and schists associated with the limestone. The sedimentary schists, slaty rocks, and gneisses are here included under name Pickering gneiss; and the Pochuck gneiss of which they have heretofore been treated as a part is restricted to the black gneisses of igneous origin which are intrusive in the Franklin limestone and the sedimentary gneisses and schists.

Named for fact that Pickering Creek, Chester County, Pa., lies almost wholly within this gneiss area.

Pickhandle Formation

Miocene, middle: Southern California.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 138. Mentioned in discussion of silver-barite veins at Waterman mine, Calico district. Principal vein roughly follows bedding of a sequence of dacitic tuffs, lakebed clays and siltstones, and granitic fanglomerate probably belonging to Pickhandle formation; jasper appears bedded and may have been an original member of Pickhandle. Name credited to Thane McCulloh (unpub. rept.).

Waterman mine is in NE¼ sec. 13, T. 10 N., R. 2 W., 4 miles north of Barstow, via Camp Irwin Road, Barstow quadrangle, San Bernardino County.

Pico Formation

Pico Formation (in Fernando Group)[1]

Pliocene: Southern California.

Original reference: B. L. Clark, 1921, Jour. Geology, v. 29, p. 608–609, chart facing p. 586.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 50 (table 1), 54 (fig. 2), 56–61, pls. 14, 16. Described in Placerita oil field. Consists of three members: lower Pico marine, middle Pliocene; upper Pico marine, upper Pliocene; and continental upper Pliocene Sunshine Ranch member. Marine members not recognized north of San Gabriel fault. Thickness about 3,000 feet. Unconformably underlies Saugus formation; overlies Elsmere member of Repetto siltstone, gradually overlaps it, and lies directly on crystalline rocks at Whitney Canyon and north.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 23 (fig. 2), 24 (fig. 3), 74–75, 81–83, pls. 1–3. Term Pico is here applied to members of middle and upper Pliocene age. Three members recognized: marine

middle Pliocene Lower Pico, marine upper Pliocene Upper Pico, and continental upper Pliocene Sunshine Ranch member. Underlies Saugus formation; overlies Repetto formation. Present both north and south of San Gabriel fault in San Fernando quadrangle.

E. L. Winterer and D. L. Durham, 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. In Ventura Basin, Pico formation consists of light-olive-gray and bluish-gray siltstone and fine-grained sandstone, light-brown and gray sandstone and conglomerate. Upper part interfingers with Saugus formation; lower part interfingers with Towsley formation. Thickness about 5,000 feet in western part of area; only a few hundred feet to the east, near Placerita oil field. Many beds that are here referred to Pico formation were included in the Saugus by Kew (1924, U.S. Geol. Survey Bull. 753).

D. L. Durham and R. F. Yerkes, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–195. Term Pico in Los Angeles Basin should be replaced by a new formational name. Strata not named in present report.

Named for exposures in Pico Canyon, Los Angeles County.

Pico Peak Series

Cambrian(?): Central Vermont.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 653, 654, 657. Local unit consisting of quartz schists, quartzites, quartzose gneisses and dolomitic marble. Replaces Mount Holly series in this area. Underlies Plymouth Union series (new). Age difficult to determine without fossil evidence.

Type locality: East side of Green Mountain Range in Plymouth and Bridgewater Townships, Windsor County. Distinctive marble bed best exposed in valley east of Blue Ridge Mountain.

Picton Granite[1]

Precambrian: Northern New York.

Original reference: J. M. Clarke, 1909, New York State Mus. Bull. 133, p. 9–10.

Crops out on Grindstone and Wellesley Islands. Named for Picton Island (also called Robbins Island) in St. Lawrence River.

Pictonian Stage

See Trenton Stage.

Pictured Cliffs Sandstone[1]

Upper Cretaceous: Northwestern New Mexico and southwestern Colorado.

Original reference: W. H. Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. for 1875, p. 248, 250, 251, pl. 35.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2159. Discussion of revised nomenclature of Mesaverde group in San Juan basin and its bearing on problem of nomenclature of Pictured Cliffs and Cliff House sandstones. As result of southward thinning and termination of Lewis shale, Pictured Cliffs and Cliff House sandstones are in direct contact and for several miles southeast of Newcomb form an inseparable unit. It seems advisable, however, to maintain name Pictured Cliffs and its identity as a distinct formation for the following reasons: its long-standing and well-understood usage; it represents closing stages of marine Cretaceous deposition in San Juan

basin, and there is some suggestion that part of it may have had a northern source differing from that of underlying Mesaverde; everywhere separated from Mesaverde in subsurface; known intertonguing relations with both Lewis shale and overlying Fruitland formation suggest that there may develop a need for named tongues of Pictured Cliffs.

Named for Pictured Cliffs on San Juan River, in northwestern New Mexico.

Picuris Basalts

Precambrian (Proterozoic) : Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 23–24, 44. Series of basalt and andesite flows that occur principally interspersed with the sedimentary schists of the Hopewell series in Picuris and Petaca areas. The basalts could be grouped definitely as part of the Hopewell series, except that they persist up into Ortega quartzite, especially in Petaca area; therefore, the basalt intrusives have been given a distinctive name. Although basalts are schistose, their igneous nature is definitely established by presence of lath-shaped phenocrysts of plagioclase. Half a mile thick in Picuris Canyon.

Most readily recognizable exposure observed in Picuris area is near mouth of Picuris Canyon. Also recognized in Petaca area, Rio Arriba and Taos Counties.

Picuris Tuff

Miocene(?) : Northern New Mexico.

E. C. Cabot, 1938, Jour. Geology, v. 46, no. 1, p. 91. In Badito locality, consists of (ascending) about 680 feet of buff water-laid tuff interbedded with cemented gravel; 190 feet of salmon-pink sandy clay with layers of cemented gravel; 10 feet of giant conglomerate characterized by rounded boulders having maximum size of about 4 feet; 100 feet of gravel similar to unit below but with smaller pebbles and cobbles; 40 feet of basaltic lava; and some gravels above basalt. Total thickness about 1,000 feet. About 2 miles east of Badito section, red and green silts and clays and a giant conglomerate, totaling 200 feet in thickness, lie below the tuff so that total thickness of Picuris in this area seems to be in excess of 1,200 feet. Overlies Magdalena formation unconformably. Tertiary (pre-Santa Fe).

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 52, pl. 1. Probable Miocene. Maximum thickness estimated to be from 1,250 to 1,750 feet. Exposed on northeast, southeast, and across central parts of Picuris Range.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118. Although Cabot (1938) extended Picuris tuff southward to include exposures just north of Santa Fe, Kottlowski is proposing name Bishops Lodge member of Tesuque formation.

Beds crop out typically in the Picuris reentrant near towns of Badito and Placita, Taos County.

†Piedmont Group[1]

Precambrian and Cambrian : Western North Carolina.

Original reference: W. C. Kerr, 1869, North Carolina Geol. Survey Rept. 2, p. 13–35.

Named for development in Piedmont Plateau of North Carolina.

Piedmont Sandstone

Permian: Western Oklahoma.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). Shown on cross section at top of Cedar Hills member of Hennessey formation. Underlies Flowerpot shale.

Type locality and derivation of name not stated.

†Piedmont Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Northern West Virginia, Maryland, and western Pennsylvania.

Original reference: C. A. Ashburner, 1877, Am. Philos. Soc. Proc., v. 16, p. 519–560.

Probably named for Piedmont, Mineral County, W. Va.

†Piedra Formation[1]

Upper Cretaceous: Southwestern Colorado.

Original reference: W. Cross and A. C. Spencer, 1899, U.S. Geol. Survey Geol. Atlas, Folio 60.

Piedra Rhyolite (in Potosi Volcanic Group)

Piedra Rhyolite or Group (in Potosi Volcanic Series)[1]

Tertiary, middle or upper: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 36.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 144–156. Piedra rhyolite included in Potosi volcanic series. Thickness 2,000 to 3,000 feet. Made up of four distinct members: lower rhyolite, tridymite rhyolitic latite, tuff, rhyolitic latite.

E. S. Larsen, Jr., and others, 1958, U.S. Geol. Survey Bull. 1070–B, table 2. Lead-alpha dating of Piedra rhyolite shows age to be about 16 million years.

U.S. Geological Survey tentatively assigns a middle or late Tertiary age to the Piedra.

Named for exposures in Piedra Peak, San Cristobal quadrangle.

Piedras Altas Formation (in Asuncion Group)

Upper Cretaceous: West-central California.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 132 [preprint 1941]. Lower formation of Asuncion group (new) in southern Santa Lucia Range. Underlies Godfrey shale (new).

Santa Lucia Range is mountainous area, between Salinas Valley and the coast, which extends from Monterey Bay to central part of San Luis Obispo County.

Piegan Group

Precambrian (Belt Series): Western Montana.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1890–1892. Limestones, dolomites, and dominantly argillaceous clastics which lie between Missoula and Ravalli groups. Despite variations, they form the sole dominantly calcareo-magnesian group in the Meagher facies and the second in the Glacier Park. Characterized by

great development of calcareous algae. Contains Siyeh, Spokane, and Sheppard formations in ascending order at type locality.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112–113. Restricted at top to exclude Shepard formation which is included in Missoula group. Where Helena limestone is recognizable, it is regarded as upper formation of group. Greyson, Spokane, and Empire shales (named in ascending order), which overlie the Newland and underlie the Helena in vicinity of Helena, may be local units or may correspond to argillaceous rocks of other regions. Principal component of group has been variously called Siyeh, Newland, and Wallace limestone or formation, and these names are retained locally. In Glacier Park, Piegan group, as herein defined, consists largely of massive dolomite and dolomitic limestone with interbedded argillite, quartzite, oolite, and mud breccia. Maximum reported thickness 5,400 feet. Overlies Ravalli group.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000) : U.S. Geol. Survey. As mapped, includes Wallace formation, Newland limestone, Siyeh limestone, Greyson shale, Spokane shale, Empire shale, and Helena limestone.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 33–43, pls. 1, 2. Restricted to include only Siyeh limestone. As far as Glacier National Park and neighboring areas are concerned, name "Piegan group" as restricted might well be dropped. At present, name is retained because of its usefulness in correlation throughout Montana and because of Siyeh limestone is expected to be divided into several units of formational rank when more detailed mapping is done. At that time, Siyeh limestone may be restricted in its application or abandond.

Type locality: Piegan Mountain, Glacier National Park. Well exposed on Mounts Gould, Wilbur, Cleveland, Lineham, and other high peaks of Glacier-Waterton region.

Pie Knob Andesite[1]

Pleistocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 403–404, map.

Forms large part of Pie Knob, north of University Campus, Berkeley, Alameda County.

Pierce Limestone (in Stones River Group)[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 258–267.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 32–34. Gray and blue to light-blue and dove-colored thinly bedded limestone separating the more massively bedded overlying Ridley limestone and underlying Murfreesboro limestone. Thickness 23 to 28 feet. Type section was at Pierce's Mill which has now been replaced by a power plant located on north bank of East Fork of Stones River one-half mile south of Walterhill on Murfreesboro-Lebanon Highway. Formation is nearly completely exposed, base and lower part being exposed on west side of power plant, and the top few feet and contact with overlying Ridley occurring east of power plant.

Type section: Pierce's Mill, point at which Murfreesboro and Lebanon Turnpike crosses Stones River, Rutherford County.

Pierce shales[1] (in Tusayan series)

Pennsylvanian(?): Northwestern Arizona.

Original reference: C. [R.] Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251, 337.

Charles Keyes, 1936, Pan.-Am. Geologist, v. 66, no. 3, p. 215 (table). Underlies Seligman limestones; unconformably overlies Elden limestones. In Tusayan series (new) of Carbonic age.

Exposed in section at mouth of Grand Canyon near Pierce's ferry.

†Pierce Canyon Redbeds[1] (in Dockum Group)

Permian or Triassic: Southeastern New Mexico and western Texas.

Original reference: W. B. Lang, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 2, p. 262–270.

A. M. Morgan, 1942, Am. Geophys. Union Trans., v. 23, pt. 1, p. 33 (figs. 5, 6). Cross sections show Pierce Canyon redbeds in Dockum group below Santa Rosa sandstone and above Rustler formation.

U.S. Geological Survey has abandoned Pierce Canyon Redbeds in favor of Dewey Lake Redbeds.

Named for exposures in vicinity of Pierce Canyon, southeast of Loving, Eddy County, N. Mex.

Pierce Estate Sands

Oligocene: Southern Texas (subsurface).

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1630 (fig. 5), 1631 (fig. 6), 1632, 1634. Name suggested for the thick body of sand above an Oligocene marine shale wedge [Old Ocean sand] and below the Fleming, or zone of reworked Cretaceous foraminifera, now loosely designated as *Discorbis*. Name Flour Bluff also suggested for this unit.

Named for well No. 20 in east section Wharton County (Pierce Estate Fee No. 2).

Piercefield Gneiss[1]

Precambrian: New York.

Original reference: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2, p. 463, 469–470.

Named for exposures about Piercefield, St. Lawrence County.

Piermont Group

Precambrian: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 158–159, 160. Sequence of clastic rocks. Thickness approximately 10,000 feet. Four mappable units (ascending): A, B, C, and D recognized. Base not exposed. Underlies Prospect Mountain quartzite. Cambrian-Precambrian boundary arbitrarily placed at top of ledge-forming shaly interval about 100 feet thick at top of unit D.

Named for Piermont Creek on eastern side of Schell Creek Range, Ely quadrangle. Well exposed on second ridge north of creek.

Piermont Member (of Albee Formation)

Ordovician: West-central New Hampshire.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500):

New Hampshire Highway Dept. Consists of dark-gray quartz-mica schist, mica schist, staurolite schist and local beds of fine conglomerate, of volcanic origin in part, interbedded with the schists and quartzites of the Albee formation. Upper Ordovician(?).

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 117, 119 (fig. 2), 126–127. Maximum thickness estimated 1,000 feet. Occurs about 1,000 feet above base of Albee formation. Type locality cited.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Ordovician(?).

Type locality: Mount Cube area. Occurs in and near village of Piermont, Grafton County.

Pierpont Sandstone (in Pocahontas Group)

Pierpont Sandstone (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 218.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 98; P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 217, 244. Included in Pocahontas group, Pottsville series.

Exposed at Pierpont Station on Slab Fork of Guyandot River, Wyoming County.

Pierre Shale (in Montana Group)[1]

Upper Cretaceous: South Dakota, eastern Colorado, western Minnesota, Montana, Nebraska, New Mexico, North Dakota, and eastern Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1862, Philadelphia Acad. Nat. Sci. Proc., v. 13, p. 419, 424.

K. F. Mather, James Gilluly, and R. G. Lusk, 1928, U.S. Geol. Survey Bull. 796–B, p. 77, 86–92. Pierre shale, in northeastern Colorado, includes (ascending) Hygiene sandstone, Terry sandstone, Rocky Ridge sandstone, Larimer sandstone, and Richard sandstone members and unnamed higher beds. Thickness 4,500 to 10,000 feet. Overlies Niobrara formation; underlies Fox Hills sandstone.

W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A, p. 3–4. Pierre shale, in Black Hills area, includes (ascending) Gammon ferruginous member with Groat sandstone bed, Mitten black shale member, unnamed mudstone and shale, Monument Hill bentonitic member, and unnamed dark-gray fissile shale and mudstone. Overlies Niobrara formation; underlies Fox Hills sandstone.

M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7. Pierre shale, in northwestern Kansas, includes (ascending) Sharon Springs, Weskan, Lake Creek, Salt Grass, and Beecher Island members. Overlies Niobrara chalk.

C. S. Lavington, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 4, p. 399. Pierre shale, in eastern Colorado, contains Apache sandstone in basal part.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 5–63. Pierre formation, in region along Missouri River, divided into (ascending) Gregory, Sully, Virgin Creek, Mobridge, and Elk Butte members (all new). Thickness 361 to 1,204 feet. Overlies Niobrara formation; underlies Fox Hills formation.

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D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2337–2346. Pierre shale, as herein revised for central South Dakota, comprises (ascending) Sharon Springs, Gregory, Crow Creek, DeGrey (new), Verendrye, Virgin Creek, Mobridge, and Elk Butte.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 22–23. Pierre shale, northwestern Kansas, is 1,000 to 1,400 feet thick. Includes the following members (ascending): Sharon Springs shale, 155 feet; Weskan shale, 170 feet; Lake Creek shale; Salt Grass shale; unnamed shale; and Beecher Island shale. Overlies Niobrara formation.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 8–10. Oldest formation exposed in Emmons County. Most of unit belongs to Elk Butte member although some Mobridge may be present. Thickness 135 feet. Underlies Fox Hills formation.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 109. Underlies Sanborn formation at type section of Sanborn.

G. C. Prescott, Jr., 1953, Kansas Geol. Survey Bull. 100, p. 53–54. In Cheyenne County where it is poorly exposed and is oldest outcropping in formation, the Pierre underlies Ogallala formation.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. Described in eastern Colfax County, N. Mex., where it is 1,600 to 1,700 feet thick. Overlies Smoky Hill marl member of Niobrara formation. Interfingers with overlying Trinidad sandstone.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. In La Veta area, Huerfano County, Colo., the Pierre shale is about 2,000 feet thick. A 10-foot bed of sandstone that forms ledge about 500 feet above base of Pierre is exposed on western flank of Greenhorn anticline. This sandstone may be Apache sandstone of Prommel (Lavington, 1933). Overlies Smoky Hill marl member of Niobrara formation; underlies Trinidad sandstone.

C. S. Robinson, W. J. Mapel, and W. A. Cobban, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 101–123. Marine Pierre shale, on northern and western flanks of Black Hills, consists of dark-gray shale with some sandy shale and sandstone, and many beds of bentonite. Thickness 2,000 to 2,700 feet. In this area, divided into several members on basis of lithologic differences in the shale and presence of sandy and bentonitic units. These are (ascending) Gammon ferruginous member (including Groat sandstone bed), Mitten black shale member, an unnamed upper part that consists of half or more of formation, and near top Monument Hill and Kara bentonitic (new) members. Overlies Niobrara formation; underlies Fox Hills sandstone.

Named for exposures at old Fort Pierre, in either Stanley or Hughes County, S. Dak.

Pierson Glauconite

See Pearson Glauconite Member (of Sabinetown Formation).

Pierson Limestone[1] (in St. Joe Group)

Pierson Limestone Member (of Chouteau Formation)

Mississippian (Osage): Southwestern Missouri.

Original reference: S. Weller, 1901, Jour. Geology, v. 9, p. 140, 144.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 193. Rank reduced to member of Chouteau formation. Overlies Northview member;

underlies Reeds Spring member. Maximum thickness about 30 feet. Cannot be distinguished from rest of Chouteau north of Greene County; continues at least as far as Barry County. Lower Mississippian.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2157–2160. Recommended that term Pierson be dropped as a synonym of St. Joe; both St. Joe and Pierson occupy same stratigraphic position; fauna of both formations are identical.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71, 72 (fig. 1), 75, 76. Uppermost formation in St. Joe group. Overlies Northview formation. Kinderhookian-Osagean line is defined as contact between Northview and Pierson. Pierson is extended northward to include silty dolomitic limestone unit which lies between Northview and Burlington in west-central Missouri. This unit was included in Sedalia by Moore (1928) and Kaiser (1950). In Greene County, Northview is included in Chouteau group. Note on type area.

Type area: North side of county road D in NE¼SW¼SW¼ sec. 29, T. 29 N., R. 20 W., near Turner Station, Greene County. Named from exposures on Pierson Creek.

Pierson Point Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 80.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42. "Pierson Point" shale, as defined by Condra (1927), includes at its type locality the section between Dover and Tarkio limestones and not from Maple Hill limestone as was originally supposed. This makes it part of "Table Creek shale;" however, Maple Hill limestone is missing at "Pierson Point" type locality leaving the latter without an upper boundary marker, but the Maple Hill is well developed at other places. Name "Pierson Point" is dropped, and name Wamego (new) applied to shale between Maple Hill and Tarkio limestones.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15. Reference made to Pierson Point shale by Condra and Reed (1943) is in error and name is retained because recent excavation at type locality exposes full thickness of the member, about 9 feet. Thickness in Missouri 3 to 4 feet.

H. G. O'Connor, 1953, Kansas Geol. Survey [Repts.], v. 12, pt. 1, p. 18–19, pl. 1. In eastern Kansas, name Stormont limestone member (new) is applied to lowest of three limestones occurring near middle of Pierson Point. The Stormont at its type locality occurs about 12 feet below Maple Hill limestone and 13½ feet above Tarkio limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12. In N½SE¼SW¼ sec. 36, T. 70 N., R. 43 W., Fremont County, beds are exposed which are here tentatively correlated with part of Table Creek-Willard shale interval. At top of section, 3½ feet of blocky green shale is identified as basal part of Pierson Point shale. Overlies Tarkio limestone.

Type locality: Pierson's Point, a spur of upland about 2 miles southeast of Falls City, Richardson County, Nebr. Well exposed on east flank of Pony Creek near Pony Creek Bridge, 1½ miles south of Falls City.

Cotype locality: Upland 4 miles west of Wamego, Kans.

Pigeon Slate[1] **or Siltstone** (in Snowbird Group)

Precambrian (Ocoee Series): Eastern Tennessee and western North Carolina.

Original reference: A. Keith, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 2.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 8, p. 639–640. Term Pigeon siltstone used in this report (base of the Cambrian in southern Appalachian). Name derived from same type locality as Pigeon slate of Keith's early work.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 956–957. Pigeon siltstone included in Snowbird group (herein rank raised). Thickness at designated type locality 10,000 to 15,000 feet. Consists of uniform body of gray to greenish-gray thin- to thick-bedded siltstone, composed of recrystallized quartz and feldspar silt in a matrix altered to sericite and chlorite. Siltstone is well exposed along Pigeon River northwest of Waterville; it is not represented in Snowbird group farther south, where it disappears by intertonguing with Roaring Fork sandstone (new). Contact with Roaring Fork is placed at top of highest persistent sandstone bed at any locality, but sandstones finger out westward so that the base of the Pigeon as thus defined descends in this direction. At east end of mountains, the Pigeon is overlain conformably by Rich Butt sandstone (new) and other unclassified formations.

Type section (siltstone): Along Little Pigeon River between Richardson Cove and Pittman Center, Sevier County, Tenn. Pigeon slate was named for exposures near West Fork of Little Pigeon River, Sevier County.

Pigeon Point Formation

Upper Cretaceous: Northern California.

C. A. Hall, Jr., D. L. Jones, and S. A. Brooks, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2855–2859. Dominantly brown and greenish-gray sandstone interbedded with siltstone, mudstone, and conglomerate; convoluted bedding and sole markings common. Estimated thickness more than 8,500 feet; base not exposed. Formation is both faulted against and unconformably overlain by Vaqueros(?) and Purisima formations of Tertiary age. Sedimentary rocks of Cretaceous age exposed along Pacific Coast south of Pesadero Point were originally assigned to the Chico formation by Branner, Arnold, and Newsom (1909, U.S. Geol. Survey Geol. Atlas Folio 163). However, application of this term to beds lithologically different, located nearly 200 miles from type locality of Chico, is unwarranted in absence of established continuity between the two sections; hence, new name is proposed.

Type section: All rocks exposed in sea cliffs from Pescadero Point to midway between Franklin Point and Ano Nuevo Point, or between lat 37°07′45″ N. and long 122°20′ and 122°25′ W. Named from prominent headland on Pacific Coast, approximately 5 miles south of town of Pescadero, San Mateo County. Rocks crop out in a belt a little less than 2 miles wide.

Piinaau Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 95 (table), 96. Dense dark-gray nonporphyritic basalt.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 126. Pleistocene(?)

Named for exposures along banks of Piinaau Stream. Flow followed gulch cut into older alluvium along foot of west wall of Keanae Valley, and at sea spread out to form terrace on each side of gulch.

Pike Gravel (in Trinity Group)

Pike Gravel Member (of Trinity Formation)[1]

Lower Cretaceous (Comanche Series) : Southwestern Arkansas.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690–B.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Pike gravel, basal formation in Trinity group in Arkansas. Underlies Delight sand (new). Subsurface equivalents discussed.

Named for Pike, Pike County.

Pike Creek Volcanic Series[1]

Pliocene, lower : Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington [State] Univ. Pub. in Geology, v. 3, no. 1, p. 7–130.

Howel Williams and R. R. Compton, 1953, U.S. Geol. Survey Bull. 995–B, p. 24 (table), 25–27, pls. 8, 9. Rhyolitic and dacitic flows and tuffs. Thickness more than 1,500 feet. Overlies Alvord Creek formation; unconformably underlies basalts and lavas and Steens Mountain volcanic series. Early Pliocene. In addition to exposures at type locality, unit here considered to include siliceous volcanic rocks that crop out west of Alvord Lake, on Red Hill, along Cottonwood Creek, and at Tumtum Point.

Type locality : West of Alvord Desert, Harney County.

Pike River Granite[1]

Precambrian : Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

Pikes Peak Granite[1]

Pikes Peak Group

Precambrian : Eastern Colorado.

Original reference : W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 7.

J. M. Bray, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 769–770. In this report, Pikes Peak group (Algonkian) includes (ascending) Boulder Creek granite and Overland Mountain granite (new).

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 7–8. Granite described in Garfield quadrangle where it is cut by a granite referred to as Silver Plume(?).

Forms main mass of Pikes Peak.

Piketon Gravel[1]

Tertiary : Southeastern Missouri.

Original reference: C. F. Marbut, 1902, Missouri Univ. Studies, v. 1, no. 3, p. 18, 27, 32.

Named for exposures at Piketon, Stoddard County.

Pikian series[1]

Precambrian: Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 284.

Pilar Phyllite Member (of Ortega Formation)

Precambrian: Central northern New Mexico.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 8 (fig. 2), 19–21, pl. 1. Name proposed to replace Hondo slate because the latter name had been applied to other rocks prior to Just's usage. The rock is dense, homogeneous, and hard, and is gray-black to black in color, with a gray sheen on cleavage surfaces. Has irregular slaty cleavage. Minimum thickness appears to be 2,300 feet in Picuris Range. Overlies Rinconada schist member and underlies Vadito formation.

Name derived from village of Pilar, situated at north-central border of Picuris Range at a point several miles east and north of prominent outcrops of the phyllite. Occurs in two main east-west belts of half a mile width that extend from upper Hondo Canyon to Piedra Lumbre Canyon, and thence offset to the south to continue as a single, westward tapering belt; Picuris Range, Taos County.

Pilarcitos Sandstone (in Franciscan Group)[1]

Jurassic(?): Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

Along Pilarcitos Creek and Pilarcitos Lake, in San Mateo County.

Pilcher Quartzite (in Missoula Group)

Precambrian (Belt Series): Western Montana.

W. H. Nelson and J. P. Dobell, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–296. Reddish quartzite with strongly accentuated crossbedding. Overlies Garnet Range quartzite.

Mapped in Bonner quadrangle. Type locality and derivation of name not given.

Pilchuck Clay Member (of Vashon Drift)

Pleistocene: Northwestern Washington.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 18–19, pl. 1. Largely an advance outwash deposit, characteristically fine-grained; some sediments are dirty sands and gravels with thick clay beds and peat streaks; some clays are massive and yellow and nearly white in color. In some areas, overlies Admiralty clay (new).

Exposed in scattered areas in western part of Snohomish County.

Pilgrim Limestone[1] **or Dolomite**

Upper Cambrian: Montana.

Original references: W. H. Weed, 1899, U.S. Geol. Atlas, Folio 55; Folio 56; 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 284–287.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1280–1281, 1333–1335. Weed's definition emended. Pilgrim is basal formation of Upper Cambrian in Montana and Yellowstone Park. Overlies Park shale (emended); underlies Dry Creek shale (emended). At emended type locality herein designated, consists of thick- and thin-bedded light- and dark-

gray crystalline to fine-grained irregularly bedded limestones; variable amounts of tan and buff clay irregularly disseminated; interbedded limestones are 2- to 20-inch beds of hard gray crystalline intraformational conglomerates whose flat pebbles consist of gray-green, tan, and maroon, argillaceous lithographic limestone. Lower part of formation in north-central Montana contains more shale than upper and middle parts; in western and southern part of State, lower-middle and upper parts of formation consists of massive thick-bedded hard finely crystalline dark-gray limestone, which is oolitic and mottled drab tan or buff. Thicknesses: 315 feet, type locality; 661 feet, Big Snowy Mountains; 175 feet, Big Belt Mountains; 172 feet, Crowfoot Ridge, Yellowstone Park. Lower part of Pilgrim in north-central Montana contains more shale than upper and middle parts and also more than in western and southern parts of State and in Yellowstone Park. In latter areas, the lower-middle and upper parts of Pilgrim consist of massive thick-bedded hard finely crystalline dark-gray limestone, which is oolitic and mottled drab tan or buff. These are the beds Peale (1893, U.S. Geol. Survey Bull. 110) called "Mottled limestones" in Gallatin formation in his Three Forks section. [See Flathead quartzite.]

Erling Dorf and Christina Lochman, 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 551. Unit termed Pilgrim by Deiss (1936) in Crowfoot Ridge section is the Maurice formation (new).

Christina Lochman and Donald Duncan, 1944, Geol. Soc. America Spec. Paper 54, p. 2–3, 4 (fig. 1), 6–9. Dry Creek-Pilgrim boundary discussed. Dry Creek shale partly emended by restricting all limestone pebble conglomerates and gray-green shales to the Pilgrim formation. This restriction gives lithologic unity to both Dry Creek and Pilgrim in all sections and restricts the fossil horizons to the Pilgrim. Park-Pilgrim contact is boundary between Middle and Upper Cambrian.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 16–17. As used in this report, the Pilgrim is a carbonate unit, essentially Dresbachian in age, underlain by Park shale and overlain by Red Lion or Snowy Range formation. Locally, where post-Cambrian erosion has removed Red Lion, the Pilgrim may be directly overlain by Maywood formation. Consists of four rock types: limestone conglomerate; crystalline limestone; oolitic limestone, some of which has distinctive mottling; and dolomite. Lochman and Duncan draw Park-Pilgrim boundary to coincide with Middle-Upper Cambrian time boundary; in present report, the boundary is drawn to conform with lithologic change from shale to limestone; the boundary thus drawn differs from late Middle Cambrian to early Upper Cambrian. Term Maurice has been used for Pilgrim equivalent, but distinction between the two is presence of mottled oolitic limestone in the Maurice. Name Maurice considered unnecessary.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 397, 398–399. Described in area east and southeast of Livingston, Mont., where it is 175 feet thick and crops out as first cliff-forming unit above Precambrian rocks. Underlies Snowy Range formation. Name used in preference to Maurice in this area.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 10–12, pls. 1, 2, 3. Five lowest Cambrian natural map units in southern Elkhorn Mountains are lithologically similar to Flathead sandstone, Wolsey shale, Meagher limestone, Park shale, and Pilgrim

dolomite of nearby areas as redefined by Deiss (1936) and these formational names have been adopted. Pilgrim dolomite is 380 to 510 feet thick. Threefold subdivision recognized. Lower unit, typically about 50 feet, is principally mottled light-gray and dark-gray crystalline dolomite. Middle unit, typically about 175 feet, is light-gray and medium-gray crystalline limestone with irregular ribbons of yellowish-gray silty dolomite. Upper unit, 150 to 225 feet thick, is light-gray medium-crystalline to sugary dolomite that weathers to rough cuspate surface; beds typically between 6 inches and 4 feet but rather indistinct. Underlies Maywood or Red Lion formation. Upper Cambrian.

Type locality (emended section): North side Dry Wolf Creek, Little Belt Mountains. Section measured on spur east of eastern small unnamed creek, which heads on Big Baldy Mountain, and on Dry Wolf Creek. Locality lies in sec. 14, T. 14 N., R. 9 E. Section begins at point 350 feet up the small stream from its mouth at Dry Wolf Creek, 2 miles west of mouth of Lion Gulch. Section was not measured opposite Lion Gulch where Weed said he measured his section because at that place Cambrian rocks are largely covered with glacial drift and lower beds of emended section are beneath floor of that part of Dry Wolf Creek valley. Named for exposures in valley of Pilgrim Creek, southwestern corner Fort Benton quadrangle.

Piliguilla Conglomerate

Pliocene(?): Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 134 (correlation chart), pl. 10 (map). Name appears on correlation table. Overlies Chucunaque formation. Pliocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 343. Undefined name. Pliocene(?).

In Darién area.

Pillar Bluff Limestone

Lower Devonian: Central Texas.

V. E. Barnes, P. E. Cloud, Jr., and L. E. Warren, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 166–169 [1945]. Proposed for calcitic rocks carrying a fauna of Helderberg age. Predominantly of two types: One a fine- to coarse-grained yellowish-gray to ivory-colored fairly pure highly fossiliferous limestone; the second type of limestone is fine to very fine grained, gray, dull yellow, or olive drab, ranging to gold and light bronze with roan splotches; slightly dolomitic, few or no fossils. Finer grained limestone occurs below the more coarsely granular coquinalike limestone. Because of manner in which Pillar Bluff is preserved, no estimation of thickness is practical.

Type locality: Ancient joint or cave filling at Pillar Bluff on Pillar Bluff Creek, 5 miles southwest of Lampasas and just south of Lampasas County line in northern Burnet County. This pocket of Lower Devonian rocks, replete with fossils, is surrounded by limestone and dolomite of Ellenburger group (Lower Ordovician) of the *Ceratopea "keithi"* zone. Lies 30 feet vertically below lower margin of covering debris which conceals overlap of Carboniferous strata on the Ellenburger.

†Pillar Falls Mud Flow[1]

Miocene, upper(?): Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 32, 38–39, pl. 5. Thickness about 40 feet. Rests on eroded surface of Shoshone Falls andesite.

H. T. Stearns, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 463. Suggested that the Pillar Falls mud flow represents the typical block lava top of the underlying Shoshone Falls andesite.

Type section: At Pillar Falls on Snake River, in Jerome and Twin Falls Counties.

Pillsbury Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275–2276. Defined to include strata between Stotler limestone (new) above and Zeandale limestone (new) below. Replaces Langdon shale of Condra and Reed (1943). Thickness ranges from about 1 foot to 50 feet; average thickness 25 feet.

Type exposure: In roadcut in SE¼NE¼NE¼ sec. 28, T. 10 S., R. 9 E., Riley County. Name derived from Pillsbury Crossing, a ford across Deep Creek in NE¼NW¼ sec. 5, T. 11 S., R. 9 E., Riley County. Sections typical of facies changes of formation, designated as paratype sections, are exposed in stream bank in center of SW¼NE¼ sec. 32, T. 10 S., R. 9 E., Riley County, and in NE¼NE¼ sec. 19, T. 11 S., R. 13 E., Wabaunsee County.

Piloncillo Formation

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 10–11, 17 (table 1), pl. 1. Sediments occur as small alluvial fans, windblown tuffaceous dune sands, tuffs, and stream-channel sandstones and conglomerates. At type locality, tuffaceous and fluvial sediments reach maximum thickness of 400 feet in a buried valley. Elsewhere formation is either absent or much thinner. All clastic sediments of similar age and lithology in Dwyer quadrangle have been mapped as Piloncillo, even where their outcrops are not continuous with the type locality.

Type locality: Given in text as Piloncillo Hill, after which the sediments were named, in sec. 18, T. 18 S., R. 10 W., Dwyer quadrangle. Shown on plate 1 as sec. 18, T. 19 S., R. 10 W.

Pilot Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group is divided into 15 cyclic formational units. The Pilot, seventh in the sequence (ascending), occurs below the Scammon and above the Weir. Includes Pilot coal. [For complete sequence see Cherokee group.]

Type locality and derivation of name not given. Cherokee outcrop in Kansas covers an area of about 1,000 square miles and includes parts of Labette, Bourbon, Crawford, and Cherokee Counties.

Pilot Shale[1]

Pilot Shale Member (of White Pine Shale)

Upper Devonian and Lower Mississippian: Eastern Nevada and Utah.

Original reference: A. C. Spencer, 1917, U.S. Geol. Survey Prof. Paper 96, p. 24, 26, map.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 22. Geographically extended into Confusion Range, Millard County, Utah, where it is from 900 to 1,200 feet thick and consists of buff papery shales interbedded with thin black platy limestone. Overlies Guilmette formation; underlies Joana (Joanna) limestone. Upper Devonian.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2), 149. Rank reduced to member status in White Pine shale. Basal member of formation; underlies Joana member.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 52–53. Described east of Eureka where there are four narrow bands of outcrop. Where exposures are good, two units can be distinguished. Lower one, which makes up one-third or more of formation, is more calcareous, and some of the beds are thin-bedded shaly limestones rather than platy calcareous shales; commonly pinkish or reddish; sandy limestone contains conodont fauna. Upper unit is lithologically more uniform; it is yellowish-brown- or dark-gray-weathering black platy shale, which in most places is calcareous. Thickness ranges from about 315 feet in Packer Basin to 425 feet in Water Canyon; poorly exposed section in Pancake Range is approximately 1,000 feet; it is probable that formation has localized fault movement within it that may account for variations in thickness. Overlies Devils Gate limestone; underlies Joana limestone; both contacts sharp. Faunal evidence indicates Late Devonian age; stratigraphic relations suggest that beds of early Mississippian age are also present in upper part of formation. Pilot shale is basal part of White Pine shale as defined by Hague (1892, U.S. Geol. Survey Mon. 20) at Eureka.

R. L. Langenheim, Jr., 1960, Illinois Acad. Sci. Trans., v. 53, nos. 3, 4, p. 122–131. Discussion of Pilot shale, West Range limestone, and Devonian-Mississippian boundary in eastern Nevada. At reference section, herein designated, Pilot shale consists of upper unit of 190 feet of nonfossiliferous black fissile shale and a lower unit, 193.1 feet thick, of black calcareous siltstone with interbedded silty limestone and minor amounts of fine-grained gray limestone. Overlies Guilmette limestone, contact sharp; underlies Joana limestone, contact sharp. The 383.1 feet of Pilot shale at reference section are comparable to the 350 feet of covered rock assigned to Pilot shale just north of Pilot Knob. It is assumed that the members present at Willow are also present at Pilot Knob and underlie the bench between Joana limestone and Guilmette on west side of Ward Mountain as mapped by Langenheim and others (1959). At type locality of West Range limestone, 32 feet of lower Pilot shale overlies the West Range. At this locality, the lower Pilot is disconformably overlain by Bristol Pass (Joana) limestone.

Reference section: Exposure south-southwest of triangulation station "Willow," sec. 6, T. 13 N., R. 63 E., on west flank of Egan Range about 2 miles north of south boundary of Ely No. 3 quadrangle. Named for Pilot Knob in western part of Ely quadrangle, Nevada.

Pilot Creek Basalt Member (of Cove Mountain Formation)

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1). Thickness 0 to 400 feet. Underlies Cedar Spring member (new); overlies Racer Canyon tuff member (new).

Occurs in Washington County.

Pilot Knob conglomerate[1]

Upper Cambrian: Southeastern Missouri.

Original reference: C. R. Keyes, 1894, Missouri Geol. Survey, v. 4, p. 30, 31.

Occurs on Pilot Knob, Iron County.

Pilot Knob facies (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 146–148. Consists mainly of shale and siltstone. Average thickness approximately 200 feet. Comprises, in lower part, Culver Springs shale below and Lebanon Junction siltstone members (both new) of Brodhead formation. Merges with Holtsclaw Hill facies (new) on west and Athertonville facies (new) on east. Underlies Floyds Knob formation; overlies New Providence formation, Keith Knob facies (new).

Named for Pilot Knob, 4½ miles northeast of Lebanon Junction, southern Bullitt County. Pilot Knob is one of many "knobs" characteristic of region.

Pilot Knob Formation[1]

Precambrian: Southeastern Missouri.

Original references: E. R. Buckley, 1908, Am. Min. Cong. Rept. Proc. 10th Ann. Sess., p. 286; 1909, Missouri Bur. Geology and Mines, 2d ser., v. 9, pt. 1, p. 15–17.

Pilot Knob Iron Formation[1]

Precambrian: Southeastern Missouri.

Original reference: G. W. Crane, 1912, Missouri Bur. Geology and Mines, v. 10, 2d ser.

Pilot Knob Sandstone[1] Member (of Anderson Formation)

Pennsylvanian: Northern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 23, 33, 319.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, pl. 4. Renamed Pilot Mountain sandstone because name Pilot Knob is preoccupied.

Occurs in Tennessee coal field in Briceville region.

Pilot Knob Tuff (in Dessau Formation)

Upper Cretaceous: South-central Texas.

C. O. Durham, Jr., 1955, Corpus Christi Geol. Soc. [Guidebook] Ann. Field Trip, Mar. 11–12, p. [58, 59], pl. 16. Tuff mentioned in discussion of Upper Cretaceous volcanics in Travis County. Stratigraphic section shows Pilot Knob ash in Dessau formation below St. Edwards tuff (new) in Burditt formation. Page [59] refers to Pilot Knob mudflows. [Durham

refers to article published by him (1949, Shreveport Geol. Soc. Guidebook 17th Ann. Field Conf.) entitled "Stratigraphic relationships of the Pilot Knob volcanics." However, in copy of guidebook used by compiler title reads "Pilot Knob pyroclastics"].

Pilot Knob is 6 to 8 miles south-southwest of State Capitol, Austin, Travis County.

Pilot Mountain Andesite

Age not stated: Northern California.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2). Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Pilot Mountain is in southeastern part of Lassen Volcanic National Park.

Pilot Mountain Sandstone (in Vowell Mountain Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19, pls. 2, 3, 4. New name for Pilot Knob sandstone (Glenn, 1925). Name Pilot Knob preoccupied. Thickness at designated type locality 60 feet; in Cross Mountain section 35 feet. Overlies a shale interval about 100 feet thick at base of group and underlies shale interval 35 to 90 feet thick which in turn underlies Frozen Head sandstone.

Type locality: Pilot Mountain in Duncan Flats quadrangle. Also well developed in Petros, Windrock, Fork Mountain, Lake City, Norma, and Block quadrangles.

Pima Sandstone[1] or Formation

Middle Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 466, 482.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1 (column 41). Listed as formation.

Traced from Whetstone Mountains, Cochise County to Picacho de Calera Hills, Pima County.

Pimoe Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1246, 1247, pl. 1 (fig. 4). May have been extruded during earthquake in 1938. Radiocarbon dating gives $<$ 100 years.

On southwest side of Haleakala.

Pimple Hill Conglomerate[1] (in Cherry Ridge Red Beds)

Upper Devonian: Northeastern Pennsylvania.

Original reference: Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 578.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 279 (table 30), 284. Upper Devonian.

Named for Pimple Hill, a knob in Monroe County.

Pinal Schist[1]

Precambrian: Southeastern Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Mapped in Globe quadrangle. Early Precambrian.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8–9 (table), 10–11, pl. 5. Described in central Cochise County where it is oldest formation exposed. Contains several small intrusive masses of albite granite, quartz diorite, gneissic granite, and sausuritic quartz monzonite which are also referred to the Precambrian. Base on which the Pinal was deposited not exposed in area; hence, no reliable estimate of thickness possible. Underlies Bolsa quartzite. In areas of intense metamorphism, distinguished with difficulty from metamorphosed Bisbee formation.

F. F. Sabins, Jr., 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1320–1322, table 1, pl. 1, Several rock types included in Pinal schist in Cochise Head and Vanar quadrangles. Unnamed quartzite member, of light-pink to light-gray medium- to coarse-grained quartzite, is most conspicuous unit for it forms rugged precipice of Bowie Mountain and ridge southwest of Helens Dome. Underlies Bolsa quartzite.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. Mapped in Haunted Canyon quadrangle. Probably intruded by Ruin granite but contacts not exposed in quadrangle.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 113. In fault contact with Samaniego granite (new).

Rocks well exposed in Pinal Mountains, whence their name.

Pina Vititos sandstone[1]

Upper Cretaceous: New Mexico.

Original reference. C. R. Keyes, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 2, 10.

Around southern end of the Rocky Mountains. Derivation of name not stated.

Pinckneyville Granite[1]

Pinckneyville Quartz Diorite Complex

Post-Carboniferous: Eastern Alabama.

Original references: W. F. Purdy, 1922, Elisha Mitchell Sci. Soc. Jour., v. 38, p. 16; 1922, Alabama Geol. Survey map of Clay County; 1923, Alabama Geol. Survey County Rept. 1, p. 51–62.

H. R. Gault, 1945, Geol. Soc. America Bull., v. 56, no. 2, p. 181–246. Quartz diorite complex, originally described as granite, is one of largest intrusions in Alabama. Underlies area extending from Coosa River in northwest Elmore County northeast through Coosa and Tallapoosa Counties into Clay County. Dark-gray coarse-grained quartz diorite gneiss constitutes major part of complex; smaller amounts of granodiorite and granite gneiss. Intrudes Ashland mica schist and Wedowee formation. Age uncertain.

Named for occurrence in vicinity of Pinckneyville, Clay County.

Pine Sand

Pleistocene, upper: Eastern North Carolina.

W. B. Wells, 1944, Elisha Mitchell Sci. Soc. Jour., v. 60, no. 2, p. 131–132, pls. 63, 64. Vertical cliff exposes four layers (or horizons) which show progressively decreasing consolidation upward; each lies unconformably on the preceding. Maximum thickness of exposure a little more than 9 feet. Pine sand is a poorly consolidated stratum of highly variable thickness; thin superficial peaty medium-sand deposits in upper zone. Underlies Galveston sand (new); overlies Castalia sand (new).

Exposed between Kure's Beach fishing pier and Ethyl Dow Bromine Plant on lower Cape Fear Peninsula.

Pine Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: Charles Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 10.

H. E. Rothrock, 1949, Alabama Geol. Survey Bull. 61, pt. 1, p. 22, fig. 2. Shown on columnar section (St. Clair County) as light-gray to light-brown friable conglomeratic sandstone 210 to 250 feet thick; in lower part of formation, stratigraphically above Shades sandstone member and separated from it by 200 to 230 feet of claystone, siltstone, and sandstone; underlies about 2,800 feet of sandstone, siltstone, and carbonaceous claystone with thin coaly beds.

Named for Pine Ridge, Jefferson County.

Pinean series[1]

Devonian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 55, 80.

Eureka district.

†Pine Barren beds[1]

Name applied in some early Alabama reports to the basal Eocene beds now known as Clayton formation, which are "best seen in eastern Wilcox County, on Pine Barren Creek and in adjoining part of Butler County in Little Texas region."

Statement above appeared in the Wilmarth lexicon. The compiler of present report searched several early Alabama publications but failed to find any reference that used the expression "Pine Barren beds." There were references to a "Pine Barren section" and "section on Pine Barren Creek." Therefore, it is believed that MacNeil's (1946) Pine Barren Member (see below) is the first formal usage of the term Pine Barren.

Pine Barren Member (of Clayton Formation)

Paleocene: Southwestern Alabama.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 8–9. Proposed for lower member of Clayton. Hard crystalline fossiliferous coarse sandy limestone ["*Turritella* rock"] about 8 feet thick forms upper part of member; below this is sequence of limestone, sandy clay shale, and loose to moderately porous to tight fine-grained calcareous sand; beds of crystalline *Turritella*-bearing limestone occur at several levels in these lower beds; coarse-grained sandy channel limestone or calcareous sand occurs sporadically at base. Maximum thickness about 175 feet. Underlies McBryde limestone member (new).

Type locality: In roadcuts and ditches on south side of Pine Barren Creek, along State Highway 100, from southern junction with State Highway 11 to bed of creek at McConnicos Mill in SE¼ sec. 21, T. 12 N., R. 10 E., Wilcox County.

Pine Bluff Member (of Lewisville Formation)

Pine Bluff volcanic zone (in Eagleford Formation)

Cretaceous: Northeastern Texas.

R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 138, 139–143. Lower most of three volcanic zones in the Medill-Woodland area. At Pine Bluff locality, zone is represented by 37 feet of tuffaceous sand which is characterized by the development of large concretionary masses, spherical to flattened ellipsoidal in shape; this persistent concretionary zone referred to as "Cannon Ball" zone. Westward from Pine Bluff, a clay shale-tuffaceous sand wedge breaks "Cannon Ball" zone into an upper and a lower "Cannon Ball" zone. Separated from overlying Kanawha volcanic zone by a shale interval that varies from 158 to 212 feet in thickness; overlies a shale and tuffaceous sand above the base of the Eagleford.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945, Reference Rept., v. 2, p. 475, 476, 477. Reallocated to basal member of Lewisville formation. Unconformably overlies Euless formation.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 4. Locally abandoned; as used in this report, the so-called Pine Bluff member is a part of the Lewisville member of the Woodbine formation.

First described in Medill-Woodland area where it is well exposed at Pine Bluff, Red River County.

†Pine Canyon Limestone[1]

Mississippian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 18. Term Pine Canyon abandoned in favor of Deseret limestone, the more widely acccpted stratigraphic name. Loughlin (1919) locally included within boundaries of Pine Canyon the upper cherty member of Gardner dolomite which is upper unit of upper member of Madison limestone of this report [East Tintic Mountains].

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 40, 43–45. In Stansbury Mountains, subdivided into three units: lower and upper cherty limestone and a medial sandstone, siltstone, and argillaceous limestone unit. Lower cherty unit was placed in Madison group by Morris (1957). Thickness 170 to 950 feet. Unconformably overlies Gardner dolomite; underlies Humbug formation. Name Pine Canyon is used in preference to Deseret limestone as latter did not include the cherty beds.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 43–49, 158–161. Described in southern Oquirrh Mountains where it consists of a lower member, chiefly limestone, 258 feet thick, and an upper member, chiefly limestone with shale, 378 feet thick. Some of upper strata of what Gilluly (1932, U.S. Geol. Survey Prof. Paper 173) mapped as Madison limestone are included in lower member of Pine Canyon limestone of this report. A prominent phosphatic shale is used as key bed in marking base of upper member. Gilluly (1932) placed this bed as basal unit of his Deseret

limestone; Deseret is herein restricted. Overlies Gardner dolomite (used in this area in preference to Madison). In Fivemile Pass quadrangle and northern Boulter Mountains, Pine Canyon is 1,289 feet thick and includes both lower and upper members; uppermost beds of upper member may represent southerly extension of Deseret limestone. Underlies Humbug formation; overlies Gardner formation.

Named for exposures in Pine Canyon, between Godiva Mountain and Sioux Peak, Tintic district.

Pinecate Formation[1] (in San Lorenzo Group)

Oligocene: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 472, map.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 27, pls. 1, 2, 3. Described in San Juan Bautista quadrangle. Upper formation of San Lorenzo group. Thickness about 1,000 feet. Underlies Vaqueros sandstone; overlies San Juan Bautista formation.

Typically exposed at Pinecate Peak, 4 miles northwest of San Juan, and also near San Juan Cement Works, San Benito County.

Pinecone Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 98 (fig. 4). Named on structure section in report on Paleozoic continental margin in central Nevada. Underlies Wildcat Peak formation (new).

Toquima Range, Nye County.

Pine Creek Conglomerate[1]

Cretaceous(?): Southeastern Iowa.

Original reference: J. A. Udden, 1899, Iowa Acad. Sci. Proc., v. 6, p. 54–56.

Leland Horberg, 1950, Illinois Acad. Sci. Trans., v. 43, p. 173. Incidental mention in report on correlation of preglacial gravels of Henry County, Ill., with gravels in other parts of Mississippi Valley region.

Named for Pine Creek, Muscatine County.

Pine Creek Limestone (in Conemaugh Group)

Pine Creek Limestone Member (of Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 32.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Pine Creek limestone in Conemaugh group, shown on generalized columnar section below Woods Run limestone and above Buffalo sandstone.

Named for Pine Creek, Allegheny County, Pa.

†Pine Creek Sandstone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1880, Pennsylvania 2d Geol. Survey Rept. H_5, p. xxi, 319.

Armstrong County.

Pinecrest Formation[1]

Lower Triassic: Central northern Utah.

Original reference: A. A. L. Mathews, 1929, Chicago Univ., Walker Mus. Mem., v. 1, no. 1, p. 1.

C. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 28. Thaynes formation, in Fort Douglas area east of Salt Lake, has been separated by Mathews on basis of fossil evidence, into Pinecrest and Emigration formations.

Named for Pinecrest Ridge, which lies between North and South Forks of Red Butte Creek in Fort Douglas area, east of Salt Lake City.

Pinedale Glaciation, Drift, Till

Pinedale glacial stage[1]

Pleistocene: Rocky Mountain region.

Original reference: E. Blackwelder, 1915, Jour. Geology, v. 23, p. 310, 324–340.

G. M. Richmond, 1953, Friends of the Pleistocene, Rocky Mountain Sec., [Guidebook] 2d Ann. Field Trip, Oct. 4–5, correlation chart. Pinedale stage comprises an early Pinedale substage, Pack Creek substage (new), and late Pinedale substage. Follows Lackey Creek stage (new) and precedes a Recent stage, the Castle Valley (new).

John de la Montagne, 1956, Wyoming Geol. Soc. Guidebook 11th Ann. Field Conf., p. 30. Glacial sequence in Jackson Hole area (ascending) Buffalo, Bull Lake, and Pinedale.

G. M. Richmond, 1957, Internat. Assoc. for Quaternary Research, 5th Cong., Madrid, p. 157. Pleistocene deposits in Rocky Mountain region are grouped into three stages: Buffalo (oldest), Bull Lake, and Pinedale, each with characteristic topographic expression and soil development. Pinedale stage consists of three substages whose moraines are youthful. Lower and middle substages, where superimposed, are separated by weak azonal soil. Upper substage (radiocarbon age slightly older than 6,170 240 years B. P.) probably represents subsidiary halt or minor readvance following the middle. Tills of all three substages, where not superimposed, have a moderately developed immature zonal soil, formed largely during post-glacial optimum.

G. M. Richmond, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1371–1382. Discussion of glaciation of east slope of Rocky Mountain National Park, Colo. This area has been subjected to at least three Pleistocene glaciations, oldest to youngest correlated with Buffalo, Bull Lake, and Pinedale of Blackwelder (1915) in Wind River Mountains, Wyo. Deposits of Pinedale glaciation comprise three sets of moraines indicative of maximum advance of ice and two recessional halts or minor advances.

G. M. Richmond, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B223–B224. Discussion of correlation of alpine and continental glacial deposits of Glacier National Park and adjacent high plains, Montana. Deposits of two late Pleistocene alpine glaciations are correlated with Bull Lake and Pinedale glaciations of Wyoming. Pinedale glaciation consists of three advances separated by minor recessions. These are correlated with advances of classical Wisconsin glaciation of Illinois.

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Named for moraines around lakes near Pinedale, on southwest side of Wind River Range, Wyo.

Pine Hill Quartzite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: J. E. Wolff, 1891, Geol. Soc. America Bull., v. 2, p. 331–338.

Pine Hill is a short distance northwest of Rutland and a short distance southeast of Proctor, in Proctor Township, Rutland County.

Pine Hill Quartzite[1]

Silurian: Southeastern New York.

Original reference: E. C. Eckel, 1902, New York State Mus. 54th Ann. Rept., pt. 1, p. r144–r150.

Well developed in Pine Hill, east of Highland Mills, Orange County.

Pine Island Shale

Pine Island Shale Member (of Pearsall Formation)

Pine Island Formation

Pine Island Member (of Glen Rose Formation)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, and Texas.

George Weber, 1938, Oil and Gas Jour., v. 37, no. 4, p. 30. Pine Island member of Lower Glen Rose formation proposed by Shreveport Geological Society. Black and green shale, brown shale in lower part; limestone at base locally. Underlies Rodessa member; overlies Travis Peak formation.

A. F. Crider, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1665 (table 1), 1666–1667. Red, purple, and greenish shale, siltstone, and sand, with thin beds of calcareous shale and limestone, a part of which is fossiliferous, underlying lower Glen Rose, make up what is here called Pine Island formation. Has been called Travis Peak. In Bellevue Field, overlies Cotton Valley formation. Thickness 1,850 to 1,860 feet.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 32–33, cross sections. Pine Island formation was defined by Crider for beds here called Hosston. Pine Island was originally proposed by Shreveport Geological Society for beds above the Hosston (then called Travis Peak) and below James limestone lentil. The Society has further restricted Pine Island to dark shales with some interbedded limestone and sandstone lying above "Three Finger limestone" lentil and below James limestone member. Restricted Pine Island overlies Sligo formation (new); underlies Rodessa formation. Type section and boundaries of formation will be described by Nomenclature Committee of Shreveport Geological Society.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Lower member of Pearsall formation (new) in south Texas. Underlies Cow Creek member. Thickness about 100 feet. Occupies same stratigraphic position as Pine Island shale in Arkansas-Louisiana-east Texas area.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2340–2342. Herein defined as lowest member of Pearsall formation or its time-stratigraphic equivalent, including those rocks above top of Sligo formation and below base of James limestone member or its recog-

nizable stratigraphic equivalents. Imlay (1940) published section which he termed Pine Island formation from Stanolind Oil and Gas Company's Dillon Heirs well No. 131, sec. 14, T. 21 N., R. 15 W. He selected top of Pine Island at 3,127 feet in this section. It is believed that in this well section called Pine Island formation by Imlay represents entire Pearsall formation. James limestone is not recognizable lithologic unit in this well. Imlay included in the Pine Island formation both the limestone and shale which are the time-stratigraphic equivalent of both the James limestone member and of the shale stratigraphically above James limestone member. James limestone member and lower part of Rodessa formation undergo facies change over Pine Island structure. They grade from characteristic lithologic type into black shale, dark calcareous shale, and thin beds of limestone. In Stanolind's Dillon Heirs well No. 1313, both lower Rodessa and James limestone member time-stratigraphic equivalents are lithologically similar to Pine Island shale member. Pine Island is not recognized beyond limits of either James or Cow Creek limestone members.

Type locality: Pine Island field, northwestern Louisiana. Formation completely penetrated in Dixie Oil Co.'s Dillon No. 92, sec. 13, T. 21 N., R. 15 W., Pine Island field, Caddo Parish, La., from a depth of 3,897 to 5,919 feet.

Pine Knob Sandstone

Lower Mississippian (Oil Lake): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 14–15. Name will probably be used following more definitive study of area for unit here termed Sandstone G and described as a sandstone and shale sequence. At type locality, unit is shaly at bottom, grading upward with slight unconformity into gray-brown sandstone. As a whole, it is thin bedded and indistinctly ripple marked. Thickness 35 to 75 feet; 42 feet at type locality. Disconformably underlies Sandstone H; conformably overlies Sandstone E (Linderman sandstone) or its equivalent, Conglomerate F (Hopwood conglomerate).

Type section: In highway cut at scenic lookout below Summit Hotel on Route 40 east of Hopwood, Fayette County.

Pinelog Conglomerate[1]

Lower Cambrian: Northwestern Georgia.

Original reference: L. LaForge, 1919, Georgia Geol. Survey Bull. 35, p. 40.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1383. Pinelog conglomerate of Bartow County is claimed by LaForge (1919) to be lower part of the Weisner quartzite, but the Pinelog appears to lie at base of Talladega series, where as the Weisner is the top of the Lower Cambrian arenaceous series.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 277. Basal conglomerate beds of Pine Log conglomerate of east end of Pine Log Mountain, which lies north of the Corbin granite and east of the fault [Cartersville] are derived from the Corbin granite and rest on that granite which is brought up in an anticline.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 9. For purposes of this report, Pinelog conglomerate is included in the Weisner formation.

First described in Cartersville district. Forms Pinelog, Pine, and eastern part of Brushy Knob and Signal Mountains.

Pine Mountain Complex[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1898, 1911–1913, pl. 1. Chief rock type is granite porphyry with abundant quartz phenocrysts; color varies, black, green, pink, and yellow. Porphyritic quartz syenite and granite occur locally. Composes an independent subsidiary stock; not part of main intrusion of Belknap Mountains. Assigned to White Mountain magma series, but age relative to other units in series unknown.

Occurs in Pine Mountain-Rocky Mountain area of Belknap Mountains.

Pine Mountain Formation[1]

Pine Mountain Group or Series

Precambrian(?): Central western Georgia.

Original reference: S. L. Galpin, 1915, Georgia Geol. Survey Bull. 30, p. 74–76.

G. W. Crickmay, 1935, *in* L. M. Prindle, Georgia Geol. Survey Bull. 46, p. 32. Pine Mountain series includes Hollis quartzite below and Manchester formation (new).

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 22–23. Discussion of crystalline rocks of Georgia. Rocks are grouped into 11 belts, in part using names proposed by Adams (1933, Jour. Geology, v. 41, no. 2). Pine Mountain series includes quartzites and schists of Pine and Oak Mountains in southwestern part of Wacoochee belt. Four formations recognized (ascending): Sparks schist, Hollis quartzite, Chewacla marble and Manchester schist. Chewacla marble (type locality Alabama) not known in Georgia. Adams believes that series is Paleozoic. It is here assigned to Precambrian.

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 6 (table). Referred to as Pine Mountain group. In Thomaston quadrangle, includes Hollis quartzite below and Manchester formation above. Overlies Woodland gneiss; underlies schist-gneiss migmatite. Precambrian(?).

Named for occurrence on Pine Mountain, from western part of Harris County to eastern part of Pike County.

†Pine Mountain Group (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: A. R. Crandall, 1889, Kentucky Geol. Survey Whitley County Rept.

Named for Pine Mountain.

Pine Mountain Porphyry

Precambrian: Central Arizona.

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1129, 1139, pl. 11. Rhyolite porphyry which is typically a fine-grained porphyritic gray rock that weathers pale yellowish gray. Maximum width 1 mile. Occurs sparsely as dikes at various places in Yaeger greenstone and Alder series.

Prominent only in vicinity of Pine Mountain in central part of Mazatzal Mountains.

Pine Nut Limestone Member (of Gold Hill Formation)[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Exposed on Pine Nut claim, Manhattan district.

Pine Plains Formation

Upper Cambrian: Southeastern New York.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212. Mainly dark impure dolomites; lower beds carry cryptozoon reefs, some edgewise conglomerate, and oolite. Thickness 1,300 feet. Occurs below Briarcliff dolomite (new) and above Stissing dolomite. Upper Cambrian.

E. B. Knopf, 1956, (abs.) Geol. Soc. America Bull., v. 67, pt. 2, p. 1817. Variable assemblage comprising dark, sandy, and argillaceous dolomites at three horizons with intervening heavier bedded and lighter colored dolomites accompanied by edgewise conglomerates, oolitic beds, and cryptozoon reefs. Upper(?) Cambrian.

J. D. Weaver, 1957, Geol. Soc. America Bull., v. 68, no. 6, p. 730–734, pl. 1. Described in Copake quadrangle as Pine Plains formation or group. Complete section not present in area, but group constitutes much of the carbonate belt. Presence of heterogeneous lithologies associated with much of the very dark-gray compact dolomite distinguishes it from other carbonate units. Thickness 406 feet to possibly as much as that given at type area. Upper Cambrian.

First described in Stissing Mountain area, Dutchess County.

Pine Ridge Sandstone Member (of Mesaverde Formation)[1]

Pine Ridge Sandstone (in Mesaverde Group)

Upper Cretaceous: Southeastern Wyoming.

Original reference: C. E. Dobbin and others, 1929, U.S. Geol. Survey Bull. 806, p. 140.

J. R. Bergstrom, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 114. Informally named Mesaverde group consists of (ascending) Allen Ridge formation (new) and Pine Ridge sandstone. Underlies Lewis formation. Thickness 400 feet.

Named for exposures in Pine Ridge, about 2 miles southeast of Rock River, Albany County.

Pinery Limestone Member (of Bell Canyon Formation)

Upper Permian (Guadalupe Series): Western Texas and southern New Mexico.

P. B. King *in* A. K. Miller and W. M. Furnish, 1940, Geol. Soc. America Spec. Paper 26, p. 9. Incidental mention.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p 582–583, 585 (fig. 7), pl. 2. Consists of dark-gray fine-grained somewhat cherty limestone in thin straight beds, with several thicker lighter colored granular layers toward base At type locality and along foot of Reef escarpment, lies about 30 feet above base of formation and is 150 feet thick; southeastward in Delaware Mountains, and out in Delaware Basin, member thins to about 25 feet; here, dark thin straight-bedded limestones persist, the lighter gray beds are absent, and much sandstone is interbedded. Lies above the Hegler limestone member and below the Rader limestone member.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 55–56, pl. 3 [1949]. Mapped in New Mexico.

Type section: On slope above Pine Spring, 2½ miles east of Guadalupe Peak, Culberson County, Tex. Named for "The Pinery", an old stage stand on the Butterfield trail at Pine Spring.

Pinesburg Member (of Shippensburg Formation)

Middle Ordovician (Bolarian): Western Maryland and south-central Pennsylvania.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 718–722. Name proposed for basal member of formation. Described as dark-gray fine- to medium-grained limestone, cobbly below and platy above. Contains three metabentonites. At base in type section, is dark-gray to black medium-grained dark platy-weathering limestone with irregular partings; above is thicker unit consisting largely of dark-gray fine-grained cobbly blue-weathering limestone with prominent thick silty partings; at top is dark-gray fine- to medium-grained platy to slabby limestone. Similar lithologic zoning recognized throughout Cumberland Valley. Thickness 21 to 238 feet; 114 feet in type section. Conformably underlies Fannettsburg member (new); disconformably overlies "Stones River" limestone.

Type section: Exposure on south side of U.S. Route 30, 1 mile southwest of St. Thomas, Franklin County, Pa. Named for exposures along Western Maryland Railroad at Pinesburg Station, Washington County, Md.

Pinesburg Station Dolomite (in Beekmantown Group)

Lower Ordovician: Western Maryland.

R. H. Flower, 1956, Jour. Paleontology, v. 30, no. 1, p. 78. Incidental mention. Name credited to W. J. Sando.

W. J. Sando, 1956, Geol. Soc. America Bull., v. 67, no. 7, p. 935, 936. Formally proposed. Name applied to succession of dolomites overlying Rockdale Run formation (new) and underlying Row Park limestone. Top of formation is placed at base of lowest limestone bed in overlying Row Park formation. Thickness averages 450 feet.

W. J. Sando, 1957, Geol. Soc. America Mem. 68, p. 6 (table 1), 28–32, pls. 1, 3, 5. Consists of unfossiliferous cherty dolomite, most of which is laminated; mottled varieties occur throughout formation and are particularly common in lower half; chert nodules and irregular masses abundant. Thickness 372 to 503 feet.

Type section: On Suffecool Farm about 0.8 mile northwest of Pinesburg Station, Washington County. Total outcrop area is 2½ square miles; 75 percent of area is in western belt; eastern belt exposures are confined to narrow strip along northeast margin of Conococheague syncline.

Pinetop Chert[1]

Lower or Middle Devonian: Southeasten Oklahoma.

Original reference: H. D. Miser, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 8, p. 974, 975.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, chart 4. Included in Onesquethaw stage (new) [considered to be Lower or Middle Devonian].

Named for Pinetop School, sec. 5, T. 2 N., R. 15 E., about 20 miles south of McAlester, Pittsburg County.

Pine Valley Latite

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 18, 63–69. An augite-biotite latite porphyry, hard and heavy, with a rough fracture surface. Varies in color from dark gray to red purple. Phenocrysts compose 60 percent of the rock. Well developed platy partings. Basal glass 10 to 150 feet thick averaging about 50 feet. Maximum thickness more than 2,000 feet. Basal contact unconformable. Generalized section of formation in area shows Pine Valley latite stratigraphically above Page Ranch formation (new) and below Eight Mile dacite and Culbert breccia (both New).

Exposed in upper parts of the northern Pine Valley Mountains, Washington and Iron Counties.

Pine Valley Quartzite

Cambrian: Northeastern Utah.

J. D. Forrester, 1937, Geol. Soc. America Bull., v. 48, no. 5, p. 638–639, pls. 2, 3. Conformably overlying Ophir shale in Uinta Mountains is the so-called Ogden (Ordovician) quartzite of Weeks (1907, Geol. Soc. America Bull., v. 18, p. 437). This unit, believed to be of Cambrian age, is here named Pine Valley quartzite. Thickness approximately 1,200 feet; tends to pinch out gradually to eastward. Underlies Mississippian limestones considered to be equivalent of Madison limestones of Wasatch Range; well defined angular unconformity.

A. A. Baker, J. W. Huddle, and D. M. Kinney, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1166 (fig. 3), 1168. About 400 feet thick in vicinity of Duchesne River where it overlies Ophir(?) shale.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2738–2739. In western Uinta Mountains, two formations, Ophir and Pine Valley, heretofore assigned to Cambrian and thought to be conformable, are separated by a 20° angle of disconcordance. Plane of disconformity is proposed as proper position for Precambrian contact. Rocks earlier mapped as Ophir(?) are here named Red Pine shale. Name Pine Valley is superfluous, for if Pine Valley is lowermost Cambrian, as considered in this paper, it can be properly correlated, at least in part with the Tintic of the Oquirrh and Wasatch Mountains.

Named from exposures near Stewarts' Ranch on Provo River, Uinta Mountains. Present in discontinuous exposures as far east as Blacks Fork of Green River, Summit County.

Pineville Sandstone (in New River Group)

Pineville Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 211.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 241. Generally massive, grayish-white, coarse-grained. Thickness 30 to 50 feet. Locally its position in column is occupied by shale. Occurs below Little Fire Creek coal and above Pocahontas No. 9 coal. In New River group, Pottsville series.

Forms cliffs nearly 100 feet high at Pineville, Wyoming County.

Piney Formation[1]

Upper Cretaceous: Northern Wyoming.

Original reference: N. H. Darton, 1906, U.S. Geol. Survey Prof. Paper 51, p. 13, 59–60.

Named for exposures on Piney Creek, northwest of Buffalo, Johnson County.

Piney Creek Alluvium

Recent: North-central Colorado.

C. B. Hunt, 1954, U.S. Geol. Survey Bull. 996–C, p. 114–117. Alluvium well stratified; individual beds commonly several inches thick. Material largely silt but contains many thin layers of silty sand and some gravel. Contains a few pebbles or cobbles. Locally, especially in deep and narrow valleys like Lakewood Gulch, alluvium includes layers of coarse cobbly gravel in silt matrix. Layers of clean sand uncommon. Stratification rises toward mouths of tributaries, and composition of sediments varies according to kind of sediments furnished by tributaries. Charcoal, hearths, and stone artifacts found in alluvium. About 7 feet of alluvium exposed at the section. Overlies Wisconsin alluvium.

Type locality: Along Piney Creek, an eastern tributary to Cherry Creek in NW¼NW¼ sec. 25, T. 5 S., R. 66 W., in Denver area, Arapahoe County.

Piney Creek Conglomerate (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: D. White, 1895, Geol. Soc. America Bull., v. 6, p. 305–320.

On Piney Creek along New River.

Piney Point Formation

Eocene, upper: Subsurface in Maryland and Virginia.

E. G. Otton, 1955, Maryland Dept. Geology, Mines and Water Resources Bull. 15, p. 85–89, pls. 1, 5. 14. Name applied to glauconitic sands and interspersed shell beds of Jackson age that lie above Nanjemoy formation and below Calvert formation; contacts conformable. Occurs as a wedge shaped unit; attains maximum thickness of 60 feet in wells near Lexington Park and Breton Beach, Md.

Type well: St. M–Fe 24, drilled for Curtiss Steuart in 1950 near tip of Piney Point Peninsula 0.8 mile northeast of Piney Point lighthouse, St. Marys County, Md. Present in southern Maryland southeast of a line extending southwestward from Kenwood Beach across Calvert and St. Marys Counties to vicinity of Cobb Island in Charles County; recognizable in Northumberland and Westmoreland Counties, Va.

Piney Ridge Sandstone Member (of Chemung Formation)[1]

Upper Devonian: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 535.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Member of Chemung formation. A persistent bed about 50 feet thick, 30 to 200 feet above base of the Chemung. Allegrippis sandstone member occurs about 1,400 feet above the Piney Ridge.

Named for exposures along Piney Ridge, Huntingdon County.

Pinkard Formation[1]

Upper Cretaceous: Southeastern Arizona.

Original reference: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43.

Exposed in vicinity of Pinkard Gulch, west of Morenci, Clifton region.

†Pink Cliff series[1]

Eocene: Southwestern and central southern Utah.

Original reference: C. E. Dutton, 1880, Geology of High Plateaus of Utah, p. 143–159, 188–210.

Exposed at the Pink Cliffs, northern part of Kane County.

Pinkerton Sandstone[1] (in Pocono Group)

Lower Mississippian: Northeastern West Virginia.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 101). Shown on correlation chart as sandstone in Pocono group. Underlies Maccrady formation; overlies Myers shale. Osagean series.

C. B. Read, 1955, U.S. Geol. Survey Prof. Paper 263, p. 10–11. On basis of paleobotanical studies, it seems that the age of the post-Hedges formations should be restudied. Lithologic evidence favors correlation of the Myers with Mauch Chunk, and Pinkerton with basal Pennsylvanian.

Occurs on Pinkerton Knob, W. Va.

Pinkerton Trail Limestone or Formation (in Hermosa Group)

Pennsylvanian (Atoka and Des Moines): Colorado and Utah.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2161 (fig. 2), 2167 (fig. 7), 2168–2169. Proposed to separate a limestone-dolomite-clastic sequence of Atoka and earliest Des Moines age from underlying Molas shale and overlying Paradox evaporite sequence. Widespread throughout Paradox Salt basin region as dark-gray fine to coarsely crystalline crinoidal and fusulinid-bearing limestone with some dark-gray shale. Thickness ranges from wedge-edge to more than 200 feet where intra-formational detrital section is best developed in Cedar Mesa anticline of Monument upwarp. Formerly referred to as "lower Hermosa member".

S. A. Wengerd, 1957, New Mexico Geol. Soc. Guidebook 8th Field Conf., p. 134, 135. Table shows Pinkerton Trail formation as lowermost unit in Hermosa group. Thickness at type locality 84 feet.

J. R. Clair, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 34. In subsurface, stratigraphically restricted below to exclude unit herein named Lime Ridge formation.

Type locality: Pinkerton Trail near Denver and Rio Grande Railroad tracks, in sec. 26; T. 37 N., R. 9 W., approximately 12 miles north of Durango, Colo., on west side of U.S. Highway 550.

Pinnacle Formation (in Camels Hump Group)

Pinnacle Graywacke,[1] Arkose, or Formation

Cambrian(?): Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 225–226.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 140–143. Feldspathic sandstone containing much detrital magnetite and

ilmenite; usually some shale of gray tinged with green. Well bedded; thickness of beds variable. Crossbedding prominent. Maximum thickness 400 feet. Underlies White Brook dolomite; overlies Call Mill slate. Type locality cited.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1141–1145. Extended to Vermont where known as Pinnacle formation because of lithologic variations. If a few feet of Call Mill slate are present in Vermont they are included in Pinnacle.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Precambrian(?).

J. B. Thompson, Jr., 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for field trips in New England, p. 16, 39. Pinnacle arkose makes up lower part of Mendon series of Vermont Valley sequence.

P. H. Osberg, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg, p. 47. Pinnacle formation of this report [Coxe Mountain area, Vermont] includes rocks called Mendon and Nickwaket.

Type locality: In Lot 1, Range 1, Dunham Township, Sutton quadrangle, Quebec, on north side of road and on western limb of same syncline that caps Pinnacle Mountain and Spruce Hill. Named for Pinnacle Mountain which has capping of graywacke.

Pinnacle[1] (System)

Cenozoic (pre-Pliocene): Southeastern Alaska.

Original reference: I. C. Russell, 1891, Nat. Geog. Mag., v. 3, p. 167–175.

D. J. Miller, 1953, Jour. Geology, v. 61, no. 1, p. 32. Deposits of system between Icy Bay and Yakutat Bay formerly thought to be either Pliocene or Pleistocene (Smith, 1939, p. 59), but collections of fossils made recently from some of the beds previously correlated with Pinnacle system probably not younger than Miocene.

Best exposed in cliffs of Pinnacle Pass and along northern and western borders of Samovar Hills, St. Elias region.

Pinnacle Point Beds or Formation

Miocene, upper: Southeastern Oregon.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Bros., Inc., p. 108–109. Quartzose sandstone; locally interbedded with friable sandstone and siltstone. Sparsely fossiliferous. Unconformably overlies truncated or channeled Owyhee basalt; where Owyhee is missing, it is difficult to distinguish Pinnacle Point beds from Payette formation. Capped by Grassy Mountain basalt. Tentatively assigned to late Miocene (Barstovian).

Well exposed along eastern margin of Owyhee Reservoir from Burnt Ridge, Pinnacle Point, Dry Creek Butte, along margins of Oxbow Basin, Mitchell Brown and Vale Buttes.

Pinnacles Formation

Miocene, middle(?): West-central California.

Philip Andrews, 1936, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 1, p. 19, 25, 26, map 1. Volcanic breccias and tuffs, chiefly rhyolite. Miocene(?).

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 217–218, 224 (fig. 3), pl. 4. In San Benito quadrangle, underlies Monterey

group; overlies Gabilan limestone. Thickness as much as 2,600 feet. Middle(?) Miocene.

Named for exposures in Pinnacles National Monument, near King City, southeast of Salinas.

Pinney Hollow Formation (in Camels Hump Group)

Pinney Hollow Schist[1] or Formation

Lower Cambrian: East-central and west-central Vermont.

Original reference: E. L. Perry, 1927, Vermont State Geologist 15th Rept., p. 161.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 55–61, 116, geol. map. Formation described in eastern sequence in Green Mountain anticlinorium near Rochester and East Middlebury. Thickness 1,000 to 1,500 feet. Includes Hancock member (new) in middle part. Overlies Granville formation (new); underlies Ottauquechee formation. Cambrian.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 48–50, tables 2, 3. In Rutland area, overlies Grahamville formation (new); underlies Ottauquechee formation. Consists of three parts: lower, white green phyllite, green albitic phyllite and grit, thin black phyllite, middle, green white phyllite, thin greenstone, black phyllite; upper, green phyllite, finely banded green and gray siltstone. Thickness 3,500 to 4,000 feet. Cambro-Ordovician.

Type exposures in Pinney Hollow, Plymouth Township, Windsor County.

Pinnick Coal Member (of Mansfield Formation)

Pennsylvanian: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 26–27. Important stratigraphic marker or key bed at top of lower unit of Mansfield. Average thickness about 1 foot. Coal named by D. W. Franklin (1939, unpub. thesis). Franklin's type section no longer exposed. Other good exposures noted.

Type section (Franklin): Mine on Pinnick property in SE¼SW¼ sec. 32, T. 2 N., R. 2 W., Orange County.

Pinole Tuff[1]

Pliocene: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 118–121, pls. 11, 12. Overlies Neroly sandstone. Type section designated because no type exposure had been designated previously; tuff exposed along Pinole Valley has been dropped by faulting and is not representative of the entire sequence. Thickness at type locality nearly 1,000 feet.

Type section: Exposures along shore of San Pablo Bay between Oleum and Rodeo; tuff exposed on both limbs of a synclinal fold. Named for exposures near town of Pinole, on San Pablo Bay, Contra Costa County.

†Pinos Altos limestones[1]

Ordovician: Southwestern New Mexico.

Original reference: C. R. Keyes, 1904, Am. Jour. Sci., 4th, v. 18, p. 360–362.

Probably named for town in Grant County.

Pinto Diorite[1]

Pinto Metadiorite

Precambrian: Central Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

E. W. Heinrich, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1432. A number of post-Cherry Creek intrusives, all of which show varying degrees of metamorphism, include among others, Dillon granite gneiss, widespread in Beaverhead and Madison Counties, granite of Jardine district, and Pinto metadiorite in Little Belt Mountains.

Pinto Formation[1]

Pleistocene: Southern California.

Original reference: D. Scharf, 1935, Southwest Mus. Paper 9, p. 11–20.

Exposed in hill between Eagle Mountains and the Coxcombs and in Pinto Wash; also occurs in Pinto Basin, north-central part of Riverside County.

Pinto Gneiss

Precambrian: Southern California.

W. J. Miller, 1938, Geol. Soc. America Bull., v. 49, no. 3, p. 419 (fig. 2), 424–428. Comprises a complex of rocks, chief constituents of which are metamorphic facies of Gold Park gabbro-diorite (new) and Palms granite (new) and pegmatitic granite, together with some metasediments. Cut by White Tank monzonite (new).

Named because of its widespread, typical development in the Pinto Mountains, Riverside County.

†Pinto Limestone[1]

Upper Cretaceous (Gulf Series): Southwestern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 222, 229, 230.

Named for Pinto Creek, Val Verde County.

†Pinto Sandstone[1]

Cretaceous: Southwestern Utah.

Original reference: C. K. Leith and E. C. Harder, 1908, U.S. Geol. Survey Bull. 338, p. 37.

J. H. Mackin, 1954, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–14. Pinto sandstone, as defined by Leith and Harder (1908) included all sedimentary rocks between Homestake limestone and overlying Claron formation. The dominantly maroon sandstone and shale which forms lower part of Pinto, however, rests gradationally on Homestake and is separated by an unconformity from dominantly gray and brown sandstone, shale, and conglomerate that forms bulk of Pinto. Maroon beds beneath unconformity are now correlated with the Entrada. Term Pinto is abandoned, and portion of that formation between the Entrada and Claron designated Iron Springs formation.

Probably named for Little Pinto Creek, which appears to cross formation just south of Iron Springs quadrangle.

Pintoan series[1]

Lower Cambrian: Southeastern California and western Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 80.

Named for Pinto Mountains, near Waucoba Springs, in White Mountain Range, Calif.

Pinto Canyon Formation

Permian (Leonard and lower Guadalupe): Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981; 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map. 22. Proposed for all Permian rocks above Alta formation in area. Divided into four unnamed members (ascending): regularly medium-bedded chert and limestone; irregularly bedded chert; regularly bedded chert and limestone with fossiliferous limestone lenses; thin-bedded siltstone with large limestone concretions. Thickness about 600 feet. Underlies Yucca formation.

Type section: In bed of Pinto Creek; base is three-sixteenth mile upstream from fourth creek crossing of Marfa-Ruidosa Road, Pinto Canyon area, Presidio County.

Pinyon Conglomerate[1]

Paleocene: Northwestern Wyoming.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

J. D. Love, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 27. Consists almost entirely of rounded red, black, gray, and yellow pebbles, cobbles, and boulders of Precambrian quartzites and other hard Cambrian metamorphic and igneous rocks. Contains fragments of wood. In southeastern part of area, thickness ranges from 1,000 to more than 1,500 feet; near Turpin Meadows about 500 feet; on Gravel Mountain at least 2,000 feet. Rests on Upper Cretaceous sandstones, shales, and thin coal beds of Mesaverde age in southeastern part of area and on successively younger strata of Cretaceous age along outcrops to northwest. Paleocene.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1903, 1906. Uncomformably overlies Harebell formation (new) and unconformably underlies Colter formation (new).

Well exposed on Pinyon Peak, Yellowstone Park. Forms broad outcrops along eastern margin of Jackson Hole area, and is well developed along both forks of Fish Creek in Mount Leidy Highlands, and on Gravel Mountain.

Pinyon series[1]

Ordovician: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53.

Derivation of name not stated.

†Pinyon Mesa Group[1]

Eocene and older(?): Northwestern New Mexico and southwestern Colorado.

Original reference: W. H. Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. 1875, p. 248, 249, 251.

Forms escarpment of Pinon Mesa in northwestern part of San Juan County, N. Mex.

†Pinyon Peak Conglomerate[1]

Eocene: Yellowstone National Park.

Original reference: A. Hague, 1899, U.S. Geol. Survey Mon. 32, pt. 2, p. 184.

Pinyon Peak Limestone[1]

Upper Devonian and Lower Mississippian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

K. C. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 11–14. In Lake Mountain area, crops out north of mouth of Rock Canyon in fault block that rests unconformably on Humbug limestone. Thickness 331 feet. Conformably underlies Gardner dolomite. Devonian.

T. S. Lovering and others, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1506. Stratigraphic location of Upper Devonian Pinyon Peak was incorrectly designated in original description as between Bluebell dolomite and Victoria quartzite. However, it lies above the Victoria and below the Gardner. As redefined, comprises beds formerly included in the three lower units of the Gardner dolomite, now known to contain an Upper Devonian fauna.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 11 (fig. 3), 13–14, pl. 1. In East Tintic Mountains, consists chiefly of thin-bedded, fine-grained, medium- to light-blue limestone seamed with veinlets and partings of buff- to brown-weathering clay and mudstone. Thickness 70 to 300 feet. Gradational with overlying Madison limestone, contact arbitrarily placed at base of thin bed of calcareous sandstone or sand-streaked limestone referred to as "sand-grain" or "ant-egg" marker by mining geologists of district. (Name Madison preferred to Gardner in this area). Loughlin (1919) did not recognize Pinyon Peak limestone in Tintic district where he believed Victoria formation to be of Mississippian age and to overlie an unconformity at base of Mississippian sequence. Consequently he included Pinyon Peak with his Gardner formation in this area. Data obtained since 1947 show that Pinyon Peak limestone occurs throughout East Tintic Mountains immediately above Victoria formation. Fossil evidence indicates that Devonian-Mississippian boundary is in upper part of Pinyon Peak; thus, age is considered to be Late Devonian and Mississippian(?).

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 38 (fig. 5), 39. In Stansbury Mountains, overlies Stansbury formation (new). Underlies Gardner dolomite. Thickness as much as 85 feet.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 152–153. Recognized in Fivemile Pass and North Boulter Mountains quadrangles where it is as much as 105 feet thick, conformably underlies Gardner formation and disconformably overlies Victoria formation.

Named for exposures on Pinyon Peak, Tintic district.

Pinyon Ridge Granodiorite

Jurassic(?): Southern California.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Prevailingly dark granodiorite, varying to quartz diorite, commonly gneissic; intruded locally by quartz monzonite and pegmatite and at some places complexly by fine-grained white aplite. May be related to Pleasant View complex (new).

Type locality: Pinyon Ridge, Valyermo quadrangle.

Pioa Rhyolite (quartz trachyte) and Breccia

Pleistocene(?): Samoa Islands (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 100, 106–108, 129–130. Rhyolite (quartz trachyte) dome and associated breccia. In

Tutuila, a long stage of basaltic development was followed by series of explosions that produced Pioa and Matafao breccias; this stage was followed by eruptions of Pioa rhyolite and Matafao, Papatele, Afono, and Vatia trachytes, which seem to have been erupted contemporaneously or nearly so.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285–1286 (table 1), 1300–1302. Pioa trachyte plug is associated with Pago volcanic series (new). Pliocene and early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 191. Pleistocene(?). Late unit in Pago volcanic series; unconformably overlies basaltic tuffs, breccias, and flows forming floor of Pago caldera.

Occurs on Pioa Peak, east of Pago Pago Bay. Covers about 0.01 square mile.

Pioche Shale[1]

Lower and Middle Cambrian: Eastern Nevada, northwestern Arizona, eastern California, and western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9–12.

J. F. Mason, 1936, *in* A. W. Grabau, Paleozoic formations in the light of the pulsation theory, v. 1, Lower and Middle pulsation: 2d ed., Peiping, China, University Press, Natl. Univ. Peking, p. 274–276. Restricted to exclude two newly named units: Forlorn Hope shale and Comet shale. Restricted Pioche is 305 feet thick and includes "Combined Metals bed" of miners. Overlies Prospect Mountain quartzite.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1139, 1141 (fig. 3), 1143, 1154–1156, 1158 (fig. 6), 1159. Walcott's House Range, Utah, section emended. Here Pioche is 265 feet thick, overlies Prospect Mountain quartzite and underlies Tatow limestone (new). Westgate's (1932, U.S. Geol. Survey Prof. Paper 171) Highland Range, Nev., section emended. Here Pioche shale restricted to the 600 feet below Comet shale (redefined). Overlies Prospect Mountain quartzite. Lower-Middle Cambrian boundary placed at top of Pioche beneath the *Kochaspis liliana* zone at base of Comet shale. Term Forlorn Hope rejected in this report. Type locality of emended Pioche on north side of Lyndon (Shodde) Gulch, Nev.

H. E. Wheeler and D. W. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 33, 34. Thickness in Pioche district 970 feet. Underlies Lyndon limestone; overlies Prospect Mountain quartzite. Mason's term Comet shale rejected.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, p. 1786, 1788–1789, 1790 (fig. 2), 1793, 1800, 1803, 1805, 1811–1815. Pioche shale is recognized from Eureka to western Grand Canyon and eastward throughout most of western Utah. In southeastern Nevada and northwesternmost Arizona, Pioche has been regarded as part of Bright Angel shale, and in western Utah it has been called Ophir and Cabin. Formation is both Lower and Middle Cambrian over most of Great Basin area, but it is Lower Cambrian at Eureka and Cave Valley(?), Nev., and in House and Deep Creek(?) Ranges, western Utah, and Middle Cambrian in Tintic and Sheeprock Ranges, central Utah.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 29. Uppermost 70 feet of beds previously assigned to Pioche shale in Wah Wah Range (Wheeler, 1943) are here assigned to Busby shale.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 28, 31–32, pl. 1. Mapped in Ivanpah quadrangle, California. Together with Prospect Mountain quartzite and Noonday dolomite, comprises what is termed western facies of the Cambrian.

A. R. Palmer, 1958, Jour. Paleontology, v. 32, no. 1, p. 154. At Pioche, Nev., includes Combined Metals member.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 668–669. Data presented in this report [northern Utah and southeastern Idaho] prove presence of Pioche formation throughout most of west-central and northern Utah and suggest its presence in the northern Wasatch, in part of Bear River Range, and in southeastern Idaho.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1066. In Deep Creek Mountains, Utah, replaces name Cabin shale.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 32, 35–39. Included in Ophir group. Underlies Busby quartzite.

H. K. Stager, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B70–B71. At Mount Wheeler mine, Pine County, Nev., the Pioche overlies Prospect Mountain quartzite and is about 450 feet thick. Consists mainly of micaceous, siliceous, highly indurated shale but includes several beds and lenses of limestone. Thickest limestone bed, known locally as "Wheeler limestone," is about 50 feet above quartzite contact and may be equivalent to Combined Metals limestone at Pioche. It is 20 to 50 feet thick.

Type locality: Southeast of Pioche, Nev., on road to Panaca, Utah.

Pioneer Group

Upper Cretaceous (Chico): Northern California.

F. M. Anderson, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1863. Chico series subdivided into Pioneer, Panoche, and Orestimba groups. Maximum thickness of Pioneer group 7,500 feet.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 183, 185 (fig. 69) [preprint 1941]. Shown as lowest group in Chico series; underlies Panoche group; overlies Horsetown group.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 24, 32. Taliaferro and Anderson proposed divisions of Panoche group wherein Anderson's Pioneer group is approximately the equivalent of Taliaferro's Pacheco group and Anderson's Panoche and Moreno groups are inclusive of Taliaferro's Asuncion group. In area of present report [Ortigalita Peak quadrangle], both the Pacheco and Asuncion groups of Taliaferro or Pioneer and Panoche groups of Anderson are represented though they have not been satisfactorily separated.

Crops out in Cottonwood district and southward along the border of Sacramento Valley.

Pioneer Sandstone[1] (in Indian Bluff Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33–B, p. 18–19, 21, 22.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6,

19, pls. 2, 3, 4. Assigned to Indian Bluff group (new). Top of sandstone forms Poteet Gap, where it is about 55 feet thick; in Cross Mountain section 50 to 60 feet thick; in Petros section 4 feet. Separated from underlying Indian Fork sandstone (new) by shale interval that is as much as 80 feet thick in some places; separated from overlying Armes Gap sandstone (new) of Graves Gap group (new) by a shale interval that contains the Jordan coal and Norman Pond coal.

Named from exposures at Old Pioneer, near Poteet Gap, Pioneer quadrangle, Campbell County.

Pioneer Shale,[1] Formation, or Quartzite (in Apache Group)

Precambrian: Central and southeastern Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 100 (fig. 31). Shown as quartzite on columnar section of rocks in Globe-Miami district. Thickness 270 feet. Overlies Scanlan conglomerate; underlies Barnes conglomerate.

N. P. Peterson, C. M. Gilbert, and G. L. Quick, 1951, U.S. Geol. Survey Bull. 971, p. 15, fig. 3, pl. 1. Formation composed mainly of hard, fine-grained, reddish-brown arkosic sandstone in Castle Dome area. At least 165 feet thick. Mapped with Scanlan conglomerate.

Gordon Gastil, 1954, Am. Jour. Sci., v. 252, no. 7, p. 436–440. Pioneer rocks studied in southeastern Arizona consist of arkose grit and gravel conglomerate, feldspathic sandstone, argillaceous and feldspathic siltstone, silty mudstone, tuffaceous siltstone, and rhyolite tuff. At nine localities, sections consist predominantly of rhyolite tuff, and tuffaceous siltstone.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Formation mapped in Globe quadrangle where it is about 270 feet thick, overlies Scanlan conglomerate and underlies Barnes conglomerate.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–128. Thickness approximately 300 to 500 feet in Haunted Canyon quadrangle. Overlies Scanlan conglomerate; underlies Barnes conglomerate.

U.S. Geological Survey currently classifies the Scanlan Conglomerate as a bed in the Pioneer Formation on basis of a study now in progress.

Named for exposures at old mining settlement of Pioneer, just south of Globe quadrangle.

Pipe Creek Shale Member (of Java Formation)

Pipe Creek Member (of Hanover Shale)

Pipe Creek Shale Member (of Wiscoy Formation)[1]

Upper Devonian: Western and west-central New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 15, pl. 3. In southwestern New York, considered member of Wiscoy sandstone. Overlies Nunda sandstone.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 37. Reallocated to member status in Hanover shale. Overlies Angola shale to west and Nunda sandstone to east. Maximum thickness about 20 feet in Springfield quadrangle and northern part of Arcade quadrangle; thins westward to 2 feet in Silver Creek quadrangle;

thins eastward and interfingers with gray shale until in western part of Hornell quadrangle it cannot be identified.

I. H. Tesmer, 1957, New York State Mus. Bull. 362, p. 5, 9, 13. In surface referred to as member of Chemung formation.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1933–1934, 1935 (fig. 2). Redefined as basal member of Java formation (new) in western and west-central New York. Underlies Hanover shale member; overlies Nunda sandstone member of West Falls formation.

Type exposure in Pipe Creek Glen, West Falls, Erie County.

Pipeline Shale Member (of Brushy Canyon Formation)

Pipeline Shale

Permian: Southwestern Texas.

W. C. Warren, 1955, *in* P. B. King, N.D. Newell, and D. W. Boyd, Permian field conference to the Guadalupe Mountains: Soc. Econ. Paleontologists and Mineralogists, p. 11. Name suggested for a black shale that intervenes between Bone Spring limestone below and the Brushy Canyon sandstone above. Has been correlated with Cutoff member [of Bone Spring] and name is used to distinguish shale from the type Cutoff. Contains fusulinids. Apparently transitional in time between Leonard and Guadalupe and is a "starved basin" shale.

U.S. Geological Survey currently classifies the Pipeline Shale as a member of Brushy Canyon Formation on basis of a study now in progress.

El Paso Natural Gas and the Pasotex pipelines cross outcrop of Pipeline shale a short distance north of Highway 62 in Delaware Mountains, Culberson County.

Piper Formation (in Ellis Group)

Middle Jurassic: Montana.

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 32. Defined to include all Middle Jurassic red beds, gypsum, and associated normal marine beds underlying Rierdon formation in eastern Montana east of Sweetgrass-Big Belt line of uplift. Basal part locally includes equivalents of type Gypsum Spring formation of central Wyoming as described by Love (1945); upper part includes beds that have been placed in lower part of lower Sundance in Wind River basin and central Wyoming. In Montana, consists of a lower red bed and gypsum member, a middle member of gray shale, limestone, and dolomite, and an upper red-bed gypsum member; these members grade into each other vertically, and to some extent the red beds grade laterally into middle marine member; upper member grades laterally into yellowish calcareous marine siltstone and sandstone. At type section, consists of (ascending) about 12 feet of massive white gypsum, 6 feet of brittle, chocolate-gray limestone, 57 feet of maroon and green siltstone and shale, 5 feet of gray, silty limestone, 9 feet of gray papery to chunky shale, and 4 feet of yellowish-gray sandy limestone. Thickness ranges from 0 to nearly 300 feet and varies considerably within short distances. Grades laterally into Sawtooth formation.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 967–968, chart 8C (columns 55, 57, 58, 60, 63, 64). Piper includes all Middle Jurassic beds underlying Rierdon formation in eastern Montana east of Sweetgrass-Big Belt-Bridger line of uplift. First identified as Gypsum Spring

formation (Imlay, 1947); later fieldwork showed that Gypsum Spring of type area in central Wyoming represents only basal Middle Jurassic and correlates with lower member of Gypsum Spring, as employed by U.S. Geological Survey parties in Montana and parts of Big Horn Basin of Wyoming. This usage in Montana arose because it was practical in mapping and because Gypsum Spring was assumed to include all beds of Middle Jurassic age older than type Sundance. Because beds equivalent to type Gypsum Spring in Montana are not mappable, name Piper is used in that state for beds hitherto called Gypsum Spring. Middle member of Piper has furnished such ammonites as *Defonticeras* and *Teloceras*, which are of middle or upper Bajocian age; upper red-bed member grades laterally in western Montana into yellowish siltstone, sandstone, and limestone that contains *Arctocephalites* and *Procerites* and is considered of upper Bathonian age.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 99–104, fig. 2. Subdivided to include (ascending) Tampico shale, Firemoon limestone, and Bowes members (all new). These units are recognized in subsurface and surface sections. In subsurface in Williston basin overlies Kline member of Nesson formation (both new).

T. P. Storey, 1958, Alberta Geol. Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston basin and adjacent areas. On basis of faunal, environmental, and tectonic evidence, units are grouped into four major depositional sequences or stagelike intervals which Imlay refers to as Gypsum Spring (or Piper), Sawtooth, Rierdon, and Swift formations. Miscorrelation of type sections of these formations are result of variations in stratigraphic succession caused by sub-Swift and sub-Rierdon unconformities which correspond respectively to Arkell's (1956, Jurassic geology of the world: New York, Hafner Publishing Co.) Lower Callovian, and uppermost Callovian to Lower Oxfordian marine transgressions. Recognition of regional extent and significance of these unconformities suggests these are the following stratigraphic variations from those generally accepted: (1) the Lower Swift (Stockade Beaver-Hulett of Lower Sundance) is older than type Swift and younger than type Rierdon formations; and (2) Sawtooth is discrete stratigraphic unit which is younger than Piper or Gypsum Spring.

Type section: About 1 mile southwest of Piper on northwest corner of an escarpment due east of Bacon Ranch in sec. 17, T. 14 N., R. 20 E., Fergus County.

Pipes Fanglomerate[1]

Pliocene, upper, or Quaternary, lower: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 379–380, map.

Named for occurrence near The Pipes, a watering place in San Bernardino County.

Pipestem Shale (in Bluestone Formation)[1]

Mississippian (Chesterian): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 322.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 182, pl. 15. Geographically extended into Virginia and redefined as member of Bluestone for-

mation. Thickness 10 to 20 feet. Overlies Pride shale member; underlies Glady Fork sandstone member. Chester series.

Type locality: In Tallery Mountain Road near foot of Davy Knob, about 1 mile northeast of Pipestem, Summers County, W. Va.

†Pipestone Quartzite[1]

Precambrian (Huronian): Southwestern Minnesota.

Original reference: N. H. Winchell, 1888, Minnesota Geol. Nat. History Survey Final Rept., v. 2, p. xxii.

Pipestone County.

Pipestone Canyon Formation

Eocene(?): Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 175. Series of arkose, shale, and conglomerate. Basal member poorly sorted conglomerate of fairly well-rounded pebbles and boulders in massive bed approximately 20 feet thick. Succeeding sandstone is light gray to buff in color, in beds 6 inches to 4 feet thick interbedded with siltstones. These beds often tinged with purple. Upper part of formation shaly. Total thickness approximately 2,300 feet. Overlies Midnight Peak formation (new) unconformably.

Type locality: In Pipestone Canyon, Methow quadrangle.

†Pipestone Creek Beds[1]

Oligocene, lower: Western central Montana.

Original reference: E. Douglass, 1902, Am. Philos Soc. Trans., v. 20, new ser., pt. 3, p. 237–245.

On Pipestone Creek, just above Piedmont, Jefferson County.

Pipestone Springs Formation

Oligocene (Chadronian): Western central Montana.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 28, pl. 1. Pipestone Springs (also Pipestone, preoccupied, and Pipestone Creek), early Chadronian local fauna and inadequately described formation composed of confluent alluvial fans filling valleys in crystallines.

L. S. Russell, 1953, Billings Geol. Soc. Guidebook 4th Ann. Field Conf., p. 112. Pipestone Springs beds of Montana mentioned as approximately same age as Cypress Hills formation, Saskatchewan.

Present in Jefferson County.

†Piqua limestone member[1]

Pennsylvanian: Southeastern Kansas.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Bull. 328, p. 20.

Named for Piqua, Woodson County.

Piru Formation

Eocene: Southern California.

S. J. Kriz, 1955, Dissert. Abs., v. 15, no. 3, p. 393. Name given to Eocene sediments of area. Five members [unnamed] are differentiated. These range in age from early Maganos [Meganos] to late Domingene or Tejon. Uppermost member contains marine strata and unconformably underlies sediments of typical Sespe formation.

Area is Whitaker Peak-Reasoner Canyon in Ventura and Los Angeles Counties.

Piru Gorge Sandstone (in Ridge Basin Group)

Pliocene, middle: Southern California.

D. I. Axelrod, 1950, Carnegie Inst. Washington Pub. 590, p. 161, pl. 1. Made up of several massive, lenticular coarse-grained, crossbedded sandstones which range from 3 or 4 feet to as much as 30 feet in thickness. Unit as much as 150 feet thick. Underlies an unnamed shale zone below Peace Valley beds; overlies gray shales and blue-gray mudstones above French Flat sandstone (new).

Forms a conspicuous cuesta south of Pyramid rock on south bank of Piru Creek in Ridge Basin area along U.S. Highway 99, between Los Angeles and Bakersfield, in region from 5 miles north of Castaic to vicinity of Gorman.

Piscataway Indurated Marl Member (of Aquia Formation)[1]

Eocene, lower: Eastern Maryland and eastern Virginia.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene Volume, p. 58, 60–62.

R. A. Schmidt, 1948, Jour. Paleontology, v. 22, no. 4, p. 390, 392 (table 1), 393. The Piscataway indurated marl member below and Paspotansa greensand marl member above are present at type locality of Aquia formation. They cannot be distinguished on basis of their ostracods. Lower Eocene.

Named from Piscataway Creek which empties into the Potomac on Maryland bank about 10 miles below Washington, D.C.

†Piscataway Sands[1]

Eocene: Eastern Maryland

Original reference: A. Heilprin, 1884, Philadelphia Acad. Nat. Sci. Jour., 2d ser., v. 9, pt. 1, p. 120, 124–127.

Pisgah Member (of Kincaid Formation)[1]

Paleocene: Northeastern to southwestern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 536, 540, 550.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 13. Middle member of formation in Texas. Overlies Littig glauconite member; underlies Tehuacana member. Consists of yellow, gray, green, and buff clay and glauconitic sand containing several limestone beds. Beds equivalent to Pisgah member crop out at many localities in southwestern Arkansas.

G. R. Kellough, 1959, Gulf Coast Geol. Soc. Trans., v. 9, p. 152–153. At Tehuacana Creek, section consists of 148 feet of strata divisible into 3 units: basal, 20 feet thick, gray slightly sandy shale; middle, 53 feet thick, gray slightly sandy shale or shaly sand interbedded with thin layers of sandy shale containing small amounts of coarse dark-green glauconite; and upper, 75 feet thick, gray sandy shale with small amounts of very fine-grained light-green glauconite. Overlies Littig member; underlies Tehuacana member.

Named for exposures on Pisgah Ridge, Navarro County, on road between Richland and Wortham, 6 miles north of Limestone County line.

Pismo Formation[1]

Miocene, upper, and Pliocene: Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio 101.

B. M. Page and others, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 16. Thickness about 3,200 feet. Overlies Monterey formation; underlies Paso Robles. Upper Miocene and Pliocene.

Named for exposures at town of Pismo, San Luis Obispo County.

Pit Shale[1] or Formation

Middle and Upper Triassic: Northern California.

Original reference: H. W. Fairbanks, 1894, Am. Geologist, v. 14, p. 28.

J. P. Albers, 1953, California Div. Mines Spec. Rept. 29, p. 7–8, pls. 1, 3, 4, 5. Formation, in Afterthought Mine district, Shasta County, is about 500 feet thick. Consists of shale and tuff, with tuff making up more than half of formation. Overlies Bully Hill rhyolite.

A. H. Coogan, 1957, (abs.) Geol. Soc. America Bull., v. 68, no. 12, pt. 2, p. 1821. Conformably overlies Dekkas formation (restricted).

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 5–7, pl. 1. Oldest formation exposed in area [southwest quarter Big Bend quadrangle, Shasta County]. Underlies Hosselkus limestone. Only upper part of formation studied. Middle Triassic.

A. H. Coogan, 1960, California Univ. Pubs. Geol. Sci., v. 36, no. 5, p. 243–255. Pit shale consists of black and gray siliceous shale which weathers to lighter shades of gray or white. Conformably overlies Dekkas formation of Bollibokka group (new). Owing to presence of middle Permian fusulinids in Dekkas and lack of diagnostic Triassic fossils in lower part of Pit, it is possible that Mesozoic-Paleozoic boundary is within Pit shale. [Spelled Pitt by J. P. Smith (1894), Jour. Geology, v. 2, p. 592, 601–604).]

Named for exposures at Silverthorns Ferry, on Pit River, Shasta County.

Pitcairn Gneiss Complex

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 15–17. A belt of heterogeneous rock comprising gneiss skarn, granulite, feldspathic quartzite, and rock resembling artertic migmatite.

Extends along northwest border of Diana complex from just southeast of Harrisville, Lewis County, for about 10 miles or more to northeast.

Pitchfork Formation

Eocene, middle: Northwestern Wyoming.

R. L. Hay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1863–1898. Consists largely of detrital rocks—sandstones, siltstones, and conglomerates—containing volcanic debris from eruptive centers in Yellowstone Park-Absaroka volcanic province. Thickness 200 to about 1,200 feet; average about 1,000 feet. Interfingers northward with breccia; toward the south, pinches out against axis of Owl Creek Range. Almost everwhere underlain by Willwood and Tatman formations; overlain by basalt and equivalent breccia. West and south of Anchor post office, Masursky (1952, Wyoming Geol. Assoc. Guidebook 7th Ann. Field Conf., map) mapped beds equivalent to Pitchfork as Aycross formation. He showed Aycross strata extending as far south as Owl Creek Range, where, on axis of range, they pinch out between limestone of Paleozoic age and Tepee Trail formation. It is believed that use of Aycross for these beds is misleading because beds considered Aycross in Bighorn basin may never have been continuous with beds of Aycross south of Owl Creek

Range, in Wind River basin. As used here, Pitchfork formation includes beds in Bighorn basin named Aycross by Masursky. Vertebrate and plant remains indicate a probable middle Eocene age.

Name derived from Pitchfork post office in Greybull Valley. No single type section encompasses the lithologic variety of formation but exposures on cliff on east side of Francs Fork, in sec. 9, T. 47 N., R. 103 W., Park County, most nearly approach type section.

†Pithole Grit[1]

Mississippian: Northwest Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. I_3, p. 82, 93, 121, 130.

Well developed in and around Pithole, Venango County, and crops out along Allegheny River on south and along Oil Creek on west.

Pitkin Limestone[1]

Upper Mississippian: Northern Arkansas and eastern Oklahoma

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 27, 109.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1939. In Arkansas, underlies newly defined Cane Hill member of Hale formation.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 71–75. Described on flanks of Ozark Uplift, northeastern Oklahoma, where it is conformable with the subjacent Fayetteville and unconformable with the overlying Hale formation. Maximum thickness 82 feet; average thickness 25 to 30 feet.

Named for exposures near Pitkin post office in Washington County, Ark.

Pitt Series[1]

Middle Triassic: North America.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, p. 1106–1108.

Pittsburg Formation

Carboniferous: Central western Idaho and northeastern Oregon.

W. R. Wagner, 1945, Idaho Bur. Mines and Geology Pamph. 74, p. 4–5, pl. 1. Mainly conglomerates and sandstones with some argillaceous beds and here and there a dense tuffaceous bed. Conglomerates of subangular to rounded pebbles and boulders from 1 to 4 inches in diameter in coarse gray-green sandy matrix. Sandstones are coarse. Formation gray green to dark green in color and seems to have been formed mostly of debris eroded from Permian volcanics. Estimated thickness between 200 to 300 feet. Overlies Seven Devils volcanics.

Exposed near Pittsburg Landing on Snake River, Idaho County, Idaho. Covers area of approximately 1½ square miles on Idaho side of river and much larger but undetermined area on Oregon side.

†Pittsburg Formation[1]

Eocene: Western Washington.

Original reference: B. Willis, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 424–430.

Named for Pittsburg.

Pittsburg Formation

Pleistocene: Northern California.

C. F. Tolman, 1931, California, California Dept. Public Works, Div. Water Resources Bull. 28, p. 354, pl. D–IX, D–X. Fine clayey sandstone and tawny-yellow to brown and brownish-yellow sandy silt; obscurely bedded. Grades into material designated as recent alluvium. Thickness about 500 feet.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 106. Replaced by Montezuma formation; name Pittsburg preoccupied.

Occurs in upper San Francisco Bay region.

Pittsburg Bluff Formation

Pittsburg Bluff Sandstone[1]

Oligocene: Northwestern Oregon.

Original reference: L. G. Hertlein and C. H. Crickmay, 1925, Am. Philos. Soc. Proc., v. 64, no. 2, p. 254.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 112–113. Term Pittsburg Bluff sandstone originally was intended to include the fossiliferous beds at town of Pittsburg. This stratigraphic horizon is probably near middle of Oligocene section exposed in Columbia County. Total thickness of middle Oligocene between Pittsburg and Clatskanie, approximates 4,000 feet. Seems desirable that term Pittsburg Bluff formation be applied to entire middle Oligocene sequence in county and that type section be considered along Nehalem River, between Pittsburg and Mist. Overlies Keasey formation. Also referred to as Pittsburgh Bluff.

W. C. Warren and Hans Norbisrath, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 228–231. Formation, in upper Nehalem River basin, consists of firm, sparingly fossiliferous, tuffaceous sandstone and shale with beds of fine-grained white tuff; stratified cross-bedded sandstone with pebble bands and carbonaceous material; massive loosely consolidated brown-weathering medium-grained concretionary sandstone; gray fine-grained fossiliferous sandstone with calcareous beds. Thickness 700 to 850 feet. Disconformably underlies Scappoose formation (new); overlies Keasey formation; actual contact not observed, evidence suggests unconformity with angular discordance of several degrees. Middle Oligocene.

Named for exposures at Pittsburg Bluff, Columbia County.

Pittsburgh clay member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 65. Subjacent to Pittsburgh (No. 8) coal is a thin zone of clay or clay shale known as the Pittsburgh clay member; overlies Upper Pittsburgh limestone member. Top of this clay marks top of Conemaugh series in Ohio. Thickness 1 inch to 4½ feet.

Well exposed in Union Township, Morgan County.

Pittsburgh cyclothem

Pennsylvanian (Monongahela Series); Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 161–166. Lowest cyclothem in Monongahela series. Succeeded by Upper Pittsburgh cyclothem (new). In normal successsion, includes seven members (ascending): Lower Pittsburgh (Bellaire) shale and (or) sandstone, Lower Pittsburgh redbed, Upper Pittsburgh limestone, Pittsburgh underclay and shale, Pittsburgh (No. 8) coal, roof shale, and Pittsburgh "rider" coal. Thickness about 40½ feet. In area of this report, Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are listed (ascending): Pittsburgh, Upper Pittsburgh, Redstone, Fishpot, Lower Sewickley, Sewickley, Benwood, Arnoldsburg, Lower Uniontown, Uniontown, Little Waynesburg, and Waynesburg.

Present in Athens County. Members of cyclothem are named from Pittsburgh (No. 8) coal, which was first described from exposures in Pittsburgh, Pa., area, but was formerly referred to in Athens County as Federal Creek coal bed.

†Pittsburgh Limestone (in Conemaugh Formation[1] or Group)

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 628–635.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 34, 48. Pittsburgh limestone, first named by Rogers for its occurrence immediately below the Pittsburgh coal seam in western Pennsylvania and generally known as Upper Pittsburgh limestone in West Virginia, is widely distributed across southeastern Ohio. Member may consist of a single irregular layer of limestone separated from base of Pittsburgh coal by thin bed of clay, nodular limestone embedded in clay or clay shales, or several layers of limestone interstratified with calcareous argillaceous shale. Thickness of limestone and associated beds ranges from 2 feet to more than 20 feet, but the usual thickness is 4 or 5 feet. Conemaugh series.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Shown on columnar section as Pittsburgh limestone in Conemaugh group. Above Clarksburg coal and below Pittsburgh coal.

Named for its occurrence immediately below Pittsburgh coal in western Pennsylvania.

Pittsburgh Member (of Monongahela Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh Red Beds, Red Shale, or Reds (in Conemaugh Formation[1] or Group)

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

[Original reference] (Pittsburgh red shale): I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 263–265.

M. T. Sturgeon, 1958, Ohio Geol. Survey Bull. 57, p. 130. Widespread variegated clays and shales occur at many places in Maryland, Ohio, Pennsylvania, and West Virginia in interval between Portersville (Friendsville) shale and limestone and Ames limestone. Thicknesses range up to 50 or

even 100 feet. To these beds in Ohio, Condit (1912) gave name Round Knob. Elsewhere in northern Appalachian region these shales and clays are known as Pittsburgh red shale or redbed, a name given by White (1903) and a name which Condit deems unsatisfactory because of previous and general use of Pittsburgh for No. 8 coal and for its underlying limestone. Condit's opinion is valid, and name Round Knob is used for these beds in Ohio.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4). Pittsburgh redbed shown on generalized columnar section for Pennsylvanian of western Pennsylvania above Saltsburg sandstone and below Harlem coal. Conemaugh group.

Named for exposures along grade lines of many railroads at Pittsburgh, Pa.

Pittsburgh (Lower) Sandstone (in Conemaugh Formation)[1]

See Lower Pittsburgh Sandstone (in Conemaugh Formation)

Pittsburgh Sandstone Member (of Monongahela Formation)[1]

Pittsburgh sandstone member

Upper Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 503–507.

Wilber Stout, 1954, Ohio Geol. Survey Open File Rept. 1, p. 26–27. Described in Ohio as Pittsburgh or Upper Pittsburgh sandstone member of Monongahela series. Scattered in its occurrence in eastern Ohio. Where best developed, it is gray to drab, medium fine in texture, and commonly marked by crossbedding planes.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 19. Upper Pittsburgh sandstone listed in summary of stratigraphic section of Monongahela formation in Harrison County. Thickness as much as 15 feet. Underlies Redstone limestone and overlies unnamed limy shale above Pittsburgh coal.

First described in Greene County, Pa.

†Pittsburgh Series[1]

Pennsylvanian: Central western Pennsylvania.

Original reference: H. D. Rogers, 1839, Pennsylvania Geol. Survey 3d Ann. Rept., p. 88–108.

G. H. Ashley, 1945, Jour. Geology, v. 53, no. 6, p. 374–389; M. N. Shaffner, 1946, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 55, p. 48, pl. 4. Discussion of Pittsburgh-Pottsville boundary. Pittsburgh series is equivalent to Monongahela, Conemaugh, and Allegheny groups.

Named for exposures in vicinity of Pittsburgh, Allegheny County.

Pittsburgh Underclay

Pittsburgh underclay and shale member

Pennsylvanian (Conemaugh Series): West Virginia and eastern Ohio.

J. B. McCue and others, 1948, West Virginia Geol. Survey, v. 18, p. 12. Pittsburgh underclay is topmost member of Conemaugh series. Thickness 2 to 12 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 163. Pittsburgh underclay and shale member of Pittsburgh cyclothem in report on Athens County. Average thickness about 2 feet. Above Upper

Pittsburgh limestone member and below Pittsburgh (No. 8) coal member. Monongahela series.

Probably named for association with Pittsburgh coal.

Pittsfield Member of (of Littleton Formation)

Lower Devonian: Northern New Hampshire.

M. T. Heald, 1955, The geology of the Gilmanton quadrangle, New Hampshire: New Hampshire State Plan. Devel. Comm., p. 8, 10 (table 1), geol. map. Oldest unit of Littleton formation in Gilmanton quadrangle. Coarse-grained schists and gneisses. Underlies Jenness Pond member (new).

Good exposures at Sabattus Heights and along Pleasant Street in Loudon.

Pittsford Shale (in Salina Group)

Pittsford Shale Member (of Salina Formation)[1]

Upper Silurian: Western to east-central New York.

Original reference: J. M. Clarke, 1908, New York State Mus. Bull. 69, p. 867.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Pittsford shale at base of Salina group, Cayugan series. Underlies Vernon shale.

R. E. Griswold, 1951, New York State Water Power and Control Comm. Bull. GW-29, p. 10. Salina formation consists of (ascending) Pittsford shale, Vernon shale, Syracuse salt, Camillus shale, and Bertie limestone members. Of these, only the Vernon and Camillus have been recognized in Wayne County.

D. W. Fisher, 1957, New York State Mus. Bull. 364, p. 6, 11. Discussion of Vernon formation in its type locality. Name Pittsford shale is suppressed. It is not a widespread, clearly recognizable mapping unit. This discontinuous occurrence of greenish-black shale above Lockport dolomite is included within the Vernon.

Named for exposures in excavations in Erie Canal near Pittsford, Monroe County.

Pittsford Valley Dolomite

Cambrian: West-central Vermont.

G. W. Bain, 1938, New England Intercollegiate Geol. Assoc. [Guidebook] 34th Ann. Field Mtg., p. 8. Chiefly dolomite with about 30 percent graywacke beds occurring in cyclic series. Graywacke zones are about 10 feet thick and have buff-weathering dolomite "spacers" between. Thickness 800 feet. Overlies Florence dolomite (new).

Occurs in central Vermont marble belt, Rutland County.

Piutean series[1]

Pliocene: California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 80.

Well exposed under Piute Point, in Furnace Canyon, east of Death Valley, Inyo County.

Placer Creek Formation

Pleistocene: Southeastern Utah.

G. M. Richmond, 1956, Dissert. Abs., v. 16, no. 6, p. 1128. Consists of two members that comprise nine lithofacies, including till and various alluvial. colluvial, and eolian deposits. Till forms two sets of lower canyon

end moraines. Weakly developed Porcupine Ranch soil is formed on lower member where it is overlain by the upper member. Moderately developed Castle Creek soil is formed on upper member and on deposits of lower member not overlain by the upper member. Older than Beaver basin formation (new); younger than Harpole Mesa formation (new).

Located in La Sal Mountains area.

Placerita Formation[1]

Pre-Cretaceous: Southern California.

Original reference: W. J. Miller, 1934, California Univ. at Los Angeles Pub. in Math. and Phys. Sci., v. 1, no. 1, p. 3–12, 63–65, 83, map.

G. B. Oakeshott, 1937, California Jour. Mines and Geology, v. 33, no. 3, p. 220–223, pl. 3. Crystalline limestone; graphite, biotite, sillimanite, and tremolite schist; quartzite and schistose conglomerate. No estimate of thickness in Little Tujunga quadrangle; at least 5,000 feet in Placerita Canyon district. Intruded by Rubio diorite. Carboniferous(?).

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 50–52, pls. 1, 2. Mapped as pre-Cretaceous. Intruded by Upper Jurassic(?)-Lower Cretaceous(?) granitic rocks. Occurs south of San Gabriel fault.

Named for exposures in Placerita Canyon, at west end of San Gabriel Mountains.

†Placer Mountain Group[1]

Upper Cretaceous: Central northern New Mexico.

Original reference: F. V. Hayden, 1869, U.S. Geol. and Geog. Survey Terr. 3d Ann. Rept. p. 90, 190.

Occurs in Placer Mountain, about 30 miles south of Santa Fe, Santa Fe County.

Placid Shale Member (of Brad Formation)[1]

Placid Formation

Placid Shale (in Brad Group)

Upper Pennsylvanian: Central Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 109–110, 115; 1922, Jour. Geology, v. 30, p. 24, 31, 35.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 111. Cedarton shale and Winchell member (including Clear Creek limestone of Drake and lower or limestone-bearing part of Placid shale member of Plummer and Moore) have been found to be included in typical Graford formation. Beds here included in "shale member" of Brad formation represent upper part of Placid shale member of Plummer and Moore.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Brad here raised to group status. Underlies Ranger limestone; overlies Winchell formation.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, April 17–19, p. 51 (columnar section). Shown on columnar section as member of Brad formation. Consists of shale, gray to brownish red to orange red, locally silty and sandy; contains local channel deposits of chert conglomerate and sand, and cherty limestone reefs; includes Corn Creek limestone member of Placid formation of Jenkins (1952, unpub. thesis).

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 66, pl. 27. Jenkins (1952, unpub. thesis) described Placid as a formation and, in

Mercury quadrangle, named persistent limestone beds in unit the Corn Creek limestone member. These beds can be traced north into Brown County to a point about 2 miles west of village of Brookesmith beyond which they are replaced by sandstone and conglomerate. In present report, the Placid is classified as basal member of Brad formation. Underlies Ranger limestone member; overlies Winchell limestone. Thickness 125 to 145 feet along Colorado River; about 95 feet in central and north-central parts of Brown County.

Named for town of Placid, McCulloch County.

Placita Marl[1]

Probably Miocene and Pliocene: Central northern New Mexico.

Original reference: E. D. Cope, 1875, Ann. Rept. Chief Engrs. U.S. Army, Rept. Secy. War to 44th Cong., v. 2, pt. 2, p. 997.

Occurs in region from Zandia [Sandia] Mountains to and beyond village of Placita [now Placitas], Sandoval County.

Placitos limestone[1]

Pennsylvanian: Central northern New Mexico.

Original reference: C. R. Keyes, 1903, Ores and Met., v. 12, p. 48.

In Sandia Mountains. Derivation of name not stated.

Plainfield Quartz Schist[1] or Quartzite

Plainfield Quartz Schist Member (of Putnam Series)

Pre-Triassic: Eastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 132, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 69, pl. 1. Rank reduced to member. Occurs near base of Putnam series which is probably Precambrian in age.

John Rodgers and others, 1956, Preliminary geologic map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Includes local occurrences of fine-grained feldspathic gneiss which grades into aplitic phase of Sterling granitic gneiss. Pre-Triassic. Derivation of name stated.

C. B. Sclar, 1958, Connecticut Geol. Nat. History Survey Bull. 88, p. 10. Not mapped as separate unit in New London County.

R. M. Perhac, 1958, Connecticut Geol. Nat. History Survey Bull. 89, p. 8–9, pls. Plainfield quartzite described in Voluntown and Oneco quadrangles. Varies in texture and composition from fine-grained muscovite-quartz schist to fine-grained massive quartzite. Latter is definitely more abundant type. Bedding visible in many areas. Maximum possible thickness about 2,000 feet.

Named for town of Plainfield, Windham County.

†Plainfield Schist[1]

Ordovician: Western Massachusetts.

Original reference: R. Pumpelly, 1894, U.S. Geol. Survey Mon. 23, p. 29–30.

Named for occurrence in Plainfield Township.

†Plains Marl[1]

Miocene, Pliocene, and Pleistocene: Western Kansas.

Original reference: R. Hay, 1893, Kansas State Bd. Agric. 8th Bienn. Rept., p. 101.

J. C. Frye, 1952, Kansas Geol. Survey Bull. 99, p. 110. Listed with locally named units which are properly classed at least in part as Sanford formation.

Occurs on High Plains of western Kansas.

†Plains Series[1]

Pleistocene: Nebraska.

Original reference: A. L. Lugn, 1935, Nebraska Geol. Survey Bull. 10, 2d ser., p. 128, etc., charts.

A. L. Lugn, 1939, Am. Jour. Sci., v. 237, no. 12, p. 853 (fig. 1), 854. Surface of loess plain of south-central Nebraska, an area of more than 8,000 square miles, west of the till-covered area is underlain by yellowish Peorian loess and the Loveland formation (the Plains series), which increase in total thickness westward to a maximum of about 300 feet.

Plainview Sandstone Member (of South Platte Formation)

Lower Cretaceous: North-central Colorado.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 28–30, figs. 10, 11, 17, 19. Persistent unit which forms characteristic brown- to rusty-brown-weathering ledge of markedly tabular cross-laminated sandstone. Includes the black shale and conglomerate at the base of the formation. Thickness about 45 feet. Basal member of South Platte formation (new); disconformably overlies Lytle formation.

Named for exposures which occur in cut of Denver and Salt Lake Railroad (Moffat Tunnel Route) through the Dakota hogback at Plainview, NE¼NE¼ sec. 12, T. 2 S., R. 71 W., Jefferson County.

Plateau gravel phase[1]

Quaternary: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 29, 35–42, 188.

Plateau Valley Beds[1]

Paleocene: Central western Colorado.

Original reference: B. Patterson, 1936, Geol. Soc. America Proc. 1935, p. 397.

G. G. Simpson, 1937, Cambridge Philos. Soc. Biol. Rev., v. 12, no. 1, p. 9 (footnote). Name Plateau Valley has been applied by Patterson to Paleocene part of the Ruby formation.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 28, pl. 1. Paleocene, Tiffanian. Member(?) of DeBeque formation.

C. L. Gazin, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 134 (fig. 1). Chart shows Plateau Valley beds in lower part of DeBeque formation. Tiffanian.

First mentioned in Mesa County.

Platte channel facies (of North Park Formation)

Miocene, upper: Central northern Colorado.

J. de la Montagne and W. C. Barnes, 1957, Rocky Mountain Assoc. Geologists Guidebook to geology of North and Middle Parks Basin, Colorado, p. 58, fig. 2. Crossbedded conglomerate and sandstone comprised mostly of rounded fragments of Precambrian rock and fragments of volcanic flow-rock. Angular fragments only rarely present. Although individual strata of this material not persistent for more than a few hundred yards along the valley, the mean size grade of volcanic fraction increases southward,

passing from grit size at north end of valley to boulder size 60 miles to south near Independence Mountain. Interbedded with overbank facies of North Park formation in central part of valley.

Restricted to central parts of Saratoga Valley in North Park area.

†Platte Series[1]

Upper Cretaceous: From Rocky Mountains eastward.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 49.

Occurs in area of that segment of North American Interior Plateau which extends from Rocky Mountains eastward and constitutes the higher part of the Plains. Named for Platte River, which, in Colorado and Nebraska, cuts all divisions of the series.

†Platte Series[1]

Pleistocene: Nebraska.

Original reference: A. L. Lugn, 1935, Nebraska Geol. Survey Bull. 10, 2d ser., p. 88+, charts.

A. L. Lugn, 1939, Am. Jour. Sci., v. 237, no. 12, p. 853 (fig. 1). Shown on Pleistocene geologic map of Nebraska.

Platte shale[1]

Pennsylvanian: Southwestern Iowa and northwestern Missouri.

Original reference: C. R. Keyes, 1898, Am. Geologist, v. 21, p. 349.

Well exposed along Platte River of northwest Missouri. Named for exposures at mouth of Platte River at Nebraska-Iowa boundary.

Platte River Formation[1]

Upper Cretaceous or Eocene: Nebraska.

Original reference: H. Engelmann, 1876, Engr. Dept. U.S. Army, J. H. Simpson's Expl. of Great Basin of Terr. Utah, p. 247, 282–284.

On North Fork of Platte River.

Platteville Limestone[1] or Formation

Platteville Dolomite or Group

Middle Ordovician: Southwestern Wisconsin, northwestern Illinois, eastern Iowa, and southern Minnesota.

Original reference: H. F. Bain, 1905, U.S. Geol. Survey Bull. 246, p. 18–19.

C. A. Bays, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 269. Formation subdivided to include Mifflin limestone member which overlies Pecatonica member and underlies Magnolia member.

A. F. Agnew and A. V. Heyl, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 9, p. 1585–1588. Formation subdivided to include Quimbys Mill member which overlies McGregor member and underlies Spechts Ferry shale member of Decorah formation.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 10–11 (fig. 3). Considered a group in Dixon-Oregon area, Illlinois, where it includes (ascending) Pecatonica, Mifflin, Grand Detour (new), Nachusa (new), and Quimbys Mill formations, Underlies Galena group; overlies Ancell group (new).

M. P. Weiss and W. C. Bell, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 57–64. Restricted below to exclude Glenwood shale herein given formation status. In southeastern Minnesota, includes (ascending) Pecatonica, McGregor, and Carimona

members. In Twin City area, includes Mifflin, Hidden Falls (new), and Magnolia members; McGregor is used where these three latter units are absent or insufficiently distinct to permit use of their names.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 274–285. In zinc-lead district of Wisconsin, Illinois, and Iowa, formation includes (ascending) Glenwood shale, Pecatonica dolomite, McGregor limestone, and Quimbys Mill members. At reference section in roadcut, U.S. Highway 151, NW¼NE¼ sec. 12, T. 2 N., R. 2 W., Grant County, Wis., formation is about 54 feet thick. In eastern part of mining district and farther east, strata of Platteville, Decorah, and Galena age are dolomite, and gross lithology of the three formations is somewhat similar. This eastern area is the type for Sardeson's (1896) Beloit formation. However, since term Beloit has been virtually forgotten and terms Platteville and Decorah have been used consistently since 1906, they are retained in this report.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1030–1033. Described in Fillmore County, Minn.

Reference section: Roadcut U.S. Highway 151, NW¼NE¼ sec. 12, T. 2 N., R. 2 W., Grant County, Wis.

†Platteville Stage[1]

Ordovician: Iowa.

Original reference: S. Calvin, 1906, Iowa Geol. Survey, v. 16, p. 60, 84.

Plattford Formation (in Scranton Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 41, 58.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 30. Cotype locality designated. Here Plattford section is about 14 feet thick and includes the Vinland shale member. Westphalia limestone member is missing, and Tonganoxie sandstone member is recorded in the subsurface. Underlies Cass formation; Vinland shale in its outcrop areas in Cass County rests unconformably on the Stanton formation.

Type locality: In Platte River bluffs in west part of Plattford Township, Sarpy County. Cotype locality: In first and second Burlington quarries located northwest of South Bend, Cass County.

Plattin Limestone[1]

Plattin Group

Middle Ordovician: Eastern Missouri, central northern Arkansas, and western Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 111.

E. O. Ulrich, 1939, Kansas Geol. Survey Guidebook 13th Ann. Field Conf., p. 105–109. In sections near Cape Girardeau overlies Murfreesboro; underlies Kimmswick. Black River group.

J. G. Grohskopf, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 3, p. 351–365. Name Rock Levee proposed for rocks which underlie basal Plattin oolitic and conglomeratic limestone and overlie a chert zone which occurs in the "Joachim" dolomite. Thus, it restricts the "Plattin" and "Joachim" and contains a part of each. Overlapped by "Decorah".

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2041–2075. Rank raised to group. Comprises (ascending) Bloomsdale, Beckett, Hager, and Macy formations (all new). Overlies Rock Levee formation; underlies Decorah formation. Thins northward from about 400 feet at Cape Girardeau to about 125 feet in southern Lincoln County. Has been classified as Bolarian, Black River in age, and correlated with the Platteville of upper Mississippi Valley. Faunules from upper Macy suggest those beds are lower Trentonian. Lower formations resemble Bolarian.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 116. Underlies Barnhart formation (new).

Named for exposures near mouth of Plattin Creek, Jefferson County, Mo.

†Plattsburg Group[1]

Pennsylvanian: Northwestern Missouri.

Original reference: G. C. Broadhead, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 317, 327.

Named for exposures at Plattsburg, Clinton County.

Plattsburg Limestone (in Lansing Group)[1]

Plattsburg Limestone Member (of Lansing Formation)[1]

Pennsylvanian (Missouri Series): Northwestern Missouri, eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: G. C. Broadhead, 1868, St. Louis Acad. Sci. Trans., v. 2, p. 317, 327.

N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, p. 70–75. Includes (ascending) Merriam limestone, Hickory Creek shale, and Spring Hill limestone members. Basal formation of Lansing group; underlies Vilas shale; overlies Bonner Springs shale of Kansas City group.

Above is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33–34. Thickness of formation 10 to 12 feet in Nebraska; 20 feet in Missouri; 20 to 24 feet in Kansas.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness of formation about 15 feet in Iowa. Members not recognized with certainty. Underlies Vilas formation; overlies Bonner Springs formation. Lansing group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24, fig. 5. Formation in Lansing group. Exposed only in western Madison County where it is a highly fossiliferous gray to maroon nodular fine-grained algal limestone with interbedded red and green shale. Thickness about 4 feet. Overlies Bonner Springs shale; underlies Vilas shale.

Named for exposures at Plattsburg, Clinton County, Mo.

Plattsmouth Limestone[1] **Member** (of Oread Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: C. R. Keyes, 1898, Am. Geologist, v. 21, p. 349, 350.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 149.

Plattsmouth limestone member of Oread formation; underlies Heumader shale member; overlies Leavenworth limestone member. This classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness about 5½ feet in measured section near Winterset, Madison County; consists of blue-gray uneven beds separated by thin shales, some black chert; lower 1 foot a persistent massive bed.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 41, pl. 1. Thickness about 18 feet in Douglas County where it is composed almost entirely of light-gray to nearly white wavy-bedded limestone which weathers a light gray to tan; scattered blue-gray chert nodules persistent near middle of bed.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20–21, fig. 5. As exposed in quarries in Montgomery County, includes thin upper cherty limestone, thick section of shaly limestone containing abundant fusulinids, and lower unit containing less shale and fewer fusulinids. Thickness about 20 feet. In Cass County, thickness is about 13 feet and includes (descending) about 2 feet of thin-bedded limestone; 3 to 4 feet of fusulinid-bearing argillaceous limestone; 4 feet of calcareous olive shale weathering buff and containing abundant *Chonetes, Echinoconchus, Juresania, Neospirifer, Composita*, crinoid columnals, and large ramose bryozoans; and 3 feet of argillaceous to sublithographic cherty fossiliferous limestone. In Madison and Adair Counties, includes 4 feet of *Osagia*-bearing wavy-bedded sublithographic limestone, 2 to 3 feet of argillaceous shale, 3 to 4 feet of alternating dark-blue cherty limestone and platy shale, and 1½ feet of massive limestone containing *Ottonosia* at base. Overlies Heebner shale member; underlies Heumader shale member.

Type locality: In Missouri River bluffs in vicinity of Plattsmouth, Cass County, Nebr.

Playas Peak Formation (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 534, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 24–25, pl. 1. Sandstone and shale underlain in Eureka section by a basal conglomerate and capped by massive limestones. Basal conglomerate locally bouldery and unsorted. Thickness in Eureka section, where both contacts are disconformable, ranges from 800 to 2,000 feet; in Sylvanite section exposed section between 3,000 and 3,500 feet. In Eureka district, underlies Skunk Ranch conglomerate (new); overlies Corbett sandstone (new). Trinity age.

Named after Playas Peak in Eureka half of Little Hatchet Mountains.

Pleasant Hill Limestone[1]

Pleasant Hill Formation

Middle Cambrian: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 528, 534, 537.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 278. Thickness at type locality 600 feet; 350 feet at Williamsburg, upper part of section

exposed; sandy layers, some siltstone and shale occur rather high in section. Underlies Warrior limestone.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation.

Named for exposures of upper part at Pleasant Hill Church, 1 mile northwest of Henrietta, Blair County.

Pleasant Lake Gabbro

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 59, 61. A folded sheet in limestone. Zone of basal contact with limestone is strongly injected by granitic pegmatite to form an arteritic migmatite. Intruded by a sheet of syenite in northern and uppermost part, as now exposed.

Crops out in an oval area about 2½ miles long and 1 mile wide just southeast of Pleasant Lake in Hammond quadrangle.

Pleasanton Formation[1] or Group[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and northeastern Oklahoma.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 274, pl. opposite p. 290; 1895, Am. Jour. Sci., 3d, v. 50, p. 457, pl. opposite p. 466.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 20, 25–26, pl. 5. Upper boundary of Henrietta group has been placed at approximate position of unconformity which separates the Des Moines and Missouri, and base of Pleasanton group has been raised to correspond. Underlies Hertha limestone of Kansas City group. Thickness 100 to 200 feet.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 26–27 (fig. 2). Thins northward from Missouri into Appanoose County, Iowa.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Columnar section, Jackson and Cass Counties, Mo., shows Pleasanton group comprises (ascending) Warrensburg channel sandstone, Sni Mills limestone, Dawson coal horizon, Wayside sandstone, Exline limestone, and Knobtown sandstone. Thickness 120 to 262 feet. Overlies Henrietta group; underlies Kansas City group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028, 2031 (fig. 4). According to interstate agreement, lowermost deposits of Missourian age, mostly clastic in nature, are to be called Pleasanton, a name first applied in stratigraphic sense by Haworth (1895) for rocks between uppermost Pawnee limestone and base of Hertha formation. Pleasanton was similarly used in Missouri until 1938 (McQueen and Greene) when it was revised to exclude Desmoinesian strata. In Kansas (Moore, 1932) and Nebraska (Condra, 1935), name was dropped. Now accepted definition, which was first used by McQueen and Greene, precisely corresponds to Bourbon formation or group as recognized in Kansas and Nebraska. Name Bourbon will be suppressed. Overlies Marmaton group; underlies Kansas City group.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 69–74. Group includes Hepler sandstone at base, Checkerboard limestone, and some massive sandstones known collectively as Knobtown sandstone. Thickness 35 to 150 feet along outcrop in Kansas.

C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 130–133. Boundary between Missouri series and Des Moines series in area investigated [Nowata and Craig Counties, Okla.] is marked by erosional unconformity, with Seminole formation lying unconformably on Lenapah limestone. Two members of Pleasanton group, Checkerboard and Seminole were mapped.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 28–29, fig. 5. Group composed primarily of shale with some sandstone, thin limestones, and minor amounts of coal. Not subdivided into formations although distinctive units such as Exline limestone and Ovid coal are recognized. Top of Des Moines series is an erosional surface; hence, thickness of Pleasanton varies considerably. Thickness 19 feet in Madison County. Upper boundary at base of Hertha limestone.

Named for exposures at Pleasanton, Linn County, Kans.

Pleasants Sandstone Member (of Williams Formation)

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named as upper member of Williams formation (new). Consists of light-colored shaly sandstones with intercalated beds of limy fossiliferous sandstone. Approximate thickness 320 feet. Unconformably underlies Eocene Martinez(?) formation; overlies Schulz member (new).

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 175. Member discontinuous in its distribution, being cut out of the section in many places by faulting and by overlap. Derivation of name given.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Shown on stratigraphic sections as underlying Silverado formation (new). In this report, name Schulz member has been altered to Schulz Ranch sandstone member.

Named for Pleasants Ranch at mouth of Williams Canyon, northern Santa Ana Mountains, Orange County.

Pleasant Valley Member (of Cuyahoga Formation)

Mississippian (Kinderhook): Central Ohio.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172. Included in Toboso conglomerate facies of the formation.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 48. Essentially a gray buff shale, about 16 feet thick, containing thin layers of medium-grained sandstone; base seldom exposed. Along Licking River, east of Newark, about 15 feet are exposed; here consists of massive tan siltstone, grading to tan and gray arenaceous shale with lenses of medium-grained sandstone. Underlies Black Hand conglomerate member. Derivation of name stated.

Named from exposures northwest of Pleasant Valley School on north valley wall of tributary of Clear Fork in SW sec. 5, T. 20 N., R. 19 W., Richland County.

Pleasant View Complex

Paleozoic and Mesozoic: Southern California.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Name applied to a complex of deep-seated igneous intrusive and metamorphic rocks, some of which may be metasediments. Prevailing rocks are dark-gray

quartz diorite gneiss and metadiorite. In large part probably represent San Gabriel complex.

Type locality: Pleasant View Ridge, Valyermo quadrangle.

Pleasant View Member (of Arapahoe-Denver Formation)

Tertiary: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 100 (fig. 23), 103–104, 105. Sediments vary from poorly bedded clays to arenaceous shales with occasional lenticular beds of gray friable medium- to coarse-grained sandstones, which are best developed in lower third. Dominantly light gray. Sandstones suggest channel deposits by their cross-laminated and poorly sorted composition. Thickness averages about 113 feet on Table Mountains. Base corresponds to Cretaceous-Tertiary boundary, and is marked by distinct color change from tan to light brown. Underlies Golden member (new).

Type section: On eastern extremity of South Table Mountain; NW¼ sec. 31, T. 3 S., R. 69 W., Morrison quadrangle. Recognized only on slopes of the Table Mountains, Jefferson County.

Pleasantview Sandstone Member (of Carbondale Formation)[1]

Pleasantview Sandstone (in Carbondale Group)

Pennsylvanian: Western and northern Illinois.

Original reference: H. R. Wanless, 1929, Illinois Geol. Survey Bull. 57, p. 49, 90–91, 124.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 95, 98, 190. Consists of two types: channel sandstone and nonchannel or sheet sandstone. Nonchannel ranges in thickness from 2 or 3 to 15 or 20 feet and is commonly very fine grained and blue gray or yellow gray. Major part of channel sandstones consists of lenticular massive beds, alternating with thin shaly beds. Thickness as much as 80 feet. In some areas, channel sands rest unconformably on all beds down to Colchester (No. 2) coal. Included in Summum cyclothem, Carbondale group. Name credited to W. V. Searight (unpub. ms.). Type exposure given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 66, pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Purington shale member and below Kerton Creek coal member (new). Thickness about 18 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type exposure: Mill Creek, sec. 36, T. 2 N., R. 1 W., and sec. 31, T. 2 N., R. 1 E., vicinity of Pleasantview, Beardstown quadrangle, Schuyler County.

†Pleito Formation[1]

Oligocene and Miocene: Southern California.

Original reference: C. M. Wagner and K. H. Schilling, 1923, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 14, p. 235–252.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, fig. 14. Chart shows Pleito as occurring in upper Refugian and lower Zemorrian stages; thus, age is Oligocene and lower Miocene.

Exposed on Pleito Creek, Kern County.

Plum Bentonite (in Manning Formation)

Eocene: Central Texas.

H. B. Stenzel, 1953, Am. Assoc. Petroleum Geologists Guidebook Field Trips Houston Mtg., p. 45, 46. Name applied to bentonite bed in Manning formation. Thickness 1½ feet. Bentonite can be traced as separate lenses southwestward for 50 miles to region of Hells Gate on Guadalupe River in Gonzales County.

Named for occurrence in vicinity of village of Plum, Fayette County.

Pluma Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Min. Jour.-Press, v. 115, p. 793–799, 836–843, maps.

E. P. Rothrock, 1944, South Dakota Geol. Survey Bull. 15, p. 24. In vicinity of Homestake mine, consists of alternating beds of garnet schist and carbonaceous slates, some of which are pyritiferous. Thickness 4,000 feet. Overlies Garfield formation.

Named for exposures near Pluma, about 1½ miles east of Lead, Lawrence County.

Plumas Series[1]

Lower, Middle, and Upper Jurassic: Northern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, table opposite p. 217.

Plumas County.

Plumb Shale Member (of Wood Siding Formation)

Pennsylvanian (Virgil Series): Eastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Defined to include strata between Nebraska City limestone below and Grayhorse limestone above. Thickness at type locality about 20 feet; average thickness across Kansas 13 feet. Name credited to M. R. Mudge and R. H. Burton (work in preparation).

Type locality: In an east-west roadcut in SW¼SE¼SE¼ sec. 30, T. 14 S., R. 13 E., about 1½ miles west of Harveyville, Wabaunsee County. Name derived from Plumb Township.

Plum Brook Shale

Devonian: Northern Ohio.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 181. Proposed to replace Plum Creek shale of Grabau, 1917 (not Foerste, 1905, or Ulrich, 1917). Grabau derived his name from Plum Brook, 2 miles northeast of Prout Station, Sandusky quadrangle, but erroneously recorded the name as Plum Creek. The more accurate designation is therefore substituted.

E. C. Stumm, 1942, Jour. Paleontology, v. 16, no. 5, p. 549. Soft gray shale containing thin bands of argillaceous limestone. Exposed thickness (upper part) 20 feet; in wells 40 to 60 feet. Underlies Prout limestone.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 8–15. Stratigraphic position and correlation of Olentangy shale discussed in detail. Here suggested that the Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek are stratigraphically correlatable, with the reservation that the Olentangy is probably Upper Devonian. At various

times and by different authors, the Plum Brook shale has been correlated with the Olentangy, and the so-called Prout limestone has been regarded as member of Olentangy. Olentangy stratigraphic interval is represented by Prout limestone and Plum Brook shale in northern Ohio. Regional information regarding thickness of Plum Brook shale-Prout limestone has not been worked out. Combined thickness of 36 feet of Plum Brook and Prout has been reported in outcrop area in Erie County. Eastward, this interval is represented by Plum Brook shale which has been reported to be 142 feet thick. Plum Brook is in apparent conformable contact with Huron shale.

Type locality: On Plum Brook, near Prout Station, Sandusky quadrangle, Erie County.

†Plum Creek Beds (in Chester Group)[1]

Mississippian: Southwestern Illinois.

Original reference: E. O. Ulrich, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, pt. 2, p. 44, 56, 230, pl. D.

J. M. Weller *in* Stuart Weller and J. M. Weller, 1939, Illinois Geol. Survey Rept. Inv. 59, p. 12; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 837. Name Baldwin formation proposed for preoccupied Plum Creek beds.

Occur in Randolph County.

Plum Creek Clay[1]

Plum Creek Member (of Brassfield Formation)

Silurian (Niagara): East-central Kentucky.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 44, 61.

E. B. Branson and C. C. Branson, 1947, Jour. Paleontology, v. 21, no. 6, p. 549, 550 (fig. 1). Reallocated to member status in Brassfield formation. Underlies Oldham limestone; overlies dolomitic limestone in Brassfield formation.

Named for Plum Creek, Powell County.

Plum Creek Shale[1]

Middle Devonian: Northern Ohio.

Original reference: A. W. Grabau, 1917, Jour. Geology, v. 25, p. 337–343.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 181. Name Plum Brook shale proposed to replace Plum Creek shale. Grabau derived his name from Plum Brook, 2 miles northeast of Prout Station, Sandusky quadrangle, but erroneously recorded name as Plum Creek.

Locality is in Erie County.

Plummer Limestone Member (of Pawhuska Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: D. E. Winchester, 1918, U.S. Geol. Survey Bull. 686–C, p. 11–12.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49–50. In Tps. 27, 28, and 29 N., northern Osage County, the Pawhuska is about 150 feet thick and contains six named limestone members (ascending): Lecompton, Plummer, Deer Creek, Little Hominy, Pearsonia, and Turkey Run. The Plummer limestone was not found south of center of sec. 35, T. 23 N., R. 7 E.

Named for exposures near house on Plummer Ranch, T. 26 N., R. 9 E., Osage County.

Plummer Hollow Mudstone Member (of Juniata Formation)

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. Consists of red silty mudstone with interbeds of red siltstone and sandstone. Overlies East Waterford red sandstone and shale member (new); underlies Run Gap red sandstone member. Thins eastward, and, at Waggoners Gap, beds lithologically referable to Plummer Hollow are not present and instead are about 360 feet of red sandstones of type that forms East Waterford member. [Swartz refers to his 1955 report *in* Pennsylvania Geologists Guidebook 21st Ann. Field Conf. Compiler was unable to locate this reference.]

Named for Plummer Hollow, in vicinity of Tyrone Gap.

Plum Point Marl Member (of Calvert Formation)[1]

Miocene, middle: Eastern Maryland.

Original reference: G. B. Shattuck, 1904, Maryland Geol. Survey, Miocene Volume, p. lxxiv.

Lincoln Dryden and R. M. Overbeck, 1948, Maryland Dept. Geology, Mines and Water Resources [Repts.] Charles County, p. 56–57. Upper member of formation. Overlies Fairhaven [diatomaceous earth] member; contact believed to occur just below oyster bed near south end of Calvert Cliffs. Contact with Choptank formation not definitely recognized, but it lies somewhere between Shattuck's "zones" 13 and 17. Thickness at least 50 feet and probably as much as 75 feet. Member believed to be present in Charles County near Hughesville, about 13 miles east of La Plata. Unit referred to here as Plum Point marls.

Named for Plum Point, Calvert County.

Pluto Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 295, 334.

Named for association with Pluto coal in Summers County.

Pluto Shale (in Hinton Formation)[1]

Mississippian: Southern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 214, 219–220.

Occurs in Mercer and Summers Counties, W. Va., and in Tazewell County, Va.

Plutos Cave Basalt

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 42–44, pl. 1. Uniform black vesicular olivine-rich augite basalt with fairly smooth crust marked by gentle swells and hollows. Oval schollendomes, a few feet to 20 feet high, scattered at random over surface of lower half of flow. Evidence concernimg thickness meager; thickest part probably median part that extends northwestward through Pluto's Cave; just north of cave approximately 290 feet of basalt encountered in well; locally may

be 400 feet thick. Largest flow of any age in Macdoel quadrangle; seems to have issued from fissures near northeast base of Mount Shasta.

Seymour Mack, 1960, U.S. Geol. Survey Water-Supply Paper 1484, p. 20 (table), 41–43, pl. 1. Constitutes most prolific aquifer in Shasta Valley.

Occupies eastern half of Shasta Valley; covers more than 50 square miles and exceeds 20 miles in length. Named for Pluto's Cave, a large lava tube near its southern end. (Locality named The Caves on Williams' (1949) geol. map, pl. 1.)

Plymouth Conglomerate[1]

Lower Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1931, Vermont State Geologist 17th Rept., p. 220.

In Windham Township, Windham County.

Plymouth Ferruginous Chert Member (of Ironwood Iron-Formation)[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501, 502.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 105 (table 10), 106 (table 11), 107 (fig. 3). Underlies Yale member; overlies Palms quartzite. Thicknesses (taken from drill holes) 133 and 154 feet.

Named for Plymouth mine, Gogebic Range, Mich.

Plymouth Granite[1]

Late Paleozoic: Southeastern Vermont.

Original reference: E. L. Perry, 1929, Vermont State Geologist 16th Rept., p. 44–46.

Occurs on south slope of Morrison Hill in Plymouth, Woodstock quadrangle, about one-half mile northwest of Pinney Hollow road and an equal distance due west of Pinney Hollow Schoolhouse, east of road to abandoned Morrison Farm in Windsor County.

Plymouth Marble[1]

Plymouth Member (of Grahamville Formation)

Plymouth Member (of Hoosac Formation)

Lower Cambrian: East-central Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

J. B. Thompson, Jr., 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for field trips in New England, p. 41. Rank reduced to member in upper part of Hoosac formation. Has approximately same stratigraphic position as Turkey Mountain member which occurs south of outcrop area of the Plymouth. Cambrian or Lower Ordovician.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 47, 48, tables 2, 3. Reallocated to member status at top of Grahamville formation (new). Includes massive gray dolomite and white vitreous thinly bedded quartzite. Maximum thickness 100 feet, typically 10 to 20 feet. Underlies Pinney Hollow formation. Cambro-Ordovician. Outcrop area mentioned.

Well exposed in lower slopes of Ottauquechee and Black River valleys south of West Bridgewater in Rutland area. Crops out in Plymouth Township, Windsor County.

Plymouth Union Series

Cambrian(?): Central Vermont.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 653, 654–656, 657. A local unit consisting of quartz schists, quartzites, quartz conglomerates, and dolomitic marbles. Replaces Mendon series in this area. Clean massive quartzite at base. Several massive dolomite beds in upper part near Plymouth. North of Sherburne includes Sherburne conglomerate. Underlies Pinney Hollow schist with transition zone; overlies Pico Peak series (new).

Type locality: East side of Green Mountain Range in Plymouth and Bridgewater Townships, Windsor County.

Plympton Formation (in Park City Group)

Permian: West-central Utah and eastern Nevada.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2181–2184. Permian rocks in Confusion Range, Utah, above the Kaibab limestone are divisible into two formations, the older of which is herein named Plympton formation and the younger Gerster. Defined on basis of two partial sections, localities 7 and 8 of present report. Consists predominantly of dolomite and smaller amounts of chert. Five lithic zones differentiated. Aggregate thickness 690 feet. Park City group. Newell (1948, Geol. Soc. America Bull., v. 59, no. 10) applied name Phosphoria to all Permian rocks above the Kaibab. Term Phosphoria is herein considered inappropriate.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 107–108. Geographically extended into east-central Nevada. In Pequop and Cherry Mountains and Ferguson Spring Mountains, the Plympton overlies Loray formation and underlies the Phosphoria. In Butte Mountains, overlies the Loray and underlies Gerster formation. Thickness 983 feet in Butte Mountains.

Has greatest areal extent in Millard and Plympton Ridges in Confusion Range, Utah. Locality 7 is 1.4 miles N. 60° E. of east end of Indian Pass. Locality 8 is 9 miles S. 20° W. of Granite Mountain. Section at locality 8 broken by several faults.

Pocahontas Formation (in Pottsville Group)[1]

Lower Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 26, p. 3.

C. B. Read, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 273. Formation mentioned in discussion of Pennsylvanian floral zones and floral provinces.

Named for Pocahontas, Tazewell County, Va.

†Pocahontas Group (in Pottsville Group)[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2A, p. 13.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 12, chart 6 (column 12). Pocahontas group, lower Pottsville series, southern West

Virginia, includes (ascending) Squire Jim coal, No. 2 Pocahontas coal, No. 3 Pocahontas coal, Pocahontas sandstone, No. 4 Pocahontas coal, and Flattop Mountain sandstone. Underlies New River group.

Named for Pocahontas, Tazewell County, Va.

Pocahontas Sandstone (in Lee Formation)

Pocahontas Sandstone (in Pocahontas Group)

Pocahontas Sandstones (in Pottsville Group)[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 224–232.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (columns 12, 19). Correlation chart shows Pocahontas sandstone in Pocahontas group in southern West Virginia and in Lee formation in Virginia.

Quarried at Pocahontas, Tazewell County, Va.

Pocatello Formation

Precambrian: Southeastern Idaho.

J. C. Ludlum, 1942, Jour. Geology, v. 50, no. 1, p. 89–92. Thick series of unfossiliferous metamorphosed sediments. Considerable variations in thickness and distribution of component sediments. Divided into two series: lower tillite series consisting of silicified sandstones, slates, intraformational limestone conglomerate, thin-bedded metamorphosed limestones, argillites, and tillites, approximately 1,100 feet thick; and an upper varved slate series consisting of alternating bands of dark and light slate with a few thin beds of sandstone in upper part, 350 feet thick. Underlies Blackrock limestone. Overlies Bannock volcanic formation of which it was formerly a part.

Exposed in Pocatello quadrangle.

Pochnoi Volcanics

Tertiary(?) or Quaternary: Alaska.

R. R. Coats, 1960, U.S. Geol. Survey Bull. 1028–0, p. 481–482, 486, 503–504, pl. 59. Sequence of tuff-breccia, lava, and agglomerate, and minor amounts of sandstone. Thickness in walls of caldera, 1,700 feet. Oldest rocks on island. Apparently erupted by volcano, which had approximately same dimensions as present island, whose center of eruption lay somewhere within area of present central depression.

Well exposed west and north of Pochnoi Point, Semisopochnoi Island, largest of young volcanic islands of western Aleutians. Exposed chiefly in northeast, south, and southwest parts of island, outside central lowland; elsewhere covered by products of later volcanic eruptions.

Pochuck Diorite[1]

Pochuck diorite phase (of Hudson Highlands Complex)

Precambrian: Eastern New York.

Original reference: C. P. Berkey and Marion Rice, 1919, New York State Mus. Bulls. 225–226, p. 51–52.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 143. Berkey and Rice (1919) showed oldest igneous representative distinguishable in Hudson Highlands as essentially a diorite but indicated that it is practically

always intimately associated with Grenville metamorphics. Hornblende-plagioclase gneiss layers at Bear Mountain are believed to represent Grenville rocks reworked selectively by this diorite invasion. They correspond to Colony's (1921, New York State Mus. Bulls. 249–250) Pochuck-Grenville. Presence of a diorite parent rock of unquestionable magmatic origin could not be demonstrated in region, therefore, term "phase" is used for this earliest igneous interval. There is no intention to question the validity of the intrusive concept.

Report discusses area around Bear Mountain, a prominent summit of the Hudson Highlands, about 40 miles north of New York City.

Pochuck Gneiss

Pochuck Gabbro Gneiss[1]

Precambrian: Northern New Jersey and eastern Pennsylvania.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 439.

D. M. Fraser *in* B. L. Miller, D. M Fraser, and R. L. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 163 (fig. 30), 175–187. Described in Northampton County, Pa. In Chestnut Hill exposure, conformably underlies Moravian Heights formation (new); both formations strike N. 50° E., and dip northwest at an angle of 59°. This superposition of Moravian Heights gives no indication of relative periods of origin as all rocks of Precambrian have been extensively disturbed. Pochuck may be older, younger, or interbedded with Moravian Heights. Intruded by Byram granite gneiss.

W. S. Bayley, 1941, U.S. Geol. Survey Bull. 920, p. 46, 47–49, pl. 5. Pochuck gneiss as heretofore defined includes two groups of dark gneisses of different age and different origin, one group comprising sedimentary gneisses that are older than the Byram and Losee types and of pre-Franklin age, and the other comprising igneous rocks that may be differentiates of Byram and Losee magmas. In this report name Pochuck gneiss is restricted to igneous rock; the older dark- and light-colored schists and gneisses and slaty rocks of sedimentary origin are mapped and described as Pickering gneiss. Formation to which name Pochuck gabbro gneiss is herein applied is a black or dark-gray rock with chemical composition of many diorites and gabbros, but differing from them mineralogically in containing orthoclase, microcline, and oligoclase rather than the more basic plagioclases. Considered to be older than the more granitoid Byram and Losee gneisses. Where the Pochuck is associated with Losee diorite gneiss, oligoclase is principal feldspar of the Pochuck; where it is closely associated with Byram gneiss, microperthite and microcline are prominent in the black gneiss and hornblende exceeds diopside.

Named for occurrences on east slope of Pochuck Mountain, N.J.

Pochuck Mountain Gneiss Series

Precambrian: Northern New Jersey.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 468, 469, fig. 18. Sequence changes from thick series of oligoclase gneiss containing hornblende and microcline gneiss bands in Pimple Hills to interlayered hornblende gneiss, microcline gneiss, and biotite gneiss in Lake Lenape syncline, on Pochuck Mountain, and in Glenwood syncline. Thickness over 2,000 feet. Overlies Wildcat marble (new).

On Pochuck Mountain in Franklin-Sterling area.

Pocket Hollow Oolite (in Lutie Member of Theodosia Formation)

Lower Ordovician: Northern Arkansas and southern Missouri.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 31, pl. 2. Medium- to coarse-grained oolitic chert about 3 feet thick that occurs just below the top of the Lutie member. Lies stratigraphically above Hercules Tower sandstone bed (new) and separated from it by numerous beds of finely crystalline dolomite and "cotton rock".

Well exposed at the bottom of South Pocket Hollow in SE¼ sec. 29, T. 22 N., R. 14 W., Thornfield quadrangle, Ozark County. Mo.

Pocono Formation,[1] Group,[1] or Sandstone

Pocono Series

Lower Mississippian: Pennsylvania, eastern Ohio, western Maryland, Virginia, and West Virginia.

Original reference: J. P. Lesley, 1876, Pennsylvania 2d Geol. Survey Rept. L., app. E., p. 221, 222, pls.

C. A. Ashburner, 1885, Pennsylvania 2d Geol. Survey Rept. R_2, p. 104–105. Includes Benezette limestone.

M. R. Campbell, 1904, U.S. Geol. Survey Geol. Atlas, Folio 110. Includes Patton shale member (new).

Charles Butts, 1904, U.S. Geol. Survey Geol. Atlas, Folio 115. Includes Burgoon sandstone member (new).

G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179. Group includes (ascending) Rockwell formation, Purslane sandstone, Hedges shale, Myers shale, and Pinkerton sandstone.

Bradford Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 573. Formation includes Peters Mountain sandstone (new).

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 17–18, pls. Formation, in south-central Pennsylvania, consists of 1,600 feet of sandstones and pebble beds. Comprises (ascending) Second Mountain (new), Peters Mountain, and Cove Mountain (new) members. Underlies Mauch Chunk red beds; overlies Catskill red beds.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 252, 283–294. Series consists of coarse reddish-brown micaceous sandstone, commonly crossbedded and conglomeratic, with brown, bluish-gray, and occasional red or green sandy shales, together with some impure and lenticular coals. Thickness 600 feet. Includes (ascending) Berea sandstone, shale and sandstone, Broad Ford sandstone, Merrimac coal, and sandstone and shale. Underlies Maccrady series; overlies Catskill series.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 336–337. Names Pocono and Price are practically synonymous. In this report, name Pocono is applied in northern Virginia as far south as western Alleghany County, where the formation occurs on high knobs along State line. Name Price is applied throughout region from southern Alleghany and western Botetourt Counties to Tennessee.

M. N. Shaffner, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141. Group in Donegal quadrangle, includes Burgoon sandstone in upper part. Thickness not determined. Underlies Loyalhanna limestone. Base of surface section in area.

R. C. Bolger and H. V. Gouse, 1953, Pennsylvania Geol. Survey, 4th ser., Bull. M–36, p. 5–7, pl. 3. Group in Driftwood quadrangle is 396 to over 500 feet thick. Includes Patton shale member (or formation) and Burgoon sandstone member (or formation) near top. Occurs below Mauch Chunk red shale and above Oswayo formation.

T. W. Amsden, 1954, Maryland Dept. Geology, Mines and Water Resources Bull. 13, p. 23–24. Formation described in Garrett County, where it is exposed on flanks of Deer Park and Accident anticlines. Consists largely of sandstone interbedded with some siltstone and shale. Thickness about 1,080 feet. Overlies Hampshire formation, contact gradational; underlies Greenbrier formation, contact placed where noncalcareous sandstones of Pocono are overlain by calcareous shales or sandy limestones.

J. L. Dally, 1956, Dissert. Abs., v. 16, no. 12, p. 2425. Group, in West Virginia, represented by (from base upward) Marlinton formation (new), Sunbury shale, and Matoaka formation (new) in southern part of State; Manheim formation (new) and Burgoon formation in northern part; Rockwell formation, Purslane sandstone, and Hedges shale in eastern part. In southern and eastern areas, sequences are continuous and contemporaneous and range in age from early Kinderhook to late Osage, and intertongue laterally with Hampshire red beds; sequence in northern part of State is younger, ranges in age from upper part of Osage through Meramec, is vertically transitional with Hampshire red beds, and intertongues laterally with lower Greenbrier limestone in south and Myers red shale in east.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Field Trips Pittsburgh Mtg., p. 2–3. Formation rests unconformably on beds of Catskill formation in southern and western parts of anthracite region. Successively younger Catskill strata wedge in beneath Pocono in easterly and northerly directions. Contact between the two formations commonly placed at highest red bed of definite Catskill lithology. Pocono consists of 1,000 to 1,500 feet of conglomerate, sandstone, siltstone, shale, and coal beds. Sandstone and conglomerate are principal rock types. Color of beds light- to dark-gray olive, light-brown, and greenish-yellow. Formation appears to thin gradually to north and northeast in southern and western parts of anthracite region. Not certain that representatives of Burgoon and Griswold Gap conglomerates of central Pennsylvania are present in anthracite region. Unconformably overlies Mauch Chunk formation. Lower Mississippian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Group includes, in Appalachian Plateau, Burgoon, Shenango, Cussewago, Corry, and Knapp formations; includes part of "Oswayo" in Potter and Tioga Counties.

No type locality designated by Lesley. Later workers have assumed type area to be in Pocono Mountains of northeastern Pennsylvania.

Poe Evaporite Member (of Nesson Formation)

Jurassic: Subsurface in North Dakota and Montana, and Manitoba, Canada.

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 104–105, fig. 2. Basal member of Nesson formation (new). Underlies Picard shale member (new); unconformably overlies Triassic(?) Spearfish formation. In type section, consists of basal 65-foot bed of massive salt overlain by 53 feet of white to pink gypsum and anhydrite and

dark-red shale with a few thin interbeds of gray to red dense dolomite; thin bed of buff to brown very finely crystalline to earthy limestone present at top. Thins eastward from type well and appears to merge in Bowdoin dome area with younger members of formation. Unit exhibits rapid facies changes on east flank of Williston basin where member overlaps Spearfish formation and Madison limestone and rests on pre-Mississippian sediments.

Type section: Interval 6,947 to 7,065 feet in Phillips-Skelly-Gulf No. 1 Hoehn (Poe Unit) well, center NE SE sec. 13, T. 152 N., R. 102 W., McKenzie County, N. Dak.

Pogonip Group

Pogonip Formation (in Mount Hamilton Group)

Pogonip Limestone[1]

Lower and Middle Ordovician: Eastern and southern Nevada, southeastern California, and western Utah.

Original references: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, Map IV; 1878, U.S. Geol. Expl. 40th Par., v. 1, p. 187–195, 248.

C. W. Merriam and C. A. Anderson, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1682 (fig. 2), 1683–1684. Referred to as group. Pogonip limestone has been used broadly for strata in Great Basin lying between base of Eureka quartzite and top of Upper Cambrian Dunderberg shale (Eureka district). Following this interpretation, the Pogonip may embrace faunal zones ranging from Upper Cambrian to approximately Black River Middle Ordovician. In Antelope and Monitor Ranges, at least three recognizable formational units are present within vertical limits of the Pogonip. In Roberts Mountains, group is poorly represented and, even where best developed on west flank of Western Peak, shows little similarity to the thick section in Antelope and Monitor Mountains.

L. F. Hintze, 1951, Utah Geol. Soc. Guidebook 6, p. 38–42. Pogonip group geographically extended into Ibex area, Utah, where it underlies Swan Peak quartzite and overlies Upper Cambrian. Six lithologic units and 15 faunal zones recognized. Canadian and Chazyan.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 11–96. In western Utah and eastern Nevada, Pogonip group comprises (ascending) House limestone, Fillmore limestone, Wahwah limestone, Juab limestone, Kanosh shale, and Lehman formation (all new). Restricted to Ordovician; lower boundary is lithologic change below the *Symphysurina* faunal zone; in western Utah, underlying unit is Notch Peak formation; in central Utah and several Nevada localities underlying rocks are dolomitic. Two Middle Ordovician quartzites overlie group in western Utah. In this sequence, the lower (Swan Peak) quartzite, 390 feet in central Utah, thins in western Utah to disappear in eastern Nevada, grading into successively younger Pogonip zones westward; the upper (Eureka) quartzite persists to west, halfway across Nevada. Thins by convergence from about 3,000 feet at Ibex, Utah, to about 1,700 feet near Scipio.

L. F. Hintze, 1952, Utah Geol. and Mineralog. Survey Bull. 48, p. 48. Complete typical Pogonip Ordovician section has not been found in fault blocks of Ely Springs Range, Nev. In addition to hiatus of 200 to 500 feet of beds between top of Yellow Hill and bottom of Tank Hill (top of Ordovician sequence), there is also a gap, probably of 500 feet or more, at bottom of Ordovician.

R. L. Langenheim, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2087 (fig. 3), 2091. In Independence quadrangle, California, group includes Mazourka formation. Underlies Barrel Spring formation of Eureka group. Chiefly early Ordovician in age.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 23–29. In Eureka district, Nevada, group includes (ascending) Goodwin limestone, Ninemile formation (new), and Antelope Valley limestone (new). Overlies Cambrian Windfall formation (new) and underlies Eureka quartzite. As now defined, group may range in age from earliest Ordovician to Chazy or Middle Ordovician. Note on type locality.

M. S. Johnson and D. E. Hubbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 345–349, pls. 32, 33. Considered as a group, the Pogonip of Eureka area embraces several mappable formations falling between top of Cambrian system and base of Eureka quartzite. In Nevada proving grounds area [this report] latter definition is applied arbitrarily. Present study does not favor formal naming of formational divisions within group, though such procedure may eventually be called for. Hence provisional subdivision is used with nine minor units designated A through I in ascending order. Total thickness about 3,150 feet. Overlies unnamed upper Cambrian rocks; underlies Eureka quartzite.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 4 (table 1). In Inyo Mountains, Calif., group is about 1,350 feet thick; base not exposed; underlies Eureka quartzite.

Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 227. Group described in Snake Range, Nev., where it is about 3,000 feet thick; not subdivided. Conformably overlies Corset Spring shale. As used here, group includes at least 550 feet of Upper Cambrian rocks which could not be separated from lithologically similar Ordovician part.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull., v. 57, p. 16, 18 (fig. 7), 19–23, pl. 1. Formation included in Mount Hamilton group (new). Upper formation in group; overlies Goodwin formation; underlies Eureka quartzite. Comprises four members: member 1, about 400 feet thick, consists of alternating thin-bedded shale-parted limestone and massive medium-gray limestone beds from 1 to 3 feet thick; member 2, about 600 feet thick, consists of thin-bedded reddish-brown weathered limestone, commonly with thin reddish, but locally buff, shale partings; member 3, about 160 to 210 feet, fairly massive medium- to dark-gray medium-grained limestone; member 4, about 800 feet, thin-bedded limestone, most fossiliferous member of formation. Lower Ordovician. [Editor's note states that Pogonip formation of this paper equals Pogonip group of Nolan, Merriam, and Williams, (1956)].

Marshall Kay, 1960, Internat. Geol. Cong. 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Underlies Gatecliff formation (new) in Toquima Range.

Type locality: Pogonip Ridge in White Pine or Hamilton district, about 30 miles southeast of Eureka, Nev. On Pancake Summit and Green Springs 15-minute topographic quadrangle of U.S. Geological Survey, Pogonip Ridge of King's usage is shown as Mount Hamilton of the White Pine Range.

†Pogonipan series[1]

Ordovician: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53, 80.

Pohakuloa Stage and Drift

Pleistocene: Hawaii Island, Hawaii.

C. K. Wentworth and W. E. Powers, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1942; 1941, Geol. Soc. America Bull., v. 52, no 8, p. 1207–1210. Four stages of glaciation, presumably correlative with Ice Age elsewhere, occurred on Mauna Kea. These are (beginning with latest) Makanaka, Waihu, Pohakuloa, and pre-Pohakula stages. Till 50 to 90 feet thick.

H. T. Stearns, 1945, Geol. Soc. America Bull., v. 56, no. 3, p. 269. Of glacial deposits described by Wentworth and Powers, only Makanaka deposits can be accepted as definitely glacial. Pohakuloa drift believed to be volcanic explosion deposits.

Drift occurs on walls of Pohakuloa Gulch between 8,750 and 9,500 feet.

Pohono Granodiorite[1]

Probably Cretaceous: East central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 123.

Named for occurrence near Pohono Trail.

Poinsettan series[1]

Tertiary, upper: Illinois and Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Point Arena Beds or Formation

Miocene, upper: Northern California.

C. E. Weaver, 1943, California Div. Mines Bull. 118, p. 630–632; 1944, Washington [State] Univ. Pubs. in Geology, v. 6, no. 1, p. 4, 19, 21–22, pl. 2. Alternating units of interstratified grayish-brown clay shales, foraminiferal shales, diatomaceous shales, cherty shales strongly contorted, and units of thinly laminated sandstones and cherty shales and clay shales; occasional layers of sandstone 50 feet thick. Thickness 3,355 feet. Underlies terrace deposits; overlies Gallaway beds (new).

Exposed in sea cliffs almost continuously from Abalone Cove northward to Point Arena Lighthouse, a distance of about 30,000 feet. Point Arena-Fort Ross area, Mendocino County.

Point au Gres Limestone

Point aux Gres Limestone[1]

Mississippian: Eastern Michigan.

Original reference: C. C. Douglass, 1839(?), Michigan Leg. House Doc. 27, between p. 97 and 111.

G. H. Pringle, 1937, Michigan Dept. Conserv., Geol. Survey Div. Prog. Rept. 3, p. 14. At Point au Gres, 6 feet of Bayport limestone occur along lakeshore on west side of the point. This is limestone named Pointe aux Gres by Douglass.

G. M. Ehlers and W. E. Humphrey, 1944, Michigan Univ. Contr. Mus. Paleontology, v. 6, no. 6, p. 114–117. Description of fauna from Point au

Gres limestone at Grand Rapids. Thickness in Grand Rapids area 50 to 70 feet. History of nomenclature reviewed and reference made to work of Lane (1893, 1895, 1899, 1900, 1909). Concluded that Point au Gres instead of "Grand Rapids" or "Bayport" should be used. Usage is based on definition by Douglass (1841 [1849]). Continued reference to limestone as "Bayport" would be unfortunate since this name and also "Grand Rapids" were used only in casual manner by Lane.

Typically exposed at Point au Gres on western side of Saginaw Bay, Lake Huron.

Point aux Barques Lighthouse[1] (Sandstone)

Mississippian: Michigan.

Original reference: A. C. Lane, 1899, U.S. Geol. Survey Water-Supply Paper 30, p. 85.

In Huron County.

Point aux Barques Sandstone[1]

Mississippian: Michigan.

Original reference: A. Winchell, 1871, Am. Philos. Soc. Proc., v. 11, p. 60–66.

Saginaw Bay region.

Pointe aux Chenes Formation or Shale (in Salina Group)

Upper Silurian (Cayugan): Northern Michigan.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv. Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 26, 27, 33, 35–52 Proposed for strata which in recent reports have been designated by group term Salina. Consists of green and red shale with thin beds of dolomite of varied lithologic character and small irregular masses and thin beds of gypsum. Thickness varies from 8 to as much as 35 feet in outcrop sections; well records show between 500 and 600 feet on St. Ignace Peninsula. Occupies position between Middle Silurian Engadine dolomite and Upper Silurian St. Ignace formation (new). Further study may show that Salina group of Mackinac Straits area contains several formations and that the Pointe aux Chenes is its uppermost division. Pointe aux Chenes formation includes strata referred to Onondaga salt group by Hall (1851, Geological Reports pub. *in* pt. V. *of* Foster and Whitney report on Geology of Lake Superior Land District, U.S. Senate, Spec. Sess., March, 1851, Ex. Doc. no. 4) and Rominger (1873, Geology of the Upper Peninsula: Michigan Geol. Survey, v 1, pt. 3).

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 23–24. Most of strata are shales; hence, unit termed Pointe aux Chenes shale.

Named for exposures in area near Pointe aux Chenes, a headland on Lake Michigan about 9 miles northwest of city of St. Ignace.

Point Farfan diorite.

Miocene: Panamá.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 26. Grades regularly from coarse texture to fine grained and andesitic. Probably a small neck or intrusive plug. Pre-Pliocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 343–344. Augite-quartz diorite and presumably intrudes Panamá formation. Miocene.

Quarried at Point Farfan, near southern terminus of Thatcher Ferry, Point Farfan in on west side of Pacific entrance to Panamá Canal.

Point Hey Member (of Katalla Formation)

Point Hey Sandstone Member (of Redwood Formation)[1]

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 773.

D. J. Miller, D. L. Rossman, and C. A. Hickcox, 1945, Preliminary report on petroleum possibilities in the Katalla area, Alaska: U.S. Geol. Survey, p. 7 (table), 12–13; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Member of Katalla formation. East of long 144°19′ W. member consists of at least several hundred feet of gray to nearly black partly sandy shale and fine- to medium-grained gray sandstone. Sandstone beds range in thickness from 1 to 100 feet. Near long 144°19′ W., member is about 850 feet thick. West of long 144°19′ W., member includes a lower division mostly of shale which thickens westward to more than 2,000 feet and an upper division of thick sandstone beds and thin shale beds. Lies conformably between unnamed organic shale member below and Puffy member above. In unpublished manuscript by oil-company geologists, Point Hey shale and Point Hey sandstone are treated as two distinct units in Redwood formation.

Named for excellent outcrops in vicinity of Point Hey, Katalla district, Controller Bay region.

Point Lookout Granite[1]

Precambrian(?): Southwestern Virginia.

Original reference: A. I. Jonas, 1935, Geol. Soc. America Bull., v. 46, p. 49.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties Rept., p. 17. Described as biotite quartz monzonite. Intrudes a biotite gneiss injection complex, the oldest rock of which is the newly named Saddle gneiss. Cut by pink pegmatite.

Named from occurrence in Point Lookout Mountain, Grayson County.

Point Lookout Sandstone (in Mesaverde Group)[1]

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

Original reference: A. J. Collier, 1919, U.S. Geol. Survey Bull. 691–K.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 90, 94, pl. 1. Described in Fort Defiance-Tohatchi quadrangle where it overlies Crevasse Canyon formation (new) and underlies Menefee formation. Made up of one thin and two thick units, totaling 320 feet. Northward, the thick units are separated by tongue of finer-grained material (Satan tongue of Mancos shale) so that combined thickness is about 400 feet; south of Crevasse Canyon, within 1 mile they thin abruptly and completely disappear within 2 miles. Lower cliff-making unit is here called Hosta sandstone tongue.

P. T. Hayes and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144. Described in Barker dome-Fruitland area, San Juan County, N. Mex., where it includes North Hogback tongue (new). Intertonguing relationships with Menefee discussed.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156. Discussion of revised nomenclature of Mesaverde in San Juan basin, and term Point Lookout sandstone is extended throughout area. Point Lookout as a formation replaces Hosta sandstone member where that member is undivided and also replaces upper part of Hosta sandstone member where its lower part is absent or is separated from its upper part by tongue of Mancos. Hosta tongue of Point Lookout sandstone replaces lower part of Hosta sandstone member where that is present.

Well exposed in cliffs at Point Lookout, about 7½ miles southwest of Mancos, Montezuma County, Colo.

†Point of Rocks Group[1]

Upper Cretaceous (Montana): Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 47, 155.

Point of Rocks Station, Sweetwater County, Wyo.

Point of Rocks Sandstone

Point of Rocks Sandstone Member (of Tejon Formation)

Eocene, upper: Southern California.

R. D. Reed and J. S. Hollister, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 12, p. 1566 (fig. 9). Named on columnar section of upper Eocene strata in Devils Den area. Underlies Kreyenhagen and overlies "Tejon" shale.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496, 497 (fig. 211). Described as tawny massive cavernous crossbedded medium to coarse quartzose sandstone; contains large chocolate-brown concretions in lower part; includes two thin silty claystone beds. Thickness 3,005 feet. Underlies Welcome formation; overlies Gredal formation (new).

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 7, pl. 1. Described in Bitterwater Creek area, Kern County, as coarse- to medium-grained sandstone characterized by red-brown "cannonball" concretions of calcarinate sandstone up to 4 or 5 feet in diameter. Maximum thickness 600 feet; southeastward along strike there is a gradual decrease in apparent thickness due to progressive overlap by younger Santos shale member of Monterey formation and at one locality Twisselmann sandstone member (new) of the Monterey. In Antelope Valley, sandstone wedges out or is truncated by either the McDonald shale or Tulare sediments.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 10, 11, 19, 70, 101, 282. Report makes several references to Point of Rocks sandstone member of Tejon formation. At Media Agua Creek, bulk of Point of Rocks member was deposited during early Narizian, *Uvigerina churchi* time.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook Field Trip, May 9, p. 13, 14. Chart and columnar section of Chico-Martinez Creek area show Point of Rocks sandstone and shale member of Tejon formation unconformable below Salt Creek shale member of Tejon formation.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 28. Conspicuous craggy sandstone at Red Man Rocks, Orchard Peak area, has been mapped as Eocene, usually as Point of Rocks whose type locality lies 4 miles southeast of Devils Den. Craggy sandstone in northeast corner of area has been regarded as Cretaceous. In present report, both exposures are mapped as Upper Cretaceous Red Man sandstone (new).

Type locality: T. 26 S., R. 18 E., Devils Den district, Kern County.

Point Peak Shale Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

Frederick Romberg and V. E. Barnes, 1944, Geophysics, v. 9, no. 1, p. 88, fig. 7 (geol. map). Greenish shale underlying San Saba limestone member and overlying Morgan Creek limestone member (new). Name credited to Josiah Bridge and V. E. Barnes.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America v. 58, no. 1, p. 115–116, pls. 1, 2. Consists of well-bedded soft greenish calcareous shales with subordinate amounts of fine-grained compact dolomite; medium- to fine-grained glauconitic limestone; intraformational conglomerates; and near top, occasional beds of oolitic limestone and commonly extensive to scattered stromatolitic bioherms that locally coalesce to form biostromes. Average thickness 160 feet; at type section 270 feet; thins to 25 feet along Pedernales River in Blanco County. At type locality, underlies San Saba limestone member and overlies full but thin section of Morgan Creek limestone member. Locally in contact with Pedernales dolomite member. Top of the Point Peak drops abruptly southward in Sudduth area of Burnet County; bottom boundary likewise is not at a constant stratigraphic horizon, it ranges from 90 feet above base of formation on Point Peak to about 170 feet in Salt Branch section; difference in position of boundary probably due chiefly to facies change from shale to limestone.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 155, 188, 225, 254, 310 [1946]. Local stratigraphy described.

Type section: On south slope of Point Peak, an isolated hill about 4 miles northeast of Lone Grove, Llano County.

Point Pleasant Formation

Point Pleasant Limestone[1]

Middle Ordovician: Southwestern Ohio and northern Kentucky.

Original reference: J. S. Newberry, 1873, Ohio Geol. Survey, v. 1, p. 89 (table), 119–121.

M. P. Weiss and C. E. Norman, 1960, Ohio Geol. Survey Inf. Circ. 26, pl. 1. Chart shows development of stratigraphic classification of Ordovician rocks in Cincinnati region. Point Pleasant (Cynthiana) formation is below the Eden which is basal formation of Covington group, Cincinnatian series.

Named for exposures at Point Pleasant, Clermont County, Ohio.

Point Reyes Granodiorite

[Cretaceous]: Northern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Discussed in report dealing with potassium-argon determinations. Age given as 83.9 million years.

Crops out in vicinity of Point Reyes lighthouse and along northern shores of Point Reyes Peninsula toward Tomales Point at head of Tomales Bay. Dated specimen collected from quarry near old Government Landings.

Point Rock Shale Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart above Morgan Creek limestone member and below San Saba limestone and Pedernales dolomite members. [This may be lapsus for Point Peak shale member of Wilberns formation (Romberg and Barnes, 1944).]

Central mineral region.

Point Sal Formation

Miocene, lower and middle: Southern California.

C. R. Canfield, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, 66 (footnote). Name provisionally proposed for the Siltstone and Shell zone in Monterey formation.

W. P. Woodring, M. W. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1341 (table 1), 1344–1345; W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 11 (chart), 16–17, pls. 1, 3. Consists chiefly of dark-gray brown-weathering mudstone and siltstone. Includes thin beds of sandstone, limestone concretions, and diabase sills. Thickness ranges from 150 to 1,500 feet, thickest section being on south slope of Mount Lospe. In Point Sal area, appears to overlap the Lospe and to rest on Knoxville or Franciscan. On Mount Lospe, conformably overlies Lospe formation. Underlies Monterey formation. Type locality redesignated.

Type locality: As redesignated, on south slope of Mount Lospe, Santa Maria district. As designated by Canfield, on Point Sal Grade, approximately one-half mile east of old Point Sal Landing (Guadalupe quadrangle).

Poison Canyon Formation[1]

Paleocene: Southeastern Colorado.

Original reference: R. C. Hills, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 148–164.

G. H. Wood and others, 1951, U.S. Geol. Survey Coal Inv. Map C–4 Described in Stonewall-Tercio area, Las Animas County, where several hundred feet of basal part of formation are exposed. Intertongues with underlying Raton formation. Paleocene.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Exposed over much of La Veta area where it is composed of approximately 2,500 feet of alternating beds of buff to red massive arkosic sandstone and conglomerate and thin beds of yellow shale. Overlies Vermejo formation (Raton formation not present in this area). Underlies Cuchara formation.

Well exposed in beds extending down Poison Canyon, west of Gardner, and across Muddy Creek to Promontory Bluffs, Huerfano County.

Poison Canyon Sandstone (in Westwater Canyon Sandstone Member of Morrison Formation)

Jurassic: Northwestern New Mexico.

R. T. Zitting and others, 1957, The Mines Magazine, v. 47, no. 3, p. 55, 57; L. S. Hilbert and A. F. Corey, 1957, U.S. Geol. Survey Trace Ele-

ments Inv. Rept. TEI–690, book 2, p. 370 (fig. 86), 371. Upper Westwater sandstone lens which intertongues with overlying Brushy Basin shale member of Morrison formation. Generally separated from main body of Westwater by a shale. Practically absent in parts of area and up to 100 feet thick in other places. Base of Poison Canyon consistently 160 feet below base of Dakota formation.

In Ambrosia Lake area, McKinley County.

†Poison Canyon Series[1]

Eocene: Southeastern Colorado.

Original reference: R. C. Hills, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 148–164.

In Huerfano Basin, Huerfano County.

Poison Creek Formation[1] (in Idaho Group)

Pliocene: Southwestern Idaho.

Original reference: J. P. Buwalda, 1923, Idaho Bur. Mines and Geology Pamph. 5, p. 3.

U.S. Geological Survey currently classifies the Poison Creek as a formation in Idaho Group on basis of a study now in progress.

Type locality: At north end of Silver City Range at Poison Creek grade, Snake River valley.

Pokeberry cyclothem (in Carbondale Group)

Pennsylvanian: Western Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82 (fig. 22), 60, 113, 189, 190. Thickness 11 to 17 feet. Includes Pokeberry limestone. In sequence, occurs above Brereton cyclothem and below Sparland cyclothem. May be equivalent to Jamestown cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 56 (table 3). Replaced by Jamestown cyclothem.

Named from outcrops about 1 mile east of Pokeberry school in sec. 26, T. 2 N., R. 1 W., Beardstown quadrangle, Schuyler County.

Pokeberry Limestone Member (of Carbondale Formation)

Pokeberry Limestone (in McLeansboro Formation)

Pennsylvanian: Western Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 17, 98. Marine limestone in lower McLeansboro, between Danville (No. 7) coal above and Brereton limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11. Included in Jamestown cyclothem. Type locality designated.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 113. Blue-gray to greenish-gray limestone commonly 1½ to 2 feet thick. Columnar section shows Pokeberry limestone stratigraphically below Copperas Creek sandstone and above Sheffield shale. Included in Pokeberry cyclothem (new), Carbondale group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 48 (table), pl. 1. Rank reduced to member status in Carbondale formation (redefined). Occurs above Lawson shale member (new) and below

Copperas Creek sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NW¼ sec. 26, T. 2 N., R. 1 W., Schuyler County.

Pokegama Quartzite[1] (in Animikie Group)

Precambrian: Northeastern Minnesota.

Original reference: H. V. Winchell, 1893, Minnesota Geol. Survey 20th Ann. Rept., p. 123.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1042–1044. Base of Animikie group; lies on truncated pre-Animikie rocks—Archean greenstone, pre-Knife Lake granite, Knife Lake group, and Giants Range granite; overlain conformably, or nearly so, by Biwabik iron-bearing formation. Quartzite changes across strike from conglomerate at base through thin-bedded micaceous quartzite to very massive coarse-grained quartzite at top; succession fairly persistent where quartzite is thick; strike parallels Mesabi Range. Total thickness not more than 200 feet; commonly not over 75 feet.

Named for outcrops at Pokegama Falls on Mississippi River north of Grand Rapids, Itasca County.

Poland Limestone Member (of Denmark Formation)

Middle Ordovician (Mohawkian): East-central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599, 600–601, 603, 605; 1953, New York State Mus. Bull. 347, p. 45, 53–55. Name proposed for middle member of formation. Consists principally of dense fossiliferous limestone with intercalated calcareous shale southeastward to Newport, passing wholly into sparsely fossiliferous argillaceous calcilutite and shale of the "Dolgeville" facies at East Canada Creek, and ultimately into black shale at Canajoharie. Includes black dense resistant limestone at its base; not exposed at Trenton Falls. In various section contains a metabentonite near the base, two higher in unit, and a fourth at contact with overlying Russia limestone member (new). Contrasts with underlying Rathbun limestone member (newly defined) by lack of coquinal beds. Thickness about 60 feet.

Type section: At Trenton Falls on West Canada Creek near Oneida-Herkimer County line. Named for Poland, Herkimer County, southeast of Trenton Falls.

Pole Canyon Limestone

Middle Cambrian: East-central Nevada.

Harald Drewes and A. R. Palmer, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 1, p. 106 (fig. 2), 109 (fig. 4), 110–113, 118–119; Harald Drewes, 1958, Geol. Soc. America Bull., v. 69, no. 2, p. 224 (fig. 2), 225–226, pl. 1. Gray and white limestone, commonly massive. Total thickness about 2,000 feet. On west side of Snake Range, five alternating gray and white members are recognized (ascending): A, 415 feet thick; B, 630 feet; C, 160 to 320 feet; D, 220 to 380 feet; E, 340 feet. Conformably overlies Pioche shale; underlies Lincoln Peak formation (new). No complete type section available.

Named for Pole Canyon on west side of Mount Washington, on which most of formation is well exposed. Forms cliffs extending in broad, continuous

outcrop band from Minerva district on west flank of Snake Range to Mount Washington and eastward into Big Wash drainage.

Pole Canyon Member (of Oquirrh Formation)

Pennsylvanian (Virgilian) : Northwestern Utah.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 121–126, pls. 1, 2. Interbedded and intercalated orthoquartzites, calcareous orthoquartzites, calcareous sandstones, crystalline limestones, cherty fossiliferous-fragmental limestones, and argillaceous to silty limestones, some of which contain chert nodules. Thickness 1,526 feet. Overlies Lewiston Peak member (new) ; underlies strata referred to as Wolfcampian(?).

Type locality: On east-trending spur in west side of Pole Canyon in secs. 2 and 11, T. 6 S., R. 3 W., Utah County. This is on west limb of Pole Canyon syncline (east limb of Ophir anticline).

Polecat Bench Formation

Paleocene: Northwestern Wyoming.

G. L. Jepsen, 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 231–238. Proposed to replace name Fort Union for sediments in vicinity of Polecat Bench. Thickness about 3,500 feet. Bounded below by *Triceratops*-bearing (Lance?) beds and above by *Homogalax*-bearing (Gray Bull) beds. Composed of rocks, at Polecat Bench, mapped and described as Lebo and Tongue River by Stow (1938, Geol. Soc. America Bull., v. 49, no. 5, p. 731–762) and as Paleocene and Fort Union by Jepsen (1930, Am. Philos. Soc. Proc., v. 69, no. 7). Includes (ascending) Mantua lentil, Rock Bench quarry beds, Silver Coulee beds, and Clark Fork beds.

F. B. Van Houten, 1944, Geol. Soc. America Bull., v. 55, no. 2, p. 178. Underlies Willwood formation (new) ; in middle of Big Horn Basin, contacts are conformable; near basin's margin Willwood dips basinward and is locally nonconformable or overlaps Polecat Bench.

Well exposed at Polecat Bench, in Bighorn near Powell, Park County.

Pole Creek Dacite

Pliocene(?) : Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–690, book 2, p. 304, 306–307. Medium-gray to black vitrophyre in form of small domical protrusions. Maximum thickness as much as 900 feet and maximum exposed length about 1½ miles; parts of masses concealed by gravels. Older than Gods Pocket dacite (new) ; younger than Robinson Creek vitrophyre.

Near eastern border of Jarbidge quadrangle.

Poleo Sandstone Lentil (in Chinle Formation)

Poleo Sandstone[1]

Upper Triassic: Central northern New Mexico.

Original reference: F. V. Huene, 1911, Neues Jahrb., Beilage-Bd. 32, p. 730–739, pl. 32.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Rank reduced to lentil in lower part of Chinle; overlies Salitral shale tongue (new). Prior to this survey, unit had been mapped

as Senorito sandstone lentil of Chinle(?) in vicinity of Senorito Canyon and as Poleo sandstone in Mesa Poleo region.

Forms crest of Mesa Poleo.

Poleslide Member (of Brule Formation)

Oligocene: Southwestern South Dakota.

J. D. Bump, 1956, Am. Jour. Sci., v. 254, no. 7, p. 431–432. Unit formerly known as *Proteceras* beds (*Leptauchenia* beds) here designated Poleslide member. Subdivided into three units: lower zone includes approximately 100 feet of rather barren clays capped with light-gray clay band; middle zone, about 110 feet thick, is buff and gray clays where *Leptauchenia* nodules are developed and channel sandstones occur; upper unit, about 85 feet thick, is vertically weathered gray silty ash. Overlies Scenic member (new); underlies Arikaree white ash.

Standard section: NW¼ sec. 23, T. 43 N., R. 44 W., 8½ miles south of Scenic, and on south rim of Sheep Mountain Table, Shannon County.

†Polk Bayou Limestone[1]

Middle and Upper Ordovician: Northern Arkansas.

Original reference: H. S. Williams, 1899, Am. Jour. Sci., 4th, v. 8, p. 139–152.

Named for Polk Bayou, near Batesville, Independence County.

†Polk County Ash Bed (in Stanley Shale)[1]

Pennsylvanian: Southwestern Arkansas.

Original reference: J. F. Williams, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 375–376.

Named for exposures in Polk County.

Polk Creek Shale[1]

Upper Ordovician: Southwestern Arkansas and southeastern Oklahoma.

Original references: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557; 1909, Slates of Arkansas, Arkansas Geol. Survey, p. 30, 36.

B. H. Harlton, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 4, p. 781 (fig. 2), 787. Described in Ouachita Mountains of southeastern Oklahoma where it is well developed at Black Knob Ridge and in the Potato Hills. In most exposures, shale is somewhat altered, hard, siliceous, and darker than the normal Sylvan; lower part is dark gray to black, dolomitic, and resembles "Normal Sylvan" of the Arbuckles; it includes the black bituminous type at its base, everywhre along south front of mountains east of Ardmore on Highway 77 and at Apache; the remainder, approximately 60 feet, consists of rather soft dark-greenish to greenish-gray platy shale, which is indistinguishable from the Sylvan of the Arbuckles. Unconformably overlies Big Fork chert; unconformably underlies Missouri Mountain shale. Silurian.

Named for Polk Creek, Montgomery County, Ark.

Pollack Quartz Latite

Tertiary, upper: Southwestern New Mexico.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 47, pl. 1. Quartz latite ranges in color from a dominant pinkish brown to light red and purple. Attains maximum thickness of about 300 feet. Disconformable contacts with overlying Razorback formation and underlying Mimbres Peak formation. Late Tertiary.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 37. Described as purplish-gray rhyolite in Dwyer quadrangle. Underlies Santa Fe fanglomerates. Tertiary(?).

Type area: Along Taylor Creek which branches off to north of Pollack Creek. Named for exposures on Pollack Creek, Lake Valley quadrangle.

Pololu Volcanic Series

Pliocene(?): Hawaii Island, Hawaii.

H. T. Stearns, and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 171, 176, 197; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 127. Predominantly olivine basalt with minor amounts of picrite-basalt and a few intercalated vitric tuff beds. At type section, consists of 450 feet of thin-bedded highly vesicular aa and pahoehoe primitive-type basalts dipping about 5° NE.; they extend an unknown distance below sea level; section is capped by flow of andesite of Hawi volcanic series (new). Maximum exposed thickness about 3,500 feet; 891 feet on southeast wall of Waipio Valley. Separated from overlying Hawi volcanic series by erosional unconformity.

Type section: Exposures on trail down northwestern wall of Poholu Valley. Composes lower slopes of much of Kohala Mountains at north end of island.

Polonio Sandstone Tongue (in McLure Shale)

Miocene, upper: Southern California.

O. T. Marsh, 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 32–33, pls. 1–2. Comprises alternating beds of siliceous quartz sandstone and interbeds of siliceous shale in approximately equal amounts. The massive sandstones crop out at prominent ledges and range in thickness from 1 foot to 36 feet; 10-foot-thick beds are common. Beds much broken by vertical closely spaced joints. Characteristic feature is intricate criss-crossing of thin siliceous veinlets which weather into sharp relief as ledges. Approximately every 20 feet along bedding are light-gray-brown lenticular concretions up to 3 by 5 feet which weather to brown.

Named for Polonio Pass at head of Antelope Valley [Kern County]. Tongue enters Orchard Peak area from northwest, thins southeastward and pinches out northwest of Hughes Ranch, near head of valley.

Pomeroy Member (of Naknek Formation)

Upper Jurassic: Central southern Alaska.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Comprises two facies. Sandstone facies approximately 400 feet thick on Oil Bay and 1,300 feet on south shore of Chinitna Bay. Sandstone beds on Oil Bay averaging 10 feet in thickness are interbedded with arenaceous siltstone beds averaging 1 foot in thickness. Sandstone is gray coarse grained arkosic grit. Conglomerate facies approximately 500 feet thick on east shore of Iniskin Bay. Lithology of conglomerate similar to that of conglomerate facies of Chisik member. Total thickness of member ranges from 600 to 1,300 feet. Conformable contacts with unnamed underlying siltstone member and overlying upper sandstone member.

Conglomerate facies forms northwest-facing cliff and hogback ridge extending from Iniskin Bay to Mount Pomeroy and eastward; on Iniskin Peninsula.

Pomeroy Quartz Monzonite[1]

Tertiary(?): Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 79.

J. W. Adams, 1953, U.S. Geol. Survey Bull. 982–D, p. 98, 103–104. Probably of Tertiary age.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 23. Name changed to Mount Pomeroy quartz monzonite because name Pomeroy was preempted.

Named for Pomeroy Mountain, Monarch district, Garfield quadrangle, Chaffee County.

Pomeroy Sandstone (in Monongahela Formation)[1]

Pomeroy sandstone member

Pennsylvanian (Monongahela Series): Southeastern Ohio and West Virginia.

Original reference: E. Lovejoy, 1888, Ohio Geol. Survey, v. 6, p. 630, 631, 635.

A. T. Cross and M. P. Schemel, 1956, West Virginia Geol. Survey, v. 22, pt. 1, p. 76 (figs. 1–70). Geologic section shows Pomeroy sandstone present in Guyandot quadrangle, Wayne County, W. Va. Thickness about 8 feet. Occurs above Redstone (Pomeroy) coal zone.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 71, geol. map. Pomeroy sandstone member (Monongahela series) underlies Fishpot limestone and shale member and overlies Redstone-Pomeroy (No. 8–A) coal. In early reports, Pomeroy coal was considered correlative of Pittsburgh (No. 8) coal, and term Pomeroy was applied to the overlying sandstone, which is the Upper Pittsburgh sandstone. With the recognition of the equivalency of the Pomeroy coal and the Redstone (No. 8–A) coal, term Pomeroy was applied in its present meaning. Ohio Geological Survey no longer considers the Fishpot sandstone correlative with the Pomeroy and has abandoned term Fishpot sandstone. In Morgan County, the Pomeroy member is a well-developed sandstone unit in many areas and a sequence of sandstones and shales in other areas. The massive phase locally extends upward to coalesce with the stratigraphically higher Lower Sewickley sandstone in areas where the Fishpot limestone, clay, and coal members are not present. The Pomeroy coalesces with the Upper Pittsburgh sandstone where Redstone coal and limestone members are absent. Where underlying Redstone (No. 8–A) coal and overlying Fishpot limestone members are present, the Pomeroy sandstone interval is 11 to 30 feet thick and averages 18 feet.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 170. Member of Fishpot cyclothem in report on Athens County. Term Pomeroy sandstone first used by Lovejoy (1888) for sandstone overlying Pomeroy or Redstone coal bed near Pomeroy, Ohio. Since that date, other names applied to this member include Redstone sandstone (Swartz and others, 1919) and Cedarville sandstone (Reger, 1916). Name Pomeroy has priority and is retained in this report. Thickness 0 to 30 feet; average thickness 12 feet. Underlies Fishpot redbed member; overlies roof shale at top of Redstone cyclothem. Monongahela series.

Named for Pomeroy, Meigs County, Ohio.

Pomfret Granite[1]

Devonian: Southeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for Pomfret Township, Windsor County.

Pomfret Phyllite[1]

Pomfret phyllite phase (of Hebron Gneiss)

Pre-Triassic: Northeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 129.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey [Bull. 84]. Refers to Pomfret (Worcester) phyllite phase of the Hebron gneiss. Occurs at the eastern margin of the Hebron outcrop area. Pre-Triassic.

Typically developed in northeastern part of Pomfret [Township], Windham County.

Pompey Member (of Skaneateles Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 219, 220.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Overlies Delphi Station member (name replaces Delphi of Cooper, 1930); underlies Butternut shale member (name replaces Berwyn member of Cooper, 1930). Middle Devonian.

Type section: Upper 60 feet of section at top of Pratt Falls. Name is probably from village of Pompey, Onondaga County.

Pomponio Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Consists of about 2,300 feet of rhythmically interbedded siliceous mudstones and siltstones with a sandstone, siltstone, and mudstone facies locally developed. Overlies Tahana member (new); underlies San Gregorio member (new).

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Ponca sandstone[1]

Upper Cretaceous: Northeastern Nebraska and northwestern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148, 150.

Named for Ponca, Dixon County, Nebr.

Ponce Limestone

Ponce Chalky Limestones[1]

Oligocene, upper, and Miocene, lower: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 10, 17.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85, 2 sheets. Ponce limestone, in this report, comprises entire sequence of limestones overlying Juana Díaz formation; as mapped, is divided into a lower buff chalky limestone member and an

upper hard white limestone member. Maximum thickness about 1,300 meters—between river valleys south of Peñuelas and west and southwest of Ponce. Uncomformable below undifferentiated Quaternary deposits.

R. C. Mitchell-Thome, 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 138. Includes Mercedita lentil (new) in lower part.

On south coastal plain, main outcrop of formation extends 55 kilometers, from hills 5 kilometers southeast of Juana Díaz to Ponce and westward from there to Bahia Montalva.

Poncho Rico Formation[1]

Miocene(?) and Pliocene: Southern California.

Original reference: R. D. Reed, 1925, Jour. Geology, v. 33, p. 591, 592, 605–607.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1956–1957. Underlies King City formation (new).

J. E. Kilkenny, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 12, p. 2260–2261. Described in Salinas Valley where it consists of sands, silts, shales, and conglomerates, and contains Pliocene megafossil assemblage. Both conformable and unconformable on underlying Santa Margarita sand on Central fault block where it is generally less than 500 feet thick. Reaches maximum thickness of 900 feet in Cholame Hills where unconformable with underlying McLure shale. Unconformably underlies Paso Robles formation. Term Poncho Rico preferred here to Etchegoin because type section of former is in Salinas Valley, and type section of latter is in San Joaquin Valley. King City formation is limited in extent and for convenience is included in uppermost part of Santa Margarita formation.

Probably named for exposures along or near Poncho Rico Creek, Monterey County. [Now spelled on topographic map as Pancho Rico.]

Pond Limestone[1]

Mississippian (Chester): Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

Tishomingo County.

Pond Creek Coal Member (of Modesto Formation)

Pennsylvanian: Southeastern Illinois (subsurface).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), pl. 1. Proposed for coal member reported at depth of 125 feet in drill hole. Occurs above DeGraff coal member (new) and below Lake Creek coal member (new). Coal has been referred to informally as 2d Cutler Rider coal. Piasa limestone and DeGraff, Pond Creek, and Lake Creek coals may be included in the complex West Franklin limestone member in eastern part of area. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Consolidated Coal Co. drill hole 91 in SW¼NE¼NE¼ sec. 21, T. 8 S., R. 3 E., Williamson County. Name derived from Creek that flows through northern part of township.

Pondera Till

Pleistocene: Central northern Montana.

J. F. Smith, Jr., I. J. Witkind, and D. E. Trimble, 1959, U.S. Geol. Survey Bull. 1071–I, p. 142, 153, pl. 10. Till is light brown but weathers chocolate

brown to contrast markedly with light buff of underlying Lothair till (new) or the yellow of the intertill silt. Semiplastic and consists of clay that contains small amounts of unsorted pebbles, cobbles, and boulders of quartzite, limestone, dolomite, granite, and foliated metamorphic rocks. Rocks are rounded and average about half an inch in diameter. Thickness in most places about 30 feet; in a few exposures as much as 60 feet.

Named for exposures along north valley wall of Pondera Coulee in T. 29 N., Rs. 4 and 5 E., Liberty County. Best exposed on both sides of Marias River valley, in secs. 2, 10, and 11, T. 29 N., R. 5 E., and along north valley wall of Pondera Coulee in T. 29 N., Rs. 4 and 5 E.

Pond Hill Granite[1]

Upper Devonian or Upper Carboniferous: West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire: Concord, New Hampshire State Plan. Devel. Comm., p. 28, map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 510, pl. 12. Discussed under New Hampshire magma series. Medium-fine gray granite. On map legend, Pond Hill granite is above Sugar Hill quartz monzonite and below Moody Ledge granite. However, relative ages of units of series have not been determined with complete satisfaction for in few places are they in contact.

Mapped on Pond Hill in northern part of Moosilauke quadrangle.

Pondville Conglomerate[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134–141.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Interfingers with Wamsutta formation in southern part of quadrangle; partly older than "red beds" of Wamsutta and partly equivalent to them. Pennsylvanian.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Basal beds are chiefly white to buff coarse conglomerate with pebbles and boulders mostly of quartzite. These are interbedded with layers of gray to dark-gray sandstone. Bedding variable; crossbedded in part. Thickness generally 100 to 160 feet in Natick area. Underlies Rhode Island formation with gradational contact. Not recognized south of Greenwich Bay, R. I., where unit as mapped by Emerson (1917) is assigned to the Rhode Island formation.

Basal beds well exposed near Pondville Station on Walpole and Wrentham Railroad, Norfolk County, Mass.

Ponia (Poniya) Limestone

Pleistocene: Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 345, 346 (correlation table) [English translation in library of U.S. Geol. Survey, p. 2, correlation table.] Poniya limestone shown on correlation chart below Mariana limestone and above Hirippo limestone. Pliocene(?).

S. Hanzawa, 1956, *in* Jacques Avias and others, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 53. Limestone complex. Forms foundations of

successive terraces; consists of Foraminifera, calcareous algae, and fragmental reef-building corals; commonly thinly stratified. Dips toward sea at angle of 20°. Present in altitude less than 200 meters while Mariana limestone is found even in highest terrace of island, 470 meters in height. Sometimes unconformably overlain by Mariana limestone. In this case, it may be contemporaneous with one of Mariana limestone of higher terraces. Also considered forereef detrital facies of Mariana.

Type locality: Ponia, south coast of Rota Island.

Pontchartrain Clay[1]

Pleistocene: Southeastern Louisiana and southwestern Mississippi.

Original reference: L. C. Johnson, 1891, Geol. Soc. America Bull., v. 2, p. 24–25.

In region north of Lake Pontchartrain, La.

Pontiac Limestone (in McLeansboro Formation)[1]

Pontiac Limestone (in McLeansboro Group)

Pennsylvanian: Central eastern Illinois.

Original reference: J. E. Lamar, 1929, Illinois Geol. Survey Rept. Inv. 17, passim.

M. E. Ostrom, 1957, Illinois Geol. Survey Circ. 243, p. 4 (fig. 2), 7. Rank raised to formation in McLeansboro group. Lies approximately 150 to 200 feet above Lonsdale limestone and 250 to 300 feet below Millersville, LaSalle, and Livingston limestones.

Crops out southeast, northeast, and northwest of Pontiac, Livingston County.

Pontotoc Group[1]

Pennsylvanian and Permian: Central southern Oklahoma.

Original reference: G. D. Morgan, 1922, Oklahoma Geol. Survey Circ. 11.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Upper part of group mapped. Hart limestone member of Stratford formation of Pontotoc group at base in Pontotoc, Garvin, and Murray Counties. Permian.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, pl. 1. In Seminole County, comprises Vanoss formation below and Konawa formation above. Overlies Ada formation. Pennsylvanian (Virgil) and Permian.

Named for development in western part of Pontotoc County.

Pony Group, Metamorphics or Gneiss

Pony Series[1]

Precambrian (pre-Belt): Southwestern Montana.

Original reference: W. Tansley, P. A. Schafer, and L. H. Hart, 1933, Montana Bur. Mines and Geology Mem. 9, p. 8, map.

E. W. Heinrich, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1329. Cut by Blacktail granite gneiss (new).

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 20. Locally underlies Flathead sandstone.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 350, pl. 1. Group mapped and described in Lima

region, Montana. Intruded by Dillon granite gneiss (term replaces Blacktail granite gneiss, preoccupied). Stratigraphic relations between Pony group and Cherry Creek group not clear in this area.

R. R. Reid, 1957, Montana Bur. Mines and Geology Mem. 36, p. 3–4, 14, geol. map. Metamorphics mapped and described in Tobacco Root Mountains. Within map area, Pony metamorphics are separated from Cherry Creek metamorphics by seemingly continuous greenish quartzite layer with only small isoclinal folds present within it. Foliation in Cherry Creek metamorphics appears to be everywhere parallel to that in Pony in vicinity of contact. Discordance suggested by Tansley and Schafer (1933) not observed. Most significant structural fact is that Cherry Creek metamorphics dip beneath Pony metamorphics. Unless some kind of large scale structural overturning has occurrred, the Cherry Creek metamorphics in Tobacco Root Mountains are older than Pony metamorphics (in range in which their type locality has been defined). This is contrary to generally accepted opinion.

Named for exposures at and in vicinity of town of Pony, Madison County.

Pony Creek Shale Member (of Wood Siding Formation)

Pony Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 74, 81.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 41. Pony Creek shale was named by Condra (1927) to include too much section; it was redefined to a thickness of about 6 feet, which, at places, does not represent a natural formation and probably not a good member. Rank reduced to member status in Wood Siding formation (new); Pony Creek as restricted by Moore is not a good formation in Nebraska. Overlies unnamed sandstone and shale units; underlies Brownville limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 13. New type locality selected.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Included in Wood Siding formation (redefined). Underlies Brownville limestone member; overlies Grayhorse limestone member.

P. B. Greig, 1959, Okla. Geol. Survey Bull. 83, p. 65–67. Described in Pawnee County where it is 60 to 75 feet thick. Overlies Brownville limestone member; underlies "Grayhorse" limestone member. Further southward continuation of unit appears likely but its extent is not known.

Type locality (Selected by Nebraska Survey): On Towle Farm 2½ miles southwest of Falls City, Richardson County, Nebr. Named for exposures east of Pony Creek, between Kansas-Nebraska line and 2 miles south of Falls City.

Pony Express Limestone Member (of Wanakah Formation)

†Pony Express Beds (in Morrison Formation)[1]

Pony Express Limestone Member (of Morrison Formation)

Upper Jurassic: Southwestern Colorado, New Mexico, and Utah.

Original reference: J. D. Irving, 1905, U.S. Geol. Survey Bull. 260, p. 56.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1748 (fig. 2), 1750, 1752, (fig. 3), 1853 (table). Referred to as limestone member of Morrison. Underlies Bilk Creek sandstone member (new); overlies Entrada sandstone. [See La Plata sandstone.]

E. B. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 27 (table), 28, 29. Described in La Plata district, Colorado, where it is reallocated to member status in Wanakah formation (redefined). In places, consists of single massive bed, and, in others, comprises three or more beds, each about a foot thick. In latter areas, upper beds are commonly massive and lower ones thinly laminated; most limestone bituminous. Thickness 6 inches to 30 feet; average 3 feet; variations in thickness probably due to irregularities in surface of Entrada upon which limestone was deposited. Underlies Bilk Creek sandstone member.

Named for occurrence in Pony Express mine, Ouray district, Colorado.

Pony Spring Siltstone Member (of Maroon Formation)[1]

Pony Spring Siltstone Member (of Minturn Formation)

Pennsylvanian or Permian: Central Colorado.

Original reference: D. B. Gould, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 7, p. 971–1009.

C. A. Arnold, 1941, Michigan Univ. Mus. Paleontology Contr., v. 6, no. 4, p. 59–70. Mentioned in discussion of some Paleozoic plants from central Colorado and their stratigraphic significance. Bath submember of Pony Spring has yielded *Walchia sp. Walchia* has been found in Pennsylvanian strata as well as in Permian and is, therefore, not a strict time marker, but rather a reflection of environment.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 43–44, 152–153, pls. 1, 8. Described in South Park area where, near Salt Creek, it is about 6,000 feet thick; conformably overlies Chubb siltstone member. At type locality, upper limit is Tertiary erosion surface formed before extrusion of Buffalo Peak flows; upper contact now concealed by lavas and talus. [Text states locality from which unit was named and refers to appendix for type section; however, sections in appendix are headed representative sections, but none agree exactly with locality from which unit was named. Most detailed section is on p. 152–153.].

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 820, 836–837. Pony Spring siltstone considered member of Minturn formation in this report [Permo-Pennsylvanian zeugogeosyncline, Colorado and New Mexico]. Overlies Chubb member and consists of 4,000 to 6,000 feet of greenish-gray and red siltstone and sandstone and was deposited in piedmont cyclothems. Contact of Minturn and Maroon formations lies in lower Pony Spring member at top of limy zone a few hundred feet above top of Bath sandstone (Gould, 1935); zone consists of gray shale and thin beds of limestone on Salt Creek and can be traced southward to Muleshoe Gulch where limestone is thinner. Zone lies about 2,700 feet above the gypsum [in Chubb member] and about 4,300 feet above base of Pennsylvanian. Chubb siltstone assumed to be Desmoinesian because of position in section; on basis of correlations, basal Pony Creek is probably Desmoinesian.

Named for Pony Spring at west side of Pony Park, near NW cor. sec. 28, T. 12 S., R. 77 W., Park and Chaffee Counties. Representative section

(Stark and others, p. 152–153) is in secs. 20, 29, 32, and 33, T. 12 S., and sec. 16, T. 13 S., R. 77 W., [Park-Chaffee Counties].

Pooleville Member (of Bromide Formation)

Ordovician: Southern Oklahoma.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 120, 121. Name proposed for upper limy beds of formation. At type section, mostly a light-gray to nearly white limestone, thin-bedded except for top 15 feet which is massive. Thickness at type section about 250 feet. Overlies Mountain Lake member (new); unconformably underlies Viola formation.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 95, fig. 1. Pooleville apparently includes Ulrich's Criner and Webster (name preempted) formations. Corbin Ranch (new) of this report is the topmost lithographic limestone and calcareous shale section of Cooper's Pooleville.

Type section: On Spring Creek about on the line between secs. 8 and 17, T. 2 S., R. 1 W., Murray County. Name taken from Pooleville on west side of Arbuckle Mountains.

Pools Brook Limestone[1] (in Manlius Group)

Pools Brook Limestone Member (of Manlius Limestone)

Silurian(?): Central New York.

Original reference: Burnett Smith, 1929, New York State Mus. Bull. 281, p. 27, 31.

G. H. Davis 3d, 1953, New York State Mus. Circ. 35, p. 8, 10. Described as a member of Manlius limestone.

Named for exposure along southern rim of Pools Brook Valley, eastern Onondaga County.

Poorman Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. and Min. Jour.-Press, v. 115, p. 793–799, 836–843, maps.

J. A. Noble and J. O. Harder, 1948, Geol. Soc. America Bull., v. 59, no. 9, p. 944 (fig. 1), 945–946. Thickness possibly 2,000 feet or more; base not exposed. Underlies Homestake formation. Includes unit formerly termed De Smet formation.

Named for exposed section at junction of Poorman and Deadwood Gulches, along railroad track, Lead district, Lawrence County.

Poor Mountain Limestone Series,[1] or zone[1]

Cambrian(?): Northwestern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 6, 10.

Exposed from a high point on Poor Mountain to a low point on a dale of Rich Mountain. Named for exposures along Poor Mountain, Oconee County.

Poor Valley Ridge Member (of Clinch Sandstone)

Lower Silurian: Southwestern Virginia and northeastern Tennessee.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76 (2 sheets); 1954, Virginia Geol. Survey Bull. 71, p.

143–148, 188; R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 76–79, 122, 125–126, pl. 1. Fine- to medium-grained buff to greenish-white sandstone in beds a few inches to two feet thick, with partings and interbeds of green shale. Sandstone most massive in lower part; shale most abundant in upper part. Thickness 183 feet. Overlies Hagan member (new); underlies Clinton shale.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Lower Silurian.

Named for exposures along Louisville and Nashville Railroad cut in gap through Poor Valley Ridge near Hagan, Lee County, Va.

Pope Chapel Sandstone Member (of Atoka Formation)[1]

Pennsylvanian (Atoka Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 28–29. Hard calcareous greenish-gray to buff sandstone. Thickness 10 to 20 feet. Overlies unnamed shale above Coody sandstone member; underlies unnamed shale below Georges Fork sandstone member.

Named for exposure at Pope Chapel, sec. 24, T. 12 N., R. 19 E., Muskogee County.

Pope Creek Coal Member (of Abbott Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 45 (table 1), pl. 1. Assigned to member status in Abbott formation (new). Occurs above Tarter coal member and below Bernadotte sandstone member. Name Pope Creek sandstone discontinued. Coal named by Wanless (1931, Illinois Geol. Survey Bull. 60). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: Center sec. 33, T. 14 N., R. 2 W., Mercer County.

Pope Creek cyclothem (in Abbott Formation)

Pope Creek cyclothem (in Tradewater Group)[1]

Pennsylvanian: Western, northern, and central Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 189, 192.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Shown on correlation chart below Seville cyclothem and above Tarter cyclothem (new).

R. M. Kosanke, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2). In Abbott formation (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Named from exposures on south side of Pope Creek near center sec. 33, T. 14 N., R. 2 W., Alexis quadrangle, Mercer County.

Pope Creek Sandstone

Pennsylvanian: Western, northern, and central Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63–64, 67–70, 192, 201, 204, 205. Pope Creek sandstone is commonly light gray, fine grained, very slightly micaceous, not very massive, and not well

laminated. Thickness a few inches to 5 feet; average about 1 foot. Thickness of cyclothem as much as 17 feet. Bernadotte sandstone, in basal part of Seville cyclothem, truncates Pope Creek shale at several localities, and locally cuts out entire Pope Creek cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31. Name Pope Creek sandstone discontinued so that term Pope Creek may be retained for coal member.

Cyclothem named from exposures on south side of Pope Creek near center sec. 33, T. 14 N., R. 2 W., Alexis quadrangle, Mercer County.

†Pope Hollow Conglomerate[1]

Pope Hollow Conglomerate Member (of Venango Formation)

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: J. F. Carll, 1883, Pennsylvania 2d Geol. Survey Rept. I_4, p. 180–181.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 14, 243, 253. Prominent conglomerate band in middle part of Venango formation. Underlies Saegerstown shale member; overlies North Warren shale member. Upper Devonian.

Probably named for occurrence at Pope Hollow, Chautauqua County, N.Y.

Pope Springs Sandstone

[Upper Paleozoic]: Southeastern Wyoming.

C. M. Boos, 1941, (abs.) Colorado-Wyoming Acad. Sci. Jour., v. 3, no. 1, p. 25–26. Sand stratum close to the Satanka-Casper contact. Referred to also as Pope Spring sandstone.

In foothills of Laramie Mountains, a few miles east and south of town of Laramie, Laramie County, where there are a number of large springs.

Poplar Mountain Gneiss

Middle Paleozoic: North-central Massachusetts.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Described in Mount Toby quadrangle. Underlies Erving hornblende schist with gradational contact. Probably an eastern partially granitized facies of Amherst schist. Name credited to Robert Balk. Pre-Triassic.

Robert Balk, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–93. Described in type area as dark-gray well-foliated micaceous gneiss consisting of thin parallel black layers of biotite intercalated with fine-grained gray layers containing quartz and biotite in equal amounts. Lenses and beds of brittle light-gray well-stratified quartzite widespread; some actinolitic. Thickness of quartzite layers varies from less than 1 inch to 400 feet. Thin layers of typically dark-green to nearly black amphibolite common. Intermixed with Dry Hill granite gneiss. Represents sedimentary facies of the domelike gneissic complex termed Pelham granite by Emerson (1917, U.S. Geol. Survey Bull. 597). Middle Paleozoic.

Named for excellent exposures on Poplar Mountain 1 mile northeast of Millers Falls, Millers Falls quadrangle.

Popo Agie Member (of Chugwater Formation)

Popo Agie Beds[1]

Popo Agie Formation (in Chugwater Group)

Upper Triassic: Western Wyoming.

Original reference: W. C. Knight, 1901, Eng. and Min. Jour., v. 72, p. 359.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 43, 45. Allocated to member status in Chugwater formation. Underlies Gypsum Spring member; overlies Crow Mountain member (new). Thickness 297 feet. Area of report is southern margin of Absaroka Range.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 135–136. Rank raised to formation in Chugwater group. In Wind River Mountains, overlies Crow Mountain formation; underlies Wyopo formation (new). Thickness as much as 125 feet.

J. D. Love and others, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 17. Popo Agie, as used in this report [central Wyoming], is youngest member of Chugwater and is characterized by 100 to 200 feet of ocher-colored oolitic, siliceous, dolomitic claystones, limestone pellet conglomerates, purple and red shales, and red silty sandstones. Overlies Alcova limestone member. No consistent base for member has been found, either on surface or in subsurface. Underlies Nugget sandstone. Name Popo Agie used in this area in preference to Jelm.

Named from exposures on Popo Agie River, near Lander.

Popotosa Formation

Miocene, upper: Central New Mexico.

C. S. Denney, 1940, Jour. Geology, v. 48, no. 1, p. 77–84. Consists of debris eroded from volcanic rocks, plus small amount of tuff which was contributed by relatively small contemporaneous eruptions. Highly faulted. Estimated minimum thickness 3,000 feet; possible maximum 5,000 feet. Unconformably overlies volcanic rocks of Miocene(?) age to east of Silver Creek; underlies Santa Fe formation.

Well exposed in Silver Creek valley, T. 1 N., R. 2 W., San Acacia area, Socorro County. Named for Arroyo Popotosa.

Porcupine Beds[1]

Tertiary: Southwestern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 197, 253.

Exposed on Porcupine River, between mouth of Driftwood River and head of the Ramparts, Yukon gold district.

Porcupine Group[1]

Ordovician and Silurian: Eastern Alaska, and northwestern Yukon, Canada.

Original reference: D. D. Cairnes, 1912, Canada Geol. Survey Summ. Rept. 1911, p. 26–32.

Yukon-Alaska boundary between Porcupine and Yukon Rivers.

Porcupine Ranch Substage

Pleistocene (Wisconsin): Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, correlation chart. Substage of Bull Lake stage. Occupies Iowan-Tazewell interval between Iowan sub-age and Tazewell sub-age.

Twin Lakes area.

Porphyry Peak Rhyolite[1]

Tertiary: Central southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, volcanics in order of succession are Rawley andesite, Bonanza latite, Squirrel Gulch latite, Porphyry Peak rhyolite, and Bremer [Brewer] Creek latite. In South Bonanza district, the volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and the Bonanza latite is replaced by Hayden Peak latite.

Exposed on slopes of Porphyry Peak, Bonanza district, Saguache County.

Porphyry Peaks Conglomerate

Pleistocene(?) : North-central Colorado.

R. L. Ives, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1049–1050. Poorly consolidated conglomeratic material. In two layers, separated in places by crossbedded sand. Most of the larger boulders are gray porphyry derived from the erosion of a steep-walled canyon through a porphyry dike near Pony Park. Top of conglomerate veneered with injection gneiss fragments which probably were washed from nearby moraines. Fills valley of Stillwater Creek to maximum depth of about 100 feet.

In valley of Stillwater Creek from Sleepy Hollow School to Pony Park in Monarch Valley, Grand County. In places nearly 1 mile wide.

Porphyry Peaks Rhyolite[1]

Tertiary : Central northern Colorado.

Original reference: L. E. Spock, Jr., 1928, New York Acad. Sci. Annals, v. 30.

Caps Porphyry Peaks and occurs on mountain tops on either side of Stillwater Creek farther south, in northeastern part of Grand County.

†Portage Group,[1] Formation,[1] or Shale[1]

Upper Devonian: New York, Maryland, Pennsylvania, and western Virginia.

Original references: J. Hall, 1840, New York Geol. Survey 4th Rept., p. 391–392, 452–455; L. Vanuxem, 1842, Geology of New York, pt. 3, p. 171, 172; J. Hall, 1843, Geology of New York, 4th dist., p. 224–249.

H. S. Williams, R. S. Tarr, and E. M. Kindle, 1909, U.S. Geol. Survey Geol. Atlas, Folio 169. Following the Genesee, and conformable with it, are beds of Portage formation. In this are included those beds which have been generally referred to by term Portage, or Portage group. Portage group was originally defined by Hall (1840) and applied to sandstones lying above Gardeau flagstone of Genesee Valley and distinct from the Gardeau, Ithaca, and Cashaqua groups which were named in same report. In this folio [Watkins Glen-Catatonk], rocks between the Genesee and Chemung are called Portage formation. Portage formation, which in typical region of Genesee Valley is composed of the Cashaqua, Gardeau, and "Portage" members, consists in Watkins Glen quadrangle of (ascending) Sherburne, Ithaca, and Enfield members.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 13–16. Upper Devonian begins with lowest beds of Portage group which in Juniata Valley are represented by remnant of Tully. This rests disconformably upon highest Hamilton, the Moscow shale, with its *Vitulina* zone. Top of Portage group lies approximately at base of Catskill red beds, of early Chemung age. Divisions of Portage recognized in Pennsylvania are (ascending) Rush formation (with Tully shale and limestone and Burket black shale) and Fort Littleton formation (with Harrell gray shale, Brallier sandstone and shale, Losh Run

shale, Trimmers Rock sandstone, and Parkhead sandstone). Changes among members of group occur from Allegheny Front into eastern Pennsylvania. In the west, members are all shale except Tully and group is dominated by Brallier shale. From Susquehanna Valley east, dominant element of group is Trimmers Rock sandstone which has largely displaced Brallier shale. Tully is little known east of Susquehanna and is presumably displaced by Burket black shale.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. On Devonian correlation chart term "Portage" formation is used in column for east-central West Virginia. Portage shale is used in column for Genesee Valley, Portage is shown above the Letchworth and below the Wiscoy.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 385. Term Brallier shale replaces "Portage" shale as formerly used in West Virginia.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 392–396. Four formations, Grimes sandstone, Gardeau flags and shales, Nunda sandstone, and Wiscoy shale, overlie Naples group in Batavia quadrangle. No group name is applied to them, although they belong to Chemung stage. They had previously been included in Portage group but Chadwick (1933, Pan-Am. Geologist, v. 60) returned name Portage to formational status.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2821, 2826. Report presents revised correlations of lower Upper Devonian rocks in western and central New York. Sherburne flagstone member is excluded from Portage formation of Williams (1906, Science, new ser., v. 24) and Williams and others (1909) and assigned to Genesee formation. Ithaca shale member of Portage is redefined as Ithaca member of Genesee. In area south of Cayuga Lake, the Sonyea formation occupies the upper four-fifths of rock sequence that was designated Enfield shale member of Portage by Williams and others (1909).

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Unit mapped as marine beds (Dm) consists of gray to olive-brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully limestone at base.

In 1843, Hall redefined "Portage or Nunda" Group to include older rocks, specifically Sherburne Flagstones, Cashaqua Shale, the Gardeau and Portage Groups of the annual reports. As redefined, Hall's Portage comprises all of the West Falls Formation, all of the Sonyea Formation, and upper two-thirds of Genesee Formation of de Witt and Colton (1959).

Named for exposures along banks of Genesee River in district formerly included in town of Nunda now Portage, Livingston County, N.Y.

†Portage Sandstone[1]

Upper Devonian: New York.

Original reference: J. Hall, 1843, Geology New York, div. 4, 4th dist., p. 226, 228–229, 248.

Well exposed in deep gorge below Portageville, Wyoming County.

Portage Lake Lava Series

Precambrian (Keweenawan): Northern Michigan.

W. S. White, 1952, Jour. Sed. Petrology, v. 22, no. 4, p. 190. First appearance of name. Credited to White, Cornwall, and Swanson, 1952 [1953].

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Name proposed to include the Eagle River, Ashbed, Central Mine, and Bohemian Range groups of old reports; these older subdivisions are quite arbitrary and depend on the continuity of individual flows or conglomerate beds for validity and are not useful for purpose of this report. A thick sequence of basalt and andesite flows with a few thin interbedded rhyolite conglomerates. Some flows are uniformly fine grained, but most increase in grain size from both the top and the bottom toward the center. Capping the massive lava that forms the bulk of each flow is a layer of amygdaloidal lava 1 to 75 feet thick (5 to 10 feet thick on most flows). Conglomerate and sandstone beds within the lava series composed primarily of rhyolitic material. The bulk of the clastic particles range in diameter from a small fraction of an inch to about 6 inches; pebbles and cobbles are generally well rounded. Most conglomerate beds or their equivalent horizons can be recognized for tens of miles northeast and southwest of this quadrangle. Tops of conglomerate beds, therefore, form excellent reference horizons for stratigraphic subdivisions of the series, and most of these beds, in consequence, have acquired names in local usage. Designated in ascending order these names are St. Louis conglomerate, the Old Colony and Wolverine sandstones, and the Kingston, Calumet and Hecla, Houghton, Allouez, Pewabic West, and Hancock conglomerates. Because of their exceptional thickness or economic interest, a few of the more persistent lava flows have acquired names in local usage, but most of the flows are nameless. Seven of the flows shown here are designated: the Greenstone, Kearsarge, Scales Creek (new), and Copper City (new) are noteworthy for their thickness; and the Ashbed, Iroquois (new), and Osceola flows, together with the Kearsarge, are of economic interest. Series represents oldest rocks in Ahmeek quadrangle; conformably underlies Copper Harbor conglomerate. Locally intruded by small body of rhyolite.

J. C. Wright and H. R. Cornwall, 1954, Bedrock geology of the Bruneau Creek quadrangle, Michigan: U.S. Geol. Survey Geol. Quad. Map [GQ–35]. Total thickness of 17,000 feet in Bruneau Creek quadrangle, including about 350 separate lava flows and approximately 20 thin beds of sedimentary rocks. Includes Bohemia conglomerate and Gratiot flow.

Other named units that have been assigned to the series are: the Ashbed, Calumet, Kearsarge, Medora, and Osceola amygdaloids and Lac la Belle conglomerate.

Named from Portage Lake, 10 miles southwest of the Ahmeek quadrangle, which was the site of one of Marvine's classic stratigraphic sections of the unit (Pumpelly, 1873, p. 47–89).

Portal Formation

Upper Devonian: Southeastern Arizona.

F. S. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 47, no. 3, p. 475–480. Consists of four members (ascending): alternating very thin beds of calcareous olive-colored shale and shaly aphanitic dark olive-gray limestone—93 feet thick at type section; hard fissile siliceous black shale—37 feet; alternating very thin beds of shale and limestone—153 feet; and alternating thick and very thick beds of bioclastic limestone—

59 feet. Total thickness ranges from 200 to 342 feet; 342 feet at type section. Overlies El Paso formation with disconformable contact; underlies Escabrosa limestone.

Type section: About 2½ miles northwest of village of Portal, from which name is derived. Exposed in SW¼ sec. 14, T. 17 S., R. 31 E., where formation forms ridge between Round Valley on north and Silver Creek on south.

Port Austin Sandstone[1]

Mississippian: Michigan.

Original reference: A. C. Lane, 1899, U.S. Geol. Survey Water-Supply Paper 30, p. 85.

Named for exposures at Port Austin, Huron County.

Port Byron Formation (in Coe Group)

Port Byron Limestone[1] or Dolomite

Port Byron Stage

Middle Silurian: Northwestern Illinois.

Original reference: T. E. Savage, 1926, Geol. Soc. America Bull., v. 37, p. 525–526, 531–533.

J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 191 (table 8). Shown on table of general classification of geologic time as Port Byron stage of Niagaran epoch.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as Port Byron dolomite; overlies Cordova dolomite (new). Niagaran and questionably Cayugan.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 18. Uppermost formation in Coe group (new).

Exposed in quarry at Port Byron, Rock Island County.

Port Clarence Limestone[1] (in Nome Group)

Lower and Upper Ordovician, Silurian, and Devonian: Northwestern Alaska.

Original reference: A. J. Collier, 1902, U.S. Geol. Survey Prof. Paper 2, p. 18, map.

R. M. Moxham and W. S. West, 1953, U.S. Geol. Survey Circ. 265, p. 2, 3. Probably mostly Silurian in age in Serpentine-Kougarok area.

Type locality: York Mountains, north of Port Clarence, Seward Peninsula.

Port Deposit Gneiss[1] **or Granite**

Lower Paleozoic(?) (Post-Glenarm): Northeastern Maryland, Delaware, and southeastern Pennsylvania.

Original reference: G. P. Grimsley, 1894, Cincinnati Soc. Nat. History Jour., v. 17, p. 112.

Ernst Cloos and H. G. Hershey, 1936, Acad. Nat. Sci., Philadelphia, Proc., v. 22, no. 1, p. 71–80. Port Deposit granite and Baltimore gabbro are intrusive into Glenarm series. Port Deposit granite and its associates, and Baltimore gabbro are not Precambrian, but Paleozoic (post-Conestoga).

Ernst Cloos, 1937, Maryland Geol. Survey [Rept.], v. 13, p. 33 (table 1). Included in Port Deposit granodiorite complex. Post-Lower Ordovician.

Norman Herz, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 980. Cuts Baltimore gabbro complex.

Port Deposit Granite or Gneiss cuts the Glenarm Series. U.S. Geological Survey currently designates age of the Glenarm Series as Lower Paleozoic(?).

Named for occurrences at Port Deposit, Cecil County, Md.

Port Deposit Granodiorite Complex

Post-Lower Ordovician: Northeastern Maryland, Delaware, and southeastern Pennsylvania.

Ernst Cloos, 1937, Maryland Geol. Survey [Rept.], v. 13, pt. 1, p. 13 (table 1). Includes, in addition to Port Deposit granodiorite, hornblende granodiorite, hornblende granodiorite with quartz diorite, pegmatite and aplite dikes, granite porphyry, and hornblende lamprophyre dikes. Post-Lower Ordovician.

H. G. Hershey, 1937, Maryland Geol. Survey [Rept.], v. 13, pt. 2, p. 109–148. Port Deposit granodiorite is part of Appalachian Piedmont complex in northeastern Maryland and northwestern Delaware. The Piedmont in these States, as elsewhere, is composed of metamorphosed sedimentary formations and intrusive igneous materials. In Maryland and Pennsylvania, metamorphism in this belt increases from northwest to southeast. Most of the igneous rocks are found in southeastern part, and of these the Port Deposit granodiorite complex is the largest. It is composed of three large and several small rock bodies, separated by schists, and extends over area about 30 miles long and 9 miles wide. Gabbro makes up parts of the north, west, and south boundaries of the complex. Rest of north boundary is composed of schists, probably of Glenarm series, and serpentine. A belt of metamorphic sedimentary rocks occurs north of the gabbro and south of the Paleozoic rocks. It is interrupted by a narrow, northeast-striking syncline of slate and conglomerates just north of Peach Bottom. Rest of south boundary is marked by overlap of unconsolidated Coastal Plain sediments and "Baltimore gneiss".

Porter Shale[1] or Formation

Oligocene, middle: Western Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–22.

C. E. Weaver, 1937, Washington [State] Pubs. in Geology, v. 4, p. 110. Suggests abandoning name and retaining Lincoln formation for the middle Oligocene of Washington.

Exposed in cliffs on east and west sides of town of Porter along north side of Chehalis River near junction with Porter Creek [Thurston County].

Porterfield Stage

Middle Ordovician (Mohawkian): North America.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 8, chart 1 (facing p. 130). Mohawkian series divided into five stages (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness. Sequence of formations in type area of Porterfield is (ascending) Arline (new), Effna, Rich Valley (new), and Chatham Hill (new). Name credited to G. A. Cooper and B. N. Cooper.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 94, 95. Constitutes lower part of type Bolarian series and therefore lower part of stage is equivalent to upper Chazyan.

Named from Porterfield quarry 5 miles east of Saltville, Maccrady quadrangle, Virginia, and its environs where it is well represented.

Porters Creek Clay[1] **or Formation** (in Midway Group)

Paleocene: Western Tennessee, southwestern Alabama, southwestern Illinois, western Kentucky, eastern Mississippi, and southeastern Missouri.

Original reference: J. M. Safford, 1864, Am. Jour. Sci., 2d, v. 37, p. 361, 368.

F. S. MacNeil, 1946, U.S. Geol. Survey Mineral Inv. Prelim. Rept. 3–195, p. 10–12. In addition to typical clay facies, the Porters Creek includes Tippah sand lentil in lower part, in northern part of Tippah County, Miss., and Matthews Landing marl member at top, from Winston County, Miss., to Butler County, Ala. At outcrop in northern Mississippi, the Porters Creek is about 200 feet thick but thickens southward in subsurface to about 600 feet. Typical clay facies extends from southern Illinois and southeastern Missouri to Tombigbee River in western Alabama. Underlies Naheola formation; overlies Chalybeate member (new) of Clayton formation. Midway group. Paleocene. Name Sucarnooche clay, formerly used for entire Porters Creek in Alabama as well as for the calcareous clay east of Tombigbee River, has been abandoned.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 36–41. Described in Choctaw County, Ala., where it is about 350 feet thick and represents lowermost deposits of Midway group exposed in county. Includes Chalybeate limestone member (at base) and Matthews Landing marl member at top. Underlies Naheola formation.

T. W. Lusk, 1956, Mississippi Geol. Survey Bull. 80, p. 11–15. Described in Benton County where it is oldest outcropping formation. Only upper 70 to 80 feet exposed. Underlies Betheden formation.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 94–117. Described in Kemper County where it is about 500 feet thick. Consists of the typical clay facies, somewhat sandy and laminated at top. Includes Matthews Landing marl member at top. Conformably overlies Clayton formation (Chalybeate member at top); unconformably underlies Naheola formation. Midway group.

Named for exposures on Porters Creek, Hardeman County, Tenn., about 1½ miles west of railroad station at Middleton.

Portersville Limestone or fossiliferous horizon (in Conemaugh Formation)[1]

Portersville shale and limestone member

Pennsylvanian: Southeastern Ohio.

Original reference: D. D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 20, 41.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 68, table 1. Portersville shale and limestone member listed as member of Anderson cyclothem in report on Perry County. Greater part of member is shale, but embedded fossiliferous limestone nodules are very conspicuous. Thickness 3 to 8 feet. Conemaugh series.

M. T. Sturgeon and others, 1957, Ohio Geol. Survey Bull. 58, p. 95 (table 11), 122–123. Shale and limestone member of Anderson cyclothem in report on Athens County. Average thickness 2⅓ feet. Occurs above An-

derson coal and Cow Run sandstone member of Upper Bakerstown cyclothem. Conemaugh series.

Named for village in eastern part of Perry County.

Port Ewen Limestone (in Helderberg Group)

Port Ewen Limestone (in Oriskany Group)[1]

Lower Devonian: Eastern New York, New Jersey, Pennsylvania, Virginia, and West Virginia.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 21.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 50, 62–65, tables 13, 14. Becraft and Port Ewen shale occur as units to which these names can be applied only in eastern part of Monroe County. Table 13 shows Port Ewen shale in Nearpass quarries, New Jersey. Overlies Becraft limestone. Helderberg group.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1162, 1168, 1181. Thickness at Delaware Water Gap 136 feet; underlies Oriskany shale; overlies Becraft(?) limestone. Thickness 174 feet on Bushkill Road; overlies Becraft limestone; underlies Oriskany shale.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 97–110. Thickness in West Virginia 30 to 105 feet. Underlies Port Jervis limestone; overlies New Scotland limestone. Believed to comprise main part of "Shriver chert" of previous reports.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 190–195. Port Ewen beds consist of series of shaly limestones, above Alsen limestone and below Oriskany sandstone. Maximum thickness 6 to 8 feet in Coxsackie quadrangle [this report]. Maximum thickness in New York about 200 feet (Port Jervis area).

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Helderberg formation consists of dark-gray calcareous thin-bedded shale (Mandata) at top, equivalent to Port Ewen shale and Becraft limestone in the east; dark-gray cherty thin-bedded fossiliferous limestone (New Scotland) with some local sandstones in the middle; and, at base, dark-gray medium- to thick-bedded crystalline limestone (Coeymans), sandy and shaly in places with some chert nodules.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 50. Thickness about 95 feet in Rockingham County. Overlies New Scotland limestone; underlies Port Jervis limestone.

Named for exposures in vicinity of Port Ewen, Ulster County, N.Y.

Port Hudson Formation[1]

Pleistocene: Southeastern Louisiana, southern Mississippi, and eastern Texas.

Original references: E. W. Hilgard, 1869, Am. Jour. Sci., 2d, v. 47, p. 77–88; v. 48, p. 332; Preliminary Report of a Geological Reconnaissance of Louisiana, 1869.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1714, chart 12. Shown on correlation chart as underlying Hammond terrace deposits and overlying Prairie member (Fisk, 1938).

Named for prominent development at Port Hudson, East Baton Rouge Parish, La.

Port Jervis Limestone (in Oriskany Group)[1]

Port Jervis Limestone and Chert (in Helderberg Group)

Lower Devonian: Southeastern New York, Maryland, Pennsylvania, Virginia, and West Virginia.

Original reference: G. H. Chadwick, 1908, Science, new ser., v. 28, p. 346–348.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 110–127, measured sections. Referred to as Port Jervis limestone and chert in Helderberg group. Geographically extended into West Virginia. At type locality, limestone is about 30 feet thick and consists of blue-gray partly siliceous or finely arenaceous limestone with specimens of *Dalmanites*, *Rensselaeracria*, and *Homalonotus*. In central eastern Pennsylvania, formation disappears in an erosional unconformity between Oriskany sandstone and early members of Helderberg group. It is believed to reappear in Franklin County, southern Pennsylvania, and continues southward across Maryland, into West Virginia. In this belt, it occupies more of the Licking Creek limestone of Swartz (1938). Formation thins and is absent in Massanutten syncline of northern Virginia. Overlies Port Ewen limestone; underlies Ridgeley sandstone. Equivalent to part of Shriver chert or "Becraft limestone" of previous reports. Thickness as much as 90 feet.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 49, 50. Thickness about 10 feet in Rockingham County. Overlies Port Ewen limestone. Helderberg group.

Named for Port Jervis, Orange County, N.Y.

Portland Arkose (in Newark Group)

Portland Formation

Upper Triassic: Central Connecticut.

P. D. Krynine, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1919. Named as formation. Maximum thickness 4,000 feet. Overlies Meriden formation. A fluvial deposit similar to New Haven arkose.

P. D. Krynine, 1950, Connecticut Geol. Nat. History Survey Bull. 73, p. 30–31, 32, 69–70. Described as arkose. Consists of conglomerates, reddish-brown, purple, and grayish arkoses, fine-grained micaceous siltstones, and subordinate red and dark shales; these compose the normal sedimentary facies. Material becomes coarser from west to east; at the eastern margin in the vicinity of the Great Fault are coarse conglomerates and fanglomerates. Included in Newark group. Outcrop areas described.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 8 (table 1), 25–30. In this report [Middletown quadrangle] Newark group comprises (ascending) New Haven arkose, Talcott basalt, Shuttle Meadow formation (new), Holyoke basalt, East Berlin formation (new), Hampden basalt, and Portland arkose. Except for small area in extreme southeast corner of quadrangle where pre-Triassic Bolton schist crops out, Portland arkose underlies entire eastern half of quadrangle; appears in northwest quarter as result of faulting. Estimated thickness 3,000 to 3,500 feet.

Best exposures in the Portland "brownstone" quarries near Middletown, Middlesex County.

Portland Clays[1]

Age(?) : Maine.

Original reference : C. H. Hitchcock, 1861, Rept. Geology Maine, p. 275–282.

At and around Portland, Cumberland County.

†Portland division (of Selma Chalk)[1]

Upper Cretaceous : Alabama.

Original reference : E. A. Smith, 1903, 58th Cong., 1st sess., S. Ex. Doc. 19, p. 12–20, map.

Along Tombigbee River from Pace's Landing nearly to Moscow, and along Alabama River from Elm Bluff to Old Lexington Landing. Named for exposures at Portland, Dallas County.

Portland (delta) Gravels[1]

Portland Sands and Gravels

Pleistocene : Western Oregon.

Original reference : J. P. Buwalda and B. N. Moore, 1930, Carnegie Inst. Washington Pub. 404, p. 21–22.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000) : Oregon Dept. Geology and Mineral Resources. Referred to on map legend as Portland terrace gravels. Correlates with Clackamas, Tualatin, and Willamette terrace deposits and glacial outwash.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 17–19. Portland gravels, sometimes referred to as Portland delta gravels, were deposited mainly by Columbia River during the Pleistocene. Base of gravels not known with certainty. Maximum thickness may be nearly 600 feet.

E. M. Baldwin, 1957, Northwest Sci., v. 31, no. 3, p. 114–115. Term Portland sands considered more appropriate than gravels.

Present in Willamette Valley in vicinity of Portland.

†Portland Quartzite[1]

Precambrian (Middle? Huronian) : Central southern Wisconsin.

Original reference : T. C. Chamberlin, 1877, Geology Wisconsin, v. 2, p. 252–256.

Crops out in several places in town of Portland, Dodge County.

†Portland Shale[1]

Upper Devonian : Western New York.

Original reference : J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 24, chart.

Probably named for exposures at Portland, Chautauqua County.

Portland Hills Silt Member (of Troutdale Formation)

Pliocene, upper, or Pleistocene, lower : Northern Oregon and southwestern Washington.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 10–13, pl. 2. In most roadcuts where silt has been exposed, it is structureless light-brown or yellowish-brown mass which in upper part may be mottled with gray streaks. In deep cuts, light-brown silt grades down into a reddish-brown, clayey silt. Surprisingly uniform in grain size, and suggestion of stratification noted in only few places. Scattered

well-rounded quartzite pebbles occur in silt at elevation of 1,100 feet along crest of Portland Hills and attest to water-laid origin there. Thickness 300 to more than 700 feet. Uppermost member of formation.

E. M. Baldwin, 1957, Northwest Sci., v. 31, no. 3, p. 112–113. Rhinoceros tooth from the Portland Hills identified as form not known in North America beyond the Hemphillian. This strengthens Pliocene age for unit.

Forms thick cover over much of the Portland Hills in Oregon. Observed in clay pit west of West Pioneer, Wash. Traced eastward to Underwood Mountain on north side of Columbia River in Washington near Hood River, Oreg.

Portland Point Member (of Moscow Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 21, 229.

G. A. Cooper, 1933, Am. Jour. Sci., 5th, v. 26, p. 544, 550. In Schoharie Valley, overlies Panther Mountain shale and sandstone member (new).

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 4 (fig. 2), 7. Basal limestone of Portland Point member extends westward [from type locality] and is considered equivalent of Menteth limestone member. Thickness 8½ feet at type locality.

Named for exposures at Portland Point (formerly Shurger Point), Cayuga Lake area.

Portneuf Limestone Member (of Thaynes Formation)

Portneuf Limestone (in Thaynes Group)[1]

Lower Triassic: Southeastern Idaho.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 31–33, pl. 1. Limestone unconformably underlies Timothy formation where mapped in Ammon and Paradise Valley quadrangles. In Lanes Creek, Freedom, and Montpelier quadrangles farther east and southeast, the limestone contains a well-developed red-bed unit, which consists of interbedded red sandstones and shales and ranges from 200 to 1,000 feet in thickness.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 173, fig. 18. Described as member of Thaynes formation. Underlies Timothy sandstone member.

Named for Portneuf River, in Fort Hall Indian Reservation, at head of which the limestone is well exposed.

Port Orford Formation

Pliocene, middle: Southwestern Oregon.

E. M. Baldwin, 1945, Jour. Geology, v. 53, no. 1, p. 37–39. Name proposed for beds lying unconformably between Empire formation and overlying terrace deposits. Formation has been included with terrace deposits under name of Elk River beds, which are here restricted to exclude newly named unit. Formation consists of a basal bed of buff sand overlain by conglomerate and separated from it by a local unconformity; above the conglomerate is rusty sand that grades upward into blue-gray argillaceous sand which bears fossiliferous concretions; top of argillaceous sand has been truncated by the sea and Elk River beds have been deposited on this truncated surface; locally the sand pinches out and Port Orford

conglomerate is difficult to distinguish from the gravels of the terrace deposits.

J. H. Van Voorthuysen, 1953, Jour. Paleontology, v. 27, no. 4, p. 604. Foraminiferal studies indicate an Amstelian age—oldest Pleistocene.

Exposed south of Cape Blanco within the Port Orford quadrangle, Curry County.

Portsmouth Conglomerate[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 328–329.

Exposed near Portsmouth Grove Station, in Portsmouth camp-meeting grounds, and elsewhere in that region of Newport County.

Portsmouth Member (of Black Hand Formation)[1]

Portsmouth Member (of Logan Formation)

Portsmouth Shale Member (of Cuyahoga Formation)

Lower Mississippian: Southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 758.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 1), 61. Included in Scioto shale facies (new) of Logan formation. Underlies Vinton sandstone member; overlies Buena Vista sandstone member; both contacts poorly exposed. In eastern Pike and Ross Counties, Portsmouth grades eastwardly into Byer sandstone member; along Ohio River, it is probable that upper part of Portsmouth is westward equivalent of the lower Vinton sandstone member of the adjacent Pretty Run facies. Maximum thickness 253 feet.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio as middle member of Cuyahoga formation. Underlies Black Hand member; overlies Buena Vista member.

Named for Portsmouth, Scioto County.

Portuguese Tuff Bed[1] (in Altamira Shale Member of Monterey Shale)

Miocene, middle: Southern California.

Original reference: W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 131.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 16–19. Basal part of Altamira. Thickness at least 280 feet. Below Miraleste tuff bed of Altamira. Type region redesignated.

Type region: Along Klondike Canyon, near Portuguese Bend, Palos Verdes Hills, Los Angeles County.

†Portville Conglomerate[1]

Devonian or Carboniferous: Southwesern New York.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 83.

On hills about Portville, Cattaraugus County.

Port Washington Stage[1]

Pleistocene: Southeastern New York.

Original reference: J. B. Woodworth, 1901, New York State Mus. Bull. 48, p. 621–663, pl. 1, map.

On northern and western extremity of Manhasset Neck, near Port Washington, Long Island.

Port Wing Brownstone Member (of Orienta Formation)

Cambrian: Northwestern Wisconsin.

G. O. Raasch, 1950, Illinois Acad. Sci. Trans., v. 43, p. 145 (fig. 8), 147. Critical examination of evidence on which Thwaites (1912) established his Chequamegon formation reveals that his Chequamegon brownstone formation is none other than the Port Wing brownstone member of the Orienta formation, repeated by faulting. [Thwaites' (1912 general section referred to Upper brownstone (of Port Wing); thickness 500 to 700 feet.].

Type locality not given. Thwaites referred to quarries at Port Wing, Bayfield County.

Portwood Formation (in New Albany Shale)

Upper Devonian: Eastern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 860 (fig. 4), 861, 862–866. Portwood formation *Hypothyridina* zone is basal stratum of the New Albany in eastern Kentucky and includes all beds between Middle Devonian limestone and Trousdale shale. Consists of Duffin dolomite, Harg calcareous shale (new), and Ravenna carbonaceous shale as members, which are regarded as coeval facies within the *Hypothyridina* zone. Generalized section of Estill County shows maximum thickness 22 feet; all three facies present.

Type locality and derivation of name not given.

Posey Formation

Quaternary, late: Western California.

P. D. Trask and J. W. Rolston, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1082. Firm sandy clay and sand as much as 50 feet thick. Underlies Merritt sand; overlies San Antonio formation.

Occurs in area around San Francisco-Oakland Bay Bridge. Named for the fact that it is well developed near Posey Tube between Alameda and Oakland.

Posideon Shale Member (of Graford Formation)[1]

Posideon Shale Member (of Palo Pinto Formation)

Pennsylvanian (Canyon Series): North-central Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 48–50, map.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in redefined Palo Pinto formation. Overlies Wynn limestone member (new).

Typically exposed in vicinity of Posideon, Palo Pinto County.

Possum Sandstone Tongue (of Revard Sandstone Member of Tallant Formation)

Possum Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series) : Northeastern Oklahoma.

Original reference: M. I. Goldman, 1920, U.S. Geol. Survey Bull. 686–W, p. 330, 332.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 32, 38, pl. 1. Rank reduced to bed in Tallant formation. More or less massive sandstone about 10 feet thick. Goldman (1920) identified it correctly as probably a tongue of the Revard sandstone.

Named for occurrence as a prominent ledge along sides of Opossum Creek in SE cor. T. 29 N., R. 11 E., Osage County.

Possumtrot Shale (in Bluefield Formation)[1]

Mississippian : Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 414.

Type locality: On west side of Indian Creek 1.6 miles northeast of Raines Corner and slightly north of Possumtrot Branch, Monroe County.

Post Oak Conglomerate Member (of Wichita Formation)

Permian : Southwestern Oklahoma.

G. W. Chase, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2028–2035. Proposed for conglomerate and arkose beds surrounding Wichita Mountains as a near-shore facies of lower part of Wichita formation. Composed of four distinct conglomerate facies: granite boulder conglomerate, rhyolite porphyry conglomerate, limestone boulder conglomerate, and conglomerate with zeolite-opal cement. This latter facies was named Tepee Creek (Merritt and Ham, 1941,). Tongues into Wellington formation.

W. E. Ham, C. A. Merritt, and E. A. Frederickson, 1957, Panhandle Geol. Soc. [Guidebook] May 2, 3, 4, p. 28. As now used, term Tepee Creek is applied to zeolite-opal sediments that were deposited as anorthosite conglomerates and sandstones unconformably on basic igneous rocks in central part of Wichita Mountain region. These sediments probably are coarse-clastic shoreward facies of shales in Wichita formation of Lower Permian age. Also included in this general classification are the limestone conglomerates, granite conglomerates, and arkoses which in eastern part of Wichita Mountains are called Post Oak conglomerate member of Wichita formation. General concept of Post Oak member must be revised to take into consideration rather extensive granite conglomerates and arkoses in overlying Hennessey formation that border granite hills in Quartz Mountain area near Lugert.

Name taken from Post Oak Creek in sec. 12, T. 2 N., R. 15 W., and from Post Oak Mission in NE cor. sec. 7, T. 2 N., R. 14 W., where the conglomerate is thick and well developed.

Post Pond Volcanic Member (of Orfordville Formation)

Post Pond Volcanics

Middle Ordovician (?) : Western New Hampshire and eastern Vermont.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle, (1:62,000) ; C. A. Chapman and others, 1938. Geologic map and structure sections of the

Mascoma quadrangle, New Hampshire (1:62,500) : New Hampshire Highway Dept. Member consists of green chlorite-sericite schist in low grade metamorphic zone of Orfordville formation and amphibolite, amphibole gneiss, calcareous amphibole gneiss, fine-grained biotite gneiss, and gray quartz-mica schist in middle grade zone. Occurs near base of formation below Hardy Hill quartzite member (new). Middle Ordovician(?).

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 119–121, 123–124. Thickness 2,000 to 4,000 feet.

R. J. Bean, 1953, Geol. Soc. America Bull., v. 64, no. 5, pls. 1, 2. Volcanics are mapped as separate unit underlying the Albee formation and overlying the Orfordville formation. Map legends show Upper(?) Ordovician age.

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 113, 114–116, pl. 1. Stratigraphic revision of the Orfordville formation implies that the Post Pond and Sunday Mountain volcanic members are essentially equivalent; latter is not mapped separately. Assigned higher stratigraphic position; occurs above the Hardy Hill quartzite member.

Named for outcrops in vicinity of Post Pond, Lyme Township Grafton County, N. H. Outcrop belt extends southwestward into Vermont.

Potapaco Clay Member (of Nanjemoy Formation)[1]

Eocene, lower: Eastern Maryland and eastern Virginia.

Original reference: W. B. Clark and G. C. Martin, 1901, Maryland Geol. Survey, Eocene Volume, p. 58, 65–66.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 2, 24. In York-James Peninsula, Va., the lower Eocene (Wilcox) part of Nanjemoy formation, Potapaco clay member, truncates Aquia formation. Downdip from the Fall Line the Aquia formation and Potapaco member, as well as basal pink Marlboro clay member of Nanjemoy, have been truncated by transgressive sea of middle Eocene time.

Potapaco is early name for Port Tobacco Creek, eastern Maryland.

Potato Sandstone[1]

Miocene(?) : Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 374–375, map.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 557. Conglomeratic Potato sandstone, which occupies several square miles in San Bernardino Mountains, was tentatively correlated with Puente formation by Vaughan (1922). Potato sandstone is arkosic, nonfossiliferous, and well indurated. Many of its pebbles are slabs of dark lustrous Pelona schist. Absence of Pelona shist fragments from conglomerates of Puente, indicates that the two formations, if contemporaneous, obtained their detritus from different and restricted areas.

Named for Potato Canyon, San Bernardino County. Forms the part of the ridge between Potato Canyon and Mill Creek east of Wilson Creek.

Potato Hill Andesite (in Buck Hill Volcanic Series)

Potato Hill Andesite (in Pruett Tuff or Formation)

Oligocene and younger(?) : Southwestern Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Lavas intercalated with Pruett tuff (new) are

(ascending) Crossen trachyte, Sheep Canyon basalts, and Potato Hill andesite (all new).

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1155–1156, pl. 1. Dark-reddish-brown porphyritic flow and flow breccia in upper part of Pruett tuff. At Potato Hill, the andesite is 31 feet thick. It lies on about 50 feet of tuff which rests on Crossen trachyte. Andesite overlain by 25 feet of hard, dense, red tuff. North of Potato Hill, the andesite is 18 feet thick and is overlain by 29 feet of well-stratified tuff below Cottonwood Spring basalt. Eocene(?).

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 549–550, pl. 1. Described in Cathedral Mountain quadrangle where it is given rank of formation in Buck Hill volcanic series. Thickness 35 to 190 feet. Overlies Sheep Canyon basalt; underlies Cottonwood Spring basalt. Oligocene and younger(?).

Named for Potato Hill on Crossen Mesa, Buck Hill quadrangle, Brewster County.

Poteau Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. Unit is essentially the Boggy formation.

Name is from Poteau Mountains, Le Flore County, Oklahoma, and Segastian County, Arkansas.

Poteet Limestone

Middle Ordovician: Southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Gray, brown, and tan, dense fine-grained limestone with abundant chert nodules; darker colored limestone predominant in lower part, and lighter colored limestone predominant in upper part; locally has zone of coarsely crystalline fragmental limestone at or near base, and one or more beds of dolomitic limestone higher up. Thickness 45 to 97 feet. Underlies Rob Camp limestone (new); unconformably overlies Dot limestone (new). Poteet limestone and Dot limestone shown as Murfreesboro limestone (after Butts) on U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 37–39, pl. 1. Unconformably underlies Martin Creek limestone in areas where Rob Camp limestone is absent. Derivation of name given. Discussion of problems of correlation and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Named from Poteet Ford, an old crossing of the Powell River in central part of Jonesville district, Lee County. Well exposed along a woods lane at base of bluff overlooking Powell River 0.2 miles north of suspension footbridge at Poteet Ford.

Potem Formation[1]

Lower and Middle Jurassic: Northern California.

Original reference: J. S. Diller, 1906, U.S. Geol. Survey Geol. Atlas, Folio 138.

A. F. Sanborn, 1960, California Div. Mines Spec. Rept. 63, p. 6 (figs. 3, 4), 14–16, pl. 1. In southwest quarter of Big Bend quadrangle, consists of argillites and fine-grained tuffaceous sandstone with small amounts of conglomerate, tuff, medium to coarse tuffaceous sandstone and a few beds of limestone and coarse pyroclastic material. Thickness about 1,000 feet. Intercalated with Bagley andesite. Underlies Montgomery Creek formation. Middle and Upper Jurassic (text); Middle Jurassic (map bracket).

Named for exposures on Potem Creek, Shasta County.

Potlatch Anhydrite[1]

Potlatch Member (of Three Forks Formation)

Upper Devonian: Subsurface in Montana, North Dakota, and South Dakota.

Original reference: E. S. Perry, 1928, Montana Bur. Mines and Geology Mem. 1, p. 4–6.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2322–2323, 2326. Designated member of Three Forks formation in area east of 110° meridian in Montana. In current informal subsurface usage, this unit is called "Potlatch". Wilson (1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf.) recognized that "Potlatch" represented only a small part of type Potlatch and used term Potlatch anhydrite (restricted). Used as member (as herein recommended), unit does not imply any redefinition or restriction of Perry's Potlatch anhydrite formation which is valid subsurface unit in its type area. From Little Rocky Mountains westward, upper part of Three Forks consists predominantly of green fossiliferous calcareous shale interbedded with thin beds of limestone and siltstone, and Potlatch member consists of anhydrite, dolomite, and dolomitic siltstone interbedded with calcareous and dolomitc shale.

Named for the fact that complete section is shown in cuttings of Potlatch-Adams No. 1 well on sec. 21, T. 34 N., R. 1 W., Toole County, Mont.

Potomac Group[1]

Lower and Upper Cretaceous: Virginia, Delaware, and Maryland.

Original references: W. J. McGee, 1886, Rept. Health Office, D.C., 1885, p. 19–21; Am. Jour. Sci, 3d., v. 31, p. 473–474.

N. H. Darton, 1951, Geol. Soc. America Bull., v. 62, p. 747, 752. Consists of (ascending) Patuxent, Arundel, and Patapsco formations. Group does not represent a large part of Lower Cretaceous. Structurally, a wedge-shaped mass lying on east-sloping floor of crystalline rocks; well records show that it thickens eastward to more than 1,000 feet. South of Fredericksburg, Aquia formation overlaps edge of Potomac group slightly, onto crystalline rock, and the Potomac in turn is overlapped by Miocene Calvert formation, Nanjemoy formation with its Marlboro clay member having thinned out or been eroded. In some areas, unconformably underlies Raritan formation.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2169 (fig. 1), 2173–2177. Lower Cretaceous. This assignment is made on basis of both floral and faunal evidence. Detailed discussion of probelm.

D. J. Cederstrom, 1957, U.S. Geol. Survey Water-Supply Paper 1361, p. 16, pl. 1. Early and late Cretaceous. In subsurface (in York-James Peninsula, Va.), underlies Mattaponi formation (new).

Type locality and derivation of name not stated. Unit crosses Potomac River near Chain Bridge, Virginia and District of Columbia.

Potosi Dolomite[1]

Upper Cambrian: Eastern and central Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 351, 355.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 30–32. Thick-bedded crystalline bluish-gray dolomite. Contains few fossils. Maximum thickness about 400 feet. Overlies Derby formation [compound term Derby-Doe Run not used in this report]; underlies Eminence dolomite. Upper Cambrian.

V. E. Kurtz, 1960, Dissert. Abs., v. 21, no. 3, p. 595. Overlies Doerun member of Elvins formation.

Named for Potosi, Washington County.

†Potosi Group[1]

Upper Cambrian and Lower Ordovician: Southeastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 351, 355.

Probably named for Potosi, Washington County.

†Potosi Slates and Conglomerates[1]

Upper Cambrian: Eastern Missouri.

Original reference: F. L. Nason, 1901, Am. Jour. Sci., 4th, v. 12, p. 358–361.

Typically exposed near Elvins, St. Francois County.

Potosi Volcanic Group

Potosi Volcanic Series[1]

Tertiary, middle or upper: Southwestern Colorado.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

E. S. Larsen, Jr., 1949, Am. Geophys. Union Trans., v. 30, no. 6, p. 863. Includes (ascending) Conejos andesite (quartz latite), Treasure Mountain rhyolite, Sheep Mountain quartz latite, Alboroto quartz latite (rhyolite), Huerto andesite (quartz latite), and Piedra rhyolite. Lavas of Potosi volcanic series followed those of Silverton volcanic series and were in turn followed by eruption of Fisher quartz latite.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 90–166, pl. 1. Series and units described in detail. Miocene.

T. A. Steven and J. C. Ratte, 1960, U.S. Geol. Sruvey Prof. Paper 343, p. 9–10, pl. 1. Middle or late Tertiary.

Named for exposures on Potosi Peak, Silverton quadrangle.

†Potsdam Limestone[1]

Upper Cambrian: New York.

Original reference: W. B. Dwight, 1886, Am. Jour. Sci., 3d, v. 31, p. 125–133.

In Dutchess County.

Potsdam Sandstone[1]

Upper Cambrian: Central and eastern New York and Vermont.

Original references: E. Emmons, 1838, New York Geol. Survey 2d Rept., p. 214–217, 230; 1840, New York Geol. Survey 4th Ann. Rept., p. 347.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1575. Potsdam forms lowest unit of New York Paleozoic section except for beds in thrust plates of Taconic orogeny. Base of Potsdam in this area is coarse sandstone approaching a conglomerate; it grades upward into fairly massive, clean sandstone. In Vermont, rock has been metamorphosed and is more properly quartzite. Thickness about 400 feet. At Whitehall, upper beds show transition into Little Falls through interbedded dolomite and sandstone. This transition facies has been called Theresa formation. At Shoreham, in Ticonderoga quadrangle, Little Falls is immediately underlain by 50 feet of massive quartzite without transition; beneath this is 50 feet of interbedded dolomite and sandstone, and then body of Potsdam. If these beds are equivalent to "Theresa" at Whitehall, they bear out suggestion by Emmons that upper Potsdam graded from sandstone in Champlain region to calcareous sediments in Saratoga region. Upper Potsdam as here used is Franconia; remainder is presumably Dresbach.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. Evidence presented to substantiate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs region. Previously accepted sequence (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canjoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone, and Canajoharie shale. Name Galway is reintroduced for strata younger than Potsdam and older than Hoyt. Term "Theresa" not applicable in area.

John Rodgers,1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America [Guidebook] for Field Trips in New England, p. 36 (table 2), 53. At Skene Mountain, the Potsdam underlies Dewey Bridge formation (new).

A. W. Postel, A. E. Nelson, and D. R. Wiesnet, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–123. In Nicholville quadrangle, New York, Potsdam is divided into Nicholville conglomerate member (new) and upper unnamed orthoquartzite member. Unnamed member corresponds to Keeseville sandstone of Emmons (1842, Geology of New York, pt. 2). Upper member crops out in Hopkinton Brook, three-fourths mile north of Hopkinton. Upper and lower members may interfinger and may be locally unconformable.

C. W. Welby, 1959, New England Intercollegiate Geol. Assoc. Guidebook 51st Ann. Mtg., p. 23. Underlies Ticonderoga formation (new).

Named for occurrence at Potsdam County, St. Lawrence County, N.Y.

†Pottawatomie Formation[1]

Pennsylvanina: Eastern Kansas.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 92–94.

Named for Pottawatomie River.

†Pottawatomie Series[1]

Pennsylvanian: Iowa, Kansas, Missouri, Nebraska, and Oklahoma.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf., correlation chart.

Potter Formation[1]

Pliocene: Texas.

Original reference: L. T. Patton, 1923, Texas Univ. Bull. 2330, p. 78–80.

In Panhandle

Potter parvafacies[1]

Upper Devonian: Southern New York and northern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 31.

L. V. Rickard, 1957, New York Geol. Soc. Guidebook 29th Ann. Mtg., fig. 2. Figure 2 shows Potter as part of Upper Devonian depositional facies in southern New York. Interfingers with Cattaraugus and Oswayo to southwest and Elkland to northeast.

Named for occurrence in Potter County, Pa.

Potterchitto Member (of Cook Mountain Formation)

Potterchitto Member (of Wautubbee Formation)

Eocene: Eastern Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 53–57, profile C. Defined as middle member of Wautubbee formation eastern Mississippi. Lithology varies; all gradations from greensand to nonglauconitic sand are present; sands range from calcareous and marly to noncalcareous and from highly fossiliferous to nonfossiliferous and contain pellets, partings, interbeds, and lenses of carbonaceous clay and shale; bentonite and bentonic clay locally present; earthy siderite common. Thickness varies; 36 feet at type section. Overlies Archusa member (new) with contact conformable and gradational; underlies Gordon Creek shale member (new) with contact conformable and sharply defined.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Assigned to Cook Mountain formation.

Type locality: A series of roadcuts along the Newton-Decatur Highway (State Highway 15) on south side of valley wall of creek about 2 miles northeast of town of Newton, NE¼ sec. 26 and SE¼SE¼ sec. 23, T. 6 N., R. 11 E., Newton County. Named for outcrop near Potterchitto Creek.

Potter Farm Formation[1] (in Traverse Group)

Middle and Upper(?) Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 590–593. Described in Thunder Bay region where composite section is about 65 feet thick. Overlies Norway Point formation. Separated from overlying Thunder Bay limestone by covered interval about 27 feet thick that includes two resistant members which are probably limestones. Included in Traverse group.

Type locality: Fred Potter Farm, E½ secs. 18 and 19, sec. 20, T. 31 N., R. 8 E., Alpena County.

†Pottsboro Subgroup[1]

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 121, 247, 270, 280–288.

Named for Pottsboro, Grayson County.

Pottstown Shale (in Newark Group)[1]

Upper Triassic: Southeastern Pennsylvania.

Original references: B. S. Lyman, 1893, Pennsylvania Geol. Survey geol. and topog. map of Bucks and Montgomery Counties; 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2589–2638.

Exposed at Pottstown, Montgomery County.

Pottsville Formation[1] or Group[1]

Pottsville Series

Lower and Middle Pennsylvanian: Pennsylvania, Alabama, Georgia, Indiana, Kentucky, Maryland, Mississippi, Ohio, Tennessee, Virginia, and West Virginia.

Original references: J. P. Lesley, 1876, Pennsylvania 2d Geol. Survey Rept. L, app. E, p. 221–227; 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. xxiii; C. A. Ashburner, 1877, Am. Philos. Soc. Proc., v. 16, p. 520, 535; David White, 1900, U.S. Geol. Survey 20th Ann. Rept., p. 749–953.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 212–251. Pottsville series divided into (ascending) Pocahontas, New River, and Kanawha groups. Only basal members of Kanawha present in area of this report. Overlies Mauch Chunk series of Mississippian age.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 408–435. Pottsville group includes (ascending) Lee formation, Norton formation, Gladeville sandstone, Wise formation, and Harlan sandstone (possibly of Allegheny age). Overlies Bluestone formation, as in Tazewell County, or Pennington formation as in Lee and Wise Counties.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 54–56. Formation in northwest Georgia contains Lookout sandstone and Walden sandstone. Thickness about 1,430 to 1,500 feet. Stratigraphically above Rockmart slate.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 20–39, table 1. Pottsville series in Ohio includes basal Harrison formation and cyclothems from the Sharon up through the Tionesta. Base of Homewood member of Brookville cyclothem of Allegheny series is considered boundary between Pottsville and Allegheny series. In this report [Perry County], the Pottsville is subdivided into 10 cyclothems. [For sequence see Anthony cyclothem].

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2669–2688. At type section and reference section, formation subdivided into (ascending) Tumbling Run, Schuykill, and Sharp Mountain members. Thickness 1,116 feet at reference section; 1,195 feet at type section (White, 1900). Overlies Mauch Chunk formation; underlies post-Pottsville rocks (Buck Mountain coal bed). Members crop out throughout Southern anthracite field and have been tentatively correlated with strata in parts of other anthracite fields.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanina geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1. Pennsylvania strata, Pottsville series, subdivided into nine groups (ascending): Gizzard, Crab Orchard Mountains, Crooked Fork, Slatestone, Indian Bluff, Graves Gap, Redoak Mountain, Vowell Mountain, and Cross Mountain.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 68–71. Pottsville formation is uppermost Paleozoic unit cropping out in Madison County. Only lower part of formation present in county. Consists of about 85 feet of sandstone, shale, and coals. Unconformably overlies Pennington shale of Mississippian age.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 43–46, 49 (table 7). In northern Appalachian region, including Ohio, the Pottsville series has commonly been defined to include all Pennsylvanian strata from base of Brookville coal downward to underlying Mississippian formations. Flint (1951) and Merrill (1950, unpub. thesis) have included Brookville underclay and Homewood sandstone in Brookville cyclothem. If accepted, decision logically extends base of overlying Allegheny series to base of Homewood shale and sandstone. In Athens County [this report] only Tionesta cyclothem of Pottsville series is exposed for total thickness of about 15 feet.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 68–71. Pennsylvanian section subdivided into (ascending) Pottsville, Allegheny, Conemaugh, and Monongahela groups. Average thickness of Pottsville in western Pennsylvania about 240 feet. Only rocks of upper Pottsville age are represented, and, as in most areas of Pennsylvania, unconformably overlie Mississippian Mauch Chunk or Pocono formations. Throughout western Pennsylvania, the lower two-thirds of Pottsville rocks consists of relatively thick sandstones and a few thin coal beds, and the upper one-third consists of highly variable sequence of clays, shales, and sandstones. Sandstones comprise Connoquenessing formation; overlying beds are assigned to Mercer formation (contains Mercer coals, Mercer clay, and Homewood sandstone). In extreme western and northwestern Pennsylvania and in southwestern Pennsylvania, the Sharon conglomerate forms basal Pottsville but is thought to be absent in others.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as group with Tumbling Run, Schuylkill, and Sharp Mountain formations.

Type section: South of city of Pottsville along Pennsylvania Railroad cut on east side of water gap through Sharp Mountain, Schuylkill County, Pa. Reference section: About 150 feet east of type section, along east side of roadcut for U.S. Highway 122.

Potwisha Quartz Diorite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11, pl. 1. Dark gray in color with abundance of dark inclusions and schlieren. In gradational contact with Giant Forest pluton but mapped separately because of its distinctive color and mineral content.

Underlies about a square mile in vicinity of Potwisha Camp, Sequoia National Park.

Poudre Limestone Member (of Lykins Formation)

Permo-Triassic: Northern Colorado and eastern Wyoming.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Underlies Stonewall Creek shale member (new); overlies Livermore shale member (new).

Extends northward beyond Horse Creek, Wyo., and as far south as Loveland, Colo.

†Poughquag Limestone[1]

Cambrian and Ordovician: Southeastern New York.

Original reference: J. D. Dana, 1872, Am. Jour. Sci., 3d, v. 3, p. 179–186, 250–256.

Exposed at or near Poughquag, Dutchess County.

Poughquag Quartzite[1]

Lower Cambrian: Southeastern New York and western Connecticut.

Original reference: J. D. Dana, 1872, Am. Jour. Sci., 3d, v. 3, p. 179–186, 250–256.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212. Thickness about 250 feet in vicinity of Stissing Mountain, N.Y. Basal Cambrian carrying *Olenellus* and probably *Obolella* near Beacon, N.Y. Underlies Stissing dolomite; overlies Precambrian gneisses.

John Rodgers and others, 1956, Preliminary geologic map of Connecticut (1:253,400): Connecticut Geol. Nat. History Survey. Mapped as pre-Triassic. Massive or bedded vitreous quartzite, gray, white, or buff; locally small amounts of muscovite along bedding planes, or thin layers of muscovite schist between beds; most micaceous near top. In places, grades into feldspathic biotite gneiss, probably only near base of formation.

Named for exposures at Poughquag, Dutchess County, N.Y.

Poul Creek Formation[1]

Oligocene and Miocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 753.

D. J. Miller, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–187, sheets 1, 2. Redefined to consist of approximately 6,100 feet of marine interbedded siltstone and sandstone strata that lie with apparent conformity on Kulthieth formation. As defined, formation includes in upper part most of the strata originally assigned to it at type locality on Poul Creek; also includes lower part of Yakataga Reef section, which was originally assigned to overlying Yakataga formation, and excludes beds described by Taliaferro as "glacio-fluvial conglomerates," here assigned to Yakataga formation. Age given in text as late Oligocene and early Miocene; mapped as Oligocene and Miocene.

Type locality: On Poul Creek, Yakataga district, Controller Bay region.

Poultney Slate[1]

Poultney Formation (in Poultney River Group)

Poultney Group

Lower Ordovician: Southwestern Vermont and New York.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 403.

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 53, 56. Name Poultney slate was applied by Keith (1932) to lowest Ordovician formation after "good exposures in town of Poultney at the boundary of New York, 7 miles southwest of Castleton." Poultney formation as used herein, includes beds of Ordovician section up to overlying red and bluish-green slates named Indian River. Formation is variable unit consisting typically of bluish-gray waxy-looking

banded argillites, locally with indigo-colored patches replacing banding. Near base are local developments of finger-thick green and greenish-weathering black argillite and brown sandstones, and also black slates with limestone conglomerates and thin ribbon limestones. Overlies Hatch Hill formation. In Poultney River group.

J. G. Elam, 1960, Dissert. Abs., v. 21, no. 6, p. 1523–1524. Discussion of geology of Troy South and East Greenbush quadrangles, New York. Stratigraphic section has been subdivided into four groups, and the previously described dominant formational names have been elevated to group status. The groups are Bull (Lower Cambrian), Poultney (Lower Ordovician), and Normanskill (Middle Ordovician).

Named for exposures in town of Poultney, Rutland County, Vt., at boundary of New York, 7 miles southwest of Castleton.

Poultney River Group

Upper Cambrian to Middle Ordovician: Western Vermont.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Six rock types recognized (ascending): white-weathering black argillite with ribbon limestone and cherty beds; limestone-matrix limestone conglomerate; white-weathering green, gray, black, and rarely red argillite, with interbedded thin buff-weathering quartzite ("Poultney slate"); black slate with interbedded brown-weathering ankeritic massive black quartzite with edgewise conglomerate, graded bedding, and channel filling abundant; soft red slate with thin dolomitic and quartzose beds ("Indian River"); and black slate with massive black graywacke beds, commonly showing graded bedding and containing angular rock fragments. Units 1 and 3 are Dale's (1898, U.S. Geol. Survey Ann. Rept. 19, pt. 3, p. 188) Hudson white beds; unit 4 is Larrabee's (1939) Zion Hill quartzite; unit 5 is Keith's (1932) Indian River formation; unit 6 is Dale's (1898) Hudson grits. Thickness not more than 1,000 feet. Major unconformity probably separates group from West Castleton formation (new); this conclusion is based on overlap relations as well as gaps in stratigraphy; an unconformity is present within group below unit 6.

Probably named for Poultney River.

Poundridge Granite[1]

Age(?): Southeastern New York.

Original reference: G. K. Bell, Jr., 1936, Geol. Soc. America Proc. 1935, p. 65.

Occupies most of Poundridge (New York State Park) Reservation in northeast Westchester County.

Pounds cyclothem (in Caseyville-Abbott Formations)

Pounds cyclothem (in Caseyville Group)

Pennsylvanian: Southern Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39 ,no. 9, p. 1764 (table 2). Caseyville group includes (ascending) Lusk, Battery Rock, and Pounds cyclothems.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 5, 9, pl. 1. Includes (ascending): Pounds sandstone (Makanda sandstone in restricted sense) and Reynoldsburg coal. Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 3), pl. 1. In Caseyville formation (redefined) and Abbott formation (new). Above Battery Rock cyclothem and below Grindstaff cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Secs. 35 and 36, T. 10 S., R. 8 E., Gallatin County.

Pounds Sandstone Member (of Caseyville Formation)

Pounds Formation (in Caseyville Group)

Lower Pennsylvanian: Southeastern and southwestern Illinois and western Kentucky.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36, 38–39. Uppermost formation of group. Consists of a prominent sandstone below and a series of shaly beds above; sandstone has maximum thickness of more than 100 feet; shaly strata are poorly exposed and determination of their thickness depends upon recognition of overlying Grindstaff sandstone; the Grindstaff appears to lie from 40 to 60 feet above top of Pounds sandstone at most places, but locally the shaly beds have probably been cut out completely so that the Grindstaff or some younger sandstone is in direct contact with Pounds sandstone. Maximum thickness of formation 150 feet or more in eastern part of area; thins irregularly to west, and in places is not more than 50 feet thick. Probably unconformably overlies Battery Rock formation.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Included in Pounds cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 30, 44 (table 1), 61, pl. 1. Rank reduced to member status in Caseyville formation (redefined). Uppermost member of formation. In southeastern area, occurs above Gentry coal member (new); in southwestern area, occurs above Drury shale member. Thickness 80 feet at type section of Caseyville and about 100 feet at reference section of formation. In southwestern area, includes strata formerly considered to be lower part of Makando sandstone, which name is herein discontinued. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Pounds Hollow, sec. 35 and 36, T. 10 S., R. 8 E., Gallatin County.

Poverty Run Limestone (in Pottsville Formation)[1]

Pennsylvanian: Eastern Ohio.

Original reference: Wilber Stout, 1918, Ohio Geol. Survey, 4th ser., Bull. 21, p. 65.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 22. On basis of fossil content, Morningstar (1922, Ohio Geol. Survey, 4th ser., Bull. 25) correlated Poverty Run limestone with Lowellville limestone as defined by Lamb (1910).

Exposed on Poverty Run, Muskingum County.

Poway Conglomerate[1]

Eocene, upper: Southern California.

Original reference: A. J. Ellis, 1919, U.S. Geol. Survey Water-Supply Paper 446.

G. J. Bellemin and Richard Merriam, 1958, Geol. Soc. America Bull., v. 69 no. 2, p. 199–220. Massive conglomerate of well-rounded pebbles and some boulders, consisting largely of rhyolitic tuff and porphyry; interbedded and crossbedded with sand lenses of coarse sand and fine silty clay; upper zones contain caliche. Ranges in thickness up to about 1,000 feet. Nearly horizontal, and in most places lies unconformably on Cretaceous Peninsular Range batholith and accompanying metamorphic rocks. Where Poway rests on La Jolla formation, contact is in most places conformable. Locally covered unconformably by more than 1,000 feet of soft-gray to yellow marine sands of Pliocene age termed San Diego formation. Upper Eocene; equivalent to Tejon formation.

Forms Poway Mesa and occurs in narrow belt extending from that mesa east of Witch Creek. Well exposed near town of Poway, and forms south wall of Poway Valley, San Diego County.

Powderhorn Granite[1]

Precambrian: Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Occurs in divide between Cebolla and Goose Creeks, north of Powderhorn, Gunnison County.

Powell Limestone or **Dolomite**[1]

Lower Ordovician: Northern Arkansas and southeastern Missouri.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 39. Includes Bull Shoals Mountain chert bed (new) at base. Notes on derivation of name.

Arkansas Geological and Conservation Commission, 1956, *in* Kansas Geol. Soc. Guidebook 20th Field Conf., columnar sections. Fine-grained gray argillaceous dolomite with thin beds of shale, sandstone and sandy dolomite at places. Thickness as much as 215 feet. Overlies Cotter dolomite; underlies Everton formation.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23. Name Powell of Missouri-Arkansas area should not be extended into Appalachian Valley. At present there is no evidence to indicate that any beds in the Appalachian Valley of Tennessee are equivalent to the Powell formation of Ozark region.

Name derived from Powell Station, now abandoned, on Missouri-Pacific Railroad about 2 miles down Crooked Creek from present village of Pyatt, Marion County, Ark.

Powelton Shale (in Allegheny Formation)[1]

Pennsylvanian: Central southern Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 61–62.

Named for village in Huntingdon County.

Powers Bluff Quartzite[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 82.

Forms main part of Powers Bluff, near Arpin, Wood County.

Powwow Conglomerate Member (of Hueco Limestone)[1]

Powwow Conglomerate

Permian (Wolfcamp Series): Western Texas and southeastern New Mexico.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 909, 911.

M. L. Thompson, 1954, Kansas Univ. Paleont. Contr. 14, Protozoa, art. 5, p. 17. In central New Mexico, Bursum formation is unconformably overlain by conglomerates and conglomeratic sandstones which commonly are referred to Abo formation but here are classed as belonging to Powwow conglomerate member of Abo.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Described in Wylie Mountains and vicinity. Consists of sequence of poorly consolidated conglomerate, sandstone, siltstone, and shale; marl and limestone beds present near top. Typically dark reddish brown. Thickness more than 200 feet where it fills former valleys; thins to about 20 feet over buried hills. Underlies Hueco limestone; unconformably overlies Precambrian Carrizo Mountain group.

Well exposed from 2 to 5 miles south of Hueco Canyon along main escarpment of Hueco Mountains, Tex. Name derived from Powwow Canyon 3½ miles south of Hueco Canyon; which is followed by El Paso-Carlsbad Highway.

Poxino [Poxono] Island Limestone (in Wills Creek Shale)[1]

Silurian: Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 146–147, 223–224.

Exposed only in steep bluff on Delaware River opposite Poxino Island.

Poxino Island Shale[1]

See Poxono Island Shale, correct spelling.

Poxono Island Shale[1]

Silurian (Cayugan Series): Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 77, 145–146.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1184–1187, measured sections. Consists of calcareous shale weathering light colored, greenish to buff. Interbedded with shale are local bands of Bloomsburg type. Near base of shale, at type locality, is bed of blue-gray limestone, about 5 feet thick—White's (1882) Poxono Island limestone—containing great numbers of Ostracoda. Thickness varies greatly; at Schuylkill River, absent or reduced to thickness of few feet. Gradually thickens northeastward; about 150 feet at Snyders; about 200 feet at Delaware Water Gap and type locality. Underlies Bossardville limestone; overlies and intertongues with Bloomsburg red sandstone. Poxono Island shale and Bossardville limestone are similar to, and homotoxial with, Wills Creek shale and Tonoloway limestone, respectively, of central

Pennsylvania and Maryland but lie in different province and the corresponding formations differ in their time limits. Both are believed to be later than Wills Creek shale.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Cayugan series.

Named for exposures in bluff of Delaware River in Middle Smithfield Township opposite Poxono Island.

Pozo Formation[1]

Pliocene(?): Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 70.

Named for exposures in Pozo Canyon, Goldfield district.

Prairie Formation

Prairie member

Pleistocene: Central and southwestern Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 163–166. Series of Pleistocene deposits in Grant and La Salle Parishes is divided into four members, their names corresponding to the four distinct depositional terrace surfaces, Williana (oldest), Bentley, Montgomery, and Prairie. Prairie deposits, which in many areas are identical in appearance to those of the present flood plain, border the alluvial valley of the Mississippi and occur to greater distances flanking tributary streams than any of the older flood-plain materials. A typical section consists of an alternation of silty sands and silty clays, loamy material with some coarse sand lenses. Thickness 20 to 52 feet.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 182–183, pl. 1. Rank raised to formation. Described in Rapides and Avoyelles Parishes where it consists entirely of fresh-water clays, silts, sands, and basal graveliferous deposits; all but upper 20 feet of sequence is covered by Recent alluvium.

Named for Prairie Terrace typically developed near Aloha, sec. 16, T. 7 N., R. 4 W., Grant Parish, and at Nebo School, sec. 40, T. 7 N., R. 3 E., La Salle Parish.

Prairie Formation (in Elk Point Group)

Middle Devonian: Subsurface in Saskatchewan, Alberta, and Manitoba, Canada, and northeastern Montana and northwestern North Dakota.

A. D. Baillie, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 444, 445 (fig. 1), 446 (fig. 2); 1953, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 52–5, p. 11 (fig. 2), 12 (table 2), 24–25. Prairie evaporite formation proposed for salt and anhydrite beds that form upper unit of Elk Point group throughout most of Elk Point basin area. Beds range in thickness from more than 600 feet near center of basin to less than 50 feet around basin margins except on west side of map area where evaporite, as much as 450 feet thick, extend into Alberta. Thickness in type well 640 feet. Uppermost formation of group; overlies Winnipegosis formation; underlies Dawson Bay formation of Manitoba group.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2306–2307. Formation underlies deepest part of Williston basin northwestern North Dakota and northeastern Montana.

Thickness fraction of a foot to almost 500 feet. In center of basin, divided into two members: lower contains mostly anhydrite and dolomite interbedded with shale and thin beds of halite; upper is largely halite and is designated as salt member.

Type section: Interval between depths of 4,350 and 4,990 feet in Imperial Oil Co.'s Davidson well 1, in Lsd. 16, sec. 8, T. 27, R. 1 W. 3d Meridian, Saskatchewan, Canada.

Prairie Bluff Chalk[1] (in Selma Group)

Upper Cretaceous: Southwestern Alabama and Mississippi.

Original reference: A. Winchell, 1857, Am. Assoc. Adv. Sci. Proc., v. 2, p. 83, 84, 90.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Assigned to Selma group.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 68–78, pls. 1, 5, 6, 10. Described in Kemper County where it consists of massive hard brittle glaring white to blue-gray chalk. Thickness about 30 feet. Disconformably overlies Ripley formation; unconformably overlain by Chalybeate limestone member of Clayton formation.

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 25–27. Consists dominantly of impure sandy chalk with subordinate amounts of clay, sand, and chalky limestone. Maximum thickness about 70 feet. Thickness 15 feet at type locality. Recognizable from southernmost Tippah County, Miss., to Bullock County, Ala., where it interfingers with Providence sand. In northeastern Mississippi, interfingers with Owl Creek formation; in northern Mississippi, overlain by Clayton formation. Overlies Ripley formation.

Named for exposures in Prairie Bluff, Wilcox County, Ala.

Prairie Creek Limestone Lentil (in Geuda Springs Shale Member of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 13. Uppermost 40 feet of the Geuda Springs consists of drab clays which weather greenish. They are delimited by 2 thin limestones separated by about 5 feet of shale. The limestones are rarely much more than 1 foot thick, but are almost invariably accompanied by prominent veins of secondary calcite which produce a honeycomb rock. Name Prairie Creek limestone lentil is proposed for these beds.

Named for occurrence along Prairie Creek, southeast of Furley, Sedgwick County. Have been traced from Gore Township (T. 30 S., R. 2 E.) northward to a point east of Furley in Lincoln Township (T. 25 S., R. 2 E.).

Prairie d'Ane Clay[1]

Pleistocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 32–33, 46–47, 188.

Forms Prairie d'Ane at Prescott, Prairie de Roan at Hope, and Bois d'Arc Prairie, 10 miles south of Washington. Named for exposures in Prairie d'Ane at Prescott, Nevada County.

Prairie de Roan division[1]

Pleistocene: Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 29, 33.

Named for Prairie de Roan at Hope, Hempstead County.

Prairie Divide Glacial Stage

Pleistocene (pre-Wisconsin) : Northeastern Colorado.

Kirk Bryan and L. L. Ray, 1940, Smithsonian Misc. Colln., v. 99, no. 2, p. 28–29; L. L. Ray, 1940, Geol. Soc. America Bull., v. 51, no. 12, p. 1856–1857. Till and gravel of Prairie Divide represent widespread glaciation to which name Prairie Divide stage is applied. Oldest glacial deposit in Cache la Poudre drainage area. Probably correlative with Cerro glaciation of San Juan Mountains.

Till and gravel form surface of Prairie Divide, a broad mountain flat, with altitude of approximately 7,900 feet in T. 10 N., R. 72 W., Livermore and Home quadrangles.

Prairie du Chien Group[1]

Prairie du Chien Formation

Lower Ordovician: Southwestern Wisconsin, Illinois, Iowa, and southern Minnesota.

Original reference: H. F. Bain, 1906, U.S. Geol. Survey Bull. 294, p. 18.

R. L. Heller, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 29–40. Prairie du Chien group of most authors is revised to formation status. As thus defined, formation consists of (ascending) Oneota dolomite, New Richmond sandstone, and Shakopee dolomite. Name Root Valley sandstone, employed by some for sandstone facies of middle member in southeastern Minnesota is suppressed. As thus defined, the Prairie du Chien consists of a thick sequence of predominantly dolomitic rocks that occurs between the Jordan sandstone of Croixan age and St. Peter sandstone of Chazy age. Ranges in thickness from less than 100 feet in shoreward areas north and west of Minneapolis to 260 feet near Lanesboro, Minn. Canadian.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 272–273. In some areas, group is divisible into Oneota dolomite, New Richmond sandstone, and Shakopee dolomite. In some areas, no recognizable sandstone is found and threefold division cannot be made. Maximum thickness 240 feet. Underlies St. Peter sandstone.

Named for exposures in vicinity of Prairie du Chien, Wis.

Prairie Grove Member (of Hale Formation)

Pennsylvanian (Morrow Series) : Northwestern Arkansas and northeastern Oklahoma.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1935, 1940–1942. Name applied to upper member of formation. Described as a massive, variously sandy crossbedded, pock-marked limestone; lenses of relatively pure, crinoidal, highly fossiliferous limestone and oolitic limestone beds common. Thickness 60 to 200 feet. Overlies Cane Hill member (new) with angular discordance; underlies Bloyd shale.

Named for exposures in mountains east and south of Prairie Grove, Washington County, Ark. Member is distinguishable westward in Oklahoma to Arkansas River valley.

Prairie Hollow Member (of Prairie Mountain Formation)

Prairie Hollow Member (of Wildhorse Mountain Formation)

Mississippian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 857, 880. Variegated maroon and green shale, about 450 feet above base of Prairie Mountain formation (new).

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 49–51. Reallocated to Wildhorse Mountain formation. Thickness about 300 feet.

Type locality: In Prairie Hollow on west side of Round Prairie syncline at type locality of Prairie Mountain formation which is in sec. 25, T. 1 S., R. 12 E., Atoka County.

Prairie Mountain Formation (in Jackfork Group)

Mississippian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 857, 880–884. Defined to include strata underlying Markham Mill formation (new) and overlying Wildhorse Mountain formation (new). Consists of siliceous shale, commonly dark gray to gray, followed by alternating sandstones and shales. Includes the maroon and green shale Prairie Hollow member (new) about 450 feet above base. Thickness varies; in Round Prairie syncline approximately 1,350 feet; in Tuskahoma syncline about 4,300 feet. Jackfork group. Pushmataha series.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 101, 102. Harlton's map units extended into central Ouachitas. Restudy of type section of the Jackfork formation reveals that upper part of type Wildhorse Mountain formation duplicates an equivalent interval in lower type Prairie Mountain formation. By definition, Harlton's type Prairie Mountain formation includes type locality of Prairie Hollow maroon shale member. It has been found that the Prairie Hollow also occurs in midst of Wildhorse Mountain type section; the stratigraphic overlap is about 3,600 feet.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 43 (table 3), 51–54, pls. Formation in Ouachita Mountains overlies Wildhorse Mountain formation and underlies Markham Mill formation. Restricted to exclude Prairie Hollow shale member which is reallocated to member status in Wildhorse Mountain formation. Harlton lists thickness of 1,350 feet for formation at type locality, but when allowance is made for his error in including upper part of Wildhorse Mountain with the Prairie Mountain, the Prairie Mountain cannot be more than 400 or 500 feet thick in type area. Harlton's thickness of 4,300 feet in Tuskahoma syncline is believed to be too great. Maximum thickness less than 2,000 feet in Kiamichi Range. Mississippian (Meramecian and Chesterian).

Type locality: In Prairie Mountain, located in center of sec. 25, T. 1 S., R. 12 E., Atoka County.

Prairie River Granite[1]

Precambrian: Northeastern Minnesota.

Original reference: G. E. Culver, 1894, Minnesota Geol. Nat. History Survey 22d Ann. Rept., p. 102–114.

Exposed in SE¼SE¼ sec. 32, sec. 33, and sec. 34, T. 56, R. 25, Itasca County.

Prairie Rock Limestone[1]

Upper Cretaceous: Mississippi.

Original references: E. C. Eckel, 1905, U.S. Geol. Survey Bull. 243, p. 206–219; A. F. Crider, 1905, U.S. Geol. Survey Bull. 260, p. 510–521.

Quarried on southwest side of Bogue Chitto Creek, Neshoba and Kemper Counties; one-half mile east of Prairie Rock.

Prallsville Member (of Stockton Formation)

[Upper] Triassic: West-central New Jersey.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 53 (table). Shown on stratigraphic table as Lower Prallsville member and Upper Prallsville member, each consisting of thick-bedded medium to coarse arkose with red sandstone interbeds and separated one from the other by 136 feet of red and brown sandstone and red shale. Thickness of Lower Prallsville 474 feet, of Upper Prallsville 205 feet. Prallsville may or may not include overlying 373 feet of red and brown sandstone and underlying 447 feet of red sandstone [see Stockton formation]. Older than Cutalossa member (new); younger than Solebury member (new).

In area along Delaware River from Stockton northward to 3 miles west of Milford, Hunterdon County.

Pratt Ferry Formation

Middle Ordovician (Mohawkian): Central Alabama.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 75, 85–86, chart 1 (facing p. 130). Name proposed for somewhat bituminous calcarrenite occurring in layers up to 4 inches or more in thickness. Total thickness about 8 feet. Underlies black shale of Columbiana formation (new); overlies limestone mapped as Lenoir but which had faunal similarities to Little Oak formation. Name attributed to B. N. Cooper and G. A. Cooper.

Occurs 0.2 mile southeast of Pratt Ferry.

Pratt Point Member (of Little Sitkin Dacite)

Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 182, pl. 23. A body of obsidian (chemically a rhyodacite). Rhyodacite ranges from light-gray to white glass, has many plagioclase and few pyroxene and hornblende phenocrysts, ranges from slightly to very vesicular, and, locally, contains small pink devitrification spherulites. Contact with surrounding low-silica dacite of Little Sitkin dacite extremely complex—apparently they were extruded contemporaneously from same vent.

Type locality: On north side of Pratt Point along coast of Little Sitkin Island, in Rat Islands group of Aleutian Islands. A long narrow body from 200 to 700 feet wide and about 2 miles long that extends from rim of Little Sitkin crater to coast north of Pratt Point.

Prattsburg Sandstone and Shale[1]

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 25 and chart.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Table shows sandstone as youngest unit of Chemung stage in Canandaigua Lake area. Underlies Dunkirk shale; overlies Nunda sandstone.

Named for occurrence at Prattsburg, Steuben County.

Praysville Porphyry[1]

Precambrian (Keweenawan) : Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 81, 176, 177.

Occurs on Old Suffolk mining location, Praysville, Keweenaw Point.

Preble Formation

Middle or Upper Cambrian: North-central Nevada.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]; 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Schist, slate, and hornfels with crystaline limestone lenses a few hundred feet to over a mile long in lower part, partly dolomitized. Thickness at type locality may exceed 15,000 feet. In Winnemucca quadrangle, Cambrian(?) Osgood Mountain quartzite (new) and Preble formation are in thrust contact with other Paleozoic formations; in Golconda quadrangle, the Preble is apparently in normal contact with Ordovician Comus formation and is overlain unconformably by formations of Pennsylvanian age.

Type locality: Emigrant Canyon, near Preble Station, Golconda quadrangle.

Prescott Diorite[1]

Upper Carboniferous or post-Carboniferous: Western central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, pl. 34.

Comprises Packard Mountain in Prescott, Hampshire County.

Presidio Formation (in Trinity Group)[1]

Lower Cretaceous (Comanche Series) : Western Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10, 11, 25–30.

C. P. Ross, 1943, U.S. Geol. Survey Bull. 928–B, p. 66–78, pl. 7. Five subdivisions recognized (ascending) : basal unit, 50 to 90 feet thick, of soft marl, clay, thin-bedded arenaceous limestone, calcareous sandstone and shell breccia; a conglomerate unit, 90 to 120 feet; tripartite unit, about 95 feet thick, of medium-bedded to massive limestone, calcareous sandstone, thin-bedded limestone, in part arenaceous, thin beds of shell breccia composed mainly of *Ostrea* sp. and a fairly massive sandstone, in part arenaceous; shell-breccia unit 110 to 165 feet thick; and cap rock of arenaceous limestone 30 feet thick. Underlies Shafter limestone (restricted); overlies Permain (Cibolo formation). Trinity age.

Named for exposures west of shaft of Presidio Mining Co., Presidio County.

Presque Isle Granite[1]

Precambrian (pre-Animikie) : Northwestern Michigan.

Original reference: R. C. Allen and L. P. Barrett, 1915, Jour. Geology, v. 23, p. 697.

N. K. Huber, 1959, Econ. Geology, v. 59, no. 1, p. 85 (table 1). Considered to be pre-Animikie (pre-Huronian of older reports).

Named for Presque Isle River.

Presque Isle Series[1]

Middle Devonian: Northeastern Michigan.

Original reference: E. R. Pohl, 1930, U.S. Natl. Mus. Proc., v. 76, art. 14, p. 4, 25.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 573. Presque Isle series or stage and its synonym, Long Lake series, are abandoned.

Occurs in Presque Isle and Alpena Counties. Derivation of name not stated.

Presque Isle Volcanics

Precambrian: Michigan and Wisconsin.

T. E. Hendrix, 1960, Dissert. Abs., v. 21, no. 3, p. 594. Incidental mention in discussion of structural history of East Gogebic Iron Range.

†Preston Formation (in Washita Group)[1]

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: R. T. Hill, 1894, Geol. Soc. America Bull., v. 5, p. 302, 303, 326.

Named for Preston, Grayson County.

Preston Gabbro[1]

Carboniferous or post-Carboniferous: Southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 74, 115, 153, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Mainly massive dark-green to purple or black medium- to coarse-grained gabbro, locally porphyritic. Dark speckled quartz-bearing gabbro at western border. Locally converted to coarse amphibolite by shearing; mylonite at contact. Pre-Triassic.

C. B. Sclar, 1958, Connecticut Geol. Nat. History Survey Bull. 88, p. 85–124, map. Preston gabbro is irregular plutonic mass approximately 18 square miles in area. Field evidence suggests that the gabbro is laccolithic mass whose floor is eastern contact and whose roof is western contact, respectively, of gabbro with Putnam gneiss. At least six distinct facies present.

Crops out in Preston Township, New London County.

Preston Hornblende Diorite[1]

Upper Paleozoic(?): Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1–2, p. 128, map.

J. C. O'Brien, 1952, California Jour. Mines and Geology, v. 48, no. 4, p. 265. Commonly a fine-grained gray rock closely cut by quartz veins. Green hornblende more characteristic than brown, though both are present. Intruded by Siskiyou granodiorite. Late Paleozoic(?).

Named for occurrence in Preston Peak, Siskiyou County.

Preston Limestone (in Wabaunsee Group)[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 16, 26, 28.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45. Preston limestone formation was named to include two limestones separated by a shale. This formation lies between the Willard and Auburn

shales. When it was found that these beds represent the "Emporia" of older Kansas surveys, the Nebraska Survey accepted and used name Emporia for a few years, that is, until it was discarded by Moore (1936, Kansas Geol. Survey Bull. 22), when he revived names Elmont and Reading, gave the name Harveyville to shale located between these limestones, and ranked the three divisions each as formations. Although the authors [Condra and Reed] believe that these units represent only members of the Preston limestone their formational rank is accepted, and name Preston limestone is dropped.

Type locality: Near railroad bridge, west of Preston, Richardson County.

Presumpscot Formation

Pleistocene, upper: Southwestern Maine.

A. L. Bloom, 1959, Late Pleistocene changes of sea level in southwestern Maine: New Haven, Conn., Yale Univ., Dept. Geology, p. 55–80. Proposed for the late Pleistocene marine silty clay of southwestern Maine. Thickness 0 to more than 110 feet. Thickness changes rapidly within short distances as formation was deposited on surface of considerable relief. Overlies bedrock, till, or stratified drift.

Named from exposures in valley of Presumpscot River in cities of Portland and Westbrook and adjoining township of Falmouth; no single type section can be given.

Prettymarsh Diorite

Devonian: Southeastern Maine.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1796, 1797. Referred to as diorite and coeval diabase in list of formations. Older than Cadillac granite; younger than Ireson felsite. Devonian (post-Lower Devonian).

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 174, 176, 177. Described as trap or "black granite." Occurs in form of cupolas, chonoliths, laccoliths, and dikes. Texture variable; large masses very coarse grained.

Occurs on Mount Desert Island and nearby islands, Hancock County.

Pretty Meadow Glacial Stage

Pleistocene (Illinoian?): North-central Colorado.

R. L. Ives, 1953, Geog. Rev., v. 43, no. 2, p. 235–237, 238, 249 (table). Time covered by the deposition of the Pretty Meadow moraines. Glaciation also evidenced by a large abandoned melting basin, now known as Pretty Meadow, a smaller melting basin to the north, and several glacially smoothed surfaces at high levels near crest of main range. Older than Albion glacial stage (new).

In Silver Lake Valley near head of Boulder Creek in Boulder County.

Pretty Run sandstone facies (of Logan Formation)

Mississippian (Osage): Central Ohio.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172–173; 1942, Jour. Geology, v. 50, no. 1, p. 54 (fig. 3), 55–60. One of three facies distinguished in the formation. Includes Rushville shale, Vinton sandstone, Allensville conglomerate, Byer sandstone, and Berne conglomerate members; only latter four present at type locality. Lies to east of Scioto Valley shale facies.

Type locality: SE sec. 22, NE sec. 26, and NW sec. 25, T. 10 N., R. 19 W., Vinton County. Facies extends from eastern Scioto County northward into Wayne and Medina Counties.

Preuss Sandstone[1] **or Redbeds**

Upper Jurassic: Southeastern Idaho, north-central Utah, and western Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98, p. 76, 81.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1276 (fig. 8), 1277–1278, 1280 (fig. 10), strat. sections. Preuss redbeds present in western Uinta Mountains where they underlie Stump sandstone and overlie Twin Creek limestone. Measured sections show thicknesses of 669, 858, and 1,196 feet. East of Lake Fork, replaced by crossbedded Entrada sandstone.

R. W. Imlay, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1735–1753. Includes Wolverine Canyon limestone member (new), in Bingham County area, Idaho. Origin and distribution discussed.

Named for Preuss Creek in northeastern part of Montpelier quadrangle, about 12 miles northeast of Montpelier, Idaho. Occurs mainly in area of thrust faulting along Idaho-Wyoming border and in north-central Utah, extending from southern end of Teton Mountains west of Jackson, Wyo., southward to southern end of central Wasatch Mountains near Thistle, Utah.

Prewitt Sandstone Member (of Morrison Formation)

Upper Jurassic: Northwestern New Mexico.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 38. Massive conglomeratic crossbedded sandstone. Overlies Chavez member (new); underlies Brushy Basin member.

C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 16–17, pl. 1. Brown-weathering massive coarse-grained light-pinkish-red conglomeratic sandstone; near base is 4-foot purplish siltstone similar to underlying Chavez member; a similar purplish siltstone with great range of thickness occupies central part of member for many miles. Thickness 185 to 190 feet in type section (herein designated). Stratigraphic interval of Westwater Canyon sandstone member of Morrison in southeastern Utah and northeastern Arizona is approximately equivalent to position of the Prewitt in Thoreau quadrangle; some investigators have extended Westwater Canyon sandstone member into Thoreau quadrangle and applied it to all of sandy facies in upper part of Morrison.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 23. Upper Jurassic.

Type section: South of Mount Powell in western part of Thoreau quadrangle in sec. 9. T. 14 N., R. 13 W. Named for exposures along cliffs north of U.S. Highway 66, north of Prewitt, McKinley County.

Price Sandstone,[1] **Formation, or Siltstone**

Mississippian: Southwestern Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 177, pl. 4.

A. K. Miller, 1936, Jour. Paleontology, v. 10, no. 1, p. 69–72. At least lower part of Price formation is Kinderhook in age. Determination made on basis of goniatite specimen.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 336–350. Names Price and Pocono are practically synonymous. Name Pocono is applied in northern Virginia as far south as Alleghany County. Name Price is applied throughout region from southern Alleghany and western Botetourt Counties to Tennessee. Thicknesses: about 300 feet at Cumberland Gap and Little Stone Gap, Wise County; about 1,000 feet, Pine Mountain; 1,700 feet in Brush and Price Mountains; about 600 feet in Bland and Smyth Counties. Includes Cloyd conglomerate member (new). Underlies Maccrady formation (restricted).

B. N. Cooper, 1948, Jour. Geology, v. 56, no. 4, p. 258, 259. Supposed Osagean age of all of Price formation can no longer be affirmed. Although Keokuk age of upper part of Price seems reliably indicated, the lower parts of formation which contain fossils of early New Providence and Cuyahoga are probably Kinderhookian.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Price siltstone, in Duffield quadrangle, consists of about 400 feet of pale-olive to greenish-gray siltstone, which weathers to light olive gray; contains some interbedded shale. In other regions where Price is apparently coarser grained, it has been referred to as sandstone. Occurs above Big Gap siltstone and below Maccrady shale. Mississippian.

Named for Price Mountain, Montgomery County.

Price River Formation (in Mesaverde Group)[1]

Upper Cretaceous: Central and central eastern Utah and central western Colorado.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, p. 445.

D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852, p. 8–9 (table), 14. Traced eastward from Price River Canyon above Castle Gate, formation thickens greatly, and beyond Price River is divisible into four members (ascending): Castlegate sandstone, Sego sandstone, Neslen coal-bearing member (new), and Farrer non-coal-bearing member (new).

S. C. Schoff, 1938, Ohio State Univ. Abs. Doctors' Dissert. 25, p. 379. Underlies North Horn formation (new) in central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 130–132, fig. 15. Age fixed as Montana and probably late Montana. Unconformably overlies progressively older rocks from east to west.

E. M. Spieker, 1949, Utah Geol. Soc. Guidebook 4, p. 23–26. On west side of Wasatch Plateau, formation almost entirely conglomerate ranging from few tens of feet to over 2,000 feet in thickness. Conglomerate mostly gray to buff, but in northern part of Plateau and in Cedar Hills it is locally red. Unconformably overlies Indianola group.

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2), 2417. Includes Buck shale member in Colorado and Utah.

R. E. Hunt, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 1, p. 120. Overlies South Flat formation (new) in northern part of Gunnison Plateau. Thins and disappears westward in Chicken Creek Canyon and North Maple Canyon.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 186–188, figs. 2, 3, pl. 3. Comprises a western (Farrer) facies and an eastern (Neslen) facies. Members included in Neslen facies are (ascending) Castlegate, Sego, Corcoran (new), Cozzette (new), and Cameo (new). Geographically extended to Colorado. Thickness ranges from about 1,000 to 2,000 feet at western end of Book Cliffs in Utah and from 1,000 to 2,500 feet in western Colorado.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332. p. 11 (table), 13, 14, pls. Restricted at base by removal of Castlegate sandstone which is herein raised to formation rank. Price River (restricted) extends eastward from type locality. South of type locality, it is widespread; to the west, it extends beyond divide between Price River and Spanish Fork of Provo River to valley of Spanish Fork where it forms part of a series of coarse-grained conglomerate beds. In western Book Cliffs, formation is sequence of gray shale beds, about 530 feet thick at Horse Creek. In western Book Cliffs, includes Bluecastle sandstone member at top.

Named for exposures in Price River Canyon, northwest of town of Castlegate, Utah, in Book Cliffs.

Prichard Slate[1] or Formation[1]

Precambrian (Belt Series) : Northern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 29–32, pl. 11. Mostly argillite, blue-black to blue-gray, commonly showing distinct and regular banding. Considerable interbedded gray indurated sandstone. Upper part characterized by numerous alternations of argillaceous and arenaceous layers, and by shallow-water features. Thickness about 8,000 feet. Base not exposed. Underlies Burke formation.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111, 112. Exposed at intervals from northwest corner of Montana to vicinity of Philipsburg, Mont.

R. E. Wallace and J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–M, p. 578–579, pl. 48. Described in western Mineral County, Mont. Contact with Burke and Revett formations undifferentiated is gradational. From junction of Clark Fork and Flathead Rivers southwest to Paradise Ferry across Clark Fork River, an airline distance of 5½ miles, an almost continuous section of the Prichard is exposed in Canyon walls of Clark Fork River and in railroadcuts and roadcuts along the canyons. Discounting unidentified faults, this section is nearly 17,000 feet thick. A few apparently minor faults were identified northeast of the ferry, and top of the section is truncated by a major fault.

J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–P, p. 728, pl. 57. In Murray area, Idaho, formation divided into two mappable units. Lower unit consists of about 75 to 80 percent dark-gray argillite and 20 to 25 percent light-brownish-gray fine-grained impure quartzites. Base of unit not exposed in area, but observed thickness in Bear Gulch about 9,000 feet. Upper unit forms transition zone between lower part and overlying Burke formation. Contains quartzite and argillite in roughly a 2 to 1 ratio. Quartzite ranges from thin bedded, impure, and greenish gray near base to thick bedded, pure, and light gray to white near top. Argillite is thinly laminated; dark-gray fine-grained material alternates with light-

gray coarser grained material. Thickness of unit on ridge running northwest from Goose Peak about 1,800 feet.

Occupies almost entire drainage basin of Prichard Creek, Coeur d'Alene district, Idaho.

Prickly Pear Member (of Spokane Formation)

Precambrian (Belt Series): Western Montana.

C. L. Fenton, and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877, 1878, 1898. Occurs in typical Meagher facies (new) of Belt series. Contains argillites interbedded with sandstones and lenticular conglomerates. Mud cracks and ripple marks common. Thickness 3,000 to 4,500 feet. Underlies Empire member and overlies Greyson member.

Typical Meagher facies interpreted to be exposed along Prickly Pear Creek and in Belt Mountains, central western Montana.

Prida Formation (in Star Peak Group)

Middle Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Lithology variable; basal beds locally quartzitic sandstone, elsewhere conglomerate or coarse fanglomerate; above is 50 to 100 feet of interbedded clastics and brown dolomite and shale, then 100 to 200 feet of dark calcareous shale and thin-bedded limestone; at top thicker-bedded limestone. Average thickness about 250 feet. Unconformably overlies Koipato formation; conformably underlies Natchez Pass formation (new).

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Lower formation in Star Peak group. In Buffalo Mountain quadrangle, overlies Weaver rhyolite of Koipato group, angular unconformity; underlies Natchez Pass formation. Middle Triassic.

Type locality: East Range west of Prida Ranch, Winnemucca quadrangle.

Pride Shale (in Bluestone Formation)[1]

Pride Shale Member (of Bluestone Formation)

Mississippian (Chester): Southwestern Virginia and southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 294, 325.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 182, pl. 15. Redefined and renamed as member of Bluestone formation. In Burkes Garden quadrangle, Virginia, is basal member of formation. Average thickness about 100 feet. Underlies Pipestem shale member; overlies Princeton sandstone.

Type locality: At base of Bent Mountain, just south of Pride, Mercer County, W. Va.

Pride Mountain Formation

Upper Mississippian: Northern Alabama and northeastern Mississippi.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. At type locality, consists of relatively thick units of shale that alternate with thinner units of limestone, sandstone, and siltstone. Has maximum thickness of about 325 feet in Tishomingo County, Miss.; thins eastward to about 150 feet in eastern Lawrence County, Ala. In Colbert County, Ala., and Tishomingo County, Miss., formation is divisible into several

members on basis of the alternation of sandy beds with beds of calcareous shale and limestone (ascending): Alsobrook, Tanyard Branch (new), Wagnon (new), Southward Spring sandstone, Sandfall (new), Mynot sandstone (new), and Green Hill (new). Southward Spring sandstone member not present at type locality. Underlies Hartselle sandstone; overlies Tuscumbia limestone.

Type locality: About 2 miles east of Pride, Ala., and ½ mile south of U.S. Highway 72 in SE¼ sec. 15, T. 4 S., R. 12 W. Named for exposure in roadcuts on northeastern slope of Pride Mountain in north-central Colbert County.

Priest Granite

Precambrian: Central New Mexico.

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1138–1139. Coarse-grained rock composed chiefly of pink feldspar, quartz, and biotite. There are numerous irregular areas of pegmatite with gradational borders into finer grained granite. Contains many xenoliths of schist. Xenoliths of quartzites less common.

Named for occurrence at Priest Peak in Manzano Mountain. Forms northern abutment of belts of Sais quartzite and Blue Springs schist 1 mile north of Abo Pass and continues northward into heart of Manzano Mountains.

Priest Canyon Member (of Fremont Formation)

Upper Ordovician (Richmond): Central Colorado.

W. C. Sweet, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 295–296, 302. Sequence of thin-bedded argillaceous fine-grained dolomite which overlies massive dolomite member throughout central part of outcrop area. In Canon City region, a persistent 4- to 8-foot bed of very finely laminated cherty dolomitic shale occurs at base of member, but not present in sections west of Canon City region. Thickness of 211 feet in Kerber Creek area near head of San Luis Valley, only 75 feet at type section, and becomes thinner on both north and south. Gradational contact with lower member; unconformably underlies Williams Canyon formation.

Type locality: In Priest Canyon, sec. 13, T. 18 S., R. 71 W., Fremont County.

Priest Hill Granite[1]

Upper Devonian: Northwestern New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1935, Geology of Franconia quadrangle, New Hampshire, p. 9.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1023. Considered to belong to New Hampshire magma series, which is probably late Devonian. Considered younger than Bethlehem gneiss and Kinsman quartz monzonite, but older than Bickford granite.

Exposed on Priest Hill, Franconia quadrangle.

Priest Pass Leucomonzonite

Priests Pass Leucomonzonite

Upper Cretaceous: Southwestern Montana.

Adolph Knopf, 1957, Am. Jour. Sci., v. 255, no. 2, p. 81, 94–95, map facing p. 88. Monzonitic composition, nearly devoid of quartz, has only moderate content of biotite and hornblende.

Occurs at Priests Pass [Priest Pass, correct spelling], just south of Mullan Pass, Lewis and Clark and Powell Counties.

Priest River Group

Priest River terrane[1]

Precambrian: Northwestern Idaho and northeastern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 6, 7, 116°30′ to 117°30′.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6, pl. 1. Group is complex sequence of metamorphic rocks that includes phyllites and schists, limestones, dolomites, quartzites, and volcanics in Metaline quadrangle, Washington. Underlies Shedroof conglomerate (new).

Outcrops at and to east of headwaters of Priest River, Idaho.

†Prieta Sandstone[1]

Upper Cretaceous: Central northern New Mexico.

Original reference: C. L. Herrick and D. W. Johnson, 1900, New Mexico Univ. Bull., v. 2, pt. 1, p. 3–63.

In Albuquerque quadrangle. Derivation of name not stated.

Primrose Sandstone (in Springer Group)

Primrose Sandstone Member (of Golf Course Formation)

Primrose Sandstone Member (of Springer Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: E. Roth, 1928, Econ. Geology, v. 23, p. 45.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 900–901. Harlton (1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 8) proposed to subdivide Wapanucka into basal, middle, and upper units. It is now proposed to apply names Primrose and Limestone Gap (new) formations to unit designated as basal Wapanucka. Included by Taff (1902, U.S. Geol. Survey Geol. Atlas, Folio 79) in Chickachoc chert lentils. In frontal Ouachitas and north of Arbuckles, overlies Union Valley sandstone and underlies Limestone Gap shale. North of Arbuckles, Primrose has been known as Union Valley limestone. South of Arbuckles, overlies Lake Ardmore and underlies Limestone Gap shale. Springer group, Morrow series; Morrow is here included in the Bendian.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Shown on correlation chart as Primrose sandstone in Springer group.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2), 97–99. In southern Arbuckles, underlies Gene Autry shale (new). Morrow series.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig. 2), 138. Reallocated to member status at base of Golf Course formation (new). In Dornick Hills group.

Named for Primrose Ridge, in sec. 7, T. 4 S., R. 2 E., on which stand buildings of Primrose dairy farm.

Prince Creek Formation (in Colville Group)

Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 166–167, fig. 2. Includes all nonmarine beds above top of Niakogon tongue (new) of Chandler formation (new) and intertongues with marine Schrader Bluff formation (new). Like the Chandler, it is made up of sandstone, conglomerate, shale, and coal, but contains more bentonite and tuff than does the Chandler. Separated into Tuluvak tongue (new) below and Kogosukruk tongue (new) above. Underlies Sagavanirktok (new) and Gubik formations.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 69, 70, 126–127, pls. Exposures of formation in Utukok-Corwin region are restricted to cutbacks in Arctic coastal plain province and north edge of northern foothills section along Utukok and Kokolik Rivers, where they form dark-gray vertical cliffs. Formation includes sandstone, conglomerate, ironstone, coal, bentonitic clay, shale, and claystone. Total thickness not known. Maximum exposed thickness about 93 feet. Overlies Corwin formation; unconformably underlies unconsolidated deposits of Quaternary age.

Type locality: Prince Creek, a tributary to Colville River.

Princes Anne Formation (in Columbia Group)[1]

Pleistocene: Eastern Virginia, eastern Maryland, and eastern North Carolina.

Original reference: C. K. Wentworth, 1930, Virginia Geol. Survey Bull. 32, p. 81.

S. W. Lohman, 1936, U.S. Geol. Survey Water-Supply Paper 773, p. 13. Surface of Pasquotank and Camden Counties, in vicinity of Elizabeth City, N.C. is underlain by fine sands and sandy loams of the undifferentiated Pamlico and Princess Anne formations, which are lowermost terrace deposits along Atlantic coast and are youngest formations of Columbia group. Terrace deposits conceal marine beds of Pleistocene and Pliocene age or both.

Named for typical occurrence at village of Princess Anne, Princess Anne County, Va.

†Princeton Limestone[1]

Mississippian: Western Kentucky.

The original use of this name is said to be by Ulrich in Crittenden Press, Dec. 1890. This publication is not in U.S. Geological Survey Library nor in Library of Congress.

Probably named for Princeton, Caldwell County.

Princeton Quartz Monzonite[1]

Tertiary: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 78.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 25. Now designated Mount Princeton quartz monzonite.

Named for Mount Princeton, north of Monarch-Tomichi district.

Princeton Sandstone (in Pennington Group)

Princeton Sandstone[1]

Upper Mississippian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 489.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 180–181, pl. 15. Described in Burkes Garden quadrangle where it is about 30 to 50 feet thick, overlies Pennington formation, and underlies Bluestone formation.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Upper Mississippian.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Assigned to the Pennington herein raised to group rank. Overlies Hinton formation; underlies Bluestone formation. Thickness about 50 feet in Duffield quadrangle, Virginia.

Named for Princeton, Mercer County, W. Va.

Princeton Series[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: R. C. Allen, 1914, Jour. Geology, v. 22, p. 571.

Named for Princeton mine, Gwinn district, Marquette County.

Pringle Andesite[1]

Tertiary: Central southern Colorado.

Original reference: W. Cross, 1890, Colorado Sci. Soc. Proc., v. 3, pt. 3, p. 276.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, the volcanics, in order of decreasing age, consist of Rosita fragmental andesite, Bunker massive andesite, Fairview diorite in dike cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Forms upper part of Pringle Hill, west of Rosita, Silver Cliff-Rosita region.

Proctor Dolomite[1]

Upper Cambrian: Central and eastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 366.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236. Considered to be upper part of Eminence formation in certain areas.

Named for exposures on Proctor Creek, Morgan County.

Proctor Sandstone (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: I. C. White, 1883, The Virginias, v. 4, p. 124.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Proctor sandstone in Greene formation listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness 45 to 65 feet (full thickness not present). Overlies Windy Gap limestone.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Lower, Middle, and Upper Proctor sandstone listed at top of Greene series.

Named for occurrence below mouth of Proctor Creek, just south of Marshall-Wetzel County line.

Prospect Formation

Pleistocene: South-central Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19 (fig. 3), 20–21, pl. 1. Silts, sands, and fine gravels similar to Martinsville formation (new) but more deeply weathered. Occurs as eroded terraces 20 to 50 feet above flood plain of present streams. Exposed thickness about 30 feet. Thickness 18 feet at type section (east of area of this report). Overlies most of bedrock formations of area; underlies parts of Martinsville formation; probably underlies windblown sand facies of Atherton formation (new) and probably intertongues with sand and gravel facies of Atherton. Early Wisconsin, Sangamon, or perhaps Illinoian. Name credited to W. J. Wayne (in preparation).

Type section: Along U.S. Highway 150, just west of village of Prospect, Orange County.

Prospect Gneiss

Prospect Porphyritic Gneiss[1]

Ordovician or Devonian: Southwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 59, 102–104, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey; John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 16. Age of Prospect gneiss designated pre-Triassic.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 14–17, pl. 1. Restricted to the dark-gray biotite augen gneiss; the interbanded schists are considered part of undifferentiated Hartland formation. Prospect gneiss always found at same stratigraphic position, that is, between The Straits schist member and the quartzitic member of Hartland formation.

Crops out in eastern part of Prospect Township, New Haven County.

†Prospectan series[1]

Cambrian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 51, 53, 80.

Prospect Hill Formation (in North Hill Group)

Prospect Hill Sandstone Member (of Hannibal Shale)[1]

Prospect Hill Siltstone Member (of Hannibal Formation)

Lower Mississippian: Southeastern Iowa and western Illinois.

Original reference: R. C. Moore, 1928, Missouri Bur. Geology and Mines, v. 21, 2d ser., p. 22, 23–24.

L. A. Thomas, 1949, Geol. Soc. America Bull., v. 60, no. 3, p. 408–409, 410. Referred to as siltstone member of Hannibal formation. Conodont assemblage indicates Lower Mississippian age.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 30. Included in North Hill group. In this

report, name Prospect Hill formation is used for the siltstone that, in Adams and Hancock Counties, occupies stratigraphic position in North Hill group between McCraney limestone (below) and Starrs Cave limestone. Essentially light-gray to buff calcareous pyritic massive siltstone. From eastern limit, thickens westward to maximum of 29 feet.

First described at Prospect Hill, near Burlington, Des Moines County, Iowa.

†Prospect Mountain Limestone[1]

Middle Cambrian: Eastern Nevada.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 254–259.

Named for exposures on Prospect Mountain, Eureka district.

Prospect Mountain Quartzite[1]

Lower Cambrian: Eastern Nevada, eastern California, and western Utah.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d. Ann. Rept., p. 253. 254–259.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1139–1140, 1141 (fig. 5), 1142, 1156–1158. In House Range area, Utah, underlies Pioche shale. Thickness about 1,000 feet. In Highland Range, Nev., underlies Pioche shale; thickness about 450 feet.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 17–18, 33, 34. In Eureka district, underlies Eldorado formation; thickness 1,660 feet; base not exposed. In Pioche district, underlies Pioche shale; thickness 2,000 feet; base not exposed.

H. E. Wheeler, 1943, Geol. Soc. America Bull., v. 54, no. 12, pt. 1, 1786, 1788, 1792–1793, 1796–1797, 1808–1811. Prospect Mountain quartzite (Eureka district, Nevada) is present throughout entire region [Great Basin], ranging from Upper Algonkian(?) and Lower Cambrian in eastern Nevada and western Utah to lower Middle Cambrian in northwestern Arizona (Granite Gorge), central Arizona, northwestern Utah, and southeastern Idaho. The quartzite had been locally designated as Tapeats sandstone, Tintic, and Brigham quartzites. In Granite Gorge area, name Prospect Mountain substituted for term Tapeats.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 146–147 (fig. 2). On correlation chart of recommended revision of stratigraphic units in Great Basin region, Prospect Mountain quartzite is replaced by Stirling quartzite in Death Valley, Providence Mountains, and Nopah-Resting Springs Mountains, Calif.; by Tapeats sandstone in Grand Canyon; by Tintic quartzite in central Utah; and by Brigham quartzite in southeastern Idaho.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 30–31, pl. 2. In Providence Mountains, replaces preoccupied term Tough Nut quartzite (Hazzard, 1938). Underlies Latham shale (new) which replaces preoccupied term Kelso. Maximum thickness 1,085 feet. Unconformable above Precambrian granite, gneiss, and schist.

F. D. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 28, 29–31, 36 (fig. 6), pl. 1. Described in Ivanpah quadrangle (California-Nevada) where, together with the Noonday dolomite and Pioche shale, it makes up what is termed western facies of the Cambrian. Well exposed and underlies large areas in broad belt that extends from Clark Mountain 30 miles

northwest to hills that lie 10 miles north of Kingston Range. Thickness 3,000 to 5,000 feet.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 6–7. Described in vicinity of Eureka, Nev., where total area of outcrop is about half a square mile. Forms discontinuous hook-shaped band that extends northward from west slope of Prospect Peak to south side of Ruby Hill and then swings southward along east side of ridge nearly to Eureka Tunnel; discontinuity due in part to transgression of outcrop band by Spring Valley fault. Total thickness unknown as base not exposed. Conformable below Pioche shale.

K. F. Bick, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1065–1066. In Deep Creek Mountains, Utah, stratigraphically restricted below to exclude 3,000-foot sequence of alternating quartzite and shale units here named Goshute Canyon formation. As restricted, Prospect Mountain is 3,000 feet thick and consists completely of quartzite. Underlies Pioche shale (Cabin shale).

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 159. In Ely area, overlies Piermont group (new).

Named for occurrence in Prospect Peak, Eureka district, Nevada.

Prospect Peak Basalts[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 682. Cenozoic.

Occur in Lassen National Park.

Prosperity Limestone Member (of Greene Formation)[1]

Permian: Southwestern Pennsylvania and southeastern Ohio.

Original references: F. G. Clapp, 1907, U.S. Geol. Survey Bull. 300, p. 13, 128; 1907, U.S. Geol. Survey Geol. Atlas, Folio 144; name suggested by M. J. Munn; 1907, U.S. Geol. Survey Bull. 318, p. 77.

Named for village of Prosperity, Washington County, Pa.

Prosser Member (of Galena Dolomite)

Prosser Limestone[1]

Middle Ordovician: Southeastern Minnesota, northwestern Illinois, and northeastern Iowa.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, p. 368, 369, 524, 525, pl. 27.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29. Member of Galena formation. Underlies Stewartville member; overlies Decorah shale member. Chiefly hard compact drab limestone with subordinate amount of shale; some beds fairly thick, especially in upper middle part; several cherty horizons. Thickness 115 to 120 feet at type section herein designated.

M. P. Weiss, 1955, Jour. Paleontology, v. 29, no. 5, p. 764, 765. In Minnesota, restricted at base to exclude interbedded limestones and shaly limestones here named Cummingsville member of Galena.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1029 (fig. 1), 1037–1039, 1054–1058, pl. 3. Described in Fillmore County, Minn., where

it is middle member of Galena formation; overlies Cummingsville member; underlies Stewartville member. First reference to term Prosser was by Winchell and Ulrich (1897, Minnesota Geol. Nat. History Survey Final Rept., v. 3. pt. 2) when they diagrammed and described a section in Galena limestone from Prosser's ravine near Wykoff, Fillmore County, Minn. This section now known to be in valley of Mahood's Creek, and the real Prosser's ravine exposes only 25 feet of uppermost Stewartville rock. Winchell and Ulrich's section is similar to Part F of Mahood's Creek section (pl. 3) of present report, except that lower 37 feet is no longer accessible above mouth of Mahood's Creek. Member name was given by Ulrich (1911) who intended Prosser to be a formational name for a faunal zone. Stauffer and Thiel (1941) described a new measured section from valley of Mahood's Creek at Wykoff, although they still referred to it as Prosser's ravine. From about 180 feet of limestone bounded by *Prasopora* below and upper *Receptaculites* zone above, the Prosser is restricted in this report to limestone lying between very argillaceous limestone below and dolomitic limestone above. Both these boundaries in Fillmore County are delineated arbitrarily. Type section includes good exposure of member but no longer exposes its base. Concept of type section here expanded to include all exposures listed as parts of Mahood's Creek measured section (F192), and these include exposures of entire member with distance of half a mile. Thickness 51 feet at type locality. Toward the southeast, where lower Galena cannot be recognized as Cummingsville, the middle Galena is also unrecognizable as Prosser. The Cummingsville is not a phase or facies of the Galena. Name Prosser, whether restricted or not, is applicable only over relatively small part of upper Mississippi Valley. To give new name to strata in restricted Prosser of Weiss (1955) and present report would require suppression of name Prosser.

Type section (Stauffer and Thiel): Prosser Creek, 2½ miles west of Wykoff, Fillmore County, Minn.

Type section (Weiss): Mahood's Creek section compiled from several exposures in valleys of Spring Valley and Mahood's Creeks from about center of south edge of SE¼ sec. 8 southward to head of Mahood's Ravine along south edge of SE¼ sec. 20, T. 103 N., R. 12 W., Fillmore County.

Prout Limestone[1]

Prout Limestone Member (of Olentangy Shale)

Middle Devonian: Northern Ohio.

Original reference: C. R. Stauffer, 1907, Jour. Geology, v. 15, p. 592.

E. C. Stumm, 1942, Jour. Paleontology, v. 16, no. 5, p. 549–553. Prout limestone and underlying Plum Brook shale form bedrock along an arcuate line running from northeast to southwest through Erie County from Slate Cut, just south of shore of Lake Erie and 4 miles east of Sandusky, to Strong's Ridge, just northeast of Bellevue. The Prout is a hard, siliceous limestone 3 to 9 feet thick. Underlies Ohio shale.

R. E. Metter, 1953, Ohio Geol. Survey Rept. Inv. 18, p. 14. Prout limestone member of Olentangy shale underlies Huron shale in exposure at Slate Cut on U.S. Route 6, three-fourths mile east of new Cedar Point entrance.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 8–15. Stratigraphic position and correlation of Olentangy shale discussed in detail. It is here suggested that the Olentangy, Plum Brook shale, Prout limestone, Silica

shale, and Ten Mile Creek dolomite are stratigraphically correlatable, with reservation that Olentangy is probably Upper Devonian. At various times and by different authors, Plum Brook shale has been correlated with the Olentangy, and the so-called Prout limestone has been regarded as member of Olentangy. Regional information regarding Plum Brook shale-Prout limestone has not been worked out. Thickness of 36 feet for Plum Brook shale and Prout limestone has been reported in its area of outcrop in Erie County.

Type locality: Cut on B. & O. Railroad, 6 miles south of Sandusky and 1 mile north of Prout, Erie County.

Prout Series[1]

Middle Devonian: Northern Ohio.

Original reference: A. W. Grabau, 1915, Geol. Soc. America Bull., v. 26, p. 112.

Probably named for Prout, Erie County.

Providence Limestone Member (of Lisman Formation)

Providence Limestone (in McLeansboro Formation)[1]

Providence Limestone Member (of Dugger Formation)

Middle Pennsylvanian: Western Kentucky and west-central Indiana.

Original reference: L. C. Glenn, 1922, Kentucky Geol. Survey, ser. 6, v. 5, p. 98.

E. J. Harvey, 1956, U.S. Geol. Survey Water-Supply Paper 1356, p. 47, 55 (fig. 9), 64, 65, 67. Reallocated to member status in Lisman formation. In Henderson area, consists of gray fossiliferous strata that vary from massive and compact to thin and shaly. Thickness varies—maximum 10 feet. Overlain by No. 12 coal or, in places, by Anvil Rock sandstone member; basal member of formation, overlies No. 11 coal in Carbondale formation.

H. H. Murray, 1955, Indiana Geol. Survey Directory 3, p. 8 (fig. 1). Shown on stratigraphic column as member of Dugger formation in Indiana.

Well exposed in and about Providence, Webster County, Ky.

Providence Sand (in Selma Group)

Providence Sand Member (of Ripley Formation)[1]

Upper Cretaceous: Western Georgia and southeastern Alabama.

Original reference: Otto Veatch. 1909, Georgia Geol. Survey Bull. 18, p. 86.

C. W. Cooke and C. A. Munyan, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 791; C. W Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 34–39. Rank raised to formation. Unconformably overlies Ripley formation and transgresses across it in its extension to northeast in Georgia. Overlapped by Paleocene Clayton formation east of Flint River.

D. H. Eargle, 1948, Southeastern Geol. Soc. [Guidebook] 6th Field Trip, p. 44, 51–53; 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 105; 1955, U.S. Geol. Survey Bull. 1014, p. 69–83, pls. 1, 2. Subdivided to include Perote member (new) in lower part. At type locality of Providence, the variegated coarse sand of upper unnamed member is about 144 feet thick and overlies about 40 feet of fossiliferous fine sand of Perote member. In Alabama grades laterally westward into Prairie Bluff chalk. In Alabama, Providence included in Selma group.

Named for exposures on deep gullies at Providence, 8 miles west of Lumpkin, Stewart County, Ga. In Georgia, occurs in broad belt from Chattahoochee River in Clay and Quitman Counties northeastward to Flint River valley in Peach and Macon Counties; farther east, present in outliers in deeper stream valleys as far as Ocmulgee River valley. East of Ocmulgee River cannot be distinguished from underlying Cretaceous formations.

Providence Island Limestone or Dolomite

Lower Ordovician (Canadian) : Northwestern Vermont.

E. O. Ulrich. 1938, *in* E. O. Ulrich and G. A. Cooper, Geol. Soc. America Spec. Paper 13, p. 26, pl. 58 (columns 24, 27). Limestone which underlies Chazyan beds and overlies Cassin formation

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 11, 63, 92–93, pls. 1 2. Described on Isle La Motte and South Hero Island as a dark-blue and gray fine-grained generally massive dolomite. At type locality, underlies Day Point limestone. Type locality cited and several exposures described.

Type section said to be on Providence Island in Lake Champlain. Other exposures at extreme end of Isle La Motte and at southwestern end of South Hero Island in Lake Champlain.

Providence Mountains Limestone

Pennsylvanian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 240. Listed as underlying Mount Edgar limestone (new), possible unconformity, and overlying Mississippian Monte Cristo limestone, possible unconformity. Thickness 825 feet.

Occurs near Kelso, in Providence Mountains, San Bernardino County.

†Provo Epoch[1]

†Provo Stage[1]

Provo Epoch is name applied to the time during which Lake Bonneville of Utah stood at the Provo Stage.

Terms have been abandoned by U.S. Geological Survey.

Provo Formation (in Lake Bonneville Group)

Pleistocene: West-central Utah.

K. C. Bullock, 1951, Utah Geol. and Mineralog. Survey Bull. 41, p. 21–22. Youngest of Lake Bonneville deposits—that is younger than Bonneville and Alpine formations. Divided into four units: gravel, sand, silt, and clay members; stratification and sorting well developed. Name credited to H. J. Bissell (unpub. thesis).

C. B. Hunt, H. D. Varnes, and H. E. Thomas, 1953, U.S. Geol. Survey Prof. Paper 257–A, p. 13, 21–25, pl. 1. Deposited during what Gilbert (1890, U.S. Geol. Survey Mon. 1) called Provo stage. In most of the valley, rests on Alpine formation; locally rests on glacial outwash or on pre-Lake Bonneville deposits. Thickness about 19 feet. Included in Lake Bonneville group.

Well developed at base of Wasatch Mountains in form of terraces, deltas, spits, bars, beaches, and deeper water deposits. Well developed on western side of Lake Mountain.

Pruett Formation (in Buck Hill Volcanic Series)

Pruett Formation (in Green Valley Volcanic Series)

Eocene(?) or Eocene, upper: Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Constitutes lower 900 feet of Green Valley volcanic series. Underlies Cottonwood Spring basalt (new). Includes intercalated lava flows (ascending): Crossen trachyte, Sheep Canyon basalts, and Potato Hill andesite. Overlies Boquillas limestone.

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Oct. 29–31, p. 13, 14 (table 1), 17 (fig. 3), 18–19. Basal unit of Buck Hill volcanic series. [Authors make no reference to term Green Valley volcanic series.]

S. S. Goldich and M. A. Elms, 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1138 (table 1), 1144 (fig. 3), 1145–1151, pl. 1. Chiefly tuff, gray to bluish-gray, but variegated and banded in many colors generally well lithified; commonly calcareous grading into fresh-water limestone; upper breccia, 6 feet thick; basal conglomerate and arkosic sandstone; includes intercalated lava flows as noted above. Thickness 900 to 1,000 feet. Unconformable above Boquillas limestone. Eocene(?). Derivation of name given.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 542–546, pl. 1. Described in Cathedral Mountain quadrangle. Intercalated lava flows are here treated as separate formations and name Pruett restricted to the tuff, sandstone, conglomerate, and limestone below Crossen trachyte. Thickness between 474 and 798 feet. Vertebrate fossils indicate late Eocene (Duchesne) age.

Named for Pruett Ranch, north-central Buck Hill quadrangle, Brewster County.

Pryor Conglomerate Member (of Cloverly Formation)[1]

Lower Cretaceous: Central southern Montana and central northern Wyoming.

Original reference: C. J. Hares; 1917, Washington Acad. Sci. Jour., v. 7, p. 429.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 42–43, pl. 1. Described in Bighorn Canyon, Hardin area, where it is composed of resistant sandstones, commonly with chert-pebble-bearing conglomerates at base. Ranges in thickness from about 30 feet at Soap Creek dome, where it is not conglomeratic, to 150 feet south of mouth of Bighorn Canyon. Occurs at base of formation. Where Pryor is absent, it is difficult to differentiate Cloverly from underlying Morrison.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1143, 1145, 1147–1148, pl. 1. In this report [northern Bighorn Basin], Cloverly formation is redefined on lithogenetic basis. Name Pryor conglomerate retained for well-defined basal chert-pebble-conglomerate in northern part of area. Unit is of limited extent; unconformably overlies Morrison formation in outcrops from Sykes Mountain northwestward to Red Dome and at some exposures on west side of basin. Locally underlies Little Sheep mudstone member (new).

First described at base of Pryor Mountains, Carbon County, Mont.

Pryor Creek Shale (in Cherokee Shale)[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 13.

Well exposed in vicinity of town of Pryor Creek, Mayes County.

Puckett Sandstone Member (of Mingo Formation)[1]

Middle Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 40.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 99, 102, 104, 148. In Mingo formation between Wallins Creek coal (above) and Slater sandstone.

Named for Puckett Creek, Bell County, Ky.

Puckmummie Schist[1]

Post-Ordovician(?): Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geol. Survey Bull. 433, p. 50, 62, map.

Well exposed on lower part of Puckmummie Creek and on rocky knob to east, in low hill northwest of Post Creek, and in a few scattered outcrops in Seward Peninsula.

Puckwunge Conglomerate[1]

Puckwunge Formation (in Keweenawan Group)

Precambrian: Northeastern Minnesota.

Original reference: N. H. Winchell, 1897, Am. Geologist, v. 20, p. 50–51.

G. M. Schwartz, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1003, pl. 1. Formation underlies Keweenaw Point volcanics; overlies Thomson slate.

G. M. Schwartz, 1949, Minnesota Geol. Survey Bull. 33, p. 18, 36, In Duluth area, consists of some conglomerate at base that grades upward into gray sandstone. Overlies Thomson slate. Thickness 100 to 200 feet.

F. F. Grout, H. P. Sharp, and G. M. Schwartz, 1959, Minnesota Geol. Survey Bull. 39, p. 13 (table 1), 29–30. Formation at base of Keweenawan group. Exposures along bluffs south of Pigeon River indicate thickness of at least 100 feet and maximum of 200 feet seems reasonable. Structurally conformable to Rove below and lava flows above. Area of report, Cook County.

Name derived from Puckwunge (Stump) River, a tributary of Pigeon River in T. 64 N., Rs. 3 and 4 E., Cook County.

†Puckwunge Slate[1]

Precambrian (upper Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1897, Am. Geologist, v. 20, p. 50–51.

Extends across Puckwunge Valley. Probably named for stream that enters Pigeon River from west to north of Grand Portage village, Cook County.

Pucro Sandstone

Pucro Sandstone Member (of Gatún Formation)

Miocene, middle: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no. 29, p. 132, 134 (correlation chart). Overlies Tuira formation; underlies Chucunaque formation. Contains typical Gatun fauna. Middle Miocene.

R. A. Terry, 1956, California Acad. Sci. Occasional Paper 23, p. 50, 51, 55. Uppermost member of Gatún formation. Thickness 1,500 to 2,000 feet.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 344. Miocene. Note on locality.

Río Pucro is southwestward flowing tributary of Río Tuira. American Geographical Society's sheet N. B–18 shows village of same name on Río Pucro.

Pueblan series

Cretaceous (Mid-Cretacic): New Mexico.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 2, p. 119 (plate 12); 1940, v. 74, no. 3, p. 213. The Cordilleran geosynclinal. Cretacic sediments on the east side of the Rocky Mountains include (ascending) Graneros shales, Greenhorn limestones, Carlile shales, Timpas limestones, and Apashapa shales.

Pueblo Formation[1]

Mesozoic or older: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Pueblo Mountains, southern part of Harney County.

Pueblo Formation (in Wichita Group)

Pueblo Formation (in Cisco Group)[1]

Pueblo Group

Permian (Wolfcamp): Central and central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

C. O. Nickell, 1938, *in* Wallace Lee and others, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 132–134. Formation includes (ascending) Camp Creek shale, Coon Mountain sandstone, Stockwether limestone, a series of shale beds with some sandstones and thin limestones, and Camp Colorado limestone members. Overlies Harpersville formation; underlies Moran formation of Wichita group. Pennsylvanian.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91, 93. Rank raised to group and expanded below to redefined Permian-Pennsylvanian boundary (Wolfcamp-Cisco) which is placed at disconformity in Harpersville formation above Waldrip-Newcastle coal zone about 40 to 150 feet below Saddle Creek limestone. As redefined. includes (ascending) Saddle Creek, Stockwether, and Camp Colorado formations. Underlies Moran group; overlies Thrifty group (redefined).

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Formation includes beds lying between disconformity at base of Waldrip shale and top of Camp Colorado limestone. Average thickness in southern Coleman County 225 feet. Comprises (ascending) Waldrip shale, Saddle Creek limestone, Camp Creek shale, Stockwether limestone, Salt Creek Bend shale, and Camp Colorado limestone members. Underlies Moran formation; overlies Pennsylvanian Cisco group.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 267–270. Formation, in Brazos River valley, comprises (ascending) Waldrip shale, Saddle Creek limestone, Camp Creek shale, Stockwether limestone, Salt Creek Bend shale, and Camp Colorado shale members. Thickness 275 to 400 feet. Overlies Chaffin limestone member of Thrifty formation; underlies Watts Creek shale member of Moran formation. Locally, Chaffin and underlying shale members of Thrifty are absent and Pueblo rests on rocks as old as Breckenridge member of Thrifty. Boundary between Pueblo and Moran not mapped north of Elm Creek (east-central Throckmorton and west-central Young Counties); boundary difficult to discern because of probable absence of Camp Colorado limestone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 75–76, pl. 27. Formation in Brown and Coleman Counties comprises (ascending) Waldrip shale, Saddle Creek limestone, Camp Creek shale, Coon Mountain sandstone, Stockwether limestone, Salt Creek Bend shale, and Camp Colorado limestone members. Overlies Chaffin limestone member of Thrifty formation. Permian. Only lower part of formation discussed in this report.

Named for exposures along valley of Battle Creek at Pueblo, Callahan County.

†Pueblo Limestone Member (of Pueblo Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

Type locality of Pueblo formation: In Pueblo Mountains, southern part of Callahan County.

†Pueblo Quartzite[1]

Precambrian: Central northern New Mexico.

Original reference: J. W. Gruner, 1920, Jour. Geology, v. 28, p. 731–742.

Exposed at head of Pueblo Creek, Tps. 26 and 27 N., Rs. 14 and 15 E., Taos County.

Pueblo Mountain Series[1]

Tertiary, upper: Northwestern Nevada and southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington Univ. Pub. Geology, v. 3, no. 1, p. 14.

Occurs on Pueblo Mountain.

Pueblo Range Series[1]

Miocene, lower: Northwestern Nevada.

Original reference: J. C. Merriam, 1910, California Univ. Pub., Dept. Geol. Bull., v. 6, no. 2, p. 26–52, pl. 2.

On west side of Pueblo Range.

Puente Formation[1]

Miocene, upper: Southern California.

Original reference: G. H. Eldridge and R. Arnold, 1907, U.S. Geol. Survey Bull. 309.

M. L. Krueger, 1936, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1520. In Whittier Hills, underlies Sycamore Canyon formation (new).

M. L. Krueger, 1943, California Div. Mines Bull. 118, p. 363 (fig. 150). Upper part of Puente in Chino area divided into (ascending) Papel

Blanco shale, Blanco sandstone, Cubierto shale, Hunter sandstone and conglomerate, Peculiar shale, and Mahala sandstone and conglomerate (all new).

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 515, 516–517 (fig. 2), 519–523. Described in Puente and San Jose Hills where it is divided into three unnamed members: lower of shale and sandstone, middle of sandstone, and upper of shale, conglomerate, and sandstone. Delimitation of middle sandstone is key to threefold division. Thickness possibly 9,000 feet in Puente Hills; thinner in San Jose Hills. Krueger's (1943) subdivisions of upper Puente recognized in Slaughter Canyon and thicknesses measured. Overlain by sediments assigned to Repetto formation. In some areas, overlies Buzzard Peak conglomerate member (new) of Topanga formation.

S. N. Daviess and A. O. Woodford, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 83. In this report [northwestern Puente Hills], four divisions of Puente are recognized: lower siltstone member made up chiefly of interbedded siltstone and sandstone: sandstone member: upper siltstone member; and conglomeratic unit, Sycamore Canyon member. Krueger called this conglomeratic part of upper Puente the Sycamore Canyon formation. For purposes of this report, the unit is treated as local member of Puente because lower beds of conglomerate lens out within map area and in places interfinger with beds of upper siltstone member. Maximum thickness 8,500 feet or more. Underlies Repetto formation. Suggested that different plan of nomenclature for rocks herein assigned to the Puente may be desirable.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Subdivided into (ascending) La Vida, Soquel, and Yorba (all new), and Sycamore Canyon members. Overlies El Modeno volcanics (new). On Burruel Ridge, Sycamore Canyon member is unconformably overlain by Repetto(?) formation. Late Miocene; correlative with Modelo formation of Santa Monica Mountains and with parts of Monterey formation.

R. F. Yerkes, 1957, U.S. Geol. Survey Prof. Paper 274–L, p. 326, pl. 46. In El Modeno area, strata of Puente formation rest with apparent conformity upon El Modeno volcanics. North of Santiago Creek and elsewhere strata overlap El Modeno volcanics, and Topanga, Vaqueros, and Sespe formations. Average thickness about 1,800 feet. In type area, to northwest of El Modeno, formation reaches thickness of about 11,000 feet.

Named for occurrence in Puente Hills, in southern part of Los Angeles County.

Puercan Age

Paleocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 8, pl. 1. Provincial time term, based on the Puerco formation of the San Juan Basin, northwestern New Mexico, type locality, Rio Puerco area. Covers the interval from Upper Cretaceous to Dragonian (Paleocene) time.

Above report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. Paleocene: Puercan, Dragonian, Torrejonian, Tiffanian, and Clarkforkian; Eocene: Wasatchian, Bridgerian, Uintan, and Duchesnean; Oligocene: Chadronian,

Orellan, and Whitneyan; Miocene: Arikareean, Hemingfordian, and Barstovian; Pliocene: Clarendonian, Hemphillian, and Blancan.

Most typical and only fossiliferous exposures, the escarpment running from northwest of Ojo Alamo about 25 miles to Arroyo Eduardo, east of Kimbetoh, [New Mexico].

Puercan series[1]

Upper Cretaceous: New Mexico.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, no. 4, p. 289.

Puerco Formation (in Nacimiento Group)[1]

Paleocene: Northwestern New Mexico.

Original reference: E. D. Cope, 1875, Ann. Rept. Chief Engrs. USA, Rept. Secy War to 44th Congress, v. 2, pt. 2, p. 1008–1017.

T. E. Reynolds, 1936, Jour. Paleontology, v. 10, no. 3, p. 202. Formation has limited exposure in New Mexico. Lower Paleocene.

H. E. Wood 2d and others. 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 29, pl. 1. Overlies Ojo Alamo formation; underlies Torrejon formation. Paleocene (Puercan).

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 272. Puerco and Torrejon are not recognizable except as faunal zones in San Juan basin; here this part of stratigraphic sequence is considered as single formation, the Nacimiento, containing Puerco and Torrejon faunas.

Named for occurrence in valley of upper Puerco River.

Puertecito Formation[1]

Lower Cretaceous(?) to base of Triassic: Northwestern New Mexico.

Original reference: E. H. Wells, 1919, New Mexico School Mines Bull. 3 [1920].

Christina Lochman-Balk, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 108. Sedimentary beds between Permian and Cretaceous. Purple-red and purple-gray sandstones, shales, and conglomerates. Thickness 1,150 to 1,250 feet. New Mexico Bureau Mines recommends abandoning term.

Puertecito district, Socorro and Valencia Counties.

Puerto Ferro Limestone[1]

Miocene: Puerto Rico.

Original reference: H A. Meyerhoff, 1933, Geology of Puerto Rico, p. 74.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 337. Name given to Miocene deposits of island of Vieques, consisting of well-stratified limestone with some non-calcareous impurities, and containing numerous foraminifera, mollusca, and corals. Thickness about 200 feet. Rests discordantly on Cretaceous rocks.

Occurs on Vieques Island.

Puffy Member (of Katalla Formation)

Puffy Shale Member (of Redwood Formation)[1]

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 773.

D. J. Miller, D. L. Rossman, and C. A. Hickcox, 1945, Preliminary report on petroleum possibilities in the Katalla area, Alaska: U.S. Geol. Survey, p. 7 (table), 13; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Redefined as member of Katalla formation. Extends from base of lowest bed of shale-matrix conglomerate through the highest exposed Tertiary beds in Katalla area. Consists of dark-gray massive partly sandy shale, many beds of coarse- to medium-grained sandstone, and several thick beds and lenses of conglomerate. More than 3,700 feet thick. In unpublished manuscript by oil company geologists, Puffy conglomerate and Puffy shale treated as two distinct units in Redwood formation.

W. Waloweek and W. L. Norem, 1957, Jour Paleontology, v. 31, no. 3, p. 674–675. Miocene.

Named from exposures along Puffy Creek, Katalla district, Controller Bay region.

Puget Group[1]

Eocene and Oligocene(?): Western Washington.

Original reference: C. A. White, 1888, Am. Jour. Sci., 3d, v. 36, p. 443–450.

C. E. Weaver. 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 26, (table), 53-74. Thick series of massive sandstone, shales, interstratified sandstone, intercalated layers of carbonaceous shales, and coal seams; units vary in lithology from one locality to another, making it impossible to correlate details of any sequence at one locality with the stratigraphic columns at other adjacent places. The strata, which are all of continental origin, usually occur in shallow or closely compressed plunging anticlines synclines which in most localities have been displaced as the result of complex faulting. In Green River area, group includes (ascending) Bayne, Franklin, and Kummer formations; in Carbon River area includes (ascending) Carbonado, Wilkeson, and Burnett formations.

W. C. Warren and others, 1945, Preliminary map of the coal fields of King County, Washington: U.S. Geol. Survey. Described in King County where it overlies and interfingers with volcanic series of Eocene age; consists of sandstones, shale, and carbonaceous beds and is undifferentiated. In Newcastle-Issaquah area, group is 3,000 to 3,200 feet thick and is overlain by marine Oligocene beds. Southeast of Reton, group is overlain with slight angular discordance by marine beds of Oligocene and Miocene age. Farther east at Cedar Mountain, no Oligocene and Miocene sedimentary beds appear, but shales at top of group have increased in thickness from about 300 feet near Renton to about 1,200 feet at Cedar Mountain. Where well-exposed along Green River, group is at least 6,500 feet thick and base is not exposed. Top of group, as exposed in western part of Green River district, occurs in sec. 25, T. 21 N., R. 6 E., where Kummer syncline crosses river. In this syncline, the group is overlain by rocks of volcanic origin. Along east edge of Green River district, uppermost 500 feet of group includes tuffaceous sediments and tuff beds, which are not easily distinguished from tuffs in overlying Keechelus andesitic series. Relation of Puget group of Green River district to Puget group in northern coal fields of King County is uncertain. The two groups may be equivalent, or the Puget group in Green River district may be equivalent to the combined Cowlitz(?) formation, the overlying group of the northern area.

D. R. Crandell and L. M. Gard, Jr., 1960, U.S. Geol. Survey Geol. Quad. Map GQ–125. Oldest rocks exposed in Buckley quadrangle. Consists of

light-gray to buff feldspathic and micaceous sandstone, siltstone, gray to black shale, and coal. Thin dark-brown bed of volcanic conglomerate in upper part of group. Group not differentiated. Underlies Keechelus andesitic series.

Occupies a large part of Puget Sound Basin and extends upon the west flank of the Cascade Range.

Pugh Formation[1]

Middle Pennsylvanian: Northeastern West Virginia.

Original reference: J. A. Taff and A. H. Brooks, 1896, U.S. Geol. Survey Geol. Atlas, Folio 34.

Named for exposures at Pugh post office, Webster County.

†Pulaski Formation (in Arago Group[1] or Series)

Eocene: Southwestern Oregon.

Original reference: J. D. Diller, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 319–320.

W. H. Twenhofel, 1943, Oregon Dept. Geology and Mineral Industries Bull. 24, p. 4. Sandstones, siltstones, and claystones. Possibly of continental origin. Underlies Coaledo formation; unconformably overlies Myrtle formation. In Arago series.

Forms hills about head of Pulaski Creek and Pulaski Arch, which separates Beaver Slough and Coquille coal basins.

Pulaski Shale[1]

Upper Ordovician: New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 373–374.

Rudolf Ruedemann, 1925, New York State Mus. Bull. 258, p. 149 (fig. 7), 154 (fig. 9). Pulaski shale comprises (ascending) Tremaines Bridge, Worthville, Sandy Creek, and Bennett Bridge beds.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 19). Shown on correlation chart as Pulaski shale in Lorraine group. Occurs above Whetstone Gulf shale and below Oswego sandstone.

Named for occurrence on Salmon River at Pulaski, Oswego County.

†Pulaski Shale[1]

Mississippian: Southwestern Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 178, pl. 4.

In Pulaski, Wythe, and Montgomery Counties. Named for Pulaski, Pulaski County.

Pullen Formation (in Wildcat Group)

Miocene, upper, to Pliocene, lower: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 26–28, 102–105, pls. 1, 2. Diatomaceous mudstone with local basal sandstone. Thickness 600 to 1,100 feet. Thins from its southern outcrop northward and is overlapped by younger Tertiary beds; thins to south and east and is overlapped by Eel River formation (new). Overlies Yager formation (new) with angular unconformity.

Type section: Along west bank of Eel River, near Scotia, Humboldt County. Named for exposures at Pullen Ranch on Price Creek.

†Pulliam Formation[1]

Upper Cretaceous (Gulf Series) : Southern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Geol. Atlas, Folio 64, p. 2.

Named for Pulliam Ranch, on Nueces River, Zavalla [Zavala] County.

Pulpit Conglomerate (in Almy Conglomerate)

Paleocene: Northern Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 842, 843, pl. 1. Coarse red cliff-making conglomerate. Thickness about 2,000 feet. Underlies Saw Mill conglomerate division (new); overlies Henefer formation (new).

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart), 142. Discussion of Frontier formation in Coalville area, Utah. Chart of nomenclature history of Cretaceous rocks of area shows column credited to Trexler (1955, unpub. thesis). On column, Pulpit conglomerate occurs above Henefer formation and below Knight formation. Text refers to Echo Canyon (formerly Pulpit) conglomerate. Echo Canyon conglomerate overlies Henefer.

Named for Pulpit Rock at mouth of Echo Canyon, Morgan County.

Pulteney Shale Member (of Sonyea Formation)

Upper Devonian: Western and west-central New York.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Consists largely of silty dark-gray and dark-brownish-gray shale; much very dark gray shale, finely interlaminated with lighter gray shale, present in lower part of member; numerous discrete beds of very dark gray shale and a few beds of brownish-black or black shale from 1 inch to 3½ feet thick present throughout member; most of these very dark shales are gradational into lighter colored shale above; layers of siltstone ranging from laminae a few hundredths of an inch thick to discrete beds 1½ feet thick are interbedded in member. Thickness 2 feet in southwestern Genesee County; 9 feet at reference section of the Sonyea south of Mount Morris; 162 feet at type exposure; thickens southward to about 250 feet in southeastern Yates County. Grades downward into Middlesex member through transition zone that ranges in thickness from a few inches in Genesee County to approximately 40 feet in Yates County; lower boundary arbitrarily placed at point above which dark-gray and dark-brown shale predominates over very dark gray, grayish-black, and black shale; locally in Ontario and Yates Counties, a bed of siltstone 2 to 10 inches thick in base of Pulteney marks the contact. In southern Genesee County and most of Livingston County, underlies Cashaqua shale member with boundary gradational through an interval of several feet; from eastern Livingston County to east edge of mapped area, overlain by Rock Stream siltstone member, boundary sharply marked.

Type exposure in Wagner Glen, one-half mile north of center of Pulteney, Pulteney Township, Steuben County.

Pumpernickel Formation

Pennsylvanian(?): North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S.

Geol. Survey Geol. Quad. Map [GQ–11]. Greenstone, dark chert, and dark argillite with interbedded limestone and clastic sediments. Greenstone varies from chlorite schist to recognizable andesitic lavas and breccias. Dark chert may be in part silicified ash or fine-grained tuff. Interbedded siliceous slate and phyllite, probably tuffaceous in part. May be identical with Leach formation. Thickness may exceed 6,000 feet. Underlies Havallah formation (new) with contact gradational Pennsylvanian(?).

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2847–2848. Probably Mississippian or older.

Named for Pumpernickel Valley on eastern border of Winnemucca quadrangle.

Pumpkin Creek Limestone Member (of Big Branch Formation)

Pumpkin Creek Limestone Member (of Dornick Hills Formation)[1]

Pennsylvanian (Des Moines Series): Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40–Z, p. 14.

B. H. Harlton, 1956, *in* Ardmore Geol. Soc., Petroleum Geology of southern Oklahoma—a symposium, v. 1. Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 137 (fig 2), 140. A member at top of Big Branch formation (redefined).

Named from outcrops on Pumpkin Creek in SE¼ sec. 19, T. 6 S., R 2 E., Carter County.

Pumpkin Valley Member (of Conasauga Shale)

Pumpkin Valley Shale (in Conasauga Group)

Middle Cambrian: Eastern Tennessee and southwestern Virginia.

Josiah Bridge, 1945, Geologic map and structure sections of the Mascot-Jefferson City zinc mining district, Tennessee (1:31,690): Tennessee Div. Geology. Named on may legend and mapped with Rome formation.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 7–9. Pumpkin Valley shale formally proposed for 360 feet of shale which lies between typical Rome and typical Rutledge. Unit has commonly been included in the Rome. Derivation of name given. Report gives stratigraphic section at Lee Valley, Hawkins County.

John Rodgers, 1952, Geology of the Niota quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map. Southeast of Kennedy Ridge, in northwestern part of quadrangle, lower part of Conasauga shale differs from overlying main part of formation in being more silty, more purple in color, and in containing more siltstone but no limestone layers; particularly characterized by dull shales of green and purple and by monotonous uniformity that contrasts with underlying heterogeneous and varicolored Rome formation. In Hayes' original description of Rome and Conasauga formations, he classed these beds with the Conasauga, but in most of his mapping in northwest Georgia and Tennessee he mapped them as upper part of Rome. In this report, they are classed as Pumpkin Valley member of Conasauga shale. Member is exposed only in belt of Conasauga southeast of Kennedy Ridge. In other belts, member apparently does not reach surface. Thickness about 600 feet. Middle Cambrian.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 48, 49, 50 (table 4). In eastern Tennessee, the Conasauga varies in lithology and three phases are recognized; in northwestern phase, is termed Conasauga shale and the Pumpkin Valley is classed as a member; in central phase, Conasauga is termed a group and consists of six formations of which the Pumpkin Valley is the lowermost. Thickness 200 to 400 feet.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. Pumpkin Valley shale described in Duffield quadrangle, Virginia. Thickness about 350 feet. Overlies Rome formation; underlies Rutledge limestone.

Named from Pumpkin Valley which lies between Cooper Ridge and Pine Ridge, Hawkins County, Tenn. Crops out along northwest side of valley and is typically exposed along State Highway 66.

Puna Volcanic Series

Pleistocene, upper(?), and Recent: Hawaii Island, Hawaii.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 100 (table), 103–110. Series covers most of Kileauea volcano and was erupted in Recent and latest Pleistocene time. Rocks on western and southern slopes were mapped as Kamehame basalt, but this name includes lavas from both Mauna Loa and Kileau; hence, new name is used herein. Series includes a prehistoric member and an historic member. Prehistoric member ranges in thickness from a few feet in a flow on southern slope to more than 410 feet in Uwekahuna Bluff at western edge of Kilauea caldera where base is not exposed. Historic lava flows, erupted since 1750(?), differ only in degree of blackness from the late prehistoric flows. Historic flows are olivine basalts ranging from 1 to 20 feet in thickness on flanks of volcano; flows ponded in caldera are massive and columnar jointed. Correlative with Kau volcanic series on Mauna Loa as both series overlie Pahala ash. Wentworth's (1938) Keanakakoi formation is here treated as aa member of Puna volcanic series.

G. A. Macdonald, 1949, U.S. Geol. Survey Prof. Paper 214–D, p. 64–72. Includes Uwekahuna ash.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat. v. 6, Océanie, fasc. 2, p. 128. Late Pleistocene(?) and Recent.

Named for Puna district where rocks of series are most abundant.

Punchbowl Formation

Miocene, upper: Southern California.

R. E. Wallace, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 790. Incidental mention as Punch Bowl formation.

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Described in Pearland quadrangle as conglomeratic sandstone and siltstone with gypsiferous shale member in middle. Thickness about 1,600 feet. Deposit strongly faulted and folded. Unconformable on Vasquez formation and basement rocks; relationship to Pliocene Anaverde formation unknown. Present only south of San Andreas fault.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Described in Valyermo quadrangle as consisting of two facies. The western, present

only north of San Andreas fault, corresponds in lithology to lower and middle member of formation as described in Pearland quadrangle; the eastern is divided into two members (mapped separately); upper member about 3,000 feet thick; lower member about 1,000 feet thick.

Type locality: Devils Punchbowl, Valyermo quadrangle.

Punchbowl Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 55–60.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 128–129. Prominent cone of brown palagonitized tuff containing fragments of reef limestone and basalt of Koolau volcanic series, with minor amounts of black cinder and spatter and lava flow of nepheline basalt. Maximum thickness of tuff about 550 feet. Unconformably overlain by black ash of Tantalus and Sugar Loaf eruptions. Underlies reef limestone of plus 25-foot (Waimanalo) stand of sea and displaced a stream valley graded to the minus 60-foot (Waipio) stand of sea.

Named after Punchbowl Hill, the cone built by it. Exposed over area of about 0.7 square mile in Honolulu, on south side of Koolau Range about 13 miles west of Makapuu Head.

Puncheon Creek Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: I. B. Browning and P. G. Russell, 1919, Kentucky Geol. Survey, 4th ser., v. 5, pt. 2, p. 13.

Well developed along, and named for Puncheon Creek of Licking River, Magoffin County.

Punta de la Mesa Sandstone Member (of Mesaverde Formation)[1]

Upper Cretaceous: Central northern New Mexico.

Original references: C. L. Herrick, 1900, Am. Geologist, v. 25, p. 331–346; 1900, New Mexico Univ. Bull., v. 2, pt. 1, p. 3–63; pt. 2, p. 1–17.

Named for Punta de la Mesa, north of San Ignacio, Guadalupe County.

Purcell Basalt[1] (in Missoula Group)

Purcell Lava

Precambrian (Belt Series): Southeastern British Columbia and southwestern Alberta, Canada, and northwestern Montana.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Ast., 1910, v. 2, p. 207.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Dark-greenish-gray altered effusive basalt. In Glacier National Park, it is near base of Missoula group; but in other localities, mainly in Canada, it is reported in other stratigraphic positions.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 51–52, pl. 1. Purcell basalt included in lower part of Missoula group. Consists of dark greenish and purplish lava, much altered but originally basaltic. In Glacier National Park, principal flows are at or somewhat above top

of Siyeh limestone of Piegan group and below Shepard formation. Thickness about 200 feet.

So named because maximum known thickness is in McGillivray division of Purcell Mountain system, British Columbia.

Purcell facies (of Belt Series)

Precambrian: Northern Idaho and northwestern Montana, and southern British Columbia, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1877. Within its northern basin, Belt series is divisible into facies that differ in lithology, stratigraphic sequence, thickness, recorded conditions of deposition, fauna, and flora. Purcell facies marked by abundant clastics throughout, with reduction of carbonate rocks. Quartzites, thick in lower parts, reach the known base of the Belt.

In Purcell Range.

Purcell Sandstone Lenses (in Hennessey Shale)[1]

Permian: Northern central Oklahoma.

Original reference: D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1465.

O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1546 (fig. 6). Sandstone lenses in Hennessey formation.

Present in vicinity of Purcell, Kingfisher County.

Purefoys Mill Series[1]

Precambrain or Lower Cambrian: Northern central North Carolina.

Original reference: W. H. Fry, 1911, Elisha Mitchell Sci. Soc. Jour., v. 27, p. 124.

L. R. Thiesmeyer and R. R. Storm, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1964. Series originated in fresh-water lakes. A stratigraphic position, similar to that of varved shales in the so-called Lower Cambrian of Virginia and of suspected varve horizons in the Hiwassee slates of Tennessee, implies that the Purefoys sediments may be approximately contemporaneous with either or both of these deposits. It is suggested that such sediments were formed from melt waters of valley glaciers near margins of Appalachia during general refrigerations which accompanied continental glaciation of northern hemisphere in latest Precambrian or early Cambrian time.

In Chapel Hill area. Derivation of name not given.

Purgatoire Formation[1]

Lower Cretaceous: Eastern Colorado, central northern and northeastern New Mexico, and western Oklahoma.

Original reference: G. W. Stose, 1912, U.S. Geol. Survey Geol. Atlas, Folio 186.

G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203. In Colorado Springs area, includes Lytle sandstone and Glencairn shale members (both new).

S. L. Schoff, 1939, Oklahoma Geol. Survey Bull. 59, p. 54–57. In Texas County, includes Cheyenne sandstone member and shales tentatively identified as Kiowa member.

J. W. Stovall, 1942, (abs.) The Compass, v. 22, no. 4, p. 327. In Cimarron County, comprises Cheyenne sandstone member, 66 feet, and Kiowa shale member, about 50 feet.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 62. In Quay County, N. Mex., subdivided into (ascending) Tucumcari shale, Mesa Rica sandstone (new), and Pajarito shale (new) members. Overlies Morrison formation; underlies Graneros shale.

K. M. Waagé, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 375 (fig. 1), 378 (fig. 3), 380–384. In Denver area, includes Lytle and Glencairn members. Overlies Morrison formation; underlies Dakota sandstone. Thickness 230 feet.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in Cimarron County with Cheyenne sandstone and Kiowa shale members.

T. G. McLaughlin, 1954, U.S. Geol. Survey Water-Supply Paper 1256, p. 17 (table 3), 96–100. In Baca County, Colo., includes beds above Morrison formation and below Dakota sandstone. Subdivided into Cheyenne sandstone member below and Kiowa shale member above. Thickness 75 to 225 feet.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2007. Term Purgatoire abandoned in Tucumcari-Sabinoso area, New Mexico. Members of Purgatoire, as used by Dobrovolny and Summerson (1946) raised to formation rank.

Named for Purgatoire Canyon, in Mesa de Maya quadrangle, Colorado.

Purgatory Conglomerate[1]

Pennsylvanian: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 364–374.

Typically developed at Purgatory.

Purington Shale Member (of Carbondale Formation)

Purington Shale[1] (in Carbondale Group)

Pennsylvanian: Northern and western Illinois.

Original references: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 804; 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 94, 192, 197, 198. Light to medium gray; contains flattened oval ironstone concretions, which are most common in middle and lower parts. [In about half of area, the shale is cut out by channel deposits of the Pleasantview sandstone; in those areas where there is little or no truncation by the sandstone, it attains maximum thickness of about 50 feet.] In areas where shale attains its maximum thickness, upper 5 or 6 feet are silty to very fine sand and appears to grade upward into the Pleasantview sandstone; contact is abrupt where the sandstone is in channels. Overlies Oak Grove beds. Derivation of name credited to R. S. Poor (unpub. ms.). Occurs at top of Liverpool cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 66, pl. 1. Rank reduced to member status in Carbondale formation (redefined). Occurs above Oak Grove limestone member and below Pleasantview sandstone member. Thickness about 15 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in

Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: SW¼ sec. 17, T. 11 N., R. 2 E., Knox County. Named for exposures at pits of Purington Paving Brick Co., East Galesburg.

Purisima Formation[1]

Pliocene: Western California.

Original reference: H. L. Haehl and R. Arnold, 1904, Am. Philos. Soc. Proc., v. 43, p. 16–53.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 3), 38, pls. 1, 3. Described in San Bautista quadrangle as a conformable series of poorly consolidated clays, silts, sands, and gravels, predominantly marine towards base and continental in upper portion; highly variable in composition both vertically and laterally, fossiliferous in marine facies; folded, exhibits attitudes varying from horizontal to vertical. Thickness nearly 10,000 feet. Overlaps upon Santa Lucia granite, Franciscan, and Monterey; unconformably underlies Pleistocene Aromas red sands. Middle and upper Pliocene.

C. F. Tolman and J. F. Poland, 1940, Am. Geophys. Union Trans., v. 21, pt. 1, p. 26–27 (fig. 3). In Santa Clara County, underlies Santa Clara formation.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Formation, in La Honda and San Gregorio quadrangles, subdivided into (ascending) Tahana, Pomponio, San Gregorio sandstone, Lobitos mudstone, and Tunitas sandstone members (all new). Maximum thickness 5,670 feet. Conformably overlies Monterey formation.

Named for exposures near Purisima and along Purisima Creek, San Mateo County.

Purslane Sandstone (in Pocono Group)[1]

Purslane Sandstone Member (of Pocono Formation)

Lower Mississippian: Northeastern West Virginia and western Maryland.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 91–92. In PawPaw-Hancock area, the Pocono is considered to have group rank and is divided into five formations; in western Maryland where the five units cannot be differentiated, the Pocono is treated as a formation and the Purslane as a member. In West Virginia, member attains maximum thickness of 310 feet; in Maryland, uppermost beds have been eroded and thickest section is 144 feet. Consists of thick-bedded coarse white sandstone with interbedded conglomerate and with coal seams and red shales between the sandstones; contains a few plant remains. Overlies Rockwell member.

Purslane Mountain, Morgan County, W. Va., is formed of this sandstone. In Maryland, forms crest of Sideling Hill in Washington County and Town Hill in Allegany County.

Purvine Hills Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 132, pl. 15. Mentioned in discussion of

Capulin basalts in Des Moines quadrangle. [Most of discussion refers to basalts from Purvine Hills.]

Purvine Hills, a group of four small volcanic cones, on Purvine Ranch, Union County.

Purvine Mesa Basalt or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 120, 136 (table 4), 146 (fig. 23), pl. 1–b, 15. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined, but stratigraphic position of Purvine Mesa, Dunchee Hill, Sierra Grande, and Gaylord Mountain is not known.

Underlies several square miles of Purvine Ranch east of Folsom, Union County.

Pushmataha Series

Carboniferous (Bendian): Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 855–856. Bendian system (period) subdivided into two series, the older, the Pushmataha (new), and the younger, the Morrow. Series consists of Stanley group and most of Jackfork group. Comprises seven subdivisions (ascending): Tenmile Creek, Moyers, Chickasaw Creek, Wildhorse Mountain, Prairie Mountain, Markham Mill, and Wesley (all new). First three comprise what was formerly called the Stanley, and latter group are subdivisions of former Jackfork.

Name derived from Pushmataha County.

Put-in-Bay Dolomite Member (of Bass Islands Dolomite)[1]

Put-in-Bay Formation (in Bass Islands Group)

Upper Silurian: Southeastern Michigan and northern Ohio, and Ontario, Canada.

Original reference: W. H. Sherzer and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 546.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 38, 40, chart facing p. 46. Put-in-Bay formation included in Bass Islands group in Ohio. Overlies Tymochtee formation; underlies Raisin River formation. Consists of fairly pure dolomite, thin to massive bedded, gray to drab to light brown in color. Thickness 50 to 250 feet.

C. K. Swartz, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows occurrence in Ontario, Canada.

Named for exposures on Put-in-Bay Island, Lake Erie.

Putnam Formation (in Wichita Group)[1]

Putnam Group

Permian (Wolfcamp Series): Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31, 40.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 93. Rank raised to group. Includes Santa Anna Branch formation below and Coleman Junction formation above. Underlies Admiral group (redefined); overlies Moran group.

R. C. Moore, 1949, *in* M. G. Cheney, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets 3, 4; R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as a formation about 140 feet thick. Includes Santa Anna Branch member below and Coleman Junction member above. Underlies the Admiral and overlies the Moran herein designated as formations.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 271. Formation, in Brazos River valley, is 140 to 210 feet thick and comprises Santa Anna Branch shale member and Coleman Junction limestone member. Overlies Moran formation; underlies Admiral formation. Wichita group.

Named for Putnam, Callahan County.

Putnam Gneiss[1]

Putnam Series

Pre-Pennsylvanian: Eastern Connecticut and southern Massachusetts.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 129, 133, 134, 136, 140, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 67–73, pl. 1. Rank raised to series. Consists of five members: metamorphosed conglomerate, quartzite, quartz-biotite schist, hornblende schist and amphibolite, and limestone and dolomite. The quartzite is mapped as Plainfield quartz schist member. Probably Precambrian.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey; 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 55, 56. Age of gneiss designated pre-Triassic. Derivation of name given.

C. C. Sclar, 1958, Connecticut Geol. Nat. History Survey Bull. 88, p. 9–85. Bedrock in area of this report [New London County] consists of (1) a highly diverse group of metamorphic foliates known collectively as Putnam gneiss; (2) basic magmatic intrusive mass, the Preston gabbro; and (3) gneisses of granitic composition referred to as Sterling granitic gneisses. Plainfield quartzite not mapped as separate unit.

R. M. Perhac, 1958, Connecticut Geol. Nat. History Survey Bull. 89, p. 7–8. Putnam quartz-biotite schist underlies about 15 square miles in Voluntown and Oneco quadrangles. This rock constitutes a part of Putnam gneiss formation. Maximum possible thickness of schist about 2,000 feet. Plainfield quartzite not included in Putnam gneiss in present report.

Named for town of Putnam, Windham County, Conn.

Putnam Limestone (in Putnam Formation)[1]

Permian: Central northern Texas.

Original reference: O. F. Hedrick, E. Owens, and P. A. Meyers, 1929, Geologic map of Shackelford County, Texas (1:48,000): Texas Bur. Econ. Geology.

Shackelford County.

Putnam Sandstone (in Putnam Formation)[1]

Permian: Central northern Texas.

Original reference: O. F. Hedrick, E. Owens, and P. A. Meyers, 1929, Geologic map of Shackelford County, Texas (1:48,000): Texas Bur. Econ. Geology.

Probably named for town of Putnam, Callahan County.

Putnam Hill Limestone Member (of Allegheny Formation)[1]

Putnam Hill limestone member

Pennsylvanian: Eastern Ohio.

Original reference: E. B. Andrews, 1870, Ohio Geol. Survey Rept. Prog. 1869, p. 84–85.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 41–42, table 1. Member of Brookville cyclothem in report on Perry County. Average thickness 1½ feet. The limestone lies an average distance of 7 inches above Brookville coal, but the shale between the limestone and coal is nearly everywhere fossiliferous and is considered a part of Putnam Hill member. At most exposures, Putnam Hill member is overlain by sandy shale or interbedded fine- to medium-grained sandstone and shale of Clarion cyclothem. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 52–53. Uppermost member of Brookville cyclothem in Athens County. Average thickness about 2 feet. Occurs above Brookville (No. 4) coal member of Brookville cyclothem and below sandstone of Ogan cyclothem.

Named for Putnam Hill, Muskingum County.

Putnam Peak Basalt

Pliocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 130–131, pl. 7. Dense black and vesicular basalt. Thickness 25 to 300 feet. Unconformably overlies Markley sandstone and San Pablo group; commonly has a low eastward dip.

Named from Putnam Peak in northeast Mount Vaca quadrangle, Solano County, where it covers slightly more than a square mile.

Puyallup Formation, Interglaciation

Puyallup Sand[1] or interglacial epoch[1]

Pleistocene, middle(?): Western Washington.

Original reference: Bailey Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 19–20, pl. 1. In Kitsap County, conformably overlies Kitsap clay member (new) of Orting gravel. Maximum thickness about 300 feet.

D. R. Crandell, D. R. Mullineaux, and W. W. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 390, 392–394. Puyallup sands of Willis redefined as Puyallup formation to include a thicker and laterally more extensive deposit characterized by coarse and fine alluvium, lacustrine sediments, and mudflows. Maximum thickness about 135 feet. Separated from older Alderton formation (new) by Stuck drift (new). [For Pleistocene sequence in area see 1958 entry under Orting glaciation.]

Typical occurrence on west side of Puyallup Valley, Pierce County.

Puye Conglomerate (in Santa Fe Group)

Puye Gravel (in Santa Fe Group)

Pliocene(?): North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103; 1938, Jour. Geology, v. 46, no. 7, p. 937 (fig. 4), 959. Quaternary formations in Abiquiu quadrangle comprise Canjillon till, Canones andesite, Vallecito

basalt (all new), and Black Mesa basalt, which were poured out on high-level erosion surfaces, and Puye gravel (new), which overlies an erosion surface of intermediate level and is overlain, locally, by Bandelier rhyolite and Santa Clara basalt (both new).

E. H. Baltz and others, 1952, New Mexico Geol. Soc. Guidebook 3d Field Conf., p. 12. Ancha formation (new) is eastward extension of Puye gravel.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118 (fig. 2), 119. Mentioned in discussion of upper unit of Santa Fe group. Puye gravel, Ancha formation, and Tuerto gravel all rest with angular unconformity on deformed beds of Tesuque formation. These units of gravel are 500, 300, and 150 feet in maximum thickness, respectively. In Buckman area, Ancha formation appears to intertongue with Puye gravel. Early Pleistocene.

Mapped in valley of Chama River, Rio Arriba County.

Puyer Formation[1]

Eocene: Central Washington.

Original reference: J. Daniels, 1915, Geol. Soc. America Bull., v. 26, no. 1, p. 132.

Pierce County coal field.

P. W. A. Quarry Limestone Member (of Drum Formation)

Pennsylvanian (Missouri Series): Eastern Nebraska and south-central Iowa.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. Basal member of formation. Thickness about 1 foot in Sarpy County, Nebr., and about 2 feet in south-central Iowa; this is a "middle" limestone zone and may not extend very far southward. Underlies Richfield Quarry shale member (new); overlies Quivira formation.

Type locality: P. W. A. quarry in Missouri River bluffs, east of Richfield quarry, Sarpy County, Nebr.

Pyburn Limestone Member (of Oliver Hill Formation)[1]

Lower Devonian: Western and central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 685.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 288. Use of name, Pyburn limestone, is discontinued and all limestone formerly classed as Pyburn is included in Ross limestone member of Ross formation (new).

Named for exposures in Pyburn Bluff, Hardin County.

Pyramid conglomerate[1]

Upper Cretaceous: Southwestern (?) New Mexico.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 338.

Crops out in Pyramid Butte.

Pyramid shale[1]

Cretaceous (?): Eastern New Mexico.

Original reference: C. R. Keyes, 1905, Am. Jour. Sci., 4th, v. 20, p. 424.

Derivation of name not stated.

Pyramid Rock Basalt (in Honolulu Volcanic Series)

Pleistocene: Oahu Island, Hawaii.

H. T. Stearns, 1940, Hawaii Div. Hydrography Bull. 5, p. 50–51. Lava flow and feeder dike of nepheline basalt.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 129. Thickness unknown; Pyramid Rock has summit altitude of 100 feet, but lava extends below sea level. Overlain by reef of plus 25-foot (Waimanalo) stand of sea. Included in lower part of Honolulu volcanic series. Pleistocene.

Named for Pyramid Rock, a hill on Mokapu Peninsula that is composed of the lava and may mark vent from which it issued. Exposed over area of about 0.01 square mile at northwest corner of Mokapu Peninsula on northeast coast of Oahu, 13 miles northwest of Makapuu Head.

Pyrites Granite[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 66, 71–73, 96.

Located just northeast of Pyrites, in southwestern corner of Canton quadrangle.

Quabin Quartzite[1]

Carboniferous: Western central Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 60. 72–75, map.

Composes large part of Quabin and Felton Mountains.

Quadrant Quartzite[1] or **Formation**[1]

Pennsylvanian: Wyoming and Montana.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

C. C. Branson, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1215–1217. Quadrant together with upper part of beds which Scott (1935) referred to as Amsden are herein regarded as attenuated edge of Tensleep sediments.

M. L. Thompson and H. W. Scott, 1941, Jour. Paleontology, v. 15, no. 4, p. 349–353. Lower part (beds 1 and 2) of Scott's (1935) section on Quadrant Mountain are Mississippian. In present report, Scott's section is revised; beds 1 and 2 are referred to Sacajawea(?) formation (Mississippian). Beds 3 to 21 are included in the Quadrant, and name Amsden is deleted from the section. At this locality, the Quadrant is 279 feet thick and underlies the Phosphoria. Fusulinids of type section discussed.

L. L. Sloss and C. A. Moritz, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2164–2165. Thickness 2,662 feet in Big Sheep Creek section, Beaverhead County, Mont. The east-to-west increase in thickness of the Quadrant may suggest post-Pennsylvanian erosion of formation on tectonically positive areas and its preservation in negative trends.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 20–22, pl. 1. Formation in southern Elkhorn Mountains

consists of interbedded light-colored quartzitic sandstone and light-gray sugary and sandy dolomite. Thickness 225 to 325 feet. Overlies Amsden formation; underlies Phosphoria formation.

D. O. Peterson, 1959, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of regional stratigraphy of Pennsylvanian in northeastern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Many nomenclatural problems exist. One of the suggested changes is that Quadrant and Casper formational names be abandoned and the Tensleep-Amsden-Sacajawea terminology extended to include strata formerly referred to by these names.

Named for Quadrant Mountain, in Gallatin Range, northwest corner of Yellowstone Park, Wyo. Forms bluff encircling the mountain.

Quail Porphyry[1]

Upper Cretaceous or lower Tertiary: Western central Colorado.

Original reference: S. F. Emmons, 1898, U.S. Geol. Survey Geol. Atlas, Folio 48.

Ogden Tweto, 1953, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–12. Fine-grained dark-gray monzonitic porphyry found only in a few dikes in eastern part of Pando area.

Largest sheet occurs under White Quail group of mines, Tenmile quadrangle. Pando area is in Eagle and Summit Counties.

Quajote Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 9–10, 16–17, pl. 27. Consists of following divisions (ascending): friable yellow and greenish-yellow sandstone, friable yellow sandstone, whitish and yellow-green shale and greenish sandstone with layers of dark-green limestone, weak drab limestone, hard brownish limestone, and light-buff streaked sandstone. Thickness 32 feet. Underlies Perilla member (new); overlies unnamed shale and sandstone division.

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Quakertown cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 8. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 23, table 1, geol. map. Includes (ascending): Quakertown shale and (or) sandstone, 8 feet thick, Quakertown clay, 1 to 5 feet; and Quakertown (No. 2) coal. Locally, the clay is replaced by Massillon sandstone. Overlies Huckleberry cyclothem; underlies Bear Run cyclothem. In area of this report, Pottsville series is described on a cyclothemic basis; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

Exposed in western and northern Perry County.

Quakertown Fire Clay (in Pottsville Formation)[1]

Quakertown clay member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. 332.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 23, table 1. Member of Quakertown cyclothem in report on Perry County. Plastic, sandy, and ferruginous at most outcrops. Commonly gray or dark gray. Thickness 1 to 5 feet. Underlain either by shale or sandstone and overlain by Quakertown coal. Locally clay replaced by Massillon sandstone.

†Quakertown Group (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. xxi–xxxvi, 319–333.

Quakertown Shale (in Breathitt Formation)

Pennsylvanian: Southeastern Kentucky.

R. E. Hauser, 1953, Kentucky Geol. Survey, ser. 9, Bull. 13, p. 11 (fig. 2), 14. Hard black fissile shale, 3 to 6 inches thick. Occurs from 6 to 18 feet above top of Lee formation. Underlies an unnamed shale 25 to 30 feet thick. In western part of area, a thin coal occurs in the position of the Quakertown; it may be that there is a lateral change from east to west of shale to coal.

This may or may not be a geographic extension of Quakertown shale listed below.

Occurs in Paintsville quadrangle.

Quakertown Shale (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania and western Maryland.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. 66.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 54–55. Quakertown coal and shale mentioned in report on Fayette County. Coal and shale separate the Upper and Lower Connoquenessing sandstone. As much as 15 feet thick in places.

Occurs at the "Falls" on Quakertown Run, near Quakertown Station, Lawrence County, Pa.

Quakertown Slate (in Kanawha Formation)[1]

Pennsylvanian: Northern West Virginia and western Maryland.

Original reference: D. B. Reger, 1918, West Virginia Geol. Survey Rept. Barbour and Upshur Counties, p. 273.

Named for occurrence along Tygart Valley River in northern Randolph County, W. Va., where it lies just above Quakertown (Winifrede?) coal.

Quall Limestone[1]

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 746.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 307. Erosion following flooding of Pickwick Lake has exposed section of 40 feet of Harriman limestone just across valley from old Quall place—type locality of Quall limestone. On basis of recent studies, it is concluded that Dunbar's Quall limestone is an unweathered phase of Harriman formation, and it is recommended that name Quall be discontinued.

Named for development on farm of Jim Quall, in valley of Dry Creek, a small stream entering Tennessee River near Walnut Grove, Hardin County.

Quanah Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 137–138.

G. W. Chase, 1952, Oklahoma Geol. Survey Circ. 30, p. 11, 12. Makes up major part of the Quanah Mountain group and rests in a sill-like position on Lugert granite.

Named for Quanah Mountain in Wichita Mountains.

Quanah Gypsum[1]

Permian: Central northern Texas and southwestern Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 356 (footnote), 357.

In Hardeman County, Tex., and Greer County, Okla. Named for Quanah, Hardeman County, Tex.

Quantico Slate[1]

Upper Ordovician: Northeastern Virginia.

Original reference: N. H. Darton, 1894, U.S. Geol. Survey Geol. Atlas, Folio 13.

Named for Quantico Creek, Prince William County.

Quapaw Chert[1]

Mississippian: Northeastern Oklahoma.

Original reference: S. Weidman, 1932, Oklahoma Geol. Survey Bull. 56, p. 17.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named from Quapaw Village in Ottawa County.

Quapaw Sandstone (in Wann Formation)

Pennsylvanian: Central northern Oklahoma.

C. C. Branson, 1955, The Hopper, v. 15, nos. 10–11, p. 129. Name applied by F. C. Greene (1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 122) to

massive sandstone exposed at Quapaw. Revard is valid name for this unit.

Quapaw was small village in sec. 35, T. 25 N., R. 10 E., Osage County,

Quarry Conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 656–657. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of the Puente Hills, Los Angeles County.

Named from an abandoned quarry on north side of Sycamore Canyon Road.

Quarry Creek Limestone[1]

Pennsylvanian: Southeastern Illinois.

Original reference: A. H. Worthen, 1875, Illinois Geol. Survey, v. 6, p. 10–17.

Named for Quarry Creek, 1½ miles east of Martinsville, Clark County.

Quarry Peak Rhyolite Complex

Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 65–68, table 1, pl. 1. Flows, breccias, and tuffs of rhyolite composition. Most of sequence consists of holocrystalline equigranular aphanitic white or light-gray rhyolite which contains a few small inconspicuous phenocrysts of quartz and feldspar. Many of the breccias and tuffs are well bedded. Thickness about 1,000 feet. Overlies unnamed andesite with slight angular unconformity; disconformably underlies unnamed basalt.

Forms prominent peak west of Steins and north of Southern Pacific Railroad and State Highway 14. For convenience of this report, the peak above the abandoned quarry is called Quarry Peak from which sequence of rhyolitic rocks takes its name. The complex also crops out west and northwest of Quarry Peak and north of Steins, Hidalgo County.

Quartermaster Dolomite (in Quartermaster Formation)[1]

Permian: Western Oklahoma.

Original references: Noel Evans, 1928, Am. Assoc. Petroleum Geologists Bull., v. 12, no. 7, p. 706, 708; G. G. Suffel, 1930, Oklahoma Geol. Survey Bull. 49, p. 107, 114, 124, 128.

In Weatherford district, Custer County.

Quartermaster Formation[1]

Quartermaster Formation (in Custer Group)

Quartermaster Group

Permian: Southwestern and northwestern Oklahoma, southern Kansas, and northwestern Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bienn. Rept., p. 42, 57.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 421–433. Mentioned in general discussion of extension into Texas and loose use of Kansas and Oklahoma formation names in Texas.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1526 (fig. 3), 1527–1528. Quartermaster used as group term to include Doxey shale and Elk City sandstone. Cloud Chief removed from Quartermaster and considered uppermost formation in underlying Whitehorse group.

Robert Roth, N. D. Newell, and B. H. Burma, 1941, Jour. Paleontology, v. 15, no. 3, p. 312–317. Age of Quartermaster formation of Oklahoma and Texas has been subject of controversy, being variously given as late Permian or Triassic(?). Fossils have been discovered in lower part of Doxey shale at base of Quartermaster. Some of the species recognized also characterize recently described Whitehorse fauna and indicate close relationship of enclosing beds with Whitehorse formation. If Whitehorse is Guadalupian (late Permian) in age, then fossiliferous Quartermaster beds probably are to be correlated with some part of Guadalupian or perhaps Ochoa of western Texas. Table shows Quartermaster formation as uppermost unit of Custer group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 156–157. Permian beds above Day Creek dolomite are classified as belonging in Quartermaster group. They seem to be equivalent to lower part of Quartermaster formation of western Oklahoma and Panhandle of Texas. Maximum outcrop thickness in Kansas about 45 feet. Includes Taloga formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, formation includes Doxey and Elk City members.

Named for exposures along banks of Quartermaster Creek, Roger Mills County, Okla.

Quartz Spring Sandstone Member (of Lost Burro Formation)

Upper Devonian: Southern California.

R. L. Langenheim, Jr. and Herbert Tischler, 1960, California Univ. Pubs., Geol. Sci., v. 38, no. 2, p. 92, 94 (fig. 2), 134–135, 136. Consists of quartzite and interbedded sandy dolomite and limestone; contains fauna characterized by *Cyrtospirifer cf. C. monticola* Haynes. Thickness about 38 feet. Underlies Tin Mountain limestone.

Type locality: Exposures below type section of Tin Mountain limestone which is on southern slope of hills about 2½ miles southeast of Quartz Spring, Inyo County, and about 3,000 feet north of road to Rest Spring.

Quatal Formation

Quatal Red Clay Member (of Santa Margarita Formation)

Miocene, upper(?): Southern California.

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 35–37, pl. 33. Nonmarine facies of the upper Santa Margarita. Underlies a sandstone bed; overlies a gypsum bed stratigraphically above Caliente red beds. Total thickness of shale and sandstone above the gypsum is 75 to 100 feet. Occurs in Quatal Canyon gypsum deposit, Ventura County.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2978 (fig 3), 2996, 2997. Quatal formation is herein designated as the nonmarine claystone and sandstone, probably upper Miocene in age, that lies conformably between Caliente formation below and Morales formation above. At type locality, the formation, of probable lacustrine origin, is approximately 800 feet thick and consists of reddish-gray soft thin-bedded gypsiferous claystones weathering to reddish clay soil; contains basal bed of white massive gypsum that attains maximum thickness of 30 feet in Quatal Canyon. In southern part of Cuyama Badlands, formation thickens to about 2,700 feet and becomes mainly fluviatile pebbly sandstone of prevailing orange-buff color of which only basal 500 feet is lacustrine red claystone. West of mouth of Quatal Canyon, on west bank of Cuyama River, formation consists of about 600 feet of light brown sandstone-cobble conglomerate and sandstone which grades westward along strike into marine Santa Margarita sandstone. On northeast slope of Caliente Range adjoining Carrizo Plain, type Caliente redbeds are overlain conformably by about 700 feet of soft gray gypsiferous lacustrine claystone containing some thin-bedded hard sandstones in basal part; these claystones are believed to be correlative with Quatal red claystone of Cuyama Badlands but could belong to overlying Morales formation. Name replaces preoccupied Apache formation (Dibblee, 1947).

Type locality: Ballinger Canyon, Ballinger Canyon quadrangle. Named for exposures in Quatal Canyon.

Queantoweap Sandstone

Lower Permian: Northwestern Arizona.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 515 (fig. 2), 525–526. Massive pink and gray ledge- and cliff-forming crossbedded sandstones which rest on Pakoon (new) and upper Callville limestones. Thicknesses: 393 feet, Hurricane Cliffs; 645 feet, North Grand Wash Cliffs; 400 feet Pakoon Ridge. Underlies Hermit formation with contact transitional in interval ranging from 5 to 50 feet. Not present in southwestern part of area where Supai is undifferentiated. Northward, could represent most, if not all, of massive-bedded tan, yellow, and pink sandstones of extreme northwest Arizona and southwest Utah that have commonly been referred to as "Supai."

Type section: On east side of Queantoweap Valley, Mohave County, between the upper and lower lava flows, near a well locally known as Gramps basin.

†Quebecan Substage (of Wisconsin Stage)[1]

Pleistocene: Great Lakes region.

Original reference: M. M. Leighton, 1931, Jour. Geology, v. 39, p. 51–53.

Named for Quebec, Canada.

Quebradillas Limestone[1]

Miocene: Puerto Rico.

Original reference: T. W. Vaughan, 1924, Geol. Soc. America Bull., v. 35, no. 4, table 3.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. Quebradillas and Los Puertos limestones form an indivisible unit and in this report are termed Aymamón limestone.

Quebrancha Limestone Member (of Caimito Formation)

Quebrancha Limestone

Oligocene, upper: Panamá.

T. F. Thompson, 1944, Geological explorations in the vicinity of Río Quebrancha for the Panamá Cement Co.: Panamá Canal, Spec. Eng. Div., p. 17–20. The so-called Quebrancha limestone deposit consists of a 110 to 135 meter thick layer of variably argillaceous, sandy, or semicrystalline limestone. Separated from underlying Gatuncillo shale (new) by an interval of gritty sandstone, basalt, and conglomerate, and from overlying Río Duque shales (new) by interval by calcareous siltstone.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 234, 246 (fig. 2). Member of Caimito limestone. Thickness 350 to 450 feet. Grades upward into unnamed calcareous siltstone member; overlies, probably without marked discontinuity, volcanic member of Bohío formation.

Type region: On south limb of Quebrancha syncline; includes quarry of Panamá Cement Co.

Queen Formation (in Whitehorse Group or Artesia Group)

Queen Sandstone Member (of Chalk Bluff Formation)[1]

Permian (Guadalupe Series): Southeastern New Mexico and western Texas.

Original references: F. S. Prout, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 656; K. H. Crandall, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 8, p. 940–941.

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 9. Whitehorse group of West Texas and New Mexico divided into (ascending) Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

W. C. Fritz and James Fitzgerald, Jr., 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 24–25. Includes Yoakum dolomite member (new) in subsurface.

N. D. Newell, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 43–46. Overlies Grayburg formation; underlies Seven Rivers formation. Lower boundary used herein is essentially that selected by Crandall (1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 982, 983, 987) on Queen Mesa, but top of formation is drawn above Shattuck member (new), a prominent sandstone approximately 100 feet thick over much of shelf area in Guadalupe Mountains, except near reef where it thins rapidly.

W. R. Moran, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1288. Crandall (1929) did not designate type locality. At type section herein designated, Queen is 421 feet thick and consists of alternating

sandstone and sandy dolomite. At this section, Queen underlies Seven Rivers formation and overlies the Grayburg; Shattuck member is present in uppermost 100 feet of section.

P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112. Formation described in Carlsbad Caverns West quadrangle which contains type section as designated by Moran. Overlies Grayburg formation; underlies Seven Rivers formation of Carlsbad group.

Term Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) replaces terms Whitehorse and Chalk Bluff in New Mexico.

Type section (Moran): West wall of Dark Canyon, in SW¼ sec. 36, T. 24 S., R. 22 E., Eddy County, N. Mex. Named for exposures in vicinity of Queen post office, sec. 30, T. 24 S., R. 22 E., Eddy County.

Queen City Sand Member (of Mount Selman Formation)[1]

Queen City Sand or Formation (in Claiborne Group)

Eocene, middle: Northwestern Louisiana and eastern Texas.

Original reference: W. Kennedy, 1892, Texas Geol. Survey 3d Ann. Rept., p. 50–52.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 78–93 [1938]. Queen City sand described in Leon County where it is about 440 feet thick. Includes Omen glauconitic sand member at top and lower unit referred to as glauconitic sand at Venetia. Overlies Marquez shale member (new) of Reklaw formation; underlies Tyus marl member (new) of Weches formation.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 10 (fig. 3), 83–100. Formation described in Henrys Chapel quadrangle where it is youngest of Eocene formations present and is only incompletely preserved. Thickness 105 to 131 feet. Includes (ascending) Arp member, Omen glauconitic sandstone member, and unnamed upper sand member. Overlies Reklaw formation; underlies Pleistocene gravels.

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2517–2522. Three-fold division of Queen City as recognized on surface in Texas is also present in surface in Caddo Parish, La. Lower sand unit is correlative with Arp member; middle glauconitic member is correlative with Omen member; upper sand member is herein named Myrtis sand member. Underlies Weches formation. Present study shows that sand on surface at Queen City, Cass County, Tex., is equivalent to sand at type locality of Sparta sand. The sand occupying stratigraphic position between Reklaw and Weches formations, "Queen City" by name, has incorrect type locality and alternate type locality is herein suggested.

Alternate type locality: Exposures extending from town of Vivian north and west along old Vivian-Atlanta Road for 4 miles through secs. 23, 15, 10, and 4 to Myrtis Mill Creek, Caddo Parish, La. Well developed in vicinity of Queen City, Cass County, Tex., in which area it was described by Kennedy (1892).

Queen Hill Shale Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 44, 46, 47.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 154; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. Queen Hill shale member of Lecompton formation; underlies Beil limestone member; overlies Big Springs limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24. Type locality and derivation of name stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20, fig. 5. Dark to greenish gray and argillaceous in upper part; and black and fissile below. Thickness 4½ feet. Not identified farther northeast than Montgomery County.

Type locality: Queen Hill, a prominent point in Missouri River bluffs, northeast of Rock Bluff, Cass County, Nebr.

Queenston Shale[1]

Queenston Shale (in Richmond Group)

Upper Ordovician: Western New York, and Ontario, Canada.

Original reference: A. W. Grabau, 1908, Science, new ser., v. 27, p. 622–623.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 22 (fig. 6). Uppermost unit of Richmond group in Clyde and Sodus Bay quadrangles.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1981 (fig. 2), 1986. Discussion of stratigraphy of Silurian Medinan group. Queenston shale underlies the Whirlpool, basal formation of Medinan. In some areas the Queenston underlies the Grimsby.

Named for town of Queenston on Niagara River, opposite Lewiston, Niagara County, N.Y.

Queets Beds

Pleistocene, upper: Northwestern Washington.

S. L. Glover, 1940, Northwest Sci., v. 14, no. 3, p. 69–71. Name applied to late Pleistocene deposits on coastal area of Olympic Peninsula. Probably correlate with sediments of Vashon age in Puget Sound area. Beds are generally flat lying. Thickness about 15 feet. Overlies Taholah formation (new).

S. L. Glover, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2022–2023. Younger than Browns Point formation (new).

Well exposed on south bank of Quinault River near Indian village of Taholah, Grays Harbor County.

Quercan Sandstone[1]

Miocene: Central western California.

Original reference: C. E. Weaver, 1909, California Univ. Pub., Bull. Dept. Geology, v. 5, p. 251.

In San Pablo Bay region. Derivation of name not stated.

Quichapa Formation or Group

Oligocene(?) : Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 18–24, 53–57. Group consists of three ignimbrite units in Pine Valley Mountains. Lowermost unit is hard dense welded tuff; pale red violet on fresh surfaces, weathers pale red brown; sparsely scattered through rock are angular red latite (?) fragments, averaging under 10 millimeters in diameter; ranges in thickness from less than 100 feet just east of Stoddard Mountain to about 800 feet near Pinto Peak; 5 to 20 feet of black glass containing angular red fragments at base of unit. Middle unit is a vitric rhyolite ignimbrite, consisting of strongly welded tuff, contains basal black glass, 10 to 20 feet thick, which unconformably overlies basal unit of group. Uppermost ignimbrite unit is red brown to purplish brown on fresh surfaces, weathers brown or dark brown; basal black glass of unit is as much as 35 feet thick; maximum thickness of unit in Pine Valley Mountains about 550 feet; conformably overlies middle unit. Thickness of group in Pine Valley Mountains ranges from a fraction of a foot to about 1,600 feet, the variation being due largely to an unconformity at top of group. In most exposures, lowermost unit of group appears to overlie Claron formation conformably. Underlies Rencher formation (new). Name credited to J. H. Mackin (personal commun.).

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 89, 97. Rank reduced to formation. Subdivided into (ascending) Leach Canyon tuff, Swett tuff, Bauers tuff, and Harmony Hills tuff members (all new). Underlies Rencher formation; overlies Isom formation (new).

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 37–40, maps 1 and 2. Formation, in Washington County, includes (ascending) Leach Canyon tuff, Bauers tuff, Little Creek breccia (new), and Harmony Hills tuff. Thickness 0 to 1,800 feet. Overlies Isom formation; underlies Rencher formation. Leach Canyon tuff has zircon age of 28 million years; this suggests that formation is Oligocene.

Named from exposures in Quichapa Canyon of the Harmony Hills, Iron and Washington Counties.

Quien Sabe Volcanics

Miocene, middle(?) : West-central California.

N. L. Taliaferro, [1949], Geologic map of the Hollister quadrangle, California (1:62,500) : California Div. Mines Bull. 143, pl. 1 [preprint?]. Shown on map legend as consisting of flows and agglomerates with plugs, dikes, and a sandstone member. Overlies Vaqueros formation.

C. J. Leith, 1949, California Div. Mines Bull. 147, p. 12 (fig. 2), 22–24, pl. 1. Described in Quien Sabe quadrangle. Thickness 4,000 feet. Unconformably underlies upper Pleistocene Peckham formation (new); unconformably overlies Vaqueros formation.

E. B. McKee, Jr., 1959, Dissert. Abs., v. 19, no. 11, p. 2913. In Pacheco Pass area, slightly folded erosional remnants of Quien Sabe group (late Cenozoic) locally lie with angular unconformity on Franciscan rocks.

Occurs in west-central part of Quien Sabe quadrangle and extend westward into Hollister quadrangle.

Quillayute Formation[1]

Miocene(?) or Pliocene: Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 203.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 24 (chart), 195. Composed of medium- and coarse-grained pebbly sandstone, shaly sandstones, and sandy shales; prevailingly brownish gray. Maximum thickness probably under 1,000 feet; dips range between 5° and 15°. Rests with marked unconformity upon steeply dipping strata of older rocks which may be in part middle Miocene. Pliocene. Exposures noted.

Exposed in southwestern part of Clallam County in valley of Quillayute River near junction of Solduc and Bogachiel Rivers.

Quimbo Dolomite (in Joserita Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11. Ochre-colored dolomite, in places grades laterally into light-yellow calcareous shale. Underlies Saavedra member (new); overlies Corta sandstone (new).

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Quimbys Mill Member (of Platteville Formation)

Quimbys Mill Formation (in Platteville Group)

Middle Ordovician: Southwestern Wisconsin, northern Illinois and eastern Iowa.

A. F. Agnew and A. V. Heyl, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 9, p. 1585–1587. Proposed for "glass rock" beds that overlie McGregor limestone member of Platteville and underlie Spechts Ferry shale member of Decorah formation. Consists of limestone and dolomite in medium to thin beds which are separated by thin carbonaceous shale laminae. Thickness at type locality 12 feet; upper 6 feet is dolomite with carbonaceous shale partings; lower 6 feet is limestone. Unit thins toward northwest and thickens southeast becoming completely a dolomite in latter direction.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, 10 (fig. 3), 18 (fig. 9). Geographically extended into Dixon-Oregon area, Illinois, where it is considered a formation at top of Platteville group; includes (ascending) Hazel Green, Shullsburg, and Strawbridge members (all new). Overlies Nachusa formation (new). Underlies Guttenberg formation of Galena group.

A. F. Agnew, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1734. Geographically extended into eastern Iowa.

Type section: Quarry at Quimby's Mill, SE cor. sec. 11, T. 1 N., R. 1 E., Etna, Wis.

Quimper Sandstone

Oligocene, lower: Northwestern Washington.

J. W. Durham, 1942, Jour. Paleontology, v. 16, no. 1, p. 86–87. Massive-bedded sandstone 900 feet thick at type section. Underlies moderately well-bedded shale; overlies Townsend shale (new) or overlaps onto older rocks of Oligocene or Eocene age.

J. W. Wyatt, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 106. On Marrowstone Island, underlies Marrowstone shale (new). Here consists of nearly 700 feet of moderately well-bedded medium-grained arkosic sandstones; on south shore of Port Townsend Bay, section is approximately 800 feet thick; in this area, unconformity at base is well marked and Quimper overlies Lyre conglomerates, Townsend shale, and various parts of the Eocene section; rests successively on older rocks toward the northeast.

Type section: On east side of Kilisut Harbor, Marrowstone Island [Jefferson County], Quimper Peninsula.

Quinault Formation[1]

Pliocene: Northwestern Washington.

Original reference: R. Arnold, 1906, Geol. Soc. America Bull., v. 17, p. 451–468, map.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 191–194. On north side of Quinault River, consists of alternating layers of sandstone, shale, and conglomerate; on south side of river, consists of massive fossiliferous shaly sandstones. Thickness about 936 feet. At Cape Grenville, appears to rest unconformably upon a complex of basaltic lavas, tuffs, agglomerates and associated intrusive dikes which probably correspond to the Eocene Metchosin volcanics, a fault may separate these volcanics from the Quinault.

S. L. Glover, 1940, Northwest Sci., v. 14, no. 3, p. 70. Unconformably underlies newly defined lower Pleistocene Taholah formation.

T. J. Etherington, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 191. Chart shows Quinault formation stratigraphically above Montesano formation.

Occurs on Quinault Indian Reservation north and south of mouth of Quinault River between Cape Elizabeth and Point Grenville, Grays Harbor County.

Quincy Amygdaloid[1] (in Ashbed Group)

Precambrian (Keweenanwan): Northern Michigan.

Original reference: R. Pumpelly, 1893, Michigan Geol. Survey, v. 1, pt. 2, p. 21–25, 28.

Named for occurrence in Quincy mine, Houghton County.

Quincy Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth)

Probably named for occurrence in Quincy mine, Houghton County.

Quincy Granite[1]

Mississippian(?): Eastern Massachusetts and Rhode Island.

Original reference: W. O. Crosby, 1876, Rept. on geol. map of Massachusetts, p. 1–42.

N. E. Chute, 1940, Massachusetts Dept. Public Works Bull. 1, p. 4, 11–12, pls. 2–A, 2–B. Devonian(?).

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1949, *in* Alonzo Quinn and others, Bedrock geology of the Pawtucket quadrangle, Rhode Island-

Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Mississippian(?).

Type area; In Quincy and Milton, Mass.

Quincy Syenite[1]

Precambrian: Massachusetts.

Original reference: C. H. Hitchcock, 1872, Am. Jour. Sci., 3d, v. 3, p. 47.

In Abington, Plymouth County.

Quincy Pewabic Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, pl. 18.

Named for occurrence in Quincy and Pewabic mines, Houghton County.

Quincy Pewabic Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, pl. 18.

Probably named for occurrence in Quincy and Pewabic mines, Houghton County.

Quindaro Shale[1] **Member** (of Wyandotte Formation)

Quindaro Member (of Iola Limestone)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook p. 92, 97.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 282. Member of Iola limestone; consists of gray calcareous shale 1 to 2 feet thick.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033; 1949, Kansas Geol. Survey Bull. 83, p. 103. Quindaro shale member of Wyandotte formation; underlies Argentine limestone member; overlies Frisbie limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. The Frisbie limestone, Quindaro shale, and Argentine limestone, which were indicated as members of the Iola limeston in western Missouri. are classified with overlying Island Creek shale and Farley limestone as members of the Wyandotte.

T. L. Welp. L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 420. Thickness 4 feet in vicinity of Winterset, Iowa

H. G. Hershey and others. 1960, Iowa Highway Research Board Bull. 15. p. 25, fig. 5. Member of Wyandotte. Top poorly defined. Argentine-Quindaro contact arbitrarily placed where limestone is subordinate and shale dominates section. In Madison and Union Counties, Quindaro shale consists of black fissile shale overlain by gray to live-gray fossiliferous shale and underlain by gray shale. Thickness about 3.7 feet. Overlies Frisbie limestone member. Although Condra and Upp (1933, Nebraska Geol. Survey Paper 4) did not recognize Quindaro in their Middle River traverse in Iowa it is recognized here.

Typically exposed in floor of Boyn's quarry, near NW cor. sec. 30, T. 10 S., R. 25 E., northeast of Welborn, Wyandotte County, Kans. Named for Quindaro Township.

Quinn Clay (in Harpersville Formation)

Pennsylvanian (Cisco): North-central Texas.

F. B. Plummer *in* M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 7. Named in road log.

F. B. Plummer and H. B. Bradley, 1949, Texas Univ. Bur. Econ. Geology Pub. 4915, p. 5–17, pl. 3. Purplish-red, green, and maroon clay which occurs between Parks Mountain sandstone or its probable equivalent, the Cisco Lake sandstone, and upper Breckenridge limestone. Best described as the next to lowest clay in Harpersville formation, as defined by Plummer and Moore (1921, Texas Univ. Bull. 2132). Most conveniently mapped as the clay between the lower Crystal Falls limestone and the upper Breckenridge limestone. Average thickness 30 feet, maximum thickness 48 feet.

L. F. Brown, Jr., 1960, Texas Univ. Bur. Econ. Geology Rept. Inv. 41, p. 21–23. Quinn clay, according to Plummer and others (1949), is the clay between the Crystal Falls and upper Breckenridge limestone. Present study shows that this upper Breckenridge limestone in northern Stephens County is type Breckenridge and that no lower Breckenridge limestone occurs in subject area. Also correlation has not been demonstrated of type Quinn clay in northern Eastland County with Quinn clay mapped by Plummer and others in northern Stephens County. Quinn clay of present report (Stephens County) thins north of Clear Fork of Brazos River. Member is divided into upper clay and lower clay-shale units by thin sandstone south of Clear Fork of Brazos River and by a limestone north of the river. Clay contains several thin sandstone lentils, a limestone lentil, and a sandstone channel deposit. Thickness 30 to 50 feet.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 73. Beds that intervene between Breckenridge and Chaffin limestone members of the Thrifty in Brown County and north of Home Creek in eastern Coleman County are red clay containiing abundant hematite nodules and plant fossils. This is Quinn clay of Plummer and Bradley. In many places, lenticular beds of sandstone are present within unit, particularly near the base, and some channel-fill conglomerate is also present. Conglomerate may perhaps be correlated with Parks Mountain sandstone member of Thrifty.

Type locality: On north side of Eastland-Cisco Highway (U.S. Highway 80), 2 miles east of Cisco, Eastland County. Named for Quinn Ranch.

Quinnesec Formation

Quinnesec Greenstone[1]

Precambrian: Northern Michigan and northeastern Wisconsin.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 33. Term Quinnesec formation applied to greenstone amphibolite and schist that form a belt in southernmost Dickinson County and adjacent parts of Wisconsin. These rocks were referred to as schists by Van Hise and Bayley (1900) who assigned them to the Archean and as greenstone by Leith, Lund, and Leith (1935) who assigned them to the middle Huronian. Recent mapping in the type area shows that rocks placed in the Quinnesec by previous workers comprise metavolcanic rocks and younger

metagabbro sills. Term Quinnesec formation is retained for the metavolcanic rocks, which are clearly older than granitic rocks that form a mass of batholithic dimensions to the south. Relationships of Quinnesec formation and of the granitic rocks to known Animikie strata are not clear; the metavolcanic and granitic rocks are believed to be pre-Animikie; the younger metagabbro sills are intrusive into the formation and are younger than the granitic rocks to the south; they are tentatively correlated with the post-Animikie and metagabbro.

Quinnesec Falls, Dickinson County, Mich., is on some of the harder ledges of these rocks.

Quinnesec Ore-Formation[1]

Precambrian: Northern Michigan.

Original reference: C. L. Rominger, 1881, Michigan Geol. Survey, v. 4, pt. 2, p. 182.

Crops out at many localities along the range, especially north of the Norway, Quinnesec, and Chapin mines, Menominee iron region.

†Quinnimont Beds[1]

†Quinnimont coal group[1]

Pennsylvanian: West Virginia, western Pennsylvania, and southwestern Virginia.

Original reference: J. P. Lesley, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. xxii–xxiv.

Quinnimont Sandstone (in New River Group)

Quinnimont Sandstone (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 206.

P. H. Price, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 237–238. Hard, gray, massive, medium-grained, lenticular. As much as 70 feet thick. Underlies Beckley coal; overlies Quinnimont shale. New River group, Pottsville series.

Named for exposures in New River Canyon at Quinnimont, Fayette County.

Quinnimont Shale (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 206.

Named for exposures at Quinnimont, Fayette County.

Quinnimont Shale Member (of New River Formation)

Quinnimont Shale (in New River Group)

Quinnimont Shale (in Pottsville Group)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1896, U.S. Geol. Survey Geol. Atlas, Folio 29.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 238. Dark-gray siliceous to argillaceous laminated lenticular sandstone 5 to 40 feet thick. Underlies Quinnimont sandstone; overlies Fire Creek coal. New River group, Pottsville series.

U.S. Geological Survey currently classifies the Quinnimont Shale as a member of the New River Formation on basis of a study now in progress.

Named for exposures at Quinnimont, Fayette County, W. Va.

Quinto Formation (in Orestimba Group)

Quinto Member (of Moreno Group)

Upper Cretaceous (Chico Series) : Northern California.

R. D. Reed, 1943, California Div. Mines Bull. 118, pt. 2, p. 109 (table 6) [preprint 1941]. Shown in table as Quinto formation in Orestimba group; underlies Garzas formation; overlies Moreno formation.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 185 (fig. 69), 186 [preprint 1941]. Middle member of Moreno group. Underlies Garzas member; overlies Moreno member of group.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Quinto member described by Bennison (1941, unpub. map of late Upper Cretaceous deposits south of San Luis Creek, Merced and Fresno Counties) includes sandy shale and two beds of massive biotitic sandstone at Los Banos Creek and at Salt Creek, but units at Salt Creek are poorly exposed. Quinto discussed under heading of Panoche formation in this report [Ortigalita Peak quadrangle].

Has been traced at intervals from Los Banos Creek northward to Brentwood, Contra Costa County.

Quinto B reef beds

Upper Cretaceous : Central western California.

C. T. Smith, 1945, Jour. Paleontology, v. 19, no. 1, p. 37–38, 39 (table 1). Sandstones and sandy shales with some conglomerates. Contain almost exclusively *Glycymeris veatchii major*. Includes Los Banos Creek member. Discussion of biostratigraphy of *Glycymeris veatchii*. Name credited to Alan Bennison (unpub. thesis) :

Exposed on Los Banos Creek, west of Los Banos, Merced County. Also crops out along Garzas Creek, Moreno Gulch, and other streams that flow into San Joaquin Valley.

Quitman Bed (in Trinity Group)[1]

Lower Cretaceous (Comanche Series) : Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 728, 736.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Quitman formation shown on correlation chart above Mountain formation and below Glen Rose equivalents.

Named for Quitman Mountain and Quitman Gap, El Paso County.

†Quitman Limestone[1]

Pennsylvanian : Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 54–55.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 204. Name preoccupied by Cretaceous formations in Texas.

Named for exposures at Quitman, Nodaway County.

Quitman Quartz Monzonite

Oligocene(?) : Western Texas.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 1034–1036, pl. 1. Chiefly quartz monzonite, includes some granodiorite; monzonite, syenite, and granite; holocrystalline, medium- and coarse-grained to porphyritic, generally pink or gray. Principal rock in Quitman pluton; and forms a discontinuous ellipse, elongated north-south, around volcanic rocks of area. Age of pluton cannot be dated exactly; youngest sedimentary rocks invaded are upper Washita [Lower Cretaceous] in age; also pluton cuts volcanic rocks which are presumably Eocene and Oligocene and is overlain by basin fill at least partly Pliocene; unlikely that pluton is later than Miocene; because it is comagmatic with the volcanic rocks, it is probably Oligocene.

Occurs in northern Quitman Mountains, Hudspeth County.

Quivira Shale Member (of Cherryvale Shale)

Quivira Formation (in Kansas City Group)

Quivira Shale (in Kansas City Formation)[1]

Pennsylvanian (Missouri Series) : Northeastern Kansas, southwestern Iowa, and northwestern Missouri.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 96–97. Quivira shale member of Cherryvale formation; overlies Westerville limestone member; underlies Cement City limestone member of Drum limestone. This classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. However, Kansas proposed to deviate from the interstate classification by adopting Dewey instead of Cement City [see explanation under Cement City].

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. In Nebraska, considered a formation in Kansas City group. Underlies P. W. A. Quarry limestone member (new) of Drum formation; overlies Westerville limestone member of Sarpy formation (new). Type locality stated.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 420. Thickness 5 feet in section measured near Winterset, Iowa.

H. G. Hershey and others, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Formation in Kansas City group. Thickness about 6 feet near Crescent, Pottawattamie County; here it is brownish calcareous fossiliferous shale containing thin coquina limestone seams. Thickness about 1 foot in Madison County. Underlies Drum limestone; overlies Westerville limestone.

Type locality: At Quivira Lake, near Kansas River east of Holliday, Johnson County, Kans.

Quoddy Shale[1]

Quoddy Formation

Silurian (Niagaran) : Southeastern Maine.

Original references: E. S. Bastin and H. S. Williams, 1913, Maine Water Storage Comm. 3d Ann. Rept., p. 168; 1913, Geol. Soc. America Bull., v. 24, p. 378, 379.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Listed as a formation.

Named for exposures at West Quoddy Head, Washington County.

Quoggy Joe Quartz Trachyte[1]

Age(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 109, 111, 164–168.

Forms entire mass of Quoggy Joe group of hills, Aroostook County.

Rabbit Hill Limestone

Lower Devonian: Eastern Nevada.

E. L. Winterer and M. A. Murphy, 1960, Jour. Geology, v. 68, no. 2, p. 134 (fig. 6), 135, 136. Consists of tan-weathering silty limestone and calcareous shale; lighter colored than underlying Roberts Mountains formation and more silty and more thinly bedded than overlying Nevada formation; both contacts appear to be conformable and gradational. Contains Helderbergian fauna. Name credited to C. W. Merriam.

U.S. Geological Survey currently designates the age of the Rabbit Hill as Lower Devonian on basis of a study now in progress.

Type section: Monitor Range, Horse Heaven Mountain quadrangle.

Rabbit Spring Formation[1]

Pliocene(?): Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 71.

Exposed in bluffs above Rabbit Spring and in other places along edge of Maipais Mesa, Goldfield district.

Rabble Run Red Sandstone Member (of McKenzie Formation)[1]

Silurian (Niagaran): Western Maryland and northern West Virginia.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey, Silurian Volume, p. 36.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 54, 118, 128, 154, 174. McKenzie formation includes Rabble Run sandstone near its base in Maryland. Throughout southern Pennsylvania and east-central Maryland, has red shale member near top; this red unit, Rabble Run member, although 80 feet thick north of Potomac near Hancock County, Md., thins rapidly southward and is represented in Morgan County, W. Va., by only 5 feet of red sandy shale; it has no other important representative elsewhere in West Virginia. It is believed that Rabble Run red bed thickens northeastward to coalesce with the eastern red, nonmarine facies (Bloomsburg) of the Cayugan group.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 76. Rabble Run sandstone member is present about 100 feet below top of formation. Member is as much as 100 feet thick in Bear Pond area and thins westward and disappears before reaching Cumberland. It appears first in Cacapon section southeast of Hancock and replaces gray shale and limestone toward east in Washington County. Beds resemble the overlying Bloomsburg red sandstone and shale member of the Wills Creek formation.

Named for exposures in Rabble Run in North Mountain, Washington County, Md.

Rabens Branch Bed (in Parkers Formation)

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, pl. 132, 133 (fig. 2) [1948]. Fossiliferous clay band or ferrous carbonate band about 1 inch thick that overlies a thin coal bed near base of formation; horizon is about 20 feet below the Parkers coal and its black sheety shale.

Named from exposure on Rabens Branch, a small stream crossing the north-south road about one-quarter mile south of center of sec. 11, T. 5 S., R. 12 W., 1½ miles southwest of St. Wendells, Posey County.

Raber bed or member

Silurian: Northeastern Michigan.

W. A. Kelly, 1954, Michigan Geol. Soc. [Guidebook 18th] Ann. Field Trip, p. 21. Mentioned in notes on correlation of Silurian of Manitoulin Island with Silurian of Michigan. Bed contains corals identical with Fossil Hill member [formation]. Underlies Engadine dolomite.

Type locality and derivation of name not given. Town of Raber is in Chippewa County.

Raccoon Shale[1]

Raccoon Shale Member (of Cuyahoga Formation)

Mississippian (Kinderhook): Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d, v. 16, p. 216, 219.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 46, 47. Raccoon shale member included in Granville shale facies of Cuyahoga formation. Lateral and vertical extent not well known. Underlies Black Hand siltstone member (emended); overlies Sunbury shale.

Named for exposures on Raccoon Creek, Licking County.

Raccoon Mountain Member (of Gizzard Formation)

Raccoon Mountain Formation (in Gizzard Group)

Lower Pennsylvanian; Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 4, 19, pls. 2, 3, 4, 12–D. Alternation of shales and sandstones with several coals. Includes all beds from base of Warren Point sandstone to base of Pennsylvanian which is recognized by lithologic contrast between Mississippian limestone and variegated (red, maroon, and green) shale and Pennsylvanian coals and plant bearing shales. Thickness in type locality 353 feet; elsewhere thickness varies, but formation is generally thick to east and thin to west. In northwest part of plateau, Warren Point sandstone thins, and the Raccoon Mountain, which cannot be differentiated, is included in lower part of Fentress formation. Basal formation of Gizzard group, Pottsville series.

U. S. Geological Survey classifies the Raccoon Mountain as a member of the Gizzard Formation on the basis of a study now in progress.

Type section: On a mine road beginning 0.4 mile northwest of Whiteside, Marion County, and leading to strip mines at head of Scratch Ankle Hollow, Shellmound quadrangle.

†Raccoon River Beds[1]

Pennsylvanian: Central southern Iowa and northwestern Missouri.

Original reference: H. F. Bain and A. G. Leonard, 1898, Geol. Soc. Amercia Bull., v. 10, p. 11–12.

Named for Raccoon River, Dallas County, Iowa.

Racer Canyon Tuff Member (of Cove Mountain Formation)

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 44. Succession of rhyolitic ignimbrites with maximum thickness of about 1,500 feet. White, gray, pale-pink, or pale-yellow, nonwelded to moderately welded, vitric-crystal tuff in which red or purple lithic fragments are generally abundant. Weathers into spectacular "hoodoos." Overlies Willow Spring member (new); underlies Pilot Creek basalt member (new). Name credited to H. R. Blank (unpub. thesis).

Occurs in Washington County.

Racetrack Dolomite

Middle and Upper Cambrian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 8–9, 14 (fig. 6), pls. 1, 2, 3. Name applied to oldest rock unit in sedimentary sequence of Quartz Spring area. Predominantly gray dolomite. Thickness about 1,900 feet; possible unmapped faults make questionable the measurements of lowest units of formation. Underlies Nopah formation. Base not satisfactorily defined because alluvium overlaps lowest exposures. Middle (?) Cambrian.

Type locality: In Last Chance foothills on western side of Racetrack Valley, about 3 miles west of Quartz Spring, Inyo County. Locality extends from southern tip of spur west of Hidden Valley Road junction, for roughly 7,000 feet to saddle north of U.S. Geological Survey bench mark at 5,330 feet above sea level. Named for Racetrack Valley, the long depression draining southward to the Racetrack playa from a low divide between Tin Mountain and Dry Mountain.

Racine Dolomite[1]

Racine Dolomite (in Coe Group)

Silurian: Southeastern Wisconsin and northeastern Illinois.

Original reference: J. Hall, 1861, Wisconsin Geol. Survey Rept. 1860, p. 1–7.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows that Racine dolomite underlies Guelph dolomite and overlies Manistique dolomite in eastern Wisconsin. Underlies Guelph dolomite and overlies Bellwood dolomite (new) in northeastern Illinois.

H. B. Willman, 1943, Illinois Geol. Survey Rept. Inv. 90, p. 29–30. Formation in Chicago area has maximum thickness of 250 to 300 feet; thinner in western part of region. Racine strata contains many coral reefs which consist predominantly of high-purity dolomite. Overlies Waukesha dolomite. Locally in Chicago area, overlies Joliet formation. Term Bellwood as used in Silurian correlation chart (Swartz and others, 1942) includes strata herein considered Waukesha and Racine.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 18. Coe group (new) comprises Waukesha, Racine, and Port Bryon formations, as Savage (1926, Geol. Soc. America Bull., v. 37, no. 4, p. 513) differentiated them in northwestern Illinois.

Named for exposures at Racine, Racine County, Wis.

Radcliff Formation[1] (in Telescope Group)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 355, 372, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Murphy tentatively assigned all rocks above Panamint metamorphic complex to Lower Paleozoic. Sentinel dolomite, Radcliff formation, and Redlands dolomite limestone are correlated with Noonday dolomite here assigned to Precambrian as defined in this report.

Occurs in southern part of Panamint Range, Inyo County.

Rader Limestone Member (of Bell Canyon Formation)

Upper Permian (Guadalupe Series): Western Texas and southern New Mexico.

P. B. King *in* A. K. Miller and W. M. Furnish, 1940, Geol. Soc. America Spec. Paper 26, p. 9. Incidental mention.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 583, 585 (fig. 1), pl. 2. Consists of massive light-gray limestone, with a few layers of thinner darker limestone. At type locality and elsewhere along foot of Reef escarpment, about 100 feet thick, and lies 225 feet above base of formation. Eastward into Delaware Mountains, thins to about 15 feet, massive beds disappear, and thinner darker beds predominate. Separated from overlying Lamar member by several hundred feet of predominantly sandstone beds. Lies above Pinery limestone member.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 56–57, pl. 3 [1949]. Mapped in New Mexico.

N. D. Newell and others, 1953, The Permian reef complex of the Guadalupe Mountains region Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 15. Lies below the McCombs limestone member (new).

Named for Rader Ridge, which projects from foot of Reef escarpment near Hegler Ranch, Culberson County, Tex.

Raft Formation

Raft Lake Beds[1]

Pleistocene, middle or upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 31, 48–50, pl. 4. Thickness about 200 feet. Overlie Rockland Valley basalt and, locally, Massacre volcanics. Middle(?) Pliocene. Geographical extent indicated.

H. T. Stearns and Andrei Isotoff, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 27. In Eagle Rock area, Raft lake beds extend under most of older alluvium on west side of Snake River and probably also for some distance under Cedar basalt. Upper Pliocene(?).

U.S. Geological Survey has amended the name to Raft Formation and designates the age as middle or late Pleistocene on basis of a study now in progress.

Type section: Exposures along Raft River near mouth, Cassia County.

Raft River Formation[1]

Pliocene(?) : Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 202.

Crops out on north side of Raft River, Grays Harbor County.

Ragg quartzite

Precambrian (Keweenawic) : Iowa.

Charles Keyes, 1941, Pan-Am. Geologist, v. 75, no. 2, p. 99 (chart), 107. Name applied to quartzites (sandstones) about 10 feet thick. On chart appears below Hull porphyry and above Splitrock slates.

Ragged Valley Formation

Ragged Valley Shale Member (of Arroyo Hondo Formation)

Ragged Valley Shale Member (of Moreno Grande Formation)

Upper Cretaceous : Central California.

H. E. Vokes, 1939, New York Acad. Sci. Annals, v. 38, p. 27–28. Name proposed for unit described as Clay Shale member of Martinez(?) by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603). Underlies an unnamed white sandstone member. Cantua member of Arroyo Hondo lies entirely within Ragged Valley shale, and a basal part of the shale, approximately 100 feet thick, appears to underlie Cantua throughout; hence, Ragged Valley shale overlies Moreno formation.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2). Shown as a member (or formation) in Panoche formation (or group). Underlies Brown Mountain sandstone; overlies Joaquin Ridge sandstone.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 31. Ragged Valley shale (*Pachydiscus* silt) included as lower member of Moreno Grande formation (new). Underlies Brown Mountain sandstone member; overlies San Joaquin sandstone member of Panoche formation.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 31. Ragged Valley shale and Brown Mountain sandstone, poorly defined stratigraphic units of late Upper Cretaceous, are included in uppermost part of Panoche formation of this report [Ortigalita Peak quadrangle].

Type locality: On Domengine Creek in Ragged Valley, north of Coalinga, Fresno County.

Raggedy Mountain Gabbro[1]

Raggedy Mountain Group

Precambrian : Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 136.

G. W. Chase, 1952, Oklahoma Geol. Survey Circ. 30, p. 11. Raggedy Mountain group is composed of anorthosite that grades downward into augite gabbro. Meers quartzite [oldest rock in region] and Raggedy Mountain group are cut by intrusions of olivine gabbro.

Named for Raggedy Mountains, Kiowa County.

Ragland Sandstone[1]

Middle Devonian: Eastern Alabama.

Original references: Charles Butts, 1927, Washington Acad. Sci. Jour., v. 17, p. 128–129; 1927, Am. Jour. Sci., 5th, v. 14, p. 365–380; 1927, U.S. Geol. Survey Geol. Atlas, Folio 221, p. 9, footnote.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1777, chart 4. Tentatively correlated with *Meristella*-Coral zone of Schoharie Valley sequence occurring about 250 feet above Onondaga limestone and containing *"Spirifer" venustus*. Shown on chart as younger than Frog Mountain sandstone.

Named for exposures in abandoned quarry 1½ miles south-southwest of Ragland, St. Clair County.

Raiff Limestone

Cambrian: Eastern Nevada.

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 159–160. At type section, consists of 2,789 feet of limestones; lower A member, 1,456 feet thick, consists of medium-dark- to medium-light-gray aphanitic dolomite about 200 feet from light-gray aphanitic dolomite about 200 feet from top; B member, about 269 feet, composed of thin-bedded limestone and subordinate olive-drab shale; C member, 1,064 feet, characterized by two cliff-forming units. Overlies Monte Neva formation (new); underlies Dunderberg formation.

Type section: Northern Egan Range in NW¼ sec. 33, T. 22 N., R. 63 E. on divide north of Monte Neva Hot Springs. Name derived from Raiff siding on Nevada Northern Railroad, 3 miles east-northeast of type section.

Rail Cabin Formation

Upper Triassic: Northeastern Oregon.

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Upper Triassic sequence includes Begg, Brisbois, and Rail Cabin formations. Thickness of sequence, which is overlain by Lower Jurassic Graylock formation (new), is nearly 15,000 feet.

Type locality and derivation of name not stated. Report discusses Izee area, Grant County.

Rail Canyon Sandstone Member (of Vermejo Formation)[1]

Upper Cretaceous: Northeastern New Mexico.

Original reference: W. T. Lee, 1924, U.S. Geol. Survey Bull. 752.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10–b (column 21). Shown on correlation chart as occurring about middle of formation.

Named because of economic importance in making roof in Dawson mines, in Rail Canyon, Raton coal field.

Railroad Bridge Basalt[1]

Pliocene: Northwestern Nevada.

Original reference: R. E. Fuller, 1931, Washington Univ. Pub. Geology, v. 3, no. 1, p. 14.

Occurs in Thousand Creek Basin, south of Pueblo Mountain.

†Rainbow Beds[1]

Miocene or Pliocene: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 174–185.

Fresno and King Counties.

Rainbow Series[1]

Post-Franciscan: Northern California.

Original reference: W. Stalder, 1915, California State Mining Bur. Bull. 69, p. 447–449.

Humboldt County.

Rainbow Flat Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 294–295, geol. map. Metasedimentary rocks and migmatites north of El Dorado Ridge quartz diorite (new) are included in Rainbow Flat group; they are folded into approximately east trending anticlines and synclines and have been intruded by Stoddard Canyon quartz monzonite (new) to north of area studied. Relation to [Aurela Ridge] granulite (new) not ascertained.

Area studied is Cucamonga Canyon-San Antonio Canyon, Cucamonga quadrangle, San Bernardino and Los Angeles Counties.

Raine Ranch Formation

Miocene, upper: Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1195–1198, pl. 1. Consists of 2,000 feet of pumice lapilli tuff, volcanic breccia, lava flows, conglomerates, rhyolitic tuff, diatomite, shale, and limestone. Vertebrate fossils. In Pine Valley, rests unconformably and older Tertiary formations; normal fault separates formation from Paleozoic rocks of Pinon Range; in Susie Creek Valley rests in sedimentary contact on Paleozoic rocks. Underlies Palisade Canyon rhyolite (new); also underlies Carlin formation (new).

Named for Raine Ranch, sec. 6, T. 31 N., R. 52 E. Crops out in northern part of Pine Valley and valley of Susie Creek, vicinity of Carlin.

Raines Corner Limestone (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 404.

Type locality: In bed of Indian Creek one-half mile northwest of Raines Corner, Monroe County, W. Va.

Raines Corner Shale (in Bluefield Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 409.

Type locality: On west side of Indian Creek along the State road, about 1½ miles northeast of Raines Corner, Monroe County, W. Va.

Rainer Lavas or Volcanics

See Mount Rainier Lavas.

Rainvalley Formation (in Naco Group)

Rainvalley Formation (in Snyder Hill Group)

Permian: Southern Arizona.

D. L. Bryant, 1955, Dissert. Abs., v. 15, no. 7, p. 1224. Uppermost formation of Snyder Hill group. Overlies Concha limestone (expanded).

W. D. Pye, 1959, Arizona Geol. Soc. Guidebook 2, p. 277. Thickness 400 feet. Gray-brown, red, and black limestone and dolomite with sandstone. Type area stated.

U.S. Geological Survey currently classifies the Rainvalley as a formation in the Naco Group on the basis of a study now in progress.

Type area: Mustang Mountains.

Rainy Limestone Member (of Arroyo Formation)

Rainy Limestone Member (of Clear Fork Formation)[1]

Permian (Leonard Series): North-central Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 27, pl. 1.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as basal member of Arroyo formation. Older than Lytle limestone; younger than Lake Kemp formation.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Shown on correlation chart at base of Arroyo formation. Underlies Standpipe limestone member.

Type locality: Along Rainy [also spelled Rainey] Creek, 6 miles east of Abilene, Taylor County.

Rainy Mountain Limestone[1]

Lower Ordovician: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 138–140.

Charles Schuchert, 1943, Stratigraphy of the eastern and central United States: New York, John Wiley & Sons, Inc., p. 871. Abandoned.

Named for Rainy Mountain, Kiowa County.

Raisin River Dolomite Member (of Bass Islands Dolomite)[1]

Raisin River Formation (in Bass Islands Group)

Upper Silurian: Southeastern Michigan and northern Ohio, and Ontario, Canada.

Original reference: W. H. Sherzer and A. W. Grabau, 1909, Geol. Soc. America Bull., v. 19, p. 546.

Wilber Stout, 1941, Ohio Geol. Survey, 4th ser., Bull. 42, p. 38 40, chart facing p. 46. Uppermost formation in Bass Island[s] group in Ohio. Overlies Put-in-Bay formation; unconformably underlies Oriskany formation. Consists of fairly pure dolomite, regularly bedded, layers commonly 2 to 6 inches thick, locally more massive; color bluish gray to brownish gray. Thickness about 50 feet. Limited to small areas west of Toledo.

J. E. Carman, 1960, Fieldiana: Geology, v. 14, no. 1, p. 1–5. In Lucas County, Ohio, fossiliferous Holland Quarry shale (new) occupies depression in Raisin River dolomite.

Named for exposures on Raisin River, Monroe County, Mich.

Raker Peak Pyroxene Andesites,[1] Dacite

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 287, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 682. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2), 79, 80 (table 4 and text), 81, 82. Listed on tables and mentioned in text in report on uranium geochemistry of Lassen volcanic rocks.

Raker Peak is in Lassen Volcanic National Park.

Rakes Creek Shale Member (of Tecumseh Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska and southwestern Iowa.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 47, 53.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23. Top member of formation; overlies Ost limestone member. Thickness 6 to 10 feet in Nebraska and northern Kansas. In southern Kansas, lower boundary is not distinct. [Not treated as a subdivision of the Tecumseh by Kansas Geological Survey.]

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 19, fig. 5. Identified in quarry in sec. 15, T. 71 N., R. 43 W., Mills County where it consists of greenish-gray sandy shale with thin stringer near base. Thickness about 7 feet. Uppermost member of formation; overlies Ost limestone member.

Type locality: On Rakes Creek in NW¼ sec. 5, T. 10 N., R. 14 E., Cass County, Nebr.

Raleigh Graphite

Precambrian: Central North Carolina.

J. W. Harrington, 1947, Jour. Geology, v. 55, no. 6, p. 516–521. Name applied to several parallel tilted beds of earthy schistose graphite enclosed in the Precambrian schists and gneisses of Wake County.

All exposures mapped lie in belt 10 miles long and 2 miles wide; northern end is at town of Six Forks, 10 miles north of Raleigh; southern end may be 18 miles southwest of Raleigh.

Raleigh Sandstone Member (of New River Formation)

Raleigh Sandstone (in New River Group)

Raleigh Sandstone (in Pottsville Group)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 493.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 234–236. Raleigh sandstone includes the Upper Raleigh and Lower Raleigh of White (1908, West Virginia Geol. Survey, v. 2a). The Upper Raleigh, 50 to 75 feet thick, underlies thin shale below Welch

coal and overlies and is separated from Lower Raleigh sandstone by an interval containing shale and coal interval that includes Raleigh coals; locally coalesces with overlying Welch sandstone, cutting out Welch coal. Lower Raleigh sandstone, 50 to 100 feet thick, overlies Beckley coals above the Quinnimont sandstone. Both Lower and Upper Raleigh are included in New River group, Pottsville series.

U.S. Geological Survey currently classifies the Raleigh Sandstone as a member of the New River Formation on the basis of a study now in progress.

Named for exposures on road from Prince to Raleigh, Raleigh County, W. Va.

Ralston Formation[1]

Precambrian: Central northern Colorado.

Original reference: M. F. Boos and C. M. Boos, 1934, Geol. Soc. America Bull., v. 45, no. 2, p. 306.

In Boulder region.

Ralston Formation

Upper Jurassic: North-central Colorado.

W. A. Waldschmidt and L. W. LeRoy, 1944, Geol. Soc. America Bull., v. 55, no. 10, p. 1098. Underlies Morrison formation. Name credited to LeRoy (1944, unpub. thesis).

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 46–55. Represented by two lateral lithic variations: a shale-marlstone facies and a gypsiferous facies. Former facies essentially gray to maroon shales. Thin dense gray impure lithographic to sandy marlstones, and fine- to medium-grained yellow to buff calcareous sandstones and silts commonly present as minor components. Marlstones best developed near Mount Vernon Canyon where they are conspicuously laminated and arenaceous. Bedding moderately uniform. Thickness at type section 83 feet. Gypsiferous facies essentially of thin beds of white massive to fibrous gypsum and numerous thin layers of gypsiferous silt. Several conspicuous beds of hard massive yellow calcareous medium-grained sandstone and minor amounts of thin-bedded maroon shale in upper part of facies. Thickness at type section 67½ feet. Formation disconformably underlies basal sandstone of Morrison; overlies Lykins formation.

E. A. Frederickson, J. M. DeLay, and W. W. Saylor, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2120–2147. Four sedimentary facies recognized in Canon City embayment: conglomerate facies, sandstone facies, gypsum-shale facies and sand-shale facies. These are intergradational from west to east. Shale-marlstone and gypsum facies of Golden-Morrison area (of LeRoy) considered equivalent respectively to sand-shale and gypsum-shale facies of this paper. Thickness in embayment from fraction of a foot to as much as 180 feet.

Richard Van Horn, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 755–756. Proposed that rocks that LeRoy (1946) described as Ralston formation be renamed Ralston Creek formation because the former name had been applied to two other units at the time LeRoy published his paper—one of which had its type locality only a few miles from LeRoy's type section. Late Jurassic.

Type section of shale-marlstone facies: Along irrigation ditch and water level on west side of Ralston Reservoir, Ralston Creek, 5 miles north of

Golden, sec. 5, T. 3 S., R. 70 W., Blackhawk quadrangle, Jefferson County. Facies prevalent between Bear Creek and Ralston Creek.

Type section of gypsiferous facies: On east side of Glennon Canyon, 1½ miles southeast of Morrison, NW¼ sec. 12, T. 5 S., R. 70 W., Morrison quadrangle, Jefferson County. Facies well exposed along west slope of Dakota hogback between Bear Creek and Turkey Creek.

†Ralston Formation[1]

Eocene, lower: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1912, Am. Mus. Nat. History Bull., v. 31, p. 60–62.

Occurs on north side of Shoshone River in bluff opposite Ralston Station Bighorn Basin region.

Ralston Group[1]

Pennsylvanian and Permian: Central northern Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 7, 13.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. If validated, the name preoccupies name Ralston formation, Eocene, of Wyoming.

Named for Ralston, Pawnee County.

Ralston Creek Formation

Upper Jurassic: North-central Colorado.

Richard Van Horn, 1957. Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 755–756. Name Ralston Creek formation used in place of name Ralston formation as described by LeRoy (1946). Change in name desirable to avoid confusion because Ralston formation has been used previously for several different formations. Encompasses same rocks that were described by LeRoy (1946) as Ralston formation. Consists of varicolored claystone, siltstone, and limestone and contains thin beds and disseminated nodules of moderate-red to dark-gray chalcedony. Underlies Morrison formation; overlies Lykins formation.

Richard Van Horn, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–103. Shale-marlstone about 110 feet thick in Golden quadrangle. At base of formation, a 5-foot-thick bed of grayish-red to light-gray fine- to medium-grained calcareous sandstone is exposed below highwater mark of Ralston Reservoir. This bed not indicated in sections measured by LeRoy (1946; p. 41, 51) of the Ralston and Lykins formations in Ralston Creek, and here tentatively assigned to Ralston Creek formation.

Type section: At the locality described by LeRoy (1946, p. 51), on south side of Ralston Creek in NW¼SW¼ sec. 5, T. 3 S., R. 70 W., Ralston Buttes quadrangle. [LeRoy, 1946, p. 51 gives type section of shale-marlstone facies of Ralston formation as sec. 5, T. 3 S., R. 70 W., Blackhawk quadrangle.]

‡Ramona Formation[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 36.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named for Ramona, Washington County.

Rampart Group[1]

Mississippian (probably lower) : East-central Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 155–169.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000) : U.S. Geol. Survey. Name appears on map legend under Mississippian volcanic rocks.

Named for exposures in Lower Ramparts of the Yukon. Yukon-Tanana region.

Rampart Cave Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 19, 84–87. Consists almost entirely of gray or dark-gray aphanitic limestone with small amount of light-brown or tan silty mottling. Mostly thick bedded and massive, although thin beds found at top and bottom in many sections. In vicinity of Grand Wash Cliffs, maximum thickness about 160 feet. Thins to the east. Basal subdivision of Muav formation; overlies Flour Sack member (new) of Bright Angel shale.

Named from a cavern near base of member, a few miles east of Grand Wash Cliffs on south side of Lake Mead. In western half of Grand Canyon.

Ramp Creek Member (of Harrodsburg Limestone)[1]

Ramp Creek Member (of Warsaw Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1929, Indiana Acad. Sci. Proc., v. 38, p. 233–242.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 805. Reallocated to member status in Warsaw formation. Lowest member of formation; underlies Leesville member (reallocated).

Exposed in ravine tributary to Ramp Creek, southeastern part of Monroe County.

Ramshorn Slate[1]

Lower Ordovician: Southern central Idaho.

Original references: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth; 1934, Geol. Soc. America Bull., v. 45, p. 945.

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 11, 14–17, pl. 1. In Bayhorse region, overlies Bayhorse dolomite and underlies Kinnikinic quartzite. Thickness 2,000 feet. Lower Ordovician.

Named for mine near head of Bayhorse Creek, Custer County.

†Ramshorn Volcanic Series[1]

Eocene, post-middle: Central Wyoming.

Original reference: D. Love, 1934, Wyoming Geol. Survey Bull. 24, pt. 4, p. 21–22.

J. D. Love, 1939, Geol Soc. America Spec. Paper 20, p. 79. Name preoccupied. Replaced by Wiggins formation.

Named for The Ramshorn, a mountainous ridge about 12 miles west of area studied (Owl Creek Mountains).

Rancheria Formation

Mississippian (Meramec): Western Texas. and central southern New Mexico.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 9, 11, 17–19, 22, 34, 38. Sequence of cherty black bituminous argillaceous limestone beds that unconformably overlies Las Cruces formation (new) and unconformably underlies Helms formation (restricted) in Franklin Mountains of New Mexico. At type locality, section comprises (ascending) few inches of black, detrital, sandy shale; black, detrital quartz sandstone containing numerous plant fossils and considerable carbonaceous material; 8 feet of soft yellow to brown sandy siltstone; massive black bituminous detrital limestone made up largely of minute fragments of crinoidal material; and the remaining 235 feet of typical medium-bedded dense black silty limestone beds that weather brown and contain large amounts of brown-weathering porous chert. Thickness approximately 255 feet in type area; 215 feet at Rancheria Peak; thins by progressive overlap from south toward north in Sacramento Mountains and missing in northern part of range. Of Meramec age.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of West Texas: West Texas Geol. Soc., p. 19. Moorefield faunule present mostly in lower part, which was Laudon and Bowsher's evidence of Meramec age, but which would place it in upper Osage also, if section in Llano region were used for comparison. Probably upper part of Rancheria in Hueco and Franklin Mountains is of Meramec age.

Type locality: On southwest side of small south fork of shallow canyon that leaves west slope of Franklin Mountains, almost directly east of Vinton, Tex. (SW¼ sec. 67, S. Blk. 82, El Paso County, Tex.). Named for Rancheria Peak in Hueco Mountains where it is well exposed. Also present in parts of San Andres Mountains, New Mex.

Rancholabrean Age

Pleistocene, late: North America.

D. E. Savage, 1951, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 28, no. 10, p. 289. Provincial time term typified by Rancho La Brea (vertebrate) fauna. The Rancholabrean is post-Irvingtonian.

Rancocas Formation[1] **or Group**[1]

Paleocene and Eocene: New Jersey and Delaware.

Original references: W. B. Clark, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 337–338; 1894, Jour. Geology, v. 2, p. 161–177.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184. Group comprises (ascending) Hornerstown sand, Vincentown formation, and Manasquan formation.

Rancocas Creek, Burlington County, N.J., cuts through the formation, exposing its full sequence.

Rand Schist[1]

Precambrian(?): Southern California.

Original reference: C. D. Hulin, 1925, California State Min. Bur. Bull. 95, p. 23–29, map.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1), 13–14, pls. 1–3. Partial section of Rand schist, totaling about 2,000 feet,

is exposed on north slope of Rand Mountains in Saltdale quadrangle. Schist is compressed into several folds, and uppermost layers are in contact with intrusive quartz monzonite; greenish-gray actinolite facies, which is abundant in Randsburg quadrangle, is not common in Saltdale quadrangle. Columnar section shows Rand schist older than newly defined Mesquite schist. Precambrian(?).

First described in Kern County where it composes bulk of Rand Mountains.

Randels Island Gneiss[1]

Age(?) : New York.

Original reference: R. P. Stevens, 1867, New York Lyceum Nat. History Annals, v. 8, p. 116–120.

Along southern shore of Spuyten-Duyvel Creek and Harlem River, Manhattan Island.

Randle Laharic Breccia-Conglomerate or deposit

Eocene-Oligocene: Northwestern Washington.

R. V. Fisher, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 127–132. Consists of three well-exposed massive volcanic breccia-conglomerate beds. Beds are poorly sorted and show no marked vertical or horizontal grading of fragment sizes, no preferred orientation of fragments, and no internal laminae. These characterictics indicate deposition by either lahars or pyroclastic flows but preclude deposition from air.

Occurs 1 mile west of Randle, eastern Lewis County.

Randlett horizon (in Duchesne River Formation)[1]

Eocene (Duchesnean) : Eastern Utah.

Original reference: J. L. Kay, 1934, Carnegie Mus. Annals, v. 23, p. 357–359.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 29, pl. 1. Underlies Halfway horizon; overlies Uinta formation. Eocene (Duchesnean).

Type locality: North and east of town of Randlett, Uintah County.

Randolph Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Quarried at Randolph, Randolph Township, Orange County.

Randolph Granite[1]

Upper Devonian or Upper Carboniferous: Northern New Hampshire.

Original reference: M. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, p. 82, map.

Type locality: In Ravine of the Castles, which lies south of Randolph Range and Randolph Township, 1 mile northwest of Mount Jefferson, in Mount Washington quadrangle.

Randolph Limestone[1]

Lower Cretaceous(?) : Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

Tombstone district.

Randolph Phyllite[1]

Middle Ordovician: Northeastern and southeastern Vermont.

Original reference: C. H. Richardson, 1924, Vermont State Geologist 14th Rept., p. 90.

Extends in north-south direction, entirely across Randolph Township, Orange County.

Rand Ranch Formation

Oligocene(?): Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 60, no. 8, p. 1191. 1193, pl. 1. Consists of 1,700 feet of sandstones and conglomerates; basal 450 feet is gray volcanic-pebble conglomerate and gray and yellow volcanic sandstones; upper 1,250 feet is interbedded white, yellow, and red sandstones and Paleozoic-pebble conglomerates. Conformably overlies volcanic rocks of Cortex Mountains. Believed to be older than Safford Canyon formation (new) which unconformably overlies the volcanic rocks of Cortex Mountains. Nonfossiliferous; tentatively referred to Oligocene.

Named for Rand Ranch, SW¼ T. 30 N., R. 52 E., near Carlin.

Randville Dolomite[1] (in Chocolay Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 9–16.

J. E. Gair and K. L. Wier, 1956, U.S. Geol. Survey Bull. 1044, p. 14 (table 2), 28–34, pl. 1, Exposed in south-central part of Kiernan quadrangle, near south shore of Michigamme Reservoir, and on east flank of Amasa oval (uplift). Has maximum thickness of about 1,800 feet on flanks of oval and consists largely of almost pure dolomite; locally contains phases of quartz-sericite slate, sericite and chlorite schist, feldspathic quartzite, and arkose. Unconformably overlies Margeson Creek gneiss (new); unconformably underlies Goodrich quartzite; in Dickinson County, Sturgeon quartzite commonly lies between the Randville and older granitic rocks; in Kiernan area, there is no equivalent quartzite in the section.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Uppermost formation in newly defined Chocolay group; in parts of Iron and Dickinson Counties is only representative of group.

Named for exposures near Randville, west-central Dickinson County.

Rangeley Conglomerate[1]

Devonian(?): West-central Maine.

Original reference: E. S. C. Smith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 147–154.

E. S. Pratt and H. W. Allen, 1949, Maine State Geologist Rept. 1947–1948, p. 23. Oldest rock in region [Franklin County]. Overlain by staurolite schist of varying composition.

Named for development near Rangeley and at southeast end of Rangeley Lake, Franklin County.

Rangely Tongue (of Mancos Shale)

Upper Cretaceous: Northwestern Colorado and northeastern Utah.

L. A. Hale, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 92, 93 (fig. 3). Equivalent to Black Butte tongue (new) of Rock Springs formation (or Mancos shale).

Rangely, Colo., to Vernal, Utah.

†Ranger Formation (in Canyon Group)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii.

Named for exposures in vicinity of Ranger, Eastland County.

Ranger Limestone Member (of Brad Formation)[1]

Ranger Limestone (in Brad Group)

Upper Pennsylvanian: Central and central northern Texas.

Original references: F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133, 145; F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology 3801, p. 111–115. Upper member of Brad formation (redefined). Overlies an unnamed shale member which represents upper part of Placid shale member of Plummer and Moore, the lower part of which is here included in Winchell member of Graford. Ranger appears to be equivalent of Drake's (1893) Home Creek limestone at the type locality. As exposed on Home Creek, about 35 feet thick. It is massive bluish-gray noncherty limestone; upper part broken by bedding planes. At section measured on river bluff half a mile west of mouth of Home Creek, the Ranger is 70 feet thick. Because the limestone section of the Ranger passes into overlying Home Creek of northern Brown County by a series of relatively thin limestone beds interstratified with shale, it is difficult to place top of member and top of Brad formation. Along Colorado River, shale partings are so thin that it seems reasonable to place top of Ranger at top of unbroken limestone and to consider first thick shale as first bed of Caddo Creek formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Brad group. Underlies Hog Creek shale; overlies Placid shale.

M. G. Cheney, 1948, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, p. 20. Underlies Colony Creek shale (new) which replaces name Hog Creek shale.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, April 17–19, p. 51. In Brown and Coleman Counties, member consists of limestone, pale yellowish brown to light gray, generally slabby, cherty; contains "seaweed" structures; locally abundant fusulinids and other foraminifers, brachiopods, and crinoid columnals. Reeflike in vicinity of Colorado River. Thickness about 20 feet. Overlies Placid shale member; underlies Colony Creek shale member of Caddo Creek formation.

Named for exposures west of Ranger, Eastland County.

Ranger Marble[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 622, 642.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new)

Exposed at various points northeastward to Brooklyn ranger station, Medicine Bow Mountains.

†Ranger Series[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii, pl. 3.

Rapid Limestone[1]

Rapid Limestone Member (of Cedar Valley Formation)

Upper Devonian: Central eastern Iowa

Original references: C. [R.] Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149; 1913, Iowa Acad. Sci. Proc., v. 20, p. 205, 206.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1751. Shown on correlation chart as middle member of Cedar Valley formation. Underlies Coralville limestone member; overlies Solon limestone member. Middle Devonian. Age of entire Cedar Valley is difficult to establish, and dating of some of its parts presents problems. Upper zone of the Rapid formation (*Atrypa waterlooensis*) probably should be correlated with part of the Callaway of Missouri.

W. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 157. Independence shale is stratigraphically below the Cedar Valley and above the Wapsipinicon. The Independence, by its fossils, is lower Upper Devonian; hence, Cedar Valley limestone is Upper Devonian in age and post-Independence.

Named for locality in Johnson County.

Rapid City Lens (in Newcastle Formation)

Upper Cretaceous: Western South Dakota.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 17. Primarily shale but containing 3 feet of sandstone. Maximum thickness about 27 feet. In this report, seven lenses are named in the Newcastle.

Named for exposure near Rapid City, Pennington County.

Rapides Shale or Formation (in Austin Group)

Cretaceous (Gulfian): Central Louisiana (subsurface).

J. M. Forgotson, 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 117, 124. Proposed for sediments lying immediately below the base of either the Ector chalk or the Ector format and concordant with the sedimentary sequence making up the Austin group. Consists of dark gray shale, dark chalky shale, thin beds of chalk, shaly chalk, and thin limestones. In type well, occurs between electrical log depths of 9,055 and 9,245 feet. Formation has unconformity for basal boundary, therefore, concordant beds added below those encountered in type well are included in this definition.

Type well: Union Producing Company No. 1 Belgard, sec. 14, T. 4 N., R. 3 E., Rapides Parish.

†Rapids Schist[1]

Lower Paleozoic or older: Northern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 473.

Traversed by Chandler River in region of the rapids. Extends for several miles downstream nearly to West Fork in Chandler region.

†Rappahannock Series[1]

Lower Cretaceous: Eastern Virginia.

Original reference: L. F. Ward, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 321.

Rarden Shale Member[1] (of Cuyahoga Formation)

Rarden Shale Member (of Logan Formation)

Rarden Shale Member (of New Providence Formation)

Lower Mississippian: Southern Ohio and northeastern Kentucky.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 762.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 133. Rarden shale member of New Providence formation in Kentucky; included in Vanceburg facies of formation.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1950, Jour. Geology, v. 50, no. 1, p. 62–63. In Ohio considered a member of Logan formation; included in Vanceburg siltstone facies of formation.

Named for Rarden, Scioto County, Ohio.

†Raritan Clay[1]

Upper Cretaceous: New Jersey and eastern Maryland.

Original reference: T. A. Conrad, 1869, Am. Jour. Sci., 2d v. 47, p. 360–363.

Occurs along Raritan River, N.J.

Raritan fire clay[1] (in Raritan Formation)

Cretaceous: New Jersey.

Original references: G. H. Cook and J. C. Smock, 1877, New Jersey Geol. Survey map of district of Middlesex County; G. H. Cook, 1878, New Jersey Geol. Survey Rept. on clays, p. 34.

H. C. Barksdale and others, 1943, New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 66, 140. Basal member of Raritan. Includes "Raritan potters clay" of earlier reports. Thickness 0 to 35 feet. Underlies Farrington sand member (new).

Crops out near Nixon, Bonhampton, Fords, Keasbey, and Milltown, Middlesex County.

Raritan Formation[1]

Upper Cretaceous: Eastern New Jersey, Delaware, and Maryland.

Original reference: G. H. Cook, 1888, Am. Geologist, v. 2, p. 260.

H. C. Barksdale and others, 1943, New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 66–140. Formation, in Middlesex County, divided into several distinct mappable units. Clays of Raritan have been extensively used in ceramic industry and received informal names. The other members, composed dominantly of sands were not named but given numbers. In this report these are given member names. Thus, Raritan comprises from top to bottom Amboy stoneware clay, Old Bridge sand member (No. 3 sand of previous reports); South Amboy fire clay. Sayreville sand member (No. 2 sand of previous reports), Woodbridge clay, Farrington sand member (No. 1 sand of previous reports), and Raritan fire clay. Underlies Magothy formation. Upper Cretaceous.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 15–21. Evidence cited to substantiate Lower and

Upper Cretaceous age. Writers believe that the nonmarine beds lying below the Magothy in New Jersey and called Raritan are equivalent to nonmarine sediments in Delaware-Maryland-Virginia lying below the Magothy and referred to the "Raritan," Patapsco, Arundel, and Patuxent, and that the entire series should be considered as single unit.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2161–2184. Presentation of paleobotanical analyses and discussion bearing on age, correlation, and stratigraphic relationships of Cretaceous plant-bearing beds of Coastal Plain from New Jersey to South Carolina. In New Jersey, evidence is presented which challenges recent correlation by Spangler and Peterson, of greater part of plant-bearing Raritan formation with Potomac group of Maryland-Delaware, and assignment, by same authors, of major part of Raritan formation to Early Cretaceous. It is shown that both floral and faunal evidence indicates that none of the Potomac group can be correlated with any part of the Raritan formation of New Jersey. In Delaware-Maryland-Virginia area, assignment of Arundel and Patapsco formations of Potomac group to Late Cretaceous, as is done in two recent reports, is shown to be based on doubtful evidence. These formations are regarded as more reasonably assigned to Early Cretaceous, on evidence of both plants and vertebrates. The beds overlying the Potomac group in Maryland and Delaware are here considered correctly assigned to Raritan formation.

Well exposed in vicinity of Raritan River and Raritan Bay, N.J.

Raso Limestone[1]

See Lasso Limestone.

Raspberry Formation

Upper Triassic: North-central Nevada.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Gray, black, buff, or green slate, locally phyllitic; limestone lenses and limestone conglomerate, especially in lower part; quartzite lenses a few inches to 100 feet in thickness form about 5 percent of unit. Thickness in East Range approximately 3,000 feet; top and base not visible. In fault contact with older formations.

Type locality: Raspberry Creek, northwestern part of East Range.

Raspberry Mountain Granite[1]

Precambrian: Eastern Colorado.

Original reference: E. B. Mathews, 1900, Jour. Geology, v. 8, p. 214–240.

Named from its conspicuous development on Raspberry Mountain, Pikes Peak region.

Rat Formation

Tertiary or older: Alaska.

R. Q. Lewis, W. H. Nelson, and H. A. Powers, 1960, U.S. Geol. Survey Bull. 1028–Q, p. 558–560, pl 70. Porphyritic hornblende andesite lava flows and breccias, and conglomerates derived from them. No fossils found, and contact with Gunners Cove formation (new) not exposed; trace of contact trends north-south across high crest of island and is probably high-angle normal fault. Inferred to be older than Gunners Cove.

Limited to southeastern part of Rat Island which is on midpart of segment of Aleutian Ridge that includes Amchitka and southern Kiska Islands.

Rat Creek Quartz Latite

Rat Creek Quartz Latite (in Potosi Volcanic Series)[1]

Middle or late Tertiary: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

Named for development on Rat Creek, Creede district.

Rathbun Limestone Member (of Denmark Formation)

Rathbun Member (of Shoreham Formation)

Middle Ordovician (Mohawkian): East-central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599–600. Name proposed for basal member of Denmark formation. Described at type section as brachiopod coquina, calcilutite, and calcareous shale. Contrasts with underlying Shoreham limestone by abundance of calcilutite; contrasts sharply with overlying Poland limestone member (newly defined) by presence of coquinal beds. Lithologically more similar to Shoreham than to Poland, but arbitrarily placed in Denmark formation because persistent basal calcarenite suggests subjacent disconformity. Maximum thickness 10 feet; 6 feet in type section. Persists along West Canada Creek but thins southeastward and is absent to the east at Little Falls.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 525–526. Reallocated to Shoreham formation because beds in West Canada Creek valley are faunal and lithologic equivalents of top Shoreham beds of Black River valley. Shales generally thicker and more calcareous than those in underlying part of Shoreham. Coquinal beds increase in number toward top. Thickness at type section about 9 feet.

Type section: On Rathbun Brook, a tributary of West Canada Creek, 1½ miles northwest of Newport, Herkimer County.

Raton Basalts

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1354. Incidental mention only.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1022, 1027–1028, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1049, 1050. Medium- to dark-gray predominantly fine-grained vesicular olivine basalts. Some iddingsite. Rarely diabasic. Quaternary. Derivation of name and geographic distribution given.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141 (sheet 2). Consists of two series of flows. Cumulative local thickness ranges from 100 to 500 feet.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 114–115. In Des Moines quadrangle, Raton basalts lie with apparent conformity on Ogallala formation. Topographically continuous with older Raton basalts mapped by Wood and others (1953) in Colfax quadrangle.

Named after Raton Mesa. Occurs in Colfax and Union Counties in Johnson Mesa, gap between Hunter and Johnson Mesas, Mesa Llargo, Hereford Park, Oak Canyon, Devoy Peak, mesa north of Valley post office, and Black Mesa.

Raton Formation[1]

Upper Cretaceous and Paleocene: Northeastern New Mexico and southeastern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept., p. 89–91.

G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. In Colfax County, N. Mex., formation is about 1,110 feet thick and consists of interbedded shale, siltstone, graywacke, arkosic or feldspathic sandstone, quartzose sandstone, conglomerate, and coal. Unconformably overlies Vermejo; in some areas overlies Trinidad sandstone. Upper Cretaceous and Paleocene.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 714–716. Crops out over most of Raton Mesa region; as much as 1,700 feet thick southeast of Spanish Peaks. Consists of thin basal sequence of gray to dark-purple-gray siliceous granule to pebble conglomerate or gray siliceous conglomeratic sandstone beds. Above basal sequence, formation is buff, gray, and olive-gray very fine- to coarse-grained arkose, graywacke, and quartzose sandstone beds; gray to dark-gray siltstone and silty shale beds; numerous coal beds. Intertongues and grades into Poison Canyon formation. Overlies Vermejo formation. Cretaceous and Tertiary.

Type area: In high mesa region between Trinidad, Colo., and Raton, N. Mex.

Ratonan series[1]

Eocene: New Mexico.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259.

†Raton Hills Group[1]

Upper Cretaceous and Eocene: Southeastern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Colorado and New Mexico 3d Ann. Rept., p. 89–91.

Occurs in Raton Hills, Raton Mesa region.

Raton Pass coal group (in Raton Formation)[1]

Eocene: Eastern Colorado.

Original reference: R. C. Hills, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58.

Elmoro region.

†Rattlesnake Beds[1] or Formation[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 41–54.

Named for Rattlesnake Mountain, Brewster County.

Rattlesnake Formation[1]

Pliocene and Pleistocene: Central northern Oregon.

Original reference: J. C. Merriam, 1901, California Univ. Pub. Bull. Dept. Geology, v. 2, no. 9, p. 310.

W. D. Wilkinson, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1534. Contains layer of welded tuff that stands in cliffs 50 to 75 feet high and extends from type locality near Picture Gorge eastward along both sides of John Day Valley to vicinity of town of John Day.

T. P. Thayer, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Maps MF–49, MF–50, and MF–51. In Aldrich Mountain quadrangle and Mount Vernon quadrangle, overlies Mascall formation with angular unconformity. In John Day quadrangle overlies Columbia River basalt with angular unconformity. Pliocene and Pleistocene(?).

T. P. Thayer, 1957, Some relations of later Tertiary volcanology and structure in eastern Oregon: Internat. Geol. Cong., 20th, Mexico, 1956. Consists of fanglomerate, boulder gravel, and welded rhyolite tuff. Gravels and about 15 feet of tuff near the center form a 650-foot bluff southeast of Dayville and extend below floor of valley. Tuff member has maximum thickness of about 110 feet. Vertebrate fossils below tuff date beds below tuff as lower Pliocene; beds above tuff range up to Pleistocene in age.

Type exposure: On Rattlesnake Creek about 1 mile west of Cottonwood, Malheur County.

Rattlesnake Granite[1]

Late Mesozoic: Southern California.

Original reference: F. S. Hudson, 1922, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 13, no. 6, p. 181, 207–209, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 485, table 4. Described under late Mesozoic plutonics. In plutonic sequence, central San Diego County, Rattlesnake granite is listed as youngest intrusive, younger than La Posta quartz diorite.

D. L. Everhart, 1951, California Div. Mines Bull. 159, p. 87–88, pls. 2, 3, 4. Mapped as Upper Cretaceous.

E. S. Larsen, Jr., 1958, U.S. Geol. Survey Bull. 1070–B, p. 44, 50. Lead-alpha age 117 million years.

Named for Rattlesnake Valley, Cuyamaca region, San Diego County.

Rattlesnake Point Granite

Precambrian: Southeastern Arizona.

F. F. Sabins, 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1322–1323, pl. 1. Coarse-grained with granitic-porphyritic texture. Fresh surfaces are greenish gray and weather light brown. Abundant large light-colored euhedral feldspar phenocrysts which have maximum dimensions of 15 by 25 mm. At Rattlesnake Point and other outcrops, there is pronounced flow-type preferred orientation of feldspar phenocrysts. Unconformably underlies Bolsa quartzite. Intrudes Pinal schist along west side of Bowie Mountain.

Crops out along northeast front of Chiricahua Mountains from vicinity of Emigrant Hills and Little Emigrant Canyon east to Rattlesnake Point from which granite takes its name, Cochise Head quadrangle, Cochise County. Also crops out along north flank of Blue Mountain, at Timber Mountain, and on southwest side of range in vicinity of Apache Pass.

Raul Canyon Basalt

Tertiary: Northwestern Utah.

G. H. Thomas, 1958, Brigham Young Univ. Research Studies, Geology Ser., v. 5, no. 4, p. 14, pl. 1. Dark fine-grained porphyritic basalt. Mapped as Raul Canyon intrusive.

Named for exposures in Raul Canyon, Tooele County.

Ravalli Group[1] or Argillite

Ravalli Formation[1]

Precambrian (Belt Series): Northwestern Montana and northeastern Idaho.

Original reference: C. D. Walcott, 1906, Geol. Soc. America Bull., v. 17, p. 7, 9.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1880–1881. In Glacier National Park, Ravalli group represented by (ascending) Altyn formation, Appekunny formation, and Grinnell formation. Thickness 7,800 to 15,000 feet. Type locality cited.

C. E. Erdmann, 1944, U.S. Geol. Survey Water-Supply Paper 866–B, p. 47. Strata in Bad Rock Canyon on main Flathead River called Ravalli argillite.

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 11–12, pl. 1. Formation in Libby quadrangle, Montana. Overlies Prichard formation; underlies Wallace formation. Thickness about 10,000 feet. Ravalli correlated with Burke formation, Revett quartzite, and St. Regis formation of Coeur d'Alene district.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 111–112. Term Ravalli group is used herein to include formations of Belt series that overlie or are believed to overlie Neihart and Prichard formations and are below Newland limestone of Piegan group or its stratigraphic equivalent. In and near Lincoln, Mineral and Sanders Counties, Mont., group contains Burke formation, Revett quartzite, and St. Regis formaton. In extreme northwestern part of Montana, maximum thickness may be 10,000 feet. In and south of Glacier National Park, group contains Altyn limestone, Appekunny argillite, and Grinnell argillite with aggregate maximum thickness of more than 12,000 feet. In Little Belt Mountains, Chamberlain shale (1,500 feet thick) is at present regarded as sole unit that can be correlated with Ravalli group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 18–27, pls. 1, 2. Altyn limestone assigned to Ravalli group provisionally. May prove to be pre-Ravalli.

Type locality: Hills along Jocko River, near Ravalli, Mont.

Ravallian series[1]

Precambrian: Montana.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44.

Raven Member (of Montoya Dolomite)

Upper Ordovician: Southwestern New Mexico.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 18. Thick-bedded gray dolomite with some red chert. At base is a shell limestone. Thickness at Raven claim 120 feet. Overlies Par Value member (new); underlies Fusselman dolomite.

Typical exposures: On Raven claim, from which member is named, Boston Hill mining district, Grant County.

Ravenna Plutonic Series[1]

Mesozoic(?): Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, pl. 1, map.

Probably named for occurrence at Ravenna Station, Los Angeles County.

Ravenna Shale Member or facies (of Portwood Formation)

Middle Devonian: Eastern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 863, 864, 865. Black fissile shale with lenses of black or brownish limestone; indistinguishable from overlying Trousdale shale. Considered a coeval facies with Harg shale facies (new) and Duffin dolomite.

Type section: One mile west of Ravenna, along railroad at southwest corner of Irvine, Estill County. Occurs only on eastern border of New Albany outcrop.

Raven Rock Member (of Stockton Formation)

[Upper] Triassic: West-central New Jersey.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 52 (table). Massive medium to coarse white and gray arkose. Thickness 293 feet. May or may not include overlying 724 feet of red and brown sandstone and underlying 787 feet of red and gray fine sandstone, red shale, and arkose [see Stockton formation]. Younger than Cutalossa member (new); older than Lockatong formation.

In area along Delaware River from Stockton northward to 3 miles west of Milford, Hunterdon County.

Ravenswood Granodiorite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1910, New York Acad. Sci. Annals, v. 19, p. 250.

Wallace de Laguna and M. L. Brashears, Jr., 1946, New York State Water Power and Control Comm. Bull. GW–13, p. 8 [reprinted 1948, p. 7]. Intrudes Fordham gneiss in many localities. Composition ranges from granite to diorite but term granodiorite is appropriate for most of it.

Named for typical development in Long Island City, a part of which is called Ravenswood.

Rawley Andesite[1]

Miocene(?): Central southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, the volcanics in order of succession are Rawley andesite, Bonanza latite, Squirrel Gulch latite, Porphyry Peak rhyolite, and Bremer [Brewer] Creek latite. In South Bonanza district, the volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and the Bonanza latite is replaced by Hayden Peak latite.

Exposed on slopes of Rawley Gulch and in Rawley mine, Bonanza district, Saguache County.

Rawlins Ash Bed (in Ash Hollow Member of Ogallala Formation)

Pliocene: Northwestern Kansas and southwestern Nebraska.

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 254. Name applied to volcanic ash bed. Thickness 3½ feet at type locality. Basal 2 feet relatively pure and massive; upper part interbedded with fine to medium sand. Lies about 10 feet above base of Ash Hollow member; lies stratigraphically below Fort Wallace ash bed (new).

Named from exposures at center of west line SW¼ sec. 4, T. 4 S., R. 34 W., Rawlins County, Kans.

Rawlinsian series

Cretaceous (Cretacic) : Northwestern Kansas.

[C. R.] Keyes, 1941, Pan-Am. Geologist, v. 76, p. 304 (chart). Series in the late Cretacic. Includes Arickaree formation. Occurs below the Eocene and above an unnamed interval above the Buckskinian series.

Rawls Basalt (in Buck Hill Volcanic Series)

Pliocene(?) : Western Texas.

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Fall Field Trip Oct. 29–31, p. 14 (table 1), 22. Name applied to the thick flows above the Tascotal formation (new); flows are youngest rocks of Buck Hill series known to date. At least four flows 180 feet thick are included in the Rawls at Wire Gap; in southern part of Tascotal quadrangle contains eight flows at least 300 feet thick. Flows are separated by several beds of sandy tuff.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 555–558, pl. 1. Described in Cathedral Mountain quadrangle where it has a maximum thickness of 545 feet on Cathedral Mountain; at northernmost exposure—two outliers on butte west of McIntyre Peak—thickness is 30 and 75 feet respectively. Possibly early Pliocene.

Named for Rawls Ranch on Tascotal Mesa, Tascotal quadrangle, Presidio County.

Raymond Limestone (in Monongahela Formation)[1]

Pennsylvanian : Western West Virginia.

Original reference : I. C. White, 1882, The Virginias, v. 3, p. 142.

Exposed at Raymond City post office, Putnam County.

Raymond City Limestone[1]

Pennsylvanian : Western West Virginia.

Original reference : I. C. White, 1882, The Virginias, v. 3, p. 142.

Exposed at Raymond City post office, Putnam County.

Raymond Peak Andesites

Late Tertiary : Central eastern California.

H. G. Wilshire, 1957, California Univ. Dept. Geol. Sci. Bull., v. 32, no. 4, fig. 1. Named on map of Ebbetts Pass region. Older than Silver Peak andesites (new).

Ebbetts Pass region is in Alpine County.

Raymond Quarry Beds[1]

Devonian : Central eastern Iowa.

Original reference: M. F. Arey, 1906, Iowa Geol. Survey, v. 16, p. 420–448.

Blackhawk County.

†Raysor Marl[1]

Miocene, upper : Southern South Carolina.

Original reference : C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 182. Recommended that use of name Raysor marl be discontinued and the Miocene bed at Raysor Bridge be included in Duplin marl.

Named from Raysor Bridge, on Edisto River, 8 miles southwest of St. George, near which only known outcrops occur.

Raytown Limestone Member (of Iola Limestone)

Raytown Limestone Bed (in Kansas City Formation)[1]

Raytown Limestone Member (of Chanute Shale)

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, and eastern Kansas.

Original reference: H. Hinds and F. C. Greene, 1915, Missouri Bur. Geology and Mines, v. 13, 2d ser., p. 7, 27–28, 118.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. Member of Chanute shale. Thickness 5 to 8 feet. Overlies Muncie Creek shale member.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Member of Chanute shale. Underlies Liberty Memorial shale member (new).

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032: F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vi (fig. 2), 13. Miscorrelation of Iola formation by Haworth and Bennett (1908) in tracing limestone in this part of section northeastward to Kansas City has been responsible for long standing error in nomenclature of Missourian units in northeastern Kansas and northwestern Missouri. Settlement of Iola problem has led to changes in Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Paola limestone, Muncie Creek shale, and Raytown limestone, which were treated as members of Chanute shale, are recognized as belonging to Iola formation. Underlies Lane shale (redefined for Missouri).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Member of Iola limestone. As recognized in Middle River section in Madison County, is composed of a 9-foot sequence of light-gray wavy-bedded fossiliferous limestones separated into two or three units by thin shales. This unit differs from the Raytown of Condra and Upp (1933, Nebraska Geol. Survey Paper 4). They describe it as several thin limestone beds, all of which are quite fossiliferous and report a thickness of about 3 feet. Overlies Muncie Creek shale member; underlies Lane shale.

Named for Raytown, Jackson County, Mo.

Rayville Formation (in Kickapoo Creek Group)

Pennsylvanian (Lampasas Series): North-central Texas.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 207 (chart 1), 210–211. Proposed for bed from disconformity above Dennis Bridge limestone down to top of Parks formation. Includes approximately 1,000 feet of alternating limestone, blue and black shales, and sandstones. Outcropping members include Dennis Bridge limestone; an unnamed 100 to 125 foot section of shale, dolomitic limestones, and sandstone; Kickapoo Creek limestone; and Dickerson shale—a combined thickness of about 200 feet. Formation thins rapidly westward from type area, being less than 300 feet thick in Brown and Coleman Counties.

Type locality: Southwestern Parker County. Name derived from early settlement now almost abandoned, located 3½ miles southeast of Dennis and a like distance northeast of Kickapoo Falls.

Razburg Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: Northern central Alabama.

Original reference: C. Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 9.

Named for Razburg, Jefferson County.

Razorback Formation

Tertiary: Southwestern New Mexico.

F. J. Kuellmer and others, 1953, *in* New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 50 (map). Name appears on legend of map of Mimbres Valley. Referred to as andesite, trachyte, and latite.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39 (table 3), 47–48, pl. 1. In Lake Valley quadrangle, consists mainly of pyroxene andesites. Thickness 250 to 500 feet. On west side of White Rock Canyon, a 40-foot layer of fairly coarse grained well-sorted sandstone is interbedded with two of flows of formation. Underlies Bear Springs basalt (new); overlies Mimbres Peak formation. Flows of Razorback formation overlie Pollack quartz latite (new) along Taylor Creek.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 32–34. Formation consists of two superficially similar members, the lower andesite and the upper rhyolite that is close to being a trachyte or latite. Both are black or dark gray and fine grained. Total thickness of both members varies between 300 feet west of Mimbres Peak, at least 700 feet at Caballo Blanco, and 800 feet or more in Donahue Canyon. In northwest part of Dwyer quadrangle, it lies on an irregular surface of Caballo Blanco rhyolite; near Box Well, on Piloncillo sediments (new); in Mimbres fault zone, on Caballo Blanco rhyolite; and east of fault, on beveled rhyolites of Mimbres Peak and Caballo Blanco formations. Derivation of name.

Named after a mountain in sec. 36, T. 18 S., R. 11 W., Dwyer quadrangle.

Reading Gneiss[1]

Upper Cambrian: Southeastern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 237, table opposite p. 288.

In Windsor and Windham Counties. Named for fact that its outcrops occupy whole of southern part of Reading, Windsor County.

Reading Limestone Member (of Emporia Limestone)

Reading Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: A. J. Smith, 1905, Kansas Acad. Sci. Trans., v. 19, p. 150.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Emporia limestone here recognized and used as originally defined. Underlies Harveyville shale member; overlies Auburn shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 56–57. Described in Pawnee County, where it is 15 to 26 feet thick. Underlies Harveyville shale member; overlies Auburn shale. Unit not easily traced and both northern and southern extremities in county are indistinct. Occurs south of Pawnee County, but southern extent not yet known.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Geographically extended into southwestern Iowa where it is classified as formation in Wabaunsee group. Consists of two beds of gray crinoidal limestone which characteristically weather to deep brown; commonly fossiliferous with crinoid and brachiopod fragments. Thickness about 3 feet. Underlies Harveyville shale; overlies Auburn shale.

Type locality: In vicinity of Reading, Lyon County, Kans. Well exposed in roadcut near NW cor. sec. 33, T. 17 S., R. 13 E., 1 mile north of Reading.

†Reading Sandstone[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: E. V. D'Invilliers, 1883, Pennsylvania 2d Geol. Survey Rept. D_3, v. 2, p. 99–100.

Well exposed south of Reading, Berks County, in cuts of Philadelphia & Reading Railroad.

Readsboro Schist[1]

Upper Cambrian(?): Southwestern and southeastern Vermont.

Original reference: G. D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 282–288, 291, 294, map.

Named for extensive outcrops in Readsboro Township and around Readsboro, Wilmington quadrangle, Bennington County.

Ready Pay Member (of Percha Shale)

Upper Devonian or Lower Mississippian: Southern New Mexico.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 94–95. Black fissile nonfossiliferous shale. In most sections, comprises lower two-thirds of total thickness of formation. Underlies Box member (new) with gradational contact. Possibly a different facies of Contadero formation (new).

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 241, 243, figs. 2, 6, 13. Upper Devonian. Thickness 132 feet. Overlies Sly Gap formation in San Andres Mountains. Derivation of name given.

M. A. Stainbrook, 1947, Jour. Paleontology, v. 21, no. 4, p. 298. Basal black shale of Percha termed Silver by Keyes (1908). There is little doubt that the Silver and Ready Pay were proposed for identical division of Percha and there is little reason to replace earlier names. Percha of early Mississippian age.

Named after gulch which drains to south into Percha Creek, 400 yards east of a narrow canyon called "The Box", in vicinity of Hillsboro.

Reagan Sandstone[1] (in Timbered Hills Group)

Upper Cambrian: Central southern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56. Basal formation in Timbered Hills group (new). Underlies Cap Mountain sandstone. Pebbly sandstone 500 feet thick; carries much glauconite and becomes calcareous at top. Separated from Precambrian by unconformity; Colbert porphyry and Tishomingo granite are oldest exposed rocks.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 18. Commonly rests unconformably on igneous rocks, but in one exposure about 98 feet of dense limestones separate it from igneous rocks. In some

places, contact with overlying Honey Creek is fairly sharp; more commonly there is gradation zone at top, especially on northeast flank of Wichita Mountains. Here an alternation of sandstones and limestones make it impossible to choose distinct plane of separation between the two formations. Note on type section. Thickness 460 feet at type section.

E. A. Frederickson, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1349–1355. Two units, namely, the so-called Cap Mountain formation and the "basal limestone" are, on basis of faunal evidence and stratigraphic position, herein considered to be equivalents of all or parts of Honey Creek formation.

Type section: About 5 miles southwest of village of Mill Creek, Johnston County. Named from town of Reagan in Tishomingo quadrangle.

Reager Ash Bed (in Ash Hollow Member of Ogallala Formation)

Pliocene: Northwestern Kansas.

J. S. Carey and others, 1952, Kansas Geol. Survey Bull. 96, pt. 1, p. 9–13, 27. Name applied to volcanic ash bed. Approximately 10 feet thick. Lies near middle of member and stratigraphically above Calvert ash bed (new) and stratigraphically below an unnamed ash bed.

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 254. Listed in stratigraphic sequence as overlying Dellvale ash bed (new) and underlying Reamsville ash bed (new).

Type locality: NW¼NE¼ sec. 35, T. 2 S., R. 25 W., Norton County. Named for exposures 1 mile north of stop on Burlington Railroad in west-central part of county.

Reamsville Ash Bed (in Ash Hollow Member of Ogallala Formation)

Pliocene: Northwestern Kansas.

Ada Swineford, J. C. Frye, and A. B. Leonard, 1955, Jour. Sed. Petrology, v. 25, no. 4, p. 244 (fig. 1), 254–255. Highest named [volcanic] ash bed in Ogallala formation of central Great Plains. Thickness at type locality 3 feet; occurs in sequence of partly cemented sand and silty sand. Lies slightly above middle of Ash Hollow member and stratigraphically above Reager ash bed.

Named from exposures along Kansas Highway 8 in center of west line SW¼ sec. 32, T. 1 S., R. 14 W., Smith County, west-southwest of Reamsville.

Recapture Shale Member (of Morrison Formation)[1]

Upper Jurassic: Southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 36 (table), 58, pl. 15, strat. sections. Series of strongly colored shales and sandstones 100 to 300 feet thick. Shales are prevailingly dark red, but some are variegated—pink, ash, brown, and gray; many include firm strongly calcareous beds that break into slabs and friable imbricated gypsiferous beds that weather as tiny cliffs. Sandstones are white beds of glistening quartz cemented by lime, a few of them more than 1 foot thick or continuous for more than 1,000 feet. Overlies Bluff sandstone member; underlies Westwater Canyon sandstone member (new).

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 962–964, table 1. As interpreted here, type section of Recapture includes Salt Wash member as well as about 150 feet of overlying alternating sandstones and

shales. The Salt Wash is thin and rests directly on the Entrada (Bluff), and the Summerville is absent. In Carrizo Mountains, distinction between Salt Wash and overlying part of Recapture is more clear cut, and term Recapture can best be used for the upper part only and is therefore a more restricted usage than Gregory employed. Gregory's description of the Recapture includes certain features of the Salt Wash; the two are very similar in gross lithologic characteristics but differ in type of sandstone and shale and in appearance and manner of weathering. [Also referred to as Recapture Creek shale.]

J. W. Harshbarger, C. A. Repenning, and R. L. Jackson, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 97. In Navajo country, Summerville formation, Recapture shale member, and Bluff sandstone member of Morrison formation grade laterally southward into distinct sand facies here named Cow Springs sandstone.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 137–140. Member is present in northeastern Arizona, northwestern New Mexico, and small areas of southeastern Utah and southwestern Colorado. Unit was formed as large alluvial fan. To the north, member intertongues with and grades into Salt Wash member; upper part is most extensive and is recognized to south of Monticello, Utah. To the southwest, member pinches out along zero isopach line passing south of Gallup, N. Mex. Both at northwestern and southeastern extremities of this zero isopach, the line marks apparent limit of deposition, but in middle, south of Gallup, beds equivalent to Recapture have been removed by erosion; eastward extent of member in north-central New Mexico not known. Unit arbitrarily divided into three facies: conglomeratic sandstone; sandstone; and claystone and sandstone. Thick part of member is elongate curving area from northeastern Arizona into northwestern New Mexico; maximum thickness 680 feet in Arizona. Extension of Salt Wash as recognizable unit through southeastern Utah and into northeastern Arizona and northwestern New Mexico constitutes restriction of Gregory's original definition of the Recapture.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 313–314, 315 (fig. 60), 322, 325, 327, 328–329, 330–331, 333–334. In Gallup-Albuquerque area, member ranges from about 20 to as much as 276 feet in thickness, in general thinning southward. Consists largely of grayish-red sandy claystone and clayey sandstone with limy nodules and white clean fine- to medium-grained sandstone in alternating units 5 to 10 feet thick; the clean sandstone beds are most common in western part of area and probably represent tongues of Cow Springs sandstone. Clayey sandstone is dominant rock in eastern and southern parts of area. In most of area, conformable with underlying Bluff sandstone; to the north near Ysidro, rests directly on Summerville formation. Overlain by Westwater Canyon member.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 52–53. Gregory (1938) apparently included in type section some basal sands that are now correlated with Salt Wash member (Stokes, 1944). Usage in this paper [Navajo country] follows that of Stokes in considering as Recapture only the upper sandstone and shale at Gregory's type locality. Lower sandstone beds are referred to as Salt Wash member. Present in northeastern part of Navajo country;

intertongues with and grades into Salt Wash member where both members are present; intertongues with overlying Westwater Canyon member. Not present in northwestern part of area because Salt Wash sandstone member occupies entire Morrison interval. Not recognizable in southwestern part of area; where it grades into main mass of Cow Springs sandstone; the white sandstone tongue of Cow Springs, at base of Morrison, is only tongue of Cow Springs that can be separated from Recapture on regional scale. Near Fort Wingate, upper tongues of Cow Springs grade into Recapture, and Recapture is thicker toward east. Exclusive of white sandstone tongue but including all other tongues and lenses of Cow Springs that are present, Recapture is 483 feet thick at northern end of Chuska Mountains and thins to 215 feet at Todilto Park and 104 feet at Lupton, Ariz.; not recognizable at Black Rock, N. Mex.; 59 feet thick at Fort Wingate and thickens eastward to 207 feet at Thoreau, N. Mex.

Named for exposures near mouth of Recapture Creek, San Juan County, Utah.

Recapture Creek Shale Member (of Morrison Formation)

See **Recapture Shale Member** (of Morrison Formation).

Reclamation Group

Pennsylvanian (Des Moines): Eastern Wyoming and southwestern South-Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3, 28, 32. Consists mostly of limestones and shales colored shades of red, gray, and green. Comprises Division V of Hartville "formation" (Condra and Reed, 1935). Thickness 72 to 87 feet. Underlies Roundtop group (new); overlies Fairbank formation (new).

Type locality: Reclamation Hill, sec. 27, T. 27 N., R. 66 W., Platte County, Wyo.

Recreation Redbeds

Cretaceous: South-central Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 710 (fig. 2), 715–716, pl. 1. Series of uniformly brick-red fine-grained sandstones. Uniformity broken by conglomerate 5 to 30 feet thick. Thickness 1,265 feet at Gould Gulch. Underlies Amole arkose; overlies Cretaceous volcanics.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, pl. 1. Upper Cretaceous.

D. L. Bryant and J. E. Kinnison, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1235. Lower Cretaceous.

Named because of its color and occurrence in Tucson Recreational area. Practically confined to Red Hills and numerous small outcrops in zone of the great thrust east of Amole Peak, Tucson Mountains, Pima County.

Rector Formation

Lower Cretaceous (Shasta Series); Northern California.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 210–2105. Includes 20 to 400 feet of sandstone, conglomerate, and mudstone just above unconformity at base of Cretaceous section. Unit rests unconformably on igneous and metamorphic rocks of Klamath Mountains complex. Conformably underlies Ono formation (new), contact gradational.

Named for typical development along Rector Creek, a small tributary to the North Fork of Cottonwood Creek at Ono, Shasta County.

Red Amphitheater Breccia

Pliocene(?): Southern California.

C. A. Richards, 1958, *in* Pacific Petroleum Geologist, v. 12, no. 3, p. 4. Proposed for the masses of huge blocks, breccia, and minor amounts of fanglomerate that are exposed on the hills around Red Amphitheater. Believed to be derived from landslides, debris slides, or mass wasting from the rising Pyramid Peak fault block.

Area is part of the Funeral Mountains of the Amargosa Range, Death Valley National Monument.

Red Bank Sand (in Monmouth Group)[1]

Red Bank Formation

Red Bank Member (of Monmouth Formation)

Upper Cretaceous: New Jersey.

Original references: W. B. Clark, 1894, New Jersey Geol. Survey Ann. Rept. 1893, p. 337; 1894, Jour. Geology, v. 2, p. 165–166.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 28, 49–51. Rank reduced to member status in Monmouth formation. Conformably overlies Navesink member; conformably underlies Tinton member; toward south where Tinton is missing, Red Bank grades into overlying Hornerstown. Thickness in Monmouth County 125 feet; thins to southeast and not present south of Sykesville; decreases in thickness as sand member basinward or downdip and becomes more and more shaly and is inseparable from Hornerstown or Navesink.

S. K. Fox, Jr., and R. K. Olsson, 1955, [abs.] Jour. Paleontology, v. 29, no. 4, p. 736. Upper Cretaceous Navesink, Red Bank, and Tinton are formations with distinct microfaunas indicating time differences. Microfauna of Red Bank indicates correlation with latest Navarro of Gulf Coast section. Stratigraphic evidence indicates unconformity between Cretaceous and Tertiary formations. Hornerstown rests successively from northeast to southwest on Tinton, Red Bank, and Navesink.

H. W. Miller, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 722–736. Red Bank and Navesink formations (Cretaceous) interfinger at least locally, and Red Bank formation extends southwestward to Delaware as unit referred to as "middle greensand."

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063. Subdivided into two members: Shrewsbury and Sandy Hook.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Uppermost formation in Monmouth group. Overlies Navesink formation; underlies Hornerstown sand of Rancocas group. Average dip southeast 35 feet per mile. Thickness 0 to 140 feet. Thickens in outcrop to northeast.

Well exposed in vicinity of Redbank, Monmouth County.

Red Beach Granite

Post-Silurian—pre-Upper Devonian: Southeastern Maine.

D. H. Amos, 1958, Dissert. Abs., v. 19, no. 5, p. 1053. All diorites and granites in area were emplaced in post-Silurian—pre-Upper Devonian interval. All but Red Beach granite were formed under relatively deep-

seated conditions. Contact features establish that Red Beach granite is the youngest. [Other diorites and granites not named.]

Report discusses geology and petrology of Calais and Robbinston quadrangles.

Red Bluff Clay

Red Bluff Clay (in Vicksburg Group)[1]

Red Bluff Member (of Forest Hill Formation)

Oligocene, lower: Southern Mississippi and southwestern Alabama.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric. Rept., p. 135.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1315 (fig. 1), 1318–1324. Cooke (1918) originally regarded Forest Hill sand as contemporaneous with Red Bluff clay but later accepted view of of Gulf Coast geologists that the Red Bluff comes in from east as wedge between Yazoo clay and Forest Hill sand. Concept derived from present study is that Forest Hill is deltaic equivalent of Red Bluff as Cooke originally believed. Vicksburg group is restricted below to exclude Forest Hill sand and Red Bluff clay. Chart shows Red Bluff clay overlies Yazoo clay and underlies Marianna limestone. Note on derivation of name.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839. Overlies Shubuta (clay) member (new) of Yazoo formation.

W. J. Hendy, 1948, Mississippi Geol. Soc. [Guidebook] 6th Field Trip, p. 27–28. Rank reduced to member status in Forest Hill formation. As restricted, consists of 10 to 14 feet of highly to slightly glauconitic fossiliferous dark-gray clay with one or more zones of argillaceous glauconitic limestone concretions.

C. W. Stuckey, Jr., 1953, Am. Assoc. Petroleum Geologists Guidebook Houston Mtg., p. 27. Included in Vicksburg group in this report.

Named for exposures at Red Bluff on Chickasawhay River just above railroad bridge 1½ miles south of Shubuta, Wayne County, Miss.

Red Bluff Epoch[1]

Pleistocene: California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, p. 1–29.

Name probably derived from Red Bluff, Tehama County.

Red Bluff Formation

Cenozoic: Southwestern Montana.

D. B. Andretta and S. A. Alsup, 1960, Billings Geol. Soc. Guidebook 11th Ann. Field Conf., p. 186, 189. Fine siltstone to coarse conglomerate and breccia. Beds chiefly deep red with purple, yellow, and white layers interspersed. Distinctly bedded, thoroughly indurated, and well sorted. Individual beds range from 3 inches to about 5 feet in thickness; each bed well defined and sharply differentiated from overlying and underlying beds. Appears to be deposited on topography of rolling relief on stripped Precambrian rocks. Middle Cenozoic.

Occurs between towns of Norris and Red Bluff along highway between Anceney and Norris, Madison-Gallatin Counties.

Red Bluff Formation[1]

Red Bluff Gravel

Pleistocene: Northern California.

Original reference: J. S. Diller, 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, p. 413–416, pl. 44, map.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology. v. 35, no. 3. p. 235. Described as an alluvial deposit consisting largely of gravels with a minor amount of interbedded sand; commonly deep brick red in color. Thickness near Redding more than 100 feet. Overlies Tehama formation, locally overlies the Tuscan, and also overlaps upon the Cretaceous.

M. A. Murphy, chm., 1957, Sacramento Geol. Soc. [Guidebook] Ann. Field Trip, May 25–26, geol. map. Red Bluff gravel mapped in Ono quadrangle, Shasta County.

Named for exposures at Red Bluff, Tehama County.

Red Bluff Granite

Precambrian: Western Texas.

L. A. Nelson, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 160. Name proposed for granite occurring in the Franklin Mountains.

T. S. Jones, 1953, Stratigraphy of the Permian basin of west Texas: West Texas Geol. Soc., p. 1. Underlies Lanoria quartzite.

Occurs at Red Bluff Park, in McKelligan Canyon, near El Paso.

†Red Bluff Sandstone (in Cimarron Group)[1]

Permian: Central southern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 40.

Named for exposures at former post office of Red Bluff, Comanche County.

Red Branch Member (of Woodbine Formation)

Upper Cretaceous: Northeastern Texas and southwestern Oklahoma.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Described at its type locality as consisting of tuffaceous sandstone, carbonaceous shale, and lignite; elsewhere also includes sandy shale and ferruginous sandstone, entire sequence being from 50 to 80 feet thick. Overlies Dexter member; downdip grades into material indistinguishable from overlying Lewisville and is classed with that member.

N. M. Curtis, Jr., 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 240–244. Geographically extended into Bryan County, Okla.

Type locality: Near Red Branch community in northwestern Grayson County, Tex.

Red Bridge Limestone Member (of Liston Creek Formation)

Silurian (Niagaran): Northeastern Indiana.

Original reference: E. R. Cumings and R. R. Shrock, 1927, Indiana Acad. Sci. Proc., v. 36, p. 74–75.

Crops out along Mississinewa River at village of Red Bridge, Wabash County.

Red Buttes Quartz Basalt (in Tropico Group)

Pliocene(?) : Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138 (fig. 2), 142–143. Black basalt or mafic andesite consisting of several flows totaling about 360 feet in maximum thickness At Red Buttes, rests on pre-Tertiary quartz monzonite and unconformably underlies fanglomerate of probable Pleistocene age; in Kramer Hills, basalt overlies, probably unconformably, the lower part of the Tropico group and is overlain conformably by the upper part.

Type locality: Sec. 5, T. 8 N., R. 6 W., Kramer quadrangle, San Bernardino County. Also prominantly exposed in the Kramer Hills, Kramer and Barstow quadrangles. Name derived from Red Buttes.

Red Canyon Member[1] (of Lykins Formation)

Triassic(?) : Southeastern Colorado.

Original reference: J. T. Duce, 1924, Colorado Geol. Survey Bull. 27, pt. 3, p. 81–82.

Probably named for exposures in eastern end of Red Rock Canyon, Las Amimas County.

Redcloud Dacite Flows, Lavas

Pleistocene: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 44, 49, 53, 63, 101, 138, pl. 1. Dacite lava flow that issued from vent on northern slope of former Mount Mazama and erupted after andesitic phase of Mazama's activity had ended. Watchman and Hillman vents were active before the vents of the Llao. Cleetwood and Redcloud dacite lavas younger than Mount Scott lavas. In section southwest of Wineglass, the steep margin of Redcloud flow (lava) presumably prevented Wineglass tuff from spreading farther south.

Redcloud Cliffs are on eastern side of Crater Lake.

Red Cloud Sand and Gravel

Pleistocene: Southern Nebraska.

C. B. Schultz, E. C. Reed, and A. L. Lugn, 1951, Science, v. 114, no. 2969, p. 548. Proposed that name Grand Island be restricted to the "Upper Grand Island" and name Red Cloud sand and gravel be applied to the "Lower Grand Island" of Condra and Reed (1950) which includes pro-Kansan sand and gravel. At type locality, consists of sand and gravel that grades from sand to medium-coarse gravel; gray in color throughout except for upper few feet which is strongly weathered to a yellowish brown, indicating a profile of weathering and unconformity at its top; thickness of 33 feet exposed in sand and gravel pit; occurs below Sappa formation and above Niobrara. Appears to be equal in age, at last in part, to pro-Kansan sand and silt (Atchison formation) in glaciated area of eastern Kansas and Nebraska.

Type locality: Red Cloud Township 2½ miles west-northwest of Red Cloud in E½ sec. 28, T. 2 N., R. 11 W., Webster County.

Red Cone Basalt Flow

Pliocene to Pleistocene, lower: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 32. Name applied to basalt flow on Red Cone. [See Timber Crater Basalt Flow.]

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 27. Here considered to be pre-Mazama.

Red Cone is in northwest corner of Crater Lake National Park.

Red Creek Quartzite[1]

Red Creek Complex

Precambrian: Northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 42, 62, 70, 137.

W. R. Hansen, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf. p. 23–25, 26 (fig. 3), pl. 1; 1957, U.S. Geol. Survey Geol. Quad. Map GQ–101. Consists mostly of rocks of moderately high metamorphic grade. Underlies Uinta Mountain group. Mapped in Cold Spring Mountain area, Colorado.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 17–18, geol. map. Because of diversity of rock types present in older Precambrian of area, whole assemblage is referred to as Red Creek complex. Most abundant rock type is quartzite with quartzose mica schist second most common type. Unconformably underlies Uinta Mountain group.

Named for exposures in Red Creek Canyon at head of Willow Creek. Red Creek Canyon separates Quartz Mountain and Mount Wheeler, northeast corner Uintah County, Utah.

Red Desert Tongue (of Wasatch Formation)

Eocene, lower: Southwestern Wyoming.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100, 101 (chart). Sequence of coal beds, clay shale, siltstone, biotitic sandstone, and low-grade oil shale. Upper 400 feet contains many coal beds including Creston and Tierney coal zones. Only upper 400 feet of tongue exposed in central part of Great Divide Basin, but similar rocks on east flank of Rock Springs uplift are about 1,000 feet thick. Underlies Luman tongue (new) of Green River formation; unconformably overlies Fort Union formation. Intertongues with Battle Spring formation (new) to the north.

Named from exposures southwest of Red Desert Flat at Tipton Buttes and northeast of Red Desert Flat in NW cor. T. 21 N., R. 94 W., and adjoining parts of T. 21 N., R. 95 W., T. 22 N., R. 94 W., and T. 22 N., R. 95 W., Sweetwater County.

Red Eagle Limestone (in Council Grove Group)

Red Eagle Limestone Member (of Elmdale Formation)[1]

Red Eagle Limestone Member (of Konawa Formation)

Permian: Oklahoma, Kansas, Missouri, and Nebraska

Original reference: K. C. Heald, 1916, U.S. Geol. Survey Bull. 641, p. 24.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 167–168. Includes two limestones and a shale member. In southern Kansas, Red Eagle is a single ledge about 20 feet thick, but the two limestone members that are differentiated in central and northern Kansas can be identified in southern Kansas. Includes (ascending) Glenrock limestone, Bennett shale, and Howe limestone members. Underlies Roco shale; overlies Johnson shale. Council Grove group. Wolfcampian.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 87–89, Condra (1935, Nebraska Geol. Survey Paper 8) subdivided the Red Eagle into Glenrock limestone, Bennett shale, and Howe limestone members. These subdivisions have been recognized across Kansas and tentatively identified in Osage County, Okla. In north and central part of outcrop belt in Pawnee County, a threefold division of Red Eagle sequence is possible, but there is no sound basis for correlation with subdivisions in Kansas and Nebraska. For purpose of this report, Red Eagle is considered a single unit and defined as first persistent limestone zone above Long Creek limestone. Unit can be traced into Lincoln County. Consists of interbedded limestone and shale, thickening from less than 3 feet in north to more than 6 feet in south. Underlies Neva limestone.

A. E. West, 1960, Shale Shaker, v. 11, no. 3, p. 4–7. Described in Lincoln County, Okla., where it is classified as uppermost member of Konawa formation. Thickness 3 to 5 feet. Commonly made up of massive bed at base 2 to 3 feet thick with remainder of unit being thin-bedded limestones with shale partings. Overlies Long Creek limestone member. Overlain by redbeds.

Named for exposures near Red Eagle School, southwest of Foraker, Osage County, Okla.

†Red Eagle Shale (in Elmdale Formation)[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: G. C. Clark and C. L. Cooper, 1927, Oklaholma Geol. Survey Bull. 40H.

Occurs in T. 22 N., Rs. 2 W.–5 E.

Redfield Formation

Eocene (Jacksonian): Southeastern Arkansas.

L. J. Wilbert, Jr., 1953, Arkansas Div. Geology Bull. 19, p. 80–87. Embraces the nonmarine Jacksonian deposits which overlie and are partially equivalent to the White Bluff formation. From north to south, the Redfield successively overlies the Pastoria and Rison members (both new) of the White Bluff; boundary is an erosion surface which is either subaerially exposed or is overlain by Pleistocene terrace deposits. Estimated maximum thickness 150 to 200 feet.

Name derived from village of Redfield in northern Jefferson County. Well exposed at White Bluff, 4 miles east of the village. Formation is restricted to northern part of Jacksonian outcrop area.

Red Gap Member (of Grinnell Argillite[1] or Formation)

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol Soc. America Bull., v. 48, no. 12, p. 1889. Argillites, dominantly red, but incidentally brownish or green; interbedded with pink, white, or greenish-white quartzites, brown sandstones, and sandy argillites. Recognized some places by thick beds of red argillite with flat mud-crack polygons. Maximum thickness 2,800 feet. Thins to 700 or 800 feet in Blackiston Valley. Intergrades with Rising

Bull member above and Rising Wolf member below. Type locality designated.

Type locality: Mountain between Red Gap and Ptarmigan Wall, Glacier National Park. Typically developed in Lewis Range, north of Many Glaciers.

Red Hill Complex

Carboniferous(?): East-central New Hampshire.

A. P. Smith and others, 1938, Geologic map and structure sections of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Includes gray to yellowish coarse-grained syenite, light-gray medium- to coarse-grained nephelite-sodalite syenite, gray to pink medium-grained syenite, white to brownish medium-grained quartz syenite, gray fine-grained quartz syenite, and gray to yellowish-gray fine-grained granite. Belongs to White Mountain magma series.

Occurs on and around Red Hill in southwestern corner of Mount Chocorua quadrangle.

Redhill sandstone[1]

Miocene: Southeastern California.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 61, 80.

Probably named for red sandstone mountain north of Ryan and east of Furnace Creek Wash, Inyo Canyon.

Red Hill Shale Member (of Lykins Formation)

Permo-Triassic: Northern Colorado.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Uppermost member of formation; overlies Park Creek limestone member (new).

Red House Formation (in Magdalena Group)

Pennsylvanian: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 91–92, 255–256, figs. 2, 11. Consists dominantly of thin-bedded limestone and shale or claystone with limestone nodules and lenses. Color gray to dark gray. Massive cherty limestone beds present locally. A thin sandstone bed locally marks base of formation; a coarse-grained conglomeratic sandstone ledge is widely present in northern part of mountains near middle of section. Comprises about lower third of group. Thickness 362 feet. Conformably underlies Nakaye formation (new); unconformably overlies Cutter formation at type section; elsewhere it overlies Upham dolomite (new), Percha formation, and Nunn member of Lake Valley formation.

Type section: Along South Ridge in sec. 10, T. 15 S., R. 4 W., Sierra County. Named from Red House Mountain in southern part of Caballo Mountains area.

Redil Shale (in Panoche Group)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Basal formation in group. White shale with silty and sandy

interbeds. Includes Papanatas conglomerate member (new) at base. Thickness 5,325 feet. Underlies Benito sandstone (new). Fault contact with Franciscan. Name credited to D. W. Sutton (unpub. thesis).

Type locality: Papanatas Canyon, secs. 23 and 24, T. 14 S., R. 10 E., Fresno County. Name derived from Redil Canyon.

Red Knobs Formation

Middle Ordovician (Mohawkian): Eastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 86, chart 1 (facing p. 130). A thick succession of red to pink calcarenites and limy ferruginous sandstones. Lower part consists of red to pink marble, the Holston marble of other authors. Upper beds, which yield a characteristically dark-maroon sandy regolith, are calcareous sandstones and ferruginous sandy calcarenites with partings of greenish-gray to buff shale. Maximum thickness 750 feet. Underlies Sevier formation; overlies Arline formation (new). Name attributed to B. N. Cooper and G. A. Cooper.

Named from exposures near and along the Blount-Loudon County line, near Meadow, on Meadow quadrangle.

Redlands Limestone[1] (in Telescope Group)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July–Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p 355, 372, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Murphy tentatively assigned all rocks above Panamint metamorphic complex to Lower Paleozoic. Sentinel dolomite, Radcliff dolomite, and Redlands dolomitic limestone are correlated with Noonday dolomite, here assigned to Precambrian as defined in this report.

Occurs in southern part of Panamint Range, Inyo County.

Red Lion Formation[1]

Upper Cambrian: Western Montana.

Original reference: F. C. Calkins and W. H. Emmons, 1913, U.S. Geol. Survey Prof. Paper 78.

E. N. Goddard, 1940, U.S. Geol. Survey Bull. 922–G, p. 165 (table). Thickness 225 to 350 feet in Philipsburg district. Overlies Hasmark formation; underlies Maywood formation.

L. L. Sloss and C. A. Moritz, 1951, American Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2146–2147. Described in extreme southwestern Montana. Thickness as much as 57 feet. Overlies Hasmark formation; underlies unnamed basal Devonian unit; upper contact marked by disconformity with varying amounts of formation removed by pre-Middle Ordovician and pre-Middle Devonian erosion. Term Snowy Range would be appropriate to area; however, Red Lion, named in Philipsburg area in 1913, is equivalent to Snowy Range (Dorf and Lochman, 1938). Hence, term Red Lion is favored for beds formerly assigned to "Dry Creek" in this area.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 17–19, strat. sections. In many areas of southwestern Montana, term Dry Creek

has been applied to a mappable unit composed of beds equivalent to Red Lion and overlying unfossiliferous red mudstones and silty dolomites of Maywood formation of Devonian age. Lochman (1950) restricted term Dry Creek to Peale's original usage and as thus defined, it becomes lower shale member of Red Lion and Lochman's Sage pebble conglomerate member of Snowy Range formation becomes upper member of Red Lion. Terms Dry Creek and Sage members are applicable as far west as Philipsburg. In Philipsburg area, overlies Hasmark formation; in central and southwestern Montana, overlies Pilgrim formation. Underlies Maywood formation and locally Bighorn dolomite. Thickness 34 to 350 feet.

Named for mine at head of North Fork of Flint Creek, Philipsburg region, Granite County.

Red Man Sandstone

Upper Cretaceous: Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 26–28, pls. 1, 2. Massive concretionary cavernous-weathering arkose with two thin conglomerates; contains *Parapachydiscus*, *Inoceramus* prisms, and Foraminifera. Thickness at type locality 1,180 feet. Conformably overlies Moonlight formation (new) in Sawtooth Ridge syncline, along south limb of Devil's Den syncline, and west of Sawtooth Ridge. Elsewhere is faulted against other units. Underlies Moreno formation. Probably equivalent to Brown Mountain sandstone (Anderson, 1941). Unit has been mapped by some workers as Point of Rocks formation.

Type locality: South limb Devil's Den syncline, Sawtooth Ridge Quadrangle, Kern County. About 2 miles northwest of synclinal axis formation crops out in prominent crags which are here named Red Man Rocks.

Red Mesa Member (of Entrada Formation)

Upper Jurassic: Northeastern Arizona, southwestern Colorado, northeastern New Mexico, and southeastern Utah.

W. B. Hoover, 1950, New Mexico Geol. Soc. Guidebook 1st Field Conf., p. 77, 78 (fig. 1), 79 (fig. 2). Introduced for the crinkly shale and sandstone beds, 100 feet thick, between the Entrada proper (lower bed of Entrada) and Bluff sandstone member.

Well exposed at west end of Red Mesa, on Utah-Arizona line, about 17 miles west of the four corners.

Red Mountain Andesite[1]

Pliocene(?): Southern California.

Original reference: C. D. Hulin, 1925, California State Min. Bur. Bull. 95, p. 55–58, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 510, table 4. Overlies Rosamond beds; older than Black Mountain basalt. Probably Pliocene.

Named for its occurrence on Red Mountain, east of Randsburg, San Bernardino County.

Red Mountain Dacites

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1355. Have built volcanic cones and occur as plugs and necks.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1022, 1031–1033, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1066–1067. Series of intrusives and extrusives. Flows exhibit uniformly whitish to light-gray fine-grained nonvesicular hornblende dacite. Partly weathers pinkish-red; the balance of rock remaining gray, markedly displaying flow structure. Age, type locality, derivation of name, and geographic distribution given.

Type locality: Red Mountain (also called Bell Mountain), after which the dacites are named, on Johnson Mesa in eastern Colfax County. Other outcrop areas include Towndrow Peak, Green Mountain, Cunningham Butte, Laughlin Peak, Palo Blanco, Raspberry Peak, and Sierra Grande.

Red Mountain Formation[1]

Silurian: Northern Alabama and northwestern Georgia.

Original reference: E. A. Smith, 1876, Alabama Geol. Survey Rept. Prog. for 1876, p. 11, 23, 25, 42, 207–208.

G. W. Stose, 1952, Washington Acad. Sci. Jour., v. 42, no. 8, p. 243. In Murphree Valley anticline, Alabama, formation crops out near center of anticline and underlies Chattanooga shale and overlies Chickamauga limestone.

W. H. Robinson, J. B. Ivey, and G. A. Billingsley, 1953, U.S. Geol. Survey Circ. 254, p. 50. Sandstone, shale, and calcareous and siliceous iron-ore beds. Thickness 200 to 300 feet. Overlies Chickamauga limestone; underlies Frog Mountain sandstone.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey Rept. 3, p. 25–28. Described in Madison County, Ala., where it has maximum exposed thickness of about 30 feet and is composed of thin to moderately thick beds of limestone intercalated with thin beds of sandstone and shale. Lies unconformably upon rocks ranging in age from Cambrian to Ordovician or Upper Ordovician; contact with underlying rocks not exposed in county; unconformably underlies Chattanooga shale.

Named for development on Red Mountain (presumably East Red Mountain), east of Birmingham, Ala.

Red Mountain Gneiss

Precambrian: Central Texas.

Frederick Romberg and V. E. Barnes, 1949, Geophysics., v. 14, no. 2, fig. 2 (geol. map). Shown on map legend below Big Branch gneiss and above Town Mountain granite.

V. E. Barnes *in* V. E. Barnes, D. A. Shock, and W. A. Cunningham, 1950, Texas Univ. Bur. Econ. Geology Pub. 5020, p. 7. Description of rocks and type locality should have been given in text of Romberg-Barnes paper but were inadvertently omitted. Paige (1912, U.S. Geol. Survey Geol. Atlas, Folio 183) described granite at Red Mountain. Derivation of name given.

V. E. Barnes [1952?], Geologic map of the Blowout quadrangle, Blanco, Gillespie, and Llano Counties, Texas (1:31,680): Texas Univ. Bur. Econ. Geology. The two large outcrops of Red Mountain gneiss entering the quadrangle are continuations of area of gneiss forming Red Mountain. Age relation of Red Mountain gneiss and Big Branch gneiss not known. The two gneisses may be nearly of same age and derived from common source.

Named from Red Mountain in southeastern corner of Llano quadrangle, Llano County.

†Red Mountain Group[1]

Cambrian, Ordovician, Silurian, and Devonian: Northern Alabama.

Original reference: M. Tuomey, 1850, Alabama Geol. Survey 1st Bienn. Rept., p. 9, 10.

Named for Red Mountain, east of Birmingham, Jefferson County.

Red Mountain Leucogranodiorite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 209–210, 235. Grayish rock characterized by scattered dark biotite clots. Intrudes Bald Mountain tonalite (new).

Exposed along ridge that trends northeast from summit of Red Mountain, Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Red Mountain Pyroxene Basalts,[1] Flows

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 274, 281, 285, geol. map.

Red Mountain is in Plumas County, in southern part of Lassen Volcanic National Park.

Red Mountain Rhyolite[1]

Tertiary: Central Colorado.

Original reference: J. V. Howell, 1919, Colorado Geol. Survey Bull. 17.

Probably named for Red Mountain, Chaffee County.

Red Mountain Rhyolite

Tertiary: Southwestern Montana.

D. B. Andretta and S. A. Alsup, 1960, Billings Geol. Soc. 11th Ann. Field Conf., p. 187. Red rhyolite with small quartz phenocrysts. Rests on Flathead quartzite. Apperas to be truncated by Cherry Creek fault. This flow was listed as "Tertiary volcanics" on Montana State geological map.

Caps Red Mountain which is on west side of Madison River opposite mouth of Cherry Creek, Madison County.

Redoak Granite[1]

Precambrian: Central southern Virginia.

Original reference: F. B. Laney, 1917, Virginia Geol. Survey Bull. 14, p. 35–36, map.

Named for occurrence at Redoak, Charlotte County.

Red Oak Member (of Dunleith Formation)

See Buckhorn Member of Dunleith Formation.

Redoak Hollow Formation

Redoak Hollow Sandstone Member (of Goddard Shale)

Mississippian (Chester): South-central Oklahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc. Petroleum Geology of southern Oklahoma—a symposium, Tulsa, Okla., Am. Assoc. Petroleum Geologists, v. 1, p. 70 (table 2), 83–85. Fossiliferous sandstone in lower part of Goddard shale.

M. K. Elias, 1957, Jour. Paleontology, v. 31, no. 3, p. 487–527. Fossils described from Redoak Hollow formation.

Name derived from Redoak Hollow, a westward-draining valley in S½ sec. 19, T. 2 S., R. 1 W., Carter County.

Redoak Mountain Group

Pennsylvanian (Pottsville Series) : Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 11, 19, pls. 2, 3, 4, 6, 8. Includes all strata between top of Graves Gap group (new) below and base of Vowell Mountain group (new) above, that is, between top of Windrock coal and top of Pewee coal. Thickness 300 to 440 feet; in Cross Mountain section 345 feet. Includes (ascending) shale interval, Caryville sandstone (new), shale interval, Fodderstack sandstone (new), shale interval, Silvey Gap sandstone (new), and Pewee coal.

Type locality: Cross Mountain, Lake City quadrangle, Anderson County. Name derived from Redoak Mountain in southwestern part of quadrangle, beds of group being exposed on south end of mountain above Graves Gap.

Redonda Formation

Redonda Member (of Chinle Formation)

Upper Triassic: Northeastern New Mexico.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 62. Member consists of variegated red shale, argillaceous limestone, and red or buff sandstone, and siltstone. Overlies lower unnamed member; underlies Wingate(?) sandstone. Thickness 25 to 425 feet.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2004–2006. Rank raised to formation. Consists of alternating beds of clayey siltstone and fine-grained sandstone. Thickness of beds of each lithologic type ranges from about 2 to 10 feet; greater part of unit is siltstone. Siltstone beds predominantly brownish red and commonly marked with thin streaks and spots of grayish green; sandstone beds distinctively orange red. Thickness ranges from zero at points where truncated to about 225 feet at section 18 miles west of Tucumcari; thickness commonly about 50 feet. Unconformably overlies Chinle formation; unconformably underlies Entrada sandstone. Absent over large areas owing to pre-Entrada erosion. Probably of latest Triassic age as indicated by presence of tracks of bipedal dinosaurs and a phytosaur skull. Derivation of name given.

Name taken from Redonda (also spelled Redondo) Mesa, about 15 miles south of Tucumcari, Quay County.

Redondo sandstone

Mesozoic (Early Cretacic) : New Mexico.

Charles Keyes, 1940, Pan-Am; Geologist, v. 74, no. 2, p. 105 (chart), 153. Lowest unit of Tucumcarian series. Underlies Pyramid shales; overlies Dixie shales unconformably. Thickness 250 feet.

Red Peak Member (of Chugwater Formation)

Red Peak Formation (in Chugwater Group)

Triassic: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 12, 44. Red shales and sandstones, about 566 feet thick. Underlies Crow Mountain member

(new); overlies Dinwoody formation. Thickness changes considerably even in adjacent sections, owing to lack of persistent beds at top of member.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 134–135. Referred to as Red Peak formation in Chugwater group. In Wind River Mountains, consists of 600 to 1,000 feet of commonly designated "red" siltstone. Overlies Dinwoody formation; underlies Alcova dolomite.

T. C. Woodward, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 2, p. 230–231. Described in Deadman Butte area where it is basal member of formation, underlies Alcova limestone member, and overlies Dinwoody formation. Consists of series of pale to moderate reddish-brown siltstones with minor number of thin interbedded yellowish-gray sandstones. Thickness 600 to 875 feet.

S. S. Oriel and L. C. Craig, 1960, *in* Guide to the geology of Colorado: Denver, Rocky Mountain Assoc. Geologists, p. 45. Adoption of name Goose Egg formation by many geologists in Wyoming has resulted in restriction of names Red Peak and Chugwater to beds above Little Medicine tongue of Dinwoody formation. Red Peak member, therefore, now includes only rocks of Early and possibly of Middle Triassic age. Age designation is based primarily on intertonguing relations westward with well-dated marine Thaynes limestone in western Wyoming.

Named after Red Peak, a few miles east of Red Creek, southern margin of Absaroka Range.

Red Pine Shale (in Uinta Mountain Group)

Precambrian: Northeastern Utah.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2736 (fig. 1), 2737 (fig. 2), 2738, 2740 (fig. 3). Mottled-brown, greenish-brown, and gray thinly bedded micaceous shale. Thickness variable due to irregular surface on which unit was deposited; 1,775 feet at mouth of Red Pine Creek; 1,200 feet, 2 miles westward in same canyon; decreases westward to South Fork basin, where it is locally absent. Conformably overlies Mutual quartzite; unconformable below Tintic quartzite (Pine Valley of previous works); where Tintic and overlying formations are absent, underlies Madison limestone. Unit has been referred to as Ophir.

R. E. Cohenour, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 34, 37 (fig. 2), 38. In this report [Uinta-Wasatch Mountain junction and part of central Utah], Red Pine shale and Mutual formation not included in Uinta Mountain group.

Type section: Along Red Pine Canyon, a tributary to Smith and Morehouse Creek, Summit County. Forms uniform slope ascending from lower contact in bottom of canyon to base of Paleozoic cliff-making formations.

Red River Formation[1] (in Bighorn Group)

Upper Ordovician: Surface and subsurface in Manitoba, Canada, and subsurface in Montana, North Dakota, South Dakota, and Wyoming.

Original reference: A. F. Foerste, 1929, Denison Univ. Bull., v. 29, no. 2, Sci. Lab. Jour., v. 24, p. 35, 37.

V. H. Kline, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 345. Geographically extended into subsurface in North Dakota.

A. D. Baillie, 1952, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 51–6, p. 14–18, geol. map. Formation consists of predominantly

carbonate strata between underlying shales and sandstones of Winnipeg formation and overlying argillaceous limestones and dolostones of Stony Mountain formation. Strata comprising formation were first described by Dowling (1900, Canada Geol. Survey Ann. Rept. 1898, pt. F) who divided them into three divisions: Lower Mottled, Cat Head, and Upper Mottled. Foerste (1929) introduced term Red River formation for these strata and designated three members, Dog Head, Cat Head, and Selkirk, to correspond with the three divisions of Dowling. Thickness about 250 feet in outcrop and in wells.

H. D. Erickson, 1954, South Dakota Geol. Survey Rept. Inv. 74, p. 43. Names Trenton, Decorah, and Platteville have been used for strata now termed Red River. Present in subsurface in South Dakota.

R. J. Ross, Jr., 1957, U.S. Geol. Survey Bull. 1021–M, p. 446 (fig. 68), 447–448. Discussion of Ordovician fossils from wells in Williston basin, eastern Montana. Red River formation is basal unit of Bighorn group. Underlies Stony Mountain formation. Overlies Winnipeg formation. Members not differentiated. Upper Ordovician.

M. R. McCoy, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 27 (fig. 1), 29. Geographically extended into Powder River Basin, Wyoming, where, in most areas, it overlies Roughlock siltstone. Where Stony Mountain formation is not present, the Red River is overlain by Lodgepole formation or farther south by either Pahasapa limestone or Englewood shale.

Crops out on western and southern shores of Lake Winnipeg, Manitoba, Canada. Red River flows through southern part of outcrop.

†Red River Group[1]

Upper Cretaceous (Gulf Series): Northeastern Texas.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 583, 589.

Named for exposures along Red River, northeastern Texas.

Red River Loess[1]

Pleistocene: Southwestern Arkansas, Louisiana, southeastern Oklahoma, and northeastern Texas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 29–32, 188.

Named for exposures in Red River Valley at Fulton, Hempstead County, Ark.

Red Rock Channel Sandstone[1]

Pennsylvanian: Central southern Iowa.

Original reference: C. R. Keyes, 1891, Am. Jour. Sci., 3d, v. 4, p. 273–276.

Named for Red Rock, Marion County.

Red Rock Limestone

Triassic: Central Nevada.

F. N. Johnston, 1941, Jour. Paleonotology, v. 15, no. 5, p. 448. Massive limestone, badly jointed fractured and veined with calcite. Thickness 800 feet.

In South Canyon, New Pass or Desatoya Range. So named because it is believed to be equivalent to the "Red Rocks" at the head of Congress Canyon, West Humboldt Range.

Red Rock member[1]

Precambrian (Keweenawan) : Northeastern Minnestoa.

Original reference: A. H. Elftman, 1898, Am. Geologist, v. 21, p. 90–109, 175–188.

Named for its persistent red color.

Red Rock Rhyolite (in Yavapai Group)

Precambrian: Central Arizona.

E. D. Wilson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 112; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118 (table 1), 1120–1121, pl. 10. Dominantly rhyolitic rocks, consisting of flows and minor amounts of agglomerate, breccia, and intrusives. Characteristically massive, with flow banding or bedding apparent only in places. Intrusive masses not readily distinguishable from flows. Typical rhyolite is grayish-brown to reddish-brown dense rock that breaks with splintery fracture; in places porphyritic. Thickness apparently exceeds 1,000 feet. Middle member of group; in fault contact with Yaeger greenstone (new) below and Alder series (new) above.

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1498 (table 2). Placed stratigraphically above Alder series; unconformably underlies Deadman quartzite.

Named from typical occurrence in Red Rock Butte, in central segment of Mazatzal Range. Also crops out prominently in Pine Creek, eastern Tonto Basin, and southern Black Hills areas.

†Red Rock Canyon Beds[1]

Pliocene, lower: Southern California.

Original reference: J. C. Merriam, 1919, California Univ. Pub., Dept. Geol. Bull., v. 11, no. 5.

In Red Rock Canyon at Ricardo, eastern part of Kern County.

Redrock Canyon Sandstone Member (of Santa Margarita Formation)[1]

Miocene, upper: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

Named for occurrence in small area in Redrock Canyon, Cuyama Valley, southwestern part of Kern County.

Red Shale Butte Complex

Pleistocene: Northern California.

C. A. Anderson, 1941, California Univ. Dept., Geol. Sci. Bull., v. 25, no. 7, p. 364–365. Made up of a number of coalescing flows characterized by andesitic lavas.

Occurs in Medicine Lake Highland, approximately in center of Modoc Lava Bed quadrangle.

Red Spring Sandstone Member (of Hignite Formation)[1]

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 43.

Named for association with Red Spring coal in Cumberland Gap coal field.

Redstone Clay (in Monongahela Formation)[1]

Redstone underclay member

Pennsylvanian: Western Pennsylvania and eastern Ohio.

[Original reference]: M. G. Wilmarth, 1938, U.S. Geol. Survey Bull. p. 1789.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 70. Redstone clay member (Monongahela series) recognized in several exposures in Union Township, Morgan County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 169. Underclay member of Redstone cyclothem in report on Athens County. Average thickness 1 foot. Monongahela series.

Redstone cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 167–170. Embraces interval between Upper Pittsburgh cyclothem (new) below and Fishpot cyclothem (new) above. Except for locality where Upper Pittsburgh cyclothem is developed, the Redstone includes rock units from top of Pittsburgh roof shale to top of Redstone roof shale. Wherever Redstone cyclothem extends downward to top of Pittsburgh roof shale, all members common to Monongahela cyclothems are present; normal sequence includes six members (ascending): Upper Pittsburgh shale and sandstone, Redstone redbed, Redstone limestone, Redstone underclay, Redstone (Pomeroy) (No. 8a) coal, and roof shale. Where base of Redstone rests on Upper Pittsburgh coal, thickness of cyclothem is 25 feet; where base overlies Pittsburgh roof shale, which is commonly the case, average thickness is 35 feet. In area of this report Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County.

Redstone Granite[1]

Pre-Triassic: Southeastern Connecticut and southwestern Rhode Island.

Original reference: L. H. Martin, 1925, Connecticut Geol. Nat. History Survey Bull. 33.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic. Derivation of name stated.

Named for Redstone Ridge north of Westerly, R. I., and Pawcatuck, Conn.

Redstone Limestone Member (of Monongahela Formation)[1]

Redstone Limestone (in Monongahela Group)

Redstone limestone and shale member

Upper Pennsylvanian: Western Pennsylvania, western Maryland, Ohio, and northern West Virginia.

Original reference: F. Platt and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 55–104, 286.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. M–26, p. 119. Included in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 70–71, geol. map. Redstone limestone and shale member (Monongahela series) occupies interval between Upper Pittsburgh sandstone and shale member and

the Redstone (Pomeroy) (No. 8–A) coal. In Morgan County, the Redstone is represented only locally by limestone; the usual exposure consists of calcareous shales, whose boundaries are indefinite. In many areas, Redstone limestone and shale interval is occupied by the merging Upper Pittsburgh and Pomeroy sandstones. Superjacent Redstone (No. 8–A) coal present only locally; hence, summit boundary indefinite in areas where Pomeroy sandstone is not well developed or where that unit is represented by thin limestones and shales. Where boundaries of Redstone limestone and shale member can be determined, a thickness of 10 to 18 feet is indicated.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 169. Redstone limestone member of Redstone cyclothem in report on Athens County. Average thickness 5 feet. Monongahela series.

Named because it occurs immediately below Redstone coal, which outcrops along Redstone Creek, Fayette County, Pa.

Redstone Member (of Monongahela Formation)[1]

Redstone redbed member

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 169. Member of Redstone cyclothem in report on Athens County. Thickness 3 to 20 feet. Wherever Upper Pittsburgh sandstone is exceptionally thick, Redstone redbed member may be missing, its interval occupied by sandstone. Monongahela series.

†Redstone Quartzite[1]

Precambrian: Central southern Minnesota.

Original reference: F. W. Sardeson, 1908, Geol. Soc. America Bull., v. 19, p. 221–242.

Composes Redstone Hill in Courtland Township, midway between towns of New Ulm, Brown County, and Courtland, Nicollet County.

Redstone Sandstone (in Monongahela Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 567–596.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 119 (table 1). Table of classification and nomenclature lists Redstone sandstone in Monongahela series. Equivalent to Fishpot limestone.

Probably named for its relation to Redstone coal.

Redstone Ridge Group[1]

Silurian: Central Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 823.

Probably named for Redstone Ridge.

Red Tanks Member (of Madera Limestone)

Pennsylvanian: West-central New Mexico.

V. C. Kelley and G. H. Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Lower part of member consists of dark-red-brown siltstone, sandstone, and shale. Locally, as in Carrizo Arroyo, base contains

buff sandstone and limestone conglomerate. Upper part consists mostly of cement-gray thin-bedded nodular limestone and gray shale. Most prominent limestone generally at top of member. Thickness 200 to 300 feet. Some intertonguing of marine sediments of Red Tanks member with continental beds of overlying Abo formation. Conformably underlain by Atrasado member (new) of Madera limestone.

Forms continuous belt along eastern side of Los Vallos from Breach Canyon on north to west floor of Monte de Belen on south. Also exposed in wide fork extending south from Carrizo Arroyo where the most complete section of the member is exposed. Crops out in several places in tributaries of Red Tanks Arroyo, for which member is named, located in secs. 4 and 5, T. 3 N., R. 3 W., Valencia County. Also crops out in Comanche Arroyo.

Red Top Limestone[1] (in Stevens Series)

Middle Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 80, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 58, no. 7, p. 602 (table 4), 611, pl. 1. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify adoption there of formation names established by Park and Cannon (1943) for the Metaline quadrangle. Correlative with the Middle Cambrian Metaline limestone are most of Weaver's Northport limestone, Republican Creek limestone, Red Top limestone, and Deep Lake argillite, and part of Boundary phyllite.

Probably named for occurrences on Red Top Mountain, Stevens County.

Redwall Limestone[1]

Mississippian: Northern Arizona, New Mexico, and Utah.

Original reference: G. K. Gilbert, 1875, U.S.G. and G.S.W. 100th M., v. 3, p. 162, 177–186, 197, figs. 81, 82.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 495. At Jerome, Ariz., unconformably overlies Devonian Jerome formation; disconformably underlies Permian Supai. Thickness 300 feet.

R. C. Gutschick, 1943, Plateau, v. 16, no. 1, p. 1–11. In Yavapai County, comprises four unnamed members (ascending): white crystalline oolitic limestone; fine-grained cherty porous limestone; massive coarsely crystalline limestone; gray micro-oolitic dense limestone. Thickness about 285 feet. Overlies Jerome formation; underlies Supai formation. Kinderhook and Osage.

E. D. Koons, 1945, Geol. Soc. America Bull., v. 56, no. 2, p. 154. In Grand Canyon, east of Toroweap fault, overlies Temple Butte formation; underlies Supai formation. Thickness 600 feet.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 28). Correlation chart shows age range (southwestern Utah) Kinderhook-Chester.

A. N. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 515 (fig. 2), 518. Section from South Hurricane Cliffs to a little beyond Peach Springs Canyon, Ariz., shows Redwall limestone underlying tongue of Callville formation; southeastward underlies Supai red beds. Laterally equivalent to Rogers Spring limestone.

J. W. Huddle and Ernest Dobrovolny, 1952, U.S. Geol. Survey Prof. Paper 233–D, p. 77 (fig. 14), 81 (fig. 19), 86–90, geol. sections. Thin limestone

of Mississippian age in central Arizona is equivalent of Redwall limestone of northwestern Arizona and Escabrosa limestone of southeastern Arizona. Name Redwall extended for use in central Arizona as it has priority over Escabrosa. Consists of lower impure dark-gray limestone, 50 to 70 feet thick; a middle massive cliff-forming limestone; and an upper thin- to medium-bedded cherty limestone. North of Salt River these divisions tend to disappear, and formation there consists of loose blocks of limestone, surrounded by red sandy mudstone, and a few solid limestone beds. Thickness as much as 552 feet. Overlies Devonian Martin formation; underlies Pennsylvanian Naco formation.

G. W. Crosby, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 3, p. 20–21, 52. In Millard County, Utah, disconformably overlies Cove Fort quartzite (new).

Type locality: Shinumo drainage basin, on north side of Grand Canyon. Named for red appearance of its escarpment on either side of Grand Canyon.

Red Warrior Limestone[1]

Silurian(?) and Devonian(?): Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

J. J. McFarlane, 1955, Brigham Young Univ. Research Studies, Geology Ser., v. 2, no. 5, p. 19 (fig. 1), 21. Although formation was thought to be Silurian and Devonian, it actually includes representatives of Ordovician, Silurian, and Devonian systems. Lower Red Warrior limestone was correlated with Ordovician Fish Haven dolomite of northern Utah. Chart shows Red Warrior limestone above Morehouse quartzite and below Mowitza shale.

Type locality: Red Warrior mine, southeast of Frisco district.

Red Wash Formation

Lower Triassic: Northeastern Utah and northwestern Colorado.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 477, 478. As Woodside, Thaynes, and Ankareh (restricted) formations are traced eastward along flank of Uinta Mountains, each becomes thinner, and in vicinity of Whiterocks Canyon the Thaynes disappears completely. Red beds east of that point are in part equivalent to Ankareh (restricted) sandstone and shale and in part to Woodside shale. Since none of the terms Woodside, Ankareh, or Moenkopi can appropriately be applied to these beds, name Red Wash formation is proposed. Thickness at type locality 1,080 feet. At type section, overlies Park City formation and underlies Shinarump conglomerate, both contacts unconformable.

B. F. Curtis, 1951, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 39. Stratigraphic column shows Red Wash formation present in vicinity of Vermillion Creek, Colo. Occurs below Stanaker formation and above Phosphoria formation. Permian and Triassic.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 101–102. Discussion of stratigraphy of Triassic sequence in Wasatch and Uinta Mountains. William's introduction of name Red Wash rather than Moenkopi does not seem justified.

Type section: In Red Wash Canyon north of Dinosaur quarry in Dinosaur National Monument, Utah; section measured on Brush Creek along traverse beginning near mouth of Brush Creek Gorge in sec. 3, T. 2 S., R.

22 E., Uinta Base and Meridian, and running southward to base of Shinarump conglomerate.

Redwater Shale Member (of Sundance Formation)

Upper Jurassic: Southwestern South Dakota and northwestern Wyoming.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 259–264, geol. sections. Consists of 80 to 190 feet or more of greenish-gray to gray soft fissile shale that includes some soft glauconitic sandstone in lower 20 to 30 feet and some thin beds of coquinoid or oolitic limestone in upper half. At type section, lower 18 feet consists of alternating beds of gray shale and soft yellow sandstone; upper 118 feet consists mainly of soft dark-gray shale but contains lenses of sandy limestone at several levels and many limestone concretions in upper half. Overlies Lake member (new); underlies Morrison formation, contact gradational through an interval of 10 to 15 feet.

Type section: Bluff one-half mile north of Redwater Creek, near mouth of Crow Creek, 9 miles northwest of Spearfish, in S½ sec. 2, T. 7 N., R. 1 E., Butte County, S. Dak.

Redwood Formation[1]

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 770–782.

Occurs between Redwood and Burls Creeks and ridge between Cave and Hey Point, Katalla district, Controller Bay region

Redwood Creek Schist

See Kerr Ranch Schist.

Ree Beds[1]

Eocene or Oligocene: South Dakota.

Original reference: E. D. Cope, 1892, Am. Assoc. Adv. Sci. Proc., v. 40, p. 285.

Ree Heights is in Hand County.

Reed Dolomite[1]

Precambrian(?): Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. R. Longwell, 1952, Washington Acad. Sci. Jour., v. 42, no. 7, p. 42. In view of a study made of lower limit of the Cambrian in the Cordilleran region, it is believed that Reed dolomite should be carried under the heading of "age unknown." Designation of definitely Precambrian does not seem warranted by evidence now available.

Named for exposures along east side of Reed Flat; best section in canyon at head of Wyman Creek, in sec. 7, T. 6 S., R. 35 E., Inyo Range.

Reed Formation[1]

Upper Mississippian: Central northern Utah.

Original reference: F. F. Hintze, Jr., 1913, New York Acad. Sci. Annals, v. 23, p. 109.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 136. Reed (or Reade) and Benson formations are approximately equivalent to

Brazer and Madison, respectively; not certain that boundaries between formations correspond.

Exposed in Big Cottonwood Canyon at north end of Reade and Benson Ridge, which separates Big Cottonwood Canyon from Day's Fork, central Wasatch Mountains.

Reed Canyon Silt Member (of Tejon Formation)

Eocene, upper: Southern California.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922. Listed as upper member of Tejon formation in type area of Tejon. Thickness 160 feet. Shown as unconformably underlying continental deposits of Oligo-Miocene age and overlying Metralla sandstone member (new) of Tejon formation.

J. G. Marks, 1943, California Div. Mines Bull. 118, pt. 3, p. 535, 536 (fig. 232), 537 (fig. 233). Shale, glauconitic silt, and fine sand. Shown on stratigraphic column as unconformably underlying Tecuya formation.

Type locality: Reed Canyon, Tehachapi Mountains, Kern County.

†Reeder Sandstone[1]

Uppper Cretaceous: Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 381, 382.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Dakota formation as herein defined contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Named for exposures in upper valley of Medicine Lodge River near post office at Reeder. Town of Reeder now abandoned. Upper valley of Medicine Lodge River is in Kiowa and Barber Counties.

Reedian series

Precambrian (Protozoic): Eastern California.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 307 (chart). Listed as a series consisting of 2,500 feet of dolomites. Unconformable below Deepian series and above Wymanian series.

Occurs in Death Valley region.

Reeding Sandstone

Permian: Western Oklahoma.

Henry Schweer *in* O. E. Brown, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1553 (fig. 9). Shown on cross section a little above middle of Hennessey formation.

Type locality and derivation of name not given.

Reeds Creek Andesite

Eocene, middle, to Oligocene, lower: Northern California.

B. L. Clark and C. A. Anderson, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 935 (fig. 2), 938, 940–941. Andesitic conglomerates and breccias. Rests in part on basement complex and is in part intercalated with or lies above Ione formation.

Occurs in Sacramento Valley near Wheatland, Yuba County.

Reeds Spring Chert Member (of Boone Formation)

Reeds Spring Limestone[1]

Reeds Spring Formation

Reeds Spring Member (of Chouteau Formation)

Lower Mississippian: Southwestern Missouri and northeastern Oklahoma.

Original reference: R. C. Moore, 1928, Missouri Bur. Geology and Mines v. 21, 2d ser., p. 143–145, 161–163, 169, 170, 190, 191, 193.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 184 (fig. 28), 196–199, 202–204. Report refers to Reeds Spring limestone and quotes extensively from unpublished manuscript by Clark (1941) who classed Grand Falls chert as member of the Reeds Spring. Report also refers to Reeds Spring member of Chouteau formation.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 43–44, pls. Formation described in northeastern Oklahoma where it is as much as 175 feet thick and consists of nearly equal amounts of thin alternating fine-grained dense thin-bedded limestone and dark-gray to blue-gray chert. Unconformably overlies St. Joe, Chattanooga, and St. Clair formations; unconformably underlies Keokuk formation. Osagean.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1958, Deutschen Geol. Gesell., Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Chart shows Reeds Spring member in lower part of Boone formation. Thickness 30 to 45 feet.

Named for exposures in vicinity of Reeds Spring, Stone County, Mo.

Reedsville Shale[1]

Upper Ordovician: Central Pennsylvania, eastern Tennessee, and southwestern Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

Charles Butts and E. S. Moore, 1936, U.S. Geol. Survey Bull. 855, p. 43–45, pls. 1, 3. In Bellefonte quadrangle, Pennsylvania, 1,000 feet thick and consists of dark calcareous shale with thin layers of fossiliferous limestone. Thick-bedded calcareous sandstone at top, 40 feet thick, carrying *Orthorhynchula* and *Byssonichia; Orthorhynchula* zone. Overlies Trenton limestone; underlies Oswego sandstone.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 2, p. 114. Restricted below to exclude about 400 feet of dark brownish-weathering shale herein named Antes shale.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, pls. Mapped in eastern Tennessee where, east of Kingston fault, it overlies unit 4 of Chickamauga limestone; thickness 250 to 400 feet. Underlies Sequatchie formation. In folio mapping the Reedsville was largely ignored though Hayes (1894, folio 4; 1895, folio 20) called it Athens shale and Keith (1901, folio 85) thought it represented featheredge of Sevier shale.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 71–73, measured sections. Described in Jonesville district, Lee County, Va., where it conformably overlies Trenton limestone and conformably underlies Sequatchie formation. Thickness 282 to 460 feet.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58p. From Tyrone Gap to Susquehanna Gap, underlies Bald Eagle sandstone (Centennial School member, new, in western part of area).

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 7, pl. 1. Reedsville of central Pennsylvania is equivalent to Martinsburg formation of eastern Pennsylvania. Transitional with underlying Trenton limestone; underlies Bald Eagle formation. Thickness approximately 1,000 feet.

Named for exposures at Reedsville, Mifflin County, Pa.

Reef Ridge Shale[1]

Reef Ridge Shale Member (of Monterey Formation)

Miocene, upper: Southern California.

Original reference: W. F. Barbat and F. L. Johnson, 1933, Pan-Am. Geologist, v. 59, no. 3, p. 239.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 165. Treated as a member of Monterey formation.

S. S. Siegfus, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 24–44. Restricted at its type locality to exclude brown shales and silts in lower part of the originally defined Reef Ridge shale because that part of the section has been included in McLure shale by Henney (1930). As thus restricted, formation corresponds more nearly with the "caving blue shale" of Kettleman Hills. Thickness about 300 feet. Underlies Jacalitos formation; overlies McLure shale; upper and lower contacts gradational at type locality.

Exposed on Reef Ridge, west of Kettleman Hills, Fresno and Kings Counties.

Reel Limestone Member (of Bond Formation)

Reel Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern and eastern Illinois.

G. H. Cady and others, 1955, Illinois Geol. Survey Rept. Inv. 183, p. 7 (fig. 3), 8–9. Fine-grained compact fossiliferous limestone faintly mottled in shades of dove to gray with irregular reddish-brown spots; weathers grayish yellow. Identification of limestone not based upon lithologic characteristics but upon its relative position and the absence of other limestone beds for some distance above and below; 1 foot of dark-gray to black shale underlies limestone and overlies a coal bed 7 to 10 inches thick. Columnar section shows Reel limestone stratigraphically below Friendsville limestone and above Mount Carmel sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), pl. 1. Rank reduced to member status in Bond formation (new). Occurs above Flannigan coal member and below Livingston and Millersville limestone members. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Sec. 8, T. 1 S., R. 12 W., Wabash County. Named from exposures on Emmanual Reel Farm.

Reelsville Limestone

Reelsville Limestone[1] (in West Baden Group)

Reelsville Limestone Member (of Paint Creek Formation)

Mississippian (Chester Series): Southwestern Indiana and northern and central Kentucky.

Original reference: C. A. Malott, 1919, Indiana Univ. Studies, v. 6, no. 40, p. 7–20.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig 1), 269, 270 (fig. 2), 274 (fig. 3), 275–276. Paint Creek is used here to include group of formations above Sample sandstone and below Cypress sandstone between Ohio River and southern end of Hardin and Breckinridge Counties, Ky. The three formations of the Paint Creek are correlatives of three formations of Indiana (ascending): Reelsville limestone, Elwren sandstone and shale, and Beech Creek limestone. Names Reelsville and Elwren are here proposed for two lower members of the Kentucky formation; term *Productus inflatus* zone is used for upper member. Thickness of Reelsville 28 feet near Germantown, Breckinridge County; in Gasper River region, thickens and rests on underlying Renault with no apparent break in sedimentation.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 828; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 76). Considered member of Paint Creek formation in Indiana.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations in southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7, 26–27. Paint Creek of standard Chester column has triple expression in southern Indiana (ascending): Reelsville limestone, Elwren sandstone, and Beech Creek limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves name in its own right. At designated type section, Reelsville limestone is 2⅔ feet thick. Truncated and overlapped by Pennsylvanian Mansfield sandstone and not present north of Reelsville. Putnam County.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 24–25, pl. 1. In Indiana, Reelsville limestone is less than 10 feet thick and commonly is exposed as a single massive bed in which entire thickness is represented; locally absent and stratigraphic interval represented by clastic rocks. Underlies Elwren sandstone; overlies Sample sandstone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 45–46, pl. 1. Included in West Baden group (redefined). Thickness 0 to 7 feet. Underlies Elwren formation; overlies Sample formation.

Type section: Near center sec. 21, T. 13 N., R. 5 W., along highway downhill, south bluff of Walnut Creek, just south of Reelsville, Putnam County, Ind.

Reese Formation[1]

Eocene(?): Central southern Montana.

Original reference: W. R. Calvert, 1912, U.S. Geol. Survey Bull. 471, p. 412.

Type locality: Reese Creek, Park County.

Reeve Meta-Andesite[1]

Pennsylvanian: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood sheet (1:250,000): California Div. Mines. Mapped with Permian marine sedimentary and metasedimentary rocks.

Named for unidentified locality near Genesee, east of Taylorsville, Plumas County.

Reformatory Granite[1]

Precambrian: Southwestern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

C. A. Merritt, 1958, Oklahoma Geol. Survey Bull. 76, p. 33–38, pl. 1. Described in Lake Altus area as coarsely crystalline reddish granite, locally containing xenoliths of gabbro, andesite or aplite. Considered to include unit formerly termed Flat Top granite, that occurs on Flat Top and Soldier's Spring Mountains.

Exposed in Quartz Mountain-Headquarters Mountain area. Named after the quarry rock at the State Reformatory near Granite, Greer County.

Refugian Stage[1]

Oligocene: California.

Original reference: H. G. Schenck and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 215–225.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 99–103, fig. 14 (correlation chart). Stage nearly everywhere occurs conformably above beds considered age equivalents of Upper Tejon formation, although irregular contacts are reported in some areas. Subjacent to lower Miocene Zemorrian stage.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 73. Refugian stage occurs conformably above beds of Narizian age nearly everywhere.

Type locality: Canada de Santa Anita, on south side of Santa Ynez Mountains, Santa Barbara County, about 5 miles west of Gaviota Pass. Name derived from the Spanish land grant "Nuestra Senora del Refugio".

Reisner Limestone Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 41, 51 (table 1), pl. 1. Proposed to replace name Newton limestone; name Newton preempted. Uppermost member of formation; stratigraphically above Woodbury limestone member. Thickness about 9 inches. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NE¼ sec. 16, T. 7 N., R. 10 E., Jasper County. Named for Reisner School 1½ miles southwest of type outcrop.

Reklaw Member (of Mount Selman Formation)[1]

Reklaw Formation (in Claiborne Group)

Eocene, middle: Eastern Texas and northwestern Louisiana.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 65–78 [1938]. Rank raised to formation in Claiborne group. Thickness about 80 feet. Comprises Newby glauconitic sand member below and Marquez shale member above (both new). Unconformably overlies Carrizo sand; underlies Queen City sand.

B. W. Blanpied and R. T. Hazzard, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 128 (correlation chart). Correlation chart shows Reklaw formation includes Arp sand member (new).

H. B. Stenzel, 1950, Texas Univ. Bur. Econ. Geology Pub. 5019, p. 23–27, pl. 1. Recent work indicates that the Reklaw, as described by Wendlandt and Knebel (1929, American Assoc. Petroleum Geologists Bull., no. 10) that is, the 20 to 40 feet of brown to dark-blue micaceous sandy clay, does not belong in Reklaw because it interfingers with and grades laterally into Carrizo sand and is separated from Reklaw glauconites by regionally continuous disconformity. Reklaw, as restricted here, consists of two divisions, a lower glauconite 4 to 15 feet thick and an upper brown shale as much as 100 feet thick. These two divisions are precisely the two members described by Stenzel (1939) [1938] in Leon County.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 243–C, p. 37. Because of similarity of their stratigraphic position above Carrizo sand and similarity of ferruginous beds partly composing them, Reklaw and Bigford members of Mount Selman formation have been regarded as contemporaneous. Geographic and stratigraphic positions of fossiliferous ferruginous sandstones north of Leming, Atascosa County, suggest that they represent eastward extension of the Bigford from Frio County; if the Leming and Scruggs Creek localities should prove to represent the same zone, then on assumption that the conglomerate is basal part of the Reklaw, it would appear that the Bigford is not exact equivalent of the Reklaw, but is older and intervenes between the Carrizo sand and the Reklaw.

H. B. Stenzel, 1953, Texas Univ. Bur. Econ. Geology Pub. 5305, p. 34–83. Described in Henrys Chapel quadrangle where it includes Newby glauconitic sand member and Marquez shale member. Thickness about 40 feet. Overlies Carrizo sand; underlies Arp member of Queen City formation.

Well exposed at Reklaw, Cherokee County, Tex.

Relay Quartz Diorite[1]

Ordovician [?]: Northeastern Maryland.

Original reference: E. B. Knopf and A. I. Jonas, 1929, Maryland Geol. Survey Baltimore County Rept., p. 104.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43 (table 7), 63. At least three periods of granite formation are recognized in Maryland rocks. The oldest are the probable migmatites associated with Baltimore gneiss; those of second period cut the Glenarm series; the Relay quartz diorite is among representatives of the second period. Table lists unit under Ordovician with comment, age uncertain.

Occurs at Relay on Patapsco River, Baltimore County.

Relay Creek Dolomite Beds (in Marlow Formation)

Relay Creek Dolomite[1]

Relay Creek Dolomite or Dolostone Member (of Whitehorse Formation)

Permian: Northwestern Oklahoma and southern Kansas.

Original reference: N. Evans, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 405–432.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1803, 1804–1805. Dolomite member of Whitehorse sandstone. In Kansas, Whitehorse sandstone is divided into four members: Marlow, Relay Creek dolomite, an even-bedded sandstone member, and an upper shale member. In Oklahoma, Relay Creek dolomites are regarded as being upper part of Marlow.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 64. Relay Creek dolomite beds included in upper part of Marlow formation. Consists of two thin beds separated by 15 to 20 feet of red sandy shale.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as Relay Creek dolostone member of Whitehorse formation.

Named for exposures both north and south of Relay Creek in T. 15 N., R. 12 W.

Relief Quartzite[1]

Mississippian: Northern California.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey Geol. Atlas, Folio 66.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on correlation chart above Kanaka formation and below Cape Horn slate.

Named for exposures at Relief, Colfax quadrangle.

Relizian Stage[1]

Miocene, middle: California.

Original reference: R. M. Kleinpell, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 3, p. 376–378.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 117–121, fig. 14 (correlation chart). Superjacent to Saucesian stage and subjacent to Luisian stage. Comprises two zones: *Siphogenerina hughesi* and *Siphogenerina branneri*. Systematic catalogue.

Type locality: Reliz Canyon, Monterey County.

Remick Tonalite[1] (in New Hampshire Plutonic Series)

Upper Devonian(?): Northwestern New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 28, maps.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 507–508, pls. 1, 12. Included in New Hampshire magma series. Distribution on map indicates it is younger than Albee and Ammonoosuc formations.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in New Hampshire plutonic series whose age is Upper Devonian(?).

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 54. Derivation of name.

Named for Remick Park, a municipal park in Littleton, Grafton County.

Remmel Granodiorite[1]

Jurassic(?): Central northern Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

Probably composes the cliffs of Mount Remmel, Wash., 5 miles south of international boundary.

Renault Formation[1]

Renault Formation (in New Design Group)

Upper Mississippian (Chester Series): Southwestern and southeastern Illinois, southern Indiana, western and central Kentucky, and southeastern Missouri.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 122.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 268 (fig. 1), 269, 270 (fig. 2), 271–273. In Meade, Hardin, and Breckinridge Counties, Ky., Renault formation consists of (ascending) unnamed limestone ranging in thickness from 0 to 23 feet, Mooretown sandstone, and Beaver Bend limestone members; the latter two names being geogphically extended from Indiana. Overlies Ste. Genevieve limestone; underlies Sample sandstone.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 824–826. Renault formation assigned to New Design group (new). In standard Mississippian section, overlies Aux Vases sandstone and underlies Bethel sandstone. In southwestern Illinois, underlies Yankeetown chert. Locally in southern half of Monroe County, Ill., overlaps Aux Vases and becomes basal member of Chester series. In Johnson, Pope, and Hardin Counties, Ill., and adjacent parts of Kentucky, formation is divisible into two members which are locally unconformable; the lower, or Shetlerville member, is typically developed in Hardin County, Ill. Eastward in Kentucky, shaly layers of Renault become less conspicuous, and formation consists of a limestone that cannot be distinguished from Paint Creek formation where Bethel sandstone is absent; from Todd to Grayson County, this limestone unit is known as Girken limestone. In Indiana, consists of three members (ascending): Paoli, Mooretown, and Beaver Bend. Also present in Ste. Genevieve County, Mo.

Elwood Atherton, 1947, Illinois Acad. Sci. Trans., v. 40, p. 129, 130 (fig. 7), 131 (fig. 8). In Hardin County, Ill., formation comprises Shetlerville member below and Downeys Bluff member (new). Overlies Levias member of Ste. Genevieve formation.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Renault formation of standard Chester column has triple expression in Indiana (ascending): Paoli limestone, Mooretown sandstone, and Beaver Bend limestone. Each of these is a distinct stratigraphic unit in parity with other formations of the Chester and deserves a name in its own right.

Named for Renault Township, Monroe County, southwestern Illinois. Typically developed in valley of Horse Creek and its tributaries in eastern part of Township.

Rencher Formation

Tertiary: Southwestern Utah.

E. F. Cook, 1957, Utah Geol. and Mineralog. Survey Bull. 58, p. 16 (fig. 2a), 18–25, 57–59. Complex assemblage of welded tuff and tuff-breccia, breccia, air-fall tuff, bedded tuff-breccia, volcanic sandstone, and lenticular limestone and conglomerate. Maximum thickness of 600 feet. Overlies

Quichapa group (new) unconformably; underlies Atchinson formation (new).

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 97, 98. Overlies Quichapa formation; underlies Page Ranch formation. Zircon age dating suggests that Rencher-Page Ranch period of extrusive-intrusive igneous activity is late Oligocene or early Miocene.

Type locality: Vicinity of Rencher Ranch at north end of Grass Valley, Pine Valley Mountains, Washington and Iron Counties.

†Renfroes Marl[1]

Upper Cretaceous: Western Georgia.

Original reference: J. O. Veatch, 1909, Georgia Geol. Survey Bull. 18, p. 86–89.

Named for exposures at Renfroes, Chattahoochee County.

Rennie Shale[1]

Middle Cambrian: Northern Idaho.

Original reference: E. Sampson, 1928, Idaho Bur. Mines and Geology Pamph. 31, p. 9.

C. E. Resser, 1938, Smithsonian Misc. Colln., v. 97, no. 3, p. 2–3. Consists of soft olive argillaceous shale, sometimes micaceous. Thickness 50 to 75 feet. Overlies Gold Creek quartzite; underlies Lakeview limestone.

Crops out in stream along west side of Rennie Ridge, a spur on south side of Packsaddle Mountain, Pend Oreille district.

Rennix Limestone[1]

Upper Ordovician (Richmond): Southeastern Kentucky.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 435.

Named for Rennix Creek, Cumberland County.

Reno Member (of Franconia Formation)

Upper Cambrian: Eastern Minnesota and southwestern Wisconsin.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. [2]; 1953, Jour. Paleontology, v. 27, no. 4, p. 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 864–865, measured sections. Consists of beds of wormstone with high glauconite content, separated by thinner beds of crossbedded greenstone; thin beds of greenstone conglomerate are common; top of member is marked by a 1- to 6-foot bed of dolomitic, flat-pebble conglomerate. Thickness at type locality 116 feet. Overlies Tomah sandstone member (new); interfingers with Mazomanie member (new).

Type locality: In Hell Hollow, 1½ miles north of Reno, SE¼ sec. 23, T. 102 N., R. 4 W., Houston County, Minn.

Rensselaer Graywacke[1]

Lower Cambrian(?): Eastern New York.

Original reference: T. N. Dale, 1893, U.S. Geol. Survey 13th Ann. Rept., pt. 2, p. 301–340, map.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 327, p. 1–17. Discussion of supposed occurrence of *Oldhamia* in Rensselaer grit. It is apparent that *Oldhamia occidens* of the Nassau beds and the supposed *Oldhamia* of the grit are of entirely different nature and origin and the

Rensselaer grit "*Oldhamia*" can not be used for correlation of the Rensselaer with the Nassau beds or any other Cambrian formation.

Theodore Arnow, 1951, New York Water Power and Control. Comm. Bull. GW–25, p. 8 (table 1), 11, pl. 2. Only outcrop of Rensselaer graywacke in Columbia County is small outlier in northern part of county. Thickness of outlier not known but believed to approximate the 1,400 feet assigned to main body of Rensselaer graywacke plateau that lies north of Columbia County. Lower Cambrian(?). Considered to have been deposited at same time Schodack and Nassau formations were deposited. Underlies Stockbridge limestone.

Named for exposures on upper part of east side of Renssalaer grit plateau, eastern New York; also the southeastern, western, and northern faces of the plateau.

Renwick Shale Member (of Genesee Formation)

Renwick Shale (in Ithaca Shale)

Renwick Shale Member[1] (of Middlesex Shale)

Upper Devonian: South-central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Shale reallocated to base of Ithaca shale. Underlies Six Mile shale; overlies Cornell shale and sandstone.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2817 (fig. 4), 2821, 2827. At Cayuga Lake, Sherburne flagstone member of Genesee is overlain by a 5- to 40-foot unit of black and very dark brown shale containing siltstone scour channels. Base of unit is sharply defined, but upper boundary is gradational. This unit of dark shaly rock was informally named Ithaca *Lingula* shale by Williams (1906, Science, new ser., v. 24) and was apparently named Renwick shale member of Middlesex shale by Caster (1933). Caster's Renwick was proposed in an abstract, and type area and boundaries were not described. Name Renwick shale member of Genesee formation is herein adopted for stratigraphic unit above Sherburne. Thickness at reference section (herein designated) 38 feet. Underlies Ithaca member; boundary placed at top of beds of dark-brown shale above which rocks are gray silty shale and thin beds of dark-gray siltstone. Renwick extends westward to vicinity of Keuka Lake where member is present as thin tongue of black shale in middle of Penn Yan shale member.

Reference section: In Renwick Brook on east side of Cayuga Lake, 0.3 mile north of Ithaca, Tompkins County.

Repettian Stage

Pliocene: Southern California.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. Lowermost of four stages, based on foraminiferal assemblages, in the Pliocene and Pleistocene of southern California. Occurs below the Venturian stage. In western part of Ventura Basin, lower and middle Repettian are absent and the upper Repettian lies apparently conformably on Delmontian upper Miocene.

†Repetto Formation[1] or Siltstone[1] (in Fernando Group)

Pliocene, lower: Southern California.

Original reference: R. D. Reed, 1932, 16th Int. Geol. Cong. Guidebook 15, p. 31.

M. L. Krueger, 1936, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1520. In Whittier Hills area, underlies Sycamore Canyon formation (new).

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof Paper 207, p. 40–42, pl 1. In type region, formation consists of 2,000 to 3,000 feet of siltstone and rests conformably on diatomaceous shale referred to upper Miocene. Farther east in Puente Hills, the Repetto includes thick beds of conglomerate and sandstone. In Palos Verdes Hills [this report], the Repetto consists entirely of siltstone, and term Repetto siltstone is used. Siltstone is about 150 feet thick and disconformably overlies Malaga mudstone member of Monterey shale. Underlies Lomita marl in type region of Lomita. Lower Pliocene.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 51 (table 1), 54 (table 2), 55–56. Name Repetto formation is used in this report [Placerita oil field, Los Angeles County] for lower Pliocene sedimentary rocks, including basal Elsmere member and Repetto siltstone member. Relationship between Elsmere and siltstone members not certain. Elsmere member is used for lower Pliocene beds including typical Elsmere fauna described by Grant and Gale (1931, San Diego Soc. Nat. History Mem., v. 1). The two members may be in part contemporaneous although siltstone member probably overlies Elsmere. Thickness of Elsmere about 100 feet; thickness of siltstone 300 feet. Unconformably overlies Mint Canyon formation; unconformably underlies Pico formation; in some areas unconformably underlies Sunshine Ranch member (new) of Pico formation.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 75–78, pl. 1. Formation described in San Fernando quadrangle where it is distributed in discontinuous belt along western and southern margin of San Gabriel Mountains for 13½ miles, as far east as Sunland and Tujunga. Maximum thickness 3,000 feet, measured in Lopez Canyon (south of San Gabriel fault) from top of underlying Modelo contact to base of overlying Saugus formation. South of San Gabriel fault, includes Elsmere member, which reaches maximum thickness of 1,400 feet, from its contact on pre-Tertiary crystalline rocks to overlying base of Pico formation, in upper Elsmere Canyon. North of San Gabriel fault, thickness of formation, from top of Modelo to base of Saugus formation, in Humphreys syncline, is about 500 feet.

D. L. Durham and R. F. Yerkes, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–195. Included in Fernando group. Basal formation of group; underlies unnamed formation that constitutes upper part of group. In eastern Puente Hills, conformably overlies Sycamore Canyon member of Puente formation. Maximum thickness of 1,600 feet exposed on ridge south of Olinda.

U.S. Geological Survey has abandoned the term Repetto.

Type locality: In Repetto Hills, along west side of Atlantic Boulevard, Los Angeles.

Republic Chert[1]

Pennsylvanian: Southwestern Missouri.

Original reference: E. M. Shepard, 1898, Missouri Geol. Survey, v. 12, pt. 1, p. 125–126, 141.

Named for Republic, Greene County.

Republic Conglomerate

Precambrian: Northern Michigan.

R. M. Dickey, 1938, Jour. Geology, v. 46, no. 3, p. 331–334. Named in discussion of Ford River granite (new) of Southern Complex of Michigan.

Named for occurrence south of town of Republic, Marquette County. Upper part of principal exposure is near Republic baseball park near State Highway 95.

†Republic Formation[1]

Pre-Cambrian (Huronian): Northwestern Michigan.

Original reference: M. E. Wadsworth, 1890, Lake Superior along the south shore, by Julian Ralph, p. 77–99; 1891, 2d ed.

Named for occurrence at Republic, Marquette County.

Republic Granite[1]

Precambrian: Northern Michigan.

Original reference: C. A. Lamey, 1933, Jour. Geology, v. 41, no. 5, p. 487–500.

C. A. Lamey, 1937, Jour. Geology, v. 45, no. 5, p. 487–510. Two granites, one of Archean age and one of post-Huronian, possibly Killarnean, are now generally recognized as present in Southern Complex. Agreement does not exist regarding relative amounts of these granites nor the criteria by which their extent should be judged. Evidence is cited to show that granite at Republic is younger than a conglomerate there which has been described as containing granite fragments. Believed that there is sufficient evidence to warrant conclusion that northern part of Southern Complex, extending from about 5 miles west of Republic to at least 3 miles east of Palmer, is a post-Huronian granitic unit to which name Republic granite is applicable. Republic granite is probably continuous with more northern intrusions, thus making northern part of Southern Complex a post-Huronian unit.

R. M. Dickey, 1938, Jour. Geology, v. 46, no. 3, p. 321–335. Granite-porphyry, herein named Ford River granite, is post-Lower Huronian and pre-Middle Huronian. It has been considered post-Huronian and called Republic granite by Lamey. Term Republic granite is not desirable, since known post-Huronian granite is exposed only in small quantities in vicinity of Republic. Since name Republic is established in literature, it is retained as designation for port-Huronian granite found in some abundance about margins of Southern Complex.

Named for exposures in vicinity of Republic, Marquette County.

Republic Quartzite[1]

Precambrian (Huronian): Northwestern Michigan.

Original reference: M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891–1892, p. 63–64, 84–85, 102–127.

Probably named for occurrence at Republic, Marquette County.

Republican Creek Limestone[1] (in Stevens Series)

Middle Cambrian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 78, map.

C. D. Campbell, 1947, Geol. Soc. America Bull., v. 50, no. 7, p. 602 (table 4), 611. Remapping of northeastern Stevens County and discovery of Cambrian and Ordovician fossils are thought to justify the adoption there of formation names established by Park and Cannon (1943) for the Metaline quadrangle. Correlative with the Middle Cambrian Metaline limestone are most of Weaver's Northport limestone, Republican Creek limestone, Red Top limestone, and Deep Lake argillite, and part of Boundary argillite.

Extends from head of Republican Creek southwest past north end of Deep Lake, Stevens County.

†Republican River Formation[1]

Pliocene, lower: Northern Kansas and central southern Nebraska.

Original reference: H. F. Osborn, 1907, Am. Mus. Nat. Hist. Bull., v. 23, p. 250, 251; W. B. Scott, 1907, Textbook of Geology, p. 724.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1271–1273. Exposures generally referred to the Republican River beds in southwestern Nebraska and parts of Kansas are now known to belong to lower part of Ogallala group, that is, they are equivalent to upper part of Valentine formation and lower part of Ash Hollow formation.

Exposed along Republican River.

Resendez Shale Member (of Fayette Formation)

Eocene (Jackson): Western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 267–268. Proposed for series of shaly beds with local developments of argillaceous sandstone and oyster streaks. Underlies Roma sandstone tongue and overlies Salineno sandstone tongue. Thickness about 80 feet in Roma area; apparently grades northward into nonmarine bentonitic red and green shale.

Named from Resendez ranchhouse, 1 mile northwest of Roma, Roma quadrangle, Starr County.

Reserve Shale Member[1] (of Falls City Limestone)

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 9.

Type locality: In upland near State line, northwest of Reserve, Brown County, Kans.

Reservoir Formation

Pliocene(?) and Quaternary, lower: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 45–46. Mentioned in discussion of "Muddy Creek" formation. Name credited to H. R. Blank (unpub. thesis).

Present in Washington County.

Reservoir Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and Marion Rice, 1919, New York State Museum Bull. 225, 226, map and passim.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 63, no. 3, p. 143. In place of Canada Hill, Reservoir, and Mahopac granites described by Berkey and Rice (1919), the term Canada Hill granite phase of Hudson Highlands complex is used here to include all rocks representative of granitic igneous activity in the Hudson Highlands after the Pochuck diorite phase and earlier than the Storm King granite intrusion.

Type locality: At north end of Boyd Corners Reservoir, Putnam County.

Reservoir Hill Granite[1]

Precambrian: Northwestern New York.

Original reference: H. P. Cushing and D. H. Newland, 1925, New York State Mus. Bull. 259, p. 42–47.

Reservoir Hill, southeast of Gouverneur, St. Lawrence County.

Resolution Dolomite Member (of Minturn Formation)

Pennsylvanian: Colorado.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 199–201, 215–216. Consists of lower dolomite bed 35 to 40 feet thick, middle shale and grit unit 15 to 35 feet thick, and upper dolomite bed 15 to 22 feet thick. Separated from overlying Robinson limestone member by a 400-foot section of grayish clastic rocks. Separated from underlying Hornsilver dolomite member (new) by interval, about 800 feet thick, of grit, conglomerate, shale, and dolomite. About 3,700 feet above base of formation.

Named for the fact that it caps Resolution Mountain, an 11,927-foot peak on the divide between Resolution and Wearyman Creeks, Pando area.

Resting Springs Formation

Pleistocene(?): Southern California.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 2, 102–103, pl. 1. Succession of limy sandstone, conglomerate, and pumice at least 1,000 feet thick, deposited upon remnants of a thrust plate of late Pliocene age.

Occurs in Pahrump Valley, Inyo County, near Resting Springs.

Rest Island Granite[1]

Precambrian: Minnesota, and Ontario, Canada.

Original reference: I. H. Cram, 1932, Jour. Geology, v. 40, no. 3, p. 270–278.

Named for the granite of Rest Island batholith, in Rainy Lake area.

Restoration Point horizon[1]

Oligocene: Northwestern Washington.

Original reference: B. L. Clark, 1930, Geol. Soc. America Bull., v. 41, p. 751–770.

Restoration Point Member (of Blakeley Formation)

Miocene, lower: Northwestern Washington.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1341. At type section of Blakeley, Restoration Point member consists of approximately 4,000 feet of marine hard massive gray-tan siltstone inter-

bedded with thin hard fine-grained sandstone; soft limonitic-stained sandstone largely covered by beach gravels; and massive dark-gray, silty shale; contains the typical Blakeley molluscan faunule. Overlies Orchard Point member; underlies an unnamed lithologic unit consisting of approximately 4,650 feet of massive nonmarine conglomerates interbedded with thin gray sandstone and soft carbonaceous siltstones.

Named for occurrence at Restoration Point near entrance to Bremerton Inlet, Kitsap County.

Rest Spring Shale

Mississippian and Pennsylvanian(?): Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 25–26, pls. 1, 2, 3. Characteristically an argillaceous shale grading into siltstone; basal shale contains discoidal concretions 2 to 6 inches in diameter shale grades upward into siltstone, fine-grained sandstone and in some places thin isolated beds of light-gray quartzite; some sandstone is conglomeratic in thin inconspicuous beds. Thickness about 310 feet. Underlies Tihvipah limestone (new); overlies Mississippian Perdido formation (new).

J. F. McAllister, 1956, U.S. Geol. Survey Geol. Quad. Map GQ-95. In long exposure from western side of Ubehebe Peak stock to northern side of [Ubehebe Peak] quadrangle, outcrop width of nearly vertical, highly sheared Rest Spring shale ranges from 200 to 1,000 feet; on flank of open fold west of Lee Flat the thickness is about 300 feet. Overlies Perdido formation; underlies Bird Spring(?) formation.

Type locality: Extends from head of gulch 2,000 feet south of Rest Spring northward to within 200 feet of top of hill that is 2,000 feet northwest of Burro Spring, Inyo County. Named from extensive exposures around Rest Spring.

Retort Phosphatic Shale Member or **Tongue** (of Phosphoria Formation)

Permian: Southwestern Montana, eastern Idaho, northeastern Utah, and western Wyoming.

R. W. Swanson, 1956, *in* V. E. McKelvey and others, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2832 (fig. 3), 2836 (fig. 4), 2850–2851; 1959, U.S. Geol. Survey Prof. Paper 313-A, p. 29–30, pls. 2, 3. Upper phosphatic shale member of Phosphoria formation, provisionally called D member in recent preliminary reports on area in Montana and Wyoming, is here named Retort phosphatic shale member. At type locality, divided into three principal zones: lower phosphatic zone, 26 feet thick; middle somewhat calcareous mudstone, 15 feet thick, lower 10 feet of which includes oil shale beds; upper phosphatic zone, 19 feet thick. Thickness of member 55 to 90 feet. Thins progressively northward from Retort Mountain to about 30 feet near Melrose, 20 feet near Philipsburg, 10 feet near Maxville, and 3 to 5 feet in Garrison region where it is composed almost wholly of phosphorite; east of Ruby River, thins abruptly to generally less than 10 feet; in Centennial Mountain about 20 feet; 35 feet or less in Jackson Hole region; thins to the north; probably in large part by facies change to chert, and toward the southwest in Idaho where it intertongues with and grades laterally into cherty shale member. Overlies Rex chert member; underlies Tosi chert member (new); both contacts appear conformable. Also intertongues with Franson member (new) of Park City formation and Shedhorn sandstone (new).

T. M. Cheney, 1957, Utah Geol. and Mineralog. Survey Bull. 59, p. 28. Geographically extended into northeastern Utah.

Type locality: Small Horn Canyon, just northwest of Retort Mountain in sec. 23, T. 9 S., R. 9 W., about 10 miles south of Dillon, Beaverhead County, Mont. Retort Mountain was named from retort built there nearly 40 years ago in attempt to recover oil from the shale.

Retreat Group

Silurian and Devonian: Southeastern Alaska.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Dominant rock types are fine-grained gray to greenish-gray sericite schist, sericite-chlorite-albite schist, medium-grained quartz-muscovite schist, fine-grained green chlorite-albite-epidote schist, black graphitic quartzose pyrite-bearing slate, and black graphitic slate. Gray fine- to medium-grained graywacke and silvery sericte schist form minor part of group. Gray to buff marble with dark-gray laminae in beds 0.5 foot to more than 100 feet thick exposed at several localities. Individual beds of all above-mentioned rock types are a few inches to a few hundred feet thick. Thickness of group at least 6,000 feet. In contact with Barlow Cove formation (new) along a bedding plane fault. On southwest limb of Shelter syncline.

U.S. Geological Survey currently designates the age of the Retreat Group as Silurian and Devonian on basis of a study now in progress.

Underlies western part of Mansfield Peninsula from Point Retreat to south boundary of Juneau (B–3) quadrangle.

Reusens Migmatite

Reusens migmatite facies (of Moneta Gneiss)

Precambrian: South-central Virginia.

W. R. Brown, 1951, (abs.) Virginia Jour. Sci., new ser., v. 2, no. 4, p. 346. Complex of quartz monzonite gneiss and dark hornblendic gneisses. Unconformably underlies Rockfish conglomerate. Grades into Lovingston quartz monzonite gneiss.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1). Precambrian. Type locality designated.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 12–16, pl. 1. Facies of Moneta gneiss which is included in Virginia Blue Ridge complex (new). In most typical development, it consists of from two to four distinct interbanded and interlensed phases, ranging from almost black hornblende gneiss to white basic pegmatite.

Type locality: In vicinity of Reusens on James River 2 miles northwest of Lynchburg, Campbell County. Lynchburg quadrangle.

Revard Sandstone Member (of Tallant Formation)

Revard Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Central northern Oklahoma.

Original reference: D. E. Winchester, K. C. Heald, and others, 1918, U.S. Geol. Survey Bull. 686–G, p. 60–64.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119–120. Reallocated to member status in Tallant formation (new). Stratigraphically above Bigheart sandstone member.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 36–37, 38. Thickness commonly 18 to 22 feet; locally (west of Okesa), thickens to

between 35 and 40 feet. Base commonly falls between two-fifths and one-half of the way from the bottom to the top of formation. South of Caney River, Hulah sandstone member appears in upper part of the Revard and would seem to be an equivalent of the latter; elsewhere the bed named Hulah appears as a lens between the Bigheart and Revard members.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 14–15, 22–24, pls. Limits of Revard are obscure even at type locality, and consequently the unit is of doubtful stratigraphic value. Name is applied to persistent sandstone normally present in upper part of Tallant. Lenticular nature of upper Missouri sandstones makes it doubtful if the "Revard" of one locality is exact equivalent of the "Revard" of adjacent localities unless beds can be continuously traced. Revard of Pawnee County [this report] is a massive crossbedded sandstone containing thin lenses of red shale and white siltstone. Thickness 35 feet. Separated from underlying Bigheart sandstone member by 100-foot unnamed shale interval. Underlies unnamed red shale sequence.

Type locality: Revard Point, sec. 13, T. 26 N., R. 10 E., Osage County.

Revett Quartzite (in Ravalli Group)[1]

Precambrian (Belt Series): Northeastern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 35–36, pl. 11. White quartzites, commonly rather thick bedded; interstratified with subordinate amounts of micaceous sandstone. Thickness about 1,200 feet. Overlies Burke formation; underlies St. Regis formation.

F. C. Calkins, 1909, U.S. Geol. Survey Bull. 384, p. 38. Middle formation in Ravalli group.

J. W. Hosterman, 1956. U.S. Geol. Survey Bull. 1027–P, p. 729, pl. 57. Described in Murray area, Shoshone County, Idaho, where it is approximately 2,200 to 2,400 feet thick. Except for transition zone with underlying Burke formation, uniform throughout section; consists of fine- to medium-grained almost white; pure quartzite; beds commonly 1 to 6 feet thick; a few thin greenish-gray argillite beds. Underlies St. Regis formation.

Named for exposures surrounding Revett Lake, Coeur d'Alene district, Idaho.

Revuelto formation or shales

Mesozoic (Early Cretacic): Northeastern New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 3, p. 209; v. 74, no. 4, p. 306–307. Name presented as a substitute for Pyramid shales, the latter name found to be preoccupied. Included in the Tucumcarian series. Thickness 50 feet. Overlies Redondo sandstone.

Name derived from Revuelto Mesa, Cerro Tucumcari region.

Reward Conglomerate Member (of Owens Valley Formation)

Reward Conglomerate[1]

Permian: Eastern California.

Original reference: E. Kirk, 1918, U.S. Geol. Survey Prof. Paper 110.

C. W. Merriam and W. E. Hall, 1957, U.S. Geol. Survey Bull. 1061–A, p. 8, 10. Rank reduced to member status in Owens Valley formation (new). Permian.

Named for exposures south of Reward mine, Inyo Mountains.

Rex Chert Member (of Phosphoria Formation)[1]

Permian: Northeastern Utah, eastern Idaho, southwestern Montana and southwestern Wyoming.

Original reference: R. W. Richards and G. R. Mansfield, 1912, Jour. Geology, v. 20, p. 683–689.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2847–2849; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 25–28. Richards and Mansfield did not publish description of section from Crawford Mountains; only section of Rex described by them is one measured in sec. 12, T. 10 S., R. 44 E., a few miles west of Phosphoria Gulch. Because they described the section near Phosphoria Gulch (which has chert as dominant constitutent), in preference to Crawford Mountain section (where beds of Rex age are mainly carbonate rock), it is assumed that they intended Phosphoria Gulch to be type locality for Rex chert member as well as of Phosphoria formation as a whole. Adoption of alternate interpretation—that they meant Rex Peak to be type locality—would require displacing name Rex with new name for chert member in southeastern Idaho, if rules of stratigraphic nomenclature were adhered to strictly. Because Rex chert is known internationally as name of main chert in Phosphoria, its displacement by new name seems undesirable. Richards and Mansfield described the Rex in Phosphoria Gulch as consisting of 100 feet of gray limestone and black chert in lower part, 60 feet of red-stained black chert in middle, and 80 feet of dark cherty shale in upper part. Latter unit has been recognized over wide area and in recent reports has been separated from Rex and referred to as "upper shale member"; this separation is continued here, and name Rex is restricted to hard resistant dark chert above Meade Peak phosphatic shale member. North, east, and south from typical area, upper part of Rex passes into carbonate rock of Franson member (new) of Park City formation; lower part continues as far as southwestern Montana, western Wyoming, and north-central Utah, where it passes into the Franson. North-northwest of typical area, Rex passes into cherty mudstone, which composes entire upper part of Phosphoria in Portneuf quadrangle and Fort Hall Indian Reservation and is designated as separate member.

Type locality: Phosphoria Gulch, 2½ miles northwest of Meade Peak, Bear Lake County, Idaho. Measured in sec. 12, T. 10 S., R. 44 E. Named for Rex Peak in Crawford Mountains, 4 miles east of Randolph, Rich County, Utah, where chert forms an anticlinal cap.

Rexroad Formation

Rexroad Member (of Ogallala Formation)

Pliocene, upper: Kansas and Oklahoma.

H. T. U. Smith, 1940, Kansas Geol. Survey Bull. 34, p. 95–99, 112. At localities where diagnostic fossils have been found, formation consists of alternating beds of gray to reddish mudstone, buff sandy silt, rusty sand and gravel, and a few thin seams of lignite. Has been mapped as Ogallala, and some Rexroad beds are indistinguishable from typical Ogallala. Base not exposed in Meade County; hence, complete thickness is problem-

matical. Individual exposures do not exceed 35 feet, but it is probable that thickness is at least as great as local relief of topography, which is about 80 feet. Contact with overlying Ogallala not exposed. In some areas, as in Clark County, underlies Kingsdown formation (redefined).

J. C. Frye and C. W. Hibbard, 1941, Kansas Geol. Survey Bull. 38, pt. 13, p. 395 (fig. 2), 399 (table), 400 (fig. 3A), 407–410. Smith (1940) named the Rexroad from exposures along tributary to Crooked Creek on Rexroad Ranch, in same general locality from which Rexroad fauna was collected by Hibbard (1938, Kansas Acad. Sci. Trans., v. 40). Choice of type locality was unfortunate because only uppermost part of formation is here exposed. Top of formation was not defined by Smith, although it is exposed in this area, and beds of Pleistocene sand and gravel, which unconformably overlie Pliocene beds, were not clearly excluded from the Rexroad. Beds called Rexroad by Smith are here designated Rexroad member (upper Pliocene) of Ogallala formation. Thickness 50 to 250 feet. Lower and thicker part of Rexroad member does not crop out at surface in Meade basin area; hence, thickness and character of member are known only from test-hole samples and well logs. Upper beds of member, which are exposed at surface, consist of blue-gray, tan, and gray sand, silt, and clay. Where entire member is present, it is about 200 feet thick, but in deepest part of basin it may attain maximum thickness of 250 feet, and east of Crooked Creek fault it is only about 30 feet thick. Unconformably overlain by basal sand or gravel of Meade formation (redefined) of Pleistocene age.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 5, p. 91–105. Includes XI member (new) in lower part. Overlies Laverne formation, angular unconformity.

C. W. Hibbard, 1950, Michigan Univ. Mus. Paleontology Contr., v. 8, no. 6, p. 113–192. Treatment of Rexroad formation by many authors working in different areas of western Kansas has been varied. This report traces development of the term Rexroad formation and Meade formation and relationship of Rexroad fauna to other known faunas.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 65. Blanco formation has its maximum development in southwestern Kansas where formation attains maximum thickness of more than 250 feet. In this area, Smith (1940) described and named Rexroad formation from exposures now classed as Blanco formation. Frye and Hibbard (1941) redescribed these beds as Rexroad member of Ogallala.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55, 56. Underlies Angell member of Ballard formation (both new). Rexroad formation was included in Blanco formation of former State Geological Survey of Kansas classification. Position of Rexroad formation was discussed at Pleistocene conference held in Lawrence, Kans., but decision on it was deferred. Formation is now recognized as older than Meade group. It is here considered to be of late Pliocene age.

Named from exposures along tributaries of Crooked Creek on Rexroad Ranch, in sec. 22, T. 33 S., R. 29 W., Meade County, Kans.

Reynales Limestone (in Clinton Group)

Reynales Limestone Member (of Clinton Formation)[1]

Silurian: Western New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as formation in Clinton group. Occurs above Maplewood shale and below Sodus shale.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. In Clinton group. Occurs above Neahga shale; interfingers with Brewer Dock limestone to east and overlies Maplewood shale. Unconformable below Irondequoit limestone. Name Wallington limestone proposed for limestone formerly regarded as Reynales at Rochester and eastward. This limestone is younger than type Reynales of Niagara and Clinton Counties. Middle Silurian.

Named for exposures at Reynales Basin (also spelled Reynolds), 8 miles east of Lockport.

Reynolds Limestone (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 301, 426.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County p. 255, 264. In Greenbrier County, a shaley blue to yellowish-blue fossiliferous limestone, 15 to 40 feet thick. Underlies a yellow to olive shale beneath the Droop sandstone; separated from underlying Webster Springs sandstone by a yellow sandy shale which may be the equivalent of the Bickett shale of Reger (1926). Mauch Chunk series.

Type locality: In public road 0.3 mile eastward from Reynolds School and 0.6 mile northwest of Knobs village, Monroe County.

Reyolds Sandstone Member (of Hignite Formation)[1]

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 43.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 12, 111, 119, 125, 149. Massive locally conglomeratic sandstone. In Hignite formation between High Splint coal above and Fossil limestone.

Named for Hanging Rock of Reynolds Mountain, Bell County, Ky.

Reynoldsburg Coal Member (of Abbott Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), pl. 1. Assigned to member status in Abbott formation (new). Occurs at base of formation below Grindstaff sandstone member. Coal named by J. M. Weller (1940, Illinois Geol. Survey Rept. Inv. 71).

Type locality: North of Cedar Creek, W½ sec. 32, T. 11 S., R. 4 E., Johnson County.

†Reynosa Formation,[1] Limestone,[1] or Caliche

Pleistocene: Northern Mexico and southern Texas.

Original reference: R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., p. 57, 58, 63.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull. ,v. 29, no. 12, p. 1695 (fig. 1), 1715. Referred to as Reynosa caliche. Covers parts of Fleming and Goliad formations.

Named for occurrence at Reynosa, Tamaulipas, Mexico.

†Rhems Shale[1]

Eocene, lower: Eastern South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449, 451, 452, 453.

Type locality: Perkins Bluff, Black River, 5 miles from Rhems, Williamsburg County.

Rhinestreet Shale Member (of West Falls Formation)

Rhinestreet Shale[1] (in Naples Group)

Upper Devonian: Western and west-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19. p. 23, chart.

J. F. Pepper, Wallace de Witt, Jr., and George W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Chart OC–55. Rank reduced to member status in West Falls formation (new). In Lake Erie area, underlies Angola shale member and overlies Cashaqua shale; in Genesee River valley-Letchworth Park area, underlies Gardeau shale member and overlies Cashaqua shale, in Naples-Hammondsport area, underlies Hatch shale member and overlies Cashaqua shale. Thins eastward; 195 feet on Eighteen Mile Creek; 19 feet at Conklin Gully.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Overlies Cashaqua shale member of Sonyea formation.

R. G. Sutton, 1960, New York State Mus. Bull. 380, p. 18–19. Included in Naples group. Overlies Rye Point member (new) of Cashaqua formation; underlies Hatch formation. Term Attica shale abandoned and Rhinestreet understood to be applicable westward to Lake Erie. Thickness 4 to 152 feet.

Named for exposures along Rhinestreet north from Naples, Ontario County.

Rhinoceros Hill Beds (in Ogallala Formation)[1]

Rhinoceros Hill Beds (in Ash Hollow Formation)

Pliocene, lower: Western Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7, p. 159–163.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 144–145. Included in Ash Hollow formation (Ogallala group). Consist of about 10 to 15 feet of unconsolidated sand with mammalian remains and a 6- to 7-foot deposit of white diatomaceous marl (above) that contains plant remains and fresh-water fishes. Occur a few tens of feet above Edson beds. Rhinoceros Hill sands may belong in the channel of the same late Tertiary river system as the Wray beds and the Long Island beds and are probably nearly or quite contemporaneous with them.

Named from Rhinoceros Hill in northwestern part of Wallace County.

Rhoda Creek Formation

Pennsylvanian (Springer Series): South-central Oklahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2), 91–95. Uniformly gray shale; ferruginous concretions (at several horizons) that are locally concentrated in zones or lentils. Thickness at type locality 140 feet. At type locality, overlies Sand Branch member (new) of Caney shale with angular unconformity and

underlies an unexposed and unnamed shale interval, which in turn underlies Union Valley formation.

Type locality: NW¼ sec. 8; T. 2 N., R. 7 E., about 1 mile northwest of Frisco; Pontotoc County. Name derived from Rhoda Creek, largest eastern tributary to Clear Boggy Creek.

Rhode Island Formation[1]

Pennsylvanian: Eastern Rhode Island and southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 159–201.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts; U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Interfingers with Wamsutta formation in southern part of Pawtucket quadrangle, partly younger than "red beds" of the Wamsutta and partly equivalent to them.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Underlies large part of East Greenwich quadrangle. Overlies Pondville conglomerate with gradational contact. Wamsutta formation and Pondville conglomerate, as mapped by Emerson(1917) south of Greenwich Bay, R.I., are assigned to this unit. Subdivision of formation in this quadrangle not possible.

D. R. Nichols, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–91. Two units of formation mapped in Narragansett Pier quadrangle, Rhode Island; may include some of Pondville conglomerate south of Pettaquamscutt River. Beds of schistose conglomerate and pebbly sandstone occur on the mainland and on Dutch Island. These are described as glossy gray to dark-gray rocks with intercalated muscovite schist and meta-anthracite. Bedding is variable with crossbedding locally. Pebbles of quartz and quartzite greatly elongate. Stratigraphically higher is the soft fissile phyllite exposed on Conanicut Island. Phyllite is black to light gray and greenish gray with a silvery luster; bedding usually indeterminate.

Named for fact that it includes graphite coal beds of Rhode Island.

Rhodes Canyon Formation

Devonian: Southern New Mexico.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook, 11th Field Conf., p. 74. Comprises 75 feet of soft shale, the lower part with white marly beds, middle with silty beds, and top with soft thin clay shale. Overlies Thoroughgood formation (new).

F. E. Kottlowski, 1959, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., and Roswell Geol. Soc. Guidebook Joint Field Conf. Apr. 17–18, p. 265–266. Thoroughgood and Rhodes Canyon formations are informal units not yet properly defined. The "Rhodes Canyon" consists of 50 feet of interbedded light- to dark-gray silty fissile shale and dark-gray to brownish-gray micaceous siltstone with some thin tan sandstone beds in Hembrillo Canyon (called Contadero in 1956) and 75 feet of pale- to dark-olive-gray calcareous silty micaceous shale with a few lenses of gray or olive-gray calcareous micaceous siltstone in Rhodes Canyon (called Percha in 1956).

In Rhodes Canyon [San Andres Mountains, Sierra County].

Rhododendron Formation[1]

Miocene, upper: Central northern Oregon.

Original reference: E. T. Hodge, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 157.

D. E. Trimble, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1667. Formation is now known to overlie middle Miocene Molalla formation of Harper and underlie Troutdale formation of Hodge, originally designated as Pleistocene but referred to lower Pliocene by Chaney in 1944. In northeast-trending outcrop belt about 5 miles wide and 25 to 30 miles long southeast of Portland, formation ranges from about 100 to about 500 feet thick and consists predominantly of hypersthene andesite tuff breccias. Weathering of pre-Troutdale age suggests that Rhododendron formation is no younger than upper Miocene.

Columbia River Gorge. Derivation of name not given.

Rhyolite Canyon Formation

Rhyolite Canyon Series

Cenozoic: Southeastern Arizona.

H. E. Enlows, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 105–107. Series is volcanic sequence made up of rhyolite flows and tuffs. Composite thickness of 1,025 to 1,405 feet. Underlies Sugarloaf series (new); unconformably overlies Faraway Ranch series (new).

H. E. Enlows, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1218–1236, pl. 1. Referred to as formation. Most of the rhyolite deposits of Cenozoic age in Chiricahua National Monument, heretofore termed flows, are more correctly classified as welded rhyolite tuff or ignimbrite, the result of many eruptions of nuess ardentes. Beds of formation are pale brown to pinkish gray, darkening to pale brown or grayish red on exposure. All are porphyritic containing phenocrysts of quartz and sanidine. Consists of nine unnamed members of which all but the uppermost member are rhyolites. Upper member of black to medium-dark-gray rhyodacite. Thickness of formation 1,900 feet. [Presumably includes rocks described as Sugarloaf series (Enlows, 1951).] Unconformably overlies Faraway Ranch formation. Traced southward into main portion of Chiricahua Mountains, and apparently crops out all along central and western parts of range, extending eastward into Portal area. Raydon (unpub. thesis) named 4,500 feet of rhyolite tuffs and welded tuffs which cap section in Cave Creek area, the Cave Creek formation, and states they are probably correlative with those of Chiricahua National Monument.

Best exposed in Rhyolite Canyon from which it is named, Chiricahua National Monument, Cochise County.

Ribbon Gneiss[1]

Precambrian(?): Central Washington.

Original reference: A. Waters, 1927, Jour. Geology, v. 35, p. 159–160.

Named for Ribbon Rock, Ribbon Cliff, and Ribbon Mesa, Douglas County.

Rib Hill Formation or Sandstone

Pennsylvanian or Permian: Eastern Nevada.

E. N. Pennebaker, 1932, Mining and Metallurgy, v. 13, no. 304, p. 164. Series of sandstone and sandy limestone about 3,200 feet thick. Lower 1,100 feet

consists of medium- and fine-grained sandstone weathering yellow and buff with local patches of red; succeeding 800 feet are made up of lenticular sandy limestone beds; upper part predominantly sandstone. Overlies Ely limestone with no apparent unconformity; underlies Arcturus limestone. Formerly included in Ely limestone. Name credited to Roland Blanchard.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Age of Rib Hill sandstone shown as Permian.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2170. Pennebaker (1932) in report on Robinson (Ely) mining district, separated a predominantly sandstone unit of Permian age, which he called Rib Hill formation, from beds that were previously mapped at Rib Hill as Ely limestone by Spencer (1917). Present writers [Hose and Repenning] believe that in vicinity of Rib Hill, where exposures are poor, inclusion of this predominant sandstone sequence in the Ely by Spencer was inadvertent and that it should have been included in Arcturus formation.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 102–103. Preoccupied name Rib Hill abandoned. Pennebaker's Rib Hill lies stratigraphically above Spencer's (1917, U.S. Geol. Survey Prof. Paper 96) Ely limestone and within Lawson's (1906) Arcturus limestone. Pennebaker placed upper boundary of Rib Hill 2,000 feet above base of previously named Arcturus limestone. Basal 1,000 feet, predominantly sandstone, is distinctive mappable unit. This basal sandstone member of Pennebaker's Rib Hill is herein named Riepetown sandstone.

Present in Robinson mining district west of Ely, White Pine County. Derivation of name not given.

Rib Hill Quartzite[1]

Precambrian (middle Huronian?) : Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 41.

Exposed on Rib Hill, southwest of Wausau, Marathon County.

Ribolt Clay Shale[1]

Ribolt Member (of Crab Orchard Clay Shales)

Silurian (Niagaran) : Northeastern Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 171, 172, 173, 189, 202.

R. N. Thomas, chm., 1955, Kentucky Geol. Soc. [Guidebook] Field Trip 1955, p. 31 (fig. 11). Shown on generalized section of Serpent Mound region, Adams and Highland Counties, Ohio, as Ribolt member of Crab Orchard clay shales. Shales with thin dolomite lenses; thickness about 50 feet. Overlies Estill member; underlies Bisher formation.

Type exposure: Ribolt, Lewis County, Ky., 10 miles west of Vanceburg.

Ricardo Formation[1]

Pliocene, lower : Southern California.

Original reference: J. C. Merriam, 1914, California Univ. Pubs., Dept. Geol. Bull., v. 8, p. 276, 278.

H. S. Gale, 1946, California Jour. Mines and Geology, v. 42, no. 4, p. 326, 335, 338–350, pl. 52. Described in Kramer borate district where it is

divisible into three units or members, post-borate conglomerate (at top), "lake bed" deposits, and Saddleback basalts, which form the base on which the borate-bearing lake beds rest. Approximate thickness 1,500 feet. Unconformably underlies older alluvium; unconformably overlies Rosamond formation.

T. W. Dibblee, Jr., 1952, California Div. Mines Bull. 160, p. 12 (fig. 1), 25–30, pls. 1, 2, 3. Described in Saltdale quadrangle where it is well developed on northwest flank of El Paso Mountains extending from Redrock Canyon northeast through Last Chance Canyon to Black Hills. Consists of a series of continental and lacustrine sediments containing lava flows and tuff of supposed Pliocene age. Maximum exposed thickness 7,000 feet; northeast of Last Chance Canyon, thins to less than 1,000 feet in Black Hills. Separated from underlying Goler formation (new) by pronounced angular unconformity; overlapped by Black Mountain basalt.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 142. Unit defined as Saddleback basalt in Ricardo formation by Gale (1946) is here redefined as formation in Tropico group (new).

Occurs in vicinity of Ricardo, Kern County.

Rices Mudstone Member (of San Lorenzo Formation)

Oligocene (Refugian and Zemorrian): Western California.

E. E. Brabb, 1960, Dissert. Abs., v. 21, no. 5, p. 1163. Overlies Twobar shale member (new). This is type Oligocene of California, although it does not correspond to Oligocene of Europe.

Type section: Along Kings Creek, Big Basin area, Santa Cruz Mountains. Derivation of name not stated.

Riceville Shale

Riceville Shale Member (of Chemung Formation)[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1352. In Crawford County, Riceville shale, which is equivalent to uppermost part of Chagrin shale of Ashtabula County, Ohio, consists of interbedded gray silty shale, greenish-gray to tan semifissile to massive mudrock, and white to tan thin- to thick-bedded fossiliferous siltstones. The siltstones are lenticular and cannot be correlated between adjacent exposures. Underlies Cussewago sandstone; where the Cussewago is absent, the Riceville is capped by Corry sandstone.

Well exposed on Oil Creek in bluff just west of Riceville, Crawford County.

Riceville Stage[1] or monothem[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, table opposite p. 61.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 11. Riceville stage listed in Conewango series. Unit termed Sandstone D of Riceville stage will probably be named Jumonville sandstone when more definitive study of area is published.

Riceville is in Crawford County.

Richard Sandstone Member (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: M. W. Ball, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 81–87.

G. R. Scott and W. A. Cobban, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 128–129. Olive-gray massive fine-grained sandstone is characteristic. Large orange-brown calcareous sandstone concretions common. Thickness about 60 feet at Richard Lake and Round Butte.

Exposed along north bank of Richard Lake, sec. 30, T. 8 N., R. 68 E., Larimer County.

Richardson Subgroup[1] (of Wabaunsee Group)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, northwestern Missouri, and northern Oklahoma.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 4, 5, 9.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035, 2037 (fig. 6); 1949, Kansas Geol. Survey Bull. 83, p. 188; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 12–15; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20–21. The subgroups named (ascending) Sacfox, Nemaha, and Richardson by Condra (1935) have been included in the interstate classification agreed upon by the Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. As thus defined the Richardson subgroup in standard section includes (ascending) Wamego shale, Maple Hill limestone, Langdon shale, Dover limestone, Dry shale, Grandhaven limestone, Friedrich shale, Jim Creek limestone, French Creek shale, Caneyville limestone, Pony Creek shale, and Brownville limestone. Nomenclature in the several States may deviate from this by a combination or omission of terms where certain named rock units are not recognizable.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Nemaha-Richardson boundary lowered to base of Tarkio limestone herein reduced to member status in newly proposed Zeandale formation. This change has been agreed to by the Nebraska and Kansas Geological Surveys which are chiefly concerned. As herein redefined, the Richardson subgroup comprises five formations (ascending): Zeandale limestone, Pillsbury shale, Stotler limestone, Root shale, and Wood Siding formation (with Brownville limestone member at top).

Type locality: Big Nemaha Valley of southern Richardson County, Nebr., between points south of Humboldt and southwest of Falls City.

Rich Butt Sandstone

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 953 (fig. 2), 955 (table 1), 956 (fig. 3), 960. In type area, characteristic rock is light feldspathic sandstone, medium- to fine-grained and medium- to thick-bedded, that contains sharply contrasting pelitic layers; on Rich Butt Mountain, sandstone is coarser grained and thicker bedded and contains a few lenses of very coarse feldspathic sandstone and fine ar-

kosic conglomerate; locally contains dark argillaceous rocks that are generally thinly and evenly layered and in places are interbedded with fine reddish-weathering ankeritic sandstone. Conformably overlies and somewhat intertongues with Pigeon siltstone of Snowbird group; top of formation cut off by Greenbrier fault; along Big Creek about 3,000 feet of formation is preserved beneath the fault, on Rich Butt Mountain about 1,800 feet.

Type section: Southeast of Mount Cammerer on Big Creek, above community of Mount Sterling, [Cocke County]. Named for Rich Butt Mountain, a northwestern spur of Mount Cammerer, near northeast end of Great Smoky Mountains.

Richfield Member (of Lucas Formation)

Middle Devonian: Michigan (subsurface).

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 7. Term applied to porous dolomite at base of Lucas. In center of basin and on west flank, contains beds of sandstone. Thickness as much as 80 feet.

Named for Richfield (now Au Sable) Township in northern Roscommon County.

Richfield Quarry Shale Member (of Drum Formation)

Pennsylvanian (Missouri Series): Eastern Nebraska and south-central Iowa.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37. Consists of grayish shale and dark fissile shale. Thickness 1 to 1½ feet in Sarpy County, Nebr., and south-central Iowa, and may pinch out southward. Underlies Cement City member; overlies P. W. A. Quarry limestone member (new).

Type locality: Richfield quarry located in Platte Valley bluffs 2½ miles south of Richfield, Sarpy County, Nebr.

Rich Fountain Formation (in Jefferson City Group)

Lower Ordovician: Northern Arkansas and southern Missouri.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 15, 17–24, pl. 2. Massive to thin-bedded white to buff to gray fine-grained argillaceous to coarsely crystalline dolomite; thin buff to brown dolomitic sandstone lenses and layers abundant; chert commonly dull white to brown massive or nodular to thin lenticular; lower part predominantly thick-bedded coarsely crystalline dolomite here named School Mine ledge bed; upper part predominantly argillaceous dolomite. Thickness 140 to 180 feet. As defined, name replaces the Jefferson City (restricted) of Grawe and Cullison (1931, Jour Geology, v. 39, no. 4) except that slightly younger rocks are included in new unit; also includes lower part of Jefferson City dolomite of Winslow (1894). Unconformably underlies Theodosia formation (new); unconformably overlies Roubidoux formation.

Type section: Near Rich Fountain, Osage County, Mo.

Rich Hill Limestone Member (of Cherokee Shale)[1]

Pennsylvanian (Des Moines Series): Central western Missouri.

Original reference: F. C. Greene and W. F. Pond, 1923, Missouri Bur. Geology and Mines, v. 19, 2d ser., p. 37, 51–53.

Named for occurrence at Rich Hill, Bates County.

Richland Formation (in Conococheague Group)

Richland Member (of Conococheague Formation)

Upper Cambrian: Southeastern Pennsylvania.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of the Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Dolomite sequence that stratigraphically overlies Millbach member (new); top is drawn at base of first thick bed of medium-light-gray limestone containing crinoid fragments and other fossils; contact with Ordovician Stonehenge formation concealed. Basal part of member consists of thick-bedded medium-light- to medium-dark-gray finely crystalline dolomite that is in part laminated and contains beds of edgewise conglomerate and calcarenite; *Cryptozoon* present at two horizons in lower 120 feet of beds. Chert, which is frequently oolitic, and oolitic medium-gray limestone interbeds occur in the more limy center of member. Upper part of member reflects cyclic sedimentation, medium-gray siliceous dolomites are repeated at least 12 times; these beds are usually overlain by limy dolomite, magnesian limestone, or banded limestone and dolomite; the bands are often broken into conglomerate; above this are typically medium-gray to light-gray dolomites with shaly partings or bands; the cycle then begins again with siliceous dolomite. Total thickness of member probably in excess of 1,300 feet; approximately 1,264 feet at type section with base not exposed.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Upper Cambrian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Conococheague group.

Type section: Along Reading Railroad about one-fourth mile east of Richland and along road immediately west of Sheridan, Lebanon County.

Richland Limestone and Flint[1]

Mississippian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, pl. opposite p. 933.

Probably named for Richland, Vinton County.

Richland Loess

Pleistocene (Wisconsinan): Northern Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 7, 11. Name applied to loess that lies on Shelbyville till and successively younger Woodfordian moraines. Thickness about 8 feet; lower 3 feet calcareous and fossiliferous. Woodfordian substage. Has been commonly referred to as Tazewell loess.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 546. Classification presented of Wisconsin glacial stage of north-central United States. Consideration also given to other classifications including one proposed by Frye and Willman. Name Richland loess proposed by Frye and Willman considered superfluous.

Named from exposures in east bluff of Illinois Valley north of Richland Creek in roadcut in NW¼SE¼SW¼ sec. 11, T. 28 N., R. 3 W., Woodford County.

†Richland Sandstone[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxv, pl. 3.

Named for Richland Creek, San Saba County.

†Richmond earth[1]

Miocene: Eastern Virginia and eastern Maryland.

Original reference: W. B. Clark, 1897, Maryland Geol. Survey, v. 1, p. 197.

Can be traced from Eastern Shore of Maryland entirely across the State and thence southward into Virginia. Probably named from its wide occurrence in vicinity of Richmond, Henrico County, Va.

Richmond Group[1] or Formation

Richmond Formation (in Cincinnati Group)

Upper Ordovician: Indiana, Illinois, Kentucky, Michigan, Missouri, southwestern Ohio, and West Virginia.

Original reference: N. H. Winchell and E. O. Ulrich, 1897, Minnesota Geol. and Nat. History Survey Final Rept., v. 3, pt. 2, p. ciii.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 17–23. Group, in Clyde and Sodus Bay quadrangles, contains Queenston shale; base of Queenston not exposed in area. Underlies Whirlpool sandstone and Grimsby sandstone of Silurian Albion group.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., p. 110, 113–114, chart facing p. 108. Group in Ohio comprises (ascending) Arnheim, Waynesville, Liberty, and Whitewater formations. Thickness about 265 feet. Overlies Maysville group; underlies Silurian Medina group (top of which is Elkhorn formation).

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 201–239. Discussion of pre-Chattanooga stratigraphy in central Tennessee. Richmond group comprises (ascending) Arnheim formation, Sequatchie formation, Fernvale limestone, and Mannie shale. Overlies Maysville group; underlies Brassfield limestone of Silurian Medinan series.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 27, 28, 32, 113, 327, 330. Group comprises Oswego sandstone and Juniata formation. Overlies Maysville group which here includes Martinsburg formation. Rock units here called Juniata and Oswego have previously been described in West Virginia reports as "Red Medina" and "Gray Medina," respectively.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14. Richmond comprises (ascending) Bills Creek, Stonington, and Big Hill members. Some beds formerly included in Bills Creek are included in Haymeadow Creek member (new) of Trenton formation.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Group comprises (ascending) Waynesville, Liberty, Saluda, Whitewater, and Elkhorn formations. Overlies Maysville group, top of which is Arnheim formation; underlies Medina group (Brassfield formation). Cincinnatian series.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 66, no. 3, p. 247–298, chart 2; Marshall Kay, 1960, Internat. Geol. Cong., 21st,

Copenhagen, pt. 7, p. 28–33. Cincinnatian series comprises (ascending) Edenian, Maysvillian, Richmondian, and Gamachian stages.

A. M. Gutstadt, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 3, p. 518–521. Term Cincinnati group revived to include (ascending) Eden shale, Maysville formation, and Richmond formation.

W. N. Melhorn, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 819 (fig. 1). As shown on generalized stratigraphic section of Southern Peninsula, Mich., Richmond formation comprises (ascending) Utica shale, Lorraine shale, and Queenston shale. Underlies Cataract formation.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1029–1030. In Cincinnati region, Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations [of Richmond group] define Richmond stage of the Cincinnatian. Richmond stage succeeds Maysville stage. Covington group contains standard sections of both Eden and Maysville stages.

Named for Richmond, Ind.

Richmond or Richmondian Stage

See **Richmond Group or Formation.**

Richmondville Sandstone[1]

Mississippian: Michigan.

Original reference: A. C. Lane, as reported by M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891–1892, p. 66.

Named for exposures at Richmondville, Sanilac County.

Rich Mountain Conglomerate (in Pottsville Group)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1918, West Virginia Geol. Survey Rept. Barbour and Upshur Counties, p. 292.

Named from its exposure along Rich Mountain Range.

Rich Valley Formation

Middle Ordovician: Southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 86–87, chart 1 (facing p. 130). Consists of black and chocolate-brown shales, which contain graptolites, brachiopods, and trilobites. Ranges in thickness from a few feet to 350 feet. Overlies Arline formation (new); underlies Chatham Hill formation (new). Beds herein defined as Rich Valley are the lower and characteristic part of a unit widely identified by Butts, Decker, and others as Athens shale. Rich Valley corresponds to lower part of Liberty Hall black limestone-black shale succession of central western Virginia. Name credited to B. N. Cooper and G. A. Cooper.

Type section: Immediately south of Porterfield quarry and Worthy mine of Mathieson Chemical Corp., about 7 miles east-southeast of Saltville on Maccrady quadrangle, Smyth County.

Richville Formation

Pleistocene, upper: Northeastern Arizona.

G. K. Sirrine, 1959, Dissert. Abs., v. 19, no. 8, p. 2064. Incidental mention.

Springerville-St. Johns area, Apache County.

Rickard facies (of Schoharie Formation)

Lower or Middle Devonian: East-central New York.

J. H. Johnsen, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Schoharie formation redefined. Includes Carlisle Center (lower) facies, Rickard facies (new), and Leeds facies. Richard facies overlies Carlisle Center facies and corresponds to Schoharie formation of Vanuxem (1840). Rickard facies passes eastward into Leeds facies.

Rickenbach Dolomite (in Beekmantown Group)

Rickenbach Formation (in Beekmantown Group)

Lower Ordovician: Southeastern Pennsylvania.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2713, 2715–2719. Proposed for thick- to thin-bedded fine-grained and coarse-grained dolomite overlying Stonehenge limestone and underlying interbedded limestone and dolomite here referred to as Epler formation. Upper and lower contacts transitional. Consists of two unnamed members, an upper fine-grained and a lower coarse-grained. Total thickness about 580 feet. Type sections for both members given.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of the Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Described in Lebanon County where it is about 335 feet thick, base not exposed.

Type sections: Lower member, cut along west side of Reading Co.'s railroad tracks beginning about 1,000 feet south of crossing at Rickenbach, Berks County; upper member, on southwest bank of Schuylkill River one-half mile east by northeast of Epler School.

Ricker Limestone

See Ricker Station Limestone.

Ricker Sandstone Member (of Mineral Wells Formation)[1]

Ricker Conglomerate

Middle Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 386.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 92–94, 98. Ricker member, on State Highway 7, 6 miles east of Brownwood, near type locality, consists of 6 feet of conglomerate and an estimated 20 feet of sandstone beneath it. Conglomerate is irregularly stratified, coarse sandstone and conglomerate grading upward into brown sandstone; contains some dense hard fossiliferous limestone pebbles 3 inches or less in diameter, and many small pebbles of chert—red, brown, yellowish, white, purple, gray, black, and green. In Brownwood area; separated from overlying Capps limestone member by 30 feet of gray shale, near base of which is small coral reef.

M. G. Cheney, chm., 1949, Abilene Geol. Soc. [Guidebook], p. 8 (chart), 17. At Stop No. 5, Ricker conglomerate, 5 feet thick, overlies about 25 feet of sandstone. Type locality of Ricker conglomerate is on hill about 1.3 miles to the southeast. About 100 feet below Ricker conglomerate and one-fourth mile southwest of Ricker Station is a 3-foot limestone with abundant fusulinids and other fossils. Correlation of Ricker conglomerate with Brazos River conglomerate and Ricker Station limestone with Goen limestone of Palo Pinto County appears plausible.

M. G. Cheney, chm., 1950, Abilene Geol. Soc. Guidebook Nov. 2–4, p. 13. Road log refers to Ricker conglomerate (Drake's bed no. 23 [Ricker

bed]) which is correlated with Brazos River sandstone and conglomerate.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 61, pl. 27. Drake's Ricker bed, which he placed at top of his Strawn division, is separated from underlying Ricker Station limestone of Cheney by 50 to 70 feet of interbedded gray shale and sandstone. Drake (1893) stated that the sandstone and conglomerate of his Ricker bed caps an isolated butte north of Ricker Station, 5½ miles east of Brownwood. Other exposures, he said, were along west side of Steppes Creek and along crest of high escarpment west of Pecan Bayou. Nickell (1938) correlated a bed of sandstone along Colorado River, 5 to 9 miles east of Winchell, with this unit. In his stratigraphic section in Brownwood area, Nickell placed the Ricker sandstone in Mineral Wells formation. Best exposure of basal sandstone of Ricker bed of Drake is in cut on recently relocated Fort Worth division of Gulf, Colorado, and Santa Fe Railroad, 5 miles east of courthouse at Brownwood and 0.3 of a mile south of U.S. Highway 84 in spur in west valley wall of Steppes Creek. At this locality, the bed is a 25- to 35-foot brown sandstone containing chert pebbles. It irregularly overlies 17 feet of greenish-gray shale. Lower part of the Ricker in this cut locally occupies channels cut 10 to 12 feet into underlying shales. Top of the conglomeratic Ricker sandstone member is in face of a borrow pit north of crossing of Santa Fe Railroad on military road to Camp Bowie, 2 miles south of this junction with U.S. Highway 84. Shales of Ricker sandstone member of Nickell is separated from Capps limestone lentil of Moore and Plummer by gray silty shale.

Named for Ricker post office, near Brownwood, Brown County.

Ricker Station Limestone (in Lone Camp Group)

Ricker Station Limestone Member (of Grindstone Creek Formation)

Pennsylvanian: Central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Ricker limestone shown on correlation chart as member at top of Grindstone Creek formation (Goen limestone-Ricker limestone). Occurs above Santo limestone member.

Gayle Scott and others, 1941, *in* West Texas Geol. Soc. [Guidebook] Spring Field Trip, p. 24. Following correlation now seems well established both by paleontology and well-log cross sections: Ricker Station limestone (Colorado River Valley) with Goen-Santo limestone (Brazos River Valley). In the column, Ricker Station limestone occurs below Ricker-Rochelle conglomerate which is said to rest on limestone of Big Saline group, 70 miles southwest of Palo Pinto County.

M. L. Thompson, 1945, Am. Jour. Sci., v. 243, no. 8, p. 453. Collection made from highly arenaceous limestone near depot at Ricker. This limestone, commonly known as Ricker limestone, occurs immediately below Ricker conglomerate sandstone, that is, in lower part of Drake's (1893, Texas Geol. Survey, 4th Ann. Rept. pt. 1) Ricker bed.

M. G. Cheney and others, 1949, Abilene Geol. Soc. [Guidebook], p. 8 (chart), 17. About 100 feet below Ricker conglomerate and one-fourth mile southwest of Ricker Station is a 3-foot limestone with abundant fusulinids and other fossils. Correlation of Ricker conglomerate with Brazos River conglomerate and Ricker Station limestone with Goen limestone of southeastern Palo Pinto County appears plausible.

M. G. Cheney, chm., 1950, Abilene Geol. Soc. Guidebook Nov. 2–4, p. 14. Stop No. 2 on road log is at Ricker Station limestone; thickness 2 feet; contains fusulinids and gastropods. Overlies a well-bedded sandstone. This thin limestone and sandstone section evidently belongs in Drake's (1893) Indian Creek shale (No. 22). Type locality mentioned.

M. G. Cheney and D. H. Eargle, 1951, Geologic map of Brown County, Texas (1:62,000): Texas Univ. Bur. Econ. Geology. Columnar section shows Ricker Station limestone in Lone Camp group below Ricker sandstone.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 60, pl. 27. Limestone unit that Cheney called Ricker Station limestone was listed by him (1940) as Ricker limestone in his table of Paleozoic strata but not described. He listed it again in 1949 in a similar table but called it Ricker Station limestone apparently to avoid confusion with Ricker bed described by Drake (1893). The limestone, although discontinuous, is an important stratigraphic unit. It is lowermost limestone bed of Strawn group in Colorado River valley. Outcrop of the Ricker Station limestone is indicated by scattered blocks of limestone as much as 3 feet across in a pasture 0.1 mile south of road crossing at Ricker Railroad siding, 5½ miles S. 76° E. of courthouse at Brownwood on the Gulf, Colorado, and Santa Fe Railroad. Limestone traced discontinuously for 5 miles southwest of this locality but has not been found to northeast. Where well exposed on face of cuesta locally called Six-Mile Mountain (6 miles southeast of Brownwood Courthouse), the unit is a 4-foot-thick bed of grayish-brown limestone containing fine-grained sand; fusulinids abundant. Limestone is overlain by 12 feet of greenish-gray clay. Drake's Ricker bed, which he placed at top of his Strawn division, is separated from underlying Ricker Station limestone by 50 to 70 feet of interbedded gray shale and sandstone.

Type locality: Three and one-half miles northeast of Stop No. 2, Brown County. [This would be approximately at Ricker.]

Rico Formation[1]

Rico Member (of Cutler Formation)

Pennsylvanian and Permian: Southwestern Colorado, northwestern New Mexico, and southeastern Utah.

Original reference: W. Cross, 1899, U.S. Geol. Survey Geol. Atlas, Folio 57.

A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1420, 1423, 1424, 1441, 1443, 1446. Underlies Halgaito tongue or member (new) of Cutler formation.

W. S. Burbank and E. N. Goddard, 1937, Geol. Soc. America Bull., v. 48, no. 7, pl. 3. Discussion of thrusting in Huerfano Park region, Colorado. Stratigraphic column for region shows "type of sediments like Rico formation" overlying "type of sediments like Hermosa formation."

L. G. Henbest, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1329–1330. Species of *Fusulina* in Rico indicates middle, or possibly upper, Des Moines age. *Triticites* sp. from Rico of Moab region. Utah indicates that Rico of that region is of upper Pennsylvanian age. Thus, evidence indicates that type Rico is of Des Moines age and the transition facies of the Rico rises in time scale toward west and southwest.

S. A. Wengerd, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 5, p. 1041–1042, 1044 (fig. 5). In San Juan Canyon, Utah, gradationally

overlies Hermosa formation. Considered transitional from Late Pennsylvanian to early Permian.

S. A. Wengerd and J. W. Strickland, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2174–2175. Rico, transitional between Hermosa marine strata below and Cutler continental strata above is here considered basal member of Cutler. It is not a mappable unit of any stratigraphic constancy over a wide area and probably should not be called a formation.

George Herman and S. L. Sharps, 1956, Intermountain Assoc. Petroleum Geologists [Guidebook] 7th Ann. Field Conf., p. 81. Writers disagree with Wengerd and Strickland (1954) in considering Rico as basal facies of Cutler. It is unfortunate that type section lies within area of continuous sedimentation across Permo-Pennsylvanian boundary because, in center of embayment where time break is present, the so-called transition series lies beneath unconformity. In Rico quadrangle, the unit is of Des Moines age, equivalent to post-salt Des Moines upper Hermosa of southern part of embayment and to uppermost saline and penesaline sequence in northern part of Paradox Salt embayment.

S. A. Wengerd and M. L. Matheny, 1958, Am. Assoc. Petroleum Geologists Bull., v. 212, no. 9, p. 2054, 2056 (fig. 3). New terminology shows Rico transition facies at base of Cutler group. Transitional between Hermosa group below and Halgaito formation.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1911. Discussion of stratigraphy in Sangre de Cristo Mountains between La Veta Pass and Westcliffe, Colo. Name Madera replaces Hermosa and Rico formations of Burbank and Goddard (1937) in south-central Colorado, and restricts these terms to southwestern Colorado west of San Luis-Uncompahgre highland.

Named for exposures in Rico Mountains, Colo.

Riddle Formation (in Myrtle Group)

Upper Jurassic: Southwestern Oregon.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2774–2782. Introduced for clastic sedimentary rocks of Late Jurassic (Portlandian) age in southwestern Oregon. Consists mostly of medium- to dark-gray siltstone in which pebble lenses are common. Where well exposed, divisible into two members: a lower, of medium- to dark-gray siltstone in which pebble lenses and limestone lenses are common, chert conglomerate locally at top; conglomerate and metavolcanics locally at base; and an upper, dominantly medium-gray siltstone, sandstone beds fairly common; limestone lenses few; conglomerate of chert and graywacke common at top. Thickness about 1,088 feet. Underlies Days Creek formation (new) with probable disconformity; overlies Rogue formation near Days Creek and in valley of Myrtle Creek; overlies Dothan formation in Dutchman Butte, Roseburg, and Bone Mountain quadrangles. Name Riddle replaces Jurassic part of Knoxville formation as used by Diller and Kay (1924, U.S. Geol. Survey Geol. Atlas, Folio 218) in southwestern Oregon.

Type section: About 10 miles east of Riddle along South Umpqua River from ½ to 1 mile above mouth of Days Creek in E½ sec. 16 and W½ sec. 15, T. 30 N., R. 4 W., Douglas County. Named for town of Riddle. Well exposed in valley of South Umpqua River and its tributaries, Days

Creek, Cow Creek, and Myrtle Creek, in Days Creek, Canyonville, Roseburg, and Dutchman Butte quadrangles.

Riddlesburg Shale Member (of Pocono Formation)[1]

Mississippian: Western Pennsylvania and southwestern Virginia.

Original reference: D. B. Reger, 1927, Geol. Soc. America Bull., v. 38, p. 156–157, 397–410.

W. M. Laird, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 161–163. Name Riddlesburg shale extended to cover basal Mississippian beds along Allegheny front from Altoona, Pa., southward to U.S. Route 30.

Type section: One and one-half miles north of Riddlesburg, Bedford County, Pa.

Ridenhower Shale[1]

Ridenhower Member (of Paint Creek Formation)

Upper Mississippian (Chester Series): Southeastern Illinois and western Kentucky.

Original reference: Charles Butts, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, pt. 1, p. 73.

Elwood Atherton and D. H. Swann, 1948, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 32, no. 2, p. 300. Lower Chester formations are correlated in western Illinois, the subsurface of southeastern Illinois basin, Hardin County, Ill., and Indiana. Paint Creek of southern and western Illinois is divided into three members: upper limestone and shale zone, named Ridenhower member and correlated with "Paint Creek" of southeastern Illinois; middle sandstone and shale zone correlated with Bethel sandstone of southeastern Illinois; and a lower "pink crinoidal limestone" correlated with upper part of "Renault" formation and called Downeys Bluff member in southeastern Illinois. Correlations credited to F. E. Tippie (unpub. ms.).

A. H. Sutton and W. A. Oesterling, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1786. Paint Creek was named by Weller (1913) from exposures in southwestern Illinois. Name Ridenhower was applied by Butts (1917) to same part of Chester section, the shale between the Bethel and Cypress sandstones in Fluorspar district.

Named for Ridenhower, Johnson County, Ill.

Ridge Formation

See Ridge Route Formation.

Ridge Basin Group

Miocene, upper, and Pliocene: Southern California.

D. I. Axelrod, 1950, Carnegie Inst. Washington Pub. 590, p. 161, 165–168, pl. 1. Name applied to a section of sediments, about 22,000 feet thick, that crop out on U.S. Highway 99 between Los Angeles and Bakersfield. Wide variety of clastics is represented, ranging from marginal fanglomerates to finely bedded calcareous shales. Sediments form an asymmetrical syncline plunging northwestward, with the axis lying just east of the highway. Apparently includes (ascending) French Flat sandstone (new), Piru Gorge sandstone (new), Peace Valley beds, and Hungry Valley formation.

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J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. In mapped area, includes Violin breccia (new), 27,000 feet thick, and Hungry Valley formation, 4,500 feet thick. Conformably overlies Castaic formation (new) with interfingering contact that is marked by an abrupt upward increase in the proportion of sandstone beds.

Well exposed in region 5 miles north of Castaic to vicinity of Gorman about 20 miles northwestward, Los Angeles County.

Ridgeley Sandstone (in Oriskany Group)[1]

Ridgeley Sandstone Member (of Oriskany Formation)

Lower Devonian: Eastern West Virginia, central Pennsylvania to central western Virginia.

Original reference: C. K. Swartz and others, 1913, Maryland Geol. Survey Lower Devonian vol., p. 92, table facing p. 30.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 130–132, pl. 14. Thickness about 4 feet in Burkes Garden quadrangle. Overlies Rocky Gap sandstone; underlies Huntersville chert.

H. P. Woodward, 1948, West Virginia Geol. Survey, v. 15, p. 32, 130–149, 278–306. Ridgeley sandstone replaces Oriskany "sandstone" of previous reports. Maximum thicknesses—275 to 350 feet—occur in Hampshire and Morgan Counties. Overlies Port Jervis limestone of Helderberg group. Underlies Huntersville chert or in some areas Needmore shale.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 86–87. Member of Oriskany formation. Overlies Shriver chert member. Underlies Romney shale.

F. G. Lesure, 1957, Virginia Polytech. Inst. Bull., Expt. Sta. Ser. 118, p. 52–53, pl. 1. Described in Clifton Forge district. Thickness 2 to 25 feet. Overlies Licking Creek sandstone; underlies Needmore shale.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Oriskany formation, as mapped, includes Ridgeley sandstone at top and Shriver chert below.

Named for Ridgeley, W. Va.

Ridge Route Formation

Miocene, upper, or Pliocene, lower: Southern California.

Thomas Clements, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 2, p. 217 (fig. 1), 218. Continental beds consisting of rather well-bedded sandstones and shales with many beds of conglomerate. Overlies Modelo with slight angular discordance; underlies Saugus formation.

L. R. David, 1945, Jour. Paleontology, v. 19, no. 3, p. 315. Paleontological evidence indicates that age may be Pliocene or upper Miocene.

Peter Dehlinger, 1952, California Div. Mines Spec. Rept. 26, p. 6–8, pl. 1. Ridge Route formation, as exposed in area of study, consists of about 5,050 feet of sediments. Contact with underlying Modelo is not a sharp break. Ridge Route beds have been folded concordantly with the Modelo strata into the northwestward plunging Ridge Basin syncline.

Occurs in southeastern part of Tejon quadrangle.

Ridgetop Shale[1]

Lower Mississippian: Western Tennessee.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 29.

C. W. Wilson, Jr., and E. L. Spain, Jr., 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 6, p. 805–809. From stratigraphic and paleontologic evidence, it is believed that "Ridgetop shale" is not separate formation and that strata previously assigned to the "Ridgetop" are only a phase of the New Providence. If beds of Kinderhook age (other than probably the Chattanooga shale) are present in central Tennessee, they are not represented in beds formerly separated as "Ridgetop shale."

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 164. New Providence and Ridgetop shales, as locally recognized, appear to be slightly different developments of beds of same age.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 33. At type locality, overlies Maury formation.

Type section: Outcrops along Louisville and Nashville Railroad between Bakers Station in Davidson County, and Ridgetop in Robertson County.

†Ridgway shale member[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 202.

Ridgway Till[1]

Ridgway Conglomerate

Ridgway Glacial Epoch[1]

Paleocene: Southwestern Colorado.

Original reference: W. W. Arnold, 1915, U.S. Geol. Survey Prof. Paper 95, p. 16, map.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 58, 59. Near Ridgway, the till is made up of two members; lower, as much as 100 feet thick, is typical glacial till; upper overlies erosional surface of lower and is clay with small pebbles. In all areas, overlies Mancos shale or older rocks; in Ridgway area, underlies Telluride conglomerate; near Gunnison, underlies San Juan tuff or other volcanic rocks. Now considered to be Paleocene.

F. B. Van Houten, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 385–388. Referred to as Ridgway conglomerate. On stratigraphic evidence, the Ridgway is a general correlative of the Upper Cretaceous and lower Paleocene Animas formation; on lithologic evidence, it is as reasonably a mudflow and stream deposit as it is a tillite.

Type locality: One mile west of Ridgway, Ouray County.

Ridley Limestone (in Stones River Group)[1]

Middle Ordovician: Central Tennessee.

Original reference: J. M. Safford, 1869, Geology of Tennessee, p. 258–267.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 2 (fig. 1), 34–39. Predominantly gray limestone that is locally bluish or dove color; beds are massive, many ranging from 4 inches to 4 feet in thickness; between 20 and 35 feet above base of formation is a thin-bedded member about 10 feet thick that consists of beds ½ to 4 inches in thickness; chert is common and consists of (1) stringers, nodules, and blebs of dense black or dark-brown chert and (2) irregular masses of brown to light-brown or white chert. Thickness at type locality—herein designated—95

feet; in southern part of Rutherford County 115 feet. Underlies Lebanon limestone; overlies Pierce limestone.

Type section: Beginning in river bluff a short distance downstream from Davis mill and continuing across Jefferson-Lascassas Road and along secondary road to south and up hill on west side of road behind first house on right. Safford named limestone for exposures at Judge Ridley's mill near old Jefferson. Name has now been changed to Davis mill which is located 0.7 mile east of Jefferson on Jefferson-Lascassas Road in north-central Rutherford County.

Ridley Park Granodiorite

Age unknown: Southeastern Pennsylvania.

A. W. Postel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2004–2005; 1941, Acad. Nat. Sci. Philadelphia Proc., v. 92, p. 125–133. Igneous rocks in Wissahickon schist in Philadelphia region originated in two ways: definite magmatic intrusions into Wissahickon and hydrothermal replacement of Wissahickon by potash and soda-rich solutions. Ridley Park granodiorite and Springfield aplitic granodiorite are products of magmatic intrusion; Springfield porphyroblastic granodiorite is product of hydrothermal reaction. Precise chronological position cannot be assigned as age of Wissahickon is in doubt. Relative age sequence is considered to be (oldest to youngest) metagabbro, Springfield porphyroblastic granodiorite, Springfield aplitic granodiorite, and Ridley Park granodiorite. Ridley Park occurs typically as conformable bodies from 2 to 100 feet in width, intrusive into Wissahickon schist parallel to the schistosity.

Area mapped is roughly rectangular, bounded on northwest by Narbeth, on northeast by Manayunk, on southwest by Chester, and on southeast by Philadelphia. Town of Ridley Park is in Delaware County.

Riepe Spring Limestone

Permian (Wolfcampain): East-central Nevada and western Utah.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 102. Name given to massive coralline and fusulinid-bearing limestones originally included in Ely limestone by Spencer (1917) and by Pennebaker (1932) but restricted from Ely in present paper at type locality. Riepe Spring is 410 feet thick and is underlain by South Ridge sandstone (new) and overlain by Riepetown sandstone (new). On north side of Rib Hill, in Ruth mining district, upper 300 feet of Ely limestone, as described by Spencer (1917), is assigned to Riepe Spring; here unit rests disconformably on Ely (restricted) with no development of South Ridge sandstone separating the formations. Recognized in Carbon Ridge area south of Eureka, unit is 618 feet thick and rests on unnamed sequence of calcareous silts and mudstones and is overlain by Riepetown sandstone. Beds here assigned to Riepe Spring, plus underlying silts and mudstones, and overlying sands of Riepetown and limestones of Pequop formation were named Carbon Ridge formation by Nolan (1956). Riepe Spring is present in Confusion Range, Utah, where it was included in Ely limestone by Hose and Repenning (1959). In Tooele County, Utah, overlies Oquirrh formation.

Type section: At north end of Ward Mountain, SE¼ sec. 7, T. 15 N., R. 63 E., White Pine County, Nev. Name derived from Riepe Spring in SE¼SE¼ sec. 36, T. 16 N., R. 62 E.

Riepetown Sandstone (in Carbon Ridge Group)

Permian (Wolfcampian) : East-central Nevada and western Utah.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart 1), 103. Name applied to basal sandstone member of Pennebaker's (1932) "Rib Hill" formation (herein abandoned). Thickness 1,008 feet at type locality where it consists of pale yellowish-gray, very fine to medium-grained, rounded to subrounded, platy to thick-bedded quartz sandstone which weathers brownish red and yellowish tan. Overlies Riepe Spring limestone (new); underlies Arcturus formation. At Moorman Ranch, Riepetown is about 1,200 feet thick, conformably overlies Riepe Spring limestone and underlies Moorman Ranch facies of Pequop formation. Identified in Utah. Hose and Repenning (1959) did not apply "Rib Hill" to beds in Confusion Range, but used Lawson's Arcturus limestone for those rocks stratigraphically above Riepe Spring limestone (referred to as Ely by them) and below Kaibab formation.

Type section: At Rib Hill, NW¼ sec. 21, T. 16 N., R. 62 E., White Pine County, Nev. Name derived from village of Riepetown, about 2 miles north-northwest of Rib Hill.

Rierdon Formation (in Ellis Group)

Rierdon Formation (in Sundance Group)

Upper Jurassic: Montana, South Dakota, and Wyoming.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1264 (fig. 1), 1277–1281, strat. sections. Name applied to group of alternating gray limy shales and limestones overlying Sawtooth formation (new) and disconformably underlying Swift formation (new). At type locality, consists of (ascending) 20½ feet of medium-gray chunky limy shale containing a few dense gray nodular limestones, 33½ feet of dark-medium-gray fissile calcareous to almost noncalcareous shale containing thin beds of gray dense nodular limestone, 43½ feet of medium-gray chunky shale containing a few thin beds of limestone in lower part, and 39 feet of alternating 4- to 6-inch limestone layers and thicker beds of medium-gray chunky limy shale. At type locality, lower part of formation is of upper Bathonian age and rest lower Callovian. Basal beds are younger on flanks of South arch than along Rocky Mountain front.

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 32. In south-central Montana, overlies Piper formation (new).

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475–477, 482. Swift-Rierdon nomenclature of Ellis group in Montana is applied in eastern Wyoming to formational units of Sundance group. Indications are that names are applicable to the marine Upper Jurassic throughout most of Wyoming and western South Dakota, but term Sundance should be retained because of historical significance. Section of Rierdon, measured northeast of Newcastle, Wyo., gives thickness 212 feet; formation includes (ascending) Stockade Beaver shale, Hulett sandstone, and Lak members. Overlies Gypsum Spring formation; underlies Swift formation. In some Black Hills areas, formation includes a fourth member, Canyon Springs, at base.

T. P. Storey, 1958, Alberta Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston basin and adjacent areas. On basis of regional extent and significance of sub-Swift and sub-Rierdon

unconformities, a different stratigraphic interpretation is presented. Swift is divided into Lower, Middle, and Upper units. Lower Swift in Williston basin is equivalent to Stockade Beaver and Hulett members of Sundance and unconformably overlies Rierdon, which has been considered equivalent to the Stockade Beaver and Hulett. Rierdon herein corresponds essentially to type Rierdon of Sweetgrass arch where it occurs with notable unconformity, both below Middle and Upper Swift and above Sawtooth and older Gypsum Spring beds. Lower Swift of Williston basin is absent over Sweetgrass arch and over most of western Montana, where it is overlapped by Swift formation of Cobban.

Type locality: Rierdon Gulch, sec. 23, T. 24 N., R. 9 W., Teton County, Mont.

Rifle Member (of De Beque Formation)

[Tertiary]: Colorado.

D. B. Kitts, 1956, Am. Mus. Nat. History Bull., v. 110, Art. 1, p. 47, 49, 51. Incidental mention in fossil locality data.

Type locality and derivation of name not stated.

Rift Shale (in Pocahontas Group)

Rift Shale (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 217.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 100; P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 217, 244. Included in Pocahontas group, Pottsville series.

Named for exposures at Rift, McDowell County.

†Riga Schist[1]

Ordovician: Northwestern Connecticut and southwestern Massachusetts.

Original reference: W. H. Hobbs, 1893, Jour. Geology, v. 1, p. 717–736, 780–802.

Typically developed on Mount Riga Peak, Conn.

Riggs Formation

Paleozoic(?): Southern California.

D. H. Kupfer, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 187, 194–196, 199, pls. 1, 2. Name provisionally applied to carbonate rocks of unknown age that compose Riggs thrust plate. Stratigraphic section not worked out and structure only partially known. Formation consists of interbedded recrystallized limestone and dolomite with a few thin beds of orthoquartzite and other clastic rocks. Estimated thickness about 2,500 feet; measured sections are of little help in estimating true thickness because structure is not understood and formation is locally dolomitized; sections may not give minimum thickness because area is highly faulted and repetitions could occur; several sections could fit together to give composite section many thousands of feet thick. No fossils found and little is known of stratigraphic position of formation. It may have been unconformable on Pahrump group before thrusting. Unconformably overlain by Tertiary(?) rocks. Formation may represent part of geologic column hitherto unidentified in this region. Tentative correlations suggest formation is younger than Crystal Spring formation (late Precambrian). Best evidence for age is Paleozoic(?). If future work should establish an

unmetamorphosed correlative of Riggs rocks with a more nearly complete and structurally less complicated section, name Riggs should not be considered as having priority over any name given to new section.

Caps major peaks and ridges and is well exposed along Riggs Ridge north of Riggs silver mine and in Hill 2979 just east of Riggs Ridge (pl. 1). Area of report is Silurian Hills, San Bernardino County, 15 miles southeast of Death Valley.

Riley Formation

Upper Cambrian: Central Texas.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 154–155 [1945]; Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 111–112, pl. 2; P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 29, 225, 253, 290, 309 [1946]. Proposed to include all Cambrian strata in central Texas beneath Wilberns formation. Includes, from base to top, rocks formerly known as Hickory sandstone, Cap Mountain formation, and Lion sandstone member of Cap Mountain formation. Contacts of these rock units intergrade laterally, crossing faunal zones. They are here considered to be members of the Riley. Thickness in Moore Hollow area 780 feet. Riley as here defined is distinct from and not a revival of Riley series (Comstock and Dumble, 1890).

Named from Riley Mountains, southeastern Llano County, where included members are typically exposed.

†Riley Series[1]

Upper Cambrian: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxi, 286–289, pl. 3.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 154–155 [1945]; Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 111–112, pl. 2; P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 29, 225, 253, 290, 309 [1946]. Riley formation as herein defined is distinct from, and not a revival of Riley series of Comstock and Dumble (1890).

Named for Riley Mountains, Llano County.

Riley Creek Glaciation

Pleistocene: Central southern Alaska.

Clyde Wahrhaftig, 1953, *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 8, 13 (table 1); Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 18, 45–47, pls. 2, 3, 5. Four distinct glacial advances separated by marked ice withdrawals recognized along Nenana River. Riley Creek succeeded Healy glaciation (new). Drift much better preserved than older deposits. End moraine forms ridge along south bank of Riley Creek near its mouth at McKinley Park station. Lateral moraines and ice-contact deposits traced several miles up valleys of Yanert Fork and Nenana Rivers. Ground moraine has well-preserved drumlinoid hills, medium moraine ridges; and numerous lakes. Outwash plain extends downstream as set of terraces.

In Nenana River valley area.

Rillito Andesite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 736, fig. 2, pl. 1. On fresh surfaces, red to brown and contains numerous prominent feldspar crystals, most about one-half centimeter in length. Weathers drab to brown. Dense and breaks into angular blocks which retain their angularity and smoothness until a late stage of weathering. Maintains smooth surfaces on weathered outcrops. Thickness 450 feet west of Safford Peak. Underlies Safford tuff (new). Separated from underlying Cretaceous volcanics by poorly exposed conglomerate.

A prominent cliff-former extending from cliffs west of Safford Peak to Silver Bell pass, near north end of Tucson Mountain Range, Pima County.

Rimroad Gravel

Oligocene or Miocene: Eastern Montana.

A. D. Howard, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 578; 1960, U.S. Geol. Survey Prof. Paper 326, p. 16 (table 2), 17, pl. 1. Fluvial sands and gravels, similar to younger Flaxville gravel. Average thickness 30 feet.

Distributed along high divide between Yellowstone River and parallel-flowing Redwater Creek to west, Dawson and Prairie Counties. Town of Rimroad is in southwestern Dawson County.

Rim Rock Sandstone (in Mesaverde Group)

Upper Cretaceous: Northwestern Colorado and northeastern Utah.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 111–114, pls. 1, 2, 3. At type locality, gray medium- to fine-grained sandstone, cross-bedded in some places, thinly bedded in others, and containing a few beds of shale that are tongues from main body of Mancos; varying amounts of black chert grains. Thickness at type locality 416 feet; at Rangely anticline 580 feet; at north end Asphalt Ridge 112 feet. Overlies Asphalt Ridge sandstone (new), contact gradational. In western part of area, at lower boundary a thin tongue of Mancos shale separates it from underlying Asphalt Ridge; upper boundary at base of Williams Fork formation is marked by green or gray shale overlain by brackish-water brown thin-bedded sandstones interbedded with pink, purple, white, and black shale and thin coal beds.

Type locality: At the Rim Rock, 9 miles east of the Green River, Uintah County, Utah. Continuous outcrops from Asphalt Ridge to Rio Blanco County, Colo., as hogback ridge called the "Rim Rock."

Rincon Limestone[1]

Upper Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 469, 471, 472, 480–482.

D. L. Bryant, 1952, Arizona Geol. Soc. Guidebook 2, p. 37, figs. 6, 7. Composed of 40 feet of thick-bedded massive coarse-grained pink limestone containing abundant trilobite fragments in Picacho de Calera Hills. Disconformably underlies Picacho de Calera formation. Type section cited.

Type locality: Rincon Mountains, 25 miles southeast of Tucson. Type section: near Colossal Cave in Whetstone Mountains.

Rincon Shale[1] **or Mudstone**

Rincon Claystone

Miocene, lower: Southern California.

Original reference: P. F. Kerr, 1931, Econ. Geology, v. 26, no. 2, p. 156, 157.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 33, 38 (fig. 2), pls. In southwestern Santa Barbara County, Rincon claystone is about 1,500 feet thick. Conformably overlies Vaqueros sandstone except in Tranquillon Mountain ridge where it lies unconformably on Espada formation (new), the Vaqueros having buttressed out. Conformably underlies Monterey shale except where Tranquillon volcanics (new) intervenes. Lower third of Rincon carries upper Zemorrian (lower Miocene) foraminiferal fauna; upper two-thirds carries Saucesian (upper lower Miocene) fauna.

J. E. Upson, 1951, U.S. Geol. Survey Water-Supply Paper 1108, p. 14. Consists of massive dark-bluish-gray mudstone which develops a dark-greenish-black mucky soil. Characterized by discontinuous bands of ovoid calcareous concretions, usually limonitic and yellowish-brown in color. Thickness about 1,700 feet. Overlies Vaqueros sandstone; underlies Monterey shale; both contacts conformable. Lower Miocene.

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 113–115. On Santa Rosa Island, Rincon shale underlies Garanon member of Santa Rosa Island formation (both new).

Type section: Along Los Sauces Creek east of Rincon Mountain, Ventura County.

Rinconada Schist Member or phase (of Ortega Quartzite)

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 22, pl. 2. Consists of gray to buff quartz-muscovite schist, which in many places has interbedded quartzite members. Most of the schist is more or less even textured. Some is conglomeratic. In one area, it directly overlies Hopewell series (new).

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 6, 8 (fig. 2), 12–19, pl. 1. Rinconada schist member consists of four distinctive and mappable units: andalusite-biotite hornfels, staurolite gneiss and schist, quartzite, and muscovite-quartz-biotite-garnet phyllite. Total thickness estimated to be 1,800 feet. Lies between a lower quartzite member and the upper Pilar phyllite member (new). Derivation of name given.

Named for settlement of Rinconada 2 miles north of Dixon in the Rio Grande Canyon. Occurs in Picuris Mountain area, Taos County.

Rincon Valley Granite

Laramide: Southern Arizona.

C. J. Acker, (abs.) 1958, Arizona Geol. Soc. Digest, p. 47. Massive blocks of Paleozoic sedimentary rocks have been thrust from a southerly direction over an irregular surface of Rincon Valley granite of Laramide age.

In Colossal Cave area, Pima County.

Rindgemere Formation[1]

Pennsylvanian(?): Southeastern New Hampshire and southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 199.

Occupies broad area in Rochester, N.H., and Acton and Lebanon Townships, Maine. Named for exposures at Rindgemere Station, East Rochester, Strafford County, N.H.

Ringbone Shale (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 532, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 18–19, pl. 1. Comprises a basal conglomerate, containing boulders as large as 2½ feet in diameter, followed by dark shale, subordinate sandstone, and here and there a bed of black limestone. Thickness of any single bed rarely exceeds 5 feet. Upper 150 feet composed of tuffaceous sandstone and shale containing two purer volcanic members, one a basalt flow and one an andesite breccia, each approximately 50 feet thick. Maximum total thickness about 650 feet. In vicinity of Ringbone Ranch, formation is interfingered with conglomerate of the underlying Broken Jug limestone (new); thins out southward against old surface of Broken Jug limestone; underlies Hidalgo volcanics (new). Trinity age.

Named from Ringbone Ranch, near which formation is best exposed, Eureka district in Little Hatchet Mountains.

Ringold Formation[1]

Pleistocene, middle to upper: Northeastern Oregon and southeastern Washington.

Original reference: J. C. Merriam and J. P. Buwalda, 1917, California Univ. Pub., Bull. Dept. Geology, v. 10, no. 15, p. 255–266.

R. C. Newcomb, 1958, Am. Jour. Sci., v. 256, no. 5, p. 328–340. Type section of formation consists of about 620 feet of horizontally bedded continental sediments lying between river level [Columbia River] and the tops of the White Bluffs, from about 340 to 960 feet in altitude. Uppermost 505 feet of section composed largely of lacustrine sand and silt; lower part is a weakly indurated conglomerate that was deposited by river currents; the conglomerate extends below river level, down to an altitude of about 290 feet; it is underlain by 100 to 290 feet of lacustrine silt, clay, and sand, and some gravel. This lower lacustrine composite, commonly called the "blue clays," is here considered a part of the Ringold; it overlies the basalt bedrock.

Type locality: White Bluffs of Columbia River, Franklin and Benton Counties, Wash. Named for Ringold post office which is situated at base of White Bluffs.

Río Conglomerate[1]

Upper Cretaceous: Puerto Rico.

Original reference: H. A. Meyerhoff, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 278.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7). Thickness 300 feet. Underlies Luquillo formation; overlies La Muda limestone.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 9 (fig. 3). Table shows Río conglomerate (Meyerhoff and Smith, 1931) is possibly equivalent to Figuera volcanics of present report.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 338. Upper Cretaceous. Type locality stated.

Type locality: At Barrio Río, about 8 miles south of San Juan. Also crops out near Aguas Buenas and along railway west of Trujillo Alto. Conglomerate stands as prominent ridge which crosses the Río Piedras-Caguas Highway at northern limit of La Muda, Fajardo district.

Río Blanco Formation

Río Blanco Series[1]

Upper Cretaceous: Puerto Rico.

Original reference: B. Hubbard, 1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 26.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2). Thickness about 7,000 feet. Underlies Río Yauco series; overlies Río Culebrinas series. Term "series" is taken from original surveys, but is misnomer.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200. In Yauco area, a complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from the volcanic rocks, is divided into eight formations: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). Río Blanco and Río Yauco formations in a northern basin are considered to have been deposited penecontemporaneously with deposition of Ensenda in a southern basin. Complex ranges in age from Senonian to late Paleocene, possibly Eocene.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 344–345, pl. 1. In Mayagüez, contains massive tuffaceous volcanic rock with tongues of lava and breccia near top, bottom, and middle of unit. Includes Las Marías limestone member. Occurs between Yauco mudstone and Río Culebrinas map unit and dips generally 60° to 70° SW. Attitudes are conformable with map units above and below. Thickness 4,700 meters, of which 2,700 is measured in Mayagüez area, and 1,200 in San Sebastián area. Structural position of Yauco mudstone indicates that the Río Blanco should be stratigraphically below Yauco if the two units are conformable. Age determinations show that the Río Blanco is equivalent to or younger than the Yauco. If the Yauco is in fault contact with the Río Blanco, the age relationship may be satisfied, but there is no evidence of faulting. At present time, a fault is assumed.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 47–56. In area of this report, Río Blanco formation crops out in Ponce, Peñuelas, and Adjuntas quadrangles. Consists of unknown thickness of pyroclastic rocks alternating with andesite flows. Lenses of massive limestone and lenses of calcareous mudstone, thin-bedded argillaceous limestone, and calcareous tuff present locally. Mattson included rocks assignable to Río Yauco formation in his Mayagüez. Formation along northern border is brought in contact with middle Eocene Jacaguas group

(new) by Cerrillos-Descalabrado fault. To the west, interfingers with Río Yauco formation. To east of the Río Guayo, formation is covered by sediments of "undeformed sequence." Inasmuch as the Río Yauco and Río Blanco formations interfinger, the Río Blanco should be included in Mayagüez group.

Named from exposures along Río Blanco, Lares district.

Río Chiquito Formation

Upper Cretaceous: Puerto Rico.

E. A. Pessagno, Jr., 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 84. Consists of unknown thickness of pyroclastics alternating with andesite flows. Locally contains lenses of limestone that correlate lithologically and faunistically with massive limestones of Mattson's (1960) San Germán formation. Relationship of Río Chiquito with Río Yauco formation to west not precisely known. Cover of Oligocene and younger sediments obscures relationship of the Río Chiquito with other Cretaceous rocks to east. Intruded by Tibes diorite (new). Footnote states that name Río Chiquito is no longer used. Unit currently assigned to Río Blanco formation.

In Ponce-Coamo area, south-central part of island.

Río Culebrinas Formation

Río Culebrinas Series[1]

Cretaceous: Puerto Rico.

Original reference: B. Hubbard, 1923, New York Acad. Sci. Scientific Survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 25.

M. D. Turner, 1958, (abs.) Caribbean Geol. Conf., 1st, Antigua, British West Indies, 1955, p. 25. In San Sebastián area, the Older Series is made up of (1) tuffaceous rocks, agglomerates, and associated sedimentary rocks known as Río Culebrinas series and (2) stratigraphically younger massive volcanic flows, agglomerates, and tuffaceous rocks termed Río Blanco series. Thickness of each series about 1,000 meters. The Río Culebrinas is tightly folded and both Cretaceous units are cut across by faults.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 103. Río Culebrinas formation may interfinger with Augustinillo formation (new).

Named for exposures in Río Culebrinas Valley, Lares district.

Río de la Plata Series[1]

Lower Cretaceous: Puerto Rico.

Original reference: E. T. Hodge, 1920, New York Acad. Sci. Scientific Survey of Porto Rico and Virgin Islands, v. 1, pt. 2, p. 130.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 39, 40, 41. Predominantly tuffs. Thickness about 2,000 feet. Recent fossil discoveries help to substantiate Lower Cretaceous age. Term "series" is taken from original survey but is misnomer.

Named for Río de la Plata River which flows across the rocks, Coamo-Guayama district.

Rio Dell Formation (in Wildcat Group)

Pliocene, middle to upper: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 31–33, 107–111, pls. 1, 2. Massive mudstone, alternating thin sandstone and mudstone, "phantom-banded" mudstone, and very fine grained sandstone. In Ferndale quadrangle, divided into: upper member—mudstone; middle member—alternating sandstones and mudstones; lower member—mudstone with sandstones; units not distinguished to the east where there is more very fine grained sandstone in upper part. Thickness 3,000 to 6,000 feet; thins northward. Underlies Scotia Bluffs formation (new); unconformably overlies Eel River formation (new); top of Rio Dell arbitrarily taken as lowermost buff-weathering sandstone of Scotia Bluffs; base of Rio Dell chosen as a thin glauconite mudstone or fine-grained sandstone overlying a cut surface of upper Eel River mudstone.

Type section: East bank Eel River north of Scotia and west bank of river west of Scotia, Humboldt County.

Río Descalabrado[s] Member (of Naranjo Formation)

Río Descalabrados Series[1]

Eocene: Puerto Rico.

Original reference: E. T. Hodge, 1920, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 2, p. 161.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 54. Name Río Descalabrado[s] series discarded and name Cañas Arriba formation adopted.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 78–85. Member of Naranjo formation (new). Hodge applied name Río Descalabrado[s] series to these rocks. He overlooked the possiblity of Cretaceous sequence being repeated by faulting and mistakenly included Upper Cretaceous rocks belonging to the units now named Ildefonso and Robles formations in his "Río Descalabrado[s] series." Term "series" is here amended to member. Consists of marls, argillaceous limestones, and calcareous siltstones together with lenses and beds of Coamo Springs and Guayo conglomeratic sandstone. Thickness 0 to 7,600 feet. Interfingers with Guayo conglomeratic sandstone member (new) to west and is completely covered by alluvium east of Salinas. Lower part interfingers with Coamo Springs limestone member. Where Coamo Springs member is absent, the Río Descalabrado[s] rests directly on Miramar member (new) or on underlying Upper Cretaceous rocks.

Type area: West and north of village of Las Ollas.

Río Duque Shales

Eocene: Panamá.

T. F. Thompson, 1944, Geological explorations in vicinity of Rio Quebrancha for the Panama Cement Company: Panama Canal, Spec. Eng. Div., p. 21–23. Fine-grained silty dark-gray locally carbonaceous soft shales with thin sandstone beds. Thickness probably more than 600 meters. Believed that Río Duque and Vamos formations are identical and that age of both are either lower Miocene or uppermost Oligocene.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 345. Synonym of Gatuncillo formation. Eocene.

Río Duque is a small tributary of Río Agua Sucia in Panamá immediately west of the Quebrancha syncline.

Rio Grande Drift[1]

Pleistocene: Southwestern Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 41.

Shafter district, Presidio County.

Rio Grande Gravels[1] or Beds

Tertiary: New Mexico.

Original reference: C. L. Herrick, 1898, Am. Geologist, v. 22, p. 26–43.

Kirk Bryan and F. C. McCann, 1937, Jour. Geology, v. 45, p. 807. Instead of Santa Fe formation, Bryan (1909, New Mexico Univ. Bull., Geol. Ser., v. 3, no. 1) used term "Rio Grande beds," which should be abandoned.

Occurs in vicinity of Albuquerque.

Rio Grande Loess[1]

Tertiary, upper: Central northern New Mexico.

Original reference: C. L. Herrick, 1898, Am. Geologist, v. 22, p. 26–43.

Rio Grande Marl[1]

Probably Miocene and Pliocene: Central northern New Mexico.

Original reference: A. B. Reagan, 1903, Am. Geologist, v. 31, p. 87, 89.

Occurs in inner valley of Rio Grande.

†Rio Grande series[1]

Pennsylvanian: New Mexico.

Original reference: C. R. Keyes, 1903, *in* Report of the Governor of New Mexico to the Secretary of the Interior.

Rio Grande Series[1]

Tertiary, upper: Central northern New Mexico.

Original reference: C. L. Herrick, 1898, Am. Geologist, v. 22, p. 26–43.

In Albuquerque region.

Río Guatemala Group

Oligocene: Puerto Rico.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map. 85. Cibao marl, Lares limestone, and San Sebastián formation are largely facies equivalents showing rapid lateral transition; term "Río Guatemala group" is introduced to refer to the whole sedimentary complex. Names Cibao, Lares, and San Sebastián are retained to designate, respectively; predominantly marl and chalky limestone, predominantly reef-type limestone and predominantly clastic facies of the group. Maximum thickness about 700 meters in area between Río Camuy and longitude line through San Sebastián.

Named from the Río Guatemala, which flows its entire course in outcrop belt of group north and west of San Sebastián. Group crops out in belt extending from vicinity of Moca on west to vicinity of Bayamón on east.

Río Jueyes Series[1]

Eocene, middle(?)-upper: Puerto Rico.

Original reference: E. T. Hodge, 1920, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 2, p. 149.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 51, 52. In Coamo-Guayama district underlies Coamo Springs

series; unconformable above Guayama series. Thickness 3,500 feet. On basis of fossil evidence age is considered to be Eocene, probably upper-middle. Term "series" is taken from original surveys, but is misnomer.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 24, 44. Toa Vaca formation (new) includes Río Jueyes and Guayama series of Hodge. Part of Hodge's Río Jueyes series also included in Ildefonso formation (new).

Named from river which flows over central exposures, Coamo-Guayama district.

Río Loco Formation

Upper Cretaceous (Cenomanian): Southwestern Puerto Rico.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200, 201. In Yauco area, a complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from volcanic rocks. is divided into eight formations: Sabana Grande (new), El Rayo (new), Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). The Río Loco is considered to intertongue with Río Yauco formation.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 324–329, pl. 1. Redefined to include bronzite andesite near Parguera and Guanica and to exclude a large fairly continuous mudstone unit considered Yauco mudstone. Contains bronzite andesite porphyry lavas, more than half with pillow form, and subordinate tuff, breccia, hornblende andesite, dacite(?), and limestone. Thickness about 300 meters in northern exposures; no thicknesses measured elsewhere. Lies between Mayagüez group (new) and Bermeja complex (new).

E. A. Pessagno, Jr., Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 23. Underlies Robles formation in Barranquitas quadrangle.

Occurs on flanks of Las Mesas-Fraile anticline and in southeastern part of Mayagüez area.

Río Matón Limestone Member (of Robles formation)

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 144, 145. Occurs sporadically at base of formation from central Puerto Rico southward to a point near south coast where it lies unconformably on volcanic breccia of volcanic complex. In part a reef and in part a near-reef accumulation; consists of both massive and bedded limestones; in southernmost outcrops, interbedded with volcanic sandstone and contains volcanic debris. Fossils indicate Senonian (Coniacian-Campanian) age. Name credited to Berryhill and Glover (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. Underlies Cayey siltstone member (new). Thickness about 50 meters at type locality.

Type locality: Just west of Highway 1, at point 2.7 kilometers S.65°W. of Cayey Plaza, Cayey quadrangle. Named for exposures on south side of Río Matón.

Rio Tinto Formation

Carboniferous(?) : Northeastern Nevada.

A. E. Granger and others, 1957, Nevada Bur. Mines Bull. 54, p. 116, pl. 14. In Elko County, a thrust fault crops out south of Rio Tinto mine and divides Paleozoic rocks into two groups of formations which cannot as yet be correlated. Rio Tinto formation is lowest exposed rock of lower plate sequence and forms wall rock of Rio Tinto mine. Predominantly fine-grained quartz-sericite schist, shale, and locally fine-grained dark quartzite and dense black chert containing poorly preserved Radiolaria. Estimated minimum thickness 4,000 feet (Nolan, unpub. rept.). Stephens (unpub. rept.)gives 2,085 feet. Unconformably underlies Banner limestone (new). Age not established. Mapped as Carboniferous(?).

Named for occurrence at Rio Tinto mine, Elko County.

Río Yauco Formation or Shale

Río Yauco Series[1]

Upper Cretaceous : Puerto Rico.

G. J. Mitchell, 1922, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 3, p. 249. Strongly bedded black shale about 1,200 feet thick exposed on upper Río Yauco, Ponce district. Conformably interbedded with San Germán limestone considered to be Upper Cretaceous.

Bela Hubbard, 1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1, p. 25, 29–35. In southern part of Lares district, Río Yauco series is named from the Río Yauco shale, a term applied by Mitchell to black shales which form a prominent part of this series between Mayagüez and Consumo. In this area sequence is Río Culebrinas series (oldest), Río Blanco series, and Río Yauco series. In Río Yauco series, about 6,000 feet of shales and tuffs are exposed along Mayagüez-Las Marías Road from kilometer 13 to kilometer 19; traverse across series northeast from Rincon shows total thickness of over 8,000 feet; allowance made for duplication of strata by folding and faulting.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 60 (table 7). Thickness of shale in Ponce district about 7,000 feet; thickness of series in Lares district also 7,000 feet. Heading on table 2 (stratigraphic table for Puerto Rico) reads Upper(?) Cretaceous; however text and other table headings do not qualify the Upper Cretaceous.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200–201. In Yauco area, a complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from the volcanic rocks, is divided into eight formations: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). Río Yauco and Río Blanco formations are considered to have been deposited in a northern basin penecontemporaneously with deposition of Ensenada in a southern basin. The Río Yauco and Ensenada overlie the Sabana Grande and El Rayo formations unconformably and are separated from overlying San Germán and Jicara formations, at least locally by unconformities. Complex ranges in age from Senonian to late Paleocene, possibly Eocene.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p.

55–62. Name Río Yauco shale first used by Mitchell (1922). Slodowski (1956, unpub. thesis, [1958, Dissert. Abs.]) proposed that term shale be replaced by formation inasmuch as sequence is composed of many lithic types. Mitchell (1922) used name Peñuelas shale for rocks correlated with Río Yauco formation of present report. Mattson [1960] includes rocks assignable to Río Yauco formation in his Mayagüez group. In area of present report, Río Yauco formation is exposed in western part of Peñuelas quadrangle. Consists of heterogeneous marine assemblage of mudstone, tuffs, tuff breccias, limestones sedimentary breccias, and basalt flows. Thickness unknown; Slodowski (1956) estimated 4,500 feet. Interfingers with Río Blanco formation

Named for exposures on upper Río Yauco, Ponce district.

Ripley Formation[1] (in Selmá Group)

Upper Cretaceous; northern and central Mississippi, Alabama, Georgia, western Kentucky, and western Tennessee.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric., p. 3, 62, 83–95.

B. Wade, 1917, Johns Hopkins Univ. Circ., new ser., no. 3, Whole No. 203, p. 74, 101. Includes Coon Creek tongue (new).

W. H. Monroe, 1941, Alabama Geol. Survey Bull. 48, p. 103–129. In this report, base of formation in eastern Alabama is placed at base of a thick deposit of coarse sand and gravel rather than at contact of *Exogyra ponderosa* and *Exogyra costata* zones as was proposed by Stephenson and Monroe (1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12). This further restricts the Ripley by about 50 feet, but gravel bed rather than faunal zone contact is more logical base for formation. Proposed restriction has advantage in that base of Ripley is at very nearly the same stratigraphic position from Chattahoochee River to Sumter County. Conformably overlies Demopolis member of Selma chalk from Mississippi State line through Lowndes County, but, in eastern part of Sumter County, uppermost part of Demopolis chalk merges laterally toward the east into sand which is included in Ripley; in western part of Montgomery County, Ripley rests on westward-extending tongue of Cusseta sand; unconformably underlies Prairie Bluff chalk; in some areas overlapped by Providence sand.

D. R. Stewart, Lyle McManamy, and H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., app. 3, p. 9. Represented in Stoddard County, Mo., by McNairy member.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Included in Selma group.

D. H. Eargle, 1955, U.S. Geol. Survey Bull. 1014, p. 54–69. In Alabama, name Ripley is used in western Sumter County for chalky sand and clay beds essentially contemporaneous and continuous with Ripley of Mississippi. Farther east in Alabama, successively lower parts of Demopolis chalk grade laterally into a sand and clay facies that is designated Ripley. In eastern Alabama, the Ripley includes all strata between underlying Blufftown formation and overlying Prairie Bluff chalk or its correlative, the Providence sand. Coarse sandy beds at base of Ripley in eastern Alabama, designated Cusseta sand member, represent western featheredge of Cusseta sand of Georgia. In Georgia, name Ripley is applied to sand and sandy clay that contain fossils in upland areas. The strata, originally described as Renfroes marl (Veatch, 1909), lie between

Cusseta sand and Providence sand. Detailed description of outcrops in Georgia.

L. W. Stephenson, 1955, U.S. Geol. Survey Prof. Paper 274–E, p. 98, 100, 101. In this report, McNairy member is raised to formational rank in Missouri and Illinois. [Hence the Ripley is geographically restricted.]

F. F. Mellen, 1958, Mississippi Geol. Survey Bull. 85, p. 49–54. Includes Chiwapa sandstone member (new).

N. F. Sohl, 1960, U.S. Geol. Survey Prof. Paper 331–A, p. 9–22. Formation discussed in Tennessee and Mississippi. Thickest in northern areas of outcrop, where, in vicinity of Tennessee-Mississippi State line, it is close to 350 feet thick; thins southward until near Alabama-Mississippi State line, it is about 60 feet thick. In northern Mississippi, divided into (ascending) transitional clay, Coon Creek tongue, McNairy sand member, sand of upper part of Ripley, and Keownville limestone member (new). Base of formation is gradational downward to Demopolis chalk through transitional clay. In Tennessee and northernmost Mississippi this clay unit lies entirely within *Exogyra cancellata* zones, but, south of southern Tippah County, the transitional clay lies in part above that zone. This clay, along with rest of formation, grades into sandy chalk in Noxubee County, Miss. Upward, clay becomes increasingly sandy and grades into highly fossiliferous sand units of Coon Creek tongue. In Pontotoc and Kemper Counties, Miss., McNairy sand member is absent, and greater part of formation cannot be divided. In Noxubee County, Miss., whole formation grades into chalk facies. Unconformity at top of Ripley varies locally in magnitude. In some places, Keownville limestone member appears to be entirely eroded off, and overlying Prairie Bluff chalk rests on sand of middle part of Ripley.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 26 (fig. 4), 61–68, pl. 4. Ripley formation of this report [Prentiss County] refers to all beds above Demopolis chalk and consists of three units: transitional clay, Coon Creek tongue, and McNairy sand member. Disconformably underlies Owl Creek and Prairie Bluff formation. Maximum thickness about 300 feet.

Named for Ripley, Tippah County, Miss.

Ripleyan series[1]

Upper Cretaceous: Mississippi.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Ripogenous (Ripogenus) Series[1]

Silurian: North-central Maine.

Original reference [name appears as Ripogenous series]: F. W. Toppan, 1932, Geology of Maine, Contr. Dept. Geol. Union Coll., Schenectady, p. 71–72.

Bradford Willard, 1945, Jour. Paleontology, v. 19, no. 1, p. 67. Series revised to include Chesuncook limestone and Ripogenus volcanics (both new).

Exposed in Ripogenous [Ripogenus] Gorge, where it is intruded by Katahdin granite, just below prominent rock known as the "Little Heater," Piscataquis County.

Ripogenus Volcanics

Lower or Middle Silurian: North-central Maine.

Bradford Willard, 1945, Jour. Paleontology, v. 19, no. 1, p. 67. Named as a subdivision of the Ripogenus series; intrudes sediments of the series. Name credited to L. W. Fisher (written commun. 1941). Age not stated.

A. J. Boucot, 1954, Am. Jour. Sci., v. 252, no. 3, p. 144–145. Discussion of stratigraphic relationships near contact of Katahdin granite. Oldest stratum exposed on west side of Ripogenus Dam is basalt. Fisher (in Willard. 1945) suggested term Ripogenus volcanics be applied to the basalt. Name Ripogenus is preoccupied by Toppan's Ripogenous [Ripogenus] series. Katahdin granite cuts the basalt. No new name is suggested for the basalt.

Named from Ripogenus Dam at south end of southeast arm of Chesuncook Lake, Piscataquis County.

Ripple Quartzite[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 7.

Forms summit of Mount Ripple, British Columbia.

Ripton Conglomerate[1]

Precambrian: Northwestern Vermont.

Original reference: W. G. Foye, 1919, Vermont State Geologist 11th Rept., p. 84–85.

In Brandon quadrangle, Addison County.

Risco Formation

Upper Cretaceous(?): Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 12–16, pls. 2, 3. Massive greenish-gray concretionary graywacke, forming rugged cliffs; lower half contains six tuffaceous sandstones; conglomerate present at base of formation west of Polonio Pass fault. At type locality, formation is roughly divisible into three parts in approximate thickness ratio (from bottom to top) of 2:3:5. Upper and lower parts consists of massive concretionary coarse sandstone, sandwiching a group of thin finer-grained sandstones relatively free of concretions. Roughly the same ratio holds in Three Peaks anticline, despite thinning and facies change. Thickness 2,965 feet at type locality; 4,400 feet north of Antelope Pumping Station; 1,650 in Three Peaks anticline; thinning is toward the northeast; unit pinches out on north limb of Three Peaks anticline. Conformably underlies Johnson Peak formation (new); overlies Badger shale (new), at type locality, contact is a thrust, but elsewhere contact is conformable. No diagnostic fossils.

Type locality: Comprises upper parts of both Risco Canyon and next adjacent canyon to west, west of Orchard Peak, Annette quadrangle, Kern County. Formation extends as nearly continuous band of outcrop from northwest corner of Orchard Peak area southeastward, then eastward almost to Devil's Den where it ends abruptly against Hex thrust.

Rising Bull Member (of Grinnell Argillite[1] or Formation)

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1889–1890. Thickness 600 to 1,100 feet. Argillites, quartzites, and

mud breccias forming initial transition between Grinnell and Siyeh. Type locality designated.

Type locality: Upper cliffs of Mount Rockwell (Rising Bull of the Blackfeet), south of Upper Two Medicine Lake, Glacier National Park.

Rising Wolf Member (of Appekunny Argillite)[1]

Rising Wolf Member (of Grinnell Formation)

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1889. Thickness 200 to 700 feet. Reassigned to Grinnell Formation. Type locality designated.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 137. Discussion of stromatolites of Belt series. Rising Wolf member of Fenton and Fenton (1937) is represented by *Collenia undosa* zone 1 in Grinnell argillites.

Type locality: Southern slopes of Rising Wolf Mountain, Glacier National Park.

Rison Clay Member (of White Bluff Formation)

Eocene (Jacksonian): Southeastern Arkansas.

L. J. Wilbert, Jr., 1953, Arkansas Div. Geology Bull. 19, p. 39–40, 70–80. Defined to include all marine Jacksonian beds developed above the Caney Point member in the southern part of the outcrop area of the White Bluff. Typical lithology—silts and blocky clay containing arenaceous foraminifers, molluscan molds, local thin lenticular concretions of molluscan molds. Maximum thickness of about 140 feet attained in eastern Cleveland County; member thins to a featheredge at southern margin of outcrop area. Overlies Caney Point marl member; interfingers with and is overlapped by Redfield formation.

Type locality: Along U.S. Highway 79, near junction with Arkansas State Highway 35, west of Rison city limits, Cleveland County.

Risser Beds

Silurian: Central western North Dakota (subsurface)

Saskatchewan Geological Society, 1958, Report of the Lower Palaeozoic names and correlations committee: Saskatchewan Geol. Soc., p. 16, 17, charts A and B. Buff to cream-colored dense to chalky microcrystalline dolomites; porous in part; occasional fossil fragments. Characteristically with reddish sandy development at base (13,120 to 13,174 feet in type well). Maximum known thickness 556 feet near center of Williston Basin (in west-central North Dakota). Everywhere truncated by a pre-Middle Devonian surface of unconformity; rest with possible unconformity on Hanson beds (new). No fossil evidence of Silurian age; may be in part Devonian. Name credited to unpublished Shell Oil Co. usage.

Type locality: Amerada No. 1 Risser (center SW¼ SE¼ sec. 12, T. 149 N., R. 96 W., McKenzie County) between 12,615 and 13,174 feet; Williston Basin.

Rita Blanca deposits

Pleistocene: Western and northwestern Texas.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 493. Lacustrine deposits in part equivalent to Blanco beds. Basal

contact not exposed. Lowermost exposed strata consist of 30 feet or more of dark distinctly laminated clays containing plant remains and small fossil fish. Some sand beds and thin uniform layers of fresh-water dolomite are interbedded in the shales. Overlying the laminated clays is section, 50 feet or more thick, consisting mainly of sands, bentonitic clays, and thin-bedded calcareous sandstone.

Exposed along Rita Blanca Creek and its tributaries about 8 miles west of Channing, Hartley County.

Ritchie Limestone

Upper Cambrian or Lower Ordovician: East-central New York.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 797 (fig. 1), 799 (fig. 2b); 803 (fig. 3), 804–806. Massive very thick bedded ash-white weathering gray-blue calcilutite only slightly dolomitized. Contains black chert nodules and *Rhachopea*(?). Thickness 43 feet. Formation exposed by faulting; measured thickness may be excessive. Apparently unconformably underlain by noncherty dark-gray coarse-grained dolomite of upper Hoyt and unconformably overlain by 7 feet of conglomerate composed of dolomite cobbles in a sand matrix. Latter grades laterally into a coarse sandstone with well-rounded quartz grains, which grades abruptly upward into cherty arenaceous blue-gray dolomite with Lower Ordovician fauna. Coarse clastic layer is interpreted as Mosherville sandstone (new) and dolomite as Gailor dolomite (new). Upper Cambrian or Lower Ordovician.

John Rodgers, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, Nov. 10–12, p. 34 (table 1). Listed on table as Lower Ordovician. Age is uncertain; may be facies of beds above or below.

Type locality: Just south of Petrified Sea Gardens, owned by Mr. Ritchie, about 3 miles west of Saratoga Springs, Saratoga County. This is only known exposure.

Ritchie Red Beds (in Monongahela Formation)[1]

Ritchie redbed member

Pennsylvanian: Northern West Virginia and eastern Ohio.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 30, 44.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 181. Member of Lower Uniontown cyclothem in report on Athens County. Composed of variegated clay shale with calcareous inclusions. Thickness about 10 feet. Above Arnoldsburg shale and sandstone member; below Lower Uniontown limestone member. The Ritchie is also considered a member of Uniontown cyclothem wherever upper boundary of Lower Uniontown cyclothem is lost. Monongahela series.

Named for exposures in Ritchie County, W. Va.

Ritito Conglomerate

Miocene(?): Central northern New Mexico.

Fred Barker. 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 3, 38, 42–43, pl. 1. Consists commonly of rounded to subangular pebbles and small boulders of fine-grained to pebbly quartzite, amphibolite, and metarhyolite. Most amphibolite fragments are weathered and very friable. Matrix of conglomerate is quartzose and composed of poorly

sorted, subangular to subrounded grains. Generally the rock is weakly cemented and typically has medium-gray color. Maximum thickness of 400 feet on east side of Ritito Creek and in Escondido Canyon; pinches out entirely a mile to east of Canada del Oso. Lies directly upon Precambrian rocks along lower Vallecitos Valley.

Named after exposures in Ritito Canyon, in secs. 11 and 14, T. 27 N., R. 7 E. Other exposures 2 miles southeast and 1 mile west to south of Canon Plaza, along northeast side of Vallecitos Valley from Canon Plaza to Jarosita Creek, and along parts of Escondida and Felipito Canyons.

Rittman Conglomerate Lentil (of Cuyahoga Formation)[1]

Rittman Conglomerate Submember (of Armstrong Sandstone Member of Cuyahoga Formation)

Rittman Member (of Cuyahoga Formation)

Lower Mississippian: North-central Ohio.

Original reference: G. W. Conrey, 1921, Ohio Geol. Survey, 4th ser., Bull. 24, p. 56.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 41 (table), 49, 51. Termed Rittman conglomerate submember of Armstrong sand member of Cuyahoga formation in area of River Styx conglomerate facies. Unit consists of a layer of about 2 feet of brown and tan coarse conglomerate which is fossiliferous and rather friable, overlying a dark olive medium- and coarse-grained sandstone containing considerable mica. Not traceable throughout facies.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Rank raised to member of Cuyahoga formation. Overlies Meadville member; underlies Armstrong member. Lower Mississippian.

Well exposed at Rittman, Wayne County.

River Glacial Stage

Pleistocene (Iowan): North-central Colorado.

R. L. Ives, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 75. Younger than Stillwater glacial stage (new); older than Arapaho glacial stage (new). Evidenced by terminal moraine.

R. L. Ives, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1057–1058, 1062. Time covered by the deposition of a terminal moraine across mouth of Arapaho Creek which was mapped as moraine two. Ice and moraines of River stage dammed the Colorado River for short time, and some morainal material of this age was deposited in Colorado Valley on northwest side of river opposite Arapaho Creek.

In Monarch Valley, Grand County.

Riverbank Formation

Pleistocene, middle: Central California.

S. N. Davis and F. R. Hall, 1959, Stanford Univ. Pub. Geol. Sci., v. 6, no. 1, p. 6, 12, 16–20, pls. 2, 3. Composed of clays, silts, and sands; distinctive feature is a resistant silica hardpan in lower part of soil profile. Thickness at type section 53½ feet; however, thickness cannot be given with certainty because of difficulties in picking lower contact in subsurface; probable thickness as shown on geologic cross section (pl. 3) 150 to 200 feet. Overlies Turlock Lake formation (new); underlies Modesto formation (new). Modesto and Riverbank formations together represent the

Victor formation, and they can be traced northward into the Mokelumne area.

Type section: NW¼NE¼ sec. 26, T. 2 S., R. 9 E., Riverbank quadrangle, San Joaquin County. Exposures are in south bluff of Stanislaus River just north of intersection of Jackson and Topeka Streets in Riverbank. Exposed in a northwest-southeast trending belt of variable width that lies just west of Turlock Lake formation and east of towns of Modesto and Turlock.

River Portal Mica Schist[1]

Precambrian (Gunnison River Series): Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Named for excellent exposures in vicinity of the river portal of Gunnison Tunnel, Gunnison River region.

†River Quarry Beds[1]

Middle Ordovician: Southwestern Ohio.

Original reference: E. Orton, 1873, Ohio Geol. Survey, v. 1, p. 370–387.

Named for river quarries at Cincinnati.

Riverside Sand[1]

Miocene(?): Northwestern Iowa.

Original reference: H. F. Bain, 1896, Iowa Geol. Survey, v. 5, p. 255, 277–279.

Named for Riverside, Woodbury County.

Riverside Sandstone[1]

Lower Mississippian: Western and southern Indiana.

Original reference: T. C. Hopkins, 1896, Indiana Dept. Geology and Nat. Resources 20th Ann. Rept., p. 196, 317, pl. 9.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 1. Riverside sandstone listed in Riverside facies of Edwardsville formation.

First described in Fountain County. Quarried at Riverside.

Riverside sandstone facies (of Edwardsville Formation)

Lower Mississippian: Southeastern Indiana.

P. B. Stockdale, 1931, Indiana Div. Geology Pub. 98, p. 76, 293–300. Edwardsville formation is differentiated into following facies: Stewarts Landing, Springler Knob, Medora Knob, Allens Creek, Bear Wallow, and Riverside sandstone.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Riverside sandstone facies listed in Edwardsville formation. Includes Riverside sandstone.

Exposed in Fountain and Warren Counties along Wabash River. Probably named for quarries at Riverside, Warren County.

River Styx conglomerate facies (of Cuyahoga Formation)

Mississippian (Kinderhook): Northeastern Ohio.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 43 (fig. 2); 50–51. One of seven facies distinguished in the formation. Includes Black Hand conglomerate and Armstrong sandstone members. Merges with Tinkers Creek shale facies

(new) on the northeast and the Killbuck shale facies (new) on the southwest.

Occurs in Medina and Wayne Counties.

Riverton Formation or cyclothem (in Cherokee Group)

Riverton Formation (in Krebs Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas and southwestern Missouri.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 21; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. Riverton, first in the sequence (ascending), occurs below the Neutral formation (cyclothem) and unconformably overlies eroded surface of the Mississippian. Average thickness 38 feet. Includes Riverton coal, 3 to 10 inches thick. [For complete sequence see Cherokee group this entry.].

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Riverton formation in Krebs group. Underlies Warner formation.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 10–11. In Jasper County, Mo., formation is about 17 feet thick. Underlies Warner formation and overlies Boone chert. Krebs group. Derivation of name given.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 29–32. Described in southeastern Kansas as formation in Krebs subgroup of Cherokee group. Thickness 10 to 20 feet; average 15 feet. Consists of a basal shale 4 or 5 feet to 13 feet thick, an underclay 2 to 4 feet thick and Riverton coal. Overlies leached chert rubble derived from underlying Mississippian rocks. As presently defined, it is in part equivalent to McCurtain shale of eastern Oklahoma.

Name derived from Riverton coal in Cherokee County, Kans.

Riverton Iron-Formation (in Paint River Group)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 38. Consists dominantly of interbedded chert and siderite. Thickness ranges from less than 100 feet in western part of district to about 600 feet in eastern part. Locally upper part of formation is absent due to erosion prior to deposition of overlying Hiawatha graywacke. Overlies Dunn Creek slate (new).

Name derived from Riverton mine at Iron River, Iron County, first site of mining in district 75 years ago. Formation is visible in walls of the caved workings of the old mine.

Riverview terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg., p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703 (fig. 8), 1710, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Riverview is applied to terrace deposit younger than and lying about 8 feet below First Street; a bench about 6 feet lower is designated as Riverview No.

2. Like First Street and Beaumont (Sixth Street) deposits, it is composed of dark-weathering silt overlying limestone gravel.

Type locality: Junction of Riverview and Chicon Streets, Austin, Travis County.

Rivoli Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 24, figs. 3, 12. Argillaceous dolomite about 5 feet thick. Shown on columnar section as underlying Sherwood member (new) and overlying Mortimer member (new).

Occurs in Dixon-Oregon area.

Roach Creek Sandstone (in Graves Gap Group)

Pennsylvanian (Pottsville Series): Southeastern Kentucky and eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio]; p. 11, 19, pls. 2, 3, 4. Thickness near Roach Creek 60 feet; in western part of Cumberland Mountains 20 to 80 feet; thins to southeast; 20 to 25 feet near Fonde, Ky. Separated from overlying shales of Redoak Mountain group (new) by a shale interval 50 to 90 feet thick that contains Craig coal and Windrock coal; separated from underlying Armes Gap sandstone (new) by a shale interval 60 to 130 feet thick that contains Pioneer coal.

Named from exposures above Roach Creek, near Dean, Block quadrangle, Scott County, Tenn.

†Roan Gneiss[1]

Precambrian: Eastern Tennessee, northern Georgia, western North Carolina, and northwestern South Carolina.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 2.

T. L. Kesler, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 756, 775–781. Near Kings Mountain, mica schists and gneisses, previously mapped as Carolina gneiss, and hornblende gneisses, previously mapped as Roan gneiss, actually constitute metamorphosed upper part of Gaffney. Similar rocks in Beaver Creek area are apparently stratigraphically higher. Evidence in other parts of Carolina Piedmont indicates that intrusive diorite and possibly recrystallized mafic volcanic rocks have been included in the Roan and possibly recrystallized felsic volcanic rocks in the Carolina gneiss. Names Carolina and Roan have lithologic but not stratigraphic significance.

F. D. Eckelmann and J. L. Kulp. 1956, Am. Jour. Sci., v. 254, no. 5, p. 291, 314. In Spruce Pine district, interlayered with Carolina gneiss, and the two types of rocks grade into each other along and across the strike. The Roan-Carolina sequence appears to be a single sedimentary unit with varying lithology, complicated by intense isoclinal folding and plastic deformation. Roan-Carolina complex is interlayered with Cranberry and Henderson gneisses. These formations are in a consistent and conformable stratigraphic position below the Carolina-Roan complex as seen in Cranberry, Roan Mountain, and Mount Mitchell quadrangles where the

granitic gneisses are distributed about borders of the Roan-Carolina rocks which form the central part of the southwest-plunging Spruce Pine synclinorium.

Named for development on Roan Mountain, Carter County, Tenn.

Roaring Branch Sandstone (in Pocono Formation)[1]

Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 56–57, 235.

Occurs along Roaring Branch.

Roaring Branch Shales (in Pocono Formation)[1]

Mississippian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 56–57, 235.

Occurs along Roaring Branch.

†Roaring Creek Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Eastern West Virginia.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 462.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 100. Massive sandstone; uppermost member of Kanawha group.

Well developed along Roaring Creek, a branch of Tygart Valley River, Randolph County.

Roaring Fork Sandstone (in Snowbird Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 954–956. Thick unit of dark sandstone and interbedded pelitic rocks; in vicinity of Roaring Fork, somewhat less that half of formation consists of massive light-greenish-gray sandstone beds 5 to 50 feet thick, which ar fine to medium grained, highly feldspathic, and moderately well sorted; interbedded with them are thick- to thin-bedded finer grained sandstone, siltstone, and argillaceous rocks; current bedding common especially in finer grained and thinner bedded sandstone. At type locality, about 8,000 feet of Roaring Fork sandstone conformably underlies Pigeon siltstone, but base is cut off by faults; on Pigeon River, where complete section is present, formation is 2,700 feet thick; this decrease is interpreted as resulting from intertonguing eastward with Longarm quartzite (new) through an interval of several thousand feet.

Typical section: On Roaring Fork, 1 to 3 miles southeast of Gatlinburg, Sevier County.

Roaring River Sandstone Member (of Noel Shale)

Upper Devonian: Southwestern Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 91–92. Light gray to pale buff on fresh exposures; medium or dark reddish brown on weathering. At type locality, consists of two irregular beds 9 to 12 inches thick. Basal part of Noel. Rests unconformably on several formations involved in a surface that appears to have presented very slight relief. Most common underlying rock is Cotter dolomite; in some areas, overlies Fortune formation.

Type locality: About center of east side sec. 34, T. 22 N., R. 27 W., along Missouri State Highway 112, Barry County. Name derived from Roaring River.

Roaring River Tongue (in Ono Formation)

Lower Cretaceous; Northern California.

M. A. Murphy, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2103, 2111. Conglomerate, sandstone, and mudstone. Typical section along Roaring River consists of four beds of massive cobble. Beds range in thickness up to 40 feet and are lenticular along the strike. Interbeds are massive sandstone with minor amounts of mudstone in lower part of tongue; upper part is predominantly graywacke with increasing amounts of mudstone toward top; approximately 850 feet thick on Roaring River; thickness differs greatly along strike.

Named from Roaring River, a tributary of Cottonwood Creek, Shasta County.

Robbers Roost Formation

Permian (Wolfcamp): South-central Nevada.

J. S. Berge, April 1960, Brigham Young Univ. Research Studies, Geol. Ser., v. 7, no. 5, p. 11 (fig. 3). Named on correlation chart. Overlies Butte formation (new). Name credited to G. P. Lloyd (unpub. thesis).

North end of White River valley, White Pine County.

Robbers Roost Gravel

Quaternary: Northwestern Arizona.

Donaldson Koons, 1948, Plateau, v. 20, no. 4, p. 54 (fig. 1), 58. Composed of poorly rounded and sorted pebbles of limestone, sandstone, and chert of local derivation. Rests on steep bedrock slopes. Interpreted as a talus or alluvial cone deposit.

Name derived from Robbers Roost Mesa, Coconino County, near which the unit is well exposed.

Robbins Shale Member[1] (of Stranger Formation)

Robbins Shale

Pennsylvanian (Virgil Series): Southeastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 146, 153–156.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29. Stranger age beds are exposed in three small areas on Table Rock-Richfield anticlines in Cass and Sarpy Counties in North Branch Weeping Water Creek valley, Eightmile Creek valley and Platte River bluffs in vicinity of South Bend. Well logs show that these beds extend subsurface through Forest City basin and rise to surface in outcrop areas of Missouri and Kansas. Stranger section in Cass County is Robbins shale above and Cass formation below. Robbins shale is about 3 feet thick in Burlington quarries near South Bend. Rests conformably on Haskell member of Cass formation, but its upper boundary is at post-Stranger unconformity below the Lawrence formation.

H. C. Wagner and L. D. Harris, 1953, U.S. Geol. Survey Oil and Gas Inv. Chart OC–48. Described in Fredonia quadrangle, Kansas, where it is

more than 120 feet thick in southern part of quadrangle, thins to 50 feet in northern part. Predominantly a light-olive-gray slightly silty shale that is characterized by beds and lenses of small ironstone concretions. Overlies Haskell limestone member; underlies Ireland sandstone member of Lawrence shale.

Type locality: Robbins Farm, sec. 11, T. 26 S., R. 15 E., southwest of Yates Center, Woodson County, Kans.

Rob Camp Limestone

Middle Ordovician: Northeastern Tennessee and southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104 (2 sheets). Very massive bedded very dense cryptocrystalline, tan and dove-gray limestone with abundant small patches of white crystalline calcite; zones of thinner bedded limestone containing chert nodules present in eastern part of area. Thickness as much as 150 feet. Unconformably underlies Martin Creek limestone (new); overlies Poteet limestone (new). Same as Mosheim limestone (after Butts) on map by Miller and Fuller (1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76).

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table), 33–34, 39–43, 105, 107, 109, pl. 1. Further described; typical section and derivation of name given. Rob Camp probably correlates with Five Oaks limestone of Cooper and Prouty (1943) in Tazewell County. Summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Named from exposures one-half mile north of Rob Camp Church in Rose Hill district. Church is in northwest corner of Hancock County, Tenn., 3 miles south of Lee County line.

Roberta Sandstone Member (of Barnwell Formation)

Eocene, upper: Central and northeastern Georgia.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321–322, 329, 343 (fig. 15). Name applied to the argillaceous red sands composing the typical Barnwell, that is above and outside the area of outcrop of the Irwinton and Upper Sand members. Thickness 15 to 40 feet. In extreme northeastern Georgia, beds occur higher in the section than the other members; in Crawford and possibly Peach County, occur unconformably upon uppermost Twiggs clay member.

Type locality: At Rich Hill, a prominent topographic feature 6 miles east of Roberta, Crawford County. Present also in Glascock and Jefferson Counties.

Roberts Formation[1]

Precambrian: East-central California.

Original reference: J. H. Maxson, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 311.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 280 (fig. 4). Thickness about 2,500 feet. Underlies Wyman formation.

In Wyman Canyon, Inyo Range.

Roberts Sand[1]

Miocene(?): Southwestern Alabama.

Original reference: W. H. Dall and J. Stanley-Brown, 1894, Geol. Soc. America Bull., v. 5, p. 167, 170.

Named for exposures at Roberts, Escambia County.

Roberts Mountains Formation or **Limestone**

Middle Silurian: Eastern Nevada and western Utah.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 11–12, pl. 1. Formation lies between the light-gray dolomites of Lone Mountain (restricted) and Ordovician Hanson Creek formation (new). Predominantly limestone, well-bedded and dark slate gray. Thickness at type section 1,900 feet; at Lone Mountain 741 feet. Lower contact drawn at base of laterally persistent belt of bluish-black chert 560 feet above Eureka quartzite; at Lone Mountain, same type of chert beds occur 318 feet above the Eureka. Partial equivalent of this formation at Lone Mountain was included in Lone Mountain limestone by Hague (1892; U.S. Geol. Survey Mon. 20).

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 20–21, 22 (fig. 5). Geographically extended into Millard County, Utah, where it is 369 feet thick, underlies Jack Valley formation (new) and overlies Fish Haven dolomite.

E. L. Winterer and M. A. Murphy, 1960, Jour. Geology, v. 68, no. 2, p. 134 (fig. 6), 135, 136. Underlies Rabbit Hill formation (new).

Type section: West side Roberts Creek Mountain, about 30 miles north of Eureka, Eureka County, Nev.

Robertson Formation (in Mowich Group)

Lower Jurassic: East-central Oregon.

R. L. Lupfer, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 238–239, 241–242. Includes, in most places, two lithologic facies: (1) a basal section of conglomerate and coarse greenish-gray sandstone upon truncated beds of the Upper Triassic, and (2) an overlying reef limestone. Average thickness 250 feet; maximum about 500. Underlies Suplee formation (new).

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Lower Jurassic sequence in Izee area, Grant County, includes Robertson, Supple, Nicely, and Hyde formations. Uppermost unit in Triassic sequence is Graylock formation (new).

Type area: Along headwaters of South Fork of Beaver Creek, 7 miles Southeast of Suplee post office, in secs. 26, 27, 28, and 29, T. 18 S., R. 26 E. Named for Robertson Ranch in sec. 28, T. 18 S., R. 26 E., Crook County.

Roberts Ranch Member (of Dagger Flat Formation)

Upper Cambrian: Southwestern Texas.

J. L. Wilson, 1954, Jour. Paleontology, v. 28, no. 3, p. 251, 252; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 12, p. 2465. Principally shale with thin beds of dark sandy finely crystalline limestone and calcareous micaceous graywacke sandstone. Thickness 225 to 570 feet. Overlies Buttrill Ranch member (new); underlies Marathon formation.

Type locality: Dagger Flat, Brewster County. Crops out along crest of Marathon anticlinorium which is traversed by Roberts Ranch Road.

Robeson Conglomerate

Triassic: Southeastern Pennsylvania.

D. B. McLaughlin, 1939, Michigan Acad. Sci. Arts, and Letters, Papers, v. 24, pt. 4, p. 60, 73. Name applied to a thick succession of conglomerates and coarse sandstones with almost no shale that occur in an alluvial fan in the Triassic. Considered to be stratigraphic equivalent of Lockatong and Brunswick formations. Dip and width of outcrop indicate thickness of approximately 15,000 feet.

Named from Robeson Township, Berks County.

Robinson Diorite[1]

Miocene or Pliocene: Central southern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

Occurs on west of main summit of Castle Mountain, between Robinson and Blackhawk, Meagher County.

Robinson Formation[1]

Pennsylvanian: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California, Westwood sheet (1:250,000): California Div. Mines. Mapped with Permian marine sedimentary and metasedimentary rocks.

Named for exposures on Robinson Ranch near Taylorsville, Plumas County.

Robinson Limestone Member (of Minturn Formation)

Robinson Limestone Member (of Battle Mountain Formation)

Robinson Limestone Member (of Maroon Formation)[1]

Pennsylvanian: Northwestern Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1886, U.S. Geol. Survey Mon. 12, p. 69, 198, 279, 598, 646; 1898, U.S. Geol. Survey Geol. Atlas, Folio 48.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1376 (fig. 1), 1378 (fig. 2), 1380–1383, 1384. Reallocated to member status in Battle Mountain formation (new). Overlies Belden shale member (new); underlies Jacque Mountain member.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 201–202, 211–215. Reallocated to member status in Minturn formation. Overlies Resolution dolomite member (new); underlies Elk Ridge limestone member. Thickness 300 to 400 feet; comprises three to five beds of gray limestone separated by clastic rocks; limestone beds are 3 to 31 feet thick and 40 to 85 feet apart. Limestones contain fusulinids classed as Des Moines in age. Work in Pando area has proved that Lime Cliffs group of limestones of Minturn quadrangle are equivalent to Robinson limestone, and bed that Brill designated Robinson limestone in his type section of Battle Mountain formation, along Turkey Creek, in southern part of Minturn quadrangle, is in reality the bed here called Hornsilver dolomite member.

Named for fact it forms ore-bearing horizon of Robinson mine in Tenmile district.

†Robinson Quartzite[1]

Lower Cambrian : Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann Rept., pt. 3, p. 620–622.

Probably named for town of Robinson, Juab County.

†Robinson Shale[1]

Mississippian : Central eastern Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52; 1924, Pan-Am. Geologist, v. 41, p. 78.

Ely district.

Robinson Branch Formation or coal cycle (in Cabaniss Group)

Robinson Branch Formation (in Cherokee Group)

Pennsylvanian (Des Moines Series) : Southwestern Missouri, and southeastern Kansas, northeastern Oklahoma.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Robinson Branch formation. Underlies Fleming formation; overlies Mineral formation. Included in Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as Robinson Branch coal cycle in Senora formation, Cabaniss group in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 39. Top is Robinson Branch coal bed. In lower part, in places in Vernon and Bates Counties, Mo., in southeastern Kansas, and in northeastern Oklahoma, contains a bed of black calcareous shale containing *Marginifera muracatina*, *Linoproductus cora*, gastropods, and pelecypods. Sporadic limestone in lower part, in western Missouri, southeastern Kansas, and northeastern Oklahoma, is called Doneley limestone in Oklahoma. Upper limestone was named Ardmore (Gordon, 1893), and entire limestone and shale succession was included in the Ardmore by Cline (1941). The prominent ledge of limestone in Vernon County, Mo., is known as "diamond rock," and name Rich Hill has been applied to it (Greene and Pond, 1926).

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 62–66, 105. A formation in Cabaniss subgroup of Cherokee group. Includes (ascending) limestone and calcareous shale (cap rock of Mineral coal), dark shale, fine-grained sandstone, underclay, and Robinson Branch coal. In eastern Labette County, Kans., and Craig County, Okla., the limestone forms an almost continuous bed, averaging 18 inches in thickness; in Cherokee and Crawford Counties, Kans., ranges in thickness from featheredge to 3 feet; Branson (1952) [1954] applied name Russell Creek to this limestone in Craig County, Okla. Overlies Mineral formation; underlies Fleming formation. Derivation of name given.

Named from Robinson Branch coal, which in turn is named for Robinson Branch, a stream in Vernon County, Mo. Complete succession was formerly exposed in strip pits northeast of Walker, SW¼ sec. 2, T. 36 N., R. 30 W., Vernon County.

Robinson Creek Vitrophyre

Pliocene: Northeastern Nevada.

R. R. Coats, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–690, Book 2, p. 307. Several small gray vitrophyric perlite domes, characterized by labradorite, hypersthene, augite, magnetite, and apatite. Maximum exposed thickness of any one dome about 200 feet and greatest length about three-fourths of a mile; generally bases on which domes were extruded not visible.

Near northeastern border of Jarbidge quadrangle.

Robinson Mountain Basalt or flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 121–122, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined. Robinson Mountain is fifth in known sequence; younger than Bellisle Mountain and older than Jose Butte.

Robinson Mountain, a prominent, deeply eroded vent is about 5 miles west-northwest from Capulin Mountain and 3 miles west of Union County line.

Roblar Leucogranite

Cretaceous: Southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 97, pl. 1. Flesh-colored and aplitic; shows a little biotite and white feldspar. In most places, shows poor outcrops; exposures are of a friable sandy nature; where better exposed, yields small angular blocks due to the closely spaced sheeting. Younger than Woodson Mountain granodiorite.

Named for its exposures in Roblar Canyon, San Luis Rey quadrangle.

Robles Formation

Upper Cretaceous: Puerto Rico.

H. L. Berryhill, Jr., R. P. Briggs, and Lynn Glover 3d, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 143–147. Three facies recognized. Sandstone-siltstone facies of central and south-central part of island includes Río Matón, Lapa lava, and Las Tetas lava members (all new); this facies interfingers northward into pillow-lava-volcanic-breccia facies that intertongues to northeast with impure limestone-volcanic-breccia-conglomerate facies. Thickness of formation and probable equivalent strata ranges from approximately 3,000 feet in southern part of island to about 4,000 feet in central part; equivalent strata may be as much as 8,000 feet thick in northeastern part of island. Unconformably overlies volcanic complex in southern part of island; in central part, appears to lie conformably on lavas equivalent to Fajardo formation; underlies Cariblanco formation (new). Probably ranges from late Coniacian to early Campanian in age. Name credited to Pease and Briggs (in press).

H. L. Berryhill, Jr., and Lynn Glover 3d, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–319. In Cayey quadrangle, consists of five distinct members and a sixth unnamed member which lies at base of formation in places south of Proyecto Vazquez. Named members (ascending) Río Matón limestone, Lapa lava, Cayey siltstone (new), Las Tetas lava, and Collao (new). Maximum thickness about 1,000 meters.

M. H. Pease, Jr., and R. P. Briggs, 1960, U.S. Geol. Survey Misc. Geol. Inv. Map I–320. Described in Comerío quadrangle which contains type area.

Includes Río Matón limestone, Lapa lava, and Las Tetas lava members. Maximum composite thickness more than 1,000 meters. Overlies unit termed formation K; underlies formation L.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 21–24. In Ponce-Coamo area, crops out south of Cerrillos-Descalabrado fault in Coamo and Río Descalabrado quadrangles. Includes Lapa andesite member. Underlies Ildefonso formation (new); base not exposed. Thickness about 3,000 feet in Barranquitas quadrangle; here it overlies Río Loco formation and unconformably overlies Ildefonso formation.

Type area: Barrio Robles of Municipio of Aibonito, Comerío quadrangle.

Roca Shale[1] (in Council Grove Group)

Permian: Southeastern Nebraska, northeastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 84, 86, 88.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Defined to exclude Legion shale and Sallyards limestone. Consists of gray, red, and green shale, and thin impure limestone. Thickness 15 to 20 feet. Underlies Sallyards limestone member of Grenola limestone; overlies Howe limestone member of Red Eagle limestone. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 90–94. Roca shale, as used in this report, includes rocks between Red Eagle and Neva limestones. In essence, this is original definition of unit proposed by Condra (1927). Condra's definition has been modified by establishment of Grenola formation (Condra and Busby, 1933) which, except for Neva limestone, consists of beds formerly included in upper part of Roca. Definition of Roca as restricted by Condra and Busby is the one currently followed in Kansas and Nebraska. In Pawnee County, top of Kansas Roca is indeterminate, and only Neva limestone member of Grenola can be recognized with assurance. Hence, Roca of this report includes in its upper part a section representative of all but Neva limestone member of Grenola formation of Kansas. Thickness 80 to about 120 feet in Pawnee County.

Named for Roca, Lancaster County, Nebr.

Rochdale Limestone (in Beekmantown Group)[1]

Lower Ordovician: Southeastern New York.

Original references: W. B. Dwight, 1887, Am. Jour. Sci., 3d v. 34, p. 32; Vassar Bros. Inst. Trans. Sci. Sect., v. 4, pt. 2, p. 213.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1212. Consists of limestones and dolomites carrying *Lecanospira* and orthoceratite cephalopods. Thickness about 400 feet. Overlies Halcyon Lake calc-dolomite (new). Discussion of stratigraphy of lower Paleozoic rocks surrounding Stissing Mountain, Dutchess County.

Named for exposures near village of Rochdale, Dutchess County.

Rochelle Conglomerate (in Canyon Group)

Rochelle Conglomerate (in Graford Formation)[1]

Rochelle Conglomerate Member (of Garner Formation)

Pennsylvanian: Central Texas.

Original references: R. S. Tarr, 1890, Texas Geol. Survey 1st Ann. Rept., p. 204, 205; Am. Geologist, v. 6, p. 147–153.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1) ; 90–91. Shown on chart as member at top of Garner formation. Rochelle conglomerate, Capps and Adams Branch limestones have been miscorrelated between their type localities in Colorado River district and Brazos River district; this fact should be borne in mind in using early literature. Rochelle conglomerate can be traced northward below Capps limestone; hence it is now considered at least as old as Brazos River conglomerate. Strawn series.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 93–94, pl. 20. Lowest division of Canyon group in Llano region. Thickness 8½ to 18 feet. Underlies Brownwood shale; east of Rochelle, unconformably overlies dark-gray and dark-maroon sandy shale of Strawn age; southwest of Rochelle overlaps on Marble Falls limestone.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1515–1524. Discussion of Strawn-Canyon boundary.

L. F. Brown, Jr., 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2866–2871. Discussion of problems of stratigraphic nomenclature and classification. Upper Pennsylvanian, north-central Texas—erecting series from groups, suppression of formations, redefining and raising rank of rock-stratigraphic units, time-stratigraphic boundaries versus lithographic contacts.

Type locality: Four miles east and 1.3 miles north of Rochelle-San Saba Road, near top of prominent escarpment.

Rocher Member (of Salem Limestone)

Mississippian (Valmeyer Series) : Southwestern Illinois.

J. W. Baxter, 1959, Dissert. Abs., v. 19, no. 11, p. 2910, 2911. Salem limestone is subdivided into four members [sequence not stated] to which names Kidd, Fults, Chalfin, and Rocher are assigned. Rocher member is a skeletal calcarenite in which the tests of *Endothyra* are a prominent element; commonly more or less oolitic.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2–3, 10–11, 13, 27–30, pl. 1. Consists of thick limestone beds separated by more thinly bedded strata. Maximum thickness about 60 feet near Prairie du Rocher; thins to north to 10 to 15 feet near Valmeyer, Overlies Chalfin member; underlies St. Louis limestone.

Type section: Above spring, 1 mile south of Monroe-Randolph County line at site of a limestone mine in T. 5 S., R. 9 W. Named from exposures in northern Randolph County less than 1 mile north of town of Prairie du Rocher.

Rochester Biotite Granite[1]

Devonian(?) : Southeastern New Hampshire.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 148, 149.

Probably named for exposures at Rochester, Stafford County.

Rochester Quartzite[1]

Precambrian: Vermont.

Original reference: W. G. Foye, 1919, Vermont State Geologist 11th Rept., p. 87.

Exposed along the Mine Railroad in Rochester, Windsor County.

Rochester Rhyolite (in Koipato Group)

Rochester Trachyte[1]

Permian: Northwestern Nevada.

Original reference: A. Knopf, 1924, U.S. Geol. Survey Bull. 762.

R. E. Wallace and others, 1959 U.S. Geol. Survey Mineral Inv. Field Studies Map MF-220. Rhyolite included in Koipato group in Buffalo Mountain quadrangle. Consists of rhyolite tuff-breccia in heterogeneous intertongued pile; relatively few masses that are true flow rocks; predominantly devitrified glass, containing sparse small phenocrysts, metacrysts of tuffaceous fragments of feldspar and quartz. Thickness not uniform probably exceeding 2,000 feet in places. Older than Weaver rhyolite. Permian.

Named for occurrence in Rochester Canyon, Rochester district.

Rochester Shale (in Clinton Group)

Rochester Formation

Rochester Member (of Mifflin Formation)

Rochester Shale Member (of Clinton Formation)[1]

Middle Silurian: Maryland, New York, Pennsylvania, and West Virginia, and Ontario, Canada.

Original reference: T. A. Conrad, 1839, New York Geol. Survey 3d Rept., p. 62–63.

C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, no. 3, p. 624, 627–628, 630, 632. Geographically extended into Pennsylvania where it includes Keefer sandstone member. Thickness 70 feet. Underlies McKenzie formation; overlies Rose Hill formation.

E. R. Cumings, 1939, *in* Geologie der Erde, North America, v. 1, p. 595, 597. In Ontario, Clinton group includes Reynales and Irondequoit limestones and Rochester shale. Decew waterlime bed, formerly included in the Lockport, is here made upper member of Rochester formation. It is overlain by Gasport dolomite. Thickness 70 feet in Niagara Gorge.

W. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 106–116. Rochester shale described in West Virginia where it is as much as 30 feet thick. Overlies Keefer sandstone and underlies McKenzie formation. This usage indicates general correlation of Rochester shale with the so-called "upper Clinton shale" of previous Survey county reports. Middle Silurian. Niagaran series.

H. L. Alling, 1946, Rochester Acad. Sci. Proc., v. 9, no. 1, p. 52–53. Term Gates is a rock facies and retention of name as formation or member of the Rochester is inadvisable.

D. W. Fisher, 1959, New York State Mus. Sci. Service Map and Chart Ser. 1. There is variance of opinion as whether time break exists between Lockport group and underlying Rochester shale. Some claim that Brownsport, Waldron, and Laurel fill this "gap." Evidence is not conclusive inasmuch as apparent faunal differences may be due to ecological control. There seems to be physical break between Decew and Gasport in western New York, but no physical break is evident from Rochester eastward. The Rochester in Clinton group grades imperceptibly upward into Decew, which is transferred to Tonwandan stage (new). Grades eastward into Herkimer sandstone; overlies Irondequoit limestone.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5–6, 20, 23. Rank reduced to member status in Mifflin formation (new). Underlies McKenzie member; overlies Keefer member. Thickness 30 to 40 feet in central Pennsylvania. In Mount Union section referred to as formation. Thickness 40 feet. Overlies Keefer formation; underlies McKenzie formation. Silurian.

Named for exposures at Rochester, Monroe County, N.Y.

Rociada limestone[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 10.

In Solitario Mountain district, northwest of Las Vegas, San Miguel County.

Rockaway Conglomerate Beds (in Lutie Member of Theodosia Formation)

Lower Ordovician: Northern Arkansas and southern Missouri.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 25, 27, pls. 2, 6. Name applied to chert conglomerate and breccia beds that mark the base of the Lutie; number of beds vary from place to place and are commonly separated by "cotton rock" or crystalline dolomite. Beds are stratigraphically below the Hercules Tower sandstone (new) and are immediately overlain by a massive, crystalline dolomite, commonly more or less chert free.

Named from Rockaway Beach, Lake Taneycomo, Taney County, Mo.

Rock Bench Quarry Beds (in Polecat Bench Formation)

Paleocene; Northwestern Wyoming.

G. L. Jepsen *in* W. B. Scott, 1937, A history of land mammals in the Western Hemisphere: New York, Macmillan Co., p. 99; 1940, Am. Philos. Soc. Proc., v. 83, no. 2, p. 234–236, 238 (table). Proposed for rocks yielding the *Ptilodus-Elphidotarsius-Plesiolestes-Ancondon* fauna. A coarse buff sandstone, 9 to 31 feet thick, that occurs about 200 feet above base of formation and about 70 feet above top of Mantua lentil (new); stratigraphically below Silver Coulee beds (new).

Rock Bench is local name for part of the Polecat Bench, in Big Horn basin, near Powell, Park County.

Rock Bluff Limestone Member (of Deer Creek Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 43, 50.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Rock Bluff limestone member of Deer Creek limestone; underlies Larsh shale member; overlies Oskaloosa shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947; classification is subject to modifications imposed by lateral variations of deposits.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 157–158. Dense blue limestone; commonly a single massive stratum 1 to 2 feet thick. In Kansas, underlies Larsh-Burroak shale member.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. In Missouri, underlies Larsh-Burroak shale member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18, fig. 5. Dark blue to gray, dense; commonly one massive bed, but locally weathers into two layers. Thickness 1½ to slightly more than 2 feet. Underlies Larsh shale member; overlies Oskaloosa shale member.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 45–46, pl. 1. In Douglas County, consists of single bed of hard dense to fine-grained dark-blue-gray limestone about 2 feet thick. Overlies Oskaloosa shale member; underlies Larsh-Burroak shale member.

Named for exposures high in Missouri River bluffs northeast of Rock Bluff, Cass County, Nebr.

Rock Branch Coal Member (of Modesto Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), pl. 1. Name applied to coal previously called Scottville so that latter name can be restricted to Scottville limestone. Stratigraphically above Piasa limestone member and below Athensville coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: SW¼SW¼NW¼ sec. 21, T. 8 S., R. 9 W., Macoupin County. Named for exposures along Rock Branch in northwestern part of county.

Rock Candy Agglomerate and Latite (in Bullion Canyon Series)

Tertiary: Central Utah.

P. F. Kerr and others, 1957, Geol. Soc. America Spec. Paper 64, p. 14, 15 (fig. 6), pl. 12. Rock Candy agglomerate, 600 feet thick, underlies Rock Candy latite 50 to 500 feet thick.

Mapped in vicinity of Big Rock Candy Mountain, Marysvale area.

†Rock Canyon Conglomeratic Member (of Moenkopi Formation)[1]

Lower Triassic: Northwestern Arizona and southwestern Utah.

Original reference: H. Bassler and J. B. Reeside, Jr., 1921, U.S. Geol. Survey Bull. 726–C, p. 90–92.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 54. Abandoned as stratigraphic term. Rock Canyon conglomerate at its type locality is substantially equivalent to Harrisburg gypsiferous member of Kaibab.

Named for Rock Canyon, 5 miles north of Antelope Spring, Mohave County, Ariz.

Rockcastle Conglomerate Member (of Lee Formation)[1]

Rockcastle Sandstone (in Lee Group)[1]

Rockcastle Conglomerate (in Crab Orchard Mountains Group)

Lower Pennsylvanian: Eastern Tennessee, northern Georgia, and east-central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46, p. 3.

V. H. Johnson, 1946, Coal deposits of Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map. Geographically extended into northern Georgia where it is exposed on Lookout Mountain and overlies Vandever shale.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4, 12–A. Youngest unit in Crab Orchard Mountains group (new). Term conglomerate considered more appropriate than sandstone in this area. In type area (as used in this report), conglomerate is 160 feet thick; maximum thickness 300 feet; in general, greatest thickness is along Eastern Escarpment; thins progressively southward. Along Piney River in Rhea County, the massive conglomeratic sandstone splits eastward to form a sequence of thin sandstones and shales. Contains Nemo coal. Overlies Vandever formation; underlies Dorton shale (new). Pottsville series.

Type locality: Rockcastle Cove, near Jamestown, Fentress County, Tenn.

†Rockcastle Group (in Pottsville Group)[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: A. R. Crandall, 1889, Kentucky Geol. Survey Rept. Whitley County.

Named for Rockcastle River.

†Rock City Conglomerate[1]

Pennsylvanian: New York.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. 1, p. 96.

Named for erosional feature locally called "rock cities," Cattaraugus and Chautauqua Counties.

†Rock Creek Beds[1]

Pleistocene: Western Texas.

Original reference: J. W. Gidley, 1903, Am. Mus. Nat. Hist. Bull., v. 19, p. 622, 625.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 494. Same as Tule formation (Cummins, 1893).

Named for Rock Creek, Swisher County.

†Rock Creek Conglomerate Member (of Maroon Formation)

Permian(?): Northwestern Colorado.

C. F. Bassett, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1864. Whole thickness consists of pink to red coarse sandstone and arkosic grits and conglomerates highly crossbedded. Lower part contains a few thin interbedded gray shales and limestones. Thickness approximately 1,224 feet. Underlies State Bridge siltstone member (new); conformably overlies McCoy formation. Permian(?). Name credited to Donner (unpub. thesis).

H. F. Donner, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1223. Name abandoned and beds included in McCoy formation of Pennsylvanian age in McCoy area. Derivation of name given.

Named for its fine exposures along west bank of Rock Creek north of McCoy. In Eagle and Routt Counties.

Rock Creek Granodiorite,[1] Gabbro,[1] and Diorite[1]

Jurassic: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Ast., 1910, v. 2, p. 401.

Named for occurrence near forks of Rock Creek, British Columbia.

Rock Creek Limestone (in McLeansboro Group)

Rock Creek Limestone Member (of McLeansboro formation)[1]

Middle and Upper Pennsylvanian: Central western Illinois.

Original reference: A. H. Worthen, 1873, Illinois Geol. Survey, v. 5, p. 309, 312, 314, 315.

U.S. Geological Survey classifies the Rock Creek as a formation on the basis of the fact that the McLeansboro is given group status in Illinois.

Named for outcrops along Rock Creek, Menard County.

Rock Creek Limestone Member (of Vamoosa Formation)

Rock Creek Limestone (in Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: F. C. Greene 1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 122.

C. C. Branson, 1955, The Hopper, v. 15, nos. 10–11, p. 126–127. Referred to as Rock Creek limestone member of Vamoosa formation. Name Rock Creek is synonym and not in good standing.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Name was earlier used for a Pennsylvanian limestone in Illinois, for Pleistocene beds in the Texas Panhandle, and for a gabbro in British Columbia. Bowen (1918) named the same limestone Labadie and this is accepted name.

Well developed in T. 26 N., R. 10 E., Osage County. Rock Creek is small tributary of Sand Creek and flows through sections 3,4, 9, 10, and 15.

Rockcut Formation

Lower Paleozoic: Northeastern Washington.

J. L. Barlow, 1958, U.S. Atomic Energy Comm. [Pub.] RME–2068, p. 7. Oldest rocks in district are biotite-amphibole schists, gneisses, limestones, and quartzites which Weaver (1920) designated Orient gneiss and tentatively assigned a Precambrian age. Hougland (1933, unpub. thesis) subdivided this sequence and assigned name Rockcut formation to include two lower quartzite and limestone members of Lower Paleozoic(?) age; he also used term amphibole schist to include all basic medium- to fine-grained, more or less metamorphosed rocks in area. These schists are intercalated within the Rockcut. No evidence for establishing age of these rocks has been found; they are referred to as lower Paleozoic complex.

Report covers northern Ferry County.

Rockdale Dolomite

Silurian (Niagaran): Northeastern and northwestern Illinois.

T. E. Savage *in* C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Name appears on correlation chart. Underlies Joliet dolomite (restricted).

Type locality and derivation of name not given.

Rockdale Drift[1]

Pleistocene (Wisconsin) : Northeastern Illinois.

Original reference: D. J. Fisher, 1925, Illinois Geol. Survey Bull. 51, p. 17.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. 16th Ann. Field Conf., p. 12 (fig. 4). Shown on columnar section of Pleistocene deposits in Dixon-Oregon area above Minooka drift and below Manhattan drift.

Named for village of Rockdale, 2 miles southwest of Joliet, Will County.

Rockdale Formation (in Wilcox Group)[1]

Eocene: Eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 583.

W. M. Beckman and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. Seguin formation, as originally defined, straddles boundary between Midway and Wilcox groups. Members of Seguin, Solomon Creek clays, and Caldwell Knob sands, are redefined so that base of Wilcox is placed at disconformity marking top of Solomon Creek clays and base of Caldwell Knob sands. Where it is possible to recognize the divisions as redefined, Caldwell Knob beds should be regarded as basal member of Rockdale formation and Solomon Creek member should be regarded as member of Wills Point formation.

R. L. Folk, leader, 1960, Texas Univ. Geol. Soc. Tertiary Field Trip, Dec. 10 strat. section. Includes (ascending) Hooper clay, Simsboro sand, Butler clay, and Calvert Bluff members. Overlies Seguin formation; underlies Sabinetown. Wilcox group.

Type locality: Exposures in central Milam County, in vicinity of Rockdale.

Rockdale Run Formation (in Beekmantown Group)

Lower Ordovician: Western Maryland.

R. H. Flower, 1956, Jour. Paleontology, v. 30, no. 1, p. 77, 78. Incidental mention in discussion of cephalopods from Canadian of Maryland. Name credited to W. J. Sando.

W. J. Sando, 1956, Geol. Soc. America Bull., v. 67, no. 7, p. 936. Formal proposal of name. Applied to interbedded limestones and dolomites overlying Stonehenge limestone. Lower two-thirds of formation is predominantly limestone; upper third mostly dolomite. Average thickness about 2,450 feet. Underlies Pinesburg Station dolomite (new); top is placed at top of highest limestone bed beneath the dolomite.

W. J. Sando, 1957, Geol. Soc. America Mem. 68, p. 21–28, geol. sections 2, 3, 4, 5, 8, and 10, pl. 1. Includes three lithologic zones: a cryptozoon chert zone confined to lower 100 to 200 feet of formation; a concentration of oolitic limestones about 100 to 200 feet thick about 200 feet above cryptozoon chert zone; dolomite in upper third. Detailed description of type section.

Type section: On Robinson and Seibert Farms just south of Rockdale Run between 1 and 1½ miles west of Hicksville, Washington County. Outcrops constitute 58 square miles.

Rockdell Limestone

Middle Ordovician: Southwestern Virginia.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 135 (fig. 11), 137–139, 240 (geol. section 139), pls. 9, 18, 23. Includes the 100 to 300 feet of beds

between the Lincolnshire below and Benbolt limestone above; includes Perry and Ward Cove limestones of Tazewell County, and name Rockdell is used where these two formations cannot be differentiated. Consists of coarse-grained light gray high-calcium limestone with a few beds of dark-gray cherty limestone. Along northwest base of Clinch Mountain upper two-thirds of unit is dark-gray granular cherty limestone and lower division coarse grained light-gray and free from chert; in Rosedale belt upper part is nodular-weathering earthy limestone containing *Nidulites* and lower part, generally thicker, is light-gray to pinkish coarse-grained limestone with distinctly clastic texture. Thickness at type locality 248 feet.

Type locality: Near Elk Garden, Russell County. Also crops out in small elliptical area south of Rockdell.

Rock Falls Series[1]

Mississippian: Eastern Michigan.

Original reference: A. C. Lane, 1900, Michigan Geol. Survey, v. 7, pt. 2, p. 252–253.

In Huron County. Derivation of name not stated.

Rockfish Conglomerate[1]

Rockfish Member (of Lynchburg Gneiss)

Precambrian: Western Virginia.

Original reference: W. Nelson, 1932, Washington Acad. Sci. Jour., v. 22, no. 15, p. 456–457.

A. I. Jonas and G. W. Stose, 1939, Am. Jour. Sci., v. 237, no. 8, p. 575, 578 (fig. 2), 589, 593. At many places in Catoctin Mountain-Blue Ridge and Mount Rogers anticlinoria, the Rockfish conglomerate, which at type locality and elsewhere contains pebbles and boulders of granite and gneiss derived from the Lovingston granite gneiss and granite of the injection complex, underlies Lynchburg gneiss.

H. B. Cooke, Jr., 1952, (abs.) Virginia Jour. Sci., v. 3, new ser., no. 4, p. 336. Rockfish conglomerate divided into two members: Rockfish conglomerate (restricted) and Mount Jefferson sandstone (new).

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 583–585, pl. 1. Referred to as Rockfish member of Lynchburg. Occurs in base of Lynchburg in lenticular bodies as much as 2 miles long and 1,000 feet across at outcrop. Grades downward 10 to 100 feet into basement complex with diminution in number of clasts and disappearance of bedding. The granite clasts were doubtlessly derived from the Lovingston and Pedlar formations, and the biotite clasts probably from skialiths of basement complex gneiss.

Type locality: On Rockfish River, Nelson County.

Rockford Limestone[1]

Lower Mississippian (Kinderhook Series): Southeastern Indiana.

Original reference: F. B. Meek and A. H. Worthen, 1861, Am. Jour. Sci., 2d, v. 32, p. 167–177.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 88–89. Immediately underlies New Providence shale of Borden group and overlies New Albany shale throughout southern Indiana outcrop belt between New Albany on the Ohio River at south and Bartholomew County to north; absent in Kentucky. Thickness 1 to 3 feet, commonly 2 feet.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 855–856. Overlies Jacobs Chapel shale (new).

Typically exposed in bed of White River at Rockford, Jackson County.

†Rockford Shale[1]

Upper Devonian: Central northern Iowa.

Original reference: S. Calvin, 1878, Am. Jour, Sci., 3d, v. 15, p. 460–462.

Named for Rockford, Floyd County.

Rockfordian series[1]

Upper Devonian: Iowa.

Original reference: C. R. Keyes, 1933, Pan-Am. Geologist, v. 60, no. 3, p. 226.

Rock Grove Member (of Shell Rock Formation)

Rock Grove Substage[1]

Upper Devonian: Central northern Iowa.

Original reference: C. H. Belanski, 1927, Am. Midland Nat., v. 10, no. 10.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68–A, p. 187. Shellrock formation comprises (ascending) Mason City, Rock Grove, and Nora members.

Named for development in Rock Grove Township, Floyd County.

Rockhill Limestone (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: E. Böse, 1918, Texas Univ. Bull. 1758, p. 14–16.

Forms the flat top of the long, narrow ridge (Rock Hill) that extends southwest from southern end of Lake Bridgeport Dam in Wise County.

Rockhouse Shale[1] (in Linden Group)

Rockhouse Limestone Member, Rockhouse Shale Member } (of Ross Formation)

Lower Devonian: Western and central Tennessee.

Original reference: C. O. Dunbar, 1918, Am. Jour. Sci., 4th, v. 46, p. 736.

G. A. Cooper and others, 1942. Geol. Soc. America Bull., v. 53, no 12, pt. 1, chart 4. Rockhouse shale shown on correlation chart as Silurian.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280 (fig. 83), 283–287, 292. Rockhouse shale member and Rockhouse limestone member comprise the basal unit of newly defined Ross formation through its known outcrop belt and unconformably overlie Decatur limestone. Shale member is restricted to south-central Hardin County where its average thickness is about 25 feet; conformably underlies Ross limestone member. Limestone member is widely distributed in northern Hardin and Wayne Counties where its average thickness is about 12 feet; conformably underlies Birdsong shale member; includes basal 8 to 10 feet of Birdsong shale as described by Dunbar (1919, Tennessee Div. Geology Bull. 21). Cooper and others (1942) place Rockhouse shale in Silurian. If Rockhouse shale is Silurian, then entire Ross formation including Ross limestone member and Birdsong shale member are likewise Silurian because they bear a close relationship to the Rockhouse shale member and Rockhouse limestone member.

Named for Rockhouse, a hunters' clubhouse on Horse Creek, 5 miles northwest of Lowryville, Hardin County.

Rockingham Schist[1] or Mica Schist

Paleozoic: East-central and southeastern New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1890–1892. On older geological maps, the crystalling schists of Belknap Mountains were divided into two groups, "Rockingham mica schist" and the "Montalban series." Present study has revealed no real difference between schists in different parts of area, and they are here treated as single unit, Rockingham mica schist. Age unknown.

M. P. Billings, 1953, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 43. Part of unit which lies southeast of the Fitchburg pluton included in Merrimack group of Silurian(?) age.

Widely exposed in Rockingham [County].

Rock Island Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Assigned to member status in Spoon formation (new). Present at base of formation. Occurs below Seville limestone member. Thickness 2½ to 3 feet in type section of Abbott. Coal named by Worthen (1868 *in* Geology and Paleontology, v. 3, Illinois Geol. Survey). Presentation of new rock stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: Southwest bank of Spoon River, SW¼SW¼ sec. 23, T. 6 N., R. 1 E., Rock Island County.

Rock Lake Shale Member (of Stanton Limestone)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 41, 59, 156, 157.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 51 Rock Lake shale was named in Nebraska but was named Victory Junction shale by Newell (1935) from exposures in Kaw Valley area, Kansas. On basis of subsequent studies, it is agreed that original name is valid.

R.C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 119. Rock Lake shale member of Stanton formation; underlies South Bend limestone member; overlies Stoner limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. Average thickness 6 feet in Nebraska; 3 to 4 feet in northwestern Missouri; 3 to 8 feet in Kansas. Old type locality now badly covered; co-type locality designated.

Type locality: Exposures in vicinity of Rock Lake located in SW sec. 13, T. 12 N., R. 10 E., Sarpy County, Nebr.; co-type locality is in Platte River Bluffs just east of south gate of State Fish Hatcheries across Platte River northeast of South Bend.

Rockland Formation[1]

Cambrian or Ordovician: South-central Maine.

Original reference: E. S. Bastin, 1908, U.S. Geol. Survey Geol. Atlas, Folio 158.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Sequence of metamorphosed sedimentary rocks in Rockland quadrangle is (ascending) Ilesboro formation containing Combs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, a siliceous limestone member above the quartzite, and Rockport limestone member at top.

Well developed just west and southwest of Rockland, Knox County.

Rockland Formation[1]

Middle Ordovician (Trentonian): Ontario, Canada, and northern New York.

Original references: P. E. Raymond, 1914, Canada Geol. Survey Summ. Rept. 1912, p. 348: 1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56, p. 255, 260; 1921, Canada Geol. Survey Mus. Bull. 31, p. 1.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 251–255. Rockland limestone is lowermost formation in Trenton group. In type section, Rockland has been described as consisting of 40 feet of heavy-bedded limestones, separated from "Lowville" limestone by 18 feet of "Leray beds of the Black River." These "Leray beds" of Ottawa district carry a fauna in which *Doleroides ottawanus* Wilson is abundant; a similar fauna directly overlies Watertown limestone, the top of the Black River group, at Watertown, N.Y. Believed that the "Leray beds" at Rockland are post-Watertown rather than pre-Watertown Leray limestone of New York. Rockland, at its type section, is revised to include these "Leray beds." In southeastern Ontario and northwestern New York, beds characterized by *Doleroides ottawanus* constitute a separable member of the formation herein designated Selby member. Upper part of formation is herein named Napanee member. Thickness at Dexter, N.Y., about 64 feet. Overlies Chaumont formation; underlies Hull formation. Other formations of Rockland age are: Coboconk and Cloche Island limestones (type areas in Ontario), and Amsterdam and Isle la Motte limestones.

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 599. Type section of Rockland is east of Ottawa. It has been described as consisting of the "Leray," comprising 9½ feet of "Leray proper" and 8½ feet of "transition beds," overlain by 40 feet Rockland limestone. The writer [Kay] 1937 stated that the "Leray beds" at Rockland are post-Watertown. Restudy of section shows that only the "transition beds" are post-Watertown, and that the 9½ feet of "Leray proper" is Chaumont. That the Rockland above the "transition beds" is equivalent to the Napanee is strongly suggested by the fauna and the fact that each is overlain by limestones containing Hull crinoid fauna. Lithology, as well as fauna, of "transition beds" resembles that of Selby member of Rockland, which is post-Chaumont.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 599. Stratigraphic column of Trenton group on West Canada Creek, N.Y., shows Rockland limestone, 10 feet thick, above Lowville limestone of Black River group

and below Kirkfield limestone; both contacts disconformable. Term Kirkfield used in preference to "Hull" of previous reports.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1411–1412. Summarizes Middle Ordovician bordering Allegheny synclinorium. Lower Trentonian formations of northwestern New York and eastern Ontario, Rockland and Kirkfield limestones, disconformably overlap Black River rocks, lying locally on Canadian and Cambrian along the Mohawk River, and on Precambrian in Ontario; the Rocklandian and Kirkfieldian are considered to be stages.

Type locality: At Rockland, Ontario, 30 miles east of Ottawa.

†Rockland Sandstone[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 610.

Named for occurrence at Rockland, in Ontonagon County.

†Rockland Sandstone[1]

Miocene(?): Eastern Texas.

Original reference: E. T. Dumble, 1901, Geology of Beaumont oil field.

Named for Rockland, Tyler County.

Rocklandian (Rockland) Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1936, Geol. Soc. America Proc. 1936, p. 82. Rockland and Hull are earliest stages of Trenton group.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 251–261, 293, 298. Discussion of stratigraphy of Trenton group and list of formations of Rockland age. Early Trenton was fundamentally a time of advancing seas that progressively submerged margins of lands. In Rockland stage, oldest sediments were limited to more medial parts of Ontario basin, in Thousand Islands region and northwestward into Ottawa Valley. In late Rockland time, the seas overlapped Adirondack arch in narrow strait somewhat north of Mohawk Valley. Hull stage is essentially a continuation of this overlap.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1411–1412. Lower Trentonian formations of northwestern New York and eastern Ontario, the Rockland and Kirkfield or Hull limestones, disconformably overlap Black River rocks, lying locally on Canadian and Cambrian along Mohawk River, and Precambrian in Ontario; the Rocklandian and Kirkfieldian are considered stages.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 86, 91, 94 (table 3). Raymond's (1914, Canada Geol. Survey Summ. Rept. 1912) "formations" in Trenton were zones he thought time-defined by fossils; subsequently the lithologies were distinguished, but Rockland limestone and Rocklandian stage are identical at Rockland, Ontario. Other formations in the stage have lithic differences or were named as an incident to their isolation. Younger than Chaumontian stage of Blackriveran series.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30. Rocklandian and Kirkfieldian substages included in Nealmontian stage.

Named derived from Rockland, Ontario, Canada, for which Rockland limestone is named.

Rockland Valley Basalt[1]

Pliocene, middle(?): Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 31, 47–48, pl. 4. Series of even-bedded blue and black basalts about 250 feet thick. Interbedded with them is one bed of clay 15 feet thick. Shown on stratigraphic column above Massacre volcanics and below Raft lake beds.

Named for exposures on north side of Rockland Valley, Power County.

Rockledge Conglomerate (in Woods Corners Group)

Rockledge Limestone Breccia

Upper Cambrian: Northwestern Vermont.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1021, 1045, 1049–1052. Name Rockledge limestone breccia proposed to replace Corliss conglomerate except at its type locality. Described as breccia composed mainly of small pieces of blue slabby limestone and sandy dolomite, cemented by lime or dolomite with abundant sand grains. Thickness 0 to 40 feet. Underlies Georgia formation conformably; overlies Hungerford formation (new) disconformably.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Incidental reference to Rockledge conglomerate.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 542–543, 546, pl. 1. Schuchert's (1937) Rockledge limestone conglomerate has generally been shortened to Rockledge conglomerate. Included in Woods Corners group (new). Schuchert misinterpreted structure and believed Rockledge to overlie Hungerford. Detailed mapping has proved that Rockledge underlies Hungerford. Maximum thickness 100 feet; because of lensing no applicable figure can be given for thickness. Overlies Skeels Corners slate. Regarded as southern equivalent of Saxe Brook dolomite but separate names are retained because of lithologic differences between the two units. Note on type locality.

Type locality: On Rockledge Estate, 4.4 miles north of center of St. Albans, on west side of Highgate Road, in Franklin County. Large bioherm from which estate takes its name is not in Rockledge conglomerate but in top of underlying Skeels Corners slate. Formation extends northward from type locality in unbroken outcrop to point 1¾ miles S. 20° W. of Highgate Falls. Southward, crops out in discontinuous lenses.

Rock Levee Formation

Middle Ordovician: Eastern Missouri.

J. G. Grohskopf, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 3, p. 360–362. Proposed for those rocks which underlie the basal Plattin oolitic and conglomeratic limestone and overlie a chert zone which occurs in the Joachim dolomite; thus, it restricts the Plattin and Joachim and contains a part of each. Consists of dense gray limestone or buff dolomites with some interbedded shale. Thickness in type area (determined from wells) 270 feet.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2042 (fig. 1), 2044–2046. Underlies Bloomsdale formation (new) of Plattin group.

Type locality: 0.2 mile east of junction of U.S. Highway 61 and Missouri Highway 74, Cape Girardeau County. Name derived from siding on St. Louis-San Francisco Railway, in NW¼NW¼NW¼ sec. 24, T. 30 N., R. 13 E. Surface distribution is closely allied with the basal Plattin.

Rocklin Granodiorite

[Jurassic]: Northern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 6. Discussed in report dealing with potassium-argon age determinations. Age given as 131 million years.

Occurs in Rocklin pluton, an elliptical mass of approximately 150 square miles, which crops out in foothill belt of Sierra Nevada in western part of Auburn quadrangle. Pluton intrudes Mariposa formation and is unconformably overlain by marine beds equivalent in age to Campanian stage of Upper Cretaceous. Dated sample obtained from Rocklin quarry in Placer County.

Rockmart Slate[1]

Mississippian: Northwestern Georgia.

Original reference: C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143; 1894, Geol. Soc. America Bull., v. 5, p. 469–470, 478.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 52–54, geol. map. Succeeds Newala limestone with an erosional unconformity. Predominantly a clay rock which includes thin beds of sandstone and at one horizon a stratum of thinly bedded, slightly fossiliferous chert about 80 feet thick. Estimated thickness 1,200 to 3,000 feet; bedding is most everywhere steeply inclined and cut by slaty cleavage; no recognizable beds or horizons have been detected that would serve as datum planes for measurement. Rockmart has hitherto been regarded as a facies of Stones River group and correlated with the Chickamauga of older usage. It is here considered Mississippian and a correlative facies of the Floyd shale.

Named for Rockmart, Polk County.

Rock Mesa Lava Flow

Rock Mesa Obsidian Flow

Recent: Southwestern Oregon.

E. T. Hodge, 1925, Oregon Univ. Pub., v. 2, no. 10, p. 54 (fig. 34), 55, 57 (fig. 40). Discussion of Mount Multnomah, ancient ancestor of the Three Sisters. Rock Mesa lava flow is term applied to flow that makes up Rock Mesa.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 53, 54, 58, pl. 12(b). Referred to as Rock Mesa obsidian flow in report on volcanoes of Three Sisters region. May be among youngest rocks of region.

Rock Mesa is southwest of South Sister Mountain and north of Le Conte Crater.

Rock Point Member (of Wingate Sandstone)

Upper Triassic: Northeastern Arizona, southwestern Colorado, northwestern New Mexico, and southeastern Utah.

G. A. Kiersch, 1955, Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2, p. 4 (fig. 1), 5. Consists of reddish-orange, parallel,

and thin-bedded siltstone and sandstone. Thickens southward from Kayenta (350 feet) to 700 feet in Hopi Buttes country where it intertongues with upper Lukachukai member (new). Overlies Chinle formation. Name credited to Harshbarger and others (in press).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 8–10. Type locality designated. Formerly the "A" division of Chinle formation (Gregory, 1917, U.S. Geol. Survey Prof. Paper 93). At type locality, consists of sequence of pale reddish brown beds forming ledges of silty sandstone and slopes of siltstone; thickness 344 feet; underlies Lukachukai member; conformably overlies Chinle formation.

Type locality: The lower, slope-forming unit exposed in Little Round Rock, a prominent butte, 15 miles south of Rock Point School, Ariz.

Rockport formation[1]

Upper Cretaceous: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 36, 61–62, 280, 301.

Named from hamlet of Rockport, Summit County.

Rockport Limestone (in Greene Formation)[1]

Permian: Western West Virginia.

Original reference: C. E. Krebs, 1911, West Virginia Geol. Survey Rept. Jackson, Mason, and Putnam Counties, p. 102.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). Table shows Lower, Middle, and Upper Rockport limestones in Greene series. Lower Rockport is above Nineveh coal and below Nineveh "A" coal; Middle Rockport is below Taylor sandstone; Upper Rockport is below Gilmore limestone.

Named for occurrence at Rockport, Wood County.

Rockport Limestone[1] (in Traverse Group)

Middle Devonian: Northeastern Michigan.

Original reference: R. A. Smith, 1916, Michigan Geol. and Biol. Survey Pub. 21, Geol. Ser. 17, p. 172–175.

B. F. Hake and J. B. Maebus, 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v. 23, p. 447–461. Included in Traverse group in central Michigan.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Preoccupied Rockport limestone replaced by Rockport Quarry limestone.

Named for exposures at Rockport, Alpena County.

Rockport Limestone Member (of Rockland Formation)[1]

Cambrian or Ordovician: South-central Maine.

Original reference: E. S. Bastin, 1908, U.S. Geol. Survey Geol. Atlas, Folio 158, p. 3–4.

H. W. Allen, 1951, Maine State Geologist Rept. 1949–1950, p. 79. Member at top of Rockland. Overlies an unnamed siliceous limestone member.

Named for exposures on eastern shore of Rockport Harbor, Knox County.

Rockport Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: E. T. Cox, 1871, Indiana Geol. Survey 2d Ann. Rept., p. 169.

Probably named for Rockport, Spencer County.

Rockport Shales[1]

Pennsylvanian: Northwestern Missouri.

Original reference: C. R. Marbut, 1904, The State of Missouri, p. 69.

Rockport Quarry Limestone (in Traverse Group)

Middle Devonian: Northeastern Michigan.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 260. Proposed to replace Rockport limestone of Smith, 1916 (not Bastin, 1908; Krebs, 1911; or Marbut, 1904).

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 580–581. Section at Rockport consists predominantly of gray and brown limestone with minor amounts of shale; thickness about 41 feet. Overlies Bell shale; underlies Ferron Point formation. Included in Traverse group.

Type section: Quarry of Kelly Island Rock and Transport Co. at Rockport in northeast corner Alpena County. Also exposed in Presque Isle County and at some places along shore of Lake Huron.

Rock Prairie Sandstone (in Jackson Group)

Eocene: East-central Texas.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 5, geol. map. Basal sandstone of group. Composed of thick and thin beds of medium- to coarse-grained marly fossiliferous dark-red sandstone which weathers to dark brown; many beds are porous, almost cavernous, while others are dark buff, platy, and friable; some thick beds are slightly crossbedded coarse-grained clear quartz sandstone with uniform quartz grains; other beds are made up of irregular and nodular iron sandstone seams which thicken and thin laterally. Approximately 60 feet thick. Underlies Caddell formation; unconformably overlies Cockfield formation.

Type locality: About 2 miles east of the road where pipelines of Humble Oil Co. cross Carter's Creek Road, Brazos County. Name derived from community of Rock Prairie on Highway 6, 3½ miles south of corner of campus of A & M College of Texas. Section is composed of the compilation of the outcrops along the road, and those exposed in the branches on either side of the road.

Rock Riffle limestone member

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 131–133. Fresh-water limestone in Harlem cyclothem. Lies beneath Harlem underclay member and above Round Knob redbed member. Typically gray, weathering greenish gray; nodular to bedded and enclosed in greenish gray clay shale. Thickness about 4½ feet.

Named for exposures along Rock Riffle Run, a small tributary on south side of Hocking River, Athens Township, Athens County.

Rock River Formation[1] or Dolomite

Upper Cambrian: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 397. Lowest formation of Philipsburg series. Thickness about 500 feet.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

Rock Run Limestone[1]

Upper Ordovician (Richmond) : Northeastern Illinois.

Original reference: J. R. C. Evans, 1926, Chicago Univ., Abs. Theses, Sci. ser., v. 2, p. 199–200.

Type locality not stated.

Rock Springs Beds

Miocene and Pliocene : Central Arizona.

C. S. St. Clair, 1957, Plateau, v. 30, no. 2, p. 36, 37, fig. 2. Volcanic flow rocks and tuffaceous and clastic sandstones. Flow rocks are olivine basalt, hornblende basalt, and hornblende andesite. Tuffaceous sandstones made up mostly of fine-grained pumice with small amounts of rounded sand grains of quartz and feldspar and dark minerals. Locally in sequence are boulder conglomerates probably of fluviatile origin. Beds have been extensively eroded but represent Cenozoic rocks that may have been up to 2,000 feet thick. Underlie Pleistocene gravels.

Sequence is east of Bradshaw Mountains near Rock Springs, south-central Yavapai County.

Rock Springs Formation (in Mesaverde Group)[1]

Upper Cretaceous : Southwestern Wyoming and northeastern Utah.

Original reference : A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

W. R. Hansen and M. G. Bonilla, 1954, Colorado Sci. Soc. Proc., v. 17, no. 1, p. 4 (fig. 1), 9–10. Geographically extended into Daggett County, Utah, where it underlies Erickson formation and overlies Blair formation. Thickness 1,090 feet in Flaming Gorge area; 100 feet in Clay Basin. Intertongues with Hilliard shale toward east.

W. R. Hansen, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–101. Described in Clay Basin quadrangle, Utah, as interbedded pale-grayish-orange to light-brown fine-grained sandstone and gray Hilliard-like shale becoming punky toward top; capped by massive pale-grayish-orange to white very fine grained cliff-forming sandstone. Contact with underlying Hilliard shale mapped arbitrarily at base of a grayish-orange fine-grained sandstone bed, 24 feet thick, that separates a predominantly shale sequence below from interbedded shale, sandy shale, and sandstone above.

Present in Rock Springs uplift, Sweetwater County, Wyo.

Rock Stream Siltstone Member (of Sonyea Formation)

Rock Stream Flagstone Member (of Cashaqua Shale)

Upper Devonian : Western New York.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 12–13, pl. 3. Name proposed for flagstone member in upper part of Cashaqua shale. Consists of sequence of alternating flagstones and shale.

Thickness 180 feet. Underlies Parrish limestone lentil; overlies lower unnamed shale with sharply defined contact.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Redesignated as Rock Stream siltstone member of Sonyea formation. Is eastern lateral equivalent of large part of Cashaqua shale member. Throughout its extent in area studied, the Rock Stream is underlain by Pulteney shale member (new) and overlain by Cashaqua shale member. Not present west of eastern Livingston County. At westernmost exposure, near Hemlock Lake, consists of two beds of siltstone, from 2 to 5 inches thick, separated by 4 feet of silty gray shale. Thickens eastward. About 217 feet thick along Hamilton Creek 2½ miles west of Watkins Glen.

R. G. Sutton, 1960, New York State Mus. Sci. Service Bull. 380, p. 14–17, 54, 55–56. Member of Cashaqua formation. Overlies Sawmill member (new). After submission of this paper for publication, Colton and de Witt (1958) proposed name Pulteney for unit herein named Sawmill Creek; former name thus has priority.

Named from exposures on Rock Stream in northwestern part of Watkins quadrangle, Reading Township, Schuyler County.

Rocktown Channel Sandstone Member (of Dakota Sandstone)[1]

Rocktown Sandstone Member (of Ellsworth Formation)

Upper Cretaceous: North-central Kansas.

Original reference: W. W. Rubey and N. W. Bass, 1925, Kansas Geol. Survey Bull. 10, p. 16, 57–65.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Reallocated to member status in Ellsworth formation (new) of Dakota group. Overlies Terra Cotta shale member (new).

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Dakota formation, as herein defined, contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Named for exposures at and near the large group of "hoodoos" or houselike blocks of sandstone in NW¼ sec. 4, T. 13 S., R. 11 W., locally known as Rocktown, Russell County.

Rockvale Sandstone Member (of Vermejo Formation)[1]

Upper Cretaceous: Eastern Colorado.

Original reference: W. T. Lee, 1917, U.S. Geol. Survey Prof. Paper 101, p. 163–169.

Named for typical development near Rockvale, Fremont County.

Rockville Conglomerate[1]

Tertiary or Quaternary: Northeastern Iowa.

Original reference: W. J. McGee, 1891, U.S. Geol. Survey 11th Ann. Rept., pt. 1, p. 304.

S. D. Tuttle and R. C. Northup, 1955, Iowa Acad. Sci. Proc., v. 62, p. 366–372. Rockville conglomerate should be updated in age to Tertiary-Quaternary and extended to include a new outcrop at Olin, Jones County.

Named for Rockville, Delaware County.

Rockville Granite

Rockville Quartz Monzonite (in Stearns Magma Series)

Precambrian (middle Keweenawan) : Central Minnesota.

Eleanor Tatge, 1939, Am. Mineralogist, v. 24, no. 5, p. 303–316. Unusually coarse-grained granite with abundant microcline phenocrysts and very little secondary alteration. Rockville granite has been used as a trade name for granite quarried near St. Cloud [and Rockville].

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1006. Quartz monzonite and porphyritic quartz monzonite; typically pink, ranges to dark reddish gray. Included in Stearns magma series; grades into St. Cloud red facies of series.

Crops out between St. Cloud and Richmond, Stearns County. Most characteristic exposure is at Rockville.

†Rockville Member (of Skaneateles Formation)[1]

Middle Devonian : Eastern Pennsylvania.

Original reference: Bradford Willard and A. B. Cleaves, 1933, Geol. Soc. America Bull., v. 44, no. 4, p. 768, 781.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 16, 138. Pre-occupied name Rockville replaced by Fort Hunter sandstone.

First studied at Rockville, on Susquehanna, in Dauphin County.

†Rockville Sandstone[1]

Upper Devonian : Southwestern New York.

Original reference: H. S. Williams, 1887, U.S. Geol. Survey Bull. 41, p. 51, 73.

Exposed at old Rockville, which is 1 mile west of present Rockville, Allegany County.

Rockwell Formation[1] (in Pocono Group)

Rockwell Member (of Pocono Formation)

Lower Mississippian : Northeastern West Virginia and western Maryland.

Original reference: G. W. Stose and C. K. Swartz, 1912, U.S. Geol. Survey Geol. Atlas, Folio 179.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources, p. 91. In PawPaw-Hancock area, the Pocono is considered to have group rank and is divided into five formations; in western Maryland, where the five units cannot be differentiated, the Pocono is treated as a formation and the Rockwell as a member. Consists of greenish to gray crossbedded arkosic sandstone, fine conglomerate, and buff shales with some dark shales that locally contain coal seams. Thickness 540 to 550 feet on Sideling Hill, Washington County, Md. Underlies Purslane member.

Named for exposures in Rockwell Run, Morgan County, W. Va.

Rockwood Formation[1]

Lower and Middle Silurian : Eastern Tennessee and northwestern Georgia.

Original reference : C. W. Hayes, 1891, Geol. Soc. America Bull., v. 2, p. 143.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pls. 11, 12, 13. At Rockwood, the formation, if the Sequatchie is removed, is entirely lower Silurian, but in other areas middle Silurian and perhaps even higher rocks are present. Clinch sandstone and Rockwood formation are mainly

contemporaneous phases of lower and middle Silurian and, in areas intermediate between the two type localities, grade into each other, though in any one section the sandstone lies chiefly below. Underlies Hancock limestone; overlies Sequatchie formation.

Named for Rockwood, Roane County, Tenn.

Rockwood Oolite[1] Member (of Bangor Limestone)

Mississippian: Northwestern Alabama.

Original reference: W. B. Jones, 1928, Alabama Geol. Survey Circ. 8, p. 13–15.

W. B. Jones, 1939, Econ. Geology, v. 34, no. 5, p. 575, 576–577. Thickness at type locality about 55 feet. Overlies Spout Spring oolite member (new).

Type locality: Near Rockwood, Franklin County.

†Rockwood Sandstone[1]

Silurian: Northwestern Georgia.

Original reference: C. W. Hayes, 1894, U.S. Geol. Survey Geol. Atlas, Folio 2.

East of Chattooga Valley.

Rockwood Sandstone (in Chester Group)[1]

Mississippian: Southwestern Illinois.

Original reference: S. Weller, 1913, Illinois Geol. Survey Bull. 22, p. 31.

Probably named for Rockwood, Randolph County.

Rocky Branch bone bed (in Jeffersonville Limestone)

Middle Devonian: Southeastern Indiana.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 282–283. Name applied to bone bed near top of Jeffersonville limestone.

Crops out on Rocky Branch, northwestern Jennings County.

Rocky Butte Volcanics

Pleistocene: Northern Oregon.

R. C. Treasher, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2034. Name applied to a series of volcanic flows that capped many hills in Portland area prior to or during early stages of continental glaciation.

Rocky Canyon Granite[1]

Jurassic or Cretaceous: Northwestern Nevada.

Original reference: C. P. Jenney, 1935, Nevada Univ. Bull., v. 29, no. 6, p. 37–42.

Crops out over 6 square miles in lower Rocky and Wright's Canyons and elsewhere in Humboldt Range.

Rocky Cedar Limestone

Rocky Cedar Creek Limestone Lentil (in Kincaid Formation)[1]

Eocene: Northeastern Texas.

R. A. F. Penrose, Jr., 1890, *in* E. T. Dumble, Texas. Geol. Survey 1st Ann. Rept., p. 19–20. At Rocky Cedar Creek, is deposit of shell limestone, composed almost entirely of shells of lower Eocene fossils. It is traceable up and down Rocky Cedar Creek for 7 miles, and underlies divide between Rocky Cedar and Muddy Cedar Creeks, a distance of 4 miles. Section of well on this divide shows: lower shell limestone 3 to 4 feet thick,

coarse sand, 1½ to 2 feet, shell limestone, 3 to 4 feet, gray and yellow clay (Basal Clays), 9 feet, gray and buff sand, 3 feet. About 1 mile below point where Texas Pacific Railroad crosses Rocky Cedar, an outcrop 15 feet thick of this limestone is present, and as it still forms bed of the creek, its thickness here must be still greater than that. Village of Elmo is situated on Muddy Cedar, and just beyond is black prairie region showing Cretaceous fossils. Consequently Rocky Cedar limestone is probably lowermost bed of Tertiary series in this part of State.

Lentil typically exposed in Ola quarry, 1 mile south of Ola and along Rocky Cedar Creek between Ola and Wills Point, Kaufman County.

†Rocky Comfort Chalk[1]

Upper Cretaceous (Gulf Series) : Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72. 89–95, 188.

Named for exposures at Rocky Comfort, Little River County.

Rock Flats Alluvium

Pleistocene (Nebraskan or Aftonian) : Northeastern Colorado.

G. R. Scott, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1541, 1542 (table 1). Name applied to oldest widespread alluvium recognized in Denver area. Where typically exposed, occurs as a sheet, 10 to 40 feet thick, of reddish-brown poorly sorted stony coarse sand that unconformably overlies Mesozoic bedrock on a pediment about 1,600 feet below level of a subsummit surface on the Front Range. Occurs 100 feet above next younger alluvium here named Verdos.

Typically exposed in gravel pit at east edge of Rocky Flats in NW¼SW¼ sec. 23, T. 2 S., R. 70 W., Golden quadrangle.

Rockyford Ash Member (of Sharps Formation)

Miocene: Southwestern South Dakota.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500) : South Dakota Geol. Survey. Consists of as much as 38 feet of silty volcanic ash and ashy silt layers that are white, buff, tan, and reddish brown. Conformably underlies upper part of formation and conformably overlies Brule formation. Name credited to John Nicknish (unpub. thesis).

Type locality and derivation of name not given.

Rocky Gap Sandstone (in Helderberg Group)[1]

Lower Devonian: West Virginia and southwestern Virginia.

Original reference: F. M. Swartz, 1929, Pennsylvania Acad. Sci. Proc., v. 3, p. 80.

P. H. Price and H. P. Woodward, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 11, p. 1987. Present in vicinity of Bluefield where it has locally been mistaken for Oriskany sandstone.

Well exposed in Rocky Gap, W. Va.

Rocky Hill Volcanics (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull 30, p. 74–75.

G. A. Macdonald and D. A. Davis *in Jacques* Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 130. Thickness of lava

probably 40 feet; Rocky Hill cone 130 feet high, base not exposed. Overlain by Sugar Loaf basalt and by sand and coral of the plus 25-foot (Waimanalo) stand of sea. Extent noted.

Named for Rocky Hill, largest of the four cinder cones. Exposed over area of about 0.1 square mile in lower end of Manoa Valley, on south side of Koolau Range about 11 miles west of Makapuu Head.

Rocky Mound Limestone Member (of Graham Formation)[1]

Rocky Mound Limestone (in Graham Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: Wallace Lee *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 40–45.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook, May 25–26, p. [16], [17], fig. 4. Shown on generalized columnar section as Rocky Mound limestone in Graham group; occurs below Wayland shale and above Upper Gunsight limestone. Limestone is possibly a bioherm; consists mainly of crinoid fragments and a few fusulinids bound together with algal filaments.

Well exposed on southwest slope of Rocky Mound, 3 miles northeast of Graham, Young County.

Rocky Point Beds

Rocky Point Formation

Oligocene, upper: Northwestern Oregon.

F. W. Libbey, W. D. Lowry, and R. S. Mason, 1945, Oregon Dept. Geology and Mineral Industries Bull. 29, p. 8–9. Name Rocky Point beds applied to marine sandstones exposed in eastern Washington County, in Portland Hills area in Multnomah County, and along Dixie Mountain Road between Shady Brook School and Wallace School in sec. 18 and SW¼ sec. 5, T. 2 N., R. 2 W., and in numerous cuts along the Rocky Point Road which leads east from Skyline Boulevard to U.S. Highway 30. In most places, sandstones seem to occupy windows in overlying Columbia River basalt. Fossil evidence indicates that beds are upper Oligocene or somewhat younger.

M. L. Steere, 1955, Geol. Soc. Oregon Country News Letter, v. 21, no. 10, p. 85. Name Rocky Point formation proposed for Cowlitz formation in northwest Oregon. Type locality designated. Name credited to R. J. Deacon (unpub. thesis).

Type locality: On Rock Creek in vicinity of Keasey Station, Columbia County.

Rocky Point Conglomerate (in Deese Formation or Group)

Pennsylvanian (Desmoinesian): Southern Oklahoma.

C. W. Tomlinson, 1937, Ardmore Geol. Soc. [Guidebook] Field Trip, March 13, Road log, p. 1, 2, geol. map. Chert conglomerate in upper Deese formation.

Lynn Jacobson, 1959, Oklahoma Geol. Survey Bull. 79, p. 28 (fig. 11), 35. Rocky Point member of Deese group is about 1,400 feet above Arnold limestone. Maximum thickness 70 feet; much of thickness is sandstone. Much of outcrop covered by Lake Murray.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc. Petroleum Geology of southern Oklahoma—a symposium, v. 2: Tulsa,

Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 32–33. Rocky Point conglomerate, in Deese group, is about 1,600 feet below Camp Ground member (new). Desmoinesian. Name credited to Guthrey and Milner (unpub. ms.).

Occurs in area south of Ardmore.

Rocky Ridge Sandstone Member (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: M. W. Ball, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, no. 1, p. 81–87.

G. R. Scott and W. A. Cobban, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf. Symposium, p. 128, 129 (fig. 3). Olive-gray fine-grained massive sandstone; contains large calcareous sandstone concretions that weather dark brown. Thickness 97 feet. Separated from overlying Larimer sandstone member by 163 to 187 feet of soft yellowish-gray sandstone and sandy shale with gray sandstone concretions; separated from older Terry sandstone member by 511 to 604 feet of sandy and nonsandy shale.

Named for exposures on north and east banks of Rocky Ridge Reservoir 6 miles north of Fort Collins, Larimer County. Makes prominent ridge at many places between Round Butte and Berthoud. Forms west escarpment of Fossil Ridge.

Rocky Ridge Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: North-central Alabama.

Original references: C. Butts, 1926, Alabama Geol. Survey Spec. Rept. 14; 1927, U.S. Geol. Survey Geol. Atlas, Folio 221.

Named for fact it forms Rocky Ridge, east and northeast of Chaba pumping station in northwestern part of Vandiver quadrangle.

Rocky Run Conglomerate[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1553.

Crops out on Rocky Run, Montour Township, Pike County.

Rocky Woods Conglomerate[1]

Carboniferous: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, table.

In the Great Rock area in Rehoboth, extends eastward to Rocky Woods, near Taunton, Bristol County.

Rod Club Sandstone (in Springer Group)

Rod Club Sandstone Member (of Springer Formation)[1]

Pennsylvanian (Springer Series): Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40–Z, p. 12, 13.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, p. 143. Overlies Goddard shale (new).

M. K. Elias, 1956, *in* Petroleum geology of southern Oklahoma, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2), 89. Rod Club sandstone overlies Goddard shale. Springer series.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 10. Thickness 250 to 400 feet. Consists chiefly of shales; these typically contain several ledges of sandstone, each from 2 to 25 feet thick. Occurs above Goddard shale and 800 to 1,000 feet below Overbrook sandstone. In Springer group which here includes Chesterian and Springeran series. Basal unit of Springeran series as here defined.

Named for outcrops at smaller Rod and Gun Club Lake in NW¼ sec. 7, T. 4 S., R. 2 E., Carter County, on southeast plunging nose of Caddo anticline.

Rodeo Shale (in Monterey Group)[1]

Miocene, middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 69 (table 14), 71, pls. Occurs in southern Carquinez and Mare Island quadrangles. Apparently conformable upon Hambre sandstone where it is exposed in band 1,000 feet wide that extends from San Pablo Bay southwestward in Concord quadrangle. Underlies Briones sandstone. Average thickness 670 feet.

G. D. Robinson, 1956, U.S. Geol. Survey Quad. Map GQ–88. Described in Hayward quadrangle as arenaceous shale, locally porcelaneous, and shaly biotitic arkosic sandstone, with thin but persistent beds of siliceous rocks and limestone. Thickness varies irregularly from less than 100 feet to more than 300 feet; in general thickens southeastward. Overlies middle sandstone and shale of Monterey group; disconformably underlies Briones sandstone.

Named for exposures along Rodeo Creek, in northwest part of Concord quadrangle, Contra Costa County.

Rodessa Formation (in Trinity Group)

Rodessa Member (of Glen Rose Formation)

Lower Cretaceous (Comanche Series): Subsurface in Louisiana, Arkansas, Mississippi, and Texas.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 961 (fig. 4), 970. Lower Glen Rose is divided into Pine Island member below and Rodessa member above. Trinity group, Comanche series. Thickness about 500 feet. Name proposed by Shreveport Geological Society.

R. W. Imlay, 1940, Arkansas Geol. Survey Circ. 12, p. 33–35, cross sections. Rodessa formation includes oolitic to coquinoid limestone, calcareous shale, and two anhydrite beds. Overlies James limestone; underlies Ferry Lake anhydrite. Contains number of members, lentils, and tongues.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Rodessa formation employed as catch-all for beds between James limestone and Ferry Lake anhydrite in subsurface of Arkansas-Louisiana-east Texas area.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2350–2354. Formation redefined as those rocks between base of Ferry Lake anhydrite and base of Young zone (or its stratigraphic equivalent) as recognized in Rodessa field. Type well designated.

Type well: Union Producing Co.'s Caddo Levee Board No. B–1, sec. 26, T. 23 N., R. 16 W., Caddo Parish, La. Interval on electrical log from 5,320 to 5,805 feet represents Rodessa.

Rodman Limestone (in Black River Group)[1]

Rodman Member (of Nealmont Limestone)

Middle Ordovician: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th ser., v. 46, p. 525, 533, 537.

Charles Butts and E. S. Moore, 1936, U.S. Geol. Survey Bull. 855, p. 39–40, pls. 1, 3. In Bellefonte quadrangle, overlies Lowville limestone and underlies Trenton limestone. Thickness 10 to 50 feet. Black River group.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Type Rodman included in Nealmont limestone of Trenton group.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 192. Termed member of Nealmont.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 2, p. 97, 101, 104–105. Further described as uppermost member of Nealmont limestone. Composed of impure, brownish-weathering limestone, darker than rest of Nealmont, and thin beds of white-weathering dense limestone; frequently has nodular chert in lower part. Thickness about 30 feet in type area; 26 feet in section near Tusseyville. Overlies Centre Hall member; underlies cobbly beds below metabentonite 0 of Salona limestone. Lower limit gradational and cannot be defined readily; essential conformity exists between Nealmont and Salona, though angular unconformity found locally. Type section designated.

Type section: Along Highway 322, 1 mile west of Tusseyville, 3 miles south of Centre Hall and 6 miles east of Oak Hall, Centre County. Named at Rodman Station, near Roaring Springs, Blair County.

Rodriquez Tank Sandstone

Ordovician: Western Texas.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 20. White to buff quartzose sandstone 20 to 50 feet thick. Occurs between Marathon limestone and Fort Pena formation. Graptolites characteristic of uppermost part of the Marathon were collected 3 inches below the sandstone, and graptolites diagnostic of basal beds of Fort Pena were collected 1 inch above the sandstone; thus stratigraphic position was determined from paleontological evidence. Alsate shale commonly present between Marathon, and Fort Pena is absent in this area.

Type locality: Northern part of the Solitario, Brewster County. Named for outcrops near Rodriquez Tank. Sandstone is a continuous unit and commonly stands out forming a low ridge in area of Ordovician outcrop in the Solitario and a prominent bench in old Jones Ranch (now Slaughter Ranch) locality. Outlines recumbent anticline below Cretaceous rim in Jones Ranch area.

Roger Park Basaltic Breccia

Pliocene(?): Southwest-central Utah.

Eugene Callaghan, 1939, Am. Geophys. Union Trans. 20th Ann. Mtg., pt. 3, p. 439 (fig. 2), 440 (fig. 3), 446–447. Flows near top of formation are

dark gray with distinctly basaltic appearance; breccias are various shades of gray or red, and fragments commonly vesicular. Maximum thickness in mapped area as much as 2,000 feet. Position of Roger Park in volcanic sequence of region not clear. Breccia overlain by latite grouped with Dry Hollow latite (new) and underlain by latites and breccia of Bullion Canyon volcanics (new). May be facies of Bullion Canyon volcanics. Tertiary.

The U.S. Geological Survey currently considers the Roger Park to be Pliocene(?) in age. This designation is made on the basis of restudy of Bullion Canyon Volcanics, now considered to be Miocene(?).

Occurs in Marysvale region. Derivation of name not stated.

Rogers Chalk Lens (in Taylor Marl)[1]

Upper Cretaceous (Gulf Series) : Northern central Texas.

Original reference: W. S. Adkins and M. B. Arick, 1930, Texas Univ. Bull. 3016, p. 65.

Type locality: On a small creek from about 1 mile to 1¼ miles south and a little west of Rogers, Bell County.

Rogers City Limestone or **Formation**

Middle Devonian: Northeastern Michigan.

G. M. Ehlers and R. E. Radabaugh, 1937, Michigan Acad. Sci., Arts, and Letters, Sec. Geology and Mineralogy [Guidebook] 7th Ann. Field Excursion [p. 8–9]. Name applied to limestone overlying Dundee limestone and disconformably underlying Bell shale of Traverse group. Thickness 69½ to 72½ feet.

G. M. Ehlers and R. E. Radabaugh, 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v. 23, p. 441–445. As proposed, name Rogers City is applied to limestone and dolomite strata formerly considered part of the Dundee which is here restricted to lower 140 feet of section. Lower 8 to 9 feet of Rogers City is dolomite; upper part is limestone. Rogers City fauna is distinctive from that of Dundee.

Type locality: Quarry of Michigan Limestone and Chemical Co., at Rogers City, Presque Isle County.

Rogers Creek Member (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska (subsurface and surface).

C. L. Whittington, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 249, 250, 251, fig. 5. About two-thirds of member is medium-gray to medium-light-gray clay shale in type section. Listed in order of importance, rocks interbedded with the clay shale are tuff, siltstone, silt shale, sandstone, and bentonite. Thickness about 700 feet in vicinity of Umiat, 585 to 595 feet at type section. Lowest named member of formation. Rogers Creek member and overlying Barrow Trail member (new) defined to include rocks overlying Tuluvak tongue of Prince Creek formation that were formerly included in Tuluga member of Schrader Bluff formation. Very poorly exposed in Umiat area but is expressed as areas of subdued topography enclosed by cuestas formed by Barrow Trail member.

Type section: Gubik test well No. 1 from 295 to 890 feet and Gubik test well No. 2 from 555 to 1,140 feet. Named from upper part of Rogers Creek, about 10 miles S. 80° W. of Umiat Mountain where subdued topography is typically developed.

Rogers Gap (division) Member (of Cynthiana Formation)[1]

Middle Ordovician: Central Kentucky.

Original reference: A. F. Foerste, 1912, Denison Univ. Sci. Lab. Bull. 17, p. 19, 23, 42, 44.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1642. Division of Cynthiana. Thin- to medium-bedded limestone and shale with distinctive fauna. Overlies Nicholas limestone; underlies Fulton shale. Gratz shale division includes Rogers Gap in its upper part. Pre-Cincinnatian.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 18. All subdivisions of interval between top of Benson limestone and base of Eden formation should be referred to as members of the Cynthiana. This includes the lithologic and paleontologic units heretofore defined as Brannon, Woodburn, Greendale, Millersburg, Nicholas, Rogers Gap, Bromley, and Gratz.

L. H. Lattman, 1954, Am. Jour. Sci., v. 252, no. 5, p. 257, 268. Rogers Gap [member of Cynthiana formation] formation, uppermost member of the Mohawkian, and the overlying Fulton shales, lowermost member of the Cincinnatian, are faunally indistinguishable in this area [Ohio Valley around Cincinnati]; they appear to be lithologic facies of same time-rock unit. The Rogers Gap and Fulton rest northwardly on the Nicholas and southwardly on the Greendale; they are not present over top of Jessamine dome; Fulton (shale phase) is absent in some places toward center of dome, and the Million (Eden) rests directly on the Rogers Gap. The faunal and lithologic evidence indicates the advisability of extending the Cincinnatian series downward to embrace the Cynthiana formation, rather than including this formation in Mohawkian as has been the common practice.

Probably named for Rogers Gap, Scott County.

Rogersian series[1]

Precambrian: Montana, and Alberta, Canada.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 44.

Derivation of name not stated.

Rogers Spring Limestone[1]

Mississippian: Southeastern Nevada.

Original references: C. R. Longwell, 1921, Am. Jour. Sci., 5th ser., v. 1, p. 46; 1928, U.S. Geol. Survey Bull. 798.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 930 (table 1). Chiefly gray crystalline limestone with some cherty zones. Thickness about 600 feet. Underlies Bluepoint limestone; overlies Muddy Peak limestone Mississippian.

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 518–519. Lower Mississippian. Thickness Virgin Mountain section 577½ feet.

Ben Bowyer, E. H. Pampeyan, and C. R. Longwell, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–138. Mapped as Mississippian.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). In Virgin Mountains, underlies Illipah formation.

Well exposed along Rogers Spring fault scarp, Clark County.

Rogersville Limestone (in Greene Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 97, 106.

In Greene County.

Rogersville Shale[1] (in Conasauga Group)

Middle Cambrian: Northeastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: M. R. Campbell, 1894, U.S. Geol. Survey Geol. Atlas, Folio 12, p. 2.

John Rodgers, 1943, Geologic map of Copper Ridge district, Hancock and Grainger Counties, Tennessee (1:24,000): U.S. Geol. Survey Strategic Minerals Inv. Prelim. Map. Includes Craig limestone member (new). Overlies Rutledge limestone; underlies Maryville shale.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 48–51. In eastern Tennessee, Conasauga varies in lithology and three phases are recognized; in central phase (between Knoxville and Morristown, and north of Clinch Mountain), the Conasauga is considered a group consisting of six formations of which the Rogersville shale is third in sequence (ascending). Underlies Maryville limestone; overlies Rutledge limestone. Thickness 0 to 250 feet.

Named for exposures at and near Rogersville, Hawkins County, Tenn.

Rogue Formation

Upper Jurassic: Southwestern Oregon.

F. G. Wells and G. W. Walker, 1953, Geology of the Galice quadrangle, Oregon: U.S. Geol. Survey Geol. Quadrangle Map [GQ–25]. Name given to a sequence of metavolcanic rocks and small related intrusives of Upper Jurassic age. Sequence consists of intimately intermixed fine- to coarse-grained tuffs, agglomerates, flow breccias, and flows and their metamorphic equivalents. These types can be differentiated only in extensive waterworn exposures. Estimate of thickness depends on an assumption as to the thickening due to folding; thickness at type locality probably 15,000 feet. Bounded on west by Dothan formation; both formations dip steeply eastward; evidence indicates that volcanic rocks of the Rogue were deposited on sedimentary rocks of the Dothan prior to deformation; Galice formation lies to the east of the Rogue.

Type section: Along Rogue River, Galice quadrangle. Formation almost continuously exposed along Rogue River from confluence of Whiskey Creek to Almeda mine, along lower 5 miles of Grave Creek and along lower reaches of Reuben Creek.

Rogue River Flows, Pumice Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 81, 90–92, pl. 19 (fig. 2). Rogue River flows (pumice flows) were products of glowing avalanche that followed Rogue River and its tributaries. The flows united near confluence with Union Creek, and composite flow continued for 20 miles to point 1½ miles above present site of village of McLeod. End of flow lies 35 miles from former summit of Mount Mazama. Glowing avalanches of pumice were part of final activity of Mount Mazama and followed what is termed main pumice fall.

Rogue River is west of Crater Lake.

Rogue River Group[1]

Cretaceous: Southwestern Oregon.

Original reference: T. Condon, 1902, The two islands.

Named for Rogue River valley.

Rohnerville Formation

Pleistocene, upper(?): Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 63, pls. 1, 2. Warped terrace deposit, predominantly gravel with lesser amounts of sand, silt, and clay; unfossiliferous. Thickness 10 to 25 feet. Overlies Carlotta formation (new) with angular unconformity. No positive statement regarding age can be made; it is post-Hookton and thus probably upper Pleistocene.

Formation is of limited extent; restricted to surface upon which Rohnerville and Fortuna are built and to isolated surface known as Grizzly Bluff, Humboldt County.

Rolling Fork Limestone Member (of Brodhead Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 152, pl. 25. Upper member of Brodhead formation, Athertonville facies (new). Dense and siliceous to crinoidal cherty limestone about 60 to 80 feet thick. Underlies Floyds Knob formation; overlies Ginseng siltstone member (new) of Brodhead formation.

Well exposed along road leading up hill west of old Ginseng post office, southeastern Larue County. Probably named for Rolling Fork of Salt River which forms boundary between Larue and Nelson Counties.

Rollins Sandstone Member (of Mesaverde Formation)[1]

Rollins Sandstone Member (of Mount Garfield Formation)

Upper Cretaceous: Central western Colorado.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 341, p. 320 (table), 322.

C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23 (table), 40, 41, 44. In Book Cliffs coal field, Colorado, Rollings sandstone is basal member of Mount Garfield formation (new). Thickness 71 feet at Book Cliff mine. In Grand Mesa region, the Rollins is basal member of Mesaverde.

E. C. Dapples, 1939, Econ. Geology, v. 34, no. 4, p. 371. In Anthracite-Crested Butte quadrangles, strata near village of Baldwin that Lee identified as Bowie are believed to underlie Rollins sandstone forming part of a new member herein called Baldwin sandstone. Hence, the Rollins overlies the Baldwin sandstone member and underlies Paonia shale member.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 19. Southeast of Colorado River, beds of lower part of Mount Garfield formation below Rollins sandstone member pass into marine shales indistinguishable from Mancos shale, and the Rollins becomes basal member of the Mesaverde. Rollins sandstone member was said by Lee to rest on Mancos shale throughout Grand Mesa area. Paonia member rests, according to Lee, on Rollins sandstone member in western part of Grand Mesa area, but toward east the Bowie member appears and gradually increases in thickness eastward. According to Boyer (written commun.), Lee misidentified his units in Grand Mesa field. Upper member

of Sego sandstone of present report was mistaken for Rollins, and strata between the upper Sego and Rollins were referred to Bowie shale member.

Forms conspicuous cliff at Rollins mine, north of Delta, Delta County.

Roll Quarry Limestone[1]

Age(?): West-central Vermont.

Original reference: E. J. Foyles, 1929, Vermont State Geologist 16th Rept., p. 283.

Rolls Ford Shale Member (of McLeansboro Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1915, Illinois Geol. Survey Bull. 20, p. 99–107.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 100. Marine shale and impure limestone in lower McLeansboro, probably above Danville (No. 7) coal.

Exposed at Ralls Ford (Rolls Ford) on Sangamon River, 4 miles northwest of Springfield, Sangamon County.

Roma Sandstone Member or Tongue (of Fayette Formation)[1]

Eocene, upper: Southern Texas, and Tamaulipas, Mexico.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1376, 1383, 1387.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 268. Thickness of tongue (or member) 250 to 300 feet at Roma. Thins northward and wedges out completely near Laredo. Composed almost entirely of massive and crossbedded medium- to fine-grained sandstones which are fossiliferous; large calcareous sand concretions common throughout member. Overlies Resendez shale tongue (new); underlies Gorgora shale member (new).

Exposed at International Bridge, San Pedro de Roma on Mexican side of Rio Grande from Roma, Starr County, Tex.

Romance Arkose[1]

Precambrian: Northwestern Vermont.

Original reference: W. G. Foye, 1919, Vermont State Geologist 11th Rept., p. 84.

Probably named for Romance Mountain, in western part of Rochester quadrangle, in Addison County.

Rome Formation[1]

Lower Cambrian: Northwestern Georgia, northern Alabama, western North Carolina, eastern Tennessee, and southwestern Virginia.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. on Cahaba coal field, p. 149.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 8. Ivanhoe limestone member of Shady dolomite herein considered basal member of Rome formation.

B. N. Cooper, 1939, Virginia Geol. Survey Bull. 55, p. 8–10, pl. 2. In Draper Mountain area, Virginia, overlies Shady formation; underlies Elbrook formation. Consists of red, green, and yellow shales and siltstones; many intercalations of argillaceous dolomite. Thickness 2,000 feet.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 14–16. Described in connection with manganese deposits in northeastern Tennessee. Lower and Middle Cambrian.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 4–7. Underlies Pumpkin Valley shale (new); shale was formerly included in Rome formation. Stratigraphic section at Lee Valley, Hawkins County given; here 513 feet of Rome is exposed.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 12–17, pl. 1. In Cartersville district, Georgia, the Rome overlies Shady formation, or where Shady is absent, the Weisner formation. In extreme western part of the district, formation consists largely of crystalline dolomite and limestone whose maximum thickness is about 1,800 feet. In southeastern part, consists largely of metashale whose thickness is at least 2,000 feet. Carbonate rocks and metashale intergrade. Some dolomite formerly included in the Shady are here included in the Rome. Underlies Conasauga formation.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (geol. maps); pt. 2, p. 43–45. Summary discussion of usage of name. [See bibliography entry for Hayes and Keith, this report.] Rome formation as mapped herein [eastern Tennessee] includes Apison shale member but excludes overlying "Rome shale" as used by Hayes and Keith which belongs to Conasauga group. In this usage, Rome corresponds to Safford's (1869, Geology of Tennessee) Knox sandstone. Formation is a heterogeneous and variegated mixture of sandstone, siltstone, shale, dolomite, and limestone; proportions vary greatly. Stratigraphy of the Rome is one of major problems of east Tennessee stratigraphy; Rome occurs chiefly just above major thrust faults, is commonly folded and imbricated, and shows no base; fossils are comparatively rare. Thickness in northeast Tennessee 1,200 feet or more; elsewhere, base is missing, and thickness is unknown but is more than 700 feet in many places. Fossils of both Lower and Middle Cambrian are reported from the formation, but it is believed that the Middle Cambrian fossils come from the "Rome shale" unit; hence, most if not all of the Rome as mapped here is of Lower Cambrian age.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 40. Formation conformably overlain by Honaker limestone in Hot Springs area and occurs as single small patch in northernmost part of window.

Named for exposures at Rome, Ga.

†Rome Sandstone[1]

Lower Cambrian: Northwestern Georgia and southeastern Tennessee.

Original reference: C. W. Hayes, 1894, U.S. Geol. Survey Geol. Atlas, Folio 2.

Probably named for exposures south of Rome, Ga.

Romeo Member (of Joliet Formation)

Silurian (Niagaran): Northern Illinois.

D. L. Graf, 1952, Illinois Geol. Survey Rept. Inv. 161, p. 2, 3 (table 1). Very fine grained dolomite; widespread.

Occurs in Chicago area. [Graf (p. 2) states that he obtained his samples from Willman. Willman (1943, Illinois Geol. Survey Rept. Inv. 90, p. 26–27) divides Joliet formation into five unnamed members, A to E; on

p. 27 he [Willman] mentions locality at Romeo but name is not applied to any of his units].

Romero Conglomerate Lentil (in Debris Dam Sandstone)

Upper Cretaceous: Southern California.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1730 (fig. 2), 1733 (fig. 3). 1741. Lenticular conglomerate beds in Debris Dam sandstone (new). Well cemented; pebbles and cobbles are largely siliceous types mostly 2 to 8 inches, with some as much as 14 inches in diameter; matrix is dark arkose, which also occurs as interbeds between gravel layers of member. Although lenticular in detail, conglomerate is persistent in general, where one gravel layer tapers out another begins above or below it. Thickness, if intervening sandstone beds are included, ranges up to 2,000 feet. South of Santa Ynez fault, disconformably (?) underlies Juncal formation (new).

Occurs south of Santa Ynez River, northeast of Santa Barbara, Santa Barbara County.

Romney Shale[1]

Middle Devonian: Eastern West Virginia, western Maryland, southern Pennsylvania, and northern Virginia.

Original reference: N. H. Darton, 1892, Am. Geologist, v. 10, p. 13, 17.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 305–308. Romney shale restricted. Millboro shale, as named and as here used, includes only the Marcellus and Naples (basal Portage) shales of original Romney. In Frederick and Shenandoah Counties, Romney (restricted) includes at base much black and gray fissile shale, which rests normally upon Onondaga shale. This shale is overlain by a commonly fossiliferous mass of rock, the Hamilton, composed largely of compact very fine-grained olive-green argillaceous sandstone. Upper part of Romney (restricted) is dark-colored to black sandy fossiliferous Naples shale with *Paracardium* and *Probeloceras*, extending up to the light-greenish shale of succeeding Brallier.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 245–253. In its reports describing eastern counties (1916–39), the West Virginia Geological Survey abandoned term "Romney," indicating that its several horizons were individually recognizable. Name Romney is without adequate support because it cannot be used for any precise chronological position. Name must either be entirely redefined or abandoned. It is suggested that Romney be hereafter used to designate the black-shale Devonian facies of whatever age. In terms of this proposal, Romney black shale stands for rocks of this facies wherever they occur in geologic column of Appalachian Devonian.

Ernst Cloos. 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 87–89. Romney shale, in Maryland, comprises (ascending) Onondaga shale, Marcellus black shale, and Hamilton members. Overlies Ridgeley sandstone member of Oriskany formation; underlies Jennings formation.

F. G. Lesure, 1957, Virginia Polytech. Inst. Engineering Expt. Sta. Ser. 118, p. 18 (table 1), 20 (table 2). Described in Clifton Forge iron district where it includes Needmore shale member below and Millboro shale

member above. Overlies Ridgeley sandstone; underlies Brallier formation. Thickness 800 to 1,200 feet. Includes most of Middle Devonian and probably includes a little of the Upper Devonian.

Named for exposures at Romney, Hampshire County, W. Va.

Rondout Limestone

Rondout Limestone (in Cayuga Group)[1]

Rondout Limestone (in Keyser Group)

Rondout Limestone Member (of Manlius Formation)

Upper Silurian and Lower Devonian: New York and Pennsylvania.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

G. H. Chadwick, 1940, New York Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. In Catskill area, includes Fuyk sandstone member (new). Thickness 2 to 40 feet. Underlies Manlius (Olney limestone); overlies Normanskill.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1182–1184, 1160. Included in Keyser group. White's (1882) Stormville section reexamined. Rondout limestone includes unit correlated with Stormville hydraulic cement bed. Rondout overlies Decker sandstone. Underlies Manlius. Silurian.

H. P. Woodward, West Virginia Geol. Survey, v. 14, p. 175–176. Beds overlying Williamsport ("Bloomsburg") sandstone and below Tonoloway ("Bossardville") limestone in eastern West Virginia, although previously described as "Rondout," are here identified with Wills Creek limestone of Maryland and are treated under that name.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 44, 45–58 [1946]. Rondout waterlime includes Fuyk sandstone locally, and Glasco limestone lentil (new) near top. Underlies Manlius (Olney); overlies Normanskill. Upper Silurian.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Formation included in Helderbergian series. Underlies Thacher member (new) of Manlius formation.

Colgate University staff and students, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 2 (columnar section), 4, Referred to as member of Manlius formation. Overlies Cobleskill limestone member; underlies Olney limestone member. Columnar section (p. 2) shows Rondout member of Manlius group.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. Base of Devonian system of New York is apparently not at base of Coeymans of eastern part of State where it has been placed for many years. Present information indicates that underlying Rondout and Cobleskill formations are probably also Devonian in age.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Chart shows upper part of Chrysler (Rondout) waterlime as Devonian; lower part is Upper Silurian.

U.S. Geological Survey currently designates the age of the Rondout Limestone as Upper Silurian and Lower Devonian on the basis of a study now in progress.

Named for development in cement quarries at and near Rondout County, N.Y.

Ronkonkoma Stade, Drift

Ronkonkoma Substage[1]

Pleistocene: Southeastern New York.

Original reference: A. C. Veatch, 1903, Jour. Geology, v. 11, p. 766–776.

Occurs on eastern end of Long Island. Probably named for town and lake of Ronkonkoma.

Roodhouse Coal Member (of Carbondale Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 47 (table 1). Member of Carbondale formation. Lies between Shawneetown coal member and Summum (No. 4) coal member. Recognized only in vicinity of type locality.

Type locality: NW¼ sec. 21, T. 12 N., R. 11 W., Roodhouse quadrangle, Greene County.

Rooney Chert (in Hannan Limestone)

Rooney Chert Member[1] (of Madison Limestone)

Rooney Limestone

Mississippian (Kinderhook and (or) Osage): Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 14, 47.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (col. 38). Shown on correlation chart as being in Hannan limestone. Underlies Monitor Mountain limestone and overlies Dean Lake chert, both in Hannan limestone, Osagean.

J. M. Andrichuk, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 89. Hall (1952, unpub. thesis) proposed that Deiss' Rooney chert be recognized as a formation and be designated **Rooney** limestone. The Rooney at type section includes about 550 feet of crinoidal limestone, varying to microcrinoidal or sparsely crinoidal in lower part, with interbeds of gray bedded dense fine-grained limestone. Upper boundary is erosional surface, but about 50 miles to southeast, the Rooney is reported by Deiss to be 292 feet thick and overlain by Monitor Mountain limestone. Upper Kinderhook and possibly lower Osage age.

Type locality: On south slope of top of Lone Butte, in SE¼ sec. 23, T. 23 N., R. 13 W., about 15 miles from Pentagon Mountain.

Roop Sandstone Member (of Alhambra Formation)

Eocene, upper: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 54–55, pls. 2F, 3A, 4A. Proposed for 115 feet of brownish-gray medium-grained poorly stratified sandstone with 5 percent of interbedded silty shales; nonfossiliferous. Overlies Castro shale member (new); lies stratigraphically below Pereira shale member (new). May represent a local lens in formation but is well-marked lithologic unit at type locality; term Roop sandstone should be used as a lithologic unit only in type area.

Type section: West limb of Pacheco syncline in cuts along Santa Fe Railway east of east portal of Muir Tunnel, near Martinez, Contra Costa County.

Roosevelt Member (of Apache Group)

Precambrian (Algonkian) : South-central Arizona.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, p. 32. Seventh [upper] member of group. Chert and dark-reddish and purplish siliceous shales. Maximum thickness 30 feet. Underlies Troy quartzite and overlies a vesicular basalt flow south of Roosevelt Dam.

Present locally at and near Roosevelt Dam, Gila County.

Roosville Formation[1]

Roosville Member (of Miller Peak Formation)

Precambrian (Belt Series) : Southeastern British Columbia, Canada.

Original reference: R. A. Daly, 1912. Canada Geol. Survey, Dept. Mines Mem. 38, Map 2, 114°30′ to 115°.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1902. Designated a member of Miller Peak formation in Belt series. Underlies Mount Rowe member (new); overlies Kintla member. Type locality given.

Type locality: Three miles east-northeast of Phillips Creek cascade, near Roosville, British Columbia.

Root Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series) : East-central Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Defined to include strata between Wood Siding formation above and Stotler limestone (new) below. Thickness ranges from about 30 to 90 feet and averages 60 feet. Comprises (ascending) Friedrich shale, Jim Creek limestone, and French Creek shale members.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 15 (table 2), 30–33. Originally, strata comprising Root shale was included in McKissick Grove shale member of Wabaunsee group by Condra (1927, Nebraska Geol. Survey Bull. 1, 2d ser.). Moore (1936, Kansas Geol. Survey Bull. 22) discarded name McKissick Grove and divided strata into 11 formations of which 3, Friedrich shale, Jim Creek limestone, and French Creek shale, are now classified as members of Root shale. Average thickness 38 feet in Wabaunsee County [this report].

Type section: In a roadcut along east-flowing stream near center of N½SE¼ sec. 20, T. 21 S., R. 11 E., Lyon County. Name derived from Root Station on Atchison, Topeka, and Santa Fe Railroad.

Root Valley Member (of Prairie du Chien Formation)

Root Valley Sandstone

Ordovician (Beekmantown) : Southeastern Minnesota and northwestern Iowa.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 59–63. Medium- to fine-grained, white to buff, yellow, or brown rather even-bedded sandstone with hard quartzitic masses that have appearance of arenaceous chert. Thickness 35 to 40 feet. Underlies and is interbedded with Shakopee dolomite; overlies Oneota dolomite. In older geologic literature horizon was known as New Richmond beds or sandstone.

L. A. Thomas and C. A. Balster, 1949, Iowa Acad. Sci. Proc., v. 56, p. 236 (table 1). In discussion of micropaleontological zones in Iowa, Root Val-

ley is shown as member of Prairie du Chien formation. Occurs above Oneota member and below Willow River member.

R. L. Heller, 1956, Geol. Soc. America Guidebook for Field Trips Minneapolis Mtg., Field Trip 2, p. 31–33. Detailed studies of the Root Valley sandstone and the New Richmond sandstone indicate that these two units are one and the same. Based on priority of the name New Richmond, the name Root Valley should be suppressed.

Typically exposed along highway above State Fish Hatchery west of Lanesboro, along river bluff at Preston, in Whitewater State Park, where highway descends from St. Charles, Winona County, Minn.

†Rosalie Granite[1]

Precambrian: Central northern Colorado.

Original reference: S. H. Ball, 1906, Am. Jour. Sci., 4th v. 21, p. 383.

Forms ridge between Mount Evans and Mount Rosalie, Georgetown quadrangle.

†Rosamond Series[1]

Miocene: Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, pl. 1, map.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 135–136. Since Hershey's description, name Rosamond has been applied by later workers to Tertiary stratified rocks exposed in widely separated areas in Mojave Desert, as far north as Ricardo and as far east as Newberry. Many of these exposed sections called Rosamond were found to be of different ages, with one as old as Paleocene and another as young as Pliocene. Hence, the sequence of rocks exposed in Rosamond Hills and originally described by Hershey as Rosamond series, together with probable correlative rocks of Tertiary age exposed in vicinities of Kramer borate area and in Kramer Hills are here named Tropico group.

Type section: Near Rosamond Station, Kern County.

Rosebud Beds[1]

Rosebud facies

Miocene, lower and middle: Central southern South Dakota.

Original reference: W. D. Matthew and J. W. Gidley, 1904, Am. Mus. Nat. History Bull., v. 20, p. 241–246.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1270–1271. Rosebud is name applied to about 500 feet of pinkish sandstone and silty clay, the "lower Miocene of southern South Dakota," and has been used to some extent for bluff-forming layers of eastern part of the Pine Ridge, mainly in Sheridan County, Nebr. Matthew tentatively correlated the Rosebud with lower Miocene of western Nebraska, that is, with the Harrison. The Rosebud in northern Sheridan County encompasses all that is present of following formations: Gering, Monroe Creek, Harrison (old lower Harrison) and at least lower part of Marsland formation (old upper Harrison). Hence, term Rosebud, as far as Nebraska is concerned, is obsolete. However, Rosebud might be retained in northern Nebraska and South Dakota as an inclusive term for correlative formations where they are too indistinct for differentiation.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Rosebud strata of type

locality are traceable southwestward into three (Gering, Monroe Creek, and Harrison) formations of Arikaree group and possibly into part of overlying Marsland formation. However, the "Rosebud" in mapped area is unlike typical Marsland of Nebraska and is here informally called "Rosebud facies" pending further study. In area of report, consists of light-tan to brown interbedded calcareous sands, silts, and clays with large amounts of layered tabular concretions and cemented ledges. At Porcupine Butte, 3 miles east of southern (Manderson) quadrangle, upper contact of the Rosebud with overlying Ash Hollow formation is exposed; in this area, the Rosebud is 235 feet thick.

Well exposed along Little White River in vicinity of Rosebud Agency, Todd County.

Rose Canyon Latite-Andesite Volcanics

Oligocene: Northern Utah.

R. E. Marsell and R. L. Threet, 1960, Geologic map of Salt Lake County, Utah (1:62,500); supplement to Bull. 69 [not yet published]: Utah Geol. and Mineralog. Survey. Named on map legend. Occurs above Butterfield andesite flows (new) and below South Mountain andesite flows (new).

Mapped in southern part of Salt Lake County. Rose Canyon is in unit as mapped.

Rose Canyon Shale[1]

Rose Canyon Shale Member (of La Jolla Formation)

Eocene, lower and middle: Southern California.

Original reference: M. A. Hanna, 1926, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 7, p. 187–246.

L. G. Hertlein and U.S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 66–67. Uppermost member of La Jolla. Attains maximum thickness of at least 300 feet and is most widely distributed member of formation. Unconformably overlies Torrey sand member or overlaps the sand and rests unconformably on Black Mountain volcanics or Cretaceous sandstones. Underlies Poway formation.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Shown on chart as shale member of La Jolla formation. Lower and middle Eocene.

G. B. Oakeshott, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 254 (table). Table lists Rose Canyon shale (formation). Overlies Torrey sand; underlies Poway conglomerate.

Named for exposures at big bend in Rose Canyon, La Jolla quadrangle, San Diego County.

Rosefield Formation

Oligocene: Eastern Louisiana.

J. F. L. Connell, 1960, Southeastern Geology, v. 2, no. 2, p. 59, 115. Listed in catalog of type localities of coastal plain stratigraphic units. Name credited to Delaney (unpub. thesis).

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 100–101. Delaney (1958) in an investigation of Louisiana Vicksburg equivalents restudied Mosley Hill type locality. He reported presence of three mappable units (two silty clay units separated by a sand) between the Danville Landing and the Catahoula. He restricted the Mosley Hill to the

basal unit; the overlying sand he named Sandel formation; the uppermost fossiliferous clays and siltstones he named Rosefield formation. Rosefield at its type locality carries a Vicksburg fauna.

Type locality: Exposures at Rosefield cemetery, near junction of Louisiana State Highways 112 and 126, northwestern Catahoula Parish.

Rose Hill Formation[1]

Rose Hill Formation (in Clinton Group)

Middle Silurian: Maryland, Pennsylvania, and northern Virginia.

Original reference: C. K. Swartz, 1923, Maryland Geol. Survey Silurian vol., see index.

H. P. Woodward, 1941, West Virginia Geol. Survey [Repts.], v. 14, p. 55–91. Geographically extended into West Virginia where it underlies Keefer sandstone and overlies the Tuscarora sandstone. Thickness 200 to 600 feet.

Ernst Cloos and C. H. Broedel, 1943, Geol. Soc. America Bull., v. 54, no. 9, p. 1379 (table 1). Shown on stratigraphic column of Harrisburg, Pa., area as including Keefer sandstone; thickness 700 to 750 feet. Occurs below Bloomsburg red beds and above Tuscarora sandstone.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 112 (fig. 4), 114–119. Described in Burkes Garden quadrangle, Va., where it is 228 feet thick; underlies the Wills Creek sandstone and overlies the Clinch sandstone. Contains no Keefer or Rochester beds. White sandstone, formerly called Keefer in this area, is a part of the Rose Hill.

F. M. Swartz and H. J. Hambleton, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 21. Rose Hill shale and sandstone, in Clinton group, contains Center iron sandstone member (new).

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 6, 20, 23, 30–31, pl. 1. Greenish-gray and grayish-red fossiliferous shale and sandstone. Thickness 650 to 850 feet. Underlies Mifflin formation (new); overlies Tuscarora formation. Includes Burnt Ridge member (new) in middle.

Named for exposures on Rose Hill, Cumberland, Md.

Rose Island Arkose[1]

Carboniferous: Southern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 308, 380.

Occurs on Rose Island, one of Newport Harbor Islands.

Roseland Anorthosite

Roseland Anorthosite (in Virginia Blue Ridge Complex)

Precambrian: Central Virginia.

C. S. Ross, 1941, U.S. Geol. Survey Prof. Paper 198, p. 2–6. Name applied to anorthosite in Roseland district. Consists of antiperthitic andesine. It is cut by numerous quartz veins, dikes rich in ferromagnesian minerals, and large lenticular bodies of a rock called nelsonite; intrudes gneissic quartz monzonite that forms dominant country rock of region. Unit has been referred to as pegmatite and syenite by earlier workers.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 582, pl. 1. White or green, coarse-grained, locally granulated, granu-

lose, monomineralic rock consisting of oligoclase-andesine. Along margins are large tabular grains and veins of blue quartz and inclusions of basement complex gneiss oriented parallel to regional foliation; nelsonite forms dikelike bodies along contact of Roseland with Marshall formation In Piedmont is surrounded by Marshall formation; in Blue Ridge is surrounded by Pedlar formation.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 9. Included in Virginia Blue Ridge complex (new).

Named from exposures near Roseland, Nelson County. Length of mass is about 13 miles, greatest width about 2½ miles, and total area about 22 square miles.

Rosendale Limestone Member (of Salina Formation)[1]

Upper Silurian: Eastern New York.

Original reference: J. Hall, 1893, New York State Mus. 46th Ann. Rept., p. 156, 159.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. In southern half of Rosendale quadrangle. Rosendale waterlime overlies Accord shale (new). Upper Silurian.

Named for exposures at Rosendale, Ulster County.

Rosett Bed (in Midway Formation)

Tertiary, lower: Central Texas.

R. H. Cuyler and A. W. Weeks, 1940, *in* Geol. Soc. America [Guidebook] 53d Ann. Mtg., p. 24. Named in road log.

Near Larremore oil field, Caldwell County.

Rosewood Shale[1]

Lower Mississippian: Southeastenn Indiana and western and northern Kentucky.

Original reference: Charles Butts, 1915, Kentucky Geol. Survey, 4th ser., v. 3, pt. 2, p. 150.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 143–144. Name abandoned. Holtsclaw Hill facies (new) of Brodhead formation (new) comprises the two units "Rosewood shale" and "Holtsclaw sandstone" proposed by Butts (1915).

Type locality: Village of Rosewood, Harrison County, Ind.

Rosiclare Sandstone Member (of Ste. Genevieve Limestone)[1]

Rosiclare Member (of Ste. Genevieve Limestone)

Upper Mississippian: Southern Illinois, southern Indiana, and western Kentucky.

Original reference: E. O. Ulrich and W. S. T. Smith, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24, 40.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 816. Underlies Levias (formerly Lower Ohara) member; overlies Fredonia member.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 20–21, pl. 1. Because Rosiclare generally contains more limestone than sandstone and in places consists partly or mostly of shale, Indiana Geological Survey uses name Rosiclare member. Thickness 1 to 15 feet.

Named for Rosiclare, Hardin County, Ill. Typical development in Ohio River bluff just below town.

Rosita Andesite[1]

Eocene: Central southern Colorado.

Original reference: W. Cross, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 285.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 197. In Silver Cliff-Rosita region, the volcanics, in order or decreasing age, consist of Rosita fragmental andesite, Bunker massive andesite. Fairview diorite in dikes cutting earlier andesite, Bald Mountain dacite flows, rhyolite in dikes, eruptive channels and flows, Pringle andesite, trachyte flows, and Bassick agglomerate.

Chief occurrence in beneath and about town of Rosita, from which unit is named, Silver Cliff-Rosita region, Custer County.

Roslyn Formation[1]

Roslyn Arkose

Eocene: Central Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

C. E. Weaver, 1937, Washington [State] Pub. in Geology, v. 4, p. 26 (table), 51–52. Massive yellowish-brown sandstone and subordinate quantities of clay shales and carbonaceous shales including coal seams. Thickness 2,000 to 3,500 feet. Overlies Teanaway basalt. Middle to upper Eocene. Areal distribution noted.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 101 (table 1), 108–110, pl. 1. Roslyn arkose in area of this report [northern parts of Mount Stuart and Snoqualmie quadrangles] concordantly underlies Teanaway basalt and is in contact with two younger rocks, post-Roslyn rhyolite and Yakima basalt; the Yakima overlies Roslyn with angular unconformity. Just south of area of this report the Roslyn is deformed into asymmetrical syncline with steep limb on southwest side; west side of syncline is tightly folded and faulted. C. T. Bressler (1951, unpub. thesis) divided Roslyn into three units: basal beds—200 feet or less of red clastic rocks that grade upward into nearly white clastic rocks; 2,300 feet of largely massive yellowish-gray arkosic medium-grained sandstone with darker interbedded fine-grained sandstone and siltstone; upper 1,500 feet composed of eight major coal beds interbedded with medium- to fine-grained sandstone and siltstone. Considered middle and (or) upper Eocene on basis of one fossil fish and two turtle carapaces, which together with leaves, are only fossils found in Roslyn to date.

Best exposed on northern side of Yakima Valley between Swauk Creek and Lake Cle Elum on eastern side of Cascade Mountains. Largest area is in drainage basin of Teanaway River and southward in vicinity of Cle Elum and Roslyn, Kittitas County.

Ross Formation

Lower Devonian: Central Tennessee.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280-302, fig. 2. In this report [Pre-Chattanooga stratigraphy of central Tennessee]. Dunbar's 1919 (Tennessee Div. Geology Bull. 21) classification of the Lower

Devonian is modified. Ross formation is defined to include all beds overlying Decatur limestone and underlying Flat Gap or Harriman formations. As thus defined, includes Birdsong shale member, Bear Branch facies. Ross limestone member, Rockhouse shale member, Rockhouse limestone member. Decaturville zone, and Bryozoan zone. Cooper and others (1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1 chart 4) placed Rockhouse in the silurian, leaving Ross the oldest unit of Devonian; no reasons were given for this shift in classification, but presumably it resulted from recent analysis of fauna of Rockhouse. However, if Rockhouse is Silurian, then entire Ross formation, including Ross limestone member and Birdsong shale member, are likewise Silurian. In one respect, such a shift would clear up matter of occurrence of unique bulbs of *Camarocrinus* in a Niagaran formation and in a Devonian formation; proposed change would limit range of these fossils to the Silurian.

Type locality not given.

Ross Limestone Member (of Olive Hill Formation)[1]·

Ross Limestone Member (of Ross Formation)

Lower Devonian: Western Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 579, 685.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 280, 287–290. In this report (Pre-Chattanooga stratigraphy of central Tennessee, Dunbar's 1919 (Tennessee Div. Geology Bull. 21) classification is modified. Ross formation, which is defined to include all beds overlying Decatur limestone and underlying Flat Gap or Harriman formations, includes Birdsong shale member, Bear Branch facies, Ross limestone member, Rockhouse shale and limestone members, Decaturville zone, and Bryozoan zone. It is believed here that original separation of Pyburn from Ross was not justified, nor was separation made by later workers justified; hence, name Pyburn limestone is discontinued, and all limestone formerly classed as Pyburn is included in Ross limestone member of Ross formation. Ross limestone member, as used here, would be represented at all localities mentioned in preceding work of Foerste, Dunbar, Miser, and Jewell. Ross member conformably overlies Rockhouse shale member in areas along Tennessee River and Horse Creek to south and overlies Rockhouse limestone member in outliers in Hardin and Wayne Counties; member (and its local Bear Branch facies) unconformably underlies Flat Gap limestone or Harriman formation; northward Ross member grades into Birdsong shale member. Thickness in northern part of outcrop area 35 to 45 feet; southward thickens to about 60 feet at Chalybeate Spring and 90 feet along Dry Creek.

Named for exposures on Ross Farm, near Sulphur Spring, Hardin County.

Ross Fork Limestone (in Thaynes Group)[1]

Lower Triassic: Southeastern Idaho.

Original reference: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492.

G. R. Mansfield, 1952, U.S. Geol Survey Prof. Paper 238, p. 17, 31–32, pl. 1. Mapped in Ammon and Paradise Valley quadrangles where it consists of grayish and yellowish limestone, shale, and sandstone.

Named from Ross Fork Creek, in Fort Hall Indian Reservation, in upper waters of which this limestone is well exposed.

Rossian series[1]

Precambrian: Cordilleran region.

Original reference: C. R. Keyes, 1917, Iowa Acad. Sci. Proc., v. 24, p. 56.

Rossie Dioritic Series

Rossie Intrusive Complex[1]

Precambrian: Northwestern New York.

Original reference: A. F. Buddington, 1929, New York State Mus. Bull. 281, p. 81–86, 89.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 67–71. Referred to as Rossie dioritic series; varies from augite diorite to biotite-oligoclase quartz diorite, with local variations toward monzodiorite.

Well displayed in town of Rossie, St. Lawrence County.

Rossland Monzonite[1]

Mesozoic; Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly. 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 8.

Named for occurrence at Rossland, British Columbia, just north of international boundary.

Rossland Volcanic Group[1] or Formation

Carboniferous(?) to Cretaceous: Southern British Columbia, Canada, and northeastern Washington.

Original references: R. G. McConnell and R. W. Brock, 1904, British Columbia West Kootenay Sheet (1:253,440): Canada Geol. Survey; R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, p. 320–334, maps.

Mapped at and around Rossland Mountains, British Columbia, just north of international boundary.

Ross Mine Formation

Permian (Guadalupe): Southwestern Texas.

C. C. Rix, 1952, Geologic map of Cinati Peak quadrangle, Presidio County, Texas (1:48,000): prelim. ed., Texas Univ. Bur. Econ. Geology; 1953, West Texas Geol. Soc. [Guidebook] Spring Field Trip, May 28–30, p. 1, 5 (chart), 14, 20. Sandstone, shale, chert, and limestone. Occurs above Cibolo formation and below Mina Grande formation (new).

Type locality and derivation of name not stated. Probably named for Ross mine which is in Shafter mining district.

Rossville Shales and Sandstone[1]

Pennsylvanian: Northeastern Kansas.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 31.

Probably named for Rossville, Shawnee County.

Rota Limestone

Pleistocene or early Holocene: Mariana Islands (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, pt. 57, table 4 [English

translation in library of U.S. Geol. Survey, p. 68, 69]. Named on correlation chart. Correlated with Chatcha [Chacha] limestone of Saipan, Asuncion [Sonson] limestone of Tinian. Peleliu limestone on Palau and Fais limestone, and Barigata [Barrigada] limestone on Guam. Pleistocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 54. Raised coral reef limestone; elevated as much as 20 meters above sea level in general and 30 meters on southwest coast. Mostly coralliferous, but *Halimeda*-bearing near Sonson, Taipincot, southwest of island and only geomorphologically distinguished from Mariana limestone. Early Holocene. Name credited to S. Sugawara (unpub. ms.).

Type locality: Rota Island. Developed as belt surrounding island.

Rothwell Shale Member (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 76, 217–219, pl. 16. Shale, very clayey; dark blue gray, olive gray, green gray, and purple. Forms basal unit of Olive Hill facies (new) of formation. Thickness as much as 30 feet. Overlies Floyds Knob formation; overlain by impure limestone beds which constitute upper part of formation. The combined Rothwell shale and the Indian Fort shale member (new) at the top of the Brodhead formation, Irvine and Morehead facies (both new), constitute the Morris Mountain shaly member of the Logan formation of Butts (1922)

Type section: Along State Highway 40 between Rothwell post office and top of hill 1 mile east-northeast, Menifee County.

Roubaix Group

Precambrian: Southwestern South Dakota.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 4, 6–7, 14–19, map (on page following title page). Varied in lithology, including more than two lithologically mappable units. Basal part in places a blue-gray quartzite; in other places may be described as gray to brown quartzose schist. Interbedded with upper parts of the quartzose schists and quartzite are black quartzose schists of similar lithology, differing only in color. Where less resistant and more schistose the aluminous sediments show biotite prophyroblasts, or segregations of biotite. Mapped as part of Lead system; group is younger than and overlies rocks of the Lead system.

Mapped in vicinity of Roubaix, Galena-Roubaix district, in the Black Hills. Biotite schist lithology most characteristic northeast and southwest of Hay Creek, east of Roubaix (secs. 33 and 34, T. 4 N., R. 4 E.; and secs. 3, 4, and 5, T. 3 N., R. 4 E.) Biotite porphyroblast type of rock well developed in N½SW¼ sec. 28 and in S center sec. 32, T. 4 N., R. 4 E.

Roubidoux Formation[1] or Dolomite

Lower Ordovician: Eastern and central Missouri.

Original reference: F. L. Nason, 1892, Missouri Geol. Survey, v. 2, p. vii, 12, 93, 114–115.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 47–50. Interbedded sandstones and dolomites; variable in character; in some places is almost entirely sandstone; whereas in others it is mainly dolomite. Basal sandstone irregular in thickness, ranging from less than 1 foot up

to 30 feet; color reddish-brown or sometimes gray. Thickness 160 to 170 feet. Fossiliferous; main fossil zone 60 to 70 feet above base. Overlies Gasconade formation; unconformably underlies Jefferson City formation.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2. p. 15. Unconformably underlies Rich Fountain formation (new) of Jefferson City group.

R. L. Heller, 1954, Missouri Geol. Survey and Water Resources, 2d ser., v. 35, 118 p. As originally defined, Roubidoux did not have specific type section. Type section is herein designated. Thickness 150 feet at type section. Here formation overlies the Gasconade and underlies Rich Fountain formation of Jefferson City group. May rest unconformably on Gasconade, but there is little field evidence to support this view; Roubidoux-Rich Fountain contact appears to be one of conformity. Systematic description of fauna.

Type section (Heller): Along southeast-facing hillside above Roubidoux Creek in SE¼NW¼SW¼ sec. 10, T. 33 N., R. 12 W., Texas County. Widely distributed throughout most of Ozark uplift in Missouri.

Rough Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374–383.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 76. In ascending order, 150 feet sandstone; 50 feet blue sandy clay; 25 to 40 feet sandstone, partly massive. Commonly massive and containing considerable conglomerate, especially at top. Overlies Hamm Valley beds; underlies Buffalo Creek bed.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Rough Creek, Mills County.

†Rough Creek Shale Member (of Tesnus Formation)[1]

Pennsylvanian: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Bose, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 45

Named for exposures on Rough Creek in Dove Mountain quadrangle.

Roughlock Siltstone

Middle Ordovician: Western South Dakota.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 44, 45, 46. Pale-gray-green to cream siltstone 25 to 30 feet thick. Conformably underlies Whitewood dolomite; conformably overlies Ice Box formation (new).

Type section: In Spearfish Canyon, 2.4 miles above Maurice [Lawrence County], several hundred yards up canyon wall. Name taken from Roughlock Falls.

Rough Mountain Conglomerate Lentil (in Brownwood Shale)

Pennsylvanian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 95, pl. 20. Small lentil that varies in thickness from 6 to 20 feet. At thickest part, on east side of Rough Mountain, made up of alternating beds of gravel exhibiting crossbedding like that found in stream terraces; foreset beds dip at angles ranging from 10° to 30°. Northward from Rough Mountain and northward along base of Adams Branch escarpment, conglomerate thins and grades into a coarse-grained crossbedded sandstone.

Extends from point where Rochelle-Cowboy Road leaves the Rochelle-San Saba Road north a distance of about 3 miles to a water tank on Baker's Ranch, McCulloch County.

Roulet Conglomerate[1]

Upper Devonian: Central northern Pennsylvania.

Original reference: C. A. Ashburner, 1880, Pennsylvania 2d Geol. Survey Rept. G_3, p. 97–104.

Probably named for Roulette [Roulet], Potter County.

Round Knob Shale Member or horizon (in Conemaugh Formation)[1]

Round Knob clay shales member

Round Knob redbed member

Pennsylvanian (Conemaugh Series): Eastern Ohio and western Pennsylvania.

Original reference: D.D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 35.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 49, 50. Clay shales member of Conemaugh series in report on Morgan County. Farm Condit's description, it would appear that Round Knob shale and Saltsburg [Saltzburg] sandstone are contemporary units, or the names are applied to different facies of same unit. The Round Knob member overlies the Saltsburg sandstone in some areas in Morgan County, and in others, occupies same interval between Barton and Harlem coals as does the Saltsburg. Term Round Knob is applied to shaly phase of this interval where strata are highly colored, and term Saltsburg is applied to sandy phase. Round Knob shales are pinkish to red or chocolate red.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 130–131. Redbed member of Harlem cyclothem in report on Athens County. Widespread variegated clays and shales occur at many places in Maryland, Ohio, Pennsylvania, and West Virginia in interval between Portersville (Friendsville) shale and limestone and Ames limestone. Thicknesses range up to 50 or even 100 feet. To these beds in Ohio, Condit gave name Round Knob. Elsewhere in northern Appalachian region, these clays and shales are known as Pittsburgh red shale or redbed, a name given by White (1903, West Virginia Geol. Survey, v. 2) and a name which Condit considered unsatisfactory because of previous and general use of Pittsburgh for the Number 8 coal and its underlying limestone. Average thickness about 17 feet. Conemaugh series.

Named for Round Knob, a hill in Madison Township, Columbiana County, Ohio.

Round Mountain Member (of Little Valley Formation)

Upper Jurassic[?] or Cretaceous[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Upper member of formation. Overlies Leesville member (new); underlies Baldy Mountain member of Davis Creek formation (both new). The Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Round Mountain Silt[1]

Round Mountain Silt Member (of Temblor Formation)

Miocene, middle: Southern California (subsurface and surface).

Original reference: A. Diepenbrock, 1933, California Oil Fields, Div. Oil and Gas, v. 19, no. 2, p. 14, 16, pl. 2.

A. M. Keen, 1943, San Diego Soc. Nat. History Trans., v. 10, no. 2, p. 26 (fig. 1), 28 (fig. 2), 29–35. Mapped as Round Mountain silt in Kern River area near Round Mountain. Considered member of Temblor. Thickness about 90 feet. Underlies Santa Margarita; overlies Olcese sand member of Temblor.

Otto Hackel and K. F. Krammes, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 3, 4. Overlies Olcese sand; underlies Mon Bluff formation (new); north of Poso Creek underlies Kern River formation. Mainly brown, somewhat bedded organic siltstone. Diatomite member present about 100 feet below top in outcrop. Middle Miocene.

Type locality: At west edge of Mount Poso oil field, northeast of Bakersfield, Kern County, in Ohio Oil Co. well no. "Glide" 1, sec. 13, T. 27 S., R. 27 E.

Round Prairie Formation

Pennsylvanian (Morrow): Southern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 895–900. At type locality, section includes lower boulder bed, which overlies Union Valley sandstone, separated from an upper bouldery shale by 2 or 3 beds of sandstones. Some of these sandstones are highly calcareous and fossiliferous and are approximately 25 feet apart. The upper bouldery shale is overlain by 10 to 15 feet of jet black fissile fossiliferous shale, locally siliceous, with seams of chalcedony. Underlies Barnett Hill formation. Thickness 400 to 800 feet. Formation has been described as Johns Valley shale; term Johns Valley is herein abandoned.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains, a symposium: Dallas Geol. Soc. and Ardmore Geol. Soc., p. 131 (fig. 1), 137. Formation consists of approximately 425 feet of soft gray bouldery shale generally with two interbeds of dark-gray to black shale and thin sandstone layers. Basal boulder bed, which ranges in thickness up to 275 feet, is succeeded upward by persistent interval, about 50 feet thick, of dark-gray to black shale and intercalated thin-bedded sandstone. This zone is succeeded upward by two bouldery shale beds, separated near middle by zone of dark-gray to black flaky shale with occasional sandstone lentils. Entire thickness of this three-unit zone is a little

more than 100 feet. Formation, as thus described, is more restricted term than that defined in 1938. Underlies Barnett Hill; overlies Johns Valley shale of published reports.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 62–63. Because of uncertainties concerning use of terms Caney, Mississippian Caney, Pennsylvanian Caney, Ouachita Caney, and Johns Valley, Harlton (1938) proposed that name Johns Valley be abandoned and name Round Prairie be adopted. Subsequent workers have not followed Harlton in use of term Round Prairie, preferring instead the older term Johns Valley.

Type locality: NE¼NE¼SE¼ sec. 2, T. 2 S., R. 12 E., Round Prairie syncline.

Round Rock Member (of Esmeralda Formation)[1]

Miocene, upper, and pliocene, lower: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

Exposed in vicinity of Round Rock, about 1 mile north of Manhattan, Nye County.

Roundtop Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 32, 62. Bulk of flow consists of porphyritic andesite marked by pronounced slabby jointing parallel to banding. In places, thickness no less than 500 feet. Rests on bouldery till. Summit polished and scratched by glacial action. Lies to east of Palisade flow (new). Was part of main andesitic cone of former Mount Mazama. Wineglass welded tuff may once have been continuous over entire top of Roundtop lava. [Diller and Patton, 1902, U.S. Geol. Survey Prof. Paper 3, described Roundtop andesite area.]

Roundtop is on northeast rim of Crater Lake.

Roundtop Group

Pennsylvanian (Des Moines): Eastern Wyoming and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3, 33–34, 44. Consists mostly of shale, mudstone, and thin limestone colored various shades of red, green, and gray. Comprises Division IV of Hartville "formation" (Condra and Reed, 1935, Nebraska Geol. Survey Paper 9). Thickness 149 feet. Underlies Hayden group (new); overlies Reclamation group (new).

Type locality: Roundtop Mountain, sec. 22, T. 27 N., R. 66 W., Platte County, Wyo.

Round Valley Limestone

Lower Pennsylvanian: Northeastern Utah and northwestern Colorado.

Walter Sadlick, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 50 (chart), 52, 56–57. In Uinta Mountains, Morgan formation has been subdivided into two members. Upper member consists mainly of reddish-brown clastics that are overlain by Weber sandstone. In these aspects, the upper member is correlative with type Morgan. Lower member consists of light-gray limestones that have no counterpart in type Morgan as defined by Blackwelder (1910). Name Round Valley is here proposed for essentially Morrowan beds of typically light-gray limestone, in part dolomitic and cherty, having an average thickness

of 300 to 350 feet. Thickness 481 feet in Sols Canyon. Underlies Morgan formation (restricted); overlies Manning Canyon formation.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Field Conf., p. 69–70, pl. 1 (fig. 1). In Uinta Mountains, the Round Valley typically forms resistant ledges of light-gray limestone. Formation can be traced laterally along flanks of Uintas and as far east as Juniper Mountains, Colo. At latter locality, Abrassart and Clough (1955) published detailed section of Morgan (unrestricted). Their middle Morgan member is at least partially equivalent to Round Valley limestone. At type section herein stated, disconformably overlies Great Blue limestone.

Type section: In Round Valley about 3 miles east of Morgan, Morgan County, Utah; measured in NW¼ sec. 29, T. 4 N., R. 3 E. Traced in Wasatch Mountains from Dry Bread Hollow, east of Huntsville, Utah, southward to west of Heber, and from Salt Lake City to northwestern Colorado along flanks of Uinta Mountains. Well exposed approximately 1 mile north of U.S. Route 30S on west side of Round Valley, in approximately sec. 20, T. 4 N., R. 3 S., Morgan County, Utah.

Rove Slate[1] (in Animikie Group)

Precambrian: Western Ontario, Canada, and northeastern Minnesota.

Original reference: J. M. Clements, 1903, U.S. Geol. Survey Mon. 45, index.

D. A. White, 1954, Minnesota Geol. Survey Bull. 38, p. 3 (table 1), 4. In Gunflint district, the three units of Animikie group corresponding to Pokegama, Biwabik, and Virginia formations of Mesabi district are called respectively Kakabeka, Gunflint, and Rove formations.

Named for Rove Lake, just north of international boundary.

Rowe Formation (in Cherokee Group)

Rowe Formation or coal cycle (in Krebs Group)

Pennsylvanian (Des Moines Series): Southwestern Missouri, southeastern Kansas, and northeastern Oklahoma.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Rowe formation. Includes Rowe Coal. Underlies Drywood (Dry Wood) formation (new); overlies Warner formation. Included in Krebs group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 6. Referred to as Rowe coal cycle in Savanna formation, Krebs group, in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 14, 18, 20. Rowe formation exposed in Barton and Vernon Counties, Mo. Thickness as much as 14 feet in Vernon County. Overlies Warner formation; underlies Drywood formation. Krebs group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 35–37, 101. Formation in Krebs subgroup of Cherokee group. Thickness in Kansas as much as 22 feet. Overlies Warner formation; underlies Drywood (Dry Wood) formation. Derivation of name given.

Named from Rowe coal, which has been extensively mined in southeastern Kansas and western Missouri.

Rowe Schist[1]

Lower Cambrian(?): Western Massachusetts, eastern New York, and southern Vermont.

Original references: B. K. Emerson, 1898. U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 76–78, 158, pl. 34.

D. M. Larrabee, 1939, Eng. Mining Jour., v. 140, no. 12, p. 49 (fig. 3), 50–51. Area of report is about 10 miles southwest of Rutland, Vt. Rowe schist borders eastern edge of slate belt, from where it extends into Taconic Mountains. In map area, it is nowhere a true schist but is instead a phyllite, locally a phyllitic quartzite, and grades westward into purple and green slates. There is no sharp contact between the slates and phyllites; it is a zone of variable width—usually less than three-fourths mile—in which slates, quartzites, and phyllites are interbedded. Cambrian slates [Mettawee] grade eastward in Rowe schist. Lower Cambrian.

R. V. Cushman, 1950, New York State Water Power and Control Comm. Bull. GW–21, p. 9 (table 2), 10, 11, pl. 2. Crops out in Rensselaer County, N.Y. Thickness not determined. Lower Cambrian(?).

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Berkshire schist as mapped in this report [Cheshire quadrangle, Massachusetts] includes some rocks mapped as Berkshire, Hoosac, and Greylock by Pumpelly, Wolff, and Dale (1894, U.S. Geol. Survey Mon. 23) and Hoosac, Normanskill, and Rowe by Prindle and Knopf (1932, Am. Jour. Sci., 5th ser., v. 24).

Named for occurrence at town of Rowe, Franklin County, Mass.

Rowes Agglomerate[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1910–1911, pl. 1. Unbedded explosion agglomerate filling a volcanic vent over 1 mile long and almost one-half mile wide. On Hill 1560 are rounded to angular fragments, a few inches to a few feet across, enclosed in a dense dark-gray matrix which is largely fragmental and composed of small grains of feldspar and quartz. Included fragments of Meredith porphyritic granite are most common; a few of Sawyer quartz syenite, Belknap syenite, and Conway granite also present. Assigned to White Mountain magma series; youngest member of series with possible exception of some dikes which do not cut the agglomerate.

Exposed on Rowes Hill in Belknap Mountains. Best exposures are the broad ledges at summit of Hill 1560, 1½ miles slightly northeast of Gilford village, Belknap County.

Rowlandville Granite[1]

Age(?): Northeastern Maryland.

Original reference: G. P. Grimsley, 1894, Cincinnati Soc. Nat. History, v. 17, p. 79, 81, 88.

At Rowlandville, Cecil County.

Rowlesburg Sandstone (in Chemung Formation)[1]

Upper Devonian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Preston County, p. 97, 194.

At Rowlesburg, Preston County.

Rowley Creek Slate[1]

Precambrian: Central southern Wisconsin.

Original reference: A. Leith, 1935, Kansas Geol. Soc. Rept. 9th Ann. Field Conf., p. 329–330, fig. 216.

Named for small creek that flows through eastern part of Baraboo syncline, Sauk County.

Row Park Limestone (in St. Paul Group)

Middle Ordovician: Western Maryland, southern Pennsylvania, and northern West Virginia.

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 278–284, pls. 1, 2. Proposed for beds forming lower formation of St. Paul group (new). Typical Row Park contains four limestone types: (1) calcarenite, formed of pebbles and sand of limestone and dolomite in light crystalline matrix; (2) dove vaughanite, usually containing some white, crystalline calcite; (3) granular limestone that varies in color from almost white to dark gray; and (4) dolomitic limestone. Thickness at type locality 162 feet. Underlies New Market limestone. Base of Row Park cannot be traced along a line that corresponds exactly to a bedding plane in either underlying Beekmantown dolomite or to one within itself; beds or lenses of dolomitic limestone are interbedded with nonmagnesian limestone through a zone as much as 50 feet thick; the thickest variable zone corresponds to thickest Row Park section, and this zone thins as formation thins to south. Where Row Park is thickest, southwest of Marion and at Welsh Run, Pa., limestones are interbeded with the Beekmantown dolomite 40 to 50 feet below the stratum thought to represent base of Row Park.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 80. Neuman named an 800-foot sequence of "Stones River" the Row Park formation. Cooper and Cooper had previously identified this sequence as Whistle Creek on the basis of contained fossils. Below the New Market of Cooper and Cooper, Neuman discovered granular limestone containing abundance of *Rostricellula*. It is postulated here that both identifications of the New Market are correct but that the Row Park is a partial facies of the New Market and also the Whistle Creek.

F. M. Swartz and R. R. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 5. In Franklin County, Pa., subdivided into Social Island limestone member below and Browns Mills limestone member above. Overlies Beekmantown dolomite.

Type section: In pastures 0.2 mile northwest of Row Park, Washington County, Md. Limestone forms a wedge whose thin edge lies in West Virginia, thickening northward into southern Pennsylvania.

Roxana Silt

Pleistocene (Wisconsinan): Southwestern Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 5, 10, 12. Succession of silts below Peoria loess and above a well-developed buried soil. Basal part locally contains gray noncalcareous colluvial silts with some sand and rare pebbles; gradationally above this colluvial zone (or in its absence, as basal unit) is gray noncalcareous massive silt, locally containing humus streaks in upper part. This gray silt unit is overlain by weakly calcareous pink to pinkish-tan massive silt containing sparse fauna of large snail shells. Pink silt unit grades upward into weakly calcareous massive gray silt, sparsely fossiliferous in lower part, which in turn is overlain by another

pink massive silt, noncalcareous in upper part and commonly noncalcareous and nonfossiliferous throughout. Thickness at type section 47 feet. Altonian substage.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 535–536, 538, 546. Roxna silt of Frye and Willman is not single rock unit but a composite of Farmdale and Peorian. In type section of Roxana silt, Frye and Willman included in its basal part 4 feet of Farmdale loess and above it 43 feet of Peorian loess, lower part of which is undoubtedly Iowan. They have 15 feet of Peorian loess at top to be designated as Peorian. Instead, this uppermost unit may posibly be correlative of Bignell loess of Doniphan County, Kans.

Type section: Exposures at Pleasant Grove School, center SE¼ sec. 20, T. 3 N., R. 8 W., southeast of Roxana, Madison County.

Roxbury Conglomerate[1] (in Boston Bay Group)

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: Edward Hitchcock, 1861, Am. Jour. Sci., 2d ser., v. 31, p. 377.

M. P. Billings, F. B. Loomis, Jr., and G. W. Stewart, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1868, 1869–1870, 1877–1881. Described as a heterogeneous mixture of conglomerate, sandstone, shale, andesitic and basaltic flows, tuffs, and breccias. Minimum total thickness in Hingham area 3,440 feet. Carboniferous; possibly Pennsylvanian, probably Permian.

Named for exposures in Roxbury, Boston area.

Roxbury Granite Gneiss

Pre-Triassic: Western Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as white granite gneiss composed of microcline, albite, quartz, and muscovite. Some gneiss layers are aplitic.

R. M. Gates, 1959, U.S. Geol. Survey Geol. Quad. Map GQ–121. Replaced by Mine Hill granite gneiss. Name Roxbury preoccupied.

Named for town of Roxbury, Litchfield County.

†Roxton beds[1]

Upper Cretaceous (Gulf Series): Northeastern Texas and Southwestern Arkansas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 114, 340.

Crops out near Roxton, Lamar County, and Honey Grove, Fannin County, Tex., and at base of White Cliff section on Little River, Ark.

Roxy Formation (in Little Butte Volcanic Series)

Oligocene, lower(?): Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Sequence of flows, flow breccias, and coarse agglomerates that comprises lower part of Little Butte volcanic series. Base of formation is irregular and transitional with flows and water-laid pyroclastics in upper part of Colestin formation (new); hence, base is defined as top of uppermost layer of water-laid pyroclastics that is succeeded by at least 100 feet of

flows with or without interlayered nonwater-laid pyroclastics. Underlies Wasson formation (new); transitional with underlying Colestin formation.

Named after Rosy Ann, a well-known knob east of Medford, Jackson County.

Royal Formation[1]

Pennsylvanian: Southern West Virginia.

Original references: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 490.

Named for Royal, Fayette County.

Royal Shale (in Pocahontas Group)

Royal Shale (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western Mercer and Summers Counties, p. 366.

H. R. Wanless, 1939, Geol. Soc. America Special Rept. 17, p. 100; P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 217, 244. Included in Pocahontas group, Pottsville series.

Occurs at Royal, Raleigh County.

†Royalton Formation[1]

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 33, 72, 144, 493.

Named for exposures in Royalton Township, Cuyahoga County.

Royer Marble[1] or Dolomite (in Arbuckle Group)

Upper Cambrian: Central southern Oklahoma.

Original reference: E. O. Ulrich, 1927, Oklahoma Geol. Survey Bull. 45, p. 28.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55. Royer marble (dolomite) included in Arbuckle (here raised to group status). Underlies Signal Mountain limestone; overlies Fort Sill limestone.

W. E. Ham, 1949, Oklahoma Geol. Survey Circ. 26, p. 50–58. Royer dolomite mapped for this report (Mill Creek-Ravia area, Johnston County) consists mostly of massive-bedded coarsely crystalline, nearly pure dolomite about 550 feet thick; apparently conformable contacts with underlying Fort Sill formation and overlying Butterly dolomite.

Type section: SE cor. sec. 36, T.1 S., R. 1 E., Murray County. Named for old Royer Ranch on west side of East Timbered Hills in Arbuckle Mountains.

Royston Formation[1]

Permian: Central northern Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 26, pl. 1.

Type locality: Royston, Fisher County.

Roystone Coquinite (in Conewango Group)

Roystone Coquinite Member[1] (of Oswayo Shale or Riceville Formation)

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original references: B. K. Emerson, 1898. U.S. Geol. Survey Geol. Atlas, 71, p. 61, 97, table.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Generalized succession for marine Upper Devonian of northwestern Pennsylvania and southwestern New York lists Roystone member at base of Riceville formation. Underlies Oswayo member.

C. R. Fettke, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. M–21, p. 33. Report gives section of Oswayo formation near Knapp Creek, N.Y. The bed of limestone 23 feet above base of section probably is limestone which Ashburner (1880) called the Marvin Creek. Caster (1934) renamed this limestone the Roystone, stating that Ashburner was not sufficiently exact in his definition of type locality and that the limestone which Ashburner saw along Marvin Creek is one of calcareous horizons in lower part of Knapp formation. Writer [Fettke] does not accept this interpretation of Ashburner's use of term and states reasons. Term Marvin Creek used in this report.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 14 (tables 3, 4), 278. Table 3 shows Roystone coquinite in Oswayo shale. Footnote states that Caster (1934, Bulls. Am. Paleontology, v. 21, no. 71) renamed this coquinite Flatiron, but Roystone is in good standing. Table 4 shows Roystone coquinite at base of Riceville formation, below Oswayo shale. Page 278 lists Roystone coquinite in Conewango group, below Oswayo shale and above Cattaraugus red shale.

Named from exposures on Roosevelt Highway between Roystone and Ludlow, McKean County, Pa.

Rubio Diorite or Diorite Gneiss

Rubio Diorite and Metadiorite[1]

Pre-Tertiary (Late Paleozoic? or Precambrian): Southern California.

Original reference: W. J. Miller, 1934, California Univ. at Los Angeles Pub. Math. and Phys. Sci., v. 1, no. 1, p. 7–12, 49–65, 83, map.

G. B. Oakeschott, 1937, California Jour. Mines and Geology, v. 33, no. 3, p. 223–224. Rubio diorite is for the most part a rather dark, medium-grained gneiss containing abundant hornblende, little quartz, and with the composition of diorite. Age not conclusively determined; several considerations suggest late Paleozoic. The Rubio has been intruded by Upper Jurassic(?) granodiorite which, in a number of places, cuts across secondary gneissic banding. Diorite has intruded and metamorphosed Placerita limestone. There can be no doubt of post-Placerita (Carboniferous?) and pre-granodiorite (Upper Jurassic?) age of the Rubio. Improbable that it is Triassic or Lower Jurassic. Assigned to late Paleozoic, possibly Permian or Pennsylvanian.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 465, table 4. Placerita formation, Rubio diorite, Echo granite, and combinations of all three (San Gabriel complex) are believed to be early Precambrian in age. Rubio diorite is younger than the Placerita.

G. B. Oakeschott, 1948, California Div. Mines Bull. 129, p. 250, 251. Summary of geology of crystalline rocks in western San Gabriel Mountains lists Rubio diorite-gneiss under heading pre-Tertiary, Late Paleozoic(?).

Named for typical occurrence in large area extending from Rubio Canyon into Eaton Canyon, San Gabriel Mountains.

Rubio Peak Formation

Miocene(?): Southwestern New Mexico.

R. M. Hernon, W. R. Jones, and S. L. Moore, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 120. Listed in table of formations for Santa Rita quadrangle. Gravels and pumiceous tuffs with interbedded flows of andesitic basalt. Thickness as much as 600 feet. Underlies Lucky Bill formation (new); unconformably overlies Wimsattville formation (new). Miocene(?).

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 39, 40–44. Of late Tertiary age.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 18–23, pl. 1. Purple, brown, gray and green andesite and latite flows, flow breccia, agglomerate, and tuffs in Dwyer quadrangle. Interfingers with Sugarlump rhyolite near Mimbres Peak. Thickness, 600 to about 5,000 feet. Derivation of name given.

Named after prominent butte located in secs. 9, 10, 15, and 16, T. 19 S., R. 10 W., (as shown on pl. 1), Dwyer quadrangle.

Ruby Diorite

Age not stated: Southeastern Arizona.

G. M. Fowler, 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 121, pl. 32. Darker, finer grained, and denser than the younger diorites, Sidewinder and Blue Ribbon. Includes fragments of conglomerate and is cut by dikes of Sidewinder and Blue Ribbon formations.

Named from mine settlement of Ruby, Santa Cruz County. Exposed in and around the Montana mine.

†Ruby Formation[1]

Eocene: Western Colorado.

Original reference: W. Cross, 1892, Am. Jour. Sci., 3d, v. 44, p. 21–33.

G. G. Simpson, 1937, Cambridge Philos. Soc. Biol. Rev., v. 12, no. 1, p. 9 (footnote). Name Plateau Valley has been applied by Patterson to Paleocene part of the Ruby.

Named for Ruby Peak, near Irwin, Gunnison County.

Ruby Limestone and Gneiss[1]

Precambrian: Southwestern Montana.

Original reference: E. Douglass, 1905, Carnegie Mus. Annals. v. 3, p. 407–428.

Exposed in Ruby Canyon, west of Old Baldy, and on east slope of Ruby Mountains, east of Dillon, Beaverhead County.

Rubyan series[1]

Middle Cambrian: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 38, 78.

Well exposed on Ruby Hill at Eureka, Eureka County.

Ruby Road Formation

Age not stated: Southern Arizona.

B. P. Webb and K. C. Coryell, 1954, U.S. Atomic Energy Comm. RME–2009, p. 7. Gray intermediate(?) lavas and tuffaceous rocks. In places,

has appearance of an intrusive rock. Underlies Montana Peak formation (new).

Exposed along Ruby Road on southwest flank of the Atascosa Range, Ruby quadrangle, Santa Cruz County.

Ruddell Shale

Upper Mississippian: Northeastern Arkansas.

Mackenzie Gordon, Jr., 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1631–1634. Proposed for the section of fissile clay shales lying between the top siliceous limestone bed of the Moorefield formation (herein restricted) below and the base of the Batesville sandstone above. Typically dark-gray to greenish-gray fissile clay shale that weathers red; lower 30 to 40 feet contain arenaceous and calcareous beds some of which are platy; upper half of this interval contains dark-gray to black limestone concretions which contain a goniatite assemblage; above this interval, shale is very fissile. Thickness at type locality 125 feet, here unit is exposed near the axis of a small anticline close to the Pfeiffer fault; a complete section 165 feet thick is exposed near Batesville.

Type locality: West end of Ruddell Hill, in Ruddell civil township near Ruddell's mill, Independence County. Section is almost completely exposed along the Batesville-Bethesda Road in the NE¼NE¼ sec. 13, T. 7 N., R. 13 W., starting in a gully a few feet below the culvert three-eighths of a mile northwest of Ruddell's mill and continuing east and south to the crown of Ruddell Hill.

Rudolph Quartzite[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16.

Largest area is immediately east of Rudolph, Wood County.

Ruffner Fire Clay (in Allegheny Formation)

Pennsylvanian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1914, West Virginia Geol. Survey Rept. Kanawha County, p. 202.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 100. In Allegheny formation below Lower Freeport coal.

Named for Ruffner, 2 miles east of Charleston, Kanawha County.

Rugg Brook Dolomite or Formation

Rugg Brook Dolomite Conglomerate[1] or Dolomite Breccia

Lower or Middle Cambrian: Northwestern Vermont.

Original reference: Charles Schuchert, 1933, Am. Jour. Sci., 5th ser., v. 25, p. 356, 359, 365, 366, 368.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1014, 1021, 1039–1040. Described as a dolomite breccia and conglomerate.

C. E. Resser and B. F. Howell, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 203. Lower Cambrian.

B. F. Howell, [1939], Vermont State Geologist 21st Rept., p. 97–101. Redefined as a sandy, sometimes conglomeratic, salmon-brown- to buff-brown-weathering gray-to buff-colored dolomite. Maximum thickness about 75 to 100 feet. Lower or Middle Cambrian.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1136, 1151–1153. In Oak Hill sequence, Rugg Brook formation, 0 to 40 feet thick, overlies Parker slate and underlies Skeels Corners slate. Lower Cambrian(?).

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 534–536. Rugg Brook dolomite described in St. Albans area where it is 100 to 300 feet thick. Overlies Parker slate; underlies St. Albans slate. Middle Cambrian. In Milton quadrangle, Cady (1945, Geol. Soc. America Bull., v. 56, no. 5) mapped the Rugg Brook as Winooski dolomite. Term Winooski should be dropped and name Rugg Brook applied in both northwestern and west-central Vermont.

Type locality: On Rugg Brook less than 3 miles southwest of St. Albans, Franklin County.

Rugged Crest Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 38, 49. Name applied to flow at Rugged Crest. Overlapped by Wineglass dacite flow (new). [See Sun Creek Dacite Flow.]

Rugged Crest is on north rim of Crater Lake.

Ruin Granite[1]

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Mapped in Globe quadrangle. Typically a coarse-grained porphyritic quartz monzonite containing large phenocrysts of pale-pink orthoclase 1 to 3 inches long. Outcrops generally light brown and deeply weathered.

D. W. Peterson, 1960, U.S. Geol. Survey Geol. Quad. May GQ–128. Underlies much of northwestern part of Haunted Canyon quadrangle and occurs in scattered outcrops throughout remainder of northern half. Table 1 shows Ruin granite below Scanlan conglomerate of Apache group and above Pinal schist.

Occurs in Ruin Basin, Globe quadrangle.

Rulo Limestone Member (of Scranton Shale)[1]

Rulo Limestone (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 8, 14, 25.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 213. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Underlies Silver Lake shale; overlies Cedar Vale shale. Average thickness about 2 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Rank reduced to member status in Scranton shale, here reintroduced as a formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Underlies Silver Lake shale member; overlies Cedar Vale shale member.

Type locality: Two and one-half miles north of Rulo, Richardson County, Nebr.

†Ruma Formation (in Chester Group)[1]

Ruma Formation (in Homberg Group)

Mississippian (Chester Series): Southwestern Illinois.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 126.

J. M. Weller *in* Stuart Weller and J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 833. In Randolph and Monroe Counties, mostly shale and locally attains thickness of 75 feet. Shales are variegated and contain reddish and purplish beds similar to some of Renault shales. Arenaceous strata, mainly thin-bedded and shaly sandstones, occur in middle part of formation and locally in upper part. Sandstone beds in midst of Ruma are undoubtedly equivalent to Cypress sandstone of standard section. Parts of underlying and overlying shaly strata may be equivalent to upper and lower parts of the Paint Creek and Golconda formations where the intervening Cypress sandstone is more typically developed. Overlies Paint Creek limestone; underlies Okaw limestone. Included in Homberg group (new).

Named for Ruma, Randolph County. Exposed in tributaries of Horse Creek.

Rumsy Ridge Sandstone Member (of Fish Creek Shale)

Rumsy Ridge Shale (in Medina Group)

Lower Silurian: Western New York, and southern Ontario, Canada.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1988. Name proposed for fossiliferous light-bluish-gray calcareous sandstone. Occurs 6 feet above base of Fish Creek shale (new) in Niagara Gorge and closer to base at Lockport, N.Y.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Rank raised to formation to include green shales and thin interbedded gray siltstones lying above Whirlpool sandstone and beneath Cabot Head shale in Niagara Gorge. Locally underlies Grimsby sandstone. Replaces preoccupied name Fish Creek shale.

Named from populated part of Niagara Escarpment which overlooks village of Lewiston, Niagara County, N.Y.

Run Gap Red Sandstone Member (of Juniata Formation)

Ordovician: Central Pennsylvania.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., supp., diagram (following p. 4), fig. 3. Incidental mention as red sandstone in upper part of Juniata. Underlies Tuscarora sandstone: overlies red siltstone and sandstone members of Juniata red beds.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. At top of Juniata formation, in Tyrone Gap area, are thin red sandstones that appear to represent westerly extension of Run Gap red sandstone member that is about 250 feet thick and finely and sparingly conglomeratic at Run Gap. Overlies Plummer Hollow mudstone member (new); eastward from vicinity of Lost Creek Gap, overlies East Waterford red sandstone member (new). [Swartz refers to his 1955 report *in* Pennsylvania Geologists Guidebook 21st Ann. Field Conf. Compiler was unable to locate this reference.]

Extends from area of Jacks Mountain, north of Lewistown in Mifflin County, to area of Shade Mountain at Lost Creek Gap. Run Gap is located in Tuscarora Mountain along boundary of Juniata and Perry Counties.

Runningwater Formation

Miocene: Northeastern Nebraska and eastern Wyoming.

H. J. Cook, 1960, Internat. Geol. Cong. 21st, Copenhagen, pt. 12, p. 204 (section), 205. Name applied to deposits above lower stages of the Marsland (which were originally named Upper Harrison beds) and below Sheep Creek beds of Matthew and Cook. Generalized section shows the Runningwater below Sheep Creek group.

Name derived from local name of river on which deposits occur.

Runnymede Sandstone Member (of Ninnescah Shale)

Permian: South-central Kansas.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, p. 1773–1774. Blue-green to gray shaly sandstone 7 to 8 feet thick, with intercalated layers of red shale and sandstone. Topmost bed of the Ninnescah at its northernmost outcrop.

Named from Runnymede, Harper County.

Rush Formation[1] (in Susquehanna Group)

Upper Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 8, p. 1199.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Middle Devonian.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Included in Susquehanna group. Comprises Burket shale member and Tully limestone member.

Named for Rush Township, Northumberland County.

Rush Member (of Tully Limestone)[1]

Upper Devonian: Central Pennsylvania.

Original reference: B. Willard, 1934, Pennsylvania Acad. Sci. Proc., v. 8, p. 57–62.

Exposed in roadcut east of small brook one-half mile from railway station at South Danville (Riverside), in Rush Township, Northumberland County.

Rushford Sandstone[1]

Rushford Member (of Canadaway Formation)

Rushford Sandstone (in Canadaway Group)

Upper Devonian: West-central New York.

Original reference: D. D. Luther, 1902, New York State Mus. Bull. 52, p. 619.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC-45. Overlies Caneadea member of Perryburg formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 17. Member of Canadaway formation. Overlies Caneadea member;

underlies "Machias" member of Canadaway. Upper boundary not well established.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook Ann. Mtg., p. 17 (table 2), 18. Listed as Rushford sandstone in Canadaway group. Overlies Caneadea shale; underlies "Machias" shale.

Well exposed in Caneadea Gorge, 3.3 miles east of Rushford, Allegany County.

Rush Run Sandstone (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 191.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness about 25 feet. Top of unit about 495 feet above Waynesburg coal.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 1). In Greene series.

Named for Rush Run, which empties into Fish Creek, three-fourths mile southeast of Hundred, Wetzel County.

Rush Springs Sandstone or **Formation** (in Whitehorse Group)

Rush Springs Member (of Whitehorse Sandstone)[1]

Permian: Southwestern Oklahoma and north-central Texas.

Original reference: R. W. Sawyer, 1929, Oklahoma Geol. Survey Bull, 40–HH.

D. A. Green, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1454, 1473. Rank raised to formation; unit has unconformity at base and top. Cloud Chief gypsum is grouped with the Quartermaster rather than with Rush Springs in the Whitehorse.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Geographically extended into north-central Texas where it is given formational rank in Whitehorse group. Includes Dozier sandstone member (reallocated). Underlies Cloud Chief gypsum; overlies Marlow formation.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 68–75, pl. 1. In present report, the Rush Springs is classed as a formation in Whitehorse group. Conformably overlies Marlow formation; unconformably underlies Cloud Chief formation. Thickness 136 to 300 feet in Grady and Stephens Counties. Sawyer did not specify a type locality, but stated that his Rush Springs is the Whitehorse sandstone of Reeves (1921, U.S. Geol. Survey Bull. 726). Reeves mentioned a Whitehorse sandstone cliff which forms river bluffs 1 mile north of northeast corner of Tonkawa Township. This description places the locality in sec. 36, T. 7 N., R. 10 W., Caddo County, where almost the full thickness of formation from base upward is exposed and texture and bedding are typical. This location is considered acceptable as a type locality.

Type locality: Cliffs on river bluffs northeast of Tonkawa Township, sec. 36, T. 7 N., R. 10 W., Caddo County, Okla.

Rushville Group[1]

Rushville Shale Member (of Logan Formation)

Lower Mississippian: Central Ohio.

Original reference: E. B. Andrews, 1879, Am. Jour. Sci., 3d, v. 18, p. 137.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 1, p. 41 (table 2), 60. Rushville shale member included in Pretty Run sandstone facies (new) of Logan formation. Overlies Vinton sandstone member; locally underlies Pennsylvanian sandstone. Lower Mississippian.

Probably named for Rushville near eastern border of Fairfield County.

Rusk Formation (in Trinity Group)

Cretaceous (Comanche Series): Subsurface in northeastern Texas and northern Louisiana.

J. M. Forgotson, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 92, 94 (chart); 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2332 (fig. 2), 2355–2357. Defined as those rocks and their stratigraphic equivalents below top of Glen Rose limestone as recognized in subsurface of northeastern Texas and above top of Ferry Lake anhydrite. In type well, occupies interval from 5,785 to 7,265 feet; consists of alternating beds of nonporous dense crystalline limestone, earthy limestone, and gray to black shale; contains thin stringers of anhydrite in basal part. Occupies stratigraphic interval termed upper Glen Rose formation and Paluxy formation. Revision of Trinity nomenclature by Shreveport Geological Society eliminated term "lower Glen Rose" as formational unit; term upper Glen Rose formation became orphaned and reference to it as Glen Rose formation became a misnomer since it was equivalent only to part of Glen Rose as defined on outcrop.

Type well: Skelly Oil Co.'s G. W. Weatherby Well 1, Williams McIlvane Survey, southwest Rusk County, Tex.

Russell Feldspathic Gabbro

Precambrian: Northeastern New York.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 53–54, 260–267. Name applied to the gabbro in the Russell sheet. In area of this report, only northern half of mass was studied; here the east-northeast half consists of normal gabbro and the west-southwest half of a feldspathic gabbro; junction between the two is sharp.

North end of gabbro sheet lies about 3 miles south-southwest of Russell, Russell quadrangle, St. Lawrence County.

†Russell Formation[1]

Lower and Middle Cambrian: Southwestern Virginia and southeastern Kentucky.

Original reference: M. R. Campbell, 1894, U.S. Geol. Survey Geol. Atlas, Folio 12, p. 2.

Named for Russell County, Va.

†Russell Formation[1]

Upper Cretaceous: Central and western Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 49.

Named for exposures at Russell, Russell County.

†Russell Slate

Upper Cambrian: Northwestern Vermont.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1055. Local name; abandoned in favor of Hungerford slate (new).

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 164, 165. Name Russell slate referred to in description of graptolites *Dictyonema schucherti* and *Dictyonema vermontense*.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 547. Ruedemann (1947) referred to this formation [Hungerford] as Russell slate, but name is not necessary and is probably not valid, for it was not defined.

Occurrence: Small road-metal quarry 1 mile northwest of Highgate Center, Franklin County.

Russell Creek Limestone Member (of Senora Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma, southeastern Kansas, and southwestern Missouri.

C. C. Branson, 1954, Oklahoma Acad. Sci. Proc., v. 33, p. 191 (table 1). Name applied to limestone that forms cap rock of the Mineral coal; underlies Broken Arrow coal.

C. C. Branson, 1955, The Hopper, v. 15, no. 12, p. 137. Ferruginous clayey carbonaceous gray limestone, 10 inches to 2 feet thick in one bed; contains fusulinids.

Type section: On Leep Farm on east bank of Russell Creek where it is flowing south in NE¼SW¼ sec. 15, T. 29 N., R. 20 E., Craig County, Okla.

Russellville Shale (in Atoka Formation)[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans, v. 15, p. 51.

Probably named for Russellville, Pope County, Ark.

Russia Limestone Member (of Denmark Formation)

Middle Ordovician: Central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598–601; 1953, New York State Mus. Bull. 347, p. 55–57. Defined at Trenton Falls as extending from top of Poland member (new) through 70 feet of shaly limestone to a local disconformity 2 feet below a ferruginous bed in base of Upper High Falls. Lower 50 feet lithologically similar to the Poland but relatively barren platy calcilutite and shale form upper 20 feet. Underlies Rust member (new) of Cobourg formation. Facies discussed.

Typically developed in Trenton Falls George along west line of Russia Township.

Rust Limestone Member (of Cobourg Formation)

Middle Ordovician (Mohawkian): East-central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 601–602, 604. Name proposed for lower member of formation in Utica quadrangle and vicinity. Described as argillaceous and coquinal limestone. Slump breccias at Prospect Bridge occur near top. Thickness 115 feet. Underlies newly defined Steuben member; overlies newly defined Russia member of Denmark formation.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 59–61. Further described. Includes shaly limestone, conglomerate, calcilutite and shale in type section.

Type section: At Trenton Falls on West Canada Creek near Oneida-Herkimer County line. Named from Rust Farm in Herkimer County 1 mile east of type section.

Rustler Formation[1] **or Limestone**[1]

Permian (Ochoa Series): Western Texas and southeastern New Mexico.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 44.

L. R. Page and J. E. Adams, 1938, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1709; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 62–63. In eastern Midland basin, underlies Dewey Lake formation (new).

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1612–1615. Lang (1938, New Mexico State Engineer 12th and 13th Bien. Rept.) measured section of Rustler in Eddy County, N. Mex. He divided section into 11 members (descending 1–11). Unit 2, a 30-foot gypsiferous dolomite is here named Magenta member; unit 6, a 35-foot dolomite is here named Culebra member. Overlies Salado formation; underlies Dewey Lake formation.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 22–23. Formation described in Eddy County. Unconformably overlies Salado formation in most of area east of Pecos River and Castile formation and Whitehorse group or its equivalents west of Pecos. In northern part of county, overlies Chalk Bluff formation. Underlies red beds (Pierce Canyon red beds) and sandstones of Dockum group. Thickness 200 to 500 feet.

Named for exposures in Rustler Hills, Culberson County, Tex.

Rustler Canyon Basalt

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1). Black vesicular basal or olivine andesite flows and flow breccias. Maximum thickness 50 feet. On west side of Box Canyon, a single amygdaloidal flow about 18 feet thick is separated from Box Canyon rhyolite (new) by covered zone about 55 feet thick. In one place, 15 feet of basalt breccia is exposed beneath flow which is covered by Piloncillo sediments (new). In one locality, occurs between Kneeling Nun and Caballo Blanco rhyolites.

Named after Rustler Canyon in northwest corner of Dwyer quadrangle. Confined to two localities: on west side of Box Canyon, for about one-quarter mile north of Box Well graben, and in secs. 20 and 21, T. 18 S., R. 11 W.

†Rustler Springs Formation[1]

Permian: Western Texas.

Original reference: J. A. Udden, 1915, Am. Jour. Sci., 4th, v. 40, p. 151–155.

Named for Rustler Springs, Culberson County.

Rusty beds[1]

Rusty zone (in Pierre Formation)

Upper Cretaceous: Central and eastern Colorado, central southern Montana, and central and northern Wyoming.

Original reference: C. W. Washburne, 1908, U.S. Geol. Survey Bull. 340, p. 350.

M. O. Griffitts, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 12, p. 2012, 2014, 2015, 2017. Dane, Pierce, and Reeside (1937, U.S. Geol. Survey Prof. Paper 186–K) subdivided Pierre shale in Colorado and used Sharon Springs member for basal zone and informal terms (ascending) rusty zone, tepee zone, and transition zone for remainder of formation. These zone terms are recognized and used as formal stratigraphic terms in this report. Thickness of zone about 1,200 feet.

Rusty Beds Member (of Thermopolis Shale)

Lower Cretaceous: Central northern Wyoming.

Arthur Mirsky, 1960, Dissert. Abs., v. 21, no. 4, p. 850. Nonmarine section between marine Sundance formation (Late Jurassic) and definitely marine Thermopolis shale (Early Cretaceous) is divisible into four mappable units. Unit 4 (basal Thermopolis) is a black paper-thin shale, interbedded with thin lenticular tan cross-laminated siltstone and fine-grained sandstone. It has been informally known as "Rusty Beds" for a long time, and term is ingrained in the literature. Unit has been placed in uppermost Cloverly or lowermost Thermopolis by previous investigators. It is here proposed that it be formally named Rusty Beds member of the Thermopolis.

Area of report is southern Big Horn Mountains.

†Ruth Limestone[1]

Pennsylvanian: Eastern Nevada.

Original reference: A. C. Lawson, 1906, California Univ. Pub., Bull. Dept. Geology, v. 4, no. 14, p. 292.

Named for Ruth mine, Robinson mining district, Egan Range, White Pine County.

Rutland Dolomite[1]

Lower Cambrian: Southwestern and west-central Vermont and northwestern Massachusetts.

Original reference: J. E. Wolff, 1891, Geol. Soc. America Bull., v. 2, p. 331–338.

E. C. Jacobs, [1937], Vermont State Geologist 20th Rept., p. 71, 98–100. Geographically extended into northwestern Massachusetts.

Named for exposures in valley in vicinity of Rutland, Vt.

†Rutledge Limestone (in Midway Group)[1]

Eocene, lower: Southern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama: Birmingham, Ala., Roberts & Son, pamph. of 36 p.

Probably named for exposures at Rutledge, Crenshaw County.

Rutledge Limestone[1] **or Dolomite** (in Conasauga Group)

Middle Cambrian: Northeastern Tennessee, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 27, p. 2.

John Rodgers and D. F. Kent, 1948, Tennessee Div. Geology Bull. 55, p. 7, 9–10. In Lee Valley, Hawkins County, Tenn., Ruthledge Limestone over-

lies Pumpkin Valley shale (new); underlies Rogersville shale. Thickness 320 feet.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 1 (plates); pt. 2, p. 46 (fig. 3), 49–51. In eastern Tennessee, the Conasauga varies in lithology and three phases are recognized; in central phase (between Knoxville and Morristown, and north of Clinch Mountain) the Conasauga is considered a group consisting of six formations of which the Rutledge is second in sequence (ascending). Overlies Pumpkin Valley shale; underlies Rogersville shale. Thickness 100 to 500 feet.

Named for exposures in valley of Rutledge, Grainger County, Tenn.

Ryan Formation

Tertiary: Southeastern California.

D. I. Axelrod, 1940, Jour. Geology, v. 48, no. 5, p. 528. Unconformably overlies Furnace Creek formation (new). Furnace Creek is Miocene or Pliocene. Name credited to H. D. Curry.

In Furnace Creek Wash area, central Death Valley region.

Ryan Sandstone[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: J. R. Bunn, 1930, Oklahoma Geol. Survey Bull. 40PP, p. 10.

Typically exposed in scarps southeast and northwest of Ryan, Jefferson County.

Ryans Ford Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central eastern Illinois.

Original reference: J. E. Lamar and H. B. Willman, 1934, Illinois Geol. Survey Bull. 61, p. 129–138.

Coles and Cumberland Counties.

Rye Formation

Rye Gneiss[1]

Probably Ordovician and Silurian: Southeastern New Hampshire and southwestern Maine.

Original reference: Alfred Wandke, 1922, Am. Jour. Sci., 5th ser., v. 4, p. 141, 143–144.

M. P. Billings, 1952, *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., Geol. Soc. America Guidebook for Field Trips in New England, p. 23, 24, 29, 44. Includes an upper metavolcanic member, fine-grained biotite gneiss and amphibolite, and a lower metasedimentary member, feldspathic mica schist. Latter represents several metamorphic zones. Thickness about 4,000 feet. Conformably underlies Merrimack group. Paleozoic, probably Silurian and perhaps Ordovician also.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State, Plan. Devel. Comm., p. 38–39. Ordovician(?).

U.S. Geological Survey currently designates the age of the Rye Formation as probably Ordovician and Silurian on the basis of a study now in progress.

Named for development in Rye Township, Rockingham County, N.H.

Ryegate Granite[1] or Granodiorite

Upper Devonian(?) : Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table facing p. 288.

W. S. White and M. P. Billings, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 662, 665–667, pl. 1. Medium- to coarse-grained light-gray quartz monzonite, granodiorite, and quartz diorite. Granodiorite most abundant type; porphyritic in vicinity of Blue Mountain. Some foliation present. Forms complex of small plutons. Assigned to New Hampshire magma series.

Named for quarry in northeastern part of Ryegate Township, Caledonia County. Occurs in two general areas, Blue Mountain and Groton, in vicinity of Ryegate in Vermont part of Woodsville quadrangle, Vermont-New Hampshire.

Rye Point Member (of Cashaqua Formation)

Upper Devonian: Western New York.

R. G. Sutton, 1960, New York State Mus. Sci. Service Bull. 380, p. 17–18, 53, 55, figs. 2, 5. Proposed for fossiliferous gray calcareous shales that overlie Rock Stream member. Includes red and green nodular limestone bed known as Parrish limestone lentil (Clarke and Luther, 1904). Thickness 15 to 113 feet; thins eastward and disappears in Ithaca region. Underlies Rhinestreet black shale.

Type locality: Small stream on east side Keuka Lake, 3 miles northeast of Hammondsport and 1½ miles northeast of Rye Point, Steuben County.

Rykert Granite[1]

Jurassic(?): Northern Idaho and Washington, and British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Dept. Mines Mus. Mem. 38, p. 284.

Rysedorph Conglomerate[1]

Middle Ordovician: Eastern New York.

Original reference: R. Ruedemann, 1901, New York State Mus. Bull. 42; 1901, New York State Mus. Bull. 49.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 276–277. Discussed under heading of formations of Sherman Fall age, Trenton group.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16), 119. Correlation chart for Vermont shows Rysedorph conglomerate in Taconic sequence below Tackawasick limestone and above Normanskill formation. May represent the horizon of Middle Ordovician unconformity.

Also referred to as Rysedorph Hill Conglomerate.

Named for occurrence in Rysedorph [Rysedorf] Hill (locally called Pinnacle or Sugar Loaf Hill), 2 miles southeast of Rensselaer, across river from Albany.

Saanich Formation[1] or glacial deposits

Pleistocene: Western Oregon and northwestern Washington, and British Columbia, Canada.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Phil. Soc. Proc., v. 52, p. 565–595.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 24 (table). Described as formation consisting of post-glacial marine terrace deposits exposed in Puget Sound area together with poorly consolidated clays, sands, and gravels along the coast of Oregon and Washington.

Probably named for occurrences north of Victoria and Saanich Peninsula, Vancouver Island.

Saavedra Member (of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 11, 15–16, pl. 27. Consists of following units (ascending): detritus, white sandstone, light-brown sandstone, gray arenaceous limestone, Barata limestone (new), buff sandstone, Arkill limestone (new), soft white sandstone, yellow limestone, Chapparal sandstone (new), light-colored shales and sandstones, dense gray limestone, green shale, argillaceous limsetone, shale, light-brown sandstone, and calcareous sandstone. Thickness 218 feet. Underlies unnamed limestone and sandstone division; overlies Joserita member (new).

In standard section of Lowell formation in the Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Sabana Grande Andesite (in Mayagüez Group)

Sabana Grande Formation

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197; 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 329, 330, 338–339, pl. 1. Sabana Grande andesite was defined by Slodowski (unpub. thesis) as Sabana Grande formation. The mudstone in Sabana Grande of Slodowski is correlated with the Yauco mudstone in area of this report [Mayagüez]. Unit is composed of andesite breccia, flow breccia, and tuff, with minor basalt lava; lateral changes of texture and lithology common. No fossils identified; from its position between Parguera (new) and Yauco formation, the Sabana Grande can be dated as Turonian to Campanian.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200. In Yauco area, a complex, more than 9,000 meters thick, of volcanic flows with interbedded marine limestones, mudstones, tuffs, and sedimentary rocks derived from the volcanic rocks, is divided into eight formations: Sabana Grande, El Rayo (new), Ensenada, Río Yauco, Río Loco, Río Blanco, San Germán, and Jicara (new). Sabana Grande and El Rayo formations unconformably underlie Ensenada and Río Yauco formations. Complex ranges in age from Senonian to late Paleocene, possible Eocene.

Largest exposures are on routes 348 and 119 connecting Mayagüez, Rosario, and San Germán.

Sabanita (Sabanitas) Formation

(?)Miocene, middle: Panamá.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 5, p. 7. Continental gravels, tuffs, and clays. Masks the contact of Gatún formation with basement complex.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 906, 920. Considered middle Miocene(?) continental facies of basal part of Gatún formation. Typically a tuff-conglomerate unconformably overlying pre-Tertiary basement complex. Over wide exposures, weathering has altered it to a weathered ash and gravel. Unsorted and massive in type exposure.

Type exposure: Along Boyd-Roosevelt Highway northeast of Sabanitas, vicinity of Gatún Lake.

Sabattus Formation

Sabattus Garnet Schist (in Tacoma Series)

Sabattus Shale

Silurian: Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations as garnet schist. Uppermost unit in Tacoma series (new). Older than post-Silurian pegmatites, aplites, and granites; younger than Minwah limy gneiss (new).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss (new), Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate gneiss (new), Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite-biotite schist.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 125–130, pl. 1, table 1 (facing p. 112). Described as a formation consisting of quartz-mica schist with garnet and sillimanite and marble lenses. Only quartz-muscovite-sillimanite schist can be traced for considerable distance. Thickness 3,000 feet. Conformably overlies Androscoggin formation. Silurian. Type locality described.

R. L. Miller, 1945, Maine Geol. Survey Bull. 2, p. 9. Referred to as shale.

Type locality: Outcrops on or near Sabattus Mountain for which it is named. Crops out in area extending from Lewiston to Waterville.

Sabetha Limestone (in Council Grove Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 232, 234.

Named for exposures on Omaha-Tulsa Highway, 1 mile north of Sabetha, Nemaha County, Kans.

†Sabine Formation[1] or Group

Sabine Stage

Eocene, lower: Eastern Texas, Alabama, Arkansas, and Louisiana.

Original references: A. C. Veatch, 1905, Louisiana Geol. Survey Bull. 1. pt. 2, Rept. 1905, p. 84, 85, 88, Letter of transmittal of Louisiana Director to Governor dated Dec. 9, 1904; U.S. Geol. Survey Water-Supply Paper 114, on Louisiana and southern Arkansas, p. 180, 184–185, ms. sent to Govt. Ptg. Office, Aug. 2, 1904.

W. D. Chawner, 1936, Louisiana Dept. Conserv., Geol. Bull. 9, p. 54–64. Sabine group in Louisiana crops out over broad area in northwestern part of State where it is brought to surface by Sabine uplift. History of usage of term discussed. [Most of usage of term Sabine group in Louisiana is in reports dealing with subsurface stratigraphy.]

G. E. Murray, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 5, p. 687. Term Sabine stage recommended as time-rock term for post-Midwayan and pre-Claibornian deposits of Coastal Plain province. This is similar to original usage of Veatch (1905, 1906). As such, it is synonymous with Wilcox group used as a time-rock term. Stage includes all deposits in Gulf and Atlantic Coast province formed during the stand of early Eocene sea, beginning with initial deposition of widespread *Ostrea thirsae-Ostrea multilirata*-containing beds of East Texas, Louisiana, Mississippi, and Alabama, and their equivalents, and ending up with initial invasion of Claibornian sea. Sabine age includes all time involved in deposition of these deposits. Includes at least two substages based on cyclic alternations of regional nature.

G. G. Varvaro, 1957, Louisiana Dept. Conserv., Geol. Bull. 31, p. 63–64, pl. 4. Term Sabine stage used in discussion of subsurface stratigraphy in Evangeline and St. Landry Parishes. Includes Wilcox group.

Formation named for typical fossiliferous development on Sabine River in Sabine County, Tex., and Sabine Parish, La., and from exposures at Sabinetown Bluff.

†Sabine River Beds[1]

Eocene: Eastern Texas.

Original reference: E. T. Dumble and R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., p. xxxvi, 17, 22, pl. 3.

Named for Sabine River.

Sabinetown Formation (in Wilcox Group)[1]

Eocene, lower: Eastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 574, 601, 634.

W. M. Cowan, 1942, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 51, p. 2. In Wilson County, overlies Rockdale formation and underlies Carrizo sand.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 47 (fig. 1), 56, 63–64. In original definition, Plummer included both the beds at Pendleton Ferry and those at Sabinetown in Sabinetown formation. Term Sabinetown is herein restricted to those beds lying above High Bluff member of Pendleton formation and below Carrizo sand. Includes Pearson glauconite member at base, and an upper member that consists of silty, laminated, lignitic shale with glauconitic crossbedded fine-grained sand. Thickness about 52 feet. Note on type locality.

Type locality: Bluff on Texas side of Sabine River about one-fourth mile below old ferry landing. Named from village of Sabinetown, Sabine County, Tex.

Sabula dolomite[1]

Silurian (Niagaran): Central eastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 150.

Named for Sabula, or Sabula Junction, Jackson County.

Sac Limestone[1]

Lower Ordovician (Beekmantown): Southwestern Missouri.

Original reference: E. M. Shepard, 1898, Missouri Geol. Survey, v. 12, pt. 1, p. 49, 74–77.

Named for outcrops on Sac River, Greene County.

Sacajawea Formation[1] (in Montchauve Group)

Mississippian: Wyoming and Montana.

Original reference: C. C. Branson, 1936, Geol. Soc. America Proc. 1935, p. 391.

C. C. Branson, 1937, Jour. Paleontology, v. 11, no. 8, p. 650–660. Lower part of Amsden is Mississippian in age and is here described and named Sacajawea formation to separate it from upper part of Amsden (Pennsylvanian). At type section, formation (units 14 and 15 of measured section) consists of basal unit, 2 to 11 feet thick, of red and buff sandstone and shaly sandstone, breccia in places, shale cave filling in places; and upper unit, 43 feet thick, of massive crystalline light-gray cherty limestone, with Ste. Genevieve fauna in lower 20 feet. Beds 10 to 13 (possibly Chester in age) in section are set off by unconformity above and are possibly separated from Sacajawea by unconformity below; these beds may be added to the Sacajawea if favoring evidence appears. Disconformable on Madison limestone. Fauna described.

C. C. Branson, 1939, Geol. Soc. America Bull., v. 50 no. 1, p. 1203, 1204, 1211, 1212. Measured sections show Sacajawea formation underlies Tensleep formation (redefined); locally separated from the Tensleep by limestone interval referred to as beds of Chester(?) age.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 126 (fig. 2), 130–131. Columnar section of formations exposed in and near Wind River Mountains shows Sacajawea formation, 100 to 200 feet thick, above Madison formation and below the Tensleep. Text states that on Bull Lake Creek 60 feet of laminated limestone without fossils lies with irregular contact on the Sacajawea and is overlain disconformably above. This sequence may constitute another formation, possibly of Chester age. Term Amsden not used in area of this report.

W. F. Scott and P. C. Wilson, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1554. Distinctive red-bed sequence, usually considered basal part of Amsden formation, constitutes persistent lithostratigraphic unit over much of Montana and Wyoming. In most areas, this unit rests disconformably upon Madison limestone. In central Montana, it overlies Heath formation of Big Snowy group. Underlies typical Amsden carbonates except in western Montana, where Amsden is absent and unit underlies Quadrant quartzite, and in eastern Wyoming, where Amsden lithologies have not been separated from the Hartville and Minnelusa. Thicknesses vary, without apparent pattern, from 5 feet in central Wyoming to 230 feet in Big Snowy Mountains. Name Sacajawea, which has been applied to Mississippian part of the Amsden in northwestern Wyoming, should be restricted vertically to include only the red beds, and extended laterally throughout area where these beds are recognizable. Term Amsden should be retained for the limestone and dolomites between the Sacajawea (restricted) and the typical sandstones of the Tensleep or its equivalents.

J. D. Love, 1954, Tentative diagrammatic correlation of Tensleep, Amsden, Casper, and Hartville formations in Wyoming *in* Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf. [chart in pocket]. Correlation chart shows that Sacajawea formation at type locality extended upward to base of Darwin sandstone member of Amsden formation.

A. B. Shaw and W. G. Bell, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 3, p. 333–337. Discussion of age of Amsden formation on basis of new collection of fossils made at Cherry Creek, Wind River Mountains, Wyo. Use of name Sacajawea formation at Cherry Creek is not justifiable because Mississippian beds in this area do not constitute a mappable unit under present standards; in this the writers [Shaw and Bell] disagree with Branson (1937). Possibly such terms as Sacajawea fauna or Sacajawea beds used in colloquial sense, may be applicable.

A. B. Shaw, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 60, 61 (fig. 1), 62. As originally defined the Sacajawea did not include all of the Amsden below the Darwin sandstone, but only the *Spirifer welleri* zone. Love (1954) extended type section upward to include all post-Madison and pre-Darwin rocks; this makes the Sacajawea an objectively recognizable lithologic unit rather than a named faunal zone, but it may not serve the original purpose of separating the *Spirifer welleri* zone from overlying Pennsylvanian rocks. Whichever designation of the Sacajawea is used, the beds so designated contain in their lower part a large and distinctive fauna which Shaw and Bell (1955) regarded as Chesteran.

J. W. Strickland, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 51, 53. Term Sacajawea should be adopted throughout western Wyoming for strata of Chester age below the Darwin and above top of Madison group.

C. A. Burk, 1956, Stratigraphic summary of the pre-Niobrara formations of Wyoming, *in* Wyoming stratigraphy, pt. 1, Subsurface stratigraphy of the pre-Niobrara formations in Wyoming, Casper, Wyoming: Wyoming Geol. Assoc., p. 92. Suggests name be abandoned.

J. W. Strickland, 1957, Wyoming Geol. Assoc. Guidebook 12th Ann. Field Conf., p. 20, 21, 23–25. Sacajawea problem discussed. Confusion in interpretation and usage of term Sacajawea believed to have arisen largely as a result of original miscorrelation of type Sacajawea with Cherry Creek section and failure of most workers, including writer [Strickland], to recognize it. Believed that term Sacajawea should be used only for upper member of Upper Madison but should include the thin-bedded limestone and dolomites directly underlying Darwin sandstone and above the "massive crystalline limestone" of Branson (1937). This conclusion seems warranted on the basis of lithologic similarity with beds in unquestionable Madison strata and comment by Branson that beds referred to as Lower Amsden formation may be added to the Sacajawea if favoring evidence appears. This conclusion differs from those of earlier workers including the writer's (Strickland, 1956) who considered the term Sacajawea interchangeable with beds referred to as Lower Amsden. Type section described. Type Sacajawea as originally defined embraces only lower 50 feet or so of an 80- to 100-foot sequence of strata between the Darwin sandstone and typical looking Madison limestone.

T. W. Todd, 1959, Dissert. Abs., v. 20, no. 6, p. 2230–2231. Sacajawea formation, Amsden formation, and Tensleep sandstone are products of marine transgressive-regressive cycle that took place on Wyoming cratonic shelf during Pennsylvanian period as one phase in development of eastern Cordilleran geosyncline. Name Montchauve group is suggested for these formations.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of stratigraphy of Pennsylvanian in northeastern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Suggested that Quadrant and Casper formational names be abandoned and the Tensleep-Amsden-Sacajawea terminology be extended to include strata formerly referred to by these names and that term Sacajawea be accepted as formational name applicable to the red clastic sequence between Madison limestone or equivalent and Amsden carbonates.

Type locality (Strickland, 1957): In SE¼NW¼NE¼ sec. 11, T. 2 N., R. 4 W., along hogbacks in middle of valley above Bull Lake, Wind River Mountains, Wyo. Name derived from Mount Sacajawea at head of Bull Lake Creek. A store and inn of that name are on Yellowstone Park Highway near mouth of Bull Lake Creek. Word is Shoshone name of Bird Woman, guide of the Lewis and Clark expedition.

Sacandaga Quartzite[1]

Precambrian: Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199, p. 94, 121.

Type locality: Sacandaga River, Sacandaga mine, Day Township, Saratoga County.

Sacator Quartz Diorite

Paleozoic(?) or Mesozoic(?): Southern California.

W. J. Miller and R. W. Webb, 1940, California Jour. Mines and Geology, v. 36, p. 354–355, 356, 378 (fig. 31), pl. 2. Quartz-diorite varying to diorite, dark-colored and even-grained. Intrudes the Summit gabbro.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 512. Noted as cutting both Kernville series and Summit gabbro.

Named from exposures in Sacatar Canyon in northeastern part of Kernville quadrangle, Kern County.

Sacate Formation

Eocene, middle or upper: Southern California.

F. R. Kelley, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 1, p. 3 (fig. 2), 4 (fig. 3), 10–11. Succession of sandstones and interbedded silty and shaly strata. Thickness about 875 feet. Formation varies laterally. In Sacate Canyon, three well-defined massive sandstones crop out and are separated by sandy shales. These sandstones lose their identity toward the east and west. Conformably underlies Gaviota formation; conformably overlies Cozy Dell formation. Sandstone has been called "Coldwater" since evidence indicated it to be the probable equivalent of the Coldwater sandstone of the Ventura region.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 28–29, 38 (fig. 2). Thickness given as 1,000 to 1,500 feet. Overlies Cozy Dell; underlies Gaviota; upper and lower contacts gradational. Upper Eocene.

Type locality: Sacate Canyon, western Santa Ynez Mountains, Santa Barbara County.

Sacchi Beach Beds

See **McIntosh Formation.**

Sacfox Subgroup[1] (of Wabaunsee Group)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 4, 5, 10–11.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 2036, 2037 (fig. 6); Kansas Geol. Survey Bull. 83, p. 169–171; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 18–20; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 19–20. The subgroups named (ascending) Sacfox, Nemaha, and Richardson by Condra (1935) have been included in the interstate classification agreed to by the Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma. As thus defined, the Sacfox subgroup in standard section includes (ascending) Severy shale, Howard formation, White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Rulo limestone, and Silver Lake shale. Nomenclature in the several States may deviate from this by combination or omission of terms where certain named rock units are not recognizable.

Type locality: In Missouri River bluffs in southeastern Richardson County, Nebr., and adjacent part of northeastern Kansas, that is, between southeast of Rulo, Nebr., and White Cloud, Kans. Name derived from the Iowa-Sac-Fox Indian Reservation in northeastern Kansas and southeastern Nebraska.

Sachuest Arkose[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 284–288, 379.

Composes west and south shores of Sachuest Neck, north shore at Flint Point, and a small exposure offshore at a headland one-fourth mile south of Flint Point, Newport County.

†Sacramento Formation[1]

Middle Devonian: Northern California.

Original reference: J. P. Smith, 1894, Jour. Geology, v. 2, p. 591, 592.

In Sacramento Canyon, Redding region.

Sacramento Porphyry or **Porphyrite**[1] (in Gray Porphyry Group)

Tertiary, lower: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1883, U.S. Geol. Survey Leadville Atlas, cross-section sheet; 1886, U.S. Geol. Survey Mon. 12, p. 81.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 50–52, 57, pl. 1. Distinguished from similar rocks of Gray porphyry group by following megascopic features: coarser and less equigranular than Evans Gulch porphyry; lacks large orthoclase phenocrysts such as are

common in Johnson Gulch porphyry; relative abundance of ferromagnesian minerals and relatively small proportion of orthoclase phenocrysts and euhedral quartz distinguish it from typical Lincoln porphyry. In igneous sequence, intrusion of quartz diorite porphyry was followed by intrusions of Evans Gulch and Sacramento porphyries and typical Lincoln porphyry; relative ages of these porphyries not determinable. Older than Iowa Gulch porphyry. Igneous rocks that are younger than Precambrian in area of this report [west slope of Mosquito Range] are either wholly or mainly Tertiary and only possibly in part late Cretaceous or early Pleistocene in age.

Ogden Tweto, 1956, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–34. Mapped as early Tertiary in Tennessee Pass area, Eagle and Lake Counties, where it consists of gray, greenish-gray, or dark-orange-buff quartz monzonite porphyry characterized by abundant stout feldspar phenocrysts, predominantly plagioclase in most bodies but mostly orthoclase in some, and by abundant biotite flakes. Considered younger than Elk Mountain porphyry because some faults that offset bodies of Elk Mountain do not appear to run through the Sacramento.

Named for occurrence under Gemini Peaks, between heads of Big and Little Sacramento Gulches, vicinity of Leadville, Lake County.

Sacramento Tuff and Sand Member (of Tuscan Formation)

[Pliocene]: Northern California.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. Tuscan formation is subdivided into five members. Sacramento tuff and sand is youngest in sequence. Overlies Iron Canyon agglomerate member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

Sacramento Hill Porphyry

Lower Cretaceous: Southeastern Arizona.

W. G. Hogue and E. D. Wilson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 21. Porphyry, ranging from granitic to monzonitic in composition. Forms numerous dikes and sills and Sacramento Hill stock. Intruded Paleozoic and older rocks.

G. W. Bain, 1952, Econ. Geology, v. 47, no. 3, p. 305, 306, 308. Described as quartz porphyry. Appears to have been intruded before deposition of Lower Cretaceous strata. If porphyry is later than Dividend fault and older than Glance conglomerate, then it is of very early Lower Cretaceous age.

Forms the stock of Sacramento Hill in Bisbee or Warren district, Cochise County.

Sacred Heart Granite (in Minnesota Valley Granite Series)

Precambrian: Southwestern Minnesota.

E. H. Lund, 1956, Geol. Soc. America Bull., v. 67, no. 11, p. 1482, 1483–1484. Massive, medium-grained, pinkish-gray to red granite. Inclusions common but concentrated in swarms, rather than being everywhere present as in Morton gneiss. Inclusions commonly a few feet or less across but some measure more than 100 feet across. Appears to be younger than nearby Morton gneiss but age relationship not certain. May represent younger phase of magma that produced Morton gneiss and Fort Ridgely granite (new).

Crops out in vicinity of Sacred Heart, Renville County.

Saddle Gneiss

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carrol and Frederick Counties Rept., p. 17, 18. Oldest rock of the injection complex, a highly metamorphosed biotite gneiss with layers of biotite schist and quartzite. Intruded by Cattron diorite (new).

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 22–25, pl. 1. Comprises quartzite, biotite, schist, gneiss and garnetiferous facies with and without sillimanite. Quartzite in places contains graphite. Individual layers of these rocks, nowhere more than few feet thick, alternate with each other in every outcrop to such an extent that different kinds of rock could not be mapped separately. No sequence in the rock determined. Garnetiferous biotite gneiss is medium- to fine-grained banded rock composed of fine quartz grains, grayish-green feldspar, and bronze biotite flakes. Highly garnetiferous variety occurs 1 mile east of Cattrons Mill. Quartzite abundant in Saddle gneiss in several narrow zones which lie north of and along U.S. Route 58 from Baxter Ferry on New River southwestward to Independence. Quartzite that is interlayered with biotite gneiss is found chiefly in belt northwest of Fries overthrust and south of Striped Rock granite and north of Elk Creek village. Oldest known rocks of district. Derivation of name given.

Named from Saddle Creek in southwestern part of Gossan Lead district, Grayson County. Well exposed at intersection of Saddle Creek and U.S. Route 58. Best exposures at several places along U.S. Route 58 on State Highway 95, and on U.S. Route 21 south of its junction with State Highway 95.

Saddleback Basalt (in Tropico Group)

Saddleback Basalt (in Ricardo Formation)

Pliocene(?): Southern California.

H. S. Gale, 1946, California Jour. Mines and Geology, v. 42, no. 4, p. 326, 339, 346–350. Name applied to basaltic lavas which form base on which borate-bearing lake beds (Kramer Lake beds) rest. They rise in dip slope outcrops around northern borders of basin where borates occur. Flows vary in thickness from 600 feet maximum to where they pinch out and disappear in an area along the southern border of the basin. Present in Ricardo formation only in Kramer borate district.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 137 (fig. 1), 138 (fig. 2), 142. Redefined as local formation in Tropico group (new). At type section, rests on quartz monzonite but elsewhere rests with probable slight unconformity on lower part of Tropico group. In Kramer borate district, these underlying rocks were referred to as Rosamond formation by Gale (1946). The Saddleback is overlain unconformably by the borate-bearing shale of upper part of Tropico in Kramer district in the borate mines and unconformably by fanglomerate of probable Pleistocene age at the surface. Pliocene(?). Type locality designated.

Type locality: Saddleback Mountain in S¼ sec. 9, T. 11 N., R. 7 W., 4 miles north of Boron, Boron quadrangle, San Bernardino County. From Saddleback Mountain, basalt crops out as scattered exposures in low isolated hills toward northwest for 6 miles, and west about 10 miles.

Saddlebag Lake Conglomerate

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1033–1034. Basal conglomerate composed almost entirely of greenstone fragments in a schistose matrix of greenstone debris. Unconformably underlies Dike Lake slate (new); unconformably overlies Ely greenstone. Name credited to V. G. Sleight. [Fig. 4 shows Moose Lake conglomerate occupying stratigraphic position assigned to Saddlebag Lake conglomerate in text.]

Named for exposure on shores of Saddlebag Lake in sec. 13, T. 65 N., R. 6 W., in Vermilion district.

Saddle Bayou Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv., Geol. Bull. 10, p. 78 (fig. 6), 102–103. Series of massive fossiliferous sands averaging 20 feet in thickness. Sands are medium grained, well rounded, poorly indurated, and locally cemented by limonite. Lentil grades downward and interfingers laterally with typical Verda lignitic clays; grades laterally, eastward, into a series of unnamed sandy shales.

Exposed in cuts along a secondary road crossing a tributary of Saddle Bayou in the NW¼ sec. 20, T. 9 N., R. 2 W., Grant Parish.

Saddle Creek Limestone Member (of Pueblo Formation)

Saddle Creek Formation (in Pueblo Group)

Saddle Creek Limestone Member (of Harpersville Formation) [1]

Permian: Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 416.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Rank raised to formation and reallocated to the Pueblo here redefined, given group status and assigned to the Permian. Underlies Stockwether formation. Redefined Pennsylvanian-Permian boundary is placed at disconformity in Harpersville formation above Waldrip-Newcastle coal zone about 40 to 150 feet below Saddle Creek limestone.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as limestone member of Pueblo formation. Consists of thin irregular layers of brittle fine-grained blue-gray limestone 4 to 5 feet thick. Underlies Camp Creek shale member; overlies Waldrip shale member.

Well exposed 1 to 2 miles south of mouth of Saddle Creek, south of Colorado River, McCulloch County.

Saddlehorse Gypsum Lentil (in Quartermaster Formation) [1]

Permian: Texas.

Original reference: C. N. Gould, 1907, U.S. Geol. Survey Water-Supply Paper 191, p. 16–20.

Saddle Mountain Lavas

Age not stated: Northern California.

Howell Williams, 1932, California Univ. Pub. Bull. Dept. Geol. Sci., v. 21, no. 8, p. 274. Flat-lying lavas older than Harkness lavas.

Saddle Mountain shown on map in Shasta and Plumas Counties, Lassen Volcanic National Park.

Saddle Mountain Porphyry[1]

Saddle Mountain Rhyolite

Precambrian: Southwestern Oklahoma.

Original reference: H. F. Bain, 1900, Geol. Soc. America Bull., v. 11, p. 135, 136.

R. E. Denison, 1959, (abs.) Oklahoma Acad. Sci. Proc. 1958, p. 124. Saddle Mountain rhyolite is typically granophyric, and recent investigation indicates that it is gradational phase of Lugert granite.

Occurs near Saddle Mountain, in and around sec. 36, T. 5 N., R. 15 W., Wichita Mountains.

Sadlerochit Formation

Sadlerochit Sandstone[1]

Permian and Lower Triassic: Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 113, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Cited as formation on map legend.

In Sadlerochit Mountains, Canning River region.

Saegerstown Member (of Cattaraugus Formation)

Saegerstown Shale[1]

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original reference: G. H. Chadwick, 1925, Geol. Soc. America Bull., v. 36, p. 457–464.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Saegerstown [shale] shown on correlation chart above Salamanca and below Woodcock. Upper Devonian.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 33. Extended into Chautauqua County, N.Y., where it is considered member at top of Cattaraugus formation. Consists of shales and siltstones. Thickness about 100 feet. Overlies Salamanca member; underlies Oswayo formation. Upper Devonian.

Named for exposures along French Creek, in village of Saegerstown, Crawford County, Pa.

Safford Dacite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 739–740, pl. 1. Consists of three varieties of rock: fresh porphyritic dacite with groundmass of minute spherulites; porphyritic border facies with clear glass groundmass; and chalky porphyritic dacite. Chalky white to light gray when fresh and gray to light drab on weathered surfaces. Flow structure nearly vertical and parallel to its borders. The dacite pierces the Rillito andesite (new) and the Safford tuff (new). The mass is regarded as an eroded volcanic neck.

Largely confined to core of Safford Peak, Tucson Mountains, Pima County. Area of peak is elliptical, the long axis of which is 2,800 feet and short axis is 1,500 feet.

Safford Tuff

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 731–733, fig. 2, pl. 1. Consists of a coarse stratified but poorly sorted volcanic breccia or tuff near Safford Peak. Farther south it is usually fine grained and well stratified to thin bedded. Its materials range from sand to boulders 3 feet in diameter. Ranges through various shades of red and brown and is chalky white where altered. Thickness at least 340 feet. Rests concordantly on Rillito andesite (new) near Safford Peak, but to the southeast rests directly on Cretaceous volcanics with marked angular unconformity and is overlain by later basalts with another angular unconformity.

Named from exposures in cliffs near Safford Peak. Occurs throughout Tucson Mountain Range, Pima County.

Safford Canyon Formation

Oligocene, upper, and Miocene, lower(?): Northeastern Nevada.

Jerome Regnier, 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1191, 1193–1195, pl. 1. Consists of 700 feet of water-laid vitric tuffs and tuffaceous volcanic sandstones and conglomerates which form an open north-plunging syncline in northern end of Pine Valley. Lower part is 50-foot bed of coarse volcanic-pebble conglomerate which rests in sedimentary contact (slight angular unconformity) on volcanic rocks of Cortez Mountains; remainder of formation is interbedded tuffs, conglomerates, and a 20-foot bed of limestone. Occupies same stratigraphic position as Rand Ranch formation (new), between the volcanic rocks and upper Miocene Raine Ranch formation (new): not considered facies of Rand Ranch but believed to be younger than that formation. Nonfossiliferous.

Named for tributary of Humboldt River southwest of Palisade, vicinity of Carlin. Section measured from NE¼ sec. 11, T. 31 N., R. 51 E., toward center of sec. 1, same township.

Sagamore Siltstone Member (of Bedford Shale)

Sagamore Sandstone Lentil (in Bedford Shale)[1]

Mississippian: Northeastern Ohio.

Original reference: C. S. Prosser, 1912, Ohio Geol. Survey, 4th ser., Bull. 15, p. 26, 86, 88.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1354–1356. Here termed Sagamore siltstone member; unit is of unknown areal extent and is made up predominantly of quartzose siltstone containing a small amount of very fine sand; contains thin to massively bedded gray siltstones from 4 to 20 inches thick. Maximum thickness 20 feet. Occurs 30 feet above base of Bedford; underlain by silty gray shale containing many ripple-marked siltstones; stratigraphically above Euclid siltstone member.

Named for Sagamore Creek, Bedford Township, Cuyahoga County. Crops out along Cuyahoga River valley south of Bedford.

Saganaga Granite[1]

Precambrian: Northeastern Minnesota.

Original reference: A Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1033. Townline Lake granodiorite (new) which cuts Ely greenstone, may be offshoot of Saganaga granite.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1583 (table 2), 1590, 1613, pl. 1. In Knife Lake area, contacts of granite with overlying Knife Lake sediments dips to west at angles of 60° to 70° in many places at western edge of batholith. Crooked Lake granite pebble conglomerates (new) were deposited on arkosites and graywacke which rest directly on Saganaga granite.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1041. Underlies Animikie rocks (Gunflint formation) in hills east of Gunflint Trail (road) between Gunflint and Saganaga Lake, secs. 22 and 23, T. 65 N., R. 4 W. Intrudes Ely greenstone.

First described on shores and islands of Saganaga Lake, Cook County.

Saganaga Syenite[1]

Precambrian (Keewatin): Northeastern Minnesota.

Original reference: A. Winchell, 1891, Am. Jour. Sci., 3d, v. 41, p. 386.

Sagavanirktok Formation

Paleocene to Oligocene(?): Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 167, fig. 2. Mainly of red-bed-type poorly consolidated siltstone, sandstone, conglomerate, and lignite. Structurally conformable with underlying Colville group and no large erosional break indicated. Unconformably underlies Gubik formation. Contains early Tertiary flora.

T. G. Payne, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Nonmarine. Contains bentonite, tuff. Maximum thickness 2,000 feet. Tertiary Paleocene(?).

Type locality: In Franklin Bluffs along lower part of Sagavanirktok River. Also well exposed in White Hills area.

Sagavanirktok River Glaciation

Pleistocene: Central northern Alaska.

R. L. Detterman, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 11, 13 (table 1). Four Quaternary glacial advances recognized in Sagavanirktok-Anaktuvuk district. Sagavanirktok, the oldest well-defined advance, succeeded Anaktuvuk glaciation (new); preceded Itkillik glaciation (new). Morainal remnants cover area of 230 square miles. Piedmont lobe probably was formed with maximum extension 30 miles north of mountains.

Renamed Sagavanirktok River Glaciation in order to retain name Sagavanirktok for formation.

Morainal remnants along Sagavanirktok River, 60 miles east of Anaktuvuk.

Sage Limestone (in Gallatin Group)

Sage Limestone Member (of Gallatin Formation)

Sage Limestone Member (of Red Lion Formation)

Sage Pebble-Conglomerate Member (of Snowy Range Formation)

Upper Cambrian: Central, southern, and southwestern Montana and northwestern Wyoming.

Christina Lochman, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2212. Proposed for upper member of Snowy Range formation. Intercalated shales and limestone pebble conglomerates with dense columnar limestone near base. Thickness 150 to 175 feet in southern Montana where entire member is preserved. Overlies Dry Creek shale member. Upper Sage members is lithic unit called "Pebbly limestone" by Peale (1893, U.S. Geol. Survey Bull. 110).

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 18. In southwestern Montana, considered member of Red Lion formation.

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., chart 2. Lochman (1950) revised and redescribed the Dry Creek shale and named what in Wyoming is called "upper Gallatin limestone" the Sage pebble conglomerates. This name seems applicable in Wyoming, but because of lithic changes, term Sage limestone is preferred. Dry Creek shale is thin and rarely mappable and most commonly should be regarded as member of Sage limestone. Gallatin formation is herein raised to rank of group and includes Sage limestone.

C. R. DeLand, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12. pt. 2, p. 1374. Sage limestone considered upper member of Gallatin formation in Wind River Mountains, Wyo.

Type locality: On south slope of Castle Rock, at junction of the East Fork with Mill Creek, N¼SE¼ sec. 13, T. 6 S., R. 9 E., Livingston quadrangle, Montana. Name derived from Lower Sage Creek which enters East Fork of Mill Creek 1½ miles up stream from type locality.

Sage Breaks Shale Member (of Carlile Shale)

Sage Breaks Shale Member (of Niobrara Formation)[1]

Upper Cretaceous: Northeastern Wyoming, southeastern Montana, and western South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

H. D. Thomas, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 9, p. 1190 (table 1), 1194 (fig. 1), 1195. Term Sage Breaks member of Niobrara extended into Laramie basin, southeastern Wyoming. Replaces term "Carlile" as used in this area.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2187. Reallocated to member status in Carlile formation.

W. A. Cobban and J. B. Reeside, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 1948–1949. South-southeast of Rapid City, S. Dak., 70 feet thick; at Belle Fourche, S. Dak., 200 feet; and in Carter County, Mont., 300 feet. In all these areas, the Sage Breaks is conformable with Turner sandy member of Carlile and disconformable with Niobrara. Member is absent over much of central Great Plains. Reasons for reallocation discussed.

Named for exposures in the Sage Breaks, in T. 56 N., R. 63 W., Weston County, Wyo.

Sage Creek Basalts

Eocene: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 373, pl. 1. Named for several small basalt

flows that occur at base of Sage Creek formation in T. 12 S., R. 8 W., north of Sage Creek. Similar flows crop out 2 miles to northwest and on southwest side of Blacktail Range, secs. 2 and 11, T. 10 S., R. 9 W., where they are overlain by Cook Ranch formation (new). Rocks are all badly weathered.

Described in T. 12 S., R. 8 W., Beaverhead County.

Sage Creek Formation[1]

Eocene, upper, and Oligocene: Southwestern Montana.

Original reference: E. Douglass, 1903, Carnegie Mus. Annals, v. 2, p. 145–146.

Jean Hough, 1955, Jour. Paleontology, v. 29, no. 1, p. 22–36. Sage Creek problem discussed. Formation redefined to include 200 feet of higher breccias and tuffs at its type locality and in adjoining areas. As redefined includes Cook Ranch formation of Wood (1933).

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 373, pl. 1. Basalt flows occurring at base and top of formation are here named Sage Creek basalts.

Named for occurrences north of Sage Creek, about 7 miles northeast of Lima, Beaverhead County.

Sage Hen Limestone Member (of Colorado Shale)[1]

Upper Cretaceous: Central northern Montana.

Original reference: C. T. Lupton and Wallace Lee, 1921, Am. Assoc. Petroleum Geologists Bull., v. 5, p. 264, 266.

Named for exposures in Sage Hen Creek, Little Rocky Mountains region.

Sage Valley Limestone Member (of Goldens Ranch Formation)

Eocene, middle or upper: Central Utah.

Siegfried Muessig, 1951, Science. v. 114, no. 2957, p. 234. Relatively pure limestone with abundant plant remains. Occurs 820 feet above base of formation. Age considered middle or upper Eocene on basis of plant fossils.

Occurs in Long Ridge area, southwest of Levan, Juab County. Derivation of name not stated.

Saginaw Formation[1]

Saginaw Group

Pennsylvanian: Southern Michigan.

Original reference: A. C. Lane, 1901, Michigan Miner, v. 3, no. 1, p. 9.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 158 (table 1), 159. 165–205. Saginaw group is composed of material of fresh water, brackish water, and marine origin, and consists of sandstones, shales, coal, and limestones. Comprises many cyclical formations, one which, herein named Verne, contains a persistent shaly marine limestone member that makes it convenient to divide the group into pre- and post-Verne cyclical formations. Thickness 400 feet. Group directly overlies Parma sandstone wherever that formation is present; in some areas, directly overlies Bayport formation, as in area immediately north of Jackson; in several localities, may rest directly on Napolean sandstone. Underlies Grand River group herein proposed to include all strata younger than Saginaw. Type section given.

G. V. Cohee, Carol Mach, and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–41, sheet 5. Recommended that Eaton and Ionia be considered members of Saginaw formation and that Woodville be restricted to a sandstone member in lower part of Saginaw.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28. Includes Verne limestone member. Seven cyclothems, of which Grand Ledge is typical, are recognized in vicinity of Grand Ledge, Eaton County.

Type section: Near Grand Ledge, Eaton County. Name derived from Saginaw Valley and Saginaw County.

Sailor Canyon Formation[1]

Lower and Middle Jurassic: Northern California.

Original reference: H. W. Turner, 1894, Am. Geologist, v. 13, p. 232.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 52, no. 1, p. 99–100. Near northern end of Sierras, Triassic and Jurassic sediments and volcanics have been named Milton and Sailor Canyon formations, but there is little doubt that they are equivalent. Since name Milton has priority, it is used here to include all Triassic and Jurassic rocks of higher parts of Sierra Nevada, south of Taylorsville.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300. Correlation chart (table 1) shows lowermost part of Sailor Canyon formation in Upper Triassic.

Named for exposures in Sailor Canyon, which drains into American River about 6 miles south-east of Cisco, Placer County.

St. Albans Slate[1]

St. Albans Slate (in Woods Corners Group)

Middle Cambrian: Northwestern Vermont.

Original reference: J. Marcou, 1862, Boston Soc. Nat. History Proc., v. 8, p. 239–253.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1021, 1039–1041. Type locality cited.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1 (column 70). Listed as St. Albans shale.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 532 (fig. 5), 536–537, pl. 1. St. Albans slate is commonly black, gray-black, or tan and is micaceous. At type locality, top of formation is soft tan to golden brown micaceous slate, highly cleaved and contorted. Locally contains thick conglomerate of large blocks of arenaceous dolomite. Near Swantown Junction, a mass of limestone conglomerate is tentatively assigned to the St. Albans. Estimated thickness about 200 feet ± 50 percent. Belt of outcrop widens northward from type locality, but structure exposed in bed of Stevens Brook suggests that beds have flattened out and that formation has not thickened in that direction. Elsewhere than at type locality, formation is commonly less than 100 feet thick. Overlies Rugg Brook dolomite underlies Mill River conglomerate and Skeels Corners slate. Basal formation of Woods Corners group (new). Middle Cambrian.

Type locality: Adams pasture, at western edge of St. Albans, north of road from St. Albans to St. Albans Bay, Franklin County.

St. Charles Intraglacial Substage

Pleistocene (Wisconsin): North-central United States.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 549, 550. Name applied to Tazewell-Cary intraglacial substage. Represented by cutting of Fox River valley.

Named for St. Charles, the locality where Minooka moraine of Cary substage descends into the valley. Later West Chicago moraine of Cary substage also descends into this valley near town of Cary.

St. Charles Limestone[1]

Upper Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 6.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1108–1109, 1117 (fig. 4), 1123–1124. Walcott gave thickness of St. Charles as 1,227 feet in Blacksmith Fork section, Utah. Section is herein emended to exclude upper 777 feet which were found to contain Ordovician fossils. As emended, formation is about 400 feet thick; consists of basal dolomite zone about 148 feet thick and an upper limestone zone about 258 feet thick. Worm Creek quartzite member only questionably present here. Overlies Nounan dolomite.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 13, 14, pl. 1. Described in Randolph quadrangle, Utah, where it crops out on both limbs of Fish Haven syncline, on flanks of Bear River Range west of Garden City. Consists of basal Worm Creek quartzite and overlying limestone. Thickness approximately 400 feet. Overlies Nounan limestone. Restricted to lower 400 feet (approximately) of formation as defined by Walcott; upper 900 feet (approximately) now considered Lower Ordovician and assigned to Garden City limestone.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1134–1135, pl. 1. Described in Logan quadrangle, Utah. Overlies Nounan formation; underlies Garden City limestone. Consists of basal quartzite member (Worm Creek), middle member of thin-bedded limestone, and upper member of massive dark-gray dolomites. Deiss (1938) erred in redefinition of St. Charles in Blacksmith Fork section, because he failed to locate the Worm Creek which is distinctly present here. The 258 feet of limestone and intercalated intraformational conglomerates which he included at top of formation are basal Garden City.

H. W. Coulter, 1956, Idaho Bur. Mines and Geology Pamph. 107, p. 17–19, geol. map. Thickness east of Willow Flat, Idaho, 771 feet; Worm Creek 170 feet. Overlies Nounan formation; underlies Garden City formation.

Type locality: West of St. Charles, Bear Lake County, Idaho.

St. Clair facies (of Murfreesboro Limestone)

Middle Ordovician: Southwestern Virginia.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 126, 132, 133. Name given to a purely limestone facies in the Murfreesboro. Thickness varies from 271 feet in Lee County to as much as 1,142 feet near Bluefield, Tazewell County. The St. Clair is confined to the northwest belt of the Murfreesboro and the Blackford facies (new) to the southeast side.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 88–89. Limestone referred to by Butts (1940) as Murfreesboro is now known not to

be Murfreesboro, and the limestones have been placed in other formations.

Well exposed just south of St. Clair Railroad station, 2½ miles west of Bluefield, Tazewell County.

St. Clair Limestone[1]

St. Clair Formation (in Bainbridge Group)

Silurian: Northern Arkansas, southern Illinois, and central eastern Oklahoma.

Original reference: R. A. F. Penrose, Jr., 1891, Arkansas Geol. Survey Ann. Rept. 1890, v. 1, p. 102–103, 112–114, 124–128, 166–174.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 12, 13. Lower formation of Bainbridge group. Name is here applied regionally to the pink crinoidal limestone of early Niagaran age throughout its distribution in midwestern States except where local names are applicable to separate tongues in marginal areas, as the Lego and Laurel tongues in Tennessee and a tongue in base of Joliet formation in Illinois and Wisconsin. Underlies Moccasin Springs formation (new). Thickens progressively east and northeast from 20 to 25 feet in outcrop area along Ozark border to about 80 feet near Illinois-Indiana boundary; maximum Illinois thickness 80 to 150 feet over area beneath and just beyond wedge edge of overlying Moccasin Springs formation; locally reaches thickness of 200 feet; thins nortnwestward from area of greatest development by interfingering and gradation of upper beds into rocks typical of Chicago area with only basal member maintaining its identity. Formation occupies belt about 100 miles wide, lying on east and southsides of Ozark highland, and extending discontinuously from western Oklahoma and west-central Texas through Arkansas, western Tennessee, western Kentucky, Illinois, and Indiana to central part of Michigan basin. [Discussion of Niagaran reefs in Illinois and their relation to oil accumulation; much data relative to thickness and distribution of unit are based on subsurface studies].

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as St. Clair limestone.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 29–33, pl. 4. Described as St. Clair formation in northeastern Oklahoma on south and west flanks of Ozark uplift, where it is best exposed in Marble City area on southern and eastern sides of Quarry Mountain. Characteristically white to pink medium to coarsely crystalline massive-bedded limestone; locally has bluish tint. Because of lack of impurities and coarse texture has been called "marble" by quarry industry. Thickness 95 to 165 feet; maximum thickness not determined as base and top are not exposed near areas of greatest development. Near Qualls unconformably overlies lower beds of the Sylvan; succeeded unconformably by Frisco limestone, Sallisaw sandstone, or Sylamore member of Chattanooga formation.

Named for St. Clair Springs, 8 miles northeast of Batesville, Independence County, Ark.

†St. Claire Shale[1]

Upper Devonian: Michigan.

Original reference: A. C. Lane, as reported by M. E. Wadsworth, 1893, Michigan Geol. Survey Rept. 1891 and 1892, p. 66.

Named for exposures along St. Clair River, St. Clair County.

St. Cloud Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 426–428.

St. Cloud Gray Grandodiorite

Precambrian (late Algoman): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, 1002, 1009, 1012–1013, pl. 1. Massive but not homogeneous; exposures are dotted with small dark inclusions and schlieren, cut by numerous dikes and veins, and irregularly altered to a lighter pinker rock; this pink facies appears to be grandodiorite that was granitized by St. Cloud red granite, dikes and apophyses of which twist and branch irregularly and in some places form a network in the St. Cloud gray granodiorite. One of five major intrusives in late Algoman; these cannot be shown to be members of a single magma series; age relations of the named intrusives, St. Cloud gray granodiorite, Freedhem tonalite, Hillman tonalite, and Warman quartz monzonite, are indeterminate because no contacts are exposed.

Named for the fact that it occurs in vicinity of St. Cloud, Stearns County.

St. Cloud Red Granite (in Stearns Magma Series)

Precambrian (middle Keweenawan): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60. no. 6, p. 1002, 1005–1006, pl. 1. Pink to red augite-hornblende granite. Cuts and contains inclusions of St. Cloud gray granodiorite, Freedhem tonalite, Hillman tonalite, and Thomson formation; cuts the quartz latite porphyry of the Stearns magma series and grades into the Rockville facies and porphyritic granite facies.

Crops out near St. Cloud, Stearns County; also in Benton, Mille Lacs, and Morrison Counties. Quarried extensively near St. Cloud.

St. Cloud Sandstone (in Greene Formation)[1]

Permian: Northern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1913, West Virginia Geol. Survey Rept. Marion, Monongalia, and Taylor Counties, p. 171.

Named for St. Cloud post office, Monongalia County.

†St. Croix Formation[1], Sandstone[1], Series[1], or Shales[1]

St. Croixan Formation

Upper Cambrian: Eastern Minnesota and western Wisconsin.

Original references: N. H. Winchell, 1873, Minnesota Geol. and Nat. History Survey 1st Ann. Rept. for 1872; 1874, Minnesota Geol. Nat. History Survey 2d Ann. Rept.; 1886, Minnesota Geol. Nat. History Survey 14th Ann. Rept., p. 334–337; C. W. Hall, 1889, Minnesota Acad. Nat. Sci. Bull., v. 3, p. 125–136; N. H. Winchell, 1900, Geol. map of Minnesota.

S. G. Bergquist, 1937, Michigan Acad Sci., Arts and Letters, Papers, v. 22, p. 421-435. Discussion of part of Alger County in which St. Croixan series of the Cambrian system come in contact with younger Hermansville calcareous formation, which, in Delta County, Ulrich and Hussey have tentatively assigned to Ozarkian system. Ulrich (personal commun.) gives evidence to support view that St. Croixan formation of Wisconsin area extends into Superior region of Alger County. The so-called Lake Superior sandstone would thus be included as a member of that forma-

tion. The Pictured Rocks, which rise out of Lake Superior as range of cliffs 100 to 150 feet high, are sculptured in St. Croixan formation.

Named for occurrence in St. Croix Valley, Minn.

St. Croixan Series[1]

St. Croixan Epoch[1]

Upper Cambrian: North America.

Original reference: C. D. Walcott, 1912, Smithsonian Misc. Colln., v. 57, no. 10, p. 306–307.

G. O. Raasch, 1935, Kansas Geol. Soc. Guidebook 9th Ann. Field Conf., p. 302–315. St. Croixan series crops out in more or less crescentric belt having its base in central southern Wisconsin and its extremities in east-central Minnesota and in northern peninsula of Michigan. Belt includes northwest corner of Iowa and isolated inlier in northern Illinois. In area of outcrop, series is considerably less than 1,000 feet thick, but in subsurface reaches maximum of more than 2,000 feet. Supposed thickening takes place at base of series. Series embraces all beds from base of Mount Simon member of Dresbach to top of Madison formation. Excludes Bayfield sandstone of the Keweenawan and all older rocks; and Oneota formation of Ordovician and all younger deposits. Both lower and upper boundary coincident with major unconformities. Comprises (ascending) Dresbach formation with Mount Simon, Eau Claire, and Galesville members; Franconia formation with Ironton, Goodenough, Hudson, and Bad Axe members; Trempealeau formation with St. Lawrence, Lodi, and Jordan members; and Madison formation.

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935, Geol. Soc. America Bull., v. 46, no. 11, p. 1687–1744. Croixian series, Upper Cambrian of Upper Mississippi Valley, comprises (ascending) Dresbach formation with Mount Simon, Eau Claire, and Galesville members; Franconia formation with Ironton, Goodenough, Hudson, and Bad Axe members; and Trempealeau formation with basal greensand and conglomerate member, and St. Lawrence, Lodi, Jordan, and Madison members.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1227-1244. St. Croixian series in Minnesota comprises (ascending) Dresbach formation with Mount Simon, Eau Claire, and Galesville members; Franconia formation with Ironton, Taylors Falls, Hudson, and Bad Axe members; St. Lawrence formation with Nicollet Creek (new) and Lodi members; Jordan formation with Norwalk and Van Oser members. Minnesota classification differs from Wisconsin classification (Twenhofel, Raash, and Thwaites, 1935) or Conference classification (Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L) in that their Trempealeau is equivalent to the two topmost formations of Minnesota classification. Hinckley sandstone not included in St. Croixian series by Minnesota Geological Survey.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9 (geol. column), 24–49. As shown on geologic column, St. Croixian series occurs above Lake Superior series with Hinckley sandstone at top and below Beekmantownian series with Kasota sandstone at base.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 165–184. In Upper Mississippi Valley, Croixan strata above Franconia formation consist of dolomite and dolomitic siltstone and sandstone overlain by massive nondolomitic sandstone. Previous classifications of this successions have employed both faunal and lithologic criteria for discrimination

of formations and members. Strata can be divided on lithologic characters alone. Terms St. Lawrence and Jordan formations are applied to the dolomitic strata and massive sandstone respectively. Strata with which present report is concerned have in past been called St. Lawrence, Mendota, Trempealeau, Black Earth, Nicollet Creek, and Lodi. Trempealeau should be abandoned as formational term and its usage restricted to Trempealeauan stage.

W. C. Bell, R. R. Berg, and C. A. Nelson, 1956, Internat. Geol. Cong., 20th, Mexico City, Cambrian Symposium, pt. 2, p. 415–446. Discussion of Croixan type area, Upper Mississippi Valley. By usual definition, the Croixan is said to constitute those rocks that originated during Late Cambrian epoch of geologic time, but in practice the Croixan is defined by those faunal assemblages that by common agreement among paleontologists are assigned to the Croixan. In North America, lowest Ordovician faunas are characterized by trilobites *Symphysurina*, *Bellefontia*, and *Hystrictus*, among others, and lowest and highest Croixan faunas are characterized, respectively, by *Cedaria* and *Plethopeltis*. Only in central Texas have trilobite faunas on both sides of this commonly accepted systemic boundary received critical attention, and this study has not been published; the boundary lies within conformable strata of San Saba member of Wilberns formation. A similar situation is reported in Montana (Lochman and Duncan, 1944, Geol. Soc. America Spec. Paper 54). Neither lowest or highest strata of type Croixan series have received critical lithostratigraphic and biostratigraphic attention, nor have Raasch's biostratigraphic studies been properly documented. Apparently there has been unanimous agreement among previous workers that Croixan series consists of several formations—variously named—and that highest formation is topped by unconformity at Cambrian-Ordovician boundary. This connection is so deeply rooted that Kasota sandstone is defined as reworked Jordan sand continuing Ordovician fauna and overlying Jordan unconformably. It is herein contended that the commonly accepted Cambrian-Ordovician faunal change occurred at Kasota and St. Peter during deposition of sand that today is part of lithogenetic unit that bears formational name Jordan sandstone. In other words, to Croixan series are assigned fossiliferous strata (and their presumed unfossiliferous temporal equivalents) that contain fossil faunas that by consensus are called Croixan and to rock units such as Jordan sandstone are assigned strata on basis of petrologic criteria. In type area, Croixan series consists of two transgressive-regressive sedimentary cycles of marine deposition. Lower cycle, comprising Dresbach formation, is underlain and overlain by unconformities. Upper cycle comprising Franconia, St. Lawrence, and Jordan formations reached maximum transgressive extension during deposition of Black Earth wedge and has unconformity at its top by implication but not thus far by demonstration. Series includes Dresbachian, Franconian, and Trempealeauan stages.

Type area: Upper Mississippi Valley. Name derived from St. Croix River, Minn.

St. David cyclothem (in Carbondale Formation)

St. David cyclothem (in Carbondale Group)[1]

Pennsylvanian: Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 102-107, 197 (geol. section 21). Includes (ascending) Springfield (No. 5) coal, St. David limestone, and Canton shale. Thickness 18 to 55 feet in localities where upper part is not truncated by Cuba sandstone. Appears to be conformable on Summum cyclothem; contact with overlying Brereton cyclothem is an erosional unconformity along which more than 50 feet of St. David strata are locally eroded. Name St. David was originally applied to the limestone by Savage (1927) and subsequently extended to entire cyclothem. Type locality and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 52 (table 2), pl. 1. In Carbondale formation (redefined). Above Summum cyclothem and below Brereton cyclothem in northern, western, and eastern areas and below Briar Hill cyclothem (new) in southwestern and southeastern areas. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Ravine sloping southeast to Big Creek, SE¼SE¼ sec. 17, NE¼NE¼ sec. 20, and NW¼NW¼ sec. 21, T. 6 N., R. 4 E., 1 mile west of St. David, Havana quadrangle, Fulton County.

St. David Limestone Member (of Carbondale Formation)

St. David Limestone (in Carbondale Group)

St. David Shale and Limestone (in Carbondale Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 207–316.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 105–106, 197. St. David limestone included in St. David cyclothem, Carbondale group. Limestone is most typically developed in north half of Havana quadrangle where it is a single bed 10 inches to 2 feet thick, light blue gray, dense, and fossiliferous; weathers to buff or light yellow brown. Overlies and underlies unnamed shale intervals. Stratigraphically below Canton shale.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 47 (table 1), pl. 1. Rank reduced to member status in Carbondale formation (redefined). In southern area, occurs above Harrisburg (No. 5) coal member and below Briar Hill (No. 5A) coal member. In western and northern area, occurs above Springfield (No. 5) coal member and below Canton shale member. Replaces Absher limestone. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼SE¼ sec. 17, T. 6 N., R. 4 E., Fulton County. Named for exposures near St. David.

St. Edwards Tuff (in Burditt Marl)

Upper Cretaceous: South-central Texas.

C. O. Durham, Jr., 1955, Corpus Christi Geol. Soc. [Guidebook] Ann. Field Trip, March 11–12 [p. 59], pl. 16. Occurs within basal Burditt marl. Younger than Pilot Knob tuff (new).

Exposed near St. Edwards University, south of State Capitol, Austin, Travis County.

St. Elias Schist[1]

Age(?): Southeastern Alaska.

Original reference: I. C. Russell, 1891, Nat. Geog. Mag., v. 3, p. 167–175.

St. Elias Range in St. Elias region.

†St. Elizabeth Formation[1]

Lower Ordovician (Beekmantown): Central Missouri.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 50.

Named for St. Elizabeth, Miller County.

St. Francis Series or Group

Silurian(?) and Devonian: Quebec, Canada, and Massachusetts and Vermont.

T. H. Clark, 1937, Canada Geol. Survey Mem. 211, p. 37–42. Series made up of two members, a group of lavas and a formation consisting mainly of impure quartzite and graywacke. Thickness of lavas may be in excess of 8,000 feet. Thickness of series may be as much as 10,000 feet. Northern boundary is line drawn from Lac Rocheux in Adstock Township to Elgin Lake in Stratford. Series underlies all of Disraeli map area southeast of this line, except parts underlain by Winslow granite and Lake Aylmer series.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 7. Group extends from Quebec to Massachusetts. In Vermont, includes Waits River formation and Gile Mountain formation. Tentatively assigned to Devonian.

J. H. Eric and J. G. Dennis, 1958, Vermont Geol. Survey Bull. 11, p. 18, pl. 1. Group includes Northfield slate, Waits River formation, Gile Mountain formation, and Meetinghouse slate. Devonian and Silurian(?).

St. Francis Lake and St. Francis River are in Quebec.

†St. Francois Limestone[1]

Upper Cambrian: Eastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 346, 349–354.

Named for St. Francois County.

†Ste. Genevieve Group[1]

Mississippian: Missouri, Illinois, and western Kentucky.

Original reference: C. R. Eastman, 1903, Harvard Coll. Mus. Comp. Zoology Bull., v. 39, no. 7, p. 195.

†Ste. Genevieve Group[1]

Mississippian: Missouri, Illinois, and Iowa.

Original reference: H. S. Williams, 1922, Pan-Am. Geologist, v. 37, no. 1, p. 39–40.

Probably named for Ste. Genevieve County, Mo.

Ste. Genevieve Limestone

Ste. Genevieve Limestone (in Blue River Group)

Ste. Genevieve Limestone (in Meramec Group)[1]

Upper Mississippian (Meramec Series): Eastern Missouri, northern Alabama, Georgia, southern Illinois, Indiana, Iowa, Kentucky, and Tennessee.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 406.

Stuart Weller and F. F. Krey, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 7–8. Ste. Genevieve limestone, Iowa series, described in Dongola, Vienna, and Brownfield quadrangles where it is as much as 300 feet thick, overlies St. Louis limestone and underlies Renault limestone of Chester series. Fredonia, Rosiclare, and Levias members recognized in Dongola quadrangle but are poorly exposed and cannot be mapped separately. In addition to these members, a variable succession of clastic beds including some limestone overlies the Levias in Union County, and for these name Hoffner member is proposed.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 133–134. Ste. Genevieve limestone classified as uppermost formation in Meramec group, Valmeyer series. Overlies St. Louis limestone; underlies Aux Vases sandstone of New Design group (new) Chester series. In southeastern Illinois, consists of three members (ascending): Fredonia limestone, Rosiclare sandstone, and Levias limestone.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 366–378. Ste. Genevieve limestone occurs in Virginia in two different facies: pure oolitic limestone along Cumberland escarpment and in northwestern margin of Appalachian Valley next to the coal fields and predominant shale with subordinate limestone beds along middle belt of Greendale syncline from Saltville, Smyth County, to Tennessee. Overlies St. Louis limestone; underlies Gasper limestone. Thickness 85 to 1,500 feet.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 815–817. Classified as uppermost formation in Meramec group, Iowa series. This classification follows that of Illinois Geological Survey.

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 160–164. In this report [Burkes Garden quadrangle], term Ste. Genevieve is used in tentative sense for beds which possible, though not certainly, are same age as Ste. Genevieve of type region. Thickness 300 to 525 feet. Overlies Hillsdale limestone which name is used to replace St. Louis limestone as used by Butts (1940); underlies "Gasper" limestone of Chester series. Ste. Genevieve of this report may correspond to the lower, or Fredonia member, of the Ste. Genevieve of Ohio Valley. In West Virginia, the same beds are classified with the Sinks Grove and Patton limestones. The "Ste. Genevieve" corresponds to lower part of Newman and Greenbrier limestones of older reports. Meramec series.

F. E. Tippie, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 11, p. 1654–1667. Formation is overlain by Renault formation in Hardin and Pope Counties, Ill. In southwestern Illinois, the Aux Vases sandstone intervenes between the Ste. Genevieve and Renault, but it is not present east of western Johnson County. Ste. Genevieve consists of (descending) Levias limestone, Rosiclare sandstone, and Fredonia limestone members. Unconformity at top of the Fredonia is more important than the one at top of the Levias limestone. If this condition should be true for all of Illinois basin, it may develop that the base of the Rosiclare sandstone, rather than base of Aux Vases sandstone as now recognized, should be considered base of Chester series.

C. A. Malott, 1946, Jour. Geology, v. 54, no. 5, p. 322–326. Entire Ste. Genevieve is exposed at double falls of Mill Creek near Cataract, Owen

County, Ind. Thickness 75½ feet. Overlies St. Louis limestone; underlies thin representative of Aux Vases sandstone. Comprises (ascending) Fredonia, Rosiclare, and Levias members. Unit referred to as "Cataract Falls sandstone" (Malott, 1945) is correlated with Rosiclare sandstone of southern Illinois.

D. H. Swann and Elwood Atherton, 1948, Jour. Geology, v. 56, no. 4, p. 269–287. Comparison of logs of closely spaced wells and their assembly into cross sections appear to demonstrate a number of inconsistencies in nomenclature that is currently applied to lower part of Chester series and to Ste. Genevieve formation in different parts of Eastern Interior Basin. Evidence indicates that the oil-producing "Aux Vases" sand of central basin area is equivalent to outcropping Rosiclare sandstone member of Ste. Genevieve; the Levias limestone and part of Shetlerville (Renault) together form a continuous limestone sequence which overlies both "Aux Vases" of the basin and Rosiclare sandstone of outcrop area in southeastern Illinois.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 46, geol. map. Geographically extended into northwestern Georgia where it is about 90 feet thick. Overlies St. Louis limestone; underlies Gasper limestone.

A. H. Sutton, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 7, p. 1661–1668. Discussion of Ste. Genevieve-Renault contact and article by Tippie (1945). Evidence presented to show that unconformity between the Levias and Renault is of greater magnitude and much more significant than the one between the Fredonia and Rosiclare and that Renault limestone and shale or Aux Vases sandstone were it is present, and not Rosiclare sandstone, is basal unit of Chester series.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 18–22, 30–36, pl. 1. Ste. Genevieve limestone (late Meramec) and Chester formations (late Mississippian) crop out in northward-narrowing wedge from Ohio River to west-central Putnam County, in central Indiana. Ste. Genevieve comprises (ascending) Fredonia, Rosiclare, and Levias members. The Fredonia contains Lost River chert, and the Levias contains the Bryantsville breccia. Thickness 70 to 170 feet. Underlies Aux Vases formation; base not exposed in many areas. Field separation of Levias member from younger Paoli limestone is dependent upon recognition of Aux Vases formation if it is present or upon Bryantsville breccia. Where Bryantsville breccia is present and exposed, it is best stratigraphic marker and easiest means of locating the boundary, as currently defined, between Meramec and Chester series.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Alsobrook member of Pride Mountain formation (new) of Colbert County, Ala., and Tishomingo County, Miss., and the *Platycrinites*-bearing beds of the eastern counties are the strata that Butts (1926, Alabama Geol. Survey Spec. Rept. 14) referred to Ste. Genevieve limestone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 50–51, pl. 1. Included in Blue River group (new). Overlies St. Louis limestone; underlies Paoli limestone. Oldest formation exposed in Huron area [this report]. Only upper 35 feet exposed.

Named for outcrops in Mississippi River bluffs 1 or 2 miles below Ste. Genevieve, St. Genevieve County, Mo.

†Ste. Genevieve Marble[1]

Mississippian: Central eastern Missouri.

Original reference: G. C. Swallow, 1855, Missouri Geol. Survey 2d Ann. Rept., pt. 1, p. 96.

Quarried at St. Genevieve, St. Genevieve County.

†Ste. Genevieve Sandstone (in Chester Group)[1]

Mississippian: Central eastern Missouri.

Original reference: J. A. Gallagher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 37.

Named for exposures at Ste. Genevieve, Ste. Genevieve County.

St. George Formation[1]

Pliocene: Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1–2, p. 135, map.

William Back, 1957, U.S. Geol. Survey Water-Supply Paper 1254, p. 17 (table), 20–23, pl. 5. Principally massive poorly bedded siltstone and shale containing discontinuous irregular lenses and beds of sand and scattered pebbles and carbonized wood fragments. Exposed thickness about 75 feet near Point St. George; maximum thickness estimated about 400 feet. Underlies Battery formation; overlies Jurassic rocks. Pliocene.

Named for exposures in sea cliff at Point St. George, Del Norte County. Crops out for about 1½ miles south from Point St. George along Pebble Beach and for a short distance to north of Point St. George.

St. Helena Rhyolite Member (of Sonoma Volcanics)

St. Helena Rhyolite[1]

Pliocene: Northern California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geology Bull., v. 4, p. 59–87.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 122, 123, 128–130, pls. 6, 7, 10. Described and mapped as St. Helena member of Sonoma volcanics. Consists of lava flows, tuffs, and breccias with lentils of sandstone and conglomerate; ranges in thickness from 50 to over 500 feet; in most areas, rests on upper tuffaceous and andesitic units of the Sonoma volcanics. In Mayacmas Mountains, rhyolites appear to transgress the andesites and rest on shales of the Knoxville. Most typical development of the flows and tuffs occurs in higher parts of Howell Mountains east of Napa.

Apparently named for occurrence on Mount St. Helena, Sonoma County.

St. Ignace Formation

St. Ignace Dolomite (in Salina Group)

St. Ignace Formation (in Bass Islands Group)

Upper Silurian (Cayugan): Northern Michigan.

G. M. Ehlers *in* K. K. Landes, G. M. Ehlers, and G. M. Stanley, 1945, Michigan Dept. Conserv. Geol. Survey Div. Pub. 44, Geol. Ser. 37, p. 34, 35 (table 1), 53–73. Proposed for youngest known Upper Silurian in Northern Peninsula. Occupies position between Upper Silurian Pointe aux Chenes formation (new) and Lower Devonian Garden Island formation (new). In some areas, underlies Bois Blanc formation (new); as

result of collapse of rocks in region, large segments of St. Ignace are present in Mackinac breccia. Lower part of formation consists of even-bedded very light gray, cream-colored, and light-buff dolomites; upper part consists of thick-bedded buff dolomites overlying thick-bedded light-gray dolomites. Thickness of exposed sections varies from 10 to 76 feet; however, probable order of superposition of the strata exposed in many blocks of the Mackinac breccia indicates that thickness may not be less than 250 feet and not more than 300 feet. Bass Island[s] group.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (table), 24. Most of strata are dolomite; hence, unit is termed St. Ignace dolomite. Assigned to Salina group.

Named for exposures within the Mackinac breccia in St. Ignace area. Also occurs on Mackinac Island. Underlies Round Island, northern part of Bois Blanc Island, and northern part of Garden Island.

St. James Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9. Dolomite with weak green shale partings. Thickness about 18 feet. Shown on columnar section as underlying Beecher member (new) and overlying Buckhorn member (new).

In copy of this guidebook used by compiler name Buckhorn had been crossed out and name Red Oak written in with pen. The compiler had no way to determine whether or not this change had been made in all copies of the guidebook.

Occurs in Dixon-Oregon area.

†St. Joe Limestone (in Shawnee Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 52–53.

Named for exposures near St. Joseph, Buchanan County.

St. Joe Limestone Member (of Boone Formation)[1]

St. Joe Group

St. Joe Limestone or Formation

Lower Mississippian: Northern Arkansas, eastern Oklahoma, and southwestern Missouri.

Original reference: T. C. Hopkins, 1893, Arkansas Geol. Survey Ann. Rept. 1890, v. 4, p. 10, 212, 253–349, pl. 10.

L. M. Cline, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 9, p. 1137–1141. Rank raised to formation.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 204–207. Limestone comprises Compton, Northview, and Pierson members.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2157–2161. Formation typically consists of light-gray crinoidal limestone with a red to green silty and shaly zone near middle. Thickness 0 to 75 feet. Rests unconformably on Sedalia, Northview, Sylamore, and Chattanooga formations from north to south and at a few places on Ordovician. Conformably overlain by Reeds Spring limestone. Present only in southern part of area of this report [southwestern Missouri]. Recommended that term Pierson be dropped as a synonym for St. Joe.

T. R. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 75. Rank raised to group. Comprises (ascending) Compton, Northview, and Pierson formations. Kinderhook-Osage boundary is considered to be at contact of Northview with Pierson. Hence, St. Joe group straddles series line. In some parts of southwestern Missouri, the Northview, although persistent, is too thin to map. In such cases, the St. Joe group may be mapped as an undifferentiated unit. Overlies Chattanooga; underlies Reeds Spring.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 41–43, pls. 1–5. Group described on south and west flanks of Ozark uplift. Three-fold lithic development present. Basal part consists of about 10 feet of gray nodular-weathering limestone which is thin bedded in upper parts; middle part composed of 3 to 5 feet of olive-green soft limy shale; upper part consists of maximum of 25 feet of gray, thick-bedded finely crystalline limestone. Maximum thickness 40 feet. Thins southward by loss of units and by unconformity at top. Unconformably overlies Chattanooga shale; unconformably underlies Reeds Spring formation. Kinderhookian-Osagean.

Named for exposures at St. Joe, Searcy County, Ark.

†St. Joseph Formation[1]

Mississippian: Southeastern Indiana.

Original reference: P. B. Stockdale, 1929, Ohio Jour. Sci., v. 29, no. 4, p. 170.

Probably named for St. Joseph, Clark County.

†St. Joseph Limestone[1]

Upper Cambrian: Eastern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 347.

Named for mines of St. Joseph Lead Co. near Fredericktown, Madison County.

St. Landry Marble[1]

Cretaceous(?): Southwestern Louisiana.

Original reference: E. W. Hilgard, Suppl. and Final Rept. Geol. Reconn. Louisiana, 1869, p. 12.

St. Landry and Evangeline Parishes.

St. Laurent Limestone[1]

St. Laurent Formation

Middle Devonian: Eastern Missouri and southern Illinois.

Original reference: C. L. Dake, 1918, Missouri Bur. Geology and Mines, v. 15, 2d ser., p. 88, 175.

J. M. Weller *in* J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 16; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 26. Strata intervening between Grand Tower limestone (or Dutch Creek sandstone where Grand Tower is absent) and the black Mountain Glen shale (or the Springville shale where Mountain Glen is absent) have been referred by Savage (1920) to the Misenheimer shale and Lingle and Alto limestones. Restudy of area suggests that recognition of these three formations may be neither stratigraphically logical nor practically feasible. It might be advisable to apply to them name St. Laurent

formation which is used for the Devonian overlying Grand Tower limestone in southeastern Missouri.

G. A. Cooper and others, 1942, Geol. Soc. America Bull. v. 53, no. 12, pt. 1, p. 1778–1779, chart 4. Occurs in two areas not yet satisfactorily correlated: one is in Union and Jackson Counties, Ill., and an adjacent series of outcrops on west side of Mississippi in Altenburg quadrangle, Missouri; other is in Little Saline Valley south of Ste. Genevieve, Mo. St. Laurent limestone is herein regarded as lower Hamilton (Cazenovia stage) and below Lingle limestone. Present position of St. Laurent is tentative but it seems unlikely that formation can be placed above Lingle because no post-Centerfield (Tioughnioga) formations are now known in Midwest.

Named for exposures along St. Laurent Creek, Perry County, 3 miles south of St. Mary's, Ste. Genevieve County, Mo.

St. Lawrence Formation[1]

St. Lawrence Member (of Trempealeau Formation)

Upper Cambrian: Southern Minnesota, Illinois, Iowa, and southern Wisconsin.

Original reference: N. H. Winchell, 1874, Minnesota Geol. Nat. History Survey 2d Ann. Rept., p. 86, 132, 138–157.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 236 (table 2). Chart shows St. Lawrence formation comprises (ascending) unnamed shale, Mendota, and Lodi members. Underlies Jordan sandstone.

C. R. Stauffer, G. M. Schwartz, and G. M. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1902. In suggested revised Cambrian classification for Minnesota, St. Lawrence formation includes Judson (new) and Lodi members.

C. R. Stauffer, G. M. Schwartz, and G. A. Theil, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1237–1239. Discussion of St. Croixian classification of Minnesota. St. Lawrence formation comprises (ascending) Nicollet Creek (new) and Lodi members. Overlies Franconia formation; underlies Jordan formation.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 30, 42–46, measured sections. Formation discussed in detail. St. Croixian series.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart as member of Trempealeau formation.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 147. Member of Trempealeau. Overlies Arcadia member (new); underlies Lodi member.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 860–861. Above Franconia is a nonglauconitic unit of dolomite, dolomitic siltstone, and very fine- grained sandstone, first named St. Lawrence in Minnesota and later named Trempealeau in Wisconsin. St. Lawrence is used in this report [southern Minnesota and west-central Wisconsin] because of priority.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 167–171, 173–177, measured sections. Discussion of upper Croixan stratigraphy in upper Mississippi Valley. Terminology adopted represents return to early lithologic classification in which St. Lawrence and Jordan formations are recognized as the dolomitic strata and the massive sandstone, respectively. St. Lawrence of present study consists of dolomitic sediments

between Franconia below and Jordan above. Subdivided into Black Earth member below and Lodi member above. Term Nicollet Creek member abandoned. Thickness 63 feet in typical basinward exposure at Lake City; 15 feet in shoreward areas at Ridgeland and Kingston. Suggests that term Trempealeau, previously used as a formation name to include above strata and also as a stage name, be restricted to Trempealeauan stage.

Named for exposures at St. Lawrence, Scott County, Minn.

†St. Lawrence Limestone or Dolomite Member[1] (of Trempealeau Formation)

Upper Cambrian: Southern Minnesota and southern Wisconsin.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, p. 547.

Exposed at St. Lawrence, Scott County, Minn.

†St. Louis Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

St. Louis Conglomerate[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, p. 2, p. 79, 83.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Included in Portage Lake lava series.

Occurs on St. Louis property, Houghton County.

†St. Louis Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Copper district of Keweenaw Point.

†St. Louis Group[1]

Mississippian: Missouri, Tennessee, Illinois, Iowa, and western Kentucky.

Original reference: A. H. Worthen, 1866, Illinois Geol. Survey, v. 1, p. 41–43, 83–89.

Named for St. Louis, Mo.

St. Louis Limestone

St. Louis Limestone (in Blue River Group)

St. Louis Limestone (in Meramec Group)[1]

Upper Mississippian (Meramec Series): Missouri, Alabama, Georgia, Illinois, Indiana, Iowa, Kentucky, Tennessee, and southwestern Virginia.

Original reference: G. Engelmann, 1847, Am. Jour. Sci., 2d, v. 3, p. 119–120.

Charles Butts, 1922, Kentucky Geol. Survey, 6th ser. v. 7, p. 120–136. In northern central Tennessee and southeastern Kentucky, the St. Louis overlies Garrett Mill sandstone member (new) of Warsaw formation. Underlies Ste. Genevieve limestone.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 133. Classified as formation in Meramec group, Valmeyer series. Overlies Salem (Spergen) limestone; underlies Ste. Genevieve limestone.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 813–815. Middle formation in Meramec group, Iowa series. Overlies Salem limestone; underlies Ste. Genevieve. This classification follows Illinois Geological Survey. In southeastern Iowa, the St. Louis comprises (ascending) Croton and Verdi members; overlies older Mississippian strata unconformably and overlaps formations as low as the Kinderhook. In western Illinois and northeastern Missouri, the St. Louis has not been separated from overlying beds that may be Ste. Genevieve in age. In Indiana, the St. Louis constitutes lower part of Mitchell limestone up to and including Lost River chert member.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 359–366. In Virginia, the St. Louis rests upon Fort Payne chert or upon Price formation, as in Cumberland-Big Stone Gap area, and southeast of South Clinchfield, Russell County; upon the Maccrady or possibly upon the Warsaw, as at Bluefield, in the Narrows of New River, 1 mile southeast of Richlands, and 2 miles southeast of Bandy, Tazewell County. Succeeded by Ste. Genevieve limestone everywhere from Ste. Genevieve, Mo., to Appalachian Valley.

Paul Averitt, 1941, Virginia Geol. Survey Bull. 56, p. 14–15, 17. In Scott and Washington Counties, consists of 265 feet of very dark colored thick-bedded crystalline limestone overlain by 50 feet of shale and underlain by 16 feet of argillaceous limestone. Underlies limestones of Gasper and Ste. Genevieve ages; overlies Little Valley limestone (new).

B. N. Cooper, 1944, Virginia Geol. Survey Bull. 60, p. 158. In this report [Burkes Garden quadrangle], term Hillsdale is used to replace St. Louis, name used by Butts (1940) for same succession in southwestern Virginia. There are several objections to continued use of name St. Louis in southwestern Virginia. Beds so named are not areally continuout with the St. Louis of Mississippi Valley. Not definitely established that the so-called St. Louis limestone of southwestern Virginia does not contain correlatives of Salem limestone.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 45–46, geol. map. Geographically extended into northwestern Georgia where it is about 100 feet thick. Underlies Ste. Genevieve limestone; contact with Fort Payne not exposed.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 47–49. Youngest Mississippian formation in Beardstown-Glasford-Havana-Vermont area. Maximum thickness about 30 feet in outcrop. Overlies Salem formation; separated from overlying Pennsylvanian strata by erosional unconformity. Meramec group, Valmeyer series.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook St. Louis Mtg., Field Trip 3, p. 4 (fig. 3), 8, 9, 10–17. St. Louis-Ste. Genevieve boundary is in doubt in Alton, Ill., area as it is at many places in midwestern United States. Boundary has been placed at as many as four different positions at Alton Bluff outcrop, Madison County, as high as top of main white bed and as low as base of cycle h of cyclic beds. At other localities in area, boundary has been placed even higher, and possibly even lower. It is not possible to correlate individual beds from this area to Ste. Genevieve, some 80 miles south. Hence, a transition zone containing Ste. Genevieve-like oolites and fragmental limestone as well as St. Louis-like fine-grained light-colored pure limestones is placed in St. Louis limestone. Valmeyer series.

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H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 48, 52. Included in Blue River group (new). Underlies Ste. Genevieve limestone. Not exposed in Huron area [this report].

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2–4, pl. 1. Overlies Rocher member (new) of Salem limestone in southwestern Illinois.

Named for exposures in St. Louis, Mo.

†St. Louis Marls[1]

Mississippian: Iowa.

Original reference: H. Hinds, 1909, Iowa Geol. Survey, v. 19, p. 339.

Des Moines County.

†St. Louis Slate[1]

Precambrian: Northeastern Minnesota.

Original reference: R. D. Irving, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 440–441.

†St. Louis River Gabbro[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original references: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept. p. 143–146, pl. 14; 1883, U.S. Geol. Survey Mon. 5.

Exposed along north of St. Louis River to Duluth, St. Louis County.

†St. Louis River Slate[1]

Precambrian (upper Huronian): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 384.

Named for exposures on St. Louis River, St. Louis and Carlton Counties.

St. Luke Limestone Member (of Edinburg Formation)

Middle Ordovician: Western Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 81, 82. Proposed for the beds which form the topmost division of the Edinburg in Shenandoah Valley. Consists of rather pure, dove-gray limestone above the *Nidulites-Lambeophyllum* zone and below the *Reuschella "edsoni"* beds that characterize the basal Oranda formation (new). Thickness at type locality 90 feet.

Type locality: One mile S. 60° E. of St. Luke, Shenandoah County. Exposed west of U.S. Route 11, between Forestville and Saumsville.

St. Marks facies (of Tampa Stage)

Miocene, lower: Florida.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table 1), 20–21. Name St. Marks limestone (type locality, Wakulla County) was originally used by Finch (1823, Am. Jour. Sci., v. 7, p. 31–43) in describing the occurrence of large oysters. Name St. Marks revived to include calcareous downdip facies of Tampa stage. Near Tampa, facies consists of basal light-gray to yellow limestone of which "Silex bed" is a part. Upper part consists of greenish clay with calcareous nodules. Estimated thickness in subsurface 65 feet. Updip facies named Chattahoochee facies. [Finch, 1823 [1824], described a limestone at St. Marks, Fla., but did not use term St. Marks limestone.]

Ste. Marie Sandstone[1]

Upper Cambrian: Northern Michigan.

Original reference: W. E. Logan, 1863, Canada Geol. Survey Rept. Prog. to 1863, p. 196.

Sault Ste. Marie region.

St. Mary River Formation[1]

Upper Cretaceous: Southwestern Alberta, Canada, and northwestern Montana.

Original reference: G. M. Dawson, 1883, Canada Geol. Survey Rept. 1880–1882, p. 3B–6B.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 118. Overlies Horsethief sandstone and underlies Willow Creek formation on northwest flank of Sweetgrass arch, Montana. Thickness about 980 feet.

G. W. Viele, 1960, Dissert. Abs., v. 21, no. 4, p. 853. Overlies Hogan formation (new) in Flat Creek area, Lewis and Clark County, Mont.

Named for exposures on banks of St. Mary River, Alberta, a few miles north of Blackfeet Indian Reservation.

†St. Marys Epidote[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 25.

In St. Mary's mine, sec. 18, T. 55, R. 33, Houghton County.

St. Marys Formation[1] (in Chesapeake Group)

Miocene, middle and upper: Eastern Maryland, Delaware, and eastern Virginia.

Original reference: G. B. Shattuck, 1902, Science, new ser., v. 15, p. 906.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Age shown on correlation chart as middle and upper Miocene.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 78. Present in Delaware. Middle Miocene.

L. W. Stephenson and F. S. MacNeil, 1954, Geol. Soc. America Bull., v. 65, no. 8, p. 733–738. Underlies Yorktown formation in both Maryland and Virginia.

Named for development in St. Marys County and on St. Marys River, Md.

St. Marys Sandstone[1]

Upper Cambrian: Michigan and northeastern Wisconsin.

Original reference: C. Rominger, R. Pumpelly, and T. B. Brooks, 1873, Michigan Geol. Survey Atlas, map of Upper Peninsula.

Named for exposures on St. Mary's River, east end of Upper Peninsula of Michigan.

St. Marysan Substage

Miocene, middle: Maryland, New Jersey, and Virginia.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 767, 768. Substage based on microfaunal assemblages: includes all sediments deposited in central Atlantic Coastal Plain province during time of accumulation of St. Marys formation, type exposure of which is considered exemplary of the substage. In sequence the St. Marysan succeeds Choptankian substage and is followed by Yorktownian substage.

†St. Maurice Formation[1]

Eocene, middle: Northwestern Louisiana.

Original references: W. C. Spooner, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 1, p. 7; no. 3, p. 234–237.

†St. Maurice Formation (in Claiborne Group)[1]

Eocene, middle: Northwestern Louisiana and southwestern Arkansas.

Original reference: G. D. Harris, 1910, Science, new ser., v. 31, p. 502.

Named for exposures at St. Maurice, Winn Parish, La.

St. Paul Group

Middle Ordovician: Maryland, Pennsylvania, Virginia, and West Virginia.

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 267–324, pls. 1, 2. Proposed as a substitute for "Stones River" group as mapped through West Virginia, Maryland, and the Mercersburg-Chambersburg quadrangles in Pennsylvania. Need for such substitution has been apparent since Cooper and Prouty (1943, Geol. Soc. America Bull., v. 54, no. 6) demonstrated that central Tennessee Stones River was definitely younger than Appalachian "Stones River." As proposed, the group is bounded above by Chambersburg limestone, or by Lincolnshire where it is present, and is underlain by Beekmantown group. Type section. 485 feet thick, contains two formations, a lower Row Park (new) and overlying New Market limestone. South of Bessemer, W. Va., group contains only New Market limestone.

F. M. Swartz and R. B. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Exp. Sta. Bull. 71, p. 1–14. Row Park and New Market limestones of Middle Ordovician St. Paul group occur in Franklin County, Pa., as lower and upper parts respectively of rock mapped by Stose (1909, U.S. Geol. Survey Geol. Atlas, Folio 170) under name Stones River limestone in report on Mercersburg and Chambersburg quadrangles. Thickness 800 to 1,300 feet. Underlies Chambersburg limestone; overlies Beekmantown dolomite.

Carlyle Gray and others, 1960, Geologic map of Pennsylvanian (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, includes Annville formation.

Type section: On Boward Farm, south of U.S. Highway 40, about 500 yards southwest of St. Paul's church and junction of Maryland Highway 57 with U.S. Highway 40, 9 miles south of center of Hagerstown, Washington County, Md.

†St. Peter Group[1]

Lower Ordovician: Missouri.

Original reference: C. L. Dake, 1921, Missouri Univ. School Mines and Metallurgy, v. 6, no. 1.

St. Peter Sandstone[1]

Middle Ordovician: Minnesota, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Missouri, Ohio, Oklahoma, and Wisconsin.

Original reference: D. D. Owen, 1847, Prelim, rept. of the Geological Survey of Wisconsin and Iowa: U.S. Gen. Land Office Rept. 1847 (U.S. 30th Cong., 1st sess. S. Ex. Doc. 2), p. 169. 170.

H. S. McQueen, 1937, Missouri Geol. Survey and Water Resources 59th Bienn. Rept., app. 1, p. 10–11, 12, 22–23. In southeastern Missouri, the St. Peter overlies Everton formation and underlies Dutchtown formation

(new); where Dutchtown is absent, the St. Peter underlies the Joachim formation.

C. R. Stauffer and G. A. Thiel, 1941, Minnesotota Geol. Survey Bull. 29, p. 66–69. Thickness at type section 155 feet. Overlies Shakopee dolomite; underlies Platteville formation. Chazyan series.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. [11], fig. 3, [22], fig. 12. In Dixon-Oregon area, St. Peter sandstone underlies Kingdom formation (new) of Glenwood subgroup of Ancell group (new).

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 255 (fig. 32), 273–274, 275. St. Peter sandstone, in lead-zinc district, is about 40 feet thick, overlies Prairie du Chien group [undifferentiated] and underlies Glenwood shale member of Platteville formation. Middle Ordovician.

Type section: At Fort Snelling, Hennepin County. Named for exposures on St. Peter River, now called Minnesota River, southern Minnesota.

St. Regis Formation (in Ravalli Group)[1]

Precambrian (Belt Series): Northeastern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 37–39, pl. 11. Indurated shales and more or less flaggy sandstones; colors mostly green and purple; characterized by shallow-water features. Thickness about 1,000 feet. Overlies Revett quartzite; underlies Wallace formation.

F. C. Calkins, 1909, U.S. Geol. Survey Bull. 384, p. 38. Top formation of Ravalli group.

R. E. Wallace and J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–M, p. 582–584, pl. 48. Underlies Wallace formation; overlies Revett quartzite. In Idaho, typically gray to purplish-gray argillite, about 1,200 to 1,400 feet thick, and has an upper member of thinly laminated greenish argillite, 150 to 450 feet thick. In Mineral County, Mont., exhibits marked facies changes and thicknesses of as much as 3,000 to 5,000 feet.

Named for exposures in vicinity of St. Regis Pass, southeastern part of Coeur d'Alene district, Idaho.

St. Regis Granite

Precambrian: Northern New York.

A. F. Buddington, 1937, New York State Mus. Bull. 309, p. 8, 34–35, 38, 45–46; 1939, Geol. Soc. America Mem. 7, p. 136, 137. Pink hornblende granite; commonly contains narrow bands or small shreds of black amphibolite. In some areas, intrusive into Santa Clara complex (new) and in others adjacent to it.

Named for town of St. Regis Falls, Nicholville quadrangle, Franklin County.

†St. Stephens division,[1] Formation,[1], Group,[1] or Limestone[1]

Eocene, upper, and Oligocene: Southern Alabama.

Original reference: T. A. Conrad, 1856, Philadelphia Acad. Nat. Sci. Proc., v. 7, p. 257–258.

Named for exposures in bluff at St. Stephens, Washington County.

†St. Thomas Sandstone[1]

Lower Ordovician: Central Missouri.

Original reference: J. A. Gallaher, 1900, Missouri Geol. Survey, v. 13, p. 124.

Named for St. Thomas, Cole County.

St. Wendells Formation

St. Wendell Sandstone[1]

Pennsylvanian: Southwestern Indiana and southeastern Illinois.

Original reference: M. M. Fidlar, 1933, Indiana Acad. Sci. Proc., v. 42, p. 137.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 103. St. Wendells formation, a division of post-Allegheniau, between Friendsville above and Parker formation. Exposures noted.

F. D. Spencer, 1953, U.S. Geol. Survey Circ. 266, p. 14 (fig. 4). Chart shows St. Wendells sandstone underlying New Haven formation and overlying Parkers formation.

Fidlar appears to have applied this name to the same unit Culbertson (1932) called Claypole Hills Sandstone. Culbertson's St. Wendells Limestone appears to have been included in the Parker Formation by Fidlar.

Exposed near St. Wendells, Robinson Township, Posey County, Ind.

St. Wendells Limestone (in McLeansboro Formation)

Pennsylvanian: Southwestern Indiana.

J. A. Culbertson, 1932, The paleontology and stratigraphy of the Pennsylvanian strata between Caseyville, Kentucky, and Vincennes, Indiana: Urbana, Ill., Univ. Illinois, Abs. Thesis, p. 3, 7. Fossiliferous limestone; maximum thickness 4 feet. Separated from underlying Inglefield sandstone by Parker coal and black shale; underlies Claypole Hills sandstone (new).

This does not appear to be same as St. Wendell Sandstone of Fidlar (1933). It was apparently included in Fidlar's Parker Formation; Fidlar's St. Wendell Sandstone may be same as Culbertson's Claypole Hills Sandstone.

Type locality and derivation of name not given.

Sais Quartzite

Precambrian: Central New Mexico.

J. T. Stark and E. C. Dapples, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1936. Referred to as Sais quartzite. Older than Blue Springs muscovite schist (new); intruded by Los Pinos granite (new).

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1127–1129, pl. 1. Rocks of Sais quartzite vary from light to dark gray, with greenish and nearly white facies in a few outcrops. Grain size rarely more than 1 mm. in diameter, and in most outcrops grains cannot be distinguished megascopically. Massive quartzose beds 3 to 5 feet thick alternate with thinner bedded zones, commonly sericitic. Intruded by Priest granite (new) at northernmost outcrop. Greatest thickness about 600 feet, measured at Abo Pass.

Named for Santa Fe Railway Station of Sais near Abo Pass. Excellent exposures in quarries of Atchison, Topeka, and Santa Fe Railroad near

pass. Exposed on up-thrown side of thrust fault in belt extending along east flank of Los Pinos Range from Abo Pass southward for about 5 miles. Width of outcrop less than 500 feet in central part; averages 1,000 feet north of pass.

†Sakonnet Sandstone[1]

Pennsylvanian: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 357–365, pl. 31, map.

Forms upper part of Aquidneck series on east side of Sakonnet River and also across Portsmouth and Middletown Townships on west side of Sakonnet River, Newport County.

Salado Formation

Salado Halite

Permian (Ochoa Series): Western Texas and southeastern New Mexico.

Original reference: W. B. Lang, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 2, p. 262–270.

W. B. Lang, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1569–1572. Base of Salado formation redefined to include anhydrite formerly considered part of Castile formation. As redefined, base of Salado is placed at depth of approximately 3,300 feet in Means well (center of Loving County, Tex.) instead of at 2,350 feet as arbitrarily selected when unit was originally defined.

S. C. Giesey and F. F. Fulk, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 4, p. 598 (fig. 3), 601–604. In North Cowden Field, Ector County, Tex., the Salado underlies Rustler formation and overlies Tansill formation. Includes Cowden anhydrite member (new) in lower part.

W. B. Lang, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 1, p. 63–79. Discussion of basal beds of Salado in Fletcher potash core test, near Carlsbad, N. Mex. Sequence described extends from above Cowden member of Salado into underlying Carlsbad limestone. Two members of Salado are defined, La Huerta siltstone and Fletcher anhydrite (at base).

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 610–612. Salado formation, which overlies Castile formation, is poorly exposed in Gypsum Plain east of Delaware Mountains, but it may come to surface here and there near west edge of Rustler Hills. However, most of it is cut out in this region by unconformity at base of Rustler and it reaches its full thickness only east of the outcrop. As indicated by wells east of outcrops, maximum thickness of formation in Delaware basin is somewhat more than 2,000 feet, but decreases to 1,000 feet or less in shelf area beyond margins of the basin.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1608–1612. Includes Vaca Triste member (new) in upper part.

Western Texas and southeastern New Mexico.

Salamanca Conglomerate Member (of Conewango Formation)[1]

Salamanca Conglomerate or **Sandstone Member** (of Cattaraugus Formation)[1]

Salamanca Member (of Venango Formation)

Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. I$_3$.

R. M. Leggette, 1936, Pennsylvania Geol. Survey, 4th ser., Bull. W–3, p. 204. Conewango formation, in Warren County, has thickness of about 550 feet and is divided about in half by Salamanca conglomerate. The Salamanca is persistent throughout county and ranges in thickness from about 10 to 20 feet.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Listed as member of Venango formation; underlies Saegerstown member; overlies Panama conglomerate.

S. W. Lohman, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. W–6, p. 40. Member of Cattaraugus. Where exposed in quarry near Lewis Run, McKean County, it is greenish-gray sandstone.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Upper Devonian. In column, Salamanca occurs above the Amity and below the Saegerstown. Term Conewango group is elevated to rank of stage.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 63. Conglomerate member of Cattaraugus formation described in Wellsville quadrangle. Overlies Wolf Creek conglomerate member; underlies Oswayo formation.

Named for Salamanca "rock city," New York.

Salamanca formational suite[1]

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 85–86.

Typically developed in Olean-Salamanca region, Cattaraugus County, N.Y.

†Salem Breccia[1]

Lower Ordovician (early Chazy): Northern central Alabama.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. Cahaba coal field, p. 152.

Named for exposures in Salem Hills, southwest of Bessemer, Jefferson County.

Salem Gabbro-Diorite[1]

Lower Paleozoic(?): Eastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Massachusetts, p. 5, 7, 8, 11.

N. E. Chute, 1940, Massachusetts Dept. Public Works Bull. 1, p. 4, 9–10, pls. 2–A, 2–B. Ordovician(?) or Silurian(?).

N. E. Chute, 1950, Bedrock geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–5]. Extensively intruded by Dedham granodiorite in Brockton quadrangle. Lower Paleozoic(?).

Named for occurrence at Salem, Essex County.

Salem Lavas

Salem Hills Basalt

Miocene, middle: Northwestern Oregon.

R. E. Corcoran and F. W. Libbey, 1956, Oregon Dept. Geology and Mineral Industries Bull. 46, p. 7–8, 12. In Salem Hills area, Eugene formation is overlain unconformably by series of basalts called Salem lavas in Salem quadrangle by Mundorff (1939, unpub. thesis) and Stayton lavas

in that general region by Thayer (1939). On west side of Salem Hills, the lavas are at least 410 feet thick and dip northeast approximately 2° to 3°. According to Mundorff, the Salem lavas are typically medium to dark gray, fine grained, and dense, rarely porphyritic. Salem-Stayton lavas are correlated with Columbia River basalt. Also referred to as Salem Hills basalt.

Named for occurrence in Salem quadrangle.

Salem Limestone[1]

Salem Formation

Upper Mississippian (Meramec Series): Southern Indiana, southern Illinois, southeastern Iowa, western and central Kentucky, and eastern Missouri.

Original references: E. R. Cumings, 1901, Jour. Geology, v. 9, p. 233; Am. Geologist, v. 27, p. 147.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 224, 227, pls. 6, 25, 26. Salem limestone (Spergen of some authors) was traced across Kentucky as far as Cumberland River, southern Pulaski County. Somerset shale member of Warsaw formation (Butts, 1922) has been traced from southern Indiana to type locality at Somerset, Pulaski County, Ky., and is here interpreted as being a basal argillaceous phase of Salem limestone.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 811–813. Names Salem and Spergen, both taken from localities in Washington County, Ind., have been applied to limestone from which the Bedford, Ind., building stone is obtained. Name Salem, which was proposed first and has been used consistently by Indiana Geological Survey is preferable to name Spergen. In standard Mississippian section, the Salem underlies St. Louis limestone and overlies Warsaw limestone. In Indiana, overlies Harrodsburg limestone. In its typical development in Indiana, the Salem is lenticular; attains thickness of 50 to 60 feet near Bedford but locally pinches out; layers of buff to nearly black bituminous calcareous shale are associated with massive limestone, particularly at top and bottom, and, including these beds, formation has maximum thickness of 90 to 100 feet. In Ste. Genevieve County, Mo., 160 feet of gray to white, more or less oolitic limestone have been referred to the Salem, but paleontologic evidence suggests that upper part of these beds is of St. Louis age; central 100 feet is exceptionally pure oolite; northward the Salem becomes progressively less pure and beyond Alton, Ill., consists mainly of earthy limestone with minor shaly beds. At Warsaw, Ill., beds referred to Salem consist of 4 to 8 feet of more or less crossbedded yellowish limestone that grades laterally into calcareous sandstone, which has been termed Sonora sandstone (Keyes, 1895). Apparently equivalent beds in southeastern Iowa attain maximum thickness of nearly 30 feet; name Belfast (Van Tuyl, 1925) has been proposed for Salem formation in Iowa. South of Warsaw, Ill., boundary between Salem and Warsaw is drawn at horizon that separates a lower dominantly shale zone from an upper zone of hard massive- to thin-bedded granular to fine-grained more or less earthy, impure and dolomitic limestone beds separated by layers or partings of shale that are commonly calcareous. This report places the Salem in Meramec group, Iowa series.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. Shown on correlation chart in Meramecian series.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 28 (fig. 9), 47. In Illinois, Salem formation is included in Meramec group, Valmeyer series.

J. W. Baxter, 1959, Dissert, Abs., v. 19, p. 2910, 2911. In southwestern Illinois, Salem limestone is subdivided into four members [sequence not indicated]: Kidd, Fults, Chalfin, and Rocher.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 1–32. Salem limestone, in southwestern Illinois, subdivided into (ascending) Kidd, Fults, Chalfin, and Rocher members. Thickness about 200 feet. Overlies Warsaw formation; underlies St. Louis limestone. Valmeyer series.

Named for Salem, Washington County, Ind.

Salem Limestone (in Allegheny Formation)[1]

Pennsylvanian: Northeastern Ohio.

Original reference: Wilber Stout and R. E. Lamborn, 1924, Ohio Geol. Survey, 4th ser., Bull. 28, p. 146–150.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 27. Light-bluish- to brownish-gray dense-textured limestone. Thickness about 8 inches. Allegheny series.

Named for exposures at Salem, Columbiana County. Not positively identified outside county.

†Salem Syenite[1]

Carboniferous: Massachusetts.

Original reference: E. Cornelius, 1821, Am. Jour. Sci., v. 3, p. 232.

Named for occurrence in town of Salem, Essex County.

Salem Church Granite[1]

Precambrian: Northwestern Georgia.

Original reference: W. S. Bayley, 1928, Georgia Geol. Survey Bull. 43, p. 103–108, map.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 276–277. Stose and Stose (1944, Am. Jour. Sci., v. 242, p. 411) accepted conclusion of Bayley (1929) that the Salem Church granite intrudes the Hiwassee slate of Ocoee series and the statement of Crickmay (1936, Geol. Soc. America Bull., v. 47, no. 9) that the Corbin granite is intrusive into the Talladega series which the writers [Stose and Stose] include in the Ocoee series. Salem Church granite, exposed in an oval area in western part of Tate quadrangle and adjacent Cartersville quadrangle, is surrounded by a band of Hiwassee slate and several small areas of slate lie within the granite. Relation of the granite to the slate is confused because the granite in places is sheared to mylonite on cross fractures, which also offset the slate. The Salem Church may be part of an injection complex which is older than the Ocoee series. Hiwassee slate as mapped around the granite underlies Great Smoky quartzite and is interpreted as basal formation of Ocoee series equivalent to Hurricane graywacke (new). The Corbin granite is exposed southwest of Salem Church granite and just east of Cartersville overthrust. The Salem Church resembles phases of the Corbin granite and because of this similarity has been called Corbin granite by Furcron and Teague (1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 2 p. 1195). Precambrian.

Well exposed at Salem Church, Tate quadrangle, and west and southwest of church.

Salem Point Shale Member[1] (of Grenola Limestone)

Permian: Southeastern Nebraska, eastern Kansas, and northern Oklahoma.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1.

N. G. Lane, 1958, Kansas Geol. Survey Bull. 130, pt. 3, p. 134–137, 160. In type area of Grenola limestone, the Salem Point is shale, generally unfossiliferous, interbedded with thin earthy limestone layers. Thickness about 9½ feet. Lower boundary is marked by upper massive osagite bed of Burr limestone member; upper boundary is base of first fusulinid limestone, which is lowest bed of Neva limestone member. Lower Permian, Wolfcamp series.

Type locality: Roadcuts at Salem Point, 1½ miles northwest of Salem, Richardson County, Nebr.

Salem School Limestone Member (of Graham Formation)[1]

Salem School Limestone Member (of Gonzales Formation)

Upper Pennsylvanian: Central northern Texas.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 12, 16–18. First marine member of Graham formation. Highly fossiliferous yellowish earthy limestone. Thickness 8 inches to nearly 2 feet. Overlies both the channel deposits (Kisinger channel) at base of the Graham and the older Home Creek limestone member of Caddo Creek formation of Canyon group. Underlies unnamed shale and sandstone unit which in turn underlies Gonzales limestone member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in the Gonzales here raised to formational status in Graham group. Overlies Kisinger channel and underlies an "upper limestone."

E. L. Thackery, 1951, West Texas Geol. Soc. Guidebook, June 1–2, p. 14–15, chart. Chart shows Salem School limestone near base of Graham group. Occurs below Gonzales limestone in Brazos River section and below North Leon limestone in Colorado River section.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook May 25–26, fig. 4. Generalized columnar section shows Salem School limestone at base of Graham group, stratigraphically below Bunger limestone and above Home Creek limestone in Caddo Creek group.

Well exposed one-half mile southeast of Salem School, in southeastern part of Young County, Brazos River area.

Salesville Formation (in Whitt Group)

Salesville Shale Member (of Mineral Wells Formation)[1]

Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v, 30, p. 25, 31; Texas Univ. Bull. 2132, p. 77, charts.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Whitt group (new). Expanded below to include Lake Pinto sandstone member. Underlies Keechi Creek formation; overlies East Mountain shale in Lone Camp group. Name Mineral Wells dropped in this report.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 23–24, fig. 3, pl. 1. In this report [Parker County] Salesville is considered a formation although author does not wholly agree with Cheney's redefinition and believes it confusing to expand meaning of a rock name vertically to include a previously named rock body. As defined here, formation includes Lake Pinto sandstone at base and an unnamed shale member above which includes Dog Bend limestone bed in lower parts. Whitt group not used in this report.

Named for small town in Palo Pinto County, north of Mineral Wells.

Salida Schists[1]

Precambrian: Central Colorado.

Original reference: W. Cross, 1893, On a series of peculiar schists near Salida, Colorado: Colorado Sci. Soc. Proc., v. 4.

Chaffee County.

Salina Formation[1] or Group

Upper Silurian: New York, Michigan, and northern Ohio.

Original reference: J. D. Dana, 1863, Manual of geology, 1st ed., p. 246–251.

T. G. Payne, 1938, Rochester Mus. Arts and Sci Guide Bull. 5, p. 69. In Genesee country, group comprises (ascending) Vernon shale, 300 feet, Camillus shales, 550 feet, Bertie waterlime, 85 feet, and Akron dolomite, 6 feet.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. As shown on correlation chart, Salina group comprises (ascending) Pittsford shale, Vernon shale, Syracuse salt, Camillus shale, and Bertie waterlime. Occurs above Guelph group and below Cobleskill (Akron) dolomite.

L. V. Rickard, 1955, New York Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Upper Cayugan series (revised) contains two formations, Salina and Bertie. Salina consists of two facies, Vernon red shales near base, and Camillus gray calcareous shales and dolomites with salt and gypsum beds.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Shown on correlation chart as Salina group. Includes Camillus shale, Vernon shale, and Syracuse dolomite (salt). Name Pittsford shale discontinued. Overlies Lockport group; underlies Bertie group. In Canastotan stage (new). Cayugan series. Upper Silurian. Note on type locality.

W. P. Leutze, 1960, Dissert. Abs., v. 20, no. 12, p. 4633–4634. In central New York, group attains maximum thickness of about 1,000 feet at outcrop. Divisible into (ascending) Vernon shale, Syracuse formation, Camillus shale, and Bertie formation. In eastern New York, Camillus and Bertie cannot be separated and combined unit is called Brayman shale.

Precise type locality unknown but numerous exposures of Vernon, Syracuse, and Camillus rocks exist in northern part of Onondaga County (Syracuse quadrangle), N.Y. Supplies salt wells at Salina, N.Y.

†Salinas Shale[1]

Eocene, middle: Southern California.

Original reference: W. A. English, 1918, U.S. Geol. Survey Bull. 691, p. 219–250.

Well developed on west side of Salinas Valley.

Saline Formation (in Wilcox Group)

Eocene: Central Arkansas.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 4), 46–55, plates. Proposed for section of dark-chocolate-brown laminated clay and silt and interbedded white, tan, orange, and red sand that overlies Berger formation (new) and underlies Detonti sand (new). Thickness 350 feet at type locality; thickness recorded in drill holes 165 to 495 feet. Rests with local unconformity upon the Berger and, in places, unconformably on Wills Point and Kincaid formations and nepheline syenite masses and their included small pendants of metamorphic rocks of Paleozoic age.

Type locality: Roadcut immediately north of Benton pumping station, several hundred feet east of northwest corner SW¼SE¼ sec. 25, T. 2 S., R. 15 W., Saline County. Named for Saline River. Crops out in irregular band as much as 9 miles wide that extends in a northeasterly direction across bauxite region and surrounds or covers a part of every nepheline syenite hill. Mapped from east bank of Saline River in Saline County to west bank of Fourche Bayou near Sweet Home in Pulaski County where formation wedges out beneath Quaternary alluvium of Arkansas River flood plain.

Saline Bayou Member (in Claiborne Group)[1]

Saline Bayou Member (of Cook Mountain Formation)

Eocene: Northwestern Louisiana and eastern Texas.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 87, 96–101, pls. 3, 8 (fig. 1). Described in Winn Parish, La., as member of Cook Mountain formation. Thickness 20 to 35 feet. Overlies Milams member (restricted); underlies Little Natches member (new).

Type locality: Saline Bayou at St. Maurice, Winn Parish, La.

Saline Creek (cave) Conglomerate[1]

Pennsylvanian: Central Missouri.

Original reference: S. H. Ball and A. F. Smith, 1903, Missouri Bur. Geology and Mines, v. 1, 2d ser., p. 92–95.

Named for exposures on Saline Creek, Miller County.

Salineno Sandstone Member or Tongue (of Fayette Formation)[1]

Eocene, upper: Southern Texas, and northern Mexico.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1375, 1383, 1387.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 267. Basal member or tongue of Fayette. As sandstone enters Starr County from Mexico, it is about 40 feet thick; northward it becomes extinct in a section of red and green bentonitic shales. Contains oyster and other shells; distinguished in Roma area by abundance of calcareous sandy concretions which are highly fossiliferous; borings of *Halymenites* abundant. Underlies Resendez member (new).

Named from town of Salineno on east bank of Rio Grande, southern part of Falcon quadrangle, Starr County.

Salisbury Granite

Age not stated: Western North Carolina.

Felix Chayes, 1952, Am. Jour. Sci., v. 250, no. 4, p. 282–284. Coarse moderately gneissic granite in which quartz is always either magnificently undulant or entirely granulated.

Salisbury is in Rowan County.

†Salisbury Schist[1]

Pre-Triassic: Northwestern Connecticut.

Original references: J. D. Dana, 1874, Am. Assoc. Adv. Sci. Proc., v. 22, p. 25–27; W. M. Agar, 1932, Am. Jour. Sci., 5th ser., v. 23, p. 31–48.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic.

Occurs in Salisbury-Canaan region, Litchfield County.

Salitral Shale Tongue (of Chinle Formation)

Salitral Shale Member (of Moenkopi Formation)

Upper Triassic: Northwestern New Mexico.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Tongue of Chinle formation in and around Nacimiento Mountains and San Pedro Mountains. Consists of variegated shale with limestone concretions. Underlies Poleo sandstone lentil; overlies Agua Zarca sandstone member (new). Cannot be differentiated from main body of Chinle formation south of latitude of Los Pinos Arroyo. Upper Triassic.

J. A. Momper, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 91, 92. Considered member of Moenkopi in San Juan Basin. Thickens westward into main body of Moenkopi at expense of underlying Agua Zarca member.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 23. Thickness in San Juan Basin 30 to 100 feet. Type locality indicated.

Type locality: Salitral Creek, T. 22 N., Rs. 2 and 3 W., Rio Arriba County.

†Salkehatchie Marl[1] or phase[1]

Miocene: Southern South Carolina.

Original reference: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 18, 19.

Named for exposures along Salkehatchie River, Colleton County.

Sallisaw Formation

Sallisaw Sandstone[1]

Lower or Middle Devonian: Northeastern Oklahoma.

Original reference: I. H. Cram, 1930, Oklahoma Geol. Survey Bull. 40–QQ, p. 24, map.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 35–40, pl. 4. On southwestern flank of Ozark uplift Sallisaw formation is composed of several distinct lithologies; most common is light- to dark-gray fine-grained medium-bedded calcareous sandstone which weathers gray to brown and grades laterally into sandy limestone;

white to light-gray chert is interbedded with the calcareous sandstone or sandy limestone; locally contains large amounts of dark ferromagnesian minerals and some phosphatic material; where Sallisaw fills solution cavities in underlying St. Clair, it is typically a gray dense fine-grained limestone containing fine sand. Reaches maximum thickness of 11 feet in sec. 15, T. 13 N., R. 23 E., thins rapidly northward and is essentially absent north of T. 13 N. Unconformably overlies Frisco or St. Clair; unconformably underlies Chattanooga shale or its basal member, the Sylamore sandstone.

Well exposed along Sallisaw Creek near Marble City, Sequoyah County.

Sallisaw Marble[1]

Silurian: Central eastern Oklahoma.

Original reference: C. Schuchert. 1922, Geol. Soc. America Bull., v. 33, p. 670.

Near Marble City, Sequoyah County.

Sallyards Limestone Member[1] (of Grenola Limestone)

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma.

Original reference: G. E. Condra and C. E. Busby, 1933, Nebraska Geol. Survey Paper 1.

R. C. Moore, and others, 1951, Kansas Geol. Survey Bull. 89, p. 48. Shaly to massive limestone with thin shale breaks. Thickness ½ to 3½ feet. Underlies Legion shale member; overlies Roca shale. Wolfcamp series.

Type locality: South bank of ravine 1 mile northeast of Sallyards, Greenwood County, Kans.

Salmon Hornblende Schist[1]

Pre-Silurian: Northern California:

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 225–245.

F. G. Wells and F. W. Cater, Jr., 1950, California Div. Mines Bull. 134, pt. 1, p. 81. Within Applegate group is a massif of Precambrian(?) Salmon and Abrams schist that lies between Seiad and Beaver Creeks and extends southward across Kalamath River, Siskiyou County.

Seymour Mack, 1958, U.S. Geol. Survey Water-Supply Paper 1462, p. 15 (table 4), 16–18, pl. 1. In northern and western parts of Scott Valley, Siskiyou County, Abrams and Salmon schists are overlain unconformably by several thousand feet of greenstone and greenstone schist possibly correlative with Devonian(?) Copley greenstone. In southern part of Klamath Mountains, the Chanchelulla(?) formation of Hinds (1931), a series of moderately metamorphosed sedimentary rocks probably of Silurian age, lies unconformably on Abrams and Salmon schists. Thus, evidence indicates only that the Abrams and Salmon schists can be adjudged with certainty to be of pre-Silurian age. Any assignment of these rocks to Precambrian or lower Paleozoic would be extremely tenuous.

W. P. Irwin, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B315–B316; 1960, California Div. Mines Bull. 179, p. 19–20. Mapping in Weaverville quadrangle indicates that (1) structure of metamorphic rocks included in that quadrangle is synclinorial, with Abrams mica schist overlying Salmon hornblende schist, (2) the Abrams is probably younger rather than older than the Salmon, and (3) the marble lenses are of stratigraphic significance in that they are chiefly in lower part of Abrams.

Abrams occupies trough of synclinorium, and thus structurally overlies the Salmon. Early workers believed that the Salmon overlay the Abrams, but this view, based chiefly on reconnaissance, now seems to be erroneous, and so does the view, tentatively advanced by Diller and Ferguson (unpub. data) that the Salmon represents an intrusive body.

Named for exposures along Salmon River, Trinity and Shasta Counties.

Salmon Lake Glaciation

Pleistocene: West-central Alaska.

D. M. Hopkins, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 10–11, 13 (table 1). Four Quaternary glaciations recognized on Seward Peninsula. Salmon Lake succeeded Nome River glaciation (new); preceded Mount Osborn glaciation (new). Salmon Lake ice extended into upland valleys south of Kigluaik Mountains, and in upper parts of valleys in Bendeleben, Darby, and York Mountains. End moraines consist of arcuate zones of slightly modified knob and kettle topography. Lateral moraines on valley walls breached by gullies and ravines.

D. M. Hopkins, F. S. MacNeil, and E. B. Leopold, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 4, p. 46–57. Outwash and gravel of Salmon Lake glaciation described in report on coastal plain at Nome. Believed to be Wisconsin.

Salmon Lake, large lake a few miles southwest of Iron Creek, dammed by moraine marking most advanced position of Salmon Lake glaciation, Seward Peninsula.

†Salmon River Sandstone[1]

Upper Ordovician: Northern New York.

Original reference: T. A. Conrad, 1839, New York Geol. Survey 3d Rept., p. 58, 62–63.

Forms falls of Salmon River in town of Orwell and above Redfield village, Lewis County.

†Salmon River Sandstones and Shales[1]

Upper Ordovician: New York.

Original reference: T. A. Conrad, 1840, New York Geol. Survey 4th Rept., p. 201.

Salmon Springs Drift, Glaciation

Pleistocene, middle(?) to upper(?): Northwestern Washington.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci. v. 256, no. 6, p. 385, 394. Pre-Vashon till and pebble and boulder gravel that overlies Puyallup formation. In most areas, these sediments appear to represent a single glacial drift unit; in exposures near Sumner, presence of nonglacial sediments between post-Puyallup glacial gravels indicate that two glaciations or two advances of a single major glaciation are represented; the Salmon Springs drift is defined as including both of these post-Puyallup-pre-Vashon glacial deposits. At Salmon Springs, the drift is separated into upper and lower drift sheets by 4 feet of peat and volcanic ash. Salmon Springs glaciation is the third in a sequence of four glaciations in Puget Sound lowland. Preceded by Stuck glaciation and followed by Vashon glaciation.

Typically exposed in east valley wall of Stuck River in gully 150 feet east and another gully 400 feet north of SE cor. SW¼ sec. 18, T. 20 N., R. 5 E., in vicinity of Salmon Springs, city water supply about 1 mile northeast of Sumner, Pierce County.

Salmontrout Limestone[1]

Middle Devonian: Northeastern Alaska.

Original reference: E. M. Kindle, 1908, Geol. Soc. America Bull., v. 19, p. 262, 325–327.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown as Lower or Middle Devonian on correlation chart.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Outcrops on both banks of Porcupine River immediately above Salmontrout River.

Salona Formation[1]

Middle Ordovician (Trentonian): Central and south-central Pennsylvania, northwestern Virginia, and eastern West Virginia.

Original reference: R. M. Field, 1919, Am. Jour. Sci., 4th ser., v. 48, p. 404, 420.

R. R. Rosenkrans, 1934, Am. Jour. Sci., 5th ser., v. 27, no. 158, p. 113–134. Six bentonite beds recognized near base of Salona. These are designated in ascending order Nos. 0–5. Overlies Rodman formation.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 2, p. 109–114. Includes about 175 feet of dark argillaceous limestone and calcareous shale in type section. Contains eight metabentonite beds. Overlies Rodman member of Nealmont formation with essential conformity; base of Salona lies 2 feet below metabentonite 0. Underlies Coburn limestone. Geographically extended to West Virginia. Trenton group. Mohawkian.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 742–745. In south-central Pennsylvania, the Martinsburg shale overlies Oranda formation. Lower part of Martinsburg is equivalent in Blacklog Valley to the part of the Salona succeeding metabentonites 1 and 2 and including metabentonite 6.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 89–91, 95. Subdivided in West Virginia and Virginia to include Onego member (new), which is believed to correspond approximately to lowermost Salona of Pennsylvania, though it probably extends a little lower. Underlies "Martinsburg" formation in West Virginia and Virginia sections. Trentonian series.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 89. In Virginia overlies Oranda formation. In Pennsylvania, overlies Rodman member of Nealmont formation.

Named for occurrence at Salona, Clinton County, Pa.

Saltash Formation

Precambrian(?): East-central Vermont.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 44–45, tables 2, 3.

Consists of grits, phyllite, and quartzite, clearly divisible into three members. Lowest, member A, includes green or white grits, schist and sericite quartzite, and a few conglomerate beds. Member B is a graphitic black phyllite with thin dolomite and limestone beds; it is separated from lower grits by pyritic white sericite schist, quartzite, and dolomitic sandstone. Member C consists of vitreous quartzites; a few beds of dolomite and thin-bedded graphitic quartzite separate it from member B. Total thickness varies from about 1,700 to 2,000 feet. Underlies Tyson formation; overlies Mount Holly complex, both unconformably.

Well exposed in all east-flowing brooks of the Ottauquechee and Black River valleys from Saltash Mountain to West Bridgewater in the Rutland area.

Salt Creek Conglomerate

Upper Cretaceous: Northern California.

N. L. Taliaferro, 1954, *in* Northern California Geol. Soc. [Guidebook] Spring Field Trip, [p. 6, 7, 8], correlation chart, structure sections A, B, and C. Shown on correlation chart and structure sections as underlying Antelope shale (new) and overlying Horsetown group or Lower Cretaceous strata. Beds vertical to overturned. Thickness 1,250 to 2,200 feet. The Salt Creek is stratigraphic marker which indicates a possible disconformity or minor unconformity. Conjectural base of Upper Cretaceous.

Occurs in Rumsey Hills-Capay Valley-Wilbur Springs area on west side of Sacramento Valley.

Salt Creek Fanglomerate[1]

Pleistocene: Eastern Utah.

Original reference: A. J. Eardley, 1933, Michigan Acad. Sci., Arts, and Letters, v. 18, p. 310, 336.

K. D. Johnson, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 6, p. 26, 27–28, pl. 8. Described in Mount Nebo-Salt Creek area where, at mouth of Foote's Canyon, it forms red cap on ridges of Arapien shale and at Left Fork of Foote's Canyon overlies vertical beds of Nugget and Ankareh formations. Pleistocene.

First described in Salt Creek Canyon, southern Wasatch Mountains.

†Salt Creek Gravel Beds[1]

Pleistocene: North-central Kansas.

Original reference: W. N. Logan, 1897, Kansas Univ. Geol. Survey, v. 2, p. 218.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Used by Logan (1897) for beds which are now, at least in part, the Sanborn formation.

Named for Salt Creek, Russell County.

Salt Creek Marble (in Blaine Formation)[1]

Permian: Northwestern Oklahoma.

Original reference: G. G. Suffel, 1930, Oklahoma Geol. Survey Bull. 49, p. 69.

In vicinity of Salt and Bitter Creeks, Blaine County.

Salt Creek Member (of Moenkopi Formation)[1]

Lower Triassic: Northeastern Arizona.

Original reference: D. Hager, 1921, Oil possibilities of Holbrook area, northeastern Arizona, private publication.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, p. 19. Lower and middle subdivisions of Moenkopi, in Little Colorado Valley, referred to as the Salt Creek by Hager (1922, Mining and Oil Bull., v. 8, no. 2, p. 73), here called, respectively, Wupatki member and Moqui member.

Occurs at mouth of Salt Creek, mouth of Clear Creek, southeast corner of Winslow, and just south of Holbrook.

Salt Creek Bend Shale Member (of Pueblo Formation)

Salt Creek Bend Shale (in Cisco Group)[1]

Permian (Wolfcamp): Central Texas.

Original reference: F. M. Bullard and R. H. Cuyler, 1935, Texas Univ. Bull. 3501, p. 245, 249.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as shale member of Pueblo formation. Underlies Camp Colorado limestone member; overlies Stockwether limestone member. Average thickness 45 feet. Upper part of member consists mostly of dark-red to maroon clay; near Colorado River, a sandstone 5 to 15 feet thick is persistent subdivision; in eastern Coleman County, three limestone beds, 1 to 5 feet thick, occur in upper part, and the middle of these limestones is sandy and locally grades to sandstone.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 269. Geographically extended into Brazos River valley where it is 40 to 100 feet thick and consists of variegated shale with minor amounts of sandstone and siltstone. Underlies Camp Colorado limestone member; overlies Stockwether limestone member.

Type locality: A sharp bend on Colorado River, 0.1 mile east of mouth of Salt Creek, McCulloch County

Salt Fork Group (in Cimarron Series)

Salt Fork division (of Cimarron Group)[1]

Permian: Central southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 18.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 25–26. Referred to as group in Cimarron series. Data in this report is from subsurface records.

Named for Salt Fork, Comanche and Barber Counties, Kans.

Salt Grass Shale Member (of Pierre Shale)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 22. As currently defined, consists of gray clayey shale that contains numerous thin bentonite beds, limestone concretions, and concretionary limonite zones. Thickness 60 feet. Overlies Lake Creek shale member; underlies an unnamed shale 500 to 600 feet thick that in turn underlies Beecher Island shale member.

Named for Salt Grass Canyon, the southern tributary of Goose Creek in secs. 1 and 12, T. 12 S., R. 42 W., Wallace County.

†Saltillo Limestone[1]

Middle Ordovician: Western Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 33–35, 44.

Named for Saltillo, Hardin County.

Salt Lake Conglomerate[1]

Quaternary(?): Western Wyoming.

Original reference: A. C. Peale, 1879, U.S. Geog. and Geol. Survey Terr. 11th Ann. Rept., p. 552, 612, 641.

Occurs at various points in lower valley of Salt River, Lincoln County.

Salt Lake Formation[1]

Salt Lake Group

Pliocene: Northern Utah, southeastern Idaho, and northern Nevada.

Original reference: F. V. Hayden, 1869, U.S. Geol. and Geog. Survey Terr. Rept. on Colorado and New Mexico, 3d Ann. Rept., p. 92.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 845–846. Norwood tuff (new) is recognized as division under Hayden's Salt Lake group. When intermontane valleys west of the Wasatch become better known stratigraphically, Salt Lake group may be found to include several formations, perhaps separated in age by considerable parts of the Tertiary.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table), 1147, pl. 1. Group comprises light-colored tuffs, tuffaceous sandstones, and conglomerates that underlie foothill benches about margins of Cache Valley and extend in irregular patches through passes that connect valley with adjacent valleys to south, east, and north. Thickest section, exposed in Junction Hills horst in sec. 15, T. 13 N., R. 2 W., is 1,140 feet. Unconformable above Paleozoic rocks. Oligocene(?) to Pleistocene(?).

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 44–46, pl. 1. Formation described in Ammon and Paradise quadrangles, Idaho. As mapped, consists of conglomerate, calcareous grit, sandstone, shale, and marl; includes some bedded volcanic ash and tuff and windblown dust of Pleistocene age. Thickness varies from 0 to as much as 800 feet. Unconformably overlies rocks of all earlier formations represented. Pliocene(?).

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists Guidebook 4th Ann. Field Conf., p. 73–76. Williams (unpub. thesis) subdivided Salt Lake group in Cache Valley into basal Collingston conglomerate, West Spring formation, and Cache Valley formation (all new). Figure 2, this report, shows Norwood tuff as basal unit of group. Group is unconformable above Knight formation of Wasatch group. Oligocene through Pliocene.

C. B. Hunt, H. D. Varnes, and H. E. Thomas, 1953, U.S. Geol. Survey Prof. Paper 257–A, p. 13–14, pl. 1. Formation described and mapped in northern Utah Valley where thickness may exceed 1,000 feet. Unconformable below pre-Lake Bonneville deposits. Pliocene(?).

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23–36. Group, as described in lower Jordan Valley, Utah, comprises (ascending) Trav-

erse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and travertine unit (all new). Maximum aggregate thickness 3,700 feet. Oligocene through Pliocene.

R. D. Adamson, C. T. Hardy, and J. S. Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 1 (table 2), 2 (table 1), 4–22. Group in Cache Valley redefined to include (ascending) Colliston conglomerate, Cache Valley formation (redefined) and Mink Creek conglomerate (new). Underlies pre-Lake Bonneville group. Overlaps unit referred to as "Wasatch" conglomerate and in places overlaps Paleozoic rocks. Miocene-Pliocene.

W. J. Mapel and W. J. Hail, Jr., 1956, Utah Geol. Soc. Guidebook 11, p. 2 (table 1), 4 (fig. 3), 9–16, fig. 2. Formation described and mapped in Goose Creek district, Idaho, Utah, and Nevada. Comprises lower unit, 1,550 feet, mainly white volcanic ash containing a few beds of shale, sandstone, and conglomerate; beds of black to reddish-brown welded tuff in upper half; lenticular beds of carbonaceous shale and lignite in lower half; upper unit, about 700 feet, interbedded white and grayish-orange volcanic ash, with a few lenticular beds of conglomerate; a thick persistent bed of welded tuff at base. Overlies unit referred to as Payette(?).

Named for extensive developments in Weber and Salt Lake Valleys, Utah.

Salt Lake Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 64.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 130–131. Subaerial gray to brown tuff, partly palagonitized, containing bombs of peridotite and fragments of coral limestone. Maximum thickness about 300 feet. Overlies Aliamanu tuff and eroded gravel terraces graded to plus 95-foot (Keana) stand of sea.

Named for Salt Lake (Aliapaakai) which lies in crater of tuff cone that marks the vent. Together with Makalapa tuff covers about 6 square miles just east of Pearl Harbor, on southwest side of Koolau Range 18 miles west of Makapuu Head.

Saltlick Beds[1]

Salt Lick Limestone (in Breathitt Formation)

Pennsylvanian: Eastern Kentucky.

Original reference: W. C. Morse, 1931, Kentucky Geol. Survey, ser. 6, v. 36, p. 296, 303.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 100. Thin marine limestone in Breathitt formation between Haddix coal (above) and Magoffin marine horizon.

Well exposed at head of Salt Lick Creek, Knott County, Ky.

Salt Mountain Limestone

Salt Mountain Limestone (in Midway Group)

Salt Mountain Limestone (in Wilcox Group)[1]

Paleocene: Southwestern Alabama.

Original references: D. W. Langdon, 1891, Geol. Soc. America Bull., v. 2,

p. 589–605; 1894, Alabama Geol. Survey Rept. Coastal Plain, p. 107–122.

L. D. Toulmin, 1941, Jour. Paleontology, v. 15, no. 6, p. 567–611. Foraminifera indicate that Salt Mountain limestone, at least upper part, is younger than Midway and probably is Wilcox in age.

A. R. Loeblich, Jr., and Helen Tappan, 1957, Jour. Paleontology, v. 31, no. 6, p. 1113 (fig. 2); 1957, U.S. Natl. Mus. Bull. 215, p. 174, 177 (fig. 28). Age discussion. Chart shows Salt Mountain limestone above Naheola formation and below Nanafalia formation in Midway group. Paleocene.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1). Chart shows age of Salt Mountain limestone as Paleocene.

Named for exposures at Salt Mountain, Clarke County.

Saltos Shale Member (of Monterey Shale)

Miocene, lower and middle: Southern California.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2977 (fig. 3), 2989–2990. Lower member of Monterey in Caliente Range. Where best exposed on southwest slope, consists of (1) an upper 1,100 feet of thin-bedded brown clay shale, with minor siliceous shale beds and near its base a 75-foot basalt sill, and (2) a lower 1,000 feet of gray-brown, less well-bedded claystone and siltstone; on northeast flank of range, grades eastward into sandstone of the lower part of Branch Canyon formation (new); can be traced northwestward into a clay shale which occurs on northeast side of La Panza Range and where it was mapped as Sandholdt shale by Bramlette and Daviess (1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 24); the Saltos, therefore, is in part equivalent to Sandholt shale of Salinas Valley as defined by Thorup (1953, California Div. Mines Bull. 118). In western Cuyama Valley in vicinity of Taylor Canyon, consists of a basal 150 to 300 feet of siliceous shale overlain by about 500 feet of clay shale; this basal siliceous shale was mapped as Whiterock Bluff member of Santa Margarita formation by English (1916) and included in the Vaqueros by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2). Conformably underlies Whiterock Bluff shale herein designated as member of Monterey; conformably overlies Painted Rock sandstone. Age, based on foraminiferal content, ranges from Saucesian through most of Relizian stage. The basalt sill marks boundary between Relizian and Saucesian stages in type section of the Saltos. The Saltos was mapped by English (1916) as Maricopa shale and by Eaton and others (1941) as upper part of the "Temblor."

Type locality: The steeply dipping section exposed in an unnamed canyon in sec. 20, and offset along strike in secs. 18 and 19, T. 11 N., R. 27 W. Caliente Mountain quadrangle.

Salt Plain Formation or Siltstone (in Nippewalla Group)

Salt Plain Shale (in Cimarron Group)[1]

Permian (Leonard Series): Central southern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 20–24.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1762–1763 (fig. 2), 1764–1765 (fig. 3), 1786–1789. Included in Nip-

pewalla group (new). Overlies Harper sandstone (restricted); underlies Cedar Hills sandstone. Cimarron series, Salt Fork division.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 39. Formation consists chiefly of red, flaky, silty shale and some siltstone. Includes two prominent coarse siltstone beds, the upper, about 25 feet thick, occurring about 42 feet below top of formation and the lower, Crisfield, about 29 feet thick, occurring about 115 feet below top of formation. Thickness 265 feet. Overlies Harper sandstone; underlies Cedar Hills sandstone. In Kingman County, overlapped by Cenozoic deposits. Leonardian. In Nippewalla group (new).

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Chart shows Salt Plain siltstone with Crisfield sandstone member in upper part.

Named for Great Salt Plain of Cimarron River, Kan.

Saltsburg Formation (in Conemaugh Formation)[1]

Pennsylvanian: Southwestern Pennsylvania.

Original reference: G. H. Ashley, 1926, Pennsylvania Geol. Survey Topog. and Geol. Atlas 65, p. 23–24, pl. 4.

Punxsutawney quadrangle.

Saltsburg Member (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh quadrangle.

Saltsburg Sandstone Member (of Conemaugh Formation)[1]

Saltsburg Sandstone (in Conemaugh Group)

Upper Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K., p. 22.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 49, 50, geol. map. In this report [Morgan County] the Conemaugh is classified as a series and the included units referred to as members. Cyclothemic classification not used in this report. From Condit's (1912, Ohio Geol. Survey, 4th ser., Bull. 17) description, it seems that Saltsburg sandstone and Round Knob shale are contemporaneous units, or the names are applied to different facies of same unit. In Morgan County, interval between Barton and Harlem coals, both of which are discontinuous, is 15 to 20 feet. The Saltsburg is represented in some parts of county by sandstones or sandy shales, which change facies rapidly, and which may comprise entire interval or may be present only in lower half of interval. Term Round Knob is applied to shaly phase and term Saltsburg to sandy phase. In some areas, the Round Knob overlies the Saltsburg. Two spellings of the name, Saltsburg and Saltzberg, have appeared in literature.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 130. In this report [Athens County], Saltsburg shale and sandstone is classified as lowermost member of Harlem cyclothem, Conemaugh series. Thickness about 10 feet. Underlies Round Knob redbed member of cyclothem.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4). In this report [western Pennsylvania], the Conemaugh is classified as a group. On columnar section, Saltsburg sandstone occurs above Upper Bakerstown coal and below Pittsburgh redbed.

Named for exposures along Conemaugh and Loyalhanna Rivers near Saltsburg, Indiana County, Pa.

Saltville Chert (in Helderberg Group)[1]

Lower or Middle Devonian: Southwestern Virginia.

Original reference: F. M. Swartz, 1929, Pennsylvania Acad. Sci. Proc., v. 3, p. 80.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

Name applied from Tumbling Creek, near Saltville, Smyth County, to Gala, Botetourt County.

Salt Wash Sandstone Member (of Morrison Formation)[1]

Upper Jurassic: Eastern Utah, northeastern Arizona, southwestern Colorado and northwestern New Mexico.

Original reference: C. T. Lupton, 1914, U.S. Geol. Survey Bull. 541, p. 127.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 963. Correlates with lower part of Recapture shale member proposed by Gregory (1938).

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009-E, p. 135–137, 138 (fig. 21). Salt Wash member constitutes lower part of Morrison in eastern Utah, parts of western Colorado, northeastern Arizona, and northwestern New Mexico. It was formed as a large alluvial fan by streams diverging to north and east from an apex in south-central Utah. Blunt apex of fan lies along a northwest-southeast-trending line in south-central Utah and north-central Arizona; this line is limit of preservation; southwest of it, Salt Wash has been removed by erosion. South side of fan is limit of deposition; south of Monticello, Utah, upper part of Salt Wash intertongues with and grades into Recapture member; in northeasternmost Arizona, lower parts of Salt Wash intertongue with Recapture, and farther south a basal tongue of Salt Wash reaches limit of deposition. Western edge of fan is poorly defined limit of deposition trending almost north-south along zero isopach in south-central Utah. Rounded margin of fan is irregular line extending from northwestern to south-central Colorado, beyond which Salt Wash cannot be distinguished from upper part of Morrison. Member arbitrarily divided into four facies: conglomeratic sandstone; sandstone and mudstone; claystone and lenticular sandstone; and claystone and limestone. From maximum thickness of more than 600 feet in south-central Utah, member in general thins radially to north and east. Near Vernal, Utah, 285 feet thick; this thickening is poorly understood but may represent accumulation of sediment from source unrelated to main source of member. In southeastern Utah, a thin area of Salt Wash is related to the thickness of underlying Bluff sandstone because, in general, as Bluff thickens, Salt Wash in this area thins. Extension of Salt Wash as recognizable unit through southeastern Utah and into northeastern Arizona and northwestern New Mexico

constitutes restriction of Gregory's original definition of Recapture member.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 52, strat. sections. Stokes (1944) correlates Salt Wash member with parts of Gregory's (1938) Recapture in San Juan County, and this correlation is used in this paper on Navajo country. Present only in northern part of area; to the south, intertongues with and grades into overlying Recapture member; in vicinity of Marsh Pass, there is indication that Salt Wash intertongues with Cow Springs sandstone; at Red Mesa, Ariz., intertongues with upper part of Bluff sandstone. Thicknesses: 616 feet on Navajo Point, Utah, and 125 feet near near Rough Rock, Ariz.

T. E. Mullens and V. L. Freeman, 1957, Geol. Soc. America Bull., v. 68, no. 4, p. 505–526. Detailed discussion of lithofacies of Salt Wash member.

Named for Salt Wash, 30 miles southeast of Green River, Grand County, Utah.

†Salt Wells Group[1]

Upper Cretaceous: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 49, 154.

Occurs at and around Salt Wells Station, Sweetwater County, Wyo.

Saluda Limestone (in Richmond Group)[1]

Saluda Formation (in Richmond Group)

Saluda Limestone Member (of Whitewater Formation)

Upper Ordovician: Southeastern Indiana, north-central Kentucky, and southwestern Ohio.

Original reference: A. F. Foerste, 1902, Am. Geologist, v. 30, p. 369.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110, 114, chart facing p. 108. In Ohio, listed as member of Whitewater formation. Sequence shown on p. 110 (ascending): Weisburg, Saluda, and Oxford; stratigraphic chart and p. 114 shows sequence (ascending): Lower Whitewater, Saluda, and Upper Whitewater.

James Conkin, 1952, Kansas Acad. Sci. Trans., v. 55, p. 126–130. Liberty formation and Saluda member of Whitewater formation in this part of Kentucky [Oldham County] are separated by 14 feet of Whitewater facies. The Saluda wedges into Whitewater formation of Ohio. Upper Richmond beds thus coincide in their stratigraphic succession with Upper Richmond of Ohio. Heretofore, Kentucky section was given as Liberty, Saluda, and Whitewater (Hitz). Recognition of Whitewater beds permits division of Kentucky Upper Richmond, which is similar to that of Ohio into Liberty formation, Lower Whitewater, Saluda, and Upper Whitewater members of the Whitewater formation of Ohio.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on stratigraphic chart of Indiana as Saluda formation in Richmond group. Consists of limestone, drab-gray, granular, massive to thin-bedded, impure, dolomitic; weathers

to banded buff and salmon surface; coral masses at base. Thickness 40 to 65 feet. Underlies Whitewater; overlies Liberty.

Named for Saluda Creek, 6 miles south of Hanover, Jefferson County, Ind.

Saluda zone[1]

Precambrian: Northwestern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 6, 8, 12.

Named for exposures in Saluda Mountain Range.

Salvisa Formation

Salvisa Limestone Member (of Perryville Formation)[1]

Middle Ordovician: North-central Kentucky.

Original reference: A. M. Miller, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 329.

A. C. McFarlan, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 992. An exposure in northern Jessamine County seems to indicate that the Faulconer and Salvisa are not entirely distinct stratigraphic units but are lithologic facies, in part contemporary.

A. C. McFarlan and W. H. White, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1640. Term Perryville is a synonym of Benson; name Devils Hollow division of the Lexington is proposed for the post-Woodburn "Perryville" of the Frankfort-Versailles area. At its type section, the Devils Hollow includes 15 feet of the "Faulconer" rock and 10 feet of the "Salvisa."

J. A. Stokley and F. H. Walker, 1953, Kentucky Geol. Survey, ser. 9, Rept. Inv. 8, p. 44, 45. At Harrodsburg, Mercer County, Salvisa formation is 10 feet thick; underlies Cornishville formation; overlies Faulconer formation.

Named for Salvisa, Mercer County.

Samaniego Granite

Precambrian: Southeastern Arizona.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 113. In composition, rock ranges from granodiorite to quartz monzonite and contains large microcline crystals associated with quartz, plagioclase, and hornblende. In fault contact with late Cenozoic sediments on west and with Pinal schist on east. Name credited to R. M. Wallace (unpub. thesis).

Crops out along western side of northern Santa Catalina Mountains, Pima and Pinal Counties.

Sam Creek Limestone Member (of Savanna Sandstone)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

M. C. Oakes and M M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 51–52, pl. 3. Overlies Spaniard limestone member. In Haskell County, underlies a 20-foot massive sandstone referred to as "Spiro" sandstone member.

Named from exposure in center of W½E½ sec. 15, T. 14 N., R. 18 E., along south bank of Sam Creek, Muskogee County.

Samelias Formation

Precambrian: Western South Dakota.

J. R. Berg, 1946, South Dakota Geol. Survey Rept. Inv. 52, p. 7. Similar to and of apparently same stratigraphic horizons as Roubaix group (new). In Keystone district, overlies rocks tentatively correlated with Lead system. Name credited to R. G. Hamilton (unpub. thesis).

First described in Keystone district, southern Black Hills. Also present in Galena-Roubaix district.

Sample Sandstone

Sample Formation (in West Baden Group)

Sample Sandstone Member (of Gasper Oolite)[1]

Upper Mississippian: Western Kentucky and southwestern Indiana.

Original reference: C. Butts, 1917, Mississippian formations of western Kentucky: Kentucky Geol. Survey, p. 67, 70.

R. E. Stouder, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 3, p. 270 (fig. 2), 273–275. In Meade, Hardin, and Breckinridge Counties, Ky., Sample sandstone occurs below Reelsville limestone and above Beaver Bend limestone.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6, pl. 2. Sample formation in Indiana is 24 to 42 feet thick. Consists of thin-bedded fine-grained sandstone and siltstone and olive-gray and red-brown mudstones and shale; locally includes lenses of crossbedded sandstone. Underlies Reelsville limestone; overlies Beaver Bend limestone.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 46, pl. 1. Included in West Baden group (redefined). Thickness 22 to 36 feet. Underlies Reelsville limestone; overlies Beaver Bend limestone.

Typically exposed 1 mile east of Sample, Breckinridge County, Ky.

Sampson Rock Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, W. A. Price, and H. Bassler, 1919, Geol. Soc. America Bull., v. 30, p. 571.

Well exposed at Sampson Rock, west of Frostburg, Allegany County.

Sams Creek Metabasalt

Precambrian: Western Maryland.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 58, 63–65. Grayish-green schistose to massive rock spotted with light-green, white, or pinkish knots, which are amygdules filled with quartz, calcite, or green epidote. All gradations occur from a massive amygdular rock with inconspicuous schistosity through a schistose variety in which the amygdules are drawn out into elliptical form, to fissile slate without recognizable volcanic characteristics in which amygdules are represented by flattened blebs or stringers. Crops out in a linear belt which extends southwestward from Maryland-Pennsylvania State line,

in vicinity of Lineboro, to a point 1 mile northeast of Taylorsville; belt lies 1 mile north of Manchester and passes through Westminster. In this belt, the metabasalt overlies Wakefield marble and underlies albite-chlorite schist of Wissahickon formation. West and southwest of linear belt, the Sams Creek has a curvilinear strike which is common to the Wakefield, is repeated several times across the strike and is overlain by Ijamsville phyllite; in vicinity of Union Bridge, Unionville, Linganore, and Dollyhyde Creek, it is interbedded with Libertytown metarhyolite (new); from New London southward to New Market and Monrovia, it is overlain by Urbana phyllite; west of Parrsville, it is exposed in several narrow upfolds in Marburg schist. The unit was mapped as metabasalt in Glenarm series on geologic map of Frederick County [Maryland Geol. Survey, 1938] and age given as Precambrian(?).

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43 (table 7), 65. Volcanic series in eastern part of Piedmont province includes Sams Creek metabasalt, Libertytown metarhyolite, Ijamsville phyllite, and Urbana phyllite. Quartzites occur in all of the members; some of the quartzites pass directly from the Ijamsville into the Urbana and into the Libertytown, and from the Urbana into the Sams Creek, indicating relative contemporaneity of these formations, all of which are apparenty equivalent to Harpers formation. Late Precambrian.

Named from village of Sams Creek on Carroll-Frederick County line.

Sams Spring Formation

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3). Discussion of Paleozoic continental margin in central Nevada. Clipper Canyon sequence comprises (ascending) Charcoal Canyon, Petes Summit, Sams Spring, and Joes Canyon formations (all new). Clipper Canyon sequence is isolated by surrounding Tertiary volcanic rocks.

Clipper Canyon, Toquima Range, Nye and Lander Counties.

San Andres Limestone

San Andres Formation (in Manzano Group)

San Andres Group

San Andres Limestone Member (of Chupadera Formation)[1]

Lower and Upper Permian (Leonard and Guadalupe Series): Central and southeastern New Mexico.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 389.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42–44. Report gives geologic section from Fisher County through Andrews County, Tex., to Eddy County, N. Mex. The "Blaine of Texas" is herein called the San Andres because it is believed that unconformity at top of Dog Creek shale on east side of basin can be tied into top of San Andres on west side of basin by means of well logs. San Andres on east side can be divided into (descending) Dog Creek shale, Blaine gypsum, and Flowerpot shale, a division known in Oklahome for some time. Top of Dog Creek shale is there called top of El Reno group. Term San Andres as used on west side of basin at present time includes beds between base of Whitehorse group and top of Yeso. In Guadalupes, San Andres is about 1,250 feet thick, and in

wells in basin is about 1,460 feet. It has been assumed that this entire thickness is San Andres in age. At type locality in San Andres Mountains, formation is 500 feet thick and contains fossils which suggest its correlation with the Leonard of Glass Mountains of Texas. At type locality, base of formation is exposed, but top passes under alluvium of the Jornado del Muerto. There is evidence that the increased thickness of the so-called San Andres in the Guadalupes and in subsurface is due to the fact that additional section is younger than San Andres of type locality. This implies a division within the so-called San Andres dividing that part of section which is Leonard in age and which corresponds to San Andres as originally defined from younger beds which are probably middle Delaware Mountain in age.

F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 73–103. San Andres problem discussed. San Andres group believed to be time equivalent of Word formation, lower two divisions of Delaware Mountain group, and El Reno group, each of which is separable into an upper and lower division over wide area in south Permian basin. Evidence indicates San Andres group should be placed in Guadalupe series.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 542, 687–694, 701–703, pl. 2. Rank raised to formation; term Chupadera abandoned. In northern shelf area, upper part mostly limestone in outcrop; anhydrite and red beds interbedded to northeast; in lower part, sandstone beds replace limestone forming Glorieta sandstone member of northern New Mexico, Hondo sandstone member in Sacramento Mountains. Occurs above Yeso formation. In San Andres and other ranges of central New Mexico, formation is overlain unconformably by Mesozoic rocks, no higher Permian beds exposed; in Pecos Valley, overlain by Chalk Bluff formation. Included in Manzano group. Leonard series.

J. M. Hills *in* R. L. Bates, 1942, New Mexico Bur. Mines Mineral Resources Bull. 18, p. 269–271. In subsurface includes Lovington sandstone member (new).

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1662, 1663 (fig. 2), 1664–1666. Lee (1909) gave no detailed section. At new type section, herein designated, consists mainly of gray limestone with minor amounts of sandstone. Thicknesses 593½ feet at type section; 110 feet, Bluewater Canyon in Zuni Mountains; 15 feet, Glorieta Mesa. Overlies Glorieta sandstone herein given formational status; underlies Permian and other beds.

C. B. Read and D. A. Andrews, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 8. In upper Pecos River and Rio Galisteo region, formation consists of (ascending) Glorieta sandstone member (100 to 250 feet); light-gray thick-bedded cavernous-weathering limestone member (1 to 20 feet); and upper member (0 to 80 feet) of light-terra-cotta to orange gypsiferous siltstone and fine-grained sandstone. Overlies Yeso formation; underlies Dockum formation.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwest Mora County, restricted to exclude upper clastic member which is here named Bernal formation. Includes Glorieta sandstone member at base. Middle limestone member, recognized in other areas, not present in mapped area of this report. Overlies Yeso formation or Sangre de Cristo formation.

W. F. Tanner, 1956, Jour. Sed. Petrology, v. 26, no. 4, p. 307–308. Group, between Las Vegas and Santa Fe includes (ascending) Glorieta sandstone, Lagunita formation (new), and Bernal formation.

C. H. Dane and G. O. Bachman, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–224. As used on this map, Glorieta sandstone is considered separate formation.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 690 (fig. 1). Mapped as limestone [limestone seems more appropriate designation since Glorieta sandstone has been removed from formation].

P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112. Formation described in Carlsbad Caverns West quadrangle where it is more than 300 feet thick and consists of dolomite and limestone in even to irregular beds. Underlies Grayburg formation; basal contact not exposed. Upper part grades eastward into sandstone tongue of Cherry Canyon formation.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, p. 2. Age of formation in Zuni uplift is not certain. To southeast, in southeasternmost New Mexico and adjoining parts of Texas, the San Andres is considered, on stratigraphic grounds, to be of Guadalupe age. To west, in Arizona, Kaibab limestone with which it apparently is continuous, is considered, from faunal evidence, to be of Leonard age. Assuming that both ages are correct, the San Andres of northwestern New Mexico must either transgress time planes across the State toward its type locality or represent a lithologic unit distinct from that of type San Andres. An indication that formation transgresses time planes is found north of Guadalupe Mountains where it is reported to include rocks of both Leonard and Guadalupe age.

Type section: South wall of Rhodes Canyon 2 miles west of road fork at top of Rhodes Pass and 14.6 miles by road east of Continental Airlines beacon near Engle. Canyon extends from near middle of north line sec. 29, T. 12 S., R. 2 E. Inquiry established that canyon referred to by Lee is one now known as Rhodes Canyon, San Andres Mountains, Socorro County.

San Angelo Sandstone[1] (in Pease River Group)

San Angelo Sandstone or Formation (in El Reno or San Andres Group)

Permian: Central northern Texas.

Original reference: W. F. Cummins and O. Lerch, 1891, Am. Geologist, v. 7, p. 73–77, 321–325.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 97. Included in El Reno group. Underlies Flower Pot shale; overlies Choza formation of Clear Fork group. On east side of Permian basin, name El Reno group appears to have priority and to be more appropriate on facies basis than term San Andres group which has been suggested for beds of Leonard age.

F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 73–103. San Angelo is basal formation in San Andres group as defined in this report.

Robert Roth, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1412, 1413. Basal formation in Pease River group.

E. C. Olson, 1952, Jour. Geology, v. 60, no. 3, p. 286–288; E. C. Olson and J. R. Beerbower, 1953, Jour. Geology, v. 61, no. 5, p. 389–423. Vertebrate fauna discussed. Evidence indicates post-Leonard age.

Well exposed a few miles west of San Angelo, Tom Green County.

San Antonio Formation[1]

Pleistocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

P. D. Trask and J. W. Rolston, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1083. Thickness 15 to 120 feet. Overlies Alameda formation; underlies Posey formation (new).

Named for development in San Antonio Township, Alameda County.

San Antonio Canyon Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 295–296, geol. map. Gneisses, migmatized metamorphics, and marble. Rocks have been intruded by a fine-grained quartz monzonite which is most probably an equivalent of Stoddard Canyon quartz monzonite (new). Similar to Rainbow Flat group (new), and future work may prove that the two were a continuous unit before they were separated by the strike-slip(?) East San Antonio fault.

Exposed on west side of San Antonio Canyon and west of East San Antonio fault, Cucamonga quadrangle, Los Angeles County.

San Ardo Group

Pliocene: West-central California.

T. A. Baldwin, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 10, p. 1988. Term suggested for three partly equivalent Pliocene units (ascending) Pancho Rico, Etchegoin, and Paso Robles facies.

Well exposed on slopes of Pancho Rico Canyon and the nearby gulches which drain westward to the Salina River at the town of San Ardo, Monterey County.

Sanastee Sandstone Member (of Mancos Shale)

Cretaceous: Northern New Mexico.

W. B. Hoover, 1951, *in* C. T. Smith and others, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 46, 47, 79. Member of Mancos shale; about 450 feet above Dakota sandstone.

Dan Bozanic, 1955, Four Corners Geol. Soc. Guidebook [1st] Field Conf., p. 91. Term Sanastee was apparently applied to unit which had earlier been named Juana Lopez by Rankin (1944).

Named for prominent development around Sanastee Trading Post in vicinity of Grants, Valencia County.

Sanatoga Member (of Brunswick Formation)[1]

Upper Triassic: Southeastern Pennsylvania.

Original reference: D. G. McLaughlin, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 179.

Named for excellent exposures in a large quarry and in the railroad cut at Sanatoga Station on Schuylkill River, Montgomery County.

Sanatorium Limestone Lentil (in Geuda Springs Shale member of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 14. Name applied to limestone in Geuda Springs that caps the hills below the Geuda Springs sanatorium.

Occurs at type locality of Geuda Springs member, sec. 7, T. 34 S., T. 3 E. [Cowley County].

San Augustine Group (in Claiborne Group)[1]

Eocene: Eastern Texas.

Original reference: E. T. Dumble, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, no. 4, p. 428.

Probably named for San Augustine, San Augustine County.

San Benito Gravels[1]

Pliocene to Pleistocene: Wsetern California.

Original reference: A. C. Lawson, 1893, California Univ. Pub. Dept. Geol. Bull., v. 1, p. 151–153.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, p. 225 (fig. 4), 246–249, 257, pl. 3. In San Benito quadrangle, consists of gravels, sands, and clays, in part consolidated into conglomerate, sandstone, and clay shale. About 1,500 feet thick. Overlies Etchegoin group; overlaps Los Muertos Creek formation (new) and Tres Pinos sandstone.

In San Benito quadrangle, main belt of gravels, lying between San Benito fault zone and Tres Pinos Creek, is folded into a broad, gentle syncline, plunging toward the northwest.

Sanborn Group

Sanborn Formation[1]

Pleistocene and Recent: Western Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7, p. 163.

A. B. Leonard and J. C. Frye, 1943, Am. Jour. Sci., v. 241, no. 7, p. 453–462. Stratigraphic position of these deposits [Sanborn formation] unconformably above middle Pliocene Ogallala beds, and the snails which they contain conclusively demonstrate a Pleistocene age.

C. W. Hibbard, J. C. Frye, and A. B. Leonard, 1944, Kansas Geol. Survey Bull. 52, p. 3–26. Elias' term Sanborn is used in this paper to refer to essentially the entire Pleistocene section exposed in north-central and northwestern Kansas, although some distinct terrace beds of local extent have not been included within it. Term is used despite the fact that in some localities beds have been studied that are probably stratigraphic equivalents of the Peorian and Loveland as described by Lugn in southern Nebraska. Beds herein assigned to Sanborn formation have been observed from western Jewell County westward for more than 200 miles to Yuma County, Colo. Formation mantles upland of much of north-central part of state. Consists of an upper gray silt bed which is persistent over entire area, and an underlying soil zone that occurs only in north-central Kansas, and pre-soil zone deposits consisting of a wide variety of lithologic types.

J. C. Frye and O. S. Fent, 1947, Kansas Geol. Survey Bull. 70, p. 40–41. Proposed that late Pleistocene loesses, associated deposits, and lateral facies generally occurring in northern and central Kansas, be classed as Sanborn formation and the Loveland silt, Peoria silt, and Bignell silt and their lateral coarse-textured facies be assigned rank as members. Type section designated.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 106–110. Sanborn formation, unlike other stratigraphic units of formational rank in Kansas Pleistocene, includes deposits of two stages (Illinoian and Wisconsinan) and the several substages of the Wisconsinan. Includes two unconformities, defined by the Sangamon and Brady buried soils, and represents three distinct cycles of deposiiton. As classified by Kansas Geological Survey, includes (ascending) Crete sand and gravel member; Loveland silt member, commonly containing Sangamon buried soil at top; unnamed early Wisconsinan alluvial deposits; Peoria silt member, commonly containing Brady buried soil; unnamed Wisconsinan alluvial deposits; and Bignell silt member. Thickness 130 feet at type locality. Among units that consist in part or entirely of deposits known to be of Illinoian or younger age and which are properly classed at least in part as Sanborn are Kingsdown marl or formation, Odee formation, and Vanhem formation.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Rank raised to group. In southwestern Kansas, includes Kingsdown formation below and Vanhem formation above. For other parts of Kansas, includes (ascending) Crete formation, Loveland formation, early Wisconsin terrace deposits, Peoria formation, terrace deposits, and Bignell formation. Overlies Meade group. Classification used in this report is in accord with agreement at Pleistocene conference at Lawrence, Kans., June 28–29, 1956.

Type section: In canyons in NW¼ sec. 20, T. 1 S., R. 41 W., Cheyenne County, Kans. Name derived from Sanborn, Nebr., which is nearest town to a locality of the formation in Cheyenne County.

San Bruno Sandstone (in Franciscan Group)[1]

Jurassic(?): Western California.

Original reference: R. Crandell, 1907, Am. Philos. Soc. Proc., v. 46, p. 3–58.

Named for fact that it forms San Bruno Mountains.

San Carlos Formation[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Bull. 164, p. 81–82.

Named for San Carlos, Presidio County.

San Carlos Formation[1]

Pleistocene(?): Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 259.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 345. Poorly defined name for surficial deposits. Pleistocene(?).

Present on San Carlos Plain, Panamá Province.

Sanchez Sandstone Member or Tongue (of Fayette Formation)

Eocene, upper: Southwestern Texas and northern Mexico.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1387.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 269. Sanchez member (or tongue) overlies Gorgora shale member (new) and underlies Agua Verde shale member (new). Thickness in Starr County about 100 feet; thins and dies out half way across Zapata County.

Lies 280 feet below top of Fayette in section measured on both sides of Rio Grande between Roma and Rio Grande City, Starr County. Derivation of name not stated.

Sand Bay Agglomerate (in Sand Bay Volcanics)

Tertiary: Southwestern Alaska.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 61, 63, pls. 4, 5. At Sand Bay, composed of subangular to rounded boulders as much as 3 feet across in tuff matrix. Sorting very poor but bedding fairly well defined. Boulders mainly of two rock types: black glassy highly vesicular lava and reddish vesicular porphyry. At south end of Akuyah Cliffs, on west side of island, 1,000 to 1,500 feet thick and unconformably overlies coarse well-bedded tuffs [Finger Bay volcanics]. Numerous dikes exposed in cliffs. Similar agglomerate forms lower slopes of southern half of island. Further inland, toward the cone, agglomerate contains interbedded thin lava flows and is cut by dikes. Constitutes lower part of Sand Bay volcanics (new); underlies Sand Bay lava flows (new) and Great Sitkin volcanics (new).

F. S. Simons and D. E. Mathewson, 1955, U.S. Geol. Survey Bull. 1028–B, p. 28–29, pl. 5. Unit included in Sand Bay volcanics. Term Sand Bay agglomerate not used in this report.

Sand Bay agglomerate and lava flows combined form most of southern half of Great Sitkin Island, in central part of Aleutian Islands.

Sand Bay Lava Flows (in Sand Bay Volcanics)

Tertiary: Southwestern Alaska.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 61, 63, pls. 4, 5. Lava flows, which are porphyritic, include andesite, olivine andesite, and andesite flow-breccia, and basalt. Colors range from black through purplish gray and reddish gray to light gray. Most flows are medium grained but few are very fine grained. Platy lavas rare, and most rocks show little or no flow structure. Columnar jointing common. Vesicular flows rare. Lavas dip gently south or southeast and thicken toward center of island. Flows cap main ridges in southern part of island and reach aggregate thickness of 400 feet on Triple Divide Peak at head of Middle Yoke Valley. Constitute upper part of Sand Bay volcanics (new). Overlie Sand Bay agglomerate (new); underlies Great Sitkin volcanics (new).

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Bull. 1028–B, p. 29, pl. 5. Unit included in Sand Bay volcanics. Term Sand Bay lava flows not used in this report.

Sand Bay lava flows and agglomerate combined form most of southern half of Great Sitkin Island, in central part of Aleutian Islands.

Sand Bay Volcanics

Tertiary: Southwestern Alaska.

F. S. Simons and D. E. Mathewson, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 4, p. 61–63, pls. 4, 5. Comprise a lower pyroclastic sequence containing a few thin lava flows, designated the Sand Bay agglomerate, and an upper sequence of andesite and basalt flows, designated the Sand Bay lava flows. Overlie Finger Bay volcanics unconformably; older than Great Sitkin volcanics (new). Presumed to be of late Tertiary age.

F. S. Simons and D. E. Mathewson, 1955, U.S. Geol. Survey Bull. 1028–B, p. 28–29, pl. 5. Volcanics comprise a lower pyroclastic sequence consisting of agglomerate and a few thin flows, and an upper sequence composed of andesitic and basaltic lavas. Age not certain. Older than Great Sitkin volcanics, which have been glaciated, and of which at least part are probably of Pleistocene age.

Form most of southern half of Great Sitkin Island in central part of Aleutian Islands. Well exposed in vicinity of Sand Bay.

Sand Beach terrace deposit

Recent: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg, p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703 (fig. 8), 1710, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Sand Beach is proposed for the terrace deposits that is younger than and lies about 20 feet below the Riverview (new); a second bench, designated Sand Beach No. 2, lies about 5 feet lower, or about 10 to 15 feet above water level in Colorado River at Austin. Largely sand and silt.

Named for Sand Beach Reserve along north side of Colorado River at Austin, Travis County.

Sand Branch Member (of Caney Shale)

Mississippian (Chesterian): South-central Oklahoma.

M. K. Elias, 1956, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 65–69, 70 (table 2). Composed of dark-gray to black, finely laminated to flaky, noncalcareous bituminous shale, commonly shattered, with abundant crystals of gypsum; phosphatic concretions locally abundant; gray to dark-gray limestone concretions present along some bedding planes; locally concretions are closely spaced and produce concretionary lentils 10 or more feet thick. Consists of an upper and lower part, but in no area have the two parts been observed together; only lower part exposed at type locality. Higher shale of the Caney, with an upper concretionary lentil, is exposed in banks of Sandy Creek south of Wapanucka (SW¼SW¼ sec. 36, T. 2 S., R. 8 E.); if it should be found desirable to segregate the highest Caney shale in the Arbuckle Mountains as still another member, name Sand Branch would be retained for part exposed northwest of Frisco. Thickness about 130 feet. Overlies Delaware Creek member (new); unconformably underlies Pennsylvanian Rhoda Creek formation (new) at type locality of Rhoda Creek.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 7, 15–16. Type section redesignated. Thickness 172½ feet.

Type section: Beds 4 to 37, measured section B, sec. 14, T. 2 S., R. 7 E., Johnston County. Named derived from Sand Branch, a tributary of Clear Boggy Creek.

Sand Canyon Formation

Pleistocene, upper: Eastern New Mexico.

Sheldon Judson, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 263; 1953, Smithsonian Misc. Colln., v. 121, no. 1, p. 21–22, 24 (fig. 9), 30 (table 2). Reddish to reddish-brown alluvium; alternating beds of sand and clayey-humic material. Thickness 0 to 50 feet. Disconformably underlies Wheatland formation (new); disconformably overlies San Jon formation (new).

Type exposure: Sand Canyon, a dissected depression containing the San Jon site, which is approximately 10 miles south of town of San Jon, Quay County. Occurs in broad channels cut into underlying formations 40 to 50 feet above grade of modern arroyos.

Sand Canyon Member (of Sheep Creek Formation)

Miocene (Hemingford): Northwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 128, 129–131. Name applied to middle member of formation. The whole exposed section (type) which is about 145 feet, is made up largely of fine-grained sand, grayish in lower half and greenish in upper half; about 30 feet above base is a 3- to 4-foot bed of dark-gray volcanic ash. The fine sand below the ash bed has several zones of concretionary type of cementation and contains bones of mammals (this is zone of remains of *Merychippus* and *Pronomotherium*). Basal 10 feet is somewhat stratified by development of interbedded streaks of white fine sandy silt and contains a bed of white marl. The fine sand above the bed of the dark-gray volcanic ash is partially cemented into harder ledges, which approach in appearance the "mortar beds" of the Ogallala. Overlies Spottedtail member (new); underlies Box Butte member.

Type locality: Sand Canyon, 13 miles south and 5 miles west of Hay Springs. Type section is on southwest side of canyon at and around junction of secs. 11, 13, and 14, T. 29 N., R. 47 W., Dawes County.

†Sand Coulee Beds[1]

Eocene, lower: Western Wyoming.

Original reference: W. Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 202–205.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 30, pl. 1. Not clearly separable as member of either Gray Bull or "Bighorn Wasatch." Shown on correlation chart as local fauna, Wasatchian.

Exposed in vicinity of Big Sand Coulee in Clark Fork Basin, Bighorn basin.

Sand Creek Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 89–90. Sand Creek flows were results of glowing avalanches of pumic and scoria that descended southern slope of Mount Mazama through Kerr Notch. Flows emptied into Williamson River near present site of village of Kirk.

Glowing avalanches of pumice were part of final activity of Mount Mazama and followed what is termed main pumice fall.

Sand Creek flows southeastward from Crater Lake.

†Sand Creek Formation[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: C. N. Gould, 1925, Oklahoma Geol. Survey Bull. 35, p. 79.

R. C. Moore, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 105. Essentially synonymous with Admire group.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey.

Named for Sand Creek in north part of Osage County.

†Sand Draw Sandstone Lentil (in White River Formation)

Eocene, upper, or Oligocene, lower: Southwestern Wyoming.

F. B. Van Houten, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–140. Name applied to deposit in stream channel. Most of channel deposit is soft, pale greenish-gray to yellowish-gray tuffaceous sandstone. In upper part of lentil conglomerate lenses a foot thick contain pebbles as much as an inch in diameter. Across width of channel sediments grade upward into facies of Beaver Divide conglomerate member. At margins of channel cross section the upper part of channel fill interfingers with and is conformably overlain by volcanic facies of Beaver Divide conglomerate member. Thickness about 75 feet. Mammalian fossils suggest either Duchesnean or earliest Chadronian (latest Eocene or earliest Oligocene) age.

Name derived from Sand Draw drainage in Long Creek-Beaver Divide area, Fremont County.

Sandel Formation

Oligocene, lower: Western Louisiana.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 102, 103–106. Delaney (1958, unpub. ms.) proposed name Sandel for greenish-yellow or tan fine-grained well-sorted, sometimes crossbedded, silty quartz sand which overlies Mosley Hill formation (restricted) and underlies the Rosefield. Thickness about 15 feet at type locality. As interpreted in this report [Sabine Parish], the Oligocene series consists of basal sand, the Sandel formation, and an upper silty clay, the Nash Creek formation (new). Sandel overlies Mosley Hill, as restricted by Delaney. Roadcuts along U.S. Highway 171, in vicinity of Hodges Gardens have been leveled and sodded in recent highway development program. Delaney's type locality of Sandel including macrofossil bed, and Murray's comparative outcrop for Mosley Hill formation (Nash Creek of this report) have been destroyed. Alternate reference localities for both formations are herein designated.

H. V. Andersen, ed., 1960, Type localities project unit 1: Baton Rouge, La., Soc. Econ. Paleontologists and Mineralogists, Gulf Coast Sec., p. [46–48]. Age given as lower Oligocene.

Type section (Delaney): Series of roadcuts and ditches on east and west sides of U.S. Highway 171 on north inface slope of Catahoula cuesta, 1.1 miles southeast of Sandel, Sabine Parish, in SW¼NE¼ sec. 31, T. 5 N.,

R. 10 W., just north of main gate of A. J. Hodges experimental gardens. Alternate type locality (Andersen): In gully which heads on west side of U.S. Highway 171, 0.3 mile south of entrance to Hodges Gardens (NW¼SE¼ sec. 31, T. 5 N., R. 10 W.).

Sanders Basalt

(?)Tertiary, upper, or Pleistocene(?): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 178, p. 1, 27–28, pl. 3. Grayish-black basalt that contains conspicuous laths of plagioclase separated by microscopic crystals of olivine and augite. Individual flows of lava are thin, ranging from 5 to 50 feet in thickness. Thickness 200 feet. Along southern mesas rests directly on rhyolite tuff beds of Gila (?) conglomerate, but to north overlies Wilder formation (new) or Gila(?) conglomerate. Along eastern margin of Bozarth Mesa, flows of Sanders basalt interfinger with lava flows of Wilder formation.

Covers all the mesas and receives its name from Sanders Mesa in south-central part of Bagdad area, Yavapai County. A crescent-shaped belt extends from Nelson Mesa on east to Black Mesa on west. Caps the extensive mesas far to the west, north, and northeast beyond the mapped area.

Sanders Bridge Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstong, 1932, Texas Univ. Bull. 3224, p. 24.

Type locality: On Boone Creek, 3¼ miles northwest of Booneville, Wise County. Well exposed at Sanders Bridge over Boone Creek, on Booneville-Willowpoint Road.

Sanderson Formation (in New Albany Shale)

Sanderson Member (of New Albany Shale)

Lower Mississippian (Kinderhookian): Southern Indiana, northern Kentucky, and Ohio.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 840 (fig. 3), 847–849, 857, 870. Proposed for division of the New Albany shale between the Blackiston and Underwood or Henryville formations (all new). Thickness 10 feet. Contains two beds, each with layers of phosphatic nodules at top; shale is less hard, less brittle, and less black than the upper Blackiston shale but is so similar that under varying conditions of weathering the two cannot be distinguished on lithology; fossiliferous. Includes Falling Run member (new) at top. Uniform in character from Indiana into Kentucky and from Lake Erie to Tennessee. Southwest of Irvine, Ky., Falling Run member is present and is overlain by the New Providence; from Irvine north through Ohio, the Falling Run is absent and the Sanderson is overlain by Bedford shale.

H. H. Murray and others, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 43, pl. 1. Mississippian part of New Albany has been divided into (ascending) Sanderson, Underwood, and Henryville "formation." Indiana Geological Survey uses these terms with rank of member.

Type section: In northwest angle of intersection of Klerner and Mount Tabor Roads, 1 mile northwest of Sanderson, 2 miles north of New Albany, Floyd County.

Sandersville Limestone Member (of Barnwell Formation)

Eocene, upper: Eastern Georgia.

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 62, 63, 65. Limestone referred by Veatch and Stephenson (1911) to McBean formation and by Cooke and Shearer (1918, U.S. Geol. Survey Prof. Paper 120–C) to upper part of Barnwell is herein named Sandersville limestone member. Thickness probably not more than 40 feet; at type locality 19 feet.

P. E. LaMoreaux, 1946, Georgia Geol. Survey Bull. 50, pt. 1, p. 18. Sandersville limestone member is believed to be equivalent in part to the Irwinton sand member (new) but may represent in part a still younger bed of Jackson age.

Type locality: At a sink west of the Tenmile Road, 0.8 mile south of courthouse at Sandersville, Washington County.

Sandfall Member (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama and northeastern Mississippi.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Consists mainly of noncalcareous to slightly calcareous olive-gray shale, grading upward to calcareous shale and partly oolitic limestone in upper 30 feet; strata becomes increasingly calcareous eastward, grading completely into limestone in Madison County, Ala. Thickness ranges from 86 feet at type locality to about 65 feet on Cane Creek, Colbert County, Ala. Underlies Mynot sandstone member (new); overlies Wagnon member (new).

Named for exposures in cuts along the road up Sandfall Mountain, a northern spur of Pride Mountain, in SE¼ SE¼ sec. 15, T. 4 S., R. 12 W., Colbert County, Ala.

Sand Gap Sandstone (in Slatestone Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology, [folio], p. 6, 19, pls. 2, 3, 4. Includes both massive and thin facies. Thickness near Sand Gap about 100 feet; in Cross Mountain section about 5 feet. Underlies a shale interval 40 to 120 feet thick that in turn underlies Newcomb sandstone (new); overlies a shale interval 40 to 170 feet thick that in turn overlies the Petros sandstone (new).

Named for exposures in Sand Gap, a short distance north of Elk Valley, Pioneer quadrangle, Campbell County.

Sandgrass Andesite[1]

Tertiary: Central Nevada.

Original reference: J. E. Spurr, 1915, Econ. Geology, v. 10, p. 729.

Exposed in Sandgrass mine, Tonopah Extension mine, and other mines in Tonopah district.

Sand Hills Formation[1]

Pleistocene and Recent: Western Nebraska, eastern Colorado, and southern South Dakota.

Original reference: A. L. Lugn, 1934, Nebraska State Mus., v. 1, Bull. 41, p. 321, 322, 326, 331, 350.

D. R. Hill and J. M. Tompkin, 1953, U.S. Geol. Survey Bull. 1001, p. 32–33, pl. 1. Geographically extended into Wray area, Colorado, where it makes

up northwestward-trending ridges north of the Republican River. Consists of well-sorted pale-yellowish-brown unconsolidated sand; unfossiliferous. Estimated maximum thickness 100 feet. Overlies Grand Island formation and in some areas covers Pleistocene and Recent sandy silt. Considered late Pleistocene and Recent. Formation probably in part contemporaneous with the valley fill and the Pleistocene and Recent sandy silt and clay.

S. G. Collins, 1959, Geology of the Martin quadrangle (1:62,500): South Dakota Geol. Survey. Geographically extended into southern South Dakota. Covers most of southern third of Martin area. Consists of fine sands derived from underlying Valentine formation, reworked by Pleistocene and Recent wind action into a succession of consolidated dunes. Individual dunes rise as much as 160 feet above their base, and most are 80 to 120 feet in height. Total maximum thickness of material affected by eolian reworking estimated to be about 200 feet.

The Sand Hills occupy about 20,000 square miles of central and northern Nebraska.

Sand Hills[1] (series)

Cretaceous: New Jersey.

Original reference: W. B. Clark and G. B. Shattuck, 1897, Johns Hopkins Univ. Circ. 128, p. 13–16.

Sandholdt Shale Member (of Monterey Shale)

Sandholdt Shale

Miocene, lower, middle, and upper: West-central California.

R. R. Thorup, 1941, Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as a formation underlying Monterey shale and overlying Vaqueros formation (restricted). Subdivided into three unnamed members. Thickness about 800 feet.

R. R. Thorup, 1943, California Div. Mines Bull, 118, pt. 3, p. 465 (fig. 192), 466. Clay shale with minor amount of interbedded sandstone in lower part. Thickness about 950 feet. Occurs stratigraphically between sandy Vaqueros and overlying porcellaneous and cherty Monterey.

M. N. Bramlette and S. N. Daviess, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim, Map. 24. Described as a shale. Thickness as much as 2,100 feet in Horse Canyon, near Arroyo Seco, Salinas Valley.

U.S. Geological Survey currently classifies the Sandholdt as a member of the Monterey Shale on the basis of a study now in progress.

Type locality: N½ and SE¼ sec. 14, NE¼ sec. 15, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County.

Sandia Clay[1]

Quaternary: Central northern New Mexico.

Original reference: E. D. Cope, 1875, Ann. Rept. Chief Engineer, USA, Rept. Secretary War to 44th Cong., v. 2, pt. 2, p. 997.

In Sandia Mountains.

Sandia Formation (in Magdalena Group)[1]

Lower Pennsylvanian: Central northern New Mexico and southern Colorado.

Original references: C. L. Herrick, 1900, Jour. Geology, v. 8, p. 112–126; Am. Geologist, v. 25, p. 234–237; New Mexico Univ. Bull., v. 2, pt. 3, p. 1–14.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 49–50. In Sandia Mountains, formation, as herein interpreted, corresponds in age to lower part of type section of Armendaris group (new). Fauna in uppermost arenaceous beds corresponds in age almost exactly with fauna in lower part of type section of Elephant Butte formation (new). Thickness about 127 feet.

C. B. Read and D. A. Andrews, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 8; C. B. Read and G. H. Wood, 1947, Jour. Geology, v. 55, no. 3, pt. 3, p. 224 (fig. 1), 228 (fig. 2), 229, 230 (fig. 4), 231 (fig. 5), 233 (fig. 6). Includes lower limestone member and upper clastic member. Underlies Madera formation; overlies Precambrian.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 815. Clastic member of Sandia traced from New Mexico as far north as Huerfano Park, Colo. Thickness about 300 feet in Pecos, Gallinas River, Coyote Creek, and Whiskey Creek Pass sections and probably as much as 700 feet in western Huerfano Park.

A. K. Armstrong, 1955, New Mexico Bur. Mines Mineral Resources Circ. 39, p. 3, 13, 23, 28. In some areas, overlies Arroyo Penasco formation (new) and, in some areas, overlies Log Springs formation (new).

E. H. Baltz, Jr., and G. O. Bachman, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 98 (fig. 2), 99. Lower limestone member considered Devonian(?) and Mississippian; remainder of formation Early Pennsylvanian (Morrow).

D. W. Bolyard, 1956, Rocky Mountain Assoc. Geologists Guidebook to geology of the Raton Basin, Colorado, p. 52–53; 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1904–1910. Name Deer Creek formation proposed for beds called Clastic member of Sandia by Brill (1952).

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754 (fig. 5), 1755 (figs. 6, 7), 1756 (fig. 8), 1765, 1766 (fig. 12), 1767, 1769. In much of Sangre de Cristo region, unconformably overlies Cowles member of Tererro formation (both new). Lower Pennsylvanian.

First described in Sandia, Manzano, and San Andres Mountains, N. Mex.

Sandia quartzites[1]

Middle Carboniferous: New Mexico.

Original reference: C. R. Keyes, 1903, Ores and Metals, v. 12, p. 48.

Sandia Mountains.

†Sandia series[1]

Carboniferous: New Mexico.

Original reference: C. R. Keyes, 1903, Rept. of the Governor of New Mexico to the Secretary of the Interior.

San Diego Formation[1]

Upper Cretaceous: Eastern Puerto Rico.

Original reference: H. A. Meyerhoff, 1931, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 3, p. 289; 1933, Geology of Puerto Rico, p. 44.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2). Thickness about 600 feet. Occurs above Fajardo shale. Upper Cretaceous.

Present in Fajardo district.

San Diego Formation[1]

Pliocene: Southern California.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 337.

L. G. Hertlein and U.S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 63 (fig. 4), 68–71. Described in San Diego quadrangle as soft yellowish and gray sands, occasionally micaceous or marly, fossiliferous; minor amounts of conglomerate. Thickness 1,250 feet. Rests with angular unconformity upon Rose Canyon shale member of the La Jolla, or on Poway formation, or overlaps them and rests with marked unconformity upon Black Mountain volcanics; unconformably underlies Sweitzer formation.

G. B. Cleveland, 1960, California Div. Mines Spec. Rept. 64, p. 7–9, pl. 1. Middle or late Pliocene.

Well developed in immediate environs of city of San Diego.

San Dimas Formation[1]

Pleistocene, upper: Southern California.

Original reference: R. Eckis, 1928, Jour. Geology, v. 36, p. 228, 235–236.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 77, pl. 1. Extensively exposed as remnants of Pleistocene fan deposits along base of San Gabriel Mountains. Unconformably overlies Duarte conglomerate.

Type locality: San Dimas, 5 miles west of Claremont, Los Angeles County.

†Sand Mountain Conglomerate[1]

Pennsylvanian: Northern central Alabama.

Original reference: J. L. Campbell and W. H. Ruffner, 1883, Phys. survey from Atlantic Ga., across Alabama and Mississippi, p. 54–57.

Jefferson and Blount Counties.

Sandoval granite[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des moines, Robert Henderson, State Printer, p. 4, 11.

Magdalena and Sandia Mountains. Derivation of name not given.

Sandpoint Conglomerate[1]

Late Carboniferous(?): Northern Idaho.

Original reference: A. L. Anderson, 1930, Idaho Bur. Mines and Geology Bull. 12.

Occurs in Purcell trench, north of Sandpoint, Bonner County.

†Sand Pond Gneiss[1]

Precambrian: Northern New Jersey.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 439.

Sand Springs Basalt[1] (in Snake River Group)

Pleistocene, upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 80–82, pl. 5. Thickness about 500 feet. Older than Minidoka basalt.

Exposed along borders of Snake River for distance of 32 miles upstream from Sand Springs Creek. Fills a former deep canyon of Snake River from Paul to Sand Springs, Gooding and Jerome Counties.

Sandstorm Rhyolite[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 43.

In Sandstorm mine and hills lying west of road from the mine to Columbia, Esmeralda County.

Sandsuck Formation (in Walden Creek Group)

Sandsuck Shale[1] (in Chilhowee Group)

Precambrian (Ocoee Series): Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, no. 10, p. 626 (table), 629. In Hot Springs Window area, North Carolina, Sandsuck shale is 800 to 1,000 feet thick. Underlies Cochran quartzite; overlies Vann quartzite (new). Chilhowee group. Lower Cambrian. Name substituted for Hiwassee slate of Keith.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 300. In Hot Springs Window, lowest beds exposed in Chilhowee group are soft fine-grained arkose and shale (Sandsuck formation, which has no known counterpart in the Unicoi). Late Precambrian and Lower Cambrian.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 9, p. 627, 629 (fig. 8), 630 (fig. 9), 631 (table 4), 639. Discussion of base of Cambrian in southern Appalachians. Proposed sequence in northeast part of Great Smoky Mountains shows Sandsuck shale, about 4,000 feet thick, at top of Precambrian Ocoee series. Consists of argillaceous shale, with interbedded layers and lenses of limestone and of conglomerate (latter is Citico conglomerate of Keith's early reports). Underlies Cochran conglomerate; overlies Pigeon siltstone.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 23–25. Sandsuck formation is used in this report [Hot Springs Window area] for rocks between Unicoi above and Snowbird below. Keith's use of Hiwassee in Hot Springs area considered inappropriate.

John Rogers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 24–30; pt. 1, pls. As mapped Sandsuck shale is uppermost unit of Ocoee series. Southwest of Pigeon River (especially Sevier County) overlies Pigeon siltstone; northeast of Pigeon River overlies Snowbird formation. Sandsuck as mapped northeast of river corresponds roughly to what Keith (1904) mapped as Hiwassee slate in same area. In present usage, Wilhite slate (Keith, 1895), is considered synonym of Sandsuck shale, but Citico conglomerate (Keith, 1895) may be used as member name for conglomerate beds and lenses within Sandsuck shale, especially south of Miller Cove fault. Hayes (1895) named Starr conglomerate lentil in Sandsuck shale. Because of poor base map on which he had to work, he made error in tracing units from Hiwassee River to Ocoee

River; hence, Starr conglomerate is now considered synonym of Cochran conglomerate and should be abandoned.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962–963. Formation included in Walden Creek group (new). Lies beneath sandstone and conglomerate which Keith (1895) considered to be basal Cochran, but intertongues widely with these coarser rocks. Base of Cochran redefined at higher level, at base of persistent beds of arkose and quartzite, in part maroon; shale, sandstone, and conglomerate beneath is redefined as Sandsuck formation. Best section is not along Sandsuck Branch but on opposite northwest slope of Chilhowee Mountain; there 2,500 feet is exposed, but base is cut off by Great Smoky fault. Formation is lowest unit of sequence on Chilhowee Mountain and occurs in same position on English Mountain farther east; in both places its base is cut off by faults, and it is overlain by Cochran formation of Chilhowee group. These two occurrences are in fault blocks along front of Great Smoky thrust sheet and are not in sequence with main body of Walden Creek group. In section south of English Mountain, about 4,000 feet of beds identified as Sandsuck overlie Wilhite formation; top not preserved.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 37; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Sandsuck shale (formation) mapped in Madison and Yancey Counties. Thickness about 700 feet in Hot Springs area. Ocoee series.

Named for exposures on Sandsuck Branch of Walden Creek, Sevier County, Tenn.

Sandtrap Conglomerate

(?)Pliocene, upper: West-central Arizona.

S. G. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 14 (table 2), 35–38, pls. 1, 2. Largely light-red to dark-red poorly sorted conglomerate with discontinuous bedding. Includes prominent basalt member in northwest part of area (along Sandtrap Wash west of Maggie Canyon). Basalt is dense and partly vesicular. Thickness estimated to range from 300 to possibly 2,000 feet in main part of valley southwest of Artillery Mountains. Rests unconformably upon Cobwebb basalt (new), or, where basalt is absent, upon Chapin Wash formation (new), and extends well beyond limits of both to rest with angular unconformity upon Artillery formation (new) and Precambrian rocks. Referred to upper Pliocene because it is youngest of the three supposedly Pliocene formations in the basin and is separated from other two (Cobwebb and Chapin Wash) by erosional unconformity. Shown on plate 1 as Pliocene(?) and on plate 2 as late Pliocene(?).

Named from Sandtrap Wash, along which it is typically and extensively exposed. Occupies mainly the central part of valley between Artillery and Rawhide Mountains.

Sandusky Limestone[1]

Middle Devonian: Northern and central Ohio.

Original reference: J. S. Newberry, 1873, Ohio Geol. Survey, v. 1, p. 143–144, table opposite p. 89.

Occurs at Sandusky, Erie County, and Delaware, Delaware County.

Sandy Creek Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 85, 137, 141, 149, 154.

Exposed along upper Sandy Creek, Jefferson County.

Sandy Hook Member (of Redbank Formation)

Upper Cretaceous: Eastern New Jersey.

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063. Redbank formation is divided into Shrewsbury and Sandy Hook members.

R. K. Olsson, 1960, Jour. Paleontology, v. 34, no. 1, p. 2, 4 (fig. 2). Consists of clayey micaceous slightly glauconitic quartz sand. Underlies Shewsbury member; overlies Navesink formation.

Occurs in New Jersey Coastal Plain.

Sandy Huff Shale (in New River Group)

Sandy Huff Shale (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 193.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 226–227. Dark-gray and somewhat sandy; as much as 25 feet thick. Compensates for varying thickness of overlying Harvey sandstone and is locally cut out by it. Separated from underlying Guyandot sandstone by Castle coal. Included in New River group, Pottsville series.

Named for exposure at mouth of Sandy Huff Branch, McDowell County.

San Emedio Series[1]

Precambrian(?): Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, pl. 1, map.

Probably named for San Emigdio Mountain in Kern County.

†San Emigdio Formation[1]

Eocene, upper and Oligocene: Southern California.

Original reference: G. C. Gester, 1917, California Acad. Sci. Proc., 4th ser., v. 7, pl. opp. p. 220.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 160, fig. 14. Included in Refugian stage (Oligocene).

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Age shown as upper Eocene and lower Oligocene.

Exposed on east side of San Emigdio Creek, southwestern part of Kern County.

Sanford Formation (in Newark Group)[1]

Upper Triassic: Central North Carolina.

Original reference: M. R. Campbell and K. K. Kimball, 1923, North Carolina Geol. and Econ. Survey Bull. 33, p. 20, 43-45.

J. A. Reinemund, 1955, U.S. Geol. Survey Paper 246, p. 35–39, pl. 1. Formation includes youngest Triassic rocks in Deep River basin. Conform-

ably overlies Cumnock formation in Sanford and Durham basins, but appears to lie unconformably on Pekin formation in Colon cross structure. Thickness 4,000 feet in northeastern part of Sanford basin, southeast of Deep River fault, entire formation is exposed; about 3,000 feet thick northwest of fault. Largely sandstones, claystones, and siltstones; strata are lenticular or laterally gradational; no outcrop gives section that is typical outside a small area.

Named for development around town of Sanford, Lee County. Borders southeast edge of Deep River basin throughout mapped area in a belt that attains a breadth of 10½ miles in eastern part of Sanford basin, narrows to little more than one-half mile in Colon cross structure, and broadens again to a width of 3 or 4 miles in southern part of Durham basin.

Sanford Quartzite

Triassic(?): Eastern California.

G. A. Schroter, 1938, Eng. Mining Jour., v. 139, p. 44. Pure white to cream-colored translucent sugary grained quartzite, locally grading into hornfels. Occurs in Sebrina complex.

Area is on east flank of Sierra Nevada Mountains, southwest of Bishop, Inyo County.

San Francisco Alluvium

Quaternary: Southwestern Utah.

P. J. Barosh, 1960, Utah Geol. and Mineralog. Survey Bull. 68, p. 28, 29. Name applied to alluvium on east-sloping flank of San Francisco Mountains.

Area of report is Beaver County.

†San Francisco Group[1]

Franciscan (Jurassic?) and Tertiary, upper: Western California.

Original reference: J. S. Newberry, 1857, Pacific Railroad Repts., v. 6, pt. 2, p. 10–12.

Forms slopes of the axis lying between San Francisco and the ocean.

†San Francisco Sandstone[1]

Jurassic(?) and Tertiary, upper: Western California.

Original reference: W. P. Blake, 1856, Expl. and Survey for railroad route Mississippi River to Pacific Ocean, v. 5, 33d Cong., 2d sess., S. Ex. Doc. 78, p. 145–156.

Forms greater part of hills and mountains around the San Francisco Bay and, also, a considerable part of mass of Coast Mountains.

San Gabriel Formation[1] or Complex

Precambrian: Southern California.

Original reference: W. J. Miller, 1934, Univ. California at Los Angeles Pub. in Math. and Phys. Sci., v. 1, no. 1, p. 12, 25–65, map.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 465–469, table 4. Referred to as San Gabriel complex. Older Precambrian.

Named for extensive development in San Gabriel Mountains.

Sangamon Interglaciation

Sangamon Interglacial Stage

Sangamon (Sangamonian) Stage, Age

Sangamon stage of deglaciation[1]

Pleistocene: Mississippi Valley.

Original reference: F. Leverett, 1898, Jour. Geology, v. 6, p. 171–181.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, p. 29. Sangamon interglacial stage includes Early Sangamon soil and Late Sangamon loess. Footnote states that deposits herein referred to as Late Sangamon loess have been named Farmdale loess by Leighton who regards the Farmdale loess as pro-Wisconsin (pre-Iowan) rather than Late Sangamon age.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 358–364. Provincial classification of post-Sangamonian time into Scandian, Bradyan, and Almenan subages, proposed for use in Midcontinent region.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 3–4, 11. Revision of time-stratigraphic classification of the Wisconsinan. Names Wisconsin, Sangamon, and Yarmouth stages of previous usage are here changed to adjectival endings Wisconsinan, Sangamonian, and Yarmouthian to make them consistent with form long used for Nebraskan, Aftonian, Kansan, and Illinoian stages. In terms of stratigraphic sequence, Wisconsinan stage includes all deposits above Sangamon soil and below Recent alluvium. Sangamonian stage is followed by Altonian substage (new) of Wisconsinan stage.

Name amended to Sangamon Interglaciation to comply with Stratigraphic Code adopted 1961.

Named for exposures of the soil in Sangamon County, Ill.

San Germán Limestone[1] or Formation

Upper Cretaceous: Puerto Rico.

Original reference: G. J. Mitchell, 1922, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 3, p. 253.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 44, 47, 60 (table 7). In Ponce district, overlies Río Yauco shale and underlies Peñuelas shale. Thickness 1,000 feet.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1 p. 196. In Mayagüez area, San Germán formation includes Cotui limestone member (new) near top. Occurs above Mayagüez group (new); underlies Paleocene limestone and tuffs.

T. R. Slodowski, 1958, Dissert. Abs., v. 18, no. 1, p. 200. In Yauco district, a complex, 9,000 meters thick, of volcanic flows with interbedded marine limestone, mudstones, tuffs, and sedimentary rocks derived from volcanic rocks, is divided into eight formations [sequence not indicated]: Sabana Grande, El Rayo, Ensenada, Río Yauco, Río Loco, Río Blanca, San Germán, and Jicara (new). San Germán and Jicara formations are separated from underlying Ensenada and Río Yauco, at least locally, by unconformities. Age of complex is Senonian to late Paleocene, possibly Eocene.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 340–344, pl. 1. Mitchell (1922) used term San Germán to describe massive limestone herein called Cotui limestone. Slodowski (1956, unpub. thesis [1958, Dissert. Abs., v. 18, no. 1]) used name to refer to massive limestone and associated volcanic rocks and conglomerates. Present report [Mayagüez area] slightly expands the latter usage. The San Germán is a thick sequence of andesitic volcanic rock with interbedded conglomerate and lenses of massive limestone. One flow near base is differentiated as Cabo Rojo agglomerate; massive Cotui limestone member occurs commonly near top of volcanic sequence; locally andesitic volcanic rock, shale, and conglomerate overlies the Cotui. Maximum thickness 600 meters. Overlies Mayagüez group, probably unconformably; conformably underlies Jicara formation. Upper Cretaceous.

Type locality: In hills southwest of San Germán, Ponce district.

San Gorgonio Igneous-Metamorphic Complex

Mesozoic and older: Southern California.

C. R. Allen, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 318–322, pl. 1. Consists of migmatitic gneiss, flaser gneiss, piedmontite-bearing gneiss, and green schist. Complex crops out over most of map area and constitutes a metamorphic terrane of intermediate to basic composition that has been intruded and partially reconstituted by Mesozoic(?) quartz monzonite (the Cactus?).

Occurs in San Gorgonio Pass area, Riverside County.

Sangre de Cristo Formation[1]

Pennsylvanian and Permian: Southern Colorado and northern New Mexico.

Original reference: R. C. Hills, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58, p. 1.

C. B. Read and G. H. Wood, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 223. For continental arkoses and red beds that rest conformably, disconformably, or unconformably on Magdalena group over large areas in New Mexico, several terms have been used. Throughout most of the State, Abo formation is accepted. In Rowe-Mora basin, where indivisible arkose and red shale range in age from Upper Pennsylvanian to Permian, Sangre de Cristo formation is used. Arkosic member of Madera formation grades laterally and vertically into Sangre de Cristo.

K. G. Brill, 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 821–822. In southern Colorado, contact with underlying Madera is obscure; in this region, term Sangre de Cristo is redefined to include the Permo-Pennsylvanian strata that overlie Whiskey Creek Pass limestone member (new) of Madera limestone or its equivalent. Piedmont cyclothems characterize formation; each cyclothem consists of arkosic conglomerate grading upward into finer-grained clastic strata, and, in some, nodular limestone is present at top. Includes Crestone conglomerate near center of Sangre de Cristo Range. Thicknesses: about 500 feet near Pecos; about 2,400 feet east of Mora; about 9,500 feet east of Whiskey Pass; more than 5,500 feet east of Crestone; and about 8,800 feet in Arkansas River valley. Equivalent to Maroon formation, division between the two units placed arbitrarily at Fremont-Park County line. Assumed that formation is mainly Wolfcampian, although it may be late Pennsylvanian.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In northwestern Mora County, N. Mex., intertongues with Madera and inter-

fingers with Yeso formation; where Yeso is absent, directly underlies Glorieta sandstone member of San Andres formation.

E. H. Baltz, Jr., and G. O. Bachman, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 98 (fig. 2), 100–101. Summary article on occurrence of formation in southeastern Sangre de Cristo Mountains, N. Mex. Lower contact generally placed at top of highest marine limestone of underlying Magdalena group (Madera limestone). Underlies Yeso formation. Ranges in age from Middle or Late Pennsylvanian to Early Permian.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1903 (fig. 5), 1904 (fig. 6), 1922–1927. Described in Sangre de Cristo Mountains between La Veta Pass and Westcliffe, Colo. Comprises up to 8,000 feet or more of predominantly fluvial strata; differentiated from underlying units by its redbeds. Two members recognized in northern part of area: lower, characterized by piedmont cyclothems and Crestone conglomerate. In fault contact with Pass Creek sandstone (new); overlies Madera formation and in some areas Minturn formation. Upper Pennsylvanian(?) and Permian (probably Wolfcamp). Type locality designated.

R. B. Johnson and E. H. Baltz, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1895–1902. Sedimentary rocks of Triassic age generally have been thought to be missing from outcrops in Sangre de Cristo formation of Pennsylvanian and Permian age. Two units of probable Triassic age have been separated from top of the Sangre de Cristo formation; one is herein named Johnson Gap formation. The other correlated with Lykins formation and in this report referred to as Lykins(?) formation.

Type locality: Area east of Crestone townsite, on west flank of central anticline between Crestone Needle on south and Eureka Mountain on north, Saguache County, Colo. Here, both members are well developed and structure is least complex. Continuous type section not designated for entire formation because faulting, topography, and inaccessibility make it difficult to measure such a section.

Sangre de Cristo Granite[1]

Precambrian: Colorado.

Original reference: R. D. George, 1913, Colorado Geol. Survey geol. map of Colorado.

Sangre de Cristo Range.

San Gregorio Sandstone Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325–1326. Composed of 150 to 350 feet of lithic arenites. Overlies Pomponio member (new); underlies Lobitos mudstone member (new).

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

San Jacinto Granodiorite

Jurassic or Cretaceous: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 60–61, pl. 1. Varies from quartz diorite to granite. Constitutes main part

of San Jacinto batholith. Massive granitic dikes, presumably of San Jacinto granodiorite cut Bradley granodiorite and Palm Canyon complex (both new). Unit was described (but not named) by Fraser (1931, California Div. Mines Rept. 27).

Occurs west and southwest of Palm Springs, Riverside County.

San Jacinto Series[1]

Pliocene and Pleistocene: Southern California.

Original reference: P. H. Dudley, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 223.

Probably named for San Jacinto, Riverside County.

San Joaquin Formation[1]

Pliocene, upper: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 181.

W. F. Barbat and John Galloway, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 4, p. 476–499. San Joaquin clay described at type section herein designated. Thickness 1,860 feet. Unconformably underlies Tulare formation; overlies Etchegoin sand.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 27–53, pl. 3. Name San Joaquin formation adopted for greater part of apparently nonmarine and marine strata underlying nonmarine Tulare formation; overlies Etchegoin formation. This usage restricts name Etchegoin as used by Arnold and Anderson (1910, U.S. Geol. Survey Bull. 398). Predominantly fine-grained silty sandstone, silt, and clay. Thickness 1,200 to 1,800 feet. Includes Cascajo conglomerate member (new) at base. Faunal zone mapped.

Type section: Sec. 23, T. 22 S., R. 18 E., north dome of Kettleman Hills, Fresno and Kings Counties, San Joaquin Valley.

San Jon Formation

Pleistocene, upper: Eastern New Mexico.

Sheldon Judson, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 263; 1953, Smithsonian Misc. Colln., v. 121, no. 1, p. 18–20, 24 (fig. 9), 30 (table 2). Consists chiefly of dark-blue-gray clay grading laterally into greenish clay and into reddish compact sandy alluvium toward borders of basin. Thickness 0 to 50 feet. Disconformably underlies Sand Canyon formation (new). Rests on nearly horizontal but slightly irregular top of unit referred to as basal sand that unconformably overlies Purgatoire formation. Bones of extinct bison and artifacts found in top of blue clay.

Type exposure: San Jon site, approximately 10 miles south of San Jon, Quay County.

San Jose Formation

Eocene, lower: Northern New Mexico and southern Colorado.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 257–282; no. 6, p. 363–385. Name proposed for the "Wasatch" of authors in San Juan Basin. In this region the San Jose is preceded by hiatus representing late Paleocene time. There was gentle regional uplift and probably stronger folding outside present basin between deposition of Nacimiento and that of San Jose, but strong uplift that now defines eastern margin of basin is post-San Jose. In southern Colorado there was nearly continuous

deposition through the later Paleocene into the Eocene. As a "specific locality at which the unit is typically developed" the badlands exposures along and near continental divide about 1 mile northwest of Regina in sec. 29, T. 22 N., R. 1 W., are designated. These exposures include only one of several distinguishable facies within formation and do not include either highest or lowest beds assigned to it. Characteristically lithology of formation is highly variable, both vertically and horizontally. There is not any one continuous sequence of exposures where full thickness of all major facies of formation are displayed. It is preferable to speak of type region rather than type locality. Type region herein designated. This enlarged type locality includes good development of lithologic facies considered typical of formation and also includes localities where have been found most of early Eocene mammals which constitute typical, but not only, faunas of formation. In type region, and more generally over much of area of formation, three major facies recognized. These intergrade almost imperceptibly in places but are markedly dissimilar in their typical development. In type region are two distinguishable clay facies, corresponding with Granger's (1914) Almagre and Largo beds. These facies contain mammalian faunas also recognizably different in facies. These faunas are all Wasatchian and probably extend over early and middle parts of that age, rather than middle and later parts as commonly supposed. Total thickness as preserved in type region 1,200 to 1,300 feet. Tiffany fauna of southern Colorado, well known to be of late Paleocene age, is in beds not now separated from the San Jose but probably separable and only tentatively assigned to that formation. Discussion of previous nomenclature, especially term Canyon Largo as used by early workers (Newberry, Holmes, and Keyes) and proposed reinstatement of Canyon Largo by Wood and others (1941, Geol. Soc. America Bull., v. 52, no. 1).

Type region: Exposures extending along eastern edge of basin from Yegua Canyon southward about 25 miles to exposed base of formation northwest of Cuba and westward from this front 10 or 15 miles approximately to meridian of settlement of Lindrith. Name derived from San Jose Valley, northwestern Sandoval County, N. Mex. Valley is followed by San Jose Creek, or Arroyo, an intermittent stream rising mainly on west flank of San Pedro Mountain, above settlement of Regina, in T. 23 N., R. 1 W., and running southward from Regina near western border of T. 22 N., R. 1 W., to junction with the Rito de los Pinos and Rio Puerco near town of Cuba in T. 21 N., R. 1 W. Formation extends into southwestern Colorado.

San Juan Breccia or **Formation**

San Juan Tuff[1]

Middle and late Tertiary: Southwestern Colorado.

Original reference: W. Cross, 1896, Colorado Sci. Proc., v. 5, p. 225–228.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 69–75, pl. 1. Composed almost entirely of fragments of dark rocks. Thickness varies because both upper and lower surfaces are irregular surfaces of erosion. Maximum thickness about 3,000 feet, in southern part of Ouray quadrangle. Overlies Telluride conglomerate without apparent unconformity in Telluride quadrangle, but to the east only remnants of Telluride remain and San Juan directly overlies older pre-Tertiary rocks ranging from Precambrian to Cretaceous in age;

in Uncompahgre quadrangle, overlies Lake Fork quartz latite. Underlies flows and tuffs of Silverton volcanic series. Equivalent to West Elk breccia in Anthracite and Crested Butte areas.

F. B. Van Houten, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 383–385. Gunnison (tillite) volcanic conglomerate believed to be a volcanic-rich mudflow and stream deposit that is seemingly a basal part of San Juan tuff.

Confined to northwestern part of San Juan Mountains, chiefly to area of about 50 miles across. Extends west of Telluride quadrangle, is widely distributed in Telluride, Silverton, and Montrose quadrangles. Extends to north of Montrose and Uncompahgre quadrangles into West Elk Mountains.

San Juan Formation[1]

Pleistocene: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 10, 11.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 62–64. In strictest sense, San Juan formation refers to consolidated resistant crossbedded calcarenites of aeolian origin, generally forming ridges of calcareous sandstone elongated parallel to coastline and showing distinctly disconformable relations to the Tertiary. Composed mostly of somewhat rounded grains of shell and coral fragments, along with quartz, bonded together with calcite cement. Formation may be Pliocene, but until further studies are made it is probably best to retain Pleistocene age.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 323 (fig. 2), 348. Pleistocene dune-sand deposit. Caps Ponce formation on Cabo Rojo, in Mayagüez area.

Well developed on site of city of San Juan.

†San Juan Glacial Epoch[1]

Pleistocene: Southwestern Colorado.

Original references: W. W. Atwood and K. F. Mather, 1912, Science, new ser., v. 35, p. 315; 1912, Jour. Geology, v. 20, p. 388; 1912, Geol. Soc. America Bull., v. 23, p. 732.

San Juan Mountains.

San Juan Series[1] or Group

Devonian and Carboniferous: Northwestern Washington.

Original reference: R. D. McLellan, 1924, Am. Jour. Sci., 5th, v. 8, p. 217.

F. T. Etherington, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 191. San Juan group listed on table of formations of western Washington. Argillite, graywacke, schist, and limestone, all metamorphosed by batholithic intrusives. Underlies Nanaimo formation. Jurassic and older.

Named for exposures on San Juan Islands.

San Juan Bautista Formation[1] (in San Lorenzo Group)

Oligocene: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 471, 472, 493, map.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 27, pls. 1, 2, 3. Described in San Juan Bautista quadrangle. Basal formation of San Lorenzo group. Thickness 1,500 to 1,800 feet. Underlies Pinecate formation; overlies granite.

Named for exposures in vicinity of San Juan Bautista, San Benito County.

Sankakuyama Formation

Sankakuyama Liparite

Eocene(?): Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 50, 51]. Liparite is chocolate colored on fresh surfaces and grayish white on weathered surfaces. Feldspar is plagioclase. Lower part is lava, which is almost vertical and forms summit of Sankakuyama; middle part is tuff, extensively exposed on shore opposite Tsukimishima Island. Older than Hagman anesite; relationship not clear because contact of the units not observed.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 39–46, pl 2. chart 2. Formation consists of dacite flows and pyroclastic rocks of several textural varieties. Includes four principal facies of varied relations and known to be repeated in the general succession: Massive dacite flow rocks; vitrophyric and perlitic dacite breccias; dacite tuffs; mixed dacite pyroclastics. Maximum thickness not known, but incomplete section, estimated to be 1,800 feet, is exposed at Mount Achugau; actual thickness probably of order of few thousand feet. Dacite rocks are oldest outcropping rocks on Saipan; disconformably overlain by andesitic tuffs and flows of Hagman formation, by beds of Densinyama formation, and by Matansa limestone, all of which contain Foraminifera and are late Eocene age. Type section designated.

Type section: Succession that begins in cliffs that form northern flank of Mount Achugau, and continues through its south flank. Complete section nowhere exposed. Named for exposures at Sankakuyama (Mount Achugau) north of Densinyama.

Sankaty Beds[1] or Group[1]

Pleistocene: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 975–988.

Occurs on Gardners Island, Marthas Vineyard, and Block Island. Named for Sankaty Head, on Nantucket Island.

Sankaty Sand[1]

Pleistocene: Southeastern Massachusetts, southeastern New York, and southern Rhode Island.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 975–988.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1715, chart 12. Pleistocene (Sangamon). Area given as New England Islands and Cape Cod, Mass.

Named for Sankaty Head on Nantucket Island, Mass.

†Sankaty Head Beds[1]

Pleistocene: Massachusetts.

Original references: J. H. Wilson, 1905, Jour. Geology, v. 13, p. 713–734; 1906, Glacial history of Nantucket and Cape Cod, p. 13–30.

Probably named for Sankaty Head on Nantucket Island, Mass.

Sankoty Sand

Pleistocene (pre-Kansan or Nebraskan): Northeastern Illinois (subsurface).

Leland Horberg, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1204. An extensive fill of sand and gravel up to 300 feet thick within the ancient Mississippi (middle Illinois) bedrock valley.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, pt. 1, p. 29, 30 (fig. 5), 34–36; 1953, Illinois Geol. Survey Rept. Inv. 165, p. 12–18. Defined as lowermost sand and gravel deposit which underlies glacial till or related outwash and overlies bedrock along ancient Mississippi Valley. Typically sand is 70 to 90 percent quartz grains, about 25 percent of which are pink, rounded, and polished. Thickness varies owing to topography on which it was deposited; along axis of bedrock valley thickness may be almost 300 feet; average about 100 feet. Underlies Kansan and possibly Nebraskan drift; rests directly on Paleozoic formations.

Named for Sankoty water field, north of Peoria, where numerous wells penetrate the deposit.

San Lorenzo Formation[1]

San Lorenzo Group

Oligocene: Southern California.

Original reference: R. Arnold, 1906, U.S. Geol. Survey Prof. Paper 47, p. 16.

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 27. Referred to as San Lorenzo group in San Juan Bautista quadrangle. Includes San Juan Bautista and Pinecate formations. Thickness about 1,500 feet. Overlies Santa Lucia quartz diorite; underlies Vaqueros group.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Formation, in La Honda and San Gregorio quadrangles, San Mateo County, includes 1,900 to 3,000 feet of mudstones and sandstones of late Eocene and Oligocene (Refugian and Zemorrian) age. Diabase sills as much as 600 feet thick intrude the lower San Lorenzo and are related to igneous activity which supplied volcanic material in overlying Mindego formation (new).

E. E. Brabb, 1960, Dissert, Abs., v. 21, no. 5, p. 1163. San Lorenzo formation of Eocene and Oligocene age is divided into two members herein named Twobar shale and Rices mudstone. Latter unit is type Oligocene of California, although it probably does not correspond to Oligocene series of Europe. Fossils indicate Twobar is Narizian and Rices is Refugian and Zemorrian. Underlies Butano sandstone of late Eocene (Narizian) age.

Typically exposed along bed of San Lorenzo River about 2 miles above Boulder Creek, Santa Cruz County.

San Lorenzo Quartz Diorite[1]

Age(?): Puerto Rico.

Original reference: C. R. Fettke, 1924, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 153.

†San Lorenzo Series[1]

Oligocene: Southern California.

Original reference: B. L. Clark, 1918, California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

†San Luis Formation[1]

Jurassic(?): Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio 101.

Named for development in San Luis Valley, San Luis Obispo County.

San Marcos Gabbro

San Marcos Mountain Gabbro

Cretaceous: Southern California.

F. S. Miller, 1935, *in* C. S. Hurlburt, Jr., Am. Mineralogist, v. 20, no. 9, p. 609–611. Named San Marcos Mountain gabbro. Medium-grained dark-gray plutonic rock composed essentially of plagioclase feldspar and pyroxene. In the intrusive sequence, San Marcos Mountain gabbro is followed by Bonsall tonalite (new).

F. S. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1398–1408. Described as San Marcos gabbro. Rocks included cover a wide range of composition and texture within the gabbro family. Most abundant rock type is medium-grained dark-gray norite. Derivation of name given.

Richard Merriam, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 224–225, 227, pl. 1. Gabbro and related rocks were described from eastern edge of Ramona quadrangle by Hudson (1922) under name Cuyamaca basic intrusive. Miller (1937) described similar rocks in San Luis Rey quadrangle, where he called them San Marcos gabbro. Mapping in Ramona area, which lies between the two above-mentioned areas, has shown that the two formations are probably the same. The gabbro is here referred to as the San Marcos. Occurs as numerous small bodies scattered among younger and larger tonalite and granodiorite masses and as irregular patches cutting schist and Stonewall rocks [Stonewall formation]. Middle Cretaceous(?).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 485, table 4. Suggested Late Mesozoic plutonic sequence: San Marcos gabbro (and Cuyamaca basic intrusive), Green Valley tonalite, Bonsall tonalite, Lakeview tonalite, Stonewall granodiorite, La Posta quartz diorite, and Rattlesnake granite.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 41–53, pl. 1. Intrudes Bedford Canyon formation (new) and rocks of overlying Santiago Peak volcanics. Older than Green Valley tonalite and Lakeview Mountain tonalite; appears to be oldest rock in Cretaceous(?) batholith. Cretaceous.

Occurs in San Luis Rey, Elsinore, Corona, Ramona, and Santa Ysabel quadrangles. The norite-type gabbro makes up greater part of San Marcos Mountains, San Luis Rey quadrangle, from which name San Marcos gabbro is derived.

San Martine Limestone Member (of Boracho Limestone)

Cretaceous (Comanche Series): Southwestern Texas.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 374 (fig. 2), 383–384. Name proposed for upper member of Boracho limestone. Basal 30 to 40 feet of member consists of nodular to thick-bedded slightly argillaceous, aphanic limestone. Thickness 260 feet. Overlies Levinson limestone member (new); unconformably underlies Buda limestone.

Type section: On northwest face of a hill 1 mile south of San Martine Station on Texas and Pacific Railroad, and 1,500 feet south of the railroad, San Martine quadrangle [Reeves County].

San Mateo Formation[1]

Pliocene(?): Southern California.

Original reference: A. O. Woodford, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 169, 217–219.

Named for occurrence along San Mateo Creek, in northwest corner of San Diego County.

†San Miguel Cherts[1]

Jurassic(?): Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416.

Type locality: Rocks of San Miguel Hill, San Francisco County.

†San Miguel Conglomerate[1]

Eocene: Southwestern Colorado.

Original reference: W. Cross, 1896, Colorado Sci. Soc. Proc., v. 5, p. 235–241.

Typically exposed on north side of San Miguel River, from Marshall Creek westward for several miles.

San Miguel Formation[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull.. v. 3, p. 224–230.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 9. Shown on correlation chart above Upson clay and below Olmos formation. Upper Cretaceous.

Named from abandoned village of San Miguel, near Eagle Pass, Maverick County.

San Onofre Breccia[1]

Miocene, middle: Southern California.

Original reference: A. J. Ellis, 1919, U.S. Geol. Survey Water-Supply Paper 446.

L. E. Redwine and others, 1952, Cenozoic correlation section paralleling north and south margins, western Ventura basin, from Point Conception to Ventura and Channel Island, California: Am. Assoc. Petroleum Geologists, Pacific Section. Shown on stratigraphic column of Santa Cruz Island as about 2,000 feet thick. Underlies Monterey formation; overlies Cozy Dell. However, this breccia may better be designated as a member of Rincon formation.

A. O. Woodford and others, 1954, California Div. Mines Bull. 170, chap. 2, p. 68 (fig. 2), 71, 75 (fig. 5), pl. 1a. Described in Los Angeles Basin. Composed almost exclusively of fragments of glaucophane schist and related rocks of Western bedrock complex (Catalina schist), with numerous blocks 3 to 10 feet in diameter. Interbedded with Monterey shale that contains middle or late Miocene fish scales; overlain by Monterey shale with middle Miocene Foraminifera. Separated from underlying main part of Topanga formation by notable unconformity.

Probably named from fact it forms San Onofre Hills, in San Diego County.

San Pablo Formation

San Pablo phase (of Barbacoas Formation)

Oligocene(?): Panamá.

R. T. Hill, 1898, Harvard Coll. Zoology Bull., v. 28, no. 5, p. 184–185, 206, 236 (table). Brownish rock with fragments of decomposed light-blue eruptive material imbedded in it. Grades upward into Barbacoas formation and is termed San Pablo phase of Barbacoas, Term Panamá formation used to include analogous deposits of Barbacoas, San Pablo, and Miraflores.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 345–346. Listed as formation. Considered informal name. Oligocene(?):

Described near village of San Pablo, west of Barbacoas. Now submerged locality in Canal Zone.

San Pablo Group[1] or Formation[1]

Miocene, upper: Western California.

Original reference: J. C. Merriam, 1898, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 109–118.

B. L. Clark and A. S. Campbell, 1942, Geol. Soc. America Spec. Paper 39, p. 5. In Mount Diablo region, formation rests directly on Kellogg shale (new).

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), pls. In Tesla quadrangle, group comprises (ascending) Cierbo and Neroly formations. Thickness as much as 2,700 feet. Overlies Panoche rocks, angular unconformity; underlies Livermore gravels.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 75–85, pls. San Pablo group, in San Francisco Bay region, comprises (ascending) Briones, Cierbo, and Neroly sandstones.

F. F. Davis and D. W. Carlson, 1952, California Jour. Mines and Geology, v. 48, no. 3, p. 212. Formation, in Merced County, overlies Kreyenhagen formation and underlies Ora Loma formation (new).

C. K. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 6 (fig. 3). In Las Trampas Ridge area, San Pablo group overlies Monterey group and underlies Contra Costa group (new).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 44–46, pl. 2. Described in Ortigalita Peak quadrangle an San Pablo formation consisting of about 400 feet of bentonitic gravel, sand, and clay. Underlies Oro Loma formation; overlies Kreyenhagen formation.

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ-88. Described in Hayward quadrangle as formation consisting of two units:

an upper sequence of poorly consolidated biotitic glauconitic sandstone, clay shale, and pebble conglomerate, and a lower overlapping sequence of biotitic arkosic sandstone with ferruginous nodules. Thickness ranges from 200 feet to as much as 1,700 feet. Overlies Briones sandstone; underlies Orinda formation; contact gradational. For purpose of this report, the Briones sandstone is separated from San Pablo group.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 20–21. In Pleasanton and several others areas of San Francisco Bay region, confusion might be avoided if term San Pablo formation was redefined and used in place of Cierbo and Neroly formations. Need for restudy of San Pablo formation and group arises from fact that in some localities formational boundaries are difficult to recognize because formations have similar lithology. Formational contacts have been drawn chiefly on faunal evidence and with overemphasis on topographic expression of formations of the group. Terms San Pablo group, Cierbo, and Neroly are used with reluctance in this report.

Named for occurrence on San Pablo Bay, Contra Costa County, near town of Rodeo.

San Pedran Epoch[1]

Pleistocene: Southern California.

Original reference: O. H. Hershey, 1902, California Univ. Pub. Dept. Geol. Bull., v. 3, p. 1–29.

San Pedro Group

San Pedro Series

Pliocene: Southeastern Arizona.

G. G. Simpson, 1933, Am. Mus. Nat. History Bull., v. 67, art. 3, p. 109, fig. 2. A Pliocene series between Benson and Tombstone.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Fossiliferous unit of tuffaceous clays in arkosic gravels and conglomerates.

Between Benson and Tombstone, Cochise County.

San Pedro Sand[1] or Formation

Pleistocene, lower: Southern California.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, 1898—first published in 1897 as House Doc. 5, 55th Cong., 2d sess., p. 335.

T. L. Bailey, 1943, Geol. Soc. America Bull., v. 54, no. 10, p. 1557. Described in Santa Barbara County. San Pedro formation, as defined here, is synonymous with Pressler's (1929) Las Posas except that his so-called Kalorama member (near Ventura) which contains a typical Santa Barbara fauna, is retained in the Santa Barbara; it is also approximately equivalent to the combined Hall Canyon and Saugus formations of Eaton (1928). Saugus, Las Posas, and Hall Canyon are abandoned.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 42–53, pls. 1, 13, 14. Described in Palos Verdes Hills area as San Pedro sand. Rests directly on the Miocene or Pliocene or overlies the Lomita marl or Timms Point silt. Maximum exposed thickness about 170 feet. Lower Pleistocene. Type region designated.

California State Water Resources Board, 1953 (revised 1956), California State Water Resources Bull. 12, v. 2, p. B–103–B–104, pls. B–1C, B–2. In Ventura County, includes basal Fox Canyon member (new) and Epworth gravel member (new) near top.

T. L. Bailey, 1954, *in* Pacific Petroleum Geologist, v. 8, no. 9, p. 1. South of South Mountain, lower 200 to 500 feet of San Pedro formation is Fox Canyon member. San Pedro conformably overlies Santa Barbara formation and is between 1,000 to 3,500 feet thick.

J. F. Poland and others, 1956, U.S. Geol. Survey Water-Supply Paper 1109, p. 38 (table), 60–86, pl. 3. Described in Long Beach-Santa Ana area as a formation. Expanded to include Timms Point silt and Lomita marl as basal members. Full stratigraphic sequence underlies unnamed upper Pleistocene deposits and overlies the Pico formation. Thickness as much as 1,350 feet.

J. F. Poland, A. A. Garrett, and Allen Sinnott, 1959, U.S. Geol. Survey Water-Supply Paper 1461, p. 39–57, pls. In this report [Torrance-Santa Monica area], the San Pedro is considered to be essentially correlative with (but much thicker and more heterogeneous) the type San Pedro sand, Timms Point silt, and Lomita marl as defined by Woodring and others (1946). However, it doubtless includes some younger strata and may include some which are older than any exposed in type section. Nonlithologic designation San Pedro formation is preferred to term San Pedro sand. Timms Point silt and Lomita marl are treated as basal members of the formation. As here defined, formation embraces all strata of early Pleistocene age. In most of area, formation occurs between unnamed upper Pleistocene deposits above and Pico formation below. Thickness as much as 1,000 feet.

Type region: Localities along San Pedro waterfront, Los Angeles County.

San Pedro Schist Breccia and Sandstone[1]

Miocene or Pliocene: Southern California.

Original reference: A. O. Woodford, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 7, p. 210–221.

Probably named for San Pedro, Los Angeles County.

†San Pedro Shales[1]

Eocene(?): Western California.

Original reference: R. Crandall, 1907, Am. Philos. Soc. Proc., v. 46, p. 3–58.

Exposed in cliffs north and south of San Pedro Point, San Francisco region.

San Pedro Valley Formation

Pliocene (Blancan) to Pleistocene: Arizona.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 31, pl. 1. Replaces San Pedro as used by Simpson (1933, Am. Mus. Nat. History Bull. 67, p. 109). Term San Pedro preoccupied.

Cochise County.

Sanpete Formation (in Indianola Group)

Upper Cretaceous: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 127, 133 (fig. 17). Distinct unit of sandstone and conglomerate, with minor

amounts of shale, containing fossils of lower Colorado age. Overlies Morrison(?) and underlies Allen Valley shale (new). Where clearly differentiable, it is set apart as Sanpete formation. Consists of brown, ochre, buff, and gray sandstone, gray to ochre shale, mainly sandy, and gray conglomerate. Thickness in Salina Canyon about 1,350 feet. The lower 335 feet of the formation, as here specified, may belong to the Morrison(?).

Named from Sanpete Valley, on east side of which, south of Manti, the rocks of formation are exposed in hogbacks and low ridges. In Salina Canyon, about 4 miles east of Salina, is a complete and well-exposed section. Also exposed in canyon of Lake Fork about 1½ miles southeast of Thistle.

Sanpoil Volcanics

Sanpoil volcanic rocks

Eocene or Oligocene: Northwestern Washington.

Hunting Geophysical Services, Inc., 1960 *in* Washington Div. Mines and Geology Rept. Inv. 20, p. 6. Correspond in part to Umpleby's (1910, Washington Geol. Survey Bull. 1) andesite flows; however, with his flows he included rocks which are here assigned to Klondike Mountain formation (new). Consists of flows and flow breccias ranging in composition from quartz latite to dacite; locally tuffaceous interbeds. Intruded by bodies of Scatter Creek rhyodacite (new). Republic quadrangle and part of Aeneas quadrangle were mapped by Muessig and Quinlan (1959, U.S. Geol. Survey open-file map); Curlew quadrangle mapped by Calkins, Parker, and Disbrow (1959, U.S. Geol. Survey open-file map).

Report discusses parts of Okanogan and Ferry Counties.

San Rafael Group[1]

Middle and Upper Jurassic: Eastern Utah, Arizona, western Colorado, and New Mexico.

Original reference: A. A. Baker and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, p. 787.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1664–1668. Includes Wanakah formation geographically extended into New Mexico and adjacent parts of northeastern Arizona to include Todilto sandstone as member.

C. T. Snyder, 1952, Utah Geol. Soc. Guidebook 7, p. 12. In section from Cedar City, Utah, to Las Vegas, Nev., group includes (ascending) Carmel, Entrada, Curtis, and Winsor formations.

C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 12–14. In Thoreau quadrangle, McKinley and Valencia Counties, San Rafael group comprises (ascending) Entrada sandstone, Todilto limestone, and Thoreau formation (new). Underlies Morrison formation; overlies Glen Canyon group.

F. W. Cater, Jr., 1955, U.S. Geol. Survey Geol. Quad. Map GQ–71. In Davis Mesa quadrangle, Colorado, comprises (ascending) Carmel, Entrada, and Summerville. Overlies Navajo sandstone, Glen Canyon group; underlies Salt Wash sandstone member of Morrison formation. Group crops out in narrow band along canyon walls and on sides of Paradox Valley.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 32–48. At type locality, includes

(ascending) Carmel formation, Entrada sandstone, Curtis formation, and Summerville formation. In area of this report [Navajo country], includes (ascending) Carmel, Entrada, Todilto limestone, Summerville, and Bluff sandstone. Unconformably overlies units of Glen Canyon group; in some areas, Navajo sandstone; and in others, Wingate sandstone (Lukachukai member). In some areas, underlies Morrison formation (Salt Wash or Recapture member); in other areas, underlies Cow Springs sandstone. Middle and Upper Jurassic.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF-221. In Moqui SE quadrangle, Colorado, group comprises (ascending) Entrada sandstone, Summerville formation, and Junction Creek sandstone. Overlies Navajo sandstone; underlies Morrison formation.

Named for exposures in San Rafael Swell, southeastern Utah.

San Ramon Sandstone[1]

Oligocene, upper, or Miocene, lower: Western California.

Original reference: B. L. Clark, 1918, California Univ. Pub., Dept. Geol. Bull., v. 11, p. 54–111.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Upper Oligocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 64–65, pl. 7. Described in Coast Ranges north of San Francisco Bay, where it occurs southeast of Martinez in Carquinez quadrangle and on east side of Carneros Valley in Sonoma quadrangle. In Martinez area, approximately 140 feet thick; disconformably overlies Domengine sandstone and is slightly unconformably beneath Sobrante sandstone. Near Carneros Creek, approximately 300 feet thick; lies in fault contact with the Knoxville and disconformably underlies undifferentiated Monterey shale. Type section is 525 feet thick. Refers to Clark (1918) for derivation of name and type section.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 56–59, pls. Formation in Martinez area is exposed in east and west limbs of Pacheco syncline where it is 130 to 190 feet thick. Overlies Pereira shale member of Alhambra formation (both new); underlies Sobrante sandstone.

U.S. Geological Survey currently designates the age of the San Ramon Sandstone as late Oligocene and early Miocene on the basis of a recent study of marine mollusks.

Type section: Southwest of Walnut Creek, Contra Costa County. Named from San Ramon Creek in Concord quadrangle on west side of Mount Diablo, where it lies in two nearly parallel bands in San Ramon syncline.

San Saba Limestone Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

Frederick Romberg and V. E. Barnes, 1944, Geophysics, v. 9, no. 1, p. 88, fig. 7. San Saba member of Wilberns underlies Pedernales member (new) and overlies Point Peak shale member (new). Name credited to Josiah Bridge and V. E. Barnes.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 117–121, pls. 1, 2. Name San Saba was originally used as a series by Comstock (1890) who applied it either to these

beds or some part of them. Dake and Bridge (1932, Geol. Soc. America Bull., v. 43, p. 729–732) called these beds "Post Wilberns," correlated them with the Fort Sill and Signal Mountain formations, and suggested that Comstock's name San Saba might be revived for a part of them. The name is now applied to entire series of more or less glauconitic limestone overlying Point Peak shale member of Wilberns and underlying Threadgill member of Tanyard formation. Replaced eastward by Pedernales dolomite member. Grades downward into Point Peak shale, boundary being drawn on lithic grounds and not at definite stratigraphic horizon. In areas where stromatolitic bioherms do not occur, San Saba-Point Peak boundary is top of highest significant shale; where bioherms occur, selection of boundary commonly depends on lateral tracing and consensus of varied factors. In type section, the zone of stromatolitic bioherms formerly included in San Saba are now considered to be in Point Peak. Top boundary is Cambrian-Ordovician contact in western part of Llano uplift and contact with Pedernales dolomite member elsewhere. Thickness at type section about 280 feet.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 145, 156, 188, 193, 226, 255, pls. [1946]. Type section and local stratigraphy described in detail.

Type section: Along both sides of Mason-Brady Highway, beginning at bridge across San Saba River and extending northward for 0.7 mile, McCulloch County. Here it is in collapse contact with Threadgill member of Tanyard.

San Saba Series[1]

Upper Cambrian(?) and Lower Ordovician: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxii, 301–306, pl. 3.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v: 58, no. 1, p. 117. Name San Saba was originally used as series term by Comstock who applied it either to beds here termed San Saba limestone member of Wilberns formation or to some part of them.

Named for San Saba County and San Saba River valley.

San Sebastián Formation (in Río Guatemala Group)

San Sebastián Shale[1]

Oligocene: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 10, 17.

A. D. Zapp, H. R. Bergquist, and C. R. Thomas, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85. San Sebastián formation, Lares limestone, and Cibao marl (sequence ascending) are facies equivalents that show rapid lateral transition; term Río Guatemala group is introduced for this sedimentary complex. Names are retained to designate predominantly clastic facies, predominantly reef-type limestone, and predominantly marl and chalky limestone respectively. Formation changes upward from predominantly gravel in lower part to predominantly shale, locally interbedded and interfingered with marl and limestone at top. Maximum thickness about 300 meters in vicinity of the Río Guatemala northwest of San Sebastián. About 4 kilometers east of San Sebastián, outcrops of approximately 200 meters of basal part of formation end against a salient of Cretaceous rocks; the upper 80 to 110

meters of the sequence overlap salient and continue in outcrop eastward, finally disappearing against another promontory of Cretaceous rock a short distance east of the Rio Tanama. Farther east, thickness of sediments referred to San Sebastián increases steadily into eastern clastic basin; this increase in thickness is largely at expense of Lares limestone.

K. N. Sachs, Jr., 1959, Bulls. Am. Paleontology, v. 39, no. 183, p. 399–416. Upper Oligocene; age determination made on basis of foraminifera.

Principal outcrop area extends from the Quebrada Collazo (4 kilometers east of San Sebastián), northwestward to within 4 kilometers of Aguadilla, where outcrops disappear under alluvium of Río Culebrinas Valley.

San Simon limestone[1]

Mississippian: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52.

Derivation of name not stated.

Santa Ana[1] [metamorphic rocks]

See Santa Ana Formation (California).

Santa Ana Formation

Santa Ana Limestone[1]

Upper(?) Triassic: Southern California.

Original reference: J. P. Smith, 1898, Jour. Geology, v. 6, p. 779, 780.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 19. Replaced by Bedford Canyon formation.

Rene Engel, 1959, California Div. Mines Bull. 146, p. 16–25, pl. 1. In Elsinore quadrangle, metamorphic rocks consist of rocks of undoubted sedimentary origin, correlative with Santa Ana formation of Upper(?) Triassic age, including Bedford Canyon formation (Larsen, 1948), and rocks of igneous origin, extrusive and hypabyssal, including Santiago Peak volcanics (Larsen, 1948). Rocks to which name Santa Ana formation is applied form a band, 2 to 3 miles wide, that traverses northern part of area from Railroad Canyon westward to Clevelin Hills, northwest of Elsinore. Band disappears under alluvium at end of Lake Elsinore but is exposed without interruption from point near Leach Canyon westward toward Los Pinos Peak and Trabuco Canyon. Same band extends westward for about 3 miles into Corona quadrangle where it joins main mass of Triassic rocks in Santa Ana Mountains. North of this band, formation is exposed in a few scattered areas. To the south, a few isolated masses of the formation are enclosed by granodiorite; to the southeast in Santa Rosa region, a few patches of older sedimentary rocks are associated with undifferentiated metamorphic rocks. To the southwest, a band of these sedimentary metamorphic rocks extends northwest from Tenaja Canyon to San Juan Canyon. In the quadrangle, these rocks occupy an area of about 64 square miles. The Triassic rocks were intruded by diorite, andesite, dacite porphyry, or quartz latite porphyry, in the northern part of area, and by quartz diorite and granodiorite. Greatest thickness of undisturbed Triassic sediments measured northeast of Lake Elsinore, between North Elsinore fault and north end of Railroad Canyon where unfaulted beds that dip 50° NE. exceed 28,000 feet in thickness; about 6,000 feet of this extends beyond mapped area; entire Triassic section could not be measured be-

cause it extends beneath alluvium of San Jacinto River flood plain. Thickness of formation on west limb of Los Pinos syncline, 19,000 feet or more; on east limb of syncline, 8,600 feet. Smith (1898) used name Santa Ana limestone for the hard black siliceous limestone exposed on west slope of Santa Ana Mountain. Merrill (1915 [1914? or 1916?] California Mining Bur. Rept. 14) used term in broader sense to designate metamorphic rocks of Santa Ana Mountains, including the limestone. Moore (1930, unpub. thesis) used name "Silverado formation" to designate most Triassic rocks of southwest slope of Santa Ana Mountains. These rocks have been correlated with the metamorphosed sediments exposed in Elsinore quadrangle, and name "Silverado formation" conflicts with older name Santa Ana formation. Name "Elsinore formation" proposed by Dudley (1935) for metamorphic rocks in Railroad Canyon is not considered applicable in area of this report. Hence, it is proposed to continue earlier name Santa Ana formation to designate the Upper(?) Triassic metasedimentary rocks.

Named for occurrences on west slope of Santa Ana Mountains, Orange County.

Santa Ana Formation

Upper Cretaceous (Santonian): Puerto Rico.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayaguez, Puerto Rico, 1959, Trans., p. 83. Consists of 30,000 feet (maximum) of volcanic conglomerates, thin-bedded tuffaceous siltstones, thin-bedded argillaceous limestones, and massive argillaceous limestones. Underlies and interfingers with Toa Vaca formation (new). Footnote states that name Santa Ana no longer used; unit currently called Idlefonso [Ildefonso].

In Ponce-Coamo area.

Santa Ana Lens (in Ildefonso Formation)

Upper Cretaceous: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 34. Massive limestone lens in lower or middle part of formation.

Named for Cerro Santa Ana located 0.5 kilometer north of Río Cuyon and 3 kilometers northeast of Coamo.

Santa Ana Sandstone[1]

Probably Pliocene, upper, or Quaternary, lower: Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 378–379, map.

Named for Santa Ana River, San Bernardino County, along which it is exposed.

Santa Anna Shale Member (of Moran Formation)[1]

Permian (Wolfcamp Series): Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 419.

R. C. Moore, 1948, *in* M. G. Cheney, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets, 3, 4; R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Underlies Sedwick limestone member; overlies Gouldbusk limestone member (new).

Named for exposures in buttes at Santa Anna, Coleman County, and at various points north of town.

Santa Anna Branch Shale Member (of Putnam Formation)[1]

Santa Anna Branch Formation (in Putnam Group)

Permian (Wolfcamp Series): Central and central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 420.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Putnam group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as shale member of Putnam formation where it is about 120 feet thick and consists chiefly of variegated red and gray or light-brown shale; includes fairly prominent, persistent sandstone in upper part and a thin limestone near middle. Underlies Coleman Junction limestone member; overlies Sedwick limestone member of Moran formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 271, pls. 11, 12. Geographically extended into Brazos River valley where it is basal member of Putnam formation. Thickness 75 to 205 feet. Underlies Coleman Junction limestone member.

Probably named for exposures along Santa Anna Branch, Coleman County.

Santa Barbara Formation

Santa Barbara Beds or Marls[1]

Pleistocene, lower: Southern California.

Original reference: J. P. Smith, 1912, California Acad. Sci. Proc., 4th ser., v. 3, p. 161–182.

W. P. Woodring, Ralph Stewart, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 110–111. Name Santa Barbara formation applied to the marine formation exposed in the southwestern part of Santa Barbara and near Rincon Point. At Rincon Point, lies unconformably on vertical beds of Miocene shale. Lower Pleistocene.

J. E. Upson, 1951, U.S. Geol. Survey Water-Supply Paper 1108, p. 18–21, pl. 2. As used in this report, comprises marine sand, silt, and clay; total maximum thickness about 2,000 feet. Underlies alluvium and terrace deposits; unconformably overlies older rocks that range from Monterey shale at least down through the Sespe. In Carpenteria basin, underlies Casitas formation (new).

Type locality: On Santa Barbara "mesa" at Rincon Point near Santa Barbara-Ventura County line.

Santa Catalina Formation[1]

Middle Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 476, 477, 480, 482.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 110. Consists of mudstone near base, calcareous mudstone in middle, and sandstone near top. Thickness 300 feet. Overlies Troy quartzite; underlies Southern Belle quartzite.

Type locality: Peppersauce Canyon on north side of Santa Catalina Mountains.

Santa Catalina Gneiss[1]

Precambrian: Southern and central Arizona.

Original reference: W. P. Blake, 1908, Science, new ser., v. 28, p. 379–380.

Well developed on south side of Santa Catalina Mountains near Tucson.

Santa Clara Basalt

Quaternary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Named as seventh (and youngest) in a series of Quaternary formations in area. Santa Clara basalt and Bandelier rhyolite (new) tuff locally overlie Puye formation (new).

Occurs in Abiquiu quadrangle, Rio Arriba County.

Santa Clara Complex

Precambrian: Northern New York.

A. F. Buddington, 1937, New York State Mus. Bull. 309, p. 8, 9, 29–34, 37–38, 42–45; 1939, Geol. Soc. America Mem. 7, p. 111–116. Proposed for a group of igneous rocks which crop out over much of Santa Clara quadrangle and which appear to be genetically related; comprises: medium-grained pyroxene-hornblende quartz syenite interpreted as border chill facies; pyroxene quartzose syenite with coarse lenticular structure; hornblende and biotite granite with coarse lenticular stucture; latter two members form core of complex. Along the northwest border, the pyroxene-hornblende quartz syenite is intrusive into gabbro; here, St. Regis granite (new) appears to cut at a slight angle across banding of the quartz syenite and in Nicholville quadrangle is directly adjacent to the hornblende granite; granite pegmatite veins thought to be related to St. Regis granite occur in the quartz syenite.

Complex extends northwest from Santa Clara quadrangle into Loon Lake quadrangle and southwest across Nicholville area.

Santa Clara Formation[1]

Pliocene and Pleistocene: Western California.

Original reference: J. G. Cooper, 1894, California Acad. Sci. Proc., 2d ser., v. 4, p. 171.

C. F. Tolman, and J. F. Poland, 1940, Am. Geophys. Union Trans., no. 21, pt. 1, p. 25, 26–27. Further described in Santa Clara County. Consists of silt-cemented conglomerate, fine silt-cemented sandstone, siltstone, and claystone; evenly and well bedded near base. Near Murphy Dam site on Stevens Creek where formation is folded, exposed thickness is about 2,000 feet. Overlies Purisima formation; underlies alluvium. Crops out in foothills west of the valley from Palo Alto on north to Los Gatos on south.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 43–44, pls. 1–2. Described in San Jose-Mount Hamilton area as unconsolidated clay, siltstone, and pebbly sandstone; poorly sorted; obscurely bedded. No diagnostic evidence of age found in area. Considered younger than Packwood gravels (new).

H. C. Langerfeldt and L. W. Vigrass, 1959, *in* U.S. Congress, Joint Committee on Atomic Energy, Subcommittee on Research and Development, and Subcommittee on Legislation, Stanford Linear Electron Accelerator, Hearings: U.S. 86th Cong., 1st sess., App. D, p. 621. In Santa Clara

and San Mateo Counties, Santa Clara formation overlaps Searsville and Los Trancos formations (both new).

Appears to have been named for its extensive development in Santa Clara County.

Santa Claran Epoch[1]

Pleistocene: California.

Original reference: O. H. Hershey, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, p. 1–29.

Area of Santa Clara River valley of the South.

Santa Cruz Group

Upper Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937 (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Thin-bedded shaly limestone. Older than Sonoita group (new); younger than Patagonia group (new).

Santa Cruz Island Formation[1]

Pleistocene: Southern California.

Original reference: R. W. Chaney and H. L. Mason, 1934, Carnegie Inst. Washington Pub. 415, p. 4–6, 48 [preprint 1930].

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1118. Locally Santa Rosa formation (new) because of its location on lowest terrace, its lithology, and its fauna, is probably equivalent, in part at least, to Santa Cruz Island formation (Chaney and Mason, 1934).

Occurs on Santa Cruz Island.

Santa Emigdeo Formation

Probably lapsus for San Emigdio Formation.

Santa Fe Formation[1] or Group

Miocene, middle(?) to Pleistocene(?): Northern New Mexico and central southern Colorado.

Original reference: F. V. Hayden, 1869, U.S. Geol. and Geog. Survey Terr. 3d Ann. Rept., p. 66, 90.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Formation overlies Abiquiu tuff (new).

H. T. U. Smith, 1938, Jour. Geology, v. 46, no. 7, p. 952–957. Formation described in Abiquiu quadrangle, New Mexico. Thickest and most typical exposures are in western slopes of Black Mesa. Here thickness is 990 feet. Base of exposed section lies undetermined distance (probably several hundred feet) above base of formation, and an unknown thickness has been eroded from top of section. Formation consists of alluvial deposits with some interbedded basalt flows. Where formation overlies Abiquiu tuff, there is a gradational transition extending over vertical range of from 100 to 300 feet.

C. S. Denny, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1877. Note on type area.

C. S. Denny, 1940, Jour. Geology, v. 48, no. 1, p. 78–79 (fig. 1), 82 (fig. 3), 84–99. Formation in San Acacia area, New Mexico, overlies Popotosa formation (new). Total thickness undetermined; structure section (fig. 3) assumes thickness of about 6,000 feet just east of Loma Pelada fault. Fossils suggest middle to upper Pliocene.

C. E. Stearns, 1943, Jour. Geology, v. 51, no. 5, p. 304 (fig. 2), 316–317. Formation unconformably overlies Espinaso volcanics (new). Along base of Sangre de Cristo Mountains, Sante Fe formation unconformably overlies Precambrian granite gneiss. At north end of Sandia Mountains, formation overlies the Mesaverde with angular unconformity. Map legend shows Santa Fe formation below Cuerbio basalt (new).

E. H. Baltz and others, 1952, New Mexico Geol. Soc. Guidebook 3d Field Conf., p. 12. Surface of Santa Fe Plateau is underlain by strata of late Tertiary or Quaternary age which have been called upper beds of Santa Fe formation, or more recently, the "Ancha formation" by Baldwin, Kottlowski, and Spiegel.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 144. Proposed that Santa Fe formation be raised to group status.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 10, 11–13, 17 (table 1), 36, 37, pl. 1. Santa Fe fanglomerates in Dwyer quadrangle are postvolcanic except for minor interbedded basalts. Name Gila formation may be as applicable to rocks of Dwyer quadrangle as name Santa Fe. Term Santa Fe is used in this report to include all consolidated valley-fill sediments younger than units grouped under informal term of Upper Volcanic series. In northern part of the quadrangle, formation is confined to eastern side of Mimbres fault, but, east and southeast of mouth of Tom Brown Canyon, it covers Mimbres fault zone and all other major structures. Thickness of fanglomerates may be as much as 1,000 feet. Overlies Swartz rhyolite (new) with angular unconformity. Stratigraphically above Pollack rhyolite (new).

A. E. Disbrow and W. C. Stoll, 1957, New Mexico Bur. Mines Mineral Resources Bull. 48, p. 5 (table 1), 26–29, pl. 1. Referred to as Santa Fe group in Cerrillos area. Near city of Santa Fe, strata originally placed in Santa Fe formation have been subdivided into three map units which comprise Santa Fe group. They are (ascending) Tesuque formation (with Bishops Lodge member) and Ancha formation. Terminology has been modified in Cerrillos area, where only strata similar to basal and upper units of group are found. Tuffaceous strata similar to Bishops Lodge member are placed in Abiquiu(?) formation. Name Ancha is used in both areas. Table 1 shows Santa Fe group younger than Cieneguilla limburgite and older than Cuerbio basalt. Age of group middle Miocene(?) to early Pleistocene(?).

D. B. Givens, 1958, New Mexico Bur. Mines Mineral Resources Bull. 58, p. 18–20. Discussion of geology of Dog Springs quadrangle. Santa Fe formation consists of gravels and basalts. Summits of D Cross, Tres Hermanos, Table Mountain, and Blue Mesas are capped with basalt which is considered to be part of Santa Fe formation. The basalt truncates Mesaverde group, Baca formation, and Spears Ranch member of Datil formation. Old channels filled with Santa Fe gravel are present under basalt on Tres Hermanos Mesa and on Table Mountain Mesa. Lens of Santa Fe gravel present within basalt of Tres Hermanos Mesa. Age of formation and basalt not definitely known. Believed to be Pliocene-Pleistocene. Santa Fe beds in other parts of State may or may not be age equivalents of Santa Fe beds in area of this report.

W. J. Powell, 1958, U.S. Geol. Survey Water-Supply Paper 1379, p. 18–19. Discussion of ground-water resources of San Luis Valley, Colo. Several outcrops of formation occur in valley, but they are small and do not fully reveal character of formation. Most reliable data are logs of

artesian wells and deep oil tests. Thickness may be more than 5,000 feet. Underlies Alamosa formation. In this report, formation is considered to be largely of Pliocene age but in part of Miocene age.

A. J. Budding, C. W. Pitrat, and C. T. Smith, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 83, 84. In Chama basin, formation includes Abiquiu tuff member.

Type area (Denny): Region north of Santa Fe, N. Mex., between Sangre de Cristo and Jamez Mountains.

Santa Fe Granite[1]

Precambrian(?): Central northern Colorado.

Original reference: H. B. Patton, 1909, Colorado Geol. Survey 1st Rept., p. 126–128, map.

Forms highest point of Santa Fe Peak in Clear Creek, Summit, and Park Counties.

Santa Isabel Series[1]

Recent: Puerto Rico.

Original reference: E. T. Hodge, 1920, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, pt. 2, p. 166.

J. D. Weaver *in* R. Hoffstetter and others, 1956, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 344. Name given to recent alluvial deposits in south-central Puerto Rico. Term not employed since, and does not appear to have any stratigraphical value.

Santa Lucia Granite[1] or Quartz Diorite[1]

Santa Lucia Granodiorite

Pre-Cretaceous or Upper Cretaceous: Southern California.

Original reference: A. C. Lawson, 1893, California Univ. Pub. Dept. Geol. Bull., v. 1, p. 6, 9–18, pl. 1.

Philip Andrews, 1936, California Univ. Pubs. Dept. Geol. Sci. Bull., v. 24, no. 1, p. 7–9, geol. map. Term Santa Lucia is applied to granitic rocks of Gavilan [Gabilan] Range, since they are considered to be generally related to the granites of Santa Lucia Range. Pre-Franciscan.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 118. Several names have been given to the ancient crystalline complex in San Francisco Bay Counties. Originally it was called Santa Lucia series, a name applied to the crystalline complex as a whole. Later, name Sur schists was given to the metamorphosed sedimentary and volcanic rocks, and name Santa Lucia was retained for the plutonic rocks. It has become customary to call all schist the Sur series, all crystalline limestones, marbles, and dolomites, Gabilan limestone, and all plutonic rocks the Santa Lucia granodiorite. These names are essentially petrographic and not formational in usual sense since rocks of very different ages might be included under any one of the names.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 9. Potassium-argon age determinations on some granitic rocks given. Sample of Santa Lucia granodiorite gave age 81.6 million years. Dated specimen was collected by Lawson from quarry at Carmel Cove on Carmel Bay.

Forms main ridge of Santa Lucia Range.

Santa Lucia Series[1]

Pre-Franciscan (possibly Precambrian): Southern California.

Original reference: B. Willis, 1900, Sicence, new ser., v. 11, p. 221.

Occurs in Santa Lucia Range, Monterey and San Luis Obispo Counties, and Fremont's Peak of Gavilan Range, San Benito County.

Santa Margarita Granodiorite

[Cretaceous]: Southern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 10. Discussed in report dealing with potassium-argon age determinations. Age given as 84.1 million years.

Dated specimen collected from outcrop in bottom of creek one-fourth mile north of McKittrick 3.6 miles east of Santa Margarita, sec. 10, T. 29 S., R. 13 E., MD. Approximately 100 square miles of intrusive rocks are exposed east of Santa Margarita. Oldest unmetamorphosed sedimentary rocks lying nonconformably on the mass are Upper Cretaceous in age.

Santa Margarita Sandstone[1] or Formation

Miocene, upper: Southern California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio 101.

R. R. Simonson and M. L. Krueger, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1611 (fig. 2), 1617–1620. Term Santa Margarita, as used in this report [Crocker Flat landslide area], applies (1) to the punky diatomaceous shales and conglomerates above Antelope shale member of Monterey formation and below Etchegoin (Pliocene) formation, on northeast side of Temblor Range, and (2) to the extremely coarse clastics, conglomerates, sands, and shales containing upper Miocene macrofossils, in summit area and on southwest flank of the range. Term is used with reluctance in this area because uppermost Miocene beds are only in part similar lithologically to type Santa Margarita; also, it is believed that upper part of interval is younger than type section. Thickness about 2,700 feet on northeast side of Temblor Range; about 4,000 feet on southwest side of Range. In Recruit Pass area, unconformably underlies Tulare formation. Upper Miocene.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 222–240. Formation, in San Benito quadrangle, consists chiefly of fossiliferous grayish calcareous sandstone, containing "reef" beds and pebbly conglomeratic layers, and occasional interbedded clay-shales. Maximum thickness more than 2,000 feet. Exposed only in narrow belt along southwest flank of San Benito River in southern part of quadrangle. This belt dips uniformly to west below Etchegoin group; on the east side, the Santa Margarita is in fault contact with Etchegoin along Pine Rock fault, and base is nowhere exposed. To the southeast in Priest Valley quadrangle, Santa Margarita rests unconformably on the Franciscan. Upper Miocene.

M. N. Bramlette and S. N. Daviess, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 24. In southeast part of Salinas Valley, including type area, Santa Margarita sandstone is of upper Miocene age and extends down to about top of middle Miocene. Base of formation is of progressively later age northwestward, so that west of San Ardo and San Lucas it appears to be of lower Pliocene age.

J. E. Kilkenny, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 12, p. 2259–2260. In Salinas Valley, unconformably overlies Monterey shales;

underlies McLure formation in Northeast fault block; underlies Poncho Rico formation in Central block. Maximum thickness 2,500 feet, east of Salinas River, in Cholame Hills; some of this may be sandy phase of Monterey shales. Upper Miocene (Neroly stage of Clark; Delmontian and part of Mohnian stage of Kleinpell). King City formation is included in uppermost part of Santa Margarita.

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 35–37, pl. 3. In Quatal Canyon, Ventura County, includes Quatal red clay (new) member.

T. W. Dibblee, Jr., 1951, Soc. Econ. Paleontologists and Mineralogists [Guidebook] Pacific Sec., Stop 2, p. 1–2. In Salisbury Canyon, overlies Bitter Creek formation (new).

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2874 (fig. 1), 2978 (fig. 3), 2995–2996. Discussion of Cuyama Valley-Caliente Range area. In Morales Canyon (T. 11 N., R. 8 W.), Santa Margarita sandstone is about 1,000 feet thick and consists of fine- to coarse-grained locally pebbly, granitic white sandstone in gradational contact with underlying Monterey formation. Unconformably overlain by Morales formation. Accordant contact with underlying Branch Canyon sandstone (new). Upper part of sandstone contains at least two calcareous reefs of *Ostrea titan*. This littoral Santa Margarita sandstone unit was mapped as *Ostrea titan* zone of Monterey by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2). Northwestward from Morales Canyon, the Santa Margarita extends along northeast flank of La Panza Range and is traceable into Santa Margarita formation as mapped by Bramlette and Daviess. On northeast flank of Caliente Range, the equivalent of the Santa Margarita is Quatal formation. On southside of Cuyama Valley, formation is exposed from Bitter Creek eastward to Salisbury Canyon. At Branch Canyon (sec. 1, T. 9 N., R. 27 W.), it was mapped as Neroly by Eaton and others. Assigned to upper Miocene (Mohnian and (or) Delmontian).

Named for exposures at Santa Margarita, San Luis Obispo County.

†Santa Maria Formation[1]

Pliocene and Pleistocene: Southern California.

Original reference: C. M. Carson, 1925, Pan-Am. Geologist, v. 43, p. 265–270.

In Santa Maria district, Santa Barbara County.

Santa Monica Slate[1]

Triassic(?) and Jurassic: Southern California.

Original reference: H. W. Hoots, 1931, U.S. Geol. Survey Prof. Paper 165–C, p. 88–89.

Cordell Durrell, 1954, California Div. Mines Bull. 170, map sheet 8. Consists of metamorphosed black shale and graywacke of unknown thickness. Crops out only in eastern part of Santa Monica Mountains. Triassic(?).

U.S. Geological Survey currently designates the age of the Santa Monica Slate as Triassic(?) and Jurassic on the basis of a study now in progress.

Named for occurrence in Santa Monica Mountains, Los Angeles County.

Santa Paula Formation[1]

Miocene(?) and Pliocene, lower: Southern California.

Original references: J. E. Eaton, 1926, Oil and Gas Jour., p. 72; 1926, Oil Age, p. 16.

Well exposed on great monocline, northwest of Santa Paula, Ventura County.

Santa Rita Granodiorite Porphyry

Upper Cretaceous or later: Southwestern New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 288–289, 302, fig. 3, pl. 1. A single intrusive mass of biotite granodiorite porphyry. Groundmass of equigranular, interlocking grains of quartz and slightly sericitized orthoclase. Lustrous, striated green-gray feldspar phenocrysts common; occasional phenocrysts of hornblende and quartz.

Rounded body about 1 mile across best exposed in copper pits of Santa Rita copper mine, in southeastern corner of Santa Rita quadrangle, about 12 miles east of Silver City, Grant County.

Santa Rita Limestone[1]

Silurian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-Monthly Bull. 19, p. 7–21.

Type locality: Santa Rita, Grant County.

Santa Rita Limestone[1]

Middle(?) Devonian: Southeastern Arizona.

Original reference: C. R. Stauffer, 1927, Geol. Soc. America Bull., v. 38, p. 133.

In Santa Rita Mountains region.

Santa Ritan series[1]

Silurian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engrs. Bi-Monthly Bull. 19, p. 7–21.

Probably named from Santa Rita, Grant County.

Santa Rosa Basalt

Pliocene(?): Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 9–10, pl. 1. Name applied to olivine basalt flows that rest on a nearly horizontal surface that consists partly of Paleocene(?) sediments and partly of basement rocks. Thickness varies; in Temecula region, usually only a few tens of feet; may be as much as 100 feet.

Occurs on Hogback, Vail Mountain, and Mesa de Burro, Temecula region, Riverside County.

Santa Rosa Beds

Eocene(?): Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 47, table 4 [English translation in library of U.S. Geol. Survey, p. 57]; S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 56–57. Consist of alternate strata of tuff, shale, and marl, with 1 or 2 layers of limestone; characteristically green. Strata dip at high angles. Discordantly (unconformably) overlie Umatac andesite.

Typically exposed on Mount Santa Rosa, Mount Chachao, and Mount Tenjo, Guam.

Santa Rosa Sandstone (in Dockum Group)[1]

Upper Triassic: Northeastern New Mexico.

Original reference: D. Hager and A. E. Robitaille, 1919, Geol. Rept. on oil possibilities in eastern New Mexico, corr. table.

W. B. Lang, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1674. In Pecos Valley, Santa Rosa sandstone grades into Pierce Canyon redbeds; the two units are in part contemporaneous. Upper(?) Triassic.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 23–24. In Eddy County, overlies Pierce Canyon redbeds and redbeds that possibly represent Chinle formation. Thickness 200 to 300 feet.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. Described in northwestern Mora County where it is 425 feet thick and consists mainly of brownish-red shale and sandstone. Underlies Chinle formation; overlies Bernal formation (new). Upper Triassic.

Well exposed at Santa Rosa and Puerto de Luna, Guadalupe County, and along canyon of Pecos for many miles.

Santa Rosa Island Formation

Pleistocene, upper: Santa Rosa Island, California.

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1113–1119. Proposed for the formation that covers lower terrace on island. Includes three members (ascending): Garanon, Fox, and Tecolote. Each member has two or more facies. Unconformably overlies Rincon shale on northwest coast of island. Lower terrace is less than 300 yards in width and is underlain by three wave-cut platforms.

Type locality: Extends about 4,000 yards along sea cliffs on northwest coast. Also exposed at mouth of Soledad Canyon, Ranch House Canyon, and from San Augustine to Wreck Canyons and between China Camp and Bee Rock on south coast of island.

Santa Susana Formation[1] or Shale

Paleocene-Eocene, lower: Southern California.

Original reference: B. L. Clark, 1924, Pan-Pacific Sci. Cong. Proc. Australia, 1923, p. 874–879.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Chart shows age Paleocene through lower Eocene.

T. E. Gay, Jr., and S. R. Hoffman, 1954, California Jour. Mines and Geology, v. 50, nos. 3 and 4, pl. 4. Formation mapped in Los Angeles County with marine deposits Tejon, Llajas, and Domengine formations. Eocene.

Named for occurrence in vicinity of Santa Susana, Ventura County.

†Santee Beds[1]

Eocene (Jackson and Claiborne): Eastern and central South Carolina.

Original reference: M. Tuomey, 1848, Geology of South Carolina, p. 156, 190, 211.

Well exposed on the Santee River.

Santee Limestone[1]

Eocene, middle: Eastern and central South Carolina and North Carolina.

Original reference: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 17.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 21, 24–25. Santee limestone, long supposed to be of early

Jackson age, represents the *Ostrea sellaeformis* zone of Claiborne group, equivalent to the restricted McBean formation, of which it is an offshore facies. This determination was made on basis of field profiles and restudy of the molluscan fauna. Older than Castle Hayne limestone. Chart shows occurrence in North Carolina.

Commonly accepted type exposure is at Eutaw Springs, Orangeburg County, S.C., 3½ miles east-northeast of Eutawville. Back water from Lake Marion has partly inundated the old exposure, but some limestone still stands above level of reservoir (Cooke and MacNeil).

Santee River Beds[1]

Eocene: South Carolina.

Original reference: F. S. Holmes, 1870, Phosphate rock of South Carolina, pl. 1.

Exposed along Santee River.

†Santiago Chert[1]

Santiago Formation

Upper Devonian: Southwestern Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bull. 44, p. 41.

W. B. N. Berry and H. M. Nielsen, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2254–2259. Because King's (1937) lower two members of Caballos novaculite form one genetic unit, and King's upper three members of Caballos form another genetic unit, it is proposed to revive original terminology of Udden, Baker, and Böse and recognize two distinct formations. Name Caballos novaculite should be restricted to lower formation and name Santiago formation applied to middle chert member, upper novaculite member, and upper chert members of King. Thickness about 225 feet. Upper Devonian. Type exposure noted.

Type exposures are at east base of Santiago Range near Santiago Peak. Brewster County.

Santiago Formation

Eocene: Southern California.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Name proposed for Eocene deposits of northwestern Santa Ana Mountains. These deposits had been called Tejon by Dickerson (1914, California Univ. Dept. Geol. Bull., v. 8, no. 11) and English (1926, U.S. Geol. Bull. 768). An unnamed basal member 40 to 220 feet thick consists of massive coarse-grained poorly sorted arkosic buff or brownish-gray sandstone and conglomerate, sandstone generally predominating. In some areas, basal member is overlain by soft medium-grained moderately well-sorted arkosic gray or brownish-gray "salt and pepper" sandstone. Uppermost part of formation consists of coarse-grained arkosic gray sandstone and grit. Thickness 650 to 725 feet. Overlies Silverado formation (new) without discordance.

Type locality: North of Santiago Creek, near Irvine Park, Santa Ana Mountains, Orange County.

Santiago Formation[1]

Oligocene, upper: Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 241.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, Geol. Sci., p. 234 (chart), 241–242. Beds of sandstones and shales. Chart shows Santiago above Tonosi limestones. Upper Oligocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 346. Oligocene.

At Santiago and adjoining areas, Veraguas Province.

Santiago Peak Volcanics

Upper Jurassic(?) to Lower Cretaceous(?): Southern California.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 22–32, pl. 1. Name proposed to replace preoccupied name Black Mountain volcanics. Group of mildly metamorphosed volcanics, mostly agglomerates, that include some sediments; older than quartz diorite of southern California batholith. Thickness undetermined, probably many thousands of feet. Unconformably overlie Bedford Canyon formation (new).

Rene Engel, 1959, California Div. Mines Bull. 146, p. 17. Santa Ana formation includes Santiago Peak volcanics and Bedford Canyon formation of Larsen (1948).

U.S. Geologicl Survey currently designates the age of the Santiago Peak Volcanics as Upper Jurassic(?) to Lower Cretaceous(?) on the basis of a study now in progress.

Outcrops form a strip from south of La Jolla quadrangle, across San Luis Rey quadrangle, northward in Santa Ana Mountains nearly to Santa Ana River; exposed width about 10 miles.

Santiam Basalts or Lavas

Pleistocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 705, 706, 709 (fig. 2), 713 (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig. 2), 1617, 1619, 1625, 1626, 1627; 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 18–19, fig. 2 (geol. map). High Cascade lavas are divided into four groups; in chronological order these are: Outerson basalts, Minto basalts, Santiam basalts, and Olallie lavas. Santiam basalts and Olallie lavas are not in contact hence relative ages unknown, similar degrees of erosion suggest they may have been nearly contemporaneous. Fills North Santiam River valley to known depth of 1,800 feet; valley was cut in Minto and Outerson lavas. Pre-Wisconsin but undoubtedly Pleistocene.

Named for occurrence in North Santiam River valley.

San Timoteo Beds[1] or Formation

Pliocene: Southern California.

Original reference: C. Frick, 1921, California Univ. Pub., Dept. Geol. Bull., v. 12, p. 283–288.

D. I. Axelrod, 1938, Carnegie Inst. Washington Pub. 476, p. 129. Characterized by coarse yellowish sands and cobble beds which are crossbedded and exhibit rapid lateral variation and channeling; interbeds of finer gray-brown sands and clays present throughout formation. Unconformably overlie Mount Eden formation.

Occur in San Timoteo Canyon, San Jacinto quadrangle, Riverside County. Form badlands west of Beaumont.

Santo Limestone (in Millsap Lake Formation)[1]

Santo Limestone Member (of Grindstone Creek Formation)

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1929, Geologic map of Palo Pinto County: Texas Bur. Econ Geology.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Grindstone Creek formation.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 19, fig. 3. Correlation of Parker exposures with outcrops in Palo Pinto County is made on basis of similarity of lithology and stratigraphic position. Limestone is gray to brownish gray and fairly pure; bedding irregular to massive. Thickness 2 to 4 feet. Occurs about middle of formation. Report follows classification of Cheney (1940) [also refers to this unit as a limestone bed].

Typically exposed along creek 0.4 mile south of railroad crossing in Santo, Palo Pinto County. Outcrop of limestone is interrupted by Littlefield Bend of Brazos River.

Santos Shale[1] Member (of Temblor Formation)

Miocene, lower: Central California.

Original reference: G. C. Gester and J. Galloway, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 10, p. 1169.

H. H. Heikkila and G. M. McLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 7–9, pl. 1. Temblor formation, in Bitter Creek area, Kern County, is divided into (ascending) Agua sandstone, Upper Santos shale, Carneros sandstone, Media shale, and "Button bed" sandstone members. Upper Santos consists of tan platy siliceous and calcareous silty to sandy shale with discontinuous thin limestone and sandstone beds. Thickness of Upper Santos 0 to 1,500 feet. Lower Santos not exposed in area of present report.

L. B. McMichael, chm., 1959, San Joaquin Geol. Soc. Guidebook May 9, p. 5–6, 13. Topographic profile of Chico Martinez Creek area shows Santos shale below Carneros sands and separated from underlying Salt Creek shale by *Phacoides* reef. Columnar section shows Lower Santos shale about 200 feet and Upper Santos shale about 100 feet, separated by "Agua sand" interval about 70 feet thick. All in Temblor formation.

First mentioned in McKittrick-Miday-San Emigdio region, San Joaquin Valley. Type area presumed to be at Santos Creek, Kern County.

Santurce Sand

Miocene, lower, to Recent: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (chart), 36–37, pl. 2. Proposed for the widespread deposit of quartz sand and interbedded somewhat clayey quartz sand that forms the surficial deposit of much of the coastal plain. Characteristically white, locally bright red. Foundation borings have penetrated 80 to 100 feet of the deposit; maximum thickness not known. Pliocene(?) and Pleistocene.

U.S. Geological Survey currently designates the age of the Santurce Sand as lower Miocene to Recent on the basis of a study now in progress.

Named for town of Santurce, because deposits are particularly thick under low lying areas near there. Occurs widely as discontinuous surface deposits for a distance of 50 miles west of San Juan both on coastal plain

and on broader bottom lands between the haystack hills of middle Tertiary limestone.

Sanup Plateau Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 90–92. At Meriwitica section, member consists of thick-bedded dark-gray aphanitic limestone with prominent bands of siltstone that weather red brown. Farther west, at Quartermaster Canyon, Rampart Cave, and elsewhere, the same type of lithology prevails, but eastward and southward algal limestone dominates the facies. Thickness moderately uniform across area but becomes progressively thinner near its eastern and southern margins. Average thickness about 25 or 30 feet. Older than Spencer Canyon member (new); younger than Rampart Cave member (new).

Designation, Sanup Plateau, comes from large promontory of that name in western Grand Canyon. Lower of two thin but persistent cliff-forming units that extend through the western two-thirds of Grand Canyon between slope-forming tongues of shale and other weak sediments.

San Xavier Conglomerate Beds

Tertiary: Southeastern Arizona.

L. A. Heindl, 1959, Arizona Geol. Soc. Guidebook 2, p. 154, 155, fig. 29. Light-pinkish-brown alluvial conglomerate made up of fragments of Cretaceous(?) arkose, siltstone, and mudstone, and Tertiary rhyolite and andesite, which are commonly of pebble size but may be as large as small boulders. Individual beds lenticular and contain scour-and-fill structures. Base nowhere exposed, but unit appears to overlie older volcanic rocks on east side of Tucson Mountains and may overlie speckled rhyolite at Black Mountain. Maximum exposed thickness about 450 feet. Underlies unnamed andesite porphyry.

Crops out in discontinuous patches on north side of Black Mountain and on southeast slopes of Tucson Mountains, San Xavier Indian Reservation, central Pima County.

San Ysidro Member (of Yeso Formation)

Permian: Northwestern New Mexico.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. Thin- to medium-bedded light orange-red to dark-red sandstone and siltstone with a few thin limestone beds. Conformably overlies Meseta Blanca sandstone member (new). In area from San Miguel Canyon north to Senorito Canyon, the San Ysidro member tongues with the underlying Meseta Blanca sandstone member. Underlies Glorieta sandstone member of San Andres formation.

Type sections: Near Canon, in sec. 3, T. 16 N., R. 2 E., Sandoval County, and the area immediately to the north of this section in the Canon de San Diego Grant.

Sapello quartzite[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 11.

In Solitario Peak region, northwest of Las Vegas, San Miguel County. Derivation of name not given.

Sappa Formation

Sappa Member (of Meade Formation)

Pleistocene: Eastern Nebraska, western Iowa, southwestern Kansas, and southeastern South Dakota.

J. C. Frye, Ada Swineford, and A. B. Leonard, 1948, Jour. Geology, v. 56, no. 6, p. 504–505, 520 (fig. 1), 522. Referred to as Sappa member of Meade formation in Kansas and Sappa formation in Nebraska. Name Sappa is used to designate deposits formerly called Upland. In Nebraska, overlies Grand Island formation; in Kansas, overlies Grand Island member of Meade formation. At type locality of Meade formation, Sappa member contains Pearlette volcanic ash of the type area.

G. E. Condra and E. C. Reed, 1950, Nebraska Geol. Survey Bull. 15–A, p. 22, 25. Formation is a gray to greenish silty clay deposit of aqueous-eolian origin. Thickness 2 to 30 feet or more; average 15 feet. Overlies Grand Island sand; underlies Crete sand and gravel (new). Occurs in old valleys of till region in eastern Nebraska, western Iowa, and southeastern South Dakota where it occasionally includes lenticular beds of volcanic ash and is locally overlain by Crete sands and underlain by sand and gravel which Nebraska Geological Survey correlates as Grand Island. However, this sand and gravel and horizons represented by the Upland, Pearllette ash, Crete sand and Loveland formation in exposures northeast of Little Sioux, Iowa, have been correlated by Iowa Geological Survey as Yarmouth age.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 87. Derivation of name given.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Chart of revised classification of Kansas Pleistocene shows Sappa as member of unnamed formation in Meade group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown as formation in Kansas. Overlies Grand Island formation; underlies Pearlette ash. Yarmouthian.

E. C. Reed (1948, Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1346) stated that a new name had been substituted for name Upland (Lugn, 1930). The formation was described and type locality designated in Sappa Township, but no name was applied to unit.

Named from exposures in abandoned volcanic ash mine of Cudahay Packing Co. near Orleans in Sappa Township, Harlan County, Nebr.

Sappington Sandstone Member (of Three Forks Shale)

Sappington Sandstone or Formation

Upper Devonian and Lower Mississippian: Southwestern Montana.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 14–16. Sappington sandstone proposed for 60 feet of yellow sandstone lying above *Cyrtospirifer* zone of Three Forks shale. Contains lower Carboniferous *Syringothyris* fauna (Kinderhook). Underlies Madison formation. Formerly included in Three Forks shale.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1411. Rank reduced to member status in Three Forks formation.

F. D. Holland, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1706–1709. Thickness of Sappington sandstone at type locality is 100

feet. This is much more than thickness (60 feet) measured by Berry. Unconformably underlies Lodgepole limestone of Madison group at Sappington type section. Appears to be Kinderhookian.

M. M. Knechtel, J. E. Smedley, and R. J. Ross, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 11, p. 2398 (fig. 2c), 2399. Referred to as sandstone member of Three Forks; underlies Little Chief Canyon member (new) of Lodgepole limestone.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, p. 1389 (table 1), 1397–1399. In vicinity of Sacajawea Peak, Mont., formation comprises (ascending) black fissile conodont-bearing shale, 8 to 16 feet; pale-brown to yellow-brown thin- to medium-bedded fine-grained calcareous siltstone and sandstone noticeably more sandy in upper part, 62 feet; dark-brown to black silty shale or siltstone, 2 to 3 feet. Cooper and Sloss (1943, Jour. Paleontology, v. 17) call the upper part basal Lodgepole black shale. Devonian(?).

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2322. Considered member of Three Forks formation. Assigned Late Devonian and Early Mississippian age.

C. W. Achauer, 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 41–49. Detailed discussion on stratigraphy and microfossils of formation. Mississippian age for Sappington could be questioned on grounds that there is intermingling of Devonian forms with characteristic Mississippian fossils in Sappington middle member. Until more investigation is conducted, precise age of formation will remain in doubt.

Type locality: NW¼ sec. 36, T. 2 N., R. 1 W., near village of Sappington, Gallatin County, Mont.

†Sapulpa Group[1]

Pennsylvanian: Central northern and central Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 11.

Named for Sapulpa, Creek County.

Sarac Ridge Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 283–292, geol. map. Predominantly dark-gray biotite-hornblende-quartz-plagioclase mylonites; small amounts of amphibolite also present. Rocks are present in an east-northeast-trending belt north of East Ridge belt and south of the El Dorado Ridge-Stoddard Canyon plutons. Alf (1948, Geol. Soc. America Bull., v. 59, no. 11) referred to these rocks as the "Black Belt mylonite." In order to follow practice of adopting geographical names in nomenclature, Alf's term is discarded, and term Sarac Ridge group introduced.

Occurs in Cucamonga quadrangle, San Bernardino County.

Saragossa Quartzite[1]

Probably Carboniferous or pre-Carboniferous(?): Southern California.

Original reference: F. E. Vaughan, 1922, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 13, no. 9, p. 344, 352–363, map.

R. B. Guillou, 1953, California Div. Mines Spec. Rept. 31, p. 5, 7, pl. 1. Redefined and restricted to exclude gneisses and granitic intrusions (here

named Baldwin gneiss) and quartzites (here named Chicopee formation) that lie beneath a thrust plate that overrides Baldwin gneiss and parts of Chicopee formation. Term Saragossa quartzite is used for the quartzite of the thrust plate. Thickness of Saragossa may be over 1,000 feet if section is not duplicated by faulting. Considered younger than Baldwin gneiss and older than Chicopee formation. Age given as pre-Carboniferous(?).

Well developed near and named for Saragossa Spring, San Bernardino County. [Considered type locality by Guillou (1953).]

Saranac Formation[1]

Saranac Quartz Syenite Complex

Precambrian: Northeastern New York.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95.

David Gallagher, 1937, New York State Mus. Bull. 311, p. 15. Although it is not specifically mentioned, there is no doubt that Cushing intended to include the country rock around Lyon Mountain under this term. [Saranac formation].

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 116–123. Saranac complex forms a band in Saranac Lake quadrangle, extending west across St. Regis quadrangle on northwest and trending toward Lake Placid quadrangle on east. Its relationships to Santa Clara complex (new) and to syenites of Lake Placid quadrangle as yet to be determined. Most of discussion is of Tupper-Saranac complex.

A. F. Buddington, 1953, New York State Mus. Bull. 346, p. 15 (table 1), 67–71. Saranac quartz syenitic complex described in Saranac quadrangle. Geologic column lists Saranac complex above Loon Lake complex.

Well exposed along Saranac River, Clinton County.

Saratoga Chalk[1]

Upper Cretaceous: Southwestern Arkansas.

Original reference: J. C. Brenner, 1898, Am. Inst. Min. Engrs. Trans., v. 27, p. 52–59.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Shown on correlation chart as unconformable below the Nacatoch sand and above the Marlbrook marl.

R. G. Drouant, 1960, Dissert, Abs., v. 20, no. 11, p. 4367–4368. Saratoga formation of this paper includes a lower chalk member and an upper argillaceous-arenaceous unit which has previously been considered a part of Nacatoch formation. Base of the Saratoga marks first appearance of abundant sand sized clastics following a long period of deposition of nonarenaceous marls which constitute Marlbrook formation.

Named for typical outcrops just north and also east of Saratoga, Hempstead County.

Saratoga Sand[1]

Pleistocene: Eastern New York.

Original reference: A. Fitch, 1850, Hist., Topog., and Agr. survey of county of Washington, N.Y., pt. 3, p. 878.

Occurs in Kingsbury and Fort Edward, Washington County; also in Saratoga and counties south of it.

Sardine Series

Oligocene or Miocene: Northwestern Oregon.

T. P. Thayer, 1936, Jour. Geology, v. 44, no. 6, p. 703–704, 709 (fig. 2), 713 (fig. 3); 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1616 (fig. 2), 1623–1624. West of Mill City, andesitic lavas are so abundant in Mehama and Fern Ridge formations that formational identity is lost. and unconformity between Mehama volcanics and Stayton lavas is not traceable. Mehama, Stayton, and Fern Ridge formations are grouped in the Sardine series, which at type locality consists of about 6,000 feet of basaltic to dacitic lavas. Grades downward into Breitenbush series (new). Mineralized by Halls diorite (new).

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 8–9, fig. 1. Entire series may be Miocene, or lower part may be Oligocene; not intended that any Eocene formations be included.

Type locality: In Sardine Mountains, northwest of Detroit, Marion County.

Sarpy Formation (in Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Nebraska.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37–38. Underlies Quivira formation; overlies Fontana formation. Thickness about 15 feet. Classed on a cyclothemal basis, formation includes (descending) Westerville limestone, Wea shale, and Block limestone.

Type locality: Platte Valley bluffs at the PWA quarry, 2½ miles south of Richfield. Named for Sarpy County.

Sarten Sandstone[1]

Lower Cretaceous: Southwestern New Mexico.

Original reference: N. H. Darton, 1916, U.S. Geol. Survey Bull. 618, p. 19, 43.

H. L. Jicha, Jr., 1954, New Mexico Bur. Mines Mineral Resources Bull. 37, p. 26, 34 (fig. 3). In Lake Valley quadrangle, consists of 300 feet of light-gray massive sandstone, mostly quartzitic or very hard. Underlies Colorado shale; overlies Lobo formation.

C. H. Dane and G. O. Bachman, 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 98. Sarten is now regarded as of Kiamichi age. Contains fauna originally said to be of Washita age.

Type locality: Sarten Ridge, east of Cooks post office, Deming quadrangle.

Sasakwa Limestone Member (of Holdenville Shale)[1]

Pennsylvanian (Des Moines Series): Central southern Oklahoma.

Original references: G. D. Morgan, 1923, Oklahoma Geol. Survey Circ. 12, p. 9, 10; 1924, Bur. Geology [Oklahoma] Bull. 2, p. 103–105.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 45–48, pls. 1, 2. Occurs 30 feet or more below top of formation. Thickness a few inches to about 15 feet. Des Moines series.

Named for exposures in Saskawa, Seminole County.

†Sassafras River Greensand[1]

Upper Cretaceous: Northeastern Maryland.

Original reference: W. J. McGee, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 612.

Occurs only along Sassafras River for short distance above its mouth to Back Creek Neck and on Maudens Mountain and a few neighboring eminences.

Satan Tongue (of Mancos Shale)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. D. Sears, 1934, U. S. Geol. Survey Bull. 860–A.

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 45. Wedges into Hosta sandstone member of Mesaverde and separates it into an upper and lower part. Thickness 300 feet in northern part of Mount Taylor coal field. Stratigraphically above Mulatto tongue of Mancos.

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 94. In parts of Fort Defiance-Tohatchi quadrangles, intertongues with Point Lookout sandstone.

Named for exposures in Satan Pass, Gallup region.

Satanka Shale[1]

Permian: Southeastern Wyoming and northeastern Colorado.

Original reference: N. H. Darton, 1908, Geol. Soc. America Bull., v. 19, p. 430.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2. Discussion of correlation of formations of Laramie Range, Hartville uplift, Black Hills, and western Nebraska. Terms Satanka, Lykins, and probably Embar should be abandoned.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 34. North of Ingleside, Colo., conformably overlies Ingleside formation. Thickness about 181 feet just south of Wyoming line at Soldier Canyon.

R. S. Agatston, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 547–548. On west side of Laramie Mountains, directly overlies Casper sandstone and underlies Forelle limestone.

Named for railroad station a few miles south of Laramie, Albany County, Wyo.

†Satilla Formation (of Columbia Group)[1]

Pleistocene: Eastern Georgia.

Original reference: J. O. Veatch and L. W. Stephenson, 1911, Georgia Geol. Survey Bull. 26, p. 60, 424, 434–445.

Named for development along both sides of Satilla River, in Camden and Charlton Counties.

Satsop Formation[1]

Pleistocene: Western Washington.

Original references: J. H. Bretz, 1914, Geol. Soc. America Cordilleran section abstract of meeting in May 1914; 1915, Geol. Soc. America Bull., v. 26, p. 131.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 7, 9. Name Troutdale was introduced by Hodge (1933) for gravels and sands deposited by ancestral Columbia River, which are well displayed near Troutdale, Oreg. Williams (1916, Oregon Bur. Mines and Geology Min. Resources, v. 2, no. 3) had referred these gravels to Satsop formation.

Type section: Satsop Valley, a tributary of Chehalis Valley.

Saturday Mountain Formation[1]

Upper Ordovician: Southern central Idaho.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

C. P. Ross, 1937, U.S. Geol. Survey Bull. 877, p. 18–22, pl. 1. Type area designated.

C. P. Ross, 1947, Geol. Soc. America, v. 58, no. 12, pt. 1, p. 1104–1105, pl. 1. Described in Borah Peak quadrangle where its distribution is similar to that of Kinnikinic quartzite which immediately underlies it. Thickness 500 to 700 feet. Underlies Laketown dolomite. Upper Ordovician.

R. J. Ross, Jr., 1959, U.S. Geol. Survey Prof. Paper 294–L, p. 441–459. Brachiopod fauna described. Most of the fauna shows affinities with Late Ordovician species, but Middle Ordovician elements are present.

Named for Saturday Mountain Ridge, which lies west of lower Squaw Creek, near middle of the western boundary of Bayhorse quadrangle. The formation crops out on both sides of lower Squaw Creek from a point above Red Bird mine to mouth of the creek.

Sauceda Volcanics

Cretaceous: Southwestern Arizona.

E. D. Wilson, R. T. Moore, and R. T. O'Haire, 1960, Geologic map of Pima and Santa Cruz Counties, Arizona (1:375,000): Arizona Bur. Mines. Named on map legend. Includes rhyolite, latite, and andesite; locally contains volcanic glass.

Mapped in Pima County. Type locality and derivation of name not stated.

Saucesian Stage[1]

Miocene, lower: California.

Original reference: R. M. Kleinpell, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 3, p. 376–378.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 113–117, figs. 4, 14 (correlation chart). Superjacent to Zemorrian stage and subjacent to Relizian stage. Comprises three zones: *Siphogenerina transversa* and *Plectofrondicularia miocenica* in lower part and *Uvigerinella obesa* in upper part. Systematic catalogue.

Type locality: Los Sauces Creek, Ventura County.

†Saugerties Limy Shale

Saugerties lithofacies (of Leeds facies of Schoharie Formation)

Lower(?) Devonian: Eastern New York.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2, 3. Limy shale 80 feet thick. Overlies Esopus and underlies Onondaga. Fossils listed.

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 686. Name Saugerties formation, suggested by Chadwick as possible name for new formation, is considered inadvisable. This unit is considered to be Leeds facies (new) of Schoharie formation. Chadwick's type section for Saugerties stated.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 233 [1946]. Saugerties shaly limestone abandoned in favor of Leeds facies of Schoharie formation.

J. H. Johnson, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Referred to as lithofacies in upper part of Leeds facies of Schoharie formation. Occurs above Aquetuck lithofacies (new).

Type section: Cut three-eighths mile west of railroad underpass, on western edge of Saugerties, Ulster County.

Saugus Formation

Saugus Formation (in Fernando Group)[1]

Pliocene and Pleistocene: Southern California.

Original reference: O. H. Hershey, 1902, Am. Geologist, v. 29, p. 349–372.

R. H. Jahns, 1940, Carnegie Inst. Washington Pub. 514, p. 166. Unconformably overlies Mint Canyon strata and brownish sandstones and shale tentatively correlated with the Modelo.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 50 (fig. 3), 61–62, pls. 14, 16. Overlies upper Pliocene continental Sunshine Ranch member of Pico formation; overlaps Sunshine Ranch eastward onto Repetto siltstone; underlies (with angular unconformity) oldest terrace deposits.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 83–85, pls. 1–3. Restricted to terrestrial deposits of probable lower Pleistocene age lying with slight unconformity on members of upper Pliocene Pico formation and with great angular discordance below middle(?) and upper Pleistocene Pacoima formation and terrace deposits. Sunshine Ranch member of Pico formation is roughly equivalent of "lower Saugus" of earlier workers. Saugus occupies several square miles of San Fernando quadrangle [this report], both north and south of San Gabriel fault. Maximum thickness 6,400 feet as measured on east side of Lopez Canyon; thins in short distance eastward to 2,000 feet, 2 miles east of Little Tujunga Canyon and disappears by further thinning and minor faulting at Big Tujunga Canyon.

E. L. Winterer and D. L. Durham, 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. Includes Sunshine Ranch member. Thickness as much as 7,000 feet. Overlies Pico formation. Includes beds of both late Pliocene and Pleistocene age.

Named for exposures in Soledad Canyon, near Saugus, Los Angeles County.

†Saugus Granodiorite[1] or Quartz Diorite[1]

Lower Paleozoic: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass.

In Essex County.

Sauk sequence

Precambrian (upper Proterozoic) to Upper Cambrian: Central and western United States.

L. L. Sloss, W. C. Krumbein, and E. C. Dapples *in* C. R. Longwell, chm., 1949, Geol. Soc. America Mem. 39, p. 111–115, 116–119. An "operational unit" for use in interregional facies analysis. Name is derived from Sauk County in the Driftless Area of southern Wisconsin. Within the county all the rocks of the sequence are exposed with both bounding horizons, one at the base of the Dresbach sandstones, where they unconformably overlie the Precambrian Baraboo quartzites, and the other

at the contact between the St. Peter sandstone and the Oneota dolomite. Formational limits in Illinois, Shakopee dolomite-Mt. Simon sandstone; in Kansas, Arbuckle dolomite-Reagan sandstone; in Wyoming, Grove Creek formation-Flathead sandstone.

Sault St. Mary Sandstones[1]

Upper Cambrian: Northern Michigan, and Ontario, Canada.

Original reference: A. R. C. Selwyn, 1883, Science, v. 1, p. 11.

Sault Ste. Marie region, Michigan-Ontario.

Saunders Formation[1] (in Chocolay Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: R. C. Allen, 1910, Michigan Geol. and Biol. Survey Pub. 3, p. 33, 36.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Included in newly defined Chocolay group. Considered a partial equivalent of the Randville dolomite.

Named for [exposures east of] village of Saunders, Iron County.

Sauquoit Beds,[1] Shale, or Formation (in Clinton Group)

Middle Silurian: East-central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 333, 341.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13 (fig. 2), 72–79. Shale is dominant lithology; hence, unit is referred to as Sauquoit shale. Overlies Oneida conglomerate and in some areas Wolcott Furnace iron ore; underlies Willowvale shale; at Lakeport, underlies Williamson shale. Middle part of Clinton group. Thickness about 90 feet at Verona Station; pinches out to west.

W. L. Grossman, 1953, *in* Marshall Kay, New York State Mus. Bull. 347, p. 68–69. Formation described in Utica quadrangle. Consists of sandstone and shale. Thickness about 200 feet. Overlies Oneida sandstone and conglomerate; underlies Willowvale shale. Clinton group.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Clinton group, Ontarian stage. Middle Silurian.

Type section: On Swift Creek, north of Sauquoit village, Oneida County.

Sausalito Chert Member (of Franciscan Formation)

Sausalito Chert (in Franciscan Group)[1]

Jurassic and Cretaceous: Western California.

Original reference: A. C. Lawson, 1902, Science, new ser., v. 15, p. 416 (table).

U.S. Geological Survey currently classifies the Sausalito Chert as a member of the Franciscan Formation on the basis of a study now in progress.

Named for exposures west of town of Sausalito, on Marin Peninsula, Marin County.

†Savage Formation[1]

Pennsylvanian: Western Maryland and northeastern West Virginia.

Original reference: N. H. Darton and J. A. Taff, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

Savage River region.

Savanna Sandstone[1] or **Formation** (in Krebs Group)

Pennsylvanian (Des Moines Series): Eastern and southern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 437.

S. W. Lowman, 1933, Tulsa Geol. Soc. Digest, p. 31. Includes Spaniard limestone member (new).

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 508–510. In southern Muskogee County, Okla., includes (ascending) Tamaha sandstone, Keota sandstone, Spiro sandstone (all new), and Bluejacket sandstone members. In northern part of county, includes (ascending) Tamaha sandstone, Keota sandstone, Spaniard limestone (new), and Sam Creek limestone (new) members. Overlies McAlester shale; underlies Boggy shale. Thickness 205 to 332 feet.

C. H. Dane and T. H. Hendricks, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 3, p. 312–314. Restricted to exclude Bluejacket sandstone which is herein allocated to member status in Boggy shale.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 44–54. Restricted to exclude Tamaha sandstone and Keota sandstone members which are herein allocated to member status in McAlester formation. Thickness 450 to 1,400 feet thick on south side of Haskell County and 100 to 200 feet on north side. Overlies McAlester formation; underlies Boggy formation.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1523–1526. Included in Krebs group (new).

C. C. Branson, 1954, Oklahoma Acad. Sci. Proc., v. 33, p. 192, 193 (table 1). In Craig County includes Doneley limestone member (new).

Named for Savanna, Pittsburg County, Okla.

Saverton Shale[1]

Saverton Formation (in Champ Clark Group)

Saverton Shale (in Fabius Group)

Lower Mississippian: Northeastern Missouri, western Illinois, and southeastern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 149, 151, 153–156.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 101, chart 5; J. M. Weller, 1948, (abs.) Am. Jour. Sci., v. 246, no. 3, p. 150. Included in Fabius group (new). Overlies Grassy Creek shale; underlies Louisiana limestone. Mississippian or Devonian.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 16–18. Reallocated to Champ Clark group (new), proposed to replace Fabius group of Weller and others (1948). Overlies Grassy Creek shale; underlies Louisiana limestone in Macoupin and Montgomery Counties; elsewhere conformably overlain by either the Glen Park or Maple Mill. Thickness 0 to 75 feet.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 85–87. Keyes (1913, Am. Jour. Sci., 4th, v. 36) used name Saverton for upper part of the "black and green" shales beneath the Louisiana limestone at Louisiana. He stated that immediately beneath the Louisiana limestone at the original locality are 2 feet of blue shales; this apparently

insignificant layer is usually included in the Grassy Creek black shales below. Keyes' proposal has been generally accepted and characteristic features and distribution of Saverton were discussed in detail by Moore (1928). Branson and Mehl (1933, Missouri Univ. Studies, v. 8, no. 3) concluded that the blue shales of the "Saverton" represent the upper weathered part of the Grassy Creek and suggested that name Grassy Creek be used as originally defined by Keyes. Weller (1935) saw no reason to separate the blue and black shales and proposed that together they be known as the Saverton. Neither of these proposals has gained general acceptance and current practice in assembling stratigraphic data generally follows Keyes' proposal of separation. Regardless of fact that Keyes named these shales "Saverton," the original locality described by him (1897, [1898], Iowa Acad. Sci. Proc., v. 5), is as follows: "Immediately beneath the well-defined Louisiana limestone, in the vicinity of Louisiana, there are about 6 feet of black and green shales carrying a characteristically Devonian fish fauna." Therefore, type locality is herein specifically designated. Outcrops of Saverton are essentially coextensive with those of underlying Grassy Creek; in Missouri, confined to northeastern part of State north of Lincoln arch. In Pike County, average thickness probably a little more than 2 feet and somewhat less in vicinity of type locality. Saverton seems to thicken toward northwest; Moore (1928) reported 100 feet in river bluff near Saverton, Ralls County; it is likely that Saverton, as herein defined, is much less. Branson and Mehl (1933) measured 15 to 20 feet of shale between the Louisiana and Mineola (Callaway) on Sees Creek, west of Hannibal, Marion County; this shale, which they designated as Grassy Creek, is now believed to be Saverton. Overlies Grassy Creek shale; underlies Louisiana limestone or where Louisiana is missing, the Hannibal shale. Late Devonian.

Type locality (Mehl, 1960): Missouri River bluff several hundred feet above Champ Clark Bridge, the same as the type locality for the Grassy Creek (SW¼NW¼SE¼ sec. 18, T. 54 N., R. 1 W.), Pike County, Mo.

Savoy Schist[1]

Ordovician: Northwestern Massachusetts and southeastern Vermont.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 156–163, 220–221, pl. 34.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Shown on correlation in east Vermont above Ottauqueechee formation and below Hawley formation.

Named for development in eastern part of Savoy Township, Berkshire County, Mass.

Sawatch Quartzite[1]

Upper Cambrian: Western and central Colorado.

Original reference: G. H. Eldridge, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

Q. D. Singewald, 1947, Preliminary geologic map and section of the upper Blue River area, Summit County, Colorado (1:31,250): U.S. Geol. Survey Prelim. Map; 1951, U.S. Geol. Survey Bull. 970, p. 9 (table). Thickness 100 to 140 feet. Underlies Peerless formation; unconformably overlies Precambrian.

H. F. Donner, 1949, Geol. Soc. America Bull., v. 60, no. 9, p. 1218–1221. Described in McCoy area where it is 270 feet thick, overlies Precambrian granite, gneiss, and schist and underlies Leadville limestone.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 158–161. Described in Pando area where it consists of fine-grained thick-bedded to massive white quartzite; pink near base and at top. Thickness 140 to 185 feet. Underlies Peerless formation; unconformably overlies Precambrian.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Described along Front Range where it is about 50 feet thick, underlies Ute Pass dolomite (new); overlies Precambrian granite.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 894, 896, 897. In White River Plateau, underlies Glenwood Canyon member (new) of Dotsero formation (redefined).

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 25–27. On west slope of Mosquito Range, Sawatch is limited to the quartzite, generally white and averaging 105 feet in thickness. Underlies Peerless formation; overlies Precambrian.

M. G. Ding and C. S. Robinson, 1957, U.S. Geol. Survey Prof. Paper 289, p. 10–11. In Garfield quadrangle, consists of a lower quartzite member, a middle glauconitic sandstone member, and an upper quartzite member. Thickness 100 feet. Underlies Manitou dolomite; overlies Precambrian gneiss.

R. R. Berg and R. J. Ross, Jr., 1959, Jour. Paleontology, v. 33, no. 1, p. 107 (fig. 1), 108, 110. On basis of faunal correlations, unit called Ute Pass at Williams Canyon by Maher (1950) is restored to lower part of Manitou formation. On bases of lithology and stratigraphic position, the Ute Pass of Missouri Gulch is correlated with Peerless formation; term Ute Pass is abandoned. Hence, in some areas the Sawatch underlies the Manitou and in others the Peerless.

Named for persistent occurrence around flanks of Sawatch Range.

Sawatch Schist[1]

Precambrian: Central Colorado.

Original reference: J. T. Stark and F. F. Barnes, 1935, Colorado Sci. Soc. Proc., v. 13, no. 8, p. 466–479, map.

Probably named for Sawatch Range.

†Sawatchan series[1]

Upper Cambrian: Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 286.

Encircle Sawatch uplift in Sawatch Range.

Saw Mill Conglomerate (in Almy Conglomerate)

Paleocene: Northern Utah.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1), 842, pl. 1. Lower 400 feet, massive red cliff-making conglomerates; middle 500 feet, light-tan and gray conglomerates, grits, sandstones, and shales; upper 300 feet, brownish-tan conglomerates. Overlies Pulpit conglomerate division (new); underlies Fowkes formation.

B. E. Lofgren, 1955, Utah Geol. Soc. Guidebook 10, p. 75. Since Eardley's original mapping, he and students have remapped area and now regard Saw Mill conglomerate as Knight conglomerate.

Named from Saw Mill Canyon, 4½ miles up Echo Canyon from the Weber, Morgan County.

Sawmill Stage

Pleistocene: Southwestern Montana.

W. B. Hall, 1960, Billings Geol. Soc. [Guidebook] 11th Ann. Field Conf., p. 192–195. Discussion of multiple glaciation in Madison and Gallatin Ranges. Three stages recognized: Marble Point (oldest), intermediate, and Sawmill. Prominent feature of Sawmill stage is Sawmill moraine which rests at elevation of 7,000 feet up valley floor of Taylor Fork of Gallatin River.

Named for former establishment of Sawmill, built along the moraine in Taylor Fork valley, in Madison Range.

Sawmill Creek Member (of Cashaqua Formation)

Upper Devonian: Western New York.

R. G. Sutton, 1960, New York State Mus. Sci. Service Bull. 380, p. 14–17, 54, 55–56, figs. 2, 5. Proposed for gray and black shales that underlie Rock Stream member and overlie Middlesex black shale. Thickness 19 to 236 feet; thickens eastward. After submission of this paper for publication, Colton and de Witt (1958) proposed name Pulteney for unit herein named Sawmill Creek; former name thus has priority.

Type section: Sawmill Creek, on east side of Seneca Lake, 8 miles north of Watkins, Schuyler County.

Sawtooth Formation (in Ellis Group)

Middle Jurassic: North-central and western Montana.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1264 (fig. 1), 1270–1277, strat. sections. Consists of basal fine-grained sandstone, a medial dark-gray shale containing a few thin dark limestone layers, and an upper highly calcareous siltstone. Thickness at type section 136 feet; at Swift Reservoir section 198 feet; formation is thickest along Rocky Mountain front and in trough extending slightly south of west from Sweetgrass Hills to Rocky Mountain front; thins over Kevin-Sunburst dome; absent over most of South arch. Basal formation of group; underlies Rierdon formation (new); where Rierdon is absent, underlies Swift formation (new); in Sun River section, overlies Hannan limestone. Bathonian age indicated by fossils. Subsurface data.

R. W. Imlay and others, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 32. Detailed description in discussion of marine Jurassic formations of Montana. In south-central Montana grades eastward into Piper formation (new).

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 968–969, chart 8C (column 56). Middle Jurassic age of Sawtooth is based on presence of *Defonticeras* near its base and of *Arctocephalities* and *Procerites* in its upper silty beds and on its stratigraphic position beneath beds containing varied ammonite faunas that allow correlation

with lower Callovian ammonite zones of northwest Europe. Formation pinches out by overlap on South arch of Sweetgrass uplift and on Big Belt uplift east of Helena but grades eastward into Piper formation in northern and southern Montana.

T. P. Storey, 1958, Alberta Geol. Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston Basin and adjacent areas. On basis of faunal, environmental, and tectonic evidence units are grouped into four major depositional sequences or stagelike intervals which Imlay refers to as Gypsum Spring (or Piper), Sawtooth, Rierdon, and Swift formations. Miscorrelation of type sections of these formation are result of variations in stratigraphic succession caused by sub-Swift and sub-Rierdon unconformities which correspond respectively to Arkell's (1956, Jurassic geology of the World: New York, Hafner Publishing Co.) Lower Callovian and uppermost Callovian to Lower Oxfordian marine transgressions. Recognition of regional extent and significance of these unconformities suggests that these are the following stratigraphic variations from those generally accepted: (1) the Lower Swift (Stockade Beaver-Hulett of Lower Sundance) is older than type Swift and younger than type Rierdon; and (2) Sawtooth is discrete stratigraphic unit which is younger than Piper or Gypsum Spring.

Type section: Rierdon Gulch, W½ sec. 23, T. 24 N., R. 9 W., Teton County. Named for exposures in Sawtooth Range.

Sawyer Limestone Member (of Waxahatchee Slate)[1]

Precambrian or Paleozoic: Eastern Alabama.

Original reference: C. Butts, 1926, Alabama Geol. Survey Special Rept. 14, p. 51, map.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226, p. 3. Described as member of Waxahatchee slate. Separated from overlying Brewer phyllite by an interval of clay rock of brownish, greenish, or pinkish tint banded with thin yellowish, pinkish, or grayish laminae: Derivation of name given.

Name derived from Sawyer Cove, Shelby County, Columbiana quadrangle.

Sawyer Quartz Syenite[1]

Devonian or Carboniferous: East-central New Hampshire.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1904–1905, pl. 1. Pink medium-grained equigranular quartz syenite. Megascopically visible quartz invariably present; hornblende and biotite also visible. Contains xenoliths of schist and angular blocks of Belknap syenite. Patches of a shonkinitic type of syenite surrounded by quartz syenite occur locally. Older than Albany quartz syenite and Conway granite; younger than Gilmanton monzodiorite and Belknap syenite. Assigned to White Mountain magma series.

Named from farm at west base of Gunstock Mountain in Belknap Mountains. Extends northward from the mountain for more than 2 miles.

Saxe Brook Dolomite (in Woods Corners Group)

Saxe Brook Formation

Middle Cambrian: Northwestern Vermont, and Quebec, Canada.

B. F. Howell, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1964. Sandy dolomite, in part a dolomitic sandstone. Underlies

Hungerford formation; overlies Skeels Corners formation (new) disconformably.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 543–546, pl. 1. Dolomites south of Missisquoi River that were originally included in formation are now placed in amended Skeels Corners slate and Saxe Brook dolomite limited to beds that form Carter Hill, a mile west of Highgate Center, and the ridge to north on east side of Saxe Brook valley. Extends into Canada only in much reduced thickness. Regarded as northern equivalent of Rockledge conglomerate, but separate names retained because of lithologic differences between the two units. Contains three main rock types. Most common is highly arenaceous gray dolomite, next is sandstone with dolomitic cement, least common is nonarenaceous dolomite. These types are arbitrary divisions of a continuous, gradational lithic sequence. Thickness 600 to 700 feet; about 350 feet at international boundary. Overlies Skeels Corners slate with slight angular unconformity; contact with Hungerford slate not exposed. Included in Woods Corners group (new). Middle Cambrian.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, p. 572, pl. 3 (correlation chart). Presumably mappable unit north of boundary into Quebec.

Best exposed on Carter Hill, on eastern side of valley of Saxe Brook, northwest of Highgate Falls, Franklin County. Extends several miles northeastward and southwestward of Highgate.

Saxian Series[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 43, p. 300.

Occurs a short distance east of Missouri River.

Saxton Conglomerate Member (of Chemung Formation)[1]

Upper Devonian: Central Pennsylvania.

Original reference: C. Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 523, 535.

Charles Butts, 1945, U.S. Geol. Survey Geol. Atlas, Folio 227. Member of Chemung formation. Consists of conglomeratic sandstones and greenish-gray and chocolate-brown shales. Thickness 102 feet.

Exposed in and about Saxton, Huntingdon County.

Saxton Shale (in Catskill Formation)[1]

Upper Devonian: Central southern Pennsylvania and eastern West Virginia.

Original reference: D. B. Reger, 1927, Geol. Soc. America Bull., v. 38, p. 157, 397–410.

Well exposed on north side of deep cut at Riddlesburg, Bedford County, Pa.

Saypo Limestone (in Hannan Limestone)

Saypo Limestone Member[1] (of Madison Limestone)

Mississippian (Kinderhookian): Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 46.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 38). Shown on correlation chart as the lowermost unit in Hannan limestone. Underlies Dean Lake chert. Kinderhookian.

J. M. Andrichuk, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85. Assignment of group status to the Madison of northwestern Montana precludes any need for term Hannan.

Type locality: On south side of upper part of Pentagon Mountain, SW¼ sec. 14, T. 25 N., R. 12 W. [Flathead County]. Named for Saypo quadrangle, over much of which it is well exposed.

Sayreville Sand Member (of Raritan Formation)

Upper Cretaceous: East-central New Jersey.

H. C. Barksdale and others, 1953, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 101–103. Bed of variable composition composed dominantly of fine- to medium-grained, white, micaceous sand (No. 2 sand of previous reports). Separated from overlying Old Bridge sand member (new) by South Amboy fire clay, and from underlying Farrington sand member (new) by Woodbridge clay. North of Raritan River consists of fine white micaceous sand, crossbedded fine- to coarse-grained white sand, with or without layers of white clay, and beds of arkosic sand; here thickness is 35 to 40 feet. Near Sayreville thickness is 6 to 7 feet. In this report, Woodbridge and South Amboy clays are considered informal economic names.

Named for exposures at several localities in northern part of Borough of Sayreville, Middlesex County.

Scajaquada Limy Shale[1]

Scajaquada Shale or Waterlime (in Bertie Group)

Upper Silurian: Western New York.

Original reference: G. H. Chadwick, 1917, Geol. Soc. America Bull., v. 28, p. 173–174.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 9. Mentioned in discussion of Bertie formation in east-central New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Scajaquada shale or waterlime included in Bertie group. Overlies Falkirk dolomite; underlies Williamsville waterlime. Fieldwork has not demonstrated lateral continuity of Scajaquada and Forge Hollow shale as shown on present chart. Thick glacial deposits conceal units in area where they may merge. Therefore, distinct names are used in western and central New York.

Derivation of name not stated.

Scales Creek Flow (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ–27. Persistent lava flow noteworthy for its thickness in Portage Lake lava series. Older than Old Colony sandstone; younger than Copper City flow (new).

Geologic map indicates that Scales Creek transects the strike of the flow in southeastern part of Ahmeek quadrangle.

Scammon Formation (in Cabannis Group)

Scammon Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Missouri, and northeastern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 196. Cherokee group is divided into 15 cyclic formational units. The Scammon, eighth in the sequence (ascending), overlies the Pilot and underlies the Mineral. Average thickness 33 feet. Includes a thin coal here designated Scammon. [For complete sequence see Cherokee group.]

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Scammon formation in Cabaniss group. Underlies Mineral formation; overlies Tebo formation.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as a coal cycle in Senora formation in Oklahoma. Includes Tiawah black shale, Tiawah limestone, shale, and Chelsea sandstone. Overlies Tebo coal cycle; underlies Mineral coal cycle. Cabaniss group.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 22 (fig. 11). Thickness of formation about 4 feet in Vernon County, Mo. Includes Tiawah limestone and Chelsea sandstone. Overlies Tebo formation. Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 52–60. Formation in Cabaniss subgroup of Cherokee group. Includes beds above Tebo coal and extends to top of Scammon coal. Complete succession included in formation is exposed at only one Kansas locality (strip-pit highwall in SE¼NE¼ sec. 24, T. 28 S., R. 25 E., Crawford County). Following divisions recognized in Kansas: dark-gray to black fissile shale at base, including single limestone bed (Tiawah); fine-grained sandstone and siltstone; medium- to dark-gray shale; sandstone (Chelsea); underclay; Scammon coal bed. In some areas in Kansas and Missouri, the Chelsea sandstone rests on an erosion surface extending down through the lower beds and locally through the Tiawah limestone and underlying Tebo coal. Thickness of formation 28 to 32 feet in eastern Crawford County; 35 to 45 feet in central and southern Crawford County and northern Cherokee County.

Type locality of Scammon coal is along Cherry Creek, northwest of Scammon, Cherokee County, Kans.

Scandian Sub-Age

Pleistocene: Midcontinent region.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 359 (fig. 1), 362. Provincial time-stratigraphic and time term used to designate the interval from the end of Sangamonian to the beginning of Bradyan.

Type locality is the section (NW¼ sec. 5, T. 3 S., R. 4 W.) of fossiliferous silt, 40 feet thick, resting on Sangamon soil developed in thin Loveland silt that overlies the Greenhorn limestone, in the bluff of the Republican River valley north of the town of Scandia, Republic County, Kans.

Scanlan Conglomerate Bed (in Pioneer Formation)

Scanlan Conglomerate (in Apache Group)[1]

Precambrian: Central and southeastern Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Thickness 1 to 6 feet in Globe quadrangle. Composed of angular and subrounded fragments of vein quartz, small chips of schist, and a few fragments of the more resistant granitic rocks in a matrix that differs from underlying rock. Where it lies on schist [Pinal], matrix is dark gray to black and is composed of fine grains of schist, mica, and quartz. Where it overlies granite [Ruin], matrix is an arkose composed mainly of orthoclase and quartz. Underlies Pioneer formation.

U.S. Geological Survey currently classifies the Scanlan Conglomerate as a bed in Pioneer Formation on the basis of a study now in progress.

Named for Scanlan Pass, Globe quadrangle, through which the trail passes just east of Barnes Peak.

Scappoose Formation

Oligocene, upper, and Miocene, lower: Northwestern Oregon.

W. C. Warren and Hans Norbisrath, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 220 (table 1), 231–233. Gray yellowish-weathering firm fossiliferous sandy tuffaceous shale and shaly sandstone, commonly spotted with pumiceous material; loosely consolidated medium-grained sandstone; in some areas, strata show pebble band, crossbedding, and interbedded carbonaceous material. Thickness and distribution erratic; measured thickness in Buxton-Manning area approximately 1,500 feet. Capped by Columbia River basalt; disconformably overlies Pittsburg Bluff formation, and locally, separated from it by a conglomerate of variable thickness.

Typical exposures occur in valley of South Fork, of Scappoose Creek and along Rocky Point Road a few miles east and southeast of Scappoose on Columbia River Highway, Columbia County.

Scarboro Phyllite (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7 p. 198.

Named for exposures in Scarboro, Cumberland County.

Scatter Creek Rhyodacite or **Formation**

Eocene or Oligocene: Northeastern Washington.

Hunting Geophysical Services, Inc., 1960, *in* Washington Div. Mines and Geology Rept. Inv. 20, p. 5, 6. Consists of variety of fine- to medium-grained porphyritic rocks ranging in composition from quartz monzonite to quartz diorite; local facies of syenite, diorite, and hornblendite; also quartz monzonite and quartz diorite dikes and irregular intrusive bodies that occur in White Mountain area west of Bacon Creek fault. In Curlew quadrangle, has largely engulfed Permian-Triassic and O'Brien Creek rocks (new) and parts of Sanpoil volcanic rocks (new). Intrudes Covada group. Republic quadrangle and part of Aeneas quadrangle mapped by Muessig and Quinlan (1959, U.S. Geol. Survey open-file map); Curlew quadrangle mapped by Calkins, Parker, and Disbrow (1959, U.S. Geol. Survey open-file map).

Widespread in Republic and Curlew quadrangles. Occurs as dikes, sills, and irregular intrusive bodies that occupy considerable part of Republic graben.

Scenic Member (of Brule Formation)

Oligocene: Southwestern South Dakota.

J. D. Bump, 1956, Am. Jour. Sci., v. 254, no. 7, p. 430–431. Unit formerly known as *Oredon* beds (Wortman, 1893, Am. Mus. Nat. History Bull., v. 5), minus the upper *Oredon* bed, is here designated Scenic member. At standard section, consists of upper nodular zone of light-cream-colored clays and gray clays 123 feet thick and a lower nodular zone of pink-gray clays 36 feet thick. Underlies Poleslide member (new); overlies Chadron formation.

Standard section: SW¼ sec. 23, T. 3 S., R. 13 E., 2.2 miles south of Scenic, Pennington County.

Scenic Point Member (of Appekunny Formation)

Precambrian (Belt Series): Western Montana, and southern Alberta, Canada.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1886–1887, fig. 2. Argillites, sandstones, and gravelly conglomerates; green, purplish, buff, brown, and dull brownish red at type locality. Northward and westward from type locality, member grades into thickly bedded, coarsely mud-cracked argillites, which give way to thick quartzites and subordinate gray and iron-stained argillites. Mud breccias, mud cracks, and ripple marks abundant. Thickness 200 to 700 feet. Overlies Appistoki member of Appekunny formation and underlies Rising Wolf member of Grinnell formation.

Type locality: Scenic Point, overlooking Two Medicine Valley, Glacier National Park, Mont.

Schaefferstown Formation (in Conococheague Group)

Schaefferstown Member (of Conococheague Formation)

Upper Cambrian: Southeastern Pennsylvania.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of the Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Limestone sequence that stratigraphically overlies Snitz Creek member (new); top is drawn at base of first bed of white to pinkish-gray crystalline limestone of overlying Millbach member (new). Consists of medium-light- to medium-gray limestone with distinct shaly bands and laminae; rock is thick bedded in fresh exposures, but weathered rock appears rare; some pinkish-gray limestone beds near base; shaly bands and laminae are carbonaceous and make member particularly susceptible to flowage. Thickness probably 200 to 300 feet; partial section (type) 68 feet with neither top nor base exposed.

Carlyle Gray and D. M. Lapham, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Upper Cambrian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Conococheague group.

Type section: Partial section measured in small quarry on west side of Schaefferstown just south of Route 897, Lebanon County. No satisfactory

type section available in Lebanon County but best partial section has been measured and used as type section.

Schaghticoke Shale[1]

Upper Cambrian or Lower Ordovician: Eastern New York and western Vermont.

Original reference: E. Ruedemann, 1903, New York State Mus. Bull. 69, p. 934–966.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Schaghticoke shale in Taconic sequence below Deepkill shale. Stratigraphically above Zion Hill quartzite. Lower Ordovician.

Typically exposed along Hoosic River at and in vicinity of Schaghticoke, Rensselaer County, N.Y.

Schell shale[1]

Lower Ordovician: Eastern Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 78.

Named for outcrops in full thickness in a fault block near middle of Schell Creek Range, east of Ely, White Pine County.

Schenectady Formation[1]

Middle Ordovician: East-central New York.

Original reference: R. Ruedemann, 1912, New York State Mus. Bull. 162.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 273. Discussed under heading of formations of Sherman age, Trenton group. Composed of interbedded blue-gray calcareous sandstones with intercalated dark-gray arenaceous shale. Underlies Indian Ladder beds; overlies Snake Hill formation.

J. M. Berdan, 1950, New York Water Power and Control Comm. Bull. GW–22, p. 10 (table 2), 14. Formation, in Schoharie County, underlies Brayman shale. Thickness estimated at 2,000 feet but entire thickness not exposed in county. No record of wells that have passed completely through formation. Middle Ordovician.

Type exposures: Dettbarn quarries, at Schenectady, and at Aqueduct and Rexford Flats at Schenectady, Schenectady County.

Schenley Red Beds (in Conemaugh Formation)[1]

Pennsylvanian: Southwest Pennsylvania.

Original reference: M. E. Johnson, 1925, Pennsylvania Geol. Survey, 4th ser., Topog. and Geol. Atlas 37, p. 54, 121.

Occurs just north of Blackburn on Turtle Creek branch of Pennsylvania Railroad. Named because of their execllent exposure in Schenley district, Pittsburgh, Allegheny County.

Scherrer Formation (in Naco Group)

Scherrer Formation (in Snyder Hill Group)

Permian: Southeastern Arizona and southwestern New Mexico.

James Gilluly, J. R. Cooper, and J. S. Williams, 1954, U.S. Geol. Survey Prof. Paper 266, p. 1, 27–29. Comprises (ascending) about 65 feet of bright-red siltstone at base; about 30 feet of fine-grained gray limestone; 270 feet of sandstone containing a few beds of limestone in lower part;

165 feet of fine-grained, relatively thin bedded, and in part somewhat dolomitic, gray limestone; and 150 feet of sandstone. Sandstone nearly white on fresh fracture but generally weathers rusty brown. Thickness of type section 687 feet. Overlies Colina limestone (new) with sharp contact; underlies Concha limestone (new) at some localities and disconformably underlies Glance conglomerate at others. In Naco group.

D. L. Bryant, 1955, Dissert. Abs., v. 15, no. 7, p. 1224. Excluded from Naco group because it is not present in type area of original Naco. Reassigned to Snyder Hill group (new). Overlies Andrada formation (new) in western part of southern Arizona.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 39–41, tables 1, 2, pl. 1. In Peloncillo Mountains, N. Mex., about 50 feet of thick-bedded well-cemented dusty-red siltstone forms crest of ridge north from Cienega Peak. Overlies Colina limestone; underlies Chiricahua limstone. Formation thins in easterly direction—687 feet thick in central Cochise County, 150 feet in Chiricahua Mountains, and 30 to 50 feet in western part of Peloncillo Mountains. In Naco group.

Type section: On Scherrer Ridge (from which formation takes its name) and Concha Ridge, Gunnison Hills, central Cochise County, Ariz. Top of section measured along crest of Concha Ridge (SW¼NW¼ sec. 28, T. 15 S., R. 23 E.).

Schieffelin Granodiorite

Upper Cretaceous or Tertiary: Southeastern Arizona.

B. S. Butler, E. D. Wilson, and C. A. Rasor, 1938, Arizona Bur. Mines Bull. 143, Geol. Ser. 10, p. 25–26, pls. 3, 4. Has general appearance of a rather fine-grained light-gray granite and locally is referred to by that name. Slightly reddish tint in places and passes into various porphyritic modifications along its contact with the sedimentary rocks into which it is intrusive, including the Naco limestone and beds of the Bisbee group.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 102–104, pl. 5. Intrusive contacts found with all members of Naco group and with Bisbee formation, Bronco volcanics, and Uncle Sam porphyry. Occupies area of about 3 square miles in Tombstone district and forms Bronco Hill in central Cochise County.

Named from its typical occurrence in vicinity of Schieffelin's monument, about 1 mile northwest of Tombstone, western Cochise County.

Schodack Formation[1]

Lower Cambrian: Eastern New York and southwestern Vermont.

Original reference. R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70, map.

C. E. Resser and B. F. Howell, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 204. Bomoseen grit grades upward into calcareous beds to which Ruedemann (1914) assigned name Schodack and which Dale called "Cambric black shales." It is possible that Ruedemann's Mattawee [Mettawee] slate (Dale's "Cambric roofing slate") which crops out about Greenwich, N.Y., and in a belt extending from Pawlet to Fairhaven, Vt., is also Schodack.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 64–65. In Catskill quadrangle the following units distinguished (descending): Zion Hill quartzite, Schodack shale and limestone, Burden conglomerate, Bomoseen grit, Burden iron ore, and

Nassau beds. Zion Hill quartzite, Schodack shale and limestone, Burden conglomerate, and Bomoseen grit are intimately connected and interfolded. In conference with Resser, it was found to be more practicable to extend term Schodack formation so as to include as members the beds associated or interbedded with it such as Zion Hill quartzite, Burden conglomerate, and also Troy shale and limestone. Resser would unite Ruedemann's Mettawee slate, Schodack shale and limestone, and Eagle Bridge quartzite (Zion Hill quartzite) into Schodack formation.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 64–84. Schodack formation is used here [Coxsackie quadrangle] as extended by Ruedemann to include all members associated or interbedded with it from Bomossen grit through Zion Hill quartzite. In Troy and Cohoes quadrangles, it includes (ascending) Bomoseen grit, Diamond Rock quartzite, Troy shale and limestone, Schodack shale and limestone; in Washington County and Vermont, Bomoseen grit, Mettawee slate, Eddy Hill grit, Schodack shale and limestone, and Zion Hill quartzite; in Catskill quadrangle, Bomoseen grit, Schodack shale and limestone, and Zion Hill quartzite. Zion Hill quartzite not present in area of this report. Bomoseen grit overlies Nassau beds. Underlies Deepkill shale.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart above Bomoseen formation.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1084 (table 1), 1087–1089, 1091, pl. 1. In northern Taconic area, Schodack slate underlies Wallace Ledge slate (new) and overlies Eddy Hill grit. Units called Beebe limestone and Hooker slate by Keith (1932) are herein considered part of Schodack formation.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 50–53, pl. 2. Described in Castleton area. Crops out in several narrow north-trending bands in slate belt west of Taconic Range and south of Castleton River. North of Castleton River Kaiser (1945) mapped outcrops of Schodack both in and west of Taconic Range in townships of Castleton, Hubbardton, and Ira. Some of Schodack mapped by Kaiser on eastern flank of Taconic Range in Pittsford is here called Hortonville slate, which lies beneath Taconic overthrust. Maximum thickness about 200 feet. Underlies Zion Hill quartzite; overlies Mettawee slate; in some areas, Eddy Hill grit lies between the Schodack and Mettawee. There are two current usages of name Schodack formation: one includes the Bomoseen grit, the other does not. This report follows Cushing and Ruedemann's (1914) usage. Also Resser and Howell's (1938) interpretation of Schodack and Mettawee formations is rejected.

D. W. Fisher, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 329, 341–342. Ruedemann (1914) applied name Schodack to "Cambrian black shales" of Dale (1898, U.S. Geol. Survey 19th Ann. Rept., pt. 3B). This is regrettable because it cannot be conclusively demonstrated that fossiliferous limestone exposed near Schodack Landing in Columbia County, where Ford (1885, Am. Jour. Sci., 3d, v. 28) discovered Lower Cambrian fossils, is same lithogenetic unit that Dale had reference to in Washington County. Name Schodack has been used to delimit differing intervals of rock, and this has caused confusion toward understanding relationships of early Cambrian strata in New York. Much of what has been called Schodack in past, both in Columbia and Washington Counties, has proved to be Ordovician Schaghticoke and Deepkill shales, by virtue of discovery of graptolites. Some of Dale's

"Cambrian black shales" (Ruedemann's Schodack) have been found to contain *Dictyonema flabelliforme*, a Schaghticoke graptolite and faunal zone considered as base of Ordovician in North America.

Named for exposures 2 miles south of Schodack Landing, N.Y.

Schoharie Grit[1]

Schoharie Formation

Lower and Middle Devonian: Eastern New York, New Jersey, and northern Pennsylvania.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 378.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1779, chart 4. Lower or Middle Devonian. Onesquenthaw stage (new).

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 673–694. Schoharie and Esopus formations restudied. Formations were traced from Schoharie west to Springfield Center, then east to Helderbergs and then south of Pennsylvania border. Esopus formation restricted, and beds formerly classed as upper Esopus are separated into the new Sharon Springs formation, which may be locally separated from overlying [Schoharie] and underlying beds by glauconite bands. Instead of disappearing to south, Schoharie grit changes rapidly to a shaly and cherty facies, here termed Leeds facies, and thickens as it approaches Pennsylvania border. Contacts with overlying Onondaga are transitional.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 130, 183, geol. map [1946]. Schoharie grit is local development of sandy facies of lower Onondaga limestone.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 42, 212–225, geol. map. Schoharie grit and limestone exposed in many areas in Coxsackie quadrangle where it has maximum estimated thickness of between 60 and 70 feet. Overlies Esopus shale; underlies Onondaga limestone. Schoharie formation here is dissimilar to beds outcropping in type area and Helderberg region. Possible that this formation does not properly belong to Schoharie. On geological map, Sharon Springs formation, with thickness in northern part of area of about 35 feet, and in Leeds Gorge of about 75 feet, is largely included in Schoharie formation.

Winifred Goldring and R. H. Flower, 1944, Am. Jour. Sci., v. 242, no. 6, p. 340. Preoccupied name Sharon Springs replaced by new name Carlisle Center.

Theodore Arnow, 1949, New York State Water Power and Control Comm. Bull. GW—20, p. 8 (table 1), 11 (fig. 3), 14, pl. 2. Schoharie grit in Albany County is impure siliceous dark-bluish-gray limestone. In places, merges with underlying Esopus shale and overlying Onondaga limestone. Maximum thickness 20 feet. Lower or Middle Devonian.

J. H. Johnsen, 1957, Dissert. Abs., v. 17, no. 10, p. 2247. Schoharie formation is complex of lithologic facies and faunal zones extending from Herkimer County, N.Y., at least to Monroe County, Pa. Thickens south of Port Jervis, N.Y., and thins again in New Jersey and Pennsylvania. Overlies Esopus formation; underlies Onondaga. Includes Carlisle Center, Rickard (new), and Leeds facies.

Named for exposures at Schoharie, Schoharie County, N.Y.

†Schoharie Stage[1]

Lower Devonian: New York.

Original reference: A. W. Grabau, 1898, Buffalo Soc. Nat. History, v. 6, p. xviii.

School Canyon Granite

Jurassic(?): Southern California.

J. C. Crowell, 1952, California Div. Mines Spec. Rept. 24, p. 8, pls. 1, 2. Buff and orange coarse-grained granite. Resembles Tejon Lookout granite (new) to which it may be closely related, although the relationship has not been established.

Exposed in northwestern corner of Lebec quadrangle, Kern County, within the Pastoria fault zone. Large jagged outcrops and cockscombs occur north of School Canyon, after which the granite is named.

Schoolcraft Dolomite or Formation (in Manistique Group)

Schoolcraft Member[1] (of Manistique Formation)

Middle Silurian: Northern Michigan and eastern Wisconsin, and Ontario, Canada.

Original reference: R. B. Newcombe, 1933, Michigan Geol. Survey Pub. 38, p. 23, 37.

C. K. Swartz, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 536, chart 3. Schoolcraft dolomite and Cordell dolomite replace term Waukesha in eastern Wisconsin.

G. M. Ehlers and R. V. Kesling, 1957, Michigan Geol. Soc. [Guidebook] Ann. Geol. Excursion, p. 2 (chart), 19, 20–21. Rank raised to formation in Manistique group. Predominantly thin even-bedded finely crystalline gray dolomite. Thickness 40 to 60 feet. Underlies Cordell dolomite; overlies Hendricks dolomite of Burnt Bluff group, probably disconformably.

Exposed in abandoned quarry of White Marble Lime Company on eastern side of Manistique, Schoolcraft County, Mich. Traced from northeastern Wisconsin to region of Owen Sound, Ontario.

Schoolhouse Group

Cretaceous(?) or younger: Southwestern New Mexico.

J. G. Wargo, 1958, abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1748. Volcanic rocks ranging in composition from basalt to rhyolite. Basal units of two andesite flows which rest on Cretaceous(?) shale. Middle unit of thick sequence of pyroclastics, welded tuffs, and flows largely of rhyolitic composition. Five formations can be distinguished locally. Uppermost unit of thin basalt flows interbedded with consolidated gravels of Gila(?) age. Maximum thickness about 9,000 feet.

In Schoolhouse Mountain area, northern Grant County, approximately 20 miles west of Silver City.

Schoolhouse Sand

Schoolhouse Tongue (of Weber Sandstone)

Middle Permian: Western Colorado.

W. O. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 1, p. 72. The so-called Weber sand of Rangely oil fields thins eastward gradually and disappears among red sediments on west slope of Gore

Range, about 10 miles east of Eagle. This sandstone is referred to as Schoolhouse sand. Middle Permian (Leonardian).

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 823. Renamed tongue of Weber sandstone. On west side of McCoy area, 59 feet thick and lies between McCoy and State Bridge formation. Thickness 79 feet at South Canyon, near Glenwood Springs; 46 feet, 4 miles north of Eagle; 27 feet, 10 miles east of Eagle.

Named for typical outcrop near schoolhouse east of Meeker, Rio Blanco County.

School Mine Ledge Bed (in Rich Fountain Formation)

Lower Ordovician: Central Missouri.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 15–16, pls. 2, 3. Massive medium to coarsely crystalline dolomite that forms a prominent ledge in lower part of formation.

Well exposed at experimental mine of Missouri School of Mines and Metallurgy on east line of SW¼SW¼SE¼ sec. 10, T. 37 N., R. 8 W., Rolla quadrangle, Phelps County.

Schooner Head Series[1]

Precambrian or Cambrian(?): Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1041, 1060, map.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Abandoned; synonymous with Frenchmans Bay series (new) of Silurian age.

Named for exposures at Schooner Head, east coast of Mount Desert Island, Hancock County.

Schooner Hill facies[1] (of Locust Point Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 137–143.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. In north and south direction, Locust Point formation comprises Belmont, Nelson, Hill, Schooner Hill, and Spickert Knob facies.

Name derived from Schooner Hill in Brown County, NE¼ sec. 3 and NW¼NW¼ sec. 2, T. 8 N., R. 2 E., 3½ miles southwest of Nashville.

Schrader Bluff Formation (in Colville Group)

Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 162, 164, 166, fig. 2. Largely marine sandstone to south and shale to north. Contains considerable bentonite and tuff which increases upward through formation. Comprises three members (ascending): Seabee (new), Tuluga (new), and Sentinel Hill (new). Members exposed in over 3,000 feet of continuous outcrop at Schrader Bluff. Thickness at Fish Creek test well No. 1 is 2,600 feet. Overlies Umiat formation (new) in Umiat area and to the south; also overlies Chandler formation (new) to the south. Intertongues with nonmarine Prince Creek formation (new). Underlies Sagavanirktok formation (new).

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 212 (fig. 2), 249–251. Restricted to predominantly marine rocks lying above and interfingering with Tuluvak and Kogosukruk tongues of Prince Creek formation. Type locality redefined by restricting it to steeply south-dipping marine rocks in Schrader Bluff from top of Tuluvak tongue (800 feet above base) to top of exposure (2,700 feet above base). Divided into three members in outcrop area (ascending): Rogers Creek member (new), Barrow Trail member (new), and Sentinel Hill member. In general, formation represents marine deposits of one great transgression and regression of the sea. Thickness about 2,200 feet along Colville River northeast of Umiat, at least 1,900 feet at Schrader Bluff.

Type locality: In north (northeast) bank of Anaktuvuk River about 5 miles above mouth of Tuluga River. Named for exposures at Schrader Bluff on Anaktuvuk River just south of junction with Tuluga River, identified also in well cores from Umiat, Fish Creek, Sentinel Hill, and Cape Simpson areas.

Schreyfogels Limestone[1]

Mississippian: Northeastern Pennsylvania.

Original reference: F. Platt, 1880, Pennsylvania 2d Geol. Survey Rept. G_2, p. 187, 199.

Exposed on hillside south of Schreyfogel's Hotel and 170 feet above level of Loyalsock Creek, Sullivan County.

Schroeppel Shale[1] (in Clinton Formation)

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Charles Butts, 1939, *in* Rudolf Ruedemann and Robert Balk, eds., Berlin gebrüder Borntraeger, Geologie der Erde, North America: v. 1, p. 368. Section from Lakeport, Madison County, to Wolcott, Wayne County, shows Schroeppel shale in Clinton formation below Irondequoit limestone and above Brewerton shale.

D. W. Fisher, 1959, New York State Mus. Sci. Service Map and Chart Ser. No. 1. Gillette (1947) in his detailed study of Clinton group ignored Chadwick's (1918) Phoenix and Schroeppel shales, probably because they were so loosely defined. Instead he introduced name Willowvale for the green fossiliferous shale beneath the Herkimer and above the Kirkland. Gillette's view is followed in present report.

Type locality: Phoenix, on Oswego River, Oswego County. Phoenix is in Schroeppel Township.

Schroyer Limestone Member (of Wreford Limestone)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference:; G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 33.

D. E. Hattin, 1957, Kansas Geol. Survey Bull. 124, p. 43–49, pls. 1–3. Three units invariably present in Schroyer (ascending): basal cherty limestone, which locally contains some shale in northern Kansas; a shaly unit, which commonly contains a cherty limestone bed; and algal limestone. No exposure examined during this study includes more than 13

feet of what can be called Schroyer. On basis of lithology, much of what has been called Schroyer at type locality should be included in underlying Havensville shale. At several places in Marshall and Pottawatomie Counties, the Havensville includes a molluscan-limestone phase; at first appearance, this molluscan limestone seems to belong to the Schroyer; however, placement of this unit in the Havensville is harmonious with respect both to cycles of sedimentation and to observed thicknesses of shaly exposures of the Havensville. Therefore only 5 feet of cherty limestone at type section should be classified as Schroyer, and at present only 1.6 feet of Schroyer is actually exposed. In this report, boundary between Schroyer limestone and Havensville shale is placed at the contact of chert-bearing limestone on shale or noncherty limestone, the strata above and below the contact thus being lithologically and stratigraphically compatible units. Placed in Wolfcamp series.

Type locality: East side of Big Blue Valley, about 1¼ miles below Schroyer, Marshall County, Kans.

Schubert Creek Limestone[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 90, 97.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 41. Name introduced by Moore for lower member of Hertha. Later it was found that this limestone is the one called Hertha at Kansas City. Kansas Geological Survey now uses names Sniabar limestone, Mound City shale, and Critzer limestone as members of the Hertha.

Type locality: On Schubert Creek between Bronson and Uniontown, Kans., on U.S. Highway 54.

Schuler Formation (in Cotton Valley Group)

Upper Jurassic: Subsurface in Arkansas, Louisiana, and Texas.

H. K. Shearer, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 6, p. 724–725. Schuler formation or Schuler facies of Cotton Valley formation applied to formation underlying basal gravel of Travis Peak and overlying Buckner formation (new) or older beds where Buckner is absent in south Arkansas. Includes Morgan sands zone near top and Jones sand at base in Schuler oil field, where thickness is about 2,250 feet. Named by Shreveport Geological Socity.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 594–609. Redefined as formation to include nearshore or nonmarine pastel and red-green shales, sandstones, and basal conglomerates and offshore equivalents of these rocks which are dark-gray fossiliferous shales, limestones, sandstones, and basal conglomerates lying stratigraphically between base of Hosston formation and top of Bossier formation (new). Subdivided into (ascending) Dorcheat and Shongaloo members. In Cotton Valley group. Type section stated.

Type locality: Schuler oil field, Union County, Ark. Type section (near shore facies): Lion Oil Refining Co., and Phillips Petroleum Co.'s Edna Morgan No. 1, C., NE¼SW¼ sec. 18, T. 18 S., R. 17 W., Union County.

Schultze Granite[1]

Tertiary(?): Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

M. N. Short and others, 1950, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 50. Tertiary.

In Globe mining district.

Schulz Member (of Williams Formation)

See **Schulz Ranch Sandstone Member** (of Williams Formation).

Schulz Ranch Sandstone Member (of Williams Formation)

Schulz Member (of Williams Formation)

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named Schulz member of Williams formation (new). Light-colored coarse arkosic sandstones with numerous beds of well-rounded boulders; unfossiliferous. Average thickness 200 feet. Underlies Pleasants member (new) of Williams formation; overlies Holz member of Ladd formation (both new).

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 173–174. Type locality designated.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Renamed Schulz Ranch sandstone member. North of Silverado Canyon, underlies Silverado formation (new).

Type locality: Approximately a quarter of a mile upstream from mouth of Williams Canyon, near west boundary of Schulz Ranch, northern Santa Ana Mountains, Orange County.

Schumann Formation[1]

Pliocene(?) and Pleistocene: Southern California.

Original reference: R. D. Reed, 1933, Geology of California, p. 232.

G. F. Worts, Jr., 1951, U.S. Geol. Survey Water-Supply Paper 1000, p. 28 (footnote). Term sometimes applied to Paso Robles formation; Paso Robles used in this report.

Exposed near north end of Schumann cut, where railroad enters Casmalia Hills south of Guadalupe, Guadalupe quadrangle.

Schuyler Soapstone[1]

Precambrian: Central Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. of geol. map of Virginia.

Mapped at and around Schuyler, Nelson County.

Schuylkill Member (of Pottsville Formation)

Schuylkill Formation (in Pottsville Group)

Lower Pennsylvanian: Eastern Pennsylvania.

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2674 (fig. 3), 2675–2676, 2679–2680; 1957, U.S. Geol. Survey Coal Inv. Map C–43, sheet 1. Consists of several beds of fine to coarse pebble conglomerate and quartzose sandstone intercalated with thinner beds of shale and coal. Thickness about 300 feet at type section. Conformably overlies Tumbling Run member (new) with contact sharp where observed in anthracite region; studies in southern and western middle anthracite field indicate that Schuylkill member intertongues on a regional scale with Tumbling Run member; underlies Sharp Mountain member (new).

Carlyle Gray and others, 1960, Geologic map of Pennsylvanian (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Pottsville group in anthracite region.

Type section: Included in Pottsville formation reference section which is in roadcut on east side of U.S. Highway 122, about 150 feet farther east than original type section of the Pottsville which is on eastern side of Pennsylvania Railroad cut through water gap south of Pottsville, Schuylkill County.

Scio Beds or Formation

Oligocene, upper, or Miocene, lower: Western Oregon.

E. I. Sanborn, 1947, Oregon State Coll. Studies in Geology Mon. 4, p. 1–2, 11–12. Beds consist of a series of sandstones and water-lain tuffs and breccias which dip about 12° N. and 40° E. Character of beds varies from very fine grained white tuffaceous shale through quartz-mica sandstone containing as much as 96 percent quartz; on Franklin Butte, formation is more tuffaceous and about 75 feet of it is a well-defined white sandy shale containing fossil leaves. Beds apparently overlie marine Oligocene (Eugene) formation, but exact relationship is questionable because no contacts were observed; unconformably underlie a series of basic lava flows that are presumably middle Miocene in age. Name credited to W. M. Felts (unpub. thesis).

I. S. Allison and W. M. Felts, 1956, Geology of the Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Tentative names Scio beds and Berlin volcanics used by Felts (1936, unpub. thesis) are abandonded. Name Mehama volcanics used in area.

Well exposed in eastern part of Lebanon quadrangle, Linn County. Named for town of Scio, 9 miles southeast of Jefferson, on U.S. Highway 99.

Scioto Freestone (in Allegheny Formation)[1]

Pennsylvanian: Central southern Ohio.

Original reference: D. D. Owen, 1859, Rept. Geol. Reconn. State of Indiana in 1838, pt. 2, p. 50.

Probably named for Scioto Valley.

†Scioto Slates and Shales[1]

Upper Devonian: Southern Ohio.

Original reference: D. D. Owen, 1859, Rept. geol. reconn. State of Indiana, in 1838, pt. 2, p. 59.

Probably named for Scioto Valley.

Scioto Valley shale facies[1] (of Cuyahoga Formation)

Scioto Valley shale facies (of Logan Formation)

Mississippian: Southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 757–758.

F. T. Holden, 1941 Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942 Jour. Geology, v. 50, no. 1, p. 54 (fig. 3), 60–62. Here considered a facies of Logan formation. Includes Portsmouth shale, Buena Vista sandstone, and Vinton sandstone members. Lies between Pretty Run shale facies (new) to the east and Vanceburg siltstone facies to the west.

Crops out to the east along the Scioto River valley.

Sciotoville clay member

Sciotoville Fire Clay (in Pottsville Formation)[1]

Pennsylvanian (Pottsville Series): Southern Ohio.

Original reference: E. B. Andrews, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 166, pl. opp. p. 242.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 21, 22, table 1. Included in Anthony cyclothem in Perry County. Thickness 1½ to 6 feet. Underlies Anthony coal; overlies basal sandstone or shale member of cyclothem. Throughout most of county, the clay and coal lie only a few feet above Mississippian-Pennsylvanian boundary; locally clay lies directly on Mississippian Vinton sandstone.

R. E. Lamborn, 1954, Ohio Geol. Survey Bull. 53, p. 39–41, geol. map. Position of Sciotoville clay member (Pottsville series) is on an average about 30 feet below Sharon or No. 1 coal, and about 28 feet below Quakertown or No. 2 coal. Widely distributed but lacks continuity developed in localized basins or depressions flanked by uplands composed of strata of Mississippian age.

First described at Sciotoville, Scioto County.

Scituate Granite Gneiss

Mississippian(?) or older: Rhode Island.

A. W. Quinn, 1951, Bedrock geology of the North Scituate quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–13]. Light-gray, gray, or pink medium- to coarse-grained granite gneiss. Almost massive in places. Formerly included in Sterling granite gneiss. Intrusive into Blackstone series; intruded by Esmond granite.

G. M. Richmond, 1951, *in* G. M. Richmond and W. B. Allen, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 4, p. 14. Thickness of one mass in Georgiaville quadrangle is 2,000 to 4,000 feet. Cuts Woonasquatucket formation.

G. E. Moore, Jr., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Described in Hope Valley quadrangle. Younger than Blackstone series; grades into Hope Valley alaskite gneiss (new); cut by dike of Ten Rod granite gneiss (new). Devonian(?) or older.

U.S. Geological Survey currently designates the age of the Scituate Granite Gneiss as Mississippian(?) or older on the basis of a study now in progress.

Named for extensive exposures in Scituate Township, Providence County. Good exposures at east wall of spillway at west abutment of the Kent Dam of the Scituate Reservoir and in small quarry one-half mile west of Snake Den.

Scossa Slates[1]

Jurassic: Northwestern Nevada.

Original reference: J. C. Jones, A. M. Smith, C. Stoddard, 1931, Nevada Univ. Bull., v. 25, no. 4, p. 6, 7, 8.

Scossa district, Pershing County.

Scotia Bluffs Sandstone (in Wildcat Group)

Pliocene, upper: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 33–55, 111–113, pls. 1, 2. Massive fine-grained sandstone with mudstone members

in lower part. Thickness 1,000 to 2,000 feet. Underlies Carlotta formation (new), contact gradational; overlies Rio Dell formation (new). In Wildcat Ridge section, upper part of Carlotta formation is not exposed, and lower part is noticeably more sandy than lower Carlotta in Eel River area. Term Ferndale (MacGinitie, 1943) has been used for the sandstone and conglomerate in section along Wildcat Ridge. The two are mappable units, and name Scotia Bluffs sandstone is proposed for the lithologic unit immediately overlying the Rio Dell formation and underlying Carlotta formation.

Type section: Along Scotia Bluffs on east side of Eel River.

Scotland Schist[1]

Scotland schist phase (of Hebron Gneiss)

Pre-Pennsylvanian: Eastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 132, 141, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 76, 77, pl. 1. Abandoned in favor of Brimfield schist; two units are identical.

John Rodgers and others, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Rank reduced to a phase. Occurs in the southern and east-central parts of the Hebron outcrop area. Pre-Triassic.

Crops out in town of Scotland, Windham County.

Scott Member (of Day Point Formation)

Middle Ordovician (Chazyan): Northwestern Vermont and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 821–827, 845, geol. sections. Defined as 44 feet of light- to medium-gray coarse-grained coquinal calcarenite in medium to thick beds, commonly cross laminated,, overlying Head member (new) at Scott Point, Isle La Motte; underlies Wait member (new). Base exposed in cove south of Scott Point is calcarenitic quartz conglomerate, succeeded in lower 24 feet by strongly cross-laminated quartz-sandy calcarenite; upper 6 feet has pinkish cystid fragments and small biostromal swellings, more or less dolomitized and with bryozoans; in contact with Wait member in cove north of point. Thins eastward to 32 feet on Wait Bay; on Wool Point 17 feet; near Chazy, N.Y., minimal thicknesses are 76 and 58 feet and beds are partly dolomitized; thickens from 6 feet on South Hero to about 40 feet on southern Valcour Island where it is poorly defined . Presumably overlapped southward.

Type locality: Scott Point. Isle La Motte, Vt.

Scott Shale

Scott Shale (in Pottsville Group)[1]

Middle Pennsylvanian: Eastern Tennessee.

Original reference: A. Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 33.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 89–93, 150. Scott formation (of shale) occurs between Anderson sandstone above and Jellico formation (called Wartburg by Keith) below.

C. W. Wilson, Jr. J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [Folio], pl. 1.

As a result of recent fieldwork, names Briceville, Jellico, Scott, and Anderson formations are discontinued and a complete new classification presented.

Named for occurrence in Scott County.

Scott Canyon Formation

Lower or Middle Cambrian(?): North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]. Chert, argillite, slate, limestone, and intercalated greenstone (altered andesitic lava) predominate. Chert is dark, thin bedded, and lenticular with argillite partings. Thickness estimated to be more than 2,000 feet and may exceed 5,000 feet. Mississippian(?).

H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Type locality designated.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2829–2830. Exposed in Antler Peak quadrangle. Consists of about 5,000 feet of dark thin-bedded chert, shale, and greenstone with a little limestone and quartzite. Overthrust by Harmony formation. Relations to younger formation, such as Valmy, not known.

Type locality: Scott Canyon, a tributary of Galena Canyon, southeast flank of Antler Peak. Well exposed in Galena, Little Cottonwood, and Scott Canyons in southeastern part of Antler Peak quadrangle.

†Scotts Bluff Formation[1]

Miocene: Southwestern Nebraska.

Original reference: H. Engelmann, 1876, Eng. Dept. U.S. Army, J. H. Simpson's Expl. of Great Basin of Terr. of Utah, p. 247, 282–284.

On North Fork of Platte River.

Scotts Creek Flint[1]

Mississippian: Eastern Ohio.

Original reference: E. Orton, 1880, Review of stratigraphy of Ohio, p. 22.

Occurs on all tributaries of Scott's Creek.

Scottville cyclothem (in McLeansboro Group)

Pennsylvanian: Southwestern Illinois.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 21, 31–32. Proposed for the cyclothem which includes the Scottville limestone and is well exposed in vicinity of Scottville. At type outcrop, includes basal sandstone and shale, underclay, coal, fossiliferous shale, and Scottville limestone. In sequence occurs above Gimlet cyclothem and below Trivoli cyclothem.

Type outcrop near west limits of Scottville, Macoupin County.

Scottville Limestone Member (of Modesto Formation)

Scottville Limestone (in McLeansboro Group)

Pennsylvanian: Southern Illinois.

J. N. Payne, 1943, Illinois Geol. Survey Circ. 88, p. 4, pls. 1, 2, 3. Gray to dark gray, fossiliferous, fine grained, massive. Lies below Carlinville limestone; separated from underlying Piasa limestone by Scottville coal.

J. R. Ball, 1952, Illinois Geol. Survey Bull. 77, p. 32. Thickness 1 to 6½ feet; average about 2½ feet. Included in Scottville cyclothem (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. In McLeansboro group. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1), 69, 70, pl. 1. Rank reduced to member status in Modesto formation (new). Name Rock Branch coal member is applied to coal formerly included in Scottville so that latter name may be restricted to the limestone. Name Athensville coal member is introduced for coal formerly called Upper Scottville. Occurs below Trivoli sandstone member and above Athensville coal member (new). Thickness 6½ feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: W½SW¼ sec. 16, T. 12 N., R. 9 W., Macoupin County. Well exposed along Apple Creek and its tributaries in southern Morgan and northwestern Macoupin Counties in vicinity of village of Scottville.

Scotty Wash Quartzite[1]

Upper Mississippian: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 21, map.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). On correlation chart of recommended revision of stratigraphic units of Great Basin, Scotty Wash quartzite is replaced by Diamond Peak formation in Pioche district.

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 81–90. Discussion of aspects of Chainman stratigraphy. Chainman is recognized as a valid stratigraphic unit. Diamond Peak and Scotty Wash are not recognized as distinct units but are referred to as facies within the Chainman.

Named for Scotty Wash which passes through formation east of Silverhorn, Pioche district.

Scrag Granite[1] (in New Hampshire Magma Series)

Upper Devonian or Carboniferous: Northwestern New Hampshire.

Original reference: C. R. Williams, 1934, Appalachia, v. 20, no. 4, p. 69–78.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 510, pls. 1, 12. In New Hampshire magma series. Cuts Bethlehem gneiss. Magma series is younger than Lower Devonian, either late Devonian or late Carboniferous.

Named for occurrence on Scrag Hill, Franconia quadrangle.

Scranton Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_5, p. 45, 46, 48.

Well exposed along railroad, about one-half mile south of depot, and at many other places around Scranton, Lackawanna County.

Scranton Shale (in Wabaunsee Group)

Scranton Shale (in Shawnee Group)[1]

Scranton Shale Member (of Shawnee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original references: Erasmus Haworth and John Bennett, 1908, Kansas Acad. Sci. Trans., v. 21, pt. 1, p. 82; 1908, Kansas Univ. Geol. Survey, v. 9, p. 57–160.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 211–214. Term Scranton discarded. Named subdivision treated as formations in Wabaunsee group.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Scranton shale reintroduced as a formation with same stratigraphic span assigned originally to it by Haworth and Bennett. Consists predominantly of shale but contains some thin limestones and shaly sandstones. Comprises upper half of Sac-Fox subgroup of Wabaunsee group; includes strata between Bern limestone (new) above and Howard limestone below. Thickness about 125 feet. Includes (ascending) White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Rulo limestone, and Silver Lake shale members. Reference section proposed.

Reference section: Exposures along an eastward-flowing stream extending through middle part of sec. 34, T. 12 S., R. 15 E., Shawnee County, Kans.

Scrubgrass cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 44–46, table 1, geol. map. Includes (ascending) Scrubgrass sandstone, 9 feet; Scrubgrass coal; Vanport flint or chert, 1 foot; and Ferriferous ironstone. Occurs below Lower Kittanning cyclothem and above Clarion cyclothem. In area of this report, Allegheny series is described on a cyclothemic basis; nine cyclothems, are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 59–60. Cyclothem includes (ascending) Scrubgrass shale and (or) sandstone, Scrubgrass underclay and coal, Vanport flint, limestone or shale members. Occurs above Clarion cyclothem and below Lawrence cyclothem. In this report, Allegheny series is described on a cyclothemic basis; 13 cyclothems are named. [For complete sequence see Brookville cyclothem.]

Type area for Scrubgrass coal is along Scrubgrass Creek in Venango County, Pa.

Scrubgrass Fire Clay (in Allegheny Formation)[1]

Scrubgrass underclay member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 59. Scrubgrass underclay is member of Scrubgrass cyclothem, although it is not present in area of this report [Athens County].

Named for association with Scrubgrass coal, type locality of which is along Scrubgrass Creek in Venango County, Pa.

Scrubgrass shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 59. Member of Scrubgrass cyclothem in report on Athens County. Average thickness about 10 feet.

Seabee Formation (in Colville Group)

Seabee Member (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska (subsurface and surface).

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Formation, of which Seabee is lowest member, consists largely of marine sandstone to south and shale to north, with bentonite and tuff increasing upward through the formation. Top part of member marked by distinctive 150-foot unit of fossiliferous paper shale, which is low-grade oil shale. Thickness at type locality 450 feet. Overlies Niakogon tongue (new) of Chandler formation (new) in outcrop area; overlies Topagoruk member (new) of Umiat formation (new) to the north; underlies Tuluga member (new) of Schrader Bluff formation (new) and Tuluvak tongue (new) of Prince Creek formation (new).

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 246–248, figs. 2, 4, 5. Redefined as formation to include all dominantly marine rocks of Colville group below Tuluvak tongue of Prince Creek formation. Includes, in many areas, strata previously assigned to lower part of Tuluga member of Schrader Bluff formation as well as strata assigned to Seabee member. Thickness in vicinity of Umiat about 1,500 feet. Unconformably overlies Ninuluk formation at Umiat, and in other areas generally overlies that formation or Niakogon tongue of Chandler formation. South of Umiat area, upper part of formation contains lithologically and faunally distinct unit, the Ayiyak member, but at Umiat and farther north this unit not certainly identified. Ayiyak formerly included in Tuluga member of Schrader Bluff formation. New type locality designated for formation. Although parts of formation are exposed at localities in vicinity of Umiat, only complete section in Umiat area is in Umiat test well No. 11.

Type locality of member: Along Seabee Creek, a tributary of Colville River, for which named. Also well exposed along Maybe Creek, a tributary of Ikpikpuk River.

Type locality of formation: In Umiat test well No. 11, 2½ miles west-northwest of Umiat Mountain, between 545 and 2,040 feet. Named from area of fair to poor exposures in vicinity of Seabee Creek 6½–8½ miles west of Umiat Mountain.

Seahorne cyclothem (in Spoon Formation)

Seahorne cyclothem[1] (in Tradewater Group)

Pennsylvanian: Western and southwestern Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 76–79, 200. Includes Seahorne limestone and Seahorne sandstone. Thickness 3 to 12 feet. Underlies Wiley cyclothem; overlies DeLong cyclothem. Derivation of name and type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Spoon formation (new). Above Delong cyclothem and below Wiley cyclothem. Presentation of new rock-stratigraphic

classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type outcrop: Seahorne Branch, SE¼SE¼ sec. 5, T. 3 N., R. 3 E., Havana quadrangle, Fulton County.

Seahorne Limestone Member (of Spoon Formation)

Seahorne Limestone (in Cherokee Group)

Seahorne Limestone[1] (in Tradewater Group)

Pennsylvanian: Southwestern and western Illinois and eastern Iowa.

Original references: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 801–812; 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 31). Correlation chart shows Seahorne limestone in Cherokee group in Iowa.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 78–79, geol. sections 5–7, 23, 28–32, 34, 36, 37, 39, 40, 42. Grades from scattered limonite-stained nodules in clay about 4 inches thick to a solid ledge more than 6 feet thick. Included in Seahorne cyclothem, Tradewater group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), pl. 1. Rank reduced to member status in Spoon formation (new). In southwestern area, occurs above Vergennes sandstone member and below Davis coal member; western area, occurs above DeLong coal member and below Wiley coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: S½SE¼ sec. 5, T. 3 N., R. 3 E., Fulton County, Ill.

Seahorne Sandstone (in Tradewater Group)

Pennsylvanian: Western and southern Illinois and southern Ohio.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 77, 200. Sandstone in Seahorne cyclothem, Tradewater group. Thickness 6 inches to 6 feet. Where sandstone is more than 3 feet thick, it generally consists of two units separated by about 1 foot of light-gray sandy shale; this threefold division is found at numerous localities in western Illinois.

Type locality not stated; sandstone crops out at type outcrop of Seahorne cyclothem which is on Seahorne Branch, S½SE¼ sec. 5, T. 3 N., R. 3 E., Havana quadrangle, Fulton County, Ill. Sandstone recognized at many places in western Illinois and southern Ohio.

†Sea Island Sands[1] or loams[1]

Pleistocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; 1907, Summary of mineral resources of South Carolina, p. 2 (table); 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 485.

Named for development on islands off coast of Charleston and Beaufort Counties.

Seaman Ranch Shale (in Brad Group)

Seaman Ranch Shale Member (of Brad Formation)[1]

Pennsylvanian (Canyon Series): North-central Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31; 1922, Texas Univ. Bull. 2132, p. 111.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Shown on chart as formation in Brad group. Brad is here raised to group status.

Named for Seaman Ranch in west part of Palo Pinto County, where it is typically exposed along Caddo Creek.

Searsville Formation

Eocene: Northern California.

H. C. Langerfeldt and L. W. Vigrass, 1959, *in* U.S. Congress, Joint Committee on Atomic Energy, Subcommittee on Research and Development, and Subcommittee on Legislation, Stanford Linear Electron Accelerator, Hearings: U.S. 86th Cong., 1st sess., app. D, p. 621. Consists of interbedded sandstones, mudstones, and shales. Ratio of sandstone to mudstone is about 4:3. Sandstones are generally feldspathic, thick bedded to massive, and medium to coarse grained with kaolin matrix. Argillaceous rocks are commonly yellowish-buff massive mudstone, but some grade to grayish and brownish fissile shales. Thickness of interlayers of sand and argillaceous rocks varies from several tens of feet to less than 1 foot. Underlies Miocene Los Trancos formation (new), angular discordance; overlapped by Santa Clara formation and Recent alluvium. Name credited to R. G. Thomas (unpub. map).

Type locality and derivation of name not given. Area described is in Santa Clara and San Mateo Counties. Board on Geographic Names states that Searsville was once a town, now abandoned and flooded by Searsville Lake about 3½ miles southwest of Stanford University campus.

Seattle Formation[1]

Oligocene, upper: Northwestern Washington.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Phil. Soc. Proc., v. 52, p. 579, 582, 604.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 104, 117–118. Upper Oligocene. Suggests name is no longer useful as strata included in the Seattle as originally defined had previously been included in the Lincoln and Blakeley formations.

Probably named for occurrences in vicinity of Seattle.

Seawall Metafelsite

Age not stated: Southeastern Maine.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 176. Described as pink "sugar granite." Along margins grades into Cranberry Island volcanic facies.

Occurs in central part of southwest lobe of Mount Desert Island, Hancock County.

†Sebastian Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Sebastian County, Ark.

Seboomook Formation

Seboomook Slate[1]

Lower Devonian: West-central Maine, and Quebec, Canada.

Original reference: E. H. Perkins, 1925, Am. Jour. Sci., 5th ser., v. 10, p. 374–375.

R. A. Marleau, 1958, Quebec Dept. Mines, Geol. Survey Br., Prelim. Rept. 362, p. 2 (table), 3–4. Formation geographically extended into East Megantic area, Quebec, where it occurs as a northeasterly trending band, consists chiefly of slates with minor metasandstones. Stratigraphically equivalent to Compton formation. Underlies Frontenac formation.

A. J. Boucot, Charles Harper, and Keith Rhea, 1959, Maine Geol. Survey Spec. Geol. Studies Ser. 1, p. 6, 7–9, map. In Beck Pond area, formation consists of main body of gray slate, Bear Pond limestone member (new), and a granite talus member. Top of unit eroded; thickness not measured. Nonconformable on granitic basement complex of pre-Silurian age; locally, unconformably overlies Beck Pond limestone (new). Basal part of formation is of New Scotland (low Lower Devonian), but middle and upper parts to southeast of Beck Pond area are Oriskany (high Lower Devonian).

Best exposure at Seboomook Dam on West Branch of Penobscot River in extreme eastern part of Somerset County, Maine.

Sebree Sandstone Member (of Carbondale Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 27.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 101. Cliff-forming sandstone. Basal member of Carbondale formation, between No. 8a above and Dekoven coals.

Named for development between Sebree and Steamport Ferry, Webster County.

Sebrina Complex

Triassic(?): Eastern California.

G. A. Schroter, 1938, Eng. Mining Jour., v. 139, no. 4, p. 43–44. Intercalated arkosic sandstones, fine sandy shales, and thin-bedded dolomitic limestones metamorphosed into quartzites, schists, gneisses, and hornfels. Thickness 50 to 1,500 feet. Includes Sanford quartzite (new).

Occurs on east flank of Sierra Nevada Mountains, southwest of Bishop, Inyo County.

Seco Formation[1]

Eocene: Central Texas.

Original reference: R. A. Liddle, 1921, Texas Univ. Bull. 1860, p. 85, map, columnar sections.

Exposed in Seco Creek, 3 miles south of west of Yancey, Medina County.

Second Mountain Member (of Pocono Formation)

Lower Mississippian: Central Pennsylvania.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, ser. 4, Bull. G–8, p. 18. Name proposed for massive gray sandstone and

pebble beds composing lowest member of formation. Conformably underlies Peters Mountain member (new); overlies Catskill red beds. Lithologically similar to Cove Mountain member (new) at top of Pocono, but lacks coal beds of that member. Has been referred to as "Berea" but there seems little ground for correlation with Berea of northwestern Pennsylvania.

Named for excellent exposure at Second Mountain on the railroad north of Heckton, Dauphin County.

Second Value Formation (in Montoya Group)

Second Value Member (of Montoya Dolomite)

Upper Ordovician: Southwestern New Mexico.

L. P. Entwistle, 1944, New Mexico Bur. Mines Mineral Resources Bull. 19, p. 17, 18. Member consists of deep-purplish-gray sandy dolomite. Sand grains grouped in wormlike aggregates. In a few places, sand is thinly bedded and crossbedded, and red or black chert fragments are visible. Locally lenticular. Maximum thickness at type locality 90 feet. Underlies Par Value member (new); overlies El Paso dolomite.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 70, 72. Formation comprises the Cable Canyon and the Upham members.

Type locality: On Second Value claim, Boston Hill mining district, Grant County.

†Secretan series[1]

Middle Cambrian: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 78.

Secret Canyon Shale[1]

Middle Cambrian: Eastern Nevada.

Original reference: Arnold Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 255–259.

H. E. Wheeler and D. M. Lemmon, 1939, Nevada Univ. Bull., Geology and Mining Ser., no. 31, p. 23–25, 30, fig. 3. Overlies Geddes limestone (new); underlies Hamburg dolomite. Thickness 1,035 feet.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 12–16. Subdivided to include Clarks Spring member in upper part. Overlies Geddes limestone; underlies Hamburg dolomite.

F. L. Humphrey, 1960, Nevada Bur. Mines Bull. 57, p. 9–14. Described in White Pine district where it comprises four lithologic members, the lower two of which correspond generally to section at Eureka. Thickness at least 1,500 feet, possibly 2,500. Overlies Geddes limestone(?); disconformably underlies Dunderberg shale; Hamburg dolomite, normally present between the Secret Canyon and Dunderberg, missing in this area. Middle Cambrian. [Editor's note on p. 114 includes the following statements: Re-examination of Humphrey's collections from the "Secret Canyon" and re-collection of trilobites from top of member 2 in 1949, show that all known trilobites of "Secret Canyon" in Hamilton district are Upper Cambrian forms. Earlier identifications of *Elrathis*, *Kochaspis*, and *Glyphasis* by Lochman are in error. Trilobites from top of member 2 and also in some of Humphrey's collections represent species

of *Aphelaspis* and *Olenaspella*. Member 2 is lithically like the Swarbrick Limestone at Tybo, Nev., and have an *Aphelaspis* in their upper beds. Revision of age of "Secret Canyon" removes need for an unconformity between it and the Dunderberg. As far as can be determined, Cambrian section on west face of Mount Hamilton is without significant stratigraphic breaks.]

Named for exposures in Secret Canyon, Eureka district.

Sedalia Limestone

Sedalia Formation (in Chouteau Group)

Sedalia Limestone (in Easley Group)

Sedalia Limestone (in Osage Group)[1]

Lower Mississippian: Central, southwestern, and northeastern Missouri and western Illinois.

Original reference: R. C. Moore, 1928, Missouri Bur. Geology and Mines, v. 21, 2d ser., p. 61, 78, 84, 86, 90, 91, 144, 146, 149–154, 166, 254.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 100, 150–155, chart 5. In standard Mississippian section, Sedalia limestone is included in Easley group (new) of Kinderhookian series; overlies Chouteau limestone; underlies Gilmore City limestone.

C. P. Kaiser, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2143–2154. In much of the area of this report [southwestern Missouri], Sedalia dolomite lies conformably on Chouteau limestone. Where Chouteau is absent, the Sedalia rests either on Sylamore sandstone or on rocks of Ordovocian age. In southern area, upper noncherty zone of Sedalia conformably overlaps Northview formation. Unconformably overlain by Osagian rocks, ranging in age from St. Joe to Burlington. Thickness 0 to 70 feet; gradual thickening from east to west. Kinderhookian.

T. B. Beveridge and E. L. Clark, 1952, Missouri Geol. Survey and Water Resources Rept. Inv. 13, p. 71, 72 (fig. 1), 74. [Reprinted from Kansas Geol. Soc. Guidebook 16th Regional Field Conf.] Chouteau redefined as group to comprise (ascending) Compton, Sedalia, and Northview formations. Kinderhookian. Note on Moore's type section.

Charles Collinson and D. H. Swann, 1958, Geol. Soc. America Guidebook St. Louis Mtg., p. 24 (fig. 3), 46 (fig. 8), 49, 50 (fig. 9), 51. Described in western Illinois where it is light-buff massive calcareous dolomite or dolomitic limestone. Maximum thickness 20 feet. Conodont faunas show Illinois Sedalia to be Valmeyer in age and type Sedalia to be Kinderhook. On basis of stratigraphic position and lithologically, the Illinois Sedalia correlates with basal Osage Pierson formation of Missouri. Overlies Chouteau formation; underlies Fern Glen formation.

Type section: At M. K. and T. Sweeney quarry in SW¼SW¼SE¼ sec. 4, T. 46 N., R. 19 W., Cooper County. Named for exposures in vicinity of Sedalia, Pettis County, Mo.

Sedley Formation

Pleistocene: Eastern Virginia.

W. E. Moore, 1956, Virginia Acad. Sci., Geology Sec., Field Trip Guidebook, no pagination. Consists of sands, silts, and clays. Younger than Miocene Yorktown but older than either Sunderland or Wicomico terraces. Underlies Kilby formation (new). New formation names are necessary because names Sunderland formation and Wicomico formation are

meaningless. Both of these terraces are underlain by the same formation, not two formations as was previously believed. Terrace as used here refers to land form only and does not refer to or imply existence of any deposits genetically related to them.

Area discussed is south of James River.

Sedwick Limestone Member (of Moran Formation)[1]

Sedwick Formation (in Moran Group)

Permian (Wolfcamp): Central and central northern Texas.

Original reference: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 40.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Moran group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Described in Colorado River valley as succession of dense hard brown-weathering limestone beds, each 1 to 2 feet thick, separated by brownish clay shale, 3 to 10 feet thick; persistent thin dark chert containing gastropods at top of member. About 25 feet thick. Overlies Santa Anna shale member; underlies Santa Anna Branch shale member of Putnam formation.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 270–271. Geographically extended into Brazos River valley where it is 40 to 55 feet thick and consists principally of alternating thin limestone and thick shale beds. South of Clear Fork of Brazos River, basal limestone grades laterally into calcareous sandstone in part of Shackelford County. Uppermost member of Moran formation, three underlying members of formation not differentiated in area. Underlies Santa Anna Branch shale member of Putnam formation.

Named for outcrops west of Sedwick, Shackelford County.

Seeber Flats Sandstone (in Indian Bluff Group)

Pennsylvanian (Pottsville series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Thickness as much as 60 feet; average 25. Underlies a shale interval 40 to 120 feet thick which in turn underlies the Stockstill sandstone (new); overlies a shale interval 40 to 120 feet thick at base of group.

Named from exposures in the Briceville-Norman School section, Lake City quadrangle, Anderson County. At an elevation of 1,670 feet, a side road leads southward to Seeber Flats, formed on this sandstone.

Seekonk Beds[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 173–176.

Named for occurrence in Seekonk Township, Bristol County, Mass.

Seekonk Conglomerate[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 174, 176.

Named for occurrence in Seekonk, Bristol County, Mass.

Seekonk Sandstone[1]

Pennsylvanian: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134.

Seeley Slate[1]

Precambrian (middle? Huronian): Southern Wisconsin.

Original reference: S. Weidman, 1904, Wisconsin Geol. Nat. History Survey Bull. 13, p. 46.

Named for occurrences near Seeley Creek, Sauk County.

Seeleyville Coal Member (of Spoon Formation)

Pennsylvanian: Western Indiana and eastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), pl. 1. Assigned member status in Spoon formation (new). Only named member of formation in area. Has been referred to as Coal III in Indiana. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Mines in vicinity of Seeleyville, Ind., T. 12 N., Rs. 7 and 8 W., Vigo County, Ind.

Sego Sandstone (in Mesaverde Group)

Sego Sandstone Member (of Price River Formation)[1]

Upper Cretaceous: Central eastern Utah and central western Colorado.

Original references: C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23, 35–36, 38–40, pl. 6; D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

C. E. Erdmann, 1934, U.S. Geol. Survey Bull. 851, p. 23 (table), 32, 34–40. Lowest mappable division of Mesaverde group in Colorado is Sego sandstone, this name having been applied to these beds in Utah by Fisher (in preparation), who treats them as a member of Price River formation. Coal-bearing rocks and associated strata above the Sego sandstone are herein named Mount Garfield formation. Boundary between Mancos shale and overlying Sego sandstone marks transition from marine shale to deposits of littoral zone. The sandstone in part rests conformably on the shale and in part intertongues with it. At type locality, the Sego consists of single unit of sandstone, but in Book Cliffs of Colorado it is split by Anchor Mine tongue of Mancos shale.

J. D. Fisher, 1936, U.S. Geol. Survey Bull. 852, p. 9 (table), 14, 15–16. Price River formation thickens eastward and beyond Price River is divisible into four members (ascending): Castlegate sandstone, Sego sandstone, Neslen coal-bearing member, and Farrer non-coal-bearing member. In area of this report [Book Cliffs, Utah], Castlegate and Sego sandstones are separated by Buck tongue of Mancos shale. Thickness 140 to 210 feet.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 188, 189–190, figs. 2, 3, pl. 3. Neslen facies of Price River formation includes (ascending) Castlegate, Sego, Corcoran (new), Cozzette (new) and Cameo (new) members. Term Sego member is used to replace name Sego sandstone member as applied by Fisher (1936) to a series of interbedded sandstone and shales at town of Sego. It includes rocks formerly called Sego sandstone as well as the overlying and closely related coal-bear-

ing rocks. Base is drawn at gradational contact of lowermost littoral marine sandstone tongue with underlying marine shale. Upper boundary placed at slight disconformity between the coal-bearing rocks and overlying marine shale tongue beneath Corcoran member. Average thickness 200 feet. Littoral-marine part consists of several thin sandstone tongues; the first appears near Woodside, Utah. Three are more persistent than the rest and can be traced eastward into Colorado. In most localities, each main sandstone tongue is overlain by fresh- or brackish-water deposits of sandstone, sandy shale, or shale. Thin westward-pointing tongues of Mancos grade upward into overlying littoral-marine sandstone tongue and rest disconformably on the brackish- or fresh-water deposits. Littoral-marine sandstones vary from massive-bedded medium-grained buff sandstones to thin-bedded fine-grained silty gray sandstones with shale partings; maximum thickness of sandstones about 50 feet. Above upper sandstone tongue are 60 feet of coal-bearing rocks which include the main coal bed (Anchor coal) of the Sego member. Montana age.

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 10–11, 13, 15–16, pls. 5b, 6b, 10–12. Rank raised to formation in Mesaverde group. In eastern Book Cliffs (western Colorado), the Sego is basal unit of Mesaverde and contains Anchor Mine tongue of Mancos shale; underlies Mount Garfield formation. In central Book Cliffs (Utah, east of Green River), the Sego underlies Neslen formation.

Named for settlement of Sego in T. 20 S., R. 20 E., Utah. In Book Cliffs.

Seguin Formation (in Wilcox Group)[1]

Eocene, lower (Midway-Wilcox): Eastern Texas.

F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 558, 574, 634. Proposed for all marine strata between the compact silty clays of Midway group and base of nonmarine Rockdale formation of Wilcox group. In most places, base is marked by contact of thinly laminated carbonaceous and fossiliferous sands with silty clays; top is limited by a thin concretionary layer made up largely of shells of *Ostrea multilira* Conrad. Consists of about 50 percent fine sand, 30 percent silt, 19 percent clay, and 1 percent carbonaceous matter. Thickness throughout central Texas 50 to 75 feet; Rio Grande Valley probably 190 feet; in wells south of outcrop 100 to 160 feet. Comprises two members: Caldwell Knob oyster bed above and Solomon Creek clays and sands. Conformably overlies Kerens member of Wills Point formation in northeastern Texas; disconformable on middle Wills Point in south-central Texas; disconformable on Kincaid in southwestern Texas.

M. W. Beckman and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. As originally defined, straddles Midway-Wilcox boundary. Solomon Creek clays and Caldwell Knob sands are redefined so that base of Wilcox is placed at a disconformity marking top of Solomon Creek and base of Caldwell Knob clays. where it is possible to recognize these divisions as redefined, Solomon Creek member should be regarded as member of Wills Point formation and Caldwell Knob as basal member of Rockdale formation. Where these divisions cannot be differentiated, it may be necessary to continue use of Seguin formation, recognizing that it contains the break between the Midway and Wilcox.

Type locality: Along banks of Moss Branch 10 miles northwest of Bastrop, in northwestern part of Bastrop County.

Seigas Conglomerate or Sandstone

Upper Silurian: Northern Maine, and New Brunswick, Canada.

O. O. Nylander, 1940, Geological formations of the St. John River valley, northern Maine and New Brunswick: Caribou, Maine, p. 7–8. Limestone conglomerate made up of rounded blue limestone slabs and small boulders in a sand matrix; in center of outcrop is a coarse sandstone, about 3½ feet thick, made up of quartz pebbles.

Named for exposures 2.3 miles east of St. Ann's Church and 1½ miles west of Seigas River, northern Maine.

Seignelay glaciation

Seignelay till[1]

Pleistocene (pre-Nebraskan): Illinois and Iowa.

Original reference: C. R. Keyes, 1932, Pan-Am. Geologist, v. 58, p. 203, 217.

C. R. Keyes, 1938, Pan-Am. Geologist, v. 68, no. 2, p. 129. Referred to as glaciation.

Seine Series[1]

Precambrian: Ontario, Canada, and northern Minnesota.

Original reference: A. C. Lawson, 1912, Canada Geol. Survey Mem. 28, p. 10.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1031. Sediments of Seine series are equivalent to Knife Lake group; latter name has priority.

Selah Formation

Selah Tuff Member (of Ellensburg Formation)

Miocene and Pliocene: South-central Washington.

J. H. Mackin, 1947, (abs.) Northwest Sci., v. 21, no. 1, p. 33. Defined as tuff member of Ellensburg formation. Contains distinctive beds of pummicite and quartzitic gravel. Overlies Yakima basalt; underlies Wenas basalt member of Ellensburg.

W. N. Laval, 1956, Dissert, Abs., v. 16, no. 5, p. 945. Rank raised to formation. Consists essentially of fluviatile and aeolian clastics of volcanic origin. Miocene-Pliocene formations are (ascending) Yakima basalt, Selah, Wenas basalt, and Ellensburg. This sequence comprises a part of two mutually interfingered lithosomes—one of sedimentary rocks and other of flood lavas.

Type locality: South flank of Selah Ridge, Yakima-Ellensburg area.

Selah Butte Flow

Miocene and Pliocene: South-central Washington.

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 673, pl. 1. Wenas basalt between Selah Butte and Selah Springs is surmounted by several small buttes eroded from overlying Ellensburg formation. Four of these buttes are capped by remnants of a basalt flow. This flow, here called Selah Butte flow, is basalt tongue in Ellensburg about 150 feet above top of Wenas basalt. Flow could not have extended far to

south or west because Ellensburg sequence is well exposed on either side of Yakima Ridge and in lower Wenas Creek, but Selah Butte flow is missing at these localities. Stratigraphically below Elephant Mountain flow (new). Map bracket shows Ellensburg and associated basalt flows as Miocene and Pliocene. Text states that much or all of Ellensburg and its associated intercalated basalt flows is regarded as Pliocene.

Caps four small buttes between Selah Butte and Selah Springs, Yakima East quadrangle.

Selatna Glaciation

Pleistocene: Central-southern Alaska.

A. T. Fernald, 1953, *in* T. L. Péwé and others, U.S. Geol. Survey Circ. 289, p. 6, 13 (table 1); A. T. Fernald, 1960, U.S. Geol. Survey Bull. 1071–G, p. 222–225, 232–233. Two major glaciations of western part of Alaska Range recognized in upper Kuskokwim region. The older Selatna preceded the Farewell glaciation (new). Represented along West Fork of Kuskokwim River by high lateral moraines within mountainous area and by broad end moraine on piedmont; along Middle Fork by irregularly shaped, tundra-covered area of greatly subdued morainal topography on the piedmont, 10 to 12 miles north of range; along South Fork by scattered remnants of a lone arcuate moraine which extends to maximum distance of 25 miles from range.

Named from a tributary of Selatna River which originates in the end moraine. In upper Kuskokwim region.

Selby Member (of Rockland Formation)

Middle Ordovician: Southern Ontario, Canada, and northern New York.

G. M. Kay, 1937, Geol. Soc. America Bull., 48, no. 2, p. 252–255, pl. 2. Name proposed for lower member of formation. Includes limestone characterized by *Doleroides ottawanus* Wilson succeeding Black River group. In type section where only upper 4 feet is exposed, unit consists of dark-gray to black medium- to fine-textured petroliferous limestone in thin buff-weathering beds with a jointed splintery fracture. In northwestern New York and Ontario, lithology is variable but similar to that at type locality. Represented by rather heavy-bedded black chert-bearing limestone southeastward. Maximum thickness about 15 feet. Underlies Napanee member (new); overlies Chaumont formation of Black River group. In exposure showing contact of Selby or Watertown limestone, east of Dexter, Jefferson County, N.Y., Black River and Trenton beds are separated by undulating bedding plane. In earlier description of this section (Kay, 1931, Jour. Geology, v. 39, no. 4), the thin metabentonite that is 3 feet from base of Selby was mistakenly believed to separate Leray and Watertown members of Chaumont formation and to be same as persistent clay at that horizon in Glenburnie shale of Ontario. Type Hounsfield metabentonite is of Selby (lower Rockland) age. At Dexter section, the Selby is about 8 feet thick. Probable Selby exposures in Herkimer County, N.Y., previously called Black River. Trenton group. Mohawkian series.

Named for exposure 1 mile north of Napanee Station along Selby Creek in Lot 22, Conc. III, Richmond Township, Lennox and Addington County, Ontario.

Selden Basalt Tongue

Tertiary: Southwestern New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 32 (map), 33, 146. Olivine basalt, interbedded with basal beds of the Santa Fe group.

Near south end of Selden Canyon, Rio Grande Valley.

Seligman limestone (in Tusayan series)[1]

Permian: Northwestern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (table). Underlies Yampai shales; overlies Pierce shales. In Tusayan series (new) of Carbonic age.

Exposed best perhaps in Aubrey Cliffs near Seligman. In Grand Canyon region.

†Selinsgrove (upper) Limestone[1]

Middle Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 78–81.

Occurs below Selinsgrove, Snyder County.

Selinsgrove Limestone (in Onondaga Group)

†Selinsgrove (lower) Limestone[1]

Middle Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 78–81.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 144, 146–149. White applied Selinsgrove to five members of Middle Devonian. Here proposed to drop name for all but his "Selinsgrove lower limestone" with adjective lower now omitted. Thickness varies—65 feet at Selinsgrove Junction (probably maximum); 7 feet in Lebanon County; 20 feet in Carbon County; farther east, appears to merge with Buttermilk Falls limestone. Overlies Needmore shale (new) with contact gradational; underlies Marcellus black shales. Needmore shale was Selinsgrove shale of White (1883).

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 313. Lower Selinsgrove (Onondaga) limestone and Lower Selinsgrove shale of White are represented in Greenbrier County but limestone merges into typical Marcellus shale and cannot always be recognized.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., 53, no. 12, pt. 1, chart 4. Age shown on correlation chart as Lower or Middle Devonian.

Named from exposures near Selinsgrove Junction on east bank of Susquehanna, below Sunbury, Northumberland County.

†Selinsgrove (lower) Sandstone[1]

Middle Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_3, p. 78–81.

Occurs below Selinsgrove, Snyder County.

†Selinsgrove (upper) Sandstone[1]

Middle Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 78–81.

Well exposed in railroad cuts just opposite town of Selinsgrove, Snyder County and 1 mile below Selinsgrove Junction, Northumberland County.

†Selinsgrove Shale[1]

Lower Devonian: Central Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 78–81. 363.

Bradford Willard, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 144. Unit termed Needmore shale.

Exposed about one-fourth mile below Selinsgrove Junction, Northumberland County.

Sellers Limestone Member (of Caseyville Formation)

Sellers Limestone (in Caseyville Group)

Pennsylvanian: Southeastern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 36, 101. Ferruginous dense fossiliferous limestone about 2 feet thick. Between Battery Rock coal above and Lick Creek sandstone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Inf. Circ. 217, p. 9, pl. 1. Correlated chart shows Sellers limestone in Caseyville group below Battery Rock coal and above Battery Rock sandstone. Included in Battery Rock cyclothem. Gives type locality.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 44 (table 1), pl. 1. Rank reduced to member status in Caseyville formation (redefined). Occurs above Battery Rock sandstone member and below Gentry coal member (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 21, T. 11 S., R. 10 E., near Sellers Landing, Hardin County.

Sellersburg Limestone[1]

Middle Devonian: Southern Indiana and north-central Kentucky.

Original reference: E. M. Kindle, 1899, Bulls. Am. Paleontology, v. 3, no. 12, p. 8, 20, 110.

G. G. Sutton and A. H. Sutton, 1937, Jour. Geology, v. 45, no. 3, p. 326, 328. Subdivided to include Speeds limestone member (new) which underlies Silver Creek limestone member.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1066–1067. Close relationship of the Silver Creek and Beechwood [herein given formational rank] implied by their treatment as members of the Sellersburg does not exist. Their fossils represent separate time division in standard Hamilton scale and Beechwood species are distinct from those of all other Indiana Hamilton formations. Swanville formation (new) was deposited after the Silver Creek, and the Beechwood is separated from the Silver Creek and apparently from the Swanville by an erosional disconformity. Terms Sellersburg and Sellersburg beds, as they

have been used practically, are each equivalent to term Hamilton group (as used in this report) which includes all formations between the Jeffersonville and New Albany. To include the Speeds, Deputy (new), and Swanville in Sellersburg would indicate a relationship of all the formations that is contradicted by the different faunal associations and by the affinities of these faunal associations to those in other areas.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 41, 42, pl. 1. Term North Vernon limestone includes entire Hamilton sequence. Sellersburg in its original sense was nearly in synonymy with North Vernon, although its author failed to account for lowest rocks of Hamilton age. Sellersburg, as defined by Kindle (1899) and modified by later workers, is present in Clark County and southern Scott County—that is, throughout the area where Hamilton rocks are readily divisible into Beechwood, Silver Creek, and Speed lithologies; it is not applicable in Bartholomew and Jennings Counties or in most of Jefferson County where Hamilton rocks are not readily divisible on lithologic criteria, and a name other than Sellersburg is useful when reference is made to undifferentiated Hamilton limestones of this area. Name North Vernon as set forth by Borden (1876) is meaningful when applied to the relatively homogeneous Hamilton limestone of Bartholemew, Jennings, and Jefferson Counties. If only one name is to be retained, it should be North Vernon on grounds of priority and inclusiveness. At present, Indiana Geological Survey uses both terms North Vernon and Sellersburg as formation names that include all of the limestones of Hamilton age of southeastern Indiana outcrop. Term Beechwood is used for member at top of Hamilton sequence; names Silver Creek and Speed are applied to lithofacies of the Hamilton rocks; these lithofacies may be used as members in southern part of outcrop belt; Deputy and Swanville "formations" might better be called "zones" or "faunal facies" of the Sellersburg (North Vernon) limestone.

Named for Sellersburg, Clark County, Ind.

†Selma division (of Selma Chalk)[1]

Upper Cretaceous: Alabama.

Original reference: E. A. Smith, 1903, 58th Cong., 1st sess., S. Ex. Doc. 19, p. 12–20, map.

Exposed in bluffs along Alabama River from Kings Landing to Selma and beyond. Named for exposures at Selma, Dallas County.

Selma Group

Selma Chalk[1]

Upper Cretaceous: Alabama, Mississippi, and Tennessee.

Original reference: E. A. Smith, L. C. Johnson, and D. W. Langdon, 1894, Alabama Geol. Survey Rept. Geol. Coastal Plain of Alabama, p. 15, 22, 27, 255, 276–286.

L. W. Stephenson and W. H. Monroe, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1639–1657. Chalk overlies Eutaw formation unconformably. Consists of nearly 900 feet of chalk in west-central Alabama, but is broken by minor unconformity or diastem about 300 feet above its base, a few feet above a thin but persistent zone of hard pure limestone layers interbedded with chalk, the Arcola limestone member (new). Northwestward into Mississippi, lower third of Selma passes

by merging and intertonguing into Coffee sand; upper third merges into Ripley formation; middle third continues into Tennessee as an impure chalk unit. In eastern part of Alabama, the part of chalk below Arcola limestone member merges by intertonguing into Blufftown formation, middle part merges into and intertongues with Cusseta sand, and upper part merges into Ripley formation. Selma and Ripley are separated from overlying Prairie Bluff chalk by important unconformity.

W. S. Cole, 1938, Florida Geol. Survey Bull. 16, p. 25–26. Referred to as formation in report on stratigraphy and micropaleontology of the two deep wells in Florida.

W. H. Monroe, 1941, Alabama Geol. Survey Bull. 48, p. 48–72. Selma chalk divided into three distinct lithologic members: unnamed lower member that includes typical chalky marl exposed at Selma, Arcola limestone member, and upper member of purer chalk designated Demopolis member. Chalky sand that underlies Prairie Bluff chalk in Sumter County and that merges eastward into Ripley formation has been called part of Selma chalk. In this report, it is treated as chalky facies of Ripley formation, restricting name Selma to purer underlying chalk; thus, Selma is restricted to marl and chalk that intervene between Eutaw formation below and Ripley formation above.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Rank raised to group. Includes Mooreville chalk, Coffee sand, Demopolis chalk, Ripley formation, Prairie Bluff chalk, and Owl Creek formation.

H. L. Reade, Jr., and J. C. Scott, [1958] Profile showing geology along U.S. Highway 331, Montgomery County, Alabama (1:16,000): Alabama Geol. Survey. Map legend shows that Selma group includes (ascending) Eutaw formation, Mooreville chalk, Demopolis chalk, Ripley formation, Prairie Bluff chalk, and Providence sand.

Named for Selma, Dallas County, Ala.

Seminoe Formation[1]

Precambrian: Southern Wyoming.

Original reference: T. S. Lovering, 1930, U.S. Geol. Survey Bull. 811–D, p. 221–222.

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

A typical section is on east bank of Deweese Creek, one-fourth mile south of Pyler's Ranch in SW¼ sec. 19, T. 26 N., R. 85 W., South Park, Carbon County.

Seminole Formation (in Skiatook Group)

Seminole Conglomerate[1]

Pennsylvanian (Missouri Series): Northeastern, central, and central southern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

R. C. Moore and others, 1937, Kansas Geol. Soc. 11th Ann. Field Conf. Guide Book, p. 40 (table). Included in Skiatook group.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 23–26. Use of name Seminole formation extended into northeast Oklahoma and applied to shale and sandstone unit lying above unconformity at base of Missouri subseries and below base of Checkerboard limestone. North of Talala, uppermost Des Moines bed is Lenapah limestone; in vicinity of Oologah, it is Nowata shale; and near Tulsa, it is the Memorial shale. Type locality stated.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 47–52. In type area, lies above Holdenville formation and below Francis formation. Morgan (1924, Oklahoma Geol. Survey Bull. 2) found that in Pontotoc County the Seminole is overlapped by the Ada formation which normally occurs about 800 feet higher in the section. In Okfuskee and Tulsa Counties and northward, the Seminole lies above the Holdenville and below the Checkerboard.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 54–62. Further described in Seminole County.

Type locality: Southeast part of Seminole Nation, now Seminole County (probably T. 6 N., Rs. 7 and 8 E.).

†Seneca Chert (in Boone Limestone?)[1]

Mississippian: Southwestern Missouri.

Original reference: W. P. Jenney, 1894, Am. Inst. Mining Engrs. Trans., v. 22, p. 178.

At Seneca, Newton County.

Seneca Flow or Tongue (of Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 112, 133, 134, 143 (fig. 20). East of type locality Clayton basalt consists of many long tongues. For purposes of this report these tongues have been named, from south to north, Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that gave rise to these basalts are unknown.

Forms south rim of Seneca Creek valley, eastern Union County.

Seneca Group

Senecan Group[1]

Senecan Series

Senecan Stage

Upper Devonian: North America.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. As shown on correlation chart, Devonian comprises (ascending) Ulsterian, Erian, Senecan, Chautauquan, and Bradfordian (in part) series. Senecan comprises Finger Lakes stage (new) below and Chemung stage. Upper Devonian.

I. H. Tesmer, 1954, Dissert, Abs., v. 14, no. 12, p. 2317. In study of Cherry Creek quadrangle, New York, Chautauquan series is reduced to Chautauqua group and incorporated in upper part of Senecan series.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 8. Seneca group, Chautauquan series, comprises (ascending) Genesee, Naples, and Chemung formations. Occurs below Arkwright group and above Hamilton group of Erian series.

Charles Schuchert (1910, Geol. Soc. America Bull., v. 20, p. 514) used term Senecan Series for interval between Erian Series (below) and Chautauquan Series above.

Named for exposures in Seneca County and along shores of Seneca Lake.

Seneca Member (of Onondaga Limestone)

Seneca Limestone[1]

Middle Devonian: New York.

Original reference: L. Vanuxem, 1939, New York Geol. Survey 3d Rept., p. 275–278.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1774–1775, chart 4. In central New York, a third division of the Onondaga, the Seneca limestone, is a dark shaly rock underlying the Marcellus and containing an abundance of *Chonetes lineatus*, *Dalmanites selenurus*, and large coiled cephalopods. Name Seneca has fallen into disuse, but, because interval it defines is a well-marked unit, it is here revived. Onesquethaw stage (new). Lower or Middle Devonian.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 629–635, 637–641. Uppermost member of Onondaga in central and western New York. Underlies Moorehouse member (new). Base of member is defined by "Tioga bentonite," a prominent marker bed and an important paleontologic break. Seneca passes to east into Union Springs black shale of overlying Marcellus formation. Thickness near Union Springs (Auburn quadrangle) about 25 feet. Cooper and others (1942) included much more in "Seneca" than did early workers who defined it.

W. A. Oliver, Jr., 1960, U.S. Geol. Survey Prof. Paper 400–B, p. 173–174. Middle Devonian.

Named for occurrence in Seneca County.

Seneca Quartz Porphyry[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: R. D. Irving, 1877, Geology Wisconsin, v. 2, p. 520.

Occurs in sec. 2, T. 17, R. 11 E., Green Lake County.

Senora Formation[1] (in Cabaniss Group)

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1525. Included in Cabaniss group (new).

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 26. In northeastern Oklahoma includes (ascending) Tiawah, Chelsea, Verdigris, and Breezy Hill members. Conformably overlies Stuart shale and underlies Calvin sandstone.

Named for old post village of Senora, which was located in southern part of Okmulgee County.

†Senorito Sandstone Lentil (in Chinle? Formation)[1]

Upper Triassic: Central northern New Mexico.

Original reference: B. C. Renick, 1931, U.S. Geol. Survey Water-Supply Paper 620.

Well exposed in Senorito Canyon, western Sandoval County.

Sensori Agglomerate and Limestone[1]

See Sinosri Formation, correct spelling.

Sentinel Dolomite[1] (in Telescope Group)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 355, 372, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible the correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Murphy tentatively assigned all rocks above the Panamint metamorphic complex to Lower Paleozoic. Sentinel dolomite, Radcliff formation, and Redlands dolomitic limestone are correlated with Noonday dolomite here assigned to Precambrian as defined in this report.

Occurs on Sentinel Peak, southern part of Panamint Range, Inyo County.

Sentinel Granodiorite[1] (in Tuolumne Intrusive Series)

Cretaceous: East-central California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 125, map.

J. F. Evernden, G. H. Curtis, and J. Lipson, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2121, 2122, 2123 (fig. 1). Discussed in paper dealing with potassium-argon dating of igneous rocks. Age given as 88.4 millions of years. Younger than El Capitan granite and older than Half Dome quartz monzonite.

Named for fact it composes Sentinel Rock, Yosemite National Park.

Sentinel Butte Member (of Fort Union Formation)

Sentinel Butte Member (of Tongue River Formation)

Sentinel Butte Shale Member (of Fort Union? Formation)[1]

Paleocene: Southwestern North Dakota and northeastern Montana.

Original reference: A. G. Leonard, 1908, North Dakota Geol. Survey 5th Bienn. Rept.

W. E. Benson and W. M. Laird, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1167. Golden Valley formation (new) overlies Sentinel Butte shale member of Fort Union formation now considered to be of Paleocene age.

R. W. Brown, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 7, p. 1265–1274. New stratigraphic and paleontologic evidence indicates that Sentinel Butte shale, lately considered by some geologists to be of Wasatch (Eocene) age, is, as originally described and assigned, a dark sequence of strata in upper part of Fort Union formation (Paleocene). Correlations discussed.

E. P. Beroni and H. L. Bauer, Jr., 1952, U.S. Atomic Energy Comm. TEI Rept. 124, p. 6, 14–16. In Golden Valley County, N. Dak., shale member contains a 15-foot uraniferous lignite bed herein referred to as Bullion Butte bed. In southwestern North Dakota, member is 300 to 500 feet thick and is conformable with both underlying Tongue River member and overlying rocks tentatively identified as Golden Valley(?) formation.

S. P. Fisher, 1953, North Dakota Geol. Survey Rept. Inv. 11. Referred to as Sentinel Butte facies of Tongue River formation in area of this report [central McKenzie County].

P. R. May, 1954, U.S. Geol. Survey Bull. 995–G, p. 267, 268. About 200 feet of Sentinel Butte shale, uppermost member of Fort Union, is exposed at top of Blue Mountain in northern Wibaux area, Montana and North Dakota. Composed of gray and brown sandstone and shale and contains thin lignite beds. Overlies Tongue River member. Paleocene.

B. M. Hanson, 1955, North Dakota Geol. Survey Rept. Inv. 18. Reallocated to member status in Tongue River formation. Only lower 250 feet present in area [Elkhorn Ranch area, Billings and Golden Valley Counties]. Contact of Sentinel Butte member and underlying part of Tongue River formation is locally picked at base of most persistent and prominent clinker bed or on basis of characteristic lithologies—Tongue River light-tan to gray sand and clay and Sentinel Butte brown sands and clays. Paleocene.

Typically developed at Sentinel Butte, Billings County, N. Dak.

Sentinel Hill Member (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska (subsurface and surface)

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1941, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Marine unit characterized by volcanic glass shards, abundant bentonite, and tuff. In outcrop beds are less consolidated than the underlying members. A little over 1,100 feet of marine beds of this member and nonmarine beds of Kogosukruk member [tongue] penetrated in Sentinel Hill core test well No. 1. In outcrop belt along Colville River, equivalent intertonguing marine and nonmarine beds total 2,340 feet. Overlies Tuluga member (new); underlies Sagavanirktok formation (new). Intertongues with Kogosukruk tongue (new) of nonmarine Prince Creek formation (new).

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 251–252, figs. 3, 4, 5. Surface type locality designated. Type section includes 1,040 feet of strata, of which 335 feet near middle of section are nonmarine beds assigned to Kogosukruk tongue.

Type locality: Bluffs along northwest side of Colville River from 5 to 15 miles northeast of Umiat Mountain. Named from section in Sentinel Hill core test well No. 1.

Sentinell Limestone

Cambrian(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Described as light-gray medium-grained crystalline thin-bedded limestone, usually broken and containing numerous calcite stringers. Thickness 50

to 100 feet. Underlies newly named Vipont limestone; overlies newly named Sentinell quartzite.

In Ashbrook mining district on west side of Goose Creek Range.

Sentinell Quartzite

Cambrian(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Described as white to tan sucrose quartzite. Thickness 100 feet or more. Underlies newly named Sentinell limestone; overlies Harrison series.

In Ashbrook mining district on west side of Goose Creek Range.

Sentinel Mountain Dolomite Member (of Nevada Formation)

Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 43–44, pl. 2. Entirely composed of dolomite and typically exhibits an alternation of light- and dark-colored beds. The light-gray beds are thick bedded and are commonly coarse grained and more saccharoidal in texture than the darker dolomites interbedded with them. Mottling and a faint lamination are characteristic of the darker dolomites. Thicknesses assigned to the member are rather variable, ranging from 410 to 590 feet. The contacts between the Sentinel Mountain member and the underlying Oxyoke Canyon sandstone member (new) and the overlying Woodpecker limestone member (new) are gradational ones.

The member takes its name from Sentinel Mountain at the head of Oxyoke Canyon in the vicinity of Eureka, on the lower southeast slope of which it is well exposed.

Sentinel Rock Flow, Lava

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 47. Andesite flow from vent on Sentinel Rock. Thickness 300 to 400 feet in central part. Probably coeval with Watchman flow (andesite). [Diller and Patton, 1902, U.S. Geol. Survey Prof. Paper 3, described a Sentinel Rock andesite area].

Sentinel Rock is on southeastern rim of Crater Lake.

Sequatchie Formation[1]

Upper Ordovician: Eastern Tennessee, northeastern Alabama, northwestern Georgia, and southwestern Virginia.

Original reference: E. O. Ulrich, 1912, 12th Internat. Geol. Cong., Canada, p. 614, 646, 647, 648, 649, 651, 665, pl.

R. L. Bates, 1939, Virginia Geol. Survey Bull. 51–B, p. 42 (table 1), 55–56, pl. 6. Formation, in Powell Valley, Lee County, is top of Ordovician section. Unconformably overlies Reedsville formation; underlies Clinch formation. Thickness 135 feet along State Highway 64, south of Lee-Wise County line. Richmond age.

R. L. Miller and J. O. Fuller, 1947, U.S. Geol. Survey Prelim. Map 76, 2 sheets. Formation, in Rose Hill oil field, Lee County, Va., underlies Hagan member (new) of Clinch formation. Overlies Reedsville shale. Thickness 274 feet. Upper Ordovician.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 33–35, geol. map. Formation known to be present wherever its horizon crops out as far east as northwest slope of White Oak Mountain

and its southward continuation, Taylor Ridge. Not observed in ridges carrying Red Mountain formation east and south of Tunnel Hill to and including Lavender Mountain. Thickness about 250 feet. Map legend shows Sequatchie above the Maysville and below the Red Mountain. Silurian or Ordovician.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 209, 211, 219–229. Term Sequatchie used for the calcareous shale, mudstone, argillaceous limestone in Sumner, Macon, Trousdale, Clay, and Pickett Counties and in Sequatchie Valley that occur between Leipers formation and Brassfield limestone, or Chattanooga shale where Brassfield is absent. Fernvale limestone can be recognized in parts of Sumner and Marion Counties, and the underlying argillaceous beds are referred to Sequatchie formation. Thickness as much as 160 feet. Believed to contain beds equivalent to Mannie shale and Fernvale limestone. Western tongue of Sequatchie underlies Fernvale limestone and overlies the Arnheim or Leipers formation. Richmond group.

L. D. Harris and R. L. Miller, 1958, U. S. Geol. Survey Geol. Quad. Map GQ–111. Name Sequatchie has been applied to sequence of marine rocks between top of Reedsville shale and base of Clinch sandstone on Powell Mountain (Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1). Purported nonmarine equivalent of the Sequatchie at Clinch Mountain in Duffield quadrangle has been called Juniata formation by Butts (1940). This sequence of rocks on Clinch Mountain is calcareous throughout, and marine fossils have been collected from lower part of formation. Proposed herein to abandon name Juniata in Clinch Mountain area of Duffield quadrangle and to extend use of term Sequatchie for these rocks. Thickness 260 feet at Powell Mountain; about 325 feet at Clinch Mountain.

Named for exposures in Sequatchie Valley, Tenn.

Sequoyah Formation (in Pottsville Group)[1]

Lower Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Type locality not stated.

Serbin Sand Lentil (in Mount Tabor Member of Yegua Formation)

Eocene (Claiborne): Eastern Texas.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3945, pt. 2, p. 859 [1940]. Name applied to hard glauconitic sand lentil at top of Mount Tabor member of Yegua.

Type locality: About 1¾ miles northwest of Serbin, Lee County. Forms prominent cuesta.

Sergeant shale[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 148, 150.

Named for Sergeant Bluff, Woodbury County.

Serna schist[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 11.

In section near Picuris, north of Santa Fe, on west flank of Rocky Mountains, in Santa Fe region.

Serpiente Sandstone

Upper Cretaceous: Southern California.

O. T. Marsh, 1956, Dissert. Abs., v. 16, no. 1, p. 101; 1960, California Div. Mines Spec. Rept. 62, p. 7 (fig. 3), 20–24, pls. 1, 2. Consists of about 85 percent arkosic sandstone and 15 percent shale. Divided into three members: Huevo—massive conglomeratic, concretionary sandstone with *Glycimeris veatchi* bed—occurs locally at top of formation; Torcido—light-brown finely laminated, fine-grained arkose with hassock structures; conglomerate at top contains *Baculites chicoensis*, *Submortoniceras chicoensis*, *Trigonia* sp.; Avila member (new). Thickness 4,160 feet at type locality. Conformably overlies Aguila sandstone (new) northeast of Johnson Peak and for distance of 2.3 miles northeast of Avila Canyon: at all other places in area an undetermined thickness of basal part of formation is missing where it has been thrust upon other units. In Sawtooth Ridge and Devil's Den synclines, is overlain conformably by Moonlight formation; elsewhere upper contact is fault separating it from Red Man sandstone (new). Huevo is Spanish word for egg and refers to rounded concretions in the unit; Torcido is Spanish word for contorted and refers to contorted bed in the unit. [Hence, Huevo and Torcido are descriptive terms, not formal names.]

Type locality: Serpiente Ridge and vicinity, Pyramid Hills quadrangle, Orchard Peak area which lies principally in northwestern Kern County.

Serrano Clay Bed (in Silverado Formation)

Paleocene: Southern California.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Name applied to a white clay that lies 275 feet above the Claymont clay bed (new). It is generally a quartzose sandstone with a light-gray clay matrix. Thickness variable, not more than 1⅓ feet.

Type locality: Serrano clay pits about half a mile southeast of divide between Santiago Creek and Aliso Creek, northeastern Santa Ana Mountains, Orange County.

Servilleta Formation

Pliocene, upper, or Pleistocene, lower: Central northern New Mexico.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 53, 83, pl. 1. Consists of alluvial beds with prominent interlayered basalt flows. Alluvial beds composed of gravel, sand, and clay. Gravels distinguished by abundant layers of micaceous sand and much limonite. Flows of basalt are typically about 50 feet thick. Thickness at least 1,500 feet in area north of Picuris Range along the Rio Grande and near Embudo. Unconformably overlies both Picuris and Santa Fe beds along northeasterly and north-central borders of Picuris Range. Name credited to Butler (unpub. thesis).

Exposed along northeasterly and north-central borders of Picuris Range, Taos County.

Sespe Formation

Eocene, upper, and Oligocene: Southern California.

Original reference: W. L. Watts, 1897, California State Mining Bur. Bull. 11, p. 22–38.

W. C. Putnam, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 697 (fig. 3). Shown on generalized columnar section of Ventura region as overlying Coldwater sandstone member of Tejon formation and underlying Vaqueros formation. Thickness about 4,000 feet. Oligocene; lower part Eocene.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1913–1935. Name applied to nonmarine red-bed facies of group of sedimentary rocks up to 7,500 feet thick that range in age from upper Eocene to lower Miocene in southern and eastern parts of Ventura basin but that are probably restricted to the Oligocene in most of northern and western part of basin. Variation in age of Sespe is from east to west. North of Santa Clara River, between Fillmore and Point Conception, overlies Coldwater sandstone.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 31, 38 (fig. 2), pls. 1, 2. Formation, in western Santa Ynez Mountains, is series of continental sandstones, clays, and conglomerate lying above the Gaviota or older formations and below Vaqueros sandstone. Thickness 2,200 feet. Between Refugio and Gaviota Canyons progressively lower beds of formation grade laterally westward into marine Alegria formation (new). Oligocene.

Type locality: On Sespe Creek about 6 miles north of Fillmore, in northwestern part of Camulos quadrangle.

Seth Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southwestern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 168.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 60, 101, pl. 9. Blue-gray fossiliferous limestone that occurs a few feet above the Cedar Grove coal. Kanawha group.

Type locality: Near Seth, Sherman district, Boone County.

Setters Formation[1]

Setters Quartzite

Lower Paleozoic(?) (Glenarm Series): Maryland, Pennsylvania, and Virgina.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Rept., v. 1, p. 130–132.

E. B. Bailey and J. H. Mackin, 1937, Am. Jour. Sci., v. 33, no. 195, p. 187. Baltimore gneiss, which forms basement complex, is Precambrian; the succeeding Setters quartzite, Cockeysville marble, and Wissahickon schist are Lower Paleozoic.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12], Carroll and Frederick Counties, p. 53–55, 81. Formation directly overlies Baltimore gneiss; structural discordance is observable in many places, but in many places the contact is obscured. Comprises three lithologic types: mica schist, vitreous quartzite, and mica gneiss; base of formation in Maryland is a feldspathic mica schist. Underlies Cockeysville marble. Maximum thickness, measured on north side of Glenarm-Towson anticline in Baltimore County, 1,100 feet; estimated thickness on borders of Woodstock anticline, 250 feet. May be Lower Cambrian.

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1029 (table 1). At base of Glenarm series. Underlies Cockeysville formation; overlies Basement complex. Pre-Silurian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Most characteristic occurrence is in Setters Ridge, which forms the north front of the Chattolanee anticline, Baltimore County, Md.

Setters Ridge Quartzite[1].

Precambrian (Glenarm Series): Maryland, southeastern Pennsylvania, and Virginia.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Rept., v. 1, p. 130–132.

Seven Devils Volcanics[1]

Permian and Upper Triassic: Central Idaho.

Original reference: Waldemar Lindgren, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 193–198, pl. 8.

E. F. Cook, 1954, Idaho Bur. Mines and Geology Pamph. 97, p. 3. Age changed to Permian and Upper Triassic. Described as thick series of clastic and volcanic rocks, including andesitic flows and tuffs metamorphosed to greenstones, rhyolitic flows, waterlaid volcanic grits and conglomerates, quartzites, lenses of impure limestone, and small intrusive bodies. Because metamorphosed andesitic rocks predominate, the most common rock colors are dark green to black; some tuffs are reddish purple, quartzitic rocks are pale green or gray, and rhyolites are gray to almost white. Thickness probably exceeds 10,000 feet in Seven Devils region.

Mapped over large area at and around Seven Devils Mountains.

Seven-Mile Tuff and Sand Member (of Tuscan Formation)

[Pliocene]: Northern California.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. Tuscan formation is subdivided into five members. Seven-Mile tuff and sand is third in sequence (ascending). Underlies Iron Canyon agglomerate member; overlies Bald Hill agglomerate member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

Seven Rivers Formation (in Artesia Group or Whitehorse Group)

Seven Rivers Formation (in Carlsbad Group)

Seven Rivers Gypsiferous Member (of Chalk Bluff Formation)[1]

Permian (Guadalupe Series): Southeastern New Mexico and western Texas.

Original reference: O. E. Meinzer, B. C. Renick, and Kirk Bryan, 1926, U.S. Geol. Survey Water-Supply Paper 580–A, p. 6–7, 13–15, map.

R. K. DeFord and E. R. Lloyd, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 9. Whitehorse group of West Texas and New Mexico is divided into (ascending) Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 67–68, 101 (fig. 12). Term Seven Rivers gypsiferous member of Chalk Bluff used for outcrop

area of this report [southern Guadalupe Mountains]; correlation chart shows Seven Rivers formation in Whitehorse group in subsurface in Midland Basin.

N. D. Newell, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 46. Carlsbad group comprises (ascending) Seven Rivers, Yates, and Tansill formations; in each of these are several laterally equivalent interfingering lithologic facies arranged in belts parallel to Capitan reef. Within a few miles of equivalent part of reef, the Seven Rivers consists of thin-bedded fine-grained white dolomite about 500 feet thick. In some areas, thin sandstones, which wedge out toward reef, are interbedded with the dolomites. Entire formation passes shelfward from dolomite to gypsum within a few miles. Tongue of fine-grained thin-bedded dolomite (Azotea) in upper part of formation extends several miles shelfward into red facies.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Seven Rivers limestone described in Wylie Mountains region, Texas, where it is youngest Paleozoic formation. Maximum thickness 160 feet. Overlies Victorio Peak formation; unconformable below Cretaceous Cox sandstone.

P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Formation described in Carlsbad Cavern East quadrangle, New Mexico, where it is lowermost formation in Carlsbad group. Underlies Yates formation; grades laterally into Capitan limestone.

P. T. Hayes and R. L. Koogle, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–112. Described in Carlsbad West quadrangle, New Mexico-Texas. Basal formation of Carlsbad group. Formation present at surface in broad outcrop band, in numerous nearby outliers, and in one inlier in northwest part of quadrangle. Conformably overlain by Yates formation. Seven Rivers grades laterally into lower part of Capitan limestone of Delaware Basin margin area. In stratigraphically higher beds this facies change takes place progressively to southeast. Individual beds thicken considerably and change from dolomite to limestone within horizontal distance of several hundred feet. A little northwest of gradation between Capitan and Seven Rivers, another lateral gradation from predominant dolomite to predominant gypsum occurs within Seven Rivers. This takes place in and near Johnson Canyon. Within limits of this report gypsiferous facies contains high percentage of dolomite, but percentage of dolomite decreases in northwesterly direction. Thickness 460 feet in Bear Canyon.

Terms Carlsbad Group and Chalk Bluff Formation abandoned; replaced by Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4).

Named from exposures in bluffs south of Seven Rivers, notably bluff that lies in secs. 17 and 18, T. 20 S., R. 26 E., Eddy County, N. Mex.

†Seven Sisters Sandstone[1]

Pennsylvanian: Eastern Kentucky.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 119.

Exposed at Seven Sisters on Cumberland River.

Seven Springs Formation (in McCutcheon Volcanic Series)

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 345–346, pl. 1. Name applied to the lavas, tuffs, and interbedded sediments between Star Mountain rhyolite (new) and top of McCutcheon volcanic series. Formation is divided into four lava members and four tuff members that alternate with one another. Composite section near type locality is 682 feet thick.

Named for Seven Springs near Willis McCutcheon ranchhouse 7 miles south of Toyahvale, Reeves County. Exposed in syncline north of Star Mountain.

†Severn Formation[1]

Upper Cretaceous and Eocene: Eastern Maryland.

Original reference: N. H. Darton, 1891, Geol. Soc. America Bull., v. 2, p. 431, 438.

N. D. Darton, 1951, Geol. Soc. America Bull., v. 62, no. 7, p. 748. Incidental mention in discussion of Magothy formation. Overlies Magothy.

Named for exposures in cliffs at Round Bay, Severn River.

Severy Shale (in Wabaunsee Group)

Severy Shale (in Shawnee Group)[1]

Severy Shale Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northeastern Missouri, southeastern Nebraska, and northern Oklahoma.

Original reference: E. Haworth, 1908, Kansas Univ. Geol. Survey, v. 3, p. 66.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 20. Thickness in Iowa and southeastern Nebraska 9 to 20 feet.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 63. Underlies Bachelor Creek limestone member of Howard limestone; overlies Coal Creek limestone member of Topeka limestone. Thickness commonly 70 to 80 feet.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 45 (fig. 18), 47–48. Moore (1936, Kansas Geol. Survey Bull. 22) redefined Severy as basal formation of Wabaunsee group, including section between top limestone of Topeka formation and bottom limestone of Howard formation. Moore (1932) introduced name Aarde for shale section between lower and middle limestone members (Bachelor Creek and Church limestones, respectively) of Howard formation and suggested (1936) that where basal limestone is missing, the resulting shale section should be called Severy-Aarde shale. Lowest stratigraphic unit of Wabaunsee group in Pawnee County is shale-sandstone section between Turkey Run and Bird Creek limestones. Branson (1956, Oklahoma Geology Notes, v. 16, no. 11) applied name Severy shale to this unit in north-central Oklahoma. Inasmuch as Bird Creek is equivalent to Church limestone member of Howard, it is evident that Severy shale of Pawnee County is equivalent to Severy-Aarde shale of Kansas. Severy can be traced southward from Kansas into Creek and Lincoln Counties, Okla., where one or both of the limiting limestones pinch out. Thickness 27 to 40 feet in Pawnee County. Overlies Turkey Run limestone member of Pawhuska; underlies Bird Creek limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 14, fig. 5. Forms base of Wabaunsee group. In places, underclay is

present beneath Nodaway coal. Black slaty shale or gray fossiliferous shale overlies coal, and gray shale with some limestone nodules forms base of formation. Average thickness about 7 feet. Underlies Howard limestone; overlies Topeka limestone.

Named for Severy, Greenwood County, Kans.

Sevier Shale or Formation

Sevier Shale (in Blount Group)[1]

Middle Ordovician: Eastern Tennessee, northern Georgia, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 4.

C. H. Gordon, 1924, Tennessee Dept. Ed. Div. Geol. Bull. 28, p. 39–40, 63–65, map. Near Friendsville, Tenn. includes Meadow marble member (new).

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1182–1183. Discussion of lower Middle Ordovician of southwestern Virginia and northeastern Tennessee and suggests recommendations for revision of nomenclature. The Sevier and "Ottosee" are essentially equivalent formations, the latter being named by Ulrich to obviate use of term Sevier, which had been erroneously applied to the younger Martinsburg formation in much of earlier mapping in Virginia and Tennessee. In this respect, Ottosee formation offers no improvement over Sevier since it too has been applied erroneously in northeast Tennessee and southwest Virginia. Gratton limestone is absent in Knoxville region. Benbolt and Wardell equivalents are not readily differentiated lithologically. Therefore, terms Benbolt and Wardell are not applicable in that area; either Sevier should be redefined or a new formational name applied to these beds. According to type description, the Sevier occurs between Tellico and "Bays" sandstones. The type Bays is same as the Moccasin. The latter is in better usage in Tennessee and Virginia and should have precedence over "Bays." Base of Moccasin as generally mapped was not included in type Moccasin by Campbell and was assigned name Bowen (Cooper and Prouty, 1943). The Bowen forms base of the "Bays" and would therefore mark top of Sevier formation. The Sevier might be redefined as bluish-gray buffish-weathering shaly limestone occurring between the Tellico sandstone and Bowen formation. In absence of the latter, the Sevier would underlie Witten limestone and, in absence of this, would underlie Moccasin proper. Section southeast of Lenoir City, Tenn., may serve as a standard for the Sevier. Inasmuch as the Sevier contains equivalents of the Benbolt, Gratton(?), and Wardell, it might be considered a group. However, it is useful as a mapping unit in Tennessee and is herein maintained under formational status.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 29. In belt north of Dalton, Holston marble is overlain by yellowish fossiliferous shale about 100 feet thick. This answers character of much of Sevier or Ottosee shale in Tennessee and is tentatively referred to Ottosee. If it is Sevier, Athens shale and Tellico sandstone which normally intervene between the Holston and Sevier are absent from section in this narrow belt. No Ottosee or Sevier was recognized elsewhere in Georgia.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 76–81, pls.

Keith (1895) named Sevier shale for the wide belt of shale in Sevier

County immediately northwest of Chilhowee Mountain. First published maps on which formation is shown are plate 57 in 13th Annual Report of the U.S. Geological Survey in 1893 and Estillville folio (Campbell, 1894); on these maps, name Sevier was applied to whole mass of shale between the thin limestone below (called Chickamauga by Campbell and Keith) and Bays formation above (Campbell also applied it to the younger Martinsburg shale north of Clinch Mountain, but this erroneous usage may be ignored). Later Keith attempted to subdivide the shale in Bays Mountain area into Athens shale below and Sevier shale above and that in Sevier County area into three units—Athens shale, Tellico sandstone, and Sevier shale, but as result he actually mapped very little of type belt as Sevier. Except southwest of Sevier County, Keith's subdivisions have not proved usable, partly because of complex structure; the mass of shale forms a single mappable unit, though locally it may be possible to map members in it. It is proposed here to return to original meaning of term Sevier and apply it to whole mass of shale where undivided. As thus defined, includes equivalents of typical Athens and Ottosee shale and also of typical Lenoir and Holston formations.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 160–164, pl. 28. Discussion of Middle Ordovician rocks of Tellico-Sevier belt, eastern Tennessee; it includes type area of Sevier shale of Keith. Term Sevier formation is applied to sequence of calcareous shale, calcareous sandstone, and calcarenite about 1,800 feet thick. At top is distinctive unit, 40 to 165 feet thick, characterized by slump-bedding structures, here named Bacon Bend member. Main body of Sevier is similar to Tellico formation, having beds and lenses of sandstone and calcarenite interbedded with shale. Keith (1895) applied term Sevier to interbedded sandstone, shaly limestone, and shale northwest of Chilhowee Mountain. He divided formation into three parts: two shale divisions separated by sandstone lentil. In present report, the shale division below the lentil is assigned to Tellico formation, the sandstone lentil is termed Chota formation, and the Sevier is restricted to shales and sandstones that lie between the Chota and Bays formations.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Keith (1895) mapped as Sevier shale the rocks in Shooks quadrangle herein called Ottosee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 90. Name is applied to thick series of sandy shales and fine-grained sandstones with intercalated beds of calcarenite, bryozoan "reefs" and thin lenses of sandy limestone. Best developed in belts south of Knoxville and along Great Smoky Mountain front into northern Georgia. In vicinity of Friendsville, overlies Red Knobs formation (new) and contains fossils that suggest a Benbolt age. In belt along Great Smoky Mountain Front, the Sevier is very extensive. In northern Georgia, near village of Cisco, Sevier-type lithology succeeds Tellico sandstone and extends to base of Bays red beds. The Sevier appears to be a facies rather than a definite formation.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

Named for exposures in Sevier County, Tenn.

Sevier River Formation

Pliocene, upper, or Pleistocene, lower: Central Utah.

Eugene Callaghan, 1937, (abs.) Washington Acad. Sci. Jour., v. 27, p. 359; 1938, U.S. Geol. Survey Bull. 886–D, p. 100–101. Series of partly consolidated sediments of fanglomerate, conglomerate sand, and silt; fanglomerate and conglomerate grade eastward into pinkish sand and silt, which in turn grade into white diatomite beds. Overlies Tertiary volcanic rocks; underlies Quaternary alluvium.

P. E. Dennis, G. B. Maxey, and H. E. Thomas, 1946, Utah State Engineer Tech. Pub. 3, p. 28 (table). Shown on table of rocks exposed in vicinity of Pavant Valley. Thickness about 800 feet. Occurs below Pavant flow.

P. F. Kerr and others, 1957, Geol. Soc. America Spec. Paper 64, p. 36–37. Only widespread younger sedimentary unit in Marysvale region. Importance of this sediment is its indirect structural implication. Believed to represent accumulation from torrential runoff. It is plastered on steep walls of Mount Belknap rhyolite along Beaver Creek Canyon. Probably deposited after, partly as a result of, main period of Pleistocene graben faulting. Thickness commonly less than a few hundred feet and related to underlying topography.

R. R. Kennedy, 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 4, p. 26, 28, 29, geol. map. Thickness in Tushar Range 300 feet. Unconformable above Tushar conglomerate (new).

Well exposed north of Junction of Clear Creek and Sevier River, Sevier County.

Seville cyclothem (in Abbott-Spoon Formation)

Seville cyclothem[1] (in Tradewater Group)

Pennsylvanian: Western and central Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 189, 192.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63, 70–73. Thickness in outcrop 3 to 26 feet. Includes (ascending) Bernadotte sandstone, Rock Island (No. 1) coal, and Seville limestone. Underlies DeLong cyclothem; commonly rests unconformably on Pope Creek shale or coal. Type locality and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Abbott-Spoon formations (both new). Above Pope Creek cyclothem and below Hermon cyclothem (new). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: In bluff of Spoon River, in SW¼SW¼ sec. 23, T. 6 N., R. 1 E., about 1 mile southwest of Seville, Vermont quadrangle, Fulton County.

Seville Limestone Member (of Spoon Formation)

Seville Formation (in Cherokee Group or Krebs Group)

Seville Limestone (in Pottsville Formation)[1]

Seville Limestone (in Tradewater Group)

Pennsylvanian: Central Illinois, Iowa, southeastern Kansas, and western Missouri.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, no. 3, p. 805.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748, (fig. 1). Shown on composite stratigraphic column of Desmoinesian rocks in northern midcontinent as Seville formation in Krebs group. Underlies Weir formation; overlies Bluejacket formation.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 4), 41. Seville formation, as defined in southeastern Kansas and southwestern Missouri, includes only Seville limestone (Wanless, 1931). Present in Barton and Vernon Counties, Mo., and in southeastern Kansas near Pittsburg, Crawford County. At this place, identification is tentative being based mainly on stratigraphic position because limestone is very impure, has little resemblance to Seville of western Missouri, and, although fossiliferous, does not contain fauna characteristic of Seville. In Kansas, bed tentatively identified as Seville is argillaceous and weathers to thin, irregular slabs; thickness about 6 inches. Seville lies above Bluejacket coal and below underclay of Weir-Pittsburg coal bed where complete succession is present. Forms uppermost unit of Krebs subgroup of Cherokee group. Also present in Iowa.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 72–73, 201 (geol. section 33). Seville limestone included in Seville cyclothem, Tradewater group. At type exposure of cyclothem, the limestone is about 4 feet thick and is argillaceous, blue gray, unevenly bedded, fossiliferous (brachiopods, bryozoa, crinoid stems). Was designated Parks Creek sandstone by Savage (1927)—apparently a typographical error for Barker Creek near Seville.

R. M. Kosanke and others, 1961, Illinois Geol. Survey Rept. Inv. 214, p. 33, 45 (table 1), 63, pl. 1. Assigned to member status in Spoon Formation (new). Occurs above Rock Island (No. 1) coal member and below Hermon coal member (new). Thickness 3¼ feet at type section of Spoon formation. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Southwest bank of Spoon River, SW¼SW¼ sec. 23, T. 6 N., R. 1 E., Vermont quadrangle, Fulton County, Ill.

Sevilleta Metarhyolite

Sevilleta Rhyolite or Formation

Precambrian: Central New Mexico.

J. T. Stark and E. C. Dapples, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1936. Rhyolite younger than White Ridge quartzite (new); intruded by Los Pinos granite (new).

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1134–1135, pl. 1. Two distinct facies of rhyolite recognized—light-buff to reddish-brown sericitic schistose rock at base and upper flows of dense dark-red to black less metamorphosed rhyolite. Base of formation contains about 500 feet of sericitic rhyolite which grades downward into White Ridge quartzite; its groundmass extremely fine grained and compact and exhibits silky luster due to abundance of sericite. Thickness measured north of Los Pinos Arroyo 4,500 feet but undoubtedly greater than exposed in this section. Derivation of name given.

J. T. Stark, 1956, New Mexico Bur. Mines Mineral Resources Bull. 34, p. 11–13, pl. 1. Mapped and described as metarhyolite in South Manzano Mountains. Easily recognized rock types are banded rhyolite, sericite

schist, garnet schist, chloritoid schist, and hornblende-rich rhyolite. Name spelled Sevillita in text.

Named after old Sevilleta Grant within the bounds of which the rhyolites occur; Los Pinos Mountains.

Sevillita Metarhyolite

See Sevilleta Metarhyolite.

Sevy Dolomite[1]

Lower(?) and Middle Devonian: Western Utah and east-central Nevada.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

J. C. Osmond, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1911–1931. Geographically extended into east-central Nevada. Overlies Laketown dolomite; underlies Simonson dolomite. Lower part probably late Silurian. Tentatively correlated with Lone Mountain formation. Detailed discussion of unit.

J. K. Rigby, 1958, Utah, Geol. Soc. Guidebook 13, p. 34–35. Described in Stansbury Mountains where it is as much as 80 feet thick; gradationally overlies Laketown and underlies Simonson(?) dolomite.

M. H. Staatz and F. W. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 8, 29–31, pl. 1. Described in Juab County, Utah, where it is 1,122 feet thick; overlies Thursday dolomite (new) and underlies Simonson dolomite and Guilmette formations undifferentiated.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 143–145. Described in Fivemile Pass-North Boulter Mountain area where it is 128 feet thick; disconformably overlies Laketown dolomite and underlies Simonson dolomite. Dora dolomite (in part at least) should be termed Sevy.

U.S. Geological Survey currently designates the age of the Sevy Dolomite as Lower(?) and Middle Devonian on the basis of a study now in progress.

Named for exposures in Sevy Canyon, on western side of Deep Creek Range, Gold Hill region, Utah.

Sewanee Conglomerate (in Lee Group)[1]

Sewanee Conglomerate Member (of Lookout Sandstone)

Sewanee Member (of Crab Orchard Mountains Formation)

Sewanee Conglomerate (in Crab Orchard Mountains Group)

Sewanee Conglomerate Member (of Lee Formation)

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: J. M. Safford, 1893, Tennessee State Bd. of Health Bull., v. 8, no. 6, p. 89–98.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

V. H. Johnson, 1946, Coal deposits of Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map. Geographically extended into northern Georgia where it is reduced to member status in Lookout sandstone. Overlies Gizzard member; underlies Whitwell shale.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio],

p. 4, 19, pls. 2, 3, 4, 12–C. Basal unit of Crab Orchard Mountains group (new). Medium- to coarse-grained crossbedded massive extremely conglomeratic sandstone in most areas. Thickness as much as 160 feet; average about 80 feet. In northwestern part of the plateau, merges into Fentress formation. The sandstone that has been called "Bon Air" at Bon Air, White County, is equivalent to the Sewanee conglomerate; Sewanee has priority, and name Bon Air is discontinued. Pottsville series. Type locality stated.

Type locality: In area around town of Sewanee, Franklin County, Tenn.

Seward Formation

Pliocene: Southeastern Nebraska.

G. E. Condra and E. C. Reed, 1947, Nebraska Geol. Survey Bull. 15, p. 15–16, fig. 8. Consists principally of medium- to light-gray, in part brownish-gray, very calcareous silts and siltstones with some interbeded marly zones; locally includes basal gravel member composed principally of pebbles of reworked Cretaceous bedrock. Thickness varies from knife edge to about 200 feet. Unconformably overlies Cretaceous or older bedrock; unconformably underlies Holdrege sands and gravels or younger Pleistocene formations. Can be traced westward through late Tertiary channels into typical Ogallala sediments.

Profile section shows Seward present from Lancaster County westward into Buffalo County.

†Sewell Formation (in Rancocas Group)[1]

Eocene: New Jersey.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 316–338.

Named for Sewell, Gloucester County.

Sewell Member (of New River Formation)

Sewell Formation (in Pottsville Group)[1]

Lower Pennsylvanian; Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell and W. C. Mendenhall, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 487, 494.

U.S. Geological Survey currently classifies the Sewell as a member of the New River Formation on the basis of a study now in progress.

Occurs along New and Kanawha Rivers, W. Va. Named for Sewell, Fayette County.

Sewemup Member (of Moenkopi Formation)

Lower and Middle(?) Triassic: Southwestern Colorado and southeastern Utah.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1839–1840, 1842, 1846–1847. Chiefly chocolate-brown fissile siltstone or shale with subordinate interbedded light-brown fine-grained sandstone; gypsum present throughout member, mainly as interstitial cement or crosscutting veinlets near base and in discrete thin nodular beds near top; some beds of light maroon coarse-grained sandstone; locally sandstone is conglomeratic. Thickness 0 to about 450 feet. Cut out toward Uncompahgre Plateau, and locally over salt anticlines and small folds peripheral to Fisher Valley by angular unconformity at base of overlying Chinle formation; in Sinbad Valley, over-

lapped by Pariott member (new) toward axis of anticline. Conformably overlies and intertongues with Ali Baba member (new). Underlies Pariott member (new).

Type section: East side Sinbad Valley, sec. 15, T. 49 N., R. 19 W., Mesa County, Colo. Named for Sewemup Mesa which forms east wall of Sinbad Valley.

Sewickley cyclothem

Pennsylvanian (Monongahela Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 173–176. Embraces interval between Lower Sewickley cyclothem (new) below and Benwood cyclothem (new) above. Normal sequence includes six members (ascending): unnamed shale and sandstone, Sewickley redbed, Sewickley limestone, Sewickley underclay, Sewickley (Meigs Creek) (No. 9) coal, and Sewickley roof shale. Thickness ranges from 11 to 64 feet and averages 33. This variation is accounted for in part by where basal boundary is drawn. Usually base of cyclothem is placed at top of Fishpot coal bed and roof shale; however, if Lower Sewickley cyclothem is present, base is drawn at top of Lower Sewickley coal bed, which results in average thickness of 17 feet for Sewickley cyclothem. Wherever Lower Sewickley cyclothem is present, base of Sewickley cyclothem is placed at top of Lower Sewickley coal zone, and an unnamed shale and sandstone of local occurrence becomes basal member of Sewickley cyclothem. Laterally, this sandstone grades into redbed or is lost in a thick deposit of Lower Sewickley sandstone and cannot be identified. Wherever this unnamed sandstone and underlying Lower Sewickley coal zone cannot be carried laterally Lower Swickley cyclothem is lost and base of Sewickley cyclothem is then drawn at top of Fishpot coal bed and roof shale. Name Lower Sewickley shale and sandstone is used for lowest unit of Sewickley cyclothem when its lower boundary rests on Fishpot cyclothem because it is proper term for this lithology in usual Fishpot to Sewickley coal bed interval, and is continuous with Lower Sewickley shale and sandstone of Lower Sewickley cyclothem. Also, Lower Sewickley redbed member may be represented laterally as either a redbed or sandstone facies of Sewickley cyclothem when base of that cyclothem is considered to be a top of Fishpot coal and roof shale. Under this condition, name Sewickley redbed is more appropriate than Lower Sewickley redbed and is adopted for this facies where Lower Sewickley cyclothem is absent. In area of this report Monongahela series is discussed on a cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County.

†Sewickley Limestone (in Monongahela Formation)[1]

Sewickley limestone member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt and G. W. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 55–104, 286.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 175. Name Sewickley limestone was first used by Platt and Platt (1877) to designate the fresh-water limestone underlying Sewickley coal bed in Somerset County, Pa. White (1891, U.S. Geol. Survey Bull. 65) continued to use this term but applied it to all limestone strata between the Redstone

and Sewickley coal beds, and it was not until after Clark and Martin (1905, Maryland Geol. Survey, v. 5) named and described Fishpot coal bed that name Sewickley limestone was restricted to interval between Fishpot and Sewickley coal beds. In present report [Athens County], Sewickley limestone is referred to as a member of Sewickley cyclothem. Occurs between Sewickley redbed member and Sewickley underclay member. Limestone member is thin or wanting in Athens County but prominent in parts of West Virginia and Pennsylvania.

Named for association with Sewickley coal in Somerset County, Pa.

Sewickley Member (of Monongahela Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Pittsburgh quadrangle.

Sewickley redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 175. Member of Sewickley cyclothem in Athens County. Present above an unnamed shale and sandstone member and below Sewickley limestone member. Thickness 2 to 26 feet.

Sewickley roof shale member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon, 1958, Ohio Geol. Survey Bull. 57, p. 176. Member of Sewickley cyclothem in Athens County. Persistent clay shale 3 or 4 inches to 5½ feet thick. Overlies Sewickley coal bed.

Sewickley Sandstone Member (of Monogahela Formation)[1]

Sewickley Sandstone (in Monongahela Group)

Upper Pennsylvanian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 60.

R. V. Hennen, 1912, West Virginia Geol. Survey [Rept.] Doddridge and Harrison Counties, p. 199–200. Sewickley sandstone (White, 1891) is herein renamed Upper Sewickley sandstone in contradistinction to Lower Sewickley ledge belonging immediately under Sewickley coal. Thickness 40 to 60 feet.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 121, 124 (fig. 29). In Fayette County, Sewickley sandstone lies 120 to 150 feet above Pittsburgh coal which is base of Monongahela group. Thickness as much as 35 feet; average 20 feet. Separated from underlying Fishpot limestone by lower Sewickley coal and from overlying Benwood limestone by upper Sewickley coal.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 19 (table 3). Shown on summary of stratigraphic sections of Monongahela formation in Harrison County as Lower and Upper Sewickley sandstone. Units are separated by (ascending) unnamed sandy shale, Sewickley coal and (or) slate, and unnamed brown shale. Underlies unnamed shale below Benwood limestone; overlies Sewickley limestone and (or) shale.

See Lower Sewickley Sandstone and Upper Sewickley Sandstone.

Probably named for its association with Sewickley coal which was named for exposures along Sewickley Creek, Westmoreland County, Pa.

Sewickley shale and sandstone member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958 Ohio Geol. Survey Bull. 57, p. 177. Shale and sandstone member of Benwood cyclothem in Athens County. Sewickley sandstone was named by White (1891, U.S. Geol. Survey Bull. 65) in his study of Pennsylvanian coal fields of Ohio, West Virginia, and Pennsylvania. In much of its area of occurrence, this member varies radically from thin flaggy sandstone to a massive one from 20 to 60 feet thick or gives way entirely to limestone or redbeds. In Athens County, member is represented by all gradations of sandy shale to massive sandstone. Average thickness 27 feet. Locally member gives way laterally almost in its entirety to redbed facies; more commonly, it is upper part of the member that grades laterally into redbeds and is interbedded with them. Below Tyler redbed member.

Sewickley underclay member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 175. Referred to as member of Sewickley cyclothem in Athens County. Usually occurs in association with Sewickley coal bed. Discontinuous in its lateral extent.

Sexton Creek Limestone[1]

Lower Silurian (Alexandrian Series): Southwestern Illinois and eastern Missouri.

Original reference: T. E. Savage, 1909, Am. Jour. Sci., 4th v. 28, p. 518.

J. M. Weller *in* J. M. Weller and G. E. Ekblaw, 1940, Illinois Geol. Survey Rept. Inv. 70, p. 10; J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71. p. 20. In southern Illinois, overlies both Edgewood and Girardeau limestones and may overlap locally on Orchard Creek shale; in Missouri, overlaps upon strata as old as Kimmswick. Underlies Bainbridge limestone. Consists principally of more or less cherty limestone; lower part of formation is gray, more or less crystalline limestone with thin tabular masses or continuous beds of chert; higher strata are more massive, crystalline, generally darker colored, slightly glauconitic, and less cherty. Locally as much as 40 feet thick.

Named for exposures on Sexton Creek, Alexander County, Ill .

Seymour Formation[1]

Pleistocene: Central northern Texas.

Original reference: W. F. Cummins, 1893, Texas Geol. Survey, 4th Ann. Rept., pt. 1, p. 181–190.

G. W. Willis and D. B. Knowles, 1953, Texas Board Water Engineers Bull. 5301, p. 9. In Odell Sand Hills, Wilbarger County, composed of discontinuous layers of sandy clay, sandy caliche, medium- to very coarse-grained sand, and pebbles that range in diameter from about an eighth of an inch to slightly more than an inch; the beds of pebbles and coarse-grained sand range in thickness from about 1 foot to 85 feet and are, in general, near base of formation. Unconformably overlies Permian rocks. Type locality stated.

Type locality: Between Brazos and Wichita Rivers in Baylor and Knox Counties. Named for town of Seymour, Baylor County.

Shadehill facies

See **Ludlow Member** (of Fort Union Formation)

Shades Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: Charles Butts, 1910, U.S. Geol. Survey Geol. Atlas, Folio 175, p. 10, 11.

T. N. McVay and L. D. Toulmin, 1945, Alabama Geol. Survey Bull. 55, p. 27. Mentioned in report on Alabama shales and fire clays. Base of Pottsville is placed at base of Brock coal seam which underlies Shades sandstone in Cahaba coal field.

Named for occurrence on Shades Mountain, Jefferson County.

Shadow Mountain Basalt Flow

Quaternary: Northwestern Arizona.

D. N. Hinckley, 1955, U.S. Atomic Energy Comm. [Pub.] RME–81 (rev.), p. 8. The Quaternary period was marked by igneous activity in the region. The Tappan lava flow and the Shadow Mountain cinder cone and basalt flow are the nearest volcanics.

In Cameron region, Coconino County.

Shadrick Mill Sandstone (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept. pt. 1, p. 374, 376.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. [Guidebook] Spring Mtg., p. 76. Sandstone, commonly massive but with some flaggy beds and thin conglomerate. Thickness 150 feet. Overlies Elliott Creek bed; underlies bed no. 8. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Shadrick Mill, Lampasas County.

Shady Dolomite[1] or **Formation**

Lower Cambrian: Eastern Tennessee, northern Alabama, northwestern Georgia, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 1–30. Shady dolomite of Great Valley of Virginia is Lower Cambrian and rests on Erwin quartzite and is overlain by Rome formation. Shady dolomite is equivalent to Tomstown dolomite. On lithologic grounds, they may be divided in most places into a lower blue argillaceous banded dolomite and an upper gray to white purer granular dolomite. In southwestern Virginia, Butts (1933) divided Shady into a lower ribboned limestone member (Patterson) and an upper saccharoidal dolomite mem-

ber. Currier (1935, Virginia Geol. Survey Bull. 43) locally included at top of saccharoidal dolomite member a pure limestone which he named Ivanhoe member. In present report, the Ivanhoe is included in base of Rome formation. Partial section of typical Shady south of Fosters Falls Mountain is about 620 feet thick. The equivalent of the Lower Cambrian dolomite in small area on southeastern edge of Great Valley, southeast of Austinville contains group of fossiliferous beds whose fauna, lithology, and stratigraphic position are comparable with Kinzers formation of the York and Lancaster valleys of Pennsylvania. This fossil-bearing series of beds, although equivalent to Shady dolomite of Great Valley, is different sedimentary facies deposited to southeast of main Applachian geosyncline and has been carried northwestward by thrust faulting to rest on typical Shady dolomite. Proposed to extend Pennsylvania names Vintage dolomite, Kinzers formation, and Ledger dolomite to the lower dolomite, middle fossil-bearing beds, and upper dolomite, respectively, of the Shady equivalents of this area.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 40-56. Name Shady has been used south of Roanoke and name Tomstown north of Roanoke. Term Shady has priority and is used throughout this report. Predominantly dolomite, but in some areas includes limestone in both upper and lower parts. In New River district, three members recognized: Patterson limestone in lower part; saccharoidal dolomite in middle herein named Austinville; and Ivanhoe limestone at top. Thickness 1,400 feet at Jackson Ferry; 5,040 feet near Austinville. Overlies Erwin quartzite-Antietam sandstone; underlies Rome formation.

T. L. Kesler, 1950, U.S. Geol. Survey Prof. Paper 224, p. 10–12, pl. 1. In Cartersville district, Georgia, the Shady dolomite consists of variably siliceous specular hematite interbeded with dolomite. Age of rocks is established by fossils, which occur in great numbers in some parts of hematite beds and in residual silicified parts of the dolomite. Thickness about 30 feet. Conformably overlies Weisner formation but is lenticular and not everywhere present. Overlain in most places by dolomite, which has been regarded previously as Shady dolomite. However, name Shady should be restricted to stratigraphic zone containing interbedded hematite and dolomite. The dolomite beds are here included in the carbonate rocks of Rome formation.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 9–12, pl. 1. Shady dolomite, within Hot Springs window, exhibits the several distinct rock types noted in Shady in Tennessee—basal ribboned member, lower blue member, ribboned member, middle blue member, upper white member, and upper blue member. Thickness about 1,975 feet. Overlies Helenmode member of Erwin formation; underlies maroon shales of Rome formation.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. Shady dolomite, oldest exposed unit in Shooks Gap quadrangle, Tennessee, is at base of overriding block of Dumplin Valley fault southwestward from Bean Ridge. Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16) mapped these beds with considerable thickness of overlying beds as Apison shale. Underlies Rome formation; faulted against Knox dolomite.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 45–52, pl. 1. Shady dolomite is lowest carbonate unit of Paleozoic section of Appalachians. The Shady is widely distributed and underlies wide areas of lowlands of Shady Valley, Stony Creek valley, Johnson

County cove, and Doe River cove; north of area of this report, north of Damascus, Va., it crops out in Appalachian Valley. Few outcrops occur at type locality. Much better section is exposed in Stony Creek valley but whole sequence not exposed at single locality. Here Shady is 1,150 feet thick and consists of six members: lower white member (dolomite), about 35 feet; lower blue member (dolomite), 90 feet; ribboned member (dolomite and limestone), 250 feet; middle blue member (dolomite), 250 feet; upper white member (dolomite), 125 feet; and upper blue member (dolomite), 400 feet. Regionally the members probably form interfingering wedges because same members cannot recognized everywhere. In Shady Valley, type locality, the dolomite underlies upper basin and basin below Crandull, the two areas being separated by Helenmode member of Erwin formation of Chilhowee group. Here whole formation is probably present because red shale of Rome formation is exposed along U.S. Highway 421. Inferred that same members are present as in Stony Creek valley and that thickness is about the same.

Typically exposed in Stony Creek valley, Carter County, Tenn. Named for Shady, Johnson County, Tenn.

Shaffer Shale[1]

Middle Devonian: West-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 22, table.

Ontario County.

Shafter Limestone (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: J. A. Udden, 1904, Texas Univ. Min. Survey Bull. 8, p. 10, 11, 25, 30–39.

C. P. Ross, 1943, U.S. Geol. Survey Bull. 928–B, p. 78–83, pl. 7. Rocks herein designated Shafter limestone are exposed in and around town of Shafter and on banks of Cibolo Creek south of Shafter and form part of prominent range of hills about 3.2 miles southeast of Shafter and the valley north of the range. They appear to rest unconformably on Presidio formation. Shafter is defined by Udden contains rocks of both Trinity and Fredericksburg age. Because the Walnut(?) and other younger rocks are susceptible of being mapped separately and are not present close to Shafter, it is here proposed to restrict name Shafter to beds of upper Trinity. Thickness as restricted 1,085 feet. Shafter (restricted) is lithologically similar to Glen Rose limestone and contains similar faunal assemblage.

Exposed in and around town of Shafter, Presidio County.

Shaggy Peak Rhyolite[1]

Eocene(?): Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173, p. 59–60.

In Shaggy Peak, Fairfield quadrangle.

Shakopee Dolomite (in Prairie du Chien Group)[1]

Shakopee Dolomite Member (of Prairie du Chien Formation)

Lower Ordovician: Southern Minnesota, northern Illinois, Iowa, and southern Wisconsin.

Original reference: N. H. Winchell, 1874, Minnesota Geol. Nat. History Survey 2d Ann. Rept., p. 138–147.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 62, 63–66. Overlies and interbedded with Root Valley sandstone (new). Underlies St. Peter sandstone. Thickness 35 feet in Winona County.

R. L. Heller, 1956, Geol. Soc. America Guidebook Minneapolis Mtg. Field Trip 2, p. 38–39. Prairie du Chien group reduced to formation and Oneota dolomite, New Richmond sandstone, and Shakopee dolomite reduced to member status. Name Root Valley shale suppressed. Typical Shakopee is fine- to medium-grained light-brownish-gray to buff thin- to thick-bedded dolomite. Chert not common but where present can be of use in differentiating upper and lower dolomites of the Prairie du Chien. Thickness 37 to 56 feet.

Named for outcrops at Shakopee, Scott County, Minn.

†Shakopee Group[1]

Ordovician: Minnesota.

Original reference: F. W. Sardeson, 1924, Pan-Am. Geologist, v. 41, p. 107–122.

Shaktolik Group[1]

Lower Cretaceous: Central western and central Alaska.

Original reference: P. S. Smith and H. M. Eakin, 1911, U.S. Geol. Survey Bull. 449, p. 57.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 246). Age given as Lower Cretaceous on correlation chart.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Mostly marine. Group divided into (descending) Kaltag formation (nonmarine), Nulato, and Melozi formations (marine) in Koyukuk geosyncline and Hogatza uplift areas.

J. M. Hoare and W. L. Coonrad, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I–292. Group, in Russian Mission quadrangle, comprises part of rocks mapped and described by Harrington (1918, U.S. Geol. Survey Bull. 683) north of the Yukon as Upper Cretaceous. Rocks described by Harrington that are included in group are interbedded sandstone, shale, "argillite," grit, and conglomerate. They are mapped on basis of Harrington's field notes and on basis of photogeologic interpretation. Tuffaceous, "argillaceous," and siliceous rocks as well as "associated grit and conglomerate" mapped by Harrington as Upper Cretaceous are probably of Early Cretaceous (Neocomian) age or older and do not belong to Shaktolik group. Fossils indicate Shaktolik is late Early Cretaceous (Albian) age. Not subdivided in this area. Correlative with lower part of Kuskokwim group.

Named after Shaktolik River which affords good section of the beds. In Lower Yukon River, Norton Bay-Nulato, and Koyukuk River regions.

Shamokin Black Shale Member[1] (of Marcellus Formation)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, Proc. Paleont. Soc. Feb. 28, p. 202–203.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 173. Includes

a dark coquinite. Usually lithologically indistinguishable from Mahanoy black shale member above unless intervening sandy members are present.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 27. In Juniata, Mifflin, and Perry Counties, the Marcellus is subdivided into (ascending) Shamokin shale, Turkey Ridge sandstone, and Mahanoy shale members. Thickness 82 feet at East Waterford section.

Named for Shamokin Creek in western part of Northumberland County.

Shandon Formation

†Shandon Quartzite[1]

Upper Cambrian: Southwestern New Mexico.

Original reference: C. H. Gordon, 1907, Jour. Geology, v. 15, p. 91–92.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 65–66. Discussion of Cambrian-Mississippian beds of southern New Mexico. Here are included basal sandy beds of the Paleozoic which lies between the Precambrian and the El Paso. They are conspicuous dark-weathering beds, appearing black between the tan El Paso and the Precambrian which is pink and granitic. These beds were formerly known as Shandon quartzite in New Mexico, but this name was suppressed in favor of older name Bliss sandstone because they were believed to be identical. Bliss has long been considered Cambrian. Discovery of Canadian fossils in the Bliss in Van Horn region has raised question as to whether whole of formation might be Ordovician. In Caballo Mountains, Mud Springs Mountain, and Tonuco Mountain, the so-called Bliss consists of two parts. Lower unit is of very late Franconian age. Above is 70 feet of dominantly very thin bedded sands and glauconites, somewhat calcereous, and with a narrow but thin conspicuous zone of green silt near top which yields *Dictyonema flabelliforme* var. angelicum. Term Shandon formation is applied to this unit. The Shandon here contains a hiatus, embracing Trempealeauan time, upper Upper Cambrian and Canadian deposition begins with a conspicuous coarse crossbedded sandstone.

Named for Shandon, eastern part of Sierra County.

Shannon Sandstone Member (of Cody Shale)

Shannon Member (of Eagle Formation)

Shannon Sandstone Member (of Steele Shale)[1]

Upper Cretaceous: Central Wyoming.

Original reference: C. H. Wegemann, 1911, U.S. Geol. Survey Bull. 452, p. 43, 47.

C. J. Hares and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 51. Stratigraphic section [southeastern part of Wind River Basin and adjacent areas in central Wyoming] shows Shannon sandstone member of Cody shale. Occurs in upper part of formation. Term Cody shale replaces terms Carlile shale, Niobrara shale, and Steele shale as used in this area by Hares (1916, U.S. Geol. Survey Bull. 641–I).

J. M. Parker, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90–102. Reallocated to member status in Eagle formation in Powder River Basin. Subsurface cross section shows that the Shannon extends into Montana. Stratigraphic unit terms Lewis, Mesaverde, Steele, Cody, Ferguson, and Ash Creek should not be used in Powder River Basin.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 49, pls. Described in Buffalo-Lake De Smet area, Johnson and Sheridan Counties, Wyo.,

where it is member of Cody shale. Consists mainly of nonresistant fine-grained light-gray sandstone with thin partings of dark-gray shale. Thickness 215 feet near Elgin Creek. Separated from underlying Niobrara shale member by unnamed shale and sandstone member; underlies unnamed upper shale member.

Shannondale Limestone Member (of Benbolt Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 833, 834–835, 868–869, 870, 871, 884 (fig. 3). In Tazewell County the strata embraced by the Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Shannondale limestone member is applied to zones 11 and 12. These comprise the second coarse-grained limestone below and the *Opikina* beds, which in type locality are 19 and 60 feet thick respectively. Maximum thickness 125 feet. Underlies Burkes Garden member (new); overlies Peery limestone member (new).

Type section: About three-fourths mile south of Shannondale, Tazewell County.

Shannon Run Limestone (in Washington Formation)[1]

Permian: Northern West Virginia.

Original reference: E. L. Core, 1929, West Virginia Acad. Sci. Proc., v. 3, p. 205.

Named from its exposure on Shannon Run, 2 miles west of Mount Morris, Monongalia County.

Shark River Marl[1]

Eocene, middle: Northeastern New Jersey.

Original reference: T. A. Conrad, 1865, Acad. Nat. Sci. Philadelphia Proc., v. 17, p. 70–73.

H. G. Richards, 1945, Geol. Soc. America Bull., v. 56, no. 4, p. 402. There is no evidence, faunal or stratigraphic, for an unconformity between the Manasquan and Shark River formations (Eocene). It is more probable that these two formations represent a single unit.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 59–61. Originally described as separate formations, Manasquan and Shark River marls are now thought to be equivalent. Manasquan-Shark River formation is reported to overlie conformably the Vincentown and dips on average about 15 feet per mile southeast. No good exposures of the formation occurs in which both upper and lower limits are exposed; hence, thickness is not known but is probably 25 to 30 feet. Chart shows Shark River-Manasquan stratigraphically below Kirkwood formation.

Typically developed in valley of Shark River, Monmouth County.

Sharon Clay[1]

See Sharon cyclothem.

Sharon Conglomerate Member (of Pottsville Formation)[1]

Sharon Conglomerate (in Pottsville Group)

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. P. Lesley, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. 319–333.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 141. Conglomerate is at base of Pottsville formation in Ohio. Varies from medium-grained sandstone to coarse pebbly conglomerate, very loosely cemented. Deposits occupy broad, deep depressions, resembling erosion valleys, cut in Mississippian floor; erratic in distribution; vary from 10 to 250 feet in thickness.

J. O. Fuller, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 159–176. Basal Pennsylvanian Sharon conglomerate of Ohio lies disconformably on even-bedded marine Mississippian shale and sandstone, in relationship similar to its correlatives, the Olean of New York and the Mansfield of Indiana. Crops out in three separate areas: A, B, and C. A covers about 150 square miles in Ohio and is continuation from type area in Mercer County, Pa.; B covers about 2,400 square miles and is separated from area A by the 12-mile-broad Grand River valley; C. covers about 450 square miles in south-central Ohio and is separated from areas A and B by an area about 100 miles along the strike in which the Sharon is lacking and basal Pennsylvanian is a younger formation than the Sharon. This paper deals chiefly with area B in which mapping has been most detailed. In this area, the Sharon is dominantly an orthoquartzite; long narrow belts of conglomerate with a southerly trend lie in the orthoquartzite. It is difficult to separate Sharon orthoquartzite phase from Massillon sandstone (orthoquartzite) when Sharon shale is absent; hence, many sections of sandstone have been classed as Sharon when actually both Sharon and Massillon are present; also lack of recognition that Sharon is dominantly orthoquartzite instead of conglomerate has caused much of orthoquartzite away from conglomerate belts to be classed as Massillon rather than Sharon. This latter fact supported idea of a formation confined to long narrow depressions. Detailed mapping has established the Sharon as a sheetlike deposit with fairly flat top and an irregular base, caused by filling of irregular topography of Mississippian surface. Thickness of sheet of orthoquartzite in area B, 0 to 170 feet. Source of conglomerate and environment of deposition discussed.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 68. In extreme western and northwestern Pennsylvania, and also in southwestern Pennsylvania, the Sharon conglomerate [conglomerate sandstone] forms basal Pottsville but is thought to be absent in other areas.

Type area: Sharon, Mercer County, Pa.

Sharon cyclothem

Pennsylvanian (Pottsville Series): Eastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey Bull. 48, p. 21. Consists of (ascending) Sharon sandstone, shale, and conglomerate, Sharon clay, Sharon (No. 1) coal, unnamed shale, Sharon ironstone, marine. None of named units definitely identified in Perry County [this report].

Name derived from Sharon, Mercer County, Pa.

Sharon Group[1] or Series[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477, 489.

Named for Sharon, Mercer County, Pa.

Sharon Sandstone[1]

See **Sharon Conglomerate Member** (of Pottsville Formation).

†Sharon Shale Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 474–477, 489.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 67–70. In this report, term Sharon (Pottsville series) is used to include the rock strata in interval between top of Sharon No. 1 coal and base of Sciotoville clay. Thickness about 25 feet.

Named for Sharon, Mercer County, Pa.

Sharon Syenite[1]

Devonian(?): Southeastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 182–184, map.

Well developed in town of Sharon, Norfolk County.

Sharon Mountain Quartz Diorite[1]

Precambrian(?): Northwestern Connecticut.

Original reference: W. M. Agar, 1929, Am. Jour. Sci., 5th, v. 17, p. 202–238.

Occurs only in range of hills between Sharon, Litchfield County, and Housatonic River.

†Sharon Springs Formation

Middle Devonian: East-central New York.

Winifred Goldring and R. H. Flower, 1942, Am. Jour. Sci., v. 240, no. 10, p. 677–678, 679, 689–690, 694. Name applied to 20 feet of siliceous shale in vicinity of Sharon Springs, set off from Esopus below and Schoharie above by comparatively thick beds of glauconite. Beds were formerly included in Esopus shale. Both at top and base, contact may be gradational, and exact position of its boundaries is a matter of opinion for many sections in the Helderbergs and in Hudson Valley. In Port Jervis region, has estimated thickness of 200 to 225 feet.

Winifred Goldring and R. H. Flower, 1944, Am. Jour. Sci., v. 242, no. 6, p. 340. Preoccupied name Sharon Springs replaced by term Carlisle Center.

Named for exposures near Sharon Springs, Schoharie County.

Sharon Springs Member (of Pierre Shale)[1]

Upper Cretaceous: Northwestern Kansas, eastern Colorado, western and northwestern Nebraska, and southeastern South Dakota.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7.

W. V. Searight, 1938, Iowa Acad. Sci. Proc., v. 45, p. 137. Geographically extended into South Dakota where it underlies Gregory zone [marl] of Sully formation. Overlies Niobrara. Considered contemporaneous with beds described by Searight (1937) as lower Gregory.

A. L. Moxon, O. E. Olson, and W. V. Searight, 1939, South Dakota State Coll. Agriculture and Mech. Arts Tech. Bull. 2, p. 20–22. In South Dakota, all beds above the Niobrara and below Gregory marl are included in Sharon Springs. Member as here identified consists of beds of dark bituminous shale in lower part, and dark-rusty-weathering beds above. Thicknesses: 7 feet at Yankton; 155 feet at mouth of White River and eastward; possibly 200 to 250 feet north of Belle Fourche.

J. P. Gries and E. P. Rothrock, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 8 (fig. 2), 9–11, 31–32; J. P. Gries, 1942, South Dakota Geol. Survey Rept. Inv. 42, p. 6 (fig. 2), 7–9. Beds comprising "upper" member (Moxon and others, 1939) actually lie above Gregory marl and are characterized by absence of fish remains. The Sharon Springs of Moxon and others and the "upper beds" are included in redefined Gregory member. Sharon Springs of this report underlies Gregory member (redefined) and overlies Niobrara formation. Divisible into a lower zone, characterized by fish remains and an upper zone in which fish remains are absent. Thickness 35 feet at Rosebud Bridge, Gregory County.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2346. Restricted to the fish-bearing bituminous shale that underlies Gregory member and overlies Niobrara formation.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Columnar section shows Sharon Springs shale member underlying Weskan member and overlying Smoky Hill chalk.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 31–34. Described in Yankton area, South Dakota and Nebraska, where it is 5½ to 11 feet thick and consists of a lower bituminous unit and an upper nonbituminous unit. Underlies Gregory member; overlies Smoky Hill chalk member of Niobrara formation.

First described and mapped at and around Sharon Springs, Wallace County, Kans.

Sharp Mountain Member (of Pottsville Formation)

Sharp Mountain Formation (in Pottsville Group)

Lower and Middle Pennsylvanian: Eastern Pennsylvania.

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2674 (fig. 3), 2676–2678, 2679; 1957, U.S. Geol. Survey Coal Inv. Map C–43, sheet 1. Consists chiefly of cobble and coarse pebble conglomerate and fine to coarse sandstone and siltstone, shale, and coal; basal conglomerate beds are coarser and topographically more conspicuous than the other beds in member and are followed by several sequences of conglomeratic sandstone, sandstone, siltstone, shale, and coal intercalated with sequence of finer pebble conglomerate. Comprises upper 280 feet of formation at type section. Conformably overlies Schuylkill member (new). In many localities in the southern anthracite field, basal beds are 30 feet more or less above the Lykens Valley No. 1 coal bed; at type section, they are 40 to 70 feet above the Lykens Valley No. 1 coal; such variations in stratigraphic interval may be due either to local intertonguing of the fine conglomerate and sandstone and shale facies of the Schuylkill member with coarser conglom-

erate and sandstone facies of the Sharp Mountain. Upper contact of Sharp Mountain with post-Pottsville rocks is at base of carbonaceous shale beneath the Buck Mountain coal bed which rests conformably on the conglomerate; contact is sharp and even.

Carlyle Gray, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Pottsville group in anthracite region.

Type section: Included in Pottsville reference section which is in road-cut on east side of U.S. Highway 122, about 150 feet farther east than original type section of Pottsville which is on eastern side of Pennsylvania Railroad cut through water gap south of Pottsville, Schuylkill County.

Sharps Formation (in White River Group or Arikaree Group)

Miocene: Southwestern South Dakota.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Composed of massive poorly consolidated compact pinkish-tan silt with gray calcareous potato-ball concretions; some lenses of impure limestone; clastic and chalcedonic dikes present throughout formation but not as common as in underlying Brule; channel sands and gravels present at several levels. Thickness approximately 340 feet. Includes Rockyford ash member (new) at base. Underlies Monroe Creek formation of Arikaree group. White River group.

S. G. Collins, 1960, Geology of the Patricia quadrangle, South Dakota (1:62,500): South Dakota Geol. Survey. Lowermost formation in Arikaree group. Thickness at least 153 feet. Underlies Monroe Creek formation. Contact with Monroe Creek only approximately located; practicality of separating the two units in future mapping farther east questionable.

Named for exposures 8 miles north and 5 miles west of Sharps corner.

Sharpsdale Formation

Pennsylvanian: Southwestern Colorado.

D. R. Williamson and Lorraine Burgin, 1950, Colorado School Mines Mineral Industries Bull., v. 3, no. 1, p. 11 (chart), 12. About 400 feet of red-gray siltstone, sandstone, and conglomerate that contains several fossiliferous marine limestones. Transitional into overlying Madera formation; overlies Kerber formation.

May extend as far north as Hayden Pass and as far south as New Mexico border. Type locality and derivation of name not stated.

Sharpsville formational suite[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 131, table facing p. 131.

Sharpsville Sandstone (in Cuyahoga Group)

Sharpsville Sandstone Member (of Cuyahoga Formation)[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1880, Pennsylvania 2d Geol. Survey Rept. Q_3, p. 61–62.

H. P. Cushing, Frank Leverett, and F. R. Van Horn, 1951, U.S. Geol. Survey Bull. 818, p. 50–52. Cuyahoga, in its typical area, is elevated to group rank and its subdivisions (ascending) Orangeville shale, Sharpsville sandstone, and Meadville shale are treated as formations. Thickness 25 to 50 feet in Cleveland, Ohio, district. Contacts with Orangeville and Meadville transitional.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology, v. 50, no. 1, p. 41. Included in Tinkers Creek shale facies (new) of Cuyahoga formation.

Wallace de Witt, Jr., 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 21. Sharpsville is composed of varying amounts of flaggy sandstone and interbedded sandy shales. Base is drawn at first massive sandstone in shale section above Berea sandstone or Corry sandstone. Locally, near Warren, Ohio, and Meadville, Pa., lower part of Sharpsville is composed almost completely of massive sandstone and can be used for local correlation. Elsewhere the Sharpsville is composed of thin flaggy sandstones, and boundaries can not be drawn definitely. Base of Sharpsville is irregular. In some areas, flags of the Sharpsville are almost in contact with the Berea, but in some areas a thick shale separates the two units. In vicinity of Titusville, Pa., the Sharpsville merges with underlying Orangeville shale.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 45. In Ohio, base of Sharpsville is generally placed at base of first massive bed of siltstone in shale sequence above the Berea except in those areas where the Aurora or Chardon member is present near base of Orangeville shale. In northwestern Pennsylvania, the Sharpsville is first massive siltstone above Bartholomew siltstone member of Orangeville shale, except in local area in Crawford County where the Bartholomew is absent and its place is occupied by Hungry Run sandstone member.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. In northern Ohio, eight members recognized in Cuyahoga formation. They are (ascending) Orangeville, Sharpsville, Strongville (new), Meadville, Rittman, Armstrong, Wooster (new), and Black Hand.

Named from village of Sharpsville on Shenango River, in Mercer County, Pa.

Shasta Lavas

Pliocene: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Shasta Series[1]

Shasta Group

Lower Cretaceous: California and Oregon.

Original reference: W. M. Gabb, 1869, California Geol. Survey Pal., v. 2, p. vii, xvi, 129, 133.

F. M. Anderson, 1938, Geol. Soc. America Spec. Paper 16, p. 37–86, pl. 84. Series in Great Valley sections in California has been divided into two major groups, primarily upon paleontological grounds, but division is supported by other important criteria, found in their distribution and lack of coincidence, and in the thick beds of conglomerate usually lying

between them, and in some places by direct evidence of disconformity and transgression. Later, and somewhat thicker, part of series constitutes Horsetown group and lower part is Paskenta group. In its more complete sections, Shasta series is set off from underlying Knoxville and overlying Chico series by well-marked unconformities.

N. L. Taliaferro, 1943, California Div. Mines Bull. 118, pt. 2, p. 129, 130 [preprint 1941]. Referred to as Shasta group. The divisions of Shasta, the Paskenta and Horsetown, classed as groups by some authors, are here considered to be stages. Mid-Cretaceous disturbance separates Shasta group from Upper Cretaceous Pacheco group (new). Group in northern Coast Ranges has maximum thickness of over 20,000 feet; maximum thickness in central Coast Ranges not known, but in some localities group is more than 5,000 feet thick.

F. M. Anderson, 1943, California Div. Mines Bull. 118, pt. 2, p. 183, 184 (fig. 68) [preprint 1941]; 1945, Geol. Soc. America Bull., v. 56, no. 10, p. 914–937. Paskenta group of Shasta series overlies Newville group (new) of Knoxville series. Where Shasta is in contact with Knoxville, it is generally unconformable, but in places it overlaps the Knoxville and rests directly upon pre-Knoxville. Lower Cretaceous.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 287–2891. Shasta series, in Sacramento Valley south of Willows, Glenn County, underlies Venado formation (new) of Chico series. Evidence of mid-Cretaceous disturbance of Santa Lucian orogeny, postulated by Taliaferro as separating Chico and Shasta series and as basis for his Pacheco and Asuncion groups respectively, is meager in this area.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 31–39, pls. 6, 7, 11, 12. Shasta series as used in this report [Coast Ranges immediately north of San Francisco Bay region] includes Knoxville and Horsetown(?) formations. Rocks of series are mainly thinly laminated siltstones with interbedded medium-grained brownish-gray sandstones, lenses of conglomerates, and occasional thin layers of limestone. These are entirely marine and nearly 19,000 feet thick. No definite depositional base of Knoxville observed in area, but formation is in contact with Franciscan group at many places such as south of St. John Mountain, west of Oakville, and in area west and north of Capell Valley. The contacts are along thrust or normal faults, Underlies Chico formation, erosional unconformity. Jurassic and Lower Cretaceous.

W. P. Irwin, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2284–2297. Discussion of Franciscan group in Coast Ranges and its equivalents in Sacramento Valley. Shasta series has been divided into a lower and upper part, Paskenta and Horsetown formations, respectively. Contact between Shasta and Knoxville is marked by a fairly abrupt and complete change in fauna, and at many places by beds of conglomerate. The concept of a "basal conglomerate" has much influenced the subdivision of the Sacramento Valley section. However, along much of Sacramento Valley, the transition from one unit to the other is one of nearly continuous deposition and, judged from broad structural conformity, was accomplished with little disturbance. Strata referred to Shasta series have higher ratio of sandstone to shale than has Knoxville formation. Average total thickness of the Shasta is about 10,000 feet, and is divided about equally between lower and upper faunal divisions, the Paskenta and Horsetown. Term Shasta

series has generally been considered as including only Lower Cretaceous strata, but along much of west side of Sacramento Valley there has been little agreement as to contact between Shasta series and Upper Cretaceous strata. This lack of agreement casts doubt as to validity of a hiatus many earlier workers have postulated between the Lower and Upper Cretaceous. Some geologists have placed contacts at base of Venado sandstone (Kirby, 1943). Others have placed it lower in the section, at base of a conglomerate. The conglomerate and Venado are separated by thickness of several thousand feet of shale referred to by Kupper (1956) as Antelope shale of Taliaferro. If Shasta series is to be restricted to Early Cretaceous, the base of the conglomerate below the so-called Antelope shale fo Taliaferro appears to be a better choice for its upper limit, and is so considered in this paper. Evidence indicates that Franciscan group has been deposited contemporaneously with the Knoxville, Paskenta, Horsetown, and lower Upper Cretaceous strata.

Named for development of the rocks in Shasta County, Calif.

Shasta Bally Quartz Diorite

[Jurassic]: Northern California.

G. H. Curtis, J. F. Evernden, and J. Lipson, 1958, California Div. Mines Spec. Rept. 54, p. 5–6. Name applied to quartz diorite in Shasta Bally pluton. Potassium-argon dating gives age of 134 million years.

Batholith is southernmost of granitic masses exposed in Klamath Mountains, northern California. Specimens collected 1 mile north of Ono, Shasta County.

†Shastan System[1]

†Shastian System[1]

Lower Cretaceous: Western North America.

Original reference: T. C. Chamberlin and R. D. Salisbury, 1906, Geology, v. 3, p. 107–137.

Shattuck Member (of Queen Formation)

Permian (Guadalupian): New Mexico and Texas.

N. D. Newell and others, 1953, Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 15 (fig. 6), 43 (fig. 26), 44 (fig. 27), 45–46. Name applied to persistent sandstone in upper part of Queen formation. Thins rapidly from 100 feet at Wind River Gap to a series of small lenses and pockets of sandstone at top of Goat Seep reef, about 1 mile down North McKittrick Canyon. Underlies Seven Rivers formation. Mapped by King (1948, U.S. Geol. Survey Prof. Paper 215) as basal sandstone of Carlsbad group.

Named from outcrops along Shattuck Valley escarpment in vicinity of Devils Den, El Paso quadrangle, New Mexico.

Shawangunk Conglomerate[1]

Shawangunk Formation

Silurian: Southeastern New York, northern New Jersey, and Pennsylvania.

Original reference: W. W. Mather, 1840, New York Geol. Survey 4th Rept., p. 246–250.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Albion and Niagaran series.

K. L. Glenby, 1942, Geological Review, v. 2, no. 2, p. 11, 12, 13. Conglomerate overlies Ordovician Hudson River shales in Shawangunk Mountains.

Bradford Willard, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1089. Shawangunk formation unconformably overlies Martinsburg group in northern New Jersey and at Otisville, N.Y. Contact not exposed at Delaware Water Gap.

P. K. Sims and P. E. Hotz, 1951, U.S. Geol. Survey Bull. 978–D, p. 104–105. Thickness 250 to 300 feet at Shawangunk mine, Sullivan County, N.Y., section does not include approximately 475 feet of lower part of the Shawangunk. Underlies High Falls shale; unconformably overlies Ordovician slates, shales, and sandstone.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation, as mapped, consists of light-gray to tan thick-bedded impure quartzitic sandstone and conglomerate with thin shale interbed. In eastern Pennsylvania only.

Named for occurrence on Shawangunk Mountain, Ulster County, N.Y.

Shaw Mountain Formation

Lower or Middle Silurian: Central Vermont.

L. W. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1492, 1496–1501. Thin group of beds with three lithologic varieties; at base is massively bedded quartz conglomerate which grades upward into papery to platy soda rhyolite tuff; near top is white to slightly bluish crinoidal limestone occurring as thin beds and lenses usually interbedded with the tuff. Thickness difficult to determine, maximum total probably about 900 feet. Underlies Northfield slate unconformably; overlies Cram Hill formation (new) unconformably. Ordovician(?).

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Middle Ordovician.

W. H. Bucher, 1953, Geol. Soc. America Bull., v. 64, no. 3, p. 283. Devonian.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. In Montpelier quadrangle, underlies Northfield slate; overlies Moretown formation. Silurian.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pl. 3. Lower and Middle Silurian.

Named for good exposure near base of north slope of Shaw Mountain, 2 miles south-southwest of Northfield, Barre quadrangle. Also occurs in Randolph and Montpelier quadrangles, and is traced northward by reconnaissance to Quebec border.

Shammut Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Shawmut mine, Houghton County.

Shawmut Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 527, 536, 546, 554, pls. 11, 12, fig. 50.

Named for occurrence at Shawmut mine, Houghton County.

Shawmut Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burkank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Shawmut mine, Houghton County.

Shawmut Group[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. O. Crosby, 1877, Geol. map of eastern Mass.

Occurs near Boston, on Marblehead Neck and neighboring islands, and in basin of Parker River, Boston Basin region.

Shawnee Group[1]

Shawnee Formation[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 93–94.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 48 (fig. 10), 159–199. Redefined group comprises (ascending) Oread limestone, Kanwaka shale, Lecompton limestone, Tecumseh shale, Deer Creek limestone, Calhoun shale, and Topeka limestone. Overlies Douglas group; underlies Wabaunsee group.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, p. 28–29, pl. 5. Group in Missouri comprises (ascending) Kanwaka shale, Lecompton limestone, Tecumseh shale, Deer Creek limestone, Calhoun shale, Topeka limestone, Severy shale, Howard limestone, White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Rulo limestone, Silver Lake-Auburn shale interval, Reading limestone, Harveyville shale, Elmont ("Emporia") or Preston limestone, and Willard shale. Succession of beds shown on plate 5 from base of Kanwaka to top of Howard limestone is fairly accurate and beds are regular with the limits indicated. Above Howard limestone, outcrops are so restricted and so widely scattered, that some errors may be present. There are no complete exposures of the White Cloud. Between top of White Cloud shale and Reading limestone there is discrepancy in nomenclature, thickness and lithology in section in plate 5 and sections published by Kansas and Nebraska Geological Surveys. Overlies Douglas group; underlies Wabaunsee group.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2034–2036. Interstate agreement recognized Shawnee group as comprising interval from base of Oread formation to top of Topeka. Agreed that where stratigraphic variation calls for omission or combination of stratigraphic terms, appropriate adjustment of nomenclature is to be employed.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 16–18. Shawnee group redefined for Missouri to accord with interstate agreement. Expanded at base to include Oread limestone and restricted above to exclude beds above the Topeka.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 15–23, fig. 5. Group in Iowa includes interval from base of Oread limestone to top of Topeka. Formations are persistent although members are not everywhere recognized.

Type locality: Shawnee County, Kans.

†Shawnee Limestone (in Allegheny Formation)[1]

Shawnee limestone member

Pennsylvanian: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 888, 895, pls.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 84, 86–87. Member of Bolivar cyclothem in report on Athens County. Proposed that name Shawnee be reinstated to good standing and be used for the fresh-water limestone associated with Bolivar underclay and that name Upper Freeport, as applied to limestone, be restricted to limestone associated closely with Upper Freeport underclay. Shawnee limestone is stratigraphically below Upper Freeport shale and sandstone, and the Upper Freeport limestone is above the same shale and sandstone.

Named for Shawnee, Perry County.

Shawnee Sandstone[1]

Pennsylvanian: Oklahoma.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Named by Taff (1899, U.S. Geol. Survey 19th Ann. Rept., pl. 6). A Pennsylvanian limestone in Ohio was given name Shawnee in 1878. Haworth named Shawnee formation in Kansas in 1898 and this unit has since been raised to group status. Shawnee sandstone of Taff was named Thurman sandstone in text of his [Taff's] 1899 report (p. 439).

Shawneetown Coal Member (of Carbondale Formation)

Pennsylvanian: Eastern and southern Illinois (subsurface).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), pl. 1. Proposed for coal believed to be lower of two coals formerly called No. 2 A (Harrison, 1951, Illinois Geol. Survey Rept. Inv. 153). Not recognized in outcrops but encountered at depth of 543 feet 10 inches in drill hole. In southern Illinois, stratigraphically above Colchester (No. 2) coal member and below Roodhouse coal member (new). In eastern Illinois, occurs above Colchester (No. 2) coal member and below Summum coal member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type locality: Union Colliery Co. drill hole 28, sec. 23, T. 9 S., R. 9 E., Gallatin County.

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Shaw Point cyclothem

Pennsylvanian: Southwestern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 13. In Macoupin County, four cyclothems are recognized of which the Shaw Point is fourth in series (ascending). Occurs above the Macoupin. Name credited to J. R. Ball in manuscript report.

Type locality and derivation of name not given.

Shaws sandstone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 132, table opposite p. 61.

Well exposed in ravine behind Shaws brick schoolhouse on Meadville-Franklin Highway, Meadville quadrangle.

Shea Basalt (in Ash Creek Group)

Shea Diabase

Precambrian (Yavapai Series): Central Arizona.

L. E. Reber, Jr., 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 58, 61, pl. 8. Diabase is a dark moderately fine-grained dioritic rock.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 12–13, pl. 1. Term Shea diabase modified to Shea basalt. Included in Ash Creek group (new). Composed mostly of lava flows and intercalated tuffaceous beds, and in Black Canyon, many coarse fragmental deposits contain vesicular fragments as much as 6 inches in diameter. Basalt is a dark-green to black rock. Flows commonly contain quartz and chlorite amygdules and, in a few places, pillow lavas. Interbedded tuffaceous sedimentary rocks commonly thin, from 2 to 4 feet thick. In northern exposures, tuffaceous rocks range from 20 to 40 feet in thickness. These sedimentary rocks are dark green to greenish gray. Massive lava from thick flows has diabasic texture. Overall thickness on north side of Black Canyon about 2,000 feet. Underlies Deception rhyolite; overlies Buzzard rhyolite (new).

In vicinity of Shea mine, Jerome district, Yavapai County. Crops out southeast and east of Mingus Mountain. Southeastern exposures appear north and south of Black Canyon and in the canyon west of the Verde fault. Eastern exposures form continuous belt northward from Oak Wash to Mescal Gulch.

Shedhorn Sandstone

Permian: Southwestern Montana and northwestern Wyoming.

E. R. Cressman and R. W. Swanson *in* V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2852–2854; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 31–33, pl. 3. Medium- to very fine-grained quartz sandstone that contains small amounts of black chert and phosphate grains and amber to white phosphatic shell and bone fragments; some sandstone slightly glauconitic. At type locality, consists of lower member 17 feet thick and upper member 78 feet thick, separated by tongues of Retort and Tosi members (both new) of Phosphoria formation; at this locality, sandstone is underlain by Quadrant quartzite and overlain by Dinwoody formation. In Madison Range and adjacent areas, Shedhorn is medium to brownish gray in contrast to the light gray of quartz sandstone in underlying Quadrant quartzite.

Type section: In cliffs on north side of Indian Creek in SW¼ sec. 20, T. 8 S., R. 2 E., Madison County, Mont., about one-fourth mile west of mouth of Shedhorn Creek. In Montana, Shedhorn extends east to Yellowstone River, north to Three Forks, northwest to Garrison in Garnet Range, and west to Dalys Spur; thin tongues extend southeast in Wyoming to Wyoming and Salt River Ranges.

Shedroof Conglomerate

Precambrian: Northeastern Washington and western Idaho.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 6 (table), 7–9, pl. 1. Name applied to a coarse poorly sorted gray-brown conglomerate. Thickness 3,000 to 11,000 feet. Unconformably overlies Priest River group(?); underlies and is gradational into Leola volcanics (new).

Named for exposures on Shedroof Mountain, Pend Oreille County, Wash.

Sheep Bay Granite[1]

Paleozoic(?): Southeastern Alaska.

Original reference: U.S. Grant and D. F. Higgins, 1910, U.S. Geol. Survey Bull. 443, p. 43, 46.

Occupies northeastern third of point of land separating Port Gravina from Sheep Bay, Prince William Sound region.

Sheep Canyon Basalt (in Buck Hill Volcanic Series)

Sheep Canyon Basalt (in Pruett Formation or Tuff)

Oligocene and younger(?): Western Texas.

S. S. Goldich and M. A. Elms, 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1197. Lava flows intercalated with Pruett tuff (new) are (ascending) Crossen trachyte, Sheep Canyon basalts, and Potato Hill andesite (all new).

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Fall Field Trip, Oct. 29–31, p. 14 (table 1), 17 (fig. 3), 19–20; 1949, Geol. Soc. America Bull., v. 60, no. 7, p. 1153–1155. In Sheep Canyon (type area), the Sheep Canyon basalt consists of four flows separated by beds of tuff and tuffaceous limestone. Thickness of flows together with intervening tuff and tuffaceous limestone, 234 feet. Flows rest on both Crossen trachyte and on Pruett fresh-water limestone underlying the trachyte. Thick flows assigned to Sheep Canyon basalt occur on Pruett tuff in Elephant Mountain where there are three flows totaling 380 feet. Underlies Potato Hill andesite. Eocene(?).

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 547–549, pl. 1. Described in Cathedral Mountain quadrangle. Rank raised to formation in Buck Hill volcanic series. Term Pruett restricted to the tuff, sandstone, conglomerate, and limestone below Crossen trachyte which underlies Sheep Canyon basalt. Underlies Potato Hill andesite. Thickness 0 to 454 feet. Oligocene and younger(?).

Named for Sheep Canyon, a reentrant of Calamity Creek valley in Alpine quadrangle, Brewster County.

Sheep Canyon Granite

Precambrian: Southeastern Arizona.

F. F. Sabins, 1957, Geol. Soc. America Bull., v. 68, no. 10, p. 1321–1322, pl. 1. Gneissose granite. Very pale orange on fresh surfaces and weathers light brown. Bounded on the west by a Tertiary stock of

quartz monzonite, and on south by Pinal schist. Overlapped by alluvium on the north and east. Oldest of the Precambrian igneous rocks in area.

Crops out over area of about 4 square miles in northwest corner of Cochise Head quadrangle, Cochise County. Exposure cut by steep-sided gorge of Sheep Canyon.

Sheep Creek Conglomerate[1]

Upper Paleozoic or Mesozoic: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 91, map.

Exposed on east side of Sheep Creek, Stevens County, at international boundary.

Sheep Creek Formation

Sheep Creek Beds[1] or Group

Sheep Creek Formation (in Hemingford Group)

Miocene: Western Nebraska and eastern Wyoming.

Original reference: W. D. Matthew and H. J. Cook, 1909, Am. Mus. Nat. History Bull., v. 26, art. 27, p. 362–363.

A. L. Lugn, 1938, Am. Jour. Sci., v. 36, 5th ser., no. 213, p. 226, 227. Upper formation in Hemingford group (new). Thickness 140 feet. Contains *Stipidium* and *Berriochloa* fossil seeds. Unconformable above Marsland formation (new). Underlies Valentine formation of Ogallala group.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1254–1258, 1266 (table 2). Discussion of confusion in use of terms Snake Creek and Sheep Creek formation, both of which were named by Matthew and Cook and both of which have their type localities in south-central Sioux County, Nebr. The Sheep Creek beds were said to lie unconformably on lower Miocene, equivalent to the *Daemonelix* beds of Niobrara valley [Harrison formation]. Matthew and Cook considered the Snake Creek beds to be the remains of a formation which they regarded as an outlier of the Ogallala. The Snake Creek was said to lie on the eroded surface of the Sheep Creek beds. Later, confusion resulted especially because of the "mixed" faunal lists which have resulted from mixed collections from the Sheep Creek-Snake Creek locality. The typical "Snake Creek" formation, or at least the so-called "upper Snake Creek," is correlative with some part of upper Ogallala group. However "Snake Creek" has been incorrectly(?) applied to beds, mainly channel fills, as late as Pleistocene and to other beds as old as Miocene. Much of the Miocene "Snake Creek" or perhaps the so-called "lower Snake Creek" seems to be in part not Snake Creek at all but Sheep Creek channel beds in place and in proper stratigraphic sequence. Also, some of the Miocene and "Sheep Creek" vertebrate fossils collected from "Snake Creek" channel deposits have come from large blocks of Sheep Creek formation, which were broken away from banks of Snake Creek streams. These large blocks have dimensions of 10 to 20 feet or more and were never broken up or distintegrated by Snake Creek rivers. They lie buried in younger silt and sand, the true Snake Creek sediments, which are always channel-fill material. Sheep Creek formation consists of channel gravels and sands; fine silty sands, silt and clay, and harder caliche beds of widely ranging textural

characteristics, all of which fill for the most part narrow valleys or ravines to depths ranging from 30 or 40 feet to 140 feet or more. These deposits, many of which are isolated and unconnected, are widespread in northwestern Nebraska. In central part of south half of Sioux County, the Sheep Creek extends continuously as a basin deposit of channel, flood-plain, and slack-water sediments over about 25 square miles. Total thickness of Sheep Creek exposed above unconformable contact on Harrison formation in type locality is more than 200 feet. Overlapping exposures in Dawes County indicate that fundamental formational entity includes about 70 feet of additional beds which are stratigraphically higher than uppermost Sheep Creek exposures in type locality. This does not include a still higher "member" to be described later. It is mainly this upper part of the Sheep Creek that has been called by some workers "lower Snake Creek beds." The distribution of this heretofore unrecognized member of the Sheep Creek seems to have been nearly the same as that of Marsland formation, and at present it overlies and extends beyond limit of most of the Sheep Creek valley fills more or less throughout areal extent of Hemingford group and in some areas rests on Harrison formation. Original definition of Snake Creek and Sheep Creek formations may be essentially valid and it is proposed to continue use of these names to correctly differentiated formations.

R. C. Cady, 1940, Am. Jour. Sci., v. 238, no. 9, p. 663–667. Includes Box Butte member (new) in uppermost part. Formation, exclusive of Box Butte member, fills narrow channels in Marsland formation.

M. K. Elias, 1941, Geol. Soc. America Spec. Paper 41, p. 126–132. As used by Nebraska Geological Survey, the Sheep Creek includes all higher rocks of Hemingford group between Marsland formation below and Ogallala group above. Comprises three members (ascending) Spottedtail (new), Sand Canyon (new), and Box Butte.

H. J. Cook, 1960, Internat. Geol. Cong., 21st. Copenhagen, pt. 12, p. 204. Sheep Creek group, as shown on generalized geologic section in type localities of late Tertiary deposits of northwestern Nebraska and eastern Wyoming, overlies Runningwater formation (new) of "Marsland" group and underlies Snake Creek beds of Ogallala group.

Named for Sheep Creek, Sioux County, Nebr.

Sheepeaters Basalt

Tertiary: Northwestern Wyoming.

R. E. Wilcox, 1944, Geol. Soc. America Bull., v. 55, no. 9, p. 1053–1054, 1059–1060, pls. 1, 2. Younger of two basalt flows not included in Gardiner River rhyolite-basalt complex (new)—that is, younger than Elkhorn basalt (new) and also younger than Cataract basalt (new) of Gardiner River rhyolite-basalt complex. Even-grained texture and columnar structure.

Typically exposed along Sheepeaters Cliffs on north side of Gardiner River, Yellowstone Park. Blankets entire northwest part of mapped area and crops out consistently at elevations near 7,300 feet at top of cliffs; forms walls of "The Amphitheater," an extinct waterfall of glacial tributary of the Gardiner just below Sevenmile Bridge. Outcrop continues along left bank of river almost without interruption to First Cataract where it apparently overlaps part of complex.

Sheep Mountain Quartzite[1] (in Missoula Group)

Precambrian (Belt Series): Western Montana.

Original reference: C. H. Clapp and C. F. Deiss, 1931, Geol. Soc. America Bull., v. 42, p. 683, fig. 2, 3.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25. Missoula group comprises (ascending) Miller Peak, Hellgate, McNamara, and Garnet Range formations, and Sheep Mountain quartzite.

On upper slopes of Sheep Mountain, sec. 24, T. 15 N., R. 18 W., and sec. 30, T. 14 N., R. 17 W. In Missoula to Helena region.

Sheep Mountain Quartz Latite (in Potosi Volcanic Group)

Sheep Mountain Andesite (in Potosi Volcanic Series)[1]

Tertiary, middle or upper: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 93 (table 18), 124–132. Name Sheep Mountain quartz latite is applied to unit of dark quartz latites belonging to Potosi volcanic series and normally lying between Treasure Mountain rhyolite below and Alboroto rhyolite above. Lower contact regular; upper contact irregular. Erupted from at least four centers: San Cristobal quadrangle, Summitville quadrangle, Saguache quadrangle, and Del Norte quadrangle.

U. S. Geological Survey currently designates the age of the Sheep Mountain Quartz Latite as middle or late Tertiary. This designation is made on the basis of an age change of Potosi Volcanic Group.

Named for development under Sheep Mountain, northwestern part of Summitville quadrangle.

Sheep Pass Formation

Eocene: East-central Nevada.

W. M. Winfrey, Jr., 1958, Am. Assoc. Petroleum Geologists Rocky Mountain Sec., Geol. Rec., p. 77–82. Divided into six members (ascending): A, conglomerate breccia, 630 feet; B, interbedded fossiliferous limestones, shales and mudstones, 983 feet; C, clastic sequence of sandstones, siltstones, shales, and gritty conglomerates, 642 feet; D, homogeneous interval of white, siliceous, extremely fine-grained siltstones, in part calcareous, 731 feet; E, tan lithographic thickly bedded limestone, 90 feet; and F, siltstone-claystone beds, 147 feet. At type locality unconformably overlies Ely limestone (Pennsylvanian) and Chainman shale (Mississippian); unconformably underlies Oligocene(?) Garrett Ranch volcanic group (new).

Type section: Sheep Pass Canyon, sec. 12, T. 10 N., R. 62 E. and sec. 7, T. 10 N., R. 63 E., White Pine County. Exposed continuously along western flank of Egan Range for distance of 10 miles southwesterly from sec. 21, T. 11 N., R. 63 E.

Sheep Pen Sandstone[1] (in Dockum Group)

Upper Triassic: Northeastern New Mexico.

Original references (Sheep Pen Canyon): B. H. Parker, 1930, Kansas Geol. Soc. [Guidebook] 4th Ann. Field Conf., p. 19; 1933, Jour. Geology, v. 41, no. 1, p. 40–43.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 35 (table 2), 40–42. Uppermost formation in Dockum group. Consists of thin-bedded light-brown sandstone. As much as 107 feet thick. Overlies Sloan Canyon formation; underlies Exeter sandstone.

Type locality: E½NW¼ sec. 35, T. 32 N., R. 35 E., Union County. Named for Sheep Pen Canyon, which joins Cimarron Valley about one-half mile northwest of type locality.

Sheep Pen Canyon Formation

See Sheep Pen Sandstone (in Dockum Group).

†Sheep Rock Conglomerate[1]

Age(?): Virginia.

Original reference: J. P. Lesley, 1873, Am. Philos. Soc. Proc., v. 12, p. 492–496.

Forms Sheep Rock between Big Tom's Creek and Little Tom's Creek, east of Gladeville (now called Wise), Wise County.

Sheeprock Group or Series

Precambrian: West-central Utah.

DeVerle Harris, 1958, Bringham Young Univ. Research Studies, Geology Ser., v. 5, no. 1, p. 6–8, pl. 1. Consists of phyllites, phyllitic quartzites, quartzites, graywackes, graywacke conglomerates, graywacke conglomerate semischists, and tillites(?). Includes Auts Canyon formation (new) below and Ekker formation (new) above. Total measured thickness of two formations is 9,718 feet. Base of group marked by plane of Sheeprock thrust in Dutch Peak area. Underlies Quaternary alluvium.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 17–19, 24, 128–138, pl. 1. Sheeprock series, in Sheeprock Mountains, is a 9,000- to 10,000-foot sequence of metasediments composed of slate, tillite, phyllite, quartzite, and conglomerate. Subdivided into—lower Sheeprock series, Dutch Peak tillite (new), and upper Sheeprock series. Oldest rocks exposed in Sheeprock Mountains; underlies Mutual(?) formation.

In Dutch Peak area, Sheeprock Range, Tooele County.

Sheepskull Gap Tuffs

See Keechelus Andesitic Series.

Sheffield Formation[1]

Upper Devonian: Central northern Iowa.

Original reference: C. L. Fenton, 1919, Am. Jour. Sci., 4th, v. 48, p. 355–376.

Walter Youngquist and R. F. Peterson, 1947, Jour. Paleontology, v. 21, no. 3, p. 242–253. Conodont fauna from type area of Sheffield indicates Upper Devonian age. Specimens in this report procured from clay pit of Sheffield Brick and Tile Co., near center sec. 9, T. 93 N., R. 20 W., Franklin County.

M. A. Stainbrook, 1950, Jour. Paleontology, v. 24, no. 3, p. 365–366. Stratigraphically restricted above to exclude a series of dolomitic beds here named Aplington formation.

Named for exposures in vicinity of Sheffield, Franklin County.

Sheffield Shale (in McLeansboro Formation)

Sheffield Shale (in Carbondale Group)

Pennsylvanian: West-central Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 102. In McLeansboro formation between Copperas Creek sandstone (above) and Brereton limestone.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 112–113. Light gray, with brownish, olive, or bluish cast. Maximum thickness 22 feet; average 8 or 10; 4 feet in Beardstown quadrangle; variations in thickness due to trucation by overlying Copperas Creek sandstone. Included in Brereton cyclothem, Carbondale group. Savage [1927] used name Copperas Creek to include Sheffield shale and the overlying sandstone, but name Copperas Creek has been restricted to the sandstone.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35. Replaced by Lawson shale member of Carbondale formation (redefined).

Named for exposures near Sheffield, near center sec. 24, T. 16 N., R. 6 E., Bureau County.

Shelburn Formation[1]

Upper Pennsylvanian: Southwestern Indiana.

Original reference: E. R. Cumings, 1922, Indiana Dept. Conserv., Pub. 21, pt. 4, p. 408, 525, 529, chart.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map. C–1. Unconformably overlies Dugger formation (new).

C. E. Wier, 1951, U.S. Geol. Survey Coal Inv. Map C–9. As proposed by Cumings, included rocks in the interval from top of Coal VII to base of Merom sandstone, thus including in upper part beds that had previously been included in West Franklin and Ditney formations. Upper part of Cuming's Shelburn formation has been separated from it by Schrock and Malott (1929) who restored name West Franklin formation to include two limestone members and the shale and coal between them and by Malott (1948) who restored name Ditney for formation overlying West Frankfort and underlying Merom sandstone. Shelburn is here restricted to those rocks above the unconformity that overlies Coal VII or locally cuts out Coal VII and below base of West Franklin formation. Contains 250 feet of sandstone, shale, limestone, and thin lenticular coal beds, of which only basal part, approximately 30 feet, of Busseron sandstone member is exposed in Linton quadrangle.

F. E. Kottlowski, 1954, U.S. Geol. Survey Coal Inv. Map C–11. In Dugger quadrangle, includes (ascending) Busseron sandstone member and Maria Creek limestone member (new).

Courtney Waddell, 1954, U.S. Geol. Survey Coal Inv. Map C–17. In Shelburn quadrangle, formation includes Vigo sandstone member (new).

J. D. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 46 (table 8). Table shows Shelburn formation, 210 to 300 feet, comprises (ascending) Busseron sandstone, Maria Creek limestone, Vigo limestone, and Murphys Bluff sandstone members.

Named for Shelburn, Sullivan County.

†Shelburne Gneiss[1]

Age(?): Massachusetts.

Original reference: W. O. Crosby, 1876, Rept. on geol. map of Massachusetts, Massachusetts Comm. to Centennial Exposition, Boston, p. 1–42.

At Shelburne Falls.

Shelburne Marble[1] or **Formation** (in Stockbridge Group)

Shelburne Formation

Lower Ordovician: West-central Vermont and northwestern Massachusetts.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 115.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 539–541, pl. 10. Shelburne marble mapped in west-central Vermont. Occurs between Clarendon Springs dolomite below and Cutting dolomite (new) above. Lower Ordovician.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Shelburne marble included in Stockbridge group in Cheshire quadrangle, Massachusetts. Overlies Clarendon Springs dolomite; underlies Bascom formation. Lower Ordovician.

J. B. Thompson, Jr., 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 75. Formation described in Clarendon-Dorset area where it consists of Sutherland Falls marble member, 50 to 100 feet; intermediate dolomite member, 150 to 200 feet; and Columbian marble member, 200 to 250 feet. Underlies Bascom formation; overlies Clarendon Springs formation. Lower Ordovician.

Main belt of outcrop in town of Shelburne, Burlington quadrangle, Vermont.

Shelby cyclothem

Pennsylvanian: South-central Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by S. E. Ekblaw led to tentative recognition of six cyclothems of which the Shelby is fifth in sequence (ascending). Succeeds Omega cyclothem and is followed by Shumway cyclothem. Subsequent attempts to set up a single standard section based on assumption that Omega and Greenup limestones are equivalent resulted in a series of 13 cyclothems in which the term Shelby was omitted. If the Greenup and Omega are not equivalent, the section includes 14 cyclothems with the Shelby below the Shumway or Newton and above the Omega. If this sequence is correct, or nearly so, it is probably incomplete, and other cyclothems may occur both above and below the Omega. Another difficulty in this arrangement is that the Shelbyville coal, which according to Ekblaw is a part of the Shelby cyclothem, was assigned to the Newton cyclothem by Newton (1941, Illinois Geol. Survey Rept. Inv. 76) who believed that it occurred beneath the Omega in Shelby County.

Type locality and derivation of name not given.

†Shelby Dolomite[1]

Silurian: Western New York.

Original reference: J. M. Clarke and R. Ruedemann, 1903, New York State Mus. Mem. 5, p. 9–13.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 33–34. Preoccupied name Shelby replaced by Oak Orchard Creek member (new) of Lockport formation.

Named for exposures along Oak Orchard Creek, south of village of Shelby, in Shelby, the southwest township of Orleans County.

†Shelby Limestone[1]

Middle Devonian: Central Indiana.

Original reference: A. F. Foerste, 1898, Indiana Dept. Geology and Nat. Resources 22d Ann. Rept., p. 234–235.

Type locality not stated but probably named for Shelby County.

Shelbyville Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), pl. 1. Assigned member status in Mattoon formation (new). Occurs above McClearys Bluff coal member and below Trowbridge coal member. Coal named by Broadhead (1875, *in* Geology and Paleontology, v. 4, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Outcrops and mines in vicinity of Shelbyville, T. 11 N., Rs. 3 and 4 E., Shelby County.

Shelbyville Drift or Till

Pleistocene (Wisconsin): Central Illinois.

H. B. Willman and others, 1942, Illinois Geol. Survey Bull. 66, p. 145 (fig. 85), 146 (fig. 86), 155–158. Consists of (1) till, (2) outwash, and (3) laminated clays, silts, and sand deposited in Lake Kickapoo. Maximum thickness at least 40 feet. Overlies Illinoian till and Sangamon interglacial deposits and underlies widespread pink till of Bloomington age; at some places, lake beds are overlain by gravel and sand outwash thought to be of Bloomington age. Six drifts listed in the Tazewell (ascending): Shelbyville, Bloomington, Cropsey, Farm Ridge, Chatsworth, and Marseilles.

Leland Horberg, 1950, Illinois Geol. Survey Bull. 75, pt. 1, p. 29. In Peoria area, Shelbyville drift is listed as older than Leroy drift.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 8, 11. Shelbyville till, 40 feet thick, occurs above Morton loess (new) and below Richland loess (new). Woodfordian substage.

Named for Shelbyville, Shelby County. Deposits occur principally in preglacial Ticona Valley and crop out at many places along Fox Valley and its tributaries above Dayton, along Illinois Valley east of Marseilles, and a few localities along Vermilion River.

Sheldon Limestone Member (of Topeka Limestone)

Sheldon Limestone (in Calhoun Shale)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 47.

G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 26, 30, 45, 46, 48–49. Reallocated to member status in Topeka limestone. Underlies Turner Creek shale member; overlies Jones Point shale member. Thickness varies from maximum of 3 feet or more in northern outcrops to 2 feet or less in northeastern Kansas and northwestern Missouri. Occurrences in Iowa noted. Derivation of name given.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035. Member of Topeka formation. Overlies Jones Point shale member; underlies Turner Creek shale member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16, fig. 5. Light-gray fossiliferous generally fine-grained complex of two or three beds depending upon presence of shale separations. Usually at least one of beds is massive unit containing brachiopods and pelecypods. Thickness 3. 2 feet north of Thurman, Fremont County; 2.1 feet west of Macedonia, Pottawattomie County; 5 feet near Howe, Adair County. Underlies Turner Creek shale member; overlies Jones Point shale members.

Named for exposures at Vilas Sheldon quarry, east of Nehawka, Cass County, Nebr.

Shelikof Formation[1]

Upper Jurassic: Southwestern Alaska.

Original reference: S. R. Capps, 1923, U.S. Geol. Survey Bull. 739, p. 91, 97, map.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1). Comprises (ascending) interbedded sandy shale and fine- to medium-grained silty sandstone, about 100 feet thick; well-stratified gray shale interbedded with thin lenticular layers of limestone and thin beds of soft gray sandstone, 950 feet; Chinitna shale member, 400 to 1,300 feet; gray sandy shale, 200 to 1,200 feet; massive brown to gray sandstone, 4,000 to 4,700 feet; and massive black shale, 700 to 1,000 feet.

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 48–49, table 5 facing p. 60. In Wide Bay and Puale Bay areas, consists of three lithologic members. Lower siltstone member, 800 to 1,800 feet thick, mainly of gray siltstone and sandy siltstone which contains many sandy interbeds from few inches to 200 feet thick in Wide Bay area and represented by about 800 feet of brown-weathering siltstone that includes many concretions at Puale Bay; middle sandstone member, 1,000 to 3,500 feet, dominantly of massive gray sandstone with interbeds of siltstone and lenses of conglomerate; and upper siltstone member, 900 to 1,500 feet, mostly of hard dark-gray gray-weathering siltstone. Formation shown on table as lateral correlative of Chinitna formation.

Prevailing rock formation on northwest shore of Shelikof Strait, from Katmai Bay at least as far southwest as Kialagvik Bay and in Wide Bay and Puale Bay (formerly Cold Bay) areas.

†Shell Bluff Marl[1] or Group[1] (in Barnwell Formation)[1]

Eocene, upper: Eastern Georgia and South Carolina.

Original reference: T. A. Conrad, 1866, Am. Jour. Sci., 2d, v. 41, p. 96.

Named for Shell Bluff, on Savannah River in Burke County, Ga.

Shell Creek Shale

Lower Cretaceous: Central northern Wyoming.

R. A. Paull, 1957, Dissert. Abs., v. 17, no. 10, p. 2249. Name proposed for the shale sequence above the Muddy and below the Mowry shale. Formerly included in upper part of Thermopolis shale.

This may or may not be same unit as Shell Creek Shale of Eicher (1960). In Bighorn Basin.

Shell Creek Shale

Lower Cretaceous: Central northern Wyoming.

D. L. Eicher, 1960, Yale Univ., Peabody Mus. Nat. History Bull. 16, p. 17–18, 34–36, 39, 52, 80. Proposed for soft black shale sequence that underlies Mowry shale and that was included in the upper part of Thermopolis shale of Lupton. Includes a few ironstone beds and concretions and a few prominent white bentonite beds. Thickness at type locality 252 feet; thins southward and pinches out in southern Wyoming. Overlies Muddy sandstone; contact becomes increasingly gradational southward.

Type section: Measured 6 miles northwest of Greybull in N½ sec. 14, T. 53 N., R. 94 W., Big Horn County. Named for exposures along Shell Creek, which flows within 6 miles of type locality; also mappable to north and northeast of Bighorn Basin.

Shellhammer Hollow Formation

Mississippian: Northwestern Pennsylvania.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1347, 1351, 1362. Name proposed for thin sequence of intercalated siltstones, silty mudstones, and shales. Composed of about equal parts of each rock-type in thickest parts; composed almost completely of shale in thinnest parts. Thickness 4 inches to 5 feet. Underlies Bartholomew siltstone member (new) of Orangeville shale; overlies Cussewago sandstone. Grades laterally into easternmost recognizable Bedford shale and Berea sandstone near Meadville. Grades laterally eastward into Corry sandstone. Lower Mississippian.

J. F. Pepper, Wallace de Witt, Jr., and D. F. Demarest, 1954, U.S. Geol. Survey Prof. Paper 259, p. 18 (fig. 9), 41. Further described. More exact location of type section stated.

Type locality: Two miles north of Meadville, Crawford County, where Meadville-Saegerstown Road on east side of French Creek crosses Shellhammer Hollow. Exposed on road on each side of hollow about 20 feet above stream.

Shell Rock Formation

Shell Rock Limestone[1]

Upper Devonian: Central northern Iowa.

Original reference: A. O. Thomas, 1924, Iowa Geol. Survey, v. 29, p. 411–412.

A. H. McNair, 1942, Jour. Paleontology, v. 16, no. 3, p. 349, 350. Fossil collections made from Mason City dolomite member of Shell Rock (Shellrock) formation.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 661. Formation includes (ascending) Mason City, Rock Grove, and Nora members.

Named for development along Shell Rock River between Rockford and Nora Springs and northward, Floyd County.

Shelter Formation

Lower Cretaceous(?): Southeastern Alaska.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Conglomerate with interlayered pebbly graywacke, graywacke, and greenstone. Conglomerate ranges from rock with 40 percent pebbles (by volume)

through pebbly graywacke to graywacke. Massive very fined grained chlorite-albite-epidote greenstone with aggregates of opaque white clay overlies the conglomerate. Parent rocks probably were flows and sills of basalt or andesite. Conglomerate and graywacke about 500 to 1,000 feet thick; overlying greenstone at least several hundred feet thick. Formation may grade by facies change into Symonds formation (new).

Extends the length of Shelter Island, and crops out at north end of Portland Island, Juneau (B–3) quadrangle.

Shelton Granite Gneiss[1]

Precambrian: Northern North Carolina and central southern Virginia.

Original reference: A. I. Jonas, 1928, Virginia Geol. Survey prelim. ed. geol. map of Virginia.

C. B. Brown, 1937, Virginia Geol. Survey Bull, 48, p. 14. Exposed in small area northwest of Tabscott, Goochland County. A mylonitized or crushed facies of Columbia granite.

Quarried near Shelton, Caswell County, N.C.

Shelton Cliff Sandstone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: W. N. Logan, 1924, Indiana Dept. Conserv. Pub. 42, p. 16.

Shely Group

Oligocene(?): Southwestern Texas.

D. L. Amsbury, 1957, Dissert. Abs., v. 17, no. 9, p. 1981. Named in a stratigraphic sequence as younger than Vieja formation and older than Moonstone rhyolite (new).

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Quad. Map 22. Group consists of trachyte tuff, trachyte, rhyolite and rhyolite ignimbrite, and conglomerate. Near Loma Plata mine, overlies Buckshot ignimbrite; from Loma Plata mine to Pinto Creek, overlies progressively older Comanche strata and along the Shely rim rests on Pinto Canyon formation. Underlies Brite rhyolite.

Type locality: In canyon west of Cleveland triangulation station, Pinto Canyon area, Presidio County. Named for Terry Shely Ranch.

Shenandoah Limestone[1]

Shenandoah Group

Lower Cambrian to Middle Ordovician: Eastern West Virginia and western Virginia.

Original reference: H. R. Geiger and A. Keith, 1891, Geol. Soc. America Bull., v. 2, p. 157–163, pl. 4.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 3, 4. Shenandoah limestone listed among abandoned names. It was common practice of earlier workers to group the calcareous strata of Appalachian Valley under one term; thus the Shenandoah limestone was used for the calcareous rocks above the clastics; consequently Shenandoah group of older usage includes all formation from Lower Cambrian Shady or Middle Cambrian Elbrook to Ordovician.

A. A. Pegau, 1958, Virginia Div. Mineral Resources Circ. 7, p. 9. In northern valley of Virginia, Shenandoah group includes Stones River

limestone below and Chambersburg limestone. Ordovician. Undifferentiated Shenandoah is classed as Cambro-Ordovician.

Shenandoah River valley, West Virginia, is characterized by this limestone.

Shenandoah Mountain Granite[1]

Precambrian: Southeastern New York.

Original reference: C. E. Gordon, 1911, New York State Mus. Bull. 148, p. 11, 17–18.

Occurs on Shenandoah Mountain, at summit of steep northwest slope, along road from East Hook to Hortontown, Poughkeepsie quadrangle.

Shenandoan Series[1]

Lower Ordovician: Southern Appalachians and Mississippi regions.

Original reference: A. W. Grabau, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 27.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Palaeocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines: Peiping, China, Univ. Press, Natl. Univ. Peking, p. 11–12, 13 (table), 15, 282 (table). Proposed to revive name Shenandoan group or Shenandoan by restricting it to cover the post-Ozarkian part of the Cambrovician as here defined—that is—southern equivalent of the Beekmantown or Canadian. Term is used for Lower Ordovician of southern Appalachians and Mississippian region in place of Beekmantownian or Canadian, but excluding from it the Stonehenge division and its equivalents elsewhere in this southern region.

Shenango Formation (in Pocono Group)

†Shenango Group[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. Q_4, p. 66, 77–81.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. As mapped, Pocono group includes, in Appalachian Plateau, Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp formations.

Named for exposures on Shenango River, Mercer County, Pa.

Shenango monothem[1]

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 138–139.

Shenango Sandstone[1]

Lower Mississippian: Northwestern Pennsylvania and eastern Ohio.

Original reference: J. P. Lesley and I. C. White, 1879, Pennsylvania 2d Geol. Survey geol. map of Mercer County.

E. J. Szmuc, 1958, Dissert. Abs., v. 18, no. 6, p. 2109. Shenango sandstone wedges out a short distance west of Ohio-Pennsylvania State line. Evidence indicates that sandstone and overlying Hempfield shale are stratigraphic equivalents of upper part of Meadville member of Cuyahoga; previous correlations with Logan formation are erroneous.

Exposed along Shenango River, Mercer County, Pa.

†Shenango Series[1]

†Shenango River Series[1]

Mississippian and Pennsylvanian: Western Pennsylvania.

Original reference: F. Platt, 1875, Pennsylvania 2d Geol. Survey Rept. H., p. 1–9.

Named for Shenango River, Mercer County.

Shenango Shale[1]

Mississippian: Northwestern Pennsylvania.

Original reference: I. C. White, 1880, Pennsylvania 2d Geol. Survey Rept. Q_3, p. 59–60.

R. M. Leggette, 1936, Pennsylvania Geol. Survey, 4th ser., Bull. W–3, p. 114. Top 75 feet of sandstone and shale of the Pocono group in this area (Crawford County) has been correlated with the Burgoon sandstone and is now called by that name. These beds are the Shenango shale and Shenango sandstone of White. The shale which occurs between the Sharon conglomerate [above] and the sandstone is as much as 60 feet thick.

Named for exposures on Shenango River, Mercer County.

Shenango Stage[1]

Mississippian: Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 138–139.

Hugo Greiner, 1957, Yale Univ., Peabody Mus. Nat. History Bull. 11, p. 9 (table). Discussion of evolution and paleoecology of "*Spirifer disjunctus*" in Catskill delta. Stratigraphic chart lists Shenango stage at top of Kinderhookian series. Follows Meadville stage.

Named derived from Shenango River, Mercer County.

Shepard Formation[1] (in Missoula Group)

Shepard Dolomite (in Siyeh or Wallace Group)

Shepard Formation (in Piegan Group)

Precambrian (Belt Series): Northwestern Montana, and southern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 324.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1899–1900. Shepard formation consists of argillaceous and siliceous dolomites and magnesian limestones in thin strata but thick beds; dark gray, green gray, or brown. Interbeds of greenish-white magnesian quartzites basally. Ripple marks, mud cracks, channel fillings, and edgewise mud breccias characteristic. Represents final stage of Piegan sedimentation. Thickness 585 to 1,500 feet. Younger than Spokane formation, older than Miller Peak formation. Type locality given.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112, 113. Reallocated to Missoula group. This classification follows Clapp and Deiss (1931, Geol. Soc. America Bull., v. 42, chart and p. 691).

S. D. Theodosis, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 62, chart facing p. 62. Considered to be the upper member of Upper Siyeh limestone and part of Siyeh or Wallace group.

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 52–53, pls. 1, 2. Shepard [originally spelled Sheppard] formation in Glacier National Park is coextensive with underlying Purcell basalt. Thickness about 400 feet. Missoula group.

Type locality: Cliffs of Lewis Range near Shepard [Sheppard] Glacier, Glacier National Park, Mont. Well exposed on Mount Carthew, Boulder, and Swiftcurrent Peaks, mountains near Logan Pass, and in valley of Middle Fork of Flathead River.

Shepherdstown Gravel[1]

Pliocene(?): Northern West Virginia and southern Pennsylvania.

Original reference: M. R. Campbell, 1933, Geol. Soc. America Bull., v. 44, no. 3, p. 558–573.

Well developed at Shepherdstown, W. Va.

Sheppard Formation

See **Shepard Formation.**

Sheppard Granite[1]

Tertiary: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Rept. Mines Mem. 38, p. 354–356, map 8.

Forms small stock at head of Sheppard Creek, British Columbia.

Sherburne Conglomerate[1]

Cambrian or Ordovician: Southern Vermont.

Original reference: C. H. Richardson, 1929, Vermont State Geologist 16th Rept., p. 208–246, table opposite p. 288.

H. E. Hawkes, Jr., 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 654, 655, 657. Included in upper part of Plymouth Union series (new) north of Sherburne.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 46–47, pl. 1. Included in Cambro-Ordovician Tyson formation as unnamed coarse conglomerate near base.

Good exposures about 2 miles southeast of North Sherburne, Rutland County, at head of narrow valley leading down to Sherburne.

Sherburne Flagstone Member (of Genesee Formation)

Sherburne Flagstone Member (of Portage Formation)[1]

Sherburne Formation

Upper Devonian: Eastern and central New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Ann. Rept., p. 381.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 45, 47 (fig. 2), 66–70. Name Sherburne includes rocks between top Penn Yan tongue (new) of West River and base of Middlesex remnant. According to original definition (Vanuxem, 1840), the Sherburne at type locality is a sparsely fossiliferous shale and sandstone series overlying Geneseo and terminating at first appearance in abundance of Ithaca fossils. Cooper and Williams (1935) indicate that the Sherburne east of type locality, as

indicated by workers after Vanuxem, includes beds as low as the Tully, which in this area is same facies as the Sherburne. Sherburne as used in this report includes 310 feet of interbedded shales and flags (siltstones and very fine sandstones) between Penn Yan tongue (new) of the West River and the attenuated remnant of Middlesex black shale in Cayuga Lake valley. Starkey tongue (new) penetrates westward into West River shale, between Penn Yan tongue and Milo tongue (new) of West River in central New York.

R. G. Sutton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 1, p. 231 (table 1), 236 (fig. 4), 237. Discussion of use of flute casts in stratigraphic correlation. West River shale is equivalent to Sherburne sandstone and Ithaca formation.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2821, 2824. Sherburne flagstone member is excluded from Portage formation of Williams (1906, Science, new ser., v. 24; Williams and others, 1909, U.S. Geol. Survey Geol. Atlas, Folio 169) and assigned to Genesee formation. Flagstone member, as here defined, lies above Penn Yan shale member and below Renwick shale member. Name Sherburne was originally applied to a sequence of silty and sandy rocks above a black shale that overlies the Tully limestone in vicinity of Sherburne. Member in vicinity of Cayuga Lake is western part of wedge of sandy rocks that was originally named Sherburne by Vanuxem. At reference section, herein designated, member is 110 feet thick. Member is composed largely of very silty shale, very silty mudrock, and cross-laminated siltstone in beds 1 inch to 3 feet thick. Near Ithaca, the first *Reticularia lacvis* zone of Williams and others (1909) is upper 35 feet of the member. Upper boundary of the Sherburne member is at base of lowest bed of brownish black shale of Renwick member. Traced westward from vicinity of Ithaca to exposures near south end of Seneca Lake where it is about 40 feet thick. Grades laterally into gray shale and mudrock in lower part of Penn Yan shale member in area north and west of Fir Tree Point, on west side of Seneca Lake, 6 miles north of Watkins Glen, and is not present in exposures at Keuka Lake.

Reference section: Glenwood Creek, in Cayuga Lake area. Named for occurrence near Sherburne, Chenango County.

†Sherburne Group[1]

Devonian: New York.

Original reference: T. A. Conrad, 1841, New York Geol. Survey 5th Ann. Rept., p. 31.

Occurs near Apulia, Onondaga County.

†Sherburne Shale[1]

Middle Devonian: Central southern New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1

†Sheridan Beds[1]

Pleistocene: South Dakota to panhandle of Texas.

Original reference: W. B. Scott, 1897, Introduction to geology, p. 532–533.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 110. Used by Scott (1897) for beds that are now, at least in part, the Sanborn formation.

Named for exposures in Sheridan County, Nebr.

Sheridan Formation[1]

Middle Ordovician: Northwestern Michigan.

Original reference: R. C. Allen, 1910, Michigan Geol. and Biol. Survey Pub. 3, geol. ser. 2, p. 113.

On Sheridan Hill, Iron River district.

†Sheridan Quartzite[1]

Precambrian: Northwestern Wyoming.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

J. D. Love and others, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC-43. Term abandoned. Lower 40 feet of the "rusty beds" of Morrison(?)—Cloverly sequence is a quartzite that forms cliffs. This is part of quartzite sequence that Weed (1896) named Sheridan quartzite and that he considered to be of Precambrian age. Weed's type area of the Sheridan was restudied; in several places, a normal stratigraphic section is exposed in which the lower quartzite overlies variegated beds of the Cloverly and is overlain by black Thermopolis shale. This shale is, in turn, overlain by an upper quartzite that is in the stratigraphic position of Muddy sandstone member of the Thermopolis. Weed did not explain why he considered the quartzite Precambrian.

Well exposed on slopes of Mount Sheridan, Yellowstone National Park.

Sheridan Sandstone[1]

Silurian: Northeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 45, 47–49, 51.

W. H. Twenhofel, 1941, Jour. Paleontology, v. 15, no. 2, p. 172–173, 174. Stratigraphic revision. Unit now considered younger than shales and limestones of the Ashland formation.

R. L. Miller, 1947, Maine Geol. Survey Bull. 4, p. 8, 9. Name not used; preoccupied by a Precambrian unit in Yellowstone National Park.

Named for exposures on Sheridan plantation, south of Aroostook River, in Aroostook County.

Sherman Diorite[1]

Miocene: Yellowstone National Park, Wyoming.

Original reference: A. Hague and others, 1904, U.S. Geol. Survey Mon. 32, Atlas.

Exposed on Sulphur Creek in vicinity of Hot Springs, Canyon quadrangle. Derivation of name not stated.

Sherman Granite[1]

Precambrian: Southeastern Wyoming and northern Colorado.

Original reference: E. Blackwelder, 1908, Science, new ser., v. 27, p. 778–788.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 28. Older than Silver Plume granite and probably correlated with Pikes Peak granite.

Exposed in large batholith extending from northern part of Front Range, Colo., well into Wyoming. Mapped over large area at and around Sherman, Albany County, Wyo.

Sherman Marble[1]

Lower Cambrian(?): Southeastern Vermont.

Original reference: G. D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 269–276, map.

Well exposed in and named for town of Sherman, on Hoosac Tunnel and Wilmington Railroad, Whitingham Township, Windham County.

Sherman Fall Formation (in Trenton Group)[1]

Middle Ordovician: Northwestern New York, and Ontario, Canada.

Original reference: G. M. Kay, 1929, Jour. Geology, v. 37, no. 7, p. 664–671.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 263–268, 271. Overlies Hull formation and underlies Cobourg limestone in northwestern New York and Ontario. Type section lacks exposure of about 30 feet of base of formation, but total thickness in vicinity is about 200 feet. Comprises Shoreham and Denmark members (both new). In Oneida County, includes Dolgeville facies. Trenton group.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 525–535. In this report, Shoreham and Denmark members are raised to formational rank.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 42. Sherman Fall was originally defined as "the 'Prasopora beds' or 'Trenton (restricted)' of Raymond, Johnston and others." It was originally supposed to include beds now classified as the whole of the Russia and lower half of Rust limestone at Trenton Falls, 105 feet of beds above Sherman Fall; subsequent study shows that the "Prasopora beds" correspond to the Shoreham and Denmark formations of this report [Utica quadrangle].

Named for Sherman Fall, in Trenton Falls Gorge of West Canada Creek, Oneida County, N.Y.

Shermanian (Sherman Fall) Stage

Middle Ordovician (Trentonian): Eastern North America.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Stage in middle Trenton.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 263–277, 293, 298. Discussion of stratigraphy of Trenton group and list of formations of Sherman Fall age. Medial Trenton marked a time of distinct alteration of preceding conditions [Rockland and Hull stages]. Maximum of lower Trenton submergence seems to have been reached in earliest part of Sherman Fall stage—the Shoreham. In middle Trenton Sherman Fall stage, the Vermontian disturbance produced a geanticline east of the region that became an important synchronous elevation of Adirondack arch.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Cophenhagen, pt. 7, p. 30. Suggested that term Shermanian stage be applied to Shorehamian and Denmarkian substages. Shermanian stage follows Nealmontian stage and is followed by Pictonian stage.

Name derived from Sherman Fall, Trenton Falls gorge, New York, for which Sherman Fall limestone was named.

Sherman Ridge Formation (in Hamilton Group)

Upper Devonian: East-central Pennsylvania.

H. H. Arndt and others. 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3–4. Overlies Montebello formation and consists of Mahantango-type shales. Includes as much as 550 feet of section. Name credited to Miller (unpub. ms.).

Type locality and derivation of name not stated.

Sherwin Glaciation

Sherwin glacial stage[1]

Sherwin Till

Pleistocene: East-central California.

Original references: E. Blackwelder, 1930, Geol. Soc. America Bull., v. 41, p. 91–92; 1931, Geol. Soc. America Bull., v. 42, p. 865–922.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1281, 1290. At least four ice advances occurred in Pleistocene: earliest, here named Aeolian Buttes, was followed by Sherwin, Tahoe, and Tioga, previously named by Blackwelder. Constructional forms have been destroyed on the two older tills but preserved on the later ones. Rhyolitic ash and pumice, now Bishop welded tuff, were erupted in interval between Aeolian Buttes and Sherwin glacial stages.

W. C. Putnam, 1960, California Univ. Pubs., Geol. Sci., v. 34, no. 5, p. 233–235, map 1. Sherwin till is pre- rather than post-Bishop tuff. Name Aeolian Buttes considered invalid as representing an earlier Pleistocene, pre-Sherman glacial stage. Sherwin is second in sequence of four major glacial tills on eastern slope of the Sierra Nevada; it was preceded by McGee stage. Part of till rests unconformably on pre-Tertiary crystalline rocks, another part on late Tertiary(?) basalt.

Name amended to glaciation in compliance with 1961 Code of Stratigraphic Nomenclature.

Well developed in area north of Sherwin Hill, northwest of Bishop, in Mount Morrison quadrangle. Putnam states type locality of till at Sherwin Hill in Mount Goddard quadrangle. Greatest expanse of till is in lobe east of Whiskey Canyon; along both sides of Rock Creek gorge, thickness of about 450 feet of glacial detritus is exposed.

†Sherwood Limestone[1]

Lower Cambrian: Central western Virginia.

Original reference: H. D. Campbell, 1905, Am. Jour. Sci., 4th, v. 20, p. 445–447.

Named for exposures in James River at Sherwood, Rockbridge County.

Sherwood Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 24, figs. 3, 12. Dolomite, argillaceous and very cherty in upper part. Thickness about 10 feet. Shown on columnar section as underlying Wall member (new) and overlying Rivoli member (new).

Occurs in Dixon-Oregon area.

Shetlerville Formation[1]

Shetlerville Member (of Renault Formation)

Mississippian (Chester Series): Southeastern Illinois and northern Kentucky.

Original references: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 281–290 and no. 5, p. 395–416; 1920, Illinois Geol. Survey Bull. 41.

Elwood Atherton, 1947, Illinois Acad. Sci. Trans., v. 40, p. 129, 130 (fig. 7), 131 (fig. 8). Frank Tippee (unpub. ms.) correlated upper part of Renault with basal Paint Creek of western Illinois and proposed name Downeys Bluff for this member of the Paint Creek; remainder of the Renault is referred to as the Shetlerville member. Overlies Levias member of Ste. Genevieve.

J. M. Weller and others, 1952, Illinois Geol. Survey Bull. 76. p. 62–63. In fluorspar district, discussed as member of Renault; consists of alternating beds of limestone and shale in about equal proportions. Thickness about 60 feet. Underlies Downeys Bluff member; at most places, separation of the two is difficult, especially where shale is not abundant in the Shetlerville; at Downeys Bluff, contact is unconformable; overlies Levias limestone unconformably, and at some places zone of rounded limestone pebbles marks this boundary.

Named for Shetlerville, Hardin County, Ill. Well exposed just east of Shetlerville between Rich and Melcher Hills.

Shields Formation (in Walden Creek Group)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962. Most prominent rocks are sandstone and conglomerate which form units a few feet to more than 1,000 feet thick that project in ledges and ridges; sandstones are coarse grained, feldspathic, and not graded; conglomerates are interbedded with the sandstones as seams, lenses, and thick beds; associated with sandstone and conglomerate is argillaceous shale, which contains thin lenses of gritty sandstone. In type area, shales dominate upper half of formation but intertongue at their base with sandstones and conglomerates of the lower half. Overlies Licklog formation (new); underlies Sandsuck formation.

Named for Shields Mountain, [Sevier County], a high ridge along the northwest edge of the foothills west of the Little River, which is made up of a southeastward-dipping sequence of the formation 2,000 to 2,500 feet thick.

Shiloh Marl Member (of Kirkwood Formation)[1]

Miocene, middle: Southern New Jersey.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 40–44.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 31, pl. 1. Probably late Hemingfordian.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 763. Incidentally mentioned in discussion of ostracods from middle Miocene formations.

Unit from which samples were taken might be more accurately described as a fine-grained argillaceous fossiliferous sand.

First described at Shiloh, Cumberland County.

Shimer Gypsum Member (of Blaine Formation)[1]

Permian: Central southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 27, 28, 31.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1794, 1797. Overlies Nescatunga gypsum (new). Thickness at type locality 24 feet.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 39. Underlies Haskew gypsum member; overlies Nescatunga gypsum member. Leonard series.

Type locality: Shimer Township, Comanche County, Kans. Well exposed at confluence of Nescatunga Creek with Salt Fork Creek, where it caps an outlier of the Blaine.

Shinarump Clay[1]

[Upper Triassic]: Southern Utah.

Original reference: A. C. Lawson, 1913, Econ. Geology, v. 8, p. 435.

†Shinarump Group[1]

Triassic: Utah, Arizona, and northwestern New Mexico.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 53, 54, 68, 150, 152.

Named for Shinarump Cliffs, south of Vermilion Cliffs, Kane County, southern Utah.

Shinarump Member (of Chinle Formation)

Shinarump Conglomerate[1]

Upper Triassic: Southern and northeastern Utah, northern Arizona, southeastern Nevada, and northwestern New Mexico.

Original reference: G. K. Gilbert, 1875, U.S. Geol. and Geog. Survey W. 100th M., v. 3, p. 1–187.

A. A. Baker, 1936, U.S. Geol. Survey Bull. 865, p. 44–47, pl. 1. Shinarump conglomerate, in Monument Valley-Navajo Mountain region, San Juan County, Utah, has maximum thickness of 210 feet. Unconformably overlies Moenkopi formation; underlies Chinle formation.

Parry Reiche, 1937, Am. Jour. Sci., 5th, v. 34, no. 200, p. 130. In Cameron area, Arizona, Shinarump sandstones underlie Tolchaco gravels (new).

H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 48–49. Shinarump conglomerate, in San Juan country is 0 to 120 feet thick. Unconformably overlies Moenkopi; underlies Chinle.

E. T. McKnight, 1940, U.S. Geol. Survey Bull. 908, p. 63–66, pls. Shinarump conglomerate, in area between Green and Colorado Rivers, Grand and San Juan Counties, Utah, is 0 to 50 feet thick. Unconformably overlies Moenkopi formation; underlies Chinle formation.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1392. Shinarump conglomerate in Gore area, Eagle and Summit Counties, Colo., unconformably overlies State Bridge formation.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 477–478. Shinarump conglomerate, in eastern Uinta Mountains, underlies Chinle shale and unconformably overlies Red Wash formation (new).

A. A. Baker, 1946, U.S. Geol. Survey Bull. 951, p. 58–60, pls. 1, 3. Shinarump conglomerate, in Green River Desert-Cataract Canyon area, Emery, Wayne, and Garfield Counties, Utah, is 0 to 135 feet thick. Overlies Moenkopi formation; underlies Chinle formation.

C. L. Camp and others, 1947. Plateau, v. 20, no. 1, p. 1, 8 (chart). Shinarump believed to be basal conglomerate of Chinle.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 594, 595. In Strawberry Valley quadrangle, Utah, disconformably overlies Ankareh shale and underlies Chinle formation. Thickness 35 feet.

E. D. McKee, 1952, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 87 (fig. 1). In Little Colorado River area overlies Holbrook member of Moenkopi.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 63–67, pls. 3, 6. Shinarump conglomerate, in Uinta River-Brush Creek area, Duchesne and Uintah Counties, Utah, is 0 to 90 feet thick and consists of light-gray medium- to coarse-grained in part conglomeratic sandstone. Unconformably overlies Moenkopi formation; underlies Chinle formation.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 442–444, 448 (fig. 4), 449–452. Strata formerly called Shinarump conglomerate in southeastern Utah consist, in places, of a lower sandstone and conglomerate unit, a middle claystone unit, and an upper sandstone and conglomerate unit. The lower and upper units are Shinarump-type deposits whereas middle unit is Chinle-type deposit. Deposits of Shinarump-type and Chinle-type are interstratified and intertonguing. Proposed that the two types be grouped together in Chinle formation and that Shinarump conglomerate be redefined as Shinarump member of Chinle. Lower unit is correlative with strata in southwestern Utah, that are designated as type Shinarump conglomerate, and it is proposed that term Shinarump member be restricted in southeastern Utah to this lower unit. The middle and upper units, although formerly included in the Shinarump conglomerate, are considered separate members of the Chinle; middle unit has been defined as Monitor Butte member of Chinle, and name Moss Back is proposed for upper unit. In southeastern Utah, Shinarump conglomerate included, in places, all of the Shinarump, Monitor Butte and Moss Back Members. In other places, Shinarump conglomerate consisted only of Moss Back member, and in still other parts of southeastern Utah, Shinarump conglomerate consisted of only the Shinarump member. Locally, in San Rafael Swell area, unit now called Temple Mountain member, was included in Shinarump conglomerate. Although this report deals mainly with southeastern Utah, it is believed that term Shinarump member of Chinle should replace term Shinarump conglomerate everywhere. Name Shinarump member should be restricted to strata that can be correlated with reasonable certainty with type Shinarump; where correlations are less certain or where units can be shown to be distinct from Shinarump, other names should be applied. Member has same type area as unit formerly called Shinarump conglomerate. Member ranges in thickness from wedge-edge to 225 feet; commonly not more than 50 feet. Unconformably overlies Moenkopi formation except in

few places where it overlies strata possibly correlative with Temple Mountain member; conformably underlies Monitor Butte member. Shinarump member is recognized in many areas outside southeastern Utah. It extends through much of northern and southern Utah and may be present in Nevada and New Mexico. Longwell (1928, U.S. Geol. Survey Bull. 798), Glock (1929, Am. Jour. Sci., 5th, v. 17), and Hewitt (1931, U.S. Geol. Survey Prof. Paper 162) have recognized Shinarump conglomerate (Shinarump member of present report) in southeastern Nevada, but present author considers this a tentative correlation. Unit mapped by Darton (1928, U.S. Geol. Survey Bull. 794) as Shinarump conglomerate on north and west sides of Zuni uplift, west-central New Mexico, lies 400 feet above base of Chinle and was incorrectly called Shinarump. Unit called Shinarump in northeastern Utah by Kinney (1955) and in northwestern Colorado by Thomas, McCann, and Raman (1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 16) is correlated with strata higher stratigraphically than type Shinarump, and author does not believe that term Shinarump is justified in these areas. Strata, called Shinarump in publications prior to 1952, in southeastern Utah were composed of most of units now called Temple Mountain, Shinarump, Monitor Butte, and Moss Back members of Chinle. Unit called Shinarump conglomerate by Baker (1936), Miser (1924, U.S. Geol. Survey Water-Supply Paper 538; 1924, U.S. Geol. Survey Bull. 751–D), Gregory and Moore (1931, U.S. Geol. Survey Prof. Paper 164), Hunt (1953, U.S. Geol. Survey Prof. Paper 228), and Gregory and Anderson (1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1) in Monument Valley, Circle Cliffs, and Capital Reef areas is essentially same as Shinarump member of present report. In part of White Canyon and Elk Ridge areas, Shinarump conglomerate of Gregory (1938) is Moss Back member. In these places, Gregory included the Monitor Butte member and Shinarump member, where present, in the Moenkopi. In other places in White Canyon and Elk Ridge areas, the Shinarump conglomerate of Gregory is apparently the Shinarump member, and he included the Monitor Butte and Moss Back members in the Chinle. In area near junction of Green and Colorado Rivers, the Shinarump and Monitor Butte members are absent, and unit mapped as Shinarump conglomerate by Baker (1933, U.S. Geol. Survey Bull. 84; 1946) and McKnight (1940) is the Moss Back. McKnight's Shinarump does not extend as far up the Green River as Moss Back of present report. In San Rafael Swell, Shinarump conglomerate of Gilluly (1929, U.S. Geol. Survey Bull. 806–C), Baker (1946), and Hunt (1953) consists mostly of Moss Back and Monitor Butte members or of Moss Back where Monitor Butte is absent. In San Rafael Swell, these authors included Temple Mountain member in Shinarump in some places; in other places, they included it partly in the Shinarump and partly in the Moenkopi; in still other places, they included it entirely in the Moenkopi. In Moab area, unit called Shinarump conglomerate by Baker (1933) and McKnight (1940) is not considered by present author to be correlative with either Shinarump or Moss Back, but is a stratigraphically higher conglomeratic sandstone at base of Chinle and is arbitrarily assigned to Church Rock member.

Type locality: Shinarump Cliffs, south of Vermilion Cliffs, southern part of Kane County, Utah.

Shinersville Conglomerate (in Pottsville Formation)[1]

Pennsylvanian: Northeastern Pennsylvania.

Original reference: F. Platt, 1880, Pennsylvania 2d Geol. Survey Rept. G_2, p. 186–199.

Exposed near Shinersville school house, Sullivan County.

Shingle Hills Formation (in Trinity Group)

Lower Cretaceous: Central Texas.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 1, 7 (fig. 2), 8. Proposed to include Glen Rose limestone member (above) and Hensell sand member. Upper formation of group; overlies Travis Peak formation (restricted).

Named for Shingle Hills in western Travis County where entire sequence of Hensell sand and Glen Rose limestone is traversed by road between Hamilton Pool and Shingle Hills.

Shingle Pass Tuff

Tertiary: Eastern Nevada.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 140 (fig. 4). Highly welded, dark red vitric-crystal ignimbrite. Thickness 80 to 130 feet. Occurs above Needles Range formation.

Present in Grant Range.

Shinumo Quartzite (in Unkar Group)[1]

Precambrian (Grand Canyon Series): Northern Arizona.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

J. H. Maxon, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1963. Thickness 1,500 feet in Bright Angel quadrangle. Overlies Hakatai shale. Grand Canyon series.

Named for exposures in Canyon of Shinumo Creek, Shinumo quadrangle, Grand Canyon region.

Ship Mountain Granite

Jurassic: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Shippensburg Formation

Middle Ordovician (Bolarian): South-central Pennsylvania and western Maryland.

L. C. Craig, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1963–1964. Name given to beds formerly included in basal part of Chambersburg limestone. Consists of dark-gray limestone, cobbly below and even bedded above. Thickness 500 feet. Underlies Mercersburg formation (new); overlies "Lowville." Shippensburg thins westward from Marion to extinction along Cove and North Mountains. In western belts of outcrop in Cumberland Valley, the Mercersberg and Greencastle converge, the former being separated from the Shippensburg by Hatter limestone and Snyder member of Benner limestone.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715 (fig. 1), 717–718. Redefined and subdivided. Stratigraphically restricted by assignment of beds at top of formation to Mercersburg formation. Includes five distinct limestone types: dark gray, fine-grained, and cobbly; dark

gray, fine grained, and evenly bedded; medium to coarse calcarenite; interbedded dark-gray medium-grained limestone and calcilutite pellet conglomerate; and dove-colored calcilutite. Seven metabentonites recognized in eastern belts of outcrop; not all present in one section. In western belts, includes (ascending) Pinesburg, Fannettsburg and Doylesburg members (all new). In eastern belts, where thickest only Pinesburg and Fannettsburg members are recognized. Thickness 416 feet at type locality; thins to northeast, south, and west. Unconformably overlies "Stones River" limestone; unconformably underlies Mercersburg formation. Upper contact marked by lithologic change and a prominent irregular partially silicified bedding surface; lower contact poorly exposed and marked only by contrasting lithologic character at type section. Geographically extended to Maryland. Type locality further described. Derivation of name given.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped in lower part of Chambersburg formation.

Type section: Along Cumberland Valley 2.1 miles southwest of Marion, Franklin County, Pa. Named for exposure at Middle Spring 2.5 miles northwest of Shippensburg, Franklin County.

Shipps Creek Shale Member (of Wautubbee Formation)

Eocene (Claiborne): West-central Mississippi.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 62–65, pl. 2. Carbonaceous shales complexly interbedded and interlensed with silts and sands. Thickness 43 feet at type section. Underlies Cockfield formation, contact varies from sharply defined to transitional; overlies undifferentiated Wautubbee with contact conformable and highly transitional and arbitrarily drawn at base of section in which carbonaceous shales are predominant facies in southwestern Carroll and northwestern Holmes Counties.

Type section: Along county road south of bridge across Shipps Creek, SE¼NE¼ sec. 28, T. 15 N., R. 3 E., about 4 miles northeast of Lexington, Holmes County.

†Shirley Stage[1]

Upper Jurassic: Southeastern Wyoming.

Original reference: W. C. Knight, 1900, Geol. Soc. America Bull., v. 11, p. 377–388.

Named for Shirley Mountains.

Shiwits shale[1] or sandstones (in Tusayan Series)

Permian: Northwestern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (table). In Tusayan series (new) of Carbonic age. Overlies Yampai shales; unconformably underlies Hermit shales.

In Grand Canyon region.

Shnabkaib Member or **Shale Member** (of Moenkopi Formation)[1]

Lower Triassic: Southwestern Utah and northwestern Arizona.

Original reference: H. Bassler and J. B. Reeside, Jr., 1921, U.S. Geol. Survey Bull. 726–C, p. 90, 92.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 60, 61. Described in Zion Park region where it is 216 to 476 feet thick; underlies an unnamed upper red member and overlies an unnamed middle red member. Cream-white, pink, and green-white gypsum in regular beds one-eighth to 3 inches thick and deep-red soft arenaceous gypsiferous mud shales; a few thin layers and oolitic aggregates of marine fossiliferous limestone.

Named for Shnabkaib Mesa, 2 miles southeast of town of Washington, on northwestern flank of Washington dome, Washington County, Utah.

Shoal Gneiss

Precambrian: Southwestern Virginia.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 41–43, pl. 1. Fine-grained banded gneiss containing quartz and feldspar porphyroclasts. Sericite schist interlayered with the porphyroclastic gneiss. On uplands schists weather to micaceous clay soil containing sericitic fragments. In places along Beaverdam and Brush Creeks, near Penitentiary Hill and northward, and in Privett Knob, unit is dark-colored biotite mylonite schist. Predominant rock type between New River and U.S. Route 58 and west of Saddle Creek is greenish-gray schist with blue quartz grains and coarse flesh-colored microcline. Schist and augen gneiss facies in region south of Bridle Creek. Mapped as younger than Grayson granodiorite gneiss, older than the associated mylonite.

In extreme southwestern part of Gossan Lead district, Grayson County. Extends from Beaverdam Creek, south of Independence, southwestward to south of New River. Area lies largely south of U.S. Route 58.

Shoal Creek Breccia

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1), 41, 43 (map 2). Dark massive to rudely bedded deposits of hypersthene-augite-hornblende andesite(?) with maximum thickness of at least several hundred feet. Overlies Rencher formation; underlies Maple Ridge porphyry (new). Name credited to H. R. Blank (unpub. thesis).

Well exposed along Shoal Creek, west of Enterprise, Washington County.

Shoal Creek cyclothem[1] (in McLeansboro Group)

Shoal Creek cyclothem (in Modesto-Bond Formations)

Pennsylvanian: Southern and southeastern Illinois.

Original reference: H. R. Wanless, 1931, Geol. Soc. America Bull., v. 42, p. 801–812.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 10–11. In southeastern Illinois, Shoal Creek occurs in the sequence below the Flannigan cyclothem (new) and above the Collinsville cyclothem (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 7, 11, pl. 1. Underlies Sorento cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Modesto-Bond formations (both new). Above Macoupin cyclothem and below Sorento cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Sec. 34, T. 4 N., R. 3 W., Clinton County. Named from exposures along Shoal Creek.

†Shoal Creek Limestone[1]

Lower Cretaceous (Comanche Series): Central Texas.

Original references: R. T. Hill, 1889, Am. Geologist, v. 3, p. 289; 1889, Am. Jour. Sci., 3d, v. 38, p. 470; 1889, Texas Geol. Survey Bull. 4, p. xiv, xxii.

Named for Shoal Creek at Austin, Travis County.

Shoal Creek Limestone (in McLeansboro Group)

Shoal Creek Limestone Member (of Bond Formation)

Shoal Creek Limestone Member (of McLeansboro Formation)[1]

Middle and Upper Pennsylvanian: Central western and southwestern Illinois.

Original reference: H. Engelmann, 1868, Illinois Geol. Survey, v. 3, p. 148, 159–164, 175, 220.

J. M. Weller and W. A. Newton, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 11. Included in Shoal Creek cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, pl. 1. Rank raised to formation in McLeansboro group.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 67, 73, pl. 1. Rank reduced to member status in Bond formation (new). Basal member of formation. In central and southwestern area, occurs below McWain sandstone member; in southeastern and eastern area, occurs below Mount Carmel sandstone. Thickness 6 to 13 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: Along Shoal Creek and vicinity T. 3 N., R. 4 W., Clinton County.

Shoal River Formation (in Alum Bluff Group)[1]

Shoal River facies (of Alum Bluff Stage)

Miocene, middle: Northwestern Florida.

Original reference: Julia Gardner, 1926, U.S. Geol. Survey Prof. Paper 142, p. 1–3.

H. R. Smith, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 270 (fig. 2), 271 (table 1), 275. Includes Whites Creek beds (new).

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 167–180. Includes Oak Grove member and two faunal zones, *Yoldia waltoncnsis* and *Arca rubisiniana*, formerly included in Choctawatchee formation; overlies Chipola formation; underlies Duplin marl.

Julia Gardner, 1947, U.S. Geol. Survey Prof. Paper 142–H, p. 493. Type locality stated.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 24–26. Considered facies of Alum Bluff stage. Includes Oak Grove facies in basal part.

Type locality: Shell Bluff, north bank of Shoal River, E½ sec. 4, T. 3 N., R. 21 W., 3½ miles (airline) northwest of Mossyhead and ¾ mile east of Godwin Bridge. Base of shell bed, 42 feet above river and about 135 feet above sea level.

†Shoal River Marl Member[1] (of Alum Buff Formation)

Miocene, middle: Northwestern Florida.

Original reference: G. C. Matson and F. G. Clapp, 1909, Florida Geol. Survey 2d Ann. Rept., p. 91, 104–106. table opposite p. 50.

Named for exposures on Shoal River, Walton County.

Shochary Sandstone (in Martinsburg Group)

Shochary Sandstone Member (of Martinsburg Formation)

Upper Ordovician (lower Maysville): South-central and east-central Pennsylvania and northwestern New Jersey.

Bradford Willard and A. B. Cleaves, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1183–1184, 1196. Name proposed for massive sandstone member in upper part of formation. Disconformably underlies Tuscarora sandstone. Lithologically, stratigraphically, and faunally, appears to be correlate of Bassler's Fairview sandstone in south-central sections but it is not traceable through. Carries Pulaski fauna.

Bradford Willard, 1943. Geol. Soc. America Bull., v. 54, no. 8, p. 1069, 1070, 1071–1074, 1118. Further described as unit in Martinsburg group. Upper part, unlike lower, essentially noncalcareous. Throughout, sandstone is medium to fine grained, well sorted, even bedded, and arkosic; conglomeratic beds rare. Dark-gray to gray-brown sandstone occurs in beds up to 4 feet thick. Interbedded with limestone, quartz-pebble, and limestone and shale-chip conglomerates. Thickness 750 feet at type locality. Overlies Dauphin shale (new) of Martinsburg group. No sharp line of separation between unit and underlying shaly or slaty beds of Martinsburg.

W. H. Twenhofel and others, 1954. Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 20). Geographically extended to New Jersey.

Named for Shochary Ridge in northeastern Berks County and northwestern Lehigh County, Pa.

Shoemaker Gravel

Pleistocene: Southern California.

L. F. Noble, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–50. Gravel, sand, and silt: some local beds of caliche a few inches thick near base. More consolidated than older alluvium and dips more steeply. Nature of contact with underlying Harold formation uncertain.

Type locality: Shoemaker Canyon, Valyermo quadrangle. Present only north of San Andreas fault but two small patches occur south of fault 2 miles west of quadrangle.

Shoemaker Limestone[1] Member (of Cass Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 33, 35, 173.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29–30. Redefined and reallocated to Cass formation. Shoemaker as here redefined is the lower member of "Shoemaker" limestone defined by Condra (1927); that is, the name is now applied to the lower member of the Cass. Member consists of two dense bluish limestones separated by a shale seam. Thickness about 1½ feet. Underlies Little Pawnee shale member (new); overlies Plattford formation.

Type locality: West of Shoemaker Bridge along-side Shoemaker Farm, about 2½ miles northwest of Nehawka, Cass County.

Shohola Formation[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: B. Willard, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 571, 585–587.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Generalized sequence for the (largely) nonmarine Upper Devonian or northeastern Pennsylvania shows Shohola formation above Delaware River flags and below Damascus red shale. Comprises Barryville member below and Paupack sandstone member above. Included in Catskill facies group.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7). Diagram shows facieological nomenclature of Chemung stage and shows Shohola facies group composed of Barryville and Paupack parvafacies.

Named from Shohola, on Delaware River near mouth of Lackawaxen Creek, Pike County.

Shongalo Greensand (in Claiborne Group)[1]

Eocene, middle: Northwestern Mississippi.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agr. Rept., p. 164–165.

Occurs in railroad cut at Vaiden Station, Shongalo, Carroll County.

Shongaloo Member (of Schuler Formation)

Upper Jurassic: Subsurface in northern Louisiana, southern Arkansas, and eastern Texas.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 600–602. Lower member of formation. Includes nearshore facies of red and red-green shales, red and white sandstones and basal conglomerates, and the basinward offshore equivalents of these rocks, which are dark-gray fossiliferous shales, shelly limestones and sandstones, and basal conglomerates, lying beneath the Dorcheat member. In most wells, overlies Bossier formation; in southern Arkansas unconformably overlies Buckner or Smackover formation. In type well, occurs between depths of 8,455 and 9,450 feet. Thickness ranges from featheredge at northern limit to more than 1,000 feet in southern Arkansas and in Morehouse Parish, La. Thins southward in Louisiana to about 500 feet; in east Texas averages about 600 feet.

Type well: Magnolia Petroleum Co.'s Sexton Unit No. 1, SW¼NW¼SE¼ sec. 32, T. 23 N., R. 9 W., Webster Parish, La.; Shongaloo Field.

Shoo Fly Formation

Shoofly Formation[1]

Silurian(?): Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 132, chart 5, column 14. Fusulinids reported from the Shoofly indicate that [it] is as young as Pennsylvanian. Shown on chart as Pennsylvanian(?).

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California Westwood Sheet (1:250,000): California Div. Mines. Dark

phyllite, slate, quartzite, and graywacke. Pre-Permian. Spelled Shoo Fly.

Named for exposures in road between Shoo Fly Bridge and Spanish Creek, Taylorsville region.

Shoreham Member (of Sherman Fall Formation)

Shoreham Limestone or Formation (in Trenton Group)

Shoreham Limestone Member (of Glens Falls Limestone)

Middle Ordovician: New York and Vermont, and Ontario, Canada.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 264–267. Member of Sherman Fall formation. Constitutes zone of *Cryptolithus tesselatus* Green, the limestones of lowest Sherman Fall age. In type region, beds comprise upper Glens Falls limestone, overlie lower Glens Falls Larrabee member of Hull age, and underlie Canajoharie shale of later Sherman Fall age. Beds consistently contain *Cryptolithus tesselatus*, which is limited to the member, and *Prasopora orientalis* Ulrich and *Trematis terminalis* (Emmons). This zone persists in the Sherman Fall northwestward to Lennox and Addington County, Ont., in the equivalent beds of northern Lake Champlain, and northeastward to city of Quebec. In type section, lower 36 feet of member is exposed. Along Mohawk Valley, member is composed of 15 to 25 feet of dark-gray calcareous claystones and shales that contrast with subjacent Larrabee member, and are succeeded abruptly by Canajoharie shale. Member has exposed thickness of 30 feet north of McBrides Bay, South Hero Township, Grande Isle County, Vt., with a metabentonite 11 feet from base. Overlying beds are Cumberland Head shaly limestone and Stony Point shale, both of later Sherman Fall age. In New York, underlies Denmark member (new).

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 11, p. 1611–1612. Referred to as Shoreham limestone. Overlies Hull formation.

G. M. Kay 1943, Am. Jour. Sci., v. 241, p. 597–606. Rank raised to formation. Disconformably underlies Rathbun limestone member (new) of Denmark formation. Overlies Kirkfield limestone. (Term Kirkfield is preferred to term Hull). Thickness 45 feet.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 31, 34. Blue marble that may be Shoreham member of Glens Falls is called Whipple marble (new) in this report [Castleton area]. It cannot be traced northward around Taconic Range into the Glen Falls outcrop in Sudbury, Vt.

P. A. Chenoweth, 1952, Geol. Soc. America Bull., v. 63, no. 6, p. 525–527. Term Shoreham formation extended to include all *Prasopora orientalis* beds from top of coarse-bedded calcarenites of Kirkfield formation to base of *Trocholites* subzone and base of Camp member (new) of Denmark formation. Rathbun member of Denmark is herein removed from the Denmark and placed in Shoreham formation. Maximum thickness 52 feet, Lewis County, N.Y.; minimum thickness 15 feet in Mohawk Valley where it spans Adirondack arch.

R. B. Erwin, 1957, Vermont Geol. Survey Bull. 9, p. 30, 31–32, 81–82, 89–90, pl. 1. Upper member of Glens Falls formation. Thickness about 45 feet on Isle La Motte. Overlies Larabee limestone member. Underlies Head formation.

Named for exposures in Shoreham Township, Addison County, Vt.

Shorehamian Stage or Substage

Middle Ordovician (Trentonian): Eastern North America.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1414. Middle Trentonian includes rocks equivalent to Shoreham and Denmark limestone of New York or undivided Sherman Fall limestone. The Shorehamian marked by first appearance of *Cryptolithus tesselatus* Green in New York and Ontario has been recognized in lower part of Salona limestone of central Pennsylvania and eastern West Virginia and in Oranda limestone of Cumberland and Shenandoah Valleys, the "*Christiania*" beds of "Chambersburg limestone." There is a possibility that uppermost Eggleston and Collierstown beds are of this age. Lower "Hermitage" limestone of southwestern Virginia and Logana limestone of Kentucky have been included in stage. Shorehamian is of limestone throughout its extent, being generally more argillaceous than subjacent Kirkfieldian, particularly east of Adirondack line.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 30. Suggested that term Shermian stage be applied to the Shorehamian and Denmarkian.

Name derived from Shoreham Township, Addison County, Vt., for which Shoreham member of Sherman Fall formation was named.

Short Creek Oolite Member (of Boone Formation)[1]

Short Creek Oolite Member (of Keokuk Limestone)

Upper Mississippian: Southeastern Kansas, southwestern Missouri, and northeastern Oklahoma.

Original reference: W. S. T. Smith and C. E. Siebenthal, 1907, U.S. Geol. Survey Geol. Atlas, Folio 148.

R. C. Moore, G. M. Fowler, and J. P. Lyden, 1939, Geol. Soc. America Spec. Paper 24, p. 3, 10, pl. 1. Named subdivisions of Keokuk are Short Creek oolite near top and Grand Falls chert near base. Short Creek is light-gray massive oolitic limestone which commonly appears as single bed 4 to 5 feet thick. Appears to be continuous throughout southwestern Missouri and in adjoining States wherever proper stratigraphic horizon is present.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 236. Included in Keokuk in this report with reservation that evidence for including it in Warsaw is equally strong. Occurs either at top of Keokuk or base of Warsaw. Until fauna is thoroughly studied solution of problem of its age cannot be reached.

E. L. Clark and T. R. Beveridge, 1952, Kansas Geol. Soc. Guidebook 16th Field Conf., p. 13 (fig. 1), 46 (fig. 19), 47 (fig. 20); (reprinted as Missouri Geol. Survey and Water Resources Rept. Inv. 13). Shown as member of Keokuk. Osagean.

G. G. Huffman, 1953, Oklahoma Geol. Survey Guidebook 1, p. 7. In northeastern Oklahoma, Boone formation is divided into (ascending) St. Joe, Reeds Spring, and Keokuk members. In Ottawa and northern Delaware Counties, a bed of white oolite, 2 to 10 feet thick, known as the Short Creek is present in upper Keokuk.

C. H. Behre, Jr., and A. V. Heyl, Jr., 1959, Deutsche Geol. Gesell. Zeitschr., v. 110, pt. 3, p. 517 (fig. 2). Chart shows Short Creek member of Boone formation in upper part of formation. Thickness 1 to 3 feet thick. Disconformably underlies Cherokee shale.

Named for exposures along Short Creek, a stream flowing westward between Galena and Empire in Cherokee County, Kans.

Short Mountain facies (of Fort Payne Formation)

Lower Mississippian: Central and southern Tennessee.

H. J. Klepser, 1937, Ohio State Univ. Abs. Doctors' Dissert, 24, p. 182. Named as southern facies of formation in Eastern Highlands Rim area.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 53–54. Silty siliceous limestones. Facies is everywhere underlain by Maury formation, contact conformable and district. At places where top of Fort Payne formation grades into impure, cherty limestone of the Warsaw, exact stratigraphic boundary is uncertain. Derivation of name given.

Named from Short Mountain, eastern Cannon County. Extends from central Jackson and Overton Counties to southern limit of the State.

Shorts Ranch Andesite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 734–735, fig. 2, pl. 1. One of the most massive of the series of volcanics in the area and when fresh is light purplish gray. Weathers to reddish purple or, less commonly, brown. Has marked flow structure in southern part of range. Thickness at least 400 feet and probably much thicker. West of Tucson and in area north of Ajo Road it overlies Safford tuff (new).

J. E. Kinnison, 1959, Arizona Geol. Soc. Guidebook 2, p. 149 (fig. 2). Underlies Water Tank conglomerate (new); overlies Ivy May andesite (new).

Type locality: On Shorts Ranch, 10,000 feet northeast of Cat Mountain, Tucson Mountains, Pima County.

Shoshone[1]

Upper Triassic: Western Wyoming.

Original reference: W. C. Knight, 1901, Engr. Mining Jour., v. 72, p. 359.

Wind River Mountains.

Shoshone Group[1]

Upper Cretaceous and Eocene: Montana to New Mexico.

Original reference: W. Cross, 1909, Washington Acad. Sci. Proc., v. 11, p. 27–45.

Map published by Bureau of Ethnology shows district once occupied by Shoshone and Ute Indians.

†Shoshone Falls Andesite[1]

Miocene, upper: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 32 (table), 37–38, pl. 5. Exposed thickness about 200 feet; total thickness unknown. Underlies Pillar Falls mud flow, erosional unconformity.

H. T. Stearns, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 463. Suggested that the typical block-lava top of the andesite is represented by the overlying Pillar Falls mud flow.

Type section: Forms Shoshone Falls and Pillar Falls, in Twin Falls and Jerome Counties. Exposed along Snake River from foot of Twin Falls down as far as Perrine Ranch, a distance of 6 miles.

Shoshoni Limestone[1]

Cambrian: Western Wyoming.

Original reference: E. B. Branson, 1917, Geol. Soc. America Bull., v. 28, p. 347–350.

In Wind River Mountains.

†Shot Pouch Sandstone[1]

Mississippian: Western Kentucky.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 174, pl; 1857, Kentucky Geol. Survey, v. 2, p. 85–88.

Forms cliff at the Tar Spring, Breckinridge County.

Shrewsbury Member (of Redbank Formation)

Upper Cretaceous: Eastern New Jersey.

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063. Redbank formation is divided into Shrewsbury and Sandy Hook members.

R. K. Olsson, 1960, Jour. Paleonthology, v. 34, no. 1, p. 2, 4 (fig. 2). Consists of slightly glauconitic quartz sand. Overlies Sandy Hook member; underlies Tinton formation.

Occurs in New Jersey Coastal Plain.

Shriver Chert (in Oriskany Group)[1]

Shriver Chert Member (of Oriskany Formation)

Lower Devonian: Western Maryland, central Pennsylvania, central western Virginia, and eastern West Virginia.

Original reference: C. K. Swartz and others, 1913, Maryland Geol. Survey Lower Devonian volume, p. 91, table opposite p. 30.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull., G–19. p. 67. In some areas, overlies Mandata shale and chert.

H. P. Woodward, 1943, West Virginia Geol. Survey, v. 15, p. 15 (table), 97, 107, 110. In West Virginia, replaced by Port Ewen and Port Jervis formation.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 86. In Maryland, Oriskany formation is subdivided into two members: Shriver chert below and Ridgeley sandstone above. Thickness of Shriver about 100 feet; may be absent in Washington County.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 13, 26. Referred to as member of Oriskany formation; underlies Ridgeley member. Overlies Mandata member of Hamilton formation.

Named for Shriver Ridge at Cumberland, Md.

Shublik Formation[1]

Lower(?), Middle, and Upper Triassic: Northern Alaska.

Original reference: E. D. Leffingwell, 1919, U.S. Geol. Survey Prof. Paper 109, p. 103, 115, map.

W. W. Patton, Jr., and J. J. Matzko, 1959, U.S. Geol. Survey Prof. Paper 302–A, p. 3, 7–8, figs. 1–3. Composed principally of highly carbonaceous

grayish-black shale, chert, and limestone. Comprises three members in Tiglukpuk Creek and upper Kiruktagiak River areas: lower member of black, gray, and greenish-gray shale with minor intercalated dark limestone, about 100 feet thick in upper Kiruktagiak River area but more than 500 feet thick in Tiglukpuk Creek area, with fauna dated as early Middle Triassic; middle member of dark siliceous limestone, black paper shale, and dark calcareous shale; and upper member of dark fossiliferous limestone capped by dark shale. Middle and upper members about same thickness in two areas—130 to 150 feet and 60 to 80 feet respectively—and have a Late Triassic fossil assemblage. Formation mapped and correlated over most of northern Alaska.

U.S. Geological Survey currently designates the age of the Shublik Formation as Lower(?) Middle, and Upper Triassic on the basis of a study now in progress.

Type locality: Shublik Island, on Channing River, at southwestern corner of Shublik Mountains.

Shubuta Member (of Yazoo Clay)

Eocene, upper: Eastern Mississippi and western Alabama.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839 (footnote). Shubuta (clay) member of Yazoo clay (or formation) proposed for 20 to 250 feet of clays and clayey marls, underlain by the Pachuta (marl) member (new) and overlain by the Forest Hill or Red Bluff clay of the Oligocene.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 122, 126, pl. 3. In Choctaw County, Ala., consists of light-greenish-gray and white highly calcareous clay which weathers to light greenish yellow to white; contains small irregular white lime concretions; in many places it is a white chalky calcareous clay or clayey limestone. Thickness 25 to 35 feet.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 702 (fig. 1), 703. Underlies Mosley Hill formation.

Type locality: East side of Chickasawhay River, just north of U.S. Highway 45 bridge east of Shubuta, SW¼ sec. 3, T. 10 N., R. 16 E., Clarke County, Miss.

Shubuta Hill Clay

Eocene (Jackson): Central Alabama.

R. H. Smith and others, 1944, *in* Southeastern Geol. Soc. [Guidebook] 1st Field Trip, [Geol. section of] Little Stave Creek, Clarke County, Ala. Shown on geologic cross sections and stratigraphic column as a fossiliferous, glauconitic marl with phosphate nodules near top. Stratigraphically above Yazoo clay and below Red Bluff [clay].

O. L. Bandy, 1949, Bulls. Am. Paleontology, v. 32, no. 1, p. 13. Mentioned as a fossil locality in discussion of Little Stave Creek Foraminifera.

Shuksan Formation

Upper Jurassic: North-central Washington.

C. E. Weaver, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1391, 1392 (table 3). Mentioned as Shuksan formation consisting of marine sediments partly metamorphosed. Upper Jurassic. On table, occurs above Triassic Cultus and below Cretaceous Pasayten. (Plutonics are omitted from table).

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 977, chart 8C (column 99). Shuksan formation includes sandstone, shales, conglomerates, and cherty beds. Outcrop area noted.

Crops out in valley of North Fork of Shuksan River north of Mount Baker.

Shullsburg Member (of Quimbys Mill Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9. Thin-bedded dolomite. Thickness as much as 8 feet. Shown on columnar section as underlying Strawbridge member (new) and overlying Hazel Green member (new).

Occurs in Dixon-Oregon area.

Shultz Limestone Member (of Talpa Formation)[1]

Permian: Central Texas.

Original reference: W. Kramer, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1579, 1582.

Named from ranchhouse of Mrs. Winifred Shultz which is on the ledge formed by the outcrop in NE¼ T. & N. O. Railroad Co. Survey 127, 8 miles southeast of Paint Rock, Concho County.

Shumla Sandstone[1] (in Canadaway Group)

Shumla Siltstone Member (of Canadaway Formation)

Upper Devonian: Western New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 25 and chart.

I. H. Tesmer, 1955, New York State Mus. and Sci. Service Circ. 42, p. 10 (fig. 1), 18. Termed siltstone member of Canadaway formation. Underlies Northeast shale member; overlies Westfield shale member. Thickness at type locality about 30 feet.

Exposed at Shumla, Chautauqua County.

Shumway cyclothem (in McLeansboro Group)

Shumway cyclothem (in Mattoon Formation)

Pennsylvanian: Central Illinois.

J. M. Weller and W. A. Newton, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 329. Upper part of McLeansboro formation is divided into (ascending) Merom, Shumway, Woodbury, Gila, Greenup, Newton, Bogota (upper and lower), Cohn, La Salle, Macoupin, Flannigan, and Shoal Creek cyclothems.

J. M. Weller and A. H. Bell, 1941, Illinois Geol. Survey Rept. Inv. 76, p. 7. Youngest complete cyclothem known in Illinois. Includes Shumway limestone.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 13. Studies by Ekblaw in south-central Illinois resulted in tentative recognition of six cyclothems of which the Shumway is sixth in sequence (ascending); occurs above Shelby (new). Subsequent attempts to set up a single standard section based on assumption that Omega and Greenup limestones are equivalent resulted in a series of 13 cyclothems of which the Shumway is the 13th and occurs above the Woodbury. If the Greenup and Omega are not equivalent, section includes 14 cyclothems in which the Shumway and Newton are equivalent and occur below the Greenup and above the Shelby.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Included in McLeansboro group. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Mattoon formation (new). Plate 1 shows Shumway above Omega cyclothem and below Bogota cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: SE¼SE¼ sec. 26, T. 9 N., R. 5 E., Effingham County.

Shumway Limestone Member (of Mattoon Formation)

Shumway Limestone (in McLeansboro Group)

Pennsylvanian: South-central Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, Illinois Geol. Survey Bull. 67, p. 19 (fig. 4), 28 [1943]. Shumway "middle" limestone is lower of the two marine limestones of Shumway cyclothem. A lenticular discontinuous dark-bluish-gray argillaceous hard massive bed. Maximum thickness 1½ feet. Overlies a thin coal horizon; underlies a persistent black sheety shale and "upper" limestone, 1 to 3 feet thick. Stratigraphically above Omega limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Type locality stated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), 81, pl. 1. Rank reduced to member status in Mattoon formation (new). Occurs above Omega limestone member and below Effingham limestone member. Thickness about 2 feet at type outcrop. Presentation of new rock-stratigraphic classification of Pennsylvanian strata of Illinois. Cyclical classification is retained but is independent of rock-stratigraphic classification.

Type locality: SE¼SE¼SW¼ sec. 26, T. 9 N., R. 5 E., Effingham County.

Shunganunga Shale[1]

Pennsylvanian: Northeastern Kansas.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 29.

Named for Shunganunga Creek, Shawnee County.

Shurtz Sandstone Tongue (of Navajo Sandstone)

Triassic(?) and Jurassic: Southwestern Utah.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2520, 2521. At type locality, 110 feet thick and consists of fine- to medium-grained moderate reddish-orange sandstone in beds ranging from 2 to 5 feet in thickness. Lies between 410 and 720 feet below of Navajo as mapped by Thomas and Taylor (1946, U.S. Geol. Survey Water-Supply Paper 993) and as accepted in this report. In section along Coal Creek (measured by Thomas and Taylor), the Shurtz tongue is designated as units 26 and 27 of Chinle formation; in section republished by Gregory (1950, Utah Geol. and Mineralog. Survey Bull. 37), tongue appears as units 21 and 22. Although Thomas and Taylor's section shows Shurtz sandstone as separate unit below base of Navajo, Gregory mapped base of Shurtz tongue as base of Navajo, but did not note change on republished section. Interpretation that Shurtz sandstone is more appropriately regarded as tongue of Navajo is based on observations of pronounced thinning of Shurtz from 345 feet in Coal Creek to 110 feet in Shurtz Creek, and to 62 feet in Muries Creek; this abrupt thin-

ning takes place in a distance of 8 miles. Underlies Cedar City tongue (new) of Kayenta formation. Lamb Point tongue (new) of Navajo at Kanab thins abruptly westward as Shurtz tongue at Cedar City thins southward; the possibility exists that the two tongues join somewhere between the two localities.

Type locality: Shurtz Canyon, about 6 airline miles south of Cedar City. Makes up prominent ledge that forms crest of Red Hill east of Cedar City.

†Shutesbury Serpentine[1]

Lower Cambrian: Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 55.

Named for exposure 1 mile south of village of Shutesbury, Franklin County.

Shutler Formation[1]

Tertiary, late, and Pleistocene: Central northern Oregon.

Original reference: E. T. Hodge, 1932, Oregon Univ. Pub. Suppl. to Geol. Ser., v. 1, no. 5, p. 6.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2. Chart shows age as lower and middle Pliocene:

Well developed near Shutler post office, T. 2 N., R. 21 E., Gilliam County.

Shuttle Meadow Formation (in Newark Group)

Upper Triassic: Central Connecticut.

E. P. Lehmann, 1959, Connecticut Geol. and Nat. History Survey Quad. Rept. 8, p. 7, 8 (table 1), 11–12, pl. 1. Proposed for sedimentary rocks overlying Talcott basalt and underlying Holyoke basalt. Unit had been termed lower sedimentary division of Meriden formation by Krynine (1950). Predominant rock type is grayish-red to dark-reddish-brown shale with occasional mudstone of similar color; pale-orange, grayish-orange, grayish-red, and dark-reddish-brown coarse to very fine arkose also present; minor amounts of yellowish-gray and pale-brown coarse- to fine-grained feldspathic sandstone. Shrinkage (mud) cracks, current ripple marks, and crossbedding common; some shales and sandstones very finely laminated; some mudstones massive. Of total calculated thickness of about 310 feet, only about 50 feet are exposed. Contact with underlying Talcott basalt basically conformable, but evidence suggests minor erosion.

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Described in Avon quadrangle, Connecticut, where it consists of moderate reddish-brown to grayish-red arkosic siltstone and shale with subordinate lenses of fine- to medium-grained arkose. Lies between Talcott below and Holyoke basalts; forms bench between basalt cliffs along west face of Talcott Mountain. Thickness 50 to 100 feet, thinnest at northern end of quadrangle.

Type sections: Shuttle Meadow Reservoir sections as described by Krynine (1950)—that is, southern shore of Shuttle Meadow Reservoir between Meriden and New Britain, Middletown quadrangle. Exposed in narrow belt along southern half of west margin of quadrangle; outcrops few and small in lateral extent.

Siamo Slate[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 554.

W. T. Stuart, E. A. Brown, and E. C. Rhodehamel, 1954, Michigan Dept. Conserv., Geol. Survey Div. Tech. Rept. 3, p. 11 (table 3). Thickness about 650 feet in Marquette district. Overlies Ajibik quartzite; underlies Negaunee iron-formation. Middle Huronian.

Named for exposures on Siamo Hill, just south of western part of Teal Lake, Marquette district.

Sias Quartzite

See Sais Quartzite.

Siberia Limestone (in Chester Group)[1]

Mississippian: Southern Indiana and northern Kentucky.

Original references: C. A. Malott, 1920, Science, new ser., v. 51, p. 521–522; 1925, Indiana Acad. Sci. Proc., v. 34, p. 109–132.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Replaced by Menard limestone. Local Indiana names of upper Chester are dropped, and formations given names of standard Chester column.

Named for exposures in vicinity of Siberia, Perry County, Ind.

Sicily Island Formation or terrace

Recent: Southwestern Louisiana.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1822 (table 1), 1829–1830, 1831 (table 2), 1837 (table 3), 1840. In description of physiography of southwest Louisiana the following new formation names are introduced (descending): Sicily Island, Holloway Prairie, Eunice, and Oberlin. However, text discusses Sicily Island as as terrace; hence, it is not clear which use is intended.

Town of Sicily Island is in Tensas Parish on south end of low ridge of the A series, or oldest Sicily Island sediments. Topographic feature averages about 6 miles in width and extends about 80 miles northward up valley, through Winnsboro and Delhi to a point beyond Oak Grove. Elevations rise from 75 feet at Sicily Island to 115 and 120 feet at Oak Grove.

Sidewinder Volcanic Series

Triassic(?): Southern California.

O. E. Bowen, Jr., *in* L. A. Wright and others, 1953, California Jour. Mines and Geology, v. 49, no. 1, pl. 2. Shown on columnar section as rhyolite and dacite flows and pyroclastics about 3,000 feet thick; overlies Fairview Valley formation (new).

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 42–53, pls. 1, 2, 3, 8. Replaces name Sidewinder Valley metavolcanics as used by Miller (1944). Name Sidewinder Valley does not appear on existing maps, and Miller's map does not show its location. Miller's Sidewinder Valley metavolcanics, as mapped, included rocks of several ages; Miller believed series to be interbedded with Oro Grande series and to be Paleozoic in age. As redefined, Sidewinder volcanic series is prodominantly a pyroclastic assemblage subaerially laid onto very irregular topography. Over most of Barstow quadrangle series consists of overlapping interfingering irregularly shaped masses of dacite, quartz latite, latite-andesite, and rhyolite. Unconformably overlies Permian Fairview Valley formation, intruded by Jura-Cretaceous granitic rocks.

Type locality: Sidewinder Mountain, Barstow quadrangle, San Bernardino County. Greatest thicknesses are in Silver Mountain group of hills, Sidewinder Mountain, Stoddard Mountain, and Raven Ridge.

Sidewinder Valley Metavolcanics

Upper Paleozoic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 73–74, 100–102, pl. 5. Include both original lavas and tuffs which have been highly altered and usually strongly foliated. In type area, consist entirely of schistose metavolcanics with a little interbedded quartz schist and quartzite. In some places, interbedded with late Paleozoic Oro Grande metasediments.

E. O. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 42. Replaced by Sidewinder volcanic series.

Type area: Eastern half of small mountain just north and west of Victorville-Barstow road. Named for typical occurrences in hills overlooking northeastern end (or head) of Sidewinder Valley, 3½ to 5 miles northeast of Sidewinder Well, Victorville area of Barstow quadrangle, San Bernardino County.

Sidney Gravel or Formation (in Ogallala Group)

Sidney Gravel and Silt Member (of Kimball Formation)

Pliocene, middle to upper: Southwestern Nebraska, northeastern Colorado, and western Kansas.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 224, 227; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1261–1263, 1266 (table 2). At type exposure, consists of crystalline sand and gravel ranging in texture from fine and medium river sand to pebbles and cobbles as much as 4 to 6 inches in diameter. Thickness 15 to 50 feet; at type locality 20 feet. Overlies caliche at top of Ash Hollow formation; underlies Kimball formation (new). Middle to late Pliocene.

C. B. Schultz and T. M. Stout, 1948, Geol. Soc. America Bull., v. 59, no. 6, p. 555–556. Referred to as gravel and silt member at base of Kimball formation; locally unconformable on older beds, but generally affording a transition from latest Ash Hollow sand and gravel channels.

Type exposure: Bluff at north side of town of Sidney, Cheyenne County, Nebr. Widespread in Nebraska, Colorado, and Kansas.

Sidney Shale Member (of Markley Formation)

Eocene, upper: Northern California.

B. L. Clark and A. S. Campbell, 1942, Geol. Soc. America Spec. Paper 39, p. 9–10. Radiolarian-bearing shale occurring a little more than 2,000 feet above base of the Markley. Toward the base, the Sidney is a gray shale which grades downward into the Markley. Thickness about 700 feet; thins rapidly to northwest and wedges out into sands; cut out to southeast as a result of San Pablo (upper Miocene) overlap. Near Kirker Creek, underlies about 500 feet of micaceous gray to yellow-brown sandstone, with intercalated shale included in Markley formation by Clark (1918).

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34. Unit described and assigned to member rank in Kreyenhagen formation. However, term Sidney is used in quotational sense because name Sidney is preoccupied.

C. V. Fulmer, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1341. Referred to as Sidney Flat shale member.

Type section: A long narrow outcrop beginning a little west of Kirker Creek, Mount Diablo quadrangle.

Sidney Flat Shale Member (of Markley Formation)

See Sidney Shale Member (of Markley Formation)

†Siebert Formation[1] or Lake Beds

Miocene, upper: Southern and central Nevada and southeastern California.

Original reference: S. H. Ball, 1907, U.S. Geol. Survey Bull. 308, p. 27, 32–34, map.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines. Siebert Lake beds mapped in Inyo County. Pliocene.

Probably named for occurrence in vicinity of Siebert Mountain, Tonapah region, Nevada.

Siebert Tuff[1]

Miocene, upper: Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 51–55, maps.

Exposed on east slope of Siebert Mountain, Tonopah region.

Sierra limestone[1]

Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1908, Am. Inst. Mining Engineers Bi-Monthly Bull. 19, p. 7–21.

Sierra County. Derivation of name not given.

Sierra Blanca Limestone[1]

Eocene, middle: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 10, p. 350, 352–354, pl. 46, map.

B. M. Page, J. G. Marks, and G. W. Walker, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1745–1749. Described northeast of Santa Barbara. Unconformably overlies undifferentiated Cretaceous shale. In some localities, grades upward into sandstone of Juncal formation (new). Thickness 20 to 50 feet. Lower middle Eocene. At type locality, disconformably overlies Upper Cretaceous Mono shale and grades upward into sandstone and shale of Eocene age. Thickness at type locality 225 feet.

Type locality: On Indian Creek, 10 miles northwest of Pendola Guard Station, Santa Barbara County.

Sierra Blanca Series[1]

Sierra Blanca coal measures[1]

Upper Cretaceous (Benton): Southern central New Mexico.

Original reference: D. R. Semmes, 1920, Am. Jour. Sci., 4th, v. 50, p. 415–420.

Probably named for Sierra Blanca, Lincoln and Otero Counties.

Sierra de Cayey Series

Cretaceous: Puerto Rico.

E. T. Hodge, 1920, New York Acad. Sci. Scientific Survey of Puerto Rico and the Virgin Islands, v. 1, pt. 2, p. 137–142. Series of conglomerates and

tuffs. Thickness between 3,000 and 4,000 feet. Overlies Barranquitas-Cayey series; contact sharp; underlies Guayama series.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 24. Ildefonso formation (new) includes part of the Río Jueyes, Guayama, and Sierra de Cayey series of Hodge (1920) which could not be recognized in area of present study.

Named for exposures along crest of Sierra de Cayey Mountains, Coamo-Guayama district.

Sierra de Cayey Tuffs[1]

Cretaceous: Puerto Rico.

See Cayey Tuffs.

Sierra Grande Andesite or Flow (in Clayton Basalt)

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 122–124, pl. 1–b. Ten basalt flows in what is termed Folsom sequence of Clayton basalt are named and mapped. Stratigraphic position of six of these basalts has been determined but stratigraphic position of Sierra Grande, Purvine Mesa, Dunchee Hill, and Gaylord Mountain is not known. Sierra Grande andesite resembles Red Mountain dacite of Collins (1949) and if it is a correlative it is earlier than Clayton basalt of Collins (1949) but in this report it is grouped with Clayton basalts.

Sierra Grande is in Union County.

Sierran[1] (period)

Pliocene and Quaternary: California.

Original reference: J. Le Conte, 1899, Jour. Geology, v. 7, no. 6, p. 525–544.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 23. Incidental mention in discussion of Mio-Pliocene floras from west-central Nevada.

Named for Sierra Nevada region.

Sierra Negra Basalt

Pliocene: Northwestern New Mexico.

A. J. Budding, C. W. Pitrat, and C. T. Smith, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 83 (table 1), 85. Name applied to dikes and flows of basaltic composition. Dikes cut El Rito and Abiquiu and Cutler formations. Basalt flow 90 feet thick caps Sierra Negra and overlies Abiquiu tuff.

Present in southern part of Canjilon Southeast quadrangle.

Sierrita Granite

Precambrian: Southeastern Arizona.

W. C. Lacy, 1959, Arizona Geol. Soc. Guidebook 2, p. 186, fig. 44. Coarse-grained oligoclase granite. Forms basement rock and much of core of Sierrita Mountains. Unconformably underlies Bolsa quartzite.

Exposed in long strip in western part of east Sierrita area (eastern side of Sierrita Mountains), Pima County, about 25 miles south of Tucson.

Sierrite Limestone or Formation (in El Paso Group)

Lower Ordovician: Southwestern New Mexico.

V. C. Kelley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2201 (table). On table only. Thickness from fraction of a foot to 250 feet. Underlies Bat Cave limestone (new); overlies Bliss sandstone.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 42–45, fig. 4. Thin- to medium-bedded, the thin beds and laminations result in a distinctive banded appearance. Laminations commonly consist of alternating layers of limestone and chert with latter generally the thinner. Chert laminations are brown weathering, whereas limestone generally weathers medium gray. On fresh surfaces, Sierrite limestone is medium gray to dark gray with slight brownish cast. Most beds are microgranular, but fine- to medium-grained textures are common. Limestone entirely calcite at type locality. Chert is light gray to white on fresh surfaces. Except for chert laminations, formation is almost exclusively limestone. At Molinas Canyon section in southern end of the range, a few thin lentils of brick-red shale present about 35 feet above base of formation. Thickness 167 feet at type locality. Conformable with confining formations. Lower formation of El Paso group. Type section and areal distribution indicated.

Type locality: Exposures on north side of Cable Canyon, Caballo Mountains. Named from Sierrite iron mine on south side of the canyon. Crops out all along west face of Caballo Mountains, in west face of Mud Springs Mountains, and in west face of south Red Hills, at south end of Nakaye Mountain, and in west face of Red House Mountain.

Siesta Formation[1] (in Berkeley Group)

Siesta Formation (in Contra Costa Group)

Pliocene: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 384–390, map.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 143. Described as consisting of marsh and lake clays, ostracodal clays and impure ostracodal limestone, banded impure cherts, silts, sandstones, gravels, thin lignitic beds, and beds of volcanic ash. Thickness 700 feet in south part of area; thins to less than 50 feet north of Grizzly Peak. Succeeded by and interbedded with Bald Peak lavas; interbedded with underlying Moraga volcanics. Lower Pliocene.

D. E. Savage, B. A. Ogle, and R. S. Creely, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1511. Included in sequence of formations in west-central Contra Costa County for which a new group name is proposed (name not given). Sequence (ascending) is Orinda, Moraga, Siesta, Bald Peak, and unnamed formation. Unnamed unit is exposed east of Moraga fault system in fault contact with Siesta and Moraga formations.

C. K. Ham, 1952, California Div. Mines Spec. Rept. 22, p. 15. Lists sequence of Contra Costa group (new) as Orinda, Grizzly Peak, Siesta, Bald Peak, and Mulholland (new) formations.

Named for development in Siesta Valley, Berkeley Hills, San Francisco region.

Signal Hill Beds

Pleistocene, lower: Southern California.

J. E. Eaton, 1943, California Div. Mines Bull. 118, pt. 2, p. 204 (fig. 86) [preprint 1941]. Referred to as coarse, highly deformed, and deeply

degraded beds apparently younger than the San Pedro, but their relation to this substage is unknown.

Occurs in Los Angeles Basin.

Signal Mountain Formation[1] (in Arbuckle Group)

Upper Cambrian: Southeastern Oklahoma.

Original reference: E. O. Ulrich, 1932, Geol. Soc. America Bull., v. 43, p. 742–747.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 21–22, measured sections. Thickness 114 to 478 feet in Arbuckles. On McKenzie Hill, rests with apparent conformity on Fort Sill limestone, but hiatus probably occurs at this locality, because Royer formation lies between it [Signal Mountain] and Fort Sill in northwestern part of Wichitas and in all of its exposures in Arbuckle Mountains. In latter region, it is overlain by Butterly formation (new) and occupies position between two dolomites, Royer below and Butterly above.

Named for exposures in sec. 8, T. 2 N., R. 12 W., about 1 mile south of Signal Mountain, a prominent peak at eastern end of Wichita Range.

Signal Point Shale (in Gizzard Formation)

Signal Point Shale (in Gizzard Group)

Lower Pennsylvanian: Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4. Overlies Warren Point sandstone; underlies Sewanee conglomerate of Crab Orchard Mountains group (new). Thickness at type section 52 feet; thins westward to 10 feet at type section of Gizzard group; along eastern edge of Walden Ridge averages about 60 feet; along Western Escarpment commonly very thin and locally completely truncated by Sewanee conglomerate. Pottsville series.

Type locality: On State Highway 8 east of Signal Point and just south of town of Signal Mountain, Chattanooga quadrangle, Hamilton County.

Siksikpuk Formation

Lower(?) Permian: Northern Alaska.

W. W. Patton, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–B, p. 41—43. Chiefly of variegated green, gray, and dark red shale and siltstone that locally are notably calcareous, cherty, or ferruginous. Variegated nature and bright yellow and orange weathering of ferruginous beds are distinctive. Thickness of composite section measured in type area totals 354 feet. Everywhere it appears to rest disconformably upon rocks of Lisburne group; disconformably underlies Shublik formation.

Type section is composite of two separate outcrops, approximately 2 miles apart along narrow belt of exposures immediately adjacent to north front of Brooks Range. Basal 62 feet measured in cutbank on east side of Skimo Creek at about lat 68°17′ N. and long 151°53′ W. Remainder of section measured in cutbank on east side of small tributary to Tiglukpuk Creek at about lat 68°17′ N. and long 151°48′ W. Named from Siksikpuk River, to which Tiglukpuk Creek is a major tributary.

Siletz River Volcanic Series

Eocene, lower: Northwestern Oregon.

P. D. Snavely, Jr., and E. M. Baldwin, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 5, p. 806–812. Name proposed for a series of basaltic

flows, pillow lavas, flow breccias, and pyroclastic rocks that includes small amounts of water-laid tuffaceous sedimentary rocks that contain a fauna correlative with the Capay shale of California. Base of series not exposed; minimum thickness of 3,000 to 5,000 feet computed for section between Valsetz and forks of Siletz River. Overlain with apparent conformity, except where faulting has produced local angular relationships, by rhythmically bedded micaceous arkosic sandstone of middle(?) Eocene age; in northwestern part of area upper Eocene siltstones unconformably overlap the middle(?) Eocene sandstones and rest directly on the volcanics. Structurally the volcanics are folded into broad anticlinal arches with minor flexures; one arch trends northward along western half of mass, plunging northeast; the other trends north of east and plunges beneath the Willamette Valley near Dallas. Correlated with Umpqua formation and with lower part of Tillamook volcanic series.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Described in coastal area between Cape Foulweather and Cape Kiwanda where it conformably underlies Burpee formation.

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. In west-central border area of Williamette Valley, includes Kings Valley siltstone member (new) in upper part. Volcanics extend in broad north-east trending belt from northwest corner of Monroe quadrangle into Albany quadrangle where they are well exposed in quarries near Coffin Butte.

Type section: Along Siletz River from Valsetz milldam, sec. 28, T. 8 S., R. 8 W., to the Lower Gorge, sec. 16. T. 9 S., R. 9 W., Lincoln County. Well exposed along Siletz River and its tributaries in Euchre Mountain and Valsetz quadrangles.

Silica Shale, or Formation

Silica Shale (in Traverse Formation)[1]

Middle Devonian: Northwestern Ohio.

Original reference: G. A. Stewart, 1927, Ohio Geol. Survey, 4th ser., Bull. 32, p. 5–9.

G. A. Stewart, 1936, Jour. Paleontology, v. 10, no. 8, p. 739–740. As originally defined, was considered to comprise a single shale unit about 10 feet thick. Herein stratigraphically expanded above and below to include a sequence, approximately 45 feet thick, of blue shales, blue argillaceous limestones, and blue shaly limestones. Of total thickness only basal 16 feet are exposed in quarry at Silica.

G. A. Stewart, 1938, Geol. Soc. America Spec. Paper 8, p. 6, 7. Underlies Tenmile Creek dolomite (new). Separated from underlying Columbus limestone by an 8-foot unit termed Blue limestone. Considered best to discontinue use of term Traverse for upper Middle Devonian units of northwestern Ohio between Columbus limestone and Ohio shale.

G. M. Ehlers, E. C. Stumm, and R. V. Kesling, 1951, Devonian rocks of southeastern Michigan and northwestern Ohio: Ann Arbor, Mich., Edward Brothers, Inc., p. 18–20. Stratigraphically expanded below to include 8-foot unit termed Blue limestone by Stewart (1938). Overlies Dundee limestone ("Columbus limestone" of Ohio geologists). Well records in southeastern Michigan show a northward continuation of several units of the Silica and indicate that formation is thicker than in Ohio.

K. V. Hoover, 1960, Ohio Geol. Survey Inf. Circ. 27, p. 8–16. Stratigraphic position and correlation of Olentangy shale discussed in detail. It is here suggested that the Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek dolomite are stratigraphically correlatable, with the reservation that Olentangy is probably Upper Devonian. Olentangy interval is represented by Silica shale and Ten Mile Creek dolomite in northwestern Ohio. Silica formation is series of alternating shales and limestones that are highly fossiliferous and are thin to thick bedded. Basal beds are bluish gray and have been called "Blue" limestone. Field relationships between limestone beds of Silica formation and Ten Mile Creek dolomite are similar. Regional information regarding Silica formation-Ten Mile Creek dolomite has not been worked out. Combined thickness of 93 feet for the two units has been reported in Lucas County exposures.

Named for exposures in quarry of Sandusky Cement Company [now operated by Medusa Portland Cement Company] one-half mile north of Silica, Lucas County.

†Silo Sandstone[1]

Upper Cretaceous: Southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79, p. 6.

Named for Silo, Bryan County.

Silver Shales[1]

Silver Shale Member (of Percha Shale)

Upper Devonian or Lower Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1898, Am. Inst. Mining Engineers Bi-Monthly Bull. 19, p. 7, 9.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Assigned to Linnian series.

M. A. Stainbrook, 1947, Jour. Paleontology, v. 21, no. 4, p. 298. Considered lower member of Percha shale. Lower part of Percha also termed Ready Pay member by Stevenson (1944). There is little doubt that the Silver and Ready Pay were proposed for identical division of Percha, and there is little reason to replace earlier name. Percha of early Mississippian age.

Named for Silver City.

Silverado Formation

Paleocene: Southern California.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. Name proposed for Paleocene strata of northwestern Santa Ana Mountains. In type area and nearby, formation consists of a lower nonmarine member and an upper marine member; marine member is thinner than nonmarine and thins and disappears southeastward through gradation into nonmarine deposits. Formation includes Claymont clay bed about 65 to 140 feet above base and Serrano clay bed about 275 feet above the Claymont. Thickness of formation ranges from about 700 feet to 1,475 feet. Underlies Santiago formation; rests disconcordantly on different parts of Upper Cretaceous sequence; on ridge forming divide between Sierra Canyon and Gypsum Creek and Coal Creek, formation rests successively on Pleasants sandstone, Schulz Ranch sandstone, and Holz shale.

R. F. Yerkes, 1957, U.S. Geol. Survey Prof. Paper 274–L, p. 324–325. Formation in El Modeno area, Orange County, consists of five lithologic units (ascending): conglomerate bed, 20 to 40 feet; lower arkosic sandstone about 100 feet; Claymont clay bed, about 2 feet; arkosic sandstone unit as much as 700 feet; and marine sandstone bed, about 300 feet. Underlies Santiago formation; unconformably overlies Cretaceous sedimentary rocks.

Rene Engel, T. E. Gay, Jr., and B. L. Rogers, 1959, California Div. Mines Bull. 146, p. 24, 77, 80, 81, 93, 95, 97, pls. 5, 7. Name "Silverado formation" was used by B. N. Moore (1930, unpub. thesis) to designate most of Triassic rocks on southwest slope of Santa Ana Mountains. These rocks have been correlated with metamorphosed sediments in Elsinore quadrangle [this report], and name "Silverado formation" conflicts with older name "Santa Ana formation." Footnote (p. 77) states that, in the discussion which follows, the rock units referred to as Bedford Canyon formation and Santiago Peak volcanics correspond in general to units referred to as Santa Ana formation and the Jurassic(?) volcanic and hypabyssal rocks respectively in preceding pages of bulletin. Term Silverado formation is used in place of Martinez formation to designate the Tertiary clay-bearing sedimentary rocks. Martinez formation mapped on plate 1. Silverado formation, Paleocene, is mapped on plates 5 and 7.

Type region: Area northeast of Irvine Park, northwestern Santa Ana Mountains, Orange County.

Silver Bell Formation

Tertiary: Southeastern Arizona.

J. H. Courtright, 1958, Arizona Geol. Soc. Digest, p. 7, 8. Composed mainly of angular to subrounded fragments of dark-gray to purplish-hued andesite porphyry enclosed in matrix of gritty andesitic mudstone. Fragments commonly 1 to 6 inches in diameter, but large blocks several feet in diameter occasionally present. Evidence of stratification extremely rare. Thickness from a few feet to possibly 200 feet. Appears to lie unconformably on Cretaceous and older sediments, although actual contacts not observed. Underlies volcanics that closely resemble Cat Mountain rhyolite of Tucson Mountains. Formation regarded as separate from underlying Cretaceous sediments.

Kenyon Richard and J. H. Courtright, 1960, Arizona Geol. Soc. Digest, v. 3, p. 1, 7. Unconformably overlies Claflin Ranch formation (new).

At Silver Bell mine [35 miles northwest of Tucson, in Silver Bell Mountains], Pima County. A formation of considerable extent.

Silver City Granite[1]

Age(?): Southwestern Idaho.

Original reference: A. M. Piper and F. B. Laney, 1926, Idaho Bur. Mines and Geology Bull. 11, p. 15.

Silver City, Owyhee County.

Silver City Monzonite

Eocene, middle or upper: Northern Utah.

D. R. Cook, 1957, Utah Geol. Soc. Guidebook 12, p. 65 (fig. 6). As shown on chart overlies Swansea quartz monzonite.

Area of report is Main Tintic mining district.

Silver Coulee Beds (in Polecat Bench Formation)

Paleocene: Northwestern Wyoming.

G. L. Jepsen *in* W. B. Scott, 1937, A history of land mammals in the Western Hemisphere: New York, Macmillan Co., p. 99; 1940, Am. Philos. Soc. Proc., v. 83, p. 236–237, 238 (table). Proposed for beds, 1,200 to 3,000 feet thick, that occur approximately 2,400 feet above base of formation. Matrix is fine-grained green sandstone. Faunally beds may be called the *Microcosmodon-Phenacodaptes-Litolestes* zone. Stratigraphically above Rock Bench quarry beds (new); and below Clark Fork beds.

Named for Silver Coulee, a tributary of Big Sand Coulee, in Sand Coulee Basin, Park County. Fossil quarry is in sec. 21, T. 57 N., R. 100 W.

Silver Creek Glacial Substage

Silver Creek Till

Pleistocene (Wisconsin): North-central Colorado.

D. F. Eschman, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1380. Time of third of four glacial advances in the area. Marked by terminal and recessional moraines. Followed Gould advance (new), preceded American Lakes advance (new).

D. F. Eschman, 1955, Jour. Geology, v. 63, no. 3, p. 205–206, fig. 2, table 1. Deposits of substage mapped as Silver Creek till. Substage represented by the most extensive and complete morainic system on Michigan River. Till is loose, sandy, and light brown; contains many subrounded cobbles and pebbles; reddish-brown clayey streaks rare; depth of oxidation in till about 20 inches.

Named from Silver Creek, a tributary of South Fork of Michigan River, the valley of which is choked at its lower end with a great amount of drift, Michigan River basin, North Park.

Silver Creek Limestone Member (of Sellersburg Limestone)[1]

Silver Creek Formation (in Hamilton Group)

Middle Devonian: Southern Indiana and central northern Kentucky.

Original reference: C. E. Siebenthal, 1901, Indiana Dept. Geology and Nat. Resources 25th Ann. Rept., p. 345.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1057, 1061–1063, 1067. Rank raised to formation in Hamilton group. Underlies Swanville formation (new); overlies Deputy formation (new). Close relationship of Silver Creek and Beechwood implied by their treatment as members of the Sellersburg does not exist. Their fossils represent separate time divisions in standard Hamilton scale. Beechwood is separated from Silver Creek by erosional disconformity. The two facies of upper beds of Silver Creek more or less merge in central Clark County and contain layers of bedded chert and chert nodules. New Chapel chert bed proposed by Whitlatch and Huddle (1931) is only local and perhaps of secondary origin; it does not identify bed as whole or at all localities; therefore, term seems unnecessary.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 42, pl. 1. Indiana Geological Survey considers Silver Creek and Speed as lithofacies of Hamilton rocks. These lithofacies may be used as members in southern part of outcrop belt.

Named for Silver Creek, Clark County, Ind.

†Silver Creek Shale[1]

Upper Devonian: Western New York.

Original reference: D. D. Luther, 1903, New York State Mus. Bull. 69, p. 1019–1029.

Well exposed in Walnut and Silver Creek Ravines, Chautauqua County.

Silver Dyke Breccia[1]

Tertiary: Central Montana.

Original reference: P. A. Schafer, 1935, Montana Bur. Mines and Geology Mem. 13, map.

Occurs west of Silver Dyke mine, Little Belt Mountains.

†Silverheels Porphyry or Porphyrite[1]

Eocene: Northeastern Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1886, U.S. Geol. Survey Mon. 12, p. 83, 104–107.

Named from the fact that it forms important intrusive sheets on Mount Silverheels, northeast of Alma, Park County.

Silver Hill Formation[1]

Middle Cambrian: Central western Montana.

Original reference: F. C. Calkins and W. H. Emmons, 1913, U.S. Geol. Survey Prof. Paper 78.

W. T. Holser, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1058–1059 (table 1). Underlies Hasmark dolomite; overlies Flathead quartzite. Limestone and shale 210 to 350 feet thick.

Named for exposures on steep east face of Silver Hill, south of Silver Lake, Philipsburg region.

Silver Hills facies[1] (of New Providence Formation)

Lower Mississippian: Southern Indiana and northern Kentucky.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 96–100.

J. E. Conkin, 1957, Bulls. Am. Paleontology, v. 38, no. 168, p. 110–111, 114–116. Silver Hills facies divided into three members in Jefferson and Bullitt Counties, Ky.: Kenwood sandstone. Button Mold Knob (new), and Coral Ridge (new) members.

Name derived from Silver Hills at southwest side of New Albany, Floyd County, Ind.

Silverhorn Dolomite[1]

Middle Devonian: Eastern Nevada.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Min. and Met. Eng. Trans., no. 1647, p. 7; 1932, U.S. Geol. Survey Prof. Paper 171.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1781, chart 4. Age shown on correlation chart as Middle and Upper Devonian.

Named for exposures south of old Silverhorn mining camp, 4 miles northwest of Bristol Pass, Pioche district.

Silveria Formation[1]

Pleistocene: Northwestern Illinois.

Original reference: O. H. Hershey, 1896, Am. Jour. Sci., 4th, v. 2, p. 324–330.

Named for extinct Lake Silveria, in Pecatonica Basin, Stephenson County.

Silver King Dolomite Member[1] (of Bonanza King Formation)

Middle Cambrian: Southeastern California and southern Nevada.

Original reference: J. C. Hazzard and J. F. Mason, 1936, Geol. Soc. America Bull., v. 47, no. 2, p. 236–237.

J. C. Hazzard and J. F. Mason, 1953, Am. Jour. Sci., v. 251, no. 9, p. 651–652. Geographically extended into Goodsprings area, Nevada, where it lies within the Goodsprings dolomite of Hewett (1931). Described as a very dark smoky gray dolomite with inconspicuous bands 6 inches to 10 feet thick; upper part is a transition zone 20 to 25 feet thick in which light-gray beds, averaging 1 foot thick, alternate with darker beds 2 to 3 feet thick. Thickness about 190 feet.

Named for Silver King mine, on east side of Providence Mountains, San Bernardino County, Calif.

Silver King Quartz Monzonite Porphyry

Age not stated: South-central Arizona.

M. N. Short and others, 1943, Arizona Bur. Mines Bull. 151, Geol. Ser. 16, p. 42–43. In the least altered area, the rock is medium-dark-gray quartz diorite porphyry. In vicinity of mineralized area, the porphyry is light brown and highly weathered into spheroidal forms of variable size, mostly more than 1 foot in diameter. A specimen from inside a large spheroidal boulder is medium gray with faintly greenish tint. Rock is fine grained and holocrystalline.

Crops out as a roughly elliptical mass approximately 2,500 feet long from east to west by 1,200 feet wide. Represents the rock in which was developed the Silver King ore body, Superior mining area, northeastern Pinal County.

Silver Lake Group[1]

Pliocene: Central southern Oregon.

Original reference: T. Condon, 1902, The two Islands.

Silver Lake Shale Member (of Scranton Shale)[1]

Silver Lake Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 30.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 214. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Overlies Rulo limestone; underlies Burlingame limestone. Average thickness about 25 feet.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 3090 (fig. 14). Graphic section of Pennsylvanian in western Adams County shows Silver Lake shale underlying Burlingame and overlying Elmo coal which in turn overlies Cedar Vale (Cedarvale) shale.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Rank reduced to member status in Scranton shale here reintroduced as a formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Overlies Rulo limestone member; underlies Burlingame limestone member of Bern limestone (new).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Bright-gray shale, well-bedded, with some limonitic bands at

base. Thickness about 11 feet. Underlies Burlingame limestone; overlies Cedar Vale shale. Rulo limestone which underlies Silver Lake in some areas, not identified in Iowa. Wabaunsee group.

Type locality: Northeast of Silver Lake, Shawnee County, Kans.

Silver Mine Granite

Precambrian: Southeastern Missouri.

H. B. Graves, 1938, Acad. Sci. St. Louis Trans., v. 29, no. 5, p. 119. Medium-grained red granite distinguished from other granites of area [St. Francois Mountains] by its heavy-mineral assemblage. Cut by a number of dikes.

Occurs along southern border of main mass granite in Iron Mountain and Mine La Motte quadrangles.

Silver Mountain Monzonite Porphyry[1]

Eocene(?): Southeastern Colorado.

Original reference: R. C. Hills, 1900, U.S. Geol. Survey Geol. Atlas, Folio 68.

Well exposed in Huerfano Park quadrangle, adjoining Walsenburg quadrangle on west in Huerfano County.

Silver Pass Volcanics

Paleocene or Eocene: Central Washington.

R. J. Foster, 1957, Dissert. Abs., v. 17, no. 9, p. 1982; 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 105–107, pl. 1. Proposed for unit composed mainly of andesite and more felsic volcanic rocks, including flows, tuff, and breccia. Smith and Calkins (1906) included these rocks in their Kachess rhyolite, although they commented on the differences. Silver Pass volcanic rocks include "type area" of Smith's and Calkins' Kachess. In mapped area of this report, rocks called Kachess by Smith and Calkins can be separated into two groups, presumably of different ages: Silver Pass volcanic rocks of post-Swauk and pre-Teanaway age, and rhyolite within Naches formation. At Silver Pass, the volcanic rocks unconformably overlie Easton schist; to the southwest on ridge of French Cabin Mountain, they overlie Swauk formation; near Silver Pass, they are intruded by basaltic dikes presumably of Teanaway dike swarm; farther south, on ridge between Kachess Lake and Silver Creek, they apparently unconformably underlie Teanaway basalt. Unfossiliferous. May be Paleocene or Eocene, but discovery of fossils may alter this interpretation.

Type area: Silver Pass, between Silver Creek and French Cabin Creek, both of which drain region between Kachess and Cle Elum Lakes, central Cascades Mountains.

Silver Peak Andesites

Late Tertiary: Central eastern California.

H. D. Wilshire, 1957, California Univ. Dept. Geol. Sci. Bull., v. 32, no. 4, fig. 1. Named on map legend of Ebbetts Pass region. Younger than Raymond Peak andesites (new).

Ebbetts Pass region is in Alpine County.

†Silver Peak Group[1]

Lower Cambrian: Southwestern Nevada and eastern California.

Original reference: H. W. Turner, 1902, Am. Geologist, v. 29, p. 261–272.

C. R. Longwell, 1952, Washington Acad. Sci. Jour., v. 42, no. 7, p. 210, 211. Discussion of lower limit of Cambrian in Cordilleran region. Silver Peak series is of particular interest because fossils in relative abundance range through large part of its thickness. Beds overlie Campito sandstone. Correlates with Wood Canyon formation. Thickness about 7,000 feet.

Named for exposures in Silver Peak Range, Esmeralda County, Nev.

Silver Plume Granite[1]

Precambrian: Central northern Colorado.

Original reference: S. H. Ball, 1906, Am. Jour. Sci., 4th, v. 21, p. 389.

J. M. Bray, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 768 (fig. 1), 770. Younger than rocks of Pikes Peak group—Boulder Creek granite and Overland Mountain granite (new).

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 28, 29, 74, pl. 1. Younger than Pikes Peak and Sherman granites. As used in this report, Cripple Creek granite, Longs Peak granite, and Mount Olympus granites are included in the Silver Plume.

Forms south wall of Clear Creek Canyon at mining town of Silver Plume.

†Silver Reef Sandstone[1]

Upper Triassic: Southwestern Utah.

Original reference: J. B. Reeside, Jr., and Harvey Bassler, 1922, U.S. Geol. Survey Prof. Paper 129–D, p. 62, 73.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 23–25. Reeside and Bassler noted Silver Reef sandstone in section measured on Smiths Mesa, 3 miles north of Virgin City, Utah, and 12 miles east of Silver Reef. According to these authors, Silver Reef sandstone is 260 feet above base of Chinle, yet in Silver Reef area the correlative sandstone is 620 feet above base of Chinle. Reeside and Bassler's "arkosic sandstone" or supposed Silver Reef sandstone, lies about same distance above base of Chinle as that measured in present report [Silver Reef area, Washington County] for arkosic bed in Hartley shales and sandstones (new). Silver Reef sandstone in Silver Reef area is about same horizon as "mauve crossbedded, ripple-marked sandstone" of Reeside and Bassler.

Section measured on Smiths Mesa, 3 miles north of Virginia [Virgin] City, and 12 miles east of Silver Reef, Washington County.

Silver Reef Sandstone Member (of Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1950, Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1495. Includes lenselike bentonitic shales.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 23–25, pl. 2. Subdivided into the Leeds sandstone (new) which includes mainly white to buff fine- to medium-grained sandstone beds with interbedded shales; and an overlying lavender, fine- to medium-grained sandstone called Tecumseh sandstone (new). Member is 620 feet above base of formation. Contained all known commercial quantities of silver which were mined in the past in Harrisburg (Silver Reef) mining district. Underlies Duffin sandstone and shale (new) with local unconformities; overlies Trail Hill sandstone (new). The Silver Reef sandstone (of Reeside and Bassler) may be the same zone as

the arkosic bed in the Hartley shale and sandstone (new) rather than the lateral equivalent of the Silver Reef sandstone member.

Described from Silver Reef (Harrisburg) mining district, Washington County.

Silver Run Limestone

Lower Paleozoic(?) (Glenarm Series): Western Maryland and southeastern Pennsylvania.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346; A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties [Rept. 12], p. 62–63. Blue thin-bedded argillaceous banded finely crystalline limestone in which the argillaceous material forms slaty or muscovite partings. Occurs largely northwest of Wakefield marble (new) and in places seems to grade into the marble and may be equivalent to it; infolded with and underlies Marburg schist and Ijamsville phyllite (both new).

U.S. Geological Survey currently considers the age of the Glenarm Series to be Lower Paleozoic(?).

Named from valley of Silver Run, Carroll County, Md. Also present in Frederick, Md., and York County, Pa.

Silver Star Granodiorite

Tertiary: Southwestern Washington.

W. M. Felts, 1939, Ohio Jour. Sci., v. 39, no. 6, p. 297, 302–303, 306–307, 315 (fig. 4). Contains subordinate amounts of augite diorite and quartz diorite near borders. Intrudes Eagle Creek formation and lower parts of Skamania andesites (new). Miocene. J. E. Allen (unpub. thesis) described the granitic rock near Silver Star Mountain as Silver Star Formation.

†Silver Terrace Sandstone[1]

Jurassic(?): Western California.

Original reference: R. Crandall, 1907, Am. Philos. Soc. Proc., v. 46, p. 3–58.

Forms Silver Terrace Hills, in eastern part of San Francisco.

Silvertip Conglomerate Member[1] (of Madison Limestone)

Upper Devonian or Mississippian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 46.

L. L. Sloss and W. M. Laird, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 15. On correlation chart, included in DA unit of Devonian age which underlies Madison limestone.

Named for Silvertip syncline, because it is thickest on Lone Butte, which lies nearly in center of syncline. Known to occur in only three areas—Lone Butte, Spotted Bear Mountain, and Pentagon Mountain [Flathead County].

Silverton Volcanic Group

Silverton Volcanic Series[1]

Tertiary, middle and upper: Southwestern Colorado.

Original reference: W. Cross, 1901, U.S. Geol. Survey Bull. 182, p. 29–39.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13–14, 75–81, pl. 1. Complex of lavas, tuffs, and agglomerates. Maximum thickness about 3,000 feet. Includes (ascending) Picayune quartz latite, Eureka rhyolite, Burns quartz latite, pyroxene-quartz latite flows, and Henson tuff. Overlies San Juan tuff; older than Potosi volcanic series.

U.S. Geological Survey currently classifies the Silverton as a group and designates the age as middle and late Tertiary on the basis of a study now in progress.

Named after Silverton quadrangle where units have their greatest development. Present extent is about 40 miles east and west and 25 miles north and south.

Silverwood cyclothem (in Tradewater Group)

Pennsylvanian: Western Indiana.

J. W. Alexander, 1943, Illinois Acad. Sci. Trans., v. 36, no. 2, p. 142 (fig. 1), 143. Name applied to cyclothem in which Indiana coal II is developed. Unit is a dark shale 6 feet thick where it attains its maximum thickness. Near base are two limestones, the upper 2 inches thick, and the lower 4 inches thick. Stratigraphically below Middle Delong cyclothem and above Minshall limestone.

Well exposed on Coal Creek just north of route 234 in NE¼SW¼ sec. 36, T. 18 N., R. 8 W., in vicinity of Silverwood, Fountain County.

Silvey Gap Sandstone (in Redoak Mountain Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19, pls. 2, 3, 4. Maximum thickness 60 feet, at type locality. Separated from underlying Fodderstack sandstone (new) by shale interval that ranges from 45 to 110 feet in thickness; separated from basal shale of Vowell Mountain group (new) by a shale interval and the Pewee coal.

Named from exposures in Silvey Gap, above Windrock, Windrock quadrangle, Anderson County.

Silvies River Beds[1]

Lower Jurassic: Southeastern Oregon.

Original reference: W. D. Smith and E. L. Packard, 1919, Oregon Univ. Bull., v. 16, no. 7, p. 105.

Probably named for Silvies River, Harney County.

Simi Conglomerate[1]

Eocene, lower: Southern California.

Original reference: R. N. Nelson, 1925, California Univ. Pub., Dept. Geol. Sci. Bull., v. 15, no. 11, p. 400–401, map.

Named for occurrence on flanks of Simi Hills, Ventura County.

†Similkameen Formation[1]

Lower Cretaceous: Central northern Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

Exposed throughout a large part of elevated region drained by headwaters of Similkameen River.

Similkameen Granite[1]

Similkameen Granodiorite

Mesozoic: North-central Washington, and southern British Columbia, Canada.

Original reference: R. A. Daly, 1906, Geol. Soc. America Bull., v. 17, p. 329–376.

A. C. Waters and Konrad Krauskopf, 1941. Geol. Soc. America Bull., v. 52, no. 9, pl. 1. Mapped as granodiorite.

Exposures in eastern part of Chopaka quadrangle, Okanogan County, Wash., and British Columbia.

Simmler Formation

Oligocene(?) and Miocene, lower(?): Southern California.

T. W. Dibblee, Jr., 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Guidebook, Joint Ann. Mtg., p. 82, 86. Dark-red sandstone and basal conglomerate 3,000 feet thick. Underlies Miocene Soda Lake formation (new); overlies Eocene(?) marine sandstone and shale. Outcrops noted in road log.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2978 (fig. 3), 2981, 2982–2983. At designated type locality, consists of continuous series of hard pink to dark-grayish-red fine- to medium-grained massive sandstone beds with numerous interbeds of dark maroon and greenish siltstone. Sandstones are biotitic, well laminated, and commonly crossbedded; basal part consists of about 30 feet of conglomerate in dark maroon matrix. Thickness about 3,000 feet. Overlies Pattiway formation (new), with slight angular unconformity; conformably underlies Soda Lake sandstone member (new) of Vaqueros formation. In vicinity of Soda Lake, conformably underlies Soda Lake shale member (new) of Vaqueros formation. In western Cuyama Valley and La Panza Range, consists of maroon-red conglomerate and sandstone resting unconformably on Cretaceous sediments or granitic basement and attains maximum thickness of 3,000 feet. Oligocene(?) and perhaps lowermost Miocene. This formation was mapped as Redrock Canyon sandstone member of Santa Margarita by English (1916, U.S. Geol. Survey Bull. 621–M) and nonmarine Vaqueros by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2).

Type locality: Southeastern Caliente Range, T. 10 N., R. 25 W., east of Cuyama Ranch quadrangle. Range is an anticlinal uplift developed in a thick series of Tertiary sediments and is partially overturned and thrustfaulted southwestward toward Cuyama Valley.

†Simmons Bluff Beds[1]

Pleistocene: Southern South Carolina.

Original reference: W. H. Dall, 1897, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 336, published in 1897 as House Doc. 5, 55th Cong., 2d sess.

Exposed at Simmons Bluff, about 12 miles below Rantowles, Charleston County.

Simon Limestone[1] (in Mississippian Series)

Carbonic: Southeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 243, 251, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart). In Mississippian series. Underlies Truxton limestones. Of Carbonic age.

Exposed in face of Chiricahua Mountains and overlooking San Simon bolson, in northeast corner of Cochise County.

Simon Quartz Keratophyre[1]

Middle Triassic: Central Nevada.

Original reference: A. Knopf, 1921, U.S. Geol. Survey Bull. 725–H.

Named for Simon mine in Cedar Mountains.

Simons Syenite[1]

Precambrian: New York.

Original reference: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2, map.

Exposed on shores of Simons Pond, Franklin County.

Simonson Dolomite[1]

Middle Devonian: Western Utah and east-central Nevada.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

J. C. Osmond, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1931–1953. Geographically extended into east-central Nevada. Overlies Sevy dolomite. Detailed discussion of unit.

R. W. Rush, 1956, Utah Geol. and Mineralog. Survey Bull. 53, p. 12 (fig. 3), 23 (fig. 2). Described in western Millard County where it is about 460 feet thick, consists of medium-light-gray to medium-gray dolomite, overlies Kings Canyon dolomite (new), and underlies Guilmette limestone.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 84–86, pls. 1, 21. Described in Sheeprock Mountains where it is 450 to 563 feet thick, conformably overlies Sevy dolomite and conformably underlies Victoria-Pinon [Pinyon] Peak formations undifferentiated.

H. J. Bissell, 1959, Utah Geol. Soc. Guidebook 14, p. 145–150. Described in Fivemile Pass and North Boulter Mountains quadrangles where it is 563 feet thick, disconformably underlies Victoria formation and overlies Sevy dolomite. Noah dolomite of Bluebell formation is considered equivalent to Simonson dolomite; suggested that name Simonson be used in central Utah in preference to Bluebell.

Named for exposures in Simonson Canyon, on west side of Deep Creek Range, Gold Hill region, Utah.

Simpson Group[1]

Middle Ordovician: Central and southern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56–57. Group comprises (ascending) Joins, Oil Creek, McLish, Tulip Creek, and Bromide formations. Overlies Arbuckle group; underlies Viola group, which includes (ascending) Viola proper and Fernvale. Chazy.

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 154 (table 1). Underlies Patterson Ranch group (new).

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, 333p, pls. Group comprises (ascending) Joins, Oil Creek, McLish, Tulip Creek, Bromide, and Corbin Ranch (new) formations. Comprehensive review of Simpson investigation and extensive bibliography of Simpson stratigraphy; part 2 describes Simpson Ostracoda.

Named for former village of Simpson, just north of Pontotoc, Johnston County.

Simpsonian Series

Ordovician: Central and eastern North America.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Palaeocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines: Peiping, China, Univ. Press. Natl. Univ. Peking, p. 20, 282. Term applied to rocks of Simpson, or Stones River age.

Simsboro Formation (in Wilcox Group)

Simsboro Sands Member (of Rockdale Formation)[1]

Eocene, upper: Central and southern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 586, etc.

H. B. Stenzel, 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Econ. Geologists Guidebook, Joint Ann. Mtg., Houston, p. 53 (geol. map). Shown on geologic map as a formation underlying Calvert Bluff formation and unconformably overlying Hooper formation.

Typically exposed at town of Simsboro, Freestone County.

Sinbad Limestone Member (of Moenkopi Formation)[1]

Lower Triassic: Central eastern Utah.

Original reference: J. B. Reeside, Jr., and others, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 5, p. 797.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1. p. 10. Generalized section of exposed sedimentary rocks in Henry Mountains structural basin shows Moenkopi formation 250 to 685 feet, including Sinbad limestone member.

Type area: San Rafael Swell.

Singas Formation

Upper Triassic: North-central Nevada.

R. R. Compton, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1387–1388, pl. 1. Sequence of phyllites with minor quartzite beds and clastic limestone lenses. Thickness 4,000 to 7,000 feet. Overlies O'Neill formation (new), contact drawn at top of highest O'Neill quartzite bed. Underlies Andorno formation (new).

Name derived from Singas Creek, Santa Rosa Mountains, Winnemucca region. Well exposed on ridge between Wash O'Neill Creek and Provo Canyon. Composes most all of Bloody Run Hills.

Singleshot Member (of Appekunny Argillite[1] or Formation)

Precambrian (Belt Series): Northwestern Montana.

Original reference: C. L. Fenton and M. A. Fenton, 1931, Jour. Geology, v. 39, no. 7, p. 670–679.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1885–1886. Lowermost member of Appekunny formation. Thickness 300 to 400 feet. Underlies Appistoki member; overlies Carthew member (new) of Altyn formation. Type locality designated.

Type locality: Singleshot Mountain near St. Mary Lake, Glacier National Park.

Sing Sing Marble[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and J. R. Healy, 1912, Columbia Univ. Contr., v. 20, p. 1907–1912.

In Westchester County.

Sinks Grove Limestone (in Greenbrier Limestone[1] or Series)

Middle Mississippian (Meramecian): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 451, 484.

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 903. Denmar formation (new) includes Sinks Grove and Patton limestones of Reger (1926). Age of Denmar, Middle Mississippian (Meramecian series).

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 50, no. 9, p. 1910–1912. Patton and Sinks Grove do not represent a single stratigraphic unit; in Monroe County, where they were named, they are separated by 10 to 20 feet of plant bearing shale [Patton shale]. Use of term Denmar for these two units is without merit. Middle Mississippian.

Type locality: Along Sinks Grove-Knobs Road, in vicinity of Sinks Grove, Monroe County, W. Va.

Sinosri Formation

Oligocene: Panamá and Costa Rica.

Original reference: D. F. MacDonald and others, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 364.

Karl Sapper, 1937, Mittelamerika Handbuch der regionalen Geologie: Heidelberg, vol. 8, sec. 4a, no. 29, p. 131, 132, 134 (chart), pl. 9. Chart shows middle Oligocene Senosri limestone below upper Oligocene Uscari formation.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 346. Undefined name for deposit of Oligocene age. Sinosri is correct spelling.

Bocas del Toro Province.

Sinsinawa Member (of Wise Lake Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 12. Thick-bedded dolomite, pure, brown, coarsely crystalline. Thickness 13 feet. Shown on columnar section as underlying Stewartville member (new) of Wise Lake formation and overlying Wyota member (new) of Dunleith formation.

Occurs in Dixon-Oregon area.

Siouan series[1]

Precambrian: Iowa.

Original reference: C. R. Keyes, 1912, Iowa Acad. Sci. Proc., v. 19, p. 147–151.

Sioux Quartzite[1]

Precambrian: Northwestern Iowa, southwestern Minnesota, northeastern Nebraska, and southeastern South Dakota.

Original reference: C. A. White, 1870, Iowa Geol. Survey, v. 1, p. 26, 167–171.

Brewster Baldwin, 1949, South Dakota Geol. Survey Rept. Inv. 63, p. 1–25. Consists predominantly of pink-coated fine grains of quartz sand cemented to a nonporous quartzite of silica. Seams and beds of coarse-grained quartzite present locally; also contains some shale and pipestone. Known exposures in South Dakota are in Minnehaha, Lincoln, Turner, McCook, and Hanson Counties. Covers belt some 70 miles long in eastwest direction and about 30 miles in north-south direction. On indirect evidence formation is probably Precambrian. On basis of lithology, absence of fossils, and structures, formation has been correlated with Baraboo quartzite in Wisconsin, which is overlain directly by Upper Cambrian sediments.

Named for exposures in banks of Big Sioux River, Iowa.

Sipe Springs Formation (in Big Saline Group)

Pennsylvanian (Lampasas Series): North-central Texas (subsurface).

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 84 (fig. 5), 85. Sequence of limestone and shale. Lies at depth of 3,760 to 3,870 feet in type well. Underlies Eastland Lake formation (new); overlies De Leon formation (new.

Type well: Roxana Petroleum Co. Seaman No. 1, northwest Palo Pinto County. Name derived from town in northern Comanche County.

Sisar Black Shale

Eocene, middle: California.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1920 (fig. 3), 1931. Shown on structure section as underlying Topatopa sandstone and overlying Wheeler sandstone.

Exposed in the Santa-Ynez-Topatopa Mountains north of the Santa Clara Valley, [Ventura County].

Siscowit Granite

Age not stated: Southeastern New York and southwestern Connecticut.

D. M. Scotford, 1956, Geol. Soc. America Bull., v. 67, no. 9, p. 1177, pl. 1. Name proposed for medium- to fine-grained massive light-reddish-gray granite weathering dark-reddish-gray to dark-gray. Foliation not pronounced. Formerly considered part of Thomaston granite. Not continuous with type Thomaston and bears little resemblance to it.

Named for reservoir in outcrop area [in Westchester County, N.Y.] Also mapped in Fairfield County, Conn.

Siskiyou Granodiorite[1]

Jurassic: Northwestern California.

Original reference: J. H. Maxson, 1933, California Jour. Mines and Geology, v. 29, nos. 1, 2, p. 131, map.

Del Norte and Siskiyou Counties.

Siskiyou terrane[1]

Pre-Silurian: Northwestern California.

Original reference: N. E. A. Hinds, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 20, no. 11, p. 375–410.

N. E. A. Hinds, 1940, 6th Pacific Sci. Cong. for 1939, v. 1, p. 277–278. Pre-Silurian.

Well exposed in Siskiyou Mountains, [Siskiyou County].

Sisquoc Formation[1]

Miocene, upper, and Pliocene, middle: Southern California.

Original reference: W. W. Porter, II, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 2, p. 135–143.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1340 (table 1), 1347–1352. Described as including two principal facies: a fine-grained basin facies made up dominantly of diatomaceous strata and a sandstone marginal facies represented at eastern margin of basin. When formation was named, the marginal sandstone facies was emphasized. According to current usage, term Sisquoc formation when unqualified refers to the basin facies, which is more extensive in both outcrop and subsurface sections. Marginal facies is designated Tinaquaic sandstone member; Todos Santos claystone member is applied to porcelaneous claystone forming about the lower half of basin facies in Casmalia Hills. In Purisima Hills, basin facies has exposed maximum thickness of 3,000 feet; in Casmalia Hills, formation is 2,000 to 3,000 feet thick, Todos Santos claystone constitutes about 1,500 feet of lower part. Overlies Monterey shale; underlies Foxen mudstone.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 26–36, pl. 1. Late Miocene and middle Pliocene.

Named for section on Sisquoc Ranch, on south side of Sisquoc River, in Sisquoc grant, Santa Barbara County. Woodring and others regard the western Purisima Hills as type region of basin facies.

Sites Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1942, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 26, no. 5, p. 899. Listed as underlying Funks formation and overlying Mills formation (both new).

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282, 284–285, 291, 293. Described as consisting mostly of massive- to well-bedded or rhythmically banded, concretionary, greenish-gray or light-drab sandstone. Thickness 2,095 to 3,965 feet. Conformably underlies Funks formation; conformably overlies Yolo formation (new name for preoccupied Mills). Derivation of name given.

Named for exposures both north and south of Stone Corral Creek, particularly in E¼ sec. 33 and E½ sec. 28, T. 17 N., R. 4 W., Colusa County.

Sitgreaves Tuff[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 39, map.

Named for Sitgreaves Pass, Oatman district.

Sitkin Point Formation

Early Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 175, 177, pl. 23. Waterlaid pyroclastic material; tuffaceous graywacke, dacite-boulder tuff-breccia, andestitic tuff, and pumiceous tuff. On tip of Sitkin Point, formation is of semiconsolidated volcanic wacke or graywacke in beds 2 to 20 feet thick and averaging 4 feet thick. Exposed deposits more than 450 feet thick. Underlies Double Point dacite (new) and overlies Williwaw Cove formation (new) with unconformable contacts. Probably early Quaternary.

Named for deposits exposed at Sitkin Point, Little Sitkin Island, in Rat Islands group of Aleutian Islands.

Sixmile Granite[1]

Precambrian: Central Texas.

Original reference: H. B. Stenzel, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 144.

Virgil Barnes, Frederick Romberg, and W. A. Anderson, 1954, Internat. Geol. Cong., 19th Algiers 1952, Comptes rendus, sec. 9, pt. 9, p. 153. Town Mountain granite invaded the already deformed metasediments [Valley Spring gneiss and Packsaddle schist] and was followed by the Oatman Creek granite, Sixmile granite, and Llanite, the latter being the youngest.

Quarried near Sixmile, near Llano, Mason County.

Sixmile Schist

Age not stated: Central Virginia

W. R. Brown, 1951, (abs.) Virginia Jour. Sci., new ser., v. 2, no. 4, p. 347. Incidental mention.

Lynchburg quadrangle.

Six Mile Shale (in Ithaca Shale)

Six Mile Shale Member[1] (of Middlesex Shale)

Upper Devonian: South-central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Shale reallocated to lower part of Ithaca shale. Underlies Cascadilla shale; overlies Renwick shale.

Occurs in Ithaca region.

Sixmile Canyon Formation (in Indianola Group)

Upper Cretaceous: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 128. Succession of coarse-grained gray sandstone and conglomerate containing coal-bearing member of finer grain. In Sixmile Canyon, three members recognizable (ascending): prominent gray conglomeratic sandstone about 2,000 feet thick; coal-bearing member containing gray to cream-colored and white mainly fine-grained sandstone, gray to white shale, carbonaceous shale, and coal, about 300 feet thick; conglomerate and conglomeratic sandstone of which 425 feet are exposed. Uppermost

formation in group; overlies Funk Valley formation (new); unconformably underlies Price River formation.

Named for exposures in Sixmile Canyon, south of Manti, Sanpete County.

Six-Mile Lake Amphibolite (in Dickinson Group)

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C. p. 30 (table 1). 32. Uppermost formation in group. A massive dark fine- to medium-grained aggregate of hornblende and plagioclase, with strong preferred planar and linear orientation of minerals; amphibolite is basaltic in composition and represents a metamorphosed sequence of flows and possible tuffs; amphibolite grades to the south (across the strike) into a mile-wide zone of banded gray gneiss that is the product of reaction between the amphibolite and post-Dickinson gneissic granite. Thickness about 3,000 feet. Overlies Solberg schist (new).

Named for Six-Mile Lake in sec. 22, T. 42 N., R. 29 W., Dickinson County. Well exposed in low knobs and ridges immediately south of the lake and for several miles to the east and west.

Sixshooter Group

Cretaceous (Comanche Series): Western Texas.

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21; J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 378–385. Name applied to sequence of limestone lying between Cox sandstone below and the Boquillas flags in Kent quadrangle. Name credited to J. P. Brand and R. K. DeFord (in press). In area of this report (Wylie Mountains and vicinity), group comprises 330 to 350 feet of limestone of a neritic facies; divided into three formations (ascending): Finlay, Boracho (new), and Buda limestones.

Well exposed in southern part of Kent quadrangle along U.S. Highway 80.

Sixth Street terrace deposit

Pleistocene: Southern Texas.

A. W. Weeks, 1941, (abs.) Am. Assoc. Petroleum Geologists Program 26th Ann. Mtg., p. 20; 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1697 (fig. 2), 1703 (fig. 8), 1708–1709, 1717 (fig. 16). Quaternary section of Texas Coastal Plain between Brazos River and Rio Grande is divided into 11 terraces and terrace deposits. Name Sixth Street is applied to a terrace deposit composed of 5 to 10 feet of dark-gray to reddish silt overlying limestone gravel. Younger than Capitol terrace deposit and lies about 70 feet below surface of Capitol terrace. Downstream along Colorado, the terrace appears to join surface of the Beaumont. Seems desirable to retain name Sixth Street for deposits at Austin since relation of younger terrace deposits, First Street and Riverview, at Austin, to formations near coast has not been completely determined.

Named for occurrence along Sixth Street east of Congress Avenue, Austin, Travis County.

Siyeh Limestone[1] (in Piegan Group)

Siyeh Formation (in Piegan Group)

Siyeh Group

Precambrian (Belt Series): Northwestern Montana, and southwestern Alberta and southeastern British Columbia, Canada.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 323.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1892–1894. Includes argillites, quartzites, and extensive mud breccias, as well as thick algal deposits. Dominantly dark gray to black; all dolomites weather buff or fawn. Second dominantly calcareo-magnesian formation in Glacier Park facies. Thickness 2,900 to 4,000 feet in Lewis Range; 5,400 feet in Blackfoot Canyon facies. Consists of (ascending) *Collenia symmetrica* zone, Goathaunt member, *Collenia frequens* zone, and Granite Park member in Glacier National Park. Underlies Spokane formation; overlies Grinnell formation. Type locality given.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Mapped as Siyeh group. Includes Helena limestone, Spokane formation, Newland limestone, Marsh shale, and Wallace formation in Montana.

C. E. Erdmann, 1944, U.S. Geol. Survey Water-Supply Paper 866–B, p. 48. Consists of two thick, massive bodies of impure limestone or dolomite, separated by thinner westward-lensing body of reddish argillite. Upper member known in various localities as Upper Siyeh, Blackfoot, Helena, or Wallace limestones. Middle member called red band in Siyeh or, where more fully developed, Spokane formation. Lower member called Lower Siyeh or Newland limestone.

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Limestone mapped in Piegan group.

Richard Rezak, 1957, U.S. Geol. Survey Prof. Paper 294–D, p. 137–139. Siyeh limestone contains three stromatolite zones: *Collenia symmetrica* zone (includes Goathaunt member of Fenton and Fenton); *Conophyton* zone; *Collenia multiflabella* zone (includes Granite Park member of Fenton and Fenton).

C. P. Ross, 1959, U.S. Geol. Survey Prof. Paper 296, p. 19 (table), 33–43, pls. 1, 2. Siyeh limestone (redefined) is main unit of Piegan group (redefined). Argillaceous beds that have been included by some workers at base and top of the Siyeh have been separated from it in present report. Unit termed "greenish calcareous argillite" (up to several hundred feet thick), formerly included in the Siyeh, is herein considered basal part of overlying Missoula group and separates Siyeh limestone from Purcell basalt. Believed that when later detailed mapping is done the Siyeh will be divided into several units of formational rank and name "Siyeh" will be restricted in its application or abandoned. The Siyeh underlies broad areas in median parts of Flathead and Swan Ranges. These areas extend almost entire length of parts of both ranges that are within Flathead region and in Flathead Range persists to foot of Lake McDonald. According to Clapp's map (1932, Montana Bur. Mines and Geology Mem. 4) and Deiss's unpublished geologic map of Ovando quadrangle, the Siyeh is continuously exposed as far south as T. 18 N., R. 15 W., and at intervals beyond this. In Glacier National Park, the Siyeh forms core of mountain mass. It extends from near intersection of long 113°30′ with lat 48°30′ northwestward past Canadian border, widening northward. Thickness 1,800 to 5,000 feet. Overlies Grinnell argillite of

Ravalli group. Rezak's stromatolite zones and their importance discussed.

Type locality: Mount Siyeh, Glacier National Park, Mont.

Skagit Gneiss or Gneisses

Skagit Volcanic Formation[1]

Mesozoic: Southwestern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 15.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map), 12–14. Discussion of geology of northern Cascades of Washington. Skagit gneisses originated during time of Mesozoic folding. At least most of the gneisses are probably earlier than Lower Cretaceous sediments. Older than Chilliwack granodiorite (which formed from it); on eastern border of the Skagit is Black Peak granodiorite (new) which apparently formed from the Skagit. Marblemount quartz diorite (new) was earlier than Mesozoic folding.

Extends from first summit west of Skagit River to summit of Custer Ridge, Whatcom County, Wash., the main divide of Skagit Range.

Skajit Limestone[1]

Middle(?) and Upper Devonian: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 238.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

W. P. Brosgé, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B351–B352. Skajit limestone has been referred to the Silurian. In type area on John River, it seems related to limestone that is locally interbedded in the basal part of overlying black slate and phyllite unit that contains fossils of Middle(?) Devonian age. Also fossils of Middle or Late Devonian age have been collected in Western Brooks Range from limestone which had been mapped as Skajit by Smith and Mertie (1930, U.S. Geol. Survey Bull. 815).

Named for Skajit Mountains, Endicott Range.

Skamania Andesites or Andesitic Series

Miocene to Pliocene: Southwestern Washington.

W. M. Felts, 1939, Ohio Jour. Sci., v. 39, no. 6, p. 301–302, 304–306, 315 (fig. 4). Proposed for a thick series of andesites with minor amounts of breccia and other pyroclastics; divisible into two units, an upper and a lower; lower has undergone more folding and metamorphism than upper. Thickness more than 800 feet. Overlie Eagle Creek formation; contact not exposed in mapped area, but to the east in Washougal basin, contact is disconformable. Lower part intruded by Silver Star granodiorite (new). Miocene to Pliocene.

Well exposed near Star Mountain and over wide areas in adjacent parts of Skamania County.

Skaneateles Shale (in Hamilton Group)[1]

Middle Devonian: Central and western New York.

Original reference: L. Vanuxem, 1840, New York Geol. Survey 4th Rept., p. 380.

G. A. Cooper, 1930, Am. Jour. Sci., 5th ser., v. 19, p. 214–219. In Chenango and Unadilla Valleys, subdivided into (ascending) Mottville, Delphi, Pompey, Berwyn, and Colgate. West of Cayuga Lake includes Stafford and Levanna members. Overlies Marcellus; underlies Lowville.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 180–181. Delphi Station (new), Chenango sandstone (new), and Butternut shale (new) replace Delphi shale (Cooper, 1930), Colgate sandstone (Cooper, 1930), and Berwyn (Cooper, 1930), respectively.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Mottville-Stafford members transferred to the Marcellus.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, nos. 5–6, p. 358–361, pl. 1. Formation crops out from east-central New York to extreme western limits of the State. Thickness about 215 feet in Batavia quadrangle where it is represented by Stafford and Levanna members. Overlies Oatka Creek shale member of Marcellus; underlies Centerfield limestone member of Ludlowville formation.

[G. A. Cooper], 1955, New York State Geol. Assoc. 27th Ann. Mtg., p. [10], 11. Formation comprises (ascending) Delphi Station, Pompey, Butternut, and Chenango members. Thickness 434 feet. Overlies Marcellus, underlies Ludlowville.

Name derived from Skaneateles Lake, Onondaga County.

Skate Creek Laharic Breccia or deposits

Eocene-Oligocene: Northwestern Washington.

R. V. Fisher, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 127–132. An andesitic volcanic breccia that unconformably overlies dark-gray pebbly volcanic sandstone layer as much as 2 feet thick. Fragments of breccia are porphyritic to dense andesite and angular to subangular (some well rounded) and average about one-half inch in longest dimension. Some scattered water-worn vesicular bomb-shaped fragments present. Scattered nonoriented carbonaceous fragments and one well-preserved spruce cone (*Picea* sp.) observed. These characteristics indicate deposition either by lahars or pyroclastic flows but preclude deposition from air.

Occurs at junction of Skate and Johnson Creeks, eastern Lewis County.

Skeels Corners Formation

Skeels Corners Slate (in Woods Corners Group)

Middle Cambrian: Northwestern Vermont.

B. F. Howell, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1964. Name proposed for dark-gray shale formerly lower part of Hungerford formation. Underlies Saxe Brook formation (new) disconformably. Middle or Upper Cambrian.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1 (column 70). Overlies Mill River formation.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Upper Cambrian.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1136, 1153. Thickness unknown. Middle Cambrian. More exact location of type section given.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 523 (table 1), 532 (fig. 5), 539–542, pl. 1. Skeels Corners slate includes some beds formerly called Georgia slates by Walcott (1886, U.S. Geol. Survey Bull. 30) and a large part of those referred to Hungerford and Highgate slates by Keith (1932, Washington Acad. Sci. Jour., v. 22), Schuchert (1937), and Raymond (1937, Geol. Soc. America Bull., v. 48, no. 8, p. 1079). Name originally proposed by Howell (1939) to refer to the *Bovicornellum* beds alone, but it is here extended to include all strata above Mill River conglomerate or, in its absence, St. Albans slate, and below Rockledge conglomerate. Typically black slate, with local developments of dolomite, sandstone, dolomite conglomerate, limestone bioherms, limestone, and calcareous shale in minor quantities. Accurate measurement of thickness not possible. Thickness at type locality about 400 feet, estimated 1,200 feet in adjoining Milton quadrangle. Included in Woods Corners group (new). Middle Cambrian.

Typically exposed west of Skeels Corners, 7¼ miles north of St. Albans, Franklin County. Extends northward to point northwest of Highgate Center and southward to vicinity of West Georgia.

Skeene Member (of Whitehall Formation)

See Skene Dolomite Member (of Whitehall Formation).

Skelley Limestone (in Conemaugh Formation)[1]

Skelley limestone member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

Original reference: D. D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 27.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 56–57, geol. map. In Morgan County, Skelley limestone member of Conemaugh series is a nonpersistent bed of gray to brownish-gray fine- to medium-crystalline limestone, commonly nodular to conglomeratic and locally sandy or shaly. Thickness averages 7 to 8 inches. Stratigraphically below Duquesne shale member [not present in Morgan County]; occurs 7 to 12 feet above Gaysport limestone member and from 25 to 33 feet above Ames limestone member.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 146–147. Member of Duquesne cyclothem in report on Athens County. There is a possibility that type Gaysport limestone correlates with type Skelley and that limestone under consideration here is actually without a name. At present, best choice seems to be to use both names until their correlation is shown to be in error. That mistaken field identity of Gaysport and Skelley limestones has been made is indicated by statements by Mark (1912, Ohio Geol. Survey, 4th ser., Bull. 17) and Lamborn (1951, Ohio Geol. Survey, 4th ser., Bull. 49) that Skelley occurs 15 to 35 feet above Ames limestone. In sequence of beds, the Gaysport is almost everywhere overlain by Lower Grafton shale and sandstone, but the Skelley is succeeded upward at numerous places by Birmingham redbed. Thickness commonly less than 12 inches. Overlies Skelley shale

and sandstone member; underlies Birmingham redbed member of Elk Lick cyclothem. Conemaugh series.

Named for Skelly Station, on Pennsylvanian Railroad, Jefferson County.

Skelley shale and sandstone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 146. Member of Duquesne cyclothem in report on Athens County. Overlies Duquesne coal member and underlies Skelley limestone member. Similar to underlying Lower Grafton. Skelley and Lower Grafton members may replace Duquesne coal, underclay, limestone, and redbed forming continuous sequence of shale and sandstone between Gaysport and Skelley limestone. Average thickness of Skelley shale and sandstone member is 12¾ feet.

Named for association with Skelley limestone.

Skelt Shale (in New River Group)

Skelt Shale (in Pottsville Group)[1]

Pennsylvanian (Pottsville Series): Southern West Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 198.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 227. Black shale about 6½ feet thick below Guyandot sandstone and above Sewell "B" coal. Included in New River group, Pottsville series.

Named for occurrence on north side of Sugar Creek, one-half mile east of village of Skelt, Webster County.

Skene Dolomite Member (of Whitehall Formation)

Upper Cambrian: Northeastern New York.

R. R. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939; 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Barren light-gray slightly cherty thin-bedded dolomite grading upward into crossbedded worm-riddled sandstone. Thickness about 120 feet. Overlies Hoyt limestone member; underlies Norton limestone member (new) of Tribes Hill formation. Discussion of revisions in Champlain, Hudson, Mohawk, and St. Lawrence Valleys involving definitions and succession of previously accepted Cambro-Ordovician formations (Potsdam, Theresa, Hoyt, and Little Falls of Upper Cambrian age and the Whitehall, Tribes Hill, and Beekmantown of Lower Ordovician age). Each revised unit is tied in with Divisions A through E of original "Calciferous" formation (Brainerd and Seely, 1890, Am. Mus. Nat. History Bull., v. 3). The Skene is the sandy base of C plus upper part of B.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. Term Skene dolomite not applicable in Saratoga Springs region because it was defined as Upper Cambrian. Replaced by Gailor dolomite (new). Wheeler (1942) classified Hoyt limestone as basal member of Whitehall formation and Skene as upper member, the latter being a very late Upper Cambrian offlapping unit. It is evident that Wheeler mistook

the Ordovician Gailor dolomite for the older Little Falls dolomite, because the Hoyt of his supposed "Little Falls" is in fault contact in his "unfaulted" area, 4 miles west of Saratoga Springs.

Occurs in Skene Mountain section.

Skiatook Group

Skiatook Shale[1]

Pennsylvanian (Missouri Series): Northeastern and central Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 34.

R. C. Moore and others, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 39–40. Ohern introduced term Skiatook to apply to beds between Lenapah and Dewey limestones; term was used only in southern part of area mapped by him, and, as shown by his mapping, he mistook Checkerboard limestone for Lenapah. Consequently, original application of Skiatook was really to strata between Checkerboard and Dewey. Term is herein restored to formal nomenclature and rank raised to group. Lower boundary coincides with disconformity that marks base of Missouri subseries; upper boundary is placed at top of Drum limestone, or where Drum is absent, at base of sandstone in lowermost Chanute shale of Ochelata group. Includes (ascending) Seminole sandstone, Checkerboard limestone, Coffeyville shale, Dennis limestone, Cherryvale shale, and Drum limestone.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 20–23; 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 718 (fig. 2), 720 (table 1), 721–725. Includes (ascending) Seminole formation, Checkerboard limestone, Coffeyville formation, Hogshooter limestone, Nellie Bly formation, and Dewey limestone.

Name derived from Skiatook, Tulsa County.

Skinners Eddy limestone (in Catskill Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 117, 118, pl. X.

Occurs about one-third mile below Skinner's Eddy, on Tuscarora Creek, Braintree Township, Wyoming County.

Skolai Volcanics[1]

Triassic: Eastern Alaska.

Original reference: O. Rohn, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 429–430, pl. 52, map.

Skolai Range.

Skookum Formation (in Newport Group)

Precambrian: Northeastern Washington.

M. C. Schroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (table), 13–20, pl. 1. Predominantly argillaceous sandstone and quartzite with carbonate rocks and red and dark-gray argillites. Thickness about 13,000 feet. Contains Moon Hill quartzite member (new) near top. Gradationally overlies No Name argillite (new) with transition

zone about 400 feet thick; top not exposed. Cut by Marshall diorite (new).

Named after Skookum Peak, Pend Oreille County.

Skookumchuck Formation

Eocene, upper: Southwestern Washington.

P. D. Snavely, Jr., and others, 1951, U.S. Geol. Survey Coal Inv. Map C–8, sheet 1. Predominantly massive crossbedded sandstone and thin-bedded siltstone with intercalated beds of coal, bone, and carbonaceous siltstone and shale. Maximum thickness about 2,700 feet. Unconformably underlies Oligocene(?) basaltic sandstone; overlies Northcraft formation (new) with angular unconformity.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 26–35, pl. 1. Formation, in Centralia-Chehalis district, consists generally of a lower sandstone unit which is separated from an upper sandstone unit by a westward-thickening wedge that is predominantly siltstone; possibility exists that siltstone unit is older than type Skookumchuck. Formation has maximum thickness of about 3,500 feet and crops out in a broad irregular belt that extends across mapped area from southeast to northwest. Unconformably overlies Northcraft formation; unconformity may be local in extent. Conformably underlies Lincoln formation. Strata referred to Skookumchuck were included in Puget series by Culver (1919, Washington Geol. Survey Bull. 19). Skookumchuck of this report is equivalent to part of Cowlitz formation of Weaver (1937).

Well exposed along banks of Skookumchuck River west of Willamette meridan, particularly near the Wabash Railroad junction on Northern Pacific Railway, 2 miles north of Centralia, Lewis County.

Skooner Gulch Basalt or Formation

Tertiary: Northern California.

C. E. Weaver, 1943, California Div. Mines Bull. 118, p. 629–630. Massive dense fine-grained basalt with alternating flows of vesicular and amygdaloidal rock and intercalated lenslike masses of tuffaceous sandstone; pillow structure. About 900 feet thick. Underlies Gallaway beds; unconformably overlies shales and sandstones of Gualala series.

C. E. Weaver, 1944, Washington [State] Univ. Pubs. in Geology, v. 6, no. 1, p. 4, 20–21, pl. 2. Redescribed as a formation consisting of massive- to medium-grained gritty sandstone with thin interstratified layers of sandy and clayey shales 350 feet thick. Underlies Gallaway formation; overlies Iversen basalt (new).

Exposed in sea cliffs and in the beach at low tide in a belt about 400 feet wide for a distance of 3,000 feet south of Skooner Gulch, Point Arena-Fort Ross area, Mendocino County.

Skrainka diabase[1]

Precambrian: Southeastern Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 253.

Named for old post office at Skrainka, southwest of Mine LaMotte Station, Madison County.

Skull Creek Shale

Skull Creek Shale Member (of Colorado Shale)

Skull Creek Group

Skull Creek Member (of Omadi Formation)

Skull Creek Shale Member (of Graneros Shale)[1]

Lower Cretaceous: Northeastern Wyoming, Montana, and South Dakota.

Original reference: A. J. Collier, 1922, U.S. Geol. Survey Bull. 736, p. 79, table.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 15 (fig. 7). Shown on columnar section as member of Omadi sandstone (new). Overlies Fall River member; underlies Newcastle member.

B. C. Petsch, 1949, South Dakota Geol. Survey Rept. Inv. 65, p. 15; R. E. Stevenson, 1952, South Dakota Geol. Survey Rept. Inv. 69, p. 4. Basal member of Graneros.

C. E. Dobbin and G. H. Horn, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 103. Lower Cretaceous. Thickness 160 to 200 feet in Weston County, Wyo. Overlies Fall River sandstone of Inyan Kara group; underlies Newcastle sandstone of Colorado group.

A. J. Crowley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 1, p. 83–90. Table shows Skull Creek shale at base of Skull Creek group. Newcastle sandstone is at top of Skull Creek group. Skull Creek group overlies Inyan Kara group and underlies Graneros shale. Lower Cretaceous.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 57–58. Skull Creek shale, in Johnson County, Wyo., is 165 feet thick at exposure on Muddy Creek. Overlies Cloverly formation, contact placed at top of first resistant siltstone ledge above the 15- to 45-foot basal sandstone of the Cloverly. Underlies Newcastle sandstone. Correlates with that part of Thermopolis shale which underlies Muddy sandstone member in central Wyoming.

Herbert Skolnick, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 4, p. 791–793. Includes Newcastle sandstone member. Basal formation in Colorado group. Underlies Mowry shale; overlies Fall River sandstone of Inyan Kara group. Lower Cretaceous. Correlated by Foraminifera with rocks in Kansas, Oklahoma, and Texas. Faunal and mineralogical evidence indicates that physically and spatially the Skull Creek shale, Newcastle sandstone, and lower Mowry shale are sufficiently related to be considered one unit.

W. A. Pettyjohn, 1960, (abs.) South Dakota Acad. Sci. Proc., v. 38, p. 34–38. Dakota controversy discussed. Suggested that term Dakota group be used to include Lakota, Fuson, Fall River, Skull Creek, and Newcastle formations.

Well exposed along Skull Creek southeast of Osage oil field, Weston County, Wyo.

Skunk Creek Member (of Solberg Schist)

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 32. Iron-rich unit about 100 feet thick occurring about 1,000 feet below top of formation. Exposed only in a small outcrop, but the magnetic anomaly

caused by the rock has been traced for more than 20 miles and the bed has been drilled in several places. Drill cores show rock to consist of three interlayered types: biotite-hornblende schist with magnetite layers; thin-bedded rock consisting of alternating layers of metachert and magnetite; and various mixtures of hornblende, biotite, grunerite, garnet, and epidote.

Named for Skunk Creek, a tributary of the East Branch of the Sturgeon River, which crosses the member near the SE cor. se. 17, T. 42 N., R. 28 W., Dickinson County.

Skunk Point Sandstone Member (of Frontier Formation)

See **Frontier Formation.**

Skunk Ranch Conglomerate (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

S. G. Lasky, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 5, p. 534, figs. 2, 4; 1947, U.S. Geol. Survey Prof. Paper 208, p. 25–26, pl. 1. Consists largely of coarse conglomerate composed of red boulders and pebble in a matrix of red sandstone and shale. Boulders and slabs as much as 20 inches across comparatively common, and average diameter about 4 inches. Lateral gradations from the red bouldery conglomerate to gray and finer grained limestone conglomerate and to coarse-grained sandstone exposed locally. Layers of yellow clay-shale and soft sandstone present at several horizons. Large part of upper half of formation consists of alternating beds of red clay-shale and massive red conglomerate in members 5 to 60 feet in thickness. A 200-foot layer of augite basalt exposed at one place. Maximum exposed thickness 3,400 feet. Topmost part formation covered by Miocene(?) volcanic rocks; overlies Corbett sandstone (new). Trinity age.

Crops out only west and south of Skunk Ranch in Eureka section of Little Hatchet Mountains.

Skunk Springs limestone band

See **Chainman Shale.**

Skunnemunk Conglomerate[1]

Upper Devonian: Southeastern New York and northern New Jersey.

Original reference: N. H. Darton, 1894, Geol. Soc. America Bull., v. 5, p. 367–394.

Ely Mencher, 1939, Geol. Soc. America Bull., v. 50, no. 11, p. 1786. Skunnemunk conglomerate is an outlier of Middle and Upper Devonian age.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1781, chart 4. Consists of conglomerates alternating with red sandstones. Thickness 200 to 2,500 feet. Skunnemunk Mountain, an outlier, believed to be continuation of sequence west of Catskill and represents about same facies as found in that area. From Albany and Catskill, the Hamilton outcrop belt extends seaward rather than parallel to old shore. This is shown by the fact that along Catskill Front the marine facies of Hamilton comes more and more to dominate the section, until entire sequence is marine at Port Jervis. Shoreward continuation of Catskill sequence is believed to be the Skunnemunk outlier and its continuation into New Jersey. Occurs above Bellvale sandstone. Middle Devonian.

Caps Bellvale and Skunnemunk Mountains, Orange County, N.Y.

Skwentna Group[1]

Jurassic(?) : Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 149–152, 180.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 981. Listed as Skwentna group. Has been assigned to Lower Jurassic because of stratigraphic position below Tordrillo formation and because it is lithologically similar to Talkeetna formation.

First seen on Skwentna River 10 or 15 miles above junction with Yentna River, then on right bank of the Skwentna some miles below mouth of Haynes River, Cook Inlet region.

Sky Blue Quarry Limestone[1]

Paleozoic(?) or Upper Paleozoic(?) : Southern California.

Original reference: J. W. Daly, 1935, Am. Mineralogist, v. 20, no. 9, p. 638–647, map.

A. O. Woodford, R. A. Crippen, and K. B. Garner, 1941, Am. Mineralogist, v. 26, no. 6, p. 351. Probably Upper Paleozoic.

Named for quarry at Crestmore, Riverside County.

Slagle Trachyte

Quaternary: Northeastern New Mexico.

Helen Stobbe, 1948, (abs.) Geol. Soc. America Bull., v. 59, no. 12, pt. 2, p. 1355. Associated with tinguaites and analcime microfoyaites and usually intrusives.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1021 (table 2), 1022, 1033–1034, pl. 1; H. R. Stobbe, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1071–1073. Light-tan fine-grained porphyritic rocks with phenocrysts of chalky feldspar and abundant hornblende needles. Weathering produces reddish to brown surface. Flow structure evident. Restricted area of outcrop characteristic of sills and dikes. Age, derivation of name, and geographic distribution given.

Named from exposures in Slagle Canyon, sec. 4, T. 26 N., R. 25 E., Colfax County. Found in only four localities grouped in a 10-mile radius—Slagle Canyon, Red Hill, Joe Cabin Arroyo, and Turkey Mountain, Colfax County.

Slate Creek Limestone Member (of Wellington Formation)

Permian: Central Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 4, 8–10. Two prominent chalky claystones separated by green and red clays. Thickness 12 feet. Underlies Afton limestone member (new); overlies Highland shale member (new).

Type locality: Along south side of Slate Creek in Wellington Township, T. 32 S., R. 1 W., Sumner County.

Slate Creek Member (of Wood River Formation)

Pennsylvanian (Desmoinesian-Missourian): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Older than Lake Creek member (new); younger than Hailey conglomerate member (new).

Deposited in Muldoon trough, aligned N. 30° W.

Slate Hill Shale[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 320–330, 356, 364.

Exposed at Slate Hill, Middletown Township, Newport County.

Slater Sandstone Member (of Mingo Formation)[1]

Middle Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 40.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 99, 102, 104, 150. In Mingo formation between Puckett sandstone (above) and Creech coal.

Named for Slater Fork of Catron Creek, Bell County, Ky.

Slatestone Group

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 6, pls. 2, 3, 4, 6. Includes strata between top of Crooked Fork group (new) and base of Indian Bluff group (new). Thickness at type section about 635 feet; throughout most of the outcrop, thickness ranges from 420 to 720 feet; thins northwestward, and in parts of Gobey, Robbins, and Huntsville quadrangles thickness is only 300 feet. Includes (ascending) unnamed shale interval, Stephens sandstone (new), shale interval, Petros sandstones (new), shale interval, Sand Gap sandstone (new), and Newcomb sandstone (new). Jellico coal present at top.

Type locality: Between the Wye and Cross Mountain, Lake City quadrangle. Section begins with the Poplar Creek coal, along the railroad tracks and the road at the Wye, and ends on Militia Hill where Jellico coal occurs at an elevation of 1,445 feet. Named from town of Slatestone, 1 mile west of Briceville, Anderson County.

†Slatington Shale[1]

Silurian: Southwestern Arkansas and southeastern Oklahoma.

Original reference: A. H. Purdue, 1909, Geol. Soc. America Bull., v. 19, p. 557.

Probably named for Slatington, Montgomery County, Ark.

Slaughter Creek Member (of Pendleton Formation)

Eocene, lower: Northwestern Louisiana and northeastern Texas.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 184–187. Consists of a basal glauconitic sand about 5 feet thick overlain locally by 15 to 20 feet of fossiliferous, black lignitic clay in turn overlain by 20 feet of nonfossiliferous sand containing large calcareous concretions; this sequence is followed by the thin Stone Coal Bluff lignite (new), lignitic silts, and Beulah Church sand lentil (new). Overlies Bayou Lenann member (new); underlies High Bluff member (new).

Typically exposed along banks of Slaughter Creek, Sabine Parish, La.; typical section in steep bluff near headwaters of creek in SW cor. sec.

26, T. 6 N., R. 13 W. Traced from vicinity of Geneva, Tex., to Hagewood, Natchitoches Parish, La.

Slaven Chert

Middle and Upper(?) Devonian: North-central Nevada.

James Gilluly, 1955, *in* Pacific Petroleum Geologist, v. 9, no. 8, p. 1. Above Elder formation lie over 4,000 feet of the Middle Devonian Slaven chert.

Slesse Diorite[1]

Miocene(?): British Columbia, Canada, and northern Washington.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Asst., 1910, v. 2, p. 532.

Slide Mountain Conglomerate[1]

Upper Devonian: Eastern New York.

Original reference: G. H. Chadwick, 1933, Am. Jour. Sci., 5th ser., v. 26, p. 480, 482, 483.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Slide Mountain conglomerate listed on correlation chart. Upper Devonian.

Occurs only on Slide Mountain, highest peak in Catskill Mountains.

Sligo Formation

Lower Cretaceous: Subsurface in northwestern Louisiana, southern Arkansas, and eastern and southern Texas.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 30–32. Proposed by Shreveport Geological Society for gray to brown shale containing local lenses of sandstone and limestone which represent the lowest beds of the Lower Glen Rose formation; in northern Louisiana, contains locally one or two porous oolitic limestone lentils known as Pettet limestone. Thickness ranges from about 300 feet in Louisiana and Texas to less than 100 feet in Arkansas; thins to north and not represented in outcrop in Arkansas. Base is defined by uppermost red beds of Hosston formation and top by highest of three limestone units which is called the Three Finger limestone.

R. W. Imlay, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1434–1441. Described in south Texas as mainly gray, yellowish-gray, and brown limestone separated by many partings and thin units of black shale that amounts to about 20 percent of entire formation; lower 40 to 50 feet contains sandy limestone and a few thin beds of sandstone, indicating a transitional relationship with the Hosston, but contact is easily selected within a few feet; contact with overlying shale and sandstone at base of Pearsall formation is abrupt. Shreveport Geological Society recognized term Pettet limestone (sometimes spelled Pettit) as an informal name for local porous limestone lentils within the Sligo; Pettet was not considered acceptable as a formation name because it was commonly used in Arkansas and Louisiana for a zone or zones of porosity; geologists in east Texas suggested Sligo be abandoned in favor of Pettet in order to conform with common usage in that area.

Type locality: Sligo field, Bossier Parish, northwestern Louisiana. Type well not designated, but formation is described in Stanolind Oil and Gas Co.'s Dillon Heirs No. 131 well, located in sec. 14, T. 21 N., R. 15

W., Caddo Parish, La., and in Amerada Petroleum Corp.'s Halff and Oppenheimer No. 8 well, southwest of Pearsall, Frio County, Tex.

Slim Sam Formation

Upper Cretaceous: Southwestern Montana.

V. C. DeMunck, 1956, Montana Bur. Mines and Geology Inf. Circ. 13, p. 9. Name mentioned in a discussion of the iron deposits in Montana.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 26 (table), 28–31, pl. 1. Described as sequence of coarse-grained clastic rocks. Lower part of sequence consists predominantly of gray, greenish-gray, and yellowish-gray quartz-chert sandstone and upper part of feldspathic quartz- and chert-poor sandstone with abundant beds of tuff and sedimentary tuff near the top. Thickness 800 to 1,200 feet. Underlies Elkhorn Mountains volcanics (new) with local unconformity and overlies Colorado formation. Derivation of name.

Named for exposures along east margin of Slim Sam basin, in sec. 22, T. 6 N., R. 1 W., Broadwater County, about 1 mile east of the map area.

Slippery Creek Greenstone Volcanics (in Evington Group)

Lower Paleozoic(?): South-central Virginia.

W. R. Brown, 1951, (abs.) Virginia Jour. Sci., new ser., v. 2, no. 4, p. 347. Incidental mention.

W. R. Brown, 1953, Kentucky Geol. Survey, ser. 9, Spec. Pub. 1, p. 91 (fig. 1). Dark-green to gray schistose to gneissose lava flows (dacite-andesite?). Amygdaloidal in part. Tuffaceous(?) schist at base. Thickness 1,000 to 3,000 feet. Uppermost unit in Evington group (new). Overlies Mount Athos formation. Paleozoic(?). Type locality designated.

W .R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 8 (fig. 2), 29 (table 5), 37–38, 49, pl. 1. Age shown on columnar section as Lower Paleozoic(?).

Type locality: Along Slippery Creek 5½ miles east of Lynchburg, Campbell County. Lynchburg quadrangle.

Sloan Formation (in Marble Falls Group)

Sloan Member (of Marble Falls Formation)

Pennsylvanian: Central Texas.

F. B. Plummer, 1944, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 33, p. 8. Member mentioned in report on limestones suitable for manufacture of rock wool.

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 65, 66–67, pl. 2. Marble Falls is divided into (ascending) Gibbons conglomerate lentil, Sloan, Big Saline, and Lemons Bluff members. Sloan is distinctly thin bedded; beds are uneven, have rough surfaces, and contain distinctive fossils. Basal bed is commonly a subcrystalline to crystalline dense black cherty limestone 4 to 16 feet thick that commonly carries more than 40 percent black chert. This cherty zone is overlain by 50 to 100 feet of thin-bedded black subcrystalline fossiliferous limestone. In some areas, calcareous shale partings, 2 to 30 inches thick, are in- rado River below Marble Falls, just above Barnett formation, from Cherokee Creek across San Saba County to Pontotoc-San Saba Highway in Wallace Creek valley. Present in most synclinal areas in San Saba County; absent on structural highs where it was either never deposited

or removed by erosion before deposition of Big Saline and Lemons Bluff members.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142; Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2). Sloan formation underlies Big Saline formation which here includes (ascending) Gibbons, Aylor, Lemons Bluff, and Brister formations.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 47, 52–57. Formation included in Marble Falls group. Thickness at designated type section 81½ feet.

Type section: On San Saba River opposite Lemons Camp, San Saba County. Well exposed along San Saba River and its branches on the Sloan, Lemons, and Gibbons Ranches, southwest of San Saba and along Colorado River above Alexander dam site at Marble Falls in Burnet County.

Sloan Canyon Formation[1] (in Dockum Group)

Triassic: Northeastern New Mexico.

Original reference: B. H. Parker, 1930, Kansas Geol. Soc. 4th Ann. Field Conf., p. 132, mimeo; 1933, Jour. Geology, v. 41, p. 38–51.

J. W. Stovall and D. E. Savage, 1939, Jour. Geology, v. 47, no. 7, p. 764, 765, 766. Triassic. Entire section of Triassic in Union County should be included in Dockum group, a conclusion supported by fossil evidence.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 35 (table 2), 39–40, pl. 1d. Light-green and red mudstone. Thickness as much as 150 feet. Overlies Travesser formation (new); underlies Sheep Pen sandstone. In Dockum group.

Typically exposed throughout lower part of valley of Sloan Canyon in east-central part of T. 31 N., R. 35 E., Union County.

†Sloans Valley Limestone (in Chester Group)[1]

Mississippian: Southeastern Illinois and western Kentucky.

Original references: A. D. Brokaw, 1916, Illinois Geol. Survey Bull. 35 [preprint]; 1917, Illinois Geol. Survey Bull. 35, p. 12, pl. 1.

Occurs in Saline, Johnson, Pope, Williamson, Union, and Jackson Counties, Ill.

Slocum Alluvium

Pleistocene (Illinois or Sangamon): Northeastern Colorado.

C. W. Hibbard and D. W. Taylor, 1960, Michigan Univ. Mus. Paleontology Contr., v. 16, no. 1, p. 33. Incidental mention in discussion of late Pleistocene faunas of southwestern Kansas. Name credited to G. R. Scott (in preparation).

G. R. Scott, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1542. Name applied to alluvial deposit that lies 150 feet below older Verdos alluvium (new) and 100 feet above the modern streams. Consists of 10 to 90 feet of moderate reddish-brown, well-stratified, clayey coarse sand with lenticular beds of pebbles and silt. Older than Louviers alluvium (new).

Type locality: Along one face of limestone quarry on Slocum Ranch in SW¼NW¼ sec. 35, T. 6 S., R. 69 W., Kassler quadrangle.

Slollicum Series[1]

Triassic: Central northern Washington, and adjacent British Columbia, Canada.

Original reference: C. H. Crickmay, 1930, Geol. Mag., v. 7, p. 488, 489, map.

Derivation of name not stated.

Sloway Formation (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 565–567, pl. 28. Heterogeneous sequence of thin- to medium-bedded argillaceous quartzite, viterous quartzite, quartzose argillite, and argillite; more argillaceous toward top of section. Colors are tints of red, purple, and green ranging from pale to bright. No complete section, but total thickness of about 5,000 feet estimated on basis of several partial sections which constitute type section. Conformably overlies Lupine quartzite (new); conformably underlies Bouchard formation (new).

Type section: Partial sections in secs. 7 and 18, T. 16 N., R. 26 W.; secs. 29, 33, and 34, T. 17 N., R. 26 W.; and secs. 3, 4, 10, 11, 14, and 23, T. 16 N., R. 26 W. Named from exposures in secs. 14, 15, and 16, T. 17 N., R. 27 W., near mouth of Sloway Gulch, St. Regis-Superior area, Mineral County.

Slow Fork Glaciation

Pleistocene: South-central Alaska.

A. T. Fernald, 1960, U.S. Geol. Bull. 1071–G, p. 232 (chart). Named on correlation chart. Correlated with Selatna, Healy, and Delta glaciations. Older than Wonder Lake glaciation (new). Name credited to J. C. Reed, Jr.

In Mount McKinley area.

Sly Gap Formation

Upper Devonian: Central southern New Mexico.

F. V. Stevenson, 1941, (abs.) Oil and Gas Jour., v. 39, no. 47, p. 65; 1941, (abs.). Illinois Acad. Sci. Trans., v. 34, no. 2, p. 163. Comprises 114 feet of siltstones, shales, and a few limestones at type locality. Underlies Percha shale. Devonian.

F. V. Stevenson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 18, p. 23. Chiefly thin alternating layers of shale and siltstone, with a few beds of limestone. A zone 8 to 10 feet thick at base is more massive than rest of formation and has red-brown color, which is in contrast to lighter colors of sediments above and below. Shales range from black, fissile, and carbonaceous to light buff or tan. Siltstones and limestones, in general, buff. Thickness averages approximately 100 feet in Sacramento Mountains, 110 to 135 feet in San Andres Mountains, and 80 to 90 feet in westernmost exposure in Mud Springs Mountains near Hot Springs. Overlies Canutillo formation at south end of San Andres Mountains; Fusselman limestone in central part; and Montoya limestone north of Rhodes Pass. Unconformably overlies Canutillo in south and central parts of Sacramento Mountains; and Fusselman in area to the north. Late Devonian.

F. V. Stevenson, 1944, Dallas Digest (Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Joint Ann. Mtg.), p. 94–95. Underlies Contadero formation (new).

F. V. Stevenson, 1945, Jour. Geology, v. 53, no. 4, p. 217, 219, 222. Overlies Onate formation (new), formerly identified as "Canutillo formation," in Sacramento and San Andres Mountains.

V. C. Kelly and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology v, p. 77–78. Units such as Onate and Sly Gap not distinguishable lithologically, and hence, are not mappable in New Mexico. These are no more than faunal zones at best, and prior and well-established term Percha formation should be retained and applied widely to this lithologically and topographically distinct unit in New Mexico.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 29–30. Thicknesses of section in San Andres Mountains, excluding the basal beds with an anomalous fauna that may be Middle Devonian in age and which are included in Onate formation, vary from north to south: 57 feet at type section on Sheep Mountain, 31 feet at Rhodes Canyon, 70 feet at Hembrillo Canyon, and 75 feet at Ash Canyon.

Type locality: At Sly Gap, south of Sheep Mountain, in northern extension of San Andres Mountains, sec. 25, T. 11 S., R. 4 E. Crops out the entire length of San Andres Range, and throughout Sacramento and Sierra Caballo Mountains.

Smackover Formation

Smackover Limestone

Upper Jurassic: Subsurface in Arkansas, Alabama Louisiana, Mississippi, and Texas.

D. H. Bingham, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 8, p. 1068, 1072. Smackover limestone encountered at depth of 4,900 feet at north edge of Smackover field. Limestone is 700 feet thick. Age undetermined; thought to be lower than Trinity and younger than Paleozoic.

W. B. Weeks, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 8, p. 959 (fig. 2), 960 (fig. 3), 964–965. Overlies Eagle Mills formation; underlies Buckner formation. Pre-Comanche.

W. B. Weeks, 1939, Shreveport Geol. Soc. Guidebook 14th Ann. Field Trip, p. 28, 29. In Snow Hill area, Arkansas, Buckner anhydrite is absent and Smackover underlies Cotton Valley.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 16–21, cross sections. Termed formation. In southern Arkansas, divisible into two members of which upper consists of oolitic to chalky limestone and lower of dense limestone with argillaceous bands. These limestone facies grade southward in northern Louisiana into an interbedded limestone, shale, and sandstone facies which is included in Smackover formation. Term Smackover limestone is used in this report only in reference to limestone facies. Thickness 502 to about 1,230 feet. Fossils indicate Middle or Upper Jurassic age.

R. W. Imlay, 1943, Am. Assoc Petroleum Geologists Bull., v. 27, no. 11, p. 1437 (table 1), 1440–1451. Detailed discussion with Jurassic formations of Gulf Coast region. Upper Jurassic (Argovian).

R. T. Hazzard, W. T. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945, Ref. Rept., v. 2, p. 483, 484, 488. Overlies Norphlet formation (new).

First known from Lion Oil Refining Co.'s Hayes No. 9–A, sec. 9, T. 16 S., R. 15 W., Union County, Ark. Named for Smackover field.

Smalls Falls Formation

Age not stated: West-central Maine.

I. E. Furlong, 1960, Dissert, Abs., v. 21, no. 4, p. 848. Characterized by dark maroon-stained thinly bedded highly sulfidic argillaceous rock with minor intercalated arenaceous and calcareous units. Oldest stratigraphic unit in area. Underlies Madrid formation.

Present in Farmington quadrangle.

Smarts Mountain Granite

Smarts Mountain Group

Upper Devonian(?): West-central New Hampshire.

Katharine Fowler-Lunn and Louise Kingsley, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1382, pl. 3. Granite included in Oliverian magma series. Intrudes Ammonoosuc volcanics. Upper Devonian in age.

Katharine Fowler-Billings and Louise Kingsley, 1940, Geologic map and structure sections of the Cardigan quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Group consists of fine-grained white to gray weakly-foliated quartz diorite and granodiorite. Age designated probably Upper Devonian.

Mapped in extreme northwestern corner of Cardigan quadrangle.

Smelter Granite[1]

Jurassic: British Columbia, Canada, and northern Washington.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Ast., v. 2, p. 381.

Smetana Sandstone (in Yegua Group)

Eocene (Claiborne): Eastern Texas.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 1–3, geol. map. Name applied to basal unit of group. Characteristically dark-red iron-sandstone with basal conglomerate. Beds are from 1 to 8 inches thick; and in some areas are separated by thin seams of yellow shale. Estimated thickness 138 feet. Underlies Bryan sandstone; unconformably overlies Mount Tabor shales. Stenzel (1940) placed base of Yegua above Mount Tabor shales but included Serbin sand lentil in upper part of Mount Tabor. [It is not clear whether author intended to replace Serbin by Smetana or not.]

Name derived from community of Smetana, 4.4 miles west of B.M. 0900 along Highway 21 at Bryan, Brazos County. Well exposed at Fairview 3.5 miles west of the same bench mark, but name Fairview is preoccupied.

Smethport magnafacies[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 27.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 44–45, 52–53. Shown in faciological diagram of Upper Devonian strata in northern Pennsylvania.

Named from town of Smethport, McKean County.

†Smethport Shale Member (of Knapp Formation)[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 203.

Smith Basin Formation

Lower Ordovician: East-central New York.

John Rodgers *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., 1952, Guidebook for field trips in New England: Geol. Soc. America, p. 35 (table 2). Described as cherty dolomite with limestone layers below the dolomite. Thickness 90 feet. Underlies Fort Cassin formation. Refers to R. H. Flower (unpub. ms.).

Occurs in Fort Ann quadrangle.

†Smithfield Limestone Member (of Marlboro Formation)[1]

Precambrian: Northeastern Rhode Island.

Original reference: Ebenezer Emmons, 1843, New York Nat. History Agric., v. 1, p. 90–91.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* A. W. Quinn and others, 1948, Rhode Island Port and Indus. Comm. Geol. Bull. 3, p. 10. Name abandoned in Pawtucket area. Marble beds considered part of Mussey Brook schist (new).

Named for occurrence in town of Smithfield; outcrops area subsequently became part of town of Lincoln, Providence County.

Smith Fork Glaciation

Smith Fork glacial stage[1]

Pleistocene: Northeastern Utah.

Original reference: W. H. Bradley, 1936. U.S. Geol. Survey Prof. Paper 185.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243–A, table 2. Correlates with Tahoe (Wisconsin).

Name changed to Smith Fork Glaciation to comply with 1961 Stratigraphic Code.

Named for train of lateral moraines left by its glaciers in valley of East Fork of Smith Fork.

†Smith River Lake Beds[1]

Miocene, middle: Central southern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Atlas, Folio 56.

Deposited in lake that once filled valley of Smith River, between Little Belt and Big Belt Ranges, Little Belt Mountains region.

Smiths Corner Member (of Lockatong Formation)

Triassic: Southeastern Pennsylvania.

D. B. McLaughlin, 1944, Pennsylvania Acad. Sci. Proc., v. 18, p. 65, 67. Name given to thin red argillite member. Thickness 11 to 50 feet. Occurs between two black hard argillite units of the formation, A_1 below and A_2 above.

D. B. McLaughlin, 1948, Michigan Acad. Sci. Arts and Letters Papers, v. 32, p. 298, 299. Termed Smith Corner member. Thickens rapidly southwest of Tohickon Creek and merges with lower red shales which have replaced A_1.

Exposed in a brook at Smith's Corner, Bucks County, and in bed of Tohickon Creek on both sides of the "loop" south of the "high rocks" and also south of the "big bend."

Smith Valley Beds

Pliocene, middle and upper (Hemphillian-Blancan): West-central Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 62 (fig. 4), 67. Name applied to beds that contain Smith Valley fauna. Further study may indicate desirability of retaining separate names for Morgan Ranch formation (new) and Smith Valley beds though they now appear to be facies of same basin of deposition.

Exposed along eastern side of Smith[s] Valley and south of Wilson Canyon, near Nevada-California line.

†Smithville Chert Lentil (in Stanley Shale)[1]

Mississippian: Southeastern Oklahoma.

Original reference: H. D. Miser and C. W. Honess, 1927, Oklahoma Geol. Survey Bull. 44, p. 11.

C. C. Branson, 1957. Oklahoma Geology Notes, v. 17, no. 11, p. 102. Abandoned by Oklahoma Geological Survey. Name has not been used if allowed to stand preoccupies well-known name of Lower Ordovician Smithville limestone of Arkansas.

O. B. Shelburne, 1960. Oklahoma Geol. Survey Bull. 88, p. 18. Renamed Battiest chert member of Tenmile Creek formation.

Named for village of Smithville, McCurtain County.

Smithville Formation[1]

Lower Ordovician: Northern Arkansas and southeastern Missouri.

Original reference: G. C. Branner, 1929. Geologic map of Arkansas.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65. no. 3, chart 2 (columns 52, 53). Shown on correlation chart above Powell formation and below Black Rock limestone in northern Arkansas and below Everton formation in southeastern Missouri.

First mapped at and around Smithville, Lawrence County, Ark.

Smithwick Shale (in Bend Group)[1]

Smithwick Group

Lower and Middle Pennsylvanian: Central Texas.

Original reference: S. Paige, 1911, U.S. Geol. Survey Bull. 450, p. 25.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 85–86. Smithwick beds are excluded from Morrow and Strawn (Des Moines) series and assigned to intervening Lampasas series (new). Overlies Big Saline group (new); underlies Millsap Lake group in Strawn series. In subsurface, includes (ascending) Eastland Lake, Caddo Pool, and Parks formations (all new).

F. B. Plummer, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 69–73. Formation in Bend series. At type locality, includes strata above Lemons Bluff beds in Marble Falls formation and below typical Strawn beds.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 207 (chart 1), 209. Chart shows Smithwick formation in Bend group. Formation is restricted above to exclude Caddo Pool and Parks formations which are included in Kickapoo Creek group (new). Overlies Big Saline formation.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 77–83. Formation, at type locality, includes strata above Brister Bluff [Brister limestone member] and Lemons Bluff beds in Big Saline formation. Through west and central San Saba County, it includes all shale below Strawn group and above black Marble Falls limestone. In eastern San Saba County near Bend, basal Smithwick is 60 feet above top of limestone and base is marked by first appearance of coral *Hadrophyllum aplatum* Cummins, now named *Cumminsia aplata* (Cummins) by Moore and Jeffords. Thickness at type locality 301 feet. Siltstone, fissile black shale, and conglomerate facies recognized.

Type locality (Plummer): Along Colorado River west of Smithwick, Burnet County. Section measured from Marble Falls limestone outcrop on Wall Ranch eastward to river bank opposite and old Smithwick. Named for town of Smithwick, Burnet County.

Smoke Creek Glaciation

Pleistocene (pre-Wisconsin): Northeastern Montana and northwestern North Dakota.

A. D. Howard, 1960, U.S. Geol. Survey Prof. Paper 326, p. 26. Considerations of regional history indirectly support validity of a pre-Wisconsin Smoke Creek glaciation.

Name derived from Smoke Creek, Roosevelt County, Mont.

Smoky Hill Chalk Member (of Niobrara Formation)[1]

Smoky Hill Marl Member (of Niobrara Formation)[1]

Smoky Hill Shale Member (of Niobrara Formation)

Upper Cretaceous: Western Kansas, eastern Colorado, northeastern New Mexico, and southeastern South Dakota.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 51.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 31–33. Described in Colfax County, N. Mex. Here unit is more shale than marl. Approximate thickness 900 feet (based on subsurface data). Overlies Fort Hays limestone member; conformably underlies Pierre shale.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 99. In Gove County, Kans., chalk member underlies Pleistocene Grand Island member of Meade formation.

E. J. Bolin, 1952, South Dakota Acad. Sci. Proc., v. 31, p. 190. Geographically extended into southeastern South Dakota. Difficult to distinguish Smoky Hill and Fort Hays members on basis of lithology, but this investigation demonstrated that they can be distinguished on basis of microfossils. Thickness of Smoky Hill 77 to 125 feet.

R. B. Johnson and J. G. Stephens, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–146. Marl member described in La Veta area, Huerfano County, Colo. Conformably overlies Fort Hays limestone member and gradationally underlies Pierre shale. Consists of about 500 feet of thin beds of white limestone alternating with much thicker beds of yellow chalk; includes some thin bands of bentonitic claystone. East of Raton Mesa region, grades northward from a gray shale facies into yellow-orange limestone and chalk facies.

M. A. Jenkins, Jr., 1957, Rocky Mountain Assoc. Geologists Guidebook to the geology of North and Middle Parks Basins, Colorado, p. 53, pl. 1.

Described in Red Dirt area, Grand County, Colo., where it is 410 feet thick and predominantly shale. Overlies Fort Hays member and underlies Pierre shale. Believed that names Smoky Hill and Fort Hayes have priority over terms Apishapa and Timpas, and if used they would help standardize Niobrara terminology in west-central Colorado.

D. M. Sheridan and others, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–179. Referred to as shale member; consists of light-gray to dusty-yellow calcareous shale and two thick shaly chalk beds. Report discusses Ralston Buttes quadrangle, Jefferson County, Colo.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as Smoky Hill chalk member of Niobrara chalk. Overlies Fort Hays limestone member; underlies Sharon Springs shale member of Pierre shale.

Named for Smoky Hill River, Kans.

Snake Creek Beds[1]

Snake Creek Formation (in Ogallala Group)

Pliocene, middle to upper: Western Nebraska and eastern Wyoming.

Original reference: W. D. Matthew and H. J. Cook, 1909, Am. Mus. Nat. History Bull., v. 26, art. 27, p. 362–363.

A. L. Lugn, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1254–1258, 1266 (table 2). Discussion of confusion in use of terms Snake Creek and Sheep Creek formations, both named by Matthew and Cook (1909). Typical "Snake Creek" formation, or at least the so-called "upper Snake Creek," is correlative with some part of upper Ogallala group. Snake Creek has been incorrectly(?) applied to beds, mainly channel fills, as late as Pleistocene and to other beds as old as Miocene. Much of the Miocene "Snake Creek" or perhaps the so-called "lower Snake Creek" seems to be in part not Snake Creek but Sheep Creek channel beds in place and in proper stratigraphic sequence. Some of the Miocene and "Sheep Creek" vertebrate fossils collected from "Snake Creek" channel deposits have come from very large blocks of Sheep Creek formation, which were broken away from banks of Snake Creek streams and lie buried in younger silt and sand, the true Snake Creek sediment, which is always channel-fill material. Original definition of Snake Creek and Sheep Creek formations may be essentially valid, and it is proposed to continue use of these names to apply to correctly differentiated formations. Table 2 shows Snake Creek formation (middle to late Pliocene) in Ogallala group between Sidney gravel above and Ash Hollow formation below. Sheep Creek formation (late upper Miocene) is assigned to Hemingford group.

Named for occurrence on Snake Creek, Sioux County, Nebr.

Snake Hill Formation[1]

Snake Hill Shale or Beds

Middle Ordovician: Eastern New York.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 265 (fig. 10), 272–273, pl. 4. Discussion of stratigraphy of Trenton group. Snake Hill formation is discussed under heading of formations of Sherman Fall age. Snake Hill beds were defined to comprise Middle Ordovician silty shales

of Hudson Valley that were considered equivalent to Canajoharie shale and had previously been identified with Magog shale of Quebec. Upper and lower contacts of formation are not known, and thickness has been estimated at about 3,000 feet. Formation crops out in belt extending northward along Hudson River from northeastern part of Helderberg Plateau. Similar beds have been described farther south on northwest side of the Highlands—the Reading Prong of New England Upland—in which region they overlie limestones of Black River and low Trenton age. Figure 10 and plate 4 show Snake Hill underlying Schenectady.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 47 (table), 89 [1946]. Ordovician system represented in eastern (Levis) trough by Snake Hill shale (at top), Tackawasick limestone and shale, Rysedorph conglomerate, and Normanskill shale. In Hudson Valley, Snake Hill beds form broad belt of shales between Normanskill shales and Wappinger limestone at bank of river to Skunnemunk Mountains and has computed thickness of 1,500 to 2,000 feet in Orange County. Middle Ordovician.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1574–1575. Where Mohawk Valley joins Hudson Valley near Albany, upper part of type Canajoharie shale is replaced by 1,500 to 2,000 feet of Schenectady shale. Earlier Canajoharie shales found beneath the western part of the Schenectady, are replaced in Albany area by 1,200 to 2,000 feet of grayish, silty, and sandy Snake Hill shales. Snake Hill shales may have been shifted by Taconic faults of Albany region, and it is not certain that they belong beneath the outcropping Schenectady shales in normal stratigraphic succession.

R. V. Cushman, 1953, New York State Water Power and Control Comm. Bull. GW–33, p. 10 (table 3), 15, pl. 2. Thickness about 600 feet in Washington County. Table 3 shows Snake Hill formation above Walloomsac slate. Middle Ordovician.

Name is from fossiliferous beds at Snake Hill on east side of Saratoga Lake.

Snake River Group

Snake River Basalt[1]

Snake River Lava

Pleistocene and Recent: Southern Idaho and southwestern Montana.

Original reference: Waldemar Lindgren, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, pl. 8.

I. C. Russell, 1902, U.S. Geol. Survey Bull. 199, p. 38, 59, map. Name Snake River lava proposed and geographic area described.

C. P. Ross and J. D. Forrester, 1947, Geologic map of the State of Idaho (1:500,000): U.S. Geol. Survey. Quaternary and possible Tertiary.

J. C. Bayless, 1950, Michigan Acad. Sci., Arts, and Letters, Papers, v. 34, p. 219. Lava proposed as general term by which to designate the basaltic rocks that underlie by far the larger part of Snake River Plains and that to a great extent form their actual surfaces. Described in southeastern part of Snake River Plains as mostly gray to black, fine grained, and vesicular, commonly having small feldspar and olivine phenocrysts visible to unaided eye.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 377, pl. 1. Geographically extended to Beaverhead County, Mont.

R. T. Littleton and E. G. Crosthwaite, 1957, U.S. Geol. Survey Water-Supply Paper 1460–D, p. 158 (table), 165–166. Chiefly olivine basalt flows. Occurs as cap rock on north rim of Snake River Canyon and on buttes immediately south of river, and locally as intracanyon basalt. Thickness 3 to 250 feet. Occurs above Idaho formation. Pliocene to Recent.

U.S. Geological Survey currently classifies the Snake River as a group on the basis of a study now in progress.

Named for occurrence in Snake River area, Idaho.

Snake River Series[1]

Permian(?): Northern Idaho.

Original reference: V. R. D. Kirkham, 1927, Idaho Bur. Mines and Geology Pamph. 24, p. 3–6.

Exposed in Clearwater River Canyon near Asahka [Ahsahka], Clearwater County.

Snake River Stage[1]

Pliocene: Northwestern Nebraska.

Original reference: E. H. Barbour, 1915, Am. Jour. Sci., 4th, v. 39, p. 87.

Occurs along a stream variously termed Snake Creek and Snake River near Burge, Cherry County.

Sneech Pond Schist (in Blackstone Series)

Precambrian(?): Northeastern Rhode Island.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 12, geol. map; A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Quad. Map [GQ–1]. Chiefly fine-grained gray or greenish-gray quartz-mica schist with relatively thin interbeds of quartzite and conglomerate. Contains beds, sills, and dikes of Hunting Hill greenstone (new) and thin, discontinuous marble beds. Included in Blackstone series.

Named for good exposures on west shore of Sneech Pond and in quarries east of pond, Pawtucket quadrangle, Providence County.

Sneed Andesite

Tertiary, middle(?): Southwestern Arizona.

James Gilluly, 1937, Arizona Bur. Mines Bull. 141, Geol. Ser. 9, p. 15 (table 1), 45–46, pl. 1. Chiefly reddish porphyritic lava with phenocrysts of hornblende and white plagioclase in a dense base. Most of the lava consists of andesine and green hornblende phenocrysts in an andesitic groundmass. Some breccias north of Salt Well. Estimated thickness at Tule Well 3,000 feet. Unconformably overlies Locomotive fanglomerate (new), Chico Shunie quartz monzonite (new), and Cardigan gneiss (new) near Tule Well, and probably the Cornelia quartz monzonite (new). Unconformably underlies Daniels conglomerate (new) and Black Mountain andesite (new).

James Gilluly, 1946, U.S. Geol. Survey Prof. Paper 209, p. 9, 41–42, pl. 3 [1947]. Disconformably underlies Batamote andesite at south end of Childs Mountain. Type locality designated.

Type locality: At Sneed Ranch in sec. 5, T. 12 S., R. 6 W., Ajo quadrangle, Pima County. Crops out on northwest slope of Little Ajo Mountains and at south end of Childs Mountain.

Sneeds Limestone Lentil (of Everton Limestone)[1]

Middle Ordovician: Northern Arkansas.

Original reference: A. H. Purdue and H. D. Miser, 1916, U.S. Geol. Survey Geol. Atlas, Folio 202.

Occurs in Hemmed-in Hollow, 2 miles south of Compton, Newton County. Typically exposed on Sneeds Creek.

†Sneedville Limestone[1]

Upper Silurian: Eastern Tennessee.

Original reference: J. M. Safford, 1856, Geol. reconn. Tennessee, 1st Rept., p. 157.

Named for Sneedville, Hancock County.

Sneffels Member (of San Juan Tuff)[1]

Miocene(?): Southwestern Colorado.

Original reference: W. S. Burbank, 1930, Colorado Sci. Soc. Proc., v. 12, p. 187.

In vicinity of Canyon Creek, Sneffels, and Ouray, Ouray district.

Snelson Granite

Precambrian: Central western Georgia.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 26–27, pl. 1. Made up largely of oligoclase, microcline, quartz, and biotite; most of biotite flakes are in rudely parallel layers so that rock has persistent foliation, foliation shows small folds and minute plications, granite is cut by numerous pegmatite dikes. Considered to be younger than Carolina gneiss.

Well exposed near Snelson's Crossroads, 2½ miles east of Harris, Meriwether County. Underlies large area in northwest quarter of Warm Springs quadrangle north of Towaliga fault.

Sniabar Limestone[1] (in Swope Limestone)

Sniabar Limestone Member (of Hertha Formation)

Pennsylvanian (Missouri Series): Northwestern Missouri and eastern Kansas.

Original references: J. M. Jewett, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 99, 100, 103; R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 85, 90, 97.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 193. Uppermost member of Hertha. Overlies Mound City shale member; underlies Ladore shale. Thickness as much as 10 feet; average about 5 feet.

Named for Sniabar Creek just east of Kansas City, Mo.

Sni Mills Limestone[1] Member (of Lenapah Formation)

Pennsylvanian (Des Moines Series): Northwestern Missouri and northeastern Kansas.

Original reference: F. C. Greene *in* R. C. Moore and others, 1936, Kansas Geol. Soc. Guidebook 10th Ann. Field Conf., p. 19, 20.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 9. Allocated to member status in Lenapah formation. Uppermost member; overlies Perry Farm shale member; underlies Memorial formation.

L. M. Cline and F. C. Greene, 1950, Missouri Geol. Survey and Water Resources Rept. Inv. 12, p. 25. Name Sni Mills has priority over name Idenbro, and term Idenbro is suppressed as a synonym for Sni Mills.

Named for outcrops at Sni Mills, Jackson County, Mo.

Snipes Conglomerates

Miocene, upper, or Pliocene: Central Washington.

R. C. Treasher, 1937, Geol. Soc. Oregon Country News Letter, v. 3, no. 20, p. 218–220. Name applied to persistent stratum of conglomerate, quartzite-bearing gravels, tuffaceous sandstones, and arkosic sands which overlie Wenas basalt and underlie valley silts. Thickness at type locality 238 feet. The conglomerate unit was included in Satsop formation by Bretz (1917) and placed at base of Ellensburg by other workers.

Type locality: SW¼ sec. 34, T. 10 N., R. 22 E., Yakima County.

Snitz Creek Formation (in Conococheague Group)

Snitz Creek Member (of Conococheague Formation)

Upper Cambrian: Southeastern Pennsylvania.

Carlyle Gray, A. R. Geyer, and D. B. McLaughlin, 1958, Geologic map of the Richland quadrangle, Pennsylvania (1:24,000): Pennsylvania Geol. Survey, 4th ser., Atlas 167–D. Name applied to dolomite sequence that stratigraphically overlies Buffalo Springs member (new); underlies Schaefferstown member (new). Composed of thick-bedded light- to medium-gray dolomite, commonly oolitic, with medium-light-gray limestone or medium-gray shaly limestone interbeds; where coarsely crystalline, dolomite is commonly vuggy; shaly partings, often stylolitic, occur in dolomite; sandstone beds 1 to 1½ feet thick present near top and base, with thinner sandy beds occurring throughout member; dark-gray to grayish-black chert locally abundant. Estimated thickness 350 feet; partial section (type) 62 feet, neither top nor base exposed.

Carlyle Gray and A. A. Socolow, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 148–150. Upper Cambrian. Member has same stratigraphic position of, and is lithologically similar to, Big Spring Station member (Wilson, 1952) of Conococheague.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Conococheague group.

Type section: Partial section measured along Cornwall Railroad tracks about one-half mile south of Midway Church, Lebanon County. No satisfactory type section available in Lebanon County but best partial section has been measured and used as type section.

Snomac Limestone Member (of Ada Formation)

Pennsylvanian (Virgil Series): East-central Oklahoma.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 100, 101, pl. 1. Name applied to a sequence of thin dull-white finely crystalline limestone beds that occur in the lowest third of the formation; commonly

only a single limestone is exposed at one locality. Member occurs high in a 45-foot shale interval that overlies the basal Ada sandstone.

Named after Snomac townsite in secs. 10, 11, and 14, T. 7 N., R. 6 E., Seminole County. Member extends from center of sec. 26, T. 8 N., R. 6 E., north of Little River, to secs. 14 and 15, T. 7 N., R. 6 E., south of Little River.

Snoqualmie Granodiorite[1]

Miocene and Pliocene, lower: Central Washington.

Original reference: G. O. Smith and F. C. Calkins, 1906, U.S. Geol. Survey Geol. Atlas, Folio 139.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 795, 797 (fig. 2). Probably intermediate in age between lower part of Keechelus andesitic series and the Fifes Peak andesite (new). Map legend shows age as Oligocene(?). Area of report is Mount Aix quadrangle.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 121–123, pl. 1. Predominantly granodiorite; locally includes both more basic and more felsic rocks. Intrudes Denny (new), Guye (restricted), Naches, and Keechelus formations. Youngest formation intruded is Keechelus which may be Oligocene or Miocene. In area of this report [northern parts of Mount Stuart and Snoqualmie folios], the Snoqualmie is not in contact with any younger rocks, so no upper limit can be placed on its age. Relationship of Keechelus and Snoqualmie in area discussed by Warren (1941) to rocks in area of this study is not known. Age determination of Snoqualmie (using zircon method) is reported to be 60 million years —this is usually considered Paleocene or Eocene.

Named for exposures about headwaters of Snoqualmie River, Snoqualmie quadrangle. Forms peaks and ridges, such as Granite, Denny, and Snoqualmie Mountains.

Snowbank Granite[1]

Precambrian (lower or middle Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4.

J. W. Gruner, 1941, Geol. Soc. America Bull., v. 52, no. 10, p. 1610. Snowbank granite and Snowbank stock mentioned in report on Knife Lake district.

First described in Vermilion district.

†Snowbank Lake Granite[1]

Precambrian (lower or middle Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. Nat. History Survey Final Rept., v. 4.

Occurs in Snowbank Lake and vicinity, Vermilion district.

Snowbird Group

Snowbird Formation[1]

Precambrian (Ocoee Series): Western North Carolina and eastern Tennessee.

Original reference: A. Keith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 116, p. 5.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 7, p. 390. Keith (in later publications) used names Snowbird formation and

Hiwassee slate for Cambrian rocks below Cochran conglomerate. These two names are names of Ocoee formations and should not be used for Cambrian formations.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, no. 10, p. 627. Name Vann quartzite proposed to replace term Snowbird formation as used by Keith in Hot Springs area, North Carolina.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 271–272. Name Hurricane is applied to the graywacke which underlies Great Smoky quartzite and is basal formation of Ocoee series. In Asheville and several other folios, Keith (1904, 1905, 1907, and Mount Guyot folio, unpub.) used name Snowbird formation for these beds which he assigned to Lower Cambrian; he included part of Great Smoky conglomerate in Snowbird formation at type locality and elsewhere; in 1904 and 1907, he applied name Snowbird also to well-established Lower Cambrian rocks; hence, name Snowbird is misleading, and new name applied.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 13 (table 3), 25–30. In this report on Hot Springs area, North Carolina, term Snowbird is retained for unit below Sandsuck. This is area in which Stose and Stose used names Vann quartzite and Hurricane graywacke.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 68, no. 9, p. 953 (fig. 2), 954–957, 963. Rank raised to group in Ocoee series. North of and below Greenbrier fault, includes Metcalf formation (new) in western part of area; in eastern part of area, includes (ascending) Wading Branch formation, Longarm quartzite, Roaring Fork sandstone (all new), and Pigeon siltstone. South of and above Greenbrier fault, includes Wading Branch formation, Longarm quartzite, and Roaring Fork sandstone. At type section, group rests on granitic rocks and is succeeded conformably by Rich Butt sandstone (new). South and above Greenbrier fault, conformably underlies Great Smoky group and overlies granitic and gneissic rocks.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 34–35; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped as Snowbird formation, Ocoee series, Upper Precambrian. Subdivided into five unnamed units. Thickness over 15,000 feet in vicinity of Snowbird Mountain and Pigeon River.

Type section (group): Along Pigeon River at southwest and south base of Snowbird Mountain, Haywood County, N.C.

Snow Creek Porphyry[1]

Post-Cretaceous(?): Central Montana.

Original reference: P. A. Schafer, 1935, Montana Bur. Mines and Geology Mem. 13, p. 10–15, map.

U.S. Geological Survey currently designates the Snow Creek Porphyry as post-Cretaceous(?) on the basis of a study now in progress.

Exposed continuously from vicinity of I.X.L. mine across lower end of Poverty Ridge, a short distance above junction of Snow and Carpenter Creeks, across Carpenter Creek near mouths of Hegener and Mackey Creeks, and extending to divide at heads of those Creeks, Neihart district, Cascade County.

Snowcrest Granite

Eocene: Southwestern Montana.

Robert Scholten, K. A. Keenmon, and W. O. Kupsch, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 372, pl. 1. Coarse-grained strongly jointed granite that disintegrates into small angular fragments. Snowcrest intrusive cuts through Mississippian rocks and is unconformably overlain by Blacktail Deer Creek formation (new).

Occurs as a small stock that crops out at southwestern end of Snowcrest Range, in sec. 20, T. 13 S., R. 7 W., Beaverhead County.

Snowden Member (of Harpers Formation)

Lower Cambrian: Central Virginia.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 596, pl. 1. Distinctive quartzite member which occurs 100–300 feet above bottom of formation. Thickness 50 feet.

Named for exposure on U.S. Highway 501 in James River Gorge about 0.2 mile west of Snowden post office, Amherst County.

Snow Fork Limestone (in Allegheny Formation)[1]

Snow Fork ironstone member

Pennsylvania: Southeastern Ohio.

Original reference: E. Orton, 1878, Ohio Geol. Survey, v. 3, p. 889, 897, pls. facing p. 889, 921.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 69–70. Snow Fork ironstone (Salem limestone) member included in Middle Kittanning cyclothem in report on Athens County. Average thickness about 4 feet. Member is shale with abundant plant fossils and numerous clay ironstones. Allegheny series.

Named for Snow Fork on Monday Creek, Hocking County.

Snow Hill Marl Member (of Black Creek Formation)[1]

Upper Cretaceous: Southern North Carolina and eastern South Carolina.

Original reference: L. W. Stephenson, 1923, North Carolina Geol. and Econ. Survey, v. 5, pt. 1, p. 9–10.

H. E. Le Grand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook Oct. 8–9, p. 7, 24–25. Stop 1 of field trip considered type locality of Snow Hill member. Authors assume this to be fossil locality mentioned by Conrad (1871, Am. Jour. Sci., 3d ser., v. 1, 468–469). At this site, Snow Hill member consists of 5 or 6 feet of drab-black arenaceous and micaceous clays containing abundant assemblage of megafossils. Thickness of exposed section is variable with seasonal fluctuations in river level. Uppermost part of Black Creek formation; underlies Peedee formation.

C. E. Brett, 1959, Elisha Mitchell Sci. Soc. Jour., v. 75, no. 2, p. 69–70. On basis of present study, it is believed that term Snow Hill calcareous member of Black Creek formation should be dropped from literature and that sediments at Snow Hill be included in Peedee formation.

Type locality: On farm of L. C. Daniels along Contentea Creek, about 2 miles below Snow Hill, Greene County, N.C.

Snowshoe Formation (in Izee Group)

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 259–263. Consists of approximately 2,800 feet of black shale and fine-grained dark-gray laminated sandstone in the upper part of Izee group. Unconformably underlies Trowbridge shale (new); overlies Hyde formation (new).

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4367. Weberg, Warm Springs, and Basey (new) formations are lateral equivalents of Snowshoe formation.

Type area: On southeast limb of Mowich anticline; exposures lie in narrow belt extending from Snow Mountain northeastward across South Fork valley, Crook County. Named for the "Snowshoe country" on headwaters of Silvies River.

Snowy Range Formation

Snowy Range Limestone Member (of Gallatin Limestone)

Snowy Range Member (of Boysen Formation)

Upper Cambrian: Southern Montana and northwestern Wyoming.

Erling Dorf and Christina Lochman, 1938. (abs.) Geol. Soc. America Proc. 1937, p. 276; 1940, Geol. Soc. America Bull., v. 51, no. 4, p. 545–547. Formation comprises: lower member of thin sandstones and gray-green fissile shales (average 75 feet thick) with, at top, a few limestone pebble conglomerates and thin persistent horizon (about 10 feet thick) of dense light-gray limestone with distinctive columnar structure; upper member of intercalated gray-green fissile shales and innumerable beds and lenses of glauconitic limestone flat pebble conglomerates (average 150 feet thick). Thickness at type locality 259 feet. Underlies Grove Creek formation (new); overlies Maurice formation (new). Franconia equivalent. Term Gallatin formation not applicable in this area [southern Montana].

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1093–1094, 1101 (fig. 3), 1105. Rank reduced to member status in Boysen formation (new) in Wind River area, Wyoming. Underlies Grove Creek member; overlies Maurice member. Thickness 308 feet in type section of Boysen.

V. E. Nelson and Victor Church, 1943, Jour. Geology, v. 51, no. 3, p. 145 (fig. 2). Stratigraphic chart of Gros Ventre and northern Hoback Ranges, Wyo., shows Snowy Range as upper member of Gallatin limestone.

Christina Lochman, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2202 (fig. 1), 2212, 2214 (fig. 2). Formation includes (ascending) Dry Creek shale member and Sage pebble conglomerate member (new). In area of this report [central Montana], overlies Maurice formation and underlies Maywood formation. Thickness 15 to 130 feet.

A. M. Hanson, 1952, Montana Bur. Mines and Geology Mem. 33, p. 19. In part of Montana adjacent to and northeast of Yellowstone Park, strata of same age as Red Lion formation consist of interbedded greenish-gray shales and limestones and lime-pebble conglomerates. This unit has been named Snowy Range by Dorf and Lochman.

P. W. Richards, 1957, U.S. Geol. Survey Bull. 1021–L, p. 397, 400–402. Formation described east and southeast of Livingston, Mont., where it is 175 feet thick and consists of a lower 36 feet of greenish-gray shale,

a middle 33 feet of flat-pebble limestone conglomerate overlain by columnar limestone, and an upper 106 feet of interbedded poorly exposed greenish-gray shale and light-gray dense crystalline glauconitic limestone; of these beds, the lower 34 feet are seemingly stratigraphic equivalents of Peale's (1893) Dry Creek shales and remainder of the formation is in part correlative with and in part younger than Peale's Pebbly limestone. Underlies Grove Creek formation; overlies Pilgrim limestone (used here in preference to Maurice).

R. E. Grant, 1958, Dissert. Abs., v. 18, no. 6, p. 2107. Formation consists of (ascending) Dry Creek shale, Sage, and Grove Creek members. Overlies Pilgrim limestone; underlies Maywood unit.

Type locality: On south slope of Castle Rock about 2 miles downstream from Snowy Range Ranch at junction of the East Fork with Mill Creek, Park County, Mont. Section measured in N½SE¼ sec. 13, T. 6 S., R. 9 E.

Snowy Range Series

Precambrian: Southeastern Wyoming.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Proposed for formations described by Blackwelder (1926, Geol. Soc. America Bull., v. 37, p. 622–647) from conglomerate at base of Deep Lake metaquartzite upward and including French slate. Occurs above Centennial series (new). [Formations described by Blackwelder include (ascending) Deep Lake Metaquartzite, Headquarters Schist, Heart Metagraywacke, Medicine Peak Metaquartzite, Lookout Schist, Sugarloaf Metaquartzite, Nash Marble Series, Anderson Phyllite, Ranger Marble, Towner Greenstone, and French Slate.]

C. L. Fenton and M. A. Fenton, 1957, Geol. Soc. America Mem. 67, p. 104–106. Series contains at least 24,000 feet of metamorphosed conglomerates, quartzites, graywackes, shales, and dolomites which reveal no angular unconformities, though minor disconformities are present. Terrestrial environment is indicated by three tillite deposits 125, 25, and 100 feet thick, the first of which appears about 2,000 feet above base of series. Believed to be early Huronian.

Crops out in Medicine Bow Mountains, west of Laramie basin, Wyoming.

Snyder Limestone

Snyder Member (of Benner Limestone)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania, western Virginia, and southern West Virginia.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Named as member of Benner limestone and described as sublithographic light-colored oolitic and pebbly limestone. Thickness 96 feet at type locality.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 15–17. Lower member of Benner. At type section, consists of 98 feet of light-colored detrital limestone, with limestone pebble conglomerate, and white-weathering dense relatively pure sublithographic limestone. Latter type usually present in upper part of unit. Lithology similar throughout central Pennsylvania from Union Furnace, Huntingdon County, to Bedford County; conglomerate with white limestone pebbles particularly characteristic. Contains a thin metabentonite at Oak Hall. Maximum thickness 110 feet; diminishes to extinction in western Cumberland Valley. Conformably underlies Stover member, except in Blacklog and

Path Valleys, Pa., where it underlies Nealmont limestone or Mercersburg limestone. Overlies Hostler member of Hatter formation; often difficult to distinguish the two. Derivation of name and more exact location of type section stated.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1199. Limestone included in upper Bolarian (Hunterian) series.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 21, 22). Geographic extension; listed in stratigraphic column for Highland County, Va., and Monroe County, W. Va. [Limestone apparently has formational rank in these areas.]

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 74 (table 12), 78, 95, 103. Geographic restriction. New name McGlone limestone proposed for rocks in Virginia previously referred to as Snyder. Termed a formation.

Type section: In Pennsylvania Railroad cut at Union Furnace, Huntingdon County, Pa. Named for Snyder Township, Blair County, Pa., where exposed in southern quarry along Elk Run on southern boundary of township.

Snyder Creek Shale[1]

Upper Devonian: Central Missouri.

Original reference: J. A. Gallaher, 1900, Missouri Geol. Survey, v. 13, p. 153.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 145–151. Varies from largely shales through alternating shales and limestones to dominantly limestones. Thickness less than 10 feet to as much as 63 feet. Overlies Callaway limestone, in most places conformably. In most places, overlying formation is Bushberg, and unconformity is distinct. In some places, Chouteau limestone is unconformable on Snyder Creek. Burlington limestone is overlying formation in two or three places and Cherokee shale in one. Lower half of Upper Devonian and may represent lowest part of Upper Devonian.

Named for exposures on Snyder Creek which flows through Snyder Farm, Callaway County.

Snyder Hill Formation[1]

Snyder Hill Group

Permian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1936, Geol. Soc. America Bull. v. 47, p. 530–532, 536.

J. H. Feth, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 1, p. 86 (fig. 2), 87, 88–89 (fig. 3), 92–99. Name Snyder Hill formation applied to about 2,223 feet of Permian strata in northern Canelo Hills area.

E. D. Wilson, 1951, Arizona Bur. Mines Bull. 158, Geol. Ser. 19, p. 50. In Empire Mountains, overlies Andrada formation (new) and underlies unnamed Upper Cretaceous interval. Consists of thick-bedded limestone with several quartzite members. Thickness 1,250 to 2,250 feet.

D. L. Bryant, 1955, Dissert Abs., v. 15, no. 7, p. 1224. Rank raised to group. Includes (ascending) Scherrer formation, Concha limestone, and Rainvalley formation (new). This action restricts Naco group at top.

F. S. Sabins, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 498. Strata assigned to Snyder Hill by Feth (1948) appear to include

beds equivalent to Colina, Scherrer, and Concha formations. Suggests term Snyder Hill be suppressed.

Type locality: Snyder Hill, an isolated hill about 10 miles southwest of Tucson, in Whetstone Mountains.

Snyderville Shale[1] Member (of Oread Limestone)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 32, 33, 38.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 147–148. Snyderville shale member of Oread formation; underlies Leavenworth limestone member; overlies Toronto limestone member. This is classification agreed upon by State Geological Surveys of Iowa. Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 26. In Nebraska, overlies Toronto (Weeping Water) limestone member. Type locality stated.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 419. Thickness 2 feet in measured section near Winterset, Madison County.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 38–40, pl. 1. In Douglas County, consists chiefly of green and gray argillaceous and silty shale, claystone, and siltstone. Thickness 1 to 45 feet; average 10 or 15 feet.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull 15, p. 23, fig. 5. Poorly exposed and thin limestone bed occurring at base is difficult to recognize. In Adair County, about 8 feet of shale. slightly silty and red at base, occurs between the Leavenworth and a limestone tentatively called the Toronto.

Type locality: In Heebner Creek valley, east of Snyderville quarry, about 3 miles west and 1¼ miles north of Nehawka, Cass County, Nebr.

S O Volcanics

Miocene or Pliocene: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 110–115, pl. 5. Thick series of interbedded quartz latite tuffs and hornblende andesite flows. Highly variable both laterally and vertically. Broadly divisible into three members: basal series of quartz latite tuffs, breccias, and minor obsidian flows, with interbedded conglomerates, sandstones, and mudstones also largely of pyroclastic origin—thickness ranges from 1,600 feet on southeast face of Stockton Hill to knife edge just across valley to the south, and is missing within about a mile in that direction; intermediate member of hornblende andesite flows—probably about 1,000 feet thick east of S O Ranch and about 300 feet thick south of Reeves Ranch; and upper member of quartz latite tuff, with a few local intercalations of true rhyolite and hornblende andesite—thickness about 1,100 feet on Hay Mountain, elsewhere much less. Hornblende andesite flow member apparently the most uniform and continuous part of formation. Accumulated upon older erosion surface of considerable relief so that in various localities different members lie at stratigraphic

base of formation and overlie various formations including Gleeson quartz monzonite (new) and Bisbee formation. Underlies undeformed late Quaternary alluvium at most localities. Probably not older than Miocene and early Pliocene seems an upper age limit for this volcanism.

Exposed near S O Ranch, from which it is named, in sec. 20, T. 20 S., R. 24 E. Well exposed between south end of Hay Mountain and the hills southwest of Reeves Ranch, about 8 miles to northwest. Other bodies occur south of Cowan Ranch—near Outlaw Mountain, on pediment extending northwest of Outlaw Mountain, and on west side of Dragoon Mountains near Bar O Ranch. Central Cochise County.

Soap Creek Bentonite Bed (in Belle Fourche Member of Cody Shale)

Soap Creek Bentonite Bed (in Frontier Formation)

Upper Cretaceous: Southeastern Montana and northern Wyoming.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111, sheet 2. Olive-green bentonite bed 8 feet thick at top of Frontier formation. Locally more than 10 feet thick south of Soap Creek dome.

M. M. Knechtel and S. H. Patterson, 1952, U.S. Geol. Survey Circ. 150, pl. 1. Beds present in Yellowtail district, southeastern Montana and northern Wyoming.

M. M. Knechtel and S. H. Patterson, 1956, U.S. Geol. Survey Bull. 1023, p. 19, 20, pls. 1, 3. Bed in Belle Fourche member of Cody shale. Thickness 12 to 30 feet. Area of report, Hardin district, Montana and Wyoming. In this area, term Belle Fourche replaces Frontier formation as used in previous reports.

Well exposed on east flank of Soap Creek dome, sec. 35, T. 6 S., R. 32 E., Hardin area, Big Horn and Yellowstone Counties, Mont.

Sobrante Sandstone[1] (in Monterey Group)

Miocene, middle: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 69–70, pl. 12. Exposed in Martinez syncline, near Martinez. Thickness about 520 feet. Unconformably overlies San Ramon sandstone; underlies Briones sandstone.

G. C. Lutz, 1951, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 28, no. 13, p. 367–406. Term Sobrante used in redefined and restricted sense of Clark (1918, California Univ. Pub. Dept. Geol. Bull., v. 11, no. 2). Type section designated for Sobrante (restricted). Thickness at type locality about 150 feet. Underlies Claremont shale; overlies Concord formation(?).

G. D. Robinson, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–88. Described in Hayward quadrangle. Usage here is roughly equivalent to Sobrante sandstone (restricted) of Clark (1918) and Lutz (1951). Middle Miocene.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 15–16, fig. 2, geol. map. Sobrante sandstone in Pleasanton area, Alameda and Contra Costa Counties, overlies Tolman formation (new); underlies Claremont shale. Thickness about 200 feet. Term Monterey group not considered appropriate in this region.

Type section of Sobrante sandstone (restricted): Along Bear Creek Road summit between Oursan Ridge and Lawson Hill, Contra Costa County.

Social Island Limestone Member (of Row Park Limestone)

Middle Ordovician: Central southern Pennsylvania.

F. M. Swartz and R. R. Thompson, 1958, Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. 71, p. 4, 5. Microcrystalline or vaughanitic limestone. Underlies Browns Mills limestone member (new); overlies Beekmantown dolomite. Name credited to J. G. Palacas (unpub. thesis).

In Franklin County.

Sockanosset Sandstone[1]

Pennsylvanian: Eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 159–163.

Well exposed in Sockanosset Ridge, east and west of reservoir near Providence, Providence County.

Socorran series[1]

Mississippian: Southwestern New Mexico.

Original reference: C. R. Keyes, 1906, Science, new ser., v. 23, p. 921.

Soda Lake Formation

Miocene, lower: Southern California.

T. W. Dibblee, Jr., 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Explor. Geophysicists Guidebook, Joint Ann. Mtg., Los Angeles, p. 82, 84. Marine shale and basal sandstone 1,200 feet thick. Underlies Painted Rock formation (new); overlies Simmler formation (new). Outcrops noted in road log. [This appears to be unit that was defined by Hill, Carlson, and Dibblee (1958) as the Soda Lake Shale and Soda Lake Sandstone Members of Vaqueros Formation.]

Occurs in Caliente Range, a low mountainous ridge trending northwesterly for about 30 miles between Cuyama Valley and Carrizo Plain. Range is an anticlinal uplift developed in a thick series of Tertiary sediments and is partially overturned and thrustfaulted southwestward toward Cuyama Valley.

Soda Lake Sandstone Member (of Vaqueros Formation)

Miocene, lower (Zemorrian): Southern California.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2978 (fig. 3), 2982 (fig. 5), 2984. Southeast of Caliente Mountain, the Vaqueros formation consists of three members (ascending): Soda Lake sandstone, Soda Lake shale, and Painted Rock sandstone. At type locality, the sandstone is characteristically gray white, weathering to light buff, massive bedded, fine to medium grained, well sorted, and firmly indurated; commonly crossbedded with foreset beds dipping in westerly direction. Thickness at type section 300 feet; thins westward by probable gradation into Soda Lake shale and toward southeast becomes undifferentiated from overlying Painted Rock sandstone; overlies Simmler formation.

Type locality: T. 10 N., R. 25 W., southeastern Caliente Range, east of Cuyama Ranch quadrangle.

Soda Lake Shale Member (of Vaqueros Formation)

Miocene, lower (Saucesian): Southern California.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2974 (fig. 1), 2978 (fig. 3), 2984–2986. From Caliente Mountain northwestward, the Vaqueros consists of two members, Soda Lake shale below and Painted Rock sandstone above. Thickness in type area, about 1,200 feet. Overlies Simmler redbeds. On southwest slope of Caliente Mountain, thickness is about 1,100 feet, base concealed; here it was mapped by Eaton and others (1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2) as Oligocene(?) silt and inferred to be correlative with middle Sespe and Gaviota formations of Santa Ynez Mountains; thickness in southeastern part of Caliente Range about 900 feet, this section grades into sandstone as does the 800-foot section in Cuyama Badlands.

Type locality: Northwestern Caliente Range near Soda Lake, T. 31 S., R. 19 E., Simmler quadrangle.

Soda Mountain Formation

Triassic-Jurassic: Southern California.

L. T. Grose, 1956, Dissert. Abs., v. 16, no. 1, p. 100; 1959, Geol. Soc. America Bull., v. 70, no. 12, pt. 1, p. 1526–1529, pl. 1. Thick series of volcanic flow breccia and sandstone. Rocks range from massive andesite flows through flow breccia, pyroclastic rocks, and welded tuff to volcanic sandstone and finally to nearly pure quartzite. Relative abundance of each type varies extremely and unpredictably within short distances vertically and laterally; volumetrically, flow breccia predominates and is followed by volcanic sandstone; massive flows, welded tuff, and pure quartzite are only locally abundant; yellow, gray, red, purple, and green colors common. Displays little bedding, except where interbedded sandstones and pyroclastics occur; hence, over large areas structure is almost unknown; where bedding is visible it is steep, vertical or locally overturned. Formation is generally bound in complex fault-block relations by Upper Paleozoic limestones and is intruded by Upper Mesozoic plutonic rocks. At type location, disconformably overlies Lower Triassic sedimentary rocks. No rocks are known to overlie formation stratigraphically in mapped area or elsewhere in region. Estimated minimum thickness 7,000 feet. On basis of field relations, formation is post-Early Triassic and pre-Cretaceous. Type location is selected but truly representative stratigraphic section is impossible to find (six reasons listed).

Type location: North end of Spectre Spur, northeastern Soda Mountains, San Bernardino County. This section is the most nearly complete, most orderly, and least metamorphosed and intruded of any in Soda Mountains or immediate surroundings.

Sodus Shale (in Clinton Group)

Sodus Shale Member (of Clinton Formation)[1]

Middle Silurian: Central and western New York.

Original reference: J. M. Clarke, 1906, New York State Mus. 2d Rept. Dir. Sci. Div. 1905, p. 12.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1982 (fig. 3). Sodus shale, 15½ feet thick, overlies Reynales limestone; underlies Williamson shale. Clintonian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. No. 1. Shown on chart as Lower and Upper Sodus shale. Underlies Wolcott limestone; overlies Wallington limestone (new) which replaces limestone formerly known as Reynales at Rochester and eastward, and Bear Creek gray shale. Clinton group.

Named for town of Sodus, Wayne County.

Solberg Schist (in Dickinson Group)

Precambrian: Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 32. Middle formation of group. The more northerly (stratigraphically lower) parts of unit are dark fine-grained hornblende and biotite schists; some exposures show banding, parallel or nearly parallel to the steeply dipping foliation that may represent original layering; more southerly exposures are massive gray quartz-mica schist and micaceous quartzite. Aggregate thickness about 3,000 feet. The 100-foot iron-rich Skunk Creek member occurs about 1,000 feet below top of formation. Underlies Six-Mile Lake amphibolite (new); overlies East Branch arkose (new).

Named for Solberg Lake, in secs. 17 and 20, T. 42 N., R. 29 W., Dickinson County. Exposed east of lake in scattered outcrops for about 10 miles in a belt 1 to 2½ miles wide.

Soldier Creek Shale Member (of Bern Limestone)

Soldier Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad Sci. Trans., v. 15, p. 30.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 309 (fig. 14). Graphic section of Pennsylvanian in Adams County shows Soldier Creek shale occurring below Wakarusa limestone and above Burlingame limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 18. Formation contains two quite well defined limestones and three shale members in southeastern Nebraska and adjacent area of Kansas; formerly three limestones and two lower shales were classed with the Burlingame in Nebraska.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Rank reduced to member status in Bern limestone (new). Overlies Burlingame limestone member; underlies Wakarusa limestone member.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Gray shale at top and bottom with maroon shale near top; near center is micaceous gray sandstone and siltstone. Thickness about 30 feet. Underlies Wakarusa limestone; overlies Burlingame limestone. Wabaunsee group.

Type locality not designated but presumably on "Big and Little Soldier Creeks about 3 miles from Silver Lake," Shawnee County, Kans.

Soldiers Limestone Member (of Big Saline Formation)

Lower Pennsylvanian: Central Texas.

F. B. Plummer, 1947, Jour. Paleontology, v. 21, no. 2, p. 142, 143, 145; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 196 (table 2), 197, 198. Consists of light-gray coarsely crystalline, massively bedded, crinoidal fossiliferous limestone. Thinnest southwest of Rochelle, thickens west-

ward to 75 feet at Brady, and nearly 200 feet at Big Saline Creek, Kimble County. West of Cavern Ridge, overlies Brook Ranch member (new) and, near Cavern Ridge, lies above beds with same lithology as that of Lemons Bluff spiculite at Lemons Bluff. Its stratigraphic position above beds of Lemons Bluff lithology suggests that Soldiers member has stratigraphic position similar to that of Brister member east of Cavern Ridge, although it differs from the Brister.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 70–71. Soldiers Hole lentil is massive reeflike series of limestone beds that form upper layers of Big Saline formation in Kimble, Mason, and McCulloch Counties. Extends from Big Saline Creek in Kimble County to Ellenburger ridges south of Hall near San Saba-McCulloch County line. Measured section at Soldiers Hole shows 28 feet of lentil above Lemons Bluff beds.

Soldiers Hole is 6 miles east and 2½ miles north of Brady, McCulloch County.

Soldiers Hole Lentil or Member (of Big Saline Formation)

See Soldiers Limestone Member (of Big Saline Formation).

Solduc Formation

See Soleduck Formation.

Solebury Member (of Stockton Formation)

[Upper] Triassic: West-central New Jersey.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 39, 53 (table), 61. Thick-bedded to massive coarse quartz-arkose conglomerate with interbedded arkose, red shale, and sandstone. Thickness 387 feet. May or may not include overlying 671 feet of red sandstone and gray arkose, and underlying 720 feet of arkose, red shale, sandstone, and conglomerate [see Stockton formation]. Older than Prallsville member (new).

In area along Delaware River from Stockton northward to 3 miles west of Milford, Hunterdon County.

†Soledad division[1]

Miocene, upper: Southern California.

Original reference: O. H. Hershey, 1902, Am. Geologist, v. 29, p. 349–372.

Named for exposures in Soledad Canyon, near Saugus, Los Angeles County.

Soledad Group[1]

Oligocene or Miocene, lower: Southern California.

Original reference: D. S. Jordan, 1919, Leland Stanford Jr. Univ. Pub., Univ. ser., Fossil fishes of southern California, p. 3–5.

Well developed about Soledad Pass, in extreme northern part of Los Angeles County, about 40 miles north of Los Angeles.

Soledad Rhyolite[1]

Eocene or Oligocene: Central southern New Mexico.

Original reference: K. C. Dunham, 1935, New Mexico School Mines Bull. 11, p. 53, 56.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14). Eocene or Oligocene on correlation chart.

Type locality: In mountains adjacent to Soledad Canyon, Dona Ana County.

Soledad Volcanic Conglomerate Member (of Catahoula Tuff)[1]

Oligocene or Miocene, lower: Southwestern Texas.

Original reference: T. L. Bailey, 1926, Texas Univ. Bull. 2645, p. 65, 80–89, 178–179.

H. H. Cooper, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 11, p. 1423. Shown on table of formations in Laredo district as Soledad member of Catahoula tuff. Consists of coarse brownish-gray to greenish sandstone and beds of volcanic ash, containing igneous gravel and cobbles; thickness about 600 feet. Underlies Chusa member; overlies Fant member.

Named for occurrence on Soledad Hills, western Duval County.

Soleduck Formation[1]

Cretaceous and Tertiary: Northwestern Washington.

Original reference: A. B. Reagan, 1909, Kansas Acad. Sci. Trans., v. 22, p. 161.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 17. Name Solduc suggested for non-Tertiary part of original Hoh formation.

C. E. Weaver, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1399. Rocks of interior Olympic Mountains are known only in general way. They consist of more than 10,000 feet of nonfossiliferous arkosic sandstone named Solduc formation. Middle Miocene sandstones of the Astoria resemble lithologically the sandstones of the Solduc of pre-Tertiary age and at one time were mapped with them as single unit—the Hoh formation. Astoria rocks should be differentiated from Solduc sandstones in future mapping.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1060, Geol. Soc. America Bull., v. 71, no. 10, chart 10e (column 55). Soleduck formation shown on Cretaceous correlation chart with note that formation is mostly Tertiary.

First described from occurrences along Soleduck River, Clallam County.

Solitario Formation[1]

Upper Ordovician(?): Southwestern Texas.

Original reference: W. A. J. M. Van der Gracht, 1931, K. Akad. Wetensch. Amsterdam Verb., Afd. Natuurk, Deel 27, No. 3, table Vc, p. 64.

W. B. N. Berry and H. M. Nielsen, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2254–2259. Van der Gracht published table of formations in the Solitario (furnished by Baker) in which name Solitario formation was applied to 15 to 20 feet of bright-green siliceous and argillaceous shale between Maravillas and Caballos formations. Sellards (1932) described a green shale, 25 or 50 feet thick, overlying Maravillas chert in the Solitario. King (1937) mentioned a few feet of dark-green shale between the Maravillas and Caballos in the Rough Creek exposure. Wilson (1954) proposed name Persimmon Gap shale for shale between Caballos and Maravillas formations. Thus, Solitario formation of Baker and Sellards and Persimmon Gap shale of Wilson are same rock unit. Caballos novaculite is herein restricted to the two lower members as described by King (1937), and term Santiago revived and applied to upper three members of King's Caballos novaculite; hence, there is no need for names Persimmon Gap shale and Solitario formation.

In vicinity of Solitario Peak, Brewster-Presidio Counties.

Solitario slate[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 11.

Exposed in Solitario Mountain, northwest of Las Vegas, San Miguel County.

Solitude Granite[1]

Upper Cretaceous or lower Tertiary: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

U.S. Geological Survey currently designates the age of the Solitude Granite as Upper Cretaceous or lower Tertiary on the basis of a study now in progress.

Occurs at head of Solitude Gulch, Globe quadrangle.

Solitude limestone (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 113. Massive concretionary bed of limestone, about 25 feet in thickness. Forms prominent projecting ledge amidst shales and soft shaly sandstones associated. Underlies Carbon Butte shales (new); overlies Oveja formation (new).

Well exposed in Chuar Valley sides about opposite Cape Solitude, at mouth of Little Colorado River; Grand Canyon region.

Solomon Formation (in Dakota Group)

Cretaceous (Comanche Series): Northwestern Kansas.

R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]. Dark-gray and black shale and brown sandstone, mostly marine. Thickness 15 to 100 feet. Includes sandstone at top and Hodgeman sandstone below. Unconformable above Ellsworth formation (new); underlies Graneros shale.

R. C. Moore and K. K. Landes, 1937, Geologic map of Kansas (1:500,000): Kansas Geol. Survey. Mapped with Dakota group.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Dakota formation, as herein defined contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Derivation of name not given. Dakota group is mapped along Solomon River.

Solomon Gypsum (in Sumner Group)[1]

Permian: Central Kansas.

Original reference: G. P. Grimsley, 1899, Kansas Univ. Geol. Survey, v. 5, p. 58–61.

Crops out one-fourth mile south of Dillon mill, 2 miles west of Hope shaft at Solomon gypsum mine, Dickinson County.

Solomon Schist[1]

Pre-Ordovician(?): Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geol. Survey Bull. 433, p. 50–53, maps.

Exposed along Solomon River, Seward Peninsula.

Solomon Creek Member (of Seguin Formation)[1]

Solomon Creek Member (of Wills Point Formation)

Paleocene: Southeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 575, 576, 577.

M. W. Beckman and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. Redefined and reallocated to member status in Wills Point formation. As originally defined, the Seguin straddles the Midway-Wilcox boundary; a disconformity occurs within the Solomon Creek member which is here restricted to the beds below the disconformity. Where it is possible to recognize the divisions as redefined, the Solomon Creek should be regarded as a member of the Wills Point formation. Where divisions cannot be differentiated, it may be necessary to continue use of Seguin formation, recognizing that it contains the break between the Midway and the Wilcox.

Type locality: Solomon's Creek, 6 miles southwest of Elgin, Bastrop County.

Solomonsville Beds

Solomonsville Beds (in Gila Conglomerate)

Pliocene to Pleistocene: Southeastern Arizona.

W. L. Van Horn, 1958, Arizona Geol. Soc. Digest, p. 45. Sequence of poorly to medium well consolidated sediments. Consist of lacustrine deposits overlain by terrace gravels and alluvium. Upper beds are post-early Kansan in age.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. In Gila conglomerate. Consist of massive conglomerate which intertongues with and grades into sandy to silty beds toward center of valley. Exposed thickness about 300 feet; total thickness, including subsurface deposits, may be about 2,000 feet. Conformably underlie Frye Mesa beds (new); disconformably overlie Bonita beds (new). Range in age from Pliocene to Pleistocene, possibly into Kansan.

In eastern part of Safford Valley, Graham County.

Solon Limestone[1]

Solon Limestone Member (of Cedar Valley Formation)

Upper Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1897, Iowa Geol. Survey, v. 6, p. 148.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1751, chart 4. Shown on correlation chart as basal member of Cedar Valley formation. Underlies Rapid limestone member; overlies Wapsipinicon limestone. Middle Devonian. Age of entire Cedar Valley is difficult to establish, and dating of some of its parts presents problems. The Solon (sometimes called Linwood) is linked with the main body of the formation by common presence of crinoid *Sterocrinus*.

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 157. Independence shale is stratigraphically below the Cedar Valley and above the Wapsipinicon. The Independence, by its fossils, is lower Upper Devonian;

hence, the Cedar Valley limestone is Upper Devonian in age and post-Independence.

Named for Solon, Johnson County.

Solsberry Formation[1]

Mississippian: Southwestern Indiana.

Original reference: F. C. Greene, 1911, Indiana Acad. Sci. Proc. 1910, p. 275, 281.

Named for Solsberry, Greene County.

Solsville Member[1] (of Marcellus Formation)

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 133, 219.

[G. A. Cooper], 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., [p. 10, 11]. Thickness 45 to 50 feet. Underlies Pecksport member; overlies Bridgewater member.

Type section: Woods Gully, 2 miles northwest of Solsville, Madison County.

Somerset Member (of Pottsville Formation)[1]

Pennsylvanian: Southern Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 311–312.

Named for exposures in vicinity of Somerset, Saline County.

Somerset Shale Member (of Warsaw Formation)[1]

Somerset Member (of Salem Limestone)

Upper Mississippian: Southeastern Kentucky.

Original reference: Charles Butts, 1922, Kentucky Geol. Survey, ser. 6, v. 7, p. 89, 104.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 223, 224, 227, pls. 6, 26. Throughout Kentucky belt, Butts (1922) identified three members of the Warsaw (ascending): Wildie sandstone, Somerset shale, and Garrett Mill sandstone. Somerset shale member of Butts has been traced from southern Indiana to type locality at Somerset, Pulaski County, and is interpreted as being a basal argillaceous phase of the Salem limestone at top of Harrodsburg division of Warsaw. The Wildie sandstone of Butts is included in Wildie siltstone member of Muldraugh formation (new); Garrett Mill of Butts is in upper part of Salem.

Named for Somerset, Pulaski County, where it is well exposed in railroad cut a short distance north of the station.

Somerville Granite[1]

Precambrian: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30.

Typically developed near Somerville, Fauquier County.

†Somerville Limestone[1]

Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and G. H. Ashley, 1902, U.S. Geol. Survey Geol. Atlas, Folio 84, p. 2.

F. E. Kottlowski, 1954, U.S. Geol. Survey Coal Inv. Map C–11. Replaced by West Franklin limestone.

Named for Somerville, Gibson County.

†Somerville Slate[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, geol. ser., v. 8, no. 4, p. 196–197.

Occurs at and around Somerville, Middlesex County.

Sonoita Group

Upper Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 297 (table). Named on table. Includes Fort Crittenden formation (new). Older than Duncan group (new); younger than Santa Cruz group (new). Early Tertiary.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 59. Great series of sedimentary strata. Consists of two divisions: the lower, Fort Buchanan formation (new), and the upper, Fort Crittenden formation. Late Cretaceous.

E. D. McKee, 1952, Arizona Geol. Soc. Guide Book, Field Trip Apr. 10–14, p. 2. Beds of conglomerate, hard gray and yellow sandstones, and shales of various colors. Thickness in Santa Rita Mountains 4,000 feet. Type [area] cited.

Type area: Sonoita flats near Patagonia.

Sonoma Tuff[1]

Pliocene: Northern California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 39–87.

Probably named for exposures in Sonoma Mountains, Sonoma County.

Sonoma Volcanics[1]

Sonoma Group[1]

Pliocene: Northern California.

Original reference: R. E. Dickerson, 1922, California Acad. Sci. Proc., 4th ser., v. 11, no. 19, maps.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 118, 122–128, pls. 6, 7, 10. Name Sonoma volcanics used for a complex series of lava flows and tuff beds that in some areas are interbedded with sandstone, gravel, and conglomerate. Lava flows which constitute more than 60 percent of entire sequence are prevailingly andesitic but in many places approach basalt. Includes St. Helena rhyolite member which forms upper part of sequence. Dickerson (1922) used name Sonoma group to include original Sonoma tuff, Mark West andesite, and St. Helena rhyolite. Detailed studies show that entire sequence beneath St. Helena rhyolite member, including the "Mark West andesite," varies greatly from place to place; hence, the sequence is regarded as a single geologic unit. Lavas and tuffs of the Sonoma volcanics, excluding the St. Helena rhyolite member, are exposed over an area of more than 350 square miles. Thickness in Howell Mountains, exclusive of St. Helena rhyolite, about 1,290 feet. Unconformably overlies San Pablo, Petaluma, and older formations; in some areas, interfingers with Merced formation. Volcanics were involved in folding which preceded Pleistocene deposition. Patches of lava exposed west of Tolay Creek near Lakeville School were regarded as outcrops of Tolay volcanics by Morse and Bailey (1935).

They are here mapped as part of Sonoma volcanics. Area of report is the coast ranges north of San Francisco Bay region.

W. K. Gealey, 1951, California Div. Mines Bull. 161, p. 11 (fig. 2), 22–24, pls. 1, 3. Described in Healdsburg quadrangle as Sonoma group. Includes heterogeneous series of lava flows, agglomerates, and tuffs interbedded with nonmarine conglomerate, sandstone, and clay. Maximum thickness 4,000 feet (on east limb of Windsor syncline). Overlies faulted, folded Mesozoic rocks; nonmarine Sonoma sands and gravels grade into Merced formation.

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 27 (table 6), 35–58, pl. 1. Sonoma volcanics described in Santa Rosa and Petaluma Valleys. Exposures are restricted mainly to eastern part of area where they have been intensely folded and faulted to form Sonoma and Mayacmas Mountains. On southwestern flanks of Sonoma Mountains, volcanics are in depositional contact with underlying Petaluma formation. Underlie and interfinger with Merced formation. In vicinity of Petaluma, the volcanics, for most part, directly overlie Franciscan group, although individual flows may be intercalated with Merced formation. Underlie Glen Ellen formation, locally some interbedding occurs. Where not overlain by Glen Ellen, volcanics dip beneath alluvium at valley margins. Thickness 0 to about 2,000 feet. Includes lower part of Sonoma group of Gealey (1950 [1951]). Tolay volcanics of Morse and Baley (1935) are mapped with Sonoma.

Fred Kunkel and J. E. Upson, 1960, U.S. Geol. Survey Water-Supply Paper 1495, p. 15–25. As defined and exposed in Napa and Sonoma Valleys. Sonoma volcanics constitute thick and highly variable series of continental volcanic rocks, including andesite, basalt, and minor rhyolite flows with interbedded coarse- to fine-grained pyroclastic tuff and breccia, redeposited tuff and pumice, and diatomaceous mud, silt, and sand; also a prominent body of rhyolite flows and tuff with some obsidian and perlitic glass. Unconformably overlie Neroly sandstone of Miocene age, and St. Helena rhyolite member underlies with some unconformity the Huichica formation of supposed Pleistocene age.

Named for typical exposures on west flanks of Sonoma Mountains, Sonoma County.

Sonoma Range Formation

Ordovician(?): North-central Nevada.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Dark chert, dark siliceous argillite and slate, altered andesitic lava, limestone lenses associated with pillow lava, and a little quartzite. Contains interbedded light-gray chert and quartzite. Thickness more than 3,000 feet. Underlies Valmy formation.

Type locality: West flank of Sonoma Range between Clear Creek and Water Canyon.

Sonora Sandstone[1]

Mississippian: Northwestern Illinois and southeastern and central eastern Iowa.

Original reference: C. R. Keyes, 1895, Iowa Geol. Survey, v. 3, p. 320, 344–350.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 812. Beds referred to Salem limestone at Warsaw, Ill., consist of 4 to 8 feet of more or less crossbedded yellowish limestone that grades laterally into calcareous sandstone, which has been termed Sonora sandstone.

Named for Sonora quarries on Illinois side of Mississippi River opposite Nashville and below Belfast, Lee County, Iowa.

Sonora shale[1]

Pennsylvanian: Missouri.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 252.

Derivation of name not stated.

Sonsela Sandstone Bed (in Petrified Forest Member of Chinle Formation)

Upper Triassic: Northeastern Arizona and northwestern New Mexico.

G. A. Kiersch, 1955, Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2, p. 4 (fig. 1), 5. In eastern exposures of member. Name credited to Harshbarger and others, (in press).

J. P. Akers, M. E. Cooley, and C. A. Repenning, 1958, New Mexico Geol. Soc. Guidebook 9th Field Conf., p. 91 (fig. 3), 93. At type section, comprises two conglomeratic sandstone units separated by a siltstone unit. Lower sandstone is 25-foot ledge-forming unit consisting of very light gray very fine to very coarse grained subrounded to subangular frosted, clear and stained quartz. Upper sandstone forms irregular ledge more than 60 feet high. Threefold division of the Sonsela sandstone bed at its type section is not characteristic of unit in all areas. In most areas, the Sonsela consists of a main sandstone bed and numerous sandstone tongues separated by intervening mudstone units. Thickness 50 to 200 feet depending upon local abundance of sandstone units.

Type section: About 3½ miles north of western Sonsela Butte on east flank of Defiance uplift.

Sonson Limestone

Pleistocene: Mariana Island (Tinian).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 57, table 4 [English translation in library of U.S. Geol. Survey, p. 68]. Correlated with Chatcha [Chacha] limestone on Saipan, Rota limestone on Rota, and Barrigada limestone on Guam. [Appears to be same unit as Asuncion limestone (Tayama, 1939)].

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 57. Consists of hard foraminiferal limestone; dips seaward at angle of 10°. Commonly below Mariana limestone; a forereef detrital facies of Mariana. Name credited to M. Kodaira (unpub. ms.). Data on type locality.

Type locality: Pepeinigl, Puerto (Sonson), Tinian. Also well exposed at Tachinya, Tinian.

Sonyea[1] Formation

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 96, 98.

G. W. Colton and Wallace de Witt, Jr., 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–54. Formation includes (ascending) Middlesex shale, Pulteney shale (new), Rock Stream siltstone, and Cashaqua shale members. Underlies Rhinestreet shale member of West Falls formation; overlies West River shale. Thickness 183 feet at reference section (herein designated); 45 feet in exposures along Lake Erie and along Eighteenmile Creek in southwestern Erie County; about 484 feet near Watkins Glen in south-central Schuyler County.

Type exposure (Chadwick): Outcrops on Keshequa Creek southwest of Sonyea in Groveland Township, Livingston County. Reference section: Outcrops on Buck Creek in Mount Morris Township 3 miles northwest of Sonyea.

Sooke Formation[1]

Oligocene or Miocene or both: British Columbia, Canada, and northwestern Washington.

Original reference: J. C. Merriam, 1896, California Univ. Dept. Geol. Bull., v. 2, p. 105–108.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 104, 115–116. Age given as upper Oligocene.

Probably named for occurrence near Sooke, on south coast of Vancouver Island.

†Sopchoppy Limestone[1]

Miocene, lower: Northwestern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 119–122, 158, 334.

Named for exposures at Sopchoppy, Wakulla County.

Sopris Coal group (in Vermejo Formation)[1]

Upper Cretaceous: Eastern Colorado.

Original reference: R. C. Hills, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58.

Elmoro region.

Soquel Member (of Puente Formation)

Miocene, upper: Southern California.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Consists mainly of massive to moderately well bedded coarse-grained to gritty feldspathic sandstone. Maximum exposed thickness about 2,500 feet. Underlies Yorba member (new) with contact gradational throughout most of Puente Hills; where Yorba member is missing, Sycamore Canyon member rests on Soquel. In Carbon Canyon, the Soquel overlies La Vida member (new), contact gradational; south of Pomona, the Soquel overlaps older rocks and rests directly on the basement complex; south of Santiago Creek, the Soquel is locally unconformable successively on La Vida member, Topanga formation, and Sespe and Vaqueros formations undivided.

Named for the canyon that lies north of Telegraph Canyon and joins Carbon Canyon near the boundary between secs. 10 and 11, T. 3 S., R. 9 W., in southeastern part of Puente Hills. Typical exposures are in Carbon Canyon from Gilman Peak north 1½ miles to vicinity of Carbon Canyon Mineral Springs.

Sorento cyclothem (in Bond Formation)

Sorento cyclothem (in McLeansboro Group)

Pennsylvanian: South-central Illinois.

H. R. Wanless, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 9, p. 1764 (table 2). Name appears in list of cyclothems in McLeansboro group. Occurs above Shoal Creek cyclothem and below Bunje cyclothem (new).

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 6. 7, 11, pl. 1. Simon (1946, unpub. thesis) worked out sequence above Shoal Creek limestone in Bond County and proposed terms (ascending) Sorento Bunje and Flat Creek for cyclothemic units in lower half of interval. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 52 (table 2), pl. 1. In Bond formation (new). Above Shoal Creek cyclothem and below Bunje cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illlinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Edge E½ secs. 6, 7, T. 6 N., R. 4 W., Bond County. Named for village of Sorento, east of type outcrop.

Sorento Limestone Member (of Bond Formation)

Pennsylvanian: Central and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 72–74, pls. 1. Name applied to limestone in lower part of formation. Mainly dark-bluish-gray limestone. Thickness as much as 2 feet. Stratigraphically above McWain sandstone member and below Bunje limestone member (new). Name credited to J. A. Simon, unpub. ms. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NE¼ sec. 6, T. 6 N., R. 4 W., Bond County. Named for exposures just west of village of Sorento.

Sosa Hill Basalt

Miocene, lower; Panamá Canal Zone.

S. M. Jones, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 898 (table 2). Listed on correlation chart. Unconformable above La Boca formation, and below Charges alluvium, Charges gravel, and Pacific muck. "Basalt" is used in this paper as field term applied to basic fine-grained igneous rocks including "andesite" and "basalt".

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 346. Poorly defined name. Miraflores basalt has precedence, should a name be necessary.

Occurs near Balboa, in Pacific area of Panamá Canal Zone.

Soudan Iron-Formation[1]

Precambrian (Keewatin): Northeastern Minnesota.

Original reference: C. R. Van Hise and J. M. Clements, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 401–409, map.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1027–1029. Lies near top and partly within Ely greenstone; in some areas, is in plunging folds. Dominant rock type is referred to as

"jasper" although only part of it falls strictly under this designation; slate and conglomerate also present. Thickness presumed to be several thousand feet. Probably intruded by pre-Knife Lake granite. Keewatin group.

G. M. Schwartz and I. L. Reid, 1955, Mining Eng., v. 7, no. 3, p. 298. Name Soudan formation has been applied to series of beds and lenses of jasper interbedded with original flows and tuffs of Ely greenstone. In Vermilion district, term jaspilite has been used for interbedded jasper and hematite. According to modern usage these jasper or jaspilite beds do not comprise formation separate from Ely. Soudan beds should be considered member of upper part of Ely greenstone.

Named for occurrence on Soudan Hill, Vermilion district.

Sougahatchee Granite[1]

Age(?): Central eastern Alabama.

Original reference: G. I. Adams, 1933, Jour. Geology, v. 41, p. 168–169.

Named from creek near which it is exposed at many places in southwest border of Dadeville belt, Tallapoosa County.

Sour Dough Limestone[1] (in Telescope Group)

Sour Dough Limestone Member (of Kingston Peak Formation)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-October 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 360, 365, figs. 1, 3. Redefined as middle member of Kingston Peak formation. Consists of alternating bands of dark- and medium-gray limestone with well-defined bedding planes that are laterally persistent and spaced at 3 to 30 millimeters. Thickness as much as 170 feet. Underlies South Park member (new); overlies Surprise member. Area of report Manly Peak quadrangle.

Named on basis of exposures in Sour Dough Canyon, near Panamint City, southern part of Panamint Range, Inyo County.

Sourdough Mountain Breccias

See Keechelus Andesitic Series.

Souris River Formation

Upper Devonian: Subsurface in North Dakota, and Saskatchewan and Manitoba, Canada.

W. M. Laird, 1953, Interstate Oil Compart Quart. Bull., v. 12, no. 2, p. 74. New term for part of Devonian known only in subsurface. Overlies Dawson Bay formation; underlies Duperow formation.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2309 (fig. 5), 2310–2313. Souris River was named at February 1953 meeting of Williston Basin Nomenclature Committee of American Association of Petroleum Geologists. Type section designated as California Co.'s Thompson Well 1, Bottineau County, N. Dak. Report of Committee was not published; hence Souris River has not been formally proposed or adequately defined. Standard

subsurface section is here proposed. Formation lies between depths of 10,743 and 11,052 feet in standard section. Consists of thin interbedded gray, greenish-gray, and brownish-gray argillaceous dolomite, argillaceous limestone, shale, siltstone, and anhydrite. Upper Devonian.

Standard section: Mobil Producing Co.'s Birdbear Well 1, center SE¼NW¼ sec. 22, T. 149 N., R. 91 W., Dunn County, N. Dak.

South Amboy fire clay[1] (in Raritan Formation)

Cretaceous: Northeastern New Jersey.

Original references: G. H. Cook and J. C. Smock, 1877, Map of clay district of Middlesex County: New Jersey Geol. Survey; G. H. Cook, 1878, New Jersey Geol. Survey Rept., on clays, p. 34.

H. C. Barksdale and others, 1943, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 66, 101. Thickness as much as 25 feet along outcrop. Overlies Sayreville sand member (new); underlies Old Bridge sand member (new).

Middlesex County.

South Bend Limestone Member (of Stanton Limestone)[1]

Pennsylvanian (Missouri Series): Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 23.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 51. South Bend limestone was named in Nebraska but was named Little Kaw limestone by Newell (1935) from Kaw Valley area, Kansas. On basis of subsequent studies, it is now agreed that original name is valid.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 119. South Bend limestone member of Stanton formation; overlies Rock Lake shale member; underlies Weston shale of Pedee group. This classification was agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. Thickness 8 to 12 feet in Platte and Weeping Water Valleys; 4 to 5 feet in northwestern Missouri; 4 to 6 feet in Kansas. Top of this subdivision in Nebraska exposures is at the post-Missourian contact and shows evidence of shoreline deposition. Type locality stated.

Type locality: In Platte River bluffs 1½ miles northwest of South Bend, Cass County, Nebr.

South Bend Sandstone and Shale (in Graham Formation)[1]

Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1922, Jour. Geology, v. 30, p. 24, 31, 37; 1922, Texas Univ. Bull. 2132, p. 127–136.

Typically exposed at South Bend, Young County.

South Bosque Marl[1]

Upper Cretaceous: Central Texas.

Original reference: J. K. Prather, 1902, Texas Acad. Sci. Trans., v. 4, pt. 2, no. 8.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Series, no. 4, p. 120–123, fig. 25. Revived and emended to exclude basal 20 feet of original section. So emended, formation consists of upper predominantly clay part and a lower part of platy salmon-colored thin-bedded limestones alternating with "bentonitic" shales. Thickness about 120 feet. Underlies Austin chalk; overlies Bouldin member (new) of Lake Waco formation (new); basal contact characterized by change from platy limestones and "bentonitic" shales to more blocky grayish silty limestones interbedded with dark shales and bentonitic seams.

Type area and section: Bosque escarpment, from Waco westward to South Bosque; typical and well-exposed section is in Universal Atlas Cement Co. shale pit and along Cloice Branch, 1 mile east of South Bosque, McLennan County.

South Boss Marl (in Eagle Ford Group)

Probably lapsus for South Bosque Marl.

South Britain Conglomerate[1]

Upper Triassic: Western Connecticut.

Original reference: W. H. Hobbs, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 40–43, 49–51, 63–64.

Occurs in village of South Britain, New Haven County.

South Butler Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survery Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for its occurrence south of Butler amygdaloid, in Ontonagon County.

South Butler Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for its occurrence south of Butler amygdaloid, in Ontonagon County.

South Canyon Creek Member (of Maroon Formation)

South Canyon Creek Member (of State Bridge Formation)

Permian: Northwestern Colorado.

N. W. Bass and S. A. Northrop, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1540–1551. Proposed as South Canyon Creek dolomite member. Commonly consists of basal unit of medium-gray very fine-grained dolomite; middle unit of light-gray to light-buff dense dolomite; top unit, 1 foot thick or less, of thinly laminated fossiliferous limestone. Thickness 1½ to 6⅓ feet. Dolomite is 480 feet stratigraphically below base of Entrada sandstone on South Canyon Creek and 380 feet below base of Entrada on Main Elk Creek. Brill (1944, Geol. Soc. America Bull., v. 55, no. 5) assigned limestone here called South Canyon Creek dolomite member to Triassic Dinwoody or Moenkopi formation. Fauna appears to be Permian of Phosphoria age.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 823–825. Since Maroon formation is here limited to beds that underlie Schoolhouse tongue of Weber sandstone, south Canyon [Creek] dolomite seems to be member of State Bridge formation.

Named for exposures in South Canyon Creek, which is 4½ miles west of Glenwood Springs. Crops out northwestward for 22 miles.

South Carrollton Limestone[1]

Pennsylvanian: Western Kentucky.

Original reference: C. J. Norwood, 1878, Kentucky Geol. Survey, 2d ser., v. 4, pt. 7, p. 296–301, 319.

Exposed in bluff one-half mile northwest of South Carrollton, Muhlenberg County.

Southern Belle Quartzite[1]

Middle Cambrian: Southeastern Arizona.

Original reference: A. A. Stoyanow, 1933, Geol. America Bull., v. 47, no. 4, p. 476–477, 482.

R. L. DuBois, 1959, Arizona Geol. Soc. Guidebook 2, p. 110. Overlies Santa Catalina formation; underlies Abrigo formation. Thickness 30 feet.

In Peppersauce Canyon, Santa Catalina Mountains.

South Flat Formation

Upper Cretaceous (Montanan): Central Utah.

R. E. Hunt, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 1, p. 118–128. Sequence of piedmont and flood-plain sediments. Divided into three members, each having differing distributions. Lower member of sandstones, conglomerates, a single limestone, and a discontinuous coal, is 840 feet thick. Sandstones medium-grained to gritty and dominantly gray, tan, and brown. Commonly speckled by white. Conglomerates are gray and brown, containing stones as much as 5 inches in diameter. Middle member of massive red and gray conglomerate and minor sandstones is 600 feet thick. Upper member is coal-bearing sequence of varicolored sandstones, shales, and clays 1,360 feet thick. Dominantly sandstones in middle part of which is 60 feet interval of shales, clays, and coals. Total thickness at type section 2,854 feet. Underlies Price River formation; overlies Indianola group.

Type section: Measured from SW¼ sec. 17, T. 14 S., R. 2 E., in Fourmile Canyon, northeast to South Flat (SW¼ sec. 9), then south to approximately center of sec. 21. Recognized only in northern part of Gunnison Plateau.

South Fork Limestone[1]

South Fork Limestone Member (of Burlingame Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 10.

E. H. Wenberg, 1942, Iowa Acad. Sci. Trans., v. 49, p. 343 (fig. 6). Listed as South Fork limestone in insoluble residue correlations of Missouri and Virgil strata in Iowa.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45–46. In Nebraska, Burlingame limestone includes (ascending) Taylor Branch limestone, Winnebago shale, and South Fork limestone members.

Well exposed in hill on west side of South Fork Valley three-fourths mile southwest of DuBois, Pawnee County, Nebr.

South Fork Mountain schist

Upper Jurassic: Northwestern California.

W. P. Irwin, 1960, California Div. Mines Bull. 179, p. 28–30. Name applied in California to schists that have been referred to as southwestern belt of schists and South Fork Mountain belt of schists by Diller (1903, Am. Jour. Sci., 4th, v. 15), Weitchpec schist by Hershey (1904; 1906, Am. Jour. Sci., 4th, v. 21), and Kerr Ranch schist by Manning and Ogle (1950). In southwestern Oregon, seemingly related rocks were named Colebrooke schist by Diller (1903). Age and formational affiliation of South Fork Mountain schist is not entirely clear, but generally the schist has been considered pre-Devonian, or perhaps Precambrian, and genetically unrelated to adjacent formations. South Fork Mountain schist has most commonly been correlated with Abrams formation of central metamorphic belt of Klamath Mountains arc. However, more than one adjacent formation is at least in part a lithologically suitable prototype for the schist, and one of these, the Galice, appears to grade into the schist near Weitchpec. The schist may represent narrow zone of dynamic metamorphism, and although the metamorphism may have transgressed formational boundaries, most if not all of the schist is likely a metamorphic equivalent of the slaty and phyllitic rocks herein correlated with Galice formation of middle Late Jurassic age. On west slope of South Fork Mountains and northward to near Weitchpec, the schist is in contact with nonmetamorphic rocks of Franciscan formation. Rocks of late Late Jurassic and Cretaceous age are not known to be in depositional contact with South Fork Mountain schist in California. In southwestern Oregon, the younger Mesozoic rocks are in depositional contact with Colebrooke schist, and the Colebrooke is considered correlative with South Fork Mountain schist.

Underlies a continuous even-crested ridge that marks the southern and most of the western boundary of Klamath Mountains provinces. Southwestern boundary of province is South Fork Mountains which trend N. 30° W. for about 50 miles along west side of South Fork by Trinity River.

Southgate Formation (in Eden Group)

Southgate Member (of Eden Formation)

Southgate Member (of Latonia Shale)[1]

Upper Ordovician: North-central Kentucky, southeastern Indiana, and southwestern Ohio.

Original reference: R. S. Bassler, 1906, U.S. Natl. Mus. Proc., v. 30, p. 9.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. Shown on correlation chart as middle formation of Eden group in Indiana. Underlies McMicken formation; overlies Economy formation. Consists of shale 70 to 120 feet thick.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030–1031. Middle member of Eden formation. Overlies Economy member; underlies McMicken member.

Named for Southgate, Campbell County, Ky.

South Hampton Granite[1]

Age(?): Southeastern New Hampshire.

Original reference: E. Hitchcock, 1823, Am. Jour. Sci., 1st, v. 6, p. 3–6.

At South Hampton, Rockingham County.

South Mapleton Andesite[1]

Paleozoic: Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 113, 169, 173.

Crops out in fields in southern part of Mapleton Township to north and south of Mapleton-Presque Isle Road, Aroostook County.

South Moat Flows[1]

Devonian(?): Northern New Hampshire.

Original reference: M. Billings, 1928, Am. Acad. Arts and Sci. Proc., v. 63, no. 3, p. 72, 92, map.

Typically exposed on South Moat Mountain, North Conway quadrangle, White Mountains.

South Mountain Andesite Flows

Oligocene: Northern Utah.

R. E. Marsell and R. L. Threet, 1960, Geologic map of Salt Lake County, Utah (1:62,500); supp, to Bull. 69 [not yet published]: Utah Geol. and Mineralog. Survey. Named of map legend. Occurs above Rose Canyon latite-andesite volcanics (new) and below Salt Lake group.

Mapped in southern part of Salt Lake County. Largest area mapped surrounds South Mountain.

South Mountain Quartzite[1]

Lower Cambrian: Western Maryland and Pennsylvania.

Original references: C. D. Walcott, 1894, Am. Jour. Sci., 3d, v. 47, p. 37–41; 1896, U.S. Geol. Survey Bull. 134, p. 33.

South Mountain.

South Mountain Slates[1]

Cambrian: Southern Pennsylvania.

Original reference: F. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_2, p. xxiv.

South Park Member (of Kingston Peak Formation)

Precambrian: Southeastern California.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 360, 365–367, figs. 1, 3. Defined as youngest member of formation. Consists of well-bedded platy quartz-rich sandstones, argillaceous rocks, massive quartzite, cobble conglomerate, and conglomeratic and nonconglomeratic massive subgraywacke. Thickens northward; 285 feet at mouth of Goler Wash; 1,000 feet in South Park Canyon. Overlies Sour Dough member. It is correlative of Middle Park formation, Mountain Girl conglomerate-quartzite, and Wildrose formation of Telescope group as defined by Murphy (1930).

Named for fact it is well exposed near South Park basin in northern part of Manly Peak quadrangle, in southern part of Panamint Range, just west of Death Valley, Inyo County.

†South Pass Group[1]

Pliocene: Northwestern Wyoming.

Original reference: T. B. Comstock, 1874, Rept. of reconn. of northwestern Wyoming, made in 1873 by W. A. Jones, table opposite p. 103.

South Pewabic Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. R. Marvine, 1873, Michigan Geol. Survey, v. 1, pt. 2, p. 52, 76, 77, chart.

Named for occurrence in old South Pewabic mine, Houghton County.

South Pewabic Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in old South Pewabic mine, Houghton County.

South Platte Formation (in Dakota Group)

Lower Cretaceous: North-central Colorado.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 27–34, figs. 10, 17, 19. Upper part of pre-Benton Cretaceous sequence, lying between Lytle formation and Benton shale, is here treated as single unit in northern Front Range foothills and named South Platte formation. It is equivalent to the upper sandstone, upper shale, middle sandstone, and uppermost black shale part of lower shale of Lee's (1927) Dakota group. Formation grades laterally northward from dominantly nonmarine clastic phase in Kassler quadrangle to dominantly marine shale phase in Larimer County. Consists of 200 to 350 feet of alternating units of gray to black shale and brown-weathering sandstone. Sandstone chiefly fine grained, but coarser fractions common locally in nonmarine phase. Individual sandstone units have considerable lateral extent and vary laterally in thickness, nature of bedding, and amount of contained argillaceous matter. Shale units in nonmarine phase consist of hard laminated noncalcareous silty shale that is commonly interlaminated or thinly interbedded with siltstone and fine-grained sandstone. Thin beds of white, yellow, or light-gray claystone common in the shale. Comprises (ascending) Plainview sandstone member (new), third shale, third sandstone, second shale, Kassler sandstone member (new), Van Bibber shale member (new), and first sandstone. Underlies Benton shale and overlies Lytle formation with disconformable contacts. No single exposure typical for unit over its entire area of outcrop. Three localities are designated for standards of reference.

Type exposures: In south end of hogback on north side of gap made by South Platte River, about 0.5 mile north of Kassler in NE¼NW¼SE¼ sec. 27, T. 6 S., R. 69 W., Jefferson County. This is also standard reference section for southern nonmarine phase. Standard reference section for intermediate phase is on west-facing scarp of a local prominence just south of Little Thompson Creek in SW¼NW¼ sec. 2, T. 3 N., R. 70 W. Standard for northern marine phase is located 0.25 to 0.5 mile north of Boxelder Creek in W½NE¼ sec. 9, T. 10 N., R. 69 W., Larimer County. This is about same locality described by Lee (1927) about 2 miles east of Greenacre Ranch along Boxelder Creek. Named for South Platte River. Entire outcrop area of formation in northern foothills lies within drainage basin of South Platte River.

South Prairie Formation[1]

Eocene: Western Washington.

Original reference: B. Willis, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 424–430.

Exposed on South Prairie Creek, Puget Sound region.

South Range Member (of Virginia Formation)

Precambrian: Northeastern Minnesota.

F. F. Grout and J. F. Wolff, 1955, Minnesota Geol. Survey Bull. 36, p. 3, 4, 7, 56, pl. 6. Virginia formation comprises (ascending) lower states, South Range iron-bearing member, and upper slates.

Named for occurrence in South Range, Cuyuna district.

South Ridge Sandstone

Permian (Wolfcampian): East-central Nevada.

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 93 (chart), 102. Name applied to thick sequence of fine- to medium-grained thin- to thick-bedded tan to yellowish-tan weathering calcareous cemented quartz sandstone with thin interbedded grayish-tan silty limestone. Stratigraphically above Ely limestone (restricted) and below Riepe Spring limestone (new).

Type section: SE¼ sec. 25, T. 17 N., R. 61 E., White Pine County. Named for South Ridge bench mark, NE¼SE¼ sec. 27, T. 17 N., R. 61 E., 2 miles due west of type section.

South Ross Clay (in Golden Valley Formation)

Eocene: Western North Dakota.

Great Northern Railway Co. Mineral Research and Development Department, 1958, Great Northern Railway Co. Mineral Research and Devel. Dept. Rept. 5, p. 2, 3, 12, 14, 15, map. A bed of white clay about 15 feet thick in Golden Valley formation. White Earth, Lakeside, and East Tioga clays occur in same general area.

Occurs in Little Knife River valley, south of town of Ross, Mountrail County.

South Tunnel Bed[1]

Silurian (Niagaran): Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

Named for South Tunnel, Sumner County.

South Tyler Formation

Cretaceous (Comanche Series): Northeastern Texas (subsurface).

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 475, 476, 477. Term applied to sand and mottled red and gray shale sequence between base of Dexter sand and top of Buda limestone. Includes Maness shale at base. In discovery well, occurs between depths of 5,675 to 6,065 feet.

Named after south Tyler field in Smith County, where formation is typically developed in wells. Discovery well, Phillips Petroleum No. 1 Mrs. W. T. McMinn well in the M. M. Long Survey.

South Valley Limestone[1]

Triassic: Pennsylvania.

Original reference: J. P. Lesley, 1885, Pennsylvania Geol. Survey Rept. X, map.

†South Valley Hill Slates and Mica Schists[1]

Precambrian (Glenarm Series): Southeastern Pennsylvania.

Original reference: C. E. Hall, 1881, Pennsylvania 2d Geol. Survey Rept. C_6, p. 31.

Form prominent ridge on South Valley Hill.

South Wales Member (of Perrysburg Formation)

South Wales Shale (in Canadaway Group)

Upper Devonian: Western and west-central New York.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. Composed of gray silty shale, gray silty mudstone, small amounts of black, brown, and very dark gray shale, and some thin-bedded gray siltstone. Thickness 64 feet near South Wales; thins to minimum of about 20 feet near Dalton in Nunda quadrangle; thickens to about 87 feet near Cameron. At some places, top of member is sharply marked where uppermost siltstone is overlain by black shale of Gowanda member; at other places, contact between the two is gradational; east of Genesee River Valley, member is overlain by Canaseraga sandstone member, into basal part of which upper beds of South Wales grade laterally in places. In area between Lake Erie and Genesee River valley, member is overlain by interbedded black, brown, and very dark-gray shales.

L. V. Rickard, 1957, New York Geol. Soc. Guidebook 29th Ann. Mtg., p. 15, 18. In Wellsville area, term Perrysburg formation is not applied. South Wales shale is considered formation in Canadaway group. Thickness about 20 feet.

Named for exposures on unnamed tributary of east branch of Cazenovia Creek, 3 miles south of South Wales, Erie County. Traced from shore of Lake Erie west of Van Buren Point eastward to vicinity of Cameron in Woodhull quadrangle.

†Southward Bridge Formation (in Chester Group)[1]

Mississippian: Northeastern Mississippi and northwestern Alabama.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Name abandoned. Strata included in Sandfall member and Mynot sandstone member of Pride Mountain formation (all new).

Type locality: Southward Bridge, near old village of Mingo, at confluence of Bear Creek and Cedar Creek valleys, Tishomingo County, Miss.

†Southward Pond Formation (in Chester Group)[1]

Mississippian: Northeastern Mississippi and northwestern Alabama.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Replaced by Wagnon member of Pride Mountain formation (both new).

Named for exposures in bluffs of Southward (or Cypress) Pond, at Southward homestead, Tishomingo County, Miss.

Southward Spring Sandstone Member (of Pride Mountain Formation)

Southward Spring Sandstone (in Chester Group)[1]

Upper Mississippian: Northeastern Mississippi and northwestern Alabama.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Rank reduced to member status in Pride Mountain formation (new). Overlies Wagnon member (new); underlies Sandfall member (new).

Named for exposures at Southward Spring, about 3 miles east of Tishomingo, Miss., in SE¼ sec. 18, T. 5 S., R. 11 E.

South Wells Limestone Member (of Cherry Canyon Formation)

Permian (Guadalupe Series): Western Texas.

P. B. King *in* A. K. Miller and W. M. Furnish, 1940, Geol. Soc. America Spec. Paper 26, p. 9. Incidental mention.

P. B. King *in* F. E. Lewis, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 92. Cherry Canyon formation is subdivided into (ascending) Getaway, South Wells, and Manzanita limestone members.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 580, 585 (fig. 7), pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 36, pl. 3 [1949]. At type locality, consists of several thin black or gray fossiliferous limestone beds in an interval of 75 feet; farther northwest, near base of Reef Escarpment, these change into buff or drab, sandy, dolomitic limestones; locally member grades laterally into sandstones. Lies above Getaway member, or about 600 feet above base of formation; lies about 100 feet below Manzanita member.

Type locality: On both sides of valley near the South Wells of D Ranch, 11 miles southeast of Guadalupe Peak, Culberson County.

Sowik Limestone[1]

Ordovician(?): Northwestern Alaska.

Original reference: P. S. Smith, 1910, U.S. Geol. Survey Bull. 433, p. 50, 54.

Occurs near and named for Sowik, Seward Peninsula.

Spadra Felsophyre (in Glendora Volcanics)

Miocene, middle or older: Southern California.

J. S. Shelton, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 55–56, pl. 1. Referred to as Spadra felsophyre member of Glendora volcanics. Autobreccias constitute at least 80 percent, and laminated flows about 20 percent of the member. Local lenses of limestone up to about 40 feet thick occur along basal contact where felsophyre rests on basement complex. Maximum thickness about 350 feet.

Occurs in isolated area east of Spadra and 2 miles southwest of Pomona, Los Angeles County.

†Spadra Shale[1]

Pennsylvanian: Western Arkansas.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Named for Spadra, Johnson County.

Spafford Member[1] (of Ludlowville Formation)

Middle Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 11, 50.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Spafford member shown on correlation chart above Ivy Point member and below Owasco member.

Type section: In first ravine north of Ivy (or Willow) Point on east side of Skaneateles Lake, about three-fourths mile north and slightly west of Spafford Landing, Skaneateles quadrangle.

Spaniard Limestone Member (of Savanna Sandstone)[1]

Pennsylvanian (Des Moines Series): East-central Oklahoma.

Original reference: S. W. Lowman, 1933, Tulsa Geol. Soc. Digest, p. 31.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 51–52, pl. 3. Basal member of Savanna. Underlies Sam Creek limestone member; overlies Keota sandstone herein reallocated to member status in McAlester formation.

Named for exposure in Spaniard Creek, south of Muskogee, about center of N½ sec. 11, T. 13 N., R. 18 E., Muskogee County.

†Spanish Formation[1]

Mississippian: Northern California.

Original reference: J. S. Diller, 1892, U.S. Geol. Survey Geol. Atlas, Folio 15, prelim. proofsheet ed.

Named for fact it surrounds northern end of Spanish Peak, Lassen Peak region.

Spanish Canyon Formation

Miocene: Southern California.

F. M. Byers, Jr., 1960, U.S. Geol. Survey Bull. 1089–A, p. 22–26, pls. 1, 2. Sandstone, conglomerate, tuff, and basalt flows. About 300 feet thick at type locality but wedges out southwestward within half mile. North of type locality, westward dipping beds of formation extend along west side of Spanish Canyon and Cross Canyon near east boundary of sec. 19, where formation swings eastward around nose of Spanish Canyon anticline; on east side of Spanish Canyon anticline, a fault of large displacement cuts off southern extension of formation. Overlies Alvord Peak basalt (new) and where Alvord Peak is missing rests on Clews on fanglomerate (new). Conformably underlies Barstow formation. Tentatively inferred that Spanish Canyon is of middle Miocene age.

Type locality: Near center sec. 30, west of Spanish Canyon, Alvord Mountain quadrangle, San Bernardino County.

Spanish Valley Stage

Recent: Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain sec. [Guidebook] 2d Ann. Field Trip, Oct. 4–5, correlation chart. In proposed time-stratigraphic standard for Rocky Mountains, Recent epoch includes (ascending) Castle Valley, Temple Lake, Spanish Valley, and Gannett Peak stages.

Twin Lakes area.

Spann Limestone Member (of Pennington Shale)[1]

Upper Mississippian: Southern Kentucky.

Original reference: M. J. Munn, 1914, U.S. Geol. Survey Bull. 579, p. 33.

Named for Spann, Wayne County.

Sparks Schist

Precambrian: Central western Georgia.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 27, pl. 1. Includes several varieties of mica schist, biotite gneiss, and quartzite which are so interlayered as not to be separable in

areal mapping. Underies Hollis quartzite. Considered oldest rocks in area south of Towaliga fault.

Well exposed along Sparks Creek which flows southward near western border of Warm Springs quadrangle. Confined to belt 3 to 5 miles wide that extends across quadrangle between Pine and Oak Mountains.

Sparksville facies[1] (of Carwood Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 172–178.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. Sparksville facies shown in Carwood formation.

Name derived from village of Sparksville, near White River, in SW cor. NE¼SE¼ sec. 13, T. 4 N., R. 2 E., Jackson County.

Sparland cyclothem (in Carbondale-Modesto Formations)

Sparland cyclothem[1] (in McLeansboro Group)

Pennsylvanian: Western, northern, and southeastern Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 182, 192.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Type locality given. Shown on chart as overlying Jamestown cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 60, 114–116, 189, 190, pl. 5. Thickness 8 to 80 feet. Includes (ascending) Copperas Creek sandstone, Sparland (No. 7) coal, and Farmington shale. Underlies Gimlet cyclothem; overlies Pokeberry cyclothem (new); believed to be equivalent to Jamestown cyclothem. Derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), 56 (table 3), pl. 1. In Carbondale-Modesto (new) formations. Above Jamestown cyclothem and below Gimlet cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: Sec. 2, T. 12 N., R. 9 E., Marshall County. Named for exposures of Thenius Creek, about 1½ miles north of Sparland.

Spar Mountain Sandstone (in Fredonia Member of Ste. Genevieve Formation)

Mississippian: Southern Illinois.

F. E. Tippie, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 11, p. 1657 (figs. 2, 3), 1658. Name applied to middle sandstone member of the Fredonia; this unit has been known as a "sub-Rosiclare sandstone." Typically light-gray to greenish calcareous glauconitic sandstone or siltstone grading to very sandy limestone. Thickness 8 to 15 feet.

Named for exposures on south slope of Spar Mountain in secs. 3 and 4. T. 12 S., R. 9 E., Hardin County, about 4 miles northwest of Cave in Rock.

Sparta Sand[1]
Sparta Formation } (in Claiborne Group)

Eocene, middle: Northwestern Louisiana, Mississippi, and northeastern Texas.

Original references: W. C. Spooner, 1926, Am. Assoc. Petroleum Geologists Bull., v. 10, no. 1, p. 7; no. 3, p. 220, 224, 227, 237.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 59, 114–120 [1938]. Sparta formation (sand), in Leon County, consists of well-bedded loose sands which are rich in dark grains of chert like most of other Eocene sediments of region. Individual sand beds are separated by thin layers of finer material, shale or silt. Thickness probably varies from 210 to 330 feet. Overlies Weches formation; underlies Stone City formation.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Sparta sand mapped in central Mississippi.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart shows Sparta sand in Mississippi. Overlies Zilpha clay; underlies Archusa marl member of Cook Mountain formation. Mississippi Geological Survey uses term Kosciusko sand instead of Sparta sand and Wautubbee formation instead of Cook Mountain formation.

Named for development near Sparta, Bienville Parish, La.

†Sparta Sands[1]

Tertiary: Northern Louisiana.

Original reference: T. W. Vaughan, 1895, Am. Geologist, v. 15, p. 225.

Named for development near Sparta, Bienville Parish.

Sparta Shale[1]

Upper Cambrian: Southwestern Wisconsin.

Original reference: W. D. Shipton, 1916, Iowa Acad. Sci. Proc., v. 23, p. 142–145.

In Sparta quadrangle, Monroe County.

Spaulding Quartz Diorite (in New Hampshire Plutonic Series)

Upper Devonian(?): Southwestern New Hampshire.

Katharine Fowler-Billings, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1250, 1266–1268, pl. 1. Dark-gray medium-grained granodiorite and quartz diorite. Black to brown on weathered surfaces. Larger bodies are massive, smaller ones are foliated. Has distinctive spotted appearance. Younger than Kinsman quartz monzonite; older than Concord granite. Belongs to New Hampshire magma series.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Included in New Hampshire plutonic series.

Type locality: Spaulding Hill in Dublin Township, Cheshire County. Crops out in central part of Monadnock area.

Spavinaw Granite[1]

Precambrian: Northeastern Oklahoma.

Original reference: N. F. Drake, 1897, Am. Phil. Soc. Proc., v. 36, p. 338–341.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 15–18. Base of granite unknown; unconformably overlain by Cotter dolomite. Precambrian.

Named for exposures along Spavinaw Creek, Mayes County.

Spearfish Formation[1]

Permian and Triassic: Western South Dakota, northwestern Nebraska, and eastern Wyoming.

Original references: N. H. Darton, 1899, Geol. Soc. America Bull., v. 10, p. 387; 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 4, p. 516.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2, 6; 1950, Nebraska Geol. Survey Bull. 13-A, p. 9. Redefined to apply to section between Phosphoria group and the Sundance, or at places, the section from the Phosphoria to base of Jelm formation; in places where Dinwoody is present, to the interval between the Dinwoody and the Sundance.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 235, 237–240. Underlies Gypsum Spring formation, geographically extended into Black Hills area. Contact sharp, apparently unconformable. Gypsiferous facies of Gypsum Spring was included by Darton in top of the Spearfish, but it contains marine Jurassic fossils, interfingers laterally with dolomite and limestone that contains marine fossils. In Fall River County, underlies Nugget(?) sandstone.

W. J. Mapel and M. H. Bergendahl, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 1, p. 88, 90–93. In Black Hills, the Gypsum Spring rests with sharp undulating contact on sequence several hundred feet thick of red claystone, siltstone, and sandstone assigned to Spearfish formation. Thick deposits of primary gypsum occur in lower part of Spearfish. Measured sections give thickness 30 to 50 feet. Triassic.

N. C. Privrasky and others, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 48–55. In Powder River basin, the Spearfish is restricted to include only those sediments lying below Sundance formation and above Goose Egg formation. Subsurface data.

S. S. Oriel, 1959, *in* E. D. McKee and others, U.S. Geol. Survey Misc. Geol. Inv. Map I-300, p. 3. In present report [Paleotectonic map of Triassic], all beds between Minnekahta limestone and base of Gypsum Spring formation as used by Mapel and Bergendahl (1956) are included in Spearfish. As thus defined, formation includes rocks of both Permian and Triassic age.

Named for Spearfish, Lawrence County, S. Dak.

Spearhead Rhyolite[1]

Pliocene: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 71.

U.S. Geological Survey currently designates the age of the Spearhead Rhyolite as Pliocene on the basis of a study now in progress.

Occurs at and around Spearhead Point, Goldfield district.

Spears Member (of Datil Formation)

Miocene, upper(?): Southwestern New Mexico.

W. H. Tonking, 1954, Dissert. Abs., v. 14, no. 2, p. 340. Quartz latite tuff, agglomerate, breccia, and volcanic sandstone and conglomerate. Underlies Hells Mesa member (new).

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 26, 27–29, fig. 2, pl. 1 [preprint? 1954]. At Hells Mesa, lower 1,000 feet consist of monotonous sequence of medium-gray to grayish-purple

fine- to thick-bedded tuffaceous sandstones, conglomerates, flow breccias, and agglomerates, with intercalated thin beds of silt and clay; overlain by local 18-foot bed of white vitric rhyolite tuff; overlain by 300 feet of reddish-brown volcanic conglomerates and sandstones. Disconformably overlies Baca formation. Type section designated.

D. B. Givens, 1957, New Mexico Bur. Mines Mineral Resources Bull. 58, p. 14–15, pl. 1. Referred to as Spears Ranch member of Datil in Dog Springs quadrangle. Underlies Hells Mesa member.

Type section: Measured approximately 1 mile south of Spears Ranch headquarters, where complete section is exposed. Named for Guy Spears Ranch in sec. 8, T. 1 N., R. 4 W., Puertecito quadrangle, Socorro County.

Spears Ranch Member (of Datil Formation)

See Spears Member (of Datil Formation).

Spechts Ferry Shale Member[1] (of Decorah Formation)

Spechts Ferry Formation (in Galena Group)

Middle Ordovician: Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

Original reference: G. M. Kay, 1928, Science, new ser., v. 67, p. 16.

A. F. Agnew and A. V. Heyl, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 9, p. 1585–1587. Overlies Quimbys Mill member (new) of Platteville formation. Limestone unit included in Quimbys Mill has sometimes been referred to as lithologic facies of the Spechts Ferry.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 9, p. 2045 (fig. 3), 2064, 2065. Spechts Ferry shale member of Decorah geographically extended into St. Louis County, Mo., where it overlies Macy formation (new) of Plattin group.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, fig. 3. Considered basal formation in Galena group in Dixon-Oregon area, Illinois.

A. F. Agnew and others, 1956, U.S. Geol. Survey Prof. Paper 274–K, p. 263 (fig. 36), 268 (fig. 38), 286–289. Spechts Ferry shale member consists of green fossiliferous shale, greenish-buff fine-grained limestone, phosphatic nodules near top; bentonite near base. Thickness at type locality about 8 feet; thins to east, 3 feet at Shullsburg, Wis. Underlies Guttenberg member; near Decorah, Iowa, basal green shale of Spechts Ferry thickens at expense of Guttenberg limestone.

Type locality: Ravine southwest of Chicago, Milwaukee, and St. Paul Railroad station at Spechts Ferry, Dubuque County, Iowa.

Specimen Mountain Volcanics

Age not stated: Colorado.

E. E. Wahlstrom, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1951. Incidental mention.

No type locality designated and derivation of name not stated.

†Speck Mountain Clay (in Thrifty Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann Rept., pt. 1, p. 387, 407.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 71. In Brown and Coleman Counties, Ivan limestone member of Graham formation is separated from overlying Speck Mountain limestone member of Thrifty formation by shale unit called Speck Mountain clay bed by Drake (1893).

Named for Speck Mountain, Coleman County.

Speck Mountain Limestone Member (of Thrifty Formation)[1]

Speck Mountain Formation (in Thrifty Group)

Upper Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 408.

C. O. Nickell, 1938, *in* Wallace Lee and others, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 122, 124–125. Termed Speck Mountain limestone member of Thrifty formation. Thickness 3 to 5 feet. Underlies Lohn shale member; overlies unnamed shale member which Drake (1894 [1893]) called Speck Mountain clay.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 91. Rank raised to formation in Thrifty group. Underlies Breckenridge formation; overlies Ivan formation. Limestone at top of Speck Mountain has lithographic appearance of Blach Ranch limestone of Brazos River section.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook, Apr. 17–19, p. 50. Shown on composite stratigraphic section as basal member of Thrifty formation. Consists of gray slabby very fine grained limestone; contains fusulinids. In some areas, cut out by overlying Parks Mountain sandstone member; stratigraphically above Ivan limestone member of Graham formation.

D. A. Myers, 1958, Jour. Paleontology, v. 32, no. 4, p. 678 (fig. 1). Member shown on stratigraphic column as occurring below Breckenridge member.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 71, 72, pl. 27. Basal member of Thrifty. In eastern Brown and northwestern Coleman Counties, separated from overlying Breckenridge member by shale interval. Separated from underlying Ivan limestone member of Graham formation by shale interval.

Named for Speck Mountain, Coleman County.

Speeds Limestone Member (of Sellersburg Limestone)

Speeds Formation (in Hamilton Group)

Middle Devonian: Southern Indiana.

D. G. Sutton and A. H. Sutton, 1937, Jour. Geology, v. 45, no. 3, p. 326, 328. Shaly limestone about 18 inches thick underlying Silver Creek member of Sellersburg at Speeds quarry.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1060. Rank raised to formation. In region of fullest development, a hard blue crystalline limestone which weathers to irregular thin layers and spalls. Thickness 1 to 3 feet at Sellersburg, 13 feet at Lexington, and 1 to 3 feet in Jennings County. In some areas, lies between Jeffersonville formation below and Silver Creek formation above; in other areas, underlies Deputy formation (new).

J. B. Patton and T. A. Dawson, 1955, *in* H. H. Murray, Indiana Geol. Survey Field Conf. Guidebook 8, p. 42, pl. 1. Names Speed and Silver Creek are applied to lithofacies of Hamilton rocks; these lithofacies may be used as members in southern part of outcrop belt.

Named for occurrence in Speeds quarry, near Sellersburg, Clark County.

Speers Ferry Formation

Middle Ordovician (Chazyan) : Tennessee.

E. O. Ulrich, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 106. On correlation chart, Speers Ferry formation of Clinton and Pearisburg troughs of Tennessee is shown stratigraphically below the Pierce (of central Tennessee) and above the Ottosee of Knoxville and Athens troughs of Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 91. No formal description of unit has been published. According to present understanding of Appalachian stratigraphy, the position of the Speers Ferry between the Ottosee below and Pierce formation above is impossible. The Speers Ferry may have been designed for beds now called Wardell.

Speiser Shale (in Council Grove Group)[1]

Permian: Southeastern Nebraska, and eastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 232, 234.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46. As currently defined in Kansas, consists of shale and limestone; upper part is gray fossiliferous shale underlain by fairly persistent limestone bed which is commonly less than 1 foot thick and occurs about 3 feet below Threemile limestone member of Wreford formation; remainder of formation consists of beds of varicolored shale, red being predominant; contains lenticular bed of sandstone near middle, in southern part of State. Thickness 18 feet in northern and central part of State and about 35 feet in southern. Overlies Funston limestone.

Type locality: W½ sec. 35, T. 1 N., R. 13 E., Speiser Township, Richardson County, Nebr.

Spence Shale Member (of Ute Limestone)[1]

Spence Shale Member (of Langston Formation)

Middle Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 5, 6, 8.

J. S. Williams and G. B. Maxey, 1941, Am. Jour. Sci., v. 239, no. 4, p. 276, 280–281. Spence shale is not properly a member of Ute formation since it is not present in type locality of the Ute. Furthermore, faunal studies indicate that the shale is lateral facies of dolomite found at base of Langston formation at its type locality. Therefore, the shale is considered to be a member low in Langston formation, not the basal member of Ute formation.

H. W. Coulter, 1956, Idaho Bur. Mines and Geology Pamph. 107, p. 11–12. Because of the long history of misapplication of the term Spence shale both in the literature and in general use, the advisability of William's and Maxey's usage is questioned, and it is suggested that it [the term] should be dropped.

Type locality: Spence Gulch, a ravine running up into Danish Flat from Mill Canyon, about 5 miles west-southwest of Liberty, Bear Lake County, Idaho.

Spencer Chert[1]

Upper Ordovician (Richmond): Central Missouri.

Original reference: G. H. Scherer, 1905, Bradley Geol. Field Sta. Drury Coll. Bull., v. 1, pt. 2, p. 59.

Crops out just north of Decaturville Hotel, in road from Decaturville, Camden County, to Lebanon, Laclede County.

Spencer Formation

Eocene: Western Oregon.

F. E. Turner, 1938, Geol. Soc. America Spec. Paper 10, p. 23–24. Name proposed for marine sandstones and shales of undetermined thickness in vicinity of Spencer and Coyote Creeks about 10 miles west southwest of Eugene. Beds along west side of Willamette Valley are also considered a part of the formation. Contact with overlying Comstock formation not directly observable; unconformity indicated.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Meyers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Redefined to include beds Turner (1938) referred to Comstock formation. Subdivided to include Lorane shale member (new) at base. As redefined, Spencer formation has thickness of 2,700 to 3,400 feet; thickness increases southward; lower 600 feet assigned to Lorane shale member. Unconformably overlies Tyee formation; underlies Fisher formation. Upper Eocene.

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. Mapping in Corvallis-Monroe area indicates that Lorane shale member is more closely related to Tyee formation than to Spencer formation.

West and southwest of Eugene, Lane County.

Spencer Canyon Member (of Muav Formation)

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 94–95. Medium- to dark-gray aphanitic limestone, mottled with red-brown siltstone. Average thickness about 40 feet. Beds comprising basal 20 feet are thick, massive, and cliff forming; next 10 feet is thin bedded and frequently weathers into a slope; uppermost 10 feet resembles bottom part and is also cliff forming. Younger than Sanup Plateau member (new); older than Peach Springs member (new).

A. H. McNair, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 3, p. 512. Member has shale at its base at Peach Springs Canyon and becomes progressively more shaly towards Fort Rock, where it is a light-green fissile shale containing thin beds of brown miscaceous sandstone and glauconitic limestones.

Extends eastward from Grand Wash Cliffs almost to Diamond Creek; in Grand Canyon.

Spencer Hill Volcanics (in East Greenwich Group)

Mississippian(?): Central Rhode Island.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad. Map [GQ–17]. Includes rhyolite flows with interbedded pyroclastics and conglomerate.

Rhyolite is gray, pink, or purple, fine grained, and porphyritic in part and has well-developed flow structure. Pyroclastic breccia consists of angular rhyolite fragments in rhyolitic matrix. Rhyolite pebbles of various sizes occur in the conglomerate. Intruded by thin sill of Cowesett granite (new). Included in East Greenwich group.

Named for occurrence on Spencer Hill, Kent County, where it is well exposed in roadcut on Route 2 at crest of hill and in nearby fields.

Spergen Formation

†Spergen Limestone (in Meramec Group)[1]

Mississippian (Meramecian): Southern Indiana, southern Illinois, eastern Iowa, western Kentucky, and eastern Missouri.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, 2d ser., v. 2, p. 110.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 811. Two names, Salem and Spergen, both taken from localities in Washington County, Ind., have been applied to limestone from which Bedford, Ind., building stone is obtained. Name Salem, which was proposed first and has been used consistently by Indiana Geological Survey, is preferable to name Spergen.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5. Shown on correlation chart in Meramecian series.

C. N. Brown, chm., 1957, Tri-State Geol. Soc. Guidebook 21st Ann. Field Conf., p. 16, 17, 23, 24, 34, 35. Spergen formation described in three outcrops in southeastern Iowa. Predominantly dolomite with some limestone. Thickness 4 to 12½ feet.

U.S. Geological Survey has abandoned the name Spergen Limestone in preference to the Salem Limestone, the more widely accepted term.

Named for Spergen Hill, near railroad station of Harristown, a few miles southeast of Salem, Washington County, Ind.

Sphinx Conglomerate[1]

Eocene: Southwestern Montana.

Original reference: A. C. Peale, 1896, U.S. Geol. Survey Geol. Atlas, Folio 24.

W. C. Alden, 1953, U.S. Geol. Survey Prof. Paper 231, p. 6–7. Unconformably overlies volcanic material which Peale correlated with Livingston formation and which, in turn, unconformably overlies upturned and folded Cretaceous strata. Eocene.

Exposed in Sphinx Mountains, a peak in the Madison Range.

Spickert Knob facies[1] (of Locust Point Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 77, 127–137.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Facies nomenclature discussed. In a north to south direction, Locust Point formation comprises Belmont, Nelson Hill, Schooner Hill, and Spickert Knob facies.

Name derived from Spickert Knob of the Knobstone escarpment, located chiefly in NE¼ sec. 21, T. 2 S., R. 6 E., 1 mile northeast of Floyds Knob post office, Floyd County.

Spieden Formation[1]

Lower Cretaceous: Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington [State] Univ. Pub. in Geology, v. 2, p. 93, 113–118.

W. P. Popenoe, R. W. Imlay, and M. A. Murphy, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1533, chart 10e (column 58). Valanginian beds on Spieden Island consist mostly of sandy conglomerate. Thickness more than 2,000 feet.

Present on Spieden Island, Sentinel Island, and Sentinel Rock, San Juan Islands.

Spiller Sand Member (of Cook Mountain Formation)

Spiller Sand Member (of Crockett Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table 1), 125, 149–150. Lignitic argillaceous sands underlying Mount Tabor shale member and overlying Landrum shale member of Crockett formation. Characteristic beds of member are gray or brown, commonly lenticular or crossbedded; thickness of beds a few inches to about 2 feet; shale partings carry lignitized plant fragments. Estimated thickness 105 feet. Overlying and underlying contacts transitional.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1664, 1665, 1671 (fig. 3). Reallocated to Cook Mountain formation.

Type locality: Upper reaches of Pine Branch in William Johnson survey, Leon County. Name derived from Spiller's store in southeastern part of County.

Spillway Breccia

Tertiary: Northwestern Arizona and southeastern Nevada.

U.S. Bur. Reclamation, 1950, U.S. Bur. Reclamation, Boulder Canyon Proj. Final Repts., pt. 3, Preparatory Exams., Geol. Inv., Bull. 1, p. 95–96, fig. 34 (geol. map). Intervolcanic deposit of variable character. For the most part, consists of fragments of volcanic rock, principally latite, many of which are more than 2 feet in diameter, whereas masses 6 feet in diameter are not uncommon. Coarse material grades here and there into grits, sandstones, and conglomerate with well-defined regular bedding. Overlies latite flow breccia and underlies basic latite. Younger than Dam breccia (new) and older than Dry Camp breccia (new). Part of younger volcanic series of area. Name credited to F. L. Ransome (unpub. ms.).

Named because of its prominence in Arizona spillway basin, at Hoover Dam, Black Canyon.

†Spiro Sandstone Member (of Savanna Sandstone)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., 1937, Oklahoma Geol. Survey Bull. 57, p. 50–51. Described in Muskogee-Porum district. Uppermost member of Savanna formation. Overlies Sam Creek limestone member. Maximum thickness 20 feet.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 50–52. Term Spiro sandstone member, used in Muskogee County, is not applicable in Haskell County.

Caps ridge in secs. 13 and 14, T. 9 N., R. 25 E., just north and northeast of Spiro, Le Flore County.

Spitzenberg Conglomerate[1]

Triassic(?) : Southeastern Pennsylvania.

Original reference: Lawrence Whitcomb and J. A. Engel, 1934, Pennsylvania Acad. Sci. Proc., v. 8, p. 37–43.

Lawrence Whitcomb and J. A. Engel, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 755–764. Triassic age not definitely proved, but there is strong evidence in its favor. If Spitzenberg is Triassic outlier it becomes highly significant in discussion of Triassic sedimentation in Pennsylvania.

Named for occurrence on top of Spitzenberg, a hill 2½ miles northeast of Lenhartsville, Berks County.

Split Creek Sandstone Member (of Katalla Formation)

Split Creek Shale and Sandstone Member[1] (of Katalla Formation)

Oligocene: Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 771–775.

D. J. Miller, D. L. Rossman, and C. A. Hickcox, 1945, Preliminary report on petroleum possibilities in the Katalla area, Alaska: U.S. Geol. Survey, p. 7 (table), 8–9; 1945, Geologic and topographic map and sections of the Katalla area, Alaska: U.S. Geol. Survey War-Minerals Inv. Prelim. Map. Stratigraphically restricted. Composed principally of massive thick-bedded medium- to coarse-grained brownish-gray sandstone and evenly banded fine- to medium-grained thin-bedded sandstone. Banded sandstone cross-bedded locally. Member contains a few thin shale beds. Thickness 700 to 1,400 feet; average of 1,000 feet at head of Split Creek where it is best exposed and shows characteristic lithology. Overlies unnamed shale member; underlies Basin Creek member (new). Unit raised to formational rank (to include Split Creek shale below and Split Creek sandstone above) in unpublished manuscript by oil-company geologists.

Exposed in northern part of Controller Bay region, in drainage to Bering Lake, in very narrow belt along Bering River, and in northern part of ridge between Redwood Creek and Katalla River. Best exposed at head of Split Creek.

Split Mountain Formation

Miocene(?) : Southern California.

L. A. Tarbet and W. H. Holman, 1944, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1781. Nonmarine fanglomerates and sandstones intercalated with marine sandstones and shales. Thickness as much as 2,700 feet. Unconformably overlies basement complex. Underlies Alverson Canyon formation (new).

W. E. Ver Planck, 1952, California Div. Mines Bull. 163, p. 30–31, pl. 20. Described in connection with gypsum deposits of Imperial County. In the

area, Split Mountain formation is divisible into two members, a lower, noticeably red, and an upper that is gray. Above gray member is at least 100 feet of massive gypsum.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 22 (fig. 1), 23 (fig. 2). Split Mountain formation, 0 to 2,700 feet; underlies Alverson andesite in southwestern Imperial Valley. Overlies pre-Tertiary schist, limestone, gneiss, and granitic intrusives. Split Mountain conglomerate, 0 to 400 feet, underlies Imperial formation in northwestern Imperial Valley.

Occurs on west side of Imperial Valley.

Split-Rock slate[1]

Precambrian: Northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; 1914, Science, new ser., v. 40, p. 144.

Derivation of name not stated.

Spokane Drift

Spokane Glaciation[1]

Spokane Stage

Pleistocene: Northeastern Washington.

Original reference: J. H. Bretz, 1923, Geol. Soc. America Bull., v. 34, p. 580.

R. F. Flint, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 222. Three bodies of drift occur in Creston-Spokane district; till on the plateau ("old drift"); rest of plateau drift, chiefly stratified (Spokane drift); and stratified till in deep valleys (Wisconsin outwash). It is possible that drift on plateau dates from glaciation earlier than one responsible for valley fill; it is even possible that all three bodies may be of different glacial ages. Such difference is not demonstrated from facts now known, which point to single common age for all—namely, Wisconsin.

Ernst Antevs, 1945, Am. Jour. Sci., v. 243-A, p. 8. If Spokane drift of eastern Washington is comparable to early Wisconsin drift of eastern Montana, it may be of early Wisconsin (Iowan) age.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 18. Spokane stage of glaciation is older than last or late Wisconsin stage and presumably early Wisconsin; it may prove to be somewhat older.

Named for occurrence in vicinity of Spokane.

Spokane Shale[1] or **Formation**[1] (in Missoula Group)

Spokane Formation or Shale (in Piegan Group)

Precambrian (Belt Series): Western and central southern Montana.

Original reference: C. D. Walcott, 1899, Geol. Soc. America Bull., v. 10, p. 199–215.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1897–1898. Formation comprises argillaceous and arenaceous strata lying between calcareo-magnesian formations of Piegan group. Beds range from sandstones and soft shales to quartzites and argillites; dominantly red and green, through brown, buff, and gray also seen. Thickness, 180 to 7,400 feet. Recognized in Glacier National Park; southward, in both Blackfoot Canyon and Meagher facies the formation

thickens. In typical Meagher facies, it contains (ascending) Greyson, Prickly Peak (new), and Empire members.

D. A. Andrews, G. S. Lambert, and G. W. Stose, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 25, sheet 1. Spokane formation shown on map legend as part of Siyeh group.

J. B. Lyons, 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 450. In area of Lewis overthrust, overrides Upper Cretaceous Adel Mountain volcanics (new).

C. P. Ross, D. A. Andrews, and I. J. Witkind, 1955, Geologic map of Montana (1:500,000): U.S. Geol. Survey. Name has been used over a wide area in Montana but in a strict sense can be used safely only in general vicinity of Helena. Provisionally included in Piegan group.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 4 (table), 5–6, pls. 1, 2. Thickness as much as 1,700 feet in southern Elkhorn Mountains. Overlies Greyson shale with contact gradational; grades upward into Empire shale. Where Empire is absent, overlain by Flathead quartzite.

U.S. Geological Survey currently classifies the Spokane as a formation in Missoula Group on the basis of a study now in progress.

Type locality: In Spokane Hills, 15 miles east of Helena.

Spoon Formation (in Kewanee Group)

Middle Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1), 26 (fig. 4), 27, 32–33, 45–46 (table 1), pl. 1, geol. sections. Proposed for strata from top of Bernadotte sandstone member of Abbott formation (new) to base of Colchester (No. 2) coal member of Carbondale formation. Maximum thickness about 350 feet in southern Illinois; ranges from a few feet to nearly 100 feet in western Illinois. Members—southeastern Illinois—Bidwell coal (new), New Burnside coal (new), O'Nan coal (new), Granger sandstone (new), Creal Springs limestone, Mount Rorah coal (new), Wise Ridge coal (new), Stonefort limestone, Davis coal, DeKoven coal, Palzo sandstone; southwestern Illinois—Murphysboro, Litchfield, and Assumption coals, Vergennes sandstone, Seahorne limestone, Davis coal, De Koven coal, and Cheltenham clay; western Illinois—Rock Island (No. 1) coal, Seville limestone, Hermon coal (new), Brush coal (new), De Long coal, Seahorne limestone, Wiley coal, Greenbush coal, Isabel sandstone, Abingdon coal, Browning sandstone, and Cheltenham clay; northern Illinois—Cheltenham clay; and eastern Illinois—Seeleyville coal. Presentation of new rock-stratigraphic classification for Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: Sec. 22, T. 6 N., R. 1 E., Fulton County. Name derived from Spoon River. Formation is exposed in railroad cut of T. P. and W. Railroad about one-fourth mile west of Spoon River.

Spoon Butte Beds[1]

Miocene, upper, and Pliocene, lower: Eastern Wyoming and western Nebraska.

Original reference: O. A. Peterson, 1909, Carnegie Mus. Mem., v. 4, no. 3, p. 74–77.

Named for Spoon Butte, Laramie County, Wyo.

Spoon River Sandstone and Shale (in Pottsville Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: T. E. Savage, 1927, Am. Jour. Sci., 5th, v. 14, p. 307–316.

Well exposed along Spoon River, Fulton County.

Spotted Bear Limestone Member (of Jefferson Limestone)[1]

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 44.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4 (facing p. 1788). Correlation chart shows age as Upper Devonian.

Well exposed between elevations of 6,880 and 7,005 feet on northwest slope of Spotted Bear Mountain, in NE¼ sec. 26, T. 25 N., R. 15 W. Also in Pentagon and Monitor Mountains.

Spotted Ridge Formation

Pennsylvanian: Central Oregon.

C. W. Merriam, 1942, Jour. Paleontology, v. 16, no. 3, p. 372. Coarse conglomerate, carbonaceous sandstone and indurated mudstone, bedded cherts; in part terrestrial with Pennsylvanian flora. Thickness 1,000 to 1,500 feet. Unconformably underlies Coyote Butte formation (new).

C. W. Merriam and S. A. Berthiaume, 1943, Geol. Soc. America Bull., v. 54, no. 2, p. 151–156. Type locality designated.

S. H. Mamay and C. B. Read, 1956, U.S. Geol. Survey Prof. Paper 274–I, p. 211–223. Studies indicate that on basis of fossil plants alone precise age of Spotted Ridge formation within Pennsylvanian cannot be determined with any great degree of confidence.

Type locality: On west flank of Spotted Ridge, about 15 miles southeast of Paulina, Crook County.

Spottedtail Member (of Sheep Creek Formation)

Miocene (Hemingford): Northwestern Nebraska.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 128–129. Lowermost member of formation. Includes all rocks originally included in Sheep Creek by Matthew and Cook (1909) except uppermost 10 to 20 feet in midst of which is dark-gray volcanic ash. From base up, member is composed of unconsolidated greenish to pinkish sandy clays about 60 feet thick which are similar to Box Butte clays except they do not contain concretions; above clays are pinkish sand and thin layer of light-bluish-gray volcanic ash; uppermost 105 feet is largely unconsolidated silty sands with several hard zones of "mortar beds"; about middle of upper part and about 50 feet below top is a bed of white marl 2 to 3 feet thick, and the sand below it is pinkish brown and above is buff to greenish. Total thickness more than 170 feet. Contains herbaceous flora. Underlies Sand Canyon member (new); overlies eroded surface of Harrison formation.

Type locality: About 15 miles south and 1 mile east of Agate, Sioux County, in West Kilpatrick, Aphelops, and Pliohippus draws at head of Spottedtail Creek which is tributary to North Platte River.

Spout Spring Oolite (in Bangor Limestone)

Mississippian: Northwestern Alabama.

W. B. Jones, 1939, Econ. Geology, v. 34, no. 5, p. 575, 578. Name applied to 50-foot massive-bedded hard gray oolite near base of Bangor limestone. [Appears to be stratigraphically below Rockwood oolite member.]

Occurs at Spout Spring, about 2 miles west of Rockwood, Franklin County.

Spraberry Sandstone

Permian (Leonard): Western Texas (subsurface).

Lamar McLennan, Jr., and W. H. Bradley, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 4, p. 899–903, 904–908. At type locality, consists of upper sand member about 300 feet thick and lower sand member of about same thickness; the two zones are separated by about 250 feet of shaly gray to brown limestone and streaks of brown calcareous sand. Occurs between depths of 6,400 and 7,290 feet in type well. About 260 feet above Dean sand (new). Lower Leonard.

Type section: Seaboard's Spraberry No. 6–D, sec. 38, Block 34, T. 5 N., in Spraberry field, Dawson County. Depth 6,400 to 6,636 feet not cored in Spraberry 6–D; core description from Robison 6–A substituted for this interval. Named by Seaboard geologists from first well drilled on A. J. Spraberry lease.

Sprague Glacial Substage

Pleistocene (Wisconsin): Southern Rocky Mountains.

L. L. Ray, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; 1940, Geol. Soc. America Bull., v. 51, no. 12, pt. 1, p. 1862–1863. Fifth, or youngest, substage in southern Rocky Mountains. Represented in some cirques by protalus ramparts.

Named for moraine in front of Sprague Glacier in Rocky Mountain National Park.

Sprakers[1]

Sprakers Shale Member (of Canajoharie Shale)

Middle Ordovician: Eastern New York.

Original reference: Rudolf Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, no. 2104, p. 400.

Rudolf Ruedemann, 1947, Geol. Soc. America Mem. 19, p. 118. Referred to as Sprakers shale member of Canajoharie. Overlies Gansevoort shale member; underlies Morphy shale member.

Type locality and derivation of name not given but may have been named for Sprakers, Montgomery County.

Spring Branch Limestone Member (of Lecompton Limestone)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 44, 47.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 152–153; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 17. Spring Branch limestone member of Lecompton formation; underlies Doniphan shale member; overlies Stull shale member of Kanwaka shale. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24. Average thickness 3 to 5 feet. In Nebraska, Iowa, Missouri, and northeastern Kansas, member was formerly miscorrelated with Oread limestone. Type locality and derivation of name stated.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 20, fig. 5. Massive gray cherty limestone separated into two or three beds by thin shales. Thickness 5 to 10 feet. Underlies Doniphan shale member; overlies Kanwaka shale.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 43, pl. 1. Thickness 8 to 14 feet in Douglas County. Lowest 5 feet is massive light tan or light gray brown in unweathered state but yellow brown where weathered; overlying part made up of shaly limestone, shale, and limestone commonly 3 to 8 feet thick. Underlies Doniphan shale member; overlies Stull shale member of Kanwaka shale.

Type locality: On Spring Branch north of Big Springs, Douglas County, Kans.

Spring Brook Shale Member (of Ludlowville Formation)

Middle Devonian: Western New York.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 365, 366. Described as shale and impure limestone. Thickness about 20 feet. Overlies Ledyard shale member; underlies Eighteenmile Creek member. Name attributed to G. A. Cooper (unpub. thesis); later included in Wanakah shale member by Cooper [1930].

Exposed in section along Lackawanna Railroad tracks, 3½ miles west of village of East Bethany, Batavia quadrangle.

†Spring Canyon coal group (in Blackhawk Formation)[1]

Spring Canyon Coal Member (of Blackhawk Formation)

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1954, (abs.) Jour. Paleontology, v. 28, no. 4, p. 504. Member about 100 feet thick. Separated from overlying Aberdeen member by thin tongue of Mancos shale; overlies Spring Canyon tongue of Star Point sandstone.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183–184. Coal group included in newly defined Spring Canyon member of Blackhawk formation.

In Book Cliffs, Castlegate quadrangle, Carbon County.

Spring Canyon Member (of Blackhawk Formation)

Upper Cretaceous (Montana): Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183–184, figs. 2, 3, pl. 3. Includes strata previously assigned to Spring Canyon coal group (Clark, 1928) above and Spring Canyon sandstone tongue below. Member consists of 60 to 100 feet of coal-bearing shales and sandstones of fresh- and brackish-water origin resting directly upon massive basal sandstone of the Spring Canyon, which has average thickness of about 150 feet in Spring Canyon. Underlies tongue of Mancos shale with slight disconformity. Basal sandstone absent to west and southwest, where member becomes part of undifferentiated coal-bearing rocks of Blackhawk formation. Two massive offshore bar sandstones near Helper occupy almost the entire interval between basal sandstone of overlying Aberdeen

member and basal sandstone of Spring Canyon member. Coal-bearing rocks of Spring Canyon member were deposited behind these bars, which mark eastern limits of coal-producing swamps. At least three important coal beds in member; lowest and most important is Hiawatha coal, named for typical occurrence at Hiawatha in Wasatch Plateau; ranges from 8 inches to 7 feet 4 inches in thickness.

Measured in Spring Canyon, Book Cliffs, northern part of Castlegate quadrangle, Carbon County.

Spring Canyon Member (of Frontier Formation)

Lower Cretaceous(?): Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 138, 139 (fig. 1), 140. Name applied to coaly and carbonaceous sequence overlying Longwall sandstone member (new) and underlying Chalk Creek member (new). Contains five coal beds ranging in thickness from 1 to 3½ feet. Outcrop thickness 350 feet.

Well exposed in Spring Canyon, 3¼ miles southeast of Coalville, Summit County. Also well exposed north of Chalk Creek Narrows, sec. 1, T. 2 N., R. 5 E., Summit County.

Spring Canyon Tongue (of Star Point Sandstone)[1]

Spring Canyon Member (of Star Point Sandstone)

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1954, (abs.) Jour. Paleontology, v. 28, no. 4, p. 504. Underlies Spring Canyon coal member of Blackhawk formation.

P. J. Katich, Jr., 1954, Intermountain Assoc. Petroleum Geologists [Guidebook] 5th Ann. Field Conf., p. 43 (fig. 1). Uppermost member of Star Point. Thickness 50 to 150 feet. Overlies Storrs member; underlies Aberdeen sandstone member of Blackhawk formation.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183–184. Base of Blackhawk formation is at base of Spring Canyon sandstone of Clark. Spring Canyon sandstone tongue is included in Spring Canyon member (new) of Blackhawk formation.

Forms conspicuous white cliffs in Spring Canyon in Book Cliffs, northern part of Castlegate quadrangle, Carbon County.

Spring Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists Permian Basin Section [Guidebook] Spring Mtg., p. 77. Bluish sandy clay, 300 feet thick, with 50 feet of sandstone near middle. Underlies Cottonwood Creek bed; overlies Brown Creek bed.

D. H. Eargle, 1960, U.S. Geol. Survey, Paper 315–D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to base of Drake's Ricker bed.

Named for Spring Creek, San Saba County.

Spring Creek Clays[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: C. N. Gould, 1898, Am. Jour. Sci., 4th, v. 5, p. 170–174.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 153. Dakota formation, as herein defined, contains stratigraphic units formerly called "Rocktown channel sandstone," "Ellsworth formation," "Solomon formation," "Reeder sandstone," "Marquette sandstone," "Spring Creek clay," and others.

Named for Spring Creek, 12 miles south of Belvidere, Kiowa County.

Spring Creek deposits

Pleistocene: Western and northwestern Texas.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 495. Name given to lacustrine deposits similar in lithology to, and believed to be equivalent of Tule formation.

Occur along Double Mountain Fork of Brazos River and a tributary stream known as Spring Creek in western Garza and eastern Linn Counties.

Spring Creek Granite[1]

Precambrian: Eastern Colorado.

Original reference: W. Cross, 1895, U.S. Geol. Survey 16th Ann. Rept., pt. 2, p. 23.

Occurs only on southwest half of Red Mountain and on hill to south on opposite side of Spring Creek, Cripple Creek district.

†Spring Creek Limestone (in Moorefield Shale)[1]

Mississippian: Northern Arkansas.

Original reference: H. S. Williams, 1895, Am. Jour. Sci., 3d, v. 49, p. 94–101.

Mackenzie Gordon, Jr., 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1631. Moorefield formation in Batesville district, consists of lower member of black calcareous shale and limestone and upper member of dark-gray fissile clay shale; lower member has been known as Spring Creek limestone (name preoccupied) and grades laterally into chert that has been incorrectly mapped as Boone. It is recommended that the Moorefield be restricted to lower member.

Named for Spring Creek, 2 miles west of Batesville, Independence County.

Spring Creek Member (of Stonehenge Limestone)

Lower Ordovician (Canadian): Central Pennsylvania.

A. C. Donaldson, 1960, Dissert. Abs., v. 20, no. 9, p. 3693. Basal member; contains oolites in contrast to overlying Graysville member (new).

Type locality and derivation of name not stated.

Springdale Sandstone Member (of Moenave Formation)

Springdale Sandstone Member (of Chinle Formation)

Upper Triassic(?): Southern Utah and northeastern Arizona.

H. E. Gregory and N. C. Williams, 1947, Geol. Soc. America Bull., v. 58, no. 3, p. 223 (table 1), 228, 233; H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 52 (table), 67, 68, strat. sections. Member of Chinle. Consists of light-red sandstone streaked with white; indistinct lenticular beds 2 to 10 feet thick, separated in places by thin layers of imbricated

shale; includes pellets of concretionary limestone and clay; ripple marks common. Thickness 40 to 180 feet. Underlies unnamed sandstone; overlies Petrified Forest member.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2519–2520. Reallocated to member status in Moenave formation. Overlies Dinosaur Canyon sandstone member; underlies Kayenta formation. In Echo Cliffs area, the Springdale and underlying Dinosaur Canyon member were mapped as Wingate sandstone and described separately as the upper and lower parts of the formation (Wanek and Stephens, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–145). At Cedar City, in Coal Creek section of Chinle, measured by Thomas and Taylor (1946) and republished by Gregory (1950, Utah Geol. and Mineralog. Survey Bull. 37), the Springdale comprises units 24, 23, and possibly upper part of unit 22 as designated by Thomas and Taylor, and units 19, 18, and possibly upper part of unit 17 as designated by Gregory—not unit 14 as designated by Gregory. Thickness 60 to 225 feet; typically about 175 feet.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 16–17, 62. Geographically extended into Arizona. In most parts of Navajo country, member is 100 to 150 feet thick, though thickness differs locally owing to lenticular nature of its sandstone units; 221 feet at Lees Ferry; 77 feet at Moenave. Overlies Dinosaur Canyon member, contact commonly gradational; underlies Kayenta formation and in many areas cannot be distinguished from it. In Echo Cliffs area, unit has been referred to as Wingate sandstone by several workers.

Name derived from village of Springdale, Washington County, Utah, where unit forms prominent cliff. Traceable by nearly continuous outcrops, from Kanab, Utah, along Vermilion Cliffs to Lees Ferry, Ariz., and southward along Echo Cliffs.

Springer Formation[1] or Shale

Springer Group

Mississippian and Pennsylvanian (Chester and Morrow Series): Oklahoma.

Original reference: W. L. Goldston, Jr., 1922, Am. Assoc. Petroleum Geologists Bull., v. 6, no. 1.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 37). Group comprises (ascending) "Caney" shale, Rod Club sandstone, Overbrook sandstone, Lake Ardmore sandstone, and Primrose sandstone. Underlies Dornick Hills group. Morrow series.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 7–13. Springer group is here defined as including both Goddard formation and Springeran series. Goldston's (1922) original Springer member of Glenn formation likewise included both. Boundary between Mississippian and Pennsylvanian systems probably falls within Springer group as here defined. Group includes maximum of about 4,500 feet of sediments of which Springeran series comprises upper half. Lower half of group contains Goddard formation and upper half three sandstones: Rod Club, Overbrook, and Lake Ardmore. Overlies the Caney; underlies Dornick Hills group.

Lynn Jacobson, 1959, Oklahoma Geol. Survey Bull. 79, p. 27–29. Formation conformably overlies Goddard shale. Consists of about 2,000 feet of dark-gray shale marked by presence of four or six prominent sandstone members. Springer has been widely accepted as early Pennsylvanian age and has been used as type section for Springeran stage by Moore and Thompson (1949) in their revision of Pennsylvanian system. However, no unequivocal paleontologic or stratigraphic evidence as to the age of the Springer is now known.

Well exposed at Springer, Carter County.

Springer Series

Springeran Stage or Age

Lower Pennsylvanian: Midcontinent region.

M. G. Cheney and others, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 2, p. 140 (chart 2), 142–144. Revision of Goldston's (1922) Springer member to include all Pennsylvanian beds below base of Primrose sandstone, and for elevating Springer division to rank of series will be recommended in forthcoming paper by R. H. Dott. As revised, Springer series is about 4,000 feet thick in type area north of Ardmore. About 2,000 feet of dark shales below Rod Club sandstone are now included in Springer series. These lower Springer shales, heretofore called "Pennsylvanian Caney" have been named Goddard shale. Name Springer is used in preference to Harlton's (1938) Pushmataha series partly because of priority and usage, but chiefly to avoid placing type locality of series in less accessible area where stratigraphic relationships are uncertain owing to complex overthrust faulting and folding. Series in Ouachita basin of southeastern Oklahoma and west-central Arkansas attains estimated thickness of 15,000 feet, on assumption that Hot Springs sandstone, Stanley shale, and Jackfork sandstone are all of post-Chester age, and properly assigned to Pennsylvanian.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 286, 288 (fig. 1). Springeran stage (Age) included in newly defined Ardian series (Epoch).

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma—a symposium v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 4–7. Term Springeran series comprises approximately upper half of sediments covered by original definition of series by Cheney (1945). Upper limit is base of Primrose sandstone, uppermost member of Springer formation as defined by Tomlinson (1929, Oklahoma Geol. Survey Bull. 46). Lower limit is base of Rod Club sandstone. Underlying Goddard formation is excluded because it is now believed to be of Chesterian age. As thus limited, Springeran series is coextensive with Tomlinson's (1929) Springer formation where Jolliff conglomerate forms base of overlying Dornick Hills group. Some paleontologists do not recognize Springeran as a series but consider it included in Morrowan series. However, no part of Springeran series as here described is known to be represented by sediments of contemporaneous origin, either in type Morrowan of northwest Arkansas or in type Chesterian of Illinois and Missouri. Springeran series comprises upper half of Springer group as herein defined.

Type locality: Ardmore basin, Oklahoma.

Springfield Clay[1]

Pleistocene: Southwestern Ohio.

Original reference: E. Orton, 1873, Ohio Geol. Survey, v. 1, p. 431, 443.

Named for Springfield, Clark County.

Springfield Coal Member (of Carbondale Formation)

Pennsylvanian: Western and northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 35, 47 (table 1), 66, pl. 1. Assigned member status in Carbondale formation (redefined). Occurs above Covel conglomerate member and below St. David limestone member. Thickness about 5 feet. Coal named by Worthen (1883, *in* Geology and Paleontology, v. 7, Illinois Geol. Survey). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Sec. 16, T. 16 N., R. 4 W., Sangamon County. Named from subsurface exposures in coal mines.

Springfield Conglomerate[1]

Cambrian(?): Southeastern Vermont.

Original reference: C. H. Richardson, 1931, Vermont State Geologist 17th Rept., p. 200–201.

Occurs on east side of Spencer Hollow Road, a few rods east of Spencer Schoolhouse, 1½ miles east of Springfield, Windsor County.

Springfield Granodiorite

Springfield Microcline Gneiss

Age unknown: Southeastern Pennsylvania.

A. W. Postel, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2004–2005; 1941, Acad. Nat. Sci. Philadelphia Proc., v. 92, p. 125–133. Igneous rocks in Wissahickon schist in Philadelphia region originated in two ways: definite magmatic intrusions into Wissahickon and hydrothermal replacement of Wissahickon by potash and soda-rich solutions. Springfield aplitic granodiorite and Ridley Park granodiorite (new) are products of magmatic intrusion; Springfield porphyroblastic granodiorite is product of hydrothermal reaction. Precise chronological position cannot be assigned to the igneous rocks because age of Wissahickon is in doubt. Relative age sequence is considered to be (oldest to youngest) metagabbro, Springfield porphyroblastic granodiorite, Springfield aplitic granodiorite, and Ridley Park granodiorite.

Chi-shang Ch'ih, 1950, Geol. Soc. America Bull., v. 61, no. 9, p. 925, 926, 929, 937, 949–951. Referred to as Springfield microcline gneiss in discussion of petrology of Wissahickon schist.

A. W. Postel and H. W. Jaffe, 1957, Pennsylvania Acad. Sci. Proc., v. 31, p. 120. Renamed Swarthmore granodiorite. Name Springfield preempted.

Area mapped is roughly rectangular, bounded on northwest by Narbeth, on northeast by Manayunk, and on southwest by Chester and on southeast by Philadelphia. Springfield is in Delaware County.

Springfield Limestone[1] or Dolomite

Springfield Dolomite (in Durbin Group)

Middle Silurian: Southwestern Ohio.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 274–277, 301.

C. K. Swartz, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as dolomite in Durbin group.

R. J. Bernhagen, chm., 1960, Ohio Acad. Sci., Geology Sec., Guidebook 35th Ann. Field Conf., p. 13, 17–18, 21. Silurian section in Yellow Springs region shows Springfield dolomite, 10 feet thick, above Euphemia dolomite and below Cedarville dolomite. Niagaran.

Type locality: Springfield, Clark County.

Springfield Center Member (of Onondaga Formation)

Middle Devonian: East-central New York.

R. E. Stevenson, 1949, New York State Sci. Service Rept. Inv. 3, p. 6–7. Grey to dark-grey medium- to thin-bedded fine- to medium-grained fossiliferous limestone. Massive coral reef within 5 feet of base in most localities. Thickness 3 to 30 feet. Underlies Babcock Hill member (new); overlies Carlisle Center formation. Onondaga is used both as group and formation in this report.

Named for occurrence in vicinity of Springfield Center, Otsego County.

Spring Grove Member (of Wapsipinicon Limestone)[1]

Middle Devonian: Eastern Iowa.

Original reference: A. C. Trowbridge, M. L. Thompson, and E. H. Scobey, 1935, Kansas Geol. Soc. 9th Ann. Field Conf., Guide Book, p. 36, 424, figs. 1, 2.

E. H. Scobey, 1940, Jour. Sed. Petrology, v. 10, no. 1, p. 38 (fig. 1), 41–42. Underlies Davenport member; overlies Kenwood member. In Fayette County, lies unconformably on the Silurian, overlapping lower members of the Wapsipinicon and the Gower formation. Middle Devonian(?).

Type locality: In right bank of Wapsipinicon River in central sec. 24, Spring Grove Township, Linn County.

Spring Hill Limestone[1] Member (of Plattsburg Limestone)

Pennsylvanian (Missouri Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 93, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 116. Spring Hill limestone member of Plattsburg formation; overlies Hickory Creek shale member; underlies Vilas shale. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33. Consists of two limestones separated by shale. Thickness in Kansas 6 to 40 feet; average 15 feet; 4 to 6 feet in Nebraska. Type locality stated.

Type locality: In railroad cut near center east side of sec. 14, T. 15 S., R. 23 E., southern Johnson County, Kans.

Springler Knob facies[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Dept. Conserv., Div. Geology Pub. 98, p. 76, 222–227.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Springler Knob facies listed in Edwardsville formation.

Name derived from Springler Knob on Knobstone Escarpment near center NE¼ sec. 10, T. 2 S., R. 6 E., 3½ miles southwest of St. Joseph, 5 miles north of New Albany, Floyd County.

Spring Mount Sandstone Member (of Bald Eagle Sandstone)

Upper Ordovician: Central Pennsylvania.

F. M. Swartz, 1957, Pennsylvania State Univ., Dept. Geology Contr. 3, 58 p. Upper member of Bald Eagle in vicinity of Tyrone Gap. [Spring Mount is "ridge making member of Bald Eagle" referred to by Swartz, 1948.] Overlies Centennial School sandstone and shale member (new); to the east, interfingers with Lost Run conglomerate. Underlies Juniata strata. [Swartz refers to his 1955 report *in* Pennsylvania Geologists Guidebook 21st Ann. Field Conf. Compiler was unable to locate this reference.]

Type locality and derivation of name not given.

Spring Mountain[s] Formation

Permian (Wolfcampian-Leonardian): Western Nevada.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3), 1433 (fig. 9), 1434–1435 (fig. 10). As shown on diagrams and correlation chart, Spring Mountain formation overlies Bird Spring formation and underlies Kaibab formation.

Present in Spring Mountains area.

Spring Point Greenstone (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Named for exposures at Spring Point, South Portland, Cumberland County.

Spring River Sandstone[1]

Pennsylvanian: Southwestern Missouri.

Original reference: D. White, 1897, Geol. Soc. America Bull., v. 8, p. 288.

Named for Spring River, Jasper County.

†Spring Rock limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow and F. Hawn, 1865, Kansas Geol. Survey Rept. on Miami County, p. 9.

Named for springs which come to surface from crevices in the rock.

†Spring Rock series[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 21.

Probably named for Spring Rock, the source of many springs.

†Springvale Beds[1]

Mississippian: Southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 320.

Named for old Springvale mill, 5 miles south of Delta, Keokuk County.

Springvale Sandstone[1] (in Onondaga Limestone)

Middle Devonian: Ontario, Canada and central New York.

Original reference: C. R. Stauffer, 1913, 12th Int. Geol. Cong. Guidebook 4, p. 83–85, 89.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 625, 627, 631 (fig. 2), 632, 635, 641. Chadwick (1919, New York State Mus. Bull. Nos. 207–208) extended name Springvale sandstone into New York. Springvale zone or horizon is recognized at base of Edgecliff member (new) of Onondaga formation.

Well exposed near Springvale, in region around Hagerville, Ontario, Canada.

Spring Valley Limestone (in McLeansboro Formation)[1]

Pennsylvanian: Central western Illinois.

Original reference: G. H. Cady, 1921, Illinois Geol. Survey Cooperative Mining Ser. Bull. 26, p. 36, 38.

Springville Shale[1]

Mississippian (Valmeyer Series): Southwestern Illinois.

Original reference: T. E. Savage, 1920, Am. Jour. Sci., 4th, v. 49, p. 169–178.

C. C. Collinson and A. J. Scott, 1958, Illinois Geol. Survey Circ. 254, p. 1–12. This report, based on study of outcrops and conodont faunas, correlates the two lowermost units of the Springville, as originally defined, with Hannibal shale and Chouteau limestone, both of Kinderhook age, and restricts name Springville to beds overlying the Chouteau. A 15-inch shale at base of the redefined Springville is named State Pond member. There is no definite age concerning top of Springville, but it is overlain by beds that are referred to Burlington-Keokuk formation.

Well exposed in bed and banks of a creek northwest of Springville, SE¼ sec. 13, T. 13 S., R. 1 W., Union County. Best contemporary exposures are west of Jonesboro near north line of sec. 23, T. 12 S., R. 2 W., near State Pond Dam in sec. 14 and along Darty Creek in SW¼ sec. 11, both mentioned in Savage's description.

Sprout Brook Limestone[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1907, New York State Mus. Bull. 107, p. 361–378.

Occurs in Westchester and Putnam Counties.

Spruce Formation (in Missoula Group)

Precambrian (Belt Series): Northwestern Montana.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 560–563, pl. 28. Thin-bedded fine-grained greenish-gray impure quartzite containing many thick zones of thinly interlaminated greenish-gray quartzose argillite and impure quartzite and a few zones of pale-purplish-gray quartzite. Lower 300 feet and upper 700 to 800 feet partly dolomitic. Weathers buff to brown. Thickness about 3,500 feet. Underlies Lupine quartzite (new); conformably overlies Wallace formation.

Type locality: Spruce Ridge, secs. 32, 33, and 34, T. 17 N., R. 27 W., St. Regis-Superior area. Exposed on north slope Sheep Mountain, secs. 5 and 6, T. 16 N., R. 27 W., St. Regis-Superior area, Mineral County.

Spruce Pine Alaskite

Age not stated: Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, TVA Div. Geology Bull. 4, p. 10–11. Extremely coarse-textured granite containing a small amount of biotite locally. Feldspar crystals as much as 2 feet across are quite common.

Outcrops principally over an area around the town of Spruce Pine in Mitchell County and in smaller areas in Brushy Creek and Ingalls sections of Avery County.

Spud Mountain Volcanics (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 21–26, pl. 1. Comprises four lithologic units: andesitic breccia and interbedded tuffaceous sedimentary rocks—maximum outcrop width about 5,500 feet; fine-grained andesitic tuffaceous rocks—maximum outcrop width about 5,000 feet; intercalated andesitic flows—maximum outcrop width 1,000 feet; and interbedded rhyolitic tuff—maximum outcrop width 1,500 feet. Outcrop widths may about equal stratigraphic thickness for local or partial sections. Underlies Iron King volcanics (new) and overlies Indian Hills volcanics (new) with gradational contacts.

Named from exposures on and near Spud Mountain in Jerome area, Yavapai County. Representative section exposed in area from Spud Mountain to the Iron King mine.

Spurwink Limestone (in Casco Bay Group)[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 198.

Named for exposures on Spurwink River, in Scarboro and Cape Elizabeth, Cumberland County.

Squam Granite[1]

Early Carboniferous: Northeastern Massachusetts.

Original reference: C. H. Clapp, 1910, Igneous rocks of Essex County, Mass, p. 9, 10, 12.

Occurs along Squam River and in Danvers, Essex County.

†Squankum Marl[1]

Eocene: Eastern New Jersey.

Original reference: T. A. Conrad, 1869, Am. Jour. Sci., 2d, v. 47, p. 363–364.

Occurs around Squankum, Monmouth County.

†Squantum Slates[1]

Mississippian(?): Massachusetts.

Original reference: F. H. Lahee, 1914, Am. Jour. Sci., 4th, v. 37, p. 316.

Squantum Tillite Member (of Roxbury Conglomerate)[1]

Squantum Tillite

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: R. W. Sayles, 1914, Harvard Coll. Mus. Comp. Zoology Bull., v. 56, p. 141–170.

M. P. Billings, F. B. Loomis, Jr., and G. W. Stewart, 1939, Geol. Soc. America Bull., v. 50, no. 12, p. 1867, 1868. Tillite overlies Roxbury conglomerate of Carboniferous age.

Named for peninsula of Squantum in Quincy.

Square Lake Limestone[1]

Lower Devonian: Northeastern Maine.

Original reference: H. S. Williams, 1900, U.S. Geol. Survey Bull. 165, p. 21, 22, 26, 30–33, 51, 54–78.

J. M. Trefethen, 1947, Maine State Geologist Rept. 1945–1946, p. 70. Gray highly fossiliferous limestone, resembling the younger Ashland limestone in appearance. Devonian.

Named for exposures on west shore of Square Lake (or Sedgwick Lake), Aroostook County.

Square Peak Volcanics

Square Peak Volcanic Series

Tertiary: Western Texas.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 1027–1033, 1038–1039. Name Square Peak volcanic series proposed for lavas and pyroclastic rocks, approximately 3,500 feet thick, which constitute single unit covering 16 square miles in center of northern Quitman Mountains. Consist mostly of varicolored rhyolites with alternating flows of trachyte, quartz latite, andesite, and basalt and beds of tuff, flow conglomerate, and volcanic breccia. Volcanic rocks are commonly surrounded by folded sedimentary rocks on the north and west; at south flows are in contact with Quitman quartz monzonite; on northwestern Bug Hill, lavas of series lie on Bluff limestones.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 558. Probably in part equivalent to Buck Hill volcanic series.

Named for Square Peak in Quitman Mountains, southern Hudspeth County.

Squaw Flows

Tertiary: Northwestern Wyoming.

R. D. Krushensky, 1960, Dissert. Abs., v. 21, no. 4, p. 849. Augite-olivine andesites with some minor autobrecciated flows. Overlie Papoose volcanics and underlie Closed volcanics (both new).

Hurricane Mesa area, Park County.

Squaw Bay Limestone[1] (in Traverse Group)

Upper Devonian: Northeastern Michigan.

Original reference: A. S. Warthin, Jr., and G. A. Cooper, 1935, Washington Acad. Sci. Jour., v. 25, no. 12, p. 524–526.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3), 594–595. Described in Thunder Bay region. Thickness at type section 8 feet; subsurface data indicates greater thickness elsewhere. Overlies Thunder Bay limestone; considered top of Traverse group; an overlying shale or "transition zone" is not included in the Traverse.

Type locality: Squaw Bay shoreline of Partridge Point, center south line sec. 11, T. 30 N., R. 8 E., Alpena County. At high stages of Lake Huron, outcrop is covered by water.

Squaw Creek Diatomite Member (of Yakima Basalt)

[Miocene]: South-central Washington.

J. H. Mackin, 1947, (abs.) Northwest Sci., v. 21, no. 1, p. 33. Defined as occurring one flow below top of Yakima basalt. In Squaw Creek syncline, member consists of bed of essentially pure diatomite 7 to 17 feet thick, overlain conformably by lacustine siltstone as much as 10 feet thick.

Occurs in Yakima-Ellensburg area.

Squire Creek Quartz Diorite

Age not stated: Northwestern Washington.

J. W. Mills, 1960, Mining Eng., v. 12, no. 3, p. 274. Light-colored medium- to coarse-grained quartz diorite composed of plagioclase, hornblende, brown biotite, and minor quartz. Cut by fine-grained alplite dikes. Name credited to J. A. Vance (unpub. thesis).

Occurs on Jumbo Mountain, Snohomish County.

†Squirrel Creek Formation[1]

Eocene: Southern Texas.

Original reference: R. A. Liddle, 1921, Texas Univ. Bull. 1860, p. 77, map, columnar section.

Named for its largest exposure on east and west branches of Squirrel Creek, above old Capt. Smith ranchhouse, in Medina County.

Squirrel Gulch Latite[1]

Tertiary: Southern Colorado.

Original reference: W. S. Burbank, 1932, U.S. Geol. Survey Prof. Paper 169.

J. W. Gabelman, 1953, Econ. Geology, v. 48, no. 3, p. 195, 196. In Greater Bonanza district, the volcanics in order of succession are Rawley andesite, Bonanza latite, Squirrel Gulch latite, Porphyry Peak rhyolite, and Bremer [Brewer] Creek latite. In South Bonanza district, the volcanic sequence is roughly the same except Porphyry Peak rhyolite is missing and the Bonanza latite is replaced by Hayden Peak latite.

Well exposed at upper part of Squirrel Creek and in north-south ridges west of Kerber Creek in sec. 23, Bonanza district, Saguache County.

Stacy Dolomite Member (of Gatesburg Formation)[1]

Upper Cambrian: Central Pennsylvania.

Original reference: Charles Butts, 1918, Am. Jour. Sci., 4th, v. 46, p. 527, 534, 537.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 282, pls. 1, 4. In Everett quadrangle, consists of about 130 feet of alternating dark crystalline massive dolomite and less resistant thin-bedded lighter dolomite. Separated from overlying Ore Hill dolomite member by a 400-foot interval referred to as lower sandy Gatesburg member; separated from underlying Warrior limestone by 50 feet of covered strata.

Named for Stacy Hill, a knob 4 miles slightly west of south of Williamsburg, Blair County.

Staendebach Member (of Tanyard Formation)

Lower Ordovician: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 2, 19–27. Top member of formation. Thickness at type section 300 feet. Consists of calcitic facies 176

feet thick and dolomitic facies 124 feet. Overlies Threadgill member; underlies Gorman formation (new). Cherokee Creek section, San Saba County described.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 36, 37, 137, 158, 195, 211–227, pls. 2, 7, 37 [1946]. Thickness at type section 300 feet; elsewhere ranges from 229 feet in western part of Llano uplift to 356 feet in the east. As a rule, upper one- to two-thirds of member is limestone in northeastern part of Llano region and in Riley Mountains of Llano County, but in the southeast and west dolomite predominates and limestone is rare or absent. Member characteristically contains abundance of sparingly dolomoldic porcelaneous to semiporcelaneous chalcedonic to semichalcedonic chert. Type section and local stratigraphy described in detail.

Type section: Part of Cherokee Creek section, Cherokee area, southeastern San Saba County. Name derived from Staendebach survey, a part of the T. H. Young Ranch which includes upper beds of type section. Cherokee area, between towns of Cherokee and San Saba, is approximately bounded by Cherokee and Little Llano River fault zones on east, Simpson Creek fault zone on north, Cherokee-San Saba Road (State Highway 16) on west, and Cherokee-Chappel Road on south.

Staff Limestone Member (of Graford Formation)[1]

Staff Limestone (in Graford Group)

Upper Pennsylvanian: Central northern Texas.

Original reference: F. Reeves, 1922, U.S. Geol. Survey Bull. 736–E, p. 120.

Robert Roth, 1956, North Texas Geol. Soc. Guidebook Field Trip May 25–26, fig. 2. Shown on generalized columnar section as limestone in Graford group. Occurs above Wolf Mountain shales and sandstones and below unnamed shale below Winchell limestone. Canyon series.

Named for outcrops near Staff, Eastland County.

Stafford Limestone Member (of Marcellus Formation)

Stafford Limestone Member (of Skaneateles Shale)[1]

Middle Devonian: Western and central New York.

Original reference: J. M. Clarke, 1894, New York State Museum 47th Ann. Rept., p. 342, 351.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1772, chart 4. Reallocated to Marcellus formation. West of Cayuga Lake continuous with Mottville. Overlies Oatka Creek black shale; underlies Levanna black shale.

Named for development at Stafford, Genesee County.

Stafford Store Quartz Monzonite[1]

Post-Ordovician: Northeastern Virginia.

Original reference: J. T. Lonsdale, 1927, Virginia Geol. Survey Bull. 30, p. 40.

Typically developed near Stafford Store post office, Stafford County.

Staghorn Point Submember[1] (of Otisco Member of Ludlowville Formation)

Middle Devonian: Central New York.

Original reference: Burnett Smith, 1935, New York State Mus. Bull. 300, p. 46–47.

W. A. Oliver, Jr., 1951, Am. Jour. Sci., v. 249, no. 10, p. 707, 708, 713–716, fig. 6 (facing p. 724). Consists of mass of closely packed rugose coral skeletons; interstices filled with same shaly sediment as that constituting body of Otisco member. Interfingers laterally with surrounding shales; upper and lower contacts sharply defined except in fringing areas where complete gradation into normal shales may occur. Thickness few inches to 12 feet. Greatest in central part.

Typically shown just south of Staghorn Point on east side of Skaneateles Lake, about 1⅕ miles northwest from Spafford Landing, Skaneateles quadrangle. Traced over 15 miles from Skaneateles Lake to east of Tully quadrangle.

†Staked Plains Formation[1]

Pliocene: Northwestern Texas.

Original reference: R. T. Hill, 1890, Am. Assoc. Adv. Sci. Proc., v. 38, p. 243.

On the Staked Plains or Llano Estacado.

Stallard Limestone

Middle Ordovician: Southwestern Virginia.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 103. Listed in glossary of stratigraphic units. Attributes name to [B. N.?] Cooper (unpub. rept.).

Type locality: In Lee County.

Stambaugh Formation (in Paint River Group)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 38. Iron-rich rocks that range from chlorite mudstone and slate to laminated cherty siderite-magnetic rock; only formation that is consistently magnetic over most of district. Underlies Fortune Lakes slate (new); overlies Hiawatha graywacke (new).

Named for town of Stambaugh, Iron County. Hill on which town is built is in large part underlain by the formation (here compressed into a tight complex syncline).

Stamford Granite Gneiss[1]

Precambrian: Southwestern Vermont and western Massachusetts.

Original reference: C. H. Hitchcock, 1861, Rept. geology Vermont, v. 2, p. 601.

Named for exposures at Stamford, Bennington County, Vt.

Stanaker Formation

Stanaker Member (of Ankareh Formation)

Upper Triassic: Northeastern Utah.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1260 (fig. 2), 1266 (fig. 5), 1271–1275. Formation name applied to basal conglomerate and overlying varicolored shales and sandstone which were included in the Nugget by Boutwell (1912, U.S. Geol. Survey Prof. Paper 77) and classed as Ankareh(?) by Sears (1924, U.S. Geol. Survey Bull. 751–G). Basal conglomerate is here named Gartra grit member. Main body of formation comprises alternation of shales which vary from maroon to red,

pink, lavender, ocher, and green, and sandstones which are gray, red, purple, or yellow. Thickness of Gartra 18 to 88 feet; thickness of upper part of Stanaker, exclusive of Gartra, 120 to 394 feet. Underlies Nugget or Navajo sandstone; at type section, overlies Woodside shale; in western Uinta and central Wasatch Ranges, overlies Ankareh formation.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 166 (fig. 18), 180. Rank reduced to member status in Ankareh formation.

W. F. Scott, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 102, 103 (fig. 2), 104 (fig. 3). Units Stanaker and Gartra grit as used by Thomas and Krueger (1946) are included in units referred to in this report as Chinle and Shinarump(?).

Type section: At point where Vernal-Manila Highway crosses Brush Creek, about 10 miles north of Vernal, in north part sec. 6, T. 3 S., R. 22 E., Uintah County. Name derived from Stanaker Draw which lies in eastern part of T 3 S., R. 21 E., Uintah County.

Standing Pond Volcanics

Standing Pond Amphibolite Member (of Memphremagog Formation)

Standing Pond Amphibolite Member (of Waits River Formation)

Middle Ordovician(?): Eastern Vermont and western New Hampshire.

C. G. Doll, 1945, Vermont State Geologist 24th Rept., p. 16, 17, pl. 4. Named as member of Memphremagog formation. Fine- to medium-grained greenish-gray or black needle amphibolite with thin layers of banded hornblende schist. Thickness 10 to 300 feet. Occurs either entirely within the limestones or along their contact with the mica schists of the Memphremagog. Middle Silurian. Plate 4 shows age also as probably Lower Devonian.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Rank raised. Overlies Waits River formation. Geographically extended to New Hampshire. Middle Ordovician(?).

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 108, 109, pl. 1. Rank reduced to member of Waits River formation. Transgresses from near top of Waits River into overlying Gile Mountain formation.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 27, pls. 1, 3. Referred to as Standing Pond lava of Waits River formation [plate 1] and as Standing Pond volcanics [plate 3]. Lower to Middle Devonian(?).

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 19–27, 38–39. Age of Waits River Silurian(?) and (or) Devonian.

Named from exposures impounding waters of Standing Pond at its west end, Strafford quadrangle, Vermont.

†Standish Flagstone (in Genesee Group)[1]

Upper Devonian: West-central New York.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 29.

I. W. Fox, 1932, Am. Assoc. Petroleum Geologists Bull., v. 16, no. 7, p. 681–683. Consists of two distinct divisions: sandstones below and shales above. Subdivided to include Crosby sandstone at base and Keuka flagstone about midway between upper and lower divisions.

W. H. Bradley and J. F. Pepper, 1938, U.S. Geol. Survey Bull. 899–A, p. 11, pl. 3. Unit, along with West River shale, occupies interval between Middlesex shale above and Genundewa limestone lentil of Geneseo shale below. Complementary to West River shale; thickens eastward and latter thickens westward. Near base at south end of Seneca Lake is a 2-foot bed of dense massive fine-grained muddy sandstone or siltstone. Northwestward near Keuka Lake, base is marked by dense massive flagstone. Included in Genesee group.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 44, 63, 64, 66, 73. Term abandoned. Not recognized as stratigraphic unit distinct from West River shale in type area. Lenses originally defined as Standish do not correlate with Starkey tongue (new) of Sherburne formation or Milo tongue (new) of West River shale, both of which have erroneously been called Standish.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2819. Standish flagstones of Clark and Luther (1904) included in West River shale, redefined as member of Genesee formation. The Standish flags are insufficiently different lithologically to warrant separation from the West River.

Named for Standish Gully, town of Italy, Yates County.

Standpipe Limestone Member (of Arroyo Formation)

Standpipe Limestone Member (of Clear Fork Formation)[1]

Permian (Leonard Series): North-central Texas.

Original reference: M. G. Cheney, 1929, Texas Univ. Bull. 2913, p. 27, pl. 1.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Shown on chart as uppermost member of Arroyo formation. Overlies Lytle limestone member; lies stratigraphically below Bullwagon dolomite member of Vale formation.

Type locality: At base of hill upon which is located standpipe in eastern part of Abilene, Taylor County.

Standpipe Sandstone (in Elmdale Formation)[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: F. C. Greene, 1928, Oklahoma Geol. Survey Bull. 40CC.

In Pawnee County.

Stanford Conglomerate[1]

Probably Tertiary, upper: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

Occurs in very prominent hills rising above flat prairie near Stanford, Judith Basin County.

Staniukovich Shale[1]

Upper Jurassic: Southwestern Alaska.

Original reference: W. W. Atwood, 1911, U.S. Geol. Survey Bull. 467, p. 25, 38.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 978. Of Portlandian (Upper Jurassic) age.

Exposed on Herendeen Bay, also on Staniukovich Mountain, and east to Port Moller; Alaska Peninsula.

Stanley Shale[1]

Stanley Group

Mississippian: Central southern and southeastern Oklahoma and western Arkansas.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

H. D. Miser, 1920, Geol. Soc. America Bull., v. 31, p. 125. Includes Hatton tuff lentil (new).

N. H. Stearn *in* J. M. Hansell and J. C. Reed, 1935, Am. Inst. Mining Metall. Engineers Trans., v. 115, p. 245; N. H. Stearn, 1936, Econ. Geology, v. 31, no. 1, p. 12–16. Thickness of shale about 2,500 feet in Little Missouri River part of Arkansas quicksilver district. Includes Parker Hill and Gap Ridge members (both new) in lower part.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856, 864–878. Rank raised to group. Divided into (ascending) Ten Mile Creek, Moyers, and Chickasaw Creek formations (all new). Maximum thickness about 7,000 feet. Underlies Jackfork group. Basal group of Pushmataha series (new) which is included in the Bendian.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 35). Stanley shale shown on correlation chart above Hot Springs sandstone and below Jackfork sandstone. Morrow series.

C. L. Cooper, 1945, Jour. Geology, v. 53, no. 6, p. 390–397. Stanley and Jackfork formations have been correlated with Pennsylvanian, but their exact age is still a problem. Flora from these formations is unlike any known flora in North America and is younger than that from Wedington sandstone member of Fayetteville shale (Chester) and older than that in Baldwin coal in Bloyd shale of Morrow group (middle Pottsville).

B. H. Harlton, 1947, Tulsa Geol. Soc. Guidebook Field Conf., May 9 and 10, p. 41. Includes Albion shale (new).

W. H. Hass, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 7, p. 1578. On basis of conodont studies, it is believed that some part of Stanley shale—including Hatton tuff lentil and barite deposits of Arkansas—is Mississippian (Meramec) in age and correlative with Caney shale of Oklahoma and Barnett formation of Texas.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Shale mapped as Mississippian and Pennsylvanian.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 22–41, pl. 1. Group attains best development in central Ouachitas where it comprises about 11,000 feet of strata, prevailingly shaly but with sandstone becoming prominent in upper 1,500 feet. Includes (ascending) Tenmile Creek, Moyers, and Chickasaw Creek formations. Underlies Jackfork group. Mississippian, Meramecian.

H. D. Miser and T. A. Hendricks, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1829–1834. Age Mississippian. Presentation of brief summary of development of different age interpretations that have been given for Stanley shale, Jackfork sandstone, and Johns Valley shale.

Named for Stanley, Pushmataha County, Okla.

Stansbury Formation

Devonian-Mississippian(?): Northwestern Utah.

W. L. Stokes and D. E. Arnold, 1958, Utah Geol. Soc. Guidebook 13, p. 135–148; J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 36–39, geol. map. Includes clastic section which underlies Pinyon Peak limestone and overlies pronounced Late Devonian unconformity. Varies rapidly in facies and thickness from place to place. Pebble and cobble conglomerate characterize formation at its northern outcrops near Flux. Southward, in Mining Canyon, formation is predominantly siltstone and vitreous sandstone with minor thin beds of platy dark-gray limestone and dolomite; quartzitic sandstone overlies entire unit with some angularity within the formation. Along the southern and western side of the range consists of minor conglomerate beds with interbedded limestone and dolomite. Thickness about 1,700 feet at northern end of range. Overlies Simonson(?) dolomite. Devonian-Mississippian(?).

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (fig. 1), 29 (fig. 9), 30–31, pl. 1. Described in southern Oquirrh Mountains where it is 10 to 190 feet thick; underlies Gardner dolomite and overlies Opex dolomite. Upper Devonian.

Type section: Well exposed and continuous outcrop lying partly in sec. 6, T. 2 S., R. 6 W., and continuing westward into sec. 1, T. 2 S., R. 7 W. No one section is entirely "typical," but all constituent lithologic types are best exposed in Stansbury Mountain section. Name taken from Stansbury Range, Tooele County.

Stanton facies (of New Providence Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 121–125. Southernmost facies of formation. Merges with Boone Gap facies (new) to the west and with Bluestone facies (new) to the northeast. Consists almost entirely of clayey shale, generally blue gray or drab with persistent, though thin, Clay City siltstone member (new) near base. Thickness ranges from 275 to 300 feet or more. Underlies Christy Creek member of Brodhead formation, Morehead facies (all new); overlies Sunbury black shale.

Typical exposure: Along secondary road leading from Stanton to Hatcher Creek Church and School, at north side of Red River, 1 mile north-northeast of Louisville and Nashville Railroad Station at Stanton, Powell County. Named for city of Stanton.

Stanton Limestone (in Lansing Group)[1]

Stanton Limestone Member (of Lansing Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: G. C. Swallow and F. Hawn, 1865, Kansas Geol. Survey Rept. on Miami County, p. 6.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 117; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 14. Stanton formation in Lansing group; overlies Vilas shale; underlies Weston shale of Pedee group;

includes (ascending) Captain Creek limestone, Eudora shale, Stoner limestone, Rock Lake shale, and South Bend limestone members. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24, fig. 5. Uppermost formation of Lansing group. Present only in western Madison, eastern Adair, and southern Ringgold Counties. In Ringgold County, consists of 13 feet of light- to dark-gray thinly bedded argillaceous limestone containing shale partings and many white brachiopod and gastropod sections. In Adair and Madison Counties, unit is 8 feet thick and commonly is a sequence of three gray and black nodular limestones separated by shales. Upper shale is gray and fossiliferous with brachiopod and crinoid fragments. Lower shale is black and carbonaceous. Overlies Vilas shale; underlies Douglas-Pedee group.

Type locality: In roadcut near SE cor. sec. 3, T. 13 S., R. 21 E., and adjacent area along Captain Creek. Named for Stanton, Miami County, Kans.

†Stanton limestone series[1]

Pennsylvanian: Eastern Kansas.

Original reference: G. C. Swallow, 1866, Kansas Geol. Survey Prelim. Rept., p. 20.

Probably named for its topmost member, the Stanton limestone.

Stapp Conglomerate Member (of Union Valley Formation)

Pennsylvanian (Morrow Series): Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 890, 893–895. Proposed for the conglomerate occurring at base of formation. Consists of rounded pebbles and boulders of chert and limestone, ranging in thickness from fraction of an inch to masses 3 feet in diameter; bedding planes absent; intercalated thin lenses of sandstone and conglomeratic sandstone show crossbedding; near top is thin black shale which is overlain by coarse loosely consolidated conglomerate. Overlies Wesley formation (new). Unit formerly considered as base of the Atoka.

Well exposed in Kansas City Southern Railway cut, 1 mile south of Stapp in SW¼SW¼ sec. 7, T. 3 N., R. 26 E., Le Flore County.

†Staran series[1]

Upper(?) Triassic: Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 59.

Named for exposures in Star Peak Mountain, Humboldt County.

Starbo altered tuffs

See Keechelus Andesitic Series.

Stark Complex

Precambrian: Northeastern New York.

A. F. Buddington, 1948, Geol. Soc. America Mem. 28, p. 24, 25–28. Quartz syenitic complex. Attitudes of foliation, arrangement of various lithologic facies of the complex, and structural relationships to country rock are all consistent with hypothesis that Stark, Loon Lake (new),

and Jennings Mountain (new) complexes are all exposed on core of domes or anticlines which are either closely folded or isoclinally overturned. Pyroxene quartz syenite is exposed on core of each, and hornblende quartz syenite and hornblende granite overlie it.

Forms elongate mass extending southwest from Santa Clara, Franklin County. Complex is about 45 miles long and underlies about 275 square miles.

Stark Shale[1] Member (of Dennis Limestone or Formation)

Stark Shale Member (of Hogshooter Formation)

Upper Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, western Missouri, and northern Oklahoma.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 91, 97.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 43; 1952, Oklahoma Geol. Survey Bull. 69, p. 59. In Oklahoma, considered member of Hogshooter formation. Overlies Canville limestone member; underlies Winterset limestone. Thickness 3 to 10 feet.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Shale member of Dennis formation. Overlies Canville limestone member; underlies Winterset limestone member. This is classification agreed upon by State Geological Survey of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 11–12. Galesburg formation redefined to exclude Canville limestone and Stark shale. Latter units included in Dennis formation.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 421. Thickness about 4 feet near Winterset, Iowa.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Member of Dennis limestone. Dark gray and fossiliferous at top; black fissile at base. Thickness 1.8 to 2.9 feet in Madison County; 5 feet in cores from Pottawattamie County. Overlies Canville limestone member; underlies Winterset limestone member.

Type locality: Near Stark, Neosho County, Kans.

Starkey Tongue (of Sherburne Formation)

Upper Devonian: West-central New York.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 66–68. Name proposed for interbedded medium quartz siltstone flags, gritty micaceous blue-gray and dark-gray shales, and some black shales; flags become thinner westward. Thickness 140 feet in type area; maximum 240 feet. In type locality, top is marked by Keuka flagstone lentil, and base is placed at Crosby lentil; first appearance of heavy and closely spaced flags identifies base in area to the east where Crosby not recognized. Penetrates West River shale between Penn Yan tongue (new) below and Milo tongue (new) above. Unit erroneously termed Standish; highest calcareous crinoidal bed was erroneously designated Parrish limestone, and a black shale band was incorrectly called Rhinestreet shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2825 In vicinity of Keuka and Seneca

Lakes, Ithaca member of Genesee formation of this report was named Starkey tongue of Sherburne formation by Grossman. However, this sequence of silty rocks is lateral extension of Ithaca member from its type area and is not tongue of Sherburne as Grossman believed.

Type locality: Crosby Gully on east side of Keuka Lake. Named from Starkey Township, Yates County, on west side of Seneca Lake. Extends from Cayuga Lake area to within few miles of east shore of Canandaigua Lake.

Starmount Limestone[1]

Middle Cambrian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 435, map.

Named for Starmount mine, Elkhorn mining district, Elkhorn region.

Star Mountain Rhyolite (in McCutcheon Volcanic Series)

Tertiary: Southwestern Texas.

G. K. Eifler, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 4, p. 345, pl. 1. Named applied to thick rhyolitic lavas overlying Huelster formation (new) and underlying Seven Springs formation (new). Rock is typically black to brownish black, but some parts, particularly the lower, are green, greenish gray, and purplish lavender. Thickness at type locality 496 feet; thins to northeast; north of Jeff Ranch it is 262 feet thick.

Type locality: Star Mountain, Barrilla Mountains, Reeves County.

Star Peak Formation[1]

Star Peak Group

Middle and Upper Triassic: Northern Nevada.

Original references: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, map 5; 1878, U.S. Geol. Expl. 40th Par., v. 1, p. 267–278, 544.

H. E. Wheeler, 1940, 6th Pacific Sci. Cong. Proc., v. 1, p. 369, 373 (fig. 2) [preprint 1939]. Middle Triassic. Overlies Weaver rhyolite.

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Rank raised to group. Includes Prida formation below and Natchez Pass formation. Overlies Weaver rhyolite of Koipato group with angular unconformity. Underlies Grass Valley formation, possible disconformity. Middle and Upper Triassic.

Named for development at Star Peak Mountain in West Humboldt Range.

Star Point Sandstone (in Mesaverde Group)[1]

Star Point Sandstone

Upper Cretaceous: Central eastern Utah.

Original reference: E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc America Bull., v. 36, p. 442.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 182–183, fig. 2, pl. 3. Redefined in area to north and east of Spring Canyon, keeping base as base of Panther sandstone, but placing upper boundary at top of Storrs sandstone. Spring Canyon tongue reassigned to overlying Blackhawk formation. Change of upper boundary impractical to the west and south in Wasatch Plateau where Spring Canyon, Storrs, and Panther sandstones unite to form single massive littoral marine tongue. Dated as medial Montana. Not included in Mesaverde group—a term no longer used in Book Cliffs. Present only in western part of Book Cliffs.

Named from Star Point, a striking headland of Gentry Mountain southwest of Price, and about 3 miles west of southwest corner of Castlegate quadrangle, Carbon County. In Wasatch Plateau and Book Cliffs.

†Starr Conglomerate[1]

†Starrs Conglomerate[1]

Lower Cambrian: Southeastern Tennessee.

Original reference: C. W. Hayes, 1895, U.S. Geol. Survey Geol. Atlas, Folio 20, p. 2.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 29. Starr conglomerate is a synonym of Cochran conglomerate and should be abandoned.

Named for exposure near Starr Mountain, Monroe County.

Starrs Cave Formation (in North Hill Group)

Mississippian (Kinderhook Series): Southeastern Iowa and northwestern Illinois.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 8 (fig. 1), 31, pl. 1. Proposed for a buff to light-brownish-gray coarsely oolitic limestone that is locally dolomitic and contains small amounts of silt. Thickness 2⅔ feet; in six wells in Hancock County, Ill., 2 to 12 feet. Conformably overlies Prospect Hill siltstone; unconformably underlies Burlington limestone. Name credited to Charles Collison.

Type section: Flint River bluff near Starrs Cave, NW¼NW¼ sec. 19, R. 2 W., T. 70 N., Des Moines County, Iowa.

Starrucca Sandstone[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: C. S. Prosser, 1894, U.S. Geol. Survey Bull. 120, p. 78.

Starrucca Shale (in Catskill or Chemung Formation)[1]

Starrucca (Starucca) Shale (in Cayuta monothem)

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1881, Pennsylvania 2d Geol. Survey Rept. G_6, p. 59, 70, 73.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 45 (fig. 7), 47, 50. Starruca shale was originally differentiated by White (1881) from overlying New Milford red shale and from underlying "Chemung," but draftsman apparently included it by mistake with New Milford red shale. Just where Willard would draw boundary of his Kingsley, which is White's New Milford under new geographic name, is not clear. It is herein considered that the Starruca is a distinct unit, which comes at about proper position to constitute top of Cayuta shale monothem.

Well exposed along Jefferson Branch Railroad above Starucca [Starrucca] Bridge, also near mouth of Starucca Creek, Susquehanna County.

State Bridge Siltstone

State Bridge Siltstone Member (of Maroon Formation)

Permian(?): Northwestern Colorado.

C. F. Bassett, 1939, Geol. Soc. America Bull., v. 50, no. 12, pt. 1, p. 1853, 1864. Upper member of Maroon formation. Overlies Rock Creek member (new). Chiefly thin-bedded micaceous brick-red siltstone, shale, and

fine limy sandstone. Thickness 525 feet. Name credited to H. F. Donner (unpub. thesis).

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1392–1393. Donner's manuscript name State Bridge is used as formation and applied in Gore area to upper Pennsylvanian or Permian sediments which lie between Battle Mountain formation and the Triassic. Thickness on North Fork of Piney River 225 feet; 750 feet on Red and White Mountain. Donner's type locality stated; there formation is 525 feet thick, conformably overlies McCoy formation, and disconformably underlies Shinarump conglomerate.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 823–825. Permian (Guadalupian). On eastern side of McCoy area, State Bridge overlies Maroon formation, but on western side, Schoolhouse tongue of Weber sandstone lies between Maroon and State Bridge. Since Maroon formation is here limited to beds that underlie Schoolhouse tongue, unit termed South Canyon [Creek] dolomite member of Maroon (Bass and Northrop, 1950), in vicinity of Glenwood Springs appears to be member of State Bridge formation.

Type section: South slope of Yarmony Mountain, 0.3 mile north of State Bridge, Eagle County.

State Farm Gneiss

Precambrian: Central Virginia.

C. B. Brown, 1937, Virginia Geol. Survey Bull. 48, p. 13–14. Relatively uniform even-banded gneiss with well-developed foliation. Light to dark gray and medium grained. Shows only limited amount of folding in any single outcrop; and shows numerous divergences in structure from regional trend.

Type locality: State Farm quarries on Chesapeake and Ohio Railway, Goochland County. Named from typical outcrops near State Farm.

†State Line Serpentine[1]

Precambrian: Northeastern Maryland and southeastern Pennsylvania.

Original reference: F. D. Chester, 1889, Pennsylvania 2d Geol. Survey Ann. Rept. 1887, p. 93–105.

Named for fact it occurs fully 16 miles along boundary between Pennsylvania and Maryland.

Staten Island Serpentine[1]

Precambrian(?): Southeastern New York and New Jersey.

Original reference: F. J. H. Merrill, 1898, New York State Mus. 15th Ann. Rept. v. 1, p. 21–31.

Forms elevated part of Staten Island, N.Y., and the Knob at Castle Point, in Hoboken, Hudson County, N.J.

State Pond Member (of Springville Shale)

Mississippian (Valmeyer): Southern Illinois.

Charles Collinson and A. J. Scott, 1958, Illinois Geol. Survey Circ. 254, p. 1, 3, 4, 5. Proposed for unit of soft shale at base of redefined Springville shale. Lower part is greenish and calcareous; upper 1½ inches consists of dark-green to black phosphate nodules. Thickness 14 to 15 inches. Overlies Chouteau formation; underlies hard tannish to greenish-gray poorly laminated shale characteristic of upper part of Springville.

Exposed in south bank of stream below spillway of State Pond Dam in NW¼SE¼ sec. 14, T. 12 S., R. 2 W., Union County.

State Quarry Limestone[1]

Upper Devonian: Central eastern Iowa.

Original reference: S. Calvin, 1897, Iowa Acad. Sci. Proc., v. 4, p. 16–21.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1783, chart 4. Occupies erosion pockets in Cedar Valley limestone in limited area. Fauna suggests a position low in Upper Devonian, and formation has been placed at top of Genesee group; possibly it should be placed higher in Naples stage (Ithaca).

Named for State quarry (or North Ben quarries), Penn Township, Johnson County.

†State Road Conglomerate[1]

Precambrian (lower Huronian): Northwestern Michigan.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 257.

Occurs north of Mud Lake and along an old road known as State Road in Marquette district.

Staunton Formation[1]

Middle Pennsylvanian: Southwestern Indiana.

Original reference: E. R. Cumings, 1922, Handb. Indiana Geology, pt. 4, Sep. Pub. 21, p. 408, 525, 529, chart.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as including Velpen limestone.

C. E. Wier, 1950, U.S. Geol. Survey Coal Inv. Map C–1. Described in Clay, Greene, and Sullivan Counties. As defined by Cumings contained Coals III, IIIa, and IV. Stratigraphic break is present above Coal III and Staunton is here restricted to rocks above this break and unconformity above Coal II. Restricted Staunton comprises sandstone and shale, and averages about 85 feet in thickness. Remainder of Staunton as originally defined is assigned to Linton formation (new). Overlies Brazil formation (not exposed in area of this report, Jasonville quadrangle).

Named for Staunton, Clay County.

Stayton Lavas[1]

Miocene, middle: Northwestern and central northern Oregon.

Original reference: T. P. Thayer, 1933, Pan-Am. Geologist, v. 59, no. 4, p. 317.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 8–9, fig. 1. Stayton lavas overlie Illahe formation in Salem Hills and have been traced eastward continuously to crest of Mehama anticline. Maximum thickness about 400 feet in Salem Hills; increase in thickness toward the northeast; less than 200 feet thick east and southeast of Stayton. Unconformable above Illahe and Mehama formations Stayton lavas may be marginal flows of Columbia River basalt and are tentatively correlated with them. Middle Miocene.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 5. Columbia River basalts in vicinity of Salem and Stayton,

Oreg., were named Stayton lavas by Thayer (1939) because Columbia River basalt had not yet been traced southward into that area. However, it seems advisable to drop name Stayton lavas in preference to Columbia River basalt, and except for intervening alluvial fill of Willamette River, exposures would be continuous.

R. E. Corcoran and F. W. Libbey, 1956, Oregon Dept. Geology and Mineral Industries Bull. 46, p. 7–8, pl. 1. In Salem Hills area. Eugene formation is overlain unconformably by series of basalts called Salem lavas in Salem quadrangle by Mundorff (1939, unpub. thesis) and Stayton lavas in that general region by Thayer (1939). Salem-Stayton lavas are time-rock equivalents of Columbia River basalt, if not actually part of same series of flows.

I. S. Allison and W. M. Felts, 1956, Geology of the Lebanon quadrangle, Oregon (1:62,500): Oregon Dept. Geology and Mineral Industries. Thickness 500 to 600 feet in Lebanon quadrangle. Unconformably overlies Eugene formation.

Forms Salem Hills, southwest of Salem and also Stayton Basin east of Salem, Marion County.

Steamboat Limestone[1]

Middle Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 37.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1089–1090. Middle Cambrian section in Lewis and Clark Range redefined. Steamboat limestone has proved to be part of upper Dearborn limestone which was repeated in Dearborn section by low angle overthrust. Therefore, rocks to which name Steamboat was applied do not exist, and this name is herein applied to limestone and shale formerly designated Gordon Mountain limestone which lies betwen Pagoda or Pentagon and overlying Switchback formation. Thickness about 216 feet.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 45. Overlies Pentagon shale in northern sections and Pagoda limestone in central and southern sections. Thickness 216 feet near Pentagon Mountain; 353 feet on ridge between Kid and Gordon Mountains. Type section described in detail.

Type locality: Crest of Prairie Reef from 54 feet below top of peak northwestward to base of Switchback shale. Name taken from Steamboat Mountain, which lies just north of Dearborn River [Lewis and Clark County].

Steamboat Hills Rhyolite

Pliocene or Pleistocene: Central western Nevada.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 58–59, pl. 3. Described as extrusive domes of fresh pumiceous rhyolite, containing very sparse phenocrysts of sanidine, quartz, plagioclase, and biotite. Some of the rhyolite is perlite and very little is obsidian. Younger than Lousetown formation in Virginia City quadrangle.

Named for occurrence in Steamboat Hills, 2½ miles west of Virginia City quadrangle. Also occurs in two widely separated areas within quadrangle, one along west base of Virginia Range, northeast of Steamboat Hills, and other at Sutro Springs, on east side of Flowery Range.

Stearns Magma Series

Precambrian (middle Keweenawan) : Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1001, 1002, 1005–1009, pl. 1. Includes (ascending) Crystal Gray quartz monzonite, quartz latite porphyry, porphyritic granite, Rockville quartz monzonite, and St. Cloud Red granite.

Occurs in parts of Stearns, Wright, Sherburne, Benton, and Mille Lacs Counties.

Stearns Shale (in Council Grove Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 230, 233, 234, 235, 237.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 46; K. L. Walters, 1954, Kansas Geol. Survey Bull. 106, p. 48, pl. 1. Contains minor amount of impure limestone; mostly gray to olive but red shale occurs in middle and lower parts; locally contains thin coal bed in Lyon and Morris Counties, Kans. Thickness ranges from about 7 feet in southern Kansas to about 20 feet in northern part of State. Underlies Eiss limestone member of Bader limestone; overlies Morrill limestone member of Beattie limestone. Wolfcamp series.

Type locality: South of Stearns School, 1½ miles northeast of Humboldt, Richardson County, Nebr. Type section now obscured, but member typically exposed along a north-south road, 6 miles south and 1½ miles east of Humboldt.

Steele Shale (in Montana Group)[1]

Upper Cretaceous: Eastern and central Wyoming.

Original reference: N. H. Darton, Eliot Blackwelder, and C. E. Siebenthal, 1910, U.S. Geol. Survey Geol. Atlas, Folio 173.

C. J. Hares and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 51. Stratigraphic section [northeastern part of Wind River basin and adjacent areas in central Wyoming] shows that term Cody shale replaces terms Carlile shale, Niobrara shale, and Steele shale as used in this area by Hares (1916, U.S. Geol. Survey Bull. 641–I).

G. H. Horn, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–164. Thickness in Sussex and Meadow Creek oil fields, Johnson and Natrona Counties, 2,240 feet, a little more than one-half of formation exposed. Includes (ascending) Shannon sandstone member and Sussex sandstone member (both exposed). Underlies Parkman member of Mesaverde formation; overlies Niobrara formation.

J. M. Parker, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90, 98. Stratigraphic unit terms Lewis, Mesaverde, Steele, Cody, Ferguson, and Ash Creek are believed to be misnomers and should not be used in Powder River basin.

J. R. Bergstrom, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 114 (columnar section). In southeastern Wyoming, underlies Allen Ridge formation (new).

Type locality: Fort Steele on North Platte River, Carbon County.

Steele Valley Granodiorite[1]

Upper Jurassic(?): Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 502, map.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 76. Rocks called Steele Valley granodiorite by Dudley (1935) belong to Woodson Mountain granodiorite, which is considered Cretaceous.

Occurs in Steele Valley, in southern part of Perris-Elsinore area, Riverside County.

Steels Knob chert facies (of Muldraugh Formation)

Lower Mississippian: Central Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 75, 201–211. Characterized by bedded chert, in layers up to 4 feet thick, which constitutes as much as 50 percent of the formation at places. Thickness 60 to 75 feet. Underlies Harrodsburg limestone; overlies Floyds Knob formation. Merges with West Point facies (new) on the west and Maretburg facies (new) on the east.

Well exposed along State Highway 49, Casey County, at steep hill from plateau to valley of Martins Creek, around Steels Knob. Name taken from topographic promontory in Casey County known as Steels Knob.

Steens Basalt[1]

Pliocene, middle: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington Univ. Pub. Geol., v. 3, no. 1, p. 7–130.

A. M. Piper, 1936, Oregon Country Geol. Soc. News Letter, v. 2, no. 8, p. 10. Steens basalt unconformably overlies siliceous extrusives in marginal upland along eastern half of Harney basin. Maximum thickness 3,000 feet. Underlies Danforth formation (new).

A. M. Piper, T. W. Robinson, and C. F. Park, Jr., 1939, U.S. Geol. Survey Water-Supply Paper 841, p. 26 (table), 49–51, pl. 2. Basalt series named Steens Mountain basalt by Fuller (1931) is here designated Steens basalt. At type section, series is more than 3,000 feet thick and comprises many layers whose thickness varies but averages about 10 feet. Underlies Danforth formation; in type area, overlies an andesitic series. Miocene.

Howel Williams, and R. R. Compton, 1953, U.S. Geol. Survey Bull. 995–B, p. 24 (table), 29–30, pl. 9. Described as cliff-forming flows of olivine basalt with rare partings of tuff. Overlies Steens Mountain volcanic series; in the High Steens, a distinct unconformity separates the two units, but below Smith Flat the two series are either conformable or their divergence of dip is so slight as to be imperceptible. Middle Pliocene.

Type section: Along highest part of east face of Steens Mountain, about 20 miles east of head of Donner and Blitzen Valleys, Harney County.

†Steens Mountain Basalt[1]

Miocene: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington [State] Univ. Pub. in Geology, v. 3, no. 1, p. 7–130.

A. M. Piper, T. W. Robinson, and C. F. Park, Jr., 1931, U.S. Geol. Survey Water-Supply Paper 841, p. 49. Basalt series named Steens Mountain basalt by Fuller (1931) is here designated Steens basalt.

Exposed almost continuously for 100 miles on east scarp of Steens and Pueblo Mountains.

Steens Mountain Formation[1]

Pliocene: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed on Steens Mountain, Harney County.

Steens Mountain Volcanic Series

Steens Mountain Andesitic Series[1]

Pliocene, lower: Southeastern Oregon.

Original reference: R. E. Fuller, 1931, Washington [State] Univ. Pub. in Geology, v. 3, no. 1, p. 7–130.

Howel Williams and R. R. Compton, 1953, U.S. Geol. Survey Bull. 995–B, p. 24 (table), 28–29, pls. 8, 9. Described as Steens Mountain volcanic series. Consists of olivine and augite basalts and amygdaloidal andesites rich in zeolites. Locally thick sheets of dacite and rhyolite cap the basic lavas. Pyroclastic interbeds rare and thin. Total thickness more than 3,000 feet in Southern Steens and Pueblo Mountains. Underlies Steens basalt; unconformably overlies Pike Creek volcanic series. Early Pliocene.

Occurs in area of Steens Mountain, Harney County.

Steep Gully Member (of Foley Formation)

Pliocene: Southwestern Louisiana (subsurface)

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 59–60. Comprises basal deposits of Foley penetrated below a depth of 200 feet by water wells and oil-test wells in vicinity of Elizabeth. Consists of a sequence of medium- to fine-grained sands interbedded with light-gray, gray-green, and blue structureless to thinly laminated clays. Beds dip south-southwestward at rates ranging from about 60 to 80 feet per mile; estimated that bottom of formation is at a depth of about 2,500 feet at Mamou, about 18 miles downdip from [Oakdale]. Underlies Mamou member (new) with contact gradational.

Named from Steep Gully Branch near town of Elizabeth in T. 2 S., R. 4 W., in Allen Parish, about 8 miles northwest of Oakdale. Most reliable records of member were obtained during drilling wells at Oakdale.

Steilacoom Gravel[1]

Pleistocene (Wisconsin): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

Type section: The Steilacoom Plains, which extend for many miles south and southwest from Tacoma, Puget Sound region.

Steins Mountain Quartz Latite Porphyry

Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 69, table 1, pl. 1. Columnar jointed flows and devitrified tuffs. Rock

is pinkish-gray porphyritic-aphanitic, with quartz and feldspar phenocrysts and numerous lithic and vitric fragments, many of which are flattened and elongated, imparting an eutaxitic structure to the rock. Conformably overlies unnamed basalt. No rock overlies unit in mapped area, but it is intruded by latite porphyry dikes.

Mapped in north-central part of Peloncillo Mountains, Hidalgo County, where it forms upper part of Steins Mountain and the hills to the east. North and northwest of mapped area it is extensively exposed.

Stennett Limestone (in Shawnee Formation)[1]

Pennsylvanian: Southwestern Iowa.

Original reference: S. W. Beyer and I. A. Williams, 1907, Iowa Geol. Survey, v. 17, p. 480.

Typically developed at Stennett, Montgomery County.

Stensgar Dolomite (in Deer Trail Group)

Stensgar Dolomite Member[1] (of Deer Trail Argillite)

Precambrian (Belt Series): Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, v. 57, map.

W. A. G. Bennett, 1941, Washington Div. Geology Rept. Inv. 5, p. 7. Termed a dolomite in Deer Trail group.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as next to youngest of five formations in Deer Trail group. Overlies McHale slate (new); underlies Buffalo Hump formation (new).

Occurs near Stensgar Mountain, Stevens County.

Stephens Sandstone (in Slatestone Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 19, pls. 2, 3, 4. Includes both massive and thin phases. Near Stephens siding, consists of about 40 feet of laminated silty sandstone with an alternation of dark- and light-colored fine sand and silt. Separated from underlying Crooked Fork group (new) by shale interval 30 to 140 feet thick; separated from overlying Petros sandstones (new) by shale interval 40 to 240 feet thick that contains Coal Creek coal.

Named from exposures along State Highway 62, south of Stephens siding, Petros quadrangle, Morgan County.

†Stephensport Bed (in Chester Group)[1]

Mississippian: Northwestern Kentucky and southwestern Indiana.

Original reference: A. F. Foerste, 1910, Kentucky Geol. Survey Rept. Prog. 1908–1909, p. 84.

Named for Stephensport, Breckinridge County, Ky.

Stephensport Group[1]

Mississippian (Chester Series): Western Kentucky, Illinois, and southern Indiana.

Original reference: E. R. Cumings, 1922, Indiana Dept. Conserv. Pub. 21, pt. 4, p. 514 (footnote).

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 37–44, pl. 1. Cumings (1922) suggested name Stephensport as a group to include formations now known as Glen Dean, Hardinsburg, Golconda, and Big Clifty. Term was little used. Proposed here to revive Cuming's group name, Stephensport. As here redefined consists of (ascending) Beech Creek limestone, Big Clifty formation, Golconda limestone (restricted), Hardinsburg formation, and Glen Dean limestone (restricted). Thickness 128 to 158 feet. Overlies West Baden group (redefined); unconformably underlies Mansfield formation.

Named for town of Stephensport, Breckinridge County, Ky., in vicinity of which all formations of group are exposed.

Stepovak Series[1]

Eocene: Southwestern Alaska.

Original reference: Charles Palache, 1904, Harriman Alaska Expedition, v. 4, p. 74.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, p. 12. "Lower beds" of series exposed in vicinity of Chichagof Peak, about 85 miles northeast of Belkofski Bay, described as pyroclastics of early Eocene age.

Occupies most of area studied about Chicagof Cove, Stepovak Bay, on Alaska Peninsula.

Steptoean series[1]

Lower Ordovician: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 78.

Named for development in Egan Mountains, which faces Steptoe Valley.

Sterling Granite Gneiss[1]

Carboniferous or post-Carboniferous: Eastern Connecticut and Rhode Island.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 131–136, 152, 154, 155, map.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 56–65, pl. 1. Discussed as an orthogneiss. Variety of granitic rocks associated with unit. Pre-Permian.

A. W. Quinn, 1951, Bedrock geology of the North Scituate quadrangle, Rhode Island: U.S. Geol. Survey Quad. Map [GQ–13]. Geographically restricted from eastern Rhode Island. Since unit has been assigned a late Carboniferous or post-Carboniferous age, it seems desirable to give a new name, Scituate granite gneiss, to pre-Pennsylvanian granite gneiss mapped in North Scituate quadrangle.

G. E. Moore, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Unit herein named Ten Rod granite gneiss was included in Sterling granite gneiss by Gregory (1906).

C. B. Sclar, 1958, Connecticut Geol. Nat. History Bull. 88, p. 126–128, geol. map. Results of a study of bedrock geology of 55 square miles in eastern part of New London County, Conn. Bedrock consists of a group of metamorphic foliates known collectively as Putnam gneiss, a basic magmatic intrusive mass known as Preston gabbro, and gneisses of

granitic composition referred to as Sterling granitic gneisses. Sterling consists of two mappable units, a granitic augen gneiss and an alaskitic to microalaskitic gneiss.

Crops out in Sterling Township, Windham County, Conn.

Sterling Station iron ore[1]

Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 49. Hematitic limestone horizon occurring at top of Reynales on Salmon Creek and in Wolcott core and, in upper part of Bear Creek shale is remarkably persistent. Chadwick (1918) named the horizon Sterling Station iron ore. The objection to considering it as a formation is its thinness and the fact that it occurs as stringers imbedded in uppermost part of underlying formation and not as a distinct unit in itself.

Named for occurrence at Sterling Station, Cayuga County.

Stetson Brook Limestone (in Tacoma Series)

Cambro-Ordovician(?): Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations. Belongs to Tacoma series (new). Older than Hill Ridge biotite schist (new); younger than Thorncrag limy gneiss (new).

Occurs in Lewiston area, Androscoggin County.

Steuben Limestone Member (of Cobourg Formation)

Middle Ordovician (Mohawkian): East-central New York.

G. M. Kay, 1943, Am. Jour. Sci., v. 241, no. 10, p. 598, 601, 602. Name proposed for upper member of formation in Utica quadrangle and vicinity. Described as coarse-textured calcite sandstone. Maximum thickness about 60 feet; 26 feet exposed above dam on Steuben Creek. Overlies newly defined Rust limestone member; underlies Holland Patent shale.

Marshall Kay, 1953, New York State Mus. Bull. 347, p. 61. Disappears by unconformity west of Poland. Outcrop areas described.

Typically exposed in small quarries and along streams south of road south of Steuben Creek for a mile from its mouth. Named from creek where exposed above dam at Prospect Bridge, Oneida County.

Steussy Shale Member (of Lazy Bend Formation)

Steussy Shale Member (of Millsap Lake Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: E. H. Sellards, 1933, Texas Univ. Bull. 3232, p. 106, 107. From manuscript of report by G. Scott and J. M. Armstrong, on geology of Parker County.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 16–17, pl. Steussy shale member of Lazy Bend formation defined as those beds occurring between Meek Bend limestone bed of Hill Creek member and lower Brannon Bridge limestone member. Total thickness 180 feet. Lower 90 feet of shale are overlain by 40 feet of sandstone. Upper 30 feet are intermittently exposed along Steussy scarp below capping Brannon Bridge limestone. Origin of name Steussy not clear in original description. Upper part of shale is exposed on scarp northwest of Rocky Creek west of Brazos River. This feature is called Steussy Scarp

in original reference, giving the impression that the geological name is after topographic feature bearing that name. Type section designated.

Type section: Exposures on west side of hill (located on southeast side of Rocky Creek) and in cuts of ranch road crossing Steussy Scarp to north, Parker County. Rocky Creek flows from southwest into Brazos River just north of Lazy Bend.

Stevens Series[1]

Silurian: Northeastern Washington.

Original reference: C. E. Weaver, 1920, Washington Geol. Survey Bull. 20, p. 49, map.

W. W. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 11, p. 2495. Silurian.

As originally defined, included the following units: Addy quartzite, Boundary argillite, Cedar Creek argillite, Chewelah argillite, Clugston limestone, Colville quartzite, Deep Lake argillite, Deer Lake argillite. Deer Trail argillite, Eagle Mountain quartzite, Fish Creek argillite, Lead Point argillite, Mission argillites, Old Dominion limestone, Red Top limestone, and Republican Creek limestone. Most of these units have been redefined or are no longer used.

Named for occurrence in Stevens County.

Stevens Creek Limestone (in Borden Group)[1]

Mississippian: Southeastern Indiana.

Original reference: C. A. Malott, 1922, Indiana Dept. Conserv. Pub. 21, pt. 2, p. 193.

Exposed in middle of the Borden in Stevens Creek and in Brummets Creek, Norman upland, Monroe County.

Stevens Creek Slates[1]

Precambrian: Northwestern South Carolina.

Original references: E. Sloan, 1908, Repts. and resolutions of General Assembly of South Carolina, regular sess., commencing Jan. 14, 1908, v. 1, p. 648–651; 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 414–417.

Probably named for exposures on Stevens Creek, Edgefield County.

Stewarts Landing facies[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana and northern Kentucky.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 228–230.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 127–128, pl. 1. Mississippian facies nomenclature discussed. Stewarts Landing facies listed in Edwardsville formation.

Name derived from Stewarts Landing, southeastern Harrison County, Ind.

†Stewartsville Group[1]

Eocene: Western California.

Original reference: B. L. Clark, 1918, Geol. Soc. America Bull., v. 29, p. 94.

†Stewart Valley Limestone

Mississippian: Southern California.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 275 (fig. 3), 332–334. A unit about 1,180 feet thick in which three unnamed members are recognized. The lowest, about 690 feet, is predominantly light- to dark-gray limestone in beds averaging 1 to 5 feet

thick; the middle, 240 feet thick, is a dense light-creamy-gray limestone with porcelainlike texture, interbeds of dark-gray limestone in lower and upper parts; the upper, 50 feet thick, is a fossiliferous dark-gray limestone and dolomite. Unconformably underlies Monte Cristo(?) limestone; overlies Sultan dolomite.

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881. Name abandoned. Unit originally described as Stewart Valley is now known to include beds of both Devonian and Mississippian age. Suggestion made that Mississippian beds previously ascribed to Stewart Valley be assigned to Dawn limestone member of Monte Cristo limestone, and the Devonian beds be assigned to Crystal Pass and Valentine members of Sultan limestone.

Present on both western and eastern slopes of Nopah Range, Inyo County. Beds crop out to east of Devonian rocks and form major part of cliffs along northern range summit.

Stewartville Member (of Galena Dolomite)

Stewartville Dolomite[1]

Stewartville Member (of Wise Lake Formation)

Middle Ordovician: Southeastern Minnesota, northwestern Illinois, and northeastern Iowa.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 27.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 88–90. Uppermost member of Galena formation. Overlies Prosser member; underlies Dubuque member of Maquoketa formation. Ulrich did not designate type locality. It is probable that name was taken from town of Stewartville and that outcrop there is to be considered the type. Thickness 50 to 55 feet; about 30 feet where typically exposed at old quarry one-half mile west of Stewartville. Mohawkian.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Cong., fig. 3. In Dixon-Oregon area, Illinois, considered upper member of Wise Lake formation (new). Overlies Sinsinawa member (new); underlies Dubuque formation.

A. F. Agnew, 1956, U. S. Geol. Survey Prof. Paper 274–K, p. 261, 297–298. Middle member of the Galena. Overlies Prosser member; underlies Dubuque member. In Zinc-lead district, consists of yellowish-buff thick-bedded vuggy dolomite with *Receptaculites* in lower part. Thickness 37 to 47 feet.

M. P. Weiss, 1957, Geol. Soc. America Bull., v. 68, no. 8, p. 1029 (fig. 1), 1039–1040. Considered uppermost member of Galena formation in this report [Fillmore County, Minn.]. Member is dolomitic limestone, pale yellowish- gray to grayish yellow, which weathers to yellowish orange. Thickness about 85 feet, where completely exposed at Mahood's Creek, near Greenleafton. Overlies Prosser member; underlies Dubuque formation.

Probably named for exposures near Stewartville, Olmsted County, Minn. Typical exposure measured at Old Quarry, north bank of Root River one-half mile above dam at Stewartville.

Stice cyclothem (in Cheorokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 40 (fig. 9), 45. Approximately 45 feet of beds occurring above Bevier cyclothem are here designated Stice cyclothem. Strata underlie persistent, relatively prominent sandstone called "Squirrel", which is interpreted as part of Breezy Hill cyclothem.

Derivation of name not given. Stice coal occurs in upper Cherokee shale in eastern Labette County.

Stiles Phyllite[1]

Lower Cambrian: Southwestern Vermont.

Original reference: A. Keith, 1932, Washington Acad. Sci. Jour., v. 22, p. 360, 400.

Named for occurrence at Stiles Mountain, 4 miles southwest of Brandon, in Brandon quadrangle, Rutland County.

Stillaguamish Group

Middle to Upper Permian: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Argillites, ribbon cherts and volcanic rocks.

On Mount Baring, Gunn Peak, and Merchant Peak, in Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Stillaguamish Sand Member (of Vashon Drift)

Pleistocene: Northwestern Washington.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 26, 27, pl. 1. An outwash deposit consisting largely of fine sand and clay with coarser material near top. Thickness about 300 feet. Underlies Arlington gravel member (new).

Area: Snohomish County; contains Tps. 26 to 32 N. of the Willamette base line.

Stillman Member (of Grand Detour Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15A. Shown on columnar section as underlying Clement member (new) and overlying Walgreen member (new). Thickness 4 to 7 feet.

Occurs in Dixon-Oregon area.

Still Ridge Formation (in Bisbee Group)

Lower Cretaceous: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 50–52, table 1, pl. 1. Silty and sandy limestone, sandstone, calcareous sandstone, and limestone pebble conglomerate. The limestone pebble conglomerate, which is prominent in the sequence, consists of black limestone pebbles which weather light gray in a dark-gray to black limestone matrix which weathers brown. Interbedded volcanic rocks. Thickness 658 feet on south slope of Still Ridge and 575 feet on east side of ridge in Rs. 20 and 21 W., T. 25 S. Underlies Johnny Bull sandstone (new) and overlies Carbonate Hill limestone (new) with conformable contacts.

Named from exposures on Still Ridge, just north of Carbonate Hill mine. Excellently exposed on south side of Still Ridge; likewise on crest and

upper slopes of small ridge in Rs. 20 and 21 W., T. 25 S., Peloncillo Mountains, Hidalgo County.

Stillwater Complex[1]

Precambrian: Montana:

Original reference: J. W. Peoples, 1933, Pan-Am. Geologist, v. 60, p. 152.

H. H. Hess, 1960, Geol. Soc. America Mem. 80, p. 1–230, plates. Complex is intrusion of lopolithic form. Floor and about 16,000 feet of layered rocks are exposed on East Boulder plateau. Estimated that another 40 percent of complex and its roof are hidden beneath cover of Paleozoic rocks. A quantitative mineralogical study. Comparisons with Bushveld complex, Great Dyke, and Skaergaard intrusion.

W. R. Jones, J. W. Peoples, and A. L. Howland, 1960, U.S. Geol. Survey Bull. 1071–H, p. 281–340, pls. 23, 24, 25. An upturned and previously beveled edge of Stillwater complex, a Precambrian stratiform sheet about 18,000 feet thick, crops out in belt 30 miles long on northeast margin of Beartooth Mountains. As subdivided in this report, complex consists of four zones: basal, 200 feet thick, of medium-grained noritic rocks; ultramafic zone, 4,000 to 6,000 feet, a succession of layers of bronzitite, granular, harzburgite, poikilitic harzburgite, and chromite; banded zone and upper zone, aggregate thickness 14,000 feet, of layers of norite, anorthosite, troctolite, and gabbro. Flathead sandstone is basal Cambrian unit throughout Beartooth Mountains except at contact of Cambrian with the complex where the overlying Wolsey is the basal unit. Tectonic structures and igneous activity discussed.

Named for exposures in Stillwater River area.

Stillwater Formation[1]

Permian: Central and northern Oklahoma.

Original reference: C. N. Gould, 1901, Kansas Acad. Sci. Trans., v. 17, p. 181.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., 21, no. 12, p. 1519 (fig. 1). Shown on graphic section as occurring in interval between Herington limestone above and Cottonwood limestone below. Falls within Wanette time division of the Permian.

Typically exposed near Stillwater, Payne County.

Stillwater Formation[1]

Eocene: Southeastern Alaska.

Original reference: G. C. Martin, 1908, U.S. Geol. Survey Bull. 335, p. 24, 30.

Arthur Troutman, ed., 1958, The Alaskan oil and gas handbook: Austin Tex. Oil Frontiers, p. 43 (strat. section). Stillwater formation believed to thin eastward forming marine tongue in coal-bearing Kushtaka formation. Eocene.

Occupies entire valley of Stillwater Creek and extends for some distance up valleys of Trout and Clear Creeks.

Stillwater Glacial Stage

Pleistocene (Illinoian): North-central Colorado.

R. L. Ives, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 75. Oldest of four ice advances recognized in Monarch Valley. Older than River glacial stage (new). Evidenced by terminal moraine.

R. L. Ives, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1056, 1062. Time covered by deposition of outer series of moraines in Monarch Valley, mapped as moraine one.

Moraines of Stillwater age forced Colorado River to adopt new channel, part of which took over valley of Stillwater Creek, Monarch Valley, Grand County.

†Stillwater Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Eastern Ohio.

Original reference: J. S. Newberry, 1874, Ohio Geol. Survey, v. 2, p. 131, pl. opposite p. 81.

Named for Big Stillwater Creek, Tuscarawas County.

Stillwater Creek Member (of Cowlitz Formation)

Eocene, upper: Southwestern Washington.

Named as basal member of Cowlitz. Underlies Pe Ell volcanics member. D. A. Henriksen, 1954, Dissert, Abs., v. 14, no. 12, p. 2316.

D. A. Henriksen, 1956, Washington Div. Mines and Geology Bull. 43, p. 36–37, 38–45, pl. 1. Consists largely of soft to indurated laminated to massive marine shales, siltstone, silty sandstones, and mudstones, together with massive to crossbedded or laminated friable to compact fine-grained arkoses, feldspathic sandstone, and sandy siltstones; locally includes thin interbedded basalt flows, pyroclastic material, and tuffaceous and basaltic sandstones. Pe Ell volcanics member is intercalated in lower part of Stillwater Creek member. Minimum thickness 2,100 to 2,600 feet near Pe Ell; maximum thickness 5,400 feet along Stillwater Creek. Overlies Metchosin volcanic series with contact gradational.

Type section: A section across widest part of roughly shaped belt of outcrop around northern and eastern margins of Willapa Hills [Lewis County]. Exposed along Stillwater Creek from contact with Metchosin Volcanic Series about 3 miles west of Ryderwood eastward to mouth of Brim Creek, 3½ miles northeast of Ryderwood.

Stine Shale Bed (in Hamlin Shale Member of Janesville Shale)

Stine Shale[1]

Permian: Southeastern Nebraska and northeastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, p. 83, 84, 89.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1). Rank reduced to bed in Hamlin shale herein reduced to member status in Janesville shale (new). Wolfcamp series.

Named for exposures south of Stine, Nemaha County, Nebr.

Stinking Water Formation

Miocene, middle: Oregon.

Jane Gray, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1768. Incidental mention in note on fossil green algae from the Miocene of the Columbia Plateau.

Stirling Quartzite[1]

Precambrian: Southeastern Nevada and eastern California.

Original reference: T. B. Nolan, 1928, Am. Jour. Sci., 5th, v. 17, p. 461–472.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 278–279, 306–307. Geographically extended into Nopah-Resting Springs Mountains, Calif., where it is 2,593 feet thick, underlies Wood Canyon formation and disconformably overlies Johnnie(?) formation.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 19. Considered synonym for Prospect Mountain quartzite.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 146 (fig. 2). On correlation chart of recommended revision of stratigraphic units in Great Basin region, Stirling quartzite replaces Prospect Mountain quartzite in Death Valley, Providence Mountains, and Nopah-Resting Springs Mountains.

B. K. Johnson, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 375–377, 378 (fig. 7), figs. 1 (geol. map), 2 (columnar section). Described in Manly Peak quadrangle where it conformably overlies Johnnie formation. Thickness (incomplete section) about 1,000 feet. Late Precambrian or Algonkian.

Named for exposures on Mount Stirling, about 5 miles east of Johnnie mine, Spring Mountains, Clark County, Nev.

Stissing Dolomite[1]

Lower and Middle Cambrian: Southeastern New York.

Original reference: C. D. Walcott, 1891, U.S. Geol. Survey Bull. 81, p. 360.

E. B. Knopf, 1946, (abs.) Geol. Soc. America Bull. 57, no. 12, pt. 2, p. 1212. Light-colored dolomites carrying *Hyolithellus micans* Billings in four localities. Upper dark dolomites carry *Paterina stissingensis* Dwight and *Prozacanthoides stissingensis* Dwight in two localities. Indicates late early Cambrian age. Thickness 500 feet. Underlies Pine Plains formation (new). Overlies Poughquag quartzite.

E. B. Knopf, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1817. Lithologic and palentologic study indicate five characteristic lithologic zones in Stissing dolomite of Early and Middle Cambrian age. Thickness 500 feet. Overlies Poughquag quartzite; underlies Upper(?) Cambrian Pine Plains formation. Top of Stissing marked by dark beds that carry *Prozacanthoides stissingensis* Dwight and *Paterina stissingensis* Dwight.

Named from Stissing Mountain, northern Dutchess County.

†Stissing Quartzite[1]

Cambrian(?): Eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, chart.

Occurs on south and east slopes of Stissing Mountain, Dutchess County.

Stobo Limestone Lens (in Borden Group)[1]

Mississippian: Southwestern Indiana.

Original reference: A. B. Reagan, 1904, Indiana Acad. Sci. Proc. 1903, p. 214.

Occurs in SE¼ sec. 33, T. 9 N., R. 1 E., and NE¼ sec. 4, T. 8 N., R. 1 E., near old Stobo post office, 6½ miles east of Bloomington, Monroe County.

Stockade Beaver Shale Member (of Sundance Formation)

Stockdale Beaver Shale Member (of Rierdon Formation)

Upper Jurassic: Southwestern South Dakota and northwestern Wyoming.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 251–255, geol. sections. Medium- to dark-gray soft fissile calcareous shale which ranges in thickness from about 5 to 85 feet; average thickness about 50 feet; at type locality 63 feet. Overlies Canyon Springs member (new) and underlies Hulett sandstone member (new). Locally overlies Gypsum Spring formation or Spearfish formation.

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 475, 482. Reallocated to member status in Rierdon formation herein assigned to Sundance group.

Type section: West side of Stockdale Beaver Creek about 5 miles northeast of Newcastle in sec. 18, T. 45 N., R. 60 W., Weston County, Wyo.

Stockbridge Limestone[1] **or Group**

Stockbridge Marble

Cambrian and Ordovician: Western Massachusetts, western Connecticut, eastern New York, and southwestern Vermont.

Original reference: Ebenezer Emmons, 1842, Geology New York, pt. 2, div., 4, Geology of 2d dist., p. 135–164.

R. V. Cushman, 1950, New York State Water Power and Control Comm. Bull. GW–21, p. 9 (table 2), 11, pl. 2. In Rensselaer County, Stockbridge limestone directly underlies Walloomsac slate; overlies rocks of Lower Cambrian age. Thickness not known.

John Rodgers and others, 1956, Preliminary geological map of Connecticut: Connecticut Geol. Nat. History Survey. Referred to as marble in Connecticut.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 18. In this report [Danbury quadrangle], unit mapped as Inwood marble was called Stockbridge limestone on State Geological Map of 1906. Moore (1935, Connecticut Geol. Nat. History Survey Bull. 56) used term Stockbridge series.

Norman Herz, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–108. Stockbridge limestone as formerly used is equivalent to at least seven formations of west-central Vermont that range in age from Early Cambrian to Early Ordovician. Stockbridge is raised to group to include (ascending) Kitchen Brook dolomite (new), Clarendon Springs dolomite, Shelburne marble, and Bascom formation. Overlies Cheshire quartzite; underlies Berkshire schist. Report is Cheshire quadrangle, Massachusetts.

Named for prominent development and quarries around Stockbridge and West Stockbridge, Berkshire County, Mass.

Stockstill Sandstone (in Indian Bluff Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 6, 11, pls. 2, 3, 4. In some areas, massive; in other areas, poorly cemented. Thickness 20 to 80 feet. Separated from overlying Indian

Fork sandstone (new) by shale interval that ranges in thickness from 25 to 100 feet; separated from underlying Seeber Flats sandstone (new) by shale interval that ranges in thickness from 40 to 120 feet.

Exposed on State Highway 116 between Petros and Armes Gap, Morgan County. Named for Stockstill Creek.

Stockton Formation (in Newark Group)[1]

Stockton lithofacies (of Newark Group)

Upper Triassic: New Jersey, New York, and southeastern Pennsylvania.

Original references: H. B. Kummel, 1897, New Jersey Geol. Survey Ann. Rept. State Geologists, 1896, p. 35–40; 1897, Jour. Geology, v. 5, p. 543–544.

M. E. Johnson and D. B. McLaughlin, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 52–53 (table), pl. 1. Stratigraphic section shows Stockton formation includes (ascending) arkose, red shale, and sandstone, 720 feet; thick-bedded to massive coarse quartz-arkose conglomerate (Solebury member, new), 387 feet; thick-bedded gray arkose, 224 feet; red sandstone, 447 feet; thick-bedded white and yellow arkose (Lower Prallsville member, new), 474 feet; red and brown sandstone, 136 feet; thick-bedded medium to coarse arkose (Upper Prallsville member, new), 205 feet; red and brown sandstone and red shale, 373 feet; medium to coarse thick-bedded arkose with interbeds of red-brown sandstone (Cutalossa member, new), 232 feet; red and gray sandstone and red shale, 787 feet; massive medium to coarse white and gray arkose (Raven Rock member, new), 293 feet; and red and brown sandstone, 724 feet. Underlies Lockatong formation; overlies Paleozoic limestone.

D. B. McLaughlin, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 62–77. Lithofacies discussed in detail in report on Bucks County. Term lithofacies used rather than formation because of intertonguing nature of units which prevents drawing distinct boundaries.

N. M. Perlmutter, 1959, New York State Water Power and Control Comm. Bull. GW–42, p. 7–9, 15–16, pls. 2, 3. Present in Rockland County, N.Y.

Named for exposures in quarries near Stockton, Hunterdon County, N.J.

Stockton Shale (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 326–327.

Probably named for fact that the coal was mined by Mr. Stockton.

Stockton Slate (in Kanawha Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 152, 409–410.

Stockwether Limestone Member (of Pueblo Formation)[1]

Stockwether Formation (in Pueblo Group)

Permian (Wolfcamp Series): Central northern Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 417.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Pueblo here given group

status. Includes Coon Mountain sandstone member. Underlies Camp Colorado formation; overlies Saddle Creek formation.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Prelim. Map 80, sheet 2. Described in Colorado River valley as limestone member of Pueblo formation. Typically fine-grained limestone containing numerous thin clear calcite veinlets and white porcelainlike foraminiferal remains; beds are uneven, to medium in thickness, and weather slabby. Thickness 5 to 30 feet, average 20 feet. Underlies Salt Creek Blend shale member; overlies Camp Creek shale member.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1801–G, p. 268–269. Stockwether member geographically extended into Brazos River valley. Thickness ½ to 3 feet. Overlies Camp Creek shale member; underlies Salt Creek Bend shale member.

Named for Stockwether Ranch, on Bull Creek, Coleman County.

Stoddard Member (of Oneota Formation)

Lower Ordovician: Southwestern Wisconsin.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 90–91, 94. At type locality lower part comprises 37 feet of massive gray crystalline-granular cherty dolomite; virtually without bedding planes, vuggy and traversed by irregular porous areas. Above is 6-foot thickness of thin-bedded cryptocrystalline dolomite. If member is restricted to strata between thin beds of dolomite above and Genoa member (new) below, thickness would range from more than 50 feet in the northwest to about 25 feet in the southwest part of quadrangle. Conversely, on basis of high level chert float of Oneota type, member may reach thickness of more than 130 feet.

Type locality: Quarry and Mississippi bluff in NW¼NE¼ sec. 33, T. 14 N., R. 7 W., Stoddard quadrangle, 1 mile south of Stoddard, Vernon County.

Stoddard Canyon Quartz Monzonite

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 301–302, geol. map. A fine-grained massive light-gray plutonic rock. Occurs as dikes and small irregular-shaped bodies ranging from a few to several hundred feet or more in width, in El Dorado Ridge-Stoddard Canyon pluton, cutting across gneissosity of El Dorado Ridge quartz diorite (new). Intrudes Rainbow Flat group (new).

Exposed in Cucamonga quadrangle, San Bernardino County.

†Stokes Sandstone (in Cheyenne Sandstone)[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 361, 367.

Named for Stokes Draw, which proceeds from foot of Stokes Hill and south of Lanphier Draw, in southeastern corner of Kiowa County.

†Stokes Hill Sandstone[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: W. H. Twenhofel, 1924, Kansas Geol. Survey Bull. 9, p. 13.

Named for Stokes or Black Hill, a few miles west of Sun City, Barber County.

Stonberger Shale

Ordovician: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in report on Paleozoic continental margin in central Nevada. Underlies Antelope Valley formation.

Toquima Range, Nye County.

†Stonebreaker Limestone Member (of Buck Creek Formation)[1]

Pennsylvanian (Virgil Series): Central northern Oklahoma.

Original reference: K. C. Heald, 1918, U.S. Geol. Survey Bull. 686–K, p. 130–131.

U.S. Geological Survey has abandoned the Buck Creek Formation and the Stonebreaker Member.

Named for Stonebreaker Ranch, Pawhuska quadrangle, Osage County.

Stone Cabin Tuff

Tertiary: Eastern Nevada.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 140 (fig. 4). Crystal-vitric ignimbrite; upper two-thirds moderately to highly welded pale purple, grading down abruptly into highly welded red-purple zone which in turn gives way downward to cavernous lightly welded to nonwelded tuff at base. Thickness 540 to 690 feet. Occurs below Currant tuff.

Present in Grant Range.

Stone City Beds or Formation (in Claiborne Group)[1]

Stone City Member (of Crockett Formation)

Eocene, middle: Eastern Texas.

Original reference: H. B. Stenzel, 1935, Texas Univ. Bull. 3501, p. 267–279.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20, 120–124 [1939]. Formation underlies Wheelock member (new) of Crockett formation; overlies Sparta formation. Thickness 80 to 120 feet.

G. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 13, 15. Rank reduced to member status in Crockett formation. Thickness about 19 feet in Lee County.

H. B. Stenzel, E. K. Krause, and J. T. Twining, 1957, Texas Univ. Bur. Econ. Geology Pub. 5704, 237 p. Thickness 61.1 feet at type locality. Overlies Sparta sand; underlies Wheelock member of Cook Mountain formation. Includes Moseley limestone of Renick and Stenzel (1931), Term Moseley no longer used. Pelecypod fauna described. Middle Eocene.

Type locality: Stone City bluff on Brazos River, Burleson County. Beds traceable to Atascosa County in southwestern Texas and to Sabine River at Texas-Louisiana boundary.

Stone Coal Bluff Lignite (in Slaughter Creek Member of Pendleton Formation)

Eocene, lower: Northwestern Louisiana.

Richard Wasem and L. J. Wilbert, Jr., 1943, Jour. Paleontology, v. 17, no. 2, p. 184 (fig. 4), 187. Occurs about 50 feet above base of member. Thickness varies from 1 to 6 feet. Occupies constant stratigraphic position and has been traced for 14 miles along strike of formation.

Named for its outcrop at Stone Coal Bluff on Sabine River, Sabine Parish.

Stone Corral Formation (in Sumner Group)

Stone Corral Dolomite (in Enid Formation)

Stone Corral[1] Member (of Harper Sandstone)

Permian: Central Kansas.

G. H. Norton, 1935, (abs.) Am. Assoc. Petroleum Geologists Program 20th Ann. Mtg., March 21, 22, p. 17. Dolomitic limestone, 6 feet maximum thickness at its northern limit in Rice County; can be traced southward about 50 miles, splitting into two or three thin layers and finally disappearing as a distinct unit north of Oklahoma line and identifiable only as zone of huge halite casts. Occurs in middle part of Harper sandstone.

E. A. Koester, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 10, p. 1410. Name Stone Corral used in table where it is placed in Cimarron series.

R. C. Moore and K. K. Landes, 1937, Geologic map of Kansas (1:500,000): Kansas Geol. Survey. Mapped as dolomite member of Enid formation. Cimarron series.

G. H. Norton, 1937, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1774–1781. Middle member of Harper sandstone. Overlies Ninnescah shale member (new); underlies Chikaskia sandstone member (new).

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1774–1781. Harper sandstone restricted below to exclude Stone Corral dolomite and Ninnescah shale. Overlies Runnymede sandstone member (new) of Ninnescah shale. Included in Cimarron series. Type locality stated.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 91. Sumner group comprises Wellington shale, Ninnescah shale, and Stone Corral dolomite. Leonard series.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Chart shows Stone Corral formation at top of Sumner group. Underlies Chikaskia siltstone. Member of Harper siltstone; overlies Runnymede siltstone member of Ninnescah shale.

Type locality: Sec. 11, T. 20 S., R. 6 W., Rice County. Named for exposures near historic Stone Corral Fort, where wagon trains of pioneers forded Little Arkansas River on Santa Fe Trail.

Stone Creek Member (of Brallier Shale)

Upper Devonian: Central Pennsylvania.

R. R. Conlin and others, 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 274, 276. Incidental mention only as basal member.

Forms first foothills of Allegheny Front along northwesterly margin of alluvial plain of Bald Eagle Creek, between Harrisburg and Tyrone.

Stonefort cyclothem (in Spoon Formation)

Stonefort cyclothem (in Tradewater Group)

Pennsylvanian: Southeastern Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 15 (fig. 2) [1943]. Stonefort cyclothem occurs below Davis cyclothem and above Macedonia cyclothem. Includes Curlew sandstone, Bald Knob coal, and Stonefort limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 5, 9, pl. 1. Includes (ascending) Curlew sandstone, Bald Hill coal, Stonefort coal, and Stonefort limestone; underlies Colbert cyclothem (formerly termed Davis). Type locality designated.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 53 (table 2), pl. 1. In Spoon formation (new). Above Macedonia cyclothem and below Colbert cyclothem. Type locality given; Wanless (1956) reference in error. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: NE¼SE¼ sec. 25, T. 10 S., R. 4 E., Williamson County.

Stonefort Limestone Member (of Spoon Formation)

Stonefort Limestone Member (of Tradewater Formation)[1]

Stonefort Limestone (in Tradewater Group)

Middle Pennsylvanian: Southeastern Illinois and western Kentucky.

Original reference: L. G. Henbest, 1928, Jour. Paleontology, v. 2, p. 70–71.

J. M. Weller, L. G. Henbest, and C. O. Dunbar, 1942, *in* C. O. Dunbar and L. G. Henbest, Illinois Geol. Survey Bull. 67, p. 15 (fig. 2), 18 (table), 21–22 [1943]. Stonefort limestone in Tradewater group is a persistent bed 1 to 2 feet thick that is medium gray, weathers brownish, and is sparingly fossiliferous. Occurs in midst of succession of thin beds including several coals. A thin limestone without marine fossils occurs locally a few feet above the Stonefort, which is the first marine horizon above Curlew limestone. Included in Stonefort cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 32, 33, 46. Included in Spoon formation (new). Overlies Wise Ridge coal member; underlies Davis coal member. Type locality corrected. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

U.S. Geological Survey has discontinued the use of the term Tradewater in Illinois.

Type locality: In roadcut and in ravines east of road in NE¼SE¼ sec. 25, T. 10 S., R. 4 E., Williamson County, Ill. Name derived from town of Stonefort, Saline County.

Stonehenge Limestone (in Beekmantown Group)

Stonehenge Limestone Member (of Beekmantown Limestone)[1]

Lower Ordovician: Central and central southern Pennsylvania, western Maryland, and northwestern Virginia.

Original reference: G. W. Stose, 1908, Jour. Geology, v. 16, p. 703.

B. N. Cooper, 1936, Virginia Geol. Survey Bull. 46–L, p. 138–139. Formation described in Marion area, Virginia, where it is dove-gray massive vaughanite about 25 feet thick. Conformable with underlying Chepultepec; in some areas, contact is "welded" in a single bed. Canadian system.

H. P. Woodward, 1951, West Virginia Geol. Survey, v. 21, p. 53–54, 58–59. Term Stonehenge has priority over Chepultepec in event the names are judged to be completely synonymous; however, term Chepultepec-Stonehenge is used in this report. Chepultepec-Stonehenge not included in Beekmantown group.

W. J. Sando, 1956, Geol. Soc. America Bull., v. 67, no. 7, p. 935–936. Basal formation in Beekmantown group. Comprises two unnamed members of approximately equal thickness: a lower division of dominantly algal limestone and an upper division of thin-bedded silty mechanical limestone. Underlies Rockdale Run formation (new); overlies Conococheague limestone. Base of formation is placed at contact of massive limestone of lower member with thin-bedded limestones that form persistent lithologic unit at top of Conococheague limestone. Inasmuch as *Symphysurina* and *Clelandia* have been recovered 30 feet below top of Conococheague, at least uppermost 30 feet of this formation is of Early Ordovician age; hence, Stonehenge-Conococheague contact does not exactly coincide with Cambrian and Ordovician systems. Type section designated.

W. J. Sando, 1957, Geol. Soc. America Mem. 68, p. 18–21, 60, 76–78, pl. 1. Thickness at Maryland reference section 726½ feet. Thickness at reference section of Beekmantown group 909 feet.

J. P. Hobson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 12, p. 2713–2715, 2716–2717 (fig. 3). Formation, in Berks County, Pa., consists of 250 feet of thick- to thin-bedded limestone and dolomite. In reference section (herein designated), divided into three members: upper or calcilutite member, middle or calcirudite member, and lower interbedded limestone and dolomite member. Underlies Rickenbach formation (new). In southern Pennsylvania and Maryland, contact between Stonehenge limestone and Conococheague limestone has been placed between relatively pure limestone of lower Stonehenge and more impure beds of the Conococheague. This contact appears to be similar to the relatively sharp lithological break between upper and middle members of Stonehenge as mapped in this report. Clastic beds beneath this contact in central Berks County are more similar lithologically and paleontologically to the Beekmantown than to the highest exposed Conococheague-Elbrook limestones as indicated on Geologic Map of Pennsylvania (Stose and Ljungstedt, 1932). An unmetamorphosed section in uppermost 300 feet of exposed part of Conococheague in vicinity of Reading was examined. A covered interval with apparent stratigraphic thickness of 500 to 600 feet overlies this section and is persistent throughout Berks County. Beds overlying the concealed interval throughout Berks County are included in Stonehenge limestone.

W. J. Sando, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 837–841, geol. sections. Described near Chambersburg, Pa. Base of Stonehenge was originally placed at contact of pure fine-grained massive limestones with underlying sandy conglomeratic thin-bedded limestone included in upper part of Conococheague formation. Cambrian-Ordovician boundary was placed at this contact. The lower thin-bedded limestones form persistent stratigraphic unit in southern Pennsylvania, Maryland, and West Virginia and bear diagnostic Lower Ordovician trilobite assemblage. These beds are here named Stoufferstown member of Stonehenge. Upper member of Stonehenge as used in this paper is equivalent to upper and lower members of Maryland (Sando, 1957). Underlies Rockdale Run formation. Thickness about 1,000 feet; Stoufferstown member 217 feet in its type section.

A. C. Donaldson, 1960, Dissert. Abs., v. 20, no. 9, p. 2693. In central Pennsylvania, subdivided into (ascending) Spring Creek, Graysville, Baileyville, and Logan Branch members. Thickness 430 to 485 feet. Larke

dolomite subdivided into four unnamed members which are lateral extensions of members in the Stonehenge.

Type section: On Hoover Farm just north of U.S. Route 30, 2 miles southeast of center of Chambersburg, Franklin County, Pa. Reference section (Maryland): Section begins in pasture northeast of barn on Forsythe Farm located 1 mile S. 5° E. of St. Paul's Church, Washington County.

Reference section (Pennsylvania): Along northwest bank of Schuylkill River in borough of Glenside, a suburb of Reading, Berks County.

Stonehengian division (of Ozarkian Series)

Lower Ordovician: Eastern United States.

A. W. Grabau, 1937, Paleozoic formations in the light of the pulsation theory, v. 3, Cambrovician pulsation, pt. 2, Appalachian, Palaeocordilleran, Pre-Andean, Himalayan, and Cathaysian geosynclines. Peiping, China, Univ. Press, Natl. Univ. Peking, p. 10, 13 (table), 15, 282 (table). The Stonehenge and Tribeshill (its Mohawk Valley partial equivalent) represent essentially the Tremadoc of the Caledonian geosyncline, and for them the same Stonehengian is proposed. The Stonehenge and Tribeshill represent the last of the transgressive series from the southern Appalachian geosyncline.

Stone Mill Member (of Ludlowville Formation)

Middle Devonian: Central New York.

G. A. Cooper and A. S. Warthin, 1941, Washington Acad. Sci. Jour., v. 31, no. 6, p. 259. Name proposed for thin bed of limestone consisting mostly of crinoidal and fragmentary shell material with considerable sand. Thickness 1 to 3 feet.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1783, chart 4. Underlies shaly sandstone of the formation; overlies Chenango sandstone.

Type section: In bed and banks of Stone Mill Brook 4½ miles (airline) southeast of Lebanon and about 1½ miles northwest of Earlville, Madison County. Exposed on both sides of Chenango Valley in Morrisville quadrangle.

Stone Mountain Granite

Permian(?): Northwestern Georgia.

T. L. Watson, 1902, Georgia Geol. Survey Bull. 9–A, p. 114–119. Name applied to granite quarried at Stone Mountain. An even-textured medium-grained light-gray biotite-bearing muscovite granite.

L. A. Herrmann, 1954, (abs.) Geol. Soc. America Bull., v. 65, no. 12, pt. 2, p. 1362; 1954, Georgia Geol. Survey Bull. 61, p. 29–32, 55–61. Stone Mountain granite (Permian?) was introduced during a late stage of the Appalachian orogeny. Intrudes Lithonia gneiss.

Named for occurrence at Stone Mountain, DeKalb County.

Stoner Limestone Member (of Stanton Limestone)[1]

Pennsylvanian (Missouri Series): Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra, 1930, Nebraska Geol. Survey Bull. 3, 2d ser., p. 11, 26, 27, 31, 33, 34.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 118–119. Overlies Eudora shale member; underlies Rock Lake shale member (this is classification agreed upon by State Geological Surveys of Iowa, Kansas,

Missouri, Nebraska, and Oklahoma, May 1947). Thickness along Kansas River and elsewhere in northeastern Kansas 11 to 15 feet; in parts of southern Kansas about 50 feet.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 32. In Nebraska, includes (ascending) Dyson Hollow limestone zone (new), Kiewitz shale zone, and unnamed limestone. Thickness at type locality 15 or 16 feet.

Type locality: On Stoner Farm, northwest of South Bend, Cass County, Nebr.

Stones River Group[1] or Limestone[1]

Middle Ordovician: Tennessee, western Maryland, northeastern Mississippi, southern Pennsylvania, western Virginia, and northeastern West Virginia.

Original reference: J. M. Safford, 1851, Am. Jour. Sci., 2d v. 12, p. 353, 354–356.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 819–886. Lower Middle Ordovician succession of Tazewell County, Va., studied in detail, and revised stratigraphic nomenclature proposed. Study revealed inconsistencies in use of names Stones River, Murfreesboro, Mosheim, Lenoir, Blount, Holston, Ottosee, Lowville, and Moccasin. Succession of beds described is post-Beekmantown. Boundary between Chazy and Black River is not clearly defined in Tazewell County. The Chazy of southern Appalachian Valley and Ridge province is, according to Ulrich, composed of Stones River and Blount groups (possibly also Ulrich's Speers Ferry group). According to Ulrich, Murfreesboro limestone is oldest formation of Stones River group which is lower Chazy. In Tazewell County, part of Ulrich's Blount group (upper Chazy) occurs beneath beds containing fauna of Murfreesboro limestone of Central basin of Tennessee. Such anomalies result from an erroneous determination of stratigraphic succession used by Ulrich in setting forth relations of Stones River and Blount groups. Neither group name should now be used. In revised terminology proposed herein, the succession of beds is grouped into eight formations. Series and group classification of the formations described in this report can be made only after regional studies between New York localities and Tazewell County have been completed.

B. N. Cooper, 1945, Jour. Geology, v. 53, no. 4, p. 263–275. Discussion of Stones River equivalents in Appalachian region. Commonly accepted correlation of Stones River group of central Tennessee with Chazy of New York and with beds immediately succeeding the Beekmantown or Knox dolomite in Appalachian Valley—the Stones River and overlying Blount—was based upon mistaken identification of formations. Both the stratigraphic position of Stones River equivalents in Appalachian region and character of Stones River faunas indicate that entire Stones River group is post-Chazyan. "Stones River" as a general time-rock term should no longer be used, nor should name be revived if a post-Chazyan, pre-Black River group is recognized. Report gives detailed history of usage of name and table of classifications of Stones River group as used through 1929.

L. C. Craig, 1949, Geol. Soc. America Bull., v. 60, no. 4, p. 715–717, geol. sections. Discussion of lower Middle Ordovician of south-central Pennsylvania. Limestone beds overlying Beekmantown and underlying the Chambersburg in Franklin County, were called Stones River by Stose (1906, Jour. Geology, v. 14; 1908, Jour. Geology, v. 16). Cooper (1945)

has shown that beds in Appalachian region of Virginia have been consistently miscorrelated with true Stones River of central Tennessee. Correlation from south-central Pennsylvania to Virginia indicates that term Stones River was misused in Chambersburg area and that equivalents of true Stones River are probably within Shippensburg formation. Term "Stones River" is used in this report for limestone underlying Shippensburg formation.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 24–75. Proposed in this report to return Carters limestone to top of Stones River group, thus making group consists of (ascending) Murfreesboro, Pierce, Ridley, Lebanon, and Carters limestones in accordance with Safford's original definition of Stones River in 1851. Contact between Carters and Hermitage formations is by far most pronounced stratigraphic break in this part of Ordovician section. Underlies Nashville group (redefined).

R. B. Neuman, 1951, Geol. Soc. America Bull., v. 62, no. 3, p. 267–324. Term St. Paul group introduced as substitute for "Stones River" group as mapped through West Virginia, Maryland, and Mercersburg-Chambersburg quadrangles in Pennsylvania. Need for substitution has been apparent since Cooper and Prouty (1943) demonstrated that central Tennessee Stones River was younger than Appalachian "Stones River."

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 87, pls. For purposes of present map, term "unit 1" of Chickamauga limestone replaces (in belts northwest of Whiteoak Mountain and Hunter Valley faults) the term Stones River of middle Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 91–92. Term Stones River group is appropriate to Central basin of Tennessee and possibly parts of Alabama but not to most parts of the Appalachians to which it has already been applied. For years this term has been used for lower or "Chazyan" part (Lenoir through Lincolnshire) of Appalachian section from Pennsylvania to Alabama. It was also just as inappropriately applied to parts of Minnesota section. Identification of Carters formation of the Central basin as Lowville, because of presence of *Tetradium cellulosum*, was chief factor in declaring subjacent beds, Lebanon through Murfreesboro, as Chazyan in age. Similar error was made in Appalachians in identifying all formations below *Cryptophragmus* and *Tetradium cellulosum*-bearing "Lowville" as Chazyan in age. This threw the lower formations of the Appalachians into correlation with Stones River formations. Thus, because of common presence of *Maclurites* and the position in relation to "Mosheim" rocks, Lenoir and Ridley were correlated, and from these false premises many other errors were brought about. Examination of fossils of Stones River formations of Central basin of Tennessee shows that affinities of this group are with the old Black River-Trenton (Wilderness stage, new) assemblage of formations rather than with the Chazy (Marmor stage, new). Stones River as group term should be dropped from the Appalachians.

Named for exposures on Stones River near Nashville, Tenn.

Stones Switch Sandstone Member (of Whitsett Formation)

Stones Switch Sand[1]

Eocene, upper: South-central Texas.

Original reference: A. C. Ellisor, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1302, 1314.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2632. Basal member of Whitsett as defined in this paper. Underlies Dubose member; overlies Conquista clay member (new) of McElroy formation (redefined). Chiefly crossbedded sandstone containing borings of marine crustacean(?) *Halymenites major* and, locally, marine or brackish-water fossils, as well as thin lenses of carbonaceous shale and bentonitic clay. Uppermost bed is generally an indurated plant-root-bearing sandstone, or, in some places, an oyster-shell bank. Note on derivation of name.

Named for railroad siding (now abandoned) from which a spur track led to a quarry on bluff overlooking Atascosa River 2½ miles north of Whitsett Bluff and 4.4 miles S. 5° W. of Campbellton, Atascosa County.

Stoneville Member (of Fox Hills Sandstone)

Upper Cretaceous: Western South Dakota.

W. V. Searight, 1934, South Dakota Geol. Survey Rept. Inv. 22, p. 4, 5, 8–11; E. P. Rothrock, 1944, South Dakota Geol. Survey Bull. 15, p. 83, 84. A succession of clay, sandstone, and coal beds in upper one-third of formation. Thickness 10 to 45 feet. Underlies unnamed upper sandstone member and overlies unnamed lower sandstone member.

Named for exposures near Stoneville, Meade County.

Stoneville Flats Limestone (in Greenhorn Formation)

Upper Cretaceous: Southeastern Montana and northeastern Wyoming.

M. N. Bramlette and W. W. Rubey *in* R. C. Moore, 1949, Geol. Soc. America Mem. 39, p. 27 (fig. 18). In lower chalk marl facies of formation. Older than Crow Creek sandy limestone; younger than Bull Creek sandy limestone (new).

Carter County, Mont., and Crook County, Wyo.

Stonewall Formation

Stonewall Quartz Diorite[1]

Jurassic(?): Southern California.

Original reference: F. S. Hudson, 1922, California Univ. Pub., Dept. Geol. Sci. Bull., v. 13, no. 6, p. 181, 191–193, map.

Richard Merriam, 1946, Geol. Soc. America Bull., v. 57, no. 3, p. 230–232, pl. 1. Described in Ramona quadrangle as Stonewall formation. Unit subdivided into Stonewall granodiorite and Stonewall quartz diorite. Each mapped separately. Shown as older than San Marcos gabbro.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 43. Probably pre-Triassic.

D. L. Everhart, 1951, California Div. Mines Bull. 159, p. 61–65, pls. 2, 3, 4, 5. A typical granodiorite, megascopically medium- to coarse-grained, with subhedral granular texture. Younger than Julian schist. Gives historical summary of name. Terms formation and granodiorite have both been applied to unit.

Richard Merriam, 1958, California Div. Mines Bull. 177, p. 11, pl. 1. Term Stonewall quartz diorite used in this report [Santa Ysabel quadrangle] though unit as mapped includes a variety of rock types. Younger than Julian schist; older than San Marcos gabbro.

H. W. Jaffe and others, 1959, U.S. Geol. Survey Bull. 1097–B, p. 86. Lead-alpha age 96 million years.

Named after Stonewall Peak, which is composed of this rock. Cuyamaca region, San Diego County.

Stonewall Creek Shale Member (of Lykins Formation)

Permo-Triassic: Northern Colorado.

T. L. Broin, 1958, Dissert. Abs., v. 19, no. 1, p. 114. Underlies Park Creek limestone member (new); overlies Poudre limestone member (new).

Stonington Beds[1] or Member (of Richmond Formation)

Upper Ordovician: Northern Michigan.

Original reference: R. C. Hussey, 1926, Michigan Univ. Mus. Geol. Contr., v. 2, no. 8, p. 113–150.

R. C. Hussey, 1952, Michigan Dept. Conserv. Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 14 (table), 42, 44, 52. Predominantly argillaceous limestones. Includes Bay de Noc member below and Ogontz beds [member] above. [Reference refers to Ogontz beds which lie above the Stonington but also states that "this member" was deposited under relatively clear water conditions.] Underlies Big Hill beds [or member]; overlies Bills Creek beds [or member] (restricted).

Named for exposures 1 mile north of Stonington post office, on east side of Little Bay de Noc, Delta County.

Stonington Gneiss[1]

Pre-Triassic: Southeastern Connecticut.

Original reference: L. H. Martin, 1925, Connecticut Geol. Nat. History Survey Bull. 33.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Described as gray, rarely pink, fine- to medium-grained gneiss. Many inclusions of biotite and hornblende gneiss and schist. Pre-Triassic. Derivation of name stated.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 61, pl. 1. Same as Mamacoke gneiss and mapped as latter.

Named for town of Stonington, New London County.

Stony Brook Beds (in Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1883, Pennsylvania 2d Geol. Survey Rept. G_7, p. 68–73, 216–217.

Well exposed at cutting along road where it crosses Stony Brook, Orange Township, Columbia County.

Stonybrook Quartzite[1]

Precambrian: Eastern Massachusetts.

Original reference: W. E. Hobbs, 1899, Am. Geologist, v. 23, p. 110.

Named for exposures at Stonybrook, Middlesex County.

Stony Clove Sandstone Member (of Katsberg Redbeds)

Stony Clove Sandstones

Upper Devonian (Senecan): Southeastern New York.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. Listed in table of formations as sandstones. Consists of continental gray flags and shale. Thickness 900 feet. Underlies Katsberg redbeds; overlies Onteora redbeds.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 130–135, 136. Included in Katsberg redbeds as basal member for mapping purposes. Possibly unit belongs with Onteora redbeds. Underlies Wittenberg conglomerate member. Considered continuation of Kattel gray flagstones. Outcrop area described.

Exposed in Stony Clove, a pass in Kaaterskill quadrangle.

Stony Creek Basalt

Pliocene: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Shown on map legend.

Stony Creek Granite Gneiss[1] or Granite

Pre-Triassic: South-central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 147, 152, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Unit referred to as a granitic gneiss. Described as medium- to very coarse-grained variably foliated red or pink gneiss or granite. Large phenocrysts and porphyroblasts of potash feldspar. Inclusions of dark hornblende and biotite gneiss common. Grades through a lit-par-lit or migmatitic zone into Middletown gneiss. Pegmatite very common. Part of East Haven granitic body, a structural unit.

H. M. Mikami and R. E. Digman, 1957, Connecticut Geol. Nat. History Survey Bull. 86, p. 7–12, 24–25, pl. 1. Stony Creek granite and Branford quartz monzonite compose Branford-Stony Creek massif. Normal Stony Creek granite is pink to reddish and is speckled by black biotite flakes. Name credited to Kemp (1899, Geol. Soc. America Bull., v. 10, p. 369–370). [Kemp referred to Stony Creek types and granites at Stony Creek. Two varieties, Stony Creek red, and Stony Creek gray.]

Named for occurrence at Stony Creek, a town in Branford Township, New Haven County.

Stony Gap Sandstone Member (of Hinton Formation)[1]

Stony Gap Sandstone (in Hinton Group)

Stony Gap Sandstone Member (of Pennington Formation)

Upper Mississippian: Southeastern West Virginia, northeastern Kentucky, and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 298, 371.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey, Greenbrier County, p. 255, 261–262. Basal formation in Hinton group, Mauch Chunk series.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 398, 399. Basal member of Pennington formation in Greendale syncline.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Basal member of Hinton formation. Underlies middle red member of formation; overlies Bluefield formation. Occurrences in Kentucky noted.

Type locality: At village of Stony Gap, Mercer County, W. Va., on both sides of Bluefield-Princeton Road. Identifiable from Pennington Gap, Va.,

to Princeton, W. Va., and from Pineville, Ky., northeastward on Pine Mountain to Osborn Gap, Ky.

Stony Hills Formation[1]

Permian: Southern Kansas and western Oklahoma.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 358, 363.

C. C. Branson, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey.

Named for Stony Hills, east of Watonga, Blaine County, Okla.

Stony Hollow Member (of Marcellus Formation)

Middle Devonian: Southeastern New York and northeastern Pennsylvania.

G. A. Cooper, 1941, Washington Acad. Sci. Jour., v. 31, no. 5, p. 179–180. Chiefly fine-grained calcareous sandstone 75 to 100 feet thick. Underlies Mount Marion formation of Grabau at its type section. Beds formerly classified as "Marcellus" shale (Bakoven of Chadwick) immediately underlie Stony Hollow member and are now proved to be equivalent of Union Springs member. Southwest of Albany, layers of limestone appear in upper part of sandstone which has thinned to 24 feet; west of Onesquethaw Creek, these limestones of the Stony Hollow become the Cherry Valley limestone as exposed in Stony Creek, Schoharie Valley.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1783, chart 4. Age given on correlation chart as Middle Devonian.

Type section: At bend of New York State Highway 28 and along railroad opposite bend at entrance to valley leading up to settlement of Stony Hollow, 1¾ to 2 miles northwest of bridge over Esopus Creek on west side of Kingston, Ulster County. Also present along U.S. Highway 209 near Echo Lake, Pa.

Stony Lonesome Bed[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1935, Geol. Soc. America Bull., v. 46. no. 2, p. 334, 337–339.

Stony Lonesome, east of Warren, Warren County.

Stony Mountain Diorite

Miocene: Southwestern Colorado.

McClelland Dings, 1941, Geol. Soc. America Bull., v. 52, no. 5, p. 698 (fig. 1), 712–714. Name applied to diorite in Stony Mountain stock which penetrated Miocene volcanic rocks of San Juan, Silverton and Potosi series. Younger than Governor diorite (new).

Vertically exposed for 1,320 feet on east side of Stony Mountain, about 5 miles southwest of Ouray in San Juan Mountains.

Stony Mountain Formation[1] (in Bighorn Group)

Upper Ordovician: Surface and subsurface in Manitoba and Saskatchewan, Canada, and subsurface in Montana, North Dakota, and Wyoming.

Original reference: D. B. Dowling, 1901, Canada Geol. Survey Ann. Rept., new ser., v. 11, p. 46F.

V. H. Kline, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 3, p. 339, 360–361. Geographically extended into subsurface in North Dakota.

R. J. Ross, Jr., 1957, U.S. Geol. Survey Bull. 1021–M, p. 446 (fig. 88), 447–448, pl. 44. Discussion of Ordovician fossils from wells in Williston Basin, Mont. Stony Mountain formation, which comprises a lower shale member and an upper dolomitic member, is upper formation in Bighorn group in subsurface. Overlies Red River formation.

M. R. McCoy, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 27 (fig. 1), 29. Discussion of Ordovician rocks of northern Powder River basin and Black Hills uplift areas, Montana, Wyoming, and South Dakota. Correlation chart shows Stony Mountain in northern Powder River basin, Williston basin, and northern Big Horn Mountains. In first two areas, overlies Red River formation, and in Big Horn Mountains, overlies Bighorn [dolomite].

Named for exposures at Stony Mountain, near Winnipeg, Manitoba, Canada.

Stony Point Shale[1] (in Trenton Group)

Middle Ordovician: Northeastern New York and western Vermont, and Quebec, Canada.

Original reference: R. Ruedemann, 1921, New York State Mus. Bull. 227, 228, p. 112, 115–116.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 275. Discussed under heading of formations of Sherman Fall age in Trenton group. Overlies Cumberland Head shaly limestone, and has exposed thickness of 215 feet in section on Hero Island, Vt. It is prevalent black shale in northern Lake Champlain region, and in southern Quebec is overlain by Iberville shale of questionably Utica age. About 500 feet thick in type area. Overlies Lacolle conglomerate in Quebec.

David Hawley, 1957, Geol. Soc. America Bull., v. 68, no. 1, p. 58–62, pl. 1. Formation described in northern Champlain Valley, Vt., where it is predominantly calcareous shale in lower part, grading upward to predominantly quartz-silty argillaceous limestone. Thickness 1,000 to 1,500 feet. Overlies Cumberland Head formation; underlies Iberville formation. Trentonian.

Named for occurence at Stony Point, 1½ miles south of Rouses Point, Clinton County, N.Y.

Storm King Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1907, New York State Mus. Bull. 107 p. 364, 377.

K. E. Lowe, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 144–148, 157–188, pls. 1, 2, 3. In vicinity of Bear Mountain, occupies core of syncline in earlier crystalline complex here termed Hudson Highlands complex. It is part of a larger synclinal pluton whose accordance with the northeast-plunging structure is shown by conformable contacts and mineral alignment in both the granite and the country rocks. Storm King represents last major invasion of magmatic origin in Hudson Highlands area. In contrast to great variety of rock types in Hudson Highlands complex and their involved field relations, this granite occurs in large masses of rather uniform character; hence, it is the most distinct lithologic unit in the crystallines of the Hudson Highlands area.

Named for occurrence on Storm King Mountain, Putnam and Orange Counties.

Storm King Mountain Gneissoid Granite[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey, 1911, New York State Mus. Bull. 107, p. 364, 377.

Constitutes whole of Storm King mountain and larger part of Crows Nest on west side of Hudson River; also forms chief rock of Bull Hill and Breakneck Ridge in Putnam and Orange Counties.

Stormont Limestone Member (of Pierson Point Shale)

Pennsylvanian (Virgil Series): Northeastern Kansas.

H. G. O'Connor, 1953, Kansas Geol. Survey [Reports], v. 12, pt. 1, p. 18–19, pl. 1. Name applied to the lowest of three limestones near middle of Pierson Point shale. Member is variable in character but generally is sandy or silty and nonresistant to weathering; fossiliferous. Thickness averages 1 to 4 feet. At type locality, occurs about 12 feet below Maple Hill limestone and 13½ feet above Tarkio limestone. Occurs 12 to 18 feet above Tarkio limestone where Tarkio is present and about 10 to 20 feet above the Elmont where the Tarkio is absent. Because of its position between the Elmont and Maple Hill limestones, it has been erroneously called the Tarkio in parts of Lyon County where the Tarkio is absent.

Type locality: Along road and in ravines in NW¼ sec. 9, T. 14 S., R. 14 E., about 1 mile northwest of former Stormont post office, Osage County, where overlying Maple Hill and underlying Tarkio are also typically exposed.

Stormville Conglomerate[1]

Stormville Sandstone[1]

Stormville Sandstone Member (of Coeymans Limestone)

Lower Devonian: Northern New Jersey and northeastern Pennsylvania.

Original references: (Conglomerate) I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 76, 132–133; (Sandstone) S. Weller, 1900, New Jersey Geol. Survey Ann. Rept. State Geologist 1899, p. 3–46.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 51–53. At Nearpass quarries in New Jersey, the Coeymans contains no appreciable amount of sand. In eastern Monroe County, Pa., 8 to 10 feet of calcareous sandstone occur at top of the Coeymans. I. C. White (1882) named this sandstone the Stormville conglomerate from exposures at that village about 3 miles southwest of Stroudsburg, where the sandstone is pebbly and 17½ feet thick, according to White's measurements. White also reported pebbles in parts of the 30 feet of limestone underlying main body of pebbly sandstone at Stormville. White applied name Stormville not only to this sandstone but also to underlying limestones and overlying shales of diverse ages. Name must be modified or discarded. Believed that name will be useful if restricted to above described sandstone member of Coeymans.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1158–1160. White's (1882) section at Stormville reexamined. Section is much concealed. Its lower part crosses minor anticline. It terminates above a sharp syncline. Stormville conglomerate is correlated with upper part of Coeymans limestone.

Named for occurrence in vicinity of Stormville, Monroe County, Pa.

Stormville Hydraulic Cement Bed[1]

Stormville Water Lime[1]

Lower Devonian: Northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 136–137.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1160, 1171. White's Stormville hydraulic cement rock ("pethstone") included in Rondout limestone.

Named for occurrence in vicinity of Stormville, Monroe County.

Stormville Limestone[1]

Lower Devonian: Northeastern Pennsylvania and northern New Jersey.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 76, 133–135.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 51–53. At Nearpass quarries in New Jersey, the Coeymans contains very little sand. In eastern Monroe County, Pa., 8 to 10 feet of calcareous sandstone occur at top of the Coeymans. White (1882) named this sandstone the Stormville conglomerate. White applied name Stormville not only to sandstone (conglomerate) but also to underlying limestones and overlying shales of diverse ages. Name must be modified or discarded. Believed that name Stormville is appropriate if restricted to sandstone which is here termed member of Coeymans limestone.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1160. White's (1882) Stormville section reexamined. Stormville limestone correlated with Manlius limestone.

Named for occurrence in vicinity of Stormville, Monroe County, Pa.

Stormville Shale[1]

Lower Devonian: Northern New Jersey and northeastern Pennsylvania.

Original reference: I. C. White, 1882, Pennsylvania 2d Geol. Survey Rept. G_6, p. 76, 131–132.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 51–53. White (1882) applied name Stormville not only to sandstone (conglomerate) but also to underlying limestones and overlying shales of diverse ages. Name must be modified or discarded. Believed that name Stormville is appropriate if restricted to sandstone which is here termed member of Coeymans limestone.

C. K. Swartz and F. M. Swartz, 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1158–1160. White's (1882) section at Stormville reexamined. Section is much concealed. Its lower part crosses minor anticline. It terminates above sharp syncline. Stormville conglomerate is overlain by Stormville shale to which White assigns thickness of 160 feet. Latter is succeeded by Oriskany sandstone. Stormville shale crops out in belt nearly 1,000 feet wide, measured perpendicular to strike. It is largely concealed, and its strikes and dips are unknown. It is bounded by beds with high dips. Evidently thickness of these beds cannot be as little as 160 feet, unless there is much concealed minor folding. Six miles east of Stormville, this interval is occupied by four geologic horizons—New Scotland, Becraft, Port Ewen, and Oriskany—with combined thickness of about 300 feet. Stormville shale is correlated with Oriskany shale.

Named for exposures at Stormville, Monroe County, Pa.

Storrs Tongue (of Star Point Sandstone)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: F. R. Clark, 1928, U.S. Geol. Survey Bull. 793.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, fig. 2. Has sharply defined top and grades downward from thick-bedded medium-grained sandstone into sandy shale and shale. About 30 feet thick at Storrs and thins to the east, disappearing about 1 mile east of Kenilworth. Separated from underlying Panther and overlying Spring Canyon sandstone tongues by westward-pointing tongues of Mancos shale. Of Montana age.

Named from exposure at Storrs, in Castlegate quadrangle, Carbon County, where it forms prominent cliff.

Story Formation (in Hansonburg Group)

Pennsylvanian (Missouri Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 63, 65–66. Name proposed for upper 58½ feet of type section of Hansonburg group (new). Formation includes 19½ feet of reddish brown shale, arkosic and micaceous sandstone, and gray shale at base; upper 38 feet is light-gray massive to massively bedded fossiliferous limestone. Underlies Del Cuerto formation (new); overlies Burrego formation (new).

Type locality: Northeast side of Oscura Mountains, Socorro County. Name derived from Story Tank, about 3 miles west of west-central front of Oscura Mountains.

Stotler Limestone (in Wabaunsee Group)

Pennsylvanian (Virgil Series): East-central Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2275. Defined to include strata underlying Root shale (new) and overlying Pillsbury shale (new). Thickness ranges from 5 to 35 feet; average 14 feet. Includes (ascending) Dover limestone, Dry shale, and Grandhaven limestone members.

Type section: In spillway and along south side of pond in SE¼ sec. 13, T. 16 S., R. 12 E., Lyon County, about 2 miles west of Miller. Name derived from old Stotler post office which was in SW¼ sec. 10, T. 16 S., R. 13 E.

Stoufferstown Member (of Stonehenge Limestone)

Lower Ordovician: Central southern Pennsylvania, western Maryland, and West Virginia.

W. J. Sando, 1958, Geol. Soc. America Bull., v. 69, no. 7, p. 838 (fig. 2), 839, 846, 847. Thin-bedded limestone at base of Stonehenge. Thickness 217 to 224 feet. Underlies upper member (unnamed); overlies Conococheague formation. In Maryland, beds called upper member of Conococheague by Sando (1957, Geol. Soc. America Mem. 68) are now referred to Stoufferstown member.

Named for occurrence in vicinity of Stoufferstown, Chambersburg area, Franklin County, Pa.

Stovall Limestone Member (of Winfield Limestone)

Stovall Limestone (in Chase Group)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 49.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Member of Winfield limestone. Consists of dense gray limestone with an abundance of steel-gray flint where thin in northern Kansas; becomes thicker and noncherty in central and southern parts; fossils rare. Thickness commonly about 1 foot. Underlies Grant shale member; overlies Gage shale member of Doyle shale. Wolfcamp series.

Type locality: In bluffs of Doyle Creek valley, southeast of Stovall elevator and farm, 7 miles southwest of Florence, Marion County, Kans.

Stover Limestone

Stover Member (of Benner Limestone)

Middle Ordovician (Bolarian): Central and south-central Pennsylvania, western Virginia, and southern West Virginia.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Member of Benner limestone. Described as dark heavy ledged limestone Thickness 93 feet at type locality.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 17–19. Upper member of Benner. Described at type section as 91 feet of dark principally dense heavy ledged limestone. Ledges have thin stylotitic partings and fucoidal mottling. One thick metabentonite exposed in several sections. Thickness decreases southeastward. Overlies Snyder member. Underlies Valley View member of Curtin limestone in northern Centre, Clinton, and Lycoming Counties; southeastward disconformably underlies Nealmont limestone. Derivation of name and more exact location of type section stated.

Marshall Kay, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1199. Limestone included in upper Bolarian (Hunterian) series.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2, columns 21, 22. Geographic extension; listed in stratigraphic column for Highland County, Va., and Monroe County, W. Va. [Limestone apparently has formational rank in these areas.]

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 74 (table 12), 78, 95, 103. Geographic restriction. New name McGraw limestone proposed for rocks in Virginia previously referred to as Stover. Termed a formation.

Type section: In Pennsylvania Railroad cut at Union Furnace, Huntingdon County, Pa. Named for station of Stover northeast of Nealmont, Blair County, Pa., where well exposed in quarries.

Stowe Formation

Upper Cambrian(?) and Lower Ordovician(?): Central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 65–66, 116. Described as pale-green albite-quartz-chlorite-muscovite schist. Includes Brackett member along eastern border of Rochester area. Thickness cannot be measured, possibly about 3,000 feet in this area. Underlies Moretown formation; overlies Ottauquechee formation. Lower Cambrian. Name attributed to Cady.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Ordovician. Derivation of name given.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. In Hyde Park quadrangle, underlies Umbrella Hill formation (new). Ordovician.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pl. 5. Upper Cambrian(?) and lower Ordovician(?).

Occurs on summits of Braintree Mountain and extends eastward beyond eastern border of Rochester quadrangle. Named for typical occurrence in southeastern part of Stowe Township, Lamoille County.

Straight Cliffs Sandstone[1]

Upper Cretaceous: Central southern Utah.

Original reference: H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164.

H. E. Gregory, 1950, Utah Geol. and Mineralog. Survey Bull. 37, p. 26 (table), 46–50. Generally in southern Utah, wherever recognized subdivisions of Cretaceous are clearly defined, Tropic formation is overlain in turn by Straight Cliffs sandstone and Wahweap sandstone. In this report [Iron County], the Straight Cliffs is recognizable and Wahweap is probably present but no plane of separation could be noted; hence, the two are described together. Combined thickness 700 to 1,150 feet.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 105–107, 128–129, pl. 5. Westward from type locality, formation changes rapidly. In Kaiparowits Plateau, consists of massive thick buff-gray sandstones, subordinate sandy shales, and coal including beds 3 to 10 feet thick. Along base of Paunsaugunt Plateau, number of thick sandstone beds decreases, the thin ones increase, and coal beds decrease in number, thickness, and purity. In Zion Park region, sandstones more than 10 feet thick make up about 50 percent of the beds; thinner sandstone beds, 45 percent; calcareous and argillaceous shale, 5 percent; coal is represented by earthy lignite or carbonaceous shale. In Santa Clara Valley, both shale and coal are absent. Conformably underlies Wahweap sandstone but in some the two units cannot be differentiated; overlies Tropic formation. Thickness of Straight Cliffs and Wahweap 1,406 feet in Zion Park region.

Named from Straight Cliffs in Escalante Valley, Utah.

Straight Ridge Sandstone Member (of Pottsville Formation)[1]

Lower Pennsylvanian: Central Alabama.

Original reference: C. Butts, 1927, U.S. Geol Survey Geol. Atlas, Folio 221.

Named for fact it forms Straight Ridge, which extends along west side and south end of Yellowleaf Basin, in Vandiver quadrangle.

Strain Shale Member (of Lykins Formation)

Triassic: North-central Colorado.

L. W. LeRoy, 1946, Colorado School Mines Quart., v. 41, no. 2, p. 31, 42–44, fig. 7. Red arenaceous shales and mudstones and fine argillaceous red sandstones with the shales and mudstones predominating. Thickness ranges from 290 to 320 feet. Overlies Glennon limestone member (new); underlies Ralston formation (new).

Named from Strain Gulch, which enters Bear Creek just east of town of Morrison, Jefferson County.

Strange Formation (in Arbuckle Group)

Lower Ordovician: Southwestern Oklahoma.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1313, 1319, table 1; 1939, Oklahoma Geol. Survey Circ. 22, p. 15, 24–25. Name proposed for dolomite beds exposed in only four outcrops on south side of Wichita Mountains. Thickness 60 to 80 feet. Occurs below Cool

Creek formation and above McKenzie Hill formation. Name substituted for preoccupied Wolf Creek dolomite (Decker, 1933).

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Dolomitization is localized within McKenzie Hill, and the dolomite facies is not stratigraphically significant.

Type section: Caps top of McKenzie Hill in sec. 8 and extends down its southeast slope. Name taken from Strange Ranch on which two outcrops occur in secs. 8 and 9, T. 2 N., R. 12 W., Comanche County.

Stranger Formation[1] (in Douglas Group)

Pennsylvanian (Virgil Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 15–16. In Missouri, formation includes Tonganoxie sandstone, Vinland shale, and Haskell limestone members. Underlies Lawrence formation; overlies Iatan limestone.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 29–30. Stranger beds are exposed in three small areas in Table Rock-Richfield anticline in Cass and Sarpy Counties, Nebr. Stranger section in Cass County is (descending) Robbins shale, Cass formation, and Plattford formation.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 29–33. Formation includes (ascending) Tonganoxie Sandstone, Westphalia Limestone, Vinland Shale, Haskell Limestone, and Robbins Shale Members. Maximum thickness about 160 feet (Douglas County). Overlies Weston Shale; underlies Lawrence Shale.

Typically exposed along east side of sec. 3, T. 12 S., R. 21 E., Leavenworth County. Named from Stranger Creek near Tonganoxie, Kans.

Strasburg cyclothem

Pennsylvanian (Allegheny Series): Southeastern Ohio.

Incidental mention in road log: N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 14.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., p. 47–48, table 1, geol. map. Includes (ascending) Strasburg shale and (or) sandstone, 10 feet; Oak Hill clay, 7 feet; and Strasburg coal. Occurs below Middle Kittanning cyclothem and above Lower Kittanning cyclothem. In area of this report [Perry County], the Allegheny series is described on a cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 64–68. Includes (ascending) Strasburg shale and (or) sandstone member, Hamden limestone member, Oak Hill underclay member, and Strasburg coal member. Occurs above Lower Kittanning cyclothem and below Middle Kittanning cyclothem. In this report [Athens County], the Allegheny series is described on a cyclothemic basis; 13 cyclothems are named. [For complete sequence see Brookville cyclothem.]

Town of Strasburg is in Tuscarawas County.

Strasburg Formation or Limestone

Middle Ordovician (Chazyan): Tennessee.

E. O. Ulrich, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 106. On correlation chart, Strasburg formation of Clinton and Pearisburg troughs of Tennessee is shown stratigraphically below Holston formation and above Lenoir formation of Knoxville and Athens troughs of Tennessee.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 75. Name Strasburg limestone was introduced without definition by Ulrich (1939) for a part of succession herein identified as Lincolnshire. Since name Strasburg has received no precise definition or description at time Lincolnshire was introduced (1943), Strasburg is considered invalid.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 92. No formal description of unit has been published. Because Strasburg appears on Ulrich's chart between Lenoir below and Holston above, it is in position of Lincolnshire formation.

Occurs in Shenandoah Valley.

Strasburg Shale

Strasburg shale and (or) sandstone member

Pennsylvanian (Allegheny Series): Eastern Ohio.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 118 (table), 145–160. Overlying Lower Kittanning coal horizon and extending up to next persistent and widely distributed member, Middle Kittanning clay, is series consisting chiefly of shale with ironstone concretions known as Strasburg shale, but also containing sandstone, limestone, coal, and clay of more or less widespread but patchy distribution. Where complete series occurs, succession is (ascending) Hamden limestone, shale, Oak Hill clay, Strasburg coal, shale, and Salem limestone. Upper and lower limits of Strasburg shale member are clearly defined across State. Thickness of horizon variable but averages about 20 feet. Allegheny series.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 47, 48, table 1. Strasburg shale and (or) sandstone included in Strasburg cyclothem (new). Table shows sequence (ascending) Strasburg shale and (or) sandstone, Oak Hill clay, and Strasburg coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 64–66. Strasburg shale and (or) sandstone member of Strasburg cyclothem in report on Athens County. Average thickness about 14 feet. At base of cyclothem; underlies Hamden limestone member. Allegheny series.

Town of Strasburg is in Tuscarawas County.

Stratford Formation[1] (in Pontotoc Group)

Permian: Central southern Oklahoma.

Original reference: G. D. Morgan, 1924, Oklahoma Bur. Geology Bull. 2, p. 137–140, pls. 3, 27, map.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Permian. Includes Hart limestone member at base in Pontotoc, Garvin, and Murray Counties.

Named for exposures at and around Stratford, Garvin County.

Strathearn Formation

Upper Pennsylvanian and Permian (Missourian-Wolfcampian): Northeastern Nevada.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2249–2255, figs. 2, 5. Quartz-silty limestones and thin commonly crossbedded chert-granule and pebble conglomerate. Poorly exposed except where topography is rugged. Crinoidal calcarenite important constituent. Few individual units exceed 20 feet in thickness, except near base where some limestone units are as thick as 40 feet. Stratification indistinctly thin- to thick-bedded in purer limestone, but more distinct and thinner in sandy or conglomeratic units. Grayish yellow-weathering, calcareous quartz siltstones common and characteristically contain fusulinids. At type section, lower 200 to 300 feet fairly pure limestone, middle 500 to 800 feet contain most of typical chert-granule beds interspersed with impure limestone, and upper few hundred feet have thicker limestones and siltstones with some associated conglomerate. In type area, composite section is 1,200 to 1,500 feet thick. Thickness at Carlin Canyon and Buckskin Mountain at least 800 to 1,000 feet. Overlies older formations with angular discordance.

T. G. Fails, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 10, p. 1693, 1695 (fig. 1). In Carlin Canyon, conformably underlies Buckskin Mountain formation (new).

Grant Steele, 1960, Dissert. Abs., v. 20, no. 12, p. 4635. Underlies Jakes Creek formation (new).

Type section: At west side of head of lower canyon of South Fork of Humboldt River, 4 miles southeast of Strathearn Ranch and northeast of Grindstone Mountain (SW¼ sec. 19, T. 33 N., R. 55 E., and along south line of sec. 24, T. 33 N., R. 55 E). Supplementary section containing higher strata occurs 1½ miles farther south, and on east side of river at mouth of the upper canyon of South Fork (NW¼ sec. 31, T. 33 N., R. 55 E.). Named for Strathearn Cattle Co. which owns ranch in Humboldt Valley, 3½ miles north of Grindstone Mountain and 2 miles east of Moleen (sec. 8, T. 33 N., R. 54 E.).

Stratton-Kennebago Granite

Upper Devonian(?) to Lower Mississippian(?): Central western Maine.

R. J. Willard, 1959, Dissert. Abs., v. 19, no. 11, p. 2918. Calci-alkalic granite.

In Kennebago Lake quadrangle.

Straven Conglomerate Member (of Pottsville Formation)[1]

Pennsylvanian: Central Alabama.

Original reference: Charles Butts, 1927, U.S. Geol. Survey Geol. Atlas, Folio 221.

H. E. Rothrock, 1949, Alabama Geol. Survey Bull. 61, pt. 1, p. 29–30. Mentioned in discussion of age relation of subdivisions of Pottsville formation. Straven conglomerate, thickness about 2,000 feet, lies immediately above Thompson coal bed, which Butts (1926, Alabama Geol. Survey Spec. Rept. 1) includes with "middle Pottsville" strata. Beds of "upper Pottsville" age occur a short distance above Straven conglomerate member.

Named for Straven, in Montevallo quadrangle, Shelby County.

Strawbridge Member (of Quimbys Mill Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 9, 15C. Dolomite, cherty, medium bedded. Thickness 2½ to 4½ feet. Shown on columnar section as underlying Garnavillo member (new) of Guttenberg formation (Spechts Ferry formation absent) and overlying Shullsburg member (new) of Quimbys Mill formation.

In copy of guidebook used by compiler, in figure 9, name Garnavillo has been crossed out and name Garnet written in. The compiler had no way to determine what change, if any, had been made in other guidebooks.

Occurs in Dixon-Oregon area.

Straw Hollow Diorite[1]

Upper Paleozoic(?): Northeastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 219–220, map.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 46–47, pl. 1. Described in Hudson quadrangle as chiefly medium-gray medium-grained diorite. In part is a finer grained rock of same composition. Commonly exhibits linear structure. Rarely shows foliation. Contact with Gospel Hill gneiss (new) appears sharp. Late Paleozoic(?).

Type locality: Straw Hollow in Northboro, Worcester County.

Strawn Group[1]

Strawn Formation

Strawn Series

Middle Pennsylvanian: Central and northern Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., pl. 3, p. lxvi.

N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 373–387. Strawn division comprises following beds (ascending): Lynch Creek, Burnt Branch, Elliott Creek, Shadrick Mill, Bed no. 8, Fox Ford, Horse Creek, Bull Creek, Big Valley, Brown Creek, Spring Creek, Cottonwood Creek, Hanna Valley, Rough Creek, Buffalo Creek, Wilbarger Creek, Comanche Creek, Antelope Creek, Indian Creek, and Ricker. Underlies Canyon division with Coral limestone bed at base.

C. O. Nickell *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 91–94, pl. 8. In this report [Brown and Coleman Counties], Capps limestone is treated as member of Mineral Wells formation, upper formation of Strawn group.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87–89. Proposed to use term Strawn series for deposits occurring above unconformity at top of Smithwick group and related beds of Lampasas series (new) and below unconformity or disconformity which separates Lake Pinto sand (Canyon series) from East Mountain shale at Mineral Wells. This places upper boundary above highest occurrence of *Mesolobus* and *Fusulina*, which characterize the Des Moines but are absent in overlying Missouri series of northern midcontinent. This upper boundary falls within Mineral Wells formation

of earlier reports. Term Mineral Wells formation dropped. As defined herein, series comprises Millsap Lake and Lone Camp (new) groups.

M. G. Cheney, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 206–211. Lampasas-Strawn series boundary placed at disconformity between Dennis Bridge limestone and overlying conglomerate. As thus restricted, Strawn series of Brazos River section is about 2,000 feet thick. Comprises Millsap Lake group below and Lone Camp group above. Overlies Kickapoo Creek group (new) of Lampasas series.

R. J. Cordell and D. A. Zimmerman, 1954, Abilene Geol. Soc. Guidebook Field Trip, Nov. 19–20, p. 46 (fig. 38), 47–48. Concluded that lower Brownwood of Brown County is probably of late Strawn age and upper Brownwood is early Canyon. Hence, base of conglomerate separating these two parts of Brownwood shale should be regarded as Canyon-Strawn contact. This would increase Strawn interval in Brown County by about 125 feet at expense of the Canyon. Believed that Canyon-Strawn contact in Palo Pinto County should be at base of Turkey Creek sandstone. Turkey Creek sandstone is immediately overlain by Keechi Creek shale near top of which *Triticites* (post Strawn age) has been found.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1515–1524. Strawn-Canyon boundary, placed at prominent surfaces as paleontologic evidence allows, is drawn at top of Capps limestone in Colorado River valley, at top of Village Bend limestone ("boulder beds") in Comanche and Eastland Counties, and at base of Lake Pinto sandstone in northeastern part of Brazos River valley. Zonation based on fusulinids is best criterion for defining boundary. Strawn series is characterized by genus *Fusulina*, Canyon series by *Triticites*.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58–62, pl. 27. Sandstone and shale beds that constitute Strawn group in Colorado River valley were first called Richland sandstone by Tarr (1890, Texas Geol. Survey 1st Ann. Rept.). These and correlative beds in Brazos River valley were called Richland-Gordon sandstones by Dumble (1890). Drake (1893) separated these rocks into 20 units or "beds" and numbered those of Strawn group, from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, but that name has been restricted to prominent sandstone at base of Drake's Ricker bed. Drake referred these units to Strawn division of Cummin's (1891, Texas Geol. Survey 2d Ann. Rept.) which he considered to include all rocks above Bend division and below his Coral limestone bed, the Capps limestone of later authors. Plummer and Moore (1921, Texas Univ. Bull. 2132) considered Strawn in Colorado River valley to be equivalent to their Mineral Wells and Millsap formations of Brazos River valley. They limited Strawn group to rocks that overlie Smithwick shale of Bend group and underlie Rochelle conglomerate. This placed Drake's Coral limestone bed, named Capps limestone lentil by Plummer and Moore, in Canyon group. The Capps was thought to overlie Rochelle conglomerate and was regarded as part of Brownwood shale member of Graford formation. Sellards (1933, Texas Univ. Bull. 3232, v. 1) transferred Capps back to Strawn group and considered it upper member of Mineral Wells formation. Rocks of Strawn group in Brazos River valley have been studied in detail and classified into

units. Strawn group in present report [Brown and Coleman Counties, Colorado River valley] represents only upper part of group elsewhere. Term Strawn group is used herein for all rocks in Colorado River valley between top of Smithwick shale of Bend group and base of Brownwood shale member of Graford formation of Canyon group. Term Mineral Wells not used in this area. The Strawn becomes thinner from central Brown County, where it is reported to be 1,100 feet thick in wells, to 500 feet in north-central Coleman County, and from 1,235 feet in northern Brown County to about 250 feet in southwestern Brown County and southeastern Coleman County. Group includes (ascending) Ricker Station limestone of Cheney (1949), Ricker sandstone member of Nickell (1938) and Capps limestone lentil of Plummer and Moore (1921).

Named for Strawn, Palo Pinto County.

†Strawn Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 110.

Named for Strawn, Coffey County.

Street Road Limestone[1]

Cambrian: Southeastern Pennsylvania.

Original reference: T. D. Rand, 1900, Philadelphia Acad. Nat. Sci. Proc. 1900, pt. 1.

Strelna Formation[1]

Mississippian: Southeastern Alaska.

Original reference: F. H. Moffit and J. B. Mertie, Jr., 1923, U.S. Geol. Survey Bull. 745, p. 18–19, 21–28, table opposite p. 28, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legends.

Named for occurrence in valley of Strelna Creek, Kotsina-Kuskulana district, Copper River region.

Stribling Formation

Lower or Middle Devonian: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 31. Limestone—microgranular, medium-gray to reddish-buff, beige, and ivory; chert—chalcedonic to subchalcedonic and brownish to grayish in lower part, occurring as irregular lenses and false joint fillings; some lenticles of yellowish siliceous limestone about 1 to 2 feet above base; basal 1 foot noncherty. Thickness 10 feet. Overlies Honeycut formation (new); underlies unnamed chert breccia. Section described is at Honeycut Bend, Blanco County.

V. E. Barnes, P. E. Cloud, Jr., and L. E. Warren, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 169–174, 175 (fig. 46), pl. 6 [1945]. Thickness at designated type locality 11 feet. Here a pocket of Devonian rocks filling a cave in limestone of Ellenburger group may be a correlative of Pillar Bluff limestone.

V. E. Barnes, P. E. Cloud, Jr., and Helen Duncan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 1031, 1033. In Llano uplift, overlies Burnam limestone (new) and in some parts of area overlies Honeycut formation.

Type locality: Five mlies due east of Johnson City, at foot of bluff on south bank in reach of Pedernales River known as Honeycut Bend. Located in Peter Jackson survey and is on Clayton and Olla Stribling (7L) Ranch.

Strickler Limestone (in Sumner Group)[1]

Strickler Limestone Member (of Donegal Limestone)

Permian: Northeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12 (graphic section).

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 30. Term Wellington is used for section between top of Herington limestone and base of Ninnescah formation. Of the 10 subdivisions listed, the Strickler limestone and Newbern shale members of the Donegal limestone (Moore, 1936) are not very persistent; name Donegal limestone is not well founded.

Type locality and derivation of name not stated.

†Stringtown Shale[1]

Lower and Middle(?) Ordovician: Southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

Named for Stringtown, Atoka County.

Striped Peak Formation[1] (in Missoula Group)

Precambrian (Belt Series): Northeastern Idaho and northwestern Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 92, p. 44, pl. 11. Sandstones, siliceous, generally flaggy to shaly; mostly green and purple; characterized by shallow-water features, such as ripple marks and sun cracks. Top removed by erosion. Thickness about 1,000 feet. Overlies Wallace formation.

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 16–17, pl. 1. Described in Libby quadrangle, Montana, where it is 2,000 to 2,500 feet thick, underlies Libby formation (new) and overlies Wallace formation.

C. P. Ross, 1949, (Abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 113. Included in Missoula group.

J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–P, p. 730, pl. 57. Described in Shoshone County, Idaho. Youngest unit of Belt series. In northern exposure, conformably overlies Wallace formation and in southern exposure is bounded by two faults. Consists of grayish-purple to dark-red impure quartzite in beds that range from 1 to 4 inches in thickness.

Named for extensive development near Striped Peak, Idaho.

Striped Rock Granite

Precambrian: Southwestern Virginia.

A. J. Stose, 1942, (abs.) Am. Geophys. Union Trans., 23d Ann. Mtg., pt. 2, p. 342. An injection complex of early Precambrian age is exposed in Elk Creek anticline in Grayson County. There, sedimentary rocks and diorite have been intruded by the Striped Rock and Carsonville granites.

A. J. Stose and G. W. Stose, 1957, Virginia Div. Mineral Resources Bull. 72, p. 26–32, pl. 1. Predominantly biotite granite, fine-grained aplite, and pegmatite; contains garnet in places; locally, as near Peach Bottom Church, contains xenolithic inclusions. A syenite facies forms a narrow body within southern part of main granite area where it parallels the strike of the main granitic mass; syenite is bordered in places by narrow bands of Saddle gneiss which separate the syenite from the Striped Rock granite. There are small inclusions and shred of Saddle gneiss and Cattron diorite in the Striped Rock. Bordered on the northern and northeastern sides and intruded by Carsonville granite.

Named from Striped Rock, a smooth-faced cliff of granite 300 feet high on spur of Point Lookout Mountain. Granite forms an elliptical area 8 miles long by 3 miles wide on southeast side of Point Lookout and Buck Mountains. Main area extends from near Pilgrims Rest Church southwestward to Saddle Creek; its greatest width is northwest of Independence.

Strites Pond Formation[1] or Limestone

Upper Cambrian or Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 397. Overlies Rock River dolomite; underlies Wallace Creek limestone. Thickness about 400 feet. Philipsburg series. Beekmantown.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

†Strong Flint (in Chase Group)[1]

Permian: Central Kansas.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 771–786, 799.

Named for Strong City, Chase County.

†Strong City Beds[1]

Permian: Central Kansas.

Original reference: L. C. Wooster, 1905, The Carboniferous rock system of eastern Kansas.

Probably named for Strong City, Chase County.

Stronghold Granite

Eocene(?) to lower Pliocene(?): Southeastern Arizona.

D. J. Cederstrom, 1946, Am. Jour. Sci., v. 244, no. 9, p. 610–611. In most places, is white where fresh and light yellow where weathered, medium- to coarse-grained texture, and may be described as porphyritic, although porphyritic character not everywhere readily apparent in hand specimens. Intrusive into Mesozoic rocks and considered to have been implaced during Laramide Revolution.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 9 (table), 106–108, pl. 5. Three major facies recognized: Main facies, rather coarse-grained granite ranging from light gray to light pink and weathers buff; border facies, porphyritic, though not conspicuously so; and aplitic facies, differs only slightly from border facies though it seems

to contain even less biotite. Youngest major intrusion in region. Cuts Dragoon thrust sheets in many places, and at one place or another it is in intrusive contact with representatives of all rocks from Pinal schist to Bisbee formation. Younger than Cochise Peak quartz monzonite. Mapped as Eocene(?) to lower Pliocene(?).

Makes up Cochise Stronghold mass, a natural fortress within northern part of Dragoon Mountains, and extends southward as narrow bands in the Dragoon Mountains, Cochise County.

Strongsville Member (of Cuyahoga Formation)

Lower Mississippian (Kinderhookian): Northern Ohio.

E. J. Szmuc, 1957, Dissert. Abs., v. 18, no. 6, p. 2109. Silty shale unit intercalated between two siltstones. Underlies Meadville member; overlies Sharpsville member.

In Cuyahoga, Summit, Medina, and Lorain Counties.

Stroudsburgian Stage

Middle Devonian: Eastern Pennsylvania.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 131 (footnote).

Name proposed to include Onondaga group, including so-called Esopus. Ulsterian stage of New York, which includes Onondaga and Schoharie, not applicable here since it does not include the Esopus, and the Schoharie is not recognized in Pennsylvania.

Named from Stroudsburg, Monroe County, where best observed.

Stuart Glacial Stage

Stuart Till

Pleistocene: Central Washington.

B. M. Page, 1939, Jour. Geology, v. 47, no. 8, p. 785, 805–814. Latest of three successive stages of valley glaciation in Leavenworth area. Characterized by deposition of Stuart till. Followed Leavenworth stage and has lingered almost to present time. Probably equivalent to all or part of Wisconsin stage.

Evidence of the stage present in vicinity of Mount Stuart, especially at junction of Rat Creek and Icicle Creek, Chelan County.

Stuart Shale[1] (in Cabaniss Group)

Pennsylvanian (Des Moines Series): Central southern and eastern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas Folio 74.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1525. Assigned to Cabaniss group (new).

Named for Stuart, Hughes County. Town is located on outcrop of formation.

Stuck Drift, Till, Glaciation

Pleistocene, middle(?): Northwestern Washington.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 385, 390, 391–392. Consists chiefly of till and sand and gravel of northern derivation; where typically exposed, includes an unoxidized or only slightly oxidized till sheet 5 to 20 feet thick, which is overlain and underlain by oxidized sand and gravel 10 to 20 feet

thick; pebble-sized fraction of till typically includes 10 to 15 percent of northern rock types and the rest is of Cascade origin; upper part of drift contains lacustrine sand and silt; locally lacustine sediments include lenticular masses of glacial sand and gravel and scattered glacial boulders, and in places beds are tilted and faulted. Separated from underlying Alderton formation (new) by erosional unconformity; underlies Puyallup formation. In sequence, Stuck glaciation followed Orting glaciation and preceded Salmon Springs glaciation (new).

Typically exposed in west wall of Puyallup-Duwanish Valley in gullies under transmission line of Bonneville Power Administration in center sec. 1, T. 19 N., R. 4 E., about one-half mile southwest of Alderton, Pierce County. Name derived from Stuck River which joins Puyallup River near Sumner.

Stull Shale Member (of Kanwaka Shale)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 94, 96 (table).

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 24. Thickness 4 feet in Weeping Water valley, Cass County.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii, 17. Columnar section shows Stull shale member at top of Kanwaka formation. [Text does not discuss unit in Missouri.]

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 62 (fig. 23), 67. Yellowish-brown sandy shale, locally one or more coal beds; sandstone containing land plant remains and partly filling channels occurs in upper part in northern Kansas; much or all of Elgin sandstone in southern part of State may belong in this division. Thickness about 25 to at least 45 feet. Overlies Clay Creek limestone member; underlies Spring Branch limestone member of Lecompton limestone.

Type locality: SE cor. sec. 26, T. 12 S., R. 18 E., near village of Stull, Douglas County, Kans.

Stump Sandstone[1]

Upper Jurassic: Southeastern Idaho and western Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98, p. 76, 81.

L. S. Gardner, 1944, U.S. Geol. Survey Bull. 944–A, p. 7. Section in Irwin quadrangle, Teton basin, shows Stump sandstone, 140 feet thick; overlies Preuss sandstone; underlies Ephraim conglomerate of Gannett group.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, p. 1269 (fig. 6), 1276 (fig. 8), 1278–1279, 1280 (fig. 10). Name Stump is used in this report [Uinta Mountains] in Weber River, Duchesne River, and Lake Fork areas so that southeastern Idaho Jurassic terminology is uniformly used in all western sections; east of Lake Fork, name Curtis is used. Thickness 223 feet, Weber River area; 210 feet, Duchesne River area; and 130 feet, Lake Fork area. Overlies Preuss sandstone; unconformity in some areas; underlies Morrison.

H. L. Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1538 (strat. column), 1566–1567. In Teton County, Wyo., is about 350 feet thick and consists of greenish sandstones with some interbedded siltstone and shale. Underlies Cloverly formation; overlies Twin Creek limestone, the Preuss sandstone, which overlies Twin Creek farther west, not definitely recognized in area of this report.

E. R. Cressman, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–118. As mapped in Snowdrift Mountain quadrangle, Caribou County, Idaho, overlies Preuss sandstone and underlies Bechler and Ephraim conglomerates undifferentiated. Thickness 400 to 500 feet.

Named for Stump Peak, east head of north fork of Stump Creek about center of T. 6 S., R. 45 E., Boise meridian, Freedom quadrangle [Caribou County], Idaho.

Stump Arroyo Member (of Crooked Creek Formation)

Pleistocene: Southwestern Kansas.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 69 (fig. 1), 71–73. Name applied to basal part of Crooked Creek formation. Consists of coarse sand, reddish to light tan, and well sorted, containing white quartz pebbles; grades upward into finer more poorly sorted sand, with calcareous nodules at top. Thickness a little more than 10 feet. Unconformably overlies Missler member (new) of Meade formation (redefined). In some areas where the Crooked Creek is not extensively developed, Pearlette Ash member rests directly on the Stump Arroyo.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1), 57. Underlies Atwater member (new).

Type locality: Sec. 21, T. 33 S., R. 28 W., Meade County. Gravels of member form high surface rubble in sec. 10, T. 33 S., R. 29 W., along tributary of Stump Arroyo north of the Deer Park and west of the northwest corner of Deer Park. Name derived from tributary of Crooked Creek which flows through Meade County State Park and empties into Crooked Creek in sec. 29, T. 33 S., R. 28 W.

Stuntz Conglomerate Member (of Knife Lake Group)[1]

Precambrian (pre-Huronian): Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept., p. 350.

Named for exposures in vicinity of Stuntz Bay of Vermilion Lake in Vermilion district.

†**Stuntz Island Agglomerate**[1]

Precambrian: Minnesota.

Original reference: N. H. Winchell and H. V. Winchell, 1890, Minnesota Geol. Nat. History Survey Bull. 6.

Sturgeon Quartzite[1] (in Chocolay Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: H. L. Smyth, 1889, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 105.

F. J. Pettijohn and F. A. Hildebrand, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1927. Overlies Fern Creek formation (new).

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Assigned to newly defined Chocolay group.

Named for exposures along Sturgeon River, Iron County.

Sturm Limestone (in Lawrence Shale)[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 6, 33.

Well exposed near Sturm's Schoolhouse, sec. 12, T. 10 N., R. 12 E., and along North Branch of Weeping Water Creek, 2 to 4 miles north of Nehawka, Cass County.

Stuver Member (of Kanayut Conglomerate)

Stuver Series[1]

Upper Devonian: Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 240.

A. L. Bowsher and J. T. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 3, 5, 11–13, figs. 2–4, pl. 2. Schrader gave name Stuver series to conglomeratic sequence beneath Lisburne formation in central Brooks Range. Although name Stuver later fell into disuse, it is herein reestablished and applied to top member of Kanayut conglomerate (new). In Shainin Lake area [this report], member restricted to upper part of Kanayut conglomerate because these beds most closely resemble those exposed on Mount Stuver from which Schrader took the name. Consists of about 860 feet of orthoquartzite, gray, red, and green shale, and conglomerate. Overlies unnamed middle conglomerate member; underlies Kayak shale (new).

Type locality of member: On ridge 0.7 mile south of Mount Wachsmuth, Shainin Lake area, central Brooks Range. Named for Mount Stuver, east of Anaktuvuk River.

Stuyvesant Beds

Primordial: Southeastern New York.

S. W. Ford, 1884, Am. Jour. Sci., 3d ser., v. 28, no. 165, p. 206. Mentioned in discussion of age of the glazed and contorted slaty rocks in vicinity of Schodack Landing, Rensselaer County. A fault intervenes between these beds and the slaty rocks which resemble Hudson River group.

Occurs near Stuyvesant, Columbia County.

†sub-Blairsville red shale member (of Chemung Formation)[1]

Upper Devonian: Western Pennsylvania.

Original reference: M. R. Campbell, 1904, U.S. Geol. Survey Geol. Atlas, Folio 110.

Named for occurrence in wells in vicinity of Blairsville, Indiana County.

†sub-Clarksville Sand[1]

Upper Cretaceous (Gulf Series): Northeastern Texas and Southwestern Arkansas.

Original reference: A. C. Veatch, 1906, U.S. Geol. Survey Prof. Paper 46, p. 24–25, table opp. p. 16.

C. L. McNulty, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 2, p. 336–337. Lake Crockett formation (new) includes at base, a gray sand that is equivalent to former sub-Clarksville of east Texas basin.

Named for development in wells at Clarksville, Red River County, Tex.

Sublett Member (of Wells Formation)

Pennsylvanian (Desmoinesian-Virgilian): Idaho.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). Name appears on chart accompanying preliminary statement on eastern Great Basin Permo-Pennsylvanian strata. Underlies Indian Fork member (new); overlies Heglar Canyon member (new).

Present in Sublett Mountain area.

†Sucarnooche Clay (in Midway Group)[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith, 1892, Sketch of geology of Alabama, pam., 36 p., Birmingham, Ala., Roberts and Son.

F. S. MacNeil, 1946, U.S. Geol. Survey Strat. Minerals Inv. Prelim, Rept. 3–195, p. 10. Name Sucarnooche clay, formerly used for entire Porters Creek clay of western Alabama as well as for calcareous clay east of Tombigbee River, is abandoned.

Named for exposures on Sucarnooche Creek at Black Bluff, Sumter County.

Sucker Creek Beds, sediments, deposits

Miocene: Eastern Oregon.

D. W. Scharf, 1935, Carnegie Inst. Washington Pub. 453, p. 98–118. Description of a Miocene mammalian fauna from Sucker Creek. The Sucker Creek beds are directly related to Payette formation as shown by the flora and such comparison as can be made between the fossil mammals obtained at Sucker Creek and those from type section of the Payette. Future geologic mapping may show that Sucker Creek beds are an integral part of Payette formation. The beds carrying the fossils consist of fine- to medium-grained pyroclastics, varying from white to green and brown. Presence of fish vertebrae and ostracod shells indicates deposition of at least part of the sediments in body of water.

Occur along lower course of Sucker Creek in eastern Malheur County. Important collecting localities are about 9 miles north of Rockville, Oreg., and about 5 miles west of Oregon-Idaho border.

Sudbury Marble[1]

Middle Ordovician (Chazy): Southwestern Vermont.

Original reference: A. Wing, 1877, Am. Jour. Sci., 3d, v. 13, p. 334–347, 404–419.

Crops out in town of Sudbury, northwest end of Taconic Range, in Rutland County.

†Suffolk Porphyry[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey Mon. 5, p. 81, 176, 177.

Occurs on Old Suffolk mining location, Praysville, Keweenaw Point.

Sugar Creek Shale in (Bethany Falls Limestone)[1]

Pennsylvanian: Missouri-Kansas.

Original reference: C. O. Dunbar and G. E. Condra, 1932, Nebraska Geol. Survey Bull. 5, 2d ser., p. 17.

In vicinity of Kansas City.

Sugar Hill Quartz Monzonite[1] (in New Hampshire Magma Series)

Upper Devonian or Upper Carboniferous: West-central New Hampshire.

Original reference: M. P. Billings, 1935, Geology of Littleton and Moosilauke quadrangles, New Hampshire, p. 28, Moosilauke map.

M. P. Billings, 1937, Geol. Soc. America Bull., v. 48, no. 4, p. 502, 508, pl. 12. New Hampshire magma series represented in Littleton-Moosilauke area by Moulton diorite, Bethlehem gneiss, Kinsman quartz monzonite, Remick tonalite, Sugar Hill quartz monzonite, French Pond granite, Moody Ledge granite, Pond Hill granite, and Scrag granite. Relative ages of units not determined for in few places are they in contact with one another.

Mapped on Ore Hill, southeast of Sugar Hill, in northeastern corner of Moosilauke quadrangle.

Sugarloaf Andesite

Miocene or Pliocene: Central Washington.

Mentioned as being a remnant of a lava cap: B. M. Page, 1940, Stanford Univ. Abs. Dissert., v. 15, p. 119.

Occurs in Entiate Mountains, near Wenatchee, Chelan County.

Sugar Loaf Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 131–132. Voluminous lava flow of melilite-nepheline basalt; contains many pegmatoid veinlets; locally columnar joint. Commonly 40 feet thick. Overlies reef limestone of plus 25–foot (Waimanalo) stand of sea. Probably simultaneous with Tantalus basalt.

Named for Sugar Loaf (Puu Kakea), the cinder cone at vent from which it issued. Well exposed in Moiliili quarry. Covers about 1 square mile in lower end of Manoa Valley, on south side of Koolau Range about 11 miles west of Makapuu Head.

Sugarloaf Formation

Sugarloaf Arkose (in Newark Group)[1]

Upper Triassic: Central Massachusetts and central Connecticut.

Original references: B. K. Emerson, 1891, Geol. Soc. America Bull., v. 2, p. 452; 1898, U.S. Geol. Survey Geol. Atlas, Folio 50.

G. W. Bain, 1941, Am. Jour. Sci., v. 239, no. 4, p. 266, 267. Underlies Holyoke lava flow in Holyoke Range, Mass. Thickness approximately 4,000 feet.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Redefined as formation which includes Sugarloaf arkose of Emerson (1898) and that part of Emerson's Mount Toby conglomerate which underlies lava and is gradational with arkose. Red arkose grades laterally into coarse arkosic conglomerate toward southeast.

Named for occurrence at Sugarloaf Mountain, Deerfield Township, Franklin County, Mass.

Sugarloaf Metaquartzite[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 620, 623, 635.

J. J. Runner, 1928, (abs.), Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consists of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Exposed on northeast side of Sugarloaf Peak, Medicine Bow Mountains.

Sugarloaf Quartz Latite

Cretaceous or Tertiary: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 90–93, pls. 5, 12. Rocks generally light gray or dense white, with slightly pinkish-gray hue on fresh fractures. In some areas, contains phenocrysts of biotite, quartz, and chalky feldspar that range up to 2 mm and average 1 mm in length. Groundmass is aphanitic. Estimated thickness at Sugarloaf Hill about 1,500 feet. Nearly all contacts with other formations are faults. Accordingly, a complete section would be still thicker. At no other point in area is a thickness of more than 500 feet exposed.

Type locality: At Sugarloaf Hill, about 1 mile southeast of Gleeson, in central Cochise County. Recognized in Courtland-Gleeson area.

Sugarloaf Sandstone[1] or Quartzite

Lower Cambrian: Central northern Maryland.

Original reference: C. R. Keyes. 1891, Geol. Soc. America Bull., v. 2, p. 306, 320–322.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 347. Name replaced by Sugarloaf Mountain quartzite because name Sugarloaf arkose, of Triassic age, has become established formation name in Massachusetts.

Ernst Cloos and C. W. Cooke, 1953, Geologic map of Montgomery County and the District of Columbia (1:62,500): Maryland Dept. Geology, Mines and Water Resources. Massive light quartzite composed of round white or blue quartz grains. Layers below more schistose and interbedded with shale or purple phyllite. Series consists of four prominent beds with phyllite interbeds. Underlies Harpers phyllite. Mapped as Cambrian.

At Sugarloaf Mountain, Frederick County.

Sugarloaf Series

Cenozoic: Southeastern Arizona.

H. E. Enlows, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 106 (fig. 1). Comprises (ascending) pink to gray rhyolite—thickness 140 feet; soft gray rhyolite tuff—80 feet; brownish red rhyolite—30 feet; gray rhyolite tuff—20 feet; and black to gray, vesicular augite dacite—220 feet. Overlies Rhyolite Canyon series (new).

Section measured in Rhyolite Canyon, Chiricahua National Monument, Cochise County.

Sugarloaf Mountain Quartzite

Cambrian(?): Western Maryland.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 347. Consists of massive white quartzite about 200 feet thick, which caps Sugarloaf Peak, lower massive quartzite, 100 to 150 feet thick, which makes prominent cliffs and ledges on upper slopes of peak and forms summits of most of the lower peaks and ridges, and thinner bedded quartzites about 150 feet between the two massive ledges. Overlies Urbana phyllite (new). Lower Cambrian(?). Formation was named Sugarloaf sandstone by Keyes (1891) but because name Sugarloaf arkose, of Triassic age, has become established formation name in Massachusetts, name Sugarloaf Mountain is applied for Maryland formation.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 71–74. Beds similar to Sugarloaf Mountain quartzite, which crop out at Park Mills, on Brush Creek and Linganore Creek, and south of Libertytown, have been placed in Urbana phyllite and may be Sugarloaf Mountain quartzite. Sugarloaf Mountain is synclinal and fold is overturned toward northwest.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 48. Quartzites on Sugarloaf Mountain were considered Lower Cambrian and therefore Weverton by such early workers as J. P. Lesley, G. H. Williams, and C. R. Keyes. Jonas and Stose (1938) mapped these rocks as Sugarloaf Mountain quartzites and assigned them to probable Lower Cambrian. These rocks are here considered equivalent of Lower Cambrian Weverton quartzite because Sugarloaf Mountain is an anticline rather than a syncline, as reported by Stose and Stose (1946).

Named for occurrence on Sugarloaf Mountain, Frederick County.

Sugarlump Tuffs

Tertiary: Southwestern New Mexico.

F. J. Kuellmer and others, 1953, *in* New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 42 (map), 50 (map). Name appears on legends for maps of parts of southwestern New Mexico. Called latitic tuffs.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 23–25, pl. 1. Latite and rhyolite tuffs, sandy tuffs, tuffaceous sandstones, ignimbrites, and conglomerates. Some units only local, others widespread. Usually green or white, with occasional pink or brown layers. Thickness 50 to 1,400 feet. Reach maximum thickness around Sugarlump Mountain and thin toward the south, north, and northwest. Overlies Rubio Peak flows. Derivation of name.

Named after hill in NE¼ sec. 5, T. 19 S., R. 10 W., Dwyer quadrangle.

Suicide Grit

Upper Triassic: Northeastern Utah.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 474–475. Manuscript name used by R. E. Marsell to apply to grit in Ankareh formation as defined by Boutwell (1912 U.S. Geol. Survey Prof. Paper 77). Eastward this grit is recognized as typical Shinarump conglomerate and northward is identical with Higham grit.

Well exposed at mouth of Parleys Canyon east of Salt Lake City along roadcut of Wasatch Boulevard and in Suicide Rock.

†Suisun Marble[1]

Age(?): Western California.

Original reference: J. D. Whitney, 1865, California Geol. Survey, v. 1, p. 104.

Probably named for Suisun, Solano County.

Sulfur Creek Formation

Upper Jurassic[?]: Northern California.

J. E. Lawton, 1956, Dissert. Abs., v. 16, no. 10, p. 1885. Lowermost formation in area studied. Underlies Blue Ridge member of Crack Canyon formation (both new): Overlies an unnamed group of sediments, volcanics, and associated igneous and metamorphic rocks. The Upper Jurassic and Cretaceous section, about 40,000 feet thick, consists of sequences of shale and silty shale which alternate with sequences of sandstone.

Occurs in Morgan-Wilbur area in Lake, Yolo, and Colusa Counties.

Sulfur Well facies (of Lexington Formation)

See Sulphur Well Member (of Cynthiana Formation).

Sully Member (of Pierre Formation)

Upper Cretaceous: Central South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 21–34, pls. 2, 3. Defined to include body of shales lying between chalk beds of upper Gregory member (new) and base of bentonitic beds at base of Virginia Creek member (new). Includes (ascending) Agency shale of Russell (1930), Oacoma, and Verendrye shale zones. Thickness 134 to about 315 feet.

W. V. Searight, 1938, Iowa Acad, Sci. Proc., v. 45, p. 135–137; A. L. Moxon and others, 1938, Am. Jour. Botany, v. 25, no. 10, p. 795 (chart 1), 796. Redefined and stratigraphically extended at base to include a fourth zone, Gregory marl. As thus redefined, overlies Sharon Springs member.

J. P. Gries and E. P. Rothrock, 1941, South Dakota Geol. Survey Rept. Inv. 38, p. 5 (pl. 1), 14–38. Redefined. Name Gregory marl dropped and term Crow Creek marl substituted for basal zone. As thus redefined, overlies Gregory member and underlies Virgin Creek member. Thickness 126 to 365 feet.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2343–2345. Abandoned. Crow Creek and Verendrye zones raised to member rank; Agency-Oacoma zones redefined as DeGrey member of Pierre.

Named for exposures along both sides of Missouri River in and opposite western Sully County. Typical exposures occur at the Little Bend opposite site of old Fort Bennett and few miles north of one of sites of Fort Sully.

Sulphur Canyon Sandstone Member or **Bed** (in Neslen Formation)

Sulphur Canyon Sandstone Bed (in Price River Formation)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: D. J. Fisher, 1935, U.S. Geol. Survey Bull. 852.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (column 39). Shown on correlation chart as uppermost

member of Neslen formation. Overlies Thompson Canyon sandstone member; underlies Farrar formation.

D. J. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 17. Referred to as bed in Neslen formation.

Named for Sulphur Canyon, T. 9 S., R. 100 W. Traced from Buck Canyon to Colorado line.

†Sulphur Creek Group[1]

Upper Cretaceous: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 40, 50, 154.

Occurs in hills near Hilliard, Uinta County, Wyo.

Sulphur Springs Formation[1]

Sulphur Springs Group

Mississippian: Central eastern Missouri and southwestern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, 2d ser., v. 2, p. 110.

A. G. Unklesbay, 1952, Missouri Geol. Survey and Water Resources, 2d ser., v. 33, p. 39–57. In classification in Boone County, Sulphur Springs is listed as group including Grassy Creek, Bushberg, and Chouteau formations. Kinderhookian.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 75–76. It must be assumed that Ulrich meant type locality to be vicinity of Sulphur Springs. This is a station on Missouri Pacific Railroad along Mississippi River bluff in Jefferson County, Mo. Choice of name was unfortunate because in the place of the best exposures, 0.3 mile north of station, there is no evidence of strata that may be assigned to the Glen Park, and the sandstone at the "base of the Kinderhook" does not fit Ulrich's description of the Bushberg. It is likely that it was the shale of this locality that led to Ulrich's stated maximum thickness of 15 feet for the bottom shale member of the Sulphur Springs. The shale here, about 15 feet thick, includes a black fissile shale at the top containing sporangites and conodonts of Upper Devonian age. The lower several feet of the shale section is Maquoketa (Ordovician): Neither the Bushberg nor the Glen Park are coextensive with widespread upper Devonian black shales of Missouri; the Bushberg is unconformable on the Glen Park. It appears incongruous to group Devonian black shale with the Glen Park and Bushberg sandstone as a formation or as members of a group. Recommended that term Sulphur Springs as a group or formation name be dropped from Missouri stratigraphic column.

Named for exposures at Sulphur Springs, Jefferson County, Mo.

Sulphur Springs Mountain Andesite

Tertiary(?): Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 110 (table 24), 116–117, pl. 12. Fine-grained greatly altered reddish andesite that occurs as small intrusive masses which have penetrated serpentines associated with the Franciscan on Sulphur Springs Mountain and shales and sandstones of Knoxville formation in upper Sulphur Springs Valley.

Mapped in Carquinez quadrangle, Solano County.

Sulphur Well Member (of Cynthiana Formation)

Ordovician: Central Kentucky.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 11 (footnote), 20–22. Proposed for beds below Greendale member of formation.

A. C. McFarlan and W. H. White, 1948. Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1643. Sulfur Well member (pre-Greendale) is recognized as facies of the upper Lexington; contains a Cynthiana fauna.

Named for Sulphur Well, 4 miles southeast of Nicholasville, Jessamine County. Exposures are along Kentucky River fault.

Sultan Limestone[1]

Middle and Upper Devonian: Southeastern Nevada and eastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 13.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 276 (fig. 3b), 328–331. Geographically extended into Nopah and Resting Springs Mountains, Inyo County, Calif., where it is about 890 feet thick, underlies Stewart Valley limestone and overlies unnamed Silurian(?).

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881, 884 (fig. 3). Thickness in Nopah Range, 1,720 feet. Herein suggested that name Stewart Valley limestone be abandoned and that Devonian beds previously ascribed to it be assigned to Crystal Pass and Valentine limestone members of Sultan. Underlies Dawn limestone member of Monte Cristo limestone. Middle Devonian.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 40–41. Described in Ivanpah quadrangle, California and Nevada. Ironside dolomite, Valentine limestone, and Crystal Pass limestone members appear to be present throughout region in which formation is recognized. Thickness 250 to 640 feet. Underlies Monte Cristo limestone.

Ben Bowyer, E. H. Pampeyan, and C. R. Longwell, 1958, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–138. Mapped as Middle and Upper Devonian.

Well exposed in vicinity of Sultan mine, Goodspring quadrangle, Nevada.

Sumas Shales (in Chuckanut Formation)

[Eocene]: Northwestern Washington.

S. L. Glover, 1941, Washington Div. Mines and Geology Bull. 24, p. 308–311. A series of interbedded shales, sandstones, and conglomerates in basal part of Chuckanut formation near Sumas. Predominantly bright-red plastic shales, turquoise-blue flint clays, and clear-colored bluish-gray fire clays. Total area covered by series not known. Deposited upon pre-Tertiary argillites and quartzites; above well-marked unconformity is massive basal conglomerate overlain by shales and sandstones.

Exposed in prospect pit or tunnels at several places near Sumas, Whatcom County.

Sumay Limestone

Pliocene or Pleistocene: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 55, table 4 [English translation in library of U.S.

Geol. Survey, p. 66]. Very similar to and correlated with Naftan (Nafutan) limestone.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 58. Pleistocene.

Type locality: Sumay, Guam.

Summer Formation[1]

Recent: Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: On east side of Summer Lake, Lake County.

†Summerfield Limestone (in Conemaugh Formation)[1]

Pennsylvanian (Conemaugh Series): Eastern Ohio.

Original reference: D. D. Condit, 1912, Ohio Geol. Survey, 4th ser., Bull. 17, p. 20, 23.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 61. Ohio Geological Survey has abandoned term Summerfield limestone in favor of term Lower Pittsburgh limestone and shale member (Conemaugh series).

Named for Summerfield, Noble County.

Summerhill Sandstone Member (of Conemaugh Formation)[1]

Upper Pennsylvanian: Western Pennsylvania.

Original reference: C. Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133.

Crops out in bold ledge, about 50 feet thick, high in bluff east of Summerhill, Cambria County.

Summers Member (of Mesaverde Sandstone)

Upper Cretaceous: Northeastern Arizona.

G. K. Sirrine, 1959, Dissert. Abs., v. 19, no. 8, p. 2064. Incidental mention: Springerville-St. Johns area, Apache County.

Summers Series

Pennsylvanian (post-Chester, pre-Morrow): West Virginia.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 19. Future work may demonstrate presence in Appalachians and in Midcontinent of a post-Chester-pre-Morrow series to which names Pushmataha (in the west) and possibly Summers (in the east) can be applied.

Named for Summers County, where the upper Mauch Chunk formations are well exposed.

Summerville Formation (in San Rafael Group)[1]

Upper Jurassic: Southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: J. Gilluly and J. B. Reeside, Jr., 1926, U.S. Geol. Survey Press Bull. 6064, March 30.

James Gilluly and J. B. Reeside, Jr., 1928, U.S. Geol. Survey Prof. Paper 150–D, p. 79–80, table. At type section, includes 163 feet of thin alternating beds of chocolate-colored gypsiferous mudstone and well-laminated sandstone with some red clays toward base. Thickens southward for some distance; 285 feet at Horn Silver Gulch; 331 feet at Drunk Man's Point. Overlies Curtis formation with boundary gradational; underlies Morrison formation.

J. W. Harshbarger, C. A. Repenning, and R. L. Jackson, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 97–98. In Navajo country, Summerville formation, Bluff sandstone member, and Recapture shale member of Morrison grade laterally southwestward into distinct sand facies here named Cow Spring sandstone.

W. L. Stokes, 1952, Utah Geol. and Mineralog. Survey Bull. 46, p. 9 (table 1), 10–11, pl. 1. In Thompson area, Grand County, averages about 50 feet in thickness, overlies Entrada sandstone and underlies Morrison formation (Salt Wash member).

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 38 (table), 63–64, 66, 67, 69 (figs. 14, 15), 73–75. Described in Henry Mountains region where it is 40 to 250 feet thick. Consists generally of evenly bedded reddish-brown sandstone and sandy shale with minor amounts of greenish-white sandstone, gypsum, and limestone. Uppermost formation of group; overlies Curtis formation; underlies Morrison formation.

L. W. Kilgore, 1955, Four Corners Geol. Soc. Guidebook [no. 1], p. 20, cross section. Shown on cross sections of Animas River valley, Colorado, as underlying Junction Creek sandstone and overlying Todilto formation.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 39–42, strat. sections. Described in Navajo country. Throughout the area it is divisible into an upper sandy facies and a lower silty facies, similar to type locality. Overlies Entrada sandstone in central part of area and Todilto limestone in eastern part. In some places, underlies Bluff sandstone (here considered upper formation of San Rafael group); in eastern, northern, and western parts of area, tongues and grades laterally into Cow Springs sandstone. Thickness 57 to 213 feet. Unit here assigned to Summerville has been assigned to Wanakah by other workers. Correlation of Summerville from San Rafael Swell to Bluff, Utah, is well established. From Bluff, the formation is traceable throughout eastern part of Navajo country and is here correlated with the "buff shale and brown-buff sandstone members of Morrison formation" (Kelley and Wood, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 47) in Laguna-Lucero area of New Mexico.

E. B. Ekren and F. N. Houser, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–221. Mapped in Moqui SE quadrangle, Colorado, where it consists of flat- and thin-bedded brick-red argillaceous sandstone and siltstone 120 to 130 feet thick. Underlies Junction Creek sandstone with contact gradational; overlies Entrada sandstone. San Rafael group. Upper Jurassic.

Named for exposures at Summerville Point, southeast of head of Summerville Wash, in north end of San Rafael Swell, southeastern Utah.

Summit Conglomerate

Miocene and Pliocene: Central Washington.

B. M. Page, 1940, Stanford Univ. Abs. Dissert., v. 15, p. 119. Name applied to fluviatile sediments capping Mount Natapoc.

C. L. Willis, 1953, Am. Jour. Sci., v. 251, no. 11, p. 796, fig. 1. Consists of approximately 200 feet of horizontal beds of andesite stream-laid gravel.

Area described is northwest of Wenatchee, Chelan County.

Summit Gabbro

Paleozoic(?) or Mesozoic(?): Southern California.

W. J. Miller and R. W. Webb, 1940, California Jour. Mines and Geology, v. 36, no. 4, p. 353–354, 378 (fig. 31), pl. 2. Typically medium to fine grained with occasional coarse-grained facies. Intrudes Kernville series and is intruded by Sacatar quartz diorite (new).

Named because of prominent exposures along crest of the Sierra in northwestern part of Kernville quadrangle, Kern County.

Summit Limestone (in Cherokee Shale)[1]

Pennsylvanian: Northeastern Missouri.

Original reference: W. J. McGee, 1892, St. Louis Acad. Sci. Trans., v. 5, p. 331.

Occurs in Macon County.

†Summit Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2, p. 25–26.

Occurs in high knobs of Perry Township, Lawrence County. Named for Summit cut on P. F. W. & C. Railroad in northwestern part of Beaver County.

†Summit Series (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: E. V. d'Invilliers, 1895, Pennsylvania 2d Geol. Survey, v. 3, pt. 2, p. 2377.

Occurs in northern part of Clarion County.

Summit Springs Evaporite Member (of Pequop Formation)

Permian (Leonardian): East-central Nevada (subsurface).

Grant Steele, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 106. Middle Leonardian evaporite sequence drilled at 4,400 to 5,400 feet. Underlies an evaporite dated lower Guadalupian and assigned on basis of stratigraphic position and faunal control, to Loray formation (new). Little surface expression of this member.

Recognized in Standard of California-Continental's Summit Springs Unit No. 1, NW¼ sec. 30, T. 20 N., R. 60 E., White Pine County.

†Summitville Andesite (in Potosi Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: E. S. Larsen, 1917, Colorado Geol. Survey Bull. 13, p. 20, 35–38.

Named for extensive development in vicinity of Summitville, Rio Grande County.

Summum Coal Member (of Carbondale Formation)

Pennsylvanian: Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 36, 47 (table 1), 66, pl. 1. Assigned member status in Carbondale formation (redefined). In southern area, occurs above Roodhouse coal member and below Hanover limestone member; in western and northern

area occurs above Kerton Creek coal member and below Hanover limestone member; in eastern area, occurs above Shawneetown coal member and below Harrisburg (No. 5) coal member. About 3 inches thick. Coal named by Wanless (1931, Illinois Geol. Survey Bull. 60). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: Northeast of Summum, NE¼ sec. 3, T. 3 N., R. 2 E., Fulton County.

Summum cyclothem (in Carbondale Formation)

Summum cyclothem[1] (in Carbondale Group)

Pennsylvanian: Western, central, and southern Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 182, 192.

H. B. Willman, 1942, Illinois Geol. Survey Bull. 66, p. 106 (fig. 50), 107–118. Commonly between 20 and 25 feet thick. Includes Pleasantview sandstone (at base), Hanover limestone, Covel conglomerate, and intervening unnamed units. Directly overlies Lowell cyclothem (new) where latter is present, and Liverpool cyclothem where Lowell is absent or unrecognized; despite this seeming overlap it is apparently conformable with both because Pleasantview sandstone seems to grade into underlying uppermost sandy shales of both cyclothems; apparently conformable with overlying St. David cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 61–62, 94–102, 204–205, pl. 5. In Beardstown-Glasford-Havana-Vermont area, cyclothem is as much as 85 feet thick, maximum thickness in channel areas of basal Pleasantview sandstone. Separated from underlying Liverpool by one of most prominent erosional unconformities in Illinois Pennsylvanian. Type locality and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 53 (table 2), pl. 1. In Carbondale formation (redefined). Above Lowell cyclothem and below St. David cyclothem. Type locality given; reference in Wanless (1957) in error. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: NE¼ sec. 3, T. 3 N., R. 2 E., Fulton County, near Summum.

Summum Sandstone (in Carbondale Formation)[1]

Pennsylvanian: Northwestern Illinois.

Original reference: T. E. Savage, 1930, Illinois Acad. Sci. Trans., v. 22, p. 498.

Sumner Group[1]

Permian: Eastern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 3, 9, 48.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 91–93. Sumner group lies between Herington limestone and Harper sandstone. Comprises Wellington shale, Ninnescah shale, and Stone Corral dolomite. Leonard series.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 159–160. Group comprises about 1,000 feet of strata at outcrop. Predominantly gray shale with beds of red and green shale and

deposits of dolomite, limestone, gypsum, and anhydrite. Underlies Harper sandstone of Nippewalla group; overlies Nolans limestone of Chase group.

Named for Sumner County, Kans.

†Sumpter Epoch[1]

†Sumter Epoch[1]

Miocene and Pliocene: Eastern South Carolina.

Original reference: J. D. Dana, 1863, Manual of Geology, p. 506, 511, 522, 798.

Named for development in Sumter district, Sumter County.

†Sunbeam Monzonite[1]

Post-Eocene: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 644, 656–657, pls. 75, 77.

Named for Sunbeam mine, Tintic district.

†Sunbury calciferous sandrock[1]

Devonian(?) and Mississippian: Central Ohio.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d v. 16, p. 216, 220–222.

Named for Sunbury, Delaware County.

Sunbury Member (of Orangeville Shale)

Sunbury Shale[1]

Mississippian: Ohio and northeastern Kentucky.

Original reference: L. E. Hicks, 1878, Am. Jour. Sci., 3d, v. 16, p. 216, 220.

Wallace de Witt, Jr., 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1163. Member of Orangeville shale. Underlies Aurora siltstone member; overlies Berea sandstone. In central and eastern Cuyahoga County, Ohio, where Sunbury shale is separated from Orangeville by local siltstones, the Sunbury can be regarded as distinct formation. This separation is impossible in much of northern Ohio where Orangeville consists of very dark gray and black shales and local siltstones are absent. Therefore, Sunbury is treated as member of Orangeville as far east as the typical zone of *Orbiculoidea herzeri* and *Lingula melie* can be found. This zone of fossils disappears from section in vicinity of Andover in eastern Ashtabula County, and Sunbury member is not recognized across State line in Pennsylvania.

Named for Sunbury, Delaware County, Ohio.

Sun Creek Dacite Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 34–35. Discussion of geology and petrography of Crater Lake National Park. Mount Mazama is name given to prominent peak that once stood on what is now rim of Crater Lake. Lavas in Mount Mazama were of three types —andesites, dacites, and basalts. Immediate rim of Crater Lake is made up wholly of andesites and dacites, chiefly the former; basalts are limited to outer slope. Dacite flows named are Sun Creek, Cloud Cap, Grouse Hill, Llao Rock, Wineglass, Cleetwood Cove, and Rugged Crest. [For basalt flows see Timber Crater Basalt Flow.] Canyon of Sun Creek

below falls has on the west a number of cliffs and terraces due to successive dacite flows, exposing total thickness of about 600 feet. At 6,300 feet east of Crater Peak, cliffs begin. First 200 feet is solid dacite flow. Nut terrace, at 5,900 feet, exposes perlitic and spherulitic banded rhyolite and forms bluff 75 feet in height. At 5,700 feet is a plain of fine material, filling the valley to width of three-fourths mile. Sun Creek has cut canyon 200 feet deep in this soft material. Layer of pumice covers nearly everything beyond canyon, so that nature of underlying rock is a matter of doubt. Sun Creek dacite is the oldest about Crater Lake.

Sun Creek Flows

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 89. Sun Creek flows were result of glowing avalanches of pumice and scoria that discharged through Sun Notch on southern slope of Mount Mazama. Avalanches deposited their load after they passed beyond snout of Sun Creek glacier 1½ miles below the notch. Glowing avalanches were part of final activity of Mount Mazama and followed what is termed main pumice fall.

Sun Creek flows southward from Crater Lake.

Sundance Formation[1]

Sundance Group

Upper Jurassic: Southwestern South Dakota, central northern Colorado, central southern Montana, northwestern Nebraska, and southwestern Wyoming.

Original reference: N. H. Darton, 1899, Geol. Soc. America Bull., v. 10, p. 387–393.

R. W. Imlay, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 2, p. 229, 232–234, 238 (fig. 2), 239 (fig. 3), 244–264, strat. sections. Formation, in Black Hills area, South Dakota and Wyoming, subdivided into (ascending) Canyon Springs sandstone, Stockade Beaver shale, Hulett sandstone, Lak, and Redwater shale members (all new). Thickness 200 to 350 feet. Overlies Gypsum Spring formation; underlies Morrison formation. Outcrops near Sundance, which is actually 18 miles southwest of Belle Fourche quadrangle, restudied and considered inadequate to serve as type section. Standard reference section of Sundance is 327 feet thick and includes all members except Canyon Springs. Represents Callovian and Oxfordian stages.

G. N. Pipiringos, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 34–37; 1957, Wyoming Geol. Survey Bull. 47, p. 6–8, 9 (table 1), 11–13, 19–25. Formation described in Laramie basin, Wyoming. Comprises following members (ascending): Canyon Springs, Stockade Beaver, Hulett, Lak, unnamed member B, Redwater, and unnamed member A. Member A is persistent sandstone unit, 4 to 30 feet thick, that bevels from north to south all underlying members except the Canyon Springs. This unit is distinct from other members of Sundance but is also distinct from overlying Morrison and for convenience is placed in Sundance. Overlies Nugget formation.

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 464 (table 1), 465–500. Proposed that, in eastern Wyoming and western South Dakota, Sundance formation be raised to rank of group comprising

two units of formational rank which are correlated with Swift and Rierdon formations of Ellis group of Montana. Because of historical significance, term Sundance should be retained, and, despite its correlation with upper units of Ellis group, term Sundance group is here applied to marine Upper Jurassic rocks of the Black Hills and vicinity, northernmost part of Colorado, subsurface of northwestern Nebraska, and all but westernmost Wyoming.

R. K. Hose, 1956, U.S. Geol. Survey Bull. 1027–B, p. 54–55, pl. 6. Described in Johnson County, Wyo., where it is approximately 285 feet thick and consists of sandstone, shale, and minor amounts of oolitic limestone. Underlies Morrison formation; unconformably overlies Gypsum Spring formation, and locally overlies Crow Mountain sandstone member of Chugwater formation.

J. C. Stewart, 1958, Geology of the Dryhead-Garvin Basin, Bighorn and Carbon Counties, Montana (1:63,360): Montana Bur. Mines and Geology. As mapped, group includes Piper, Rierdon, and Swift formations.

J. D. Love, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 64–68. Formation described in southern part of Powder River basin where it consists of a lower and an upper unit. Canyon Springs member questionably present locally. Underlies Morrison formation; overlies Gypsum Spring formation, Nugget sandstone, and members of Chugwater formation.

T. P. Storey, 1958, Alberta Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston basin and adjacent areas. On basis of regional extent and significance of sub-Swift and sub-Rierdon unconformities, a different stratigraphic interpretation is presented. The Swift is divided into Lower, Middle, and Upper units. Lower Swift is so designated because it is considered to be lithologically similar to and regionally conformable with Middle and Upper Swift which correspond to type Swift of western Montana. Lower Swift of Williston basin and equivalent Stockade Beaver and Hulett members of Lower Sundance in Black Hills are considered to lie unconformably on the Rierdon and therefore to be younger than the Rierdon and older than the Swift as designated by Cobban. This correlation is offered in lieu of the more general belief that Lower Sundance and Rierdon are equivalent in age. Thus, Lak and Redwater members of the Sundance are considered equivalent to type Swift of western Montana.

Type locality: Above Sundance which is 18 miles southwest of Belle Fourche quadrangle, South Dakota. Reference section: About one-fourth mile north-northeast of center of Spearfish in sec. 3, T. 6 N., R. 2 E., Lawrence County, S. Dak.

Sunday Quartzite[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: C. R. Van Hise and C. K. Leith, 1911, U.S. Geol. Survey Mon. 52, p. 225, 227, chart opposite p. 598, 605.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 85 (table 1). Included in Animikie series. Underlies Bad River dolomite; unconformable above granite.

Named for two exposures east of Sunday Lake, one a short distance east of Little Presque Isle River and other near Newport mine, Penokee-Gogebic district, Mich.

Sunday Mountain Volcanic Member (of Orfordville Formation)

Sunday Mountain Volcanics

Middle Ordovician(?): Western New Hampshire and eastern Vermont.

J. B. Hadley and others, 1938, Geologic map and structure sections of the New Hampshire portion of the Mount Cube quadrangle (1:62,500); C. A. Chapman and others, 1938, Geologic map and structure sections of the Mascoma quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Member consists of schistose greenstones in low-grade metamorphic zone of formation, and chiefly fine- to medium-grained amphibolite with some fine-grained biotite gneiss and black graphitic quartzite in middle-grade zone. Occurs near top of Orfordville formation above Hardy Hill quartzite member (new). Middle Ordovician(?).

J. B. Hadley, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 119, 123. Maximum thickness 400 feet.

J. B. Hadley, 1950, Vermont Geol. Survey Bull. 1, p. 15–16. Metamorphic equivalent of rhyolite and dacite tuffs and possibly some flows. Geographically extended to Vermont. Ordovician.

R. J. Bean, 1953, Geol. Soc. America Bull., v. 64, no. 5, pl. 2. Mapped together with Post Pond volcanics as a unit overlying Orfordville formation. Map legend shows Upper(?) Ordovician age.

J. B. Lyons, 1955, Geol. Soc. America Bull., v. 66, no. 1, p. 114–116. Stratigraphic revision of Orfordville formation implies that the lithologically similar Post Pond and Sunday Mountain volcanic members are essentially equivalent, and the latter is not mapped separately.

Named for outcrops on and near Sunday Mountain, Orford Township, Grafton County.

Sunderland Formation (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: G. B. Shattuck, 1901, Johns Hopkins Univ. Circ., v. 20, no. 152, p. 73–75.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Mineral Resources Bull. 10, p. 45–47, 48. Described in Prince Georges County, Md., and District of Columbia. Consists almost entirely of valley fill; lies unconformably on deposits ranging in age from ancient crystalline rocks to the Pliocene. In northern end of Potomac estuary, lies much lower than Brandywine gravel, but at southern end of county lies nearly as high. The Wicomico formation is sunk below base of the Sunderland and is separated from it by a slope exposing older rocks. Thickness about 40 or 50 feet. As here interpreted, formation spans interval between first low-water stage of the Pleistocene and the beginning of the next; therefore, presumably accumulated in early Pleistocene during first (Nebraskan) glacial stage and first (Aftonian) interglacial stage. As defined in this region, appears to be equivalent to combined Sunderland and Coharie formations of North Carolina.

J. T. Hack, 1955, U.S. Geol. Survey Prof. Paper 267–A, p. 8, 29–31. Problem of separating upland deposits in Coastal Plain into formations is discussed. No basis is found for separating the Sunderland from the Brandywine; both formations at their type localities are underlain by a littoral deposit, North Keys sand (new) of Miocene(?) age. Part of the

Sunderland as mapped by earlier workers is here included in North Keys sand.

Name derived from hamlet of Sunderland, Calvert County, Md.

Sunniland Limestone

Lower Cretaceous: Southern Florida (subsurface).

P. L. Applin, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B209–B211. Term "Sunniland", as applied to rock unit, was published by Pressler (1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10) who referred to "Sunniland zone," "Sunniland limestone," and "the formation." Neither Pressler nor later writers defined the unit or described type section. Common usage has established name "Sunniland limestone" in geologic nomenclature of Florida. Name is here used to designate subsurface unit of middle Trinity (Comanche) age in southern Florida. Composed chiefly of limestone, dolomite, and shale. Overlies the so-called "thick anhydrite" or "lower anhydrite" unit, and underlies so-called "upper anhydrite" unit, both of Trinity age. Thickness 250 to 275 feet in wells in and near Sunniland field. Penetrated in about 60 deep test wells in central and southern Florida.

Sunniland oil field, Collier County.

Sunnybrook Volcanics (in Amador Group)

Jurassic: East-central California.

G. R. Heyl and J. H. Eric, 1948, California Div. Mines Bull. 144, pt. 1, p. 51, 52, 53, pl. 7. A series of schists and greenstone in Newton mine area (near Jackson, Amador County), tentatively correlated with Jurassic Amador group described by Taliaferro (1942), is subdivided into four formations (descending): Mountain Spring volcanics, Dufrene slate, Newton Mine volcanics, and Sunnybrook volcanics. The Sunnybrook, a sequence of undetermined thickness, consists dominantly of gray felsic rocks, including bedded feldspathic tuff and felsitic quartz-bearing tuff of rhyolite composition; within the felsitic rocks is a zone, approximately 400 feet thick, of dark-green chlorite-uralite schist, probably derived from pyroclastics. Thickness at least 1,500 feet. Measured section, along Mountain Spring Creek from Mariposa slate eastward, dips steeply to east; relation of beds to Mariposa slate suggests that section is overturned and is on west limb of an overturned anticline or its faulted equivalent.

Name derived from Sunnybrook Crossing in eastern part of Newton mine area.

Sunnyside Member (of Blackhawk Formation)

Upper Cretaceous (Montana): Central eastern Utah.

R. G. Young, 1955, Geol. Soc. America Bull., v. 66, no. 2, p. 183, 185–186, figs. 2, 3, pl. 3. Composed of massive basal sandstone tongue and the overlying coal-bearing rocks which are replaced eastward by offshore bar sandstones. Basal sandstone is medium grained, buff, and massive; maximum thickness of about 50 feet at Pace Canyon, grading downward and eastward into tongue of Mancos shale which, in turn, rests disconformably on Kenilworth member (new) of Blackhawk formation. Coal-bearing rocks consist of about 25 feet of sandstone, shale, and coal which, at point about 4 miles northeast of Desert, are replaced by last of series of six offshore bar sandstones. Two important coal beds present in

member, the Upper and Lower Sunnyside coals. Upper coal about 22 feet thick at Horse Canyon; Lower coal maximum thickness about 5 feet. Separated from Grassy member (new) above by tongue of Mancos shale.

Named for exposures near town of Sunnyside, Carbon County. In Book Cliffs.

Sunol Series

Upper Cretaceous: California.

O. P. Jenkins, 1938, Geologic map of California (1:500,000): California Div. Mines, sheet 4. Grouped under marine sediments on map legend.

Sunrise Formation[1]

Lower Jurassic: Southwestern Nevada.

Original reference: S. W. Muller and H. G. Ferguson, 1936, Geol. Soc. America Bull., v. 47, p. 241–252.

H. G. Ferguson, S. W. Miller, and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–45. Black, gray, and brown shale, locally altered to slate and hornfels, with interbedded argillaceous, cherty, and arenaceous limestone, locally grading into calcareous sandstone. One bed, 10 feet, of oolitic limestone in lower part. Overlies Gabbs formation; unconformably underlies Dunlap formation.

Type section: Upper part of New York Canyon, west of Sunrise Flat. Named for Sunrise Flat in Gabbs Valley Range.

†Sunrise Series[1] or Group[1]

Paleozoic and Mesozoic: Southern Alaska.

Original reference: W. C. Mendenhall, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 305–307.

Crops out on western shores of Prince William Sound. Probably named for Sunrise City, which is in center of Turnagain Arm mining district.

Sunrise Springs Series[1]

Tertiary or Pleistocene: Northeastern Arizona.

Original reference: A. B. Reagan, 1932, Kansas Acad. Sci. Trans., v. 35, p. 253–258.

In Cornfields-Sunrise Springs district.

Sun River Dolomite (in Madison Group)

Upper Mississippian: Northwestern Montana.

V. R. Chamberlain, 1955, Billings Geol. Soc. Guidebook 6th Ann Field Conf., p. 78, 79. Typically consists of very light yellowish white dolomitic limestone and limy dolomite with occasional bed of chert. Distinguished from Charles formation by its anhydrite free limestones and dolomites. Overlies Mission Canyon formation with apparent conformity.

Well exposed along Sun River west of Great Falls in Hannon Gulch.

Sunset Member (of Arnheim Formation)

Sunset division (in Arnheim Formation)[1]

Upper Ordovician: North-central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1910, Denison Univ. Sci. Lab. Bull. 16, p. 18.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, chart facing p. 108. Shown on generalized section of Ohio

as lower member of Arnheim formation. Underlies Oregonia member; overlies Mount Auburn member of McMillan formation. Consists of calcareous shales and nodular limestones. Thickness about 60 feet. Richmond series.

Named for Sunset, Fleming County, Ky.

Sunset Point Formation

Cambrian: Southern and central Wisconsin.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 150. Dominantly sand with varied proportions of dolomite. Underlies Oneota formation; overlies Jordan member of Trempealeau formation. Name proposed to replace term Madison to alleviate much confusion, owing especially to widespread use of the same name, Madison, for a Mississippian limestone unit in Montana and Wyoming.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 85. In Stoddard quadrangle, underlies Hickory Ridge member (new) of Oneota formation.

Named after bluff of that name at Madison sandstone type locality, Madison, Wis.

Sunshine Peak Rhyolite[1] (in Potosi Volcanic Series)

Tertiary, middle and late: Southwestern Colorado.

Original reference: E. S. Larsen, 1935, U.S. Geol. Survey Bull. 843.

U.S. Geological Survey currently classifies the Sunshine Peak Rhyolite as part of Potosi Volcanic Series and designates the age as middle and late Tertiary on the basis of a study now in progress.

Named for exposures on Sunshine Peak, San Cristobal quadrangle.

Sunshine Ranch Member (of Saugus Formation)

Sunshine Ranch member (of Pico Formation)

Pliocene: Southern California.

G. B. Oakeshott, 1950, California Jour. Mines and Geology, v. 46, no. 1, p. 50 (table), 58 (fig. 3), 59–61, pls. 14, 16. Term Sunshine Ranch member of Pico formation applied to upper Pliocene continental beds lying below continental lower Pleistocene Saugus formation and above marine beds commonly called Pico. As described in unpublished report by J. C. Hazzard, Sunshine Ranch formation in its type area consists of a 20-foot basal portion of crossbedded to cobbly sandstone overlain by a coquina reef bed which averages 35 feet in thickness. This is followed by an interbedded series of gray coarse-grained to pebbly friable sandstone and gray to greenish-gray very fine grained sandstone, silty sandstone, and sandy siltstone. In Placerita oil field, thickness is approximately 1,300 feet; member has been folded into an asymmetrical syncline; here it disconformably underlies Saugus formation; overlies Mint Canyon formation with angular unconformity.

E. L. Winterer, 1955, *in* Pacific Petroleum Geologist Newsletter, v. 9, no. 6, p. 2. Reallocated to member of Saugus formation.

E. L. Winterer and D. L. Durham, 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. Term Sunshine Ranch was introduced by Hazzard (in Oakeshott, 1950) for interfingering marine, brackish-water, and nonmarine beds lying between Pico and Saugus formations in vicinity of San Fernando Reservoir in San Fernando Valley, a short distance south of the area of this report. Sunshine Ranch is here considered member of

Saugus formation and of Pliocene age. At Hazzard's type locality, Sunshine Ranch is about 3,000 feet thick.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 22 (fig. 2), 23 (fig. 3), 78, 82–83, pl. 1. Member of Pico formation. Exposed both north and south of San Gabriel fault in San Fernando quadrangle where it unconformably underlies Saugus formation. Thickness 3,000 feet where exposed in steeply north-dipping section in Mission Hills near San Fernando Reservoir. North of fault, on Sierra Highway, approximately 1,300 feet thick. South of fault, unconformably overlies fossiliferous Lower Pico; north of fault, overlies lower Pliocene Repetto formation and also upper Miocene Mint Canyon formation with angular unconformity. Upper Pliocene. Sunshine Ranch member is roughly equivalent to "lower Saugus" of earlier workers.

Type area: In foothills area north of Sunshine Ranch between axial region of Reservoir anticline and Balboa Avenue, west of San Fernando Reservoir.

Supai Formation (in Aubrey Group)[1]

Pennsylvanian and Permian: Northern Arizona, eastern California, eastern Nevada, western New Mexico, and southern Utah.

Original reference: N. H. Darton, 1910, U.S. Geol. Survey Bull. 435, p. 21, 22, 25.

D. White, 1929, Carnegie Inst. Washington Pub. 405, p. 11. Includes Esplanade sandstone member.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 525, 533–534. In Fort Apache Reservation, about 979 feet thick and includes Fort Apache limestone and Kinishba beds (both new).

J. W. Huddle and E. Dobrovolny, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 10. In central and northeastern Arizona, divided into three members which are in part contemporaneous and grade laterally into each other. Thickness ranges from 1,700 to 1,800 feet in outcrops along Mogollon Rim and thickens northward to nearly 2,500 feet in wells; thins northeastward toward Fort Defiance and Zuni uplifts; probably more than 2,500 feet thick beneath Black Mesa basin. Formation transgresses time lines and probably varies in age from Des Moines through Leonard. Overlies Naco formation; contact drawn above sequence of gray limestone and shale and below a sequence of red sandstone, shale, and limestone. Underlies Conconino sandstone; contact arbitrarily drawn at base of lowest massive sandstone with well-developed Coconino-type crossbedding.

G. S. Campbell, 1951, Utah Geol. Soc. Guidebook 6, p. 63, 64 (fig. 15). Described in Confusion Range, Utah, where it consists of 3,000 feet of varicolored sandstones, the basal part of which is considered to be Wolfcampian in age. Overlies Bird Springs formation; underlies Kaibab limestone.

S. S. Winters, 1951, Plateau, v. 24, no. 1, p. 12–14. In Fort Apache Reservation, comprises four members: lowest consists of 330 feet of reddish-brown very fine-grained noncalcareous sandstone and siltstone; about 475 feet of slope-forming reddish-brown calcareous mudstone that alternates with ledge-forming gypsum beds, light-colored very calcareous claystones and gray limestones; Fort Apache limestone 95 to 118 feet thick; 370 feet of alternating slope-forming reddish-brown calcareous mudstones and

siltstones, and ledge-forming beds of light-colored very calcareous claystones, gray limestones, and gypsum. Underlies Coconino sandstone; overlies Naco formation.

R. L. Jackson, 1951, Plateau, v. 24, no. 2, p. 90 (fig. 2). In Fort Apache area, Winters (unpub. thesis) subdivided Supai into (ascending) Amos Wash, Big "A", Apache, and Corduroy members. In Fossil Creek area [this report], the Supai comprises (ascending) Packard member (new), Oak Creek member (new), Big A sand facies, Apache member, and Corduroy member. Overlies and interfingers with Naco formation; underlies Coconino sandstone.

P. W. Hughes, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 635–657. Described in Chino Valley, Yavapai County, Ariz. Consists of two members: lower, 145 to 156 feet thick, is slope-forming unit of red sandstones and siltstones, capped by cliff-forming unit of cherty limestone; upper, about 938 feet thick, is alternating red sandstones and siltstones interbedded with a few strata of structureless claystone and some aphanitic limestone. Unconformably overlies Redwall limestone; underlies Coconino sandstone with contact gradational. Basal Supai is Lower Pennsylvanian.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 45, pl. 1. Mapped in San Bernardino County, Calif., where it overlies Bird Spring formation and underlies Kaibab limestone.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 533–540. Described in Clarkdale quadrangle, Arizona. Subdivided into three members: lower, 580 to 625 feet thick, is chiefly sandstone and siltstone with minor amounts of shaly mudstone; middle, 250 to 300 feet thick, present only north of Verde River, is principally siltstone intercalated with conglomerate, sandstone, and some limestone; and upper, 650 to 750 feet thick, present only north of Verde River, is sequence of sandstone and a few interbedded siltstone beds. Unconformably overlies Redwall limestone; intertongues with overlying Coconino. In Grand Canyon area, Hermit shale separates Supai from Coconino. Pennsylvanian and Permian.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2174. Proposed that terms Supai(?) and Supai equivalents as used by Newell (1948, Geol. Soc. America Bull., v. 59, no. 10) and Supai sandstone as used by Campbell (1951) be abandoned in Confusion Range and term Arcturus be used.

In Defiance uplift area and near Toadlena, N. Mex., term Supai is used for bedded rocks that dominantly underlie and locally interfinger with the DeChelly.

Named from exposures at Supai Village, in Havasu (Cataract) Canyon, northern Arizona. Havasu Canyon drains northward into Grand Canyon of Colorado and joins it about 85 miles north of Black Mesa. Supai is contraction of word Havasupai.

Supaian series[1]

Carbonic: Northwestern Arizona.

C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251 (table). Includes (ascending) Pierce shales (new), Seligman limestones (new), Yampai shales (new), and Shiwits sandstones (new). Underlies Verdan series.

In Grand Canyon region.

Supan Tuff and Sand Member (of Tuscan Formation)

[Pliocene]: Northern California.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. Tuscan formation is subdivided into five members. Supan tuff and sand is oldest in sequence. Underlies Bald Hill agglomerate member.

Occurs at Iron Canyon dam site near Red Bluff, Tehama County.

Superior Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Superior mine, Houghton County.

Superior Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Probably named for occurrence in Superior mine, Houghton County.

Superior West Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

In Superior mine, Houghton County.

Superior West Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

In Superior mine, Houghton County.

Suplee Formation (in Mowich Group)

Lower Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 239, 242. Consists of gradations of granular gray limestone and calcareous sandstone; poorly stratified or massive. Thickness ranges from 35 to 150 feet. Conformably underlies Nicely shale (new); overlies Robertson formation (new) in type area and Bear Valley area; where Robertson is absent, the Suplee lies discordantly upon Triassic beds.

Type area: Along headwaters of South Fork of Beaver Creek, 7 miles southeast of Suplee post office, in secs. 26, 27, 28, and 29, T. 18 S., R. 26 E. Named for Suplee post office, Crook County.

Sur Series[1]

Pre-Franciscan: Southern California.

Original reference: P. D. Trask, 1926, California Univ. Dept. Geol. Bull., v. 16, no. 6.

Parry Reiche, 1937, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 7, p. 116–132, geol. map. Name Sur series was applied by Trask (1926) to metamorphic rocks of Santa Lucia Range. Previous to that time, these rocks had been known variously as part of Santa Lucia formation and of Coast complex, although associated plutonic material had been

distinguished by Lawson as Santa Lucia formation [Santa Lucia granite]. Present report uses Trask's term Sur series, but Trask's perpetuation of name Gabilan for the marbles, which occur at various horizons, spaced irregularly over several thousands of feet stratigraphically, seems ill advised. Series in Santa Lucia quadrangle comprises variety of generally phanerocrystalline metamorphic rocks including quartzose schists and gneisses, quartz biotite schists, marbles, and plagioclase amphibolites. Series crops out over much of northern Santa Lucia Range; similar rocks are exposed in northern part of Gavilan Range, and sporadic areas have been mapped in Santa Cruz Mountains. Thickness uncertain because of possibility of unrecognized structural complexities. Assuming homoclinal structure with average dip of 35°, there must be minimum of 7,000 feet near northwest corner of quadrangle. If Sur series east of Coast Ridge fault is not repetition of rocks of this northwest area, total thickness may be approximately 10,000 feet. Paleozoic(?).

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 18–19, pls. Term Sur series used to include pre-Franciscan schist and quartzite and pre-Franciscan limestone on Point Reyes, Peninsula. Two exposures of quartzite and schist, each less than 2 acres, occur associated with quartz diorite along an intrusive contact. One exposure is about 7,000 feet southwest of Inverness on northeastern slope of Point Reyes Mountain and is less than 50 feet thick. The other exposure, which is on western shore of Tomales Bay about 1¼ miles north of Inverness, consists of a narrow strip of banded quartz-mica schist about 500 feet long and 25 feet thick. It rests upon quartz diorite and dips at a low angle eastward beneath Tomales Bay and supposedly abuts San Andreas fault. A belt of crystalline limestone a little less than 1,000 feet wide lies about 1 mile west of Point Reyes Station. It is faulted into quartz diorite so that the eastern side abuts the quartz diorite and western side passes beneath Miocene sandstone. Southern tip of belt wedges into igneous rock.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 118. Names Sur series, Gabilan limestone, and Santa Lucia granodiorite are essentially petrographic and not formational in usual sense since rocks of very different ages might be included under any one of the names.

O. E. Bowen, Jr., and C. H. Gray, Jr., 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1676. An 8,200-foot section of strongly metamorphosed sediments of Sur series is exposed astride Fremont Peak 10 miles northeast of Salinas at north end of Gabilan Range. Homoclinal sequence strikes east and dips 70° N. Three units recognized: 1,400-foot upper schist; 3,300-foot middle carbonate schist; and 3,500-foot lower schist. Neither top nor bottom of sequence exposed; boundaries have been obliterated by quartz monzonite intrusions. Fremont Peak section is within 5,000- to 10,000-foot range of thickness suggested by Reiche and Trask for series in Lucia and Point Sur quadrangles of Santa Lucia Mountains. Indistinct forms in limestone suggestive of cup corals together with clastic debris possibly derived from round-section crinoids, observed one-half mile west of Fremont Peak on Rocky Ridge, yield only age-suggestive features of series. Part of sequence is possibly Paleozoic.

Named for exposures along Sur River.

Surgener Formation

Middle Ordovician (Mohawkian): Southwestern Virginia and northeastern Tennessee.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 93, chart 1 (facing p. 130). Name proposed for chalky weathering dark limestone, cherty dark limestone, gray to buff mudstone, and maroon mudstone. Underlies Dryden formation (new). At Hagan, Va., sequence includes Poteet, Rob Camp, and Martin Creek formations of Miller and Brosge (1950); also Dot formation [according to chart]. Name attributed to B. N. Cooper and G. A. Cooper.

Type section: Just east of Hagan Switchback on the L. and N. Railroad, 4½ miles due north of Surgener Cemetery, Rose Hill quadrangle, Lee County, Va. Named for cemetery which is one-half mile east of section along Yellow Creek.

Surprise Formation[1]

Surprise Member (of Kingston Peak Formation)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 309–311, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 360, 363, figs. 1, 3. Redefined as member of Kingston Peak formation. Characteristically a conglomeratic subgraywacke or conglomeratic mudstone, locally hornfelsed and phyllitic; in one area, a nonpebbly graywacke occurs within the conglomeratic rocks. Thickness 370 feet in Goler Wash; more than 1,600 feet near mouth of Woodland Canyon; base of formation not exposed north of Coyote Canyon so actual thickness of member is not known. Basal member of formation; overlies Archean gneiss; underlies Sour Dough member. Area of report Manly Peak quadrangle.

Named for exposures along Surprise Canyon, southern part of Panamint Range, Inyo County.

Susanville Gravels

Eocene: Northern California.

Howel Williams, 1932, California Univ. Pub. Bull., Dept. Geol. Sci., v. 21, no. 8, p. 215. Susanville gravels, lying southeast of Lassen and containing an admixture of rhyolitic tuff, may be correlated tentatively with Montgomery Creek formation(new). Name credited to R. D. Russell.

Town of Susanville is in Lassen County.

Susitna Slate[1]

Jurassic(?) and Cretaceous: Southern Alaska.

Original reference: G. H. Eldridge, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 14–20, map.

Exposed up Sushitna [Susitna] River for 50 miles, from 15 miles above mouth of the Chulitna to considerable distance above mouth of Indian Creek, Cook Inlet region.

Suslota Limestone[1]

Pennsylvanian: Central eastern Alaska.

Original reference: W. C. Mendenhall and F. C. Schrader, 1903, U.S. Geol. Survey Prof. Paper 15, p. 46–47.

Occurs west of Suslota Pass, Mentasta Mountain region.

Suspension Bridge Dolomite Member (of Lockport Dolomite)

Silurian: Western New York, and Ontario, Canada.

E. R. Cumings, 1939, Geologie der Erde, North America, v. 1, p. 596 (fig. 7), 597. Finely saccharoidal medium-bedded dolomite; sparsely fossiliferous about 50 feet. Middle member of Lockport; overlies Gasport dolomite member; underlies Eramosa dolomite member.

B. F. Howell and J. T. Sanford, 1947, Wagner Free Inst. Sci. Bull., v. 22, no. 4, p. 34. Replaced by term Goat Island member; name Suspension Bridge preoccupied.

Exposed in Niagara Gorge.

Susquehanna Group

Susquehanna Series[1]

Upper Devonian: Pennsylvania.

Original reference: G. H. Ashley, 1923, Eng. Mining Jour.-Press, v. 115, p. 1106–1108.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 3. Susquehanna group defined as all units between highest Catskill red beds at top and base of Tully limestone at bottom. Includes Catskill formation, transition beds (named locally), and Upper Devonian marine beds. North of confluence of Susquehanna and Juniata Rivers, Susquehanna group is of order of 7,000 feet thick, characterized by about 3,500 feet of red beds in upper part. Transition unit about 1,500 feet thick north of confluence of Susquehanna and Juniata Rivers. Lowermost unit (2,000 feet in Susquehanna River area) consists of marine medium-gray sandstones and siltstones with dark-gray shale near base. Base of this unit placed at base of Tully limestone member. This lower unit is synonymous with Fort Littleton and Rush formations where they are mapped, and possibly some "Chemung" may be included. Middle and Upper Devonian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Map bracket shows group, in central and eastern Pennsylvania, includes (ascending) marine beds (contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully limestone at base), Catskill formation, and Oswayo formation. Upper Devonian.

Named for occurrence in Susquehanna River area.

†Susquehanna Mica Schist[1]

Precambrian: Northern Maryland.

Original reference: W. B. Clark, E. B. Mathews, and E. W. Berry, 1918, Maryland Geol. Survey, v. 10, p. 69 (table).

Sussex Sandstone Member (of Cody Shale)

Sussex Sandstone Member (of Steele Shale)

Upper Cretaceous: Wyoming (subsurface and surface).

J. B. Wilson, 1951, Wyoming Geol. Survey Rept. Inv. 3, p. 3–11. Member of Cody shale known primarily in subsurface. Light-gray fine-grained glauconitic marine sandstone about 40 feet thick where best developed in Sussex and North Meadow Creek oil fields. Occurs above Shannon sandstone member and below Parkman sandstone member.

J D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:500,000): U.S. Geol. Survey. Mapped as member of Cody shale. Member is 2,500 feet above base of Cody.

G. H. Horn, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–164. Shown on map legend as member of Steele shale.

Present in Powder River Basin. Exposed at surface near Salt Creek oil field.

Sutherland Falls Marble[1]

Sutherland Falls Marble Member (of Boardman Formation)

Sutherland Falls Marble Member (of Shelburne Formation)

Lower Ordovician: Western Vermont.

Original reference: Edward Hitchcock, 1861, Vermont Geol. Rept., v. 2, p. 767.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 25, 26. Rank reduced to lowest member of Boardman formation (new). Thin-bedded green-streaked white and cream-colored marble with contorted chains of dolomite crystals standing out on weathered surfaces; contains a central siliceous band, the Hen Hawk layer. Thickness regularly 90 to 100 feet. Underlies Intermediate dolomite member of Boardman; overlies Clarendon Springs dolomite. Type locality designated.

J. B. Thompson, Jr., 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 75 (table 1). In Clarendon-Dorset area, basal member of Shelburne formation. Thickness 50 to 100 feet. Underlies Intermediate marble member. Overlies Clarendon Springs formation.

Type locality: Probably a quarry 2,000 feet west of Sutherland Falls in Proctor, Rutland County. Name apparently taken from Sutherland Falls on Otter Creek.

Sutro Member (of Alta Formation)

Sutro Tuffs

Oligocene(?): Western Nevada.

V. P. Gianella, 1934, Mining and Metallurgy, v. 15, no. 331, p. 299. Tuffs, about 400 feet thick, are water laid and interbedded with Forman volcanics; Miocene.

V. P. Gianella, 1936, Nevada Univ. Bull., v. 30, no. 9, p. 56–59, pl. 1. Tuff member of Alta andesite composed of fine volcanic dust and ash with particles as much as one-fourth inch, occasionally much coarser. Color usually creamy yellow to light buff. Occurs 500 feet stratigraphically above base of Alta andesites. Derivation of name given.

D. I. Axelrod, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1935. Oligocene age indicated on basis of flora.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 51–52, pl. 3. A member of Alta formation ranging in texture from shale to conglomerate, with grayish-green shale especially characteristic. Oligocene(?). Only of local extent.

Named for exposures in Sutro Tunnel. Present only in Comstock Lode district, Virginia City quadrangle.

Sutter Formation[1]

Tertiary, upper: Northern California.

Original reference: R. E. Dickerson, 1916, California Univ. Pub., Dept. Geol. Bull., v. 9, p. 404–406.

Ralph Stewart, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 34, sheet 2. Expanded below to include about 150 feet of coarse gravels here termed the Butte gravel member. Upper Tertiary.

Named for occurrence in Sutter County, in what is now known as Marysville Buttes (formerly Sutter Buttes).

Sutter Mountain unit

Carboniferous(?): Northern Washington.

R. W. Jones, 1959, Dissert. Abs., v. 20, no. 3, p. 994. Consists of unmetamorphosed sedimentary and intermediate to basic volcanic rocks. These rocks are the lower plate of the Shuksan-Whitechuck overthrust which is east of map area. To the southwest, the Sutter Mountain unit is in high angle fault contact with Gold Mountain phyllite (new)

Report discusses geology of Finney Peak area, northern Cascades.

†Sutton Gneiss[1]

Precambrian: Central southern Massachusetts and northwestern Rhode Island.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

Named for exposures east of Sutton, Worcester County, Mass.

Sutton Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1917, West Virginia Geol. Survey Rept. Braxton and Clay Counties, p. 218.

Exposed just east of B. & O. Railroad Station at Sutton, Braxton County.

Sutton Island Series[1]

Precambrian or Camrbian(?): Southeastern Maine.

Original reference: N. S. Shaler, 1889, U.S. Geol. Survey 8th Ann. Rept., pt. 2, p. 1037, 1041–1043, 1061, map.

G. H. Chadwick, 1942, (abs.) Geol. Soc. America Bull., v. 53, no. 12, pt. 2, p. 1797. Sutton Island abandoned; synonymous with Frenchmans Bay series (new) of Silurian age.

Named for development on Sutton Island, south of Mount Desert Island, Hancock County.

Suwanee Basalt Flow[1]

Pleistocene: New Mexico.

Original reference: R. L. Nichols, 1934, Geol. Soc. America Proc. 1933, p. 453.

Occurs in San Jose Valley, Valencia County.

Suwannee Limestone

Suwannee Limestone (in Vicksburg Group)[1]

Oligocene, upper: Eastern Florida and south-central Georgia.

Original reference: C. W. Cooke and W. C. Mansfield, 1936, Geol. Soc. America Proc. 1935, p. 71–72.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1314, 1315 (fig. 1). Vicksburg group restricted to exclude Suwannee limestone.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 173–178. As used in this report, Suwannee limestone includes all beds of Oligocene age in Citrus and Levy Counties. Upper part of formation is considered to be equivalent to lower Chickasawhay marl of eastern Mississippi, and lower part possibly equivalent of Byram formation and Marianna limestone of Florida. Thickness 59 to 120 feet. Unconformably overlies Ocala limestone (restricted); unconformably underlies Hawthorn formation; where Hawthorn is absent, Suwannee is covered by sediments of early Pleistocene or Alachua formation, terrestrial Miocene. Upper Oligocene.

W. E. Moore, 1955, Florida Geol. Survey Bull. 37, p. 51–58. As exposed in Jackson County, consists of tan- to buff-colored limestones, dolomitic limestones, and dolomitic to calcareous clays that underlie Tampa formation and overlie Marianna limestone. Thickness 5 to 12 feet in central area of county; maximum thickness about 210 feet (in water well at Sink Creek).

Typically exposed along Suwannee River in Florida, from Ellaville almost to White Springs.

Swakane Gneiss[1]

Pre-Ordovician: Central Washington.

Original reference: A. C. Waters, 1932, Jour. Geology, v. 40, no. 7, p. 603–633.

Well exposed along canyon of Swakane Creek, for which it is named.

Swan Creek Limestone[1]

Upper Ordovician: Western Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 43–44.

Named for Swan Creek, Hickman County.

Swan Creek phosphate[1]

Upper Devonian or Mississippian: Western Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 136, 137, 138, 142.

Named for Swan Creek, Lewis and Hickman Counties.

Swan Creek Sandstone[1]

Mississippian: Southwestern Illinois.

Original reference: E. O. Ulrich, 1923, Geol. Soc. America Bull., v. 33, p. 831.

Exposed along Swan Creek, 1½ to 2½ miles east of Anna, Union County.

Swandyke Hornblende Gneiss[1]

Precambrian (Gunnison River Series): Central Colorado.

Original reference: T. S. Lovering, 1935, U.S. Geol. Survey Prof. Paper 178.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 20, 73, pl. 1. In type locality, consists chiefly of hornblende schist and hornblende gneiss interlayered with thin beds of quartz latite; thickness approximately 6,000 feet. Lithologic character and

structural relations indicate that dioritic intrusives and related extrusives and intercalated sediments were in part contemporaneous with and in part younger than upper part of Idaho Springs formation. At Coal Creek, overlain by series of quartzites and quartz pebble conglomerates at least 14,000 feet thick.

Type locality: At Swandyke, about 10 miles east of Breckenridge, Summit County.

Swan Lake Glaciation

Pleistocene (early Wisconsin): Central southern Alaska.

T. N. V. Karlstrom *in* T. L. Péwé and others, 1953, U.S. Geol. Survey Circ. 289, p. 4, 13 (table 1). At least four major Quaternary glaciations recognized in Upper Cook Inlet area. Succeeded Caribou Hills glaciation, preceded Naptowne glaciation (new). Represented by distinct moraine near Swan Lake and by discontinuous lateral moraines found along lower slopes of mountain fronts, generally 1,000 to 2,000 feet above sea level, and in major mountain valleys. Drift, in general, retains hummocky aspect, but kettle depressions partly or completely filled.

Represented near Swan Lake which is in northwest part of Kenai Mountains, Upper Cook Inlet area.

Swannanoa Formation

[Lower Cambrian]: Western Virginia.

W. A. Nelson, 1949, (abs.) Virginia Acad. Sci. Proc. 1948–1949, p. 139. Lower part of Unicoi up to top of a 300-foot acid lava flow is named Swannanoa formation and upper part of Unicoi is named East Waynesboro formation.

Report discusses structure and stratigraphy of the Blue Ridge in Albemarle and adjacent counties. Main Blue Ridge mountain is an overturned anticline, with axial plane dipping 28° SE., and a thrust fault bordering it on its western edge.

Swan Peak Formation

Swan Peak Quartzite[1]

Middle Ordovician: Northeastern Utah and southeastern Idaho.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 409.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1136–1137, pl. 1. In Logan quadrangle, Utah, formation consists of three persistent members: lower, black shale; middle brown quartzite; and upper buff quartzite. Thickness 399 feet. Conformable and intergrading with underlying Garden City; unconformable below Fish Haven dolomite. Ordovician (Champlainian).

R. J. Ross, Jr., 1949, Am. Jour. Sci., v. 247, no. 7, p. 479, 483, 484. Formation discussed in area of its type section where it overlies Garden City limestone and underlies Fish Haven dolomite. Thickness at type section 315 feet.

G. W. Webb, 1956, Utah Geol. and Mineralog. Survey Bull. 57, p. 11–12, 35, 37–38, 39–40, 42–43 (fig. 11), 44. In Millard County, Utah, includes Watson Ranch tongue (new). Thickness 129 to 711 feet. In Ibex area, underlies Crystal Peak dolomite (new); elsewhere underlies Eureka quartzite; overlies Lehman formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 75–78, pls. 1, 20. In Sheeprock Mountains, Utah, overlies Kanosh shale and underlies Fish Haven dolomite. Thickness 348 to 462 feet. Kanosh shale is approximate age equivalent of lower part of Swan Peak formation of Ross (1949) of northeastern Utah and of Orient shale member of Orient formation in West Tintic mining district. Proposed that names Orient formation and its subdivisions Orient shale and Orient quartzite be supplanted by Kanosh shale and Swan Peak quartzite.

Named for Swan Peak, Rich County, Utah.

†Swan Pond Granite[1]

Late Carboniferous or post-Carboniferous: Northeastern Massachusetts.

Original reference: J. H. Sears, 1905, Phys. geog., min., and pal. of Essex County, Massachusetts, p. 141.

Well developed on shore of Swan Pond.

Swansea Quartz Monzonite

Swansea Rhyolite[1]

Eocene, middle: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, map.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 34. Discussion of Swansea quartz monzonite stock in East Tintic district.

D. R. Cook, 1957, Utah Geol. Soc. Guidebook 12, p. 65 (fig. 6). As shown on correlation chart, Swansea quartz monzonite overlies Laguna latite series (new) and underlies Silver City monzonite (new). Middle or upper Eocene.

Exposed in Swansea and South Swansea mines, Tintic district.

†Swanton Conglomerate[1]

Lower Cambrian to Lower Ordovician: Northwestern Vermont.

Original reference: A. Keith, 1923, Am. Jour, Sci., 5th, v. 5, p. 118–126.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1045. Beds called Swanton by Keith (1923) and later renamed Corliss breccia are herein renamed Rockledge limestone breccia.

Named for exposures in eastern part of Swanton Township, Franklin County.

†Swanton Slate[1]

Lower Cambrian: Northwestern Vermont.

Original reference: J. B. Perry, 1868, Boston Soc. Nat. History Proc., v. 11, p. 347.

Occurs at Highgate Springs, Franklin County.

Swanville Formation (in Hamilton Group)

Middle Devonian: Southeastern Indiana.

Guy Campbell, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1057, 1063–1064, 1067. A gray crystalline limestone overlies Silver Creek formation and underlies New Albany shale throughout area of Hamilton outcrop. Heretofore, it has been regarded as a continuous bed of the Beechwood, but it represents two distinct formations—the Beechwood and the Swanville. The Swanville, a thick-bedded hard bluish to gray crystalline limestone, is difficult to distinguish from Beechwood on lithology alone but

the two have not been found in the same section at any place. Maximum thickness 6 feet; at type section 5 feet.

J. B. Patton and T. A. Dawson *in* H. H. Murray, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 42, pl. 1. Swanville and Deputy "formations" appear to be only faunal facies of units previously recognized and named, or combinations of such units; they might better be called "zones" or "faunal facies" of Sellersburg (North Vernon) limestone.

Type section: Scott-Jefferson County line on Highway 256, about 1 mile west of Swanville. Occurs in continuous bed from near Commiskey, Jennings County, to southeast corner of Scott County.

Swarbrick Formation[1]

Cambrian: South-central Nevada.

Original reference: H. G. Ferguson, 1933, Nevada Univ. Bull. 27, no. 3, p. 13–25.

W. H. Easton, chm., 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 148. Listed among names not used in revision of stratigraphic units in Great Basin.

Forms hanging wall of ore-bearing fissure in Swarbrick prospect, in eastern part of Tybo district.

Swarthmore Granodiorite

Late Paleozoic: Southeastern Pennsylvania.

A. W. Postel and H. W. Jaffe, 1957, Pennsylvania Acad. Sci. Proc., v. 31, p. 120–123. Introduced to replace preempted name Springfield granodiorite. Study indicates that lead-alpha ages of ziron of Wissahickon schist are older than those of Swarthmore granodiorite and related rocks and that all of the ages are younger than Precambrian.

Type locality not stated. Postel (1941) reported exposures of Springfield granodiorite in vicinity of Swarthmore, Delaware County.

Swartz Rhyolite

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 17 (table 1), 36, pl. 1. Porphyritic rhyolite flows, tuffs, and flow breccias associated with one or more domelike porphyritic rhyolite intrusive bodies and small dikes. The rhyolite consists of alternating brown and gray bands, about 3 mm wide. Flow folds common. Angular unconformities separate it from Bear Springs basalt below and Santa Fe fanglomerates above.

Named after small abandoned settlement near junction of Tom Brown Canyon and Mimbres River. A local formation found only in secs. 26, 27, 34, and 36, T. 18 S., R. 10 W., Dwyer quadrangle.

Swasey Formation[1]

Middle Cambrian: western Utah and southeastern Nevada.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 11.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1133–1134, 1141, 1145–1146. Because Walcott's section of Swasey was not part of a continuous section and original definition was not sufficiently precise,

Swasey is herein redefined and type section assigned. As emended, formation consists of a lower unit 117 feet thick and an upper unit 278 feet thick. Lower unit consists of 38 feet of interbedded dull-gray fine-grained platy argillaceous limestone and clay shale with well-preserved cranidia and pygidia of *Ehmania;* 50 feet of dull- and dark-gray platy and a few arenaceous limestones with several beds of *Ehmania*-coquina at top; and 29-foot zone of green micaceous chunky and fissile shale and interbedded gray thin-bedded limestones which increase in amount upward. Upper 278 feet consist of dark- and black-gray medium-grained massive and irregular-bedded limestone which contains oolites in the lower, and small algae (*Girvinella?*) in upper part. Overlies Dome limestone (emended); underlies Wheeler shale (emended).

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 39–40, fig. 5. Geographically extended into Nevada, where it is same as units F–G of Highland Peak limestone as described by Wheeler and Lemmon (1939). Overlies Dome limestone also extended into Nevada. Lower 117 feet of type Swasey as described by Deiss is herein named Condor member.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 35, 47, 139–140, 145–146, 150, pl. 1. In Sheeprock Mountains, stratigraphically restricted at base to exclude Condor member herein raised to formational status. Thickness 169 feet.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 43–52. Name Swasey herein restricted to cliff-forming limestone unit that overlies Whirlwind formation (new) and that underlies Wheeler shale. Term Condor member of Swasey considered invalid.

Type section: Marjum Canyon, House Range, Millard County, Utah. Here formation forms part of the continuous emended Cambrian section.

†Swatara Iron Sandstone (in Clinton Formation)[1]

Silurian (Niagaran): Southeastern Pennsylvania.

Original reference: C. K. Swartz and F. M. Swartz, 1931, Geol. Soc. America Bull., v. 42, p. 637, 638.

Occurs on Swatara Creek, Swatara Gap, 11 miles northwest of Lebanon, Lebanon County.

Swauger Quartzite

Precambrian (Belt Series): Southern central Idaho.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1096, 1097–1099, pl. 1. Mostly rather pure quartzite that varies from purple through deep-brownish-lavender and pinkish shades to almost pure white. Near base and locally at higher horizons are beds of green relatively impure quartzite. Most quartzite is distinctly bedded and some is cross-bedded. A few lenses of conglomerate and rusty impure dolomite are included. Variegated argillite is present at several horizons but is most conspicuous in lower part of formation. Beds of different colors and lithologies interfinger with each other. Unit has not been satisfactorily measured, but in vicinity of Flatiron Mountain the exposed thickness appears to be at least 1 mile. Underlies Kinnikinic quartzite and overlies Lemhi quartzite (new) with gradational contact.

A. L. Anderson, 1959, Idaho Bur. Mines and Geology Pamp. 118, p. 18–21. Thickness about 10,000 feet in Lemhi quadrangle. Overlies Lemhi quartzite.

Occupies most of southern and eastern parts of the small part of Lemhi Range included in Borah Peak quadrangle. Named after Swauger Ranch whose grazing lands include much of area in which it crops out within quadrangle.

Swauk Formation[1]

Eocene: Central and central northern Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137.

R. L. Lupher, 1944, Washington Div. Geology Rept. Inv. 11, p. 7, 12–15, pl. 2. Overlies Cle Elum formation (new).

H. A. Coombs, 1950, Am. Jour. Sci., v. 248, no. 6, p. 369–377. Discussion of granitization in the Swauk. Structurally formation rests unconformably on Swakane gneiss which has been considered pre-Ordovician. Presumably in late Eocene time, beds were folded into series of anticlines and synclines whose axes trend grenerally in northwest-southeast direction.

R. S. Yeats, 1958, Dissert, Abs., v. 19, no. 4, p. 775. In Skykomish area, Temple Mountain andesite (new) overlies Swauk with angular unconformity. Paleobotanical evidence suggests Paleocene age for Swauk, though part may be Upper Cretaceous.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 101 (table 1), 103–105, pl. 1. Predominantly arkose with some shale and minor conglomerate; rock types distributed irregularly; beds range from a few inches to more than 100 feet thick and grain size changes abruptly both laterally and vertically; most of formation massive, but crossbedding not uncommon. Thickness at least 4,000 feet, may be more. Unconformably underlies Teanaway basalt in most of area; locally, between Kachess and Cle Elum Lakes, unconformably covers pre-Tertiary peridotite and Easton schist. Where Swauk unconformably overlies peridotite, lateritic iron ores have been formed. Most authors have considered these laterites basal Swauk, but Lupher (1944) proposed name Cle Elum for these deposits. Age of Swauk has been much debated. When Knowlton (*in* G. O. Smith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 106) identified fossil leaves as Eocene, term Paleocene had not come into use. It seems clear from Knowlton's reference to what are now considered Cretaceous and Paleocene formations that he regarded the Swauk as being near Cretaceous-Teritary boundary, not Eocene as we use it today. Paleocene or Late Cretaceous age based on paleobotany is in accord with stratigraphic relationship. The Swauk unconformably overlies metamorphic basement of unknown age. Unconformably above Swauk is Teanaway basalt, and concordantly above Teanaway is Roslyn arkose that contains middle or upper Eocene fossils. Area of this report is northern part of Mount Stuart and Snoqualmie folios, central Cascade Mountains.

Named for Swauk Creek and Swauk mining district, about 15 miles north of Ellensburg, Kittitas County.

Swearinger Slate[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

C. W. Averill, 1937, California Jour. Mines and Geology, v. 33, no. 2, p. 85, 86. Composed chiefly of dark slaty shale, with thin beds of limestone and chert forming small proportion of whole mass. Thickness 200 to 400 feet. Overlies Hosselkus limestone; underlies Trail formation.

Named for fact it occurs near Swearinger's house, on north side of Genesee Valley, Plumas County.

Swede Pond Quartzite[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199.

E. N. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs above Faxon limestone and below Catamount schist.

Type locality: Swede Pond, Hague Township, Warren County.

Sweetland Creek Shale[1]

Upper Devonian or Mississippian: Southeastern Iowa and western Illinois.

Original reference: J. A. Udden, 1899, Jour. Geology, v. 7, p. 65–78.

Walter Youngquist and A. K. Miller, 1948, Jour. Paleontology, v. 22, no. 4, p. 440–450. Recent conodont studies in vicinity of type section confirms evidence that Sweetland Creek is referable to Upper Devonian and is approximately contemporaneous with Grassy Creek shale of Missouri. Formation is only of local occurrence in Iowa.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 39. Sweetland Creek beds at their type locality represent only a relatively small part of the almost 200 feet of similar beds called Grassy Creek in northwestern Illinois. Therefore name Sweetland Creek is discarded in Illinois.

Named for exposures on Sweetland Creek, about 4 miles from Muscatine, Muscatine County, Iowa.

Sweetwater Dolomite[1]

Permian: Central northern Texas.

Original reference: A. M. Lloyd and W. C. Thompson, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 953, pl. 10.

Named for outcrops in Sweetwater, Nolan County.

Sweetwater Group[1]

Oligocene: Central Wyoming.

Original reference: F. V. Hayden, 1871, U.S. Geol. Survey Terr., 4th Ann. Rept., p. 29.

Occurs along Sweetwater River and continues north to hills opposite Seminoe Pass in Sweetwater Valley.

Sweetwater Member[1] (of White River Group)

Oligocene: Western Wyoming.

Original reference: C. M. Bauer, 1934, Geol. Soc. America Bull., v. 45, p. 665–695.

Occurs along Sweetwater escarpment from Lander-Rawlins Road as far east as Alcova, Natrona County, a distance of 80 miles.

Sweitzer Formation

Pliocene or Pleistocene: Southern California.

L. G. Hertlein, 1929, Stanford Univ. Abs. Dissert., v. 4, p. 82. A conglomerate 1 to 3 meters thick. Usually unconformably overlies beds of known Pliocene age.

L. G. Hertlein and U.S. Grant, 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 63 (fig. 4), 71. Described as brown and brownish-red conglomerate or pebbly sandstone 5 to 30 feet thick. Unconformably overlies San Diego formation and caps most of the tops of mesas in area. Columnar section shows Sweitzer formation underlying Bay Point formation (new).

Type locality: Sweitzer Canyon in Balboa Park, San Diego County.

Swenson Gypsum Member[1] (of Peacock Formation)

Permian: Central northern Texas.

Original reference: L. T. Patton, 1930, Texas Univ. Bull. 3027, p. 45.

L. T. Patton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 927. Swenson gypsum is same as Wagon Yard gypsum. Name Swenson gypsum member was proposed by writer [Patton] when his manuscript was submitted in 1927. Name Wagon Yard was not proposed until 1929. The writer [Patton] retained the name originally proposed when his manuscript was revised in 1930.

Named for exposures near town of Swenson, Stonewall County. Forms prominent escarpment extending from southern border of county to near Swenson, where escarpment dies down and gypsum bed disappears.

Swett Tuff Member (of Quichapa Formation)

Oligocene: Eastern Nevada and southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 94. At type locality, underlies Bauers tuff member and overlies Leach Canyon tuff member (both new); elsewhere lava flows or other volcanic rocks, local in extent and origin, present at contacts. Thickness 30 to 45 feet in Swett Hills. An ignimbrite similar to Bauers tuff. Zircon age of Leach Canyon tuff member is 28 million years; this suggests that Quichapa formation is Oligocene. Report is discussion of ignimbrites of area.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 138 (fig. 3). Geographically extended into eastern Nevada.

Type locality: West-facing scarp of Swett Hills, Desert Mound quadrangle, Iron Springs district, Utah.

Swift Formation (in Ellis Group)

Swift Formation (in Sundance Group)

Upper Jurassic: North-central Montana, western South Dakota, and eastern Wyoming.

W. A. Cobban, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 9, p. 1264 (fig. 1), 1281–1286, 1288 (fig. 5), 1289 (fig. 6), strat. sections. At type locality, consists of two members; lower is dark-gray noncalcareous shale 54½ feet thick; upper member is flaggy ripple-marked sandstone 80 feet thick containing abundant black-gray fissile shale partings. Lithologic character of type locality persists along mountain

front from south boundary of Glacier National Park southeast almost to Sun River. From Sun River southeast along mountain front, formation becomes increasingly sandy. On South arch, formation consists of fine-grained flaggy sandstone which is locally pebbly at base. In vicinity of Little Belt Mountains, formation is massive fine-grained sandstone containing prominent basal conglomerate. Thicknesses: 135 feet at type locality; 106 feet, Rierdon Gulch; 118 feet, Sun River section, Lewis and Clark County; 101 feet, southwest of Craig. At type section, underlies Morrison formation; overlies Rierdon formation (new); in areas where Rierdon is absent, unconformably overlies Sawtooth formation (new).

J. A. Peterson, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 466 (table 2), 480, 481, 482, 483, 491–504, 505. Swift-Rierdon nomenclature of Ellis group in Montana is applied in eastern Wyoming and western South Dakota to formational units of Sundance group. Indications are that the names are applicable to marine Upper Jurassic throughout most of Wyoming and western South Dakota, but term Sundance should be retained because of historical significance. Thicknesses in outcrop sections of Swift vary from 63 feet in Laramie County to 289 feet in Johnson County. Overlies Rierdon formation; underlies Morrison formation.

T. P. Storey, 1958, Alberta Soc. Petroleum Geologists Jour., v. 6, no. 4, p. 90–104. Discussion of Jurassic of Williston basin and adjacent areas. On basis of regional extent and significance of sub-Swift and sub-Rierdon unconformities, a different stratigraphic interpretation is presented. Swift is divided into Lower, Middle, and Upper units. Lower Swift is so designated because it is considered to be lithologically similar to and regionally conformable with the Middle and Upper Swift which correspond to type Swift formation of western Montana. Lower Swift of Williston basin and equivalent Stockade Beaver and Hulett members of Lower Sundance in Black Hills, are considered to lie unconformably on the Rierdon and therefore are younger than the Rierdon and older than the Swift as designated by Cobban. This correlation is offered in lieu of general belief that Lower Sundance and Rierdon are equivalent in age. Thus, Lak and Redwater members of Sundance are considered equivalent to type Swift formation.

Type locality: Vicinity of Swift Reservoir, T. 28 N., R. 10 W., Pondera County, Mont. Section measured on north shore in NE¼ sec. 27.

Swift Run Formation

Swift Run Tuff

Precambrian: Northern Virginia, and Maryland.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 410. A series of tuffaceous and arkosic sediments that underlie Catoctin basalt and overlie injection complex on west limb of Catoctin Mountain-Blue Ridge anticlinorium.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 18–20. Geographically extended into Maryland where it underlies Catoctin metabasalt and lies directly on injection complex. Beds comprise blue and green blebby tuff, sericite schist, and a sericitic quartzite with glassy and blue quartz grains; also includes some marble just above

the basal quartzose beds. Parts of unit here described as Swift Run had formerly been mapped as part of Loudoun formation by early workers. Derivation of name given.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 311. In central Virginia, Oronoco formation (Bloomer and Bloomer, 1947) is equivalent to Swift Run tuff which had previously been mapped as far south as this part of Virginia.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 9–12, pl. 1. In Elkton, Va., area, termed Swift Run formation because unit is varied in character and tuffaceous element is subordinate. Underlies Catoctin greenstone, probably conformable. Crops out in narrow belt around inliers of injection complex.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 487–589, pl. 1. Formation in Blue Ridge area, central Virginia, consists mainly of graywackes, subgraywackes, and volcanics 0 to 400 feet thick. Beds are from a fraction of an inch to about 20 feet thick. Where formation overlies Pedlar migmatite, lower part is conglomerate graywacke with clasts composed of quartz, potash feldspar, and granite in an equigranular matrix that unconformably overlies basement complex and conformably underlies Catoctin greenstone; overlaps basement complex from east to west. Separated from unaltered basement rock by a saprolite 10 to 100 feet thick.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43, 72. Referred to as tuff member of Catoctin metavolcanics.

Named from exposures on U.S. Highway 33 just east of Swift Run Gap, Va., and on Skyline Drive just north of the gap.

Swift Water Formation[1]

Probably Cambrian: Northwestern New Hampshire.

Original reference: C. H. Hitchcock, 1874, Am. Jour. Sci., 3d, v. 7, p. 468–476.

In region from Swiftwater and Woodville on south to north of Littleton, Grafton County.

Swisshelm Formation

Upper Devonian: Southeastern Arizona.

R. C. Epis, C. M. Gilbert, and R. L. Langenheim, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2243–2256. In general, upper third of formation is largely impure limestone, whereas quartz sandstone, siltstone, and marl predominate in lower two thirds. Mostly thin bedded and nonresistant. Wherever well exposed, sandy and marly strata are shades of brown and yellow. Thickness 400 to 600 feet. underlies Escabrosa limestone; overlies El Paso limestone.

In Swisshelm and Pedregosa Mountains, southeastern Cochise County.

Swissvale Gypsum Member (of Minturn Formation)

Pennsylvanian (Desmoinesian): South-central Colorado.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 821, 833, pl. 1. A bed of gypsum which lies about 2,000 feet above base of formation in Arkansas River section west of Canyon City. Gypsum cannot be traced continuously through the area. It may rise in section toward southeast or may have been injected between different beds in different parts of area.

Named from exposures about a quarter mile northeast of Swissvale switch (Denver and Rio Grande Western Railroad), Fremont County. Crops out sporadically from vicinity of Meeker southward to Coaldale.

Switchback Shale

Switchback Limestone[1]

Middle and Upper Cambrian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 5, 39.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1078, 1084, 1089, 1090 (fig. 2); 1939, Geol. Soc. America Spec. Paper 18, p. 6, 8–9, 16, 29, 32, 46, 54 (fig. 6). Referred to as Switchback shale; overlies Steamboat limestone (as used here replaces Gordon Mountain limestone of 1933 sequence); underlies Devils Glen dolomite. Thickness at type locality 253 feet; average thickness 111 feet. Middle Cambrian.

Charles Deiss, 1943, Geol. Soc. America Bull., v. 54, no. 8, p. 1131 (table 1), 1133. Described in Sawtooth Range where it is 125 to 175 feet thick; underlies Devils Glen dolomite; overlies Steamboat limestone. Middle and Upper Cambrian.

Type locality: On ridge east of Kid Mountain and west of cirque on southwest side of Gordon Mountain, in SW¼ sec. 9, T. 19 N., R. 13 W., northern Lewis and Clark Range. Named from Switchback Pass approximately 2 miles southeast of Pentagon Mountain.

Swope Limestone[1] or Formation[1] (in Kansas City Group)

Swope Limestone (in Bronson Group)

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: C. O. Dunbar and G. E. Condra, 1932, Nebraska Geol. Survey Bull. 5, 2d ser., p. 17, table C.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Swope limestone included in Kansas City group (redefined). Underlies Galesburg shale; overlies Ladore shale.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 192–193. Swope limestone in Bronson group includes (ascending) Middle Creek limestone, Hushpuckney shale, and Bethany Falls limestone members. Average thickness 23 feet. Overlies Ladore shale; underlies Galesburg shale. Missouri series.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2028–2029, 2031 (fig. 4). Included in Kansas City group (redefined in Kansas and Nebraska). Comprises (ascending) Middle Creek limestone, Hushpuckney shale, and Bethany Falls limestone members. Overlies Ladore formation; underlies Galesburg formation. Bronson reduced to subgroup of Kansas City group (redefined). This is classification agreed upon by Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 421. Included in Kansas City group. Thickness about 27 feet. Comprises (ascending) Middle Creek limestone, Hushpuckney shale, and Bethany Falls limestone members. Overlies Ladore shale; underlies Galesburg shale.

Named for Swope Park, Kansas City, Mo.

Sybille Tongue (of Phosphoria Formation)[1]

Permian: Central southern Wyoming.

Original reference: H. D. Thomas, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1664.

H. D. Thomas, 1940, Kansas Geol. Soc. Guidebook 14th Ann. Field Conf., p. 124. Suggests that name be abandoned in favor of Minnekahta.

Type locality: Around Sybille anticline near Sybille Springs in Laramie Basin.

Sycamore Conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 656. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of Puente Hills, Los Angeles County.

Named for its occurrence in Sycamore Canyon.

Sycamore Limestone[1]

Mississippian: Central southern Oklahoma.

Original reference: J. A. Taff, 1903, U.S. Geol. Survey Geol. Atlas, Folio 98.

J. D. Prestridge, 1959, *in* Petroleum Geology of southern Oklahoma, v. 2: Tulsa, Am. Assoc. Petroleum Geologists, p. 156–164. In Ardmore basin, formation occupies stratigraphic interval between Caney (Meramecian) and Woodford (upper part-Kinderhookian) formations. Divisible into two members, herein named Cornell Ranch (lower) and Worthey (upper). Comprises up to 350 feet of slate-blue tough silty to finely sandy limestone with calcareous shales ranging from very thin partings to lentils up to 30 feet thick. Lower part contains cherty limestones and calcareous shales, with a green shale at base. Near base is bed of limestone, typically glauconitic at base, becoming cherty in upper part.

M. K. Elias and C. C. Branson, 1959, Oklahoma Geol. Survey Circ. 52, p. 22, 23. Sycamore sandstone exposed below Caney type section is unlike Sycamore of its type area and may be facies grading into Ahloso member of Caney.

Named for Sycamore Creek, Johnston County, which crosses its outcrop in T. 3 S., R. 4 E.

Sycamore Member (of Travis Peak Formation)

Sycamore Sand

Sycamore Sand (in Travis Peak Formation)[1]

Lower Cretaceous (Comanche Series): Central Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 141, 142.

R. H. Cuyler, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 5, p. 631–632. Member consists primarily of sands and conglomerates. Thickness 30 to 90 feet. Underlies Cow Creek member. Hill's Sycamore has priority over Taff's Sycamore limestone in Mississippian of Oklahoma.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5, 6–7 (fig. 1), 8. Marble Falls limestone and Smithwick shale are truncated, and deposited across them is massive conglomerate of Cretaceous age belonging to Sycamore sand member of Travis Peak formation.

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 69, figs. Referred to as Sycamore sand. Cartographic rock unit ordinarily mapped with the Sycamore but originally included in Hill's definition of Cow Creek beds is distinct unit between Sycamore sands below and Cow Creek limestone above. It is here named Hammet shale.

Named for exposures on Sycamore Creek, Burnet County.

Sycamore Canyon Member (of Puente Formation)

Sycamore Canyon Formation

Miocene, upper: Southern California.

M. L. Krueger, 1936, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 20, no. 11, p. 1520. Name Sycamore Canyon formation applied to a 3,800-foot interval of alternating conglomerates, sands, silts, and shales in Whittier Hills. Underlies Repetto formation; unconformably overlies upper Puente member of Puente formation.

S. N. Daviess and A. O. Woodford, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 83. Described in Whittier area. Rank reduced to member of Puente formation. Lower beds of conglomerate lens out within map area and in places interfinger with beds of underlying siltstone.

C. J. Kundert, 1952, California Div. Mines Spec. Rept. 18, p. 6–7. In Whittier-La Habra area member subdivided into Central Fee sandstone below and Hoover conglomerate above.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Use of name extended to include the massive- to well-bedded feldspathic sandstones, gray to brown siltstone, and local conglomerates that crop out in southeastern end of Puente Hills, between Chino and Santa Ana River, and on Burruel Ridge south of Santa Ana River. On Burruel Ridge, the Sycamore Canyon is unconformably overlain by Repetto(?) and gradationally overlies Yorba member (new) of Puente.

Whittier Hills area is in Los Angeles County.

Sycamore Creek Sandstone[1]

Upper Devonian: Northeastern and central Arizona.

Original reference: C. Lausen and E. D. Wilson, 1925, Arizona Univ. Bur. Mines Bull. 120, p. 7, 12–13.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228. Sycamore sandstone designated the middle part of the Jeromian series (new). Underlies East Verde limestone (new); overlies Vecol limestone (new). Thickness 75 feet.

Best exposed at Sycamore Creek, a tributary of East Verde River, Coconino and Yavapai Counties.

Sykes Mountain Formation

Lower Cretaceous: Northwestern Wyoming.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1139 (fig. 1), 1143 (fig. 2), 1149–1150, 1151 (fig. 5), pl. 1. Composed of thinly interbedded siltstones, sandstones, and shales, commonly containing some thicker blanket-shaped sandstone, especially near base, and thin beds of ironstones, all of which show some marine and some

nonmarine features and weather yellowish brown. Lies with sharp contact on Himes member (new) of Cloverly formation; grades upward and interfingers with marine black bentonitic clayshale of Thermopolis shale. Thickness ranges from 100 to about 300 feet; at type section 136 feet. At type section, formation displays its characteristic increase in proportion of black shale in its upper part; upper contact is placed above uppermost sandstones, siltstones, and ironstones. Formation includes the "rusty beds", Dakota silt, Dakota sandstones, and Greybull member of Cloverly formation, of various authors. Because no existing name is adequate, new name is proposed. Formations in this report—Morrison, Cloverly, and Sykes Mountain—are defined on lithogenitic basis.

Type section: Northwest of Sykes Mountain between Crooked Creek and Gypsum Creek about 1 mile south of Montana State line in NE¼ sec. 25 T. 58 N., R. 96 W., Big Horn County, Wyo.

Sykesville Formation

Sykesville Granite[1]

Paleozoic: Central northern Maryland.

Original reference: A. I. Jonas, 1928, Maryland Geol. Survey Carroll County map.

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 53–54. Intrudes Peters Creek quartzite and an amphibolite schist in a belt that parallels the Peach Bottom syncline from Hartford County, Md., to Potomac River. In part of the area, the Sykesville has a steep-axis structure and a series of prominent joints at right angles to the linear direction of the fold axis. The Sykesville was intruded before development of the steep-axis structure and has shared the regional deformation with the adjoining schists of the Glenarm series, which is tentatively assigned to Precambrian.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 42 (table 7), 63. At least three periods of granite formation are recognized in the Maryland rocks. The oldest granites are the probable migmatites associated with the Baltimore gneiss. Those of second period cut the Glenarm series. Representatives of the third period are Woodstock, Ellicott City, and Sykesville. The Sykesville is not a homogeneous rock; parts of it are a product of migmatization of the country rock and other parts show little deformation. It may include rocks of both the second and third periods of the formation of granitic rocks, and the migmatized and gneissic areas may represent the older period. Age shown on table as Devonian.

U.S. Geological Survey currently designates the age of the Sykesville Formation as Paleozoic on the basis of a study now in progress.

First described in Carroll County. Probably named from occurrence near Sykesville.

Sylacauga Marble Member (of Talladega Slate)[1]

Precambrian or Paleozoic: Eastern Alabama.

Original reference: C. Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 51, map.

Named for exposures and quarries around Sylacauga, Talladega County.

Sylamore Sandstone Member (of Chattanooga Shale)[1]

Sylamore Formation (in Champ Clark Group)

Upper Devonian: Northern Arkansas, Illinois, southwestern Missouri, and eastern Oklahoma.

Original reference: R. A. F. Penrose, Jr., 1891, Arkansas Geol. Survey Ann. Rept. 1890, v. 1, p. 113, 114.

J. G. Grohskopf, E. L. Clark, and S. P. Ellison, 1943, Missouri Geol. Survey and Water Resources 62d Bienn. Rept., App. 4, p. 7–8. Sylamore formation as used in this report is applied to sandstone that underlies Chattanooga shale or Compton formation and rests on Cotter dolomite or Fortune formation (new). Mississippian (Kinderhook).

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 185, p. 14. Sylamore formation included in Champ Clark group (new). Rarely more than 5 feet thick and commonly not more than a few inches thick. Underlies Grassy Creek formation. At base of Kinderhook series. Correlated with Sylamore sandstone of Arkansas, Misener sandstone of Oklahoma, and Hardin sandstone of Tennessee. Name Sylamore has been used for the sandstone in Missouri and western Illinois and is accepted for use throughout Illinois. It has priority over Hardin and Misener.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 38–39. Member described on south and west flanks of Ozark uplift. White, phosphatic sandstone with salt and pepper appearance on fresh surface. Basal part consists of dark-gray sandy shale and bluish-gray phosphatic limy sandstone. Maximum thickness 18 feet; thins northward and is absent in most of area. Unconformably overlies St. Clair, Frisco, and Sallisaw formations in southern part of area; northward unconformably overlies Tyner formation near Murphy and the Burgen and Cotter along Spavinaw Creek. Succeeded conformably by black shale member of formation. Age debatable; final determination awaits precise dating of overlying black shale.

G. G. Huffman and J. M. Starke, 1960, Oklahoma Geology Notes, v. 20, no. 7, p. 159–160. Chattanooga shale divided into Sylamore sandstone member below and Noel shale member above. On basis of conodonts, Noel shale appears to be Late Devonian and Early Mississippian. Distribution noted.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 66–69. Discussion of use of term Sylamore. Examination of strata involved at or near type locality does not give satisfactory answer concerning either its [Sylamore] age or relationships. There is no way of determining to which of the several sands in the section either Branner or Penrose (1891) wished to apply name Sylamore. At present there is no uniformity in the interpretation of term Sylamore. One solution lies in redefinition of term, but it seems unlikely there would be general acceptance of such a definition. It is here recommended that Sylamore be omitted from stratigraphic names in Missouri.

Named for exposures on Sylamore Creek, Stone County, Ark.

Sylvan Shale[1]

Sylvan Shale (in Patterson Ranch Group)

Upper Ordovician: Southwestern, central southern, central eastern, and northeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

R. A. Maxwell, 1936, Northwestern Univ. Summ. Doctoral Dissert., v. 4, p. 133. Unconformably underlies Hawkins limestone member (new) of Chimneyhill limestone

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 153, 154 (table 1). Uppermost formation in Patterson Ranch group (new).

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in southwestern, central southern, central eastern, and northeastern Oklahoma.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 3), fig. 4 (facing p. 8). Underlies Ideal Quarry member (new) of Chimneyhill formation.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 27–29, measured sections, pls. Described on north and west flanks of Ozark uplift, northeastern Oklahoma. Ranges from dark green and fissile to brown silty shale with concretionary weathering. Locally, thin stringers of brown dolomitic sandstone present in lower parts. Thickness 12 to 36 feet. Conformably overlies Fernvale limestone. Near Qualls and on Blackgum Mountain, succeeded unconformably by St. Clair limestone of Silurian age; northward in Nigger Hollow and in Horseshoe Bend section, overlain unconformably by Chattanooga black shale of late Devonian and early Mississippian age. Upper Ordovician, Cincinnatian.

Named for exposures near former village of Sylvan, Johnston County.

Sylvania Sandstone[1] or **Formation**

Sylvania Sandstone Member (of Amherstburg Formation)

Sylvania Sandstone (in Detroit River Group)

Middle Devonian: Northwestern Ohio and southeastern Michigan, and Ontario, Canada.

Original reference: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 4, 18.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Lower or Middle Devonian.

K. K. Landes, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 28. Sylvania formation crops out in Monroe County, Mich., and across Ohio line in vicinity of Sylvania. Underlies Detroit River formation; overlies Bois Blanc formation. Middle Devonian.

G. M. Ehlers, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1455–1456. Sylvania sandstone, oldest unit of Detroit River group, is succeeded by Amherstburg dolomite.

K. K. Landes, 1951, U.S. Geol. Survey Circ. 133, p. 1, 2 (fig. 2). In subsurface, Sylvania sandstone is considered member of Amherstburg formation. Thickness as much as 300 feet.

J. E. Carman, 1960, Fieldiana: Geology, v. 14, no. 1, p. 1–5. In northern Ohio, overlies Holland Quarry shale (new).

Named for Sylvania, Lucas County, Ohio.

†Symonds Formation

Lower Cretaceous(?): Southeastern Alaska.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Fine- to coarse-grained carbonaceous plagioclase-quartz-sericite-chlorite graywacke, much of which is laminated in layers one-quarter inch to several

inches thick, forms bulk of formation. Very fine grained black graywacke and black slate next in abundance. Augite-bearing volcanic flow breccia conformably interlayered with the graywacke and slate on Horse and Douglas Islands. A 15-foot thick layer of brown marble forms basal unit of formation at contact with Barlow Cove formation (new) on Hump Island. Greenstone sills, dikes, and flows(?) lie in slate of formation in some areas and range in thickness from several inches to several feet. Formation largely concealed by water but believed to be at least 5,000 and possibly 10,000 feet thick. Strata as exposed on Shelter Island may grade by facies change into Shelter formation (new). Overlies Barlow Cove formation (new).

Type locality: Symonds Point, Juneau (B-3) quadrangle. Crops out along eastern shore of Admiralty Island from Symonds Point to southern boundary of quadrangle, on Horse, Colt, and Portland Islands, and on parts of Lincoln, Shelter, Hump, and Douglas Islands.

Syracuse Salt (in Salina Group)

Syracuse Formation (in Salina Group)

Syracuse Salt Member (of Camillus Formation)

Syracuse Salt Member (of Salina Formation)[1]

Upper Silurian: Western to east-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 18–19, chart.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Syracuse salt in Saline group. Cayugan series.

R. E. Griswold, 1951, New York State Water and Power Control Comm. Bull. GW-29, p. 10. Salina formation consists of (ascending) Pittsford shale, Vernon shale, Syracuse salt, Camillus shale, and Bertie limestone members, of which only the Vernon and Camillus have been definitely recognized in Wayne County.

W. P. Leutze, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 7, p. 1693–1697. Term Syracuse formation is modification of term Syracuse salt. Since salt is not present at outcrop, the change seems appropriate. At outcrop (Onondoga and Madison Counties), formation is predominantly brown dolomites and gray shales. Beds of structureless clay, containing brecciated shale and dolomite or a few blocks of bedded gypsum, mark former horizons of soluble evaporite beds. Top of formation is transition from brown thin-bedded dolomite into overlying olive-colored Camillus shale. Base of formation is marked by a conglomerate of shale and dolomite pebbles and sand grains in a dolomite matrix. Overlies Vernon shale. Subdivided into (ascending) transition member, 90 to 120 feet thick; lower clay member, 10 to 15 feet; middle dolomite member, 35 to 50 feet; upper clay member 10 to 20 feet; and upper dolomite member 8 to 24 feet. Includes three faunal zones. Prior to this study, all rocks between Vernon shale and Bertie waterlime were called Camillus shale at outcrop, and consequently most publications list fossils from the Syracuse as coming from Camillus shale.

W. L. Kreidler, 1957, New York State Mus. Bull. 361, p. 6. Referred to as member of Camillus formation.

First recognized in wells near Syracuse.

Syracuse Serpentine[1]

Age(?): New York.

Original reference: G. H. Williams, 1890, Geol. Soc. America Bull., v. 1, p. 533–534.

Occurs in James Street Hill, Syracuse, Onondaga County.

Syrena Formation (in Magdalena Group)[1]

Pennsylvanian: Southwestern New Mexico.

Original reference: A. C. Spencer and S. Paige, 1935, U.S. Geol. Survey Bull. 859.

M. L. Thompson, 1942, New Mexico Bur. Mines and Mineral Resources Bull. 17, p. 23. Studies indicate that Syrena and Oswald formations each include large parts of at least two series of the Pennsylvanian. They are not useful as regional stratigraphic units and will not be considered in this report on Pennsylvanian of New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 283 (fig. 5), 284–285. Divided into Mountain Home shale, 110–130 feet thick below and Humboldt limestone (Don limestone) 250 feet thick. Where exposed in Santa Rita pit along margin of granodiorite stock, upper Syrena has been extensively metamorphosed. Entire formation has been highly silicified and chloritized. Overlies Oswald limestone; unconformably underlies Cretaceous Beartooth quartzite. In some areas, overlain by sandstone, shales, and limestone correlated with Permian Abo sandstone; where Abo is missing, Syrena is directly overlain by Cretaceous rocks. In some areas, beds considered Abo by various workers could not be distinguished from metamorphosed Syrena and for this report are considered part of Syrena.

Named for Syrena patented mining claim about 1 mile south of Hanover post office, Santa Rita mining district.

Tabernacle Flow

Pleistocene, upper: Central Utah.

G. B. Maxey, 1946, Am. Jour. Sci., v. 244, no. 5, p. 328. Overlies Pavant flow (new). Extruded in late Pleistocene, probably during later part of Bonneville stage or during Provo stage of Pleistocene Lake Bonneville.

P. E. Dennis, G. B. Maxey, and H. E. Thomas, 1946, Utah State Engineer Tech. Pub. 3, p. 27, pl. 1. Basalt tuff, lapilli, scoria, and lava in flows 30 feet or more thick. Maximum thickness 300 feet.

Covers small area approximately 7 miles west of Meadow, in Pavant Range, Millard County.

Table Creek Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, eastern Kansas and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 80.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42. Name Table Creek included beds between Dover limestone and what was supposed to be Tarkio limestone; later it was found that lower boundary of "Table Creek" at this place is top of Elmont limestone and that the Tarkio is represented higher in the section by a sandstone located about 15 feet below the Dover. This means that the so-called

"Table Creek shale" represents three formations: shale below the Dover (with Maple Hill limestone missing), plus sandstone equivalent of the Tarkio, plus the Willard shale. Consequently name Table Creek is discarded and name Langdon shale proposed for shale between base of Dover limestone and top of Maple Hill limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12. Gray sandstone at top, reddish calcareous shale near center, sandy shale near base. Nyman coal near top of formation. At SW cor. SE¼SE¼ sec. 13, T. 67 N., R. 42 W., Fremont County, formation is 3¾ feet thick. Condra and Reed (1943) proposed "Langdon" for the interval. Underlies Dover limestone. The three formations immediately below the Table Creek are not generally recognized in area. In part of Fremont County, beds are exposed that are tentatively correlated with part of Table Creek-Willard interval; basal part of Pierson Point shale is at top of this section. Wabaunsee group.

Named for outcrops on Table Creek at Nebraska City, Otoe County, Nebr.

Table Mountain Andesite[1] or Basalt

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 311 (diagram).

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 685. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2). Listed on table accompanying report on uranium geochemistry of Lassen volcanic rocks.

Composes Table Mountain, northwest of Lassen Peak.

Table Mountain Basalt Flows

Table Mountain Formation

Paleocene: North-central Colorado.

R. L. Ives, 1938, Geol. Soc. America Bull.. v. 49, no. 7, p. 1049. Interbedded sandstones, shales, and basalt flows. Thickness about 900 feet. Unconformably overlies Precambrian rocks. Interpreted as preglacial. Lovering classifies beds as Miocene, and lithologically similar beds in upper part of Middle Park formation classified as very late Upper Cretaceous or Paleocene.

S. O. Reichert, 1956, Geol. Soc. America Bull., v. 67, no. 1, pl. 1 (facing p. 107). Mapped as Table Mountain basalt flows of Paleocene age.

In Denver Basin.

Table Mountain Formation[1] or Gravels

Tertiary: Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 138, map.

Baylor Brooks and Ellis Roberts, 1954, California Div. Mines Bull. 170, map sheet 23. Mapped as Table Mountain gravels. Older than Jacumba pyroclastics and younger than La Posta quartz diorite. Tertiary.

Well exposed in Table Mountain, 4 miles northeast of Jacumba, San Diego County.

Table Mountain Flow, Latite, or Formation

Pliocene or Pleistocene: Central California.

F. L. Ransome, 1898, U.S. Geol. Survey Bull. 89, p. 14–27, 28–46. Discussion of lava flows on western slope of the Sierra Nevada in region

drained by Stanislaus River. The latites belong to at least three distinct flows. The oldest, Table Mountain flow (or facies), consists of dark compact augite-latite of somewhat basaltic aspect, with conspicuous tabular crystals of labradorite and smaller phenocrysts of augite. Older than Dardanelle flow. Rests on a variety of rocks, in some places granite and in some places on limestone or quartzite of Calaveras formation. Miocene and Pliocene.

N. L. Taliaferro and A. J. Solari, 1946, California Div. Mines Bull. 145, pls. 1, 2 [text not pub.]. Consists of lava flows in former channel of Stanislaus River. Unconformable above Mehrten formation. Pliocene or Pleistocene.

Named for occurrence on Table Mountain, Tuolumne County. Longest flow of series. Traced from the West Dardanelle where its surface is at elevation of 8,600 feet, down to Knight's Ferry where it forms plateaus at elevation of about 500 feet.

†Table Mountain Sandstone[1]

Permian: Central southern Oklahoma.

Original reference: C. N. Gould, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, no. 3, p. 324–341.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. If used, would invalidate Table Mountain formation, Cenozoic of California.

Named for Table Mountain in Garvey County.

Table Rock Granite[1]

Carboniferous(?): Northwestern South Carolina.

Original reference: E. Sloan, 1907, Summary of mineral resources of South Carolina, p. 7, 8.

Named for development at Table Rock Mountain, Pickens County.

†Table Rock Sandstone[1]

Upper Devonian: Southwestern New York.

Original reference: G. H. Chadwick, 1933, Pan-Am. Geologist, v. 60, no. 2, p. 96–98.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart. 37. Abandoned. Naming of some massive siltstones in the Gardeau shale, such as Table Rock sandstone, serves little purpose since they cannot be positively identified beyond their type occurrence.

Occurs at top of lower Portage Falls, Genesee River region.

Tabor Member (of Crockett Formation)

Eocene (Claiborne): Central Texas.

G. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 13, 14, 18, 19, 20. Crockett, as exposed in Lee County, is divided into (ascending) Stone City, Wheelock, Two Mile (new), and Tabor members. Tabor consists of sand, sandstone, and clay. Thickness as much as 47 feet. Member capped by Bryan sand. Name is from manuscript of H. B. Stenzel.

This may or may not be same unit as Mount Tabor Member (Stenzel, 1938).

Type locality and derivation of name not stated.

†Tachatna Series[1]

Middle Devonian: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 157–159, 179.

Extends from some distance below junction of Kuskokwim with East Fork down to junction of Tachatna [Takotna] River, and from the Tachatna to below Vinasale, Kuskokwim region.

Tackawasick Limestone[1]

Middle Ordovician: Eastern New York.

Original reference: R. Ruedemann, 1929, Geol. Soc. America Bull., v. 40, p. 410, 414.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Tackawasick limestone in Taconic sequence above Ryesdorph conglomerate. Taconic sequence occupies a range that extends southward from Brandon, Vt., into Massachusetts and Connecticut.

Type locality and derivation of name not given. Unit first described in Capital district, eastern New York.

Tacoma Series

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Includes (ascending) Thorncrag limy gneiss, Stetson Brook limestone, Hill Ridge biotite schist, Minwah limy gneiss, and Sabattus garnet schist (all new). Older than post-Silurian pegmatites, aplites and granites; younger than Bates limestone (new). Cambro-Ordovician(?).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss (new), Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate gneiss (new), Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite-biotite schist. Middle Silurian.

Occurs in Lewiston area, Androscoggin County.

Taconic Limestone[1]

Cambrian and Ordovician: Maine and southwestern Vermont.

Original reference: E. Hitchcock, 1862, Geology Maine, Prelim. Rept., v. 2, p. 245–259.

†Taconic Slate[1]

Ordovician: New York.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geology of 2d dist., p. 135–164.

Occurs at western base of Taconic Range.

†Taconic System[1]

Precambrian, Cambrian, and Silurian: Eastern North America.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geology of 2d dist., p. 135–164, 429.

Taft Granite[1]

Cretaceous: Eastern California.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 122, map.

Named for fact it composes Taft Point, Yosemite National Park.

Taft Sandstone Member (of Boggy Shale)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 56–57. Taft sandstone forms prominent escarpment ranging up to 200 feet in height above Crekola-Inola plain. At type locality in T. 15 N., unit consists of about 20 feet of coarse-grained massive sandstone. Upper third of the division consists of silty to sandy shale. Farther south, in T. 14 N., a series of massive sandstones and interbedded shales, amounting in aggregate to some 80 feet of beds, surmounts the Taft escarpment. Probably outcrops around Taft are equivalent only to lower part of sandstone section in T. 14 N. More work needed to determine logical boundaries of Taft member. Separated from underlying Inola limestone member by unnamed shale member.

Named for exposures south of Taft, sec. 19, T. 15 N., R. 17 E., Muskogee County.

Taft Hill Member (of Blackleaf Formation)

Lower Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2790, 2792 (fig. 3); 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90. Approximate percentages of various lithologic types are: gray bentonitic siltstone, 48; sandstone, 32; nonbentonitic marine shale and siltstone, 20. A widespread 30-foot-thick massive bed of greenish-gray impure glauconitic sandstone has its top about 100 feet above base of member. A few 2-foot-thick glauconitic sandstone beds also present. Many of the sandstone beds are coarse grained. Type section has over-all thickness of about 240 feet. Underlies Vaughn bentonitic member (new); overlies Flood member (new).

Type section: A composite from measurements at four localities between east face of Taft Hill and a point 5 miles farther east. Named for exposures along east slope of Taft Hill, a dissected prominent bench 1½ to 6 miles south of Vaughn, Cascade County.

Taggard Red Member (of Greenbrier Limestone)

Taggard Limestone (in Greenbrier Limestone)[1]

Taggard Shales (in Greenbrier Limestone)[1]

Upper Mississippian: Southern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450, 476–479.

R. H. Wilpolt and D. W. Marden, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 38, sheet 1. Term Taggard was applied by Reger (1926) to three lithologic units, a lower and upper Taggard shale with

an intervening Taggard limestone. In this report, these have been combined into one unit, Taggard red member of Greenbrier limestone. Member consists of maroon red and dense limestone and calcareous mudstone. Thickness 3 to 50 feet. Commonly present from 50 to 100 feet above Hillsdale member.

Dana Wells, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 5, p. 902–918. Name Denmar formation proposed for sequence of gray slightly cherty calcarenite and calcilutite beds that are younger than top of Hillsdale in its type section and older than the Taggard [limestone and shale] in its type section.

Type locality (Reger, 1926): On Taggard Branch of Indian Creek, Monroe County, W. Va.

Taghanic (Taughannock) Stage

Taughannock Group

Middle Devonian (Erian): North America.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. Devonian is subdivided into 10 stages of which the Taghanic (Taughannock) is sixth in sequence (ascending). [For complete sequence see Helderberg stage this reference.] Follows Tioughnioga stage (new) and is succeeded by Finger Lakes stage (new). Includes sediments of Tully and Geneseo with their correlates elsewhere on the continent.

A. T. Cross and J. H. Hoskins, 1951, Jour. Paleontology, v. 25, no. 6, p. 718 (fig. 3). Shown on composite stratigraphic column of western New York and northwestern Pennsylvania as Taughannock group. Includes Tully and Genesee formations. Overlies Tioughnioga group; underlies Finger Lakes group.

Type section: In Taghanic (Taughannock) Falls Park, northwest of Ithaca, west side of Cayuga Lake, N.Y.

Tagpochau Limestone

Miocene, lower: Mariana Islands (Saipan).

Risaburo Tayama, 1938, Geomorphology, geology, and coral reefs of Saipan Island: Tropical Industry Inst., Palau, South Sea Islands, Bull. 1 [English translation in library of U.S. Geol. Survey, p. 63–68]. The Tappocho is a coral limestone, pink, hard, fine-textured; conglomeratic or agglomeratic near base. Lower Miocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 62–77, pl. 2, chart 2. Tagpochau limestone, as used here, has been revised to include both the Tappocho and Laulau limestones of Tayama. Six lithic facies and two members are mapped within Tagpochau limestone, as follows: Donni sandstone member; Machegit conglomerate member (new); transitional facies of calcareous tuff, marl, and calcareous andesitic conglomerate; tuffaceous facies of poorly indurated, very impure limestones; marly limestone facies; rubbly limestone facies; equigranular limestone facies; and dominant inequigranular limestone facies. In several areas south from Mount Tagpochau, it is not possible to differentiate these facies. Thickness ranges from featheredge to 820 feet at type section and 900 feet in northern Saipan. Type section designated.

Type section: Extends from base of Miocene succession to head of valley that runs westward from Nicholson Spring upward to summit of Mount

Tagpochau. Tayama gave locality as summit of Mount Tappocho which is Mount Tagpochau (Ogso Tagpochau). Spelling of formational name is revised to conform with Chamorro usage.

Tahana Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Consists of 2,150 feet of tuffaceous mudstone, siltstones, and lithic arenites believed to have been largely derived from Mehrten formation. Underlies Pomponio member (new); overlies Monterey formation.

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Tahkandit Limestone[1]

Permian: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1930, U.S. Geol. Survey Bull. 816, p. 121.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Type locality: Along Yukon just above mouth of Nation River, where a belt of the rocks crosses the Yukon, trending northeast, Eagle-Circle district.

†Tahkandit Series[1]

Permian and Pennsylvanian(?): Eastern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 169–174.

Yukon River region.

Tahlequah Member (of Moorefield Formation)

Mississippian (Chesterian): Northeastern Oklahoma.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 49–51, pls. 1–5. Massive light to dark-gray medium-crystalline glauconitic limestone that in some areas contains crinoidal coquinite and nodules and stringers of whitish-tan chert; large scale crossbedding developed locally. Thickness as much as 30 feet. Conformably underlies Bayou Manard (new); at type locality, it is in fault contact with younger units of formation; unconformably overlies parts of "Boone" chert, Keokuk chert, Reed Springs chert, and Short Creek oolite.

Type locality: Along south side of a small creek south of city limits of Tahlequah, Cherokee County.

Tahoe Glaciation

Tahoe Till

Tahoe glacial stage[1]

Pleistocene: Eastern California.

Original reference: E. Blackwelder, 1931, Geol. Soc. America Bull., v. 42, p. 865–922.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1290–1291. At least four ice advances occurred in Pleistocene: earliest, here named Aeolian Buttes, was followed by Sherwin, Tahoe, and Tioga, previously named by Blackwelder. Rhyolitic ash and pumice, now Bishop welded

tuff, were erupted in interval between Aeolian Buttes and Sherwin glacial stages.

W. C. Putnam, 1960, California Univ. Pubs. in Geol. Sci., v. 34, no. 5, p. 235, 237–238, map 1. Sherwin till is pre- rather than post-Bishop tuff. Name Aeolian Buttes considered invalid as representing an earlier Pleistocene, pre-Sherwin glacial stage. Hence, glacial sequence is McGee, Sherwin, Tahoe, and Tioga.

Name amended to glaciation in compliance with 1961 Code of Stratigraphic Nomenclature.

Named for Lake Tahoe on eastern slope of the Sierra Nevada. Moraines of stage flank Rock Creek Canyon in Sierra Nevada west of Highway 395, Mono County.

Tahoka Clay

Pleistocene (Wisconsin) : Western Texas and eastern New Mexico.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 495–498. Mainly bluish-gray calcareous and gypsiferous clays and gray sands which grade marginally to coarser sands and gravels; thin discontinuous beds and small lentils of fresh-water limestone present locally in basinward facies of deposit. Thickness 21 to 35 feet. Unconformably overlies older strata—in some places Triassic shales or Cretaceous limestones; around margin of basins, overlaps older Quaternary or upper Tertiary strata which are resting upon Triassic or Cretaceous. Disconformably underlies local developments of dune and playa deposits. Late Pleistocene (Wisconsin) indicated for main body of deposit.

Named for town of Tahoka, Lynn County, Tex., which is near Tahoka Lake, Mound Lake, and other playas around which the deposit is typically developed and well exposed. Extends into eastern New Mexico.

Taholah Formation

Pleistocene, lower: Northwestern Washington.

S. L. Glover, 1940, Northwest Sci., v. 14, no. 3, p. 69–71. Name applied to early Pleistocene deposits on coastal area of Olympic Peninsula. Probably correlate with sediments of Admiralty age in Puget Sound region. Formation is generally horizontal and composed of sands, gravels, and clays. Total thickness may exceed 1,500 feet. Underlies Queets bed (new) ; overlies Quinault formation.

S. L. Glover, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2022–2023. Immediately overlies Browns Point formation (new).

Well exposed in Taholah-Moclips vicinity, Grays Harbor County.

Taihamu Limestone

See Taihanom (Taihanomu) Limestone.

Taihanom (Taihanomu) Limestone

Aquitanian: Mariana Island (Rota).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation table) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 52,

table 4 [English translation in library of U.S. Geol. Survey, p. 62]. Correlated with Kasutesho limestone on Tinian, and Laulau limestone on Saipan. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 59–60. Consists of marly limestone, calcareous sandstone, sandy limestone, and limestone-breccia (ascending order). Unconformably overlies Mariiru limestone. Aquitanian. Refers to S. Sugawara (1939, unpub. ms.) and K. Asano (1939, Jubil. Pub. Yabe's 60th birthday).

South coast of Rota Island.

Takotna Formation[1]

Middle Devonian: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 157–159, 179.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Extends from some distance below junction of Kuskokwim with East Fork down to junction of Tachatna [Takotna] River, and from the Tachatna to below Vinasale; upper Kuskokwim region.

Talawag Member (of Mutual ? Formation)

Precambrian: Western Utah.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 26–27, 127, 128, pls. 1, 4, 8. Mutual(?) formation is divided into two units: a basal slate or argillite and an upper conglomeratic quartzite herein referred to as Talawag member. Thickness 706 feet on north slope of Talawag Peak.

Named for occurrences on Talawag Peak and in Talawag Canyon, Sheeprock Mountains.

Talbot Formation (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: G. B. Shattuck, 1901, Johns Hopkins Univ. Circ., v. 20, no. 152, p. 73–75.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 75–77, pls. 2, 3. In southern Florida, the Talbot, Penholoway, and Wicomico formations comprise a conformable sequence of deposits whose differentiation is based mainly on location of their respective shore lines—42, 70, and 100 feet above present sea level. The Talbot merges downward into the Penholoway and Wicomico successively. Sequence unconformably overlies Caloosahatchee marl and is likewise separated by stratigraphic break from Pamlico formation, which fringes around it. Boundary between Talbot and Pamlico very inconspicuous.

Named for Talbot County, eastern shore of Maryland. Well exposed in Florida along Highway 18, the Childs-Okeechobee Road and west of Lake Okeechobee; also present on Immokalee Island.

Talcott Basalt (in Newark Group)

Talcott Diabase (in Newark Group)[1]

Talcott Lava Member (of Meriden Formation)

Upper Triassic: Central Connecticut.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 476.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Rank reduced to basal member of Meriden formation. Described as greenish-black rock weathering bright orange, grading from basalt near contacts to coarse dolerite in interiors. Interior parts are massive and commonly show good columnar jointing; upper parts are commonly vesicular, and upper and lower parts may show flow brecciation. Contains pillows. Underlies lower sedimentary member of Meridan formation.

E. P. Lehmann, 1959, Connecticut Geol. Nat. History Survey Quad. Rept. 8, p. 8 (table 1), 10–11, pl. 1. Term Meriden not used in this report [Middletown quadrangle]; Talcott basalt included in Newark group. Stratigraphically lowest lava flow in quadrangle. Crops out along low ridges trending east of north along west margin of map area. Estimated stratigraphic thickness about 150 feet. Contact with underlying New Haven arkose not exposed. Underlies Shuttle Meadow formation (new).

R. W. Schnabel, 1960, U.S. Geol. Survey Geol. Quad. Map GQ–134. Talcott basalt described in Avon quadrangle, Connecticut, where it ranges in thickness from about 120 feet at northern boundary to about 200 feet at southern boundary. Apparently conformable with enclosing sedimentary rocks, New Haven arkose below and Shuttle Meadow formation above.

Named for occurrence at Talcott.

Talcott Shale (in Bluefield Formation[1] or Group)

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 300, 418.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey [Rept.] Greenbrier County, p. 263. Incidental mention in report on Greenbrier County.

Type locality: On south side of Greenbrier River, 0.6 mile southeast of Talcott, Summers County.

†Talford Schist[1]

Lower Devonian: Central New Hampshire.

Original reference: M. P. Billings and C. R. Williams, 1935, Geology of Franconia quadrangle, p. 8, 13.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1015, 1019. Abandoned. Littleton formation is extended to those areas of the Franconia quadrangle where Talford schist was formerly recognized as distinct unit.

Named for Talford Brook in southern part of Franconia quadrangle.

†Talihina Chert[1]

Ordovician, Silurian, and Devonian: Southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Sequence is now divided into formations.

Named for exposures in Potato Hills, southwest of Talihina, Le Flore County.

Talisman Quartzite[1]

Pennsylvanian(?): Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 703, pl. 1 (column 53a). Correlation chart shows quartzite to be of Morrow and Lampasas age; text states that no fossils have been recovered from the unit.

Type locality: Talisman mine, southeast of Frisco district.

Talkeetna Formation[1]

Lower Jurassic: Central southern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 218, 219.

R. A. Eckhart, 1953, U.S. Geol. Survey Bull. 989–C, p. 41–42, pl. 5. Largely of interbedded tuffs, lavas, and volcanic breccias in Sheep Mountain, adjacent to upper Matanuska Valley.

In Matanuska Valley and eastern part of Talkeetna Mountains, Cook Inlet region.

Talladega Slate[1] or **Formation**

Talladega Series

Precambrian(?) to Carboniferous (?): Eastern Alabama, Georgia, North Carolina, and Tennessee.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–1888, geol. map of Alabama, no description.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1371–1392. Series has been traced from Alabama, where it is typically exposed, across northwest Georgia, into North Carolina and Tennessee. Occupies belt trending northeast, 300 miles in length and 1 to 25 miles in width. Believed to be Precambrian.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 8, p. 412–415. Term series is preferred to slate. Precambrian.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27–30. Discussion of crystalline rocks of Georgia. Rocks are grouped into 11 belts, in part using names proposed by Adams (1933, Jour. Geology, v. 41, no. 2). Talladega belt in Georgia divided geographically into two parts: one extending west and southwest from Allatoona, Bartow County, and the other north and northeast of that village. West of Allatoona, the series resembles typical expression in Alabama with phyllites predominating. North of Allatoona, the series comprises more highly metamorphic rocks, which have been grouped into 10 formations (ascending) Pinelog quartzite, Hiawassee [Hiwassee] slate, Great Smoky formation, Nantahala schist, Tusquitee quartzite, Brasstown schist, Valleytown schist, Murphy marble, Andrews schist, and Nottely quartzite. Precambrian.

Named for exposures on Talladega Creek, Talladega County, Ala.

Tallahassee Limestone

Tallahassee Limestone (in Claiborne Group)

Eocene, middle: Western Florida (subsurface)

P. L. Applin and E. R. Applin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 12, p. 1680, 1688–1693, 1747 (fig. 32). Name applied to lower unit of late middle Eocene. Ordinarily underlies Avon Park limestone (new) but in some wells occurs below the Ocala; overlies early middle Eocene beds, either the clastic sediments of Cook Mountain age or Lake City limestone (new). Composed chiefly of cream-colored and tan crystalline limestone with some softer argillaceous limestone; also with minor amounts of chert and gypsum. Thickness ranges from more than 75 feet in wells near its western edge to 550 feet in Wakulla County and 650 feet in Jefferson County. Tentatively correlated with Yegua formation (Claiborne). Avon Park limestone, Tallahassee limestone, and Lake City limestone represent Claiborne group in peninsular Florida, and, where all three units are present, they appear to make, in most places, a conformable sequence.

Unit is confined to a few wells in vicinity of Tallahassee.

Tallahatta Formation (in Claiborne Group)[1]

Eocene, middle: Southern Alabama, western Georgia, and Mississippi.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 344, chart.

R. E. Grim, 1936, Mississippi Geol. Survey Bull. 30, p. 20, 121 (fig. 18), 122, 123–128. Tallahatta formation divided into (ascending) Meridian, Basic, and Winona members. Thickness as much as 205 feet. Basal formation in Claiborne series; overlies Lisbon formation.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 42, p. 15–28, pls. Includes Basic claystone member below and Neshoba sand member (new) above. Overlies Meridian sand, herein excluded from Tallahatta; underlies Winona greensand, herein raised to formational rank.

G. F. Brown and R. W. Adams, 1943, Mississippi Geol. Survey Bull. 55, p. 14 (table), 43–56. Formation divided into Meridian sand member at base and Basic City shale member (new) at top. Underlies Winona sand member of Lisbon formation; overlies Holly Springs formation (Wilcox series). Thickness as much as 380 feet.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Chart shows Tallahatta undifferentiated in Alabama and Georgia; underlies Lisbon formation; overlies Hatchetigbee formation. In northern Mississippi includes Holly Springs sand member; elsewhere includes (ascending) Meridian sand, Basic City, and Neshoba sand members; underlies Winona formation; overlies Wilcox formation.

L. D. Toulmin, P. E. LaMoreaux, and C. R. Lanphere, 1951, Alabama Geol. Survey Spec. Rept. 21, p. 93–100. Described in Choctaw County where it is 90 to 120 feet thick, overlies Hatchetigbee formation and underlies Lisbon formation.

T. W. Lusk, 1956, Mississippi Geol. Survey Bull. 80, p. 54–61. In Benton County, overlies Meridian formation and underlies Koskiusko formation, but the Winona and Zilpha are absent in area.

Named for development in Tallahatta Hills, Choctaw County, Ala.

Tallant Formation (in Ochelata Group)

Pennsylvanian (Missouri Series): North-central Oklahoma.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119–120, 121–122. Consists of sandstone and shale. Contains two principal sandstone members (ascending), Bigheart and Revard. In addition there are

other sandstone units, some of which may be extensive enough to be mapped, eventually, as members. Unconformably overlies Barnsdall formation (new); unconformably underlies sandstone in the lower part of the Vamoosa formation. Thickness about 200 feet.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 32–39, pl. 1. Includes four fairly persistent members: Bigheart sandstone at base, unnamed shale, Revard sandstone, and a second unnamed shale. In addition, several sandstone beds have been assigned, either correctly or incorrectly, to the Tallant; among them are Buck Point, Gap, Hay Hollow, Hulah, Mission, and Possum.

Named from Tallant, sec. 35, T. 25 N., R. 10 E., Osage County.

Tallery Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 341.

Type locality: On Tallery Mountain Road, southeast of True, Summers County, W. Va.

Tallery Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 340.

Type locality: On Tallery Mountain, Summers County, W. Va.

Tallery Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 296, 342–343.

Type locality: On Tallery Mountain Road, southeast of True, Summers County, W. Va.

Tallman Fanglomerate

Permian: North-central Nevada.

H. G. Ferguson, S. W. Muller, and R. J. Roberts, 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Consists of large angular to subangular blocks of quartzite and chert, small slate fragments; thin bed of chert pebbles at base. Thickness uncertain, may be 2,000 to 5,000 feet. Underlies Koipato formation; overlies Harmony formation with angular unconformity.

Local deposit, present only near Tallman Ranch at mouth of Thomas Canyon, Sonoma Range.

Tallulah Falls Quartzite[1]

Precambrian or Lower Cambrian: Northeastern Georgia.

Original reference: S. L. Galpin, 1915, Georgia Geol. Survey Bull. 30, p. 119.

C. E. Hunter, 1946, Tennessee Valley Authority Regional Products Research Div. Rept. C, p. 46. Incidental mention in report on minerals and structural materials of western North Carolina and northern Georgia.

Named for development in vicinity of Tallulah Falls, Rabun County.

Talofofo Peat-Bearing Beds or Formation

Pliocene or Pleistocene: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 55–56, table 4 [English translation in library of U.S. Geol. Survey, p. 66]. Gravel, sandy clay, and gray clay with layer of peat. Abundant mollusca and dendritic reef-bearing corals in gray clay. Correlated with Sumay (Mariana) limestone.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 60. Pleistocene.

Type locality: Along upper course of Talofofo River, Guam.

Taloga Formation (in Cimarron Group)[1]

Taloga Formation (in Quartermaster Group)

Permian (Guadalupe Series): Southern Kansas.

Original reference: F. W. Cragin, 1897, Am. Geologist, v. 19, p. 362–363.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 36 (fig. 15), 37. As used in Kansas, the Taloga is included in the Quartermaster group and consists of silty shale, siltstone, and very fine feldspathic sandstone (called "Big Basin" in some reports). Lower 25 feet is chiefly silty shale. Maximum thickness about 45 feet. Strata are seemingly equivalent, all or in part, to the Quartermaster formation in Oklahoma. Occurs above Day Creek dolomite.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Cragin applied the name to Cloud Chief and Quartermaster rocks.

Named for Taloga, Dewey County, Oklahoma. In Kansas, crops out in western Clark and eastern Meade Counties.

Talpa Limestone Member (of Clyde Formation)[1]

Talpa Formation (in Clyde Group)

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 428.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in the Clyde herein given group status.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. In Colorado River valley, constitutes upper two-fifths of formation. Consists of even, relatively thin beds of limestone and shale similar to underlying Grape Creek member but differs in the harder, more brittle nature of the beds and the commonly slightly darker color. Thickness about 180 feet. Underlies Lueders limestone. Division of the Clyde into members in this area is not as natural as in the area north of Abilene; in area mapped herein, units might appropriately be treated as formations. Type "Paint Rock" in Concho County has been traced into type exposure of the Talpa limestone; "Paint Rock" is a synonym for Talpa limestone and preference in nomenclature is given latter term.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 275–276. Member Geographically extended into Brazos River valley where it is 45 to 55 feet thick and consists of alternating gray limestone and shale beds with less siltstone. Separated from underlying Grape Creek limestone member by unnamed shale member and from overlying Lueders limestone by an unnamed shale interval.

Named for Talpa, Coleman County.

Tamaha Sandstone Member (of McAlester Formation)

Tamaha Sandstone Member (of Savanna Sandstone)[1]

Pennsylvanian (Des Moines Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 40. Reallocated to member status in McAlester formation. New type locality designated.

Type locality: Sec. 30, T. 11 N., R. 22 E., some 2 miles west of Tamaha, Haskell County. Base of member makes prominent escarpment in SW¼ of this section.

Tamarack Formation[1]

Pre-Cretaceous: Northern California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 226.

Klamath Mountain region.

Tamiami Formation

Tamiami Limestone

Miocene, upper: Florida.

W. C. Mansfield, 1939, Florida Geol. Survey Bull. 18, p. 8, 15. Proposed for a limestone penetrated in digging shallow ditches to form roadbed of Tamiami Trail over a distance of about 34 miles in Collier and Monroe Counties. Consists mainly of dirty-white to gray rather hard porous nonoolitic limestone with inclusions of clear quartz grains. Underlies Buckingham limestone (new). Tentatively placed at base of Pliocene below Caloosahatchee.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 62–65. Tamiami formation was first noted by Sanford (1909) who named it Lostmans River limestone. Cooke and Mossom (1929, Florida Geol. Survey 20th Ann. Rept.) rejected Lostmans River limestone as valid formation and divided its rocks between Miami oolite on south and Caloosahatchee marl on north. Mansfield's (1939) Tamiami limestone is same limestone that Cook and Mossom correlated with Caloosahatchee marl. Place name Tamiami is preferred to Lostmans River because exposures on Tamiami Trail are more accessible than those of Lostmans River area. Term limestone is not appropriate because formation generally contains too much sand. Formation is, in general, a wedge-shaped deposit that thickens toward southeast and east. Thickness about 15 feet on Tamiami Trail 40 miles west of Miami; about 100 feet near shore of Biscayne Bay at Silver Bluff.

G. G. Parker, 1951, Am. Water Works Assoc. Jour., v. 43, no. 10, p. 823. Tamiami formation is of upper Miocene age and, as here indicated, includes all deposits of that age in Florida. As thus defined, includes Tamiami limestone and Buckingham limestone of Mansfield and part of Hawthorn formation of Parker and Cooke (1944, Florida Geol. Survey Bull. 27).

J. R. DuBar, 1957, Illinois Acad. Sci. Trans., v. 50, p. 192 (table 1); 1958, Gulf Coast Assoc. Geol. Soc. Trans., v. 8, p. 132–133, 136–139. Formation underlies Fort Denaud member (new) of Caloosahatchee marl. Contact with Caloosahatchee unconformable.

C. W. Cooke, 1959, U.S. Geol. Survey Prof. Paper 321, p. 2 (table 1). Upper Miocene.

Named for exposures along Tamiami Trail, Collier and Monroe Counties.

Tamihy Series[1] or Group

Jurassic: Central northern Washington, and southwestern British Columbia, Canada.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, map 16.

Hans Frebold, 1953, Geol. Soc. America Bull., v. 64, no. 10, p. 1232, chart 8d. Shown on correlation chart as Tamihi group. Probably younger than Cultus formation. Jurassic.

Mapped along Tamihy Creek, Wash., and British Columbia.

†Tampa Group[1]

Miocene, lower and middle: Northern and southern Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 112–113, 157, 335.

Named for exposures on Tampa Bay.

Tampa Limestone[1]

Tampa Formation or Stage

Miocene, lower: Central and northern Florida and southern Georgia.

Original reference: L. C. Johnson, 1888, Am. Jour. Sci., 3d, v. 36, p. 235.

C. W. Cooke and W. C. Mansfield, 1936, Geol. Soc. America Proc. 1935, p. 71–72. Name Suwannee limestone proposed for yellowish limestone typically exposed along Suwannee River in Florida; unit has been considered part of Tampa limestone.

R. O. Vernon, 1942, Florida Geol. Survey Bull. 21, p. 67–73. As used in this report [Holmes and Washington Counties], term Tampa applies to all sediments lying above Suwannee limestone and below Alum Bluff group.

C. W. Cooke, 1945, Florida Geol. Survey Bull. 29, p. 111–136. In Hillsborough, Pasco, and Pinellas Counties, which include type area, Tampa is commonly a fairly hard dense light-colored to yellowish limestone; locally closely packed with impressions of mollusks. In Chattahoochee area, soft beds alternate with hard, and much of the rock has chalky appearance. Thickest natural exposure is in Gadsden County, where 117 feet are exposed above low water in Apalachicola River at Chattahoochee. Underlies Suwannee limestone; in some areas, merges upward into Hawthorn formation. Presumably unconformable on Flint River where that is underlying formation. Lower Miocene.

H. S. Puri, 1953, Florida Geol. Survey Bull. 36, p. 16 (table 1), 17–21. Stage includes all Miocene sediments lying between Oligocene series and Alum Bluff stage (new). Definition includes such sediments exposed in Florida panhandle and their equivalents in central and western Gulf States. Stage includes all sediments deposited between post-Vicksburg (*Nodosaria blanpiedi* zone of Chickasawhay limestone) and pre-Alum Bluff ages. In Florida panhandle, two lithofacies recognized: calcareous St. Marks facies downdip and silty Chattahoochee facies updip.

R. C. Heath and P. C. Smith, 1954, Florida Geol. Survey Rept. Inv. 12, p. 13. Referred to as formation. This is usage of Florida Geological Survey.

K. B. Ketner and L. J. McGreevy, 1959, U.S. Geol. Survey Bull. 1074–C, p. 54 (table 1), 59–65. As used in this report [area between Hernando and Hardee Counties], Tampa includes lower Miocene Tampa limestone as defined by Cooke (1945) and lower Miocene strata commonly included in Alachua formation of Sellards (1914, Florida Geol. Survey 6th Ann. Rept.). In northern part of area, consists of lower phosphorite unit about 10 feet thick and upper clay unit about 25 feet thick; in southern part of area, represented by limestone unit about 100 feet thick, phosphorite and clay units not present. Overlies Suwannee limestone; underlies Hawthorn formation.

Named for exposures at Tampa, Fla.

Tampico Shale Member (of Piper Formation)

Middle Jurassic: Montana (subsurface and surface) and western North Dakota (subsurface), and Saskatchewan, Canada (subsurface).

J. W. Nordquist, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 97, 101. Consists of 86 feet of gray-green calcareous shale which is slightly silty in middle of unit in type well. In some wells, unit contains large amount of interbedded red shale and occasionally thin beds of dense buff to brown limestone, gypsum, and white calcareous sandstone. Sandstones become well developed northward in Saskatchewan. Red shales become more dominant southward in central and southern Montana. Maintains fairly uniform thickness. Upper and lower boundaries more clearly defined in subsurface of northern Montana than in outcrops in central and southern Montana. Underlies Firemoon limestone member (new). In subsurface, overlies Nesson formation (new) with apparent conformity throughout most of area of distribution. Unconformably overlies Madison limestone west of Bowdoin dome and unconformably overlies beds ranging from Upper Mississippian through Triassic in central and south-central Montana.

Type section: From interval 3,858 to 3,944 feet in Gulf Oil Corp. No. 1 Cornwell, center SW¼NE¼ sec. 14, T. 30 N., R. 38 E., Valley County, Mont. Named for town of Tampico which is 5 miles southwest of type well. Easily recognized as far east as Nesson anticline, and correlated westward to west side of Bearpaw Mountains where it pinches out by nondeposition. Crops out in central and southern Montana.

Tamworth Granite

Upper Devonian(?): East-central New Hampshire.

A. P. Smith and others, 1938, Geologic map and structure sections of the Mt. Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire State Highway Dept. Described as medium-grained pink granite. Belongs to New Hampshire magma series.

Crops out around village of South Tamworth in southeastern part of Mt. Chocorua quadrangle.

†Tanak Volcanics

Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 3, p. 28, 31, pl. 3. Thick beds of tuff-breccia, with many thin beds of agglomerate and a few interbedded lava flows. Tuff-breccia beds average about 150 feet in thickness but locally thicken to 350 feet; include small lenses of water-laid sediments locally. Tuff-breccia is neutral

gray on fresh surfaces; weathers to light reddish yellow; contains fragments of all types of precaldera rocks and minor quantities of bombs and lava fragments. Accidental material ranges in size from small grains up to blocks a foot in diameter. Weathering develops conspicuous "hoodoos." Near rim of caldera, well-indurated gray agglomerate is interbedded with tuff-breccia; within a mile of the caldera, it grades laterally into black vesicular agglomerate. Lava flows decrease in abundance away from caldera. Individual flows 20 to 80 feet thick and composed of light- to medium-gray aphanitic basalt. Many tuff-breccias probably nuée ardente deposits.

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 314. Included in Okmok volcanics (redefined).

Crops out high on walls of caldera of Mount Okmok, and on outer slopes it covers lowlands and fills precaldera valleys to depth of several hundred feet. Named from exposures on Cape Tanak on Umnak Island in eastern part of Aleutian Islands.

†Tanana Schist[1]

Precambrian: Eastern Alaska.

Original reference: A. H. Brooks, 1900; U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 468–469, 478, 483.

Well exposed along Tanana River.

Tanapag Limestone

Pleistocene or Recent: Mariana Islands (Saipan).

Risaburo Tayama, 1939, Correlation of the strata of the South Sea Islands: Geol. Soc. Japan Jour., v. 46, no. 549, p. 346 (correlation chart) [English translation in library of U.S. Geol. Survey]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 58, table 4 [English translation in library of U.S. Geol. Survey, p. 69]. Consists primarily of coral limestone and secondarily of Nullipore limestone. Correlated with Dankura limestone on Tinian, Mirikattan limestone of Rota, and Merizo limestone of Guam. Raised coral reef. Recent.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 60–61. Early Holocene.

P. E. Cloud, Jr., R. G. Schmidt, and H. W. Burke, 1956, U.S. Geol. Survey Prof. Paper 280–A, p. 86–88, pl. 1, chart 1. Mainly dirty-white to brownish coral-algal reef and bioclastic limestone; contains fossil corals and coralline algae, many of which occur in position of growth. Thickness at type site herein designated, about 10 feet; probable maximum thickness not more than 50 feet. Includes rocks which Tayama has called Chacha limestone as well as his typical Tanapag limestone. Pleistocene.

Type site: West coast of Saipan between Tanapag and Matansa.

Taneum Andesite[1]

Miocene: Central Washington.

Original reference: G. O. Smith, 1904, U.S. Geol. Survey Geol. Atlas, Folio 106.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 809. In Mount Stuart quadrangle, underlies Yakima basalt.

Well exposed on south branch of Taneum Creek, Mount Stuart quadrangle, Chelan County.

Taneytown facies[1]

Upper Triassic: Maryland.

Original reference: G. E. Dorsey, 1919, Geol. Soc. America Bull., v. 30, p. 155–156.

Probably named for occurrence at or near Taneytown, Carroll County.

Tank Volcanics[1]

Quaternary(?): Southern California.

Original reference: A. C. Lawson, 1906, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 431–462.

Well exposed in vicinity of railway tank, 2 miles below Tehachapi Station, on Tehachapi Creek, Kern County.

Tank Hill Limestone[1]

Tank Hill Limestone (in Pogonip Group)

Lower Ordovician: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171.

L. F. Hintze, 1952, Utah Geol. and Mineralog. Survey Bull. 48, p. 48–50, 51–52. In Ely Springs Range, Pogonip group includes Yellow Hill limestone and Tank Hill limestone (top of Ordovician sequence). Inasmuch as both upper and lower limits of the Yellow Hill are fault bounded, as is lower limit of the Tank Hill, it is not considered advisable to carry these formations as stratigraphic units into other areas.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 63). Shown on correlation chart below Eureka quartzite and above Yellow Hill limestone. Chazyan.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 129. Consists of 450 feet of gray thin-bedded limestone, conglomeratic in lower part. Upper 50 feet is shaly limestone with abundant fossils.

Named for exposures on west face of Tank Hill, Ely Springs Range, Pioche region.

Tanner shale[1]

Lower Triassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 338.

Crops out at Tanner's Crossing of Little Colorado River.

Tanners Hill Quarry Rock (in Conewango Formation)[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: F. A. Randall, 1883, Pennsylvania 2d Geol. Survey Rept. I_4, p. 297, 304–308, well sections by J. F. Carll.

Occurs in Tanners Hill section, Warren County.

†Tanners Hill red (in Conewango Formation)[1]

Tanners Hill red zone (in Chadakoin Formation)

Upper Devonian: Northwestern Pennsylvania and southwestern New York.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I.

Bradford Willard *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, 1939, Pennsylvania Geol. Survey, ser. 4, Bull. G–19, p. 14, 243, 252. Discussed as a red zone and reallocated to top of Chadakoin formation.

Overlies Ellicott shale member; underlies Panama conglomerate member of Venango formation. Upper Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Tanner Hill shown as occurring below Haymaker beds of Chadakoin formation in sections for Genesee Valley and Lake Erie areas, New York, and northwestern Pennsylvania.

Exposed on Tanner's Hill, Warren County, Pa.

Tansill Anhydrite or **Formation** (in Artesia Group)

Tansill Formation (in Whitehorse Group)

Tansill Anhydrite or Formation (in Carlsbad Group)

Permian (Guadalupe Series): Southeastern New Mexico and western Texas.

R. K. DeFord *in* Addison Young, Max David, and E. A. Wahlstrom, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1551. Tansill formation in Whitehorse group, name to be proposed by DeFord, Riggs, and Wills.

R. K. DeFord and G. D. Riggs, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1713–1728. Presentation of formal definition of Tansill formation and detailed measurement and description of section at type locality. Thickness 123½ feet at type locality; here formation is divided into 13 units (I–XIII, ascending); units VIII, IX, and X inclusive are termed Ocotillo member. Formation is pre-Salado. Formation is a body of limestone, silt, and anhydrite that forms widespread layer of earth's crust in southeastern New Mexico and West Texas. Limestone on south and west grades into anhydrite on north and east; limestone lies around rim of Delaware basin. Time horizon at top of Tansill limestone can be traced basinward where it becomes top of Capitan reef dipping steeply downward 1,500 feet into basin—where it becomes in turn top of Delaware Mountain group; this horizon can also be traced lagoonward where it becomes top of Tansill anhydrite and is in most places somewhat below horizon known as "base of the salt." The horizon that forms top of Tansill formation is boundary between Guadalupe and Ochoa series. In this region, the Tansill is top formation of Whitehorse group of Guadalupe series. Time horizon at base is top of the Yates. Lang's (1937) Three Twins member of Chalk Bluff formation seems to include both the Tansill formation and the Yates sand; but, if so, the two units are described as intergradational, and superposition of Tansill on Yates is not clearly recognized; Lang's Chalk Bluff formation is essentially the Whitehorse group of subsurface geologists.

P. B. King, 1948, U.S. Geol. Survey Prof. Paper 215, p. 68, 101 (fig. 12). Chart shows Tansill formation as uppermost unit in Whitehorse group in subsurface in Midland basin; overlies Yates formation. Formations of the Whitehorse group are delimited and traced in both the Chalk Bluff and Carlsbad facies of present usage.

N. D. Newell, 1953, The Permian reef complex of the Guadalupe Mountains region, Texas and New Mexico: San Francisco, W. H. Freeman and Co., p. 46–47. Uppermost formation of Carlsbad group. Formation is 123 feet thick at type locality but expands rapidly reefward as it changes to calcarenite facies. At south side of Walnut Canyon, at edge of shelf, it is 320 feet thick.

P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Formation described in Carlsbad Caverns East quadrangle, New Mexico, where it is uppermost unit of Carlsbad group. Top has been removed by erosion in this quadrangle and at type locality. In subsurface, underlies Salado formation.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 375. In Kent quadrangle, Texas, underlies Yearwood formation (new).

Term Carlsbad abandoned. Term Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) applied in New Mexico.

Type locality: On Carlsbad-Artesia Highway (U.S. 285), 3.7 miles from Eddy County Courthouse in Carlsbad. In W½ sec. 26, T. 21 S., R. 26 E., of New Mexico Principal Meridian, Eddy County, N. Mex. Name derived from Tansill power dam. Locality is on east flank of elongate dome that forms prominent topographic feature northwest of Carlsbad.

Tantalus Basalt[1] (in Honolulu Volcanic Series)

Pleistocene, upper, or Recent: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis in Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 132. Lava flow of melilite-nepheline basalt, with thick mantle of clinker and lava balls, and thick underlying clinker, that cascaded from Tantalus cone into Pauoa Valley. Cinder and clinker in valley below source cone 100 to 300 feet thick; maximum thickness of massive phase of lava about 40 feet. Unconformably overlies Koolau volcanic series and older alluvium; locally rests on black ash formed by same eruption. Probably simultaneous with Sugar Loaf basalt.

Named for Tantalus, the cinder cone at its vent. Covers about 0.3 square miles in Pauoa Valley, on southside of Koolau Range, 11 miles west of Makapuu Head.

Tanyard Formation (in Ellenburger Group)

Lower Ordovician: Central Texas.

V. E. Barnes and P. E. Cloud, Jr., 1945, Texas Univ. Bur. Econ. Geology Mineral Resources Circ. 34, p. 1, 19–29. Basal formation of group. Underlies Gorman formation (new). A sequence of limestones and dolomites. Thickness 560 feet. Comprises (ascending) Threadgill and Staendebach (new) members. Cherokee Creek section, San Saba County described.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 142–144, 151, 156–157, pls. 5, 6 [1945]. Proposed for rocks similar to and partially correlative with Lower Ordovician rocks exposed at type section at the Tanyard. Consists of fine- to coarse-grained, commonly vuggy to porous, light-yellowish to woodash-gray and pearl-gray, irregularly bedded dolomites and sublithographic, pearl- to woodash-gray and old-ivory, thickly to thinly bedded limestones, both essentially nonglauconite; locally formation is dolomite throughout. Thickness 518 to 658 feet; at type section about 550 feet. On basis of chert and grain-size differences in the dolomites, it is divided into Threadgill member below and Staendebach member above. Overlies Pedernales member or San Saba member of Wilberns formation.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 35–38, 136–137, 157–158, 194–195, 244–250, 256, 291, 312, pl. 8 [1946]. Type section and local stratigraphy described in detail.

Type section: The Tanyard on east bank of Buchanan Lake (Colorado River) opposite mouth of John Jim Creek and Cedar Hollow and 2 to 3 miles north of mouth of Fall Creek, northwestern Burnet County. Tanyard is well known locality, having given its name to Tanyard Spring, Tanyard Camp and Tanyard Crossing.

Tanyard Branch Member (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Light-olive-gray to buff very fine to fine-grained thin to medium uneven bedded sandstone 15 feet thick (at base); olive-gray shale 5 feet thick; light-olive-gray to buff, very fine to fine-grained sandstone rubble 10 feet thick (at top). Maximum thickness about 35 feet near Alabama-Mississippi State line; thins eastward to an average of about 20 feet through most of Colbert County. Underlies Wagnon member (new); overlies Alsobrook member.

Named for its exposure on a small hill on east side of Tanyard Branch just south of U.S. Highway 72 in south-central SE½ sec. 2, T. 4 S., R. 13 W., Colbert County.

Taosan series[1]

Precambrian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 11.

Named for Taos County.

Tapaliza Formation or Group

Oligocene, upper, and Miocene, lower: Panamá.

Charles Schuchert, 1935, Historical geology of the Antillean-Caribbean region: New York, John Wiley and Sons, p. 563, 660. Dark foraminiferal shales.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, Geol. Sci., p. 234 (chart), 241. Tapaliza [group] includes Arusa and Aguagua formations. Chart shows Tapaliza above Capeti limestones and below Gatún formation. Upper Oligocene and lower Miocene.

In Darien area. Tapaliza is name of village on tributary of Río Pucro.

Tapeats Sandstone (in Tonto Group)[1]

Lower and Middle Cambrian: Central and northern Arizona, southeastern California, and southern Nevada.

Original reference: L. F. Noble, 1914, U.S. Geol. Survey Bull. 549.

E. D. Wilson, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1126. In central Arizona, the Tapeats overlies, with pronounced angular unconformity, rocks of Precambrian City Creek series (new).

E. T. Schenk and H. E. Wheeler, 1942, Jour. Geology, v. 50, no. 7, p. 885, 888. Since Prospect Mountain and Tapeats formations are lithogenetically the same, the former name is employed because of its priority of definition.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 15–17, 38–39. Coarse-grained sandstone is by far the most extensive of the several lithologic facies represented in Tapeats sandstone. Fairly uniform in character throughout eastern Grand Canyon, although locally variable, and normally weathers into single sheer cliff of chocolate-brown color.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 32–34, fig. 4, pl. 1. Widely distributed throughout eastern half of Ivanpah quadrangle, California and Nevada. Thickness along eastern limits, in a general north-south direction, ranges from 130 to 600 feet. Underlies Bright Angel shale; overlies Precambrian granite. Age given as Lower Cambrian for exposures in this area.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Age given as Lower and Middle Cambrian for occurrences in northwestern and central Arizona.

Named for Tapeats Creek, below mouth of which, just north of Shinumo quadrangle, the bed of Colorado River lies within this sandstone; Arizona.

Tapotchau Limestone

See **Tagpochau Limestone.**

Tappan Lava Flow

Quaternary: North-central Arizona.

H. S. Colton, 1937, Mus. Northern Arizona Bull. 10, p. 20 (fig.), 21–22. Longest flow that can be demonstrated in San Francisco Mountain volcanic field. Over most of its course, flow is very narrow, 1 to 300 feet. Age not stated but may be contemporary with basalt action of Pleistocene.

D. N. Hinckley, 1955, U.S. Atomic Energy Comm. [Pub.] RME–81 (rev.), p. 8. Quaternary.

At Tappan Springs about 3 miles southwest of Cameron. Traced from Lockett Tank to Cameron and down Little Colorado River to Hopi Trail Canyon, and to point 9 miles below Cameron, Coconino County.

Tappocho Limestone

See **Tagpochau Limestone.**

Taputapu Volcanics

Pliocene(?): Samoa Islands (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1), 1305–1306, pl. 1. Comprise lava flows, dikes, cones, and tuff deposits making up volcanic dome 6 miles long, 3 miles wide, and 1,500 feet high, and here referred to as Taputapu Volcano. Most flows are olivine basalts 6 to 50 feet thick; they contain much clinker, have thin flow units, and are capped in places with thicker flows of porphyritic and nonporphyritic olivine-poor basalt and andesite. Beds of red vitric tuff a few inches to several feet thick and thick lenses of cinder are common between flows. Thickness about 1,639 feet. Pliocene and upper Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 214–215. Appears to overlap Pago volcanic series. Pliocene(?).

Type locality: Cape Taputapu, west end of island. Exposed over western one-fourth of island.

Tarantula Formation

Cretaceous: Western Texas.

R. M. Huffington, 1947, Harvard Univ. Summ. of Theses, 1943–45, p. 196. Strata of Washita Taranutula formation, 680 feet thick, are probably Georgetown and Grayson in age. Overlies beds of Fredericksburg Finlay formation; underlies Lasca formation (new).

Area of report is northern Quitman Mountains, southern Hudspeth County.

Tarantula Gravel

Tertiary: Southwestern Texas.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 286–295. Predominantly conglomerate; basalt flow interbedded in lower part. Pale yellowish brown where orthoquartzite fragments are plentiful and somewhat whiter where there are more tuff fragments; in places has reddish cast; basal strata cemented with calcite, and amount of cement decreases upward. Thickness at least 300 feet but may be more than 400 feet. At MS1 of type section, typical Tarantula overlies Capote Mountain tuff (new); within 6 miles north-northwestward, oversteps entire Vieja group and rests on Cox sandstone, Bluff limestone, and Yucca formation.

Type section: A composite of three measured sections (MS1, MS2, and MS3). MS1(30°36.1'N., 104°47.8'W.) extends S. 50° E. from its top at top of small hill to its base in a stream bed, adjacent to and south of main body of basalt in Rim Rock fault; MS2 (30°37.3'N., 104°50.4'W.) extends in northerly direction from its top at top of a small hill to base of a vertical exposure in stream bed, 100 feet SE of county road (Porvenir mail route); MS3 (30°35.8'N., 104°49.6'W.) extends in westerly direction from top of long gentle slope to base of steep hill in middle of Tarantula Hills. Named for Tarantula Hills, Jeff Davis County.

Target Limestone Member (of Springer Formation)

Lower Pennsylvanian: Southern Oklahoma.

A. P. Bennison, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 913–914. Gray argillaceous limestone grading laterally into impure sandy marl. Average thickness about 6 feet, and maximum thickness probably does not exceed 10 feet; this includes varying amount of interbedded clay shale. Stratigraphically about 60 feet below massive fine-grained sandstone member probably equivalent to Lake Ardmore sandstone.

Named for intermittent Target Creek flowing across limestone near target range of Ardmore Air Force Base, Carter County. Areal extent limited to secs. 2 and 3, T. 3 S., R. 2 E.

Tarkio Limestone Member (of Zeandale Limestone)

Tarkio Limestone (in Wabaunsee Group)

Tarkio Limestone Member (of Wabaunsee Formation)[1]

Pennsylvanian (Virgil Series): Southwestern Iowa, eastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: S. Calvin, 1901, Iowa Geol. Survey, v. 11, p. 420, 422, 430–437.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, 2d ser., v. 25, pl. 5. In Missouri, Tarkio limestone is basal

formation in Wabaunsee group. Overlies Willard shale and underlies Pierson Point shale.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. viii (fig. 4), 19, 20. Wabaunsee group is redefined for Missouri to accord with interstate agreement. Tarkio limestone overlies Willard shale and underlies Wamego shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 16–17. In 1910 Condra, traced Swallow's (1866 [1867], Am. Assoc. Adv. Sci. Proc., v. 15) so-called "Chocolate" limestone through outcrops in Mill Creek and Kansas River valleys of Kansas, also in southeastern Nebraska and northwestern Missouri and into division 1 of Calvin's section near Coin, Iowa. After it was realized that all of Calvin's "Tarkio", except the thin to missing top division, had been named in Kansas, Condra and Bengston (1915, Nebraska Acad. Sci. Pub., v. 9, no. 2) applied name Tarkio to top subdivision of Nemaha "formation," now called a subgroup. After it was realized that Chocolate limestone is not a geographic name and that name Tarkio could be applied to the "Chocolate" limestone, Condra (1935) [compiler unable to locate this reference] designated a type locality for the revised Tarkio, where the formation is well exposed in section extending from the Maple Hill limestone down to below the Reading limestone. Moore (1936, Kansas Geol. Survey Bull. 22) selected a type locality in Kansas. The Tarkio is a distinctive unit from northwestern Missouri and southeastern Nebraska to south-central Kansas. Thickness ranges between 2 and 11 feet, being greatest in east-central Kansas. The Tarkio, as redefined by Condra, is distinctive unit in east-central Kansas, in Richardson and Pawnee Counties, Nebr., and in Missouri River bluffs north of Corning County, Mo., but grades into sandy shale at McKissick Grove, Iowa, and Nebraska City, Nebr. Elmont limestone, as exposed in the two northern locations cited above closely resembles the type Tarkio and has been erroneously correlated as Tarkio by some earlier workers. In Nebraska, underlies Pierson Point (Wamego) formation; overlies Willard shale.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. Rank reduced to member status in Zeandale limestone (new). Underlies Wamego shale member; overlies Willard shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12, fig. 5. Formation in Wabaunsee group. The three formations immediately below Table Creek shale are not generally recognized in area of this report. In N½SE¼SW¼ sec. 36, T. 70 N., R. 43 W., Fremont County, beds are exposed which are tentatively correlated with a part of Table Creek shale—Willard shale interval. At top of this section, 3½ feet of green and gray shale is identified as basal part of Pierson Point shale. Below this is Tarkio limestone, recognized as two limestone beds with an intervening fossiliferous gray shale. Overlies Willard shale. Tarkio described here is in accordance with Kansas usage and not Tarkio as described by Calvin.

Type locality (Condra): In Missouri River bluffs northeast of Corning, Holt County, Mo. This location is west of Tarkio Valley in Missouri.

Type locality (Moore): On Mill Creek southwest of Maple Hill, Wabaunsee County, Kans. This area noted by Swallow under designation of "Chocolate limestone." Calvin applied Tarkio to rocks on Tarkio Creek, north of Coin, Page County, Iowa.

†Tarrant Formation[1] (in Eagle Ford Group)

Tarrant Member (of Eagle Ford Formation)

Upper Cretaceous: Eastern Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 239, 270, 425.

W. L. Moreman, 1942, Jour. Paleontology, v. 16, no. 2, p. 192. Basal formation in Eagle Ford group. Underlies Britton formation.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 480. Shown on correlation chart as member of Eagle Ford formation, surface and subsurface in eastern Texas.

W. L. Turner, 1951, Field and Lab., v. 19, no. 2, p. 53–54. Adkin's classification not applicable to rocks exposed in Eagle Ford quadrangle; hence, term Tarrant not used in this report.

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 3. In this report the "Tarrant" unit is included in Lewisville member of Woodbine formation.

U.S. Geological Survey has abandoned the term Tarrant.

Type locality: One mile east of Tarrant Station, Tarrant County, at crossing of St. Louis, San Francisco & Texas Railway over tributary of Bear Creek.

Tarryall Formation[1]

Carboniferous and Triassic(?): Central Colorado.

Original reference: G. A. Muilenbrug, 1925, Colorado Geol. Survey Bull. 31, p. 12–25.

Exposed in and around Tarryall Creek, Park County.

Tar Springs Sandstone[1]

Tar Springs Sandstone (in Elvira Group)

Upper Mississippian (Chester Series): Western Kentucky, southern Illinois, southwestern Indiana, and southeastern Missouri.

Original references: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, p. 174, geol. section; 1857, Kentucky Geol. Survey, v. 2, p. 85–88.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 137; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 835–836. Assigned to Elvira group (new). Sandstone is 50 to 75 feet thick in Union County, Ill., and southeastern Perry County, Mo. In standard Mississippian section, underlies Vienna limestone and overlies Glen Dean limestone.

D. J. McGregor, T. G. Perry, and W. J. Wayne, 1957, Indiana Geol. Survey Field Conf. Guidebook 9, p. 6. Unconformably underlies Pennsylvanian Mansfield formation in some areas of southwestern Indiana.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, p. 27, pl. 1. In Indiana Tar Springs is commonly light-gray to light-brown rust-spotted thick-bedded to massive fine- and medium-grained sandstone which is locally crossbedded and laminated. Thickness 40 to 90 feet. Shown on stratigraphic column below Vienna limestone and above Glen Dean limestone. Term Elvira group not used in Indiana.

Named for Tar Springs, 3 miles south of Cloverport, Breckinridge County, Ky.

Tartar cyclothem

See Tarter cyclothem.

Tarter Coal Member (of Abbott Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1). Assigned to member status in Abbott formation (new). Occurs above Manley coal member (new) and below Pope Creek coal member. Name Tarter sandstone previously applied to sandstone below Tarter coal is discontinued in order to retain name for the coal. No name given to sandstone. Coal named by Wanless (1939, Geol. Soc. America Spec. Paper 17). Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois. Cyclical classification retained but is independent of rock-stratigraphic classification.

Type locality: SE¼ sec. 2, T. 5 N., R. 1 E.. Fulton County.

Tarter cyclothem (in Abbott Formation)

Tarter cyclothem (in Tradewater Group)

Pennsylvanian: Western Illinois.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 14 (fig. 1). Shown on columnar section at top of Caseyville group. Overlies Babylon cyclothem; underlies Pope Creek cyclothem.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 64, 66–67, 202. In outcrops, cyclothem is from 3 to 10 feet thick. Includes Tarter sandstone and coal. Separated from underlying and overlying cyclothems by minor unconformities; base of Tarter sandstone is from 2 to 15 feet above Babylon coal; in many places, upper Tarter strata are truncated by Pope Creek sandstone which in one place cuts out Tarter coal; locally, Bernadotte sandstone cuts out entire Pope Creek cyclothem and rests on Tarter strata. Type locality and derivation of name given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Abbott formation (new). Above Babylon cyclothem and below Pope Creek cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type section: Ravine, one-fourth mile southwest of bridge, in SE¼ sec. 2, T. 5 N., R. 1 E., Vermont quadrangle, Fulton County. Named for Tarter Bridge over Spoon River.

Tarter Member (of Abbott Formation)

Tarter Member (of Tradewater Formation)

Tarter Sandstone (in Tradewater Group)

Lower Pennsylvanian: Western Illinois.

C. B. Read, 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 275. Incidental mention as member of Tradewater formation in discussion of Pennsylvanian floral zones and provinces.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 66, 67, geol. sections 5, 7, 26, 33–35, 41. A sandstone in Tarter cyclothem. Light gray or bluish gray locally discolored by carbonaceous matter; commonly argillaceous; at several localities, consists of irregular nodular masses at

base of underclay. Thickness a few inches to 3 feet; where more than 1 foot thick, sandstone appears to be rather massive. Base of sandstone varies from 2 to 15 feet above Babylon coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31. Name Tarter sandstone discontinued so that term Tarter may be applied to coal member of Abbott formation (new). Sandstone is only locally present and no replacement name is considered necessary.

Type locality (cyclothem): Ravine one-fourth mile southwest of bridge in SE¼ sec. 2, T. 5 N., R. 1 E., Fulton County. Named for Tarter Bridge over Spoon River.

Tascotal Formation (in Buck Hill Volcanic Series)

Oligocene and younger (?): Western Texas.

S. S. Goldich and C. L. Seward, 1948, West Texas Geol. Soc. [Guidebook] Fall Field Trip Oct. 29–31, p. 14 (table 1), 17 (fig. 3), 21–22. In Tascotal quadrangle, consists of two lithologic facies: (1) thin-bedded flaggy sandy light-colored tuff in lower part, and (2) coarse-grained crossbedded tuffaceous gray-buff sand in upper part; some conglomerate, breccia, and ash beds occur in both facies. Approximately 800 feet thick. Lies on eroded surface of Mitchell Mesa rhyolite; underlies flows of Rawls basalt. Tertiary.

R. L. Erickson, 1953, Geol. Soc. America Bull., v. 64, no. 12, pt. 1, p. 1358 (table 1), 1365–1368, pl. 1. At type locality, where it is 797 feet thick, it is divided into two members: (1) a lower member of tuff and sandy tuff beds, and (2) an upper member of sandstone, tuffaceous sandstone, and conglomerate. Overlies Mitchell Mesa tuff-flow; underlies Rawls basalt.

W. N. McAnulty, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 536 (table 1), 555, pl. 1. Described in Cathedral Mountain quadrangle where it has a maximum thickness of 462 feet; thins northward to 50 feet on butte west of McIntyre Peak where it is capped by Rawls basalt. Oligocene and younger(?).

Type locality: At Wire Gap, Presidio County. Named for high mesa in Tascotal Mesa quadrangle.

Tassia Wash Group

Tertiary(?) (pre-Pliocene): Northwestern Arizona.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, p. 1414–1415, pl. 1. Consists of (ascending): fine-grained compact limestone and sandstone with calcareous cement, in layers 3 to 10 feet thick, over 200 feet thick; limestone and sandstone interbedded with buff siltstone, thickness about 50 feet; buff siltstone, weathering to earthy incoherent silt, thickness about 50 feet; and coarse limestone breccia [this may or may not be unit referred to as Greggs breccia], firmly cemented, with reddish sandy matrix, thickness 60 feet. In structural conformity with underlying Kaibab.

In Tassai Wash east of gap where wash cuts through Tassai Ridge.

†Tassajara (lake?) Bed[1]

Pliocene(?): Western California.

Original reference: J. G. Cooper, 1894, California Acad. Sci. Proc., 2d ser., v. 4, p. 170.

Probably named for exposures on Tassajero (Tassajara) Creek, Alameda County.

Tassajero Formation[1]

Pliocene or Pleistocene: Western California.

Original reference: B. L. Clark, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 151.

B. L. Clark, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1957. Underlies Green Valley formation.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 585, chart 11. At type section, consists largely of lacustral deposits, mostly sandstones and shales with thin beds of fresh-water limestones. At base is 200 to 300 feet of volcanic ash referred to as "Moraga" tuff. Overlies Green Valley formation. Lower Pliocene.

Type section: On south and southeast side of Mount Diablo where it is crossed by Tassajero Creek, Contra Costa County.

†Tatalina Group[1]

Precambrian, Cambrian(?), and lower Ordovician: Northeastern Alaska.

Original reference: L. M. Prindle, 1913, U.S. Geol. Survey Bull. 525, p. 37–38.

Typically exposed in valley of Tatalina River, Yukon-Tanana region.

Tate Formation (in McMillan Group)

Tate Member (in McMillan Formation)[1]

Upper Ordovician: Central Kentucky and southwestern Ohio.

Original reference: A. F. Foerste, 1906, Kentucky Geol. Survey Bull. 7, p. 19, 212.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 26–27. In southern Blue Grass region, McMillan group includes (ascending) Tate formation, Gilbert limestone, and Mount Auburn formation. The Tate is a comparatively nonfossiliferous gray shale and fine-grained argillaceous limestone occupying interval between the Fairmount and the Gilbert. Northward on eastern flank of Cincinnati arch, the Bellevue wedges in at the base. Thickness 60 to 80 feet.

Traceable from Casey and Boyle Counties, Ky., to Adams County, Ohio. Derivation of name not stated.

Tatina Group[1]

Ordovician and Silurian(?): Central southern Alaska.

Original reference: A. H. Brooks, 1911, U.S. Geol. Survey Prof. Paper 70, p. 55, 69–73, map.

Type exposure: In upper basin of Tatina River, formerly called Rohn River, in Mount McKinley region.

Tatman Formation[1]

Eocene, lower: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1912, Am. Mus. Nat. History Bull., v. 31, p. 60–62.

F. B. Van Houton, 1944, Geol. Soc. America Bull., v. 55, no. 2, p. 185 (table 2), 191–199. Conformably overlies Willwood formation (new). Consists of about 870 feet of alternating fine-grained sandstone and laminated brown carbonaceous shale, swamp and lake deposits.

R. L. Hay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1880, 1886. In Absaroka Range, overlies Willwood formation and underlies Pitchfork formation (new).

Named for Tatman Mountain. Bighorn Basin.

Tatman Mountain Gravels[1]

Oligocene(?) or Eocene: Northern Wyoming.

Original reference: W. J. Sinclair and W. Granger, 1911, Am. Mus. Nat. History Bull., v. 30, p. 88, 105–111.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 32. Age post-Wasatchian but otherwise uncertain.

Occur on Tatman Mountain, Bighorn Basin.

Tatow Limestone

Lower Cambrian: Central western Utah.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1138–1139, 1141 (fig. 5), 1143–1144. Walcott, in his House Range section (1908, Smithsonian Misc. Colln., v. 53, no. 1812), doubtfully correlated limestone above Pioche shale with the Langston of Blacksmith Fork and assigned it to Middle Cambrian. Rocks overlying Pioche form cliffs in House Range, weather to red-brown slopes similar to those formed of Langston limestone in Blacksmith Fork, and occupy relatively same position in section. However, these rocks in House Range are not dolomitic, contain more arenaceous shale, and also contain a *Poulsenia* fauna considered to be Lower Cambrian in age. These rocks cannot be correlated with Middle Cambrian Langston and are here named Tatow limestone. Lower 40 feet consist of gray fine-grained limestone which contains tan clay flakes and nodules, calcareous platy sandstone, and micaceous shale partings. Upper 125 feet composed of steel-, tan-, and blue-gray more or less oolitic and arenaceous limestone; interbedded with green-gray argillaceous calcareous thin-bedded sandstone; irregular zones or partings of fissile to chunky arenaceous and micaceous shale. Poorly preserved fossils in limestones 50 feet above base and 32 feet below top. Overlies Pioche shale; underlies Howell limestone (emended); boundary between Tatow and Howell placed arbitarily. Lower Cambrian (Waucobian).

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 28–32. Unit termed Tatow limestone by Deiss is here assigned to Busby quartzite which is geographically extended into House Range. Pinches out in vicinity of Pioche, Nev.

Type section: Measured 1½ miles north of Marjum Pass, House Range, Millard County. Name derived from Tatow Knob 14 miles north of Marjum Pass.

Tau Trachyte

Pliocene and lower Pleistocene(?): Samoa Island (Tutuila).

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285 (table 1). Named in list of eight trachytes, which are described as dense jointed cream-colored trachytic dikes, plugs, and crater fills later than most of Pliocene volcanics. Thickness of series 2,141 feet or more. Tau plug associated with Pago volcanic series (new).

Taunton Clays[1]

Pleistocene: Massachusetts.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 986.

Occurs near Taunton, Bristol County.

Taylor Marl[1]

Taylor Group

Upper Cretaceous (Gulf Series): Central and eastern Texas.

Original reference: R. T. Hill, 1892, Artesian Invest. Final Rept., pt. 3, p. 73, Cong., 1st Sess., S. Ex. Doc. 41, pt. 3.

L. W. Stephenson, 1918, U.S. Geol. Survey Prof. Paper 120–H, p. 154–157. Taylor marl overlies Austin chalk and underlies Navarro formation. Includes Pecan Gap chalk and Wolfe City sand members (both new).

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 133–146. Unconformity of regional extent separates Austin chalk and beds of Austin age from overlying Taylor marl and beds of Taylor age. Time value of unconformity varies greatly from place to place along strike, owing in part to unequal erosion at top of Austin and in part to differential warping in early Taylor time. Differential warping caused deposition of Taylor sediments to begin earlier in Waco area than elsewhere; there thickness of lower Taylor sediments below Pecan Gap chalk member is 900 feet; minimum thickness or complete absence of lower Taylor sediments beneath beds of Pecan Gap age is between New Braunfels and San Antonio. Field relations of traceable beds in Red River and Lamar Counties indicate that Annona chalk as a whole is time equivalent of lower part of Taylor marl, Wolfe City sand member, and the typical Pecan Gap chalk.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 37–45. Taylor group is oldest of formations exposed in Leon County [this report]. At the outcrops, the group consists of several formations which change considerably in thickness along strike. Some of the formations wedge out completely. On account of these lateral changes, the subsurface section of the Taylor is more readily comparable with surface section of the Taylor in counties along Red River. In counties along Red River, the group is divided into (ascending) Brownstown marl, Gober chalk, lower Taylor marl (partial equivalent of Ozan formation of Arkansas), Wolfe City sand, Pecan Gap chalk, upper Taylor marl (equivalent of Marlbook marl of Arkansas).

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 39–49. Group comprises (ascending) lower marl, Annona chalk, Wolfe City sand, Pecan Gap chalk, Anacacho limestone (upper part), upper marl, and Neylandville marl. Overlies Austin strata; underlies Navarro group restricted to exclude Neylandville marl. Foraminifera described.

Named for Taylor Prairie, central Texas. Typically developed in vicinity of Taylor, Williamson County, and in Travis County.

Taylor Meta-Andesite[1]

Mississippian: Northern California.

Original reference: J. S. Diller, 1908, U.S. Geol. Survey Bull. 353.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 14). Shown on correlation chart above Arlington formation and below Pennsylvanian(?) Shoofly formation.

Named for exposures around Taylor Rock, Taylorsville region.

Taylor Sandstone (in Greene Formation)[1]

Permian: Southwestern Pennsylvania and northern West Virginia.

Original reference: R. V. Hennen, 1909, West Virginia Geol. Survey Rept. Marshall, Wetzel, and Tyler Counties, p. 173.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness about 30 feet. Lies between middle and upper Rockport limestones.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table). Listed in Greene series.

Named for Taylor Township, Greene County, Pa.

Taylor Branch Limestone[1]

Taylor Branch Limestone Member (of Burlingame Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5, 10.

E. H. Wenberg, 1942, Iowa Acad. Sci. Proc., v. 49, p. 343 (fig. 6). Listed as Taylor Branch limestone in insoluble residue correlations of Missouri and Virgil strata in Iowa.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45–46. In Nebraska, Burlingame limestone includes (ascending) Taylor Branch limestone, Winnebago shale, and South Fork limestone members.

Type locality: In clay pit south of Taylor Branch south of Table Rock, Pawnee County, Nebr.

Taylor Brook Formation or Injection Gneiss

Cambrian(?): Southwestern Maine.

L. W. Fisher, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 81. Five mappable units established in area formerly mapped as Precambrian in southwestern Maine. Sequence (ascending) Danville-Pejepscot (new) series; Taylor Brook injection gneiss (new) including a sedimentary amphibolite; Androscoggin series; and Thorncrag-Sabbatus series. Middle Silurian.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 115–117, pl. 1, table 1 (facing p. 112). Coarse-grained quartz-feldspar-biotite gneiss with a few finely granulated quartzite lenses. Thickness 3,500 feet. Conformably underlies Androscoggin formation overlies Pejepscot formation. Cambrian(?). Type locality given.

Type locality: In Taylor Brook in western part of city of Auburn, Androscoggin County. Covers an area of about 10 square miles.

Taylors Falls Member (of Franconia Formation)

Upper Cambrian (St. Croixian): East-central Minnesota.

C. R. Stauffer, G. M. Schwartz, and G. M. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1901–1902. Named in a list of

Minnesota Upper Cambrian formations. Underlies Minneiska member (new) or Hudson member; overlies Ironton member.

C. R. Stauffer, G. M. Schwartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1239. Typically a sandstone but may include much shaly sandstone, glauconitic sand, and even some dolomitic beds as traced away from type locality. Member is a northward continuation of type section of Franconia sandstone and, hence, of *Conapsis* zone. In Minnesota, name is preferred to term Goodenough member as used by Twenhofel, Raasch, and Thwaites (1935) for same faunal zone. Underlies Hudson member; overlies Ironton member. Derivation of name given.

R. R. Berg, 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 867. Abandoned in preference to Mazomanie member.

Named from outcrop along Taylors Falls Highway near southwest corner of Interstate Park at the Dalles of St. Croix River, Chisago County.

Taylorsville Formation[1]

Silurian: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 48. Devonian age questioned because of lack of faunal evidence.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California (1:250,000): Westwood sheet, California Div. Mines. Largely slate and graywacke, with lesser amounts of conglomerate, breccia and metamorphosed dikes and sills. Mapped with Silurian marine sedimentary and metasedimentary rocks.

Named for exposures on east face of spur above the limestone about 1 mile south of Taylorsville, Plumas County.

Taylortown Limestone (in Washington Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: E. V. d'Invilliers, 1895, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 3, pt. 2, p. 2577.

Probably named for Taylorstown or Taylorstown Station, Washington County.

Tazewell Stade

Tazewell Loess,[1] Drift, Till

Tazewell (Tazewellian) Substage[1] and Subage

Pleistocene (Wisconsin): Mississippi Valley.

Original reference: M. M. Leighton, 1933, Science, v. 77, p. 168.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24, 36, 37, 44, 50, 52, 123, 128. Bradyan subage (new) occurs between Tazewellian and Caryan subages. Report also mentions Tazewell substage, loess and till.

R. V. Ruhe, Meyer Rubin, and W. H. Scholtes, 1957, Am. Jour. Sci., v. 255, no. 10, p. 671–689. New radiocarbon dates in Iowa permit a grouping of age values and raise new problems in stratigraphic correlation of late Pleistocene deposits in Iowa and adjacent regions. An older group of ages greater than 29,000 years dates Iowan substage and pre-Iowan deposits.

An old group of ages of 22,900 to 25,100 years dates the Farmdale substage. An intermediate group of ages ranges 14,000 to 17,000 years. Deposition of Tazewell loess occurred in central Iowa during period 15,000 to 17,000 years before present. Minimum date of Tazewell-Cary interstadial is 15,000 years.

V. C. Shepps, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–32, p. 22–30. Advance during Tazewell substage in northwestern Pennsylvania is named Mogadore. Till deposited is named Mogadore.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 7. Presentation of revised time-stratigraphic classification of Wisconsinan stage in Lake Michigan glacial lobe. From former classification, the Woodfordian substage (new) includes Iowan substage of Illinois usage (but not of the type), the Tazewell and Cary substages.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Presentation of classification of Wisconsin glacial stage of north-central United States. Tazewell glacial substage is separated from older Iowan glacial substage by Gardena intraglacial substage and from younger Cary glacial substage by St. Charles intraglacial substage. Author [Leighton] disagrees with classification presented by Frye and Willman (1960) in which they included Iowan substage (of Illinois), Tazewell substage, and Cary substage in Woodfordian substage. Leighton believes that Frye and Willman overlooked fact that some of Tazewell and Cary drifts in eastern Illinois which they include in their "Woodfordian" are from Saginaw lobe, not Michigan lobe, Frye and Willman named Tazewell loess Richland; this name is superfluous.

Name amended to Tazewell Stade to comply with Stratigraphic Code adopted 1961.

Name derived from Tazewell, Tazewell County, Ill.

Teanaway Basalt[1]

Eocene: Central Washington.

Original reference: G. O. Smith and B. Willis, 1901, Am. Inst. Min. Engineers Trans., v. 30, p. 359.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 26 (table), 38–39. Basaltic lava flows and intercalated tuffs, possibly in part equivalent to Metchosin volcanics of western Washington. Thickness 100 to 4,000 feet. Lower to middle Eocene.

R. J. Foster, 1960, Geol. Soc. America Bull., v. 71, no. 2, p. 101 (table 1), 107–108, pl. 1. Area herein discussed [northern parts of Mount Stuart and Snoqualmie folios] contains main body of Teanaway which is composed of basaltic lava complexly interbedded with sedimentary and pyroclastic rocks. In type area, more than 5,000 feet thick and consists of basaltic lava, tuff, and lapilli-tuff; upper part of section primarily clastic with tuff and lapilli-tuff predominating; some columnar basalt. Lies unconformably above Swauk formation, and locally Silver Pass volcanic rocks (new). Overlain by Roslyn formation, Yakima basalt, and post-Roslyn rhyolite; the Roslyn, oldest of the three formations, concordantly overlies the Teanaway; the other two are unconformable. Unfossiliferous. Stratigraphic relationships suggest a tentative Eocene age.

Type area (Weaver, 1937): Basin of Teanaway River where lavas are exposed on south flank of Wenatchee Mountains and dip in southerly direction beneath later sedimentary and volcanic formations in Yakima

Valley. Type area (Foster, 1960): Along Middle Fork of Teanaway River. [This is interpreted by Foster to be area that Smith intended for type.] Crops out in an arcuate band, up to 4 miles wide, extending from east of Kachess Lake to Table Mountain. Exposures of Teanaway essentially represent a cross section through a volcanic field.

Teapot Sandstone Member (of Mesaverde Formation)[1]

Teapot Sandstone Member (of Parkman Sandstone)

Upper Cretaceous: Eastern Wyoming.

Original reference: V. H. Barnett, 1915, U.S. Geol. Survey Bull. 581, p. 113.

C. H. Wegemann, 1918, U.S. Geol. Survey Bull. 670, p. 22–23. Uppermost member of Mesaverde formation in Salt Creek oil field, Wyoming. Thickness about 50 feet. Separated from underlying Parkman sandstone member by about 325 feet of shale (unnamed). Underlies Lewis shale.

E. I. Rich, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2435–2436. Forms top of Mesaverde formation in southwestern part of Powder River and southeastern part of Wind River basin. Overlies unnamed middle member. Underlies Lewis shale in some areas and in other areas Meeteetse formation. In southeastern part of Wind River basin, member is overlain by rocks containing marine faunal assemblage characteristic of Bearpaw shale of Montana and is underlain by rocks probably equivalent to upper Claggett shale or lower part of Judith River formation. Age limits are restricted and the Teapot member is, in area of this report, of late Judith River or early Bearpaw age. Not recognized in surface or subsurface in Big Horn basin.

J. M. Parker, Jr., 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 90, 98. Present subsurface and outcrop control makes it possible to show that type Teapot is part of original Parkman, as first described near Parkman and later defined on Crow Indian Reservation. Hence, Parkman should be treated as formation with Teapot sandstone as uppermost member.

Named for Teapot Rock, a topographic feature carved from this sandstone about one-half mile east of Casper-Salt Creek Road.

Teapot Mountain Porphyry[1]

Tertiary, lower(?): Central Arizona.

Original reference: F. L. Ransome, 1919, U.S. Geol. Survey Prof. Paper 115, p. 126, pl. 45.

E. D. Wilson, 1952, Arizona Geol. Soc. Guidebook for Field Trip Excursions in southern Arizona, p. 8. Age shown as Laramide (Late Cretaceous to early Tertiary).

Largest exposure of Teapot Mountain porphyry is on ridge south of Teapot Mountain and west of the metallized schist area, Ray district.

Teay Formation[1]

Pleistocene: Southwestern West Virginia.

Original reference: M. R. Campbell, 1900, U.S. Geol. Survey Geol. Atlas, Folio 69.

Forms floor of Teay Valley, Cabell County.

Tebo Formation (in Cabaniss Group)

Tebo Formation (in Cherokee Group)

Pennsylvanian (Des Moines Series): Missouri and Kansas.

H. S. McQueen, 1943, Missouri Geol. Survey and Water Resources, 2d ser., p. 78–83, 100, 101, 102, 103, measured sections, pl. 5. Name Tebo was originally given to coal seam, type locality of which is on Tebo Creek, Henry County. Associated with coal is an underclay and overlying black roof slate which appear to make a unit. Name Tebo formation is applied to this unit. Unconformably overlies Loutre formation; unconformably underlies Ardmore formation. Thickness as much as 9 feet.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Stratigraphic column shows Tebo formation above Weir formation and below Scammon formation. Cabaniss group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as coal cycle in Senora formation, Cabaniss group in Oklahoma.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 22 (fig. 11), 23 (fig. 12). Thickness about 17½ feet in Vernon County, Mo. Underlies Tiawah limestone in Scammon formation, Cabaniss group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 48–52, measured sections. In southeastern Kansas, the following divisions recognized: dark- to light-gray silty to sandy shale at base, impure limestone, underclay, and Tebo coal. Thickness ranges from few inches to about 26 feet. Overlies Weir formation; underlies Scammon formation. Cabaniss subgroup of Cherokee group.

Type locality: Tebo Creek, Henry County, Mo.

Tecolote Member (of Santa Rosa Island Formation)

Pleistocene: Santa Rosa Island, California.

P. C. Orr, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1113, 1115 (fig. 2), 1116–1118. Consists of buff-colored clays and clay sands, old soil profiles, and thin lenses of subangular gravel; many minor unconformities representing stream channelling and at least one major unconformity in which thick layer of coarse gravel was deposited about midway in member. In some areas, earth has been burned brick red; many of these fire areas contain charred bones of dwarf mammoth and are attributed to activities of early man. One fire area about midpoint in sequence radiocarbon dated at 29,700 ± 3,000 years B. P. Upper part of sequence dated 12,000 years B. P. Thickness about 60 feet. Uppermost member of formation. Overlies Fox member.

Tecopa Shale

Lower and Middle Cambrian: Southeastern California and southeastern Nevada.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 27–28, fig. 5. Name applied to shales that lie between Zabriskie quartzite below and Lyndon limestone above. Thickness 1,119 feet. Cadiz formation of Hazzard and Mason (1936) not considered valid lithologic unit, nor is it applicable to strata in question; neither is Bright Angel as used by Nolan (1929, Am. Jour. Sci., 5th, v. 17, no. 101) in Spring Mountain area, Nevada, applicable, hence new name proposed.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 148. In suggested revision of stratigraphic units in Great Basin area, Tecopa shale is included in Wood Canyon formation.

Type section: About 6 miles northeast of Tecopa, Inyo County, Calif., near southern end of Resting Springs Range. This is Hazzard's (1938 [1937],

California Jour. Mines and Geology, v. 33, no. 4) section extending from top of Zabriskie quartzite (unit 4H) to base of Lyndon limestone (unit 5E) in cross-section B–B′. Present at west base of Eagle Mountain, near Death Valley Junction, and on west side of mountains immediately west of Shoshone.

Tecovas Formation (in Dockum Group)[1]

Upper Triassic: Northwestern Texas.

Original reference: C. N. Gould, 1907, U.S. Geol. Survey Water-Supply Paper 191, p. 20–29.

G. Maxwell, 1954, *in* Panhandle Geol. Soc. [Guidebook] Field Trip May 1, p. 15. Underlies Trujillo formation; west-central Potter County where the Trujillo is absent, the Tecovas underlies Tertiary sediments.

Named for exposures on Tecovas Creek, Potter County.

Tecumseh Sandstone (in Silver Reef Sandstone Member of Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 25, 28–29, pl. 2. Thin-bedded to massive and commonly lavender colored. A buff to yellow sandstone, prominently iron-stained and as much as 6 feet thick, occurs near middle of unit on Tecumseh Hill and along east face of White Reef near Thompson mine. Thickness on Tecumseh Hill in main mining area about 35 to 40 feet; to the north near Barbee mine about 30 feet or less, and on East Reef at Duffin mine about 50 feet. Thickness increases east of Leeds. Underlies Duffin sandstone and shale (new) with local unconformity; overlies Leeds sandstone (new) with local unconformity.

Named for exposures on Tecumseh Hill, Silver Reef (Harrisburg) Mining District, Washington County.

Tecumseh Shale (in Shawnee Group)[1]

Tecumseh Shale Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 28.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 23. As currently defined, underlies Ozawkie limestone member of Deer Creek formation and overlies Avoca limestone member of Lecompton formation. In Nebraska, divided into (ascending) Kenosha shale, Ost limestone, and Rakes Creek shale formation. Thickness in Nebraska about 36 feet; 65 feet at type locality; 12 feet at south line of Kansas.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 18–19, fig. 5. Comprises (descending) Rakes Creek shale, Ost limestone, and Kenosha shale members. Not differentiated in some areas. Where the two lower members of Deer Creek cannot be differentiated they are often included in the Tecumseh. Thickness about 10 ft. Underlies Deer Creek formation; overlies Lecompton formation. Shawnee group.

Type locality: Tecumseh, Shawnee County, Kans.

Tecuya Beds[1] or Formation

Oligocene or Miocene: Southern California.

Original reference: C. Stock, 1920, California Univ. Pub., Dept. Geol. Bull., v. 12, no. 4.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922. Referred to as Tecuya formation consisting of continental deposits of Oligocene or Miocene age. Unconformably overlies Tejon formation at its type locality; in Reed and Grapevine Canyons, underlies Tertiary dacite agglomerate and a flow of andesite.

Exposed in vicinity of Tecuja [Tecuya] Canyon in lower part of San Joaquin Valley, Kern County.

Teewinot Formation

Pliocene, middle: Northwestern Wyoming.

J. D. Love, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1899, 1907–1911, fig. 1. Succession of white limestone, tuff, pumicite, claystone, and conglomerate. Three facies developed in type area: a basal conglomerate, at least 1,400 feet thick; a middle limestone and pumicite, over 3,300 feet thick; and an upper claystone and pumicite, more than 400 feet thick. Unconformably overlain by Bivouac formation (new). Unconformably overlies rocks ranging in age from Cambrian to Miocene.

Type section: In and adjacent to Jackson Hole National Elk Refuge, Teton County, in T. 42 N., R. 115 W., and sec. 36, T. 42 N., R. 116 W. Name derived from Mount Teewinot, a sharp peak east-northeast of the Grand Teton, overlooking type area of formation in bottom of Jackson Hole at the east.

Tehachapi Formation[1]

Quaternary(?): Southern California.

Original reference: H. G. Hanks, 1886, California State Mining Bur. 6th Ann. Rept., pt. 1, p. 23.

Occurs one-half mile from town of Tehachapi, Kern County, on road to Caliente, also 9 miles west of Tehachapi, in Bright's Valley.

Tehachapi Marble[1]

Age not stated: Southern California.

Original reference: H. G. Hanks, 1886, California State Mining Bur. 6th Ann. Rept. State Mineralogist, pt. 1, p. 23.

Probably named for town of Tehachapi, Kern County.

Tehama Formation[1]

Pliocene: Northern California.

Original reference: R. D. Russell and V. L. Vander Hoof, 1931, California Univ. Pub., Dept. Geol. Sci. Bull., v. 20, no. 2, p. 11–21.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology, v. 35, no. 3, p. 232–235, pl. 3. Consists of silts, silty clays, sands, and gravels, predominantly pale and yellowish to greenish gray, weathering pale buff to yellow brown. Nomlaki tuff member at base. Thickness more than 2,000 feet in central part of Pliocene valley in which it accumulated, with Nomlaki tuff about 700 feet from base. Contemporaneous with Tuscan formation and interfingers with it in their zone of junction. Capped by Red Bluff gravels.

Named for Tehama County.

†Tehuacana Formation[1]

Eocene, lower: Eastern Texas.

Original reference: Julia Gardner, 1932, Geol. map of Texas, prelim. ed.

Tehuacana Bluff, the steep hill just west of town of Tehuacana, Limestone County.

Tehuacana Member (of Kincaid Formation)[1]

Paleocene: Eastern Texas.

Original reference: G. D. Harris, 1896, Bulls. Am. Paleontology, v. 1, no. 4, p. 129, 155.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 13–14. Uppermost member of formation in Texas. Overlies Pisgah member. Consists of grayish-white fossiliferous limestone and greenish-gray calcareous sandstone.

G. R. Kellough, 1959, Gulf Coast Assoc. Geol. Soc. Trans., v. 9, p. 153, 159–160. In Tehuacana Creek section, Tehuacana member includes 35 feet of shaly sands and sandy limestones containing minor amounts of fine-grained glauconite. Overlies Pisgah member; underlies Mexia member of Wills Point.

Type locality: Abandoned quarry at Tehuacana, Limestone County

Tejon Formation[1]

Tejon Group

Tejon Stage

Eocene, upper: Western California.

Original reference: W. M. Gabb, 1869, California Geol. Survey Pal., v. 2, p. xiii as reported by J. D. Whitney from unpublished paper by Gabb, and footnote by Gabb, p. 129.

B. L. Clark and H. E. Vokes, 1936, Geol. Soc. America Bull., v. 47, p. 853 (fig. 1), 864–868. Used as a stage name based on faunal assemblages. Occupies the interval between a transition stage above the Domengine stage and below the Gaviota stage.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1922; 1943, California Div. Mines Bull. 118, pt. 3, p. 534–535. Formation subdivided into four members in type area (ascending): Uvas conglomerate, Liveoak, Metralla sandstone, and Reed Canyon silt. Type area designated; here Tejon marine sediments form a wedge of steeply dipping strata 410 feet thick at Pastoria Creek and 4,380 feet in Reed Canyon a quarter mile east of Tecuya Creek. Underlies Tecuya formation; overlies basement complex.

E. A. Watson, 1942, Am. Midland Naturalist, v. 28, no. 2, p. 451–456. Eocene section in Pacheco syncline is conformable sequence about 5,400 feet thick. Strata were mapped as two formations, Martinez and Tejon, by Merriam (1897, Jour. Geology, v. 5, no. 8), Dickerson (1914, California Univ. Dept., Geol. Sci. Bull. 8, no. 6), Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193), and Weaver (*in* Tolman, 1932, California Dept. Public Works Water Resources Bull. 28). Name Tejon was applied to upper 2,800 feet of beds on basis of supposed equivalence in age rather than on similarity in lithology to type Tejon in Kern County. Since exact contemporaneity is difficult to prove, and since these strata are far removed from type locality and cannot be traced into them, another formational name might be advisable or term Markley used instead. In present report, the strata in question are called "Tejon." Shales of lower 1,500 feet of formation carry foraminiferal faunules that probably fall in "Tejon and Transition stage" of Clark and Vokes (1936). Upper part of section thought to be equivalent in age to Kreyenhagen as mapped by Taff (1935, Geol. Soc. America Bull. v. 46, no. 7) on north side of Mount

Diablo. Overlies Martinez with contact gradational; underlies San Ramon formation.

W. C. Putnam, 1942, Geol. Soc. America Bull., v. 53, no. 5, p. 697 (fig. 3). Used as a group term in Ventura region; includes (ascending) Matilija, Cozy Dell, and Coldwater formations. Underlies Sespe formation; overlies undifferentiated Eocene.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 587–588, chart 11. Foraminifera of lower 250 feet of "Tejon" formation in Pacheco syncline suggest a correlation of this part of section with Canoas silt (basal) member of Kreyenhagen. Not certain whether basal part of Tejon of this syncline or upper part of Martinez formation should be correlated with type Domengine. On northeast flank of syncline, about 800 feet above base of "Tejon" are beds containing *Turritella uvasana aedificata*, which is also abundant in sandstone of "Domengine stage" on south side of Mount Diablo. Upper part of "Tejon" occupies same stratigraphic position and has same foraminiferal species at top as does Markley formation at its type locality.

J. C. Brice, 1953, California Div. Mines Bull. 166, p. 12 (fig. 2), 29–30, pls. 1, 2, 7. Described and mapped in Lower Lake quadrangle. Consists principally of a white conglomeratic sandstone about 1,000 feet thick. Unconformably underlies Cache formation; unconformably overlies Martinez formation.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology 7, p. 5, 19 (correlation table). Eocene rocks south of Martinez in Concord quadrangle were mapped by Lawson (1914, U.S. Geol. Survey Geol. Atlas, Folio 193) as Martinez and Tejon formations. Contact as shown on maps of the San Francisco folio between the Martinez and Tejon on west limb of Pacheco syncline corresponds approximately to boundary between Escobar and Muir sandstones (both new) of present report. The Tejon of west limb of syncline is herein classified as Escobar sandstone and overlying Alhambra shale (new) with its three divisions. Tejon as mapped on east limb in San Francisco folio now includes the middle Eocene Muir sandstone, the upper Eocene Escobar sandstone, and Alhambra shale.

Type area: On north slope of Tehachapi Mountains at extreme south end of Joaquin Valley, between Pastoria Creek on the east and Tecuya Creek on the west. Named for occurrence in vicinity of Fort Tejon, Kern County.

Tejon Lookout Granite

Jurassic(?): Southern California.

J. C. Crowell, 1952, California Div. Mines Spec. Rept. 24, p. 10, pls. 1, 2. A light-buff medium- to coarse-grained biotite granite. Intrudes rocks similar to Lebec quartz monzonite (new); the Lebec and Tejon Lookout are probably related although now separated by Garlock fault.

Crops out in wedge-shaped area between San Andreas and Garlock faults and well exposed near Tejon Lookout, Lebec quadrangle.

Telegraph Canyon Member (of Nevada Formation)

Devonian: Northeastern Nevada.

Donald Carlisle and others, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2178 (fig. 2), 2181, 2183–2184. Thin- to thick-bedded mottled dolomite in alternating light- to dark-brown or dark-gray layers,

and including a tongue (15 to 450 feet thick) of well-bedded gray limestone. At type section, represented by 2,000 feet of dolomite, uppermost beds cut out by faulting; 1,950 feet thick at Williams Canyon; 800 feet in northern Pinyon Range. Overlies Union Mountain member (new); underlies Devils Gate limestone.

Type locality: Telegraph Canyon, Sulphur Springs Range, Mineral Hill quadrangle.

Telegraph Creek Formation (in Montana Group)[1]

Telegraph Creek Member (of Cody Shale or Colorado Shale)

Upper Cretaceous: Central southern Montana.

Original reference: W. T. Thom, Jr., 1922, U.S. Geol. Survey Bull. 736–B, p. 38.

W. A. Cobban, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1899–1900. Formation extended into Sweetgrass arch area, Montana. Unit has been included into Virgelle sandstone, mapped as separate formation and referred to as Transition zone, and termed Telegraph Creek(?). Fossil evidence definitely establishes Telegraph Creek age, and term can be used without query in this area.

P. W. Richards and C. P. Rogers, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–111. Rank reduced to member status in Cody shale. Thickness 867 feet. Overlies Niobrara shale member; underlies shale member equivalent to Eagle sandstone. Report covers Hardin area, Big Horn, and Yellowstone Counties, Mont.

J. D. Love, J. L. Weitz, and R. K. Hose, 1955, Geologic map of Wyoming (1:65,000): U.S. Geol. Survey. Montana group as mapped in northwestern Wyoming includes Telegraph Creek, Eagle sandstone, Claggett shale, and Judith River formation.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2792 (fig. 3), 2793. In Sweetgrass arch and East Glacier-Marias Pass areas, Montana, formation overlies Kevin shale member of Marias River shale (both new).

M. R. Mudge, 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 19. Described in Sun River Canyon area, Montana, where it is 340 feet thick, underlies Virgelle sandstone and overlies Kevin shale member of Marias River formation. Divisible into three parts: lower fine-grained calcareous dark-gray sandstone with many 1- to 3-inch-thick beds of fine-grained calcareous dark-gray sandstone and sandy shale partings; middle, mostly beds of calcareous hard dense dark-gray sandstone, 0.4 to 1 foot thick, in places ripple marked and crossbedded; upper, beds (as much as 4 feet thick) of light-gray calcareous poorly indurated sandstone alternating with beds of equal thickness of gray calcareous sandy shale.

U.S. Geological Survey currently classifies the Telegraph Creek as a member of the Colorado Shale in the Bearpaw Mountains area, Montana, on the basis of a study now in progress.

Typically developed at head of Telegraph Creek, T. 2 S., Rs. 28 and 29 E., Crow Creek Indian Reservation, Mont.

†Telegraph Hill Sandstone (in Franciscan Group)[1]

Jurassic(?): Western California.

Original reference: R. Crandall, 1907, Am. Philos. Soc. Proc., v. 46, p. 3–58.

Named for exposures at Telegraph Hill, San Francisco.

Telescope Group[1]

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 311, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July–Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 355, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly used in Death Valley region. Relationships of Murphy's formations to standard Death Valley section have not been generally understood. Murphy tentatively assigned all units above the Panamint metamorphic complex to the Lower Paleozoic. Units of the Telescope group—Sour Dough limestone, Middle Park formation, Mountain Girl conglomerate, Wildrose formation, Sentinel dolomite, Redlands dolomitic limestone, and Hanaupah formation—are here correlated with Precambrian Kingston Peak, Noonday, and Johnnie formations.

Appears to be named for Telescope Peak, south part of Panamint Range, on and around which formations of group are mapped.

Television Sandstone (in Panoche Group)

Upper Cretaceous: Central California.

M. B. Payne, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Section, Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Black-weathering concretionary sandstone 100 feet thick. Overlies Marlife shale (new); underlies Uhalde sandstone and shale (new). Name credited to D. W. Sutton (unpub. thesis).

Type locality: Moreno Gulch, Fresno County. Name derived from Television Hill, NW cor. sec. 10, T. 14 S., R. 11 E.

Tellera or Tellara limestone[1]

Pennsylvanian(?): Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 11.

Exposed on east flank of Sandia Range in Sandia Mountains. Derivation of name not stated.

Tellico Sandstone or Formation

Tellico Sandstone (in Blount Group)[1]

Middle Ordovician: Southeastern Tennessee, northwestern Georgia, and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 4.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1155, 1156. In Knoxville area, overlies Farragut limestone. Name proposed to replace "Holston" marble.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 29, geol. map. Formation in northwestern Georgia is predominantly a coarse-grained ferruginous sandstone with some shale and, in places, a conglomerate at base. Occurs as single narrow belt along extreme northeastern edge of Paleozoic area, extending southwestward a distance of

about 8 miles from Tennessee-Georgia line to within 4 miles north of Eton, Murray County. Thickness about 500 feet. Blount group.

John Rodgers, 1952, Geology of the Athens quadrangle, Tennessee (1:24,000): U.S. Geol. Survey Geol. Quad. Map. The red quartzose limestone overlying the Athens has hitherto been called Tellico sandstone, but typical Tellico on Tellico River has quite different lithologic character and is probably of different age. Also, the red quartzose limestone that is usually called Tellico sandstone is associated with and grades laterally into red quartz-free limestone or "marble," and the two together form a mappable unit that seemingly is equivalent to typical Holston limestone.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 69, 73, 75, 77, 78, 79, 80. In belt between Saltville fault and Knoxville and Rocky Valley faults, rocks that Keith and others have mapped as Tellico sandstone are included in Holston formation. On basis of this correlation, in belts southeast of Chestuee and Dumplin Valley faults and of Saltville fault northeast of Morristown, the typical Tellico sandstone of Keith occurs within the Athens shale and becomes the Tellico sandstone member of the Athens shale.

B. N. Cooper, 1953, Geol. Soc. America Mem. 55, p. 3 (fig. 1), 4. Discussion of trilobites of Appalachian Valley. Tellico sandstone is ferruginous clastic facies which is time equivalent of beds identified elsewhere as Athens, Sevier, or Ottosee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 145 (table), 154–155, pl. 28. Term Tellico formation is applied in this report [Tellico-Sevier belt, eastern Tennessee] to a sequence of gray silty, sandy calcareous shale and calcareous sandstone 2,700 to 4,500 feet thick. Dominant rock is shale in which sandstone forms lenticular units. In general, sandstone units are concentrated near middle of formation, and it is to this part that Keith originally applied term Tellico sandstone. Formation as used in present report includes rocks above and below those originally included in term by Keith. As herein defined, it includes upper part of Athens formation, the Tellico formation, and that part of the Sevier formation beneath the "sandstone lentil" of the Knoxville and Loudon folios. Overlies Blockhouse shale (new) with contact gradational; conformably underlies Chota formation (new). Middle Ordovician. Classification used in this report differs from that used by Rodgers (1953).

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 93–94. In its type belt, the Tellico overlies shales (Blockhouse) with graptolites that are partly equivalent to Athens formation and is overlain by shales and sandstones (Sevier) of uncertain correlation. In belts passing through Friendsville and Knoxville, the sands and calcarenites mistaken for Tellico overlie "Holston" marble (equivalent to Red Knobs) and are overlain by Sevier formation. In this belt, "Tellico" fossils are clearly related to those of Arline formation (new) and possibly fossils occurring as high as Benbolt. Probable that type Tellico is actually older than that of belts north of Athens. Entire interval of shales and sandstones from the Knox to base of Sevier formation is equivalent on basis of fossils to interval from top of Knox through the "Tellico"-Red Knobs of belts south of Knoxville.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 57. Term Blount group discarded.

J. M. Cattermole, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–76. In Shooks Gap and Bearden quadrangles, Tennessee, strata previously mapped as Tellico are named Chapman Ridge sandstone.

Named for exposures in cut on Tellico River, Monroe County, Tenn.

Tellowa Formation (in Pottsville Group)[1]

Pennsylvanian: Southwestern Virginia and southern West Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Type locality not stated.

Telluride Conglomerate[1] or Formation

Oligocene(?): Southwestern Colorado.

Original reference: W. Cross, 1901, U.S. Geol. Survey Bull. 182, p. 29–39.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 14, 60, pl. 1. Predominantly coarse conglomerate containing pebbles and boulders of schist, granite, quartzite, limestone, and other rocks derived from Paleozoic sediments; local bodies of sandy limestone. As much as 1,000 feet thick. Unconformably overlies Cretaceous and older rocks and, locally, glacial till; underlies San Juan tuff. Contains no determinable fossils; age judged by relations to other formations. Believed to be nearly same age as Blanco Basin formation which is tentatively placed in Oligocene.

F. B. Van Houten, 1957, Geol. Soc. America Bull., v. 68, no. 3, p. 386, 387 (table 1), 388. There is no good evidence for assigning Telluride and apparently equivalent Blanco Basin formations an Oligocene(?) age. They are more probably arkosic border facies of upper Paleocene and lower Eocene San Jose (Wasatch formation).

Named for exposures about town of Telluride and throughout Telluride quadrangle.

Temblor Formation[1] or Sandstone

Temblor Group or Stage

Miocene, lower and middle: Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 168–187.

R. Anderson and R. W. Pack, 1915, U.S. Geol. Survey Bull. 603. Includes Big Blue serpentinous member (new).

J. E. Eaton, U. S. Grant, and H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 196 (fig. 1), 204–205 (fig. 3), 212–213, 217 (fig. 4), 224–230. Discussion of Miocene of Caliente Range and environs. Marine Miocene is a transgressive series, essentially conformable basinward, but revealing, strandward, the occurrence of two oscillations which respectively inaugurate and divide its upper third. It comprises three nearly equal divisions, Vaqueros, Temblor, and Monterey stages, which approximate lower, middle, and upper Miocene. Each of these has more or less distinctive epeiorgenic history, fauna, and average physical aspect. At Caliente Mountain, a homoclinal section exposes about 1,100 feet of upper Oligocene(?), 4,500 feet of Vaqueros, 4,700 feet of Temblor, and 4,600 feet of Monterey strata.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 213–215, 226 (fig. 5). Temblor group, in San Benito quadrangle, is represented by three mappable units: lower sandstone, 100 to 500 feet thick; shale in middle of section, 300 to 1,000 feet thick; and upper sandstone, 400 feet thick. They are exposed along axis of Butts Ranch syncline and are youngest rocks affected by the folding. Disconformably overlies Kreyenhagen shale. Middle Miocene.

A. M. Keen, 1943, San Diego Soc. Nat. History Trans., v. 10, no. 2, p. 25–60. Correlation chart of Kern River area shows Temblor comprises (ascending) Pyramid Hill sand, Freeman-Jewett silts, Olcese sand, and Round Mountain silt members. Principal cartographic unit in area is Round Mountain silt member; less widespread are Olcese sand and the Freeman-Jewett silt. Additional members of Temblor underlie the area but outcrop beyond borders of map.

M. D. Crittenden, Jr., 1951, California Div. Mines Bull. 157, p. 22 (fig. 4), 35–36, pl. 1. In San Jose-Mount Hamilton quadrangle, formation is 500 to 1,000 feet thick; continuous section not measured. Conformably overlies Franciscan and grades upward into Monterey shale; underlies Briones. Formation is limited on west by fault of the Calaveras system.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 7–11, pl. 1. Formation, in Bitterwater Creek area, Kern County, comprises (ascending) Agua sandstone, Santos undifferentiated, upper Santos shale, Carneros sandstone, and Media shale members, and unit termed "Button bed." Thickness as much as 5,350 feet. Overlies Point of Rocks formation; underlies Monterey shale. Lower and middle Miocene.

H. P. Smith, 1956, California Univ. Pubs. Geol. Sci., v. 32, no. 2, p. 68 (fig. 2), 71–72, geol. map. In Devils Den district, overlies Wagonwheel formation.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2986, 2989. Upper 900 feet of unit herein named Painted Rock sandstone member of Vaqueros formation was included by Eaton and others (1941) in their Temblor. Saltos shale member (new) of Monterey was mapped by Eaton and others as upper part of Temblor.

Named for exposures on Temblor Ranch, McKittrick district, Kern County.

Temecula Arkose

Pleistocene: Southern California.

J. F. Mann, Jr., 1955, California Div. Mines Spec. Rept. 43, p. 3, 9, 11–13, pl. 1. White to buff to greenish arkose, buff soil zone, brown silts, silicified algal marls, white tuff; about 600 feet thick. Underlies Pauba formation (new) with angular unconformity; overlies sediments tentatively considered as Paleocene.

Widely distributed in Elsinore fault zone in western Riverside and northern San Diego Counties. Named for exposures on Pechanga Indian Reservation, southeast of Temecula, Riverside County.

Temescal Formation[1]

Pleistocene: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

D. H. Radbruch, 1957, U.S. Geol. Survey Misc. Geol. Inv. Map I–239. Clayey gravel, silty sandy clay, and sand-clay-silt mixtures. Pale yellowish orange to dark yellowish orange. Thickness 5 to 60 feet. Grades laterally into Merritt sand; overlies Alameda formation. Pleistocene.

Named for development along Temescal Creek, Alameda County.

Temescal Porphyry[1]

Upper Jurassic(?): Southern California.

Original reference: P. H. Dudley, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 223.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 528. Name replaced by Temescal Wash dacite porphyry.

Occurs between towns of Riverside, San Jacinto, Corona, and Elsinore, Riverside County.

Temescal Wash Quartz Latite Porphyry

Temescal Wash Dacite Porphyry

Jurassic(?): Southern California.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 4, p. 528. Referred to as Temescal Wash dacite porphyry. Dark-colored rock with plagioclase and quartz phenocrysts and inconspicuous biotite or hornblende. Replaces name Temescal dacite porphyry (Dudley, 1936).

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 36–38, pl. 1. Described as Temescal Wash quartz latite porphyry. Considered older than Woodson Mountain granodiorite. Relation to San Marcos gabbro not positively determined.

Exposed over wide area a few miles southeast of Puente Hills, southeast of Los Angeles.

Tempa Schist

Age not stated: Western North Carolina.

C. E. Hunter and P. W. Mattocks, 1936, Tennessee Valley Auth. Div. Geology Bull. 4, p. 13. Composed of muscovite, quartz, biotite, chlorite, and sometimes feldspar. Cut by hornblende intrusions which are very likely same age as gabbro from which Roan gneiss was derived.

Crops out on Tempa Mountain just east of Spruce Pine, Mitchell County. This mass has a width of a little over 1 mile and a length of 4 miles.

Temperance River Group[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 143–146, pl. 14.

Occurs along Temperance River.

Temperance River member[1]

Precambrian (Keweenawan): Northeastern Minnesota.

Original reference: A. H. Elftman, 1898, Am. Geologist, v. 21, p. 90–109, 175–188.

†Temple Bar Conglomerate[1]

Pleistocene, lower: Northwestern Arizona.

Original reference: W. T. Lee, 1908, U.S. Geol. Survey Bull. 352, p. 17.

C. R. Longwell, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1443. Term is confusing and should be abandoned because it was applied by Lee to deposits of widely different lithology and origin.

G. S. Lasky and B. N. Webber, 1949, U.S. Geol. Survey Bull. 961, p. 38. Name apparently applied to most of deformed valley deposits of northwestern Arizona which are now included in Sandtrap conglomerate (new), Chapin Wash formation (new), and Artillery formation (new).

Typically exposed near mouth of Virgin River at Temple Bar, northwest corner of Mohave County.

Temple Butte Limestone[1]

Upper(?) Devonian: Northern Arizona.

Original reference: C. D. Walcott, 1889, Geol. Soc. America Bull., v. 1, p. 50.

R. H. Denison, 1951, Fieldiana: Geology, v. 11, no. 5, p. 254. In Upper Devonian (Chemung stage).

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Included in stratigraphic section of rocks in northwestern and central Arizona. Upper(?) Devonian.

Named for Temple Butte, 3 miles south of junction of Little Colorado River with Colorado River.

Temple Cap Member (of Navajo Sandstone)

Jurassic: Southwestern Utah.

R. K. Grater, 1948, Am. Jour. Sci., v. 246, no. 5, p. 312, 313. Sandstone composed of crossbedded, red, tan, or yellowish deposits. Uppermost part of Navajo; overlies several hundred feet of white crossbedded sandstone.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 89, pl. 5. Upper part of member is cliff-forming sandstone, generally massive and strongly crossbedded but in places obscurely or definitely separated into layers 5 to 20 feet thick, most of them crossbedded. Lower part is miscellaneous assemblage of irregularly bedded shaly calcareous sandstones, siliceous limestones, and limestone conglomerates colored red, gray, or brown. Entire member not everywhere present and Carmel formation lies directly on central massive Navajo bed. Along Zion-Carmel highway, upper part, 70 to 180 feet thick, is intricately crossbedded mass divisible into thick beds, and lower part, 6 to 30 feet thick, a series of lenticular sandstones; east of Kanab Canyon upper division becomes thinner, less massive, and more varied in composition and lower part becomes thicker and more calcareous; from Hurricane Cliffs westward into Santa Clara Valley entire member is represented by yellow-gray sandy shale. Some fluvial and eolian beds here treated as Temple Cap have been assigned to Carmel formation by some workers. Jurassic(?). Derivation of name given.

U.S. Geological Survey currently designates the age of the Temple Cap Member as Jurassic on the basis of a study now in progress.

Unit forms an entablature for East Temple, West Temple, and similar lofty structures in Zion Park and vicinity.

Temple Lake Stade, Till

Temple Lake glacial stage

Recent: Rocky Mountain Region.

J. H. Moss, 1951, Early man in the Eden Valley: Philadelphia, Pa., Univ. Pennsylvania, Univ. Mus., p. 56–62. Name Temple Lake moraine is applied to moraine and associated outwash plain that dam Lower Temple Lake on north. The advance to the moraine is named Temple Lake readvance.

J. H. Moss, 1951, Am. Jour. Sci., v. 249, no. 12, p. 865–883. Discussion of late glacial advances in southern Wind River Mountains, Wyo. Temple Lake substage has an antiquity intermediate between late Pinedale and the present. If Pinedale is equivalent to Mankato (Wisconsin 3) relative weathering characteristics would indicate that Temple Lake advance occurred just before or soon after climatic optimum.

G. M. Richmond, 1953, Friends of the Pleistocene Rocky Mountain Section. [Guidebook] 2d Ann. Field Trip Oct. 4–5, correlation chart. In proposed time-stratigraphic standard for Rocky Mountain region, Recent epoch comprises (ascending) Castle Valley (new), Temple Lake, Spanish Valley (new), and Gannett Peak (new) stages.

G. M. Richmond, 1957, Internat. Assoc. for Quaternary Research, 5th Cong., Madrid. Two stages of Recent glaciation recognized in Rocky Mountain region: early Recent stage, Temple Lake; and late Recent stage, Gannett Peak. The Temple Lake (radiocarbon age 2800 200 years B. P.) is represented by cirque moraines, locally by two, that support scrub spruce on tundra and have thin azonal soil.

Temple Mountain Andesite

[Eocene or younger]: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. At least two separate feeders for the extrusive andesites are recognized within area. In feeders, porphyritic andesite predominates; in extrusive andesites, breccias and amygdaloids predominate, with lahars common near base. Propylitization of andesites is due to endomorphism, not regional hydrothermal metamorphism. Underlies large body of quartz latite breccia, which possibly is extrusive phase of Grotto batholith. These andesites in part overlie the Swauk with angular unconformity, and in part intrude Swauk and Tonga (new) formations.

In eastern part of Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Temple Mountain Member (of Chinle Formation)

Upper Triassic: Southeastern Utah.

R. C. Robeck, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 10, p. 2499–2506. Consists of siltstone, mudstone, and sandstone; siltstone commonly light gray to some shade of mottled or banded purple and white; locally, layers of mudstone or lenses of sandstone impart bedding effect to siltstone; mudstone is purplish red, or mottled purple and white; sandstones light gray with tendency to weather light brown. Composition of member varies within area and lithologic types interfinger. In southwest, consists mostly of purple and white mudstone with lenses and layers of jasper; toward central part, siltstone ledges and sandstone lenses more abundant; at the north end, consists of alternating beds of siltstone, mudstone, and numerous sandstone channels and lenses which may be present at any interval in member. Thickness at type section 33 feet; elsewhere ranges from 5 to 101 feet. Unconformably underlies Moss

Back member; unconformably overlies Moenkopi formation, contact difficult to determine in places.

J. H. Stewart, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 3, p. 446–449; J. H. Stewart and others, 1959, U.S. Geol. Survey Bull. 1046–Q, p. 501–504. Some strata outside San Rafael Swell may be correlated with Temple Mountain member, but these correlations are questionable, and it seems best at present to restrict member to the Swell. Locally strata similar to Temple Mountain underlies Shinarump member, suggesting that Temple Mountain member may be oldest member of Chinle.

Type section: Northeast side of South Temple Mountain at lat 38°41′04″, long 110°40′20″, on southeast flank of San Rafael Swell, Emery County.

Temples Peak Flows (of Chico Phonolites)

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1036. Bright- to gray-green porphyritic phonolite with white orthoclase phenocrysts and abundant aegirine. Topography of flows is gently rolling with sharp canyons; boundaries lobate in plan, and rise as abrupt rounded hill forms with many reentrants. Upper surface covered with thin soil and tetrahedral joint blocks.

West rim of J. T. Rincon sec. 11, T. 26 N., R. 26 E., Colfax County, and flow area 3 miles north and west.

Temples Peak Formation

[Triassic or older]: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1035. Coarse white quartz-pebble conglomerate of an allover cream to buff color which weathers brown to dark brown. Strongly lithified and locally jointed into large blocks. Total exposed thickness of 19 feet, including 2 feet or less of an underlying gray-brown sandstone member whose base is covered. Underlies Dockum conglomerate horizontally.

Type locality: In bottom of the J. T. Rincon or bowl at east base of Temples Peak, Colfax County. The only other exposure of formation is in upturned sediments on east flank of Palo Blanco, Colfax County.

Templeton Member (of Woodbine Formation)

Upper Cretaceous: Northeastern Texas.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Defined to include fossiliferous sedimentary rocks that lie between beds of Lewisville member and flags which mark base of typical Eagle Ford shale. Consists largely of smooth gray shale with lenses of glauconitic gray and tan soft sand. Thickness 70 to 80 feet.

Type locality: In pasture and in series of bluffs along Templeton Branch on A. P. Templeton property a short distance north and east of Highway 69 underpass of Texas and Pacific Railroad at Bells, Grayson County.

Tenderfoot Member (of Moenkopi Formation)

Triassic(?): Southwestern Colorado and southeastern Utah.

E. M. Shoemaker and W. L. Newman, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1814, 1843–1845. Dominantly muddy or silty poorly sorted sandstone. Commonly at base, generally directly overlying Cutler formation, is sequence of beds up to 20 feet thick composed of weathered coarse arkosic detritus which is locally overlain by gypsum as much as 7 feet thick; next is unit of brick-red or orange- to dark-brown

poorly sorted sandy mudstone to silty sandstone, which at most places makes up more than 80 percent of member; at most localities, this unit is succeeded by sequence of distinctly bedded sandstone. Thickness ranges from featheredge to 290 feet. In vicinity of Gateway, Colo., thins toward Uncompahgre Plateau; thinning due to overlap of basal beds and to truncation of top of member by overlying Chinle formation; locally cut out over salt intrusions by angular unconformity at base of overlying Ali Baba member (new) in Sinbad and Paradox Valleys, Colo., and probably in Fisher Valley, Utah. Locally overlies Paradox member of Hermosa formation.

J. H. Stewart, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1858. Correlated with Hoskinnini herein reallocated to member status in Moenkopi.

Type section: East side Sinbad Valley, sec. 15, T. 49 N., R. 19 W., Mesa County, Colo. Named for Tenderfoot Mesa, where it constitutes whole of formation on north side of mesa.

Tenley Formation[1]

Pliocene(?): District of Columbia.

Original reference: C. K. Wentworth, 1930, Virginia Geol. Survey Bull. 32, p. 37.

Named for exposures at Tenleytown.

Tenmile Granite[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

Named for Tenmile Creek, which enters Animas River, southeast of Snowdon Peak.

Tenmile Gravel

Pleistocene, lower: Southwestern Idaho.

C. N. Savage, 1958, Idaho Bur. Mines and Geology County Rept. 3, p. 20 (table 1), 26, 38–39, 48, figs. 3, 4. Characteristically, a torrential deposit of well-rounded to subangular crystalline rock. Silt, sand, gravel, and cobbles, nonconsolidated to poorly consolidated. Some caliche. Fluviatile, crossbedded, channeled, and stratified. Thickness about 500 feet. Underlies intermediate Snake River eruptives and overlies Idaho formation with unconformable contacts.

In Boise Valley, Ada and Canyon Counties.

Tenmile Limestone (in Greene Formation)[1]

Permian: Southwestern Pennsylvania.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 97, 105.

In Washington and Greene Counties.

†Tenmile Sands[1]

Pleistocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20.

Named for exposures at Ten Mile Hill, on Charleston-Lanes Railway (A. C. L. Railroad) and at Ten Mile Hill, on Charleston-Branchville Railway (S. C. Railroad), Charleston County.

Tenmile Creek Dolomite

Middle Devonian: Northwestern Ohio.

G. A. Stewart, 1938, Geol. Soc. America Spec. Paper 8, p. 6, 7, 13. Three distinct lithologic units recognized in interval between Columbus limestone and Ohio shale. Name Tenmile Creek dolomite proposed for upper division. Fossiliferous. Thickness about 40 feet. Overlies Silica shale. Lower part may be time equivalent of Prouty limestone in north-central Ohio. Name credited to J. E. Carman (unpub. ms.). Name Traverse has been applied to interval between Columbus limestone and Ohio shale.

K. V. Hoover, 1960, Ohio Geol. Inf. Circ. 27, p. 8–15. Stratigraphic position and correlation of Olentangy shale discussed. It is here suggested that Olentangy, Plum Brook shale, Prout limestone, Silica shale, and Ten Mile Creek dolomite are stratigraphically correlatable, with the reservation that the Olentangy is probably Upper Devonian. Ten Mile Creek, which overlies Silica formation in northwestern Ohio, shows faunal affinity with Prout limestone of northern Ohio. Field relationships between limestone beds of Silica formation and Ten Mile Creek dolomite are similar. Both are bluish gray, argillaceous to crystalline, and thin to massive bedded. Regional information regarding thickness of Plum Brook shale-Prout limestone or Silica formation-Ten Mile Creek dolomite has not been worked out. Combined thickness of Silica formation and Ten Mile Creek dolomite has been reported in Lucas County exposures.

Tenmile Creek (also Ten Mile Creek) is just south of Silica, Lucas County.

Tenmile Creek Formation (in Stanley Group)

Pennsylvanian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856, 864–870. Proposed for lowermost formation in group. Consists of alternating sandstones and shales; aggregate thickness 5,650 feet. Basal part overlapped to south by Cretaceous Trinity sandstone; underlies Moyers formation (new). Pushmataha series (new).

R. M. Becker, chm., 1954, Ardmore Geol. Soc. [Guidebook] Field Trip Oct. 1954, chart facing p. 1. Shown on chart as Mississippian (Meramecian); overlies Albion formation.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 25 (table 2), 29–36, pls. Includes Tuskahoma siliceous shale bed (member).

O. B. Shelburne, Jr., 1960, Oklahoma Geol. Survey Bull. 88, p. 16–19, pl. 1. In this report [Boktukola syncline], formation is mapped in two units: lower part of Tenmile Creek formation and upper part of Tenmile Creek formation. The units are separated by Battiest chert member (new). Thickness more than 7,600 feet. Underlies Moyers formation.

Type section: Three miles east of Miller, T. 3 S., R. 15 E., Pushmataha County. Name derived from Tenmile Creek at south end of Tuskahoma syncline.

Tenmile River Beds[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 164–173.

Occurs in Tenmile River, Mass.

†Tennessee Sandstone[1]

Pennsylvanian: Western Arkansas.

Original reference: A. J. Collier, 1907, U.S. Geol. Survey Bull. 326, p. 19.

Typically exposed in Tennessee Ridge, Sebastian County.

Tennesseean Series

†Tennesseean System[1]

Mississippian: Eastern United States.

Original reference: E. O. Ulrich, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24 (table).

R. C. Moore, 1948, Jour. Geology, v. 56, no. 4, p. 1. Upper Mississippian formations, which are classed as belonging to Meramecian and Chesterian parts of the American succession, collectively named "Tennesseean series," are judged on paleontological grounds to represent Visean and Namurian deposits of European continent.

Tennessee River Gravels[1]

Pleistocene: Western Kentucky.

Original reference: R. H. Loughridge, 1888, Kentucky Geol. Survey Rept. Jackson's Purchase region.

Probably named for exposures along Tennessee River.

†Tennessee River Group[1]

See Harpeth and Tennessee River Group.

Tenney Canyon Tongue (of Kayenta Formation)

Upper Triassic(?): Northeastern Arizona and southeastern Utah.

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2522. Name applied to rocks in Kanab area that were classified by Gregory (1950) as Kayenta formation. Consists of very thin bedded to laminated pale-reddish-brown siltstone, mudstone, and very fine grained sandstone considered to be of fluvial origin. Contacts of unit with overlying Navajo sandstone and underlying Lamb Point tongue (new) of Navajo are sharp and even, marked by pronounced change in color, lithologic character, and crossbedding. Thickness 120 feet in Kanab Canyon; thins eastward from Kanab and pinches out between units of Navajo west of Paria; southwest of Kanab, tongue thickens gradually to 172 feet at Moki Mountain and 220 feet near Moccasin, Ariz.; west of Sevier fault coalesces with main body of Kayenta. Name credited to R. F. Wilson (in press).

J. S. Detterman, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–137. Mapped in Tenney Canyon, where it overlies Lamb Point tongue of Navajo sandstone.

U.S. Geological Survey currently designates the age of the Tenney Canyon Tongue as Upper Triassic(?). This designation made on the basis of recent studies of the Kayenta.

Name applied to rocks in Kanab area, Utah. Tenney Canyon, a side canyon to Kanab Canyon, is approximately 3 miles north of Kanab, Kane County, Utah.

Tennison Creek Shale[1]

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 90, 97.

Named for Tennison Creek, in western part of Bourbon County.

Ten Rod Granite Gneiss

Mississippian(?) or older: Southern Rhode Island.

G. E. Moore, Jr., 1958, U.S. Geol. Survey Geol. Quad. Map GQ–105. Pinkish- to medium-gray, fine- to medium grained porphyritic granite gneiss, with strong lineation and moderate foliation in most places. Phenocrysts of salmon-colored potash feldspar average about 30 mm long and constitute as much as 15 percent of rock. Flattened rod-shaped aggregates of quartz and streaks of thin elongate lenses of biotite locally present. Cuts Scituate granite gneiss. Devonian(?) or older. Has been included in Sterling gneiss by early workers.

U.S. Geological Survey currently designates the age of the Ten Rod Granite Gneiss as Mississippian(?) or older on the basis of a study now in progress.

Typically exposed in roadcut on Ten Rod Road, 0.85 mile west of Millville, Hope Valley quadrangle. Exposed in discontinuous belt of varying width that extends northwesterly across quadrangle from vicinity of Richmond School on southern boundary of quadrangle and in small bodies elsewhere in quadrangle.

Tensleep Sandstone[1]

Tensleep Formation

Tensleep Sandstone (in Montchauve Group)

Pennsylvanian and Lower Permian: Wyoming and Montana.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 394–401.

C. C. Branson, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1199–1226. Tensleep sandstone of Darton is only locally recognizable as lithologic unit in central Wyoming and is not true stratigraphic unit. No boundary can be drawn to separate it from Amsden formation, and fauna of upper part of Amsden is indistinguishable from that of Tensleep sandstone. Name Tensleep is here retained as name of formation which includes entire Pennsylvanian sequence in central Wyoming; that is, Tensleep sandstone of Darton, the upper part of the Amsden, and some unnamed beds above Tensleep sandstone. Marine fossils indicate Des Moines age for entire formation. Measured sections show thickness varies from 180 to 535 feet. Underlies Phosphoria or Chugwater formation; overlies Sacajawea formation; in some areas, separated from the Sacajawea by unnamed limestone interval referred to as beds of Chester(?) age.

D. C. Skeels, 1939, Jour. Geology, v. 47, no. 8, p. 817 (table 1). Discussion of structural geology of Trail Creek-Canyon Mountain area, Montana. Table 1 lists Tensleep formation, 150 feet thick, above Amsden formation and below Ellis formation. Pennsylvanian.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3 [revised 1950]. Discussion of correlation of formations of Laramie Range, Hartville uplift, Black Hills, and western Nebraska. Tensleep (Darton, 1904) is herein recognized as sandstone facies of Cassa group (new), but some geologists use term at its type locality to include also sandy beds of Embar age or older.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 126 (fig. 2), 131–132. Discussion of Wind River Mountain area. Tensleep formation, 398 to 535 feet thick, overlies Sacajawea formation and disconformably underlies the Phosphoria. Tensleep, as herein defined, includes upper part of Amsden formation of Darton and that name is dropped. On Bull Lake Creek, 60 feet of laminated limestone without fossils lies with irregular contact on the Sacajawea and is overlain disconformably by Tensleep formation. This sequence of laminated limestones may constitute another formation, possibly of Chester age.

Helen Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1539 (table), 1558–1559. Tensleep formation described in Teton County, Wyo., where it is about 300 feet thick; overlies Amsden formation and underlies Phosphoria formation. Name Wells formation has been applied to Tensleep rocks in this part of Wyoming, but Wells formation probably includes not only beds equivalent to Tensleep but also younger Pennsylvanian rocks.

H. D. Thomas, 1948, Wyoming Geol. Assoc. Guidebook 3d Ann. Field Conf., p. 87, 88–89. Branson described Sacajawea formation, classed it as Ste. Genevieve, and carried name Tensleep down to base of sandstone he described (1939) as resting with marked disconformity on thin limestone he thought might be of Chester age. Now seems clear that Branson's type Sacajawea lies below Darwin sandstone and that his basal "Tensleep" sandstone, which he described as resting disconformably on older beds, is actually Darwin sandstone. Distinctive Tensleep sandstone can be recognized everywhere around Wind River basin. Lithologically it is massive crossbedded tan sandstone which in places may be pinkish or white. Locally, thin limestones, dolomites, or cherty layers are intercalated. Thickness commonly 300 to 400 feet. In Casper Mountain-Alcova area, at southeastern end of Wind River basin, name Casper has been used for Pennsylvanian rocks. Here the Casper is 400 to 500 feet thick and is therefore comparable to combined thickness of Amsden and Tensleep to west. Many geologists have divided the section into Amsden and Tensleep. Upper part of Casper is thick tan crossbedded sandstone which resembles Tensleep of areas to west, and has been called Tensleep by some geologists. However, entire Casper of this area seems completely younger than any part of Tensleep. Puzzling factor is that Tensleep sandstone of Wind River area is continuous with, and lithologically similar to, the "Tensleep" sandstone of Casper area, as proved by surface and subsurface data. Tensleep sandstone seems to be major lithologic facies which persists as a unit but which crosses time lines and becomes progressively younger to eastward.

R. S. Agatston, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 521–528. Tensleep sandstone was named by Darton (1904) and described as series of crossbedded sandstones underlying Permian red shales and limestones. Recommended herein that Tensleep be given formation status, that Darton's upper limit be retained, but that base be defined as

top of massive generally cherty carbonate rocks of Amsden formation. Formation is composed of white, tan, and pink, fine- to medium-grained crossbedded massive sandstone with dolomite, limestone, and some shale and anhydrite beds. Throughout a large part of the research area, Amsden and Tensleep contact is sharp, and the two formations are conformable. Minor unconformities present locally. North of Tensleep is a related condition of alternating sandstone, shale, dolomite, and anhydrite beds at base of Tensleep, indicating instability in that area at that time. Tensleep or equivalent beds distributed throughout Big Horn basin, Big Horn Mountains, Powder River basin, Wind River basin and Mountains, Hartville uplift, and Black Hills. Lower Desmoinesian.

L. W. Henbest, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 58–63. Biostratigraphic range from latest part of "*Fusulinella*" zone (probably late Atoka age) through *Wedekindellina euthysepta*-zone (most of early half of Des Moines age) is indicated for beds in Tensleep formation in which collections were made. Information from unpublished dissertations as cited by Love (1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf.) reports discovery of *Triticites* in upper part of Tensleep in Jackson area. Illustrations have not been published, and determinations have not been verified in print. Some of the collections described in present report were found in chert nodules. Age determinations were of necessity based entirely on content of the nodules. Problem of possible redeposition in rocks of later age should be considered in future collecting from Amsden and Tensleep formations.

C. A. Burk and H. D. Thomas, 1956, Wyoming Geol. Survey Rept. Inv. 6, p. 10. Goose Egg formation (new) rests unconformably on Pennsylvanian or early Permian strata of the Tensleep, Casper, Hartville, or Minnelusa formations throughout Wyoming.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 23–25. Sandstone described in Buffalo-Lake De Smet area, Wyoming, where it is 280 feet thick. Overlies Amsden formation; separated from overlying Chugwater formation by unnamed gypsum and red shale sequence 180 feet thick.

T. W. Todd, 1959, Dissert. Abs., v. 20, no. 6, p. 2230–2231. Lithologically defined Sacajawea, Amsden formation, and Tensleep sandstone are products of marine transgressive-regressive cycle that took place on Wyoming cratonic shelf during Pennsylvanian period as one phase in development of eastern Cordilleran geosyncline. Name Montchauve group is suggested in recognition of natural unit of these formations.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Discussion of regional stratigraphy of Pennsylvanian system in northeastern Utah, western Wyoming, northwestern Colorado, and southeastern Idaho. Suggested that Quadrant and Casper formational names be abandoned and Tensleep-Amsden-Sacajawea terminology be extended to include strata formerly referred to by these names.

Named for exposures in walls of lower canyon of Tensleep Creek, Washakie County, Wyo.

Tepee zone[1] (in Pierre Shale or Formation)

Cretaceous: Colorado.

[Original reference]: G. K. Gilbert, 1897, U.S. Geol. Survey Geol. Atlas, Folio 36.

M. O. Griffitts, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 12, p. 2020. Pierre formation subdivided into four zones (ascending): Sharon

Springs shale zone, Rusty zone, Hygiene zone, and Transition zone. These zone terms are recognized and used as formal stratigraphic names in present paper. Many geologists have noted a Tepee zone in eastern Colorado. Tepee zone should be correlated with Rocky Ridge member of Hygiene zone of northern Colorado.

Tepee Creek Formation

Permian: Southwestern Oklahoma.

C. A. Merritt and W. E. Ham, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 287, 290–299. Name applied to formation composed principally of zeolites and opal with variable amounts of dolomite and calcite; appears to be stratified. Maximum thickness 47 feet. Rests with erosional unconformity on anorthosite. Intruded by several small granite dikes of Precambrian age.

G. W. Chase, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2028, 2034. Name Tepee Creek dropped from formal nomenclature. Replaced by Post Oak conglomerate member of Wichita formation.

W. E. Ham, C. A. Merritt, and E. A. Frederickson, 1957, Panhandle Geol. Soc. [Guidebook] May 2, 3, 4, p. 26–28. As now used, term Tepee Creek is applied to zeolite-opal sediments that were deposited as anorthosite conglomerates and sandstones unconformably on basic igneous rocks in central part of Wichita Mountain region. Their age can no longer be accepted as Precambrian. Instead these sediments probably are coarse-clastic shoreward facies of shales in Wichita formation of lower Permian age. Type locality stated.

Type locality: SW¼SW¼ sec. 6, T. 4 N., R. 18 W., Kiowa County. Occurs as four scattered outcrops in interior part of Wichita Mountains. Named for exposures near junction of Tepee Creek and North Fork of Red River.

Tepee Trail Formation

Eocene, upper: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 10, 11 (fig. 2), 73–79, pls. 13, 17. Proposed for upper Eocene sequence unconformably overlying Aycross formation (new) and all older rocks and, in turn, unconformably overlain by Oligocene(?) rocks. Chiefly green and olive-drab basic andesite volcanic conglomerates; tuffs, flows, and thin carbonaceous beds. Thickness 2,000 feet. In most localities, beds are gently folded. Unconformably underlies Wiggins formation (new).

H. A. Tourtelot, 1957, Smithsonian Misc. Colln., v. 134, pt. 1, no. 4, p. 5–19. Described in northeastern Wind River basin where it forms belt of outcrop along south side of Owl Creek and Big Horn Mountains. Southern boundary of belt is marked by normal fault along which Tepee Trail has been dropped down against Wind River formation. Consists of sequence of green, brown, and gray strata rich in volcanic material of andesitic composition. Sequence divided into a lower unit referred to green and brown member and upper unit named Hendry Ranch member. Maximum thickness not determinable because formation overlaps on topography of mountains and base is not exposed; thickness composite section about 700 feet. Top of formation is everywhere an erosional surface. Middle(?) and upper Eocene.

Type section: Slopes and cliffs on eastern side of East Fork River, directly opposite Castle Rock. Name derived from Tepee Trail which crosses East

Fork Creek divide midway between Castle Rock and Steamboat Rock, descends Boulder Creek, and joins East Fork Ranger Trail at junction of Boulder Creek with East Fork River. Type section is just east of junction of the two trails. Area is southern margin of Absaroka Range.

Tequepis Sandstone[1]

Miocene: Southern California.

Original reference: R. N. Nelson, 1924, Geol. Soc. America Bull., v. 35, p. 166–167.

Occurs on north side of Santa Ynez River, one-half mile east of Redrock Canyon. Named for exposures on Tequepis Rancho.

Tererro Formation

Mississippian: Northern New Mexico.

E. H. Baltz and C. B. Read, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 11, p. 1754 (fig. 5), 1755 (figs. 6, 7), 1756 (fig. 8), 1759–1768, 1769–1773. Sequence of limestone breccia and conglomerate, crystalline limestone, and calcarenite. Thickness ranges from trace to 130 feet in southern part of Sangre de Cristo Mountains and from 6 to 48 feet farther south; thickness at type locality 118 feet. Comprises (ascending) Macho, Manuelitas, and Cowles members (all new). Overlies Espiritu Santo formation (new) with erosional unconformity; unconformably underlies Sandia formation. Sparse faunule found in Manuelitas member indicates Early Mississippian for that part of formation; Macho member is, in part, possibly as old as Devonian(?) and, in part, Early Mississippian; because of its unconformable relation to Manuelitas member, Cowles member may be of Late Mississippian age. Further studies must precede correlation, firm assignments of age, and adjustments in terminology of Tererro, Espiritu Santo, and Arroyo Penasco formations.

Type locality: On slope and slightly north of quarry designated as type locality for Espiritu Santo formation, west of Holy Ghost Creek at Tererro, San Miguel County.

Terlingua Clay[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 33–41.

R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 13–14, pl. 1. As mapped in Terlingua district, consists of about 1,000 feet of structureless clay and a few thin beds of impure limestone. Included are only the upper three-fourths of formation of Udden; lower three-fourths of formation is included in upper Boquillas as herein described. Likewise unit only includes upper half of what Adkins (1933, Texas Univ. Bull. 3232) called Terlingua formation (restricted) but includes in addition all of Adkins' Taylor formation. Overlies Boquillas flags; underlies Aguja formation.

Named for exposures along Terlingua Creek, Brewster County, in Terlingua quadrangle.

Terra Blanca Formation[1]

Quaternary: Texas.

Original reference: R. T. Hill, 1890, Am. Geologist, v. 5, p. 69.

In valley of Canadian River in Staked Plains. Terra Blanca is name used by Mexican inhabitants of valley.

Terra Cotta Clay Member (of Dakota Formation)

Terra Cotta Shale Member (of Ellsworth Formation)

Cretaceous: Central and southern Kansas.

R. C. Moore, 1935, Rock formations of Kansas, *in* Kansas Geol. Soc., Wichita: [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23.] Named on chart as lower member of Ellsworth formation. Underlies Rocktown sandstone. Overlies Mentor sandstone member of Belvidere formation.

Norman Plummer and J. F. Romary, 1942, Kansas Geol. Survey Bull. 41, pt. 9, p. 319, 329–336. Defined to include massive clay, silt, and sandstone comprising approximately lower two-thirds of Dakota formation; most conspicuous feature of member is widespread distribution of gray- and red-mottled massive clay. Thickness up to 170 feet. Underlies Janssen clay member, contact is not sharp but in most places can be drawn within 5-foot zone; in this report contact is arbitrarily placed at top of zone of concentrated concretionary siderite, limonite, or hematite, which is overlain by bed of gray massive clay containing varying amounts of siderite pellets and with yellow to yellow-orange coloring along oblique joints. Overlies Kiowa shale. Derivation of name given.

Entire section well exposed in school district of Terra Cotta, comprising part of T. 15 S., R. 6 W., in east-central part of Ellsworth County.

Terra Cotta Series[1]

Ordovician, Silurian, and Devonian(?): Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 156–157, 180.

Named for Terra Cotta Mountains.

Terra Loma Member (of Moreno Formation)

See Tierra Loma Shale Member (of Moreno Formation).

Terry Limestone (in Hinton Formation)[1]

Mississippian: Southern West Virginia.

Original reference: C. E. Krebs and D. D. Teets, Jr., 1916, West Virginia Geol. Survey Rept. Raleigh and western Mercer and Summers Counties, p. 69.

Occurs at Terry, Raleigh County.

Terry Sandstone Member (of Pierre Shale)[1]

Upper Cretaceous: Central northern Colorado.

Original reference: M. W. Ball, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, no. 1, p. 81–87.

G. R. Scott and W. A. Cobban, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf. Symposium, p. 128, 129 (fig. 3). Olive-gray massive fine-grained sandstone makes up member at type locality. Highly fossiliferous calcareous sandstone concretions 6 to 18 inches in diameter common. Thickness 10 to 20 feet. Separated from younger Rocky Ridge sandstone member by 511 to 604 feet of sandy and nonsandy shale; separated from older Hygiene sandstone member by as much as 387 feet of olive-gray sandy shale that locally includes Tepee-Butte limestone.

Named for exposures at Terry Lake 2 miles north of Fort Collins, Larimer County. Forms ridge between Terry Lake and Rocky Ridge Reservoir. North of Rocky Ridge extent of member not known.

Terry Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 295, 330.

Exposed in Mercer and Summers Counties, W. Va., and in Tazewell County, Va. Named for association with Terry limestone.

Tesla Formation

Eocene, middle: Central California.

A. S. Huey, 1937 (abs.) Geol. Soc. America Proc. 1936, p. 335. Incidental mention as formation of Eocene (Capay) age.

A. S. Huey, 1948, California Div. Mines Bull. 140, p. 16 (fig. 2), 33–38, pls. 1, 2, 3. Characterized by variety of sedimentary rocks including white quartz sand, buff sand, iron- and manganese-stained concretionary sand, dark carbonaceous shales, lignite seams, and white to light-blue clays. Maximum thickness about 2,000 feet near Tesla. East of Tesla, Corral Hollow fault cuts out about 700 feet of upper part of formation, and west of Tesla upper part of formation is progressively overlapped by Cierbo formation. Overlies Moreno Grande formation (new). Tesla, as mapped in this area, was called Tejon by Anderson and Pack (1915, U.S. Geol. Survey Bull. 603).

Typically and most completely exposed near former mining camp of Tesla, Tesla quadrangle, about 40 miles southeast of Berkeley.

Tesnus Formation[1]

Pennsylvanian: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 45.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 53). Shown on correlation chart as Upper Mississippian and Lower Pennsylvanian.

W. B. N. Berry and H. M. Nielsen, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 9, p. 2257–2258, 2259. Overlies Santiago formation (revived). At many places, the two units grade into each other without any apparent depositional break. Santiago formation of this report contains fauna interpreted to be Late Devonian.

Named for exposures around Tesnus, Brewster County.

Tessey Limestone[1]

Upper Permian (Ochoa Series): Western Texas.

Original reference: J. A. Udden, 1917, Texas Univ. Bull. 1753, p. 53.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 662–663, pl. 2. Tessey limestone, at top of Permian sequence in Glass Mountains, is an obscurely bedded, nondescript, dolomitic limestone about 1,000 feet thick, whose facies resembles that of beds laid down in back-reef area in northern Guadalupe Mountains. It may be at least in part the calcareous equivalent of some of the evaporites of Ochoa series farther north. Unconformable below Bissett conglomerate.

Named for post office once located about 2 miles north of mouth of Gilliam Canyon, Brewster County.

Tesuque Formation (in Santa Fe Group)

Miocene, middle(?) to Pliocene, lower: Central New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 148 (chart). On chart only. Contains Bishops Lodge member (new) near base. Age shown as Miocene and Pliocene.

Brewster Baldwin and F. E. Kottlowski, 1955, New Mexico Bur. Mines Mineral Resources Scenic Trips to the Geol. Past, no. 1, p. 20, 21, 24. Characterized by ledge-forming soft pinkish-tan sandstones. Thickness nearly 10,000 feet near Santa Fe. Underlies Ancha formation.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118–119. Included in Santa Fe group. Includes Bishops Lodge member at base. Puye gravel (Smith, 1938), Ancha formation, and Tuerto gravel all rest with angular unconformity on deformed beds of Tesuque formation.

Typical exposure in Sangre de Cristo Mountains, 10 miles north of Santa Fe.

Tete des Morts Member (of Edgewood Dolomite)

Lower Silurian: Northeastern Iowa.

C. E. Brown and J. W. Whitlow, 1960, U.S. Geol. Survey Bull. 1123–A, p. 39–40, pl. 3. Massive-bedded medium-grained finely porous grayish-orange to grayish-yellow glauconitic dolomite having fine white siliceous specks. Where member is thick, nodular bands of chert occur in 3-foot zone in middle. Thickness commonly 20 to 22 feet; thinner over areas of thick Maquoketa shale. Overlies Mosalem member (new); underlies Kankakee formation.

Named for many cliffs formed by these rocks along headwater drainage of Tete des Morts River in Jackson and Dubuque Counties.

Tetelna Volcanics[1]

Carboniferous: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 36, map.

Derivation of name not stated, and map shows no geographic feature of that name, but formation is mapped along Indian Creek, the Indian name of which is Tetelna.

†Teton Formation[1]

Permian and Triassic: Northwestern Wyoming.

Original reference: W. H. Weed, 1896, U.S. Geol. Survey Geol. Atlas, Folio 30.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2835. Report is summary description of Phosphoria, Park City, and Shedhorn formations; new nomenclature proposed; term Teton formation abandoned.

Named for Teton Range southwest of Yellowstone Park.

Tetro Limestone Member (of Deseret Formation)

Tetro Limestone[1]

Mississippian: Central northern Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Shown on correlation chart of recommended

revision of stratigraphic units of Great Basin. Occurs below Humbug limestone and above Gardner dolomite.

U.S. Geological Survey currently classifies the Tetro as a member of Deseret Formation on the basis of a study now in progress.

Probably named for Tetro mine, Tintic district.

Teutonia Quartz Monzonite

Upper Cretaceous or Tertiary, lower: California and Nevada.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 61–65, pl. 1. Proposed for several large bodies of intrusive rock that crop out in broad belt extending across [Ivanpah] quadrangle and exceeding 250 square miles in area.

Named for Teutonia Peak where it is typically exposed. South-central part Ivanpah quadrangle, San Bernardino County, Calif.

Teutonic Limestone[1]

Teutonic Limestone (in Hartmann Group)

Middle Cambrian: Central northern Utah.

Original reference: G. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 5 (fig. 2), 6. Described in East Tintic Mountains where it conformably overlies Ophir formation and conformably underlies Dagmar limestone. Thickness 375 to 425 feet. Type locality noted.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 13–16, 79. Described in Stansbury Mountains where it is 800 to 1,110 feet thick. Underlies Dagmar dolomite; overlies Condor formation of Ophir group.

J. K. Rigby, 1959, Utah Geol. Soc. Guidebook 14, p. 14 (table 1), 17–18. Assigned to Hartmann group in southern Oquirrh Mountains. Exposed in core of Ophir anticline above Ophir shale [Ophir group] on north side of Ophir Canyon. Underlies Herkimer limestone, contact gradational.

Type locality: At Teutonic Ridge, 1½ miles west of Eureka, Tintic district, Juab County.

†Texan System[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lvii, 276–282, pl. 3.

Named for State of Texas.

Texas Creek Granodiorite[1]

Jurassic or Cretaceous: Southeastern Alaska.

Original reference: A. F. Buddington, 1929, U.S. Geol. Survey Bull. 807, p. 22–27, 58–60, maps.

F. M. Byers, Jr., and C. L. Sainsbury, 1956, U.S. Geol. Survey Bull. 1024–F, p. 126, pl. 13. Confined chiefly to central part of Hyder district.

Named for Texas Creek, Hyder district.

Texas Gulch Formation (in Alder Group)

Precambrian (Yavapai Series): Central Arizona.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 28–30, pl. 1. Composed of alternating belts of rhyolitic tuff and purple slate. Rhyolitic tuff generally gray or white but also commonly cream or

light green; ranges from fine- through coarse-grained tuff to pebble conglomerates or to cobble conglomerates in local zones south of road to Cherry. Bulk of tuff is medium grained. Formation has been deformed intensely. Thickness and stratigraphic relationship not known. Probably older than Indian Hills volcanics (new). Crops out in band about 2,500 feet wide along western slope of Black Hills.

Representative section exposed in Texas Gulch, Jerome area, Yavapai County. Formation extends from southern border of area northward for about 14 miles to a point north of Jerome Highway where it is covered by Paleozoic rocks.

Texhoman series[1]

Tertiary, upper: Kansas.

Original reference: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 255.

Thacher Member (of Manlius Formation)

Lower Devonian: Eastern and central New York.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9 (strat. section). Basal member of Manlius formation. Underlies Olney member; overlies Rondout limestone. Thickness 0 to 50 feet. Only part of Manlius present in eastern New York.

L. V. Rickard, 1956, Dissert. Abs., v. 16, no. 1, p. 102. Evidence indicates that entire type Manlius formation near Syracuse, central New York, is equivalent in age to Lower Devonian Coeymans and Kalkberg formations of eastern New York. Its reference to Silurian can no longer be upheld. The so-called Manlius of eastern New York is entirely older; name Thacher limestone is proposed for this unit. It becomes thinner to west and is apparently replaced by underlying and thickening Rondout.

Type locality and derivation of name not given.

Thane Volcanic Group[1]

Lower or Middle Jurassic(?): Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 247, 251–252, chart opposite p. 270.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Thane volcanic group (in part) mapped with Middle Jurassic rocks.

Settlement of Thane, on Gastineau Channel, lies in midst of these rocks; Juneau region.

Thatcher Limestone Member (of Graneros Shale)

Upper Cretaceous: Southeastern Colorado.

N. W. Bass, C. E. Straub, and H. O. Woodbury, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 68. Consists of two beds of dense dark-gray limestone separated by dark-gray fissile shale, about 5 feet thick. Limestone beds weather rusty brown; lower bed is 4 to 6 inches thick and less persistent than upper bed which is about 18 inches thick. Occurs about 30 feet above base of shale.

Well exposed under east fence of U.S. Highway 350 across road from Keith's store at Thatcher, Las Animas County, and from that point northeastward for several miles. Forms prominent bench throughout Model anticline and adjacent region.

†Thayer Shale (in Kansas City Formation)[1]

Pennsylvanian: Eastern Kansas and northwestern Missouri.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, p. 276, pl. facing p. 290; 1895, Am. Jour. Sci., 3d, v. 50, p. 459, pl. facing p. 466.

Named for exposures at Thayer, Neosho County, Kans.

Thaynes Limestone,[1] Formation, or **Group**

Lower Triassic: Northeastern Utah, southeastern Idaho, southwestern Montana, and southwestern Wyoming.

Original reference: J. M. Boutwell, 1907, Jour. Geology, v. 15, p. 439–458.

W. R. Lowell and M. R. Klepper, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 240, 241. At McKnight Canyon section of Beaverhead formation (new), base of section is marked by high-angle normal faults which have dropped Beaverhead formation against Triassic Thaynes formation and Mississippian Madison limestone.

Bernard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 171–179. In type region, Thaynes formation consists of 1,190 feet of limestone, calcareous sandstone, sandstone, shale, and, in middle, red shale member. At type area, overlies Woodside formation and underlies Ankareh formation. Extends over wide area in Utah, Idaho, Wyoming, and Montana. Along southern, eastern, and northern margins, formation intertongues with Ankareh formation or Chugwater formation. Areas of occurrence discussed in detail. In vicinity of Fort Hall Indian Reservation, Mansfield (1916, Washington Acad. Sci. Jour., v. 6), raised Thaynes to rank of group and subdivided it into (ascending) Ross Fork limestone, Fort Hall formation, and Portneuf limestone. Toward Salt River Range and toward Bear Lake Valley, Ross Fork and Fort Hall formations lose their identity, and Portneuf is much more distinctive unit and name is retained as member of Thaynes. In this area, Timothy sandstone is considered uppermost member of Thaynes. In Eastern Bear Lake-Sublette Ridge area, eight lithologic units are recognized in Thaynes including Lanes tongue (new) of Ankareh formation in Portneuf limestone member. In northeastern Utah, Thaynes underlies Mahogany member (new) of Ankareh formation. Variable sequence of beds, that are commonly red, lies between top of Thaynes and base of Nugget sandstone throughout western Wyoming, southeastern Idaho, and northern Utah. Boutwell (1907) named these beds Ankareh formation. Although they are still so defined in western Wyoming, they have since been subdivided and named differently in other areas. Consequently there has been confusion in nomenclature and correlation of these formations. [See Ankareh formation.] Overlies Dinwoody in some areas of Montana and southeastern Idaho.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2185–2189, 2194. Term Thaynes formation extended into Confusion Range where it replaces term Woodside as used by Newell (1948, Geol. Soc. America Bull., v. 59, no. 10). On lithologic basis sequence could be referred either to Thaynes of northern Utah and Idaho, or Moenkopi as recognized in southern Utah. Use of Thaynes seems more appropriate because of greater lithologic similarity of Confusion Range Lower Triassic sequence to type Thaynes formation as defined by Boutwell (1907) and refined by Kummel (1954). Divided informally into seven gross lithologic zones. Aggregate thickness about 1,935 feet. Overlies

Gerster limestone; faunal evidence indicates considerable hiatus between the two formations.

Named after Thaynes Canyon, Park City district, Utah.

Thebes Sandstone (in Richmond Group)[1]

Upper Ordovician: Southwestern Illinois and southeastern Missouri.

Original reference: A. H. Worthen, 1866, Illinois Geol. Survey, v. 1, p. 139.

E. B. Branson, 1944, Missouri Univ. Studies, v. 19, no. 3, p. 94. In eastern Missouri, shales [Maquoketa] grade into a sandstone which seems to be same sandstone that was named Thebes by Worthen (1866); the Thebes seems merely to represent a facies change.

E. P. Du Bois, 1945, Illinois Geol. Survey Rept. Inv. 105, p. 7. Specific names, such as Fernvale limestone, Divine limestone, and Thebes sandstone have been applied locally to parts of Maquoketa formation, but it appears that none of these, except possibly Divine limestone, are consistent stratigraphic units.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 52). Correlation chart shows Thebes sandstone underlying Orchard Creek shale and overlying Maquoketa shale in southeastern Missouri.

Named for Thebes, Alexander County, Ill.

Theodosia Formation (in Jefferson City Group)

Lower Ordovician: Southern Missouri and northern Arkansas.

J. S. Cullison, 1944, Missouri Univ. School Mines and Metallurgy Bull., Tech. Ser., v. 15, no. 2, p. 15, 25–32, pl. 2. Predominantly dolomite, principally of the "cotton rock" type; some massive crystalline dolomite beds are present in southern part of area; generally light gray to buff; thin irregular buff to brown dolomitic sandstone lentils common; light- to dark-gray, oolitic and nonoolitic chert abundant; chert conglomerate and breccia common near base. Comprises the Lutie below and the Blackjack Knob member (both new). As defined, includes beds previously called "upper Jefferson City" and "lower Cotter dolomite." Thickness as much as 360 feet. Underlies Cotter formation with contact probably unconformable; unconformably overlies Rich Fountain formation (new).

Type section: Composed of two sections exposing two separate members; lower part, between post offices of Theodosia and Lutie in western part of Ozark County, Mo.; upper part, north side of Blackjack Knob, eastern Taney County, Mo. Lutie member is more wide-spread on outcrop in Missouri; Blackjack Knob member more widely distributed along boundary between the two States and in Arkansas.

Theresa Dolomite[1]

Upper Cambrian: Central to eastern New York.

Original reference: H. P. Cushing, 1908, Geol. Soc. America Bull., v. 19, p. 159–160.

R. H. Wheeler, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939. Cambro-Ordovician correlations revised in Champlain, Hudson, Mohawk, and St. Lawrence Valleys. Revisions involve definitions and succession of previously accepted Cambro-Ordovician formations: Potsdam, Theresa, Hoyt, and Little Falls of Upper Cambrian age and

Whitehall, Tribes Hill, and Beekmantown of Lower Ordovician age. Lower "typical" Theresa of Cambrian age is physically and faunally differentiated from "Upper Theresa" (now Heuvelton) member of Tribes Hill formation; Hoyt fauna occurs in lower half of emended Whitehall formation above Little Falls dolomite. Each revised unit is tied in with Divisions A through E of original "Calciferous" formation (Brainard and Seely, 1890, Am. Mus. Nat. History Bull., v. 3).

R. H. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 523–524. Corrected Skene Mountain section shows Theresa formation, about 80 feet thick, overlying Potsdam formation and underlying Little Falls formation.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 795–814. Evidence presented to substantiate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs region. Previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, and Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite, Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland?, Hull, Sherman Fall representatives), and Canajoharie shale. Term "Theresa" is not applicable in this area; name Galway is reintroduced for strata younger than Potsdam and older than Hoyt.

Named for exposures in Theresa Township.

Theresa Syenite[1]

Precambrian: Northeastern New York.

Original reference: H. P. Cushing and others, 1910, New York State Mus. Bull. 145, p. 38, map.

Small intrusive mass, less than 2 miles in length and less than one-half mile broad, lying south of Theresa, Jefferson County.

Thermopolis Shale

Thermopolis Shale (in Colorado Group)[1]

Lower Cretaceous: Central northern Wyoming and central southern Montana.

Original reference: C. T. Lupton, 1916, U.S. Geol. Survey Bull. 621, p. 168.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. Chart shows Thermopolis shale above Kootenai formation and below Mowry shale. Includes Muddy sandstone member at top. Not included in Colorado group.

R. M. Thompson, J. D. Love, and H. A. Tourtelot, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 36; J. D. Love and others, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–43. Name Thermopolis has been used in different senses; these usages have evolved into two general and quite different classifications in central Wyoming. Classification preferred by authors of this report and used in subsurface studies restricts Thermopolis to Lower Cretaceous black shale below Muddy sandstone and above "Rusty beds" sandstone and shale member of Cloverly formation; Muddy sandstone is considered a formation directly overlain by Mowry shale. Classification used by U.S. Geological Survey divides Thermopolis into three units: lower black shale of Lower Cretaceous age, ranging in

thickness from 100 to 200 feet, that overlies Cloverly formation; middle sandstone member, the Muddy, of Upper Cretaceous age [presently considered Lower Cretaceous]; and upper black shale which grades into Mowry shale.

P. W. Richards, 1955, U.S. Geol. Survey Bull. 1026, p. 45–47. Described in Hardin area, Montana-Wyoming, where it is 425 feet thick; overlies Cloverly formation and underlies Mowry shale. Restricted to exclude Birdbear sandstone which is reallocated to member status in Cloverly. Lower Cretaceous.

M. M. Knechtel, 1959, U.S. Geol. Survey Bull. 1072–N, p. 739–740, pl. 52. Described in Little Rocky Mountains, Montana, where it consists chiefly of dark-bluish-gray shale and includes numerous thin bentonite beds. Near the middle is a prominent sandy unit herein named Cyprian sandstone member. In earlier publications in area, unit herein called Cyprian was tentatively designated Muddy sand. Thickness about 600 feet. Overlies Kootenai formation; underlies Mowry shale.

Ralph Moberly, Jr., 1960, Geol. Soc. America Bull., v. 71, no. 8, p. 1149. Overlies Sykes Mountain formation (new).

Arthur Mirsky, 1960, Dissert. Abs., v. 21, no. 4, p. 850. Term Rusty Beds formally named as member of Thermopolis.

D. L. Eicher, 1960, Yale Univ., Peabody Mus. Nat. History Bull. 15, 126 p. As defined here, includes only that part of Lupton's (1916) Thermopolis shale which lies below Muddy sandstone (herein given formational rank) and is about 300 feet thick in Big Horn basin. Consists of black shale, basal member of which contains tan and rusty interbedded siltstones and sandstones about 120 feet thick, commonly called "rusty beds." Shale sequence above rusty beds is divided near middle into lower and upper parts by tan-weathering silty shale about 30 feet thick. Lower shale, below middle silty shale, contains a few thin ironstones, siltstones, and silty limestones throughout, and dahllite concretions in lower part. Upper shale, above middle silty shale, is generally darker and contains nearly no siltstone or limestone. Overlies Cloverly formation. Upper sequence of black shale and bentonites, overlying Muddy sandstone and formerly included in Thermopolis is herein named Shell Creek shale. Lupton named Thermopolis shale for exposures in area of town of Thermopolis but designated no type section; he presented supplementary lithologic description generalized from subsurface samples from near basin, 50 miles north. Detailed description of Thermopolis in its type area has never been published; entire sequence is not well exposed at any one place near Thermopolis. Lower Cretaceous. Type section designated for redefined Thermopolis. Regional relationships discussed. Detailed discussion of problems of nomenclature.

Type section (Eicher): On northeast and southwest flanks of Lucerne anticline, east of Big Horn River, in NW sec. 16, T. 43 N., R. 94 W., Hot Springs County, Wyo. Named for exposures near Thermopolis, Wyo.

The Rocks Sandstone

Eocene: West-central California.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1958. Listed as underlying Berry conglomerate and overlying Lucia shale (both new). Thickness about 1,500 feet.

R. R. Thorup, 1943, California Div. Mines Bull. 118, pt. 3, p. 465. Described as tan massive thick-bedded fine- to medium-grained well-sorted feldspathic sandstone. Disconformably underlies Berry conglomerate; conformably overlies Lucia shale. Formerly considered part of Vaqueros which is herein stratigraphically restricted in its type area.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 55. Quite probable that some part of The Rocks formation is of Ulatisian age.

Type locality: Sec. 27, T. 20 S., R. 6 E., Junipero Serra quadrangle, Monterey County. Named because of its tendency to form rugged topography.

Therrill Formation

Therrill Member (of Weches Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 97, 106–108. Upper member of Weches formation. Composed of black to black-green clay with iron sulphide nodules, a small amount of glauconite, and few fossils where fresh, and of brown shales or yellow and red clays with some yellow calcareous clay-ironstone concretions where weathered. Thickness about 4 or 5 feet. Overlies Viesca member (new) with boundary transitional; underlies Sparta sand.

H. B. Stenzel, 1953, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists and Mineralogists, and Soc. Econ. Geologists Guidebook, Joint Ann. Mtg., Houston, p. 47, 49. Shown on road log as formation. Thickness as much as 52 feet.

Type locality: Waterfalls near Magnolia Brown pump station and tank farm near center of Magnolia Petroleum Co. tract, J. B. and J. E. Therrill survey, Leon County.

The Straits Schist Member (of Hartland Formation)

Pre-Triassic: Western Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey; John Rodgers, R. M. Gates, and J. L. Rosenfeld, 1959, Connecticut Geol. Nat. History Survey Bull. 84, p. 14. Described as coarse to very coarse muscovite schist. Commonly crumpled and cut by quartz veins and pegmatite. Locally quartz, with feldspar, and mica dominate alternate layers, and rock approaches gneiss. Includes lenticular bodies of gneiss.

M. H. Carr, 1960, Connecticut Geol. Nat. History Survey Quad. Rept. 9, p. 7–8, pl. 1. Described and mapped in Naugatuck quadrangle. At base of Hartland.

Named for The Straits, a defile on the Bethany-Naugatuck Road or Litchfield Turnpike near north edge of town of Bethany, New Haven County.

Thetis group[1]

Upper Cretaceous: Northwestern Alaska.

Original reference: A. J. Collier, 1905, U.S. Geol. Survey Bull. 259, p. 179.

Mined at Thetis mine, East of Cape Lisburne.

Thiensville Formation[1]

Middle Devonian: Southeastern Wisconsin.

Original reference: E. R. Pohl, 1929, Pub. Mus. City Milwaukee Bull., v. 11, p. 7–8.

F. C. Foley, W. C. Walton, and W. J. Drescher, 1953, U.S. Geol. Survey Water-Supply Paper 1229, p. 14–15. Middle Devonian.

Type locality: Cut on Highway 57, 2 miles north of Thiensville, near middle of E½ sec. 10, T. 9 N., R. 21 E., Ozaukee County.

Thirteen Mile Rock Tuff

Miocene, upper: North-central Arizona.

B. E. Sabels, 1960, Dissert. Abs., v. 21, no. 3, p. 596. Incidental mention in discussion of late Cenozoic volcanism in San Francisco volcanic field.

Thirtynine Mile Volcanic Series

Oligocene, lower(?): Central Colorado.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 101–103, pl. 1. Flows, both dense and very vesicular, flow breccias, and agglomerates. Some vesicular lavas have abundant amygdules of calcite or chalcedony or both. Flow structure not well developed. Porphyritic facies subordinate to aphanitic facies. Little bedding or evidence of succession of flows and agglomerates can be seen. Composition of series ranges from andesite to basalt. Attains thickness of 2,000 feet on south side of Thirtynine Mile Mountain and in Pikes Peak quadrangle. In most places, it overlies the Precambrian complex. Patches of Cretaceous rocks and of Denver formation preserved here and there and protrude from under volcanic cover. Mapped as Thirty-nine Mile andesite on plate 1.

Well exposed in Thirtynine Mile Mountain in southeastern corner of South Park, Park County. Total area underlain by series, both within and outside the Park, is about 300 square miles.

Thomas Clay (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 7.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 121. In northern Appalachian region, Anderson underclay, which takes its name from overlying Anderson coal in Ohio, is known as (Lower) Bakerstown or Thomas clay.

Georges Creek Basin.

Thomas Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 60, 119, pl. 6.

Named for its position beneath Thomas coal in Upper Potomac Basin.

Thomas Sandstone (in Conemaugh Formation)[1]

Pennsylvanian: Western Maryland and northeastern West Virginia.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 60, 119, pl. 6.

Named for its position above Thomas coal in Upper Potomac Basin, Md.

Thomas Hill Shale[1]

Pennsylvanian: Northeastern Missouri.

Original reference: H. A. Wheeler, 1893, Missouri Geol. Survey Sheet Rept. 2, v. 9, p. 63.

Named for exposures at Thomas Hill, Randolph County.

Thomaston Granite

Thomaston Granite Gneiss[1]

Upper Ordovician: Western Connecticut and southeastern New York.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 109–110, map.

Robert Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, p. 755–756, pl. 1. Geographically extended into New York.

T. W. Fluhr, 1948, Rocks and Minerals Mag., v. 23, no. 8, p. 699. In vicinity of New York, underlies Amawalk granite (new).

E. N. Cameron and others, 1954, U.S. Geol. Survey Prof. Paper 255, p. 22. Upper Ordovician.

R. M. Gates, 1954, Connecticut Geol. Nat. History Survey Quad. Rept. 3, p. 6. Name Thomaston granite should not be applied to the granite in Woodbury quadrangle [this report]. The Thomaston includes such a variety of granites, pegmatites, granitic gneisses, and feldspathic metasediments that it has a different meaning in every area. Granite in area of this report is herein named Nonewaug granite.

D. M. Scotford, 1956, Geol. Soc. America Bull., v. 67, no. 9, p. 1177. In area of this report [northeastern Westchester County], granite that was called Thomaston by Balk (1936) is herein named Siscowit granite. Rock is not continuous with Thomaston type area and bears little resemblance to the Thomaston.

Type locality: Abandoned quarry at Reynold's Bridge south of city of Thomaston, Litchfield County, Conn.

Thomasville Glacial Substage

Pleistocene (Iowan): West-central Colorado.

R. L. Nelson, 1954, Jour. Geology, v. 62, no. 4, p. 328–329, fig. 2, table 4. Time of oldest Wisconsin glaciation in Frying Pan Valley. Older than Biglow glacial substage (new); younger than Lime Creek glacial substage (new). Marked by moraine and outwash deposits.

An end-moraine thought to be the terminal of the Thomasville advance lies 1 mile upstream from Thomasville. In Frying Pan River drainage just west of Continental Divide in Sawatch Range.

Thompson Limestone[1]

Middle Jurassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, chart 8C (column 92). As shown on correlation chart, Thompson limestone occurs above Fant andesite and below Mormon sandstone. Middle Jurassic.

Named for exposures on Thompson's Ranch, on west slope of Mount Jura, east of Taylorsville, Plumas County.

Thompson Slate[1]

Precambrian: Minnesota.

Original reference: N. H. Winchell, 1899, Minnesota Geol. and Nat. History Survey Final Rept., v. 4, p. 551.

See Thomson Slate or Formation.

Thompson Red Shale[1]

Middle Jurassic: Northern California.

Original reference: C. H. Crickmay, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 81.

Mount Jura.

Thompson Canyon Sandstone Member or **Bed** (in Neslen Formation)

Thompson Canyon Sandstone Bed (in Price River Formation)[1]

Upper Cretaceous: Central eastern Utah.

Original reference: D. J. Fisher, 1935, U.S. Geol. Survey Bull. 852.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, pl. 1 facing p. 1011 (column 39). Listed on correlation chart as member of Neslen formation.

D. J. Fisher, C. E. Erdman, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 17. Referred to as bed in Neslen formation.

Named for Thompson Canyon in Book Cliffs.

†Thompson Creek Beds[1]

Oligocene, lower: Western central Montana.

Original reference: E. Douglass, 1902, Am. Philos. Soc. Trans., v. 20, new ser., pt. 3, p. 237–245.

Probably named for exposures on Thompson Creek, 3 miles northwest of Three Forks, Broadwater County.

Thompson Valley Limestone

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1152–1156. Proposed for thick-bedded light-gray commonly variegated coarse-grained limestone referred to as zone 6 of Tazewell County classification by Cooper and Prouty. This zone was included by them in their Ward Cove limestone (1943) which is here restricted to *Nidulites* beds (zone 7). Thickness 75 feet at type section; about 250 to 300 feet in Fountain City, Tenn. Underlies Ward Cove limestone; overlies Lincolnshire formation. In Saltville belt, beds similar to Thompson Valley limestone and exposed in McNutt Quarry, 1½ miles southeast of Sharon Springs, Va., were referred to as Effna limestone (Cooper, 1944). The Effna is below the Whitesburg, Athens, and Peery limestone sequence southeast of Saltville thrust. The Effna is thought to be partly equivalent to Thompson Valley but because relationships are indefinite, use of the two names seems advisable. Partially equivalent to Farragut limestone (new).

Type locality: Thompson Valley, Tazewell County, Va.

Thomson Formation

Thomson Slate[1]

Precambrian: Northeastern Minnesota and northwestern Wisconsin.

Original reference: J. E. Spurr, 1894, Am. Jour. Sci., 3d, v. 48, p. 159–166.

G. M. Schwartz, 1942, Geol. Soc. America Bull., v. 53, no. 7, p. 1001–1020; 1949, Minnesota Geol. Survey Bull. 33, p. 18–36. Thomson formation has been referred to in literature as Thomson slate, St. Louis

slates, Cloquet slates, and Carlton slate, but term Thomson slate has priority. Herein suggested that term Thomson formation replace Thomson slate, because more than 50 percent of exposed part of formation is graywacke. Thickness about 20,000 feet. Beds have been compressed into series of folds that strike east-west. Formation has been variously correlated but in recent years has usually been considered equivalent of Animikie-Virginia slate of Mesabi Range. Detailed work suggests that this correlation is untenable and that formation is pre-Algoman. Detailed evidence given, and progressive metamorphism of formation to south described. Revised correlation suggests the possibility of occurrence of upturned Biwabik iron formation in 50-mile covered interval between Cloquet and Mesabi Range. Data likewise throw doubt on correlations proposed for Cuyuna Range about due west of southern exposures of main Thomson area. The Thomson is separated from the Lower Keweenawan (Puckwunge formation) by pronounced angular unconformity. Possibility of Thomson formation and Knife Lake series being equivalent of formations classified as Archean in Canada is not excluded.

Named for exposures along St. Louis River not far from Duluth, near Thomson, Carlton, and Cloquet, Minn.

Thoreau Formation (in San Rafael Group)

Upper Jurassic: Northwestern New Mexico.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 38. Underlies Chavez member (new) of Morrison formation; overlies Todilto limestone.

C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 14–15. Consists of lower even-bedded sandstone and siltstone member and upper cross-laminated sandstone member; distinction between units not clear cut although upper member is generally more massive and coarser grained than lower. At type locality (herein designated), a little more than 200 feet of beds are assigned to lower member and 184 feet to upper member. Thins eastward; about 275 feet at eastern edge of quadrangle; most of thinning is in lower member. Local limestone lenses and limy siltstone mark gradation between Thoreau and underlying Todilto limestone.

J. A. Momper and W. W. Tyrrell, Jr., 1957, Four Corners Geol. Soc. Guidebook 2d Field Conf., p. 23–24. Upper Jurassic.

Type section: On west edge of quadrangle south of Mount Powell in secs. 9 and 17, T. 14 N., R. 13 W. Named for exposures along cliffs north of Thoreau, McKinley County.

Thorn Group

Middle Silurian (Niagaran): Northern Illinois, northern Indiana, and southeastern Wisconsin.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 9 (fig. 2), 18. Includes all Niagaran formations exposed in Chicago region, in southeastern Wisconsin, and Wabash Valley of northern Indiana. It is predominant group of the low-clastic sedimentation belt; thins southward, forming tapering wedge that overlies Bainbridge group; at least 450 feet thick in syncline immediately west of La Salle anticlinal belt. Interreef strata are distinguished by their gray to greenish-gray color and abundance of chert; they differ from Bainbridge group in being predominantly dolomite and in containing reef-divided carbonate clastics. Local

formation names are used in Chicago area and in northern Indiana. [Report deals with Niagaran reefs and their relation to oil accumulation; much data relative to thickness and distribution of units are based on subsurface studies.]

Essentially all lithologic types in group are represented in quarry at Thornton in southern suburbs of Chicago in secs. 28 and 33, T. 36 N., R. 14 E., about one-half mile west of Thorn Creek.

Thorncrag Biotite-Sillimanite Gneiss

Thorncrag Limy Gneiss (in Tacoma Series)

Middle Silurian: Southwestern Maine.

L. W. Fisher, 1936, Am. Mineralogist, v. 21, no. 5, p. 323. Listed in table of formations. Basal unit of Tacoma series (new). Older than Stetson Brook limestone (new); younger than Bates limestone (new). Cambro-Ordovician(?).

L. W. Fisher, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 71. In Lewiston area are seven formations (ascending): Danville injection gneiss (new), Androscoggin gneiss, Bates crystalline limestone, Deer Rips lime-silicate-gneiss (new), Thorncrag biotite-sillimanite gneiss, Tacoma lime-silicate series, and Sabbatus quartz-sillimanite biotite schist. Middle Silurian.

Occurs in Lewiston area, Androscoggin County.

Thorn Hill Formation[1]

Lower Ordovician: Northeastern Tennessee.

Original reference: G. M. Hall and H. C. Amick, 1934, Tennessee Acad. Sci. Jour., v. 9, no. 2, p. 158–161.

Josiah Bridge, 1956, U.S. Geol. Survey Prof. Paper 277, p. 23, 50, 54. Unit formerly termed Thorn Hill is now included in Kingsport limestone and Mascot dolomite.

Type exposure: On highway about one-half mile from Thorn Hill post office, Morristown quadrangle, Grainger County.

Thornton Fire Clay (in Conemaugh Formation)[1]

Thornton clay member

Pennsylvanian (Conemaugh Series): Northern West Virginia, western Maryland, and eastern Ohio.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 322.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 57, 60, table 1. Included in Mahoning cyclothem in Perry County.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 28–29, geol. map. In Morgan County, Thornton clay member (Conemaugh series) occurs between Mahoning limestone member and Mahoning coal; rests on Lower Mahoning sandstone and shale member in areas where the limestone is absent. Thickness about 2½ feet.

Named for Thornton, Taylor County, W. Va.

Thorofare Andesite[1]

Upper Silurian: Central southern Maine.

Original reference: G. O. Smith, 1896, Geology of the Fox Islands, Maine, p. 12, 30–45.

Named for development on shores of Fox Island Thorofare, between North Haven and Vinalhaven Islands, Penobscot Bay region.

Thorold Sandstone (in Albion Group)

Thorold Sandstone (in Clinton Group)

Thorold Sandstone Member (of Albion Sandstone)[1]

Lower Silurian: Ontario, Canada, and western New York.

Original reference: A. W. Grabau, 1913, Geol. Soc. America Bull., v. 24, p. 431, 460–463.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3, p. 15. Correlation chart shows Thorold sandstone at top of Albion group below Maplewood shale of Clinton group. Thorold is considered base of Clinton by some workers.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13 (fig. 2), 15 (table 2), 24–29. Thorold can be traced from Niagara Gorge eastward through Lockport and Gasport outcrops to Genesee Gorge and eastward from the gorge to western Cayuga County. Overlies Grimsby sandstone; underlies (eastward) Neahga shale, Reynales limestone, Maplewood shale, and Bear Creek shale. Lower part of Clinton group.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Thorold sandstone occurs at base of Clinton group (Niagara Falls quadrangle); underlies Neahga shale; overlies Grimsby sandstone and shale of Medina group. Thorold of Gillette (1947) is not continuous with type Thorold; name Kodak sandstone (Chadwick, 1920 [?]) is revived for basal sandstone of Clinton group in New York.

Named for exposures on Welland Canal, at Thorold, Ontario.

Thoroughgood Formation

Devonian: Southern New Mexico.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook, 11th Field Conf., p. 74, 75. Yellow sands and silts with shaly interbeds. Thickness 12 feet. Only thinning edge of unit present in Rhodes Canyon where it underlies Rhodes Canyon formation (new) and overlies Contadero formation.

F. E. Kottlowski, 1959, Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec., and Roswell Geol. Soc. Guidebook Joint Field Conf., Apr. 17–18, p. 265, 266. Thoroughgood and Rhodes Canyon formations are informal units not yet properly defined. "Thoroughgood" formation consists of tan blocky silty fine-grained sandstone and shaly calcareous siltstone; thins from 12 feet on Sheep Mountain to 24–6 inches in Rhodes Canyon.

In Rhodes Canyon [San Andres Mountains, Sierra County].

Thorp Springs Limestone[1]

Lower Cretaceous (Comanche Series): Central northern Texas.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 509.

Crops out for several miles along bed of river at Granbury and Thorp Springs, Hood County, and also in bed of Paluxy at Glen Rose, Somervell County.

Thousand Creek Beds[1] or Formation

Pliocene (Hemphillian): Northwestern Nevada and southeastern Oregon.

Original reference: J. C. Merriam, 1910, California Univ. Dept. Geology Bull., v. 6, no. 2, p. 43–50.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 33, pl. 1; D. J. Jones, M. D. Picard, and J. C. Wyeth, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2221 (table). Pliocene (Hemphillian).

D. O. Cochran, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 10 (chart), 14. Thousand Creek formation listed with Cenozoic formations of Oregon. Light-colored stratified tuffs, containing rhyolite fragments and pumice. Thickness about 400 feet. Overlies Danforth(?) formation; underlies Mesa basalts.

Thousand Creek, Thousand Creek Ridge, Thousand Creek Canon (Canyon), and Thousand Creek Flats are in Humboldt County, Nev.

Thousand Springs Basalt[1] (in Snake River Group)

Pleistocene: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434–439.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 30, 75–76, pl. 5. Thickness about 100 feet. Constitutes filling of ancient river channel carved in Hagerman lake beds. Younger than Malad basalt. Older than Burley lake beds and Sand Springs basalt.

U.S. Geological Survey currently classifies the Thousand Springs Basalt as a formation in the Snake River Group on the basis of a study now in progress.

Type locality: Thousand Springs, southwest of Wendell, in Gooding County, issue from this basalt.

†Thrall Limestone Member (of Foraker Limestone)[1]

Pennsylvanian: Southeastern Kansas.

Original reference: N. W. Bass, 1936, Kansas Geol. Survey Bull. 23.

Named for Thrall post office, Greenwood County.

Threadgill Member (of Tanyard Formation)

Threadgill Limestone

Lower Ordovician: Central Texas.

V. E. Barnes, 1942, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 54, p. 1, 2. Ordovician Threadgill limestone grades downward into Cambrian Wilberns limestone. Name credited to Bridge and Barnes (unpub. ms.).

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 143, 148, 151, 156, pl. 4 [1945]. Threadgill limestone revised to include equivalent dolomite as well and designated as Threadgill member of Tanyard formation. As a general rule, member is principally or wholly limestone in west, grading eastward to dolomitic facies and showing such abrupt lateral transitions from limestone to dolomite that it is difficult to determine whether a given contact is a lateral transition, a collapse contact, or a fault. At type section 280 feet from base to Cretaceous overlap; elsewhere thicknesses range from 91 feet in eastern part of Llano region to 313 feet in west. Underlies Staendebach member; overlies Pedernales dolomite member of Wilberns formation.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 37, 190–191 pl. 6 [1946]. Type section and local stratigraphy described in detail.

V. E. Barnes and W. C. Bell, 1954, San Angelo Geol. Soc. Guidebook, Mar. 19–20, p. 35. Name Pedernales member of Wilberns formation dropped. Section shows Treadgill member of Tanyard above San Saba member of Wilberns.

Type section: On Threadgill and Mormon Creeks, south of Lange's mill, northwestern Gillespie County.

Three Forks Shale,[1] Limestone,[1] or Formation

Upper Devonian and Lower Mississippian: Montana, Idaho, North Dakota, South Dakota, and Wyoming.

Original reference: A. C. Peale, 1893, U.S. Geol. Survey Bull. 110.

G. W. Berry, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 14, 17 (fig. 4). Stratigraphically restricted at top to exclude about 60 feet of yellow sandstone herein named Sappington sandstone.

C. P. Ross, 1947, Geol. Soc. America Bull., v. 58, no. 12, pt. 1, p. 1095, 110–111, pl. 1 Three Forks limestone described in Borah Peak quadrangle, Idaho, where it is about 250 feet thick, overlies Grand View dolomite and underlies Milligen formation. Upper Devonian.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1421. In this report, Sappington sandstone is considered local member of Three Forks formation. Thickness at Logan, Mont., 150 feet. Overlies Jefferson formation; underlies Lodgepole limestone of Madison group. Recommended that term Potlatch be used in subsurface in preference to Three Forks and Jefferson in Sweetgrass arch area.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2321 (fig. 7), 2322–2326. Peale (1893) described five lithologic units in Three Forks from top to base: (1) yellow laminated sandstone, 25 feet; (2) dark-bluish-drab or black argillaceous limestone, 45 feet; (3) fossiliferous green, purple, and black calcareous shale, 70 feet; (4) grayish-brown limestone, 15 to 20 feet; and (5) reddish and brownish-yellow calcareous shale, 65 feet. Berry's (1943) Sappington sandstone is Peales uppermost unit (1). In present report, the Sappington is considered a member of the Three Forks but is assigned a Late Devonian and Early Mississippian age. Sloss and Laird (1947) excluded Peale's lowermost units 4 and 5 from the Three Forks. This was done on incorrect assumption that Peale had included these units (which Sloss and Laird described as "breccias and associated shales") with Jefferson formation. It is herein recommended that lower contact of Three Forks as originally defined by Peale be reestablished. The "breccias and associated shales" unit of Sloss and Laird is integral part of Three Forks and has been correlated northward from Logan area to Sweetgrass arch area where is is equivalent to upper part of Potlatch anhydrite formation as defined by Perry (1928). It is herein designated Potlatch member of Three Forks. In standard subsurface section, herein designated, Three Forks overlies Birdbear formation (new) and underlies Bakken formation.

Type section (Sloss and Laird): North side of Gallatin River at Logan, Mont. Named for exposures at junction of Three Forks of Missouri River, near Three Forks, Mont.

Standard subsurface section: In Williston basin and Montana east of 111° meridian in interval between depths of 10,076 and 10,310 feet in Mobil Producing Co. Birdbear Well 1, center SE¼NW¼ sec. 22, T. 149 N., R. 91 W., Dunn County, N. Dak.

Threemile Limestone Member (of Wreford Limestone)

Threemile Limestone (in Chase Group)[1]

Permian: Northeastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Soc. 10th Ann. Field Conf., Guidebook, p. 12.

D. E. Hattin, 1957, Kansas Geol. Survey Bull. 124, p. 29–39. Basal member of Wreford limestone. Consists of basal thick-bedded cherty limestone unit which is separated from main body of limestone by persistent calcareous shale or shaly to thin-bedded argillaceous limestone; locally contains algal bed at top. Thickness ranges from 6½ feet in Marshall County to slightly less than 33 feet in Wabaunsee County where reeflike expansion in upper part augments normal development. Underlies Havensville shale member. Type exposure defined as exact type locality has not been stated. Wolfcamp series.

Type exposure: In quarry in NW¼SW¼ sec. 11, T. 11 S., R. 6 E., on Fort Riley Military Reservation, near Threemile Creek, Geary County, a few miles southwest of Ogden, Riley County.

Three Rivers Schist (in Kaweah Series)

Triassic(?): Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 1, p. 15, 116, fig. 29, geol. map. Youngest of the four units included in series. Overlies Homer quartzite (new). Mica schists compose most abundant rock type with limestones next. Radiolarian type chert, acid and basic volcanic rocks, and argillaceous sediments present in lesser amounts. West of Sheep Creek, section is about 10,000 feet thick, top not present.

Occurs in southern Sierra Nevada, north-central Tulare County.

†Three Twins Member (of Chalk Bluff Formation)[1]

Permian: Southeastern New Mexico.

Original reference: W. B. Lang, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 7.

G. E. Hendrickson and R. S. Jones, 1952, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 3, p. 16 (fig. 3), 20, 21. Described in Eddy County. Consists of evaporites, red beds, and dolomitic limestone. Overlies Seven Rivers gypsiferous member of Chalk Bluff and Azotea tongue of Carlsbad limestone. Grades southward into Carlsbad.

Term Three Twins abandoned as corollary action to abandonment of Chalk Bluff Formation.

Named for exposures in Spencer Draw in Three Twins Hills, northeast of Carlsbad, Eddy County. Exposed over small area in northern part of Azotea Mesa and large area east of Lake McMillan.

Thrifty Formation (in Cisco Group)[1]

Thrifty Group

Upper Pennsylvanian: Central and central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 152, 153; 1922, Jour. Geology, v. 30, p. 24.

Wallace Lee and others, 1938, Texas Univ. Bur. Econ Geology Pub. 3801, p, 54–61, 122–128. In Brazos River section, formation includes (ascending) Avis sandstone, Blach Ranch limestone, Ivan limestone, and Breckenridge limestone members. In Colorado River section, includes (ascending) Avis sandstone, *Bellerophon* limestone, Speck Mountain shale, Speck Mountain limestone, Lohn shale, Parks Mountain sandstone, and Chaffin limestone members. Overlies Graham formation; underlies Harpersville formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 90–92. Rank raised to group and expanded upward to redefined Pennsylvanian-Permian boundary. Systemic boundary falls within Harpersville formation which term is abandoned. Includes (ascending) Avis sandstone, Ivan (Rocky Mounds; *Bellerophon*). Specks Mountain (Blach Ranch), Breckenridge, Chaffin, and Obregon (new) formations. Overlies Graham group; underlies redefined Permian Pueblo group.

John Kay, 1956, North Texas Geol. Soc. Field Guidebook May 25–26, fig. 4. Generalized columnar section shows base of Thrifty group at top of Breckenridge limestone. Includes Quinn clay, Crystal Falls limestone, and Saddle Creek limestone.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook Apr. 17–19, p. 50. Composite section of Brown and Coleman Counties shows formation includes (ascending) Speck Mountain limestone, Parks Mountain sandstone, and Chaffin limestone.

D. A. Myers, 1958, Jour. Paleontology, v. 32, no. 4, p. 678 (fig. 1). Columnar section shows formation includes (ascending) Speck Mountain, Breckenridge, and Chaffin members.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 71–74, pl. 27. Plummer and Moore described Thrifty formation as including sandstone, shale, and limestone overlying their Wayland shale and extending to top of their Breckenridge limestone (the limestone at top of Drake's Chaffin bed). As redefined herein, Thrifty formation consists of (ascending) Speck Mountain limestone, Breckenridge limestone, Parks Mountain sandstone, and Chaffin limestone members. Thickness about 55 feet in southern Coleman County; average thickness about 100 feet in northern Brown County. Overlies Graham formation; underlies Pueblo formation of Wichita group.

Named for Thrifty, Brown County, Colorado River region.

Thumb Formation

Cretaceous(?): Southeastern Nevada.

C. R. Longwell, 1952, Utah Geol. Soc. Guidebook 7, p. 34 (fig. 4), 35. Between 2,000 and 3,000 feet of gypseous redbeds, fresh-water limestone, and conglomeratic sandstones interspersed with many extensive lenses of megabreccia. Basal conglomerate bevels Aztec, Chinle, and Moenkopi formations. Unconformably underlies Horse Spring formation.

Well exposed east of Frenchman Mountains.

Thunder Bay Limestone[1] (in Traverse Group)

Middle and Upper(?) Devonian: Northeastern Michigan.

Original reference: C. C. Douglass, 1839?, Michigan Leg. H. Doc. 27, between p. 97 and 111.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 579 (fig. 3) 593–594. Although Thunder Bay was first formation named from Alpena region, most authors have overlooked its description. Grabau (1902) used term Thunder Bay for series comprising all Traverse rocks above Alpena limestone, leaving Douglass' original beds without a specific name. Warthin and Cooper (1935) proposed term Partridge Point for exact sequence described by Douglass, but this name, together with Grabau's Thunder Bay series, should be abandoned in favor of earlier usage of name. At Partridge Point, section consists of basal bluish argillaceous limestone, weathering to rusty brown, 1 foot to lake level; 3-foot covered interval; shale, gray, calcareous, with limestone lenses, becoming predominantly granular limestone at top, 7½ feet; and limestone, gray, irregularly bedded, weathering to buff, 2 feet; here underlies glacial lake deposits. Stratigraphically above Potter Farm formation and below Squaw Bay limestone. Upper Devonian. Data on type locality.

Type locality: Bluffs on shore of Partridge Point, extending from center into SE¼ sec. 11, T. 30 N., R. 8 E., Alpena County. In original description locality is given as "the south cape of Thunder Bay." This is not South Point, near Alpena-Alcona County line, but Partridge Point, about 3 miles south of Alpena, Alpena County.

Thunder Bay Series[1]

Middle Devonian: Northeastern Michigan.

Original reference: A. W. Grabau, 1902, Michigan Geol. Survey Rept. 1901, p. 192.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 539. Should be abandoned in favor of earlier use of name, Thunder Bay limestone.

Named for exposures on Thunder Bay, at and around Alpena.

Thunderhead Sandstone (in Great Smoky Group)

Thunderhead Conglomerate (in Chilhowee Group)[1]

Precambrian (Ocoee Series): Eastern Tennessee and western North Carolina.

Original reference: A. Keith, 1895, U.S. Geol. Survey Geol. Atlas, Folio 16, p. 2.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 958–959. Redescribed as sandstone. Reallocated to Great Smoky group. Thickness about 8,000 feet near Thunderhead Mountain; 6,000 feet on Mount Le Conte, and more than 10,000 feet in northeastern part of mountains. These thicknesses are not of wholly contemporaneous beds because span of formation becomes progressively higher eastward; lower part in west is equivalent to Elkmont sandstone (new) farther east, and upper part in east is equivalent to Anakeesta formation (new) farther west. Type Clingman is probably equivalent to upper beds of Thunderhead sandstone.

Named for development on Thunder Head, Blount County, Tenn., and Swain County, N.C. Thunderhead Mountain is in remote part of region; formation is better exposed on Mount Le Conte farther east where full section is present.

Thurman Formation

Oligocene and and Miocene: Southwestern New Mexico.

V. C. Kelley and Caswell Silver, 1952, New Mexico Univ. Pubs. in Geology 4, p. 114 (fig. 14), 121–123. Basal part of formation in Thurman Arroyo is dense cream- to tan-colored resistant rhyolite tuff-breccia about 50 to 100 feet thick. Above this bed are alternating and intercalated thinner units of pinkish sandy clay and thicker units of rather evenly bedded tuff and tuffaceous sandstone. White fine- to medium-grained crystal tuff dominates section. Locally, as at type locality, thin flow of dark amygdaloidal basalt intercalated with tuffaceous sandstone. Characteristically white to light buff in outcrops. Thickness about 2,100 feet at type locality where it unconformably underlies Santa Fe formation and conformably overlies Palm Park formation (new).

Type locality: Along road to Palm Park barite mine in secs. 35 and 36, T. 18 S., R. 3 W., Donna Ana County. Named from Thurman Arroyo at south end of Caballo Mountains.

Thurman Sandstone[1] (in Cabaniss Group)

Pennsylvanian (Des Moines Series): Eastern and central Oklahoma.

Original reference: J. A. Taff, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 439.

M. C. Oakes, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 6, p. 1524 (fig. 1), 1525. Basal formation of Cabaniss group (new).

J. V. A. Trumbull, 1957, U.S. Geol. Survey Bull. 1042–J, p. 335, pl. 1. In northwest Pittsburg County, Thurman is from 290 to 350 feet thick and consists of alternating beds of sandstone and shale, with basal bed of conglomerate or coarse sandstone in many places. Overlies Boggy formation; underlies Stuart shale.

Named for former village of Thurman, (about 6 miles west of Indianola) in northern part of Pittsburg County. Crops out in strip a few miles wide extending through northern Coal, western and northwestern Pittsburg, and western McIntosh Counties.

Thurmond Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southern West Virginia.

Original reference: M. R. Campbell, 1902, U.S. Geol. Survey Geol. Atlas, Folio 77.

Well exposed at town of Thurmond, Fayette County.

Thursday Dolomite

Middle Silurian: Northwestern Utah.

F. W. Osterwald, 1953, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–330, p. 105; H. M. Staatz and F. H. Osterwald, 1959, U.S. Geol. Survey Bull. 1069, p. 19 (fig. 2), 28–29, pl. 1. Light-gray medium-grained friable rock; medium-grained gray dolomite bed about 15 feet thick with 1- to 4-inch bands of pink chert parallel to bedding present about 135 feet from base of formation in northern part of Spors Mountain; in northern part of district network of thin brown chert present in several beds about 340 feet above base of formation. Thickness about 329 feet. Overlies Lost Sheep dolomite (new); underlies Sevy dolomite. Complete sections rare; formation is either cut off by faults or covered by Lake Bonneville beds in most of district.

Type section: About 4,200 feet west-southwest of Thursday mine, Juab County. Well exposed in northern half of Spors Mountain where it caps a series of long northeast-trending ridges.

Tiawah Limestone Bed (in Scammon Formation)

Tiawah Limestone Member (of Cabaniss Formation or Senora Formation)

Tiawah Lime[1] (in Boggy Formation)

Pennsylvanian (Des Moines Series): Northeastern Oklahoma and southeastern Kansas.

Original reference: S. W. Lowman, 1932, Summaries and abstracts of technical papers presented before Tulsa Geol. Soc. 1932, unpaged, paper dated Dec. 19, 1932.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 26. In northeastern Oklahoma, included in Senora formation; stratigraphically below Chelsea sandstone member.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 54–55. Limestone bed in Scammon formation. In Crawford County, Kans., typically extremely dense, tough, and pyritic, forming a single resistant ledge. Thickness in Cherokee County, Kans., about 4 inches; in type area about 4 feet.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Shown on chart as limestone member of Cabaniss formation. Below Chelsea sandstone.

Well developed in hills around Tiawah, Rogers County, Okla.

Tibbit Hill Schist[1]

Precambrian or Lower Cambrian: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1934, Geol. Soc. America Bull., v. 45, no. 1, p. 6, 10.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137–138. Chloritic and epidotic schists varying from very dark green to dull yellowish green. Less metamorphosed parts invariably fine textured. Amygdules sparingly present; occur in bands in several places. Included in discussion of Oak Hill series. Underlies Call Mill slate. Lower Cambrian or Precambrian. Type locality cited.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1138–1141. Geographically extended into Vermont. Thickness unknown since base nowhere exposed.

R. A. Christman, 1959, Vermont Geol. Survey Bull. 12, p. 14–23, geol. map. In Mount Mansfield quadrangle, underlies Camels Hump group. Occurs in core of Fletcher anticline. Cambrian.

Named for Tibbit Hill west of Brome Lake in Sutton quadrangle, Quebec. Hill is composed largely of the schist.

Tibes Diorite

Upper Cretaceous: Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 112–113, geol. map. Intrudes lower Maestrichtian [Upper Cretaceous] rocks of Río Blanco formation. Does not intrude Eocene Jacaguas group.

Time of intrusion definitely post early Maestrichtian and probably pre-middle Eocene.

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 85. Coarsely crystalline diorite made up of gray plagioclase feldspar and hornblende. Intrudes rocks of Río Chiquito formation. Footnote states name Río Chiquito no longer used; unit currently assigned to Río Blanco formation.

Occurs on western margin of Ponce quadrangle and extends several kilometers to west into Peñuelas quadrangle, south-central part of island.

Tice Shale (in Monterey Group)[1]

Miocene, upper: Western California.

Original reference: A. C. Lawson, 1914, U.S. Geol. Survey Geol. Atlas, Folio 193.

M. N. Bramlette, 1946, U.S. Geol. Survey Prof. Paper 212, pl. 2. Shown on stratigraphic section as occurring at base of Kleinpell's Mohnian stage, upper Miocene.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 17 (table 3), 70–71, pls. Described in Coast Ranges immediately north of San Francisco Bay region. Thickness 300 to 350 feet. Underlies Hambre sandstone; overlies Oursan sandstone. Locally faulted against Pinole tuff.

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 19, fig. 2, geol. map. Thickness 250 to 900 feet in Pleasanton area, Alameda and Contra Costa Counties. Overlies Oursan sandstone; underlies Hambre sandstone. Term Monterey group not considered appropriate in this area.

Named for exposures along Tice Creek, Concord quadrangle.

Tichenor Limestone Member (of Ludlowville Shale)[1]

Tichenor Formation

Middle Devonian: Western to central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 22 and table.

A. J. Mozola, 1951, New York State Water Power and Control Comm. Bull. GW–26, p. 13. In Seneca County, Tichenor limestone member defines upper limit of Ludlowville. Composed of layers of dense light-colored limestone that are several inches thick overlain by hard calcareous shale about 5 feet thick. Underlies Moscow shale.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 369–371, pl. 1. Member, in eastern part of Batavia quadrangle, is 9 feet thick; thins toward east and west. Overlies Ledyard-Wanakah member; underlies Deep Run member.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455 (fig. 2). Referred to as Tichenor formation. Thickness 1 foot, at Jacox Run near Geneseo. Overlies Wanakah formation; underlies Deep Run formation.

Type locality: Tichenor Point, on Canandaigua Lake, in Ontario County.

Tick Canyon Formation

Miocene, lower to middle: Southern California.

R. H. Jahns, 1939, Am. Jour. Sci., v. 237, no. 11, p. 819–821. Detailed mapping of so-called Mint Canyon formation north and northeast of

Saugus and study of new vertebrate material from lowermost beds have led to revision in stratigraphy. Lower beds are termed Tick Canyon formation; Mint Canyon formation is retained for middle and upper beds, and Mint Canyon series is applied to strata as a whole. Tick Canyon consists mainly of red and reddish-brown clay (in part lacustrine), siltstone, and sandstone, with irregular zone of cobble to boulder conglomerate at base. Thickness varies; average approximately 350 feet. Disconformably underlies Mint Canyon formation; overlies Vasquez series; between Mint and Vasquez Canyons, the Tick Canyon lies in a steeply dipping depositional contact upon basement complex of pre-Cretaceous schists, quartzites, granodiorites, and migmatic rock types.

R. H. Jahns, 1940, Carnegie Inst. Washington Pub. 514, p. 147–194, pls. Tick Canyon formation (basal beds of Hershey's, 1902, California Univ. Pub., Dept. Geol. Bull., v. 3, Mellenia series and Kew's, 1924, U.S. Geol. Survey Bull. 753 Mint Canyon formation) are traceable in narrow irregular band extending from Tick Canyon area northwesterly to point between Vasquez and Texas Canyons, where lack of exposures prevents their demarcation from overlying Mint Canyon strata. Thickness 593 at type locality herein designated.

R. H. Jahns and W. R. Muehlberger, 1954, California Div. Mines Bull. 170, map sheet 6. Generalized stratigraphic column for Soledad basin shows Tick Canyon 0 to 900 feet thick.

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 23 (fig. 3), 63, pl. 1. In San Fernando quadrangle, exposed in narrow band 2 miles long between Texas and Mint Canyons, and in separate area extending approximately 1 mile both east and west of Tick Canyon. Maximum thickness 593 feet (Jahns, 1940). Thins westward and is apparently overlapped by Mint Canyon formation before reaching Texas Canyon. Lies unconformably on Upper Jurassic(?) or Lower Cretaceous(?) gneissoid granite across Vasquez Canyon and, west of that canyon, was deposited across Vasquez Canyon fault and on eroded surface of Vasquez formation. Southeastern one-half mile of this contact southeast of Vasquez Canyon may be near-vertical fault. Present north of San Gabriel fault.

Type section: Between Mint and Vasquez Canyons in Humphreys quadrangle, Los Angeles County. Named for exposures about one-half mile down canyon from abandoned borax mine at head of Tick Canyon, as well as in vicinity of Tick Canyon-Mint Canyon divide, Lang quadrangle.

Ticklenaked Formation

Age not stated: Northeastern Vermont.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 20, 26, 27. Overlies Barton River formation. Refers to mapping by W. S. White and J. H. Eric, (unpub. theses).

Occurrence: Vermont part of Littleton quadrangle, Vermont-New Hampshire.

Tickville Rhyolite[1]

Eocene(?): Central northern Utah.

Original reference: J. Gilluly, 1932, U.S. Geol. Survey Prof. Paper 173, p. 60–61.

Occurs near Tickville.

Ticonderoga Formation

Cambrian (Trempealeauian) : New York and Vermont.

C. W. Welby, 1959, New England Intercollegiate Geol. Conf., p. 23, 33, pl. 1. Consists of dark-weathering medium- to dark-gray medium and finely crystalline dolostones with interbedded coarse- and medium-grained quartz sandstones. Maximum exposed thickness about 90 feet at Thompson Point; outcrop width south of Vergennes suggests thickness of as much as 350 to 400 feet. Overlies Potsdam sandstone; underlies Whitehall formation. Name credited to J. Rodgers.

Type section : On Mount Hope at Ticonderoga, N.Y.

Tidioute shale member[1]

Devonian or Carboniferous : Northwestern Pennsylvania.

Original reference : K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 116–119, table opposite p. 61.

Named for excellent exposure along Allegheny River at Tidioute, Warren County, and along State highway through Dennis Run, 1 mile southwest of Tidioute.

Tie Gulch Dolomite Member (of Manitou Formation)

Lower Ordovician : Central northwestern Colorado.

N. W. Bass and S. A. Northrop, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 5, p. 892 (fig. 2), 893, 904 (fig. 9), 906–907. Proposed for regularly bedded thin-bedded medium-brown dolomite that forms upper part of formation. Thickness 47 to 66 feet. Overlies Dead Horse conglomerate member (new) ; underlies Parting member of Chaffee formation.

Type locality : Walls of Tie Gulch at east end of U.S. Highway 6 bridge over Tie Gulch, which enters Glenwood Canyon near center sec. 15, T. 5 S., R. 87 W., Garfield County.

Tierra Blanca Member (of Lake Valley Formation)

Mississippian (Osage) : Southwestern New Mexico.

L. R. Laudon and A. L. Bowsher, 1949, Geol. Soc. America Bull., v. 60, no. 1, p. 11, 13–14, 61, figs. 4, 29. Medium-bedded hard gray to brown coarse-grained criquina that carries considerable light-colored nodular chert. Most of the basal beds are interbedded with blue-gray marl so that line between Nunn and Tierra Blanca members is difficult to draw. Upper part invariably gray to brown criquina with up to 50 percent chert. Approximately 50 feet of section exposed at Lake Valley. Thickness ranges from 10 feet in parts of Sacramento Mountains to 125 feet in Percha Creek area. Rapid lateral changes in thickness common where biohermal structures are present. Cliff former and in most places makes vertical scarp along mountain front. Conformably underlies Arcente member.

F. E. Kottlowski, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 34. Member is typical biostromal and biohermal limestone in San Andres Mountains and grades laterally and vertically into overlying and underlying shaly members. Overlies Alamogordo member in Ash Canyon; elsewhere in range overlies Nunn member.

Type section : On Apache Hill at type section of Lake Valley formation near Lake Valley, NE¼NW¼ sec. 21, T. 18 S., R. 7 W., Sierra County. Named for Tierra Blanca Creek along which are excellent exposures in vicinity of Nunn Ranch.

Tierra Loma Shale Member (of Moreno Formation)

Upper Cretaceous: Southern California.

M. B. Payne, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1954; 1951, California Div. Mines Spec. Rept. 9, p. 6 (fig. 2), 8 (fig. 4), 9, 24, pls. 2, 3, 4, 5. Principally brown shale. Thickness about 1,200 feet. Includes 190-foot Mercy sandstone lentil (new) about 70 feet below top. Underlies Marca shale member (new); overlies Dosados sand and shale member (new). On basis of this mapping, it is concluded that Anderson and Pack (1915) show base of Moreno formation in Ortigalita Creek some 1,800 feet stratigraphically lower than their type Moreno in Moreno Gulch.

Type locality: Escarpado Canyon, secs. 7 and 8, T. 15 S., R. 12 E., Panoche Hills, Fresno County. Escarpado Canyon is 6 miles south of Moreno Gulch and 2 miles north of Panoche Creek. Named for Tierra Loma Schoolhouse on Tierra Loma quadrangle near E¼ cor. sec. 9, T. 14 S., R. 12 E.

Tieton Andesite[1]

Pleistocene: Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 86.

W. C. Warren, 1941, Jour. Geology, v. 49, no. 8, p. 797 (fig. 2), 806–808. Further described in discussion of relationship of Yakima basalt to Keechelus andesitic series. Younger than Yakima basalt. Area of report is Mount Ait quadrangle.

Probably named for occurrence in Tieton Canyon, Ellensburg quadrangle.

Tiff Member (of Goddard Formation)

Mississippian: Southern Oklahoma.

C. W. Tomlinson and Allan Bennison, 1960, Oklahoma Geology Notes, v. 20, no. 5, p. 123–124. Proposed to replace preoccupied name Grindstone Creek member of Goddard formation of Tomlinson (1959). Consists of 10 to 40 feet of light- to dark-gray pelletal or gritty claystone. About 500 feet below Rod Club member of Springer formation. Fossiliferous.

Type section: NE¼SE¼SE¼SE¼ sec. 16, T. 3 S., R. 1 E., in gully at north end of large cutbank at east side of Grindstone Creek. Tiff was rural community 1 mile north and 2 miles east of type section and was on Caddo anticline in Carter County.

Tiffanian Age

Paleocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 9, pl. 1. Provincial time term, based on Tiffany local fauna, often used in a more extended sense as a faunal level, northern rim of San Juan Basin, southwestern Colorado. Includes interval between Paleocene Torrejonian (older) and Clarkforkian ages. Report defines 18 provincial time terms, based on mammal-bearing units for North American continental Tertiary. [For sequence see under Puercan.]

Typical area: Mason pocket, sec. 20, T. 33 N., R. 6 W. [La Plata County, Colo.].

†Tiffany Beds (in Wasatch Formation)[1]

Paleocene: Southwestern Colorado and northwestern New Mexico.

Original reference: W. Granger, 1917, Am. Mus. Nat. History Bull. 37, p. 826–830.

H. E. Wood 2d, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 33. Tiffany could and should be defined as either a member or a formation; additional field work is desirable.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 275, 276 (fig. 2). Tiffany is faunal rather than stratigraphic term, but its rehabilitation in latter sense is probable outcome of still more detailed, combined paleontological and stratigraphic study. Tiffany local fauna is in lower part of San Jose formation as proposed in this report.

Type locality: Sec. 20, T. 33 N., R. 6 W., La Plata County, Colo. Named from Tiffany Station, on Denver & Rio Grande Railroad, 4 miles south of Mason Schoolhouse.

Tiflis Member (of Wahluke Formation)

Pleistocene, upper: Central Washington.

G. F. Beck, 1936, Mineralogist, v. 4, no. 11, p. 12. Name applied to upper part of formation. Member grades from water-laid materials at base to loess at top. Average thickness 15 feet.

Deposited in Tiflis downward north of Warden, Grant County.

Tigaraha Schist[1] (in Kigluaik Group)

Lower Paleozoic or older: Northwestern Alaska.

Original reference: F. H. Moffit, 1913, U.S. Geol. Survey Bull. 533, p. 20–33, maps.

Type locality: Includes sharp peak, near head of Buffalo Creek, named Tigaraha Mountain, Eskimo word for pointed.

Tiger Formation

Tertiary: Northeastern Washington.

C. F. Park, Jr., and R. S. Cannon, Jr., 1943, U.S. Geol. Survey Prof. Paper 202, p. 23, pl. 1. Name applied to semiconsolidated continental deposit consisting of conglomerates, sandstones, and clays; beds ill defined and materials poorly sorted. Maximum thickness about 1,000 feet. Overlies Metaline limestone.

M. C. Shroeder, 1952, Washington Div. Mines and Geology Bull. 40, p. 7 (chart), 20–21. Described in Bead Lake district where it unconformably overlies Pend Oreille andesite.

Extensively exposed in hills south of Tiger, Pend Oreille County.

†Tiger Creek Sandstone Member (of Bristow Formation)[1]

Pennsylvanian: Central Oklahoma.

Original reference: A. E. Fath, 1917, U.S. Geol. Survey Bull. 661B, p. 73–74, pl. 5.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Appears to be Paola "limestone" member of Oread formation.

Named for exposures in south part of sec. 6, T. 17 N., R. 10 E., on south side of small tributary of Tiger Creek.

Tightner Formation[1]

Mississippian: Northern California.

Original reference: H. G. Ferguson, 1929, Am. Inst. Mining and Metall. Engineers Tech. Pub. 211, p. 4.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 15). Shown on correlation chart above Blue Canyon formation and below Kanaka formation.

Named for fact it forms principal wall rock of Tightner mine. Extends from North Yuba [Sierra County] to South Yuba.

Tiglukpuk Formation

Upper Jurassic: Northern Alaska.

R. W. Imlay, 1955, U.S. Geol. Survey Prof. Paper 274–D, p. 70–71, Coarsely clastic facies of Jurassic sedimentary rocks in northern Alaska. Characterized by conglomerate, graywacke, sandstone, chertlike material (possibly devitrified tuff), tuffs, sills, pillow lavas, and a few thin beds of limestone. Interbedded with dark siltstone and shale which constitute as much as 50 percent of some sections and as little as 10 percent of others. Coarser constituents of conglomerate range in size from granules to boulders; matrix is graywacke. Sills identified only west of Anaktuvuk River, and lavas only between Nuka and Utukok Rivers. Limestone occurs as thin coquinas composed of pelecyod *Aucella*. Thickness ranges from featheredge to about 2,000 feet; highly variable along strike and absent locally within belt of outcrop. Overlies Triassic and older rocks with angular discordance in area between Utukok and Ipnavik Rivers. Grades northward into shale-siltstone facies.

W. W. Patton, Jr., *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 213, 215, 218, 220, figs. 2, 5. Shale, siltstone, and graywacke are principal components. Graywacke typically greenish-gray, slightly calcareous, highly argillaceous, poorly sorted sandstone or conglomerate. No complete unfaulted section known. Thickest composite section, compiled from scattered outcrops along Lupine River, is approximately 1,800 feet. Type section, approximately 1,450 feet thick, believed to be most complete section exposed in continuous outcrop. Overlies Shublik formation with little or no angular discordance; underlies Okpikruak formation or younger Cretaceous rocks, in some places with angular discordance. Underlies Fortress Mountain formation (new) at type locality of Fortress Mountain. Type section designated.

Type section: Along series of cutbanks on east side of Tiglukpuk Creek between lat. 68°22′ N. and lat. 68°22′30″ N. Recognized and mapped in Arctic Foothills from Lupine River west to Nuka River.

Tigre Limestone[1]

Oligocene: Panamá and Costa Rica.

Original reference: D. F. MacDonald and others, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 364.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 347. Undefined name. Appeared in table showing that limestone overlies Watsi and Mona shales. Note on type region.

Type region: In Bocas del Toro area, in foothills about 15 kilometers southwest of mouth of Río Sixaola. Tigre is local name for small stream flowing into tributary of Río San San.

Tihvipah Limestone

Pennsylvanian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 26–27, pls. 1, 2, 3. Name applied to limestone and associated rocks above Rest Spring shale (new). Consists mostly of platy light-gray limestone, interbedded shaly limestone or calcareous shale, and some beds, 1 foot to 3 feet thick, fine-grained medium-gray limestone; shaly rocks range in color from very light gray to pale red or grayish pink. Some spherically concretionary dark-gray chert, unlike rounded chert pebbles which locally compose inconspicuous thin basal conglomerate. Thickness about 200 feet. In Quartz Spring area, top of Tihvipah limestone is eroded so its upper limit cannot be satisfactorily defined.

Type locality: On hill due east of Rest Spring, Inyo County. Named for exposure northwest of Tihvipah Spring, which is 2 miles N. 15 E. of Burro Spring. Name Tihvipah Spring does not appear on any previously published map, but in 1938 it was used by rangers of National Park Service in Death Valley.

Tijeras quartzite[1]

Precambrian: New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22 p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 11.

Well exposed in great Tijeras arch of pre-Cambric rocks at southern end of Sandia Range.

Tilden Formation[1]

Cambrian: Southwestern Montana.

Original reference: P. J. Shenon, 1931, Montana Bur. Mines and Geology Bull. 6.

Well exposed northwest of Ermont mine, Argenta, Beaverhead County.

Tilden Limestone Lentil (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 44, map, sections.

Named for Tilden mining claim, Bingham district.

Tilford Lens (in Newcastle Formation)

Upper Cretaceous: Western South Dakota.

R. M. Grace, 1952, Wyoming Geol. Survey Bull. 44, p. 14, 16. Composed almost entirely of friable sandstone. In this report, seven lenses are named in Newcastle.

Present northeast of Tilford, Meade County.

Tillamook Volcanic Series

Eocene: Northwestern Oregon.

W. C. Warren, Hans Norbisrath, and R. M. Grivetti, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 42. Name applied to series of basaltic lavas and tuffs which form backbone of Coast Range in south-central

part of area mapped. Along west and north sides of series, lava is predominant rock type; toward east and south, tuffs, and, next tuffaceous shales become increasingly abundant. Thickness 6,000 to 10,000 feet along Trask River from mouth of its canyon to its forks. Oldest rocks in region; unconformably overlain by sedimentary beds containing Cowlitz (upper Eocene) fauna.

P. D. Snavely, Jr., and E. M. Baldwin, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 5, p. 806. Lower part of Tillamook volcanic series is equivalent to newly defined Siletz River volcanic series in Lincoln County.

Well exposed along most of large streams in eastern Tillamook County.

†Timber Belt beds[1]

Eocene: Eastern Texas.

Original reference: E. T. Dumble and R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., p. xxxvi, 17, 22, pl. 3.

Named for great timber region.

Timber Canyon Fanglomerate[1]

Pleistocene, upper: Southern California.

Original reference: U. S. Grant 4th and H. R. Gale, 1931, San Diego Soc. Nat. History Mem., v. 1, p. 37, 38, 63.

Occurs on top of ridges beveling edges of upturned marine beds west of Timber Canyon, on north side of Santa Clara Valley, Ventura and Los Angeles Basins.

Timber Crater Basalt Flow, Lavas

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and H. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 23–31, 32–34. Discussion of geology and petrography of Crater Lake National Park. Mount Mazama is name given to prominent peak that once stood on what is now rim of Crater Lake. Lavas in Mount Mazama were of three types: andesites, dacites, and basalts. Immediate rim of Crater Lake is made up wholly of andesites and dacites, chiefly the former; basalts are limited to outer slope. None of the basalt flows came from central vent of Mount Mazama. Principal basalt flows are the Timber Crater, Red Cone, Desert Cone, Bald Crater, and Crater Peak.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 140–141, pl. 3. Mapped as Timber Crater lavas.

Timber Crater is 5 miles northeast of Crater Lake, Cascade Range. Slopes of Timber Crater cone are covered with pumice showing that its activity closed before that of Mount Mazama.

†Timber Creek Beds[1]

Upper Cretaceous: Eastern Texas.

Original reference: J. A. Taff, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 285.

†Timber Creek Beds[1]

Eocene: New Jersey.

Original reference: W. M. Gabb and G. H. Horn, 1862, Philadelphia Acad. Nat. Sci. Jour., 2d ser., v. 5, p. 111, 135.

Exposed on Timber Creek.

†Timber Creek Group[1]

Upper Cretaceous (Gulf Series) : Eastern Texas.

Original references: R. T. Hill and C. A. White, 1887, Philadelphia Acad. Nat. Sci. Proc. 1887, p. 40, 44; 1887, Am. Jour. Sci., 3d, v. 33, p. 296, 298.

Crops out coextensive with region known as Lower Cross Timbers.

Timbered Hills Group[1]

Upper Cambrian: Southern Oklahoma.

Original reference: C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55–57.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 15–20. Includes (ascending) unnamed basal limestone 98 feet thick, Reagan sandstone, Cap Mountain formation, and Honey Creek formation. Derivation of name given.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000) : U.S. Geol. Survey. As mapped, includes Honey Creek formation and Reagan sandstone.

Named because Reagan and Honey Creek are well exposed adjacent to East and West Timbered Hills in Arbuckle Mountains.

Timber Lake Member (of Fox Hills Formation)

Upper Cretaceous: North-central South Dakota and southern North Dakota.

R. E. Morgan and B. C. Petsch, 1945, South Dakota Geol. Survey Rept. Inv. 49, p. 15–17, fig. 4, pl. 3. Lower part commonly soft or uncemented uniform sand; upper part contains calcareous lens-shaped concretionary masses, thin limonitic claystones, and soft mottled sandstone. Thickness about 90 feet. Overlies Trail City member (new); underlies unnamed sandstones and shales in upper part of formation.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 11–12, 37. Geographically extended into Emmons County, N. Dak., where it is about 60 feet thick and consists of uncemented fine- to medium-grained green-brown and gray sands. Thins eastward. Overlies Trail City member.

R. E. Stevenson, 1957, Areal geology of the McIntosh quadrangle (1:62,500) : South Dakota Geol. Survey. Underlies Bullhead member (new).

Named for exposures in and near town of Timber Lake, Dewey County, S. Dak.

Times Porphyry[1]

Tertiary, middle or upper: Northwestern Arizona.

Original references: F. L. Ransome, 1923, U.S. Geol. Survey Bull. 743; Carl Lausen, 1931, Arizona Bur. Mines Bull. 131, Geol. Ser. 6, p. 45, map.

Exposed in Times Gulch, Oatman district.

Timms Point Silt Member (of San Pedro Formation)

Timms Point Formation[1]

Timms Point Silt

Pleistocene, lower: Southern California.

Original reference: U.S. Grant, IV, and H. R. Gale, Nov. 3, 1931, San Diego Soc. Nat. History Mem., v. 1, p. 37, 42–43.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 42–53, pls. 1, 13, 14. Described as Timms Point silt. In San Pedro where units are superimposed, the sequence is (ascending) Lomita marl, Timms Point silt, and San Pedro sand. Exposed thickness 30 to 80 feet; minimum computed thickness about 120 feet. Lower Pleistocene.

J. F. Poland, A. M. Piper, and others, 1956, U.S. Geol. Survey Water-Supply Paper 1109, p. 38 (table), 61, pl. 3. Rank reduced to member of San Pedro formation.

Type section: Timms Point, Los Angeles County.

Timothy Sandstone[1]

Timothy Sandstone Member (of Thaynes Formation)

Timothy Formation

Lower Triassic: Southeastern Idaho, central northern Utah, and central western Wyoming.

Original references: G. R. Mansfield, 1920, Am. Jour. Sci., 4th v. 50, p. 62; 1920, U.S. Geol. Survey Bull. 713, p. 29, 50.

W. F. Scott, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1530. Formation comprises 1,310 feet of red shales and siltstones, with interbedded reddish-purple and reddish-brown sandstones in central Wasatch Mountains, Utah.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 33–34, pl. 1. Sandstone has conformable contacts with Portneuf limestone below and Higham grit above where mapped in Ammon and Paradise Valley quadrangles, Idaho. Upper Triassic.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 173, fig. 18. Upper member of Thaynes formation in southeastern Idaho where it overlies Portneuf limestone member. Correlation chart shows age to be both Lower and Upper Triassic.

W. F. Scott, 1954, Dissert. Abs., v. 14, no. 8, p. 1200. Included in Moenkopi group.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 45–46. Red shale, siltstone, and sandstone overlying Thaynes formation in northwestern Wyoming referred to Timothy sandstone. Thickness between 159 to 278 feet.

Named for Timothy Creek, in Lanes Creek and Freedom quadrangles, Idaho, which cuts formation.

Timpahutean series[1]

Timpahuten series[1]

Middle Silurian: Nevada.

Original references: C. R. Keyes, 1923, Pan-Am Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist. v. 41, p. 78.

Name derived from Timpahute Peak, north of Las Vegas, Clark County.

Timpanogos (Tampanogos) shales[1]

Cambrian: Utah.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 38.

Derivation of name not stated.

†Timpas Limestone (in Colorado Group)[1]

Timpas Limestone Member (of Niobrara Formation)

Upper Cretaceous: Eastern Colorado and northeastern New Mexico.

Original reference: G. K. Gilbert, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 2, p. 566.

W. A. Cobban and J. B. Reeside, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10b (columns 48, 49, 52). Shown on correlation chart as member of Niobrara formation. Underlies Apishapa shale member.

K. M. Waagé, 1952, Colorado Sci. Soc. Proc., v. 15, no. 9, p. 375 (fig. 1). Shown on generalized stratigraphic section of rocks exposed in Denver-Golden area. Underlies Apishapa shale; overlies Benton shale. Thickness 30 feet.

M. A. Jenkins, Jr., 1957, Rocky Mountains Assoc. Geologists Guidebook to the geology of North and Middle Parks Basins, Colorado, p. 53. Believed that names Fort Hays and Smoky Hill have priority over terms Timpas and Apishapa and, is used, would help standardize Niobrara terminology in west-central Colorado.

Named for Timpas Creek, which enters Arkansas River below Rocky Ford, Otero County, Colo.

Timpoweap Member (of Moenkopi Formation)

Lower Triassic: Central southern Utah.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 226, 227; 1950, U.S. Geol. Survey Prof. Paper 220, p. 48 (fig. 24), 52 (table), 60–61. Consists of three unlike groups of strata: at base, conglomerates and breccia; higher up limestone; and at top variegated shales. Average thickness 170 feet. Conglomeratic beds unevenly distributed and variable in composition; shales, yellow, white, brown, and red, ferruginous, calcareous, arenaceous, and gypsiferous, includes calcareous sandstone in beds 1 to 3 feet thick. Basal member of formation; separated from overlying Virgin limestone member by 200-foot interval of sandstone termed lower red member; unconformably overlies Kaibab limestone.

Type locality: Near Virgin City, Washington County. Traced eastward from type locality to Paria River. [River map shows Virgin, Washington County, and Timpoweap Canyon of Virgin River, Washington County.]

Tina Limestone Member (of Altamont Limestone)

Pennsylvanian (Des Moines Series): Kansas and Missouri.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 29, 40. Proposed for lower limestone member of Altamont. Light-gray limestone; weathers buff. Thickness in Livingston and Carroll Counties, Mo., about 4 feet.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 2, p. 329–330. Geographically extended into eastern Kansas. Thickness as much as 16 feet. Underlies Lake Neosho shale member (new); overlies Bandera shale. It is unlikely that all limestone included in the Tina in Kansas is precisely equivalent to type Tina.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 7. Term Tina abandoned. Rocks chosen for type Tina have proved not to be Altamont. Name Amoret replaces Tina.

Typical exposures: About 2 miles southeast of Tina, Carroll County, Mo., in ravines in west-central part of sec. 7, T. 54 N., R. 22 W.

Tinaquaic Sandstone Member (of Sisquoc Formation)

Pliocene, lower and middle: Southern California.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1347–1352. Name applied to marginal facies of Sisquoc formation. Consists principally of sandstone; includes diatom-bearing siltstone and conglomerate. In type region, member is 1,400 feet thick and rests unconformably on Monterey.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 28, 29, pl. 1. Lower and middle Pliocene.

Type region: In Foxen Canyon-Sisquoc River area, Santa Maria district. Name derived from land grant in type region.

Tincanebits Member (of Lyndon Limestone)

Tincanebits Tongue [in Bright Angel Shale]

Lower and (or) Middle Cambrian: Northwestern Arizona.

E. D. McKee, 1945, Carnegie Inst. Washington Pub. 563, p. 14 (fig. 1), 29, 80–82. Rusty-brown dolomite tongue in Bright Angel shale of western Grand Canyon. Thickness ranges from 8½ to 30 feet. Separated from underlying red-brown cliff-forming unit of Bright Angel by 30 to 100 feet of micaceous green shale and thin-bedded brown siltstone. Lateral equivalent of certain limestone beds found in area west of Grand Canyon that probably constitute a member of the Muav, which is lower than any member within the Grand Canyon. Older than Meriwitica tongue (new).

H. E. Wheeler and V. S. Mallory, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 10, p. 2413 (fig. 2). In generalized paper on the designation of stratigraphic units, Tincanebits shown on diagram as member of Lyndon limestone.

In western Grand Canyon. Traced along walls of canyon for many miles.

Tincup Quartz Monzonite Porphyry

Paleocene(?) to Oligocene(?): Central Colorado.

M. G. Dings and C. S. Robinson, 1957, U.S. Geol. Survey Prof, Paper 289, p. 20–21, pl. 1. Typical rock consists of very conspicuous phenocrysts of white feldspar, colorless to slightly smoky quartz, and less abundant dark hornblende in a light-greenish-gray to grayish-green aphanitic groundmass. Porphyry masses occur in several forms, such as a stock, sills, a large tongue or wedge-shaped body, and two small irregular bodies with exposed lengths of less than half a mile. Probably older than Mount Princeton quartz monzonite.

Type locality: In a stock west of Napoleon Pass in Tincup mining district, Garfield quadrangle.

Tindir Group[1]

Precambrian and Lower Cambrian(?): Northeastern Alaska.

Original reference: D. D. Cairnes, 1914, Geol. Soc. America Bull., v. 25, p. 185–187.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1 :2,500,000): U.S. Geol. Survey. Appears on map legend.

Named for exposures along international boundary between Tindir, Cathedral, and Harrington Creeks. Yukon-Tanana region.

Tinian Beds

Oligocene (Aquitanian): Mariana Islands (Tinian).

Risaburo Tayama, 1936, Geomorphology, geology, and coral reefs of Tinian Island together with Aguijan and Naftan Islands: Tohoku Univ., Inst. Geology and Paleontology Contr. in Japanese language, no. 21, p. 20–21 [English translation in library of U.S. Geol. Survey, p. 19–20]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 53, table 4 [English translation in library of U.S. Geol. Survey, p. 63]. Andesitic tuff in lower part and tuffaceous and calcareous sandstone in upper part. Base is coarse-grained tuffaceous sandstone, overlain by sequence of white sandy tuff, light-pink sandy tuff, yellowish sandy tuff, and light-pink sandy tuff; several thin beds of light-yellow sandstone containing limestone blocks intercalated; contains many *Globigerina*. Thickness about 30 meters.

Typically exposed along cliff bounding northeastern margin of Carolinas plateau of Tinian Island.

Tinkers Creek shale facies (of Cuyahoga Formation)

Mississippian (Kinderhook): Northeastern Ohio.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172; 1942, Jour. Geology. v. 50, no. 1, p. 43 (fig. 2), 51–53. One of seven lithologic subdivisions in the formation. Includes Meadville shale, Sharpsville sandstone, and Orangeville shale members. Lies to northeast of River Styx facies (new).

Occurs in Cuyahoga, Geauga, Trumbull, and Ashtabula Counties.

Tinkers Falls Member[1] (of Tully Formation)

Middle Devonian: Central New York.

Original reference: G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, p. 790–806.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1787, chart 4. Middle Devonian.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 29–33. Tully type section consists of following members: Tinkers Falls, Apulia, and West Brook. In the clastic facies of the Tully, the Tinkers Falls is represented by New Lisbon member.

Type section: Just under main overhanging ledge in face of Tinkers Falls, Onondaga County.

Tinley Drift or Till

Pleistocene (Wisconsin): Northern Illinois.

J. H. Bretz, 1939, Illinois Geol. Survey Bull. 65, pt. 1, p. 55. Incidental mention.

Leland Horberg and P. E. Potter, 1955, Illinois Geol. Survey Rept. Inv. 185, p. 9 (fig. 2), 10. Clayey yellow-gray to gray calcareous till about 15 feet thick. Overlies Valparaiso till in some areas and in others Lemont till or drift.

Derivation of name not given; till is present in gravel pit at Worth, Cook County, not far from Tinley Park.

Tin Mountain Limestone

Lower Mississippian: Southern California.

J. F. McAllister, 1952, California Div. Mines Spec. Rept. 25, p. 3, 14 (fig. 6), 20–22, pls. 1, 2, 3. Lower part consists of dark-gray limestone in beds 2 to 6 inches thick, separated by much thinner beds of light-brownish-gray

to pale-red shale; upper part is medium-gray limestone in beds that range in thickness from a few inches to 2 feet; both upper and lower parts contain some dark-gray chert, that weathers dusky brown or dark yellowish brown; fossiliferous. Thickness 475 feet at type locality. Underlies Perdido formation (new); overlies Devonian Lost Burro formation (new).

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pub. Geol. Sci., v. 38, no. 2, p. 92–97, 132–134, 135–136. In Quartz Spring area, overlies Quartz Spring sandstone member (new) of Lost Burro formation. Thickness about 366 feet. Underlies Perdido formation. Lower Mississippian.

Type locality: Southern slope of hills about 2½ miles southeast of Quartz Spring, Inyo County, and about 3,000 feet north of road to Rest Spring, where entire sequence is exposed. Named for Tin Mountain, northernmost peak in Panamint Range, Inyo County.

†Tintic Andesite[1]

Tertiary: Central northern Utah.

Original reference: G. W. Tower, Jr., and G. O. Smith, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3.

Tintic district.

Tintic Quartzite[1]

Lower and Middle Cambrian: Central and northern Utah.

Original reference: G. O. Smith, 1900, U.S. Geol. Survey Geol. Atlas, Folio 65.

A. J. Eardley and R. A. Hatch, 1940, Geol. Soc. America Bull., v. 51, no. 6, p. 809 (fig. 3), 815. Extended northward to Willard Canyon [between Ogden and Brigham City] where it underlies Ophir shale and overlies Farmington Canyon complex.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 826 (table 1), 827–828. In north-central Wasatch Mountains, dominantly pink and gray quartzite, with some beds of buff, red, and blood-purple varieties; intraformational conglomerate beds common. Basal conglomerate 100 feet thick occurs in Cottonwood Canyon where it is in sedimentary contact with Farmington Canyon complex; basal conglomerate not present in Ogden Canyon. Approximately 1,000 feet thick in Cottonwood-Durst Peak area; 500 to 700 feet in front range of Wasatch. Unconformably overlies crystalline complex. Underlies Ophir shale. Name Tintic is preferred to Brigham quartzite in this area. Lower(?) Cambrian.

A. A. Baker, J. W. Huddle, and D. M. Kinney, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1165–1167. Extended into Uinta Basin. In Cottonwood-America Fork district about 800 feet thick; underlies Ophir formation; overlies Precambrian. Lower Cambrian.

A. E. Granger and others, 1952, Utah Geol. Soc. Guidebook 8, p. 7. In Wasatch Mountains, east of Salt Lake City, unconformably overlies Mutual formation (new). Underlies Ophir shale.

F. W. Christiansen, 1952, Geol. Soc. America Bull., v. 63, no. 7, p. 720 (table 1), 721–722. In Canyon Range 1,500 feet thick; underlies Ophir formation and overlies Precambrian.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2736 (fig. 1), 2737 (fig. 2), 2738–2739. In western Uinta Mountains,

overlies Red Pine shale (new), which replaces Ophir of previous reports. As used here, Tintic quartzite replaces Pine Valley quartzite.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 4, 5 (fig. 2). In East Tintic Mountains 2,300 to 3,200 feet thick; underlies Ophir formation and overlies Big Cottonwood(?) formation. Lower Cambrian.

J. K. Rigby, 1958, Utah Geol. Soc. Guidebook 13, p. 8–9, 14 (fig. 3). In Stansbury Mountains 4,200 feet thick with base not exposed; at least four subdivisions recognized. Underlies Pioche shale.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 667. Within area of this report [northern Utah and southeastern Idaho], rocks previously assigned to Tintic quartzite belong in Prospect Mountain formation.

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 30–32, pl. 1. In Sheeprock Mountains 2,572 feet thick; underlies Ophir group, which includes Pioche shale at base, and unconformably overlies Talawag quartzite member (new) of Mutual(?) formation.

Named for exposures in Tintic Canyon and other places in Tintic district.

†Tintic Slate[1]

Lower and Middle Cambrian: Central northern Utah.

Original reference: G. W. Crane, 1915, Am. Inst. Mining Engrs. Bull. 106, p. 2149–2151.

Tintic district.

Tinton Sand Member (of Red Bank Sand)[1]

Tinton Formation (in Monmouth Group)

Tinton Member (of Monmouth Formation)

Upper Cretaceous: New Jersey.

Original references: S. Weller, 1905, New Jersey Geol. Survey Ann. Rept. 1904, p. 147, 154–159; 1905, Jour. Geology, v. 13, p. 76, 81.

P. H. Jennings, 1936, Bulls. Am. Paleontology, v. 23, no. 78, p. 4, 5 (chart). Referred to as Tinton formation in Monmouth group.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 40, 51–52. Reallocated to member status in the Monmouth herein reduced to formational rank. Conformably overlies Red Bank member; conformably underlies Hornerstown formation. Where best developed in Monmouth County, reaches maximum thickness of 25 feet; dips about 20 feet per mile southeast and cannot be recognized south of Red Valley in southern part of county.

S. K. Fox, Jr., and R. K. Olsson, 1955, [abs.] Jour. Paleontology, v. 29, no. 4, p. 736. Upper Cretaceous Navesink, Red Bank, and Tinton are formations with distinct microfaunas indicating time differences. The Tinton may be post-Navarro and pre-Midway. Stratigraphic evidence indicates an unconformity between Cretaceous and Tertiary formations. Hornerstown rests successively from northeast to southwest on the Tinton, Red Bank and Navesink.

R. K. Olsson, 1959, Dissert. Abs., v. 19, no. 8, p. 2063–2064. In area of this report, New Egypt formation (new) of outcrop area is lateral equivalent of Tinton formation and in subsurface represents both Tinton and Hornerstown.

R. K. Olsson, 1960, Jour. Paleontology, v. 34, no. 1, p. 2, 4 (fig. 2). Overlies Shrewsbury member of Red Bank formation. Foraminifera described.

Exposed at Tinton Falls, Monmouth County.

Tioga Bentonite Bed (in Seneca Member of Onondaga Limestone)

Middle Devonian: Pennsylvania (subsurface), Maryland, New York, Ohio, Virginia, and West Virginia.

J. R. Ebright, C. R. Fettke, and A. I. Ingham, 1949, Pennsylvania Geol. Survey, 4th ser., Bull. M–30, p. 10; C. R. Fettke, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 10, p. 2038–2040. Thin but persistent seam of brown micaceous shale, commonly containing abundant pyrite; constitutes marker in Middle Devonian. Occurs at or near boundary between Hamilton group and Onondaga formation; shale seam appears to be bentonitic and will be referred to as Tioga bentonite.

W. A. Oliver, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 7, p. 629, 631 (fig. 2), pl. 1. At base of Seneca member in central New York is a uniform bed of clay 6 inches thick; this is Tioga bentonite which has been recognized in subsurface throughout Pennsylvania and adjacent parts of West Virginia, Ohio, and southwestern New York. Surface exposures of bentonite are deeply weathered and clean samples are rare.

J. M. Dennison, 1960, Dissert. Abs., v. 21, no. 3, p. 593. Top of Tioga metabentonite proposed as top of Onesquethaw stage. The Tioga is present in subsurface between New York and central Appalachian sections and crops out in New York in addition to 45 known localities in West Virginia, Virginia, and Maryland.

So named because it was first recognized in drill cuttings from Tioga gas field, Tioga County, Pa.

Tioga Glaciation, Till

Tioga glacial stage[1]

Pleistocene: Eastern California.

Original reference: E. Blackwelder, 1931, Geol. Soc. America Bull., v. 42, p. 865–922.

W. C. Putnam, 1949, Geol. Soc. America Bull., v. 60, no. 8, p. 1281, 1291–1292. At least four ice advances occurred in Pleistocene: earliest, here named Aeolian Buttes, was followed by Sherwin, Tahoe, and Tioga, previously named by Blackwelder. Constructional forms have been destroyed on the two older tills but preserved on the later ones. Rhyolitic ash and pumice, now Bishop welded tuff, were erupted in interval between Aeolian Buttes and Sherwin glacial stages.

W. C. Putnam, 1960, California Univ. Pubs., Geol. Sci., v. 34, no. 5, p. 235, 238–239, map 1. Sherwin till is pre- rather than post-Bishop tuff. Name Aeolian Buttes considered invalid as representing an earlier Pleistocene, pre-Sherwin glacial stage. Hence glacial sequence is McGee, Sherwin, Tahoe, and Tioga.

Name amended to glaciation in compliance with 1961 Code of Stratigraphic Nomenclature.

Occurs in Tioga Pass area on eastern slope of Sierra Nevada.

Tioga magnafacies[1]

Upper Devonian: Central northern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 23.

K. E. Caster, 1938, Jour. Paleontology, v. 12, no. 1, p. 52 (fig. 9). Upper Devonian.

Tioga-Elkland region.

Tionesta Clay (in Pottsville Formation)[1]

Tionesta clay member or underclay member

Pennsylvanian (Pottsville Series) : Eastern Ohio.

Original reference : E. Orton, 1884, Ohio Geol. Survey, v. 5.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 39. Included in Tionesta cyclothem, Pottsville series.

R. E. Lamborn, 1956, Ohio Geol. Survey, 4th ser., Bull. 55, p. 44–49, geol. map. In Tuscarawas County, Tionesta clay member (Pottsville series) is dark gray, plastic, and 2 to 3 feet thick. Occurs below Tionesta coal and above Upper Mercer limestone member.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 46, 49 (table 7). Underclay member of Tionesta cyclothem in report on Athens County. Average thickness 1⅓ feet. Pottsville series.

Name derived from Tionesta, Forest County, Pa.

Tionesta cyclothem

Pennsylvanian (Pottsville Series) : Southeastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 39, table 1, geol. map. Includes (ascending) Tionesta shale and (or) sandstone, 5 feet; Tionesta clay, 6½ feet; Tionesta No. 3b coal. Occurs above Bedford cyclothem and below Brookville cyclothem of Allegheny series. In area of this report [Perry County], Pottsville series is described on a cyclothemic basis ; 10 cyclothems are named. [For sequence see Anthony cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 44–46, 49 (table 7). Rogers (1858) named Tionesta group from exposures along Allegheny River near village of Tionesta, Forest County, Pa. Orton (1884) recognized Tionesta members in Ohio. Tionesta cyclothem is incomplete and in Athens County [this report] has only three members: Tionesta shale and sandstone, Tionesta underclay, and Tionesta coal. Uppermost cyclothem of Pottsville series.

Name derived from Tionesta, Forest County, Pa.

†Tionesta Group (in Pottsville Formation)[1]

Pennsylvanian : Northwestern Pennsylvania.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477.

Named for exposures along Allegheny River near village of Tionesta, Forest County.

Tionesta Iron Shales (in Pottsville Formation)[1]

Pennsylvanian : Northwestern Pennsylvania.

Original reference: I. C. White, 1879, Pennsylvania Geol. Survey Rept. Q_2.

†Tionesta Sandstone (in Pottsville Formation)[1]

Tionesta sandstone and shale member

Pennsylvanian: Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: H. D. Rogers, 1858, Geology Pennsylvania, v. 2, pt. 1, p. 474–477, 489, 490.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 46, 49 (table 7). Tionesta sandstone and shale member of Tionesta cyclothem in report on Athens County. Rogers (1858) applied name Tionesta to present

Homewood sandstone, but Tionesta, as now applied to clastic members is restricted to shale and sandstone below Tionesta underclay and overlying Upper Mercer cyclothem. Maximum thickness less than 12 feet. Full thickness not exposed in Athens County. Pottsville series.

Name derived from Tionesta, Forest County, Pa.

Tionesta Series[1]

Pennsylvanian: Western Pennsylvania.

Original reference: F. Platt, 1875, Pennsylvania 2d Geol. Survey Rept. H, p. 8–9.

Tioughnioga Group

Tioughnioga Stage

Middle Devonian (Erian): North America.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1733, chart 4. Devonian is subdivided into 10 stages of which the Tioughnioga is fifth in sequence (ascending). Follows Cazenovia and is followed by the Taghanic (or Taughannock). [For complete sequence see Helderberg stage this reference.] Interval embraced is from base of Centerfield to base of Tully limestone. Includes the Ludlowville and Moscow formations which are closely related faunally and are mainly restricted to eastern part of Devonian geosyncline. Except for the Centerfield and its equivalents, stage is not represented in Ohio and Mississippi Valleys.

A. T. Cross and J. H. Hoskins, 1951, Jour. Paleontology, v. 25, no. 6, p. 718 (fig. 3). Shown on composite stratigraphic column of western New York and northwestern Pennsylvania as Tioughnioga group. Includes Ludlowville and Moscow formations. Overlies Cazenovia group; underlies Taughannock group.

Name is taken from headwaters of Tioughnioga River in south half of Cazenovia quadrangle, New York.

Tippah Sand Lentil (in Porters Creek Clay)

Tippah Sandstone Member (of Porters Creek Clay)[1]

Paleocene: Northeastern Mississippi and southwestern Tennessee.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 64.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 10–11. Rank reduced to lentil in lower part of Porters Creek clay. Formerly believed to lie at top of Porters Creek and correlated with Naheola formation of Alabama, however, it is lower stratigraphically than type exposures of Porters Creek. Consists of loose white to yellow glaucontic *Halymenites*-bearing sand with some calcareous ledges, especially at top and bottom. Type locality suggested as none designated previously.

Type locality: Exposures on south side of valley of Hurricane Creek in SW¼SE½, T. 2 S., R. 3 E., Tippah County, Miss.

Tippecanoe sequence

Ordovician (Chazyan to Mohawkian): Central and western United States.

L. L. Sloss, W. C. Krumbein, and E. C. Dapples *in* C. R. Longwell chm., 1949, Geol. Soc. America Mem. 39, p. 112 (table 2), 115. An "operational unit" for use in interregional facies analysis. Named from Tippecanoe County, Indiana. Wells drilled in area start in lower Mississippian or

upper Devonian and penetrate a full section of sequence from base of New Albany shale to base of St. Peter sandstone. Formational limits in Kansas are Hunton dolomite-Simpson formations; in Wyoming Bighorn dolomite.

Tippipah Limestone

Lower Pennsylvanian to Lower Permian (?) : Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 360–363, pls. 32, 33. Subdivided into four units (ascending) A through D, all of which consist of limestone. Unit A, 295 feet thick, consists of four zones of alternating resistant and nonresistant limestone. Unit B, about 580 feet thick, consists of light-gray, buff, lavender, and light-purplish silty limestone. Unit C, about 2,035 feet thick, is alternating sequence of resistant and nonresistant light- to medium-gray and brown limestone. Unit D, 1,195 feet thick, consists of alternating resistant and nonresistant beds, but principal difference is that beds of D are thicker and definitely more massive than beds of C. Overlies Eleana formation (new) with conformable contact.

Named for exposures on Syncline Ridge, about a mile east of Tippipah Spring, Atomic Energy Commission Nevada proving grounds area, Nye County. Also exposed about one-half mile north of Syncline Ridge in single outcrop which is surrounded by alluvium, and in a few areas along north end of Mine Mountains.

Tipton sandstone[1]

Tiptonian series

Precambrian (Protozoic) : Northwestern Iowa.

Original references: C. R. Keyes, 1914, Iowa Acad. Sci. Proc., v. 21, p. 187; Science, new ser., v. 40, 144.

C. R. Keyes, 1937, Pan-Am. Geologist, v. 67, no. 4, p. 307–309. Referred to as Tiptonian series, Protozoic. Tiptonian series (sandstones) occur above Keeweenawan series. Beds do not crop out in Iowa but reach surface in Minnesota.

Derivation of name not stated.

Tipton Shale Member or Tongue (of Green River Formation)[1]

Eocene, lower: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

Original reference: A. R. Schultz, 1920, U.S. Geol. Survey Bull. 702.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 101, 102. In its type area Tipton tongue separates Niland (new) and Cathedral Bluffs tongues of Wasatch formation. Thickness about 250 feet at type locality. Lower part of Tipton is probably early Eocene; age of upper part uncertain.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1073–1074. Underlies Wilkins Peak member (new).

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 40 (fig. 4), 41–42. Geographically extended into Daggett County, Utah. Here Green River formation is broken by unconformity. Beds below unconformity are here considered Tipton tongue, and beds above unconformity as main body of Green River equivalent to Cathedral Bluffs member of Wasatch and Laney shale of Green River as mapped farther east.

Named for exposures in vicinity of Tipton, a station on Union Pacific Railroad in Sweetwater County, Wyo.

Tip Top Sand[1]

Mississippian (Chester) : Western Kentucky.

Original reference: A. H. Sutton, 1931, Kentucky Geol. Survey, ser. 6, v. 37, p. 275, 285.

L. L. Ray, A. P. Butler, Jr., and C. S. Denny, 1947, Kentucky Dept. Mines Minerals Geol. Div. ser. 8, Bull. 9, p. 16. Deposit at Tip Top, the so-called Tip Top sand, has been shown to be Chester in age and to be extension of lowest sandstone of Chester group, correlated with the Mooretown. Name Tip Top sand as proposed by Sutton (1931) is unnecessary and should be abandoned.

Exposed along Dixie Highway about one-quarter to one-half mile northwest of Illinois Central station of Tip Top. Deposit lies partly in Hardin and partly in Meade County.

†Tisbury Beds[1] or Gravel[1]

Pleistocene: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 975–988, chart.

Well exposed in Chilmark and West Tisbury [Marthas Vineyard], Dukes County.

Tishomingo Granite[1]

Precambrian : Central southern Oklahoma.

Original reference : R. T. Hill, 1891, Am. Jour. Sci., 3d, v. 42, p. 118.

C. W. Tomlinson, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1831. Washita Valley fault zone borders south side of Tishomingo anticline, which contains largest area of Precambrian rocks now exposed in Arbuckle Mountains; here the Tishomingo granite, with a narrow discontinuous border of overturned Reagan sandstone (Cambrian), is thrust southwestward on this fault plane over younger rocks to and including Caney shale (Mississippian), with maximum stratigraphic displacement about 11,000 feet.

Named for Tishomingo, Johnston County.

Titus Canyon Formation[1]

Oligocene, lower: Southeastern California.

Original reference: C. Stock and F. D. Bode, 1935, Nat. Acad. Sci. Proc., v. 21, no. 1, p. 571–579.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 33, pl. 1. Early Chadronian (lower Oligocene).

Type locality: Titus Canyon, near Leadfield. Area now in Death Valley National Monument.

Ti Valley Series

Pennsylvanian : Oklahoma, Iowa, Kansas, Missouri, and Texas.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2), 18–19; 1947, Jour. Geology, v. 55, no. 3, pt. 2, p. 268. Used to include all Pennsylvanian formations in the Midcontinent between base of Pennsylvanian system and base of Des Moines series. Name is suggested as a

solution for the Morrow-Atoka-Lampasas-Marble Falls nomenclatural problem.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey.

Formations exposed in Ti Valley, on borderline between Arbuckle and Ouachita Mountains, east-central [Pittsburg County] Oklahoma contain beds ranging in age from Morrow through Atoka.

Tiverton Arkose[1]

Carboniferous: Southeastern Rhode Island.

Original reference: A. F. Foerste, 1899, U.S. Geol. Survey Mon. 33, p. 378–379.

Extends along escarpmemt from Steep Brook to Tiverton Four Corners, eastern part of Newport County and exposed at several places in Tiverton.

Tivola Tongue (of Ocala Limestone)[1]

Tivola Member (of Ocala Limestone)

Eocene, upper: Central Georgia.

Original reference: C. W. Cooke and H. K. Shearer, 1918, U.S. Geol. Survey Prof. Paper 120–C, p. 51–56.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 331–333. In this report [Jackson group of Georgia], unit is termed Tivola member of Ocala limestone. Commonly a soft friable exceedingly fossiliferous limestone. North of Hawkinsville, Pulaski County, a massive bed of dense white argillaceous limestone, well stained with red iron oxide, is identified as the Tivola member on basis of a fossil assemblage of lower upper Ocala age. To west of main outcrop of the Tivola, a prominent thick outlier of the unit unconformably overlies eroded Tuscaloosa surface. Merges laterally into Twiggs clay member of Barnwell formation as far south as Dooling, Dooly County. Type locality stated.

Type locality: At village of Tivola, 1 mile north of Penn-Dixie cement quarry at Clinchfield, Houston County. Extends from Houston County northeastward in not too widely separated outcrops into Twiggs, Wilkinson, and Bleckley Counties. Northeasternmost exposure is south of Gordon, Wilkinson County.

Toa Vaca Formation

Upper Cretaceous (Santonian): Puerto Rico.

E. A. Pessagno, Jr., 1960, Geology of the Ponce-Coamo area, Puerto Rico: Puerto Rico Econ. Devel. Adm. and Princeton Univ. Dept. Geology, p. 44–47. Composed of 90 percent tuff breccia, 5 percent andesite flows, and 5 percent tuffaceous mudstones and sandstone. Lack of altitude makes it impossible to calculate thickness of formation. Overlies Ildefonso formation (new). Unconformably overlain by Eocene Jacaguas group (new). Includes Río Jueyes and Guayama series of Hodge (1920).

E. A. Pessagno, Jr., 1960, Caribbean Geol. Conf., 2d, Mayagüez, Puerto Rico, 1959, Trans., p. 83–84. Consists of about 11,000 feet of coarse pyroclastics; andesite flows comprise about 1 to 2 percent of unit. Overlies lower part of Santa Ana formation (new); interfingers with Santa Ana to east and with unnamed Cretaceous sediments to west. Footnote states that name Santa Ana is no longer used; unit is termed Idlefornso [Ildefonso].

Type area: Along bed of Río Toa Vaca north of Route 150 and south of Orocovis quadrangle. Toa Vaca River drains northwestern part of Río Descalabrado quadrangle.

Tobin Formation

Lower Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]. Coarse conglomerate, at base locally fanglomerate, followed by about 50 feet of massive sandy dolomite and several hundred feet of shales with occasional calcareous nodules and thin seams of shaly limestone. Andesite lava flow 100 feet thick near base at south end of Tobin Range. Thickness variable, generally about 500 feet. Maximum thickness of 1,000 feet in northwest part of Augusta Mountain. Underlies Dixie Valley formation (new); overlies Koipato formation with angular unconformity.

Type locality: South end of Tobin Range.

Toboso conglomerate facies[1] (of Cuyahoga Formation)

Mississippian (Kinderhook): Central Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 667–669.

F. T. Holden, 1942, Jour. Geology, v. 50, no. 1, p. 44. Includes (descending) Berne, Black Hand conglomerate, and Pleasant Valley (new) members. Occurs between Killbuck shale facies (new) to northeast, and Granville shale facies to the southwest.

Probably named for occurrence at Toboso, Licking County.

†Tobucksy Sandstone[1]

Tobucksy Sandstone (in Hartshorne Formation)

Pennsylvanian (Des Moines Series): Southeastern Oklahoma.

Original reference: H. M. Chance, 1890, Am. Inst. Min. Engrs. Trans., v. 18, p. 658, 659.

C. C. Branson *in* E. W. Reed, S. L. Schoff, and C. C. Branson, 1955, Oklahoma Geol. Survey Bull. 72, p. 64. Hartshorne formation, at its type locality, consists of Upper Hartshorne coal, "Hartshorne sandstone", Lower Hartshorne coal and underclay, and shale tongues locally developed between these members; the specific sandstone called Hartshorne is given its older but seldom used name, Tobucksy sandstone, conferred upon it by Chance (1890).

Type locality of Hartshorne formation is in Pittsburg County.

Toccoa Quartzite[1]

Precambrian or Lower Cambrian: Northeastern Georgia.

Original reference: S. L. Galpin, 1915, Georgia Geol. Survey Bull. 30, p. 120.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 42, Toccoa quartzite of Galpin (1915) is fine-grained phase of Lithonia granite.

Crops out for 2 miles east of Ayersville to within about 1½ miles of Toccoa. Named from exposures in ballast quarry north of Southern Railway and about 2 miles west of Toccoa, Stephens County.

†Tocito Sandstone Lentil (of Mancos Shale)[1]

Upper Cretaceous: Northwestern New Mexico.

Original reference: J. B. Reeside, Jr., 1924, U.S. Geol. Survey Prof. Paper 134.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 28–29. Unit sometimes called Tocito sandstone lentil of Mancos in area adjacent to San Juan River is correlative of Gallup sandstone member and part of Dilco coal member of Mesaverde of southern San Juan basin region. Suggested that name Tocito be dropped.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2156. In revised nomenclature of Mesaverde group in San Juan basin, New Mexico, name Gallup sandstone replaces Tocito sandstone lentil of Mancos shale.

Named for outcrops near Tocito trading post, San Juan County.

Todd Valley Formation[1] **or Sand**

Pleistocene: Eastern Nebraska.

Original reference: A. L. Lugn, 1934, Nebraska State Mus., v. 1, Bull. 41, p. 324, 349–350.

G. C. Lueninghoener, 1947, Nebraska Univ. Studies, new ser. no. 2, p. 17. Formation as defined by Lugn included all fluviatile sands and gravels in Todd Valley. Term is herein redefined to apply only to uppermost part of fill consisting of gray-white fine sands in Todd Valley and their equivalents in other valleys. Thickness of redefined formation ranges from 0 to 50 or more feet.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1950, Nebraska Geol. Survey Bull. 15–A, p. 30–31. Sand rests unevenly on eroded Loveland loess, Crete sands and gravels, and older beds. Sand of this age and condition of occurrence are found at places in Platte Valley westward to near North Platte and generally in Elkhorn, Logan, Salt Creek, and other valleys. Upper surface of formation in Todd Valley was extensively wind modified after deposition resulting in loess-mantled dunelike topography. Age of Todd Valley deposition proper is Iowan, and only upper part of Lugn's Todd Valley formation at type locality is of this age.

Named for occurrence in Todd Valley, an old filled valley of Platte River, Saunders County.

Todilto Limestone (in San Rafael Group)

Todilto Limestone Member (of Morrison Formation)[1]

Todilto Limestone Member (of Wanakah Formation)

Upper Jurassic: Northwestern New Mexico, northeastern Arizona, and southwestern Colorado.

Original references: H. E. Gregory, 1916, U.S. Geol. Survey Water-Supply Paper 380; 1917, U.S. Geol. Survey Prof. Paper 93.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 9, 55, pls. Member of Morrison formation.

W. L. Stokes, 1944, Geol. Soc. America Bull., v. 55, no. 8, p. 958–959. Todilto limestone can be correlated with San Rafael group and dated as Upper Jurassic by marine beds in group.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1668. Todilto is transitional downward into Entrada sandstone and at many localities is overlain on erosional unconformity by clastic beds of Morrison formation. Evidence seems to indicate that Todilto should be regarded as representative of the Curtis or perhaps the Summerville. Area of outcrop above the Entrada extends northward into area beneath which thinning edge of Kayenta formation

dies out between merging sandstone of Navajo and Wingate. Todilto is removed from Morrison formation, and term Wanakah formation is extended into New Mexico and northeastern Arizona. Todilto and overlying gypsum beds, where present, are members of the Wanakah.

C. T. Smith, 1951, *in* New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 13 (chart), 38; C. T. Smith, 1954, New Mexico Bur. Mines Mineral Resources Bull. 31, p. 14–15, pl. 1. Underlies Thoreau formation (new).

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 38–39, 40 (fig. 26). Described in Navajo country where it is considered of formational rank and included in San Rafael group. At type locality, consists of (ascending) 16 feet of mudstone, 4 feet of limestone, and 5 feet of mudstone. In this area, lower and upper contacts are sharp and irregular. Underlies Summerville formation; overlies Entrada. Near Ysidro, N. Mex., (outside area of this report) formation includes section of gypsum 111 feet thick. Extends into southwestern Colorado.

Named for Todilto Park, McKinley County, N. Mex.

Todos Santos Claystone Member (of Sisquoc Formation)

Miocene and Pliocene: Southern California.

W. P. Woodring, M. N. Bramlette, and K. E. Lohman, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 10, p. 1340 (table 1). A somewhat procelaneous claystone forming about lower half of basin facies of Sisquoc formation in Casmalia Hills Thickness about 1,500 feet. Overlies Monterey shale, the boundary being drawn at base of lowest thick claystone unit. Underlies diatomaceous strata of Sisquoc.

W. P. Woodring and M. N. Bramlette, 1950, U.S. Geol. Survey Prof. Paper 222, p. 26–31, pl. 2. Miocene and Pliocene.

Type region: In Casmalia Hills northwest of Casmalia, Santa Barbara County.

Togiak Gravels[1]

Pleistocene: Southwestern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 177.

Occur along banks of Togiak River and Togiak Lake.

Togo Formation (in Deer Trail Group)

Precambrian (Belt Series): Northeastern Washington.

Ian Campbell and J. S. Loofbourow, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1250. Named as oldest of five formations in group. Underlies Edna dolomite (new).

Report discusses magnesite belt of Stevens County.

Tohachi Formation (in Mesaverde Group)

Tohachi Shale[1]

Upper Cretaceous: Northwestern New Mexico and northeastern Arizona.

Original reference: H. E. Gregory, 1916, U.S. Geol. Survey Water-Supply Paper 380.

J. E. Allen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 11, p. 2569–2571. Referred to as Tohatchi formation. Recent mapping has shown that type localities described by Gregory (1917, U.S. Geol. Survey Prof. Paper 93) for Tohatchi shale consist of Upper Cretaceous rocks

which conformably overlie Menefee formation of Mesaverde group and unconformably underlie Chuska sandstone of Pliocene(?) age. Consists of lower carbonaceous member 850 feet thick and upper bentonitic member more than 500 feet thick. Included in Mesaverde group.

Caswell Silver, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 660–661. Discussion of article by Allen (1953). Allen quoted Gregory incompletely, and this gave the impression that Gregory misplaced an angular unconformity and misassigned the strata to the Tertiary. A complete reference to Gregory would note that the table (1917, p. 15) and graphic section (1917, pl. 3) made known existence of strata which were left undescribed and unnamed except for label "post-Mesaverde" (Upper Cretaceous) and which were excluded from Tohatchi shale. These beds which underlie the angular unconformity appear to be those labeled "Tohatchi formation" by Allen. Gregory did not describe the unit. It is likely Gregory misjudged the thickness, and in his reconnaissance he obviously mapped extent of Tohatchi shale incorrectly at south end of Chuska Mountains. Gregory's description of the Tohatchi appears to have been confused with upper part of post-Mesaverde strata. Thus, it would seem that the Tohatchi of Gregory should henceforth carry query—Tohatchi shale(?). Therefore, Allen should not have written that: "the Tohatchi shale lies conformably above the Menefee formation (the foregoing original description probably included the upper 500 feet of the Menefee) and may be divided lithologically into two units." At the very least, such a statement should read the redefined Tohatchi shale or the "Tohatchi formation." Tohatchi shale has been used and accepted for 36 years; the Tohatchi shale (or formation) of Allen is not the Tohatchi shale(?). Gregory's Tohatchi shale lies on "post-Mesaverde rocks." Strata in Tohatchi quadrangle called "post-Mesaverde rocks" by Gregory but apparently mapped in part by him as Tohatchi shale have a complex and confusing relationship. They appear to be angularly discordant to strata both above and below. Some local angular unconformities may even occur between individual beds. Existence of strata equivalent to Gregory's Tohatchi shale would be difficult to define unless restricted to relatively thin shaly lower part of Allen's Chuska sandstone.

J. E. Allen, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 661. Reply to Silver's article. Important fact is that rocks [Gregory] described at his two type localities are of Cretaceous age and lie below an unconformity marked by persistent conglomerate. Silty and ashy beds not over 250 feet thick crop out in a few places in Tohatchi quadrangle between conglomerate and overlying Chuska sandstone; they are dissimilar to any rocks described by Gregory, we [Gregory and Allen] both mapped them with the Chuska. Below the unconformably the "post-Mesaverde rocks" of Gregory are apparently similar to upper member of my [Allen] Tohatchi formation. They do not have "a complex and confusing relationship" and they are not "angularly discordant to the strata . . . below." Lithological type described by Gregory (p. 80) as "Tohatchi shale" occurs below and not above type of lithology which Gregory designates as "post-Mesaverde".

J. E. Allen and Robert Balk, 1954, New Mexico Bur. Mines Mineral Resources Bull. 36, p. 96–97. Because of diverse lithology and revised spelling adopted by Board on Geographic Names, name of unit is herein changed from "Tohachi shale" to Tohatchi formation. Tohatchi shale of Gregory's two type localities lies conformably above shales and sand-

stones of Menefee formation (original description included at least upper 200 feet of Menefee) and may be divided into two units. Base of lower cliff-making unit of redefined Tohatchi formation has been arbitrarily placed at top of highest massive channel sandstone of the Menefee. Above this point, 400 to 850 feet of sandstones of lower member of Tohatchi are thin to medium bedded with about 50 percent shale interbeds. Upper member consists of at least 500 feet of generally uniform light-olive- to yellow-gray indistinctly thin-bedded highly bentonitic shales which are carboniferous near base. These are probably not the "post-Mesaverde" beds, which, although not discarded by Gregory (1917, p. 75) in his text, are shown in table (1917, p. 15) and graphic section (1917, pl. 3). Lower member tentatively correlated with combined tongues Cliff House and Pictured Cliff sandstones; upper bentonitic unit may be equivalent of Fruitland formation and possibly part of Kirtland formation.

H. E. Wright, Jr., 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 8, p. 1827–1834. Tohatchi shale was named by Gregory for many colored shales and some sandstones at southern end of Chuska Mountains. He stated that it unconformably overlies Cretaceous rocks and is overlain in turn by Chuska sandstone. Both the Tohatchi and Chuska were placed in Tertiary, and an unconformity between them was mentioned at one locality. Independent field work done in area by Allen and the writer [Wright] revealed only one unconformity. This lies between tilted Cretaceous rocks and flat-lying Tertiary rocks. Shales beneath this unconformity resemble those described by Gregory as Tohatchi shale, and Allen has assigned Tohatchi formation to Mesaverde group. The Tohatchi, as thus defined, has maximum thickness of 1,350 feet and rests conformably on the Menefee. Above the unconformity, the sands, minor shale, and basal conglomerate cannot be Gregory's Tertiary Tohatchi shale because there is no room anywhere in area for more than 250 feet of the stated 200 to 1,000 feet of Tohatchi shale between the unconformity and typical Chuska sandstone caprock. The 250 feet of sands, minor shale, and basal conglomerate must therefore have been included by Gregory as part of Chuska sandstone. They are herein described as Deza formation which grades upward into crossbedded eolian Chuska sandstone.

E. C. Beaumont, C. H. Dane, and J. D. Sears, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2160–2161. Nomenclature of Mesaverde group, in San Juan basin, revised. Tohatchi formation as redefined by Allen and Balk accepted for uppermost unit in group, but Gregory's original spelling retained.

Named for exposures near Tohachi Indian School, McKinley County, N. Mex.

Tohatchi Formation

See **Tohachi Formation.**

Tok Sandstone

Tertiary(?): Eastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 473, 483.

Exposed a few miles below Tok River.

Tokio Formation[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas and southeastern Oklahoma.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690, p. 19, 24.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 42–46. Formation, in McCurtain County, includes strata formerly assigned to upper part of Bingen formation and was originally described as Tokio sand member of that formation. Name Bingen has been dropped. Tokio as defined has gravel at base and is separated from underlying Woodbine formation by unconformity. Formation thickens southeastward from featheredge in outcrop to more than 595 feet in subsurface in southern part of county. Underlies Ozan and Brownstown formations undifferentiated.

First described in vicinity of Tokio, Hempstead County, Ark.

Tokopah Porphyritic Granodiorite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 11–12, pl. 1. Notably porphyritic with stubby to equant subhedral to euhedral pink to gray microcline phenocrysts as large as 25 mm across, set in medium-grained groundmass averaging 3 to 5 mm; some of the plagioclase also present as phenocrysts as large as 15 mm in length. Relation to other named plutonic rocks in area not determined.

Named from exposures in upper Tokopah Valley in eastern part of area, Sequoia National Park.

Tokun Formation[1]

Eocene and Oligocene: Southeastern Alaska.

Original reference: G. C. Martin, 1908, U.S. Geol. Survey Bull. 335, p. 24, 35.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Name appears on map legend under Eocene rocks.

Crops out on both shores of Lake Tokun, Controller Bay region.

Tolay Volcanics[1]

Pliocene, middle(?): Central western California (surface and subsurface).

Original reference: R. R. Morse and T. L. Bailey, 1935, Geol. Soc. America Bull., v. 46, no. 10, p. 1437–1455.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 118. Patches of lava exposed west of Tolay Creek near Lakeville School and regarded as outcrops of Tolay volcanics are herein mapped as part of Sonoma volcanics.

G. T. Cardwell, 1958, U.S. Geol. Survey Water-Supply Paper 1427, p. 27 (table 6), 32. This report [Santa Rosa and Petaluma Valleys] follows Weaver (1949) and maps the Tolay volcanics of Morse and Bailey as part of Sonoma volcanics. Morse and Bailey considered Tolay volcanics to be of early Pliocene age. Inasmuch as uppermost strata of the Tolay are interbedded with lowermost beds of Petaluma, now believed to be of middle or late Pliocene age, the Tolay volcanics are probably of middle Pliocene age. Thickness in wells is more than 4,000 feet.

Exposed at surface in small area west of Tolay Creek, near Lakeville School, Petaluma quadrangle.

Tolchaco Gravels

Quaternary: Central northern Arizona.

Parry Reiche, 1937, Am. Jour. Sci., 5th ser., v. 34, no. 200, p. 130–134, pl. 1. Alluvial terrace deposits. Include two members related to previous channels of Little Colorado River and one or more members related to its present position. Upper member lies at elevations about 220 feet above the river grade and rests on Shinarump sandstones at three localities near Tappan Wash. Consists of loose massive to vaguely bedded sandy pebble and cobble gravel. Medium member, Cameron beds (new), lies at elevations about 170 feet above river profile. Lowest members, exposed at and across river from Cameron, consist of terraces formed at earlier stages of Little Colorado River, after it had attained its present location—these members have not been studied.

In Little Colorado River valley above Cameron. Named from the Navajo term for the Little Colorado River.

Tolchico shale[1]

Lower Triassic: Northeastern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 338.

Well developed around mouth of Canyon Diablo. Probably named for Tolchico Settlement, The Crossing, Little Colorado River, Coconino County.

Toledo Formation[1]

Eocene, upper, to Oligocene, middle: Northwestern Oregon.

Original reference: Harrison and Eaton (Consulting Petroleum Geologists), 1920, Mineral Resources of Oregon: Oregon Bur. Mines and Geology, v. 3, no. 1, p. 3–40.

H. E. Vokes, Hans Norbisrath, and P. D. Snavely, Jr., 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 88. Consists of two members: Moody shale at base and unnamed upper member. Thickness 2,500 to 3,000 feet. Underlies Yaquina sandstone; overlies Burpee formation. Present study establishes upper Eocene age for Moody member and middle Oligocene age for greater part of upper member; future work may raise Moody member to rank of formation and permit restricting of name Toledo to strata of upper member.

Type locality: Along banks of Yaquina River, 3 miles south of Toledo, Lincoln County.

Tolenas Marble[1]

Tertiary, upper(?), or Quaternary: Western California.

Original reference: W. L. Watts, 1890, California State Mining Bur. 10th Ann. Rept., p. 668–669.

Quarried at Tolenas Springs, Solano County.

Toll Pit Beds[1]

Silurian: Southeastern Michigan.

Original reference: W. H. Sherzer and A. W. Grabau, 1910, Michigan Geol. Survey Pub. 2, geol. ser. 1, p. 47.

Occurs at Toll Pit quarry, near Scofield, Monroe County.

Tolman Formation

Eocene: Northern California.

C. A. Hall, 1956, Dissert. Abs., v. 16, no. 12, p. 2426. Incidental mention as containing fossil algae; overlies Del Valle formation (new).

C. A. Hall, Jr., 1958, California Univ. Pubs. Geol. Sci., v. 34, no. 1, p. 14–15, fig. 2, geol. map. At type section, consists of bioclastic deposits; grades

laterally from fine- to coarse-grained sandstone, and near Niles passes into a conglomerate; bioclastic deposits consist largely of fragments of calcareous algae and other organic material in finer grained quartz sand matrix. Rocks are dirty gray or brown and weather to lighter brown. Total thickness may be 900 feet or more; minimum thickness of 470 feet measured at type locality; beds are overturned and faulted. Overlies Sobrante sandstone; overlies (but not in direct superposition) Del Valle formation.

Type locality: Tolman Peak, north of town of Niles, Alameda County. Tolman Peak is herein named; it is located at intersection of lat 37°38'8" N. and long 121°53'49" W. Formation has general trend of N. 42° W., and is well exposed 1 mile north of Niles Canyon-Highway 9 intersection, and also approximately 2.7 miles N. 25° W. from intersection.

Tolovana Limestone[1]

Silurian: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1936, U.S. Geol. Survey Bull. 872.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Mapped in Yukon-Tanana region.

In Preacher, Tolovana, and Hot Springs districts.

Toltec Andesite Member (of Treasure Mountain Rhyolite)

Miocene, upper: Northwestern New Mexico.

W. R. Muehlberger and others, 1960, New Mexico Geol. Soc. Guidebook 11th Field Conf., p. 100. Chiefly black perlitic vitric porphyritic andesite. Lowermost member; fills valleys cut into underlying Conejos quartz latite. Thickness 0 to 50 feet. Underlies Lagunitas clastic member (new). Name credited to E. L. Trice, (unpub. thesis).

Northeastern part Brazos Peak quadrangle.

Toluca Quartz Monzonite

Ordovician: Western North Carolina and western South Carolina.

W. R. Griffitts and W. C. Overstreet, 1952, Am. Jour. Sci., v. 250, no. 11, p. 779–783, 787, 788 (table 1). Monazite-bearing granitic rock, typically medium gray, moderately to strongly gneissic. Unit was included in Whiteside granite as mapped by Keith and Sterrett (1931, U.S. Geol. Survey Bull. 660–D, p. 130–132); hence, Whiteside granite is herein restricted to area of its type locality. Considered older than Cherryville quartz monzonite (new). May be Carboniferous(?) or pre-Carboniferous(?).

W. C. Overstreet and W. R. Griffitts, 1955, Geol. Soc. America Guidebook for 1955 Ann. Mtg. Age determinations on zircon and monazite from granitic rocks, from associated bodies of pegmatites and quartz veins, and from enclosing schists and gneisses gave consistent early Ordovician (about 400 million years) for zircon and monazite from Toluca quartz monzonite and enclosing metamorphosed sediments.

J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Mapped as Paleozoic.

Named for exposures near Toluca, Lincoln County, N.C.

Tomah Member (of Franconia Formation)

Upper Cambrian: Southwestern Wisconsin.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. 2; 1953, Jour. Paleontology, v. 27, no. 4, p. 554,555 (fig. 2); 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 863–864, measured sections. Consists of thinly interbedded sandstone and shale; sandstone is yellow to gray, fine grained to silty, and laminated; shale consists of equal amounts of silt and illite clay; locally contains thin beds of wormstone. Thickness at type locality is 28 feet. Underlies Reno sandstone member (new); overlies Birkmose sandstone member (new).

Type locality: Roadcuts on U.S. Highway 16, 6 miles west of Tomah, NW¼ sec. 22, T. 17 N., R. 2 W., Monroe County.

Tomahawk Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Keweenaw Point.

Tomales Formation[1]

Pleistocene, upper: Western California.

Original reference: R. E. Dickerson, 1922, California Acad. Sci. Proc., 4th ser., v. 11, no. 19, maps.

Named for occurrence on northeast side of Tomales Bay, Marin and Sonoma Counties.

Tomales Bay deposits[1]

Pleistocene: Western California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 76.

Form series of low broad hills, extending along middle of valley near Olema, and occurring at intervals on both shores of Tomales Bay, Marin County. West of main ridge, occur in occasional patches around flanks of hills at head of Drake's Estero and north of Abbott's Lagoon.

†Tombigbee[1]

Eocene: Alabama.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog, 1884–1888, geog. map of Alabama.

†Tombigbee Chalk[1]

Upper Cretaceous: Southwestern Alabama and northeastern Mississippi.

Original references: W. J. McGee, 1890, Am. Jour. Sci., 3d, v. 40, p. 25, 30, 31; 1891, U.S. Geol. Survey 12th Ann. Rept., pt. 1, p. 419, 475.

Probably named for development on both sides of Tombigbee River in Greene, Hale, Sumter, and Marengo Counties, Ala., and near Tombigbee River, in northeast Mississippi.

Tombigbee Sand Member (of Eutaw Formation)[1]

Upper Cretaceous: Northeastern Mississippi, southern Alabama, western Georgia, and western Tennessee.

Original reference: E. W. Hilgard, 1860, Mississippi Geol. and Agric. Rept., p. 3, 61, 68–75.

W. H. Monroe and D. H. Eargle, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 50. In Aubrey, Aliceville, Mantua, and Eutaw quadrangles,

Alabama, member underlies Mooreville chalk of Selma group. Thickness about 25 feet.

W. S. Parks, 1960, Mississippi Geol. Survey Bull. 87, p. 22 (table 2), 26, 36–40, pl. 1. In this report, Tombigbee sand refers to strata between lower typical Eutaw beds and Coffee formation above. In Prentiss County, member consists of 70 to 85 feet of massive, very glauconitic, in part agrillaceous, somewhat calcareous, and fossiliferous sand.

Named for exposures on Tombigbee River near Aberdeen, Monroe County, and at Plymouth Bluff, Lowndes County, Miss.

Tombstone Sandstone[1]

Upper Cretaceous: Central southern Montana.

Original reference: W. H. Weed, 1893, U.S. Geol. Survey Bull. 105, p. 16, 18.

Occurs at Cokedale, 10 miles west of Livingston, Park County.

Tombstonian series

Paleozoic [Upper Devonian]: Arizona.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Includes (ascending) Patagonia limestone (new)—thickness 250 feet and Espinal limestone (new)—150 feet. Older than Jeromian series (new); younger than Rockfordian series.

Southeastern Arizona.

Tomera Formation (in Ely Group)

Middle Pennsylvanian (Atokan-Desmoinesian): Northeastern Nevada.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2243–2248, figs. 2, 5. Chert-pebble conglomerates and interbedded limestones, with numerous brachiopod coquinites. Individual brown-weathering conglomerate units rarely more than 30 to 50 feet thick. Interbedded limestone comprises about half of formation. Quartz arenite and siltstone associated with conglomerate as matrix and interbeds. Conglomerate units generally very thin to thick bedded, with flaggy to blocky split. Thicker conglomerate units commonly rather massive. Subangular to subround, poorly to moderately sorted granules and pebbles of dense chert with varying hues of gray, green, red, and brown; average size about 10 to 20 mm. Finer detrital beds weather grayish yellow or grayish orange, and light and moderate brown. Associated limestones consist principally of crinoidal and fossil hash calcarenite and calcirudite, and brachiopod coquinites. Complete section is composite of parts of several fault blocks. Lower 1,400 feet present in Tomera Ridge; at least 300 feet of higher strata present at lower South Fork Canyon making total thickness of 1,700 to 2,000 feet. Unconformably underlies Strathearn formation (new), overlapped by Humboldt formation; overlies Moleen formation (new). Moleen and Tomera formations are practically equivalent to Ely limestone of east-central Nevada. Proposed to raise Ely to rank of group in Elko and north Diamond Ranges to include Moleen and Tomera.

Type section: At north end of lower parallel ridge east of Grindstone Mountain, here called Tomera Ridge (east-central sec. 34 and west-central sec. 35, T. 33 N., R. 54 E.), and at west side of head of lower canyon of South Fork of Humboldt River (SW¼ sec. 19, T. 33 N., R. 55 E.). Also exposed north of Highway 40 from east end of Carlin Canyon northeast toward Tomera Ranch and Moleen, and in low ridge southeast of canyon. Named for Tomera Ranch, northwest of Grindstone Mountain on south

side of Humboldt River, just east of Carlin Canyon along Western Pacific Railroad (NE¼NW¼ sec. 25, T. 33 N., R. 33 E.).

†Tomichi Limestone[1]

Lower, Middle, and Upper Ordovician: Central Colorado.

Original reference: R. D. Crawford, 1913, Colorado Geol. Survey Bull. 4, p. 56.

J. H. Johnson, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 322. Fremont limestone as differentiated in this report includes beds previously called by many names. It forms upper part of Tomichi limestone of Crawford (1913) in Monarch and Tomichi districts.

Named for Tomichi, Gunnison County.

Tomil Agglomerate

Tomil Volcanics

Oligocene or Miocene: Caroline Islands (Yap and Map)

Risaburo Tayama, 1935, Topography, geology, and coral reefs of the Yap Islands: Tohoku Univ. Inst. Geology and Paleontology Contr. in Japanese Language, no. 19, p. 29–30 [English translation in library of U.S. Geol. Survey, p. 26–27]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 62–63 [English translation in library of U.S. Geol. Survey, p. 73–74]. Consists of augite-andesite, agglomerate, and tuff; andesite commonly amygdaloidal. Contains deposits of bauxite. Unconformably overlies Map beds. Believed to be overlapped by Garim limestone, but contact not observed. Oligocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 62–63. Miocene.

W. S. Cole, Ruth Todd, and C. G. Johnson, 1960, Bulls. Am. Paleontology, v. 41, no. 186, p. 78. Referred to as Tomil volcanics. Unconformably overlies both Map and Yap formations.

Typically exposed on Tomil Plateau, Tomil Island, Yap group.

Tomlinson Shale[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Named for Tomlinson, Scott County, Ark.

†Tomlinson Stage[1]

Pennsylvanian: Western Arkansas and central eastern Oklahoma.

Original reference: H. M. Chance, 1896, New York Acad. Sci. Trans., v. 15, p. 52.

Occur along Choctaw, Oklahoma & Gulf Railway, Okla. Probably named for Tomlinson, Scott County, Ark.

Tom Sauk Limestone Member (of Bonneterre Formation)

Cambrian: Southeastern Missouri.

G. F. Brightman, 1937, (abs.) Missouri Acad. Sci. Proc., v. 3, no. 4, p. 120. Pure fine-grained sublithographic limestone which occurs in Bonneterre formation only in St. Francois Mountains.

G. F. Brightman, 1938, Jour. Geology, v. 46, no. 3, pt. 1, p. 248–267. Limestone is irregular in distribution, thickness, and stratigraphic position.

Maximum thickness at outcrop 30 feet; in drill holes as much as 225 feet. Underlies bulk of Bonneterre formation. Type locality designated.

Type locality: Outcrop on south side of Little Tom Sauk Creek, on boundary between Iron and Reynolds Counties.

Tomstown Dolomite[1]

Tomstown Formation

Lower Cambrian: Central southern Pennsylvania, western Maryland, and northern Virginia.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 208.

B. L. Miller, D. M. Fraser, and R. D. Miller, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–48, p. 223–229. Formation, in Northampton County, overlies Hardyston formation and underlies Allentown formation. Contact with Hardyston not observed. Replaces name Leithsville in this area.

G. W. Stose and A. I. Jonas, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. C–67, p. 70–72. Tomstown dolomite directly overlies Antietam quartzite and makes curving band, about 1 mile wide, around outcrop of the quartzite on plunging end of main South Mountain anticline in Cumberland County. Makes lowland between foot of steep slope of South Mountain and line of low hills composed of overlying Waynesboro formation to northeast. Offset 1½ miles southward by Reading Banks fault and makes wide lowland west of this fault. Dolomite is cut off 1 mile north of Dillsburg by eastern part of Dogwood Run fault and is here offset southwestward. Thickness estimated between 1,000 and 1,500 feet.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 40. Name Shady used in this report [Appalachian Valley] in preference to Tomstown.

B. L. Miller and others, 1941, Pennsylvania Geol. Survey Bull. C–39, p. 180–186. Described in Lehigh County where it is about 1,000 feet thick. Overlies Hardyston quartzite; underlies Allentown formation. Replaces term Leithsville in this area.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Mineral Resources [Rept. 12] Carroll and Frederick Counties, p. 42–43. Narrow belt of Tomstown dolomite extends along east foot of Catoctin Mountain west and southwest of Frederick. Lies between ridge of Antietam quartzite and Triassic border fault. Thickness about 200 feet.

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 124–139. Crops out only in Jefferson County. Outcrop is extended belt slightly more than 1 mile in width that enters county in vicinity of Antietam, Washington County, Md., and strikes southwestward along meander belt of Shenandoah River into Clark County. Estimated thickness between 1,200 and 1,500 feet. Overlies Antietam quartzite; underlies Waynesboro formation.

P. B. King, 1950, U.S. Geol. Survey Prov. Paper 230, p. 24–30, pl. 1. Described in Elkton area, Virginia, where it is about 1,000 feet thick. Overlies Antietam quartzite of Chilhowee group; underlies Waynesboro formation. Closely resembles in character and stratigraphic position Shady dolomite, whose type locality is in northeastern Tennessee. Name Tomstown is now used in Virginia as far south as Roanoke, beyond which name Shady dolomite is used for same unit. At some future time, name Tomstown may well be dropped as synonym, and Shady substituted for it.

Bradford Willard and others, 1959. Pennsylvania Geol. Survey, 4th ser., Bull. C–9, p. 10, 28–31, pl. 2. Mapped as Tomstown dolomite (Leithsville limestone) in Bucks County. Crops out in two narrow east-west strips. Overlies Hardyston quartzite. Difficult to distinguish from Triassic limestone conglomerate. Also difficult to distinguish from overlying Conococheague (Limeport) limestone.

Named for exposures at Tomstown, Franklin County, Pa.

Tom Thumb Tuff Member (of Klondike Mountain Formation)

Oligocene: Northern Washington.

Hunting Geophysical Services Inc., 1960, Washington Div. Mines and Geology Rept. Inv. 20, p. 6. At base of formation. Umpleby (1910, Washington Geol. Survey Bull. 1) referred to unit as Lake beds. Contains flora considered to be Oligocene in age. Not present in Curlew quadrangle. Republic quadrangle and part of Aeneas quadrangle mapped by Siegfried Muessig and J. J. Quinlan (1959, U.S. Geol. Survey Open-File Map).

Report discusses parts of Okanogan and Ferry Counties.

Tonawandan Stage

Middle Silurian (Niagaran) : North America.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Niagaran series divided into four stages (ascending): Lewiston(ian), Ontario(an), Tonawanda(n), and Lockport(ian). Tonawanda stage includes upper Clinton strata. Thickness at type section 90 feet; 115 feet in Genesee Gorge; 210 feet in central New York; 180 feet near Oneida Lake; 105 feet at Clinton (Rome quadrangle).

Type section: Niagara Gorge. Named from good exposures in Tonawanda quadrangle, New York.

Tonga Formation (in Easton Group)

Paleocene or older: Northwestern Washington.

R. S. Yeats, 1958, Dissert. Abs., v. 19, no. 4, p. 775. Relict graded bedding, poor sorting, flat-pebble conglomerates, and load casts suggest turbidity current origin. Intruded by Beckler quartz diorite (new).

Between central and eastern part of Skykomish area in northwestern Cascade Mountains, 45 miles east of Seattle.

Tonganoxie Sandstone[1] Member (of Stranger Formation)

Pennsylvanian (Virgil Series) : Eastern Kansas and northwestern Missouri.

Original references: R. C. Moore, M. K. Ellias, N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc: Wichita, Kans. [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; J. M. Jewett and C. C. Williams, May 1, 1935, Kansas Acad. Sci. Trans., v. 38, p. 191–198.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 15. In Missouri underlies Vinland shale member.

T. W. Lins, 1950, Kansas Geol. Survey Bull. 86, pt. 5, p. 108–140. Basal member of Stranger formation. Represents filling of large southwest-trending valley, major feature of regional disconformity which separates Pedee group or older beds (Missourian) from overlying Douglas group

(Virgilian). Tonganoxie contains four lithologic units (ascending): conglomerate, sandstone, shale, and coal. Thickness 4 to 100 feet, no complete sections exposed and thickness determined from composite sections. Underlies Westphalia limestone member.

Type locality: Area east of Tonganoxie, Leavenworth County, Kans. Well exposed along U.S. Highway 40 in secs. 26 and 35, T. 11 S., R. 21 E., about 7 miles east of Tonganoxie and on Stranger Creek and its tributaries north of Linwood, Kans.

Tongue River Member (of Fort Union Formation)[1]

Tongue River Formation (in Fort Union Group)

Paleocene: Northeastern Wyoming, eastern Montana, southwestern North Dakota, and South Dakota.

Original reference: J. A. Taff, 1909, U.S. Geol. Survey Bull. 341, p. 129–130.

W. M. Laird and R. H. Mitchell, 1942, North Dakota Geol. Survey Bull. 14, p. 21–23. Described in southern Morton County where it is considered formation in Fort Union group. Thickness 180 feet. Overlies Cannonball formation. Paleocene.

R. V. Hennen, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 12, p. 1573 (fig. 1), 1580. In Morton County, N. Dak., Almont sandstone (new) lies approximately 35 feet above base of Tongue River member of Fort Union.

W. E. Benson, 1949, (abs.) Geol. Soc. America Bull., v. 60, no. 12, pt. 2, p. 1873. Tongue River member of Fort Union formation conformably underlies Golden Valley formation.

S. P. Fisher, 1953, North Dakota Geol. Survey Rept. Inv. 11. Formation, as now recognized, includes all strata above Ludlow-Cannonball formation below Golden Valley beds. Includes Sentinel Butte shale facies in upper part. Thickness within map area [McKenzie County] 745 to 1,010 feet; average 800 feet.

P. R. May, 1954, U.S. Geol. Survey Bull. 995–G, p. 268. Tongue River member, which is exposed over nearly all Wibaux area [Montana and North Dakota], is composed of light-yellow, tan, and gray sandstones and shales; thin lenses of limestone; and numerous beds of lignite, the thicker margins of which are commonly marked by fringes of clinker. Thickness about 1,200 feet in Sidney lignite area; about 600 feet in Marmarth field. Overlies Ludlow member; underlies Sentinel Butte member. In older reports, term Fort Union formation is restricted to yellow strata herein referred to as Tongue River member. Paleocene.

B. M. Hanson, 1955, North Dakota Geol. Survey Rept. Inv. 18. Upper 350 feet of Tongue River formation well exposed in bluffs bordering Little Missouri River along its entire course through Elkhorn ranch area. Lower 750 feet of formation exposed between mapped area and Marmarth, 36 miles to south. At latter locality, the Tongue River conformably overlies Ludlow formation. Total thickness of Tongue River, including Sentinel Butte member, about 1,600 feet.

B. C. Petsch, 1956, Areal geology of the Ladner quadrangle (1:62,500) South Dakota Geol. Survey. Formation geographically extended into Ladner quadrangle, South Dakota, where it is dominantly massive sandstone that forms prominent cliffs. Thickness 35 to 200 feet. On North Cave Hills, composed of upper and lower sandstone separated by gray clay-shale,

peat clay, and lignite seam ("E" bed of U.S. Geological Survey and Atomic Energy Commission), and Lodgepole facies which is commonly radioactive. Top of section; overlies Ludlow formation.

W. J. Mapel, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 220 (fig. 2), 221. Tongue River member is at least 2,000 feet thick in southern Rosebud County, Mont., 800 feet near Sheridan; and about 600 feet near Gillette, Wyo. Overlies Lebo shale member; underlies Wasatch formation.

Named for exposures along Tongue River, northeastern Wyoming and southeastern Montana.

Tonica cyclothem (in Spoon-Carbondale Formations)

Pennsylvanian: Northern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 42, 53 (table 2), pl. 1. Proposed for strata previously referred to Liverpool cyclothem. Occurs above Abingdon cyclothem and below Lowell cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Vermilion River one-half mile west of Lowell, LaSalle County. Name derived from Tonica, 3 miles southeast of type section.

Tonka Formation

Mississippian and Pennsylvanian (Meramecian-Springeran): Northeastern Nevada.

R. H. Dott, Jr., 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 11, p. 2222–2233, figs. 2, 5. Brown weathering chert-pebble conglomerate with quartzite and fossiliferous calcareous interbeds. Coarse conglomerates and quartzites crop out as series of bold dark-brown or reddish-brown cliffs and ledges with intervening poorly exposed limestones and siltstones. Pebbles of conglomerate of varying hues of gray, brown, black, and especially grayish green. Sandstone and siltstone comprise less than one-third of formation. Calcareous interbeds are light gray, pinkish, grayish yellow, or light brown. Thickness at least 2,000 feet in type section; at least 3,000 feet in Carlin Canyon. Conformably overlies and grades eastward into White Pine? shale; conformably underlies Moleen formation (new).

Standard [type] section: Begins in ridge directly southeast of Tonka and extends three-quarters mile eastward. Two supplementary sections are: lower west side of Grindstone Mountain, 5 miles east, and Spring Canyon Mountain, 5 miles south of Tonka. Named for Tonka Siding on Western Pacific Railroad at east end of railroad tunnel in central Carlin Canyon (NE¼SE¼ sec. 28, T. 33 N., R. 53 E.).

Tonnie Siltstone Member (of Chinitna Formation)

Tonnie Sandstone Member (of Tuxedni Formation)

Tonnie Siltstone Member (of Tuxedni Formation)

Upper Jurassic: Central southern Alaska.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1). Series of alternating sandstones, shales, and coarse conglomerates with numerous fossil-bearing horizons. Thickness 1,200 feet. Uppermost member of Tuxedni formation; underlies Shelikof formation.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Youngest member of Tuxedni formation on Iniskin Peninsula. Consists of 900 feet of siltstone capped by approximately 200 feet of sandstone on Tonnie Peak. Siltstone is dark gray and weathers light brown; thick bedded and calcareous in part. Beds at top of member range from 1 to 10 feet thick and are composed of fine- to medium-grained sandstone. Overlies Bowser member (new); underlies Chinitna siltstone. Geographic distribution given.

R. W. Imlay, 1952, Geol. Soc. America Bull., v. 63, no. 9, p. 979; 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 49, 51. Massive sandstone capping Tonnie Peak disappears to south, and in most places the siltstones assigned to the Tonnie cannot be separated from the overlying siltstones of Chinitna formation. Therefore, Tonnie member placed in Chinitna, forming roughly lower third of formation.

Crops out in trough of Tonnie syncline and in long, narrow belt that extends from Chinitna Bay to Iniskin Bay along west face of coastal ridge on Iniskin Peninsula. Best exposures in vicinity of Tonnie Peak.

Tonoloway Limestone (in Cayuga Group)[1]

Upper Silurian: West Virginia, Maryland, Pennsylvania, and Virginia.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, pl. 28.

F. M. Swartz, 1939, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 75–76, 79, 84. In Pennsylvania, underlies Keyser limestone. Some beds formerly included in Tonoloway are placed in Keyser of this report.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 207–257, measured sections. Described in West Virginia where it is 100 to 600 feet thick. Overlies Wills Creek formation; underlies Keyser limestone. This is "Bossardville limestone" of earlier reports. States type locality. Cayugan series, Upper Silurian.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources [Rept. 14] Washington County, p. 79–80. In Maryland, overlies Wills Creek formation and underlies Keyser limestone member of Helderberg. Thickness about 600 feet. Includes Indian Spring sandstone and Indian Spring red beds.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 20. Thickness of formation 400 to 600 feet in central Pennsylvania. Overlies Wills Creek formation; underlies Keyser formation. Silurian.

Type locality: East flank of Tonoloway Ridge, along Cacapon near Rock Ford, Morgan County, W. Va.

Tonopah Formation[1]

Tertiary: Central Nevada.

Original reference: J. E. Spurr, 1905, U.S. Geol. Survey Prof. Paper 42, p. 41, map.

Well exposed in westerly workings of Tonopah Extension mine. Tonopah district.

Tonosí Limestone

Oligocene, middle: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, pt. 4a, no. 29, p. 134 (chart). Named on correlation chart. Occurs above Bucaro formation and below unnamed upper Oligocene unit.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4, p. 234 (chart). Name Tonosí limestone appears on correlation chart. Occurs below upper Oligocene Santiago formation and above unnamed lower Oligocene unit.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 347. An undefined name for strata of Oligocene age in Tonsí area.

Los Santos Province.

Tonto Group[1]

Lower and Middle Cambrian: Central and northwestern Arizona.

Original references: G. K. Gilbert, 1864, Phil. Soc. Washington Bull., v. 1, p. 109; 1875, U.S Geog. and Geol. Survey W. 100th Mer., v. 3, p. 60, 171–186, fig. 82.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 3, p. 237–239. Location of original outcrop of Tonto formation was Tonto Creek, from which title of formation was derived in vicinity of Fort Apache nearly 200 miles southeast from Grand Canyon station and not in Grand Canyon section which has come to be regarded by many geologists as type locality. Tonto group holds precedence over name Apache group of Precambrian age and has surprisingly limited areal expanse—not to include Grand Canyon section with which it was erroneously correlated.

Alexander Stoyanow, 1942, Geol. Soc. America Bull., v. 53, no. 9, p. 1270–1271. Since Gilbert originally referred to "Tonto group" as being located in headwaters of Verde and Tonto Creeks and because western tributaries in headwaters of Tonto Creek cut through Diamond Mesa and other mesas in which Tapeats sandstone (basal member of Tonto group) is well exposed, presence of this basal sandstone member of Tonto group in the true Tonto basin (Gilbert's type locality, 1875, p. 60) of western Gila County is beyond question. Type locality not in vicinity of Fort Apache as indicated by Keyes. Tonto confused with Apache beds.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Includes rocks of Lower and Middle Cambrian age in northwestern and central Arizona where it underlies Temple Butte limestone.

Type locality: Tonto basin, western Gila County. Group floors the valleys that contain headwaters of Big Williams Fork of Colorado River and of Verde and Tonto Creeks, tributaries of Salt River.

†Tonto Sandstone[1]

Middle Cambrian: Arizona.

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Mer., v. 3, p. 60, 171–186, fig. 82.

†Tonto Shale[1]

Middle Cambrian: Arizona.

Original reference: G. K. Gilbert, 1875, U.S. Geog. and Geol. Survey W. 100th Mer., v. 3, p. 60, 171–186, fig. 82.

Tonzona Group[1]

Silurian, Devonian, and Carboniferous: Central southern Alaska.

Original reference: A. H. Brooks, 1911, U.S. Geol. Survey Prof. Paper 70, p. 55, 66, 73, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Name appears on map legend under both Silurian and Devonian rocks.

Named for Tonzona River, in whose basin these rocks typically occur, Tonzona district, Kuskokwim region.

Topache Limestone[1]

Devonian(?) and Mississippian: Southwestern Utah.

Original reference: B. S. Butler, 1913, U.S. Geol. Survey Prof. Paper 80.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 135, pl. 2 (column 29). Name appears on Mississippian correlation chart. Parts of fauna typically of Madison limestone; others may be slightly younger.

Grant Steele, 1960, Dissert Abs., v. 20, no. 12, p. 4635. Three facies of lower part of Pennsylvanian system (Springeran to Des Moinesian) in eastern Great Basin are clearly defined by their proximity to tectonically active lands formed by Antler orogeny in late Mississippian to earliest Pennsylvanian time. Sediments characterizing eastern and southern facies (Ely, Oquirrh, Bird Spring, Callville, and Topache formations) being less affected by the Antler positives, were deposited in a limestone, dolomite, and silt province.

Type locality: Topache Peak, southeast of Frisco district.

Topagoruk Formation

Topagoruk Member (of Umiat Formation)

Lower Cretaceous: Northern Alaska (subsurface and surface).

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 162–163, fig. 2. Top 1,000 feet of member include nonmarine units of Niakogon tongue (new) of Chandler formation (new) and consists of coal, shale, sandstone, and minor amounts of ironstone. Bottom 2,100 feet entirely marine clay shale, silt shale, silt, and sandstone. Thickens southward and intertongues with Hatbox and Niakogon tongues (new) of Chandler formation. Overlies Tuktu member (new); underlies Seabee member (new) of Schrader Bluff formation (new). Lower(?) Cretaceous.

F. M. Robinson, F. P. Rucker, and H. R. Berquist, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 229–232. Most exact type locality data given. Redescribed in subsurface as formation to include major part of previously described member. Original member extended from 50 feet to 3,100 feet in test well, whereas formation as now defined extends from 1,350 feet to 3,900 feet in same well. Formation primarily of medium- to medium-dark-gray clay shale, with thin beds and laminae of medium-gray siltstone, although upper 800 feet also contain some thin beds of very argillaceous, very fine-grained sandstone. Dominantly of fine marine clastics in contrast to overlying sandstone of Grandstand formation. Unconformably overlies Oumalik formation (new) in type well; formations have gradational contact in Oumalik type area.

F. M. Robinson, 1959, U.S. Geol. Survey Prof. Paper 305–J, p. 527–528, fig. 46. Age of formation given as Early Cretaceous.

Named from section from 50 to about 3,100 feet in Topagoruk test well No. 1, a dry hole located on coastal plain of northern Alaska, at lat 70°37′30″ N., long 155°33′36″ W., approximately 72 miles S. 14° E. of

Point Barrow. Type section [as redescribed] in this well between 1,350 and 3,900 feet.

Topango Formation[1]

Miocene, middle: Southern California.

Original reference: W. S. W. Kew, 1923, Am. Assoc. Petroleum Geologists Bull., v. 7, p. 411–420.

A. O. Woodford, T. G. Moran, and J. S. Shelton, 1946, Am. Assoc. Petroleum Geologists, v. 30, no. 4, p. 515–520. In Puente and San Jose Hills area. subdivided to include Buzzard Peak conglomerate member (new) near top. Here underlies Puente formation and overlies [Glendora volcanics]. Thickness 3,000 feet.

Takeo Susuki, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1345. At type locality, consists of more than 8,000 feet of conglomerates, sandstones, and shales with intercalated basalts; disconformably overlies Oligocene Sespe and underlies Upper Miocene Modelo shales with marked angular unconformity.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 6 (table 1), 20–23. In Griffith Park area, Los Angeles County, composed of three unnamed members each separated by unconformities; aggregate thickness 4,900 feet. Underlies Hollycrest formation (new); unconformably overlies Cahuenga beds (new).

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Mentioned in Santa Ana Mountains area where it underlies La Vida member (new) of Puente formation.

J. G. Vedder, R. F. Yerkes, and J. E. Schoellhamer, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–193. In Orange County, subdivided into three members (ascending): Bommer, Los Trancos, and Paularino.

Type locality: Topanga Canyon, 10 miles northwest of Santa Monica, Los Angeles County.

†Topatopa Formation[1]

Eocene: Southern California.

Original reference: G. H. Eldridge, 1907, U.S. Geol. Survey Bull. 309.

Crops out in mountains north of Santa Clara Valley, Ventura County.

Topeka Limestone (in Shawnee Group)[1]

Topeka Limestone Member (of Shawnee Formation)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original references: E. Haworth, 1895, Kansas Univ. Quart., v. 3, pl. opposite p. 290; 1895, Am. Jour. Sci., 3d, v. 50, pl. opposite p. 466.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 160–165. Uppermost formation in Shawnee group. Thickness in Kansas 33 to 55 feet. Comprises (ascending) Hartford limestone, Iowa Point shale, Curzon limestone, Jones Point shale, Sheldon limestone, Turner Creek shale, DuBois limestone, Holt shale, and Coal Creek limestone members. Overlies Calhoun shale; underlies Severy shale of Wabaunsee group.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 20–21. Thickness of formation in Nebraska about 36 feet. Includes nine members [see above annotation]. Condra and Reed (1937), being uncertain regarding relation of the Hartford of southern Kansas to lower member of Topeka

in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa, proposed name Wolf River for basal member of Topeka in this area. Nebraska Survey will drop name Wolf River if it proves correlative with the Hartford. Underlies Severy shale; overlies Calhoun formation. Shawnee group.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. vii (fig. 3), 16, 18. As defined in Missouri, it is uppermost formation in Shawnee group. Jones Point shale, Sheldon limestone, and Iowa Point shale formerly included in underlying Calhoun shale are here classed as members of the Topeka. Hence the Topeka consists of nine members [see annotation Moore, 1949, above]. Overlies Calhoun shale; underlies Severy shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 15–17, fig. 5. In Iowa, thickness is variable largely as result of thinning and thickening of shale members. Thickness 13 feet in north at Macedonia; 35 feet northeast of Greenfield. Comprises nine members [see annotation Moore 1949, above]. Overlies Calhoun shale; underlies Severy shale of Wabaunsee group.

Type locality at Topeka, Shawnee County, Kans.

Tophet Limestone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 356.

Type locality: On hill road toward Lick Creek, 0.2 mile north of Tophet, Summers County.

Tophet Sandstone (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 357.

Type locality: On hill road toward Lick Creek, 0.2 mile north of Tophet, Summers County.

Tophet Shale (in Hinton Formation)[1]

Mississippian: Southeastern West Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 297, 356–358.

Type locality: In vicinity of Tophet, Summers County.

Top Hill Sandstone[1]

Pennsylvanian: Western central Kentucky.

Original reference: D. D. Owen, 1856, Kentucky Geol. Survey, v. 1, pl.

Hancock, Breckinridge, and Meade Counties.

Toqua Sandstone Member (of Blockhouse Shale)

Middle Ordovician: Eastern Tennessee.

R. B. Neuman, 1955, U.S. Geol. Survey Prof. Paper 274–F, p. 150–151, pl. 28. Light-gray fine- to coarse-grained calcareous sandstone. Finer grained sandstone well laminated, crossbedded, and in beds 4 to 12 inches thick separated by thinner beds of dark-gray shale. Coarser grained rock poorly laminated and in beds 10 to 20 inches thick set apart by poorly defined bedding plane partings. Weathers greenish brown or olive; its

saprolite is yellow brown to ochrous. Thickness at type section about 400 feet. Overlies Whitesburg limestone member; underlies dark shale member.

Type section: Measured 1.15 miles southeast of Toqua Church, Vonore quadrangle, Monroe County, near southeast bank of Tellico River, along and near a wagon road. Name taken from Toqua Church.

Toquima Formation[1]

Lower, Middle, and Upper(?) Ordovician: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 107. Mentioned in discussion of significance of graptolites of Athens shale.

Present over considerable part of Toquima Range.

Tor Formation

Devonian: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 97 (fig. 3), 98 (fig. 4). Named on cross section and structure section in report on Paleozoic continental margin in central Nevada. Overlies Antelope Valley formation.

Toquima Range, Nye County.

Torcer Formation[1]

Lower Cretaceous(?): Western Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 254–257, 286.

C. C. Albritton, Jr., 1937, Jour. Paleontology, v. 11, no. 1, p. 19; 1937, Field and Laboratory, v. 5, no. 2, p. 50. Redefined to include only the Lower Cretaceous fraction of original Malone. Embraces minimum thickness of 400 feet of limestone, sandstone, and shale, with persistent basal chert-pebble conglomerate and quartzitic sandstone resting conformably on the Malone. Basal member contains diagnostic *Neocomites cf. indicus* Waagen along with foraminifers *Guembelina paucistriata* Albritton and *Anomalina torcerensis* Albritton; *Ammobaculites subcretaceous* Cushman and Alexander occurs higher in section. Top not exposed in Malone Mountains.

C. C. Albritton, Jr., 1938, Geol. Soc. America Bull., v. 49, p. 1754 (fig. 2), 1764–1767, strat. sections. Section used for defining formation shows duplication of beds. Pelecypods thought to be characteristic of formation actually occur in Malone and, hence, are Jurassic rather than Cretaceous. On basis of paleontological evidence, it can be shown that approximately the upper 400 feet of sedimentary column in Malone Mountains is Lower Cretaceous. For these strata, name Torcer is retained.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 996–997, 998 (fig. 3). Formation, which crops out only in northwestern part of northern Quitman Mountains area, is composed of two distinct lithologic units: a quartz- and chert-pebble conglomerate at the base that grades upward into a quartzitic sandstone. Torcer proper is predominantly impure black limestone and sandstone with abundant thin shale layers. Basal quartzite member thins to south and is only about 10 feet thick in Third Hill. Thickness of upper member about 300 feet. Conformably overlies Malone formation; contact is a narrow gradational zone.

Contact with overlying Yucca formation not exposed. Believed to be lowermost Cretaceous.

Type locality: In Malone Mountain. Named from exposures at and near Torcer (formerly Malone) Station, on Southern Pacific Railway, west of Sierra Blanca, Hudspeth County.

Torch Lake Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Keweenaw Point.

Torch Lake Flow[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Keweenaw Point.

Torchlight Sandstone Member (of Frontier Formation)[1]

Upper Cretaceous: Northern Wyoming and southern Montana.

Original reference: F. F. Hintze, Jr., 1915, Wyoming Geol. Survey Bull. 10, p. 23.

J. H. Heathman, 1939, Wyoming Geol. Survey Bull. 28, p. 7 (table 2), 13. On south and east sides of Bighorn basin consists of massive sandstone about 75 feet thick at top of Frontier formation. Underlies Niobrara.

Exposed in Torchlight dome, Basin oil field, Wyoming.

Torcido member (of Serpiente Sandstone)

See Serpiente Sandstone.

Tordilla sandstone bed (in Dubose Member of Whitsett Formation)

Eocene, upper: South-central Texas.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2633. Local name applied to a 30-foot silicified fine-grained sandstone bed in Dubose member of the Whitsett.

Exposed in Tordilla Hill, western tip of Karnes County.

Tordrillo Formation[1]

Middle Jurassic: Central southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey Ann. Rept., pt. 7, p. 153–155.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500.000): U.S. Geol. Survey. Appears on map legend.

On Tordrillo Mountains, Cook Inlet region.

Toreo Limestone

Eocene(?): Panamá.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 239.

A. A. Olsson, 1942, 8th Am. Sci. Cong. Proc., v. 4; p. 242. Upper Eocene Torio limestone is unconformable below Montijo formation.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 348. Poorly defined name. Eocene(?). Correct spelling Toreo.

On west side of Azuero Peninsula. Along Río Toreo, Veraguas Province.

Toreva Formation (in Mesaverde Group)

Upper Cretaceous: Northeastern Arizona.

G. A. Kiersch, 1955, Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2: Tucson, Ariz., Univ. Arizona Press, p. 4 (fig. 1), 7. Comprises lower sandstone member, medial carbonaceous member, and upper sandstone member. Underlies Wepo formation (new); overlies Mancos shale. Name credited to Repenning and Page.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 271–277. Lower member is light-brown to pale-yellow ish-gray fine- to medium-grained quartz sandstone, forms vertical blocky cliffs 128 feet high. Middle member, in gradational contact with lower member, has extremely varied lithologic character from place to place; in general consists of alternation of flat and thinly bedded carbonaceous mudstone, varicolored siltstone units with coal, and thick lenses of yellowish-gray fine- to coarse-grained poorly sorted quartz sandstone; thickness 106 feet. Upper member is yellowish-gray to grayish-orange-pink sandstone; upper part commonly conglomeratic in southern part of Black Mesa; thickness 79 feet both upper and lower contacts of formation gradational.

Type locality: In Cliffs of Black Mesa 1.3 miles northwest of small settlement of Toreva, from which unit is named, in Hopi Indian Reservation, Navajo County. Traceable by nearly continuous outcrops about entire margin of Black Mesa.

Torio Limestone[1]

See Toreo Limestone, correct spelling.

†Tornado Limestone[1]

Lower Mississippian and Lower Pennsylvanian: Central Arizona.

Original reference: F. L. Ransome, 1915, Washington Acad. Sci. Jour., v. 5, p. 380–385.

N. P. Peterson, C. M. Gilbert, and G. L. Quick, 1951, U.S. Geol. Survey Bull. 971, p. 20, 21. Rocks previously included in Tornado limestone in Castle Dome area mapped as Escabrosa limestone (Mississippian) and Naco limestone (Pennsylvanian).

E. D. Wilson, 1950, Arizona Bur. Mines Bull. 156, Geol. Ser. 18, p. 52, 53. In general, the Mississippian beds are crystalline and relatively pure, whereas Pennsylvanian tend to be dense, impure, and cherty.

Named for Tornado Peak, Dripping Spring Range, Ray quadrangle.

Tornillo Clay[1]

Upper Cretaceous (Gulf Series): Western Texas.

Original reference: J. A. Udden, 1907, Texas Univ. Bull. 93, p. 17, 54–60.

J. A. Wilson and others, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 14, p. 7. On basis of vertebrate faunas, it is believed that part of strata formerly included in Tornillo are Paleocene and lower Eocene.

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R. G. Yates and G. A. Thompson, 1959, U.S. Geol. Survey Prof. Paper 312, p. 16, pl. 1. Described in Terlingua district where it is exposed only in extreme southeastern part of area. Thickness 600 to 1,000 feet. Overlies Aguja formation; underlies Chisos volcanics.

Named for exposures along Tornillo Creek, Brewster County, in Chisos Mountains quadrangle.

†Toro Formation[1]

Lower Cretaceous: Western California.

Original reference: H. W. Fairbanks, 1904, U.S. Geol. Survey Geol. Atlas, Folio 101.

N. L. Taliaferro, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 4, p. 459. Original Toro included both the restricted Knoxville (Upper Jurassic) and Paskenta stage of Lower Cretaceous; the two are separated by an unconformity. Knoxville part of Toro contains pillow basalts and intruded by basic and ultrabasic igneous rocks; Lower Cretaceous part contains no igneous material except as debris in conglomerates. Name Marmolejo formation proposed for Lower Cretaceous of Santa Lucia Range.

Named for exposures along Toro Creek, San Luis Obispo County.

Toro Limestone Member (of Chagres Sandstone)

Toro Limestone[1]

Pliocene, lower: Panamá and Costa Rica.

Original reference: D. F. MacDonald, 1915, U.S. Bur. Mines Bull. 86, p. 26.

[T. F. Thompson], 1943, Panama Canal, Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 3, p. 21–22, fig. 3–2. Names Toro limestone and Caribbean limestone have been used to describe deposits of shell breccia or cemented coquina that overlie Gatún sandstone in region between Lemon Bay and Chagres River. The formation [Toro] has been assigned to upper Miocene.

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 244, 246 (fig. 2). Rank reduced to member status in Chagres sandstone. Chiefly a lime-cemented coquina made up of barnacle and shell fragments; lenses of medium- to coarse-grained sandstone interbedded with the calcareous beds. Variable thickness; maximum 125 feet. Overlies Gatún formation. Late Miocene.

W. P. Woodring, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–1; 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 47–50, 51 (fig. 4), pl. 1. Lower Pliocene

Type locality: Toro Point, C.Z.

Torok Formation

Lower Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160, 161, fig. 2. Comprises 2,000 feet of dark silt and clay shale with limestone concretions in lower part and about 8,500 feet of dark shale and marine conglomerate and sandstone of graywacke type in upper part at Castle Mountain. Consists of 4,500 feet of dark clay and silt shale in upper part which includes 500 feet of sandstone and some conglomerate, and 1,500 feet of dark silt and clay shale in lower part in vicinity of Tuktu Bluff about 11 miles north of Castle Mountain. Total thickness at Tuktu Bluff 6,000 feet; at Castle Mountain 10,500 feet.

Unconformably overlies Okpikruak formation (new) at most places. Underlies Nanushuk group.

W. W. Patton, Jr., 1956, *in* George Gryc and others, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 219, 222–223, fig. 5. Redefined to exclude sandstone, conglomerate, and intercalated shale sequence that overlies Okpikruak formation and crops out along east-trending belt near southern margin of Arctic Foothills province. These beds now included in Fortress Mountain formation (new). Restricted to northern predominantly shale facies. Type section only about 50 percent exposed. Bulk of formation, as redefined, composed of gray silt and clay shale interbedded with subordinate amounts of green to gray siltstone. Specific type section given. Type section approximately 6,000 feet thick.

E. G. Sable, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2637, fig. 3. Underlies and intertongues with Kukpowruk formation (new) as traced southwestward.

R. M. Chapman and E. G. Sable, 1960, U.S. Geol. Survey Prof. Paper 303–C, p. 73–83, pls. Thickness about 6,458 feet in Utukok-Corwin region. Overlies Fortress Mountain formation and may be in part equivalent to it; underlies Kukpowruk formation with contact gradational and intertonguing.

Type locality: Torok Creek, a tributary to Chandler River in vicinity of Castle Mountain, and on Chandler River between mouth of Torok Creek and mouth of Kiruktagiak River. Type section along Chandler River and Torok Creek between lat 68°40′ N. and lat 68°43′45″ N.

Toronto Limestone[1] Member (of Oread Limestone)

Pennsylvanian (Virgil Series): Southeastern Kansas, southwestern Iowa, and western Missouri.

Original reference: E. Haworth and W. H. H. Piatt, 1894, Kansas Univ. Quart., v. 2, p. 117.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5). Basal member of Oread formation; underlies Snyderville shale member; overlies Lawrence formation. This is classification agreed upon by Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 26. Persistent in central and southern Kansas and correlated by Kansas Survey with Weeping Water limestone of Nebraska; if this correlation is correct, the occurrence is in Iowa, Nebraska, Missouri, and through Kansas into Oklahoma. Name Toronto has priority over Weeping Water limestone of Nebraska, although Nebraska uses term Weeping Water.

H. G. O'Connor, 1960, Kansas Geol. Survey Bull. 148, p. 38, pl. 1. Member, in Douglas County, is typically light yellow brown or light gray when fresh; weathers deep yellow brown. Average thickness about 10 feet.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 23, fig. 5. Nodular sandy limestone occurring about 8 feet beneath Leavenworth limestone in Adair County is tentatively identified as Toronto. A similar limestone is known from well records in Cass and Montgomery Counties. Data are not available to preclude possibility that this bed represents the Amazonia, Haskell, or Iatan limestones of the Lawrence-Stranger formations.

Type locality: Toronto, Woodson County, Kans.

Toroweap Formation (in Aubrey Group)

Permian: Northwestern Arizona, southeastern Nevada, and southwestern Utah.

E. D. McKee, 1937, Carnegie Inst. Washington Year Book 36, p. 341–343. Unconformity occurs at top of middle red-bed member of Kaibab. Proposed to restrict Kaibab to units above unconformity and to apply name Toroweap to units below unconformity.

E. D. McKee, 1938, Carnegie Inst. Washington Pub. 492, p. 12–28, geol. sections. In type locality, consists of two red-bed series separated by massive limestone unit. Complete lithological change occurs within distance of few miles laterally between distinctive western and eastern types (referred to as phases); western phase is larger in geographical extent and includes type locality. Western phase divided into three members, α, β, and γ, representing, respectively, the upper red member or time of receding sea, the limestone member or time of extended sea, and lower red member or time of advancing sea. Thickness at type locality about 325 feet. Conformably overlies Coconino sandstone; underlies Kaibab formation (name used in restricted sense).

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 543–545. Described in Clarkdale quadrangle, Arizona, where it is 150 to 165 feet thick, conformably overlies Coconino sandstone and underlies Kaibab limestone. Lithology indicates that in this area it is part of transitional phase where members of western phase are partly formed and intertongue with sandstone of eastern phase. Can be subdivided into three main units (ascending): red to buff sandstone; calcareous sandstone and arenaceous limestone; and alternating red and buff sandstone, siltstone, and some shale including a few white fine-grained pure sandstone beds intercalated. These units may be the easternmost, recognizable equivalents of McKee's three units. In area of present report, the middle unit is most prominent unit of formation.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map OM–201. Included in Aubrey group.

Type section: Eastern wall of Toroweap Valley in Grand Canyon National Monument, Ariz. Section is about 8 miles north of Colorado River.

Torpedo Sandstone Member (of Wann Formation)

Torpedo Sandstone (in Ochelata Group)

Torpedo Sandstone Member (of Ochelata Formation)[1]

Pennsylvanian (Missouri Series): Central northern Oklahoma.

Original reference: O. B. Hopkins, 1918, U.S. Geol. Survey Bull. 686–H, p. 76–77, pl. 12.

M. C. Oakes, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 720 (table 1), 727–728; 1940, Oklahoma Geol. Survey Bull. 62, p. 81–86. Included in Ochelata group. Overlies Wann formation (revived, restricted, and redefined); underlies unnamed shale below Birch Creek limestone, locally in contact with Birch Creek. At northern and southern extremities, cut off by unconformity at base of Birch Creek. Thickness as much as 60 feet. Type locality stated.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 34, 37. Oakes (1940) revived, restricted, and redefined term Wann formation to apply to all

strata between top of Iola formation below and base of Torpedo sandstone above or base of Birch Creek limestone where Torpedo sandstone is absent. Oakes (1951, Tulsa Geol. Soc. Digest, v. 19) included Birch Creek limestone in Barnsdall formation as basal member in northern Oklahoma. Torpedo sandstone and the shale above the Torpedo and beneath Birch Creek limestone crop out only in Washington County and eastern Osage County. This situation led Miser (1954, Geologic map of Oklahoma) to place top of Wann formation at base of Barnsdall formation throughout, and to include Torpedo sandstone and the shale above it in Wann formation. This amounts to minor change in definition of the Wann, but it is significant for northern Oklahoma only. This report follows Miser's interpretation of the Wann. Thickness of Torpedo 2 feet at Kansas-Oklahoma line; 30 feet 3 miles farther south. Unit does not appear to extend into Kansas.

Type locality: In hills, 1 mile northwest of Torpedo, on north side of Creek. Torpedo switch is on Atchison, Topeka, and Santa Fe Railroad, in SW¼ sec. 17, T. 26 N., R. 12 E., Osage County.

Torrance shale[1]

Permian(?): Central-northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 11.

In Manzano Mountains. Derivation of name not given.

Torrejon Formation (in Nacimiento Group)[1]

Paleocene: Northwestern New Mexico.

Original reference: J. L. Wortman, 1897, as reported by G. N. Calkins, secy. of Biology section, A. A. A. S., in Sci., new ser., v. 6, p. 852.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 33, pl. 1. Underlies Canyon Largo group (resurrected); overlies Puerco formation. Paleocene (Torrejonian).

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 272–273. On east side of San Juan Basin, Puerco and Torrejon are not recognizable lithologic units. Seems practical to consider this part of stratigraphic sequence as single formation, the Nacimiento, containing Puerco and Torrejon faunas.

Extends from Arroyo Torrejon in Sandoval County across southern and western parts of San Juan Basin almost to Colorado-New Mexico boundary.

Torrejonian Age

Paleocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 9, pl. 1. Provincial time term, based on Torrejon formation of San Juan Basin, New Mexico, type locality, the heads of Arroyo Torrejon. Covers interval between Paleocene Dragonian (older) and Tiffanian ages. Report defines 18 provincial time terms, based on mammal-bearing units, for North American continental Tertiary. [For sequence see under Puercan.]

Typical area: From [Arroyo Torrejon] northwest to Ojo Alamo, with additional poorer localities scattered to the north almost to Colorado line.

Torres Member (of Yeso Formation)

Permian (Leonard) : Central New Mexico.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 61. Comprises bulk of Yeso formation. Alternating beds of orange-red and buff sandstone and siltstone, gray limestone, and gypsum. Thickness ranges from 350 to 600 feet. Underlies Canas gypsum member; overlies Meseta Blanca sandstone member. Type section shown on graphic section 4.

Type locality: Outcrops in tributary of Agua Torres Canyon, after which it is named, on Sevilleta Grant, 7 miles due south of Black Butte, Socorro County.

Torrey Sand[1]

Torrey Sand Member (of La Jolla Formation)

Eocene, middle: Southern California.

Original reference: M. A. Hanna, 1926, California Univ. Pub., Dept. Geol. Sci. Bull., v. 16, no. 7, p. 187–246.

L. G. Hertlein and U.S. Grant 4th, 1939, California Jour. Mines and Geology, v. 35, no. 1, p. 66. Sand member of La Jolla. Maximum exposed thickness about 200 feet. Underlies Rose Canyon shale member; overlies Delmar sand member with gradational contact; in eastern part of La Jolla quadrangle, unconformably overlies Black Mountain volcanics.

A. M. Keen and Herdis Bentson, 1944, Geol. Soc. America Spec. Paper 56, p. 21 (fig. 4). Shown on chart as sand member of La Jolla. Middle Eocene.

G. B. Oakeshott, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 254 (table). Table lists Torrey sand (formation). Underlies Rose Canyon shale; overlies Delmar sand.

Typically exposed on Torrey Pines grade, where highway climbs from Soledad Valley, San Deigo County.

Torrington Member (of Lance Formation)[1]

Upper Cretaceous: Southeastern Wyoming.

Original reference: E. M. Schlaikjer, 1935, Harvard Coll. Mus. Comp. Zoology Bull., v. 76, no. 2, p. 31–54, 65.

Named for proximity to town of Torrington, on North Platte River, north of typical exposures on Horse Creek, Goshen County.

Tortugas Andesite

Upper Cretaceous: Puerto Rico.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (chart), 9 (fig. 3), 10 (fig. 4), 13–15, pl. 2. Nonpersistent horizon of flow rock, breccia, and in places conglomerate—all of a characteristic augite-andesite composition—lying between Guaynabo formation (redefined) and Frailes formation (new). Varies in thickness rapidly, as for example at El Laberinto where probably over 1,300 feet of volcanic rocks of the Tortugas disappear almost abruptly along strike and suggests a local vent accumulation at this place. Unit was not recognized by Meyerhoff and Smith (1931). Its outcrop in vicinity of La Muda and Trujillo Alto is included in their Guaynabo, Luquillo, and Fajardo formations.

Named for exposures at Barrio Tortugas, north and east of La Muda, San Juan district.

Tosi Chert Member or **Tongue** (of Phosphoria Formation)

Permian: Western Wyoming, eastern Idaho, southwestern Montana, and eastern Utah.

R. P. Sheldon *in* V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2830 (fig. 2), 2832 (fig. 3), 2836 (fig. 4), 2851–2852; 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 30–31, pls. 2, 3. Thin dark- to light-colored chert beds that lie above Retort phosphatic shale member (new) of the Phosphoria in Wyoming, Montana, and in limited areas in Idaho and Utah, are here designated Tosi chert member of Phosphoria formation. At type locality, composed of lower brownish-gray-black chert unit, 25 feet thick, that contains abundant columns of chert several inches in diameter and 1 to 2 feet long, oriented obliquely to bedding, and an upper light-gray sandy chert unit, 8 feet thick. Contact with underlying Retort gradational through zone consisting of interbedded fissile mudstone and thin-bedded chert. Tosi is prominent member of Phosphoria in southeastern Montana and northwestern Wyoming, where in recent reports it has been included in E unit or member; most extensive tongue of Phosphoria into Park City formation in central Wyoming and into Shedhorn sandstone (new) in Wyoming and Montana. North of type locality, thickens to about 40 feet in Yellowstone Park and 145 feet in Beaverhead County, Mont.; 70 feet in Wind River Mountains; 15 feet in Owl Creek Mountains, Wyo., about 40 feet at Brazer Canyon, Rich County, Utah. Lower part of Tosi grades from Retort member; contact progressively falls to lower horizons north and east of Tosi Creek, and in vicinity of Yellowstone Park the Tosi is separated from lower member of Shedhorn sandstone by a phosphorite 0.5 foot thick. Overlain by Dinwoody formation in Wyoming Range and in western Beaverhead County; in Brazer Canyon, underlies thin tongue of the Franson; east and north of these areas, Tosi is overlain by units of Shedhorn and Park City formations; in Owl Creek and Wind River Ranges and Conant Creek anticline, Tosi is overlain by Ervay member of Park City.

Type locality: Tosi Creek in SE¼ sec. 17, T. 39 N., R. 110 W., Sublette County, Wyo., 8½ miles ENE of Tosi Peak on east nose of small anticline.

†**Toston Beds**[1]

Oligocene, upper: Western central Montana.

Original reference: E. Douglass, 1902, Am. Phil. Soc. Trans., v. 20, new ser., pt. 3, p. 237–245.

M. R. Thorpe, 1937, Am. Jour. Sci., v. 33, 5th ser., no. 198, p. 427. Upper Oligocene.

Northeast of Toston near Cottonwood Creek, in Helena-Big Belt region, Broadwater County.

Totatlanika Schist[1]

Mississippian(?): Central Alaska.

Original reference: S. R. Capps, 1912, U.S. Geol. Survey Bull. 501, p. 22, map.

Clyde Wahrhaftig, 1958, U.S. Geol. Survey Prof. Paper 293–A, p. 12, pls. 1, 2, 5. Assigned Mississippian(?) age based on fossils recovered in Nenana River valley region. Probably underlies Nenana gravel from Slate Creek to northern edge of gravel.

Named for exposures in canyon of Totatlanika River, 15 miles east of Nenana River, Bonnifield region. Forms belt 5 to 20 miles wide that extends along north edge of Alaska, to Little Delta River, 60 miles east of Nenana River.

†Totsen Series[1] or Group[1]

Early Paleozoic(?) : Northern Alaska.

Original reference: F. C. Schrader, 1902, Geol. Soc. America Bull., v. 13, p. 239.

Named for Totsenbetna, a name formerly applied by the natives to Wild Creek.

Touchet Beds

Pleistocene: Eastern Washington.

R. L. Flint, 1938, Geol. Soc. America Bull., v. 49, no. 3, p. 493–495. Name applied to deposit of buff- to cream-colored silt and fine sand containing erratic stones. Younger than Palouse soil; grades stratigraphically and topographically into scabland fill. Thickness ranges from thin veneer up to more than 100 feet in single exposures.

Occurs in Pasco basin and in Columbia basin downstream as far as gorge through Cascade Mountains. Well exposed in vicinity of Touchet, Walla Walla County.

†Toughkenamon rock[1]

Precambrian: Southeastern Pennsylvania.

Original reference: F. Frazer, 1883, Pennsylvania 2d Geol. Survey Rept. C_4, p. 307–308, 319, 321.

Named for development near Toughkenamon Station, Chester County.

Tough Mountain Quartzite

See Tough Nut Quartzite.

Tough Nut Quartzite

Lower Cambrian: Southern California.

J. C. Hazzard, 1938, (abs.) Geol. Soc. America Proc. 1937, p. 241. Listed as underlying Kelso shale and unconformably overlying Archean gneiss. Thickness 1,085 feet.

J. C. Hazzard, 1954, California Div. Mines Bull. 170, chap. 4, p. 32 (table 1). Name preoccupied. Unit termed Prospect Mountain quartzite. Underlies Latham shale (new) which replaces preoccupied term Kelso.

Area is in Providence Mountains, San Bernardino County.

Toughnut Series[1]

Lower Cretaceous(?) : Southeastern Arizona.

Original reference: W. P. Blake, 1902, Tombstone and its mines.

In Tombstone district.

Toutle Formation

Eocene, upper, and Oligocene, lower: Southwestern Washington.

M. H. Pease, Jr., and Linn Hoover, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–188. Named on correlation chart. Younger than Hatchet Mountain formation (new). Name credited to A. E. Roberts (in press).

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (chart), 24–31, pl. 1. Consists of about 570 feet of basaltic conglomerate, sandstone, siltstone, clay, and associated beds of lignite; locally interbedded basalt flows. In type area, unconformably overlies Hatchet Mountain formation; overlies Cowlitz formation in northern half of sec. 26, T. 11 N., R. 2 W. Unconformably underlies middle(?) Miocene volcanic sequence.

Type area: Along banks of Toutle River, from its tributary, Cline Creek, east to Coalbank Rapids, and north along Cedar Creek to Windom, Toledo-Castle Rock district.

Toutle River Mud Flow

Recent: Western Washington.

Don Mullineaux, 1960, Geol. Soc. Oregon Country Newsletter, v. 26, no. 5, p. 40. Flow came down North Fork of Toutle River, traversed length of main stream valley, and debouched into Cowlitz River valley; total length exceeds 40 miles. Flow almost completely filled Toutle River valley and created Silver Lake.

Flow issued from Mount St. Helens.

Towanda Limestone Member (of Doyle Shale)[1]

Permian: Eastern Kansas and southeastern Nebraska.

Original reference: R. C. Moore, 1920, Kansas Geol. Survey Bull. 6, pt. 2, p. 61.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 44. Consists of limestone, light bluish gray to yellow slabby and platy in middle and lower parts; brecciated in upper; fossils rare. Thickness commonly 5 to 10 feet; in Geary County, Kans., about 15 feet. Underlies Gage shale member; overlies Holmesville shale member.

Named from exposures near Towanda, Butler County, Kans.

†Towanda Sandstone (in Chemung Formation)[1]

Upper Devonian: Northeastern Pennsylvania.

Original reference: A. Sherwood, 1878, Pennsylvania 2d Geol. Survey Rept. G., p. 38–39.

Crops out in Wysox Township, opposite and a little above Towanda, Bradford County.

Tow Creek Sandstone Member (of Iles Formation)

Tow Creek Sandstone (in Mesaverde Formation)[1]

Upper Cretaceous: Northwestern Colorado.

Original reference: K. M. Willson, 1920, Colorado Geol. Survey Bull. 23, p. 30–39.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 155–156. Reallocated to member status in Iles formation. Thickness 35 to 125 feet. Not everywhere a single massive bed; in some areas, consists of two or more beds separated by units of shale and sandy shale. Becomes shaly and loses identity in vicinity of Oak Creek. Underlies unnamed units of formation; overlies Mancos shale.

R. E. Kucera, 1959, Rocky Mountain Assoc. Geologists 11th Field Conf., Symposium, p. 41, 43, fig. 3. Basal member of Iles formation. Consists of

33 feet of light-brown to light-gray medium-grained crossbedded and massive sandstone in Yampa district. Overlies Mancos shale.

Forms top of ridges on both sides of Tow Creek, Routt County.

†Tower Group[1]

Precambrian: Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept., p. 330–367.

Mapped at Tower, St. Louis County.

†Tower Sandstone Lentil (of Green River Formation)[1]

†Tower Sandstone Lentil (in Laney Shale Member of Green River Formation)

Eocene: Southwestern Wyoming.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Unita Mountains, p. 40, 45.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1074. Redefined as lentil in lower part of Laney shale member of Green River; only in few places does it coincide with base of member. A crystal tuff, not fluviatile deposit, made up of clastic sand grains; uniformly fine grained—not coarse grained as it has been described many times.

Forms top of weathered rocks known as The Towers, in vicinity of Green River, Sweetwater County.

Tower Creek Conglomerate[1]

Pliocene: Yellowstone National Park.

Original reference: A. Hague and others, 1904, U.S. Geol. Survey Yellowstone Nat. Park Atlas, geol. maps to accompany U.S. Geol. Survey Mon. 32.

Well exposed in northwest corner of Gallatin quadrangle. Named for exposure on Yellowstone River, opposite mouth of Tower Creek, Canyon quadrangle.

Tower Peak Porphyritic Syenite

Age not stated: Central Montana.

R. N. Miller, 1959, Montana Bur. Mines and Geology Mem. 37, p. 21–23. Name applied to porphyritic syenite which characterizes Tower Peak. Rocks of this type are light orange to brown or dark brown on weathered surface. Freshly broken surface shows dense, glassy-appearing, moderate-grayish-brown matrix with abundant phenocrysts of dark-greenish-black ferromagnesian mineral, and two kinds of feldspar, one grayish pink and the other light gray.

Named for occurrence on Tower Peak in South Moccasin Mountains, Fergus County.

Towle Shale[1] **Member** (of Onaga Shale)

Towle Shale (in Admire Group)

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: R. C. Moore and G. E. Condra, Oct. 1932, Revised classification chart of Pennsylvanian rocks of Kansas and Nebraska.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, p. 170. Includes Indian Cave sandstone member which is present only locally and fills channels as deep as 120 feet. Wolfcamp series.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Rank reduced to member status in Onaga shale. Locally contains Indian Cave channel sandstone bed. Underlies Aspinwall limestone member; overlies Brownville limestone member of Wood Siding formation.

Type locality: Towle Farm, 2 miles south and 3 miles west of Falls City, SW¼ sec. 20, T. 1 N., R. 16 E., Richardson County, Nebr.

Towner Greenstone[1] (in Snowy Range Series)

Precambrian: Southeastern Wyoming.

Original reference: E. Blackwelder, 1926, Geol. Soc. America Bull., v. 37, p. 615, 622.

J. J. Runner, 1928, (abs.) Geol. Soc. America Bull., v. 39, no. 1, p. 202. Included in Snowy Range series (new).

R. S. Agatston, 1951, Wyoming Geol. Assoc. Guidebook 6th Ann. Field Conf., p. 130. Precambrian metamorphics consist of Anderson phyllite, Deep Lake metaquartzite, French slate, Heart metagraywacke, Headquarters schist, Nash marble series, Seminoe formation, and Towner greenstone.

Exposed along road between Brooklyn Lodge and Towner Lake, Medicine Bow Mountains.

Townline Lake Granodiorite

Precambrian (Laurentian): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1033. Name applied to granodiorite cutting Ely greenstone. May be offshoot of Saganaga granite.

Occurs as small mass on Townline Lake portage NW¼ sec. 18, T. 65 N., R. 5 W., in Vermilion district.

Town Mountain Granite[1]

Precambrian: Central Texas.

Original reference: H. B. Stenzel, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 144.

Virgil Barnes, Frederick Romberg, and W. A. Anderson, 1954, Internat. Geol. Cong., 19th, Algiers 1952, Comptes rendus, sec. 9, pt. 9, p. 153. Town Mountain granite invaded the already deformed metasediments [Valley Spring gneiss and Packsaddle schist] and was followed by Oatman Creek granite, Sixmile granite, and Llanite, the latter being the youngest.

Occurs on Llano uplift in Llano, Mason, Burnet, and Gillespie Counties.

Townsend Shale

Oligocene, lower: Northwestern Washington.

J. W. Durham, 1942, Jour. Paleontology, v. 16, no. 1, p. 86. Name proposed for a gray-black shale, 60 to 65 feet thick, that overlies the Lyre conglomerates, contact irregular, and unconformably underlies Quimper sandstone (new). Shale is well bedded and includes occasional nodular calcareous beds 6 to 12 inches thick.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 596, chart 11. Overlies Lyre conglomerate; unconformably underlies Quimper sandstone.

Type locality: North of Woodmans Wharf (now called Romana Beach), 8 miles southeast of Port Townsend, Jefferson County.

Towow Formation[1]

Pennsylvanian(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, Washington Acad. Sci. Jour., v. 7, p. 199.

Occurs only in Lebanon Township. Name derived from original name of first settlement in town of Lebanon, York County.

Towsley Formation

Miocene, upper, and Pliocene, lower: Southern California.

E. L. Winterer and D. L. Durham, 1954, California Div. Mines Bull. 170, map sheet 5; 1958, U.S. Geol. Survey Oil and Gas Inv. Map OM–196. Sequence of lenticular units of light-colored conglomerate and sandstone interbedded with units of brown-weathering mudstone. Thickness as much as 4,000 feet; attains its maximum thickness along north slope of Santa Susana Mountains where it overlies and interfingers with Modelo formation; thins eastward to about 1,500 feet and near Newhall is overlapped by Pico formation.

Area of report is part of eastern Ventura Basin, Los Angeles County.

Toyabe Quartz Latite

Pliocene(?): South-central Nevada.

H. G. Ferguson and S. H. Cathcart, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–40. Thick sequence of flows of very uniform composition. Flow breccias in places. Locally thin tuff layers between flows. Total thickness may exceed 1,500 feet, with individual flows averaging between 50 and 100 feet in thickness. Unconformable contacts with Gilbert andesite below and Pleistocene(?) basalt above.

Type locality: Crest and west flank of Toyabe [Toiyabe] Range.

Trabuco Formation[1]

Cretaceous: Southern California.

Original reference: E. L. Packard, 1916, California Univ. Pub., Dept. Geol. Bull., v. 9, p. 140–141.

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166–170. Described in Santa Ana Mountains, Orange County, as soft red friable deeply weathered boulder conglomerate with some interbedded thin lenses of red crossbedded sandstone; unfossiliferous; thickness more than 300 feet. Forms base of unmetamorphosed sedimentary section. Unconformably overlies basement complex; underlies Baker Canyon member of Ladd formation. Cretaceous(?).

Named for Trabuco Canyon, Santa Ana Mountains.

Tracian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 987–989, 1005–1006. One of six stages, based on foraminiferal assemblages, in Upper Cretaceous column between top of Moreno and base of Panoche, as defined by Anderson and Pack (1915). Includes interval between Ingramian stage (new) above and Weldonian stage (new).

Occurs in Great Valley in both surface and subsurface. Named from Amerada Petroleum Corp. F. D. L. Well 1, sec. 15, T. 2 S., R. 5 E., near town of Tracy, San Joaquin County.

†Tracy City measures[1]

Pennsylvanian: Southeastern Tennessee.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 148–153, 167, 169.

Named for Tracy City, Grundy County.

Tracy Creek Quartz Latite

Tracy Creek Andesite[1]

Miocene(?): Southwestern Colorado.

Original reference: Whitman Cross and E. S. Larsen, 1935, U.S. Geol. Survey Bull. 843, p. 64–65, pl. 1.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 86–87, pl. 1. Redescribed as quartz latite. Irregularly overlies Beidell quartz latite; underlies dark quartz latites of Conejos age.

Makes up much of drainage of Tracy Creek, for which it is named, Saguache quadrangle, Saguache County. Occurs chiefly in extreme southern part of Saguache quadrangle and extends into Del Norte quadrangle.

Traders Iron-Bearing Member (of Vulcan Iron-Formation)[1]

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1900, U.S. Geol. Survey Geol. Atlas, Folio 62.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Basal member of Vulcan iron-formation. Underlies Brier slate member; overlies Felch formation.

Named for Traders mine, north of Lake Antoine, Menominee district, [Dickinson County].

Tradewater Formation

Tradewater Formation (in Pottsville Group)[1]

Tradewater Group

Middle Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 27.

R. M. Kosanke, 1950, Illinois Geol. Survey Bull. 74, p. 63–70. Tradewater group, formerly called upper Pottsville, is known from outcrops in southern, western, and northern Illinois. Top of group in southern and western Illinois is placed at base of Palzo and Isabel sandstones. Base in southern Illinois is at base of Grindstaff sandstone. Beds from the Tarter to base of Carbondale have been placed in Tradewater group. Maximum thickness 445 feet, southern Illinois; 100 feet, western Illinois; possibly as much as 600 feet in central Illinois. Group includes a number of sandstones, shales, coal beds, and two marine limestones, the Stonefort and Curlew, in southern Illinois, and Seville and Seahorne limestones in western Illinois. Overlies Caseyville group; underlies Carbondale group.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 64–82, geol. sections. Tradewater group in Beardstown, Glasford, Havana, and Vermont quadrangles, is divided into pre-Babylon strata (at base) and the Babylon, Tarter, Pope Creek, Lower DeLong, Middle DeLong, Upper Delong, Seahorne, Wiley, and Greenbush cyclothems. Underlies Carbondale group. Pre-Babylon strata conform in position to knobs or other projections of the Mississippian surface and locally may fill solution cavities.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 8 (fig. 1). Name discontinued in Illinois. Lower part of Tradewater included in McCormick group (new) and upper part in Kewanee group (new).

U.S. Geological Survey uses the term Tradewater Formation in Kentucky, but has discontinued use of the term Pottsville Group in Kentucky.

Named for exposures along Tradewater River east of Battery Rock.

Trafalgar Formation

Pleistocene: Indiana.

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 19 (fig. 3). Named on diagram showing formations of Pleistocene age in Indiana. Name appears above Jessup formation and below Lagro formation (both new). Name credited to W. J. Wayne (in preparation).

Type locality and derivation of name not given.

Trail Formation[1]

Upper Triassic: Northern California.

Original reference: J. S. Diller, 1892, Geol. Soc. America Bull., v. 3, p. 370–394.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175, table 2. Shown on paleotectonic map as Lower Jurassic; underlies Hardgrave sandstone.

K. B. Ketner, 1959, *in* E. D. McKee and others, U.S. Geol. Survey Misc. Geol. Inv. Map I–300, p. 17. Diller (1892) listed as Upper Triassic (ascending) the Swearinger slate, Hosselkus limestone, Trail formation, and Foreman formation, but he expressed doubt as to stratigraphic position of Trail formation. Diller (1908, U.S. Geol. Survey Bull. 353) assigned the Foreman and Trail to the Jurassic, and stratigraphic positions of Hosselkus and Swearinger slate were reversed. Order of Hosselkus and Swearinger was again reversed in interpretation by Silberling (*in* Reeside and others, 1957, Geol. Soc. America Bull., v. 66, no. 11) based on data of McMath, and Trail formation was returned to the Triassic stratigraphically below the Hosselkus and Swearinger. Sequence, as interpreted by Silberling and accepted for this folio, is (ascending) Trail formation, Swearinger slate, and Hosselkus. Footnote states that McMath (1958, unpub. thesis) now doubts validity of data given to Silberling.

P. A. Lydon, T. E. Gay, Jr., and C. W. Jennings, 1960, Geologic map of California, Westwood sheet (1:250,000): California Div. Mines. Mapped with Upper Jurassic marine sedimentary and metasedimentary rocks.

Named for exposures along Hosselkus Creek on the trail, Plumas County.

Trail City Member (of Fox Hills Formation)

Upper Cretaceous: North-central South Dakota and southern North Dakota.

R. E. Morgan and B. C. Petsch, 1945, South Dakota Geol. Survey Rept. Inv. 49, p. 13–14, fig. 4. Commonly brown or buff sandy shale, becoming more sandy toward top; contains three to five locally persistent zones of fossiliferous concretions, Thickness 50 to 90 feet. Underlies Timber Lake member (new); overlies Pierre formation.

S. P. Fisher, 1952, North Dakota Geol. Survey Bull. 26, p. 10–11, 37. Geographically extended into Emmons County, N. Dak., where it is 50 to 75

feet thick and consists of brown to gray sandy shales which pass upward into brown and green-gray sands. Thins eastward. Underlies Timber Lake member.

Named for exposures in area around Trail City, Corson County, S. Dak. Recognized at least 12 miles north of Trail City along edge of breaks of Grand River and also about 50 miles southwest from city along edge of breaks of Moreau River.

Trail Creek Formation[1]

Silurian: Central Idaho.

Original reference: L. G. Westgate and C. P. Ross, 1930, U.S. Geol. Survey Bull. 814, p. 10, 23.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 8. Silurian rocks are relatively scarce in Idaho. Sequence includes Laketown dolomite which locally attains thickness of 2,000 feet, and shale and sandstone of Trail Creek formation.

Exposures confined to west side of Trail Creek, in its upper part, Hailey quadrangle.

Trail Crossing Basalt[1]

Eocene(?): Central northern Oregon.

Original reference: H. T. Stearns, 1931, U.S. Geol. Survey Water-Supply Paper 637, p. 134.

Exposed on both banks of Crooked River at Trail Crossing and extend northeast across Haystack Butte country in belt about 1 mile wide, in Deschutes Basin.

Trail Hill Sandstone (in Chinle Formation)

Upper Triassic: Southwestern Utah.

P. D. Proctor, 1953, Utah Geol. and Mineralog. Survey Bull. 44, p. 22–23, pl. 2. Brownish- to brick-red shales and interbedded fine- to medium-grained sandstones. Lenses of pebble conglomerates as much as 1 foot thick, crossbedding, and minor ripple marks characterize parts of unit. Sandstones, friable and brick-red, locally with white mottling or white banding. White to grayish-white siliceous limestone from 6 inches to 1½ feet in thickness at top of ledge sandstone. Red medium-grained friable sandstone with minor interbedded brick-red shales above siliceous limestone. Green to gray shales, locally bluish green, above pink to red sandstones; thickness 25 feet. Bed of jasper 2 to 6 inches thick occurs 8 feet below upper contact of shale. Overlies Fire Clay Hill bentonitic shale (new); underlies Leeds sandstone (new) with local unconformity.

In Silver Reef (Harrisburg) Mining District, Washington County.

Training School Volcanics[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 132–133. Cone of bedded cinders and associated lava flow of melilite-nepheline basalt. Flow at least 50 feet thick. Flow rests unconformably on sandstone and conglomerate terrace graded to the plus 95 foot (Kaena) stand of the sea and was cliffed by the sea during the plus 25 foot (Waimanalo) stand.

Named for Maunawili Training School for Girls, near which it occurs. Flow is 1½ miles long and three-fourths mile wide, on northeast side of Koolau Range about 8½ miles northwest of Makapuu Head.

†Trampan Formation[1]

Miocene, upper: Western California.

Original reference: A. C. Lawson and C. Palache, 1902, California Univ. Pub., Dept. Geol. Bull., v. 2, p. 447–448.

Named for exposures along Las Trampas Creek, Contra Costa County.

Tranquilla Shale

Eocene, upper: Panamá.

H. N. Coryell and J. R. Embich, 1937, Jour. Paleontology, v. 11, no. 4, p. 289–291. Name proposed for basal Tertiary beds that have been included in Bohío formation. Bohio is restricted to include only Oligocene sediments which overlie Tranquilla. Greenish-gray shale that contains well-preserved foraminiferal fauna. On basis of fauna, regarded as Jackson (late Eocene).

W. P. Woodring and T. F. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 2, p. 227; W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 13. Name Tranquilla has priority over Gatuncillo formation, but name Tranquilla was defined inadequately. Type locality is now flooded by Madden Lake.

Type locality: Near town of Tranquilla, 79°13′ [33′] W., 10°15′ N., in upper Chagres River valley.

Tranquillon Volcanics

Miocene, lower (Saucesian): Southern California.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 33–34, pls. 1, 2. Defined as local phase of Obispo tuff of San Luis Obispo County; composed of as much as 1,200 feet of rhyolite, agglomerate, and ash. Where exposed on Tranquillon Mountain ridge, the volcanic series lies conformably below Monterey shale and unconformably above Rincon and older formations.

Type locality: Ridge west of Canada del Rodeo, Santa Barbara County.

Traveller Rhyolite[1]

Devonian: North-central Maine.

Original reference: F. W. Toppan, 1932, Geology of Maine, Dept. Geology Union College, Schenectady, N.Y., p. 69–70.

D. W. Rankin, 1958, (abs.) Geol. Soc. America Bull., v. 69, no. 12, pt. 2, p. 1632. At least 8,500 feet of felsitic flows, tuffs, and welded tuffs. Overlies marine subgraywacke of Oriskany age.

Forms mass of Traveller Mountains, a group of peaks north of Katahdin, Piscataquis County.

Traverse Group

Traverse Formation[1]

Middle and Upper Devonian: Southern Michigan.

Original reference: A. Winchell, 1871, Michigan Geol. Survey Rept. Prog., p. 26–33.

G. M. Ehlers and R. E. Radabaugh, 1937, Michigan Acad. Sci., Arts, and Letters Sec. Geology and Mineralogy [Guidebook] 7th Ann. Field Excursion, [p. 8–9]; 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v.

23, p. 441–445. Belle shale formation of Traverse group overlies Rogers City formation (new).

B. F. Hake and J. B. Maebius, 1938, Michigan Acad. Sci., Arts, and Letters, Papers, v. 23, p. 447–461. Term group is used to designate the series of beds which underlie all gray and black shales near base of Antrim formation and which overlie massive buff to brown relatively unfossiliferous limestones and dolomites belonging to Dundee and older formations. Group, in central Michigan, comprises (ascending) Bell shale, Rockport limestone, middle shale and limestone unit, middle massive limestone unit, upper shale unit, and Squaw Bay limestone.

G. A. Stewart, 1938, Geol. Soc. America Spec. Paper 8, p. 6–7. Stauffer (1909, Ohio Geol. Survey, 4th ser., Bull. 10) applied Michigan term Traverse to upper Middle Devonian rocks in northwestern Ohio, on assumption that they were continuation of formation of that name in Michigan. However, faunal correlation was only approximate, and some have questioned whether term should be used for northwestern Ohio, especially as limits of unit have never been definitely fixed in Michigan, and it has not been possible to correlate it with formations elsewhere. Seems best to discontinue use of term Traverse for upper Middle Devonian units of northwestern Ohio between Columbus limestone and Ohio shale. Terms Blue limestone, Silica shale, and Tenmile Creek dolomite are herein used for units of this interval.

L. L. Sloss, 1939, Jour. Paleontology, v. 13, no. 1, p. 52–73. Three-fold division of Middle Devonian Traverse beds of Lower Peninsula of Michigan is suggested. Pohl (1930) divided Traverse into Gravel Point stage at base, Charlevoix stage in middle, and Petoskey formation at top. Present writer [Sloss] was unable to locate prominent angular unconformity at top of Charlevoix stage mentioned by Pohl and believes that Pohl was confused by unusually high initial dips prevailing in area due to proximity of large bioherms. Term formation not applicable to beds involved; for purposes of this paper, all three divisions are considered as faunal zones. Rugose corals indicate Traverse beds are contemporaneous with Hamilton group of New York and Cedar Valley formation of Iowa.

A. S. Warthin, Jr., and G. A. Cooper, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 571–595. First locality name for rocks now termed Traverse group was that given by Douglass in 1841 (Fourth Ann. Rept. of the State Geologist for 1840, Michigan Legis. Doc., v. 1, no. 11, p. 550). This name was "Little Traverse Bay limestones," changed to "Little Traverse Bay group" by Winchell (1871). [Winchell used Little Traverse Group.] Lane (1893, Michigan Geol. Survey Rept. State Board 1891–1892) introduced present usage by referring to Traverse group. Subdivisions of Traverse group in Thunder Bay region [this report] have been assigned to stage, series, or formation rank by different authors. Thunder Bay series, Alpena limestone, Lower Traverse series with Long Lake limestone and shale, and Bell shale (Grabau, 1902, Michigan Geol. Survey Rept. State Board, 1901); Thunder Bay series, Alpena limestone series, and Presque Isle series (Grabau and Shimer, 1910, North American Index Fossils, v. 2); Thunder Bay series, Alpena limestone, Long Lake series (Ver Wiebe, 1927, Michigan Acad. Sci., Arts, and Letters, Papers, v. 7); Thunder Bay stage, Alpena stage, Presque Isle stage with Long Lake member, Grand Lake member, and Bell shale member (Pohl, 1930, U.S. Natl. Mus. Proc., v. 76, art. 14). In present report, group is

subdivided into formations based on combination of lithological and paleontological criteria. In this classification, term Thunder Bay is used in conformity with original definition of Douglass (1839?). Limits of Alpena limestone are redefined. Term Presque Isle series or stage, with its synonym, Long Lake series, are abandoned. Name Rockport Quarry limestone replaces preoccupied term Rockport limestone. Group, in Thunder Bay region, comprises (ascending) Bell shale, Rockport Quarry limestone, Newton Creek limestone, Alpena limestone, Four Mile Dam formation, Norway Point formation, Potter Farm formation, Thunder Bay limestone, and Squaw Bay limestone. Overlies Rogers City limestone, erosional unconformity. Top of group is usually recognized as top of highest Devonian limestone in Michigan. This would exclude from group "overlying transition zone" of shale referred to by some authors. Middle and Upper Devonian.

W. A. Kelly and G. W. Smith, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 3, p. 447–469. Group described in Afton-Onaway area, Michigan. Comprises (ascending) Belle shale (recognized in wells), Rockport Quarry limestone, Ferron Point shale, Genshaw formation, Koehler limestone (new), Gravel Point formation, and Beebe School formation (new). Beebe School formation underlies Antrim shale.

Name derived from Little Traverse Bay and Grand Traverse Bay, Southern Peninsula.

Traverse Volcanics (in Salt Lake Group)

Oligocene and Miocene, lower: North-central Utah.

L. W. Slentz, 1955, Utah Geol. Soc. Guidebook 10, p. 23, 24 (fig. 6). Salt Lake group, in Lower Jordan Valley, is divided into (ascending) Traverse volcanics, Jordan Narrows unit, Camp Williams unit, Harkers fanglomerate, and Travertine unit. Figure 6 shows Traverse volcanics interfingering with Jordan Narrows unit. Thickness 1,000 to 3,000 feet.

Lower Jordan Valley is defined as that part of Jordan Valley northward from Traverse Mountains to Great Salt Lake.

Travertine unit (in Salt Lake Group)

See Camp Williams unit, Jordan Narrows unit, and Harkers Fanglomerate.

Travesser Formation (in Dockum Group)

Triassic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 35 (table 2), 38, pls. 1–a, 2. Consists largely of clayey silt and fine-grained sandstone. Sandstone beds, as much as 20 feet thick, in measured section, range from massive to thin bedded and from parallel bedded to cross laminated. Conglomeratic lenses common; some fissile clay present. Commonly medium red brown; some orange sandstone and some dark-red-brown beds. Thickness 245 feet at type section; thickens eastward to as much as 550 feet in northeast Union County. Overlies Baldy Hill formation (new), possible angular unconformity; underlies Sloan Canyon formation.

Type section: Two miles south of Baldy Hill in sec. 12, T. 31 N., R. 32 Union County. Named for exposures near Travesser Creek, Underlies slope wash and alluvium from Tollgate eastward to Oklahoma State line.

Travester shale[1]

Middle Jurassic: Northeastern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 3, 12.

Well exposed in Travester Canyon.

Travis Peak Formation (in Trinity Group)[1]

Lower Cretaceous (Comanche Series): Southern and eastern Texas.

Original reference: R. T. Hill, 1890, Texas Geol. Survey 1st Ann. Rept., p. 118–119, 133.

R. W. Imlay, 1940, Arkansas Geol. Survey Inf. Circ. 12, p. 28. Subsurface Hosston formation (new) replaces name Travis Peak, as applied to beds older than real Travis Peak of Texas. Stratigraphic equivalents of Travis Peak formation of Texas are present in Pine Island field of northwestern Louisiana in lower part of Pine Island formation which lies about 250 feet above Hosston formation. This correlation is based on occurrence of ammonites, *Dufrenoya* and *Prochelonicerας* which mark Travis Peak formation of Texas and upper Aptian stage of European section.

R. W. Imlay, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 10, p. 1416–1469. Discussion of subsurface Lower Cretaceous formations of south Texas. Evidence presented to show that Travis Peak formation of outcrop area is represented in subsurface by shaly sequence, herein named Pearsall formation which includes basally Pine Island shale member, medially Cow Creek limestone member, and at top Hensell shale member. Recommended that term Travis Peak formation be used hereafter only for outcrops.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 318–319 [1946]. Rocks of Lower Cretaceous age outcropping in Johnson City area are given conventionally as follows: Travis Peak formation with Sycamore sand, Cow Creek limestone, and Hensell sand member; and Glen Rose limestone. Mapping in Johnson City area and to west shows that the so-called Hensell sand member of Travis Peak is more really a shoreward facies of Glen Rose limestone, but present report uses conventional terminology.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5–8. Proposed to remove Hensell sand from Travis Peak formation and place it in Shingle Hills formation (new). As restricted, Travis Peak contains two members: Sycamore sand and Cow Creek limestone. Underlies Shingle Hills formation.

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Assoc., Geol. Soc. Trans., v. 6, p. 67–68. Type "Travis Peak formation" restudied. Data indicate that recognition of Travis Peak "formation," as originally defined and long accepted, should be deleted from modern stratigraphic terminology. Intra-Travis Peak disconformities at boundaries of original members (top of Cow Creek and top of Sycamore) effectively eliminate any implication of unity within "formation." At same time, with recognition of proposed new unit (Hammett shale, previously unrecognized in Cow Creek "beds" or included with the Sycamore), the remaining terminology of the historical cartographic lithic units can be retained in original or long used sense. Four other reasons given for discontinuing use of name "Travis Peak formation." Phrase "Travis Peak sand" is common synonym of "basal Trinity sand" and is applied to any sand locally at base of the Trinity, thus it spans entire Trinity division. Statements of "Travis Peak equivalence" mean only Trinity when based on member

name-correlations. Faunal reports of "Travis Peak age" are based on comparison with middle member only; no diagnostic fauna is known from the Sycamore or Hensel [herein considered correct spelling]. Fossiliferous Cow Creek is known to be Aptian and entire "Travis Peak" is commonly identified as Aptian.

Named for Travis Peak post office, Burnet County.

Travis Peak Limestone (in Travis Peak Formation)[1]

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: W. M. Winton, 1925, Texas Univ. Bull. 2544.

In Denton County.

Treadwell Slate[1] **or Formation**

Jurassic(?) to Lower Cretaceous(?): Southeastern Alaska.

Original reference: G. C. Martin, 1926, U.S. Geol. Survey Bull. 776, p. 255–256, 270, chart opp. p. 247.

Fred Barker, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–100. Black graphitic slate and interlayered gray to green fine-grained poorly schistose to massive plagioclase-quartz-sericite-chlorite graywacke form bulk of formation in Juneau (B–3) quadrangle. Thickness probably at least several thousand feet. On northeast limb of Shelter syncline. Jurassic(?) to Early Cretaceous(?).

On Treadwall Island, Juneau region.

Treasure Mountain Rhyolite (in Potosi Volcanic Group)

Treasure Mountain Quartz Latite (in Potosi Volcanic Series)[1]

Treasure Mountain Welded Tuff

Tertiary, middle or upper: Southern Colorado and northern New Mexico.

Original reference: H. B. Patton, Colorado Geol. Survey Bull. 13, p. 20, 33–35.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 13, 93 (table 18), 117–124. Described in San Juan region as Treasure Mountain rhyolite. Made up in most places of a series of alternating flows, welded tuffs, and tuff beds of rhyolite and rhyolitic quartz latite. Generally, flows and welded tuffs are 100 feet or less in thickness, but some are as much as 200 or 300 feet, and tuff layers are locally somewhat thicker. Present in three domes; thickness in central part of domes are: Conejos quadrangle, 1,500 feet; San Cristobal quadrangle, 1,200 feet; and Saguache quadrangle, 300 feet. Underlies Sheep Mountain quartz latite; overlies Conejos quartz latite; locally underlies Alboroto rhyolite or later formations of Potosi series; where directly overlain by Hinsdale formation, the two are separated by interval long enough to develop San Juan peneplain.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 38–42, pl. 1. A. P. Butler (1946, unpub. thesis) extended Treasure Mountain formation southward from Colorado to area of Tusas Valley. Only mappable unit of this formation in Las Tablas quadrangle is the bipartite layer of welded tuff; hence in this report it is termed Treasure Mountain welded tuff. Thickness 3 to 15 feet. Butler reported 100 feet.

W. R. Muehlberger and others, 1960, New Mexico Geol. Soc. Guidebook 11th Ann. Field Conf., p. 100–101. Trice (1957, unpub. thesis) subdivided Treasure Mountain rhyolite in Brazos Peak quadrangle into (ascending)

Toltec andesite, Lagunitas clastic member, and Osier Mountain welded tuff. Upper two members crop out in Chamo quadrangle [this report].

U.S. Geological Survey currently designates the age of the Treasure Mountain Rhyolite as middle or late Tertiary on the basis of an age change of Potosi Volcanic Group.

Named for exposures on Treasure Mountain in northwestern part of Summitville quadrangle, Colorado.

Treat Limestone[1]

Upper Ordovician (Richmond) : Northeastern Illinois.

Original reference: J. R. C. Evans, 1926, Chicago Univ., Abs. Theses, Sci. ser., v. 2, p. 199–200.

Type locality not stated.

†Trego zone (in Niobrara Formation)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 51.

Named for Trego County.

Tremaines Bridge Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 137, 141, 149, 154.

Observed only at head of "gulf" just above bridge leading to Tremaines and below Pulaski.

Trempealeau Formation[1]

Upper Cambrian: Southern Wisconsin, northern Illinois, northeastern Iowa, and southeastern Minnesota.

Original reference: F. T. Thwaites, 1923, Jour. Geology, v. 31, no. 7, p. 547.

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935, Geol. Soc. America Bull., v. 46, no. 11, p. 1705–1714, geol. sections. Formation subdivided into five members (ascending) basal conglomerate and greensand, St. Lawrence dolomite, Lodi "shale" (siltstone), Jordan sandstone, and Madison sandstone. Overlies Franconia formation.

Josiah Bridge, 1937, U.S. Geol. Survey Prof. Paper 186–L, p. 234 (table 1) Table shows Trempealeau formation comprises (ascending) St. Lawrence dolomite, Lodi shale and siltstone, Jordan sandstone, and Madison sandstone members. This is Kansas Geological Society Conference classification (1935).

C. R. Stauffer, G. M. Swartz, and G. A. Thiel, 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1237–1238. In proposed St. Croixian classification for Minnesota, term Trempealeau of the "Conference classification" is replaced by terms St. Lawrence and Jordan formations.

G. O. Raasch, 1939, Geol. Soc. America Spec. Paper 19, p. 97–113, 114 (fig. 14). Trempealeau formation restricted at top to exclude Madison which is restored to formation rank.

G. O. Raasch, 1951, Illinois Acad. Sci. Trans., v. 44, p. 147–150. Formation includes (ascending) Arcadia (new), St. Lawrence, Lodi, and Jordan members. Overlies Bad Axe member of Franconia; underlies Sunset Point formation (new name to replace term Madison).

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 170–171. Discussion of upper Croixan stratigraphy of upper Mississippi Valley.

Recommended that term Trempealeau, previously used as a formation name to include St. Lawrence and Jordan formations and also as a stage name, be restricted to Trempealeauan stage.

Well exposed in Trempealeau Bluff on Mississippi River at Trempealeau, Trempealeau County, Wis.

Trempealeauan Stage

Upper Cambrian: North America.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Upper Cambrian comprises three stages (ascending): Dresbachian, Franconian, and Trempealeauan. The Trempealeauan includes four faunal zones: *Platycolpus-Scaevogyra*, upper *Dikelocephalus*, *Saukiella-Calvinella*, and *Plethopeltis*.

C. A. Nelson, 1956, Geol. Soc. America Bull., v. 67, no. 2, p. 170–171. Discussion of upper Croixan stratigraphy of upper Mississippi Valley. Recommended that term Trempealeau, previously used as a formation name to include St. Lawrence and Jordan formations and also as a stage name, be restricted to Trempealeauan stage.

W. C. Bell, R. R. Berg, and C. A. Nelson, 1956, Internat. Geol. Cong., 20th, Mexico, Cambrian Symposium, pt. 2, p. 441. Authors [Bell, Berg, and Nelson] of present report concur with Nelson's (1956) recommendation that name Trempealeau be reserved only as a stage name. Consensus among Cambrian workers at present time is that Trempealeauan stage be equated to Saukia zone of Raasch (1951, Illinois Acad. Sci. Trans., v. 44), which means in terms of Cambrian correlation chart (Howell and others, 1944), it would encompass zones of *Dikelocephalus postrectus* through *Plethopeltis*, inclusive. Further investigations in other parts of North America may demonstrate useful faunal subdivisions of significant geographic extent, but at present the interval correlations with type Trempealeauan are far from precise.

Trent Marl[1]

Miocene, lower: Southern North Carolina.

Original reference: B. L. Miller, 1910, Geol. Soc. America Bull., v. 20, p. 674–675.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in Coastal Plain of North Carolina, Oct. 8–9, p. 30. Kellum (1926, U.S. Geol. Survey Prof. Paper 143) concluded that the Trent was of early Miocene age, separated from underlying Castle Hayne limestone of Jackson age by erosional unconformity. Most of Kellum's Trent species came from vicinity of Silverdale, a locality not mentioned by Miller and which is about 17 miles from type locality along Trent River. Recent work has shown that Kellum's Trent (lower Miocene) is nonexistent and that units designated by Kellum as lower Miocene are in part of Castle Hayne age and in part of Yorktown age. Original Trent of Miller is here moved from middle Eocene to upper Eocene and included within the Castle Hayne although considered a distinctive facies of it.

Named for exposures along Trent River from vicinity of Trenton, Jones County, to near Junction of Trent and Neuse Rivers.

Trenton Clays[1]

Upper Cretaceous: Western New Jersey.

Original reference: H. B. Kummel and G. N. Knapp, 1904, New Jersey Geol. Survey, v. 6, p. 197.

Occur in a number of pits along Pond Run, 2 miles east of Trenton, Mercer County.

†Trenton Gravel[1]

Pleistocene: Western New Jersey and southeastern Pennsylvania.

Original reference: H. C. Lewis, 1881, Philadelphia Acad. Nat. Sci. Proc. 1880, v. 32, p. 296–309.

Covers flat ground of Camden, N.J., and lower part of Philadelphia, and forms islands in river. Part of city of Trenton, Mercer County, N.J., is built on terrace covered with this gravel.

Trenton Limestone[1] or Group[1]

Trenton Member (of Martinsburg Formation)

Middle Ordovician: New York, Georgia, Michigan, northern Ohio, Pennsylvania, Vermont, and western Virginia.

Original reference: L. Vanuxem, 1838, New York Geol. Survey 2d Rept., p. 257, 276, 283.

R. L. Bates, 1936, Virginia Geol. Survey Bull. 46–M, p. 184–185. Member of Martinsburg formation in Big A Mountain area. Trenton member is Upper Mohawkian in age, and remainder of formation is Cincinnatian. In some regions, Trenton is removed from Martinsburg and given formational status; as such, it is known from Pennsylvania to Alabama. With Trenton removed, the remaining shales are known as Reedsville formation which extends from Pennsylvania to Tennessee.

G. M. Kay, 1937, Geol. Soc. America Proc. 1936, p. 82. Stratigraphy of Trenton group in New York and Ontario reveals influence of regional structural development of distribution, lithology, and fauna of sediments. In early Trenton, Rockland and Hull stages, limestone-depositing seas advanced on lands retaining characteristics inherited from earlier Ordovician; boreal faunas invaded in Rockland. In middle Trenton Sherman Fall stage, Vermontian disturbance produced geanticline that became important source of detrital sediments east of region; also some synchronous elevation of Adirondack arch. In later Trenton Cobourg stage, the arch continued to rise, and trough on east was restricted by incursion of sediments on its eastern side; boreal faunas invaded northern part of region. In latest Trenton Collingwood and Gloucester stages, shale-forming fine-grained clastics spread far eastward.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 233–302. Discussion of stratigraphy of Trenton group (Mohawkian series). Standard section of group comprises (ascending) Rockland limestone with Selby and Napanee members (both new); Hull formation, Sherman Fall formation with Shoreham and Denmark (new) members; Cobourg formation with Hallowell and Hillier members (both new), Collingwood shale; and Gloucester shale. Overlies Black River group. Formations of Rockland age include Rockland limestone, Coboconk limestone (Ontario), Cloche Island limestone (Ontario), Amsterdam limestone and Isle La Motte limestone. Formations of Hull age include Hull limestone and Larrabee member of Glens Falls formation (upper Glens Falls is of Sherman Fall age). Formations of Sherman Fall age include Sherman Fall limestone, Canajoharie shale, Snake Hill formation, Schenectady formation, Cumberland Head formation, Stony Point formation, Lacolle conglomerate (Quebec), and Rysedorph conglomerate. Formations of Cobourg age include Cobourg limestone, Liskeard formation (Ontario), and Utica shale.

Late Trenton shale formations include Collingwood shale (Ontario), Blue Mountain shale (Ontario), Atwater Creek shale, and Holland Patent formation. Within some part of its distribution, each formation and member is believed to be lithologically distinct; traced laterally, the differences may become obscure and faunal evidence may be useful basis of recognition. Lateral changes alter rank of certain synchronous units from one part of region to another; units have been given rank that seems most useful within each area of outcrop. Throughout New York-Ontario region, where sediments of post-Trenton age are preserved, they are of lower Cincinnatian Eden age and of clastic character. They comprise lower Lorraine sandy shales in New York and eastern Ontario, lower Dundas shales in central Ontario, and Sheguiandah shale of Manitoulin. Cincinnatian sediments lie with essential conformity on youngest Trenton shales in each area except lower Mohawk Valley, where Indian Ladder shale of Eden age lies disconformably on Schenectady formation of middle Trenton (Sherman Fall) age. Report discusses Trenton history and refers to Rockland, Hull, Sherman Fall, Cobourg, Collingwood, and Gloucester stages.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1579–1580. Discussion of Whitehall quadrangle, New York-Vermont. For mapping purposes, Trenton formation was divided into limestone part and shale part. Limestone part was mapped with Black River limestone. These are merely facies and as such can be compared with (not correlated with) rocks of similar facies in lower Mohawk Valley. Limestone part averages 100 feet and consists of thin-bedded shaly limestone, carrying characteristic Trenton fossils. At Crown Point, Amsterdam (Rockland), Larrabee (Hull), and Shoreham (lowermost Sherman Fall) formations have been recognized by Kay. Overlying limestone is at least 500 feet of shale. It is everywhere involved in minor thrust faults, being repeated by the slicing. Toward Taconic thrust on east, it is metamorphosed into low-grade slate and underlies large areas as near Benson. In some places in slate areas are outcrops of quartzitic slate, derived from sandy shale. Presumably they lie at top of section and represent an upper sandy facies of the Trenton. They would thus correspond in facies to Schenectady beds of lower Mohawk Valley. This facies has not hitherto been recognized in Champlain Valley.

Charles Butts, 1940, Virginia Geol. Survey Bull. 52, pt. 1, p. 213–216. In type region, the Trenton rests either upon Lowville or upper Black River limestone. In Lee County, Va., along northwest base of Wallen Ridge, the Trenton lies upon the Eggleston or upper Black River limestone. In type region, the Trenton is succeeded by Utica shale and the Utica by Lorraine shale. The Trenton in Lee County and adjacent areas is succeeded by Reedsville shale which corresponds approximately to the Lorraine. Trenton as distinct lithologic unit occurs only in Wise and Lee Counties; in other areas, not differentiated from Martinsburg shale.

G. M. Kay, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1969. Group, west of Adirondack axis, central Pennsylvania, includes basal Reedsville black shale (upper Utica); Coburn limestone, 175 feet at Salona (Whitcomb) (Cobourg); Salona limestone, 339 feet at Salona (Whitcomb) (Denmark and Shoreham); and Nealmont limestone, 65 to 135 feet, including type Rodman, Lemont, Center [Centre] Hall (Hull and Rockland). Overlies Black River group. Mohawkian series.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 1–23; no. 2, p. 97–116. Group in central Pennsylvania includes (ascending) Nealmont, Salona, Coburn, and Antes (new) formations. Overlies Curtin limestone of Black River group; underlies Cincinnatian Reedsville formation.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 555–561. Group in west-central Vermont includes Orwell limestone (new), Glens Falls limestone, and Hortonville slate.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 11. Safford's Nashville group redefined to include strata of Hermitage, Bigby, Cannon, and Catheys formations and to exclude strata of the Leipers, Arnheim, and Fernvale formations which were included in Safford's original definition. Thus, name Nashville group will replace name Trenton group of New York, which has been in general use for these formations. Believed best to drop all New York names that have been used for the Ordovician of Tennessee.

Charles Butts and Benjamin Gildersleeve, 1948, Georgia Geol. Survey Bull. 54, p. 32. Trenton limestone is about 150 feet thick in northwest Georgia where it is well exposed in Lookout Valley.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 31–37, pl. 1. Group, in Castleton area, comprises (ascending) Orwell limestone, Whipple marble, and Hortonville slate. Appears to be depositional hiatus between uppermost Middlebury strata (Chazy) and the Trenton.

V. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 248, no. 11, p. 785–814. Evidence presented to substantitate radical change in interpretation of Paleozoic stratigraphy of Saratoga Springs region, New York. Previously accepted sequence of beds (Potsdam sandstone, Theresa formation, Hoyt limestone, Little Falls dolomite, Amsterdam limestone, Trenton limestone, Canajoharie shale) is revised to read Potsdam sandstone, Galway formation, Hoyt limestone, Ritchie limestone (new), Mosherville sandstone (new), Gailor dolomite (new), Lowville limestone, Amsterdam limestone, Trenton limestone (Rockland?, Hull, Sherman Fall representatives), and Canajoharie shale. Thickness of Trenton in Saratoga area about 50 feet.

R. C. Hussey, 1952, Michigan Dept. Conserv., Geol. Survey Div. Pub. 46, Geol. Ser. 39, p. 13, 14. Trenton formation subdivided into Chandler Falls, Groos Quarry, and Haymeadow Creek members (all new). Overlies Bony Falls member (new) of Black River formation; underlies Bills Creek member of Richmond formation.

C. G. Winder, 1953, (abs.) Geol. Soc. America Bull., v. 64, no. 12, pt. 2, p. 1493; 1955, Western Ontario Univ. Dept. Geology Contr. No. 9, p. 1–11. Middle Ordovician (Mohawkian) sediments in New York, Ontario, and Ottawa-St. Lawrence Lowlands have been interpreted for about 100 years as a sequence of successively younger formations, and all have been named as such. Reconstruction of paleoecological conditions indicates that Black River and Trenton groups were deposited contemporaneously. Each "formation" is a phase of deposition, of which the lithology and fauna reflect the environment. Black River sediments are near-shore equivalents of Trenton sediments. The Mohawkian was deposited in a transgressive sea, whereas the repetition of Mohawkian phases in the Cincinnatian in reverse order indicates a regressive sea. Terms Black

River and Trenton refer to rocks deposited contemporaneously and have no time significance.

W. H. Twenhofel and others, 1954, Geol Soc. America Bull., v. 65, no. 3, p. 247–298, chart 2. Terms Chazyan, Black River, and Trentonian used for stages of Middle Ordovician on correlation chart. Term Trenton limestone used in parts of Ontario, New York, Virginia, Tennessee, and Georgia.

R. L. Miller and W. P. Brosge, 1954, U.S. Geol. Survey Bull. 990, p. 67–70, pls. In most of the Appalachian Valley of Virginia, beds of Trenton, Eden, and Maysville age are predominantly shale and have been grouped together in one formation, Martinsburg shale. In westernmost belts of exposure in extreme southwest Virginia and adjacent Tennessee, beds of Trenton age are predominantly limestone and have been called Trenton limestone, and overlying shales of Eden and Maysville age have been called Reedsville shale. Application of name Trenton to the limestone beds is confusing inasmuch as underlying Eggleston limestone is believed to be of early Trenton age, and the still older beds here referred to Hardy Creek and Ben Hur limestones are believed to be of earliest Trenton age. Hence, limestones (post-Eggleston) of Trenton age in Powell and Wallen Valleys of southwest Virginia and adjacent Tennessee should be given a new formation name. However, old name Trenton limestone is retained for purposes of this report [Jonesville district, Virginia]. Formation consists predominantly of brown and dark-gray limestone; three bentonite beds present. Average thickness about 560 feet.

Named for exposures at Trenton Falls on West Canada Creek, Herkimer and Oneida Counties, N.Y.

Trenton Stage

Trentonian[1] Series or Epoch

Middle Ordovician: North America.

Original reference: A. W. Grabau, 1909, Science, new ser., v. 29, p. 351–356.

Marshall Kay, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1401, 1411–1415. Mohawkian series divided into Bolarian below and Trentonian series. Term Bolarian preferred to series name Black Riverian. Original Trenton had practically content of present usage, though subsequently the name was applied to a period including the "Chazy," "Birdseye," "Black River," and "Trenton" epochs, and later "Trenton," "Utica," and "Hudson" epochs. Term Trentonian series was applied by Grabau (1909) containing essentially the rocks of original usage. Lower Trentonian formations of northwestern New York and eastern Ontario, the Rockland and Kirkfield or Hull limestones, disconformably overlap Black River rocks, lying locally on Canadian and Cambrian along Mohawk River, and on Precambrian in Ontario; Rocklandian and Kirkfieldian are considered stages. In central Pennsylvania, Nealmont formation is equivalent, and subseries in Appalachians is referred to as Nealmontian, extending from base of Trentonian. Maximum lower Trentonian thickness is about 150 feet in New York and Ontario. Dimunition westward and eastward is partly by overlap; there are intervals of no deposition within the subseries as it approaches its disappearance at Canjoharie on Adirondack line at Mohawk River. Generally, there is southward divergence along axis of maximum thickness. In Pennsylvania, there is similar overlap on regional unconformity toward the southeast to minimum at Adirondack line in Path Valley northwest of Chambersburg, and

divergence in Chambersburg limestone beyond. In Bellefonte district there are abrupt variations because of overlap on unconformity of local relief of tens of feet. Within area of outcrop of this region, there is isopachous trough that may be filling of a subsequent valley within cuesta of Curtin limestone, rather than continuation of Rideauan overlap southward in argillaceous facies in southwestern Virginia. Middle Trentonian includes rocks equivalent to Shoreham and Denmark limestones of New York or undivided Sherman Fall limestone. Middle Trentonian includes Shorehamian and Denmarkian stages. Upper Trentonian includes Cobourg limestone and disconformably overlying Holland Patent shale in northwestern New York, the latter passing into Collingwoodian calcareous shale and Gloucesterian black shale, mapped also as Billings and Eastview formations in Ontario. The Cobourg and Holland Patent become Utica black shale eastward, the change in facies and nature of stratigraphic change being abrupt but somewhat obscure. Only area on the southwest where there has been any separation of these higher units is in north-central Pennsylvania, where 700 feet of Coburn limestone and Antes black shale have been correlated. Holland Patent and Antes are commonly called "Utica" but represent only upper third of true Utica, most of which is Cobourgian.

Marshall Kay, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 84–99. Middle Ordovician limestones of Chazyan, Bolarian, and Trentonian series are exposed in western anticlines in Appalachian Mountains of West Virginia and Virginia northeast of New River. Trentonian rocks lie with disconformity on the Bolarian. In the southwest, the lower Trentonian is dominantly Moccasin argillite; northwestward, it changes into fossiliferous Nealmont limestone facies like that of Pennsylvania. In the southwest, Eggleston shale has basal quartz sandstone, and in the northwest it passes into Onego argillaceous limestone which resembles Oranda limestone of Appalachian Valley. Younger Trentonian has not been successfully divided and traced and is called the "Martinsburg," though in northeastern exposures it is essentially like Salona limestone of Pennsylvania. Base of Nealmont is judged to be basal Trentonian. In New York, and Ontario, Canada, Selby member of Rockland formation forms base of Trentonian.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 9, chart 1. In this report, term Trenton is used as a stage name. Occurs above Wilderness stage (new) of Mohawkian series. Stage is modified by removal of the Rockland which has mostly fossils derived from underlying Black River and Witten. Deposition of the Sherman Fall is thought to inaugurate Trenton stage.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, p. 90, 91, 94 (table 3). Trentonian series has its base at contact of Selby member of Rockland formation on Chaumont limestone of Black River group in northwestern New York and eastern Ontario, Canada. Trentonian extends from top of Black River in northwestern New York to top of Utica. To the southwest, there is disagreement whether base of Trentonian is within upper Witten formation or at top. Cooper (1956) placed lowest Trentonian as well as Black River equivalents in his Wilderness stage. Trentonian series includes Rocklandian stage.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 7, p. 28–33. North American Ordovician comprises Canadian, Chazyan, Blackriverian,

Trentonian, and Cincinnatian series. Trenton group was divided by Raymond (1916, Harvard Coll. Mus. Comp. Zoology Bull., v. 56) into succession of faunal zones that he thought time-stratigraphic, but which he called formations. In time these became the stages of Kay (1937; 1943; 1948): Rocklandian, Kirkfieldian, Shorehamian, Denmarkian, Cobourgian, Collingwoodian, and Gloucesterian. The lithic units are also time-stratigraphic, lithic differences reflecting physical conditions that are in turn recognizable in the successive faunas; also there are progressive changes in fauna that have time value. Probably term stages too high an order for named divisions of Trentonian; they can be considered substages of smaller number of stages. Suggested that Nealmontian be applied to Rocklandian and Kirkfieldian substages and that Shermanian be applied to Shorehamian and Denmarkian. Cobourg-Collingwood-Gloucester seems time-equivalent to Utica group, but name Utica is stongly associated with black shale facies. Hence, uppermost Trentonian stage is designated Pictonian stage originally given in more restricted sense by Raymond (1911 [1914, Canada Geol. Survey Rept. 1912]) and abandoned by him in 1921 (Geol. Soc. Canada Mus. Bull. 31); Pictonian contains Utica group of formations (Kay, 1943, Am. Jour. Sci., v. 241, no. 10; 1953, New York State Mus. Bull. 347). Boundary between Trentonian and Cincinnatian series has been defined variably because of selection of differing horizons in known successions, and varying correlations between type sections in separated areas. Boundary in North America is taken invariably as separating "Middle" and "Upper" Ordovician, although in European terms, assuming the Caradocian to be "Middle," the American boundary lies within the Cincinnatian under any definition of that series.

Trenton Falls series[1]

Ordovician: New York.

Original reference: T. A. Conrad, 1837, New York Geol. Survey 1st Ann. Rept., p. 165.

Salmon River.

Tres Hermanos Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Central northern New Mexico.

Original references: C. L. Herrick, 1900, Am. Geologist, v. 25, p. 331–346; C. L. Herrick and D. W. Johnson, 1900, New Mexico Univ. Bull., v. 2, pt. 1, p. 3–63; pt. 2, p. 1–17.

C. B. Hunt, 1936, U.S. Geol. Survey Bull. 860–B, p. 41–43. East of Mount Taylor coal field, northwestern New Mexico, are three prominent sandstones in lower 350 feet of Mancos shale to which name Tres Hermanos sandstone has been applied in previous reports. Name was first used by Herrick and Johnson (1900), though without recording type locality. Sandstone No. 2 of present report is 75 feet thick and is most persistent of the three sandstones. It crops out as prominent capping of mesa or ridges over most of area east of Mount Taylor.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 32, 36, 65, 93. Discussion of intertonguing between marine Mancos and nonmarine Mesaverde strata in New Mexico, Arizona, and southwestern Colorado. One or more sandstones near base of Mancos at various localities in New Mexico have been called Tres Hermanos. Herrick and Johnson, who first applied term, did not give type locality. Original type locality is probably east of Tres Hermanos Buttes, three volcanic necks in Alamosa Creek valley, in sec.

26, T. 3 N., R. 7 W., where sandstones occur in similar stratigraphic position. Invasion of Upper Cretaceous sea in New Mexico is divided into at least two parts; minor regressions are recorded in Tres Hermanos sandstones. This is based on the probability that the Tres Hermanos is a tongue of the Dakota(?) and joins with it in a landward direction.

W. H. Tonking, 1957, New Mexico Bur. Mines Mineral Resources Bull. 41, p. 19, 20, 21 (fig. 6), pls. Discussion of Mancos shale and Mesaverde group in Puertecito quadrangle. Mancos shale is restricted to strata below Tres Hermanos(?) sandstone. Tres Hermanos(?) sandstone is tentatively assigned to Mesaverde group, but it may be more closely related to Dakota(?) sandstone. Tres Hermanos(?) conformably underlies La Cruz Peak formation (new) of Mesaverde group. Tres Hermanos(?) apparently pinches out to south in secs. 4 and 8, T. 2 N., R. 5 W.

D. B. Givens, 1957, New Mexico Bur. Mines Mineral Resources Bull. 58, p. 7–8, pl. 1. In Dog Springs quadrangle, Tres Hermanos member of Mancos is well-layered quartzose sandstone about 25 feet thick. Probably pinches out near west boundary of quadrangle.

C. H. Dane, 1959, New Mexico Geol. Soc. Guidebook 10th Field Conf., p. 85–91. Discussion of historical background of type locality of Tres Hermanos sandstone member of Mancos shale. Derivation and definition of name Tres Hermanos sandstone has been subject of confusion in the literature for many years. Herrick's original report is herein reviewed. It is clear from this report that Herrick applied name Tres Hermanos to three dark igneous plugs in north part of sec. 26, T. 3 N., R. 7 W., still known by that name, and that he described the mountain now known as D–Cross Mountain as Turtle Mountain. It is also clear that sandstone to which name Tres Hermanos was applied by Herrick also cropped out east of his Tres Hermanos Buttes and was "a band of sandstone with enormous concretions." Herrick gives thickness of this sandstone as 75 feet. Hunt's (1936) description of "sandstone No. 2" is comparable to sandstone described by Herrick and Johnson (1900). Although Lee (1917, U.S. Geol. Survey Prof. Paper 101) used name Tres Hermanos for zone of sandstones 150 feet thick, presumably including Hunt's three sandstones and intervening shale, it now seems best to restrict use of name to the single sandstone to which Herrick originally applied it (Hunt's sandstone No. 2 in Puerco Valley) and to those sandstones that can be correlated with it.

Type locality (Dane): North part of sec. 26, T. 3 N., R. 7 W., Socorro County. Name derived from Tres Hermanos Buttes.

Tresner Limestone

Pennsylvanian: Central eastern Illinois.

E. F. Taylor and G. H. Cady, 1944, Illinois Geol. Survey Rept. Inv. 93, p. 22–23. Name applied to limestone that lies about 175 feet above No. 7 coal bed.

Exposed in S½SE¼NE¼ sec. 10, T. 14 N., R. 11 W., near Tresner, Edgar County.

Tres Peidras Granite

Precambrian: Central northern New Mexico.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 59–62, pl. 1. Unit, as exposed in type locality and along Tusas Canyon, is

pink, flesh-colored, or reddish-orange faintly to well-foliated fine- to medium-grained quartz-microcline-albite-biotite-muscovite granite. Crude laminae and flattened knots of the two micas commonly well developed. Appears to have intruded Petaca schist and Mopping metavolcanic series (new). Formerly included in Tusas granite.

Exposed along lower Rio Tusas and in and around town of Tres Piedras. Other masses of this granite found east of Hopewell in sec. 33, T. 29 N., R. 7 E., and on lower east slope of Jawbone Mountain. Dikes of it near Hopewell.

Tres Pinos Sandstone[1]

Eocene, middle: Southern California.

Original reference: P. F. Kerr and H. G. Schenck, 1925, Geol. Soc. America Bull., v. 36, p. 470, 475.

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 206–207, pl. 3. Described in San Benito quadrangle where it conformably overlies Los Muertos Creek formation (new). Exposed thickness about 900 feet; top of formation concealed by overlapping terrace deposits to southwest and San Benito gravels to southeast.

Probably named for exposures at or near Tres Pinos or Tres Pinos Creek, San Benito County.

Tribes Hill Limestone (in Beekmantown Group)[1]

Lower Ordovician: Central, eastern, and northern New York.

Original references: E. O. Ulrich and H. P. Cushing, 1910, Geol. Soc. America Bull., v. 21, p. 780–781; 1910, New York State Mus. Bull. 140.

R. R. Wheeler, 1941, (abs) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1938–1939; 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Cambro-Ordovician correlation revised in Champlain, Hudson, Mohawk, and St. Lawrence valleys. Lower "typical" Theresa is physically and faunally differentiated from "Upper Theresa" (now Heuvelton member of Tribes Hill); two marine cycles, represented by Tribes Hill formation (containing the Norton-Heuvelton, Fort Ann-Bucks Bridge, Benson-Ogdensburg members) and Cassin formation, constitute Beekmantown series.

D. W. Fisher and G. F. Hanson, 1951, Am. Jour. Sci., v. 249, no. 11, p. 808. In Saratoga region proper, rocks of Tribes Hill age are lacking due to offlap, removal by post-Canadian erosion or by facies change into Gailor dolomite (new). Thin representation of Tribes Hill sandy limestone is present to southwest in Amsterdam and Broadalbin quadrangles where it overlies Gailor dolomite.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 71–96. Name Tribes Hill restricted to limestone phase of Lower Canadian. Subdivided into (ascending) Fort Johnson, Palatine Bridge, Wolf Hollow, and Fonda members. Thickness about 145 feet. Underlies Chuctanunda Creek (new) formation. Wheeler separated Tribes Hill in Champlain Valley into Norton limestone, Fort Ann limestone, and Benson dolomite. Wheeler's subdivisions are poorly defined; he gives no type localities or sections, and application to Lower Ordovician of Mohawk Valley is untenable. New names for Mohawk Valley Canadian are necessary.

Named for exposures at Tribes Hill, Montgomery County.

†Tribune Limestone (in Chester Group)[1]

Mississippian: Western Kentucky and southeastern Illinois.

Original reference: E. O. Ulrich, 1904, Missouri Bur. Geology and Mines, v. 2, 2d ser., p. 109.

Named for Tribune, Crittenden County, Ky.

†Trickham Bed (in Graham Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 402.

Wallace Lee *in* Wallace Lee and others, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 120–121. Wayland shale member was called "Trickham shale" by Drake for Coleman County type locality, and "Wayland shale" by Plummer and Moore (1921) for locality in Stephens County. Although name "Trickham" has priority, name "Wayland" has been adopted because it has had much wider usage and is better established.

Named for Trickham, Coleman County.

Trident[1] (Formation)

Lower Mississippian: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Trimble Granite[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

Occurs in large area surrounding Trimble Pass, La Plata County.

Trimmers Rock Sandstone[1] (in Susquehanna Group)

Trimmers Rock Member (of Fort Littleton Formation)

Upper Devonian: Central southern Pennsylvania.

Original reference: B. Willard, 1935, Geol. Soc. America Proc. 1934, p. 123.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 15–16. Member of Fort Littleton formation. Overlies Losh Run shale member; underlies Parkhead sandstone member.

U.S. Geological Survey currently classifies the Trimmers Rock as a formation in Susquehanna Group on the basis of a study now in progress.

Named for Trimmers Rock, a hill 1½ miles east of Newport, Perry County.

Trincheras division[1]

Tertiary, late: Southeastern Arizona, and Sonora, Mexico.

Original references: E. T. Dumble, 1900, Am. Inst. Mining Engrs. Trans., v. 29; 1902, Am. Inst. Mining Engrs. Trans., v. 31.

In Cochise County, Ariz., and Sonora, Mex. Derivation of name not stated.

Trinidad lignitic group[1]

Cretaceous: Colorado.

Original reference: F. V. Hayden, 1875, U.S. Geol. and Geog. Survey Terr., Bull. 1, p. 402.

Typically developed at Trinidad, Las Animas County.

Trinidad Sandstone[1] (in Montana Group)

Upper Cretaceous: Southeastern Colorado and northeastern New Mexico.

Original reference: R. C. Hills, 1899, U.S. Geol. Survey Geol. Atlas, Folio 58.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 33–34; G. H. Wood, Jr., S. A. Northrop, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. In Colfax County, N. Mex., conformably overlies and interfingers with Pierre shale; conformably underlies and interfingers with Vermejo formation. Massive to thin-bedded, light-gray to light-buff, somewhat feldspathic sandstone. Thickness approximately 100 feet.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 710–712. In Raton basin, intertongues with underlying Pierre shale; tongues of Pierre wedge out in westerly direction, and tongues of Trinidad wedge out laterally in northerly and easterly directions. Conformably underlies Vermejo formation; tongues of Vermejo wedge out in easterly and northeasterly directions, and tongues of Trinidad wedge out west and northwest. Composed of buff to gray, slightly arkosic sandstone and thin interbeds of light tan to gray silty shale. Formation is absent in vicinity of Ute Park, N. Mex., and from this point northward it increases in thickness to 300 feet northwest of Walsenburg, Colo.

Named for exposures at Trinidad, Las Animas County, Colo.

†Trinity Formation[1]

Pre-Cretaceous: California.

Original reference: O. H. Hershey, 1901, Am. Geologist, v. 27, p. 226.

In Klamath Mountain region.

Trinity Group[1] or **Sand**[1]

Trinity division

Lower Cretaceous (Comanche Series): Texas, southwestern Arkansas, northwestern Louisiana, and central southern and southeastern Oklahoma.

Original reference: R. T. Hill, 1888, Science, v. 11, p. 21.

C. P. Ross, 1943, U.S. Geol. Survey Bull. 928–B, p. 53 (table), 66–83. Group, in Shafter region, Presidio County, comprises (ascending) Presidio and Shafter formations. Overlies Permian Cibolo formation; underlies Fredericksburg group.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. In outcrops in southern Arkansas, group comprises (ascending) Pike gravel, Delight sand (new), Dierks limestone, Holly Creek formation, De Queen limestone, and Paluxy sand. In subsurface of Arkansas, Louisiana, and east Texas, comprises (ascending) Pine Island shale, James limestone, Rodessa formation, Ferry Lake anhydrite, Mooringsport formation, and Paluxy formation. In subsurface of south Texas comprises (ascending) Pearsall formation and Glen Rose limestone. In outcrops in central mineral region comprises (ascending) Travis Peak formation and Glen Rose limestone. Outcrops in north-central Texas comprise (ascending) basal sand, Glen Rose limestone, and Paluxy sand.

V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Rept. Inv. 2, p. 5–12. Trinity group revised for central Texas as follows: Travis Peak formation with Sycamore sand and Cow Creek limestone members and Shingle Hills formation (new) with Hensell sand and Glen Rose limestone members.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, pl. 1. As shown on map legend, Trinity group, in Eagle Mountains, Tex., comprises (ascending) Yucca formation, Bluff Mesa formation, and Cox sandstone.

F. E. Lozo and F. L. Stricklin, Jr., 1956, Gulf Coast Geol. Assoc., Geol. Soc. Trans., v. 6, p. 67–68. Outcrop basal Cretaceous of central Texas assigned to Trinity "group" has been historically divided into two lithofacies, an upper sequence of alternating shales and limestones called Glen Rose limestone or formation and a lower predominantly arenaceous clastic interval originally called Travis Peak sands. Evaluation of rock unit boundaries within Trinity division has revealed datum planes and disconformities that permit regrouping of lithic units on basis of cyclic repetitions of systematic deviations in type of sedimentation. With this concept of tectonic—sedimentary lithogenetic entities, Trinity stratal interval is divisible into three subdivisions herein referred to as lower, middle, and upper. These lithogenetic units, with limits at least in part at variance with boundaries of previously accepted formations or members, provide nonoverlapping subdivisions of section and are thus more significant for historical stratigraphic analysis. In gross sense, each unit may be considered a couplet consisting of basal terrigenous detritus phase, quartzose or argillaceous succeeded by carbonate phase often with evidence of extremely shallow turbulent terminal depositional conditions. Data indicate that recognition of Travis Peak "formation," as originally defined and long accepted, should be deleted from modern stratigraphic terminology. Advances in knowledge of physical relations of basal Cretaceous lithic units evolved from Paleozoic mapping by Barnes. Discoveries of localities where Cow Creek limestone was in direct contact with Paleozoic eliminated notion that the Sycamore passed imperceptibly into the Hensel [herein considered correct spelling]: as basal transgressive clastic. Barnes (1948) emended Travis Peak formation to include only Sycamore and Cow Creek. He proposed Shingle Hills formation as new upper Trinity combination to include Hensel and Glen Rose. These proposals parallel questionable practice increasingly prevalent in subsurface stratigraphic terminology to have "formations" represent restricted "time" intervals. Despite certain advantages in considering some cyclic subdivisions (for example those in Trinity) as "formations" and the phases as "members," the burden of more new names and predictable usage of these names in sense of paleontologically determined zones or sub-stages weigh against the practice. Reference outcrop section designated for Trinity division. Here Trinity division comprises (ascending) Sycamore sand (lower Trinity); Hammet shale (new), and Cow Creek limestone (middle Trinity); Hensel sand, Glen Rose limestone (lower), *Corbula* bed, and Glen Rose limestone (upper).

J. M. Forgotson, Jr., 1956, Gulf Coast Assoc., Geol. Soc. Trans., v. 6, p. 91–108; 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2328–2363. Purpose of report is to present correlation of formations within Trinity group (Comanchean Cretaceous) of Gulf Coastal Plain and to interpret tectonic frame work and paleogeography existing during Trinity deposition. Each correlation is based on time-stratigraphic unit defined by recognized formation boundaries in type area. Each unit is extended geographically by correlation of electrical log markers that are assumed to represent contemporaneously deposited beds. Trinity time-stratigraphic unit (group throughout most of area) represents interval

below top of Glen Rose formation (as recognized near Austin, Tex.) or its time-stratigraphic equivalent and above top of Sligo formation (as recognized in subsurface of northern Louisiana) or its time-stratigraphic equivalent. Trinity unit subdivided into (ascending) Pearsall time-stratigraphic unit, Rodessa time-stratigraphic unit, Ferry Lake time-stratigraphic equivalent, Rusk time-stratigraphic unit (Rusk is new in this report) and, in areas where Ferry Lake is not recognizable, the undifferentiated Glen Rose (interval between top of Trinity unit and base of Rodessa unit). Term Paluxy formation used for sand unit which is time-stratigraphic equivalent of part of Walnut and Fredericksburg groups.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 20–26. Group, in McCurtain County, comprises (ascending) Holly Creek formation, De Queen limestone, and Paluxy sand. Basal division of Cretaceous rocks in county. Unconformably underlies Fredericksburg group.

Reference section (Trinity division): Hayes-Travis County area, Texas. Measured at localities in order of geologic sequence (ascending) Hammet Crossing section, Hamilton Pool, Craft Ranch, Murrah Ranch, and Shingle Hills. Named for exposures on Trinity Rivers of Texas.

Trinityan series[1]

Lower Cretaceous (Comanche): Arizona.

Original reference: C. R. Keyes, 1935, Pan-Am. Geologist, v. 64, no. 2, p. 128, 129, 139.

Triphammer Shale (in Ithaca Shale)

Triphammer shale member (of Ithaca facies subgroup)

Upper Devonian: South-central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, pt. 1, p. 202.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Shale is upper unit in Ithaca shale. Underlies Enfield shale in Skaneateles and Cayuga Lakes area.

Occurs in Ithaca region.

Trippe Limestone[1]

Middle Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

Named for exposures in Trippe Gulch, on south side of North Pass Canyon, Gold Hill district.

Triumph Conglomerate[1]

Pennsylvanian: Pennsylvania.

Original reference: J. F. Carll, 1875, Pennsylvania 2d Geol. Survey Rept. I, p. 38–40.

Exposed in hilltops at Triumph, Warren County.

Trivoli cyclothem[1] (in McLeansboro Group)

Trivoli cyclothem (in Modesto Formation)

Pennsylvanian: Illinois.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 179–193.

J. M. Weller and W. A. Newton, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 11. In sequence, occurs above Gimlet cyclothem and below Collinsville cyclothem (new). Thickness about 30 feet.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 121–122, 193. Highest Pennsylvanian unit in western Illinois. Maximum thickness 37 feet at type exposure, top eroded. Overlies Exline cyclothem. Includes Trivoli sandstone and Trivoli limestone. Derivation of name and type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Modesto formation (new). In northern, western, southeastern, and eastern areas occurs above Gimlet cyclothem; in northern and western areas occurs below Hicks cyclothem; in southwestern area occurs below Carlinville cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Ravine draining northeast and north, near Trivoli, SW¼ sec. 3, T. 8 N., R. 5 E., Glasford quadrangle, Peoria County.

Trivoli Limestone (in McLeansboro Group)

Pennsylvanian: Central western Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 104. Marine limestone in lower McLeansboro.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 123, geol. sections 8, 9. Light-gray fossiliferous buff-weathering limestone that occurs in massive bed. At type exposure of Trivoli cyclothem is 8 to 10 inches thick. Occurs near top of cyclothem above Trivoli (No. 8) coal.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 56 (table 3). Replaced by Cramer limestone member of Modesto formation (both new).

Type exposure (of cyclothem): Ravine draining northeast and north, SW¼ sec. 3, T. 8 N., R. 5 E., near Trivoli, Glasford quadrangle, Peoria County.

Trivoli Sandstone Member (of Modesto Formation)

Trivoli Sandstone (in McLeansboro Group)

Pennsylvanian: Southeastern, southwestern, western, and northern Illinois.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 121, geol. sections 8, 9. Commonly light gray or blue gray, has rusty spots, and is medium to fine grained, thin to medium bedded, and micaceous. Commonly grades without break into underlying Gimlet gray shale, but locally cuts down through shale to rest on black limestone; in such places sandstone is somewhat more massive and resembles other channel sandstones of area. Thickness at type exposure of Trivoli cyclothem 15 feet.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 38, 49 (table 1), 69, pl. 1. Rank reduced to member status in Modesto formation (new). In southeastern area, occurs above West Franklin limestone member and below Chapel (No. 8) coal member; in southwestern area, occurs above Scottville limestone member and below Chapel (No. 8) coal member; western and northern area occurs above Exline limestone member and below Chapel (No. 8) coal member. Thickness 12 to 38 feet. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois. Cyclical classification is retained but is entirely independent of rock-stratigraphic classification.

Type exposure: Ravine draining northeast and north, SW¼ sec. 3, T. 8 N., R. 5 E., near Trivoli, Glasford quadrangle, Peoria County.

Tropic Shale[1] or Formation

Upper Cretaceous: Central southern Utah.

Original reference: H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51, 102–105, 129–130, pl. 5. Formation described in Zion Park region where it is 400 to 1,250 feet thick; unconformably underlies Straight Cliffs sandstone and overlies Dakota(?) sandstone. Drab, sandy, argillaceous; many beds of sandstone, more abundant in lower part; beds of coal; marine, brackish-water, and fresh-water fossils. Exposed continuously across Kolob Terrace from Kanarra Mountain to Orderville and eastward across Skutumpah Terrace to Paria River.

Named for exposures at and around village of Tropic, Garfield County.

Tropico Group

Miocene(?) and Pliocene(?): Southern California.

T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 135–139. Name applied to sequence of nonmarine sedimentary, pyroclastic, and volcanic rocks exposed in Rosamond Hills and originally described as Rosamond series by Hershey (1902), together with similar and probable correlative rocks of Tertiary age exposed in vicinities of Kramer borate area and in Kramer Hills in western Mojave Desert. Rocks of group are moderately deformed and rest on deeply eroded surface of pre-Tertiary granitic and metamorphic rocks that form crystalline basement complex of region, and are overlain unconformably by Quaternary alluvial sediments. Maximum exposed thickness about 2,800 feet. Group is divided into several lithologic units of local extent. In most sections lower unit is pyroclastic formation, with associated rhyolitic intrusions and flow breccias; upper unit is either fanglomerate or sequence of carbonate rocks, clays, and sandstones of lacustrine and fluviatile origin; basalt flows occur locally, mostly in middle part. Group is nonfossiliferous except at one locality where diatom remains in upper part suggest early Pliocene age. Lower unit is tentatively correlated with lithologically similar formations of known Miocene age in areas west and northwest. Formations that are locally distinct are: Gem Hill formation, Fiss fanglomerate, Bissel formation, Saddleback basalt, and Red Buttes quartz basalt.

Type section: In Rosamond Hills one-half mile west of Mojave-Tropico Road 1 to 2 miles north of Tropico mines, Rosamond quadrangle, in NE¼ sec. 2, T. 9 N., R. 13 W., San Bernardino Base and Meridian, Kern County. Most complete sections are at Antelope Buttes, Rosamond Hills, hills north of Bissell, at and near Castle Butte,. and in Kramer Hills; incomplete sections are at Soledad Mountain and Kramer borate area.

Troublesome Formation

Oligocene: Northwestern Colorado.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 41. Name applied by A. H. Richards (unpub. thesis) to several hundred feet of light-gray to light-tan tuffaceous sands and clays in valley of Troublesome Creek. Contains both Oligocene and late Miocene or early Pliocene fossils.

J. D. Schlottman and L. E. Smith, 1954, U.S. Atomic Energy Comm. [Pub.] RME–1042, p. 8–9. Youngest Tertiary sediments in Middle Park Basin; lies unconformably on all older formations. Maximum thickness 960 feet, measured along Troublesome Creek north of U.S. Highway 40. Upper 800 feet consists of volcanic ash in beds as much as 30 feet thick, interbedded with clays and fluvial sands. Deposited during Oligocene time and reworked during Miocene and Pliocene.

Named for occurrence in valley of Troublesome Creek, near Kremmling in Middle Park, Grand County. Covers about 160 square miles.

Troublesome Creek Sandstone Member (of Jelm Formation)

Upper Triassic: Southeastern Wyoming.

R. G. Hubbell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2744–2748. Light gray to light buff fine-grained strongly crossbedded massive sandstone containing numerous large varicolored rounded frosted quartz and chert grains. Maximum observed thickness along southwestern flanks of Freezeout Hills 167 feet. Unconformably underlies Sundance formation.

Type section: Sec. 26, T. 24 N., R. 80 W., Carbon County in southwest Freezeout Hills, where it is well exposed.

Trough Creek Limestone Member (of Mauch Chunk Formation)[1]

Mississippian: Central Pennsylvania.

Original reference: I. C. White, 1885, Pennsylvania 2d Geol. Survey Rept. T_3, p. 73–76, 85.

J. M. Weller, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 2 (column 102). Included in Chesterian series on correlation chart.

On south bank of Trough Creek in Huntingdon County three-fourths mile below Todd (Brick) mills, on Mr. Taylor's land.

Trousdale Shale[1] or Formation

Upper Devonian: Central Tennessee and Kentucky.

Original references: E. R. Pohl, 1930, Tennessee Acad. Sci. Jour., v. 5, no. 2, p. 56–63; 1930, Am. Jour. Sci., 5th, v. 20, p. 151–152.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 857, 859, 860, 861, 866–868, 883. Basal bed of New Albany shale in Kentucky contains abundant *Schizobolus concentricus* Vanuxem through its entire thickness and is without *Leiorhynchus* assemblage that occurs above *Schizobolus* in Indiana. This change in faunal content becomes evident just south of Ohio River; *Schizobolus* shale prevails in Kentucky and Tennessee where it was described and named Trousdale shale by Pohl (1930). Since there is no apparent difference in this layer in this area, bed in Kentucky is identified as Trousdale. The Trousdale extends around Cincinnati arch to Olympian Springs where it pinches out and extends south into Tennessee. Has uniform thickness of about 10 feet. Overlies Portwood formation (new), where Portwood is present, and Hamilton limestone elsewhere. Overlain everywhere by Blackiston formation (new), and where contact is within the black shale of the two formations, the boundary can be approximately located by fossils in the Trousdale and can be determined definitely when joints in the two strata are exposed. From Estill County, Ky., north, the Olentangy shale, basal member of Blackiston, rests on Trousdale. In Tennessee, Trousdale lies below Dowelltown formation (new) of Chattanooga.

Derivation of name not stated. Map shows two towns named Trousdale, one in Sumner County Tenn., and one in Warren County.

Trout Creek Formation[1]

Miocene, upper: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

H. D. MacGinitie, 1933, Carnegie Inst. Washington Pub. 416, p. 45. Plant fossils indicate upper Miocene age.

Type locality: Trout Creek on east side of Alvord Valley, southeastern part of Harney County.

Trout Creek Sandstone Member (of Iles Formation)[1]

Trout Creek Sandstone[1] (in Mesaverde Group)

Upper Cretaceous: Northwestern Colorado.

Original reference: N. M. Fenneman and H. S. Gale, 1906, U.S. Geol. Survey Bull. 297, p. 26.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 157, pl. 19. Member consists of fine-grained massive cliff-forming sandstone about 100 feet thick. Occurs at top of formation above unnamed sandstone sequence containing coal beds. Conformably underlies Williams Fork formation.

Named for Trout Creek, on northeastern side of Twentymile Park, about 10 miles northwest of Yampa, Routt County. Typically exposed on north side of U.S. Highway 40 at Bear River, on both sides of road in Hayden Gulch.

Trout Creek Schists

Precambrian: Eastern Nevada and western Utah.

R. B. Nelson, 1959, Dissert. Abs., v. 20, no. 3, p. 997. Name appears only in stratigraphic section. Thickness 2,900 feet. Older than Cherry Canyon schists (new); younger than unnamed tectonitic dolomitic marble.

Stratigraphic section covers northern Snake Range and Kern Mountains in eastern Nevada and southern Deep Creek Range in western Utah.

Troutdale Formation[1]

Pliocene, lower: Northwestern Oregon and Washington.

Original reference: E. T. Hodge, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 157.

R. W. Chaney, 1944, Carnegie Inst. Washington Pub. 553, p. 323–351. Lower Pliocene, on basis of flora.

R. C. Treasher, 1942, Geologic map of Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. In Portland area, overlies Columbia River lava and unconformably underlies Boring lava.

W. D. Wilkinson, W. D. Lowry, and E. M. Baldwin, 1946, Oregon Dept. Geology and Mineral Industries Bull. 31, p. 24–28. Described in St. Helens quadrangle, Oregon and Washington. Troutdale sediments traced from near Camas, Wash., across Columbia River from Troutdale, northwesterly into St. Helens quadrangle. As much as 600 feet of relatively unconsolidated conglomerate, sandstone, and silt, tentatively assigned to upper part of Troutdale, cover parts of quadrangle.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, p. 7–14. Includes Portland Hills silt member (new) in upper part.

Lower part consists of sands, silts, and quartzite-bearing gravels. Also includes basaltic interbed referred to as Crown Point lava member. Although Pliocene sediments can be traced southward from Troutdale formation (as mapped by Treasher, 1942) into coalescing Molalla formation, it is desirable to retain Hodge's definition of Troutdale because not only have other names (Molalla formation and Fern Ridge tuffs farther south) been introduced but also composition of part of Troutdale is different, in that it contains quartzite pebbles. Troutdale sand and gravels are restricted to valley of lower Columbia River, but the somewhat younger Portland Hills silt is not and covers much of adjacent land. Williams (1916, Oregon Bur. Mines and Geology Mineral Resources, v. 2, no. 3) referred the sands and gravels to Satsop formation.

D. E. Trimble, 1955, (abs.) Geol. Soc. America Bull., v. 66, no. 12, pt. 2, p. 1667. Overlies Rhododendron formation of Hodge.

D. E. Trimble, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–104. In Portland quadrangle, formation consists of conglomerate, sandstone, shale, and mudstone; tuffaceous in part. Thickness more than 1,100 feet. Overlies Columbia River basalt; underlies Boring lava. Lower Pliocene.

Named for gravels and sands deposited by ancestral Columbia River, which are well displayed near Troutdale, Multnomah County, Oreg.

Troutdale Granite[1]

Precambrian(?): Central northern Colorado.

Original references: J. Underhill, 1906, Colorado Univ. Studies, v. 3, no. 4, p. 272; 1906, Colorado Sci. Soc. Proc., v. 8, p. 103–122.

Named for town in Evergreen, Denver Mountain Parks quadrangle, Jefferson County.

Trout Pond Limestone[1]

Precambrian: Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199, p. 112, 114, fig. 25.

Occurs on George W. Smith property, south of Clintonville, Clinton County.

Trowbridge Coal Member (of Mattoon Formation)

Pennsylvanian: Central and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 51 (table 1), pl. 1. Assigned member status in Mattoon formation (new). Occurs below Calhoun coal member (new) and above Opdyke coal member. Coal named by Cady (1948 Illinois Geol. Survey Bull. 62). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: About center of south line sec. 11, T. 10 N., R. 6 E., Shelby County.

Trowbridge Shale

Upper Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 263–265. Consists of black shale with large concretions. Thickness about 4,000 feet. Underlies Lonesome formation (new); overlies Snowshoe formation (new); base difficult to determine.

Type area: Trends northeast across South Fork Valley along Mowich anticline where beds dip steeply to southeast. Named for H. H. Trowbridge Ranch, at mouth of Rosebud Creek, in South Fork Valley, Crook County.

Troy Granite[1]

Precambrian: Central southern Oklahoma.

Original reference: C. H. Taylor, 1915, Oklahoma Geol. Survey Bull. 20.

Occurs along Rock Creek near town of Troy, Johnston County.

Troy Quartzite[1]

Precambrian: Central Arizona.

Original reference: F. L. Ransome, 1915, Washington Acad. Sci. Jour., v. 5, p. 380–385.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 474–475, 477 (table 1). Troy is differentiated from Apache group, not only because it overlaps Mescal limestone but because it carries Cambrian fossils and conformably underlies younger Middle Cambrian strata. Thickness 350 feet in Peppersauce Canyon where it underlies Santa Catalina formation and is disconformable above unnamed sandstone of Apache group.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, p. 32. South of Roosevelt Dam, the Troy rests either on Roosevelt member (new) of Apache group or on unnamed basalt member that overlies Mescal limestone.

N. P. Peterson, 1954, U.S. Geol. Survey Geol. Quad. Map GQ–41. Mapped in Globe quadrangle. Underlies Martin limestone and overlies Mescal limestone of Apache group with disconformable contacts.

U.S. Geological Survey currently designates the age of the Troy Quartzite as Precambrian on the basis of a study now in progress.

Named for exposures on Troy Mountain, Ray quadrangle.

Troy Shales[1]

Troy Shale and Limestone Member (of Schodack Formation)

Lower Cambrian: Eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 67–70.

Rudolf Ruedemann, 1942, New York State Mus. Bull. 331, p. 64, Term Schodack formation, in Catskill quadrangle, is extended to include as members beds that occur associated or even interbedded with it such as Zion Hill quartzite, Burden conglomerate, and Troy shale and limestone, which is for most part a mass of greenish, reddish-purplish shale in places with small beds of more or less calcareous quartzite.

Winifred Goldring, 1943, New York State Mus. Bull. 332, p. 64. In Troy and Cohoes quadrangles, Schodack formation includes (ascending) Bomoseen grit, Diamond Rock quartzite, Troy shale and limestone, and Schodack shale and limestone.

Exposed at Troy, N.Y., at dam in Poesten Kill, and other localities.

Truchas slate[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 12.

Occurs at Picuris, north of Santa Fe, Santa Fe County. Derivation of name not stated.

Truckee Formation[1]

Pliocene: Northern and central western Nevada, eastern California, and southeastern Oregon.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, map 5; 1878, U.S. Geol. Expl. 40th Par. Rept., v. 1, p. 412.

Age considered Pliocene on basis of study of molluscan fauna. Teng-Chien Yen, 1950, Am. Jour. Sci., v. 248, no. 3, p. 180–193.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042-C, p. 55–56, pl. 3. Formation described Virginia City quadrangle, Nevada, where it is composed of stream and lake deposits which occur in many disconnected areas; beds of diatomite common. Thickness uncertain; may be 3,000 feet or more in Chalk Hills but much less elsewhere. Underlies Lousetown formation; base intertongues with lower part of Kate Peak formation. Early Pliocene.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 99–102, 141–142. Type area restudied. Here formation is represented by three unnamed members: lower, basalt tuff (palagonite) as much as 80 feet thick; middle, nearly pure diatomite, about 1,500 feet thick; upper, slabby gray limestones which range in thickness from 1 or 2 inches up to several feet, with some beds 20 to 30 feet, approximately 850 feet of section exposed. Underlies Lake Lahontan deposits; overlies Desert Peak formation (new). Pliocene; lower member late Clarendonian; middle, Hemphillian; upper, higher parts of which may be as young as Blancan. Misunderstanding of nature of formation in its type area has resulted in including in Truckee rocks in western area near California-Nevada border that represent a distinct formation.

Type section: Northeastern corner Hot Springs Range, 70 miles northeast of town of Truckee and 18 miles from Truckee River at its nearest point.

Truckhaven Rhyolite

Pliocene: Southern California.

T. W. Dibblee, Jr., 1954, California Div. Mines Bull. 170, chap. 2, p. 23 (fig. 2), 24, pl. 2. A lens of varicolored felsitic rock that was extruded along an adjacent east-west fault. Maximum thickness 100 feet. Wedges out southward into Canebrake conglomerate (new).

Crops out near Truckhaven, west of Salton Sea, Imperial County.

Trujillo Formation[1]

Cretaceous: Puerto Rico.

See **Trujillo Alto Limestone.**

Trujillo Formation (in Dockum Group)[1]

Upper Triassic: Northeastern Texas.

Original reference: C. N. Gould, 1907, U.S. Geol. Survey Water-Supply Paper 191, p. 20–29.

G. Maxwell, 1954, Panhandle Geol. Soc. [Guidebook] Spring Field Trips April 24 and May 1, p. 15. Thickness 20 to 25 feet in Potter County. Consists of one to five or more sandstones or conglomerates with interbedded red and gray shales. Overlies Tecovas formation.

Name for exposures on Trujillo Creek, Oldham County.

Trujillo Alto Limestone[1]

Upper Cretaceous: Puerto Rico.

Original reference: C. P. Berkey, 1915, New York Acad. Sci. Annals, v. 26, p. 21, 61.

R. C. Mitchell, 1954, Puerto Rico Univ. Agr. Expt. Sta. Tech. Paper 13, p. 36 (table 2), 47, 48 (table 4). Thickness 200 feet. Overlies Luquillo formation; underlies Figuera formation. Upper Cretaceous.

C. A. Kaye, 1959, U.S. Geol. Survey Prof. Paper 317–A, p. 7 (table), 9 (fig. 8), 20–22, pl. 2. Fossiliferous medium-bedded to massive limestone. Maximum thickness about 900 feet. Overlies Monacillo formation (new); underlies Figuera volcanics.

Named for outcrops in vicinity north of Trujillo Alto.

Trumbull facies (of Cleveland Shale)

See **Cleveland Shale.**

Trumbull Gneiss[1]

Precambrian (Grenville): Northern New York.

Original reference: H. L. Alling, 1918, New York State Mus. Bull. 199, p. 45, 127.

E. N. Cameron and P. L. Weis, 1960, U.S. Geol. Survey Bull. 1082–E, p. 289 (fig. 28), 290. Mentioned in report on strategic graphite. Occurs at base of sequence and below Hague gneiss.

Named from Trumbull Mountain, Essex County.

Trump Conglomerate

Pliocene(?): Central Colorado.

J. H. Johnson, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 77. A series of gravels and poorly consolidated conglomerates. Overlies Wagontongue formation (new). Late Pliocene.

J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7). 70–72, pl. 1. Estimated maximum thickness 500 feet. Pliocene(?).

Widespread along extreme southern end of South Park. Well exposed along pediments sloping up to Coffman Ridge in T. 14 S., R. 76 W., and along divide between Agate Creek and Badger Creek in secs. 14 and 23 in same township. Named from settlement of Trump, Park County.

Truro Limestone[1]

Pennsylvanian: Central southern Iowa.

Original reference: J. L. Tilton, 1897, Iowa Acad. Sci. Proc., v. 4, p. 52, 54.

Named for Truro, Madison County.

†Truro Series[1]

Pleistocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 541–593.

Named for occurrence in Truro, Barnstable County.

Truxton limestones[1]

Carbonic (Mississippian Series): Northwestern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 243, 251, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart). In Mississippian series. Underlies Elden limestones; overlies Simon limestones. Of Carbonic age.

Exposed in Grand Wash Cliffs and Yampai Cliffs overlooking Truxton Plateau, Mohave County.

Tryon Peak flows

Late Tertiary: Central eastern California.

H. G. Wilshire, 1957, California Univ. Dept. Geol. Sci. Bull., v. 32, no. 4. fig. 1. Named on map legend of Ebbetts Pass region. Younger than Silver Peak andesites and Raymond Peak andesites (both new).

Ebbetts Pass region is in Alpine County.

Tsadaka Formation

Eocene(?) and Oligocene: South-central Alaska.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 13, 19–20, pls. 1, 2. Poorly indurated coarse conglomerate characterized by boulders and cobbles of granite and diorite in matrix of granitic debris. Consists of at least 700 feet of interbedded silty sandstone, siltstone, pebbly sandstone, and fine to coarse conglomerate in Tsadaka Canyon. Sandstone beds are arkosic. Youngest bedrock formation in district; underlies relatively thin veneer of unconsolidated material in area immediately south of Wishbone Lake; unconformably overlies Wishbone formation (new). Represents uppermost conglomeratic beds on Wishbone Hill, mapped as Eska conglomerate by Martin and Katz (1912).

U.S. Geological Survey currently designates the age of the Tsadaka Formation as Eocene(?) and Oligocene on the basis of a study now in progress.

In Tsadaka Canyon on Moose Creek below Premier mine, Wishbone Hill district, Matanuska coal field; also on Wishbone Hill.

Tsegi Formation

Quaternary, upper: Northeastern Arizona.

J. T. Hack, 1941, Geog. Review, v. 31, no. 2, p. 262–263; 1942, Harvard Univ. Peabody Mus. Am. Archeology and Ethnology Papers, v. 35, no. 1, p. 51–53, fig. 29. Clay beds and silt beds common, but in general, formation contains more numerous gravel lenses, as though in part deposited by more torrential streams. Not cemented in most places, but here and there, especially in center of valley, hard, sandy clay beds contain calcium carbonate cement. Gray to brown. No artifacts found in formation, but several pieces of charcoal found below ruin of Kawaika-a, probably indicating human occupation of region during deposition of formation. Deposited before 1100 A.D. Above Awatovi, where formation is thick, it consists of two members separated by erosional unconformity. Below end of Antelope Mesa, formation becomes thin, suggesting that streams must have deposited all of their load before reaching lower part of valley. Underlies Naha formation (new); overlies Jeddito formation (new).

Type locality: In Tsegi Canyon, western Navajo country.

Tualatin Gravels

Pleistocene: Northwestern Oregon.

R. C. Treasher, 1942, Geologic map of the Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Consists of

silt, grit, and gravel as much as 200 feet thick; represents piedmont fan deposition.

Form terraces along Tualatin River, Portland area.

Tub Springs Sandstone (in Cross Mountain Group)

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 11, 19, pl. 2. Sandstone, usually massive, about 20 to 50 feet thick. Overlies shale interval 110 to 200 feet thick which in turn overlies Low Gap sandstone (new); in Cross Mountain section, underlies 270 feet of shale containing minor amounts of sandstone.

Type locality: Same as Cross Mountain group, which is on road leading to top of Cross Mountain, Lake City quadrangle, Anderson County. Named from exposures near Tub Spring at top of Frozen Head Mountain above Petros, Fork Mountain quadrangle.

Tuckahoe Group (in Newark Group)[1]

Upper Triassic: Eastern Virginia.

Original reference: N. S. Shaler and J. B. Woodworth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 423–435.

Exposed in shafts and mines bordering Tuckahoe Creek, Goochland County, in vicinity of Gayton, Henrico County.

Tuckahoe Marble[1]

Precambrian: Southeastern New York.

Original reference: C. P. Berkey and J. R. Healy, 1912, Columbia Univ. Contr., v. 20, p. 1907–1912.

In Westchester County.

†Tucquan Gneiss[1]

Precambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 128–129, 136, 203, 204.

Probably named for exposures in broad, flat anticlinal arch whose axis crosses Susquehanna River at mouth of Tocquan [Tucquan] Creek (McCalls Ferry).

Tucson Sandstone[1]

Upper Cretaceous (Benton): Southern central New Mexico.

Original reference: G. H. Hansen, 1931, George Washington Univ. Bull., Summ. doctoral theses, 1925–1928, p. 84.

Well exposed on Tucson Mountain, Sierra Blanca region.

Tucson Mountain chaos

Tertiary, lower to middle(?): Southeastern Arizona.

J. H. Courtright, 1958, Arizona Geol. Soc. Digest, p. 7, 8. Characterized principally by abundance of large angular blocks of limestone, arkose, andesite porphyry conglomerate, and other rocks. In exposure one-half mile due south of Gates Pass, chaos consists of erratically positioned large rock blocks enclosed in series of thin-bedded conglomerates and silts. Underlies Cat Mountain rhyolite formation; unconformably overlies arkosic beds of probable Cretaceous age. Name credited to J. E. Kinnison (unpub. thesis).

J. E. Kinnison, 1959, Arizona Geol. Soc. Guidebook 2, p. 48–57. Includes two members—lower conglomerate member with poorly consolidated well-rounded reddish-brown cobble conglomerate at its base and well consolidated conglomerate with more numerous boulders in upper part, thickness about 150 feet, apparently only a local feature; and upper chaos member, characterized by blocks 10 to more than 200 feet in maximum dimension, with angular limestone conglomerate bodies erratically distributed throughout member, thickness of member 185 feet. Chaos overlies Amole group. Tentatively considered to be of probable early to middle Tertiary age.

Crops out extensively in Tucson Mountains, from which it derives its name, Pima County.

Tucumcari Shale

†Tucumcari Beds[1]

Tucumcari Shale Member (of Purgatoire Formation)

Lower Cretaceous: Northeastern New Mexico.

Original reference: W. F. Cummins, 1892, Texas Geol. Survey 3d Ann. Rept., p. 201–209.

Ernest Dobrovolny and C. H. Summerson, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 62. Member consists of gray shale and buff calcareous sandstone that contains nodules of argillaceous limestone and has thin basal sandstone. Contained fauna indicates Kiamichi and Duck Creek age. Name Tucumcari beds was originally used for this interval, but term included overlying unit here named Mesa Rica sandstone member. Unconformably overlies Morrison, Wingate(?), or Chinle formations.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2005 (fig. 2), 2007. Rank raised to formation; term Purgatoire abandoned in Tucumcari-Sabinoso area. Thickness 0 to about 60 feet.

Named for Mount Tucumcari, northwestern Quay County.

Tucumcarian series

Mesozoic (Early Cretacic): New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 105 (chart), 153–154. Comprises (ascending) Redondo, Pyramid, Fredericksburg, and Washita terranes.

Tuerto Gravel

Quaternary: North-central New Mexico.

C. E. Stearns, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 476, 477, pl. 1. Thickness 5 to more than 150 (300?) feet. Interbedded with basalt flows tentatively correlated with Cuerbio basalt. Younger than Santa Fe formation.

Brewster Baldwin, 1956, New Mexico Geol. Soc. Guidebook 7th Field Conf., p. 118 (fig. 2), 119. Mentioned in discussion of upper unit of Santa Fe group. Puye gravel, Ancha formation, and Tuerto gravel all rest with angular unconformity on Tesuque formation. These gravel units are 500, 300, and 150 feet in maximum thickness. Early Pleistocene.

In Galisteo-Tonque area, Sandoval and Santa Fe Counties.

Tufts Quartzite Member (of Cambridge Slate)[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: M. Billings, 1929, Am. Jour. Sci., 5th, v. 18, p. 101, 102, 106, 107, 111, 112.

Exposed in athletic field of Tufts College, Medford, Boston region, Suffolk County.

Tuira Formation

Miocene: Panamá.

Karl Sapper, 1937, Mittelamerika, Handbuch der regionalen Geologie: Heidelberg, v. 8, Abt. 4a, no 29, p. 132, 134 (correlation chart). Underlies Pucro sandstone. Equivalent to lower Gatún formation. Middle Miocene.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 349. Not properly defined. Miocene.

In Darién area.

Tuktu Formation (in Nanushuk Group)

Tuktu Member (of Umiat Formation)

Lower Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 162, fig. 2. Member consists almost entirely of marine sandstone at type locality where it is about 1,000 feet thick and underlies Hatbox tongue (new) of Chandler formation (new). Northward, member thickens progressively to about 2,500 feet and includes part of marine equivalent of Hatbox tongue. Base of member coincides with base of Umiat formation (new) and base of Nanushuk group. Overlies Torok formation (new); underlies Topagoruk member (new) of Umiat formation.

R. L. Detterman *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 233–235, figs. 2, 5. Redefined as formation. Rocks form prominent south-facing escarpment along southern edge of Northern Foothills section. Northward across strike, formation grades abruptly into shale but is present 35 miles north of escarpment. More exact data on type locality given. Approximately 1,030 feet thick at type locality. Underlies Chandler and Grandstand (new) formations. Predominantly dirty-green to greenish-gray very fine- to fine-grained sandstone. Siltstone and silt shale form subordinate part of formation. Sandstone is commonly thin bedded, calcareous, highly argillaceous, and in places micaceous.

Type locality: On Chandler River where river cuts through Tuktu Bluff, a continuous south-facing escarpment that can be traced for many miles, lat 68°44′ N., long 152°18′ W.

Tulare Formation[1]

Pliocene and Pleistocene(?): Southern California.

Original reference: F. M. Anderson, 1905, California Acad. Sci. Proc., 3d ser., v. 2, p. 181.

W. P. Woodring, Ralph Steward, and R. W. Richards, 1940, U.S. Geol. Survey Prof. Paper 195, p. 13–22, pl. 3. Formation is nonmarine and consists principally of sandstone and conglomerate and toward base of fine-grained rocks in which fresh-water mollusks and fresh- and brackish-water diatoms are abundant. Exposed thickness 1,700 to 3,500 feet.

Underlies alluvium; overlies San Joaquin formation, base drawn just above youngest widespread marine deposits constituting upper *Mya* zone of San Joaquin. Youngest folded strata in Kettleman Hills. Named by Anderson (1905) but no type locality designated. Kettleman Hills have been regarded as type region (Arnold and Anderson, 1910, U.S. Geol. Survey Bull. 398) as exposures there were only ones described, and name was derived from Tulare Lake, shore of which at that time lay close to edge of North dome. Type section suggested.

F. F. Davis and D. W. Carlson, 1952, California Jour. Mines and Geology, v. 48, no. 3, p. 212, 221 (table). In Merced County, overlies Ora [Oro] Loma formation (new). Underlies upper Pleistocene lake beds called Peckham formation by Leith (1949).

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 48–49, pls. 1, 2, 3. Formation, in Ortigalita Peak quadrangle, consists of as much as 500 feet of gravel, sand, silt, and marly beds. Overlies Oro Loma formation. Lithologic similarity of Tulare to Oro Loma led Anderson and Pack (1915, U.S. Geol. Survey Bull. 603) to consider the formations as single unit, but separation can be made on lithology and structural characteristics. Oro Loma beds are folded with bedrock series, and Tulare strata extensively overlap all these units, including Franciscan formation. Formation postdates upper Pliocene orogeny and predates mid-Pleistocene orogeny, thus limiting time of deposition to Plio-Pleistocene.

Suggested type section: On La Ceja, one-fourth mile southeast of Avenal-Lenmoore Road, sec. 35, T. 21 S., R. 17 E., on east side of northern North dome. This is probably section studied by Anderson. Owing to overlap of alluvium, only lower part of formation is exposed. Name derived from Tulare Lake.

Tularosa Formation[1]

Tertiary or Quaternary(?): Southeastern New Mexico.

Original reference: C. L. Herrick, 1904, Am. Geologist, v. 34, p. 179, 187.

Derivation of name not stated.

Tularosa Malpais Lava

Recent: Central southern New Mexico.

L. R. Dice, 1940, Scientific Monthly, v. 50, p. 419–420. Large bed of black lava with total area of about 120 square miles. Thickness around edges usually about 10 to 20 feet, but in some places as much as 50 feet. In middle of its stream, lava must be thicker.

In Tularosa Basin, in belt roughly along line extending from Malpais Spring to Carrizozo.

Tule Formation[1]

Pleistocene: Northern Texas.

Original reference: W. F. Cummins, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 199–200, 203.

G. L. Evans and G. E. Meade, 1945, Texas Univ. Bur. Econ. Geology Pub. 4401, p. 493–495. Formation consists mainly of well-bedded gray unconsolidated sands and greenish-tan bentonitic clays. Beds of unaltered volcanic ash present locally. Thickness as much as 114 feet. Vertebrate fauna indicates intermediate Pleistocene age.

J. C. Frye and A. B. Leonard, 1957, Texas Univ. Bur. Econ. Geology Rept. Inv. 32, p. 21–24, strat. sections. Discussion of Cenozoic geology along

eastern margin of Texas High Plains, Armstrong to Howard Counties. Name Tule formation is used as regional unit to include all deposits of Kansan Cycle in area of study. It is thus applied not only to relatively slack water fills of broad valleys that crossed High Plains area but also to high terrace deposits of same age that flank some of major stream canyons and to terrace deposits of equivalent age that occur beyond escarpment of High Plains. Thickness in type area 27 to 55 feet.

Named for Tule Canyon, Swisher County.

Tule Mountain Trachyandesite

Tertiary: Southwestern Texas.

J. D. Martinez, Edwin H. Statham, and L. G. Howell, 1960, Texas Univ. Bur. Econ. Geology Pub. 6017, p. 37, 42 (fig. 36). Incidental mention in paleomagnetic study of Tertiary volcanics in Big Bend National Park.

Tule Spring Limestone[1]

Lower Mississippian and Pennsylvanian: Southeastern Arizona.

Original references: W. Lindgren, 1905, U.S. Geol. Survey Prof. Paper 43; 1905, U.S. Geol. Survey Geol. Atlas, Folio 129.

A. A. Stoyanow, 1936, Geol. Soc. America Bull., v. 47, no. 4, p. 511–512. Lower 200 feet of unit carries Lower Mississippian fauna and upper 300 feet contains characteristic Pennsylvanian fossils.

Named for exposures around Tule Springs, at head of Tule Creek, Clifton quadrangle.

†Tulik Basalt

Tertiary and Quaternary: Southwestern Alaska.

F. M. Byers, Jr., and others, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 3, p. 28, pl. 3. Composed principally of basalt porphyry flows 20 to 60 feet thick. Lavas vary in texture from finely granular to porphyritic and contain as much as 60 percent of phenocrysts, mainly bytownite feldspar with some olivine. Oldest lavas interfinger with late Crater Creek flows. Partly underlies veneer of Okmok ash (new).

F. M. Byers, Jr., 1959, U.S. Geol. Survey Bull. 1028–L, p. 308. Name Tulik abandoned. Replaced by informal name.

Makes up much of Mount Tulik, large slightly dissected parasitic cone on south flank of Okmok Volcano, on Umnak Island in eastern part of Aleutian Islands.

Tulip Creek Formation[1] (in Simpson Group)

Ordovician: Central southern Oklahoma.

Original references: F. C. Edson, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 7, p. 947; C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1498–1505. Name credited to E. O. Ulrich.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 77–85, charts 1, 2, fig. 1. In chart (column 8, fig. 1) presented from manuscript before Geological Society of America at annual meeting in New York City in 1928, Ulrich introduced the Tulip Creek as a Simpson formation in stratigraphic interval between underlying McLish and overlying Criner formation. Decker (1930) published this chart. Ulrich (1929 [1930], U.S. Natl. Mus. Proc., v. 76, art. 21) published Simpson correlation chart showing Tulip Creek in stratigraphic position below the Criner, but overlying the

Falls, not McLish. He later (Edson, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8) proposed Cool Creek formation in stratigraphic position between Tulip Creek and Criner formations. Decker and Merritt (1931, Oklahoma Geol. Survey Bull. 55) placed Tulip Creek in stratigraphic position between subjacent McLish and superjacent Bromide, and subsequent stratigraphers have thus adopted it. Subdivisible into two parts: basal sandstone ("Wilcox" of type Tulip Creek locality), and an overlying section of shales and thin-bedded limestones and a few thin sandstones. Thickness at type section 395 feet (subdivisible into 175-foot basal sand and 235 feet of overlying green shales with thin limestones and occasional thin sandstone). Disconformable relationships with both underlying McLish and overlying Bromide formations. Ostracodal fauna indicates Black River age.

Type section: Along Tulip Creek, on southern side of Arbuckle Mountains, adjacent west side of U.S. Highway 77, north of Springer, Carter County.

†Tullahoma Formation[1]

Mississippian: Tennessee and western Kentucky.

Original reference: J. M. Safford and J. B. Killebrew, 1900, Elements of geology of Tennessee, p. 104, 143, 144.

Named for Tullahoma, Coffee County, Tenn.

Tullock Member (of Fort Union Formation)

Tullock Formation[1]

Paleocene: Eastern Montana, South Dakota, and Wyoming.

Original reference: G. S. Rogers and Wallace Lee, 1923, U.S. Geol. Survey Bull. 749, p. 29.

A. J. Collier and M. M. Knechtel, 1939, U.S. Geol. Survey Bull. 905, p. 10–11, pl. 3. Lance formation in McCone County, Mont., comprises two members—a lower Hell Creek, and an upper, Tullock. Footnote, page 10, states that since present report was written, Hell Creek and Tullock members have been raised to rank of formation in official classification of Geological Survey, Hell Creek being assigned to Cretaceous and Tullock to Cretaceous or Eocene.

Erling Dorf, 1940, Geol. Soc. America Bull., v. 51, no. 2, p. 230 (table 5). Discussion of relationship between floras of type Lance and Fort Union formations. In proposed revision of nomenclature, Tullock formation (equivalent to Ludlow formation and Cannonball marine member) is placed at base of Fort Union group. Eocene or Upper Cretaceous.

Erling Dorf, 1942, Carnegie Inst. Washington Pub. 508, p. 95–97. Deposits above Lance formation have been generally referred to Fort Union formation on basis of stratigraphic position, lithology, absence of dinosaurs, and presence of typical lower Eocene (Paleocene) flora. Contact between typical Lance and lowest unit of Fort Union group is traceable northward into Gillette coal field region, where it coincides with contact between Hell Creek and Tullock formations. Tullock formation was regarded by Dobbin and Barnett (1927, U.S. Geol. Survey Bull. 796–A), as elsewhere by others, as upper member of Lance. In Gillette coal field, as well as at its type locality and elsewhere, the Tullock is now known to contain plant remains of typical Paleocene Fort Union aspect. This conclusion is substantiated by southward extension of the Tullock of Gillette coal field into Fort Union beds above top of Lance formation, as defined in Lance Creek area. Lower unit of Fort Union group of Lance Creek

area is equivalent to Tullock formation, which is traceable from its type locality in eastern Montana into area of Gillette coal field. Thickness of Tullock in Lance Creek area about 400 feet. Units above Tullock in Lance Creek area not studied.

W. J. McMannis, 1955, Geol. Soc. America Bull., v. 66, no. 11, pl. 7. Plate 7 shows that Livingston formation intertongues with Claggett, Judith River, Bearpaw, Lennep, Hell Creek, Tullock, and Lebo formations.

C. E. Dobbin, W. B. Kramer, and G. H. Horn, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–185. Thickness of Tullock member, 1,110 feet, in southeastern part of Powder River Basin, Wyoming. Underlies unnamed unit in upper part of formation; overlies Lance formation.

W. J. Mapel, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 200–201. Discussion of Powder River Basin. Fort Union formation as used herein comprises (ascending) Tullock, Lebo, and Tongue River members. Tullock has maximum thickness of about 1,100 feet in southern part of basin; thins northward to about 500 feet at Montana-Wyoming border, and to about 200 to 250 feet in northern Powder River and southern Rosebud Counties, Mont. Overlies Upper Cretaceous Hell Creek or Lance formation.

Named for exposures in valley of Tullock Creek, Treasure County, Mont.

Tullos Clay Member (of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 98–99. Series of clays ranging in thickness from 75 to 175 feet; on fresh exposure clays are deep blue gray but weather to drab yellow, or light gray. Grades into overlying Verda member (new) through sandy concretionary transition phase herein named Union Church; overlies Moodys Branch marl.

Well exposed in grade cuts of Missouri Pacific Railroad, half a mile southwest of Tullos station, La Salle Parish.

Tully Limestone[1]

Tully Limestone (in Susquehanna Group)

Middle Devonian: New York and Pennsylvania.

Original reference: L. Vanuxem, 1839, New York Geol. Survey 3d Rept., p. 278.

G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, no. 5, p. 781–868. Divided into several members in different areas: Apulia, Laurens, New Lisbon (new), Tinkers Falls (new), and West Brook (new).

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1786–1788, chart 4. On basis of new information, it seems best to regard Tully as Middle Devonian, and to make a stage, the Taghanic, to include it and its correlatives in the Midwest and the overlying Geneseo shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2816–2818. Tully limestone underlies Geneseo shale member of Genesee formation. Lenses of fossiliferous pyrite and marcasite as much as 7 inches thick and 1 inch to 10 feet long separate Genesee formation from underlying Moscow shale in most outcrops between Canandaigua Lake and Lake Erie. These lenses were named Tully

pyrite by Loomis (1903, New York State Mus. Bull. 69) and Leicester marcasite member of Moscow formation by Sutton (1951). Although Tully limestone and Tully pyrite of Loomis had not been found in same outcrop, the pyrite and marcasite were considered to be older than, or equivalent in age to, the Tully limestone. Recently pyrite and marcasite lenses have been found at base of Geneseo shale overlying nodules of Tully limestone in Gage Gully on east side of Canandaigua Lake. Relation of rocks in this outcrop indicates that Tully pyrite of Loomis is younger than Tully limestone and appears to be part of Genesee formation.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook for Field Trips Pittsburgh Mtg., p. 3. At base of Susquehanna group.

Well exposed in town of Tully, Onondaga County, N.Y.

†Tulsa Group[1]

Pennsylvanian: Northeastern and central northern Oklahoma.

Original reference: C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910, Oklahoma State Univ. Research Bull. 3, p. 6, 10.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey. Name applied to strata of Marmaton group.

Named for Tulsa County.

†Tuluga Member (of Schrader Bluff Formation)

Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Distinguished by abundant bentonite and tuff interbedded with light-colored sandstone and shale. In Fish Creek test well No. 1, member almost entirely marine except for one thin coal bed and associated sandstone. Maximum thickness estimated to be 2,200 feet in outcrop belt, but this thickness includes minor units of Tuluvak tongue (new) of Prince Creek formation (new). Underlies Sentinel Hill member (new); overlies Seabee member (new), both of Schrader Bluff formation.

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 246. Rocks formerly included in Tuluga member placed in Seabee formation and newly defined Rogers Creek and Barrow Trail members of Schrader Bluff formation and name Tuluga member is abandoned.

Type locality: Schrader Bluff, which is best exposure of this member. Named from Tuluga River, which enters Anaktuvuk River at north end of Schrader Bluff. Also well exposed on Chandler River near confluence with Ayiyak River and on Colville River in Umiat area.

Tuluvak Tongue (of Prince Creek Formation)

Upper Cretaceous: Northern Alaska (surface and subsurface).

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 166, figs. 2, 3. Lower part of (nonmarine) formation. Thickness 1,200 feet in Tuluvak Bluffs. Overlies Seabee member (new) of marine Schrader Bluff formation (new). Intertongues with Tuluga tongue (new) of Schrader Bluff formation.

C. L. Whittington *in* George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 252–253, fig. 4. Nonmarine tongue is a

wedge dividing marine rocks of Colville group into two easily recognizable formations—Seabee formation (redefined) below and Schrader Bluff formation (redefined) above.

Best exposed in Tuluvak Bluffs on Chandler River.

Tumbez Limestone

Middle Ordovician: Southwestern Virginia.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66, p. 133–134, 156, pl. 23. Proposed for limestone equivalent to the typical Blackford in Russell County. The Blackford undergoes a distinct facies change along Clinch Mountain belt; shaly dolomitic beds are supplanted by predominantly coarse-grained limestone. In type section of the Tumbez, interbedding of coarse-grained limestones with the typical Blackford is well shown. Thickness at type section about 120 feet. Underlies Elway limestone; overlies "Knox" dolomite.

L. D. Harris and R. L. Miller, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–111. In Duffield quadrangle, included in Blackford formation.

Type section: South of Tumbez, Russell County.

Tumbledown Gneiss

Age not stated: West-central Maine.

Kern Jackson, 1953, Maine State Geologist Rept. 1951–1952, p. 53, 66. Described as very coarse banded metasedimentary gneiss. Composed of alternate bands of micaceous quartzite and muscovite schist. Basic dikes cut across the gneissic structure.

Makes up bulk of Tumbledown and Jackson Mountains, Rumford quadrangle.

Tumbling Run Member (of Pottsville Formation)

Tumbling Run Formation (in Pottsville Group)

Lower Pennsylvanian: Eastern Pennsylvania.

G. H. Wood, Jr., and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 11, p. 2673–2675, 2680–2683; 1957, U.S. Geol. Survey Coal Inv. Map C–43, sheet 1. Predominantly conglomerate and sandstone with less quantities of conglomeratic sandstone, siltstone, shale, and coal; conglomerate beds are coarser and less well sorted in lower part of member and proportion of sandstone, conglomeratic sandstone, siltstone, shale, and coal beds somewhat greater in upper part. Comprises basal 535 feet of formation at reference section herein designated. Underlies Schuylkill member (new). Conformably overlies Mauch Chunk formation; contact arbitrarily placed at top of uppermost sandstone, siltstone, or shale; at reference section of Pottsville, uppermost red shale, unit 0 (fig. 3), of Mauch Chunk lies directly below gray shale of unit 1 (fig. 3), basal bed of Pottsville and Tumbling Run member. Most geologists consider contact at type and reference sections to be local time boundary between Mississippian and Pennsylvanian systems. Regional stratigraphic studies indicate that there may be considerable intertonguing of facies between Tumbling Run member of Pottsville formation and Mauch Chunk formation; therefore it is possible that the time boundary, as recognized in type and reference sections, is in rocks of Mauch Chunk formation at some localities and in rocks of Pottsville formation at other places.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Mapped as formation in Pottsville group in anthracite region.

Type section: Basal part of Pottsville formation reference section, which is in road cut on east side of U.S. Highway 122, about 150 feet farther east than original type section of Pottsville which is on eastern side of Pennsylvania Railroad cut through water gap south of Pottsville, Schuylkill County.

Tumco Formation

Paleozoic or older: Southern California.

P. C. Henshaw, 1942, California Jour. Mines and Geology, v. 38, no. 2, p. 155–157, pl. 2. Fine-grained gray to pinkish-gray massive arkosite.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 489, table 4. Older Precambrian(?).

Occurs in Tumco Valley in Cargo Muchacho Mountains, Imperial County.

Tumey Formation[1]

Tumey Sandstone Lentil (in Kreyenhagen Formation)

Oligocene: Southern California.

Original reference: E. R. Atwill, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1192–1204.

John Zimmerman, Jr., 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 7, p. 953–976. In Ciervo Hills, Fresno County, the Kreyenhagen in outcrop contains three members: lower Kreyenhagen shale, Tumey sandstone lentil, and Tumey or upper Kreyenhagen shale. Sandstone crops out as lens about 9 miles long and up to one-half mile wide in shales of the Kreyenhagen.

J. E. Schoellhamer and D. M. Kinney, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–128. In this report, all strata between Domengine sandstone and overlapping Temblor formation are included in Kreyenhagen shale. Atwill's sandstone unit of Tumey formation is here called sandstone member of Kreyenhagen. Area of report is Tumey and the Panoche Hills, Fresno County.

Type locality: In S½ sec. 16, T. 16 S., R. 13 E., Fresno County. Name derived from nearby Tumey Gulch.

†Tunangwant Conglomerate[1]

Upper Devonian: Southwestern New York and northwestern Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. I_3, p. 79.

G. A. Cooper and others, 1944, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1742. Upper Devonian.

Named for exposures in New York along Tunangwant Creek, which flows north through Bradford, Pa., into New York. Exposed in hills bordering Tunangwant Creek, between Carrollton, N.Y., and Bradford, Pa.

Tunbridge Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Probably named for Tunbridge Township, Orange County, or some of villages of that name within township.

Tunitas Sandstone Member (of Purisima Formation)

Pliocene: Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1326. Maximum thickness 400 feet. Top member of formation; overlies Lobitos mudstone member (new).

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Tunnel Creek Glacial Stage

Tunnel Creek Till

Pleistocene (Wisconsin): Northwestern Oregon.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull. 15, p. 20, 24–25. Defined as time during which Tunnel Creek till was deposited. Till is composed largely of angular blocks which bear few facets or striae.

Exposed in North Santiam River valley near Tunnel Creek [Marion County].

Tunnel Hill zone[1]

Precambrian: Northwestern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 6, 8, 12.

Named for exposures at Tunnel Hill, Oconee County.

Tunnel Peak Breccia, Dacite

Tertiary: Central California.

R. L. Rose, 1960, California Div. Mines Spec. Rept. 60, p. 15 (fig. 3), 16–17. Volcanic complex that consists of hornblende dacite surrounded by tuff breccia. Contact of breccia with Mehrten formation is nearly vertical and apparently breccia intrudes Mehrten. Tunnel Peak vent breccia shown on geologic map.

Complex, about 2,000 feet in diameter, makes up topographic prominence known locally as Tunnel Peak, Golden Gate Hill area, Calaveras County.

Tunnel Point Sandstone

Tunnel Point Beds[1]

Tunnel Point Formation

Oligocene, middle: Southwestern Oregon.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 336–343.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 590, chart 11. Tunnel Point sandstone, 350 feet thick where exposed in sea cliffs north of Tunnel Point, is probably conformable on Bassendorf shale but is unconformable beneath Empire formation.

C. E. Weaver, 1945, Washington [State] Univ. Pubs. in Geology, v. 6, no. 2, p. 50–52. Type section of formation consists of 760 feet of concretionary and nodular sandstone, thickly bedded stratified sandstones, medium-grained sandstones and beds of interstratified sandstones, and shaly sandstones. Overlies Bassendorf formation; underlies Empire formation.

Type section (Weaver, 1944). In west limb of syncline at Coos Bay, Coos County.

†Tununk Sandstone Member (of Mancos Shale)[1]

Upper Cretaceous: Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of the Henry Mountains: U.S. Geog. and Geol. Survey of the Rocky Mountain region, p. 4 [2d ed. 1880].

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota(?) sandstone in Henry Mountains, Gilbert (1877) applied local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey and in present report his names for the shales are used in quotation marks because of doubt regarding relations of this whole succession of sandstone and shale to named units to north and east. R. C. Moore tentatively correlates "Tununk shale," Tununk sandstone, and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation, "Masuk shale" with Lewis shale, and Masuk sandstone with so-called Laramie sandstone of southwestern Colorado. Some geologists, however, believe entire succession corresponds to Mancos shale. Tununk sandstone is yellowish-brown medium- to massive-bedded sandstone. Thickness 50 to 75 feet in section measured across Waterpocket fold near SW cor. T. 32 S., R. 8 E., at Bitter Creek divide, head of Halls Creek.

H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164, p. 108. Discussion of Kaiparowits region, Garfield and Kane Counties, Utah. Measured section, east side of Circle Cliffs, Garfield County, shows Tununk sandstone member of Mancos shale above "Tununk shale" of Gilbert and below "Blue Gate shale" of Gilbert. Thickness 65 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 80. Replaced by Ferron sandstone member of Mancos.

In Tununk Plateau, Henry Mountains region.

Tununk Shale Member (of Mancos Shale)

†Tununk Shale (in Mancos Shale)[1]

Upper Cretaceous: Central southern Utah.

Original reference: G. K. Gilbert, 1877, Geology of the Henry Mountains: U.S. Geog. and Geol. Survey of the Rocky Mountain region, p. 4 [2d. ed. 1880].

C. R. Longwell and others, 1923, U.S. Geol. Survey Prof. Paper 132–A, p. 3–4 (table), 15, 21–22. Discussion of rock formations in Colorado Plateau of Utah and Arizona. To rocks above Dakota(?) sandstone in Henry Mountains, Gilbert (1877) applied local names (ascending) Tununk shale, Tununk sandstone, Blue Gate shale, Blue Gate sandstone, Masuk shale, and Masuk sandstone. Only Gilbert's names for the sandstones have been adopted by U.S. Geological Survey, and in present report his names for the shales are used in quotation marks because of doubt regarding the relations of this whole succession of sandstone and shale to

named units to north and east. R. C. Moore tentatively correlates "Tununk shale," Tununk sandstone, and "Blue Gate shale" with Mancos shale of southwestern Colorado and east-central Utah; Blue Gate sandstone he tentatively correlates with Mesaverde formation, "Masuk shale" with Lewis shale, and Masuk sandstone with so-called "Laramie sandstone" of southwestern Colorado. Some geologists, however, believe entire succession corresponds to Mancos shale. "Tununk shale" consists of bluish-drab sandy shale grading to fossiliferous sandstone at base. Thickness 975 feet, measured section across Waterpocket fold near SW cor. T. 32 S., R. 8 E., at Bitter Creek divide, head of Halls Creek.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 437. Discussion of Mancos shale in Wasatch Plateau. Mancos is divided into five members. Lower shale member, unnamed, is equivalent to "Tununk shale" of Gilbert's section in Henry Mountains and to Graneros and Greenhorn formations east of the Rockies. Underlies Ferron sandstone member which is faunal equivalent of Tununk sandstone of Gilbert's section in Henry Mountains.

C. B. Hunt and R. L. Miller, 1946, Utah Geol. Soc. Guidebook 1, p. 8 (table). Generalized section of exposed sedimentary rocks in Henry Mountains structural basin shows Tununk shale member of Mancos shale underlies and grades into Ferron sandstone member; overlies Dakota sandstone. Thickness 550 feet.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 37 (table), 79–80, pl. 1. Basal member of Mancos in Henry Mountains region; underlies Ferron sandstone member; overlies Dakota sandstone. Consists of dark-gray fissile shale containing a few thin beds of bentonite near base and top, and few thin, calcareous and shaly sandstone layers near middle; at top is series of interbedded sandstone and shale beds where member is transitional into overlying Ferron. Thickness 525 to 650 feet. Ferron sandstone of present report is Gilbert's (1877) Tununk sandstone.

Probably named for occurrences on Tununk Plateau, Henry Mountains.

Tununkian series[1]

Upper Cretaceous: Utah.

Original reference: C. R. Keyes, 1925, Pan-Am. Geologist, v. 43, p. 295.

†Tuolumne Group[1]

Triassic(?) and Jurassic(?): East-central California.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 233–234.

N. L. Taliaferro, 1942, Geol. Soc. America Bull., v. 53, no. 1, p. 89. Amador group substituted for preoccupied name Tuolumne.

Named for Tuolumne County, in which group is well exposed.

Tuolumne Intrusive Series[1]

Cretaceous: Yosemite National Park.

Original reference: F. C. Calkins, 1930, U.S. Geol. Survey Prof. Paper 160, p. 121, map.

Includes named units (ascending) Sentinel Granodiorite, Half Dome Quartz Monzonite, Cathedral Peak Granite, and Johnson Granite Porphyry.

Named for exposures along Tuolumne River, Yosemite National Park.

Tupelo Tongue (of Coffee Sand)[1]

Upper Cretaceous: Northeastern Mississippi.

Original reference: L. W. Stephenson, 1917, Washington Acad. Sci. Jour., v. 7, p. 243–250.

L. W. Stephenson and W. H. Monroe, 1940, Mississippi Geol. Survey Bull. 40, p. 150–151. Thickness at type exposure 80 feet. Lower 50 feet consists of massive gray more or less calcareous, glauconitic sand with several widely separated ledges of calcareous sandstone; upper 30 feet is massive reddish ferruginous marine sand, grading downward into yellowish-green massive slightly glauconitic sand.

Type locality: Abandoned cut of Fulton Road on westward-facing slope of Old Town Creek Valley, sec. 33, T. 9 S., R. 6 E., 1½ miles east of Tupelo, Lee County.

Tupper Complex

Tupper Syenite[1]

Precambrian: Northern New York.

Original reference: H. P. Cushing, 1907, New York State Mus. 60th Ann. Rept., pt. 2, p. 476–482, 515, map.

U.S. Geological Survey has modified the name to Tupper Complex on the basis of a study now in progress.

Exposed about Tupper Lake, Franklin County.

Turkey Creek Beds (in Yegua Formation)[1]

Eocene: Eastern Texas.

Original reference: L. C. Reed and O. M. Longnecker, Jr., 1929, Texas Univ. Bull. 2901, p. 163–174.

Exposed on upper part of Turkey Creek and tributaries; also in North Turkey Creek, Brazos County.

Turkey Creek Sandstone Member (of Mineral Wells Formation)[1]

Turkey Creek Sandstone Member (of Keechi Creek Formation)

Middle Pennsylvanian: Central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 77–88, charts; 1922, Jour. Geology, v. 30, p. 25, 31.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 87, 88. Reallocated to member status in Keechi Creek formation. Basal member of formation; underlies unnamed limestones; overlies unnamed sandstones and limestone that overlie Dog Bend limestone member of Salesville formation. Name Mineral Wells dropped in this report.

Leo Hendricks, 1957, Texas Univ. Bur. Econ. Geology Pub. 5724, p. 25, fig. 3, pl. 1. Sandstone forms continuous trace from Parker County line to main east fork of Rock Creek and marks base of Keechi Creek formation. Thin to massive bedded, with faint evidences of crossbedding; no conglomerate observed in Parker County. Thickness 10 to 12 feet. Underlies unnamed shale and sandstone member; overlies unnamed shale member of Salesville formation.

Type locality: On Turkey Road, 2¼ miles northwest of Mineral Wells, Palo Pinto County.

Turkey Mountain Andesite

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1033. Rock is gray-green fine-grained porphyritic andesite with ferromagnesian phenocrysts up to 10 mm. long forming 50 percent of rock. Not known whether hornblende andesite is dominant rock or a differentiation fraction.

At head of Slagle Canyon in sec. 16, T. 27 N., R. 25 E., 8 miles northwest of Chico in eastern Colfax County.

Turkey Mountain Flows (of Chico Phonolites)

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1036. Gray-green fine-grained porphyritic phonolites with much local variation in size of orthoclase phenocrysts. Top surfaces of flows undulate gently and are covered with thin soil and phonolite joint blocks.

Comprise four flow areas around Turkey Mountain, 9 miles northwest of Temples Peak, Colfax County.

Turkey Mountain Member (of Hoosac Formation)

Cambrian or Lower Ordovician: Eastern Vermont.

J. B. Thompson, Jr., *in* M. P. Billings, John Rodgers, and J. B. Thompson, Jr., 1952, Geol. Soc. America Guidebook for Field Trips in New England, p. 41. Consists of amygdaloidal greenstone and greenstone schist, metamorphosed locally to epidote-amphibolite. Thickness 0 to 1,000 feet. Overlies Bull Hill member (new). At approximate position of Plymouth member (new) in Chester dome and on east limb of Green Mountain anticlinorium from Jamaica south. Not present at Ludlow.

Type locality and derivation of name not stated.

Turkey Ridge Sandstone Member[1] (of Marcellus Formation)

Middle Devonian: Central Pennsylvania.

Original reference: Bradford Willard, 1935, Geol. Soc. America Bull., v. 46, no. 2, p. 202–203.

H. H. Arndt, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 4, 27. In Juniata, Mifflin, and Perry Counties, the Marcellus is subdivided into three members (ascending): Shamokin shale, Turkey Ridge sandstone, and Mahanoy shale. Thickness 103 feet in East Waterford section if the shaly beds exposed in syncline axis represent Mahanoy member. Northeast along strike, the Turkey Ridge member is persistent for 25 miles to type locality. East and southeast, it is included in base of Montebello formation.

Named for Turkey Ridge which separates Juniata and Perry Counties.

Turkey Run Limestone Member (of Pawhuska Formation)

†Turkey Run Limestone Member (of Buck Creek Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: K. C. Heald and K. F. Mather, 1919, U.S. Geol. Survey Bull. 686–M, p. 150, 153.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 49. In northern Osage County, the Pawhuska contains six limestone members (ascend-

ing): Lecompton, Plummer, Deer Creek, Little Hominy, Pearsonia (new), and Turkey Run.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25, 41–44. In Pawnee County, the Turkey Run is a single bed of dense gray fossiliferous limestone. Thickness 1½ to 3 feet. Overlies Lecompton limestone member; underlies Severy shale of Wabaunsee group.

Named for exposures near head of Turkey Run, in secs. 9, 16, and 17, T. 24 N., R. 8 E., Osage County.

Turkey Track limestone layer (in Richmond Group)[1]

Upper Ordovician: Southwestern Ohio.

Original reference: J. J. Wolford, 1930, Ohio Jour. Sci., v. 30, no. 5, p. 304.

Turlock Lake Formation

Pliocene, upper, and Pleistocene, lower: Central California.

S. N. Davis and F. R. Hall, 1959, Stanford Univ. Pub. Geol. Sci., v. 6, no. 1, p. 12, 13–16, pls. 2, 3. Name applied to oldest post-Mehrten formation in area (eastern Stanislaus and northern Merced Counties). Consists of sand, gravel, and silt. Thickness at type locality 51 feet; however, thickness is not definitely known due to difficulties in picking upper contact in subsurface; probable thickness shown on geologic cross section (pl. 3) ranges from 300 to 850 feet. Conformably overlies Mehrten formation; in some areas contact is sharp but in many places there is a transitional zone of decreasing andesitic material and increasing amounts of quartz, feldspars, and biotite. Crops out east of younger Riverbank formation (new); probably continuous with Laguna formation of Mokelumne area.

Type section: NW¼SE¼, SW¼SE¼, SE¼SW¼, NE¼SW¼ sec. 31, T. 3 S., R. 13 E., Cooperstown quadrangle; section consists of series of exposures on hill in Turlock Lake State Park, eastern Stanislaus County. Crops out in northwest-southeast trending belt of variable width.

Turnbull Conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 655–656. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of Puente Hills, Los Angeles County.

Named for its occurrence on north slope of Turnbull Canyon.

Turner cyclothem (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 12, 16 (fig. 2). Pennsylvanian succession between Gimlet and La Salle cyclothems, exposed in upper Illinois valley, contains several prominent, but thin limestones which are basis for recognition of incomplete cyclothems to which names (ascending), Turner, Hicks, and Hall, have been applied by H. B. Willman.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Includes Turner limestone. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 56 (table 3). Replaced by Trivoli cyclothem.

Type locality: NW¼NE¼ sec. 29, T. 33 N., R. 1 W., Putnam County.

Turner Limestone (in McLeansboro Formation)

Turner Limestone (in McLeansboro Group)

Pennsylvanian: Northern Illinois.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 29). Shown on correlation chart as limestone in McLeansboro formation. Occurs below Hicks limestone (new) and above Lonsdale limestone.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 11, pl. 1. Shown on correlation chart as limestone in McLeansboro group. Included in Turner cyclothem. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 38, 56 (table 3). Replaced by Cramer limestone member of Modesto formation (both new).

Type locality: NW¼NE¼ sec. 29, T. 33 N., R. 1 W., Putnam County.

Turner Sandy Member (of Carlile Shale)[1]

Upper Cretaceous: Northeastern Wyoming, southeastern Montana, and northwestern South Dakota.

Original reference: W. W. Rubey, 1930, U.S. Geol. Survey Prof. Paper 165–A.

W. A. Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10, p. 2187–2189. Consists of 185 to 260 feet of dark-gray noncalcareous shale with many lighter gray sandy shale partings that contain thin lenses of fine- to very fine-grained sandstone. Underlies Sage Breaks member; overlies unnamed member. Well exposed 6 miles north of Belle Fourche, Butte County, S. Dak.

Named for exposures along Turner Creek in Tps. 46 and 47 N., R. 64 W., Weston County, Wyo.

Turner Creek Shale Member (of Topeka Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 42, 52, 53.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2035 (fig. 5); 1949, Kansas Geol. Survey Bull. 83, p. 126 (fig. 22), 164; G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21; F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 18. Turner Creek shale member of Topeka formation; underlies Du Bois limestone member; overlies Sheldon limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 16 (fig. 5). Largely light- to bluish-gray massive shale that is in part calcareous with some interbedded lime nodules. Thickness 3½ feet, Fremont County: 6.1 feet in Pottawattamie County. Underlies Du Bois limestone member; where Du Bois is absent, underlies Holt shale member: overlies Sheldon limestone member.

Named for exposures on Turner Creek, southeast of Du Bois, Pawnee County, Nebr.

Turners Falls Sandstone

Triassic: Central Massachusetts.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ-8]. Name proposed for thinly bedded shaly red sandstone, locally micaceous. Near Bull Hill at south end of Mount Toby highland, brick-red sandstone and fine conglomerate occur. Thicker parts to north are finer grained, contain ripple marks, dinosaur tracks, and fossil fish. Unconformably underlies Mount Toby conglomerate; overlies Deerfield diabase. Most northern exposures in Mount Toby quadrangle and those in Greenfield quadrangle were mapped as Longmeadow sandstone by Emerson (1898, U.S. Geol. Survey Geol. Atlas, Folio 50) and as Chicopee shale by Emerson (1917, U.S. Geol. Survey Bull. 599). Southern continuations were previously included in Mount Toby conglomerate.

M. E. Willard, 1952, Bedrock geology of the Greenfield quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ-20]. Includes gray to black thin-bedded sandy shale and grayish-red sandstone interbedded with sandy limestone in Greenfield quadrangle. Thickness 400 to 600 feet in central part of quadrangle. Continental origin.

Type locality: Vicinity of town of Turners Falls near northern boundary of Greenfield quadrangle. Well exposed along Massachusetts State Highway between Turners Falls and French King Bridge in Millers Falls quadrangle.

Turnley Hornstone[1] or Shale[1]

Precambrian (Belt Series): Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, map.

Occurs only on slopes above Turnley placer, in southwestern part of Elkhorn mining district, Elkhorn region.

Turpin Sandstone Member (of Grassy Creek Shale)

Upper Devonian: Northeastern Missouri.

M. G. Mehl, 1960, Denison Univ. Jour. Sci. Lab., v. 45, art. 5, p. 84–85. Name applied to sandstone at base of Grassy Creek shale. Sandstone commonly pale buff that becomes various shades of brown and reddish brown upon weathering. Physical properties vary considerably from place to place. Thickness 1 inch to as much as 15 inches or more. Conodont fauna indicates upper Devonian age comparable to that of the Hardin of Tennessee.

Type locality: At spring near roadside in NW¼SW¼NE¼ sec. 3, T. 52 N., R. 1 E., about 2½ miles northeast of community of Turpin, Pike County.

Turquoise Granite

Triassic or Jurassic: Southeastern Arizona.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 8, 65–67, pl. 5. Highly sericitic, silicified granite. Extremely altered. Poorly exposed; hence, its relations to adjacent formations can only locally be unequivocally determined. Exposures north and south of Brown's Peak clearly indicate that it intrudes Bolsa quartzite and Pinal schist. Boundaries with Gleeson quartz monzonite and Copper Belle monzonite porphyry (both new) are faults, and none of these three rocks show facies changes that are noticeably related to the contacts. Known to be of post-Cambrian age and is probably post-Paleozoic, but is older than period of thrust

faulting that has affected region, as shown not only by the faults referred to but also by flat fault contact beneath block of Escabrosa limestone resting on it on south wall of Arroyo that divides Brown's Peak from Gleeson Hill. Relations with Sugarloaf quartz latite (new) uncertain, owing to intense sericitization that both rocks have undergone along their mutual contacts. Assigned to early Mesozoic.

Named for Turquoise Ridge, west of Courtland, in secs. 17, 20, and 23, T. 19 S., R. 25 E., on west slope of which it is widely exposed, central Cochise County.

Turtleback Complex[1]

Pre-Devonian-Late Mesozoic(?) : Northwestern Washington.

Original reference: R. D. McLellan, 1927, Washington Univ. Pub. in Geology, v. 2, p. 142–154.

W. R. Danner, 1960, (abs.) Geol. Soc. America Bull., v. 71, no. 12, pt. 2, p. 2056. Turtleback complex, described as a variety of intrusive rocks, offshoots of a late Jurassic batholith located on Vancouver Island, is now known to include many areas of an amphibolite gneiss complex intruded by diorite rocks of pre-Devonian. Granitic rocks thought to be early Mesozoic or later age also present. In addition are volcanic and sedimentary rocks of Devonian, early Permian, and middle and late Permian age.

Well exposed on Turtleback Mountain, San Juan Islands.

Tusas Granite

Precambrian (Proterozoic) : Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 44–46, pl. 3. Varies greatly in composition and texture. In general, composed of medium-sized grains and is nonporphyritic. With exception of large dike north of Kiawa Mountains, granite south of Tusas Mountain is pink and noticeably lacking in ferromagnesian minerals. In dike and north of Tusas Mountain, rock is gray, contains a good deal of biotite, and varies from monzonite to quartz monzonite in composition. Probably intruded during Pueblo revolution. Intrudes all older Proterozoic rocks in area which are considerably altered.

Fred Barker, 1958, New Mexico Bur. Mines Mineral Resources Bull. 45, p. 59. Replaced by Maquinita granodiorite and Tres Piedras granite.

Part of large intrusive mass that is irregularly exposed along east side of Petaca area from Jawbone Mountain to Servilleta Plaza and in scattered inliers near Tres Piedras. Also outcrops at Ojo Caliente Mountain and in some of adjacent hills. In dike between Tusas and Kiawa Mountains, Rio Arriba County.

Tusayan series[1]

Carbonic: Northern Arizona.

Original reference: Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart).

In Grand Canyon region.

†Tuscahoma Marl[1]

Eocene, lower: Southwestern Alabama.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 50.

Named for exposures at Tuscahoma, on Tombigbee River, in Choctaw County.

Tuscahoma Sand[1] **or Formation** (in Wilcox Group)

Eocene, lower: Southern Alabama, Georgia, and eastern Mississippi.

Original reference: E. A. Smith, 1888, Alabama Geol. Survey Rept. Prog. 1884–88, geographic map of Alabama.

L. D. Toulmin, Jr., 1944, Southeastern Geol. Soc. [Guidebook] 1st Field Trip, p. 9. Extends entirely across state of Alabama and consists of about 200 feet of unfossiliferous crossbedded sand and stratified sandy clay. In central and western Alabama, contains two fossiliferous marl beds, Greggs Landing marl and Bells Landing marl. Formation is here considered to include all the strata up to the base of the Bashi marl; it is thus extended to include the 3-foot lignite bed and overlying crossbedded sand and sandy clay strata, about 70 feet thick, that have been included heretofore in Bashi formation. Overlies Nanafalia formation.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 29. Correlation chart of outcropping Tertiary formations of eastern Gulf region shows Tuscahoma sand present in Georgia.

R. J. Hughes, Jr., 1958, Mississippi Geol. Survey Bull. 84, p. 166–177, pls. 1, 5. Tuscahoma sand described in Kemper County, Miss., where it is as much as 300 feet thick. Overlies Nanafalia formation; underlies Bashi marl member of Hatchetigbee formation. Wilcox group.

P. E. LaMoreaux and L. D. Toulmin, 1959, Alabama Geol. Survey County Rept. 4, p. 22, 124–141. Tuscahoma sand described in Wilcox County, Ala., where it includes all strata from top of Nanafalia formation to base of Bashi member of Hatchetigbee formation. Includes Greggs Landing marl member below and Bells Landing marl member above. Thickness about 275 feet.

Named for exposures at Tuscahoma, on Tombigbee River, in Choctaw County, Ala.

Tuscaloosa Formation,[1] **Gravel, or Group**

Upper Cretaceous: Coastal Plain from western Tennessee, northeastern Mississippi, and northwestern Alabama, across Alabama, Georgia, South Carolina, and North Carolina.

Original reference: E. A. Smith and L. C. Johnson, 1887, U.S. Geol. Survey Bull. 43, p. 18, 95–117, 136–138, pl. 11.

C. W. Cooke, 1936, U.S. Geol. Survey Bull. 867, p. 17–25. Formation is thought to include all strata of Upper Cretaceous age exposed at surface in South Carolina below Black Creek formation, but it is possible that beds older than the Tuscaloosa may some day be differentiated from these deposits in North Carolina and South Carolina. Term Tuscaloosa is herein substituted for name Middendorf formation as used by Cooke (1926, U.S. Geol. Survey Prof. Paper 140–E). Sand and gravel like those of Tuscaloosa formation and doubtless of same age make up at least the greater part of Cape Fear formation of North Carolina, which is now designated "Tuscaloosa," although it is possible that beds older than typical Tuscaloosa may be included in it. In South Carolina, the Tuscaloosa rests directly on crystalline rocks of the Piedmont without interposition of older Cretaceous deposits. Time interval represented by this unconformity includes all of Triassic, Jurassic, and Lower Cretaceous

time, probably much of Paleozoic time, and perhaps early part of Upper Cretaceous.

Tom McGlothlin, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 1, p. 40–43. Series of beds now called "Tuscaloosa formation" can be subdivided into two formations. In this report [Mississippi] these beds are referred to as lower Tuscaloosa and upper Tuscaloosa. There appears to be major unconformity between the two, with lower wedging out updip and being overlapped by upper. It would probably be logical to restrict term "Tuscaloosa" to those beds that are here assigned to upper Tuscaloosa, and give new name to lower beds, but name is not proposed in this report.

L. C. Conant and W. H. Monroe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 37; W. H. Monroe, L. C. Conant, and D. H. Eargle, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 2, p. 187–212. Rank raised to group to include (ascending) Cottondale, Eoline, Coker, and Gordo formations (all new). Overlies undifferentiated Paleozoic rocks; underlies McShan formation.

W. E. Belt, 1945, Geologic map of Mississippi (1:500,000) : Mississippi Geol. Survey. Formation, undifferentiated, mapped in Mississippi.

Erling Dorf, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 11, p. 2161–2184. An analysis of Cretaceous stratigraphy and paleobotany of Atlantic Coastal Plain. In South Carolina, plant-bearing beds of upper part of Cooke's (1936) Tuscaloosa formation are reassigned to Middendorf member of Black Creek formation, and are shown to be equivalent in age to lower Black Creek formation of North Carolina. Name "Tuscaloosa" is abandoned for beds in both North and South Carolina which are here referred to "Lower Cretaceous? (undifferentiated)".

C. W. Drennen, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 522–538. Group contains only two units of formational rank—lower unit, Coker formation, which is redefined to include all beds of pre-Gordo Tuscaloosa age, and upper unit, Gordo formation. Name Cottondale abandoned; Eoline reduced in rank to member of Coker formation.

D. H. Eargle, 1955, U.S. Geol. Survey Bull. 1014, p. 8–23, pls. 1, 2. Formation described in report on outcropping Cretaceous rocks of Georgia. Consists generally of coarse to gravelly and arkosic sand, and of subordinate beds of mottled clay and silt. Average thickness 250 feet. Overlies crystalline rocks; underlies Eutaw formation. Formation crops out in gradually narrowing east-northeastward-trending belt from Chattahoochee River near Columbus to Ocmulgee River near Macon; belt is about 11 miles wide in Chattahoochee River valley, 6 miles wide in Flint River valley, and 5 miles wide at Ocmulgee River.

R. G. Stearns, 1957, Geol. Soc. America Bull., v. 68, no. 9, p. 1077, 1093 (fig. 13). Subsurface data show that in northern Mississippi Embayment Cretaceous, Paleocene, and lower Eocene deposition occurred in single sedimentary cycle. Cycle began with Cretaceous deposition of nonmarine Tuscaloosa gravel, restricted in area.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook for the South Carolina Coastal Plain Field Trip Nov. 16–17, p. 3–5, geol. map. Formation in South Carolina consists typically of light-gray, white, or buff arkosic sand gravel interbedded with white, pink, brown, or purple clay. Formation broken by many local unconformities. Thickness 0 to 800 feet. Crops out in belt gradually widening from 10 to 40 miles, extending in northeast-

erly direction from Aiken County to Marlboro County. Map shows Tuscaloosa underlies Black Creek formation.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 43–44; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Described and mapped in North Carolina where it is oldest recognized formation exposed at surface in Coastal Plain. Underlies Black Creek formation; in some areas, covered by younger sediments of unknown age. Main outcrop lies along western part of Coastal Plain and extends southwest from Neuse River.

Named for Tuscaloosa, Tuscaloosa County, Ala., and Tuscaloosa (Black Warrior) River at Steele's Bluff and White's Bluff, Hale County, Ala.

Tuscan Formation

Tuscan Tuff[1]

Pliocene: Northern California.

Original reference: J. S. Diller, 1895, U.S. Geol. Survey Geol. Atlas, Folio 15.

C. A. Anderson and R. D. Russell, 1939, California Jour. Mines and Geology, v. 35, no. 3, p. 231–232, pl. 3. Formation consists of series of volcanic breccias, tuffs, volcanic gravels and sands, and tuffaceous clays. Maximum thickness about 1,000 feet. Greatest thickness occurs along eastern edge of formation, where only breccias are found. Thins in direction of Sacramento Valley, where gravels, sands, silts and clays are interbedded with the breccias. Contemporaneous with and interfingers with Tehama formation in their zone of junction. Nomlaki tuff member interbedded in both formations.

R. C. Treasher, 1947, (abs.) Geol. Soc. America Bull., v. 58, no. 12, pt. 2, p. 1257. In Tehama and Tuscan Buttes quadrangles, subdivided into five members (ascending): Supan tuff and sand, Bald Hill agglomerate, Seven-Mile tuff and sand, Iron Canyon agglomerate, and Sacramento tuff and sand.

Named for exposures at or near Tuscan Springs, Lassen Peak quadrangle.

Tuscarora Sandstone[1] or Quartzite[1]

Tuscarora Formation

Lower Silurian: Central southern and eastern Pennsylvania, western Maryland, western Virginia, and eastern West Virginia.

Original reference: N. H. Darton, 1896, U.S. Geol. Survey Geol. Atlas, Folio 28.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Tuscarora (Clinch) sandstone in Albion series. Underlies Clinton group. Underlies Castanea sandstone in northern Pennsylvania.

F. M. Swartz, 1948, Pennsylvania Geologists Guidebook 14th Ann. Field Conf., supp., diagram (following p. 4), fig. 3. In Lewiston region, Pennsylvania, overlies Run Gap sandstone (new).

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 6, pl. 1. In central Pennsylvania, Tuscarora formation (the White Medina of Pennsylvania Second Geologic Survey) is gradational with overlying Rose Hill formation and transitional with underlying Juniata formation. Thickness 350 to 750 feet.

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Named for Tuscarora Mountain which extends along border line of Juniata and Perry Counties, Pa.

Tuscher Formation[1] (in Mesaverde Group)

Tuscher Formation (in Wasatch Group)

Upper Cretaceous: Central eastern Utah.

Original reference: D. J. Fisher, 1936, U.S. Geol. Survey Bull. 852.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 140, 142. Measured section of post-Castlegate rocks on Green River between Desolation Canyon and Range Creek, Utah, shows Tuscher(?) formation, 215 feet thick, disconformable above Price River formation and below North Horn formation. This unit is almost certainly Tuscher formation of Fisher's (1936) section in eastern Book Cliffs. The place of the Tuscher in Price River-North Horn succession of the western Book Cliffs, however, is not settled. Stratigraphic evidence on Green River, as well as that observed by Fisher in the Book Cliffs, suggests alliance of the Tuscher with the overlying rather than the underlying strata. Present conclusion is that the Tuscher is a coarse basal phase of North Horn formation. This still leaves question concerning relationships to west. Along Green River, the Tuscher is disconformable on underlying Price River formation and contrastively different, whereas in western part of Book Cliffs there is no apparent break between the Price River and North Horn formations. Throughout eastern Book Cliffs, base of Tuscher marks first strong change in Cretaceous section above Mancos shale, and it would seem to signify break of regional importance.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 104, 105. Assigned to Wasatch group (redefined).

J. D. Fisher, C. E. Erdmann, and J. B. Reeside, Jr., 1960, U.S. Geol. Survey Prof. Paper 332, p. 11 (table), 18–19, 60, 62–63. Little direct evidence of age of Tuscher is available; since it seems to be essentially equivalent to Hunter Canyon formation and appears to be older than undifferentiated North Horn and Flagstaff formations, it is here assigned to Mesaverde group and arbitrarily considered of Late Cretaceous age. Overlies Farrer formation. Thickness on Green River 215 feet; east of Green River 267 to 600 feet.

Named after canyon in T. 20 S., R. 17 E., Grand County. Makes continuous unit in Book Cliffs of Utah east of Green River.

Tuscumbia Limestone[1]

Upper Mississippian: Northern Alabama.

Original reference: E. A. Smith, 1894, Alabama Geol. Survey Geol. map of Alabama.

P. E. LaMoreaux, G. W. Swindel, Jr., and C. R. Lanphere, 1950, Alabama Geol. Survey Bull. 62, p. 24 (table 1), 26–27. Limestone units of Warsaw and St. Louis age are herein considered as a unit, for which name Tuscumbia limestone is applied. Thickness about 200 feet. Overlies Fort Payne chert; underlies Ste. Genevieve limestone.

G. W. Stose, 1952, Washington Acad. Sci. Jour., v. 42, no. 8, In Murphree Valley anticline, underlies Bangor limestone and overlies Fort Payne chert. Contains many lentils and thick beds of sandstone.

G. T. Malmberg and H. T. Downing, 1957, Alabama Geol. Survey County Rept. 3, p. 40–43. Described in Madison County where it is composed of

about 150 to 200 feet of thin- to thick-bedded, gray, fine to coarsely crystalline, highly fossiliferous limestone with small amounts of gray to white chert occurring as irregular lenses and nodules. Includes rocks between Fort Payne chert and Ste. Genevieve limestone and is equivalent to St. Louis and Warsaw limestones of Mississippi Valley region.

Named for exposures at Tuscumbia, Colbert County.

Tushar Conglomerate

Cretaceous(?): Southwestern Utah.

R. R. Kennedy, 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 4, p. 26, 27, geol. map. Limestone conglomerate, light to dark gray, pebble-size to smaller, well cemented. Thickness 65 feet. Overlies Winsor formation, marked unconformity. Unconformable below Sevier River formation.

Measured section is in eastern Tushar Range, on north side of Tenmile Creek, sec. 36, T. 28 S., R. 4 W., 7 miles southwest of Marysvale, Piute County.

Tuskahoma Siliceous Shale Member (of Stanley Shale)

Tuskahoma Siliceous Shale Member (of Tenmile Creek Formation)

Mississippian: Southeastern Oklahoma.

August Goldstein, Jr., and T. A. Hendricks, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 431. Stanley shale is divided into four siliceous shale members (ascending): Basal Ten Mile Creek, Tuskahoma siliceous shale, Middle Ten Mile Creek, and Moyers. The Tuskahoma is typically carbonaceous and pyritiferous. With exception of the Tuskahoma, the names used in describing these beds are those originated by Harlton (1938), but they have been restricted to apply to the siliceous shale beds in instances where Harlton applied the name to the siliceous shale and the overlying sandstone and shale beds.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 25 (table 2), 30. Reallocated to member status in Tenmile Creek formation.

Type locality: Center of west side of sec. 22, T. 2 N., R. 20 E., Pushmataha County, approximately 4½ miles east of Tuskahoma on U.S. Highway 271. Crops out near Potato Hills.

Tusonimo Limestone (in Pàcheta Member of Lowell Formation)

Lower Cretaceous: Southeastern Arizona.

A. A. Stoyanow, 1949, Geol. Soc. America Mem. 38, p. 12. Gray weak arenaceous limestone, in places pinkish and earthy. Thickness 8 feet. Underlies Cienda limestone (new); overlies unnamed sandstone.

In standard section of Lowell formation in Ninety One Hills. Type locality of formation also designated as Ninety One Hills area, immediately north of international border in vicinity of international monument No. 91, southeast of Bisbee Junction on Southern Pacific Railway, Cochise County.

Tusquitee Quartzite[1]

Lower Cambrian: Western North Carolina, central northern Georgia, and eastern Tennessee.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 4.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60 no. 2, p. 284–285. In Murphy syncline, Keith (1907) and La Forge and Phalen (1913, U.S. Geol. Survey Geol. Atlas, Folio 187) mapped a white quartzite—the Tusquitee—which overlies Nantahala slate and underlies Brasstown schist and Valleytown formation. At most places, Keith mapped the quartzite in two parallel lenticular bands with anticlines of Nantahala slate between. These white quartzites are herein correlated with Big Butt quartzite, and the intervening slaty beds are regarded not as Nantahala slate but as part of the Big Butt quartzite equivalent to the fine-grained arkosic quartzite and argillite that separate the two quartzite beds of the Big Butt on Bald Mountain.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Included in Talladega series believed to be Precambrian. Thickness 500 to 600 feet in Georgia.

Named for exposures in Tusquitee Mountains, Clay County, N.C.

Tusseyville Limestone

[Ordovician]: Central Pennsylvania.

R. R. Conlin and others, 1957, Geol. Soc. America Guidebook Ann. Mtg., Field Trips, p. [279] (pl. 3). Incidental mention in structure section. Underlies Bellefonte dolomite; overlies Salona limestone.

In section from Tyrone Gap to Birmingham.

Tuttle Sandstone Member (of Manning Formation)

Eocene (Jackson): East-central Texas.

W. L. Russell, 1955, Gulf Coast Assoc. Geol. Soc. Trans., v. 5, p. 166–171. Name applied to sandstone, 5 to 50 feet thick, in Manning formation about 75 feet above Goodbread sandstone [member] (new). Separated from overlying Yuma sandstone member by shaly zone 30 to 60 feet thick. Renick (1936, Texas Univ. Bull. 3619) called unit Dilworth on assumption that it was equivalent to Dilworth sandstone of Gonzales County.

Type locality: In abandoned Southern Pacific right-of-way 1½ miles north of Piedmont, Grimes County.

Tutu Formation (in Virgin Island Group)

Upper Cretaceous: Virgin Islands.

T. W. Donnelly, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Relatively coarse volcanic wacke, composed almost entirely of unweathered Louisenhoj debris, with minor admixed limestone debris. Includes Coki Point megabreccia lithofacies (new). Congo Cay limestone member (new) present near top. Exposed thickness 6,000 feet. Overlies Outer Brass formation (new). May be older than or equivalent to Hans Lollik formation (new). Virgin Island group considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Tuxedni Group

Tuxedni Sandstone[1] or Formation

Middle and Upper Jurassic: Central southern Alaska.

Original reference: G. C. Martin and F. J. Katz, 1912, U.S. Geol. Survey Bull. 485, p. 59, map, chart facing p. 30.

L. B. Kellum, 1945, New York Acad. Sci. Trans., ser. 2, v. 7, no. 8, p. 203 (table 1), 207, 209. Formation comprises (ascending) sandy shale with

numerous stringers of shaly sandstone, 1,250 feet thick; Cynthia Falls member (new), 800 feet; sandy shale with stringers of shaly sandstone, 950 feet; and Tonnie sandstone member (new), 1,200 feet. Total thickness 4,000 feet. Overlies Kialagvik formation. Underlies Chinitna shale member of Shelikof formation on Iniskin-Chinitna Peninsula.

C. E. Kirschner and D. L. Minard, 1948, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 95 [1949]. Formation includes (ascending) lower siltstone member, Cynthia Falls sandstone member, Bowser member (new), and Tonnie siltstone member. Underlies Chinitna siltstone. Middle and Upper Jurassic.

R. W. Imlay, 1953, U.S. Geol. Survey Prof. Paper 249–B, p. 49, 51, table 5 facing p. 60. In most places, siltstones assigned to Tonnie member cannot be separated from overlying siltstones of Chinitna formation. Therefore, Tonnie reassigned to Chinitna. Age of formation given as Middle Jurassic.

U.S. Geological Survey currently classifies the Tuxedni as a group on the basis of work now in progress.

Type section: On south shore of Tuxedni Bay, Cook Inlet region.

Twelvemile Beds[1]

Tertiary: Southwestern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3.

Exposed at junction of Twelvemile Creek and Mission Creek, Yukon gold district.

Twelvemile Canyon Member (of Arapien Shale)

Upper Jurassic: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 125. Shale, gray in lower part, with prominent red blotches in main part, deep-red and salt-bearing member in upper 500 feet; beds of sandstone and gypsum in middle. Thickness about 7,000 feet. Basal member of Arapien; underlies Twist Gulch member (new). Base of Arapien not located in entire region south of Wasatch Mountains.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 10–15. Term Arapien shale restricted to Twelvemile Canyon member, and term Twist Gulch member raised to formational rank. Change credited to Hardy and Spieker (in preparation).

Named for outcrops in Twelvemile Creek west of Arapien Valley, Sanpete County.

Twentymile Sandstone Member (of William Fork Formation)[1]

Twentymile Sandstone[1] (in Mesaverde Group)

Upper Cretaceous: Northwestern Colorado.

Original reference: N. M. Fenneman and H. S. Gale, 1906, U.S. Geol. Survey Bull. 297, p. 27.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 158, pl. 19. Member is commonly massive white ledge-forming sandstone about 100 to 200 feet thick. Occurs above lower unnamed member, about 1,000 feet thick, consisting of shale, sandstone, and coal beds and below upper unnamed member, about 200 feet thick, consisting of sandstone, sandy shale, shale, and coal.

Named for Twentymile Park, about 10 miles northwest of Yampa, Routt County.

Twiggs Clay Member (of Barnwell Formation)[1]

Eocene, upper: Eastern Georgia.

Original references: C. W. Cooke and H. K. Shearer, 1917, Georgia Geol. Survey Bull. 31, p. 14, 158–173; 1918, U.S. Geol. Survey Prof. Paper 120–C, p. 51–56.

P. E. LaMoreaux, 1946, Georgia Geol. Survey Bull. 50, pt. 1, p. 11–17. In northern Washington and southern Jones, Baldwin, and Hancock Counties, consists of about 25 feet of pale-green hackly fuller's earth clay; to south and southwest in western Washington and Wilkinson Counties, thickens gradually and locally includes 20 to 40 feet of green hackly clay which grades down into 10 feet of gray marl, which in turn grades at some localities into 15 feet of calcareous sand at base of member. Near type locality, attains maximum thickness of 80 feet. In western and northern part of Twiggs County, interfingers with Ocala limestone (Tivola tongue). Conformably underlies Irwinton sand member (new). Type locality stated.

J. F. L. Connell, 1958, Southwestern Louisiana Jour., v. 2, no. 4, p. 321, 325, 328. Basal part of Barnwell. Conformably underlies Irwinton sand member.

Type locality: At Pikes Peak Station on Macon, Dublin, and Savannah Railroad, Twiggs County.

Twilight Granite[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

F. H. T. Rhodes and J. H. Fisher, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2514, 2518. Granite in most areas of its occurrence is light in color and intrudes schist; in localities where it underlies Ignacio quartzite, it is dark colored and contains abundant biotite which is oriented to give distinct foliation. Most contacts with Ignacio unconformable.

Composes Twilight Peak in Needle Mountains quadrangle.

Twilight Park Conglomerate

Upper Devonian: New York.

C. S. Prosser, 1899, New York State Geologist 17th Ann. Rept., p. 283–284. Incidental mention.

G. H. Chadwick, 1940, New York State Geol. Assoc. 16th Ann. Mtg. Field Guide Leaflets, p. 2. In list of formations in Catskill region below Onteora redbeds and above Kaaterskill sandstone. Cobbly puddingstone 40 feet thick.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 126, 130. Conglomerates at base of Onteora redbeds are Twilight Peak conglomerate of Prosser 1899.

Exposed in Twilight Park, one-half mile southeast of Haines' corners, Greene County.

Twin Bridges Limestone

[Eocene(?)] to Miocene: Central southern Idaho and northeastern Nevada.

F. B. Van Houten, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2816 (fig. 6). Name appears only on stratigraphic chart.

Twin Buttes Member (of Bridger Formation)[1]

Eocene: Southwestern Wyoming.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, p. 241–242.

H. E. Wood 2d, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 34, pl. 1. Bridgerian. Overlies Blacks Fork member.

Type locality: Henrys Fork Table and Twin Buttes. Name is taken from Twin Buttes, west of Green River and east of Henrys Fork Table, Sweetwater County.

Twin Creek Limestone[1] **or Formation**

Middle and Upper Jurassic: Southwestern Wyoming, southeastern Idaho, and northeastern Utah.

Original reference: A. C. Veatch, 1907, U.S. Geol. Survey Prof. Paper 56, p. 56, chart opposite p. 50, map.

R. W. Imlay, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 1020 (table 1), 1021, 1022. On basis of ammonite studies Twin Creek limestone, in Freedom quadrangle, southeastern Idaho, is assigned to Middle and Upper Jurassic.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1275–1277. In western Uinta Range, Twin Creek limestone overlies Nugget sandstone and underlies Preuss redbeds. Along Weber River, consists of 1,351 feet of light-gray limestone, sandy limestone, and calcareous shale. Thins eastward and in Lake Fork and Whiterocks Canyon area is replaced by Carmel redbeds.

Helen Foster, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1565–1566. In Teton County, Wyo., limestone is about 475 feet thick; overlies Nugget sandstone and underlies Stump formation; the Preuss, which overlies Twin Creek farther west, not recognized in this area.

R. W. Imlay, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 37–45. Described in mountains along west side of Green River basin. Overlies Nugget and underlies Preuss. Mainly medium-light-gray limestone with two persistent red members in its lower third. Comprises seven mappable members (A–G); member A is equivalent to Gypsum Spring formation (Love and others, 1945) and could properly be called Gypsum Spring member of Twin Creek. Thickens westward from about 800 to 3,000 feet. Term Twin Creek limestone should not be extended east of Darby-Absaroka line of thrusting because equivalent beds east of faulted area, such as exposed at Lower Slide Lake on Gros Ventre River, are much thinner, much less calcareous, and much more fossiliferous than the Twin Creek, and may more properly be classified according to terminology used in southern Montana or central Wyoming. This restriction does not apply to Nugget or Stump sandstones.

H. J. Bissell, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 579 (fig. 2), 597–598. Described in Strawberry Valley quadrangle, Utah. Equivalent in part to Carmel limestone, and name Carmel has been applied to it by some geologists. Thickness along West Fork of Duchesne River 950 feet. Overlies Navajo; underlies Entrada. Middle and Upper Jurassic.

R. W. Imlay, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 54–62. Report includes summary of lithologic and stratigraphic characteristics of the seven members of the Twin Creek, descriptions of some typical sections in western Wyoming and southeastern Idaho, and three lines of columnar sections.

E. R. Cressman, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–118. As mapped in Snowdrift Mountain quadrangle, Caribou County, Idaho, consists of seven unnamed members with aggregate thickness of 2,510 feet. Overlies Nugget sandstone and underlies Preuss sandstone.

Named for exposures on Twin Creek between Sage and Fossil, Lincoln County, Wyo.

Twin Lakes Andesites[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Bull. Dept. Geol. Sci., v. 21, no. 8, p. 223–230, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 686. Cenozoic.

J. A. S. Adams, 1955, Geochim. et Cosmochim. Acta., v. 8, p. 77 (table 2). Listed on table.

Twin Lakes are in Lassen Volcanic National Park.

Twin Lakes Formation

Pleistocene (Iowan-Tazewell) : Central Colorado.

G. M. Richmond, 1953, Friends of the Pleistocene, Rocky Mountain Sec., 2d Ann. Field Trip, Oct. 4–5, correlation chart, geol. map. Consists of lower and upper member. Underlies Lake Creek formation (new).

Twin Lakes region, Lake County.

Twin Lakes Glacial Substage

Pleistocene (Wisconsin) : Southern Rocky Mountains.

L. L. Ray, 1939, (abs.), Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 2007; 1940, Geol. Soc. America Bull., v. 12, pt. 1, p. 1857–1858. Earliest of five substages of Wisconsin glaciation in southern Rocky Mountains. Followed by Home substage. Terminal moraines rare; evidence of ice advance based on patches of weathered till on valley walls above till of second substage.

Named for moraine at Twin Lakes in upper Arkansas Valley.

Twin Lakes Quartz Monzonite Porphyry[1]

Tertiary: Central Colorado.

Original reference: J. V. Howell, 1919, Colorado Geol. Survey Bull. 17.

Occurs on both sides of valley of Lake Creek below Everett and in vicinity of Twin Lakes, Lake County.

Twin Mountain Basalt

Late Cenozoic: Northeastern New Mexico.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 132, pl. 15. Mentioned in discussion of Capulin basalts in Des Moines quadrangle. [Most of discussion refers to flows and basalts from Twin Mountain.]

Twin Mountains is elongate center cone that lies 3 miles southeast of Folsom, Union County.

Twin River Formation[1]

Eocene, upper, to Oligocene, upper: Northwestern Washington.

Original reference: R. Arnold and H. Hannibal, 1913, Am. Philos. Soc. Proc., v. 52, p. 579, 584, 604.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 117. Stratigraphic position of beds at Twin Rivers in upper part of Clallam County section of Oligocene and prevailing character of its molluscan fauna permit approximate correlation with Blakeley formation and elimination of newer term, Twin River formation.

J. W. Durham, 1944, California Univ. Dept. Geol. Sci. Bull., v. 27, no. 5, p. 113. Faunal studies indicate upper part of Twin River formation is younger than fossiliferous type Blakeley formation.

R. D. Brown, Jr., and H. D. Gower, 1948, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2492–2512. Redefined to include mappable sequence of predominantly argillaceous sedimentary rocks exposed in northern Olympic Peninsula. Three mappable sequences recognized: lower member consisting of thin-bedded sandstone and siltstone, middle member of massive siltstone that grades westward into bedded siltstone and sandstone, and upper member composed chiefly of massive mudstone. Lenses of conglomerate present in places. Maximum thickness 17,500 feet, south limb of Clallam syncline. Overlies Lyre formation; underlies Clallam formation as used by Weaver. Mollusks and Foraminifera indicate an age range of late Eocene to early Miocene. Redefinition of Twin River, rather than Blakeley, is preferred because Blakeley has been used as lithologic term as well as faunal stage and has become so well entrenched in literature that any change in its stratigraphic and biostratigraphic connotation seems inadvisable. Some of rocks here included in Twin River have been described by Weaver (1937) as Lyre formation and Lincoln formation. Type locality, type section, and reference sections of redefined formation designated.

Type locality (Brown and Gower): Along Deep Creek, a north-flowing stream which enters Strait of Juan de Fuca at point about 3.4 miles west of mouth of West Twin River. Type section in Deep Creek is exposed from point 3,600 feet S. 41° W., from U.S. Forest Service road bridge across Deep Creek, northward to point on axis of local east-trending syncline, 700 feet east, 4,350 feet north of SW cor. sec. 20, T. 31 N., R. 10 W., Clallam County. Reference section: In stream bed and canyon of Lyre River, about 10 miles east of type locality on Deep Creek. In Lyre River, formation is exposed from point 950 feet south, 3,690 feet west of NE cor. sec. 10, T. 30 N., R. 9 W., to point 400 feet north, 1,050 feet west of SE cor. sec. 28, T. 31 N., R. 9 W.

Twin Sisters Dunite

Tertiary: Northwestern Washington.

Peter Misch, 1952, The Mountaineer, v. 45, no. 13, p. 4 (geol. map). An ultrabasic intrusive.

Twin Sisters Mountain is in Whatcom County.

Twisselmann Sandstone Member (of Monterey Formation)

Miocene, middle and upper: Southern California.

H. H. Heikkila and G. M. MacLeod, 1951, California Div. Mines Spec. Rept. 6, p. 4 (table 1), 5 (table 2), 11, 12–13, pl. 1. Name proposed for large

sandstone lens occupying stratigraphic position equivalent in part to lower McDonald shale member and upper Gould-Devilwater shale member. Consists of friable silty to medium-grained sandstone, generally gray but locally rust mottled to tan; includes two shale beds in upper half and bioclastic reef 30- to 50-feet thick at base. In type area, has maximum thickness of 2,200 feet, conformably underlies McDonald shale member and unconformably overlies undifferentiated Cretaceous deposits; basal contact is marked locally by discontinuous massive bioclastic reef.

Type locality: Vicinity of C. Twisselman's deserted ranch building in NW cor. NE¼ sec. 14, T. 27 S., R. 18 E., Kern County.

Twist Gulch Member (of Arapien Shale)

Twist Gulch Formation

Upper Jurassic: Central Utah.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 122, 124, 125. Upper member of Arapien. Overlies Twelvemile Canyon member (new); underlies Morrison(?) formation. Siltstone and shale, red, in thin-bedded succession, with many thin beds of green-gray to white siltstone. Thickness 3,000 feet.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 10–15. Rank raised to formation.

Named for exposures on north side Salina Canyon above Twist Gulch, Sevier County.

Twobar Shale Member (of San Lorenzo Formation)

Eocene (Narizian): Western California.

E. E. Brabb, 1960, Dissert. Abs., v. 21, no. 5, p. 1163. Named as lower member of formation. Underlies Rices mudstone member (new).

Type section: Along Kings Creek, Big Basin area, Santa Cruz Mountains. Derivation of name not stated.

Two Creeks Interstade

Twocreekan Substage

Two Creeks Forest Bed

Two Creeks Intraglacial Substage

Pleistocene (Wisconsin): Eastern Wisconsin.

J. W. Goldthwait, 1907, Wisconsin Geol. Nat. History Survey Bull. 17, p. 61–62. Two Creeks forest bed may record an interval between early and late Wisconsin time; or it may mark interval between Calumet stage and readvance of ice sheet to Manistee moraine.

L. R. Wilson, 1932, Wisconsin Acad. Sci., Arts, and Letters, Trans., v. 27, p. 31–46. Bed is several inches thick and approximately 100 feet long. Lies between varved clays deposited during retreat of middle Wisconsin or "gray ice" and till of late Wisconsin or "red ice".

F. T. Thwaites, 1946, Outline of glacial geology: Ann Arbor, Mich., Edwards Bros., Inc., p. 75, 86. Referred to as Two Creeks interstadial between Valders glaciation and Cary glaciation.

R. V. Ruhe, Meyer Rubin, and W. H. Scholtes, 1957, Am. Jour. Sci., v. 255, no. 10, p. 671–689. New radiocarbon dates in Iowa permit grouping of age values and raise new problems in stratigraphic correlation of late Pleistocene deposits in Iowa and adjacent regions. Older group of ages greater than 29,000 years dates Iowan substage and pre-Iowan deposits.

Old group of ages of 22,900 to 25,100 years dates Farmdale substage. Intermediate group of ages ranges 14,000 to 17,000 years. Parts of Des Moines lobe previously classified as Mankato are dated at 11,600 and 11,800 years, and antedate Two Creeks interstadial dated at 11,400 years B. P.

R. J. Mason, 1958, Michigan Univ. Mus. Anthropology, Anthropol. Paper 11, p. 23. Two Creeks interstadial represents period between end of Mankato retreat and next and last glacial advance. Probably began about 12,000 years ago and lasted until about 11,000 B. P.; radiocarbon age determination.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 8–9. In classification proposed herein, Twocreekan is substage next younger than Woodfordian substage (new) and older than Valderan substage. It is based on Two Creeks forest bed of Wisconsin (Thwaites and Bertrand, 1957) and contains time of very short-lived retreat of glacier ice in Lake Michigan lobe. Has time span of no more than 1,500 radiocarbon years.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Presentation of classification of Wisconsin glacial stage of north-central United States. Two Creeks intraglacial substage separates older Mankato glacial substage from younger Valders glacial substage.

Exposed on shore of Lake Michigan, 2 miles east of Two Creeks, in secs. 11 and 13, T. 21 N., R. 25 E., Manitowoc County.

Two Medicine Formation (in Montana Group)[1]

Upper Cretaceous: Northwestern Montana.

Original reference: E. Stebinger, 1914, U.S. Geol. Survey Prof. Paper 90, p. 62–68.

J. B. Lyons, 1944, Geol. Soc. America Bull., v. 55, no. 4, p. 449 (fig. 2), 451–452. Formation, in northern end of Big Belt Mountains, is 1,000 feet thick; overlies Eagle sandstone and unconformably underlies Adel Mountain volcanics (new). Upper Cretaceous.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 115–116. Underlies Bearpaw shale; overlies Virgelle sandstone. Crops out on west flank of Sweetgrass arch. Thickness north of Dupuyer 2,125 feet. Almost entirely nonmarine and is largely mudstone that weathers pale greenish gray or gray.

G. W. Viele, 1960, Dissert. Abs., v. 21, no. 4, p. 853. In Flat Creek area, Lewis and Clark County, name Hogan formation is given to 2,477 feet of andesitic to latitic volcanic-rich sedimentary rocks which are stratigraphically equivalent to middle and upper Two Medicine formation. Hogan rests disconformably on lower fossiliferous Two Medicine.

Well exposed on Two Medicine River, between its mouth and Family post office, Glacier County.

Twomile Limestone (in Conemaugh Formation)[1]

Pennsylvanian: Southern West Virginia.

Original reference: I. C. White, 1885, The Virginias, v. 6, p. 8, 9.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 12). Twomile limestone shown on correlation chart below Morgantown sandstone and above Bakerstown coal. Conemaugh series.

Named for exposure on Twomile Run, below Charleston, Kanawha County.

Two Mile Member (of Crockett Formation)

Eocene (Claiborne): Central Texas.

G. D. Harris, 1941, Texas Univ. Bur. Econ. Geology Mineral Resources Survey Circ. 33, p. 13, 14, 15–19. Crockett as exposed in Lee County divided into (ascending) Stone City, Wheelock, Two Mile (new), and Tabor (new) members. Two Mile is sequence of sand and clay with minor amounts of limestone and gypsum. Thickness as much as 19 feet. Name is from manuscript of H. B. Stenzel.

Exposed in Elm Creek valley for entire length of stream. Type locality and derivation of name not stated.

Twowells Sandstone Lentil (of Mancos Shale)

Upper Cretaceous: Northwestern New Mexico.

W. S. Pike, Jr., 1947, Geol. Soc. America Mem. 24, p. 22, 35–36. Hard massive tan to pinkish sandstone. Thickness from fraction of a foot to 35 feet. Within lower part of Mancos shale, 30 to 75 feet above its base.

Named from typical exposures near Two Wells in T. 12 N., R. 19 W., McKinley County.

Tybo Shale[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1933, Nevada Univ. Bull. v. 27, no. 3, p. 13–25.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 148. Listed with names not included on chart of recommended revision of stratigraphic units in Great Basin. Reasons for omission usually are that names are incapable of being interpreted or are rejected synonyms. [Hales limestone and Swarbrick formation, noted by Ferguson, 1933, as overlying and underlying the Tybo are also omitted from chart.]

Exposed in Tybo Canyon, near Camp Tybo, Tybo district.

Tye Formation (in Clear Fork Group)[1]

Permian: Central and central northern Texas.

Original reference: W. E. Wrather, 1917, Southwestern Assoc. Petroleum Geologists Bull. 1, pl. opposite p. 96.

Probably named for Tye, Taylor County.

Tye Granite[1]

Jurassic: Central Washington.

Original references: W. S. Smith, 1915, School of Mines Quart., v. 36, p. 157; 1916, Jour. Geology, v. 24, p. 560.

Named for Tye River in Skykomish Basin.

Tyee Sandstone[1] **or Formation**

Eocene, middle: Western Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

H. E. Vokes, P. D. Snavely, Jr., and D. A. Myers, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–110. Described in Eugene area as Tyee formation since here beds include substantial proportion of mudstone. Thickness about 5,000 feet; base not exposed. Unconformably underlies Lorane shale member of Spencer formation (restricted).

H. E. Vokes, D. A. Myers, and Linn Hoover, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–150. Described in Corvallis area where it overlies Kings Valley siltstone member of Siletz River volcanic series and underlies Spencer formation. Mapping in Corvallis-Monroe area indicates that Lorane shale member is more closely related to Tyee formation than to Spencer formation. Correlation is suggested between siltstone in upper part of Tyee in Monroe and Albany quadrangles and Lorane shale member of Spencer formation.

E. W. Baldwin, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–162. Described in Marys Peak and Alsea quadrangles where it overlies Siletz River volcanic series, where it consists of thick series of rhythmically bedded sandstone and intercalated siltstone. This same sequence of sedimentary rocks is exposed along Yaquina River in Toledo quadrangle and was named Burpee formation by Schenck (1927). Recent mapping has shown that Burpee formation is equivalent at least in part, to Tyee formation. Inasmuch as name Tyee has priority, it is used in this report.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Bros., Inc., p. 13. Near Lukiamute River appears to interfinger with Yamhill formation.

U.S. Geological Survey restricts the use of the term Burpee to its type locality. Elsewhere the term Tyee is used.

Type locality: Douglas County. Forms prominent escarpment from Tyee Mountain to Camas Valley.

Tyende sandstone[1]

Jurassic: Northwestern Arizona and southwestern Colorado.

Original reference: C. R. Keyes, 1936, Pan-Am. Geologist, v. 66, no. 1, p. 71–72.

Named for Tyende Arroyo, tributary of Rio San Juan, passing by north point of Black Mesa, near Kayenta settlement, Navajo County, Ariz.

Tygee Sandstone (in Gannett Group)[1]

Cretaceous: Southeastern Idaho and southwestern Wyoming.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98–G, p. 76, 83.

V. R. D. Kirkham, 1924, Idaho Bur. Mines and Geology Bull. 8, p. 26–28. Section measured on Fall Creek, Fall Creek quadrangle, gives thickness of Tygee as 1,020 feet. Overlies Draney limestone; underlies Wayan formation. Thickness at type locality about 100 feet.

C. A. Moritz, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 68. In Fall Creek area, Bonneville County, Idaho, about 980 feet of Tygee beds are assigned to Bear River formation; section not complete.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 53, 56–57, pl. 21. Geographically extended into Wyoming where it forms uppermost beds of Gannett group. Overlies Draney limestone. Underlies Bear River formation. Units referred to as members of Gannett group. Lower Cretaceous.

R. B. Boeckerman and A. J. Eardley, 1956, Wyoming Geol. Soc. Assoc. Guidebook 11th Ann. Field Conf., p. 198. In Jackson Hole country, uppermost member of Gannett group. Consists of brownish-gray siltstone and

rust-stained shale. Contains one or more reddish sandstone beds. Thickness 198 feet. Overlies Draney limestone member; unconformably underlies Bear River formation. Lower Cretaceous.

J. D. Vine, 1959, U.S. Geol. Survey Bull. 1055–I, p. 259 (table), 261–262. In Bonneville County, Idaho, Tygee sandstone conformably overlies Draney limestone and conformably underlies Bear River formation. Thickness 285 feet where measured on Skyline Ridge. Formation consists of interbedded red shale and gray to brown sandstone. Strata in Skyline Ridge section are overturned and dip 85° NE. The intense deformation may have caused formation to be thinner here than in a normal section. Limits of formation differ greatly from limits described by Kirkham (1924), who included beds in Tygee that are here called Bear River formation. Apparently Kirkham measured his section east of Fall Creek Ranger Station, where faulting has duplicated strata.

Named for Tygee Creek [Idaho], east of which, in T. 8 S., R. 46 E., it is well exposed.

Tyger zone[1]

Precambrian: Northwestern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 6, 7, 12.

Named for exposures on Tyger River.

Tyler Formation

Tyler Sandstone Member (of Heath Formation)

Tyler Sandstone Member (of Quadrant Formation)[1]

Mississippian or Pennsylvanian: Central northern Montana.

Original reference: O. W. Freeman, 1922, Eng. and Min. Jour.-Press, v. 113, no. 19, p. 827.

H. D. Hadley, P. J. Lewis, and R. B. Larsen, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 142. Referred to as member of Heath formation. Thickness 5 to 100 feet. Mississippian.

P. A. Mundt, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1920–1925; 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 46–47. Redefined as formation. Freeman used term primarily with reference to massive sands; as redefined, the Tyler also includes black, gray, and reddish shales within which the sandstone bodies occur; also includes marine limestone tongue locally present near top. Thickness where typically exposed in secs. 21, 22, and 27, T. 14 N., R. 21 E., Fergus County, 382 feet. Underlies Alaska Bench formation; unconformably overlies Heath formation. Unit has been referred to as Amsden, Heath, Heath-Amsden transition zone, nonmarine Heath and so forth. Mississippian. Uncertainty exists as to exact geographic position of Freeman's type locality. No Tyler rocks outcrop a mile west of present site of Tyler; nearest exposures are more than 3 miles south of Tyler School and outcrop at Durfee Creek dome which cannot be considered part of Middle Bench as mentioned by Freeman. Type section restated.

G. H. Norton, 1956, Billings Geol. Soc. Guidebook 7th Ann. Field Conf., p. 58, 62, figs. 5, 6, 7. Formation includes East Buffalo Creek limestone member and Bear Gulch limestone member of lentil (both new).

R. P. Willis, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1948–1962. Formation in Montana area is limited in occurrence to central Montana trough and overlaps locally underlying Heath formation. Isopach pattern shows abrupt thinning toward north along Cat Creek trend, which may indicate truncation. Suggested that formation be divided into two members: lower characterized by predominantly dark-colored slightly calcareous shale, and upper containing predominantly red and maroon calcareous shales with abundant marine fauna. Division is made at base of the "A" zone, at which point the Tyler takes on more marine characteristics, and a trend change from east-west to southwest-northeast. Name Cameron Creek applied to upper member. The "A" zone denotes both the sand facies and its limestone equivalent; the limestone has been referred to as Bear Gulch member or tongue. This subdivision of Tyler is not everywhere applicable. Pennsylvanian (Morrow).

L. S. Gardner, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 2, p. 335–337. Name Tyler formation not used in revision of Big Snowy group because, as expressed by Scott (1935, Jour. Geology, v. 43), the sands are neither a lithologic, paleontologic, or mappable unit over broad areas. Also name is twice preoccupied. Its type section as given by Mundt (1956) is a section of Heath and Cameron Creek formations made anomalous by local appearance of about 150 feet of gray to white sandstone bedded in black shale of the Heath and overlain by red shale of Cameron Creek formation. In this study, no regional unconformity was found within Big Snowy sequence. Erosional unconformity at base of Mundt's Tyler is believed to be widely spaced local channel cuts, each of which can be traced for a few hundred yards or a few miles, depending on the angle at which present outcrop cuts ancient channel before it dies out in normal sequence of marine shale and limestone.

Type section: Section mentioned by Freeman as exposed at east end of Middle Bench. This section is about 5 miles west of Tyler School (also site of old Tyler post office), at southeast end of Middle Bench, in S½ sec. 5, T. 12 N., R. 21 E., Fergus County.

Tyler Greensand Member (of Sparta Sand)[1]

Eocene, middle: Eastern Texas.

Original reference: E. A. Wendlandt and G. M. Knebel, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1359–1360.

Well exposed throughout city of Tyler, and west and northwest of Swan, Smith County.

Tyler Red Beds (in Monongahela Formation)[1]

Tyler redbed member

Pennsylvanian: Northern West Virginia and eastern Ohio.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 30, 44.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 177. Member of Benwood cyclothem in report on Athens County. Average thickness about 31 feet. Unit variable; grades laterally into either sandstone or shale, and fresh-water limestone and redbeds may be interbedded with either Sewickley sandstone or Benwood limestone. Monongahela series.

Named for prominence in area around Tyler County, W. Va.

Tyler Slate[1]

Precambrian (Animikie Series): Northwestern Wisconsin and northwestern Michigan.

Original reference: C. R. Van Hise, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 338.

W. O. Hotchkiss, 1919, Eng. and Min. Jour., v. 108, p. 501, 506. Includes Pabst member.

U.S. Geological Survey currently considers the Tyler Slate a part of the Animikee Series.

Named for exposures at Tylers Fork, [Iron County, Wis.]

Tymochtee Formation

Tymochtee Shale[1] (in Bass Islands Group)

Upper Silurian: Western Ohio and southeastern Michigan, and southern Ontario, Canada.

Original reference: N. H. Winchell, 1873, Ohio Geol. Survey, v. 1, p. 633.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3 (column 17). Correlation chart shows Tymochtee shale present in southern Ontario.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 124–125, chart facing p. 108. Dolomite, thin- to massive-bedded, gray to brown. Thickness indefinite approximately 125 to 175 feet. Overlies Greenfield formation; underlies Put-in-Bay dolomite. In Bass Island[s] group.

Named for exposures on Tymochtee Creek at Crawford, Wyandot County, Ohio.

Tyner Formation[1]

Middle and Upper Ordovician: Eastern Oklahoma.

Original reference: J. A. Taff, 1905, U.S. Geol. Survey Geol. Atlas, Folio 122.

G. G. Huffman and others, 1958, Oklahoma Geol. Survey Bull. 77, p. 14 (fig. 2), 16 (fig. 3), 22–24, pls. 2, 3, 4. Described on southwestern flank of Ozark uplift. Cram's (1930, Oklahoma Geol. Survey Bull. 40QQ) subdivisions of lower dolomite and green shale, middle green shale, and upper cherty dolomite limestone can be recognized throughout much of area. Exposed thicknesses vary from 8 feet near Blackgum to over 90 feet on Cornshell Mountain, sec. 25, T. 16 N., R. 22 E.; 79 feet near Qualls; both contacts exposed; thins northward by truncation and overlap of Chattanooga. Conformably overlies Burgen sandstone; conformably underlies Fite limestone in southern exposures, and near contact buff, dolomitic limestone alternates with white, lithographic limestone of Fite to form narrow transition zone. Precise age and correlation questionable; fossil evidence suggests that upper part of Tyner is equivalent in part at least with units which have been classed as Black River. Figure 2 shows unit in Champlainian series.

Named for exposures along Tyner Creek, a tributary of Barren Fork in northern Adair County, near town of Proctor.

Tyonek Formation[1]

Eocene: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 171–172, 184.

Exposed along shore of Cook Inlet southwest of Tyonek.

†Tyringham Gneiss[1]

Precambrian: Western Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 18.

Named for occurrence in Tyringham Township, Berkshire County.

†Tyrone Conglomerate[1]

Upper Ordovician: Central Pennsylvania.

Original reference: A. W. Grabau, 1909, Science, new ser., v. 29, p. 353, 355.

Typically exposed at Tyrone, Blair County.

Tyrone Limestone[1] (in High Bridge Group)

Tyrone Limestone Member (of High Bridge Limestone)

Middle Ordovician: Central Kentucky and western Virginia.

Original reference: A. M. Miller, 1905, Kentucky Geol. Survey Bull. 2, p. 9, 14.

A. C. McFarlan, 1943, Geology of Kentucky: Lexington, Ky., Kentucky Univ., p. 12–13; D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 40–41. Uppermost formation in High Bridge (Highbridge) group. Overlies Oregon limestone; underlies Curdsville limestone in Lexington group. Very pure limestone of birdseye or, in places, lithographic type; contains three bentonite beds. Thickness approximately 90 feet. May be wholly or in part Trenton in age.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 46. Kentucky name Tyrone should not be used in central Tennessee; name Carters has priority.

J. L. Rich, 1951, Geol. Soc. America Bull., v. 61, no. 1, p. 18. Referred to as member of High Bridge limestone.

M. H. Ross and W. E. Moore, 1952, (abs.) Virginia Jour. Sci., v. 3, new ser., no. 4, p. 333–334. Geographically extended into Lee County, Va. Contains bryozoan fauna. Beds have previously been referred to Eggleston formation.

Named for Tyrone, Anderson County, Ky.

Tyson Formation

Tyson Member (of Monastery Formation)

Cambro-Ordovician: West-central Vermont.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 42, 43, 44. Basal conglomerate and schistose sandstone member of Lower Cambrian Monastery formation (new). Thickness varies from featheredge to 600 feet. Underlies Battell member (new) of Monastery formation; overlies Mount Holly complex. Name attributed to Thompson (unpub. thesis, 1950).

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 45–47. Rank raised to formation in Rutland area. Thickness as much as 600 feet. Underlies Grahamville formation (new); overlies Precambrian(?) Saltash formation (new) or Mount Holly complex.

Largest belt of exposures in valley of West Branch, 1 mile east of Bingo Camp in Rochester-East Middlebury area.

Tyus Member (of Weches Formation)

Eocene, middle (Claiborne): Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 97, 100–104 [1939]. Gray powdery slightly glauconitic sparingly fossiliferous calcareous marl with numerous small irregular white to gray lime nodules, which unite in some places to form thin layers; includes gray limestone bench or limestone concretions; lime in form of limestone or nodules is outstanding component of member. Thickness 2 to 15 feet; average 9 feet; thickness increases along strike from southwest to northeast. Underlies Viesca member (new), boundary transitional; disconformable above Queen City sand.

Type locality: Cut of abandoned Houston & Texas Central Railroad, 0.4 mile north of Robbins crossroads, R. M. Tyus Survey, Leon County.

U Bar Formation

Lower Cretaceous: Southwestern New Mexico.

R. A. Zeller, Jr., 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 10 (chart). Name appears only on chart. Consists of massive- and thin-bedded limestone. Thickness approximately 2,000 feet. Underlies Mojado formation (new); overlies Hell-To-Finish formation (new).

Big Hatchet Peak quadrangle, Hidalgo County.

Ucross Formation

Recent(?): Eastern Wyoming.

L. B. Leopold and J. P. Miller, 1954, U.S. Geol. Survey Water-Supply Paper 1261, p. 10. Consists of fresh rounded gravel including variety of rocks, mostly igneous and metamorphic. Pebbles average 1 to 2 inches in diameter. Formation contains occasional deeply weathered yellow- and red-stained pebbles. Upper few feet locally composed of silt and may contain lenses of clay. Upper 2 to 3 feet characteristically impregnated with large amounts of calcium carbonate and gypsum in form of strong white mottlings, concentrically-filled tubules, and hard nodules ⅛ to 1 inch in diameter. Underlies newly named Kaycee formation and disconformably overlies Arvada formation (new).

Type locality: In Clear Creek Valley, 1 mile south of Ucross.

Udall Limestone Lentil (in Geuda Springs Shale Member of Wellington Formation)

Permian: Southeastern Kansas.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 13. Limestone several feet thick that occurs in Geuda Springs about 160 feet below Prairie Creek limestone lentil (new).

Well exposed near Udall in Maple Township, T. 30 S., R. 3 E., Cowley County.

Uffington Shale Member (of Conemaugh Formation)[1]

Uffington Shale (in Conemaugh Group)

Upper Pennsylvanian: Northern West Virginia and western Pennsylvania.

Original reference: I. C. White, 1903, West Virginia Geol. Survey, v. 2, p. 323.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 78, 88, fig. 21. Lowest member of Conemaugh group.

Underlies Lower Mahoning sandstone; overlies Upper Freeport coal. Thickness as much as 20 feet in Fayette County.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22 (table 4). Listed in summary of stratigraphic section of Conemaugh formation in Harrison County.

Named for exposures at Uffington, Monongalia County, W. Va.

Uhalde Sandstone and Shale (in Panoche Group)

Upper Cretaceous: Central California.

M. B. Page, 1960, Soc. Econ. Paleontologists and Mineralogists, Pacific Sec., Guidebook Spring Field Trip, p. 5 (fig. 3), 6 (fig. 4), 7 (fig. 5), 13 (fig. 6). Equal amounts of gray-brown shale and interbedded sandstone. Thickness 3,370 feet. Overlies Television sandstone (new); underlies Dosados sandstone and shale member of Moreno shale. Name credited to D. W. Sutton (unpub. thesis).

Type locality: Moreno Gulch, Fresno County. Name derived from Uhalde Canyon, secs. 4 and 9, T. 14 S., R. 11 E., and secs. 33 and 34, T. 13 S., R. 11 E.

Uinta Formation[1]

Eocene, upper: Northeastern Utah and Colorado.

Original reference: O. C. Marsh, 1871, Am. Jour. Sci., 3d, v. 1, p. 196.

H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, p. 241–242. Includes Wagonhound member below and Myton member above.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 97 (table 1), 99 (table 2), 121–122. Central part of Uinta basin, just south of synclinal axis, is occupied by outcrops of Uinta formation. Consists of variegated shale interbedded with gray and buff sandstone. Thickness 1,648 to 1,800 feet. Conformably overlies Green River shale; conformably underlies Duchesne River formation.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 405–425. Discussion of stratigraphic and facies relationships of upper part of Green River formation and lower part of Uinta formation in Duchesne, Uintah, and Wasatch Counties, Utah. Uinta formation comprises thick sequence of chiefly fluviatile beds but includes varying amount of lacustrine beds. Westward from Colorado State line to the Green River, where formation has been most studied, it contains three vertebrate faunal zones of middle to late Eocene age, and surface exposures indicate thickness of 1,500 to 2,000 feet. This sequence conformably overlies Green River formation and was formerly divided by U.S. Geological Survey into Bridger formation, consisting approximately of horizons A and B of Osborn and Peterson (1895, Am. Mus. Nat. History, v. 7) and Uinta formation, which was horizon C of Osborn and Peterson (1895). More general and recent usage has been to refer entire sequence to Uinta formation, which usage is followed in present report. Lowest part of sequence of fluviatile beds consists of a brown massive cross-bedded medium- to coarse-grained sandstone unit that overlies Green River formation for many square miles in vicinity of Evacuation Creek and White River north of Watson, Utah, in eastern part of Uinta basin. This sandstone unit, about 800 feet thick, contains some hard greenish-gray sandy mudstone interbedded with the sandstone and is lower unit of Bridger formation of Bradley (1931, U.S. Geol. Survey Prof. Paper 168).

Lower part of this sandstone unit, about 500 feet thick, contains few fossils, but according to Peterson (Riggs, quoting Peterson, 1912, Field Mus. Nat. History Pub. 159, Geol. Ser., v. 4), specimens of *Metarhinus* and *Sphenocoelus* were found near base; upper part is more fossiliferous and the two fossiliferous parts represent closely horizon A, lowest vertebrate faunal zone of the three recognized by Osborn and Peterson. There has been some uncertainty as to whether lowest part of Osborn and Peterson's horizon A should be placed in Uinta or underlying Green River. Despite this uncertainty, the unit has generally not been included in the Green River. An indefinite lower part of horizon A beds (lower beds of Bridger formation of Bradley) has been casually referred to as Wagonhound buff sandstones, but name Wagonhound member was proposed by Wood (1934) for lower part of Uinta formation (horizons A and B of Osborn and Peterson). Top of Evacuation Creek member of Green River is regarded as base of Uinta formation. This formation boundary rises stratigraphically toward center of basin. Much of lower part of fluviatile beds of the Uinta as exposed along Colorado-Utah line grades westward into beds that are in considerable part of lacustrine, playa, and mud-flat origin in an area of which Indian Canyon is the center. These beds, formerly considered saline facies of Green River formation, are here included as part of Uinta formation.

W. B. Cashion and J. H. Brown, Jr., 1956, U.S. Geol. Survey Oil and Gas Inv. Map OM–153. Thickness about 1,500 feet in Bonanza-Dragon area, Uintah County, Utah, and Rio Blanco County, Colo. Overlies Evacuation Creek member of Green River formation; underlies Duchesne River formation.

First described in Uinta Basin, Utah.

†Uinta Glacial Epoch[1]

Pleistocene (Wisconsin) : Colorado.

Original references: W. W. Atwood and K. F. Mather, 1912, Science, new ser., v. 35, p. 315; 1912, Jour. Geology, v. 20, p. 388; 1912, Geol. Soc. America Bull., v. 23, p. 732.

Name derived from Uinta Mountains, Utah.

†Uinta Quartzite,[1] Sandstone,[1] or Group[1]

Precambrian : Northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 42, 61, 70, 138, 139, 141–145.

Forms crest and core of main axis of Uinta Mountains and extends east into Colorado, nearly as far as junction of Little Snake and Yampa Rivers.

Uinta Mountain Group[1]

Precambrian : Northeastern Utah and northwestern Colorado.

Original reference: T. S. Lovering and others, 1935, Geologic map of Colorado.

G. E. Untermann and B. R. Untermann, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 5, p. 685, 689 (table 1). In Green and Yampa River Canyons, group unconformably underlies Lodore formation. Thickness about 12,000 feet.

N. C. Williams, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2737–2738. Group, in western Uinta Mountains, divided into (ascend-

ing) Mutual quartzite and Red Pine shale (new). Underlies Tintic quartzite (Pine Valley of previous reports).

W. R. Hansen, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 25–27, pl. 1. Described in area between Clay Basin and Browns Park in Utah and Colorado. Consists predominantly of dark-red medium- to coarse-grained massive- to crossbedded siliceous sandstone and quartzite with considerable amounts of shale and conglomerate. Approximate thickness 20,600 feet; section is on west end of Cold Spring Mountain between Uinta fault on north and Browns Park on south, section incomplete. Overlies Red Creek quartzite with angular unconformity.

H. R. Ritzma, 1959, Utah Geol. and Mineralog. Survey Bull. 66, p. 18–19, 20. Core of Uinta Range exposes more than 20,000 feet of Precambrian quartzitic sandstone and argillite, the Uinta Mountain group. Proposed that older Precambrian rocks of previous studies, the Red Creek quartzite (or complex), are metamorphosed equivalents of Uinta Mountain group sediments. Group rests with apparent unconformity on contorted and faulted Red Creek complex. Unconformably underlies Lodore formation. Area of report, Daggett County.

Most widely exposed unit in Uinta Mountain area. Crops out in almost continuous exposures from one end of range to the other, a distance west to east of about 140 miles, in a belt 15 or 20 miles or more wide. Forms main divide and major peaks of range proper as well as greater part of chain of hills north of Green River between Flaming Gorge and Vermilion Creek, including Goslin, O-Wi-Yu-Kuts, and Cold Spring Mountains.

Uintan Age

Eocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 10, pl. 1. Provincial time term, based on Uinta formation of northern Utah, that is, time of deposition of Uinta A–C, inclusive (pl. 1), with included faunas. Covers interval between Bridgerian and Duchesnean ages. Report defines 18 provincial time terms based on mammal-bearing units for North American continental Tertiary. [For sequence see under Puercan.]

Ulatisian Stage

Eocene, middle: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903. Named as one of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Includes interval between Narizian stage above and Juniperan [Juniperian] stage.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 40–44, 76–78, 96–98, fig. 7, tables. Spans interval between Penutian stage (name proposed to replace Juniperian stage) below and Narizian stage above. Includes two zones, *Vaginulinopsis mexicana* below and *Amphimorphina californica* above. Interval is essentially represented by most of Laiming's (1939, 6th Pacific Sci. Cong. Proc., v. 2) "B-Zones". At base is the megafossiliferous "Domengine" and at top is the "Transition Zone" of molluscan terminology.

Type is in strata mapped by Boyd (1949, unpub. thesis) as Vacaville shale in vicinity of Dunn's Peak along Ulatis Creek, Vaca Valley quadrangle, Solano County.

Ulm coal group (in Wasatch Formation)[1]

Eocene: Eastern Wyoming and southeastern Montana.

Original reference: J. A. Taff, 1909, U.S. Geol. Survey Bull. 341, p. 123–150.

Named because of their best known occurrence in vicinity of Ulm, on Burlington Railroad in Sheridan County, Wyo.

Ulm Formation[1]

Eocene: Eastern Wyoming and southeastern Montana.

Original reference: R. L. Nace, 1936, Wyoming Geol. Survey Bull. 26, p. 104.

Named for Ulm, Sheridan County, Wyo.

Ulsterian Group[1]

Ulsterian Series

Ulsterian Stage

Lower and Lower or Middle Devonian: North America.

Original reference: J. M. Clarke and C. Schuchert, 1899, Science, new ser., v. 10, p. 874–878.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 131 (footnote). Term Ulsterian stage in New York includes the Onondaga and Schoharie, but not the Esopus which is classed with the Oriskany. If used here [Pennsylvania], it would embrace Onondaga group which includes the so-called Esopus of eastern Pennsylvania. No Schoharie is recognized in the State. Such usage being inapplicable, term Stroudsburgian stage is introduced from Stroudsburg, Monroe County, where the group may be observed at its best, for eastern Pennsylvania.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. As shown on correlation chart, Devonian comprises (ascending) Ulsterian, Erian, Senecan, Chautauquan, and Bradfordian (in part) series. Ulsterian comprises (ascending) Helderberg, Deerpark (new), and Onesquethaw (new) stages. Lower and Lower or Middle Devonian.

Named for Ulster County, N.Y.

Ultima Thule Gravel Member (of Holly Creek Formation)

†Ultima Thule Gravel Lentil (of Trinity Formation)[1]

Lower Cretaceous (Comanche Series): Southwestern Arkansas.

Original reference: H. D. Miser and A. H. Purdue, 1918, U.S. Geol. Survey Bull. 690–B.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Referred to as Ultima Thule gravel member of Holly Creek formation. Subsurface equivalents discussed.

J. M. Forgotson, Jr., 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2333 (fig. 2), 2339. Ultima Thule gravel lentil represents surface equivalent of lower part of Rodessa formation.

Exposed near Ultima Thule, De Queen quadrangle, Sevier County.

Ulupau Tuff[1] (in Honolulu Volcanic Series)

Pleistocene, upper: Oahu Island, Hawaii.

Original reference: C. K. Wentworth, 1926, Bernice P. Bishop Mus. Bull. 30, p. 85–90.

G. A. Macdonald and G. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 133. Gray to brown partly palagonitized tuff forming Ulupau Cone. Contains fragments of reef limestone. Thickness more than 500 feet. Cut by nepheline basalt dike. Unconformably underlies Kii Point limestone and beach deposits of plus 25-foot (Waimanalo) stand of sea. Has been referred to as Ulupau Head tuff (Winchell, 1947, Geol. Soc. America Bull., v. 58, no. 1).

Named for Ulupau Head, tuff cone at north end of Mokapu Peninsula. Covers about 0.3 square mile on northeast coast of Oahu, about 12 miles northwest of Makapuu Head.

Umatac Formation

Umatac Andesite

Miocene, lower: Mariana Islands (Guam).

Risaburo Tayama, 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 48, table 4 [English translation in library of U.S. Geol. Survey, p. 57–58]. Basal rock of island. Typically pillow lava with amygdaloidal structures and intercalated green tuffs and agglomerates. Cut by dikes. Underlies Bolanos (Balanos) beds. Thick stratum of Santa Rosa beds intercalated between Umatac and Bolanos beds. Eocene.

S. Hanzawa *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 64. Aquitanian.

U.S. Geological Survey currently classifies the Umatac as a formation and designates its age as lower Miocene on the basis of a study now in progress.

Typically exposed at Umatac coast, Guam.

Umbrella Hill Formation

Middle Ordovician: North-central Vermont.

A. L. Albee, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–102. Quartz- and slate-pebble conglomerate. Friable calcareous gray slate separates conglomerate bands at top and bottom. Underlies Moretown formation with apparent conformity; overlies Stowe formation unconformably.

W. M. Cady, 1960, Geol. Soc. America Bull., v. 71, no. 5, pl. 3. Middle Ordovician.

Typically exposed on and near Umbrella Hill along east-central border of Hyde Park quadrangle. Also exposed in Hardwick quadrangle to the east.

†Umiat Formation (in Nanushuk Group)

Lower and Upper Cretaceous: Northern Alaska.

George Gryc, W. W. Patton, Jr., and T. G. Payne, 1951, Washington Acad. Sci. Jour., v. 41, no. 5, p. 160 (table 1), 162–164. Inshore facies of the marine formation consists of relatively clean sandstone that grades northeast through argillaceous sandstone into shale of offshore facies. Thickness about 5,000 feet. Lower part is marine shale similar to shale of Torok formation (new) which it overlies. Underlies Schrader Bluff formation (new). Tongues into nonmarine Chandler formation (new) to the south. Divided into two new members, Tuktu below and Topagoruk above. Lower part is Lower Cretaceous; upper part probably also Lower Cretaceous.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, chart (facing p. 246). Age shown on chart as Lower and Upper Cretaceous.

George Gryc and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 211, 233. Name abandoned.

Named from marine part of section below 750 feet in Umiat test well No. 1, in vicinity of Umiat, Colville River region.

Umpqua Formation[1]

Eocene, lower to middle: Southwestern Oregon and northern California.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

C. E. Weaver and others, 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 589, chart 11. Correlation chart shows Umpqua formation below Tyee formation in Roseburg and Comstock areas, Oregon. States type section.

J. E. Allen and E. M. Baldwin, 1944, Oregon Dept. Geology and Mineral Industries Bull. 27, p. 13, 19, pls. 1, 5. In Coos Bay quadrangle, formation consists of more than 1,800 feet of tuffaceous sandstone and shale with thick lenticular basalts and pyroclastic. Overlies sediments, schists, and volcanics tentatively correlated with Franciscan-Knoxville group of California. Underlies Tyee sandstone in northeastern part of quadrangle. In some areas, underlies Coaledo formation. Middle Eocene.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 18, pl. 1. Mapped in Macdoel quadrangle, California.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Described in Medford quadrangle, Oregon-California. Forms floor of most of Bear Creek valley from Siskiyou, where it is faulted against volcanic rocks of Western Cascades, north to Rogue River. Western boundary follows trend of foothills of Cascade Range. Maximum thickness about 8,000 feet. Predominantly medium-grained sandstone with some shaly and conglomerate layers. Disconformably overlies Hornbrook formation; in northern part of area, grades into overlying Colestin and Roxy formations (both new) but to south is separated from them by angular discordance. Eocene.

U.S. Geological Survey currently considers the Umpqua Formation lower Eocene in age.

Type section: Along north Umpqua River about 17 miles northeast of Roseburg, Douglas County, Oreg.

Umpqua Group[1]

Eocene: Southwestern Oregon.

Original reference: T. Condon, 1902, The Two Islands: Portland, Oreg., The J. K. Gill Co.

Named for association with Umpqua Valley, Douglas County.

Unadilla Formation[1]

Upper Devonian: East-central New York.

Original reference: C. S. Prosser, 1903, Am. Geologist, v. 32, p. 380–384.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Unadilla shale and sandstone. Underlies Oneonta redbeds; overlies Gilboa sandstone. Genesee group.

Bradford Willard and R. E. Stevenson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2274. Onteora redbeds grade laterally westward into Unadilla marine sandstones and sandy shales. Unadilla listed under Portage group.

Named for Unadilla River below New Berlin village, Chenango County.

Uncas Shale[1]

Permian: Central northern Oklahoma.

Original reference: D. W. Ohern and R. E. Garrett, 1912, Oklahoma Geol. Survey Bull. 16, p. 10.

Named for exposures in vicinity of Uncas, Kay County.

Uncle Israels Granite

Age not stated: Southeastern Maine.

G. H. Chadwick, 1944, New York Acad. Sci. Trans., ser. 2, v. 6, no. 6, p. 172. Name proposed for white granite with cataclastic texture. Occurs as sills.

Occurs on Mount Desert Island and Bartlett Island, Hancock County.

Uncle Sam Porphyry

Eocene(?) to lower Pliocene(?): Southeastern Arizona.

B. S. Butler, E. D. Wilson, and C. A. Rasor, 1938, Arizona Bur. Mines Bull. 143, Geol. Ser. 10, p. 24–25, pl. 3. Rock designated as quartzite latite porphyry. Buff or rusty brown where weathered but dark gray on fresh fractures. Characteristic feature of rock is blotchiness or unevenness of texture due to variations in crystallinity of groundmass. Intrusive into sandstone and shale of Bisbee group west of Ajax Hill, and intrudes volcanic breccias and flows southwest toward Charleston.

James Gilluly, 1945, Am. Jour. Sci., v. 243, no. 12, p. 647–651. Intrusive into Bronco volcanics (new), Bisbee formation, and locally, into Naco limestone. At Bronco Hill and point about 1½ miles to the southeast, it is cut by Schieffelin granodiorite. Probably early Tertiary age.

James Gilluly, 1956, U.S. Geol. Survey Prof. Paper 281, p. 94–99, pl. 5. Mapped in central Cochise County as Tertiary—Eocene(?) to lower Pliocene(?). Locally invades Colina limestone and Epitaph dolomite.

Forms Uncle Sam Hills 2½ miles southwest of Tombstone and the Three Brothers, and is general country rock of State of Maine, Merrimac, San Pedro, and Montezuma mines. Occupies extensive area in western part of Tombstone district and extends westward toward Charleston, Cochise County.

Uncompahgran Quartzite

See **Uncompahgre Formation.**

Uncompahgran System

Precambrian: Western United States.

N. E. A. Hinds, 1936, Carnegie Inst. Washington Pub. 463, p. 58, 134. Strata in western United States formerly classed as Algonkian are divisible into two groups (Uncompahgran and Beltian) separated by considerable time interval during which orogenic deformation, intrusion of granite, and deep erosion occurred. The older group, for which periodic and system term Uncompahgran is suggested, includes the Needle Mountains group of San Juan Mountains, southwestern Colorado; Mazatzal quartzite of central Arizona; and Cottonwood series of Wasatch, Uinta, Oquirrh, and other ranges of northern Utah. Uncompahgran formations are chiefly quartzite, with subordinate amounts of quartzitic conglomerate and slate.

Named from fine exposures of rocks of this type in Uncompahgre Canyon, San Juan Mountains, Colo.

Uncompahgre Formation (in Needle Mountains Group)[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 120.

N. E. A. Hinds, 1940, 6th Pacific Sci. Cong. Proc., p. 290 (table). Cited as Uncompahgran quartzite.

W. S. Burbank and C. T. Pierson, 1953, U.S. Geol. Survey Circ. 236, p. 3. In Uncompahgre Canyon on western flank of San Juan Mountains, formation consists of alternate layers of quartzite and black slate from 50 to several thousand feet in thickness. Neither bottom nor top of series exposed.

Well exposed in Uncompahgre Canyon, Silverton and Ouray quadrangles.

†Uncompahgre Interglacial Interval[1]

Pleistocene: Southwestern Colorado.

Original reference: W. W. Atwood and K. F. Mather, 1912, Jour. Geology, v. 20, p. 392–409.

Underwood Formation (in New Albany Shale)

Underwood Shale Member (of New Albany Shale)

Mississippian (Kinderhookian): Southeastern Indiana and northern Kentucky.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 835, 840 (fig. 3), 849–851, 858. Underwood formation lies between Falling Run member of Sanderson formation (both new) and Henryville shale (new). At type locality, consists of soft greenish 6-inch fossiliferous shale with layer of phosphatic nodules at top.

H. H. Murray and others, 1955, Indiana Geol. Survey Field Conf. Guidebook 8, p. 43, pl. 1. Mississippian part of New Albany has been divided into (ascending) Sanderson, Underwood, and Henryville "formations." Indiana Geological Survey uses these terms with rank of member.

Type locality: On south Ester Farm, in SE¼ sec. 21, T. 2 N., R. 8 E., 2 miles east of Underwood, Clark County, Ind. Noted at Pine Lick, 1 mile northwest of Loretto, Marion County, Ky.

Underwood Lava[1]

Tertiary(?): Southern Washington.

Original reference: I. A. Williams, 1916, Oregon Bur. Mines and Geol., Min. Res. Oreg., v. 2, no. 3, p. 108, 115–117.

In vicinity of Underwood, Skamania County.

Underwood Mountain Lava

Pliocene: Northwestern Oregon and southwestern Washington.

W. D. Lowry and E. M. Baldwin, 1952, Geol. Soc. America Bull., v. 63, no. 1, pl. 2. Name appears on chart only. Younger than Hood River conglomerate.

Underwood Mountain located on north side of Columbia River in Washington, near Hood River, Oreg.

Unga Conglomerate[1]

Miocene: Southwestern Alaska.

Original reference: W. H. Dall and G. D. Harris, 1892, U.S. Geol. Survey Bull. 84, p. 234.

P. S. Smith, 1936, U.S. Geol. Survey Prof. Paper 182, p. 27. Section about 200 feet thick was measured by Dall in 1872 on Unga Island, where series consisted largely of conglomerates with some shales and sandstones containing in places abundant marine fossils. Also recognized at other places in same general region as on shores of Balboa and Herendeen Bays and Port Moller. At Port Moller, beds attain thickness of at least 1,000 feet. In type area, Unga conglomerate appears to rest conformably on highest recognized Eocene stratum but this is not believed to be normal relation, as beds usually show much less deformation than the Eocene deposits.

Type area: Unga Island.

Ungalik Conglomerate[1]

Lower Cretaceous: Central western and central Alaska.

Original reference: P. S. Smith and H. M. Eakin, 1911, U.S. Geol. Survey Bull. 449, p. 55.

R. W. Imlay and J. B. Reeside, Jr., 1954, Geol. Soc. America Bull., v. 65, no. 3, pl. 1 (facing p. 246). Age given as Lower Cretaceous on correlation chart.

Exposed on steep-faced cliffs along Ungalik River and forms most of prominent range of hills between river and coastal plain from Bonanza Creek north to about 1 mile below Camp A17; Nulato-Norton Bay district, Lower Yukon River region.

Unibon Shale[1]

Upper Cretaceous: Puerto Rico.

Original reference: D. R. Semmes, 1919, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 1, p. 69, 74.

J. D. Weaver, 1956, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2b, p. 345. Upper Cretaceous. Light porous shale, with foraminifera. Exact stratigraphical position and distribution not known.

Type locality: At junction of Morovis trail and Unibon River in northern part of island.

Unicoi Formation[1] (in Chilhowee Group)

Lower Cambrian(?): Eastern Tennessee, northwestern North Carolina, and southwestern Virginia.

Original reference: M. R. Campbell, 1899, U.S. Geol. Survey Geol. Atlas, Folio 59, p. 3.

P. B. King and others, 1944, Tennessee Div. Geology Bull. 52, p. 27–28, 37–41. In this report [northeastern Tennessee], basal clastic group of Lower Cambrian series is divided into Unicoi, Hampton, and Erwin formations. Other formation names have been used in region, and various names have been given to group as a whole. Terms Unicoi formation, Hampton shale, and Erwin quartzite were originally applied by Keith (1903, U.S. Geol. Survey Geol. Atlas, Folio 90; 1905, Folio 118; 1907, Folio 151) to broad lithologic units; Unicoi consisting dominantly of arkose and conglomerate, Hampton of shale, and Erwin of quartzite. However, formation boundaries, when based on lithologic character alone, are not of same age from place to place; also, the different rock types are so interbedded that none of the formations consists of a single rock type. In this report, boundaries of the formations are placed at top or bottom of widely traceable beds in such manner that formations are

convenient units of mapping. Lithologic titles of formations are abandoned, although their gross character corresponds approximately to Keith's original intention. Top of Unicoi is placed at top of thick unit of arkosic and vitreous quartzite which lies at rather constant interval of 2,500 to 3,000 feet below base of Shady dolomite. Upper surface of arkosic and vitreous quartzite is easily recognized and is persistent horizon that is probably of same age everywhere.

G. W. Stose and A. J. Stose, 1944, Am. Jour. Sci., v. 242, no. 7, p. 389. Discussion of Chilhowee group and Ocoee series of southern Appalachians. With present knowledge, it is not possible to decide which formation, if any, in Chilhowee type section represents Unicoi formation, but it is evident that lower part of that formation which contains the basalt flows is not present because neither Hayes (1895, U.S. Geol. Survey Geol. Atlas, Folio 20) nor Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16; 1896, Folio 25) describe such flows in the section.

P. B. King, 1949, Am. Jour. Sci., v. 247, no. 8, p. 519 (table 1), 521. Basal formation of Chilhowee group in northeastern Tennessee and southwest Virginia. Underlies Hampton shale; overlies volcanics of Mount Rogers area.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 12, 13, 18–20, pl. 1. Rocks mapped by Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116) as quartzite lentil and lower part of Nichols slate and as Cochran conglomerate are all included in Unicoi formation of present report [Hot Springs Window]. Top is placed above thick-bedded to massive vitreous and coarsely feldspathic quartzites that underlie lower shale member of Hampton formation; boundary is sharp and distinct. Lower contact is here defined as base of lowermost conglomeratic bed above the Sandsuck. Boundary difficult to recognize because slates are interbedded with Unicoi conglomerates and there are lenses of coarse conglomerate in upper part of Sandsuck. Formation thickens southwestward, from 1,400 feet on south side of Lovers Leap Ridge to 2,600 feet along East Fork Shut-in Creek; 2,250 feet along Spring Creek. Northwest of window and in overlying thrust sheet are rocks which are herein assigned to Unicoi as Keith did in his Asheville folio (1904); Stose and Stose (1947) assign these rocks to Great Smoky quartzite of Ocoee series, or Snowbird as mapped by Keith. Two sets of formation names for Lower Cambrian clastic rocks are in current usage in eastern Tennessee and western North Carolina. Northeast Tennessee names, Unicoi, Hampton, and Erwin, are used here for same rocks which Keith (1904) and Stose and Stose (1947, Am. Jour. Sci., v. 245, no. 10) named Cochran, Nichols, Nebo, Murray, and Hesse, all defined by Keith (1895) in Chilhowee Mountain area, Blount and Sevier Counties, Tenn.

H. W. Ferguson and W. B. Jewell, 1951, Tennessee Div. Geology Bull. 57, p. 11 (table 1), 12 (table 2), 21–28, pl. 1. Described in Del Rio district, Cocke County, where it is 1,825 feet thick in Stone Mountain thrust block and about 5,000 feet thick in Meadow Creek Mountain thrust block. Overlies Sandsuck formation; underlies Hampton formation. In all but Stone Mountain and Neddy Mountain thrust blocks of Del Rio thrust sheet that contain Unicoi sediments, a bed of coarse-grained quartzite about 50 feet thick occurs about 1,000 feet or more from top of formation. This unit is here named Moccasin Gap member. In several blocks of Del Rio thrust sheet, the Unicoi above the Moccasin Gap quartzite can be separated into

upper shale member and upper quartzite member. In this report, Unicoi, Hampton, and Erwin formations are referred to as clastic group of Lower Cambrian age. The Unicoi represents about same stratigraphic interval as the Cochran as mapped by Keith (1904, U.S. Geol. Survey Geol. Atlas, Folio 116).

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 34–38; pt. 1, pls. Described and mapped in eastern Tennessee where it is basal formation of northeastern sequence of Chilhowee group. Keith was not consistent in his mapping of Unicoi. In Asheville Folio (1904, U.S. Geol. Survey Geol. Atlas, Folio 116), he mapped beds now assigned to Unicoi as quartzite lentil in Nichols slate or even as Nebo quartzite. In Roan Mountain Folio (1907, U.S. Geol. Survey, Geol. Atlas, Folio 151), he mapped much of Unicoi as Hiwassee slate and Snowbird formation. Safford (1869, Geology of Tennessee) varied his usage, placing the beds in the Ocoee where they are obviously conglomeratic but retaining them in the Chilhowee where they are more quartzitic. In present usage, top of formation is taken at top of conglomeratic beds, whether quartzitic or not, beneath fairly persistent layer of argillaceous shale that has been recognized in most areas. Underlies Hampton formation. Thickness ranges from 2,000 to 5,000 feet; variation in thickness probably result of deposition on uneven floor.

R. O. Bloomer and H. J. Werner, 1955, Geol. Soc. America Bull., v. 66, no. 5, p. 594–595, pl. 1. Described in Blue Ridge region of central Virginia where it is as much as 500 feet thick and consists of volcanics and intergradational conglomeratic graywackes, subgraywackes, pebbly arkoses, and pebbly quartzites. Conformably underlies Harpers formation; owing to overlap overlies Late Precambrian and basement complex formations. Chilhowee group.

A. J. Stose and G. W. Stose, 1957, Virginia Geol. Survey Bull. 72, p. 78–98, pl. 1. Described in Gossan lead district where it is at base of Cambrian. Thickness about 1,700 feet. Underlies Hampton shale; unconformably overlies Precambrian rocks described as injection complex, and Mount Rogers volcanic series.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 38–39; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Formation in North Carolina is predominantly sandstone, quartzite, and conglomerate with interbedded shale and slate. Thickness 1,400 to 2,600 feet. Basal formation of Chilhowee group; underlies Hampton formation.

P. B. King and H. W. Ferguson, 1960, U.S. Geol. Survey Prof. Paper 311, p. 28, 36–40, pls. 1, 12. Described in northeasternmost Tennessee where it underlies Hampton formation and overlies units of Mount Rogers volcanic group. Formation is mass of arkosic coarse-grained and conglomeratic sandstone, with some beds of vitreous quartzite and shale, as well as amygdaloidal basalt. Thickness as much as 5,000 feet. At type section, herein designated, formation is about 2,000 feet thick and consists mostly of thick-bedded arkosic sandstone and quartzite but includes two basalt layers. Above the upper basalt are several beds of massive vitreous quartzite and two of sedimentary greenstone. Lower part of section contains coarse conglomerate.

Type locality: On Nolichucky River, southeast of Unaka Springs, Unicoi County, Tenn.

Union Formation[1]

Pleistocene: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910–1911, p. 26.

Named for Union County.

Union Limestone[1]

Pennsylvanian: Southeastern Nebraska.

Original reference: G. E. Condra and N. A. Bengston, 1915, Nebraska Acad. Sci. Pub., v. 9, no. 2, p. 7, 13, 37.

Exposed in old quarry at Union, Cass County, in valley side in NW¼ sec. 22, T. 10 N., R. 13 E., and 1½ miles southwest of Union, in secs. 33 and 28, T. 10 N., R. 13 E.

Union Limestone (in Greenbrier Limestone[1] or Series)

Mississippian (Meramecian): Southeastern West Virginia and southwestern Virginia.

Original reference: D. B. Reger, 1926, West Virginia Geol. Survey Rept. Mercer, Monroe, and Summers Counties, p. 450, 467.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 272; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 98, 99). Limestone in Greenbrier series. Underlies Greenville shale; overlies Pickaway limestone.

D. B. Reger, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 9, p. 1911. In southern West Virginia counties and southwestern Virginia, intermediate sandstone and shale between the Gasper and Fredonia largely disappear; hence, term "Union" limestone was applied to both of these calcareous units.

Type locality: At west edge of Union, Monroe County, W. Va.

Union Shale[1]

Upper Devonian: Western central Montana.

Original reference: W. H. Weed, 1901, U.S. Geol. Survey 22d Ann. Rept., pt. 2, p. 434, 438, map.

Occurs in Queen Gulch, also near Union mine, at head of Alpreston Gulch, Elkhorn region.

Union Church transition phase (of Tullos Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

N. H. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 99–100. Alternating thin beds of sandy silts and clays which in upper 20 feet of section contain large light-brown concretions or slabs of fossils cemented by limonite. Occurs between Tullos member and overlying Verda member.

Well exposed at Union Church, in center of sec. 30, T. 10 N., R. 2 E., La Salle Parish.

Union Corners Granite[1]

Precambrian: Southeastern New York.

Original reference: W. J. McGee, 1894, Geologic map of New York prepared under direction of James Hall.

In Bronxville, New York City.

Union Dairy member (of Hoxbar Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15.

Named for Union Dairy Hill, in NE¼ sec. 7, T. 5 S., R. 2 E., Carter County.

Union Mountain Member (of Nevada Formation)

Devonian: Northeastern Nevada.

Donald Carlisle and others, 1957, Am. Assoc. Petroleum Geologists Bull., v. 41, no. 10, p. 2178 (fig. 2), 2181, 2182–2183. Diverse unit characterized by abundant quartz sand either in sandy dolomite or as vitreous siliceous quartz arenite or quartzite, but also including white crystalline dolomite and dark crinoidal dolomite. Thickness approximately 700 to 800 feet in southern part of area; 830 feet at type section; nearly 1,200 feet in northern part of Pinyon Range. Overlies McColley Canyon member (new); underlies Telegraph Canyon member (new).

Type locality: Crest of Union Mountain, in Pinyon Range, northeastern part of Mineral Hill quadrangle.

Union Peak Lavas

Pliocene to Pleistocene, lower: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 22–25, 130, pl. 3. Lavas from Union Peak, volcano which became extinct either before Mount Mazama began to develop or shortly thereafter. Toward the north and east, Union Peak lavas pass beneath Mount Mazama; in other directions, they merge into identical lavas from other sources. Huckleberry lavas at Huckleberry Mountain may have issued from fissures at base of Union Peak volcano. [Diller and Patton, 1902, U.S. Geol. Survey Prof. Paper 3, described Union Peak andesite area.]

Union Peak is south and west of Crater Lake.

Union Springs Member (of Marcellus Shale)[1]

Middle Devonian: Central New York.

Original reference: G. A. Cooper, 1930, Am. Jour. Sci., 5th, v. 19, p. 132, 218, 219.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1745, chart 4. Bakoven shale represents easternmost known facies of Union Springs shale. In Cayuga Lake region, the Union Springs is black limestone, but in eastern central New York it is sooty-black shale. In Catskill region, the Union Springs is dark sandy shale with *Paracardium* and *Buchiola*. Basal member of Marcellus; underlies Cherry Valley limestone member; overlies Onondaga.

Type section: Upper part of Woods quarry, 1 mile south of Union Springs, Cayuga County.

Union Station Shale Member (of Chanute Formation)

Pennsylvanian (Missouri Series): Northwestern Missouri.

J. R. Clair, 1943, Missouri Geol. Survey and Water Resources, 2d ser., v. 27, pl. 1. Red, green, gray clayey shale, sandy at top. Thickness 8 to 25 feet in Jackson County; 10 to 24 feet in Cass County. Underlies Paola limestone member; overlies Cement City limestone member.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2032. Settlement of the "Iola problem" has led to a number

of changes in Missouri Survey's classification of middle and upper Kansas City beds so as to bring interstate agreement in nomenclature. Union Station shale member of Chanute formation is suppressed because it is a synonym of Chanute as a whole.

Type locality and derivation of name not given.

Uniontown cyclothem

Pennsylvanian (Monongahela Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 182–185. Embraces interval between Lower Uniontown cyclothem (new) below and Little Waynesburg cyclothem (new) above. Normal succession includes six members (ascending) : Lower Uniontown shale and sandstone, Uniontown redbed, Uniontown limestone, Uniontown underclay, Uniontown (No. 10) coal, and Uniontown roof shale. In Athens County, Uniontown commonly rests on Arnoldsburg coal and roof shale and extends uninterrupted to top of Uniontown roof shale. Where Lower Uniontown cyclothem is developed, base of Uniontown is considered to overlie Lower Uniontown coal. Arnoldsburg sandstone and Ritchie redbed members of Lower Uniontown cyclothem are continuous laterally, irrespective of presence or absence of Lower Uniontown coal horizon, and these names are carried in the Uniontown wherever its boundary is placed over Arnoldsburg coal horizon. Thickness of Uniontown varies with position of its lower boundary; average thickness where boundary is placed at Arnoldsburg coal zone 33 feet; 15 feet wherever Lower Uniontown cyclothem occurs. In area of this report, Monongahela series is discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County.

Uniontown Limestone[1]

Pennsylvanian: Southeastern Kansas.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 97.

Derivation of name not stated.

Uniontown Limestone Member (of Monongahela Formation)[1]

Uniontown Limestone (in Monongahela Group)

Uniontown limestone and shale member

Upper Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: F. Platt and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3, p. 55–104, 286, 292.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 123, 124 (fig. 29). Overlies Arnoldsburg sandstone; underlies Uniontown coal which in turn underlies Uniontown sandstone. Included in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 82–83, geol. map. In Morgan County, Uniontown limestone and shale member (Monongahela series) consists of limestone and calcareous shale or calcareous shale with limestone layers. Average thickness 4 feet. Underlies Arnoldsburg sandstone and shale member; separated from underlying Uniontown sandstone and shale member by Uniontown (No. 10) coal.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 184. Limestone member of Uniontown cyclothem in report on Athens County. Term in its present usage indicates fresh-water limestone between Arnoldsburg sandstone and Uniontown coal bed, for this lithology is not present in Lower Uniontown-Uniontown coal bed interval. Limestone is closely associated with underlying Ritchie redbed as it frequently interbeds with or grades laterally into them. Thickness varies from few inches to 20 feet, but in places member is totally absent and its position occupied by redbeds. Monongahela series.

Named for exposures at Uniontown, Fayette County, Pa.

Uniontown Member (of Monongahela Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Name derived from occurrence near Uniontown, Fayette County.

Uniontown redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 148 (table 13), 184. Member of Uniontown cyclothem in report on Athens County. Name is intended to apply to this lithology only where it is underlain by Lower Uniontown coal bed. Where Lower Uniontown coal bed is absent, this member is coalesced with Ritchie redbed of Lower Uniontown cyclothem. Thickness 14 feet.

Name derived from cyclothem.

Uniontown roof shale member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 185. Member of Uniontown cyclothem in report on Athens County. Thickness a few inches to a little more than 1 foot. Wherever present, member is clay shale, laminated or massive, that grades vertically into shale. Overlies Uniontown (No. 10) coal member. Uppermost member of cyclothem.

Uniontown Sandstone Member (of Monongahela Formation)[1]

Uniontown Sandstone (in Monongahela Group)

Uniontown sandstone and shale member

Upper Pennsylvanian: Southwestern Pennsylvania, eastern Ohio, western Maryland, and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 58–59.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 124 (fig. 29), 125. Underlies Lower Waynesburg limestone; separated from Uniontown limestone by Uniontown coal. Included in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 84, geol. map. In Ohio, Uniontown sandstone and shale member (Monongahela series) occupies interval between Uniontown (No. 10) coal below and Waynesburg limestone and shale member above. In Morgan County, consists of 20 to 40 feet of sandstones, sandy shales, and red shales.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 184. Member of Little Waynesburg cyclothem in report on Athens

County. White (1891) proposed this name for sandstone that occurs 60 to 70 feet below Waynesburg coal bed, because of its relation to underlying Uniontown coal. In West Virginia, a shale facies at this position has been designated Annabelle shale by Hennen and Reger (1913). In Athens County, member is highly variable in thickness, rock type, and prominence. Invariably member rests directly on or is separated from Uniontown coal bed by only a few inches of shale. It is most resistant unit between Sewickley sandstone and Little Waynesburg coal bed. Average thickness 21½ feet. Monongahela series.

Named for association with Uniontown coal, although it is not prominent at Uniontown, Fayette County, Pa.

Uniontown underclay member

See Uniontown cyclothem.

Union Valley Formation (in Springer Group)

Union Valley Sandstone Member (of Wapanucka Formation)[1]

Pennsylvanian: East-central Oklahoma.

Original reference: R. V. Hollingsworth, 1934, Geol. Soc. America Proc. 1933, p. 364.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 889–895. Formation (in Springer group) includes Stapp conglomerate member (new) at base. Thickness about 360 feet. At typical exposure in Ouachitas, consists of gray to dark-gray shale and intercalated massive and thin-bedded greenish-yellow fine to medium subangular sandstone. Underlies Round Prairie formation (new); overlies Wesley shale (new) in Jackfork group. Union Valley was initial deposit of Morrow time; unconformity at base of Union Valley, which in Ouachitas is marked by Stapp conglomerate, is proper horizon to draw base of Morrow.

J. C. Barker, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 180–183. Formation described in Lawrence uplift where it is about 30 feet thick. Overlies "Springer" shale; underlies Wapanucka formation.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 103. Overlying Wesley siliceous shale and underlying Johns Valley shale in Ouachitas is persistent fossiliferous sandstone containing fragments of crinoid columnals, brachiopods and bryzoans, and plant fragments. Harlton (1938) correlated this sandstone with Union Valley sandstone which, at its type locality east of Ada, contains goniatite fauna of basal Morrow age. Inasmuch as overlying Johns Valley shale contains Caney goniatite fauna of Mississippian age, this fossiliferous sandstone must be older than type Union Valley.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains—a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 132. Unit termed Union Valley sandstone by Harlton (1938) is here renamed Game Refuge formation.

Type locality: Outcrops near Union Valley Schoolhouse, Pontotoc County.

Unionville Granodiorite

Upper Cretaceous: Southwestern Montana.

Adolph Knopf, 1957, Am. Jour. Sci., v. 255, no. 2, p. 81, 90–91, map facing p. 88. Hypersthene-bearing augite-hornblende (basic) granodiorite that is

dark and heavy and resembles diorite. Represents earliest intrusion of Boulder bathylith.

Well exposed south and southeast of Helena. Named for small village south of Helena, Lewis and Clark County.

Unionville Sandstone[1]

Pennsylvanian: Northwestern Illinois.

Original reference: J. Shaw, 1873. Illinois Geol. Survey, v. 5, p. 147–149.

Named for outcrop at Unionville, Whiteside County.

United Verde Diorite[1]

Precambrian: Central Arizona.

Original references: L. E. Reber, Jr., 1920, Am. Inst. Mining Engrs.; 1922, Am. Inst. Mining Metall. Engrs. Trans., v. 66, p. 3–26, map.

L. E. Reber, Jr., 1938, Arizona Bur. Mines Bull. 145, Geol. Ser. 12, p. 59. Mentioned in report on mineralization in Jerome district.

Probably named for United Verde mine, Jerome district.

Unity Group

Upper(?) Devonian: Southwestern New Hampshire.

C. A. Chapman, 1942, Geol. Soc. America Bull., v. 53, no. 6, p. 897, 898, 902. Name proposed for plutonic rocks of Oliverian magma series in the Unity dome. Similar to Croydon group which consists of fine- to medium-grained biotite gneiss. Quartz diorite is most common rock type.

Composes core of Unity dome in southeastern part of Claremont quadrangle.

Universal Limestone Member (of Dugger Formation)

Middle Pennsylvanian: Southwestern Indiana.

C. E. Wier, 1951, U.S. Geol. Survey Coal Inv. Map C-9. About 3 feet thick; commonly in two benches separated by few inches of shale; both benches arenaceous and locally grade into calcareous sandstone. Occurs between Coals VI and VII in Sullivan and Greene Counties and between Coals Vb and VII in Vermillion and Vigo Counties.

Type locality: Half mile south of Universal, small town in southern Vermillion County, in NW¼SW¼ sec. 31, T. 4 N., R. 9 W.

University Beds[1]

Quaternary: Central northern New Mexico.

Original reference: K. Bryan, 1909, New Mexico Univ. Bull., Geol. Ser., v. 3, no. 1.

Form considerable part of Sandia Mesa, extending from Menaul School south to mouth of Power House Arroyo and to east in wedge shape to eastern limit of area in Albuquerque region.

University Mesa Marl (in Fredericksburg Group)[1]

Lower Cretaceous (Comanche Series): Western Texas.

Original reference: W. S. Adkins, 1933, Texas Univ. Bull. 3232, p. 271, 328, 339, 347.

L. W. Stephenson, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. University Mesa clay shown on correlation chart above Comanche Peak limestone and below Kiamichi clay.

Pecos County.

Unkar Group[1]

Unkar Series

Precambrian (Grand Canyon Series) : Northern Arizona.

Original reference: C. D. Walcott, 1894, U.S. Geol. Survey 14th Ann. Rept., pt. 2, pl. 60.

J. F. Mason, 1948, Geol. Soc. America Bull., v. 59, no. 4, p. 350. Incidental mention of Unkar series.

C. E. Van Gundy, 1959, Geol. Soc. America Bull., v. 62, no. 8, p. 953, 954, pl. 1. Lower group of Grand Canyon series. Stratigraphically restricted, upper part reassigned to Nankoweap group. Thickness in Basalt Canyon, 5,684 to 6,138 feet. Disconformably underlies Nankoweap group.

Named for outcrops in Unkar Valley, Grand Canyon region.

Unkpapa Sandstone[1]

Upper Jurassic: Western South Dakota.

Original reference: N. H. Darton, 1899, Geol. Soc. America Bull., v. 10, p. 393.

1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 144. Generalized columnar section of Black Hills shows Unkpapa sandstone overlying Sundance formation and underlying Morrison and where Morrison pinches Lakota. Soft massive fine-grained sandstone 0 to 225 feet thick.

W. J. Mapel and G. B. Gott, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–218. Maximum thickness about 250 feet in Angostura Reservoir and Cascade Springs quadrangles, South Dakota. Thins westward and in Flint Hill and Minnekahta quadrangles pinches out under Morrison formation. Underlies Lakota formation.

Named for Unkpapa Peak, at head of Calico Canyon, northwest of Buffalo Gap, Custer County.

Upham Member (of Montoya Dolomite)

Upham Dolomite or Limestone (in Montoya Group)

Upham Member (of Second Value Formation)

Upper Ordovician: Southwestern New Mexico and western Texas.

V. C. Kelley and Caswell Silver, 1952, New Mexico Pubs. in Geology 4, p. 11, 31 (table), 51–59–60, fig. 4. Massive-bedded medium-gray- to brownish-gray-weathering dolomite. Microcrystalline to coarsely crystalline and medium to dark gray on fresh exposure. Detrital quartz grains present as scattered grains, thin lentils, and irregular vertical streaks. Where present, chert occurs as scattered nodules of irregular shape. Thickness 20 to 80 feet. Underlies Aleman formation (new); overlies Cable Canyon sandstone (new) with gradational contact. Montoya group.

F. E. Kottlowski and others, 1956, New Mexico Bur. Mines Mineral Resources Mem. 1, p. 7, 23–25. Upham dolomite described in San Andres Mountains where it is 115 feet thick in Rhodes Canyon, 77 feet in Hembrillo Canyon, and 104 feet in Ash Canyon. Overlies Cable Canyon sandstone; underlies Aleman dolomite. Montoya group.

R. H. Flower, 1958, Roswell Geol. Soc. Guidebook 11th Field Conf., p. 70. Rank reduced to member of Second Value formation.

H. J. Howe, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 10, p. 2285–2332. Montoya group described in Trans-Pecos region, Texas.

Upham formation (limestone or dolomite) constitutes basal formation of group in areas where Cable Canyon sandstone is missing. Along southeast-facing escarpment of Baylor Mountains, a 116-foot interval composed of fine-grained sandstones and argillaceous dolomites (probably Simpson) is present between Lower Ordovician El Paso dolomite and upper Trentonian(?) Upham limestone.

Type locality: Cable Canyon section opposite Sierrite mine in NW¼ sec. 10, T. 16 S., R. 4 W., Caballo Mountains.

†Upland Formation[1]

Pleistocene: Southern and eastern Nebraska.

Original reference: A. L. Lugn and G. E. Condra, 1932, Geol. Soc. America Bull., v. 43, no. 1, p. 190.

G. E. Condra, E. C. Reed, and E. D. Gordon, 1950, Nebraska Geol. Survey Bull. 15–A, p. 22; J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 87; D. R. Hill and J. M. Tompkin, 1953, U.S. Geol. Survey Bull. 1001, p. 25. Replaced by Sappa formation (new).

Named for outcrops along West Branch of Thompson Creek, about 2½ miles west of Upland, Franklin County.

Upper Bakerstown cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 123–129. Embraces interval between Anderson cyclothem below and Harlem cyclothem above. Normal succession includes four members (ascending): Cow Run sandstone, Ewing limestone, Upper Bakerstown underclay and coal. Thickness about 30 feet. Only the two basal members are present in Athens County. In Ohio, coal from which this cyclothem is named has heretofore been called Barton coal; Flint (1951) used name Barton for cyclothem under discussion. Waagé (1950, Maryland Dept. Geology, Mines and Water Resources Bull. 9) stated that Barton coal is equivalent to Upper Bakerstown coal of Maryland and that true Barton coal is above Ames limestone, which is contrary to Condit's (1912, Ohio Geol. Survey Bull. 17, 4th ser.) interpretation. Name Upper Bakerstown is used here since Condit's correlation is in error. In area of this report. Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Athens County.

Upper Brush Creek cyclothem

Pennsylvanian (Conemaugh Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 111 (map 12), 112–113. I. C. White (1878) applied name Brush Creek to marine shale and limestone at position of Lower(?) Brush Creek limestone. Brush Creek is now applied to series of different beds comprising two more or less complete cyclothems which are now designated Lower Brush Creek and Upper Brush Creek. Upper Brush Creek embraces interval between Lower Brush Creek cyclothem below and Wilgus cyclothem above. Normal succession includes four members (ascending): Upper Brush Creek shale and (or) sandstone, Upper Brush Creek underclay, Upper Brush Creek coal, and Upper Brush Creek limestone. Thickness 27 feet. Heretofore, Upper Brush Creek members have been discussed in reports along with Lower Brush Creek members.

Little attention has been given to nonmarine members of Upper Brush Creek cyclothem, although double nature of Brush Creek limestone had long been recognized. In area of this report, Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Athens County.

Upper Brush Creek limestone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 113. Member of Upper Brush Creek cyclothem in report on Athens County. Average thickness 2 feet.

Upper Brush Creek shale and (or) sandstone member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 112. Member of Upper Brush Creek cyclothem in report on Athens County. Thicknesses of nonmarine shale and sandstone lying between Brush Creek limestones vary from 5 to 40 feet; average thickness 22 feet.

Upper Brush Creek underclay member

Pennsylvanian (Conemaugh Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 12. Member of Upper Brush Creek cyclothem in report on Athens County. Thickness 8 inches to more than 4 feet.

†Upper Freeport Clay (in Allegheny Formation)[1]

Upper Freeport clay or underclay member

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K_3.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 55–56, table 1, strat. sections. Included in Upper Freeport cyclothem (new) in Perry County, Ohio. Thickness ranges from less than 6 inches to 14 feet and averages 5 feet. Overlies Upper Freeport limestone; underlies Upper Freeport coal. In Allegheny series where limestone is missing and clay at this horizon is as thick as 14 feet, the Upper Freeport is probably in contact with Bolivar clay.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 22–23. Upper Freeport clay measured in sections 23 and 34, T. 14 N., R. 14 W., in western York Township, Morgan County. In section 34, Upper Freeport (No. 7) coal is underlain by 4 feet of poorly exposed gray to dark-gray clay shale with some sandy material near base. In northwestern corner of section 23, the coal is underlain by about 6 inches of dark-gray clay and by 1½ feet of crossbedded sandstone, which may be top part of Upper Freeport sandstone, or may represent more sandy phase of Upper Freeport clay member. Upper Freeport limestone not recognized definitely in Morgan County. Allegheny series. Cyclothemic classification not used in this report.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 90. Upper Freeport underclay present in Athens County.

Name derived from town of Freeport, Armstrong County, Pa.

Upper Freeport cyclothem

Pennsylvanian (Allegheny Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 12, 16. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 55–57, table 1, geol. map. Includes (ascending) Freeport limestone, 2 feet; Upper Freeport clay, 5 feet; Upper Freeport (No. 7) coal; and unnamed shale. Occurs above Bolivar cyclothem and below Mahoning cyclothem of Conemaugh series. In area of this report, Allegheny series is described on cyclothemic basis; nine cyclothems are named. [For sequence see Brookville cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 88–92. Topmost cyclothem in Allegheny series in Athens County. Occurs above Bolivar cyclothem. Comprises (ascending) Upper Freeport shale and (or) sandstone, Upper Freeport limestone, Upper Freeport underclay, and Upper Freeport (No. 7) coal members. Uffington shale member not known in Athens County but is considered topmost member of cyclothem and, for purposes of description, topmost member of Allegheny series. In this report, Allegheny series comprises 13 cyclothems. [For complete sequence see Brookville cyclothem.]

Name derived from town of Freeport, Armstrong County, Pa.

†Upper Freeport Limestone Member (of Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt and W. G. Platt, 1877, Pennsylvania 2d Geol. Survey Rept. H_3 p. 316.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 27–28. Discussion of limestones of eastern Ohio. From 3 to 12 feet below base of Upper Freeport coal is an irregular bed of limestone which Rogers (1855, Geology of Pennsylvania, v. 2) called Freeport limestone in northwestern Pennsylvania and which Newberry apparently described as White limestone in Mahoning County, Ohio (1878, Ohio Geol. Survey v. 3). In his report on Lawrence County, Pa., White (1879, Pennsylvania 2d Geol. Survey Rept. Q_2), renamed Butler limestone, which underlies Lower Freeport coal and which was not recognized by Rogers, the Lower Freeport and the Freeport limestone of Rogers, the Upper Freeport. This terminology has been generally accepted in reports dealing with geology of coal measures in Pennsylvania, West Virginia, and Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 90. Upper Freeport limestone included in Upper Freeport cyclothem. In this report [Athens County], Upper Freeport limestone is limited to fresh-water limestone at or near base or within Upper Freeport underclay. Average thickness 1¼ feet. Separated from base of Upper Freeport coal by 2 to 4 feet of underclay. Allegheny series.

Name derived from town of Freeport, Armstrong County, Pa.

†Upper Freeport Sandstone[1]

Pennsylvanian: Western Pennsylvania.

Original reference (Butler—Upper Freeport sandstone) : I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 40–71, 130.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 20–21. U.S. Geological Survey and Pennsylvania Geological Survey have adopted name Butler

for unit herein termed Upper Freeport sandstone and shale member. In Ohio, term Upper Freeport sandstone and shale has been used and is established firmly in the literature. Thickness about 28 feet in Morgan County [this report]. Below Bolivar clay member and above Lower Freeport (No. 6–a) coal member. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 88. Interval between Bolivar underclay and Upper Freeport limestone and underclay is occupied by Upper Freeport shale and (or) sandstone member [of Upper Freeport cyclothem]. Thickness 5 to 28 feet. Allegheny series. Area of report, Athens County.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22 (table 5). Upper Freeport sandstone listed in table of recognizable named members of Allegheny formation in Harrison County.

Name derived from town of Freeport, Armstrong County, Pa.

†Upper Kittanning Clay[1]

Upper Kittanning underclay member

Pennsylvanian: Pennsylvania, Ohio, and West Virginia.

[Original reference]: M. G. Wilmarth, 1938, U.S. Geol. Survey Bull. 896, p. 2221.

J. B. McCue and others, 1948, West Virginia Geol. Survey, v. 18, p. 16. Upper Kittanning underclay lies immediately beneath Upper Kittanning coal. Thickness 3 to 9 feet. Occurs a few feet above Hardman clay. Allegheny series.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 78. Upper Kittanning underclay included in Upper Kittanning cyclothem. Light to dark-gray thin impure clay. Thickness 2 to 18 inches. Occurs above Upper Kittaning shale and (or) sandstone member and below Upper Kittanning coal member.

Upper Kittanning cyclothem

Pennsylvanian (Allegheny Series): Eastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 51. Consists of Upper Kittanning coal and underlying shale or sandstone. An uncertain unit in Ohio column. No evidence is found for its presence in area of this report [Perry County].

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 76–78. Embraces interval between Middle Kittanning cyclothem below and Lower Freeport cyclothem above. Incomplete. Includes (ascending) Upper Kittanning shale and (or) sandstone, Upper Kittanning underclay, and Upper Kittanning coal members. Thickness about 14 feet. In area of this report [Athens County], Allegheny series is discussed on cyclothemic basis; 13 cyclothems are named. [For sequence see Brookville cyclothem.]

Type area (Upper Kittanning coal): Vicinity of Kittanning, on Allegheny River, in Armstrong County, Pa. Coal is also present in Maryland.

Upper Kittanning Limestone (in Allegheny Formation)[1]

Pennsylvanian: Western Pennsylvania and northern West Virginia.

Original reference: J. J. Stevenson, 1878, Pennsylvania 2d Geol. Survey Rept. K_3.

Fayette and Westmoreland Counties, Pa.

Upper Kittanning Marine Shale

See Kittanning Formation.

Upper Kittanning shale and (or) sandstone member

Pennsylvanian (Allegheny Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 48 (table 7), 78. Upper Kittanning shale and (or) sandstone member included in Upper Kittanning cyclothem in report on Athens County. Average thickness 12½ feet. In absence of Upper Kittanning coal and underclay, it is impossible to distinguish this member from overlying shale and sandstone, and it is treated as part of Lower Freeport cyclothem in this report.

Upper Little Pittsburgh cyclothem

Pennsylvanian (Conemaugh Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 155 (map 19), 156–157. Uppermost cyclothem recognized. Occurs above Lower Little Pittsburgh cyclothem (new). Normal succession includes five members (ascending) : Upper Little Pittsburgh sandstone, Upper Little Pittsburgh redbed, Upper Little Pittsburgh limestone, Upper Little Pittsburgh underclay, and Upper Little Pittsburgh coal. Thickness about 33 feet. Two Little Pittsburgh cyclothems underlie Pittsburgh (No. 8) coal in parts of northern Appalachian coal basin. In general, these cycles are irregular and uncertain in development, and at many places, most or even all members of one or both cyclothems seem to be missing. Hence, correlation of Little Pittsburgh members is often uncertain. In area of this report, Conemaugh series is discussed on cyclothemic basis; 15 cyclothems are named. [For sequence see Mahoning cyclothem.]

Present in Alexander, Ames, Athens, Bern, Canaan, and Rome Townships, Athens County.

Upper Little Pittsburgh Limestone[1]

Upper Little Pittsburgh limestone member

Pennsylvanian (Conemaugh Series) : Western Pennsylvania and eastern Ohio.

Original reference: J. P. Leslie, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 305–308.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 157. Limestone associated with Upper Little Pittsburgh coal, here called Upper Little Pittsburgh limestone, is poorly developed in Athens County. Average thickness 2½ feet. Upper Little Pittsburgh cyclothem. Conemaugh series.

Upper Little Pittsburgh redbed member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 157. Redbed phase of Upper Little Pittsburgh cyclothem is designated Upper Little Pittsburgh redbed member in this report [Athens County]. Overlies Upper Little Pittsburgh sandstone member and separated from Upper Little Pittsburgh coal by that coal's associated limestone and underclay where these are present. Average thickness about 11 feet. Conemaugh series.

Upper Little Pittsburgh sandstone member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 156–157. Basal member of Upper Little Pittsburgh cyclothem. Average thickness 18 feet. Underlies Upper Little Pittsburgh member of cyclothem. Condit (1912) named a sandstone closely underlying the Pittsburgh coal, the Bellaire for town of Bellaire, Ohio. He stated that it [the sandstone] "is prominent in Pennsylvania where it has been called Lower Pittsburgh sandstone." Stout (in Bownocker and Dean, 1929 [1930], Ohio Geol. Survey, 4th ser., Bull. 34) placed Bellaire sandstone in Upper Little Pittsburgh cyclothem rather than in its correct position as correlative of Lower Pittsburgh sandstone, that is, as basal member of Pittsburgh cyclothem. Unless it can be demonstrated that Lower Pittsburgh sandstone is absent in type area of the Bellaire, then Stout's correlation of Bellaire sandstone is in error.

Upper Little Pittsburgh underclay member

Pennsylvanian (Conemaugh Series) : Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 94 (table 11), 157. Gray to dark-gray silty micaceous clay about 1 foot thick. Underlies Little Pittsburgh coal. Upper Little Pittsburgh cyclothem. Conemaugh series.

Upper Little River Limestone[1]

Lower Cretaceous (Comanche Series) : Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 111, 188.

Named for exposures on Little River at Oklahoma State line.

Upper Mahoning redbed member

See Mahoning Red Bed (in Conemaugh Formation) and Mason cyclothem.

†Upper Mahoning Sandstone (in Conemaugh Formation)[1]

Upper Mahoning Sandstone (in Conemaugh Group)

Upper Mahoning sandstone and shale member

Pennsylvanian: Western Pennsylvania, Maryland, eastern Ohio, and northern West Virginia.

Original reference: F. Platt, 1876, Pennsylvania 2d Geol. Survey Rept. L.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 91, fig. 21. Upper Mahoning sandstone lies above Mahoning coals and below Brush Creek strata. Shale replaces sandstone in many areas. Conemaugh group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 29–30. In Ohio, Upper Mahoning sandstone and shale member occupies interval between Mahoning coal and Mason clay or coal. Average thickness about 28 feet in Morgan County [this report]. Allegheny series. Cyclothemic classification not used.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 104–106. Upper Mahoning shale and (or) sandstone member included in Mason cyclothem in report on Athens County. Average thickness of interval 30 feet. Lowermost member of cyclothem. Occurs below

Upper Mahoning redbed member. Occurs above Lower Mahoning coal member of Lower Mahoning cyclothem. Allegheny series.

Name taken from Mahoning Creek(s) in Indiana and Jefferson Counties, Pa.

Upper Mercer cyclothem

Pennsylvanian (Pottsville Series) : Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 36. Includes (ascending) Upper Mercer shale and (or) sandstone (contains Little Red Block ironstone) ; Upper Mercer clay; and Upper Mercer (No. 3a) coal. Occurs above Middle Mercer cyclothem and below Bedford cyclothem.

Generally inconspicuous throughout Ohio and not recognized in area of this report, Perry County.

Upper Mercer flint and limestone member

See Bedford cyclothem.

Upper Mercer Iron Shales (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

Upper Mercer Limestone (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania and eastern Ohio.

Original reference: I. C. White, 1879, Pennsylvania 2d Geol. Survey Rept. Q_2.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser. Bull. 49, p. 24. White (1879) discarded term Mahoning of Rogers (1858, Geology of Pennsylvania, v. 2. pt. 1) and renamed unit Upper Mercer. Orton (1884, Ohio Geol. Survey, v. 5) accepted White's usage of this term for Ohio although he had previously referred in reports to the Upper Mercer as Gore limestone. Member is composed of hard compact dense-textured limestone of dark-bluish-gray to gray-black color with varying amounts of black flint. Thickness varies from a few inches to nearly 10 feet; average thickness a little in excess of 1 foot. Occurs from 15 to 40 feet above Lower Mercer limestone. Pottsville series.

Named for Mercer, Mercer County, Pa.

Upper Mesa Formation or Gravels

Pleistocene: Southwestern Idaho and southeastern Oregon.

V. R. D. Kirkham, 1931, Jour. Geology, v. 39, fig. 1 (p. 202), fig. 12 (p. 211), fig. 13 facing p. 212. Overlies Idaho formation. Name appears only on geologic map and on geologic cross sections.

Mapped in Ada, Canyon, Owyhee, and Payette Counties, Idaho, and Malheur County, Oreg.

Upper Pittsburgh cyclothem

Pennsylvanian (Monongahela Series) : Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 166–167, 168 (map 21). Embraces interval between Pittsburgh cyclothem (new) below and Redstone cyclothem (new) above. Thickness about 12 feet. Includes Upper Pittsburgh coal member, occurrence of

which breaks normal cyclical sequence of strata that extend from roof shale of Pittsburgh coal bed to roof shale of Redstone coal bed into two cyclothems, Upper Pittsburgh and Redstone. In area of this report, Monongahela series is discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburgh cyclothem.]

Present in Athens County. Occurrences sparse.

Upper Pittsburgh Limestone Member (of Conemaugh Formation)[1]

Upper Pittsburgh limestone member

Upper Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 63–65, geol. map. In Morgan County, Upper Pittsburgh limestone member (Conemaugh series) is immediately subjacent to Pittsburgh (No. 8) coal or separated from it by a few inches or feet of Pittsburgh clay; overlies Bellaire sandstone and shale member or separated from it by Upper Little Pittsburgh clay shale member. Thickness as much as 40 feet; commonly 15 to 20 feet.

M. T. Sturgeon, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 161–163. Rogers (1858, Geology of Pennsylvania, v. 2, pt. 1) used name Pittsburgh for limestone immediately below Pittsburgh coal. It is thought that Rogers' original definition included Little Pittsburgh limestones as well. This limestone in Pittsburgh cyclothem is now generally called Upper Pittsburgh limestone, and is so called in this report [Athens County]. Average thickness 11 feet. In Pittsburgh cyclothem, Upper Pittsburgh limestone member occurs above Lower Pittsburgh redbed member and below Pittsburgh underclay and coal member. Monongahela series.

Named for its occurrence with Pittsburgh coal in western Pennsylvania.

Upper Pittsburgh Sandstone[1]

See **Pittsburgh Sandstone Member** (of Monongahela Formation) and Upper Pittsburgh shale and sandstone member.

Upper Pittsburgh shale and sandstone member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 159 (table 13), 167–169. Rogers (1858, Geology of Pennsylvania, v. 2) designated conspicuous sandstone strata that occur between Pittsburgh and Redstone coal beds along Conemaugh and Loyalhanna streams in Pennsylvania as Upper Pittsburgh sandstone. Coarse clastic material at this position has been similarly designated by Ohio and West Virginia Geological Surveys. In Ohio, this member is commonly represented by sandy shale containing sandstone interbeds with local variations of prominent sandstone. In Athens County, this unit is predominantly shale and siltstone. Average thickness 19 feet. Basal member of Redstone cyclothem. Underlies Redstone redbed member. Monongahela series.

Upper Sewickley Sandstone

Upper Sewickley sandstone and shale member

Pennsylvanian (Monongahela Series): West Virginia and eastern Ohio.

R. V. Hennen, 1912, West Virginia Geol. Survey [Rept.] Doddridge and Harrison Counties, p. 199–200. Sewickley sandstone (White, 1891) is herein renamed Upper Sewickley sandstone in contradistinction to Lower Sewickley ledge belonging immediately under Sewickley coal.' Massive arenaceous sandstone 40 to 60 feet thick. In Marion and Monongalia Counties. Overlies Sewickley coal.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 77–78. Upper Sewickley sandstone and shale member (Monongahela series) in Ohio overlies Meigs Creek coal and underlies Benwood limestone and shale member. As described by White (1891, U.S. Geol. Survey Bull. 65), this is unit accepted as Sewickley sandstone by U.S. Geological Survey. U.S. Geological Survey does not recognize the term Lower Sewickley, and inasmuch as that term is used in Ohio to designate sandstone and shale subjacent to Meigs Creek coal, it follows that the term Upper is necessary to designate the sandstone superjacent to that coal. Upper Sewickley member is present in only part of Morgan County [this report]. Thickness 4 to 34 feet. Monongahela series.

Upper Washington Limestone Member (of Washington Formation)[1]

Upper Washington Limestone

Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 45–47.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 39, 40. In Ohio, Upper Washington limestone is recognized only over small areas in Belmont and Monroe Counties; elsewhere its horizon is occupied by sandstones and shales. Thickness ranges from a few inches to 23 feet. Closely overlain by Jollytown "A" coal, basal member of Greene series. In Belmont County, lies about 100 feet above Washington coal. Included in Washington series which, in Ohio, consists of the following limestones (ascending): Elm Grove, Mount Morris, Lower Washington, Middle Washington, and Upper Washington.

Named for exposures near Washington, Washington County, Pa.

Upshur Sandstone[1]

Middle Pennsylvanian: Northeastern West Virginia.

Original reference: J. A. Taff and A. H. Brooks, 1896, U.S. Geol. Survey Geol. Atlas, Folio 34.

Covers large part of Upshur County.

Upson Clay[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 224–230.

L. W. Stephenson, 1937, U.S. Geol. Survey Prof. Paper 186–G, p. 135 (fig. 7). As shown on correlation chart of exposed sediments of Austin and lower Taylor age in Gulf Coastal Plain, Upson clay occurs above Austin chalk and below San Miguel formation; interfingers with Anacacho limestone.

Named for Upson, Maverick County.

Upton Sandstone Member (of Frontier Formation)

Upper Cretaceous: Northeastern Utah.

L. A. Hale, 1960, Wyoming Geol. Assoc. Guidebook 15th Ann. Field Conf., p. 136 (chart 1), 139 (fig. 2), 140, 142, 143 (fig. 2), 145 (fig. 3). Where well exposed, consists of light-yellowish- to bluish-gray fine-grained calcareous well-bedded sandstone 450 feet thick. Uppermost member of formation; overlies Judd shale member (new); underlies Henefer formation. Name credited to D. W. Trexler (unpub. thesis).

Named for exposures near settlement of Upton, 7 miles east of Coalville, Summit County.

Urbana Phyllite

Lower Paleozoic(?) (Glenarm Series): Western Maryland.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346. Green ferruginous quartzose chlorite phyllite with green slaty layers, and is probably pyroclastic facies of associated metabasalt; contains many sericitic quartzite layers, some thin calcareous layers, and infolded quartzite similar to that associated with Ijamsville phyllite (new). Underlies Sugarloaf Mountain quartzite (new). Precambrian(?).

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources [Rept. 12] Carroll and Frederick Counties, p. 69–71, 121–126. Overlies Sams Creek metabasalt (new) in southern part of Frederick County. North of U.S. Highway 40, from point 1½ miles east of New Market westward to point 1 mile east of Bartonsville, phyllite is in narrow infolds in metabasalt. South of highway it extends southward in three parallel belts to Frederick-Montgomery County line. Western of these belts is widest and contains synclinal mass of Sugarloaf Mountain quartzite which overlies Urbana phyllite. On west side of main belt, the Urbana is in contact with Ijamsville phyllite; from a point 2 miles south of Park Mills to Frederick County line, Triassic sedimentary rocks overlie the phyllite on its western border. On the east side, the Urbana lies adjacent to the Ijamsville. North of U.S. Highway 40, the Urbana grades northward into the Ijamsville. Sugarloaf Mountain syncline encloses Ijamsville and Urbana phyllites and associated quartzites, and Sugarloaf Mountain quartzite. Syncline is overturned to northwest and beds dip southeast.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 49. Phyllites of Sugarloaf area, which have been considered volcanic members of Glenarm series (Stose and Stose, 1946) are Harpers phyllite. Stose and Stose divided this phyllite into the Ijamsville and Urbana. Although this division may be valid, it is difficult to map contacts accurately, and they are here considered to be part of the Harpers. Area is interpreted as anticlinal dome.

A. J. Stose and G. W. Stose, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 697–699. Discussion of article by Scotford. Stose and Stose interpret area as synclinal.

U.S. Geological Survey currently considers the age of the Glenarm series to be Lower Paleozoic(?).

Named from Urbana, Frederick County, Md. Mapped in a belt 4 miles wide, adjacent to Sugarloaf Mountain; has been traced a maximum of 12 miles northeastward to narrow tongues, where it apparently interfingers with the metabasalt.

Utah Metals Limestone[1]

Pennsylvanian: Utah.

Original reference: O. P. Peterson, 1924, Am. Inst. Mining Metall. Engineers Trans., v. 70, p. 908–926.

Probably named for mine in Bingham district.

Ute Limestone[1]

Middle Cambrian: Northeastern Utah and southeastern Idaho.

Original reference: C. King, 1876, Am. Jour. Sci., 3d, v. 11, p. 477.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1113–1114, 1116, 1117 (fig. 4), 1120–1121. Walcott's (1908, Smithsonian Misc. Colln., v. 53, no. 1804) Blacksmith Fork section emended. Thickness 685 feet. Shale at base of formation cannot be correlated with Spence shale of Idaho. Overlies Langston limestone; underlies Blacksmith dolomite (emended).

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 9–10, pls. 1, 6. Described in Randolph quadrangle, Utah, where it is 480 to 585 feet thick and considered to include Spence shale member. Overlies Langston limestone and underlies Blacksmith limestone.

J. S. Williams and G. B. Maxey, 1941, Am. Jour. Sci., v. 239, no. 4, p. 280, 281; J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1133. Restricted to exclude Spence shale member, which is herein reallocated to Langston formation.

G. B. Maxey, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 653–654, 670 (fig. 2), 671–672, 673 (fig. 3). Maximum thickness is 745 feet at High Creek, Utah; estimated thickness 790 feet at Promontory Point, Utah.

Type locality: Slopes of Ute Peak, near forks of East Fork, east of Paradise, Cache County, Utah.

Ute Canyon Tongue (of Cliff House Sandstone)

Upper Cretaceous: Northwestern New Mexico.

P. T. Hays and A. D. Zapp, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–144, sheet 1. In central part of Barker dome-Fruitland area, the Cliff House sandstone consists of two massive sandstone bodies separated by approximately 350 feet of shaly sandstone. Upper sandstone thins northeastward and in northeastern part of area is represented by thin sandy stratum not differentiated from enclosing Lewis shale. This wedge is called Ute Canyon tongue.

Stratigraphic relations of this sandstone wedge well displayed in exposures in Ute Canyon in southeastern part of Ute Mountain Indian Reservation, San Juan County.

†Ute Pass Dolomite

Upper Cambrian(?): Central Colorado.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 39. Name applied to dolomite unit which rests with gradational contact on Sawatch sandstone and underlies Manitou limestone (as restricted in this report). Thicknesses of 8½ to 16 feet measured in Gove Canyon, Williams Canyon, and Missouri Gulch. There is little difference in lithologic character of formation at these localities. Red glauconitic coarsely crystalline dolomite predominates although a few feet of pinkish-buff

coarsely crystalline dolomite is present at top in Williams Canyon exposure. Amount of sand in dolomite beds appears to increase to north because outcrop in Gove Canyon is very sandy and that in Williams Canyon only slightly sandy. In Missouri Gulch section, formation consists of sandy micaceous dolomite beds in lower part, separated by 6 inches of brown platy shale from nonsandy dolomite beds in upper part. Paper-thin green shale partings present near middle of formation in Williams Canyon.

R. R. Berg and R. J. Ross, Jr., 1959, Jour. Paleontology, v. 33, no. 1, p. 106–108. Term abandoned. On basis of faunal correlations, unit formerly called Ute Pass at Williams Canyon is reassigned to lower part of Manitou formation. On basis of lithology and stratigraphic position, Ute Pass of Missouri Gulch is correlated with Peerless formation.

Type section: In Williams Canyon, NW¼ sec. 32, T. 13 S., R. 67 W., Ute Pass area, El Paso County.

Utica Clay (in Carbondale Formation)

Pennsylvanian: Northern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 25, 106. Fire clay in lower part of Carbondale formation. Extends from La Salle Third vein (Colchester No. 2) coal down to base of Pennsylvanian.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 56 (table 3). Term discontinued.

Occurs near Utica, La Salle County.

†Utica Limestone[1]

Silurian: Southeastern Indiana.

Original reference: W. W. Borden, 1874, Indiana Geol. Survey 5th Ann. Rept., p. 143, 172.

Quarried at Utica, on Ohio River, in Clark County.

Utica Quartz Monzonite Porphyry[1]

Tertiary: Central northern Colorado.

Original reference: F. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 31–32.

Occurs as dike extending for about one-half mile southeast from Utica mine in Boulder County.

Utica Shale[1]

Upper Ordovician: New York and Michigan, and Ontario, Canada.

Original reference: E. Emmons, 1842, Geology of New York, pt. 2, div. 4, geol. 2d dist., p. 116–118, 183, 278, 319, 397, 429.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 233–302. Nomenclature of Utica shales is complex and confusing. At type locality, the Utica is probably wholly upper Utica, but, in sections a few miles east of city, the formation is separable into three faunal divisions. Lower two are probably of Cobourg age, but upper seems equivalent to Deer River and Atwater Creek shales of northwestern New York and to Collingwood and Gloucester formations of Ontario. Thus, a single member of the Utica, when traced laterally, becomes equivalent to two formations. It is confusing to consider the zones of the Utica as members of the formation. Nowadaga member has been defined as "lower Utica or zone of *Climacograptus typicalis*" (Hall). Loyal Creek member has been defined as

"middle Utica, or zone of *Dicranograptus nicholsoni*" Hopkinson. Holland Patent member is "upper Utica, or zone of *Climacograptus pygmeus*" and *Glossograptus quadrimucronatus timidus* of Ruedemann. Overlies Canajoharie.

Marshall Kay, 1960, Internat. Geol. Cong. 21st, Copenhagen, pt. 7, p. 31. Pictonian stage of Trentonian series contains Utica group of formations.

Named for exposures at Utica, Oneida County, N.Y.

Utley Metarhyolite[1]

Precambrian: Central southern Wisconsin.

Original reference: S. Weidman, 1898, Wisconsin Geol. Nat. Hist. Survey Bull. 3, Sci. ser. 2, p. 4–31.

O. E. Gram, 1947, Jour. Geology, v. 55, no. 5, p. 427–438. Porphyritic meta-rhyolite. Phenocrysts of quartz and feldspar range from less than one-sixteenth to three-eighths inch in diameter. Groundmass uniformly aphanitic and almost glassy in hand specimen, and of very dark to black color.

Consists of rounded knoblike area more than 100 feet high at Utley, Green Lake County.

Utopia Limestone[1] Member (of Howard Limestone)

Pennsylvanian (Virgil Series): Eastern Kansas, Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 21, 94, 96.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 209. Uppermost member of Howard limestone. Underlies White Cloud shale; overlies Winzeler shale member of Howard limestone. Type locality designated.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 19. Mentioned as occurring in Iowa.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 57 (fig. 22), 61–63. Gray to brown limestone and sandy limestone resembling coquina in many outcrops. Consists of two or more limestones and ostracode-bearing shale in parts of the State. Thickness ranges from less than 1 foot to maximum of about 16 feet.

F. C. Greene and W. V. Searight, 1959, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20. Church, Winzeler, and Utopia members distinguishable in Missouri.

Type locality: Just east of village of Utopia, sec. 5, T. 25 S., R. 11 E., Greenwood County, Kans.

Utuado Complex

Post-Lower Cretaceous, pre-lower Miocene: Puerto Rico.

R. C. Mitchell, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2972. Incidental mention.

Uvalde Gravel[1]

Uvalde Formation

Pliocene(?): Southern Texas.

Original reference: R. T. Hill, 1891, Am. Geologist, v. 7, p. 368.

R. W. Mathis, 1944, Jour. Sed. Petrology, v. 14, no. 2, p. 87. Formation near Austin consists almost wholly of rounded flint cobbles and boulders and

occasional limestone pebbles. Accumulations of this material are extensive coastward from Balcones fault. In vicinity of Austin, accumulations are on hilltops at elevations up to 320 feet above river level; they are not at definite level and do not form continuous deposit. Delaney gravel (new) tops hill 245 feet above river level on Delaney Ranch; this is lower than Uvalde formation.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1703 (fig. 8), 1704–1707. Uvalde gravels discussed with Quaternary deposits of Texas Coastal Plain. Uvalde is restricted to deposits herein described, though it is possible that Uvalde of other geologists perhaps included writer's [Weeks] Uvalde as well as remnants of older terrace deposits which are no longer in place and which have come down from higher levels as erosion progressed. Writer [Weeks] does not agree with Mathis' (1944) views on Uvalde formation or Delaney gravel; Delaney gravel may have come down from higher levels as erosion progressed and therefore may not be in place. Uvalde occurs between terrace deposits termed Bastrop Park and Asylum. Pleistocene.

H. R. Blank and others, 1952, Texas Univ. Bur. Econ. Geology Rept. Inv. 12, p. 10 (table 1), 16. Upland gravel (Uvalde formation), as much as 1 foot thick, unconformably overlies Pecan Gap formation and unconformably underlies Brazos River terraces near Waco. Pliocene(?).

Named for occurrences in vicinity of Uvalde, Uvalde County.

Uvalde Phonolite[1]

Eocene(?): Southern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Geol. Atlas, Folio 64, p. 4, maps.

Occurs at Inge Mountain. Named for Uvalde, Uvalde County.

Uvas Basalt or Basaltic Andesite

Miocene: Southwestern New Mexico.

F. E. Kottlowski, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 32 (map), 40, 144, 145, 148 (chart). Dark-gray glassy rock. Interbedded with scoria and basaltic tuffs, as much as 145 feet thick near Las Cruces. Underlies Santa Fe group; overlies Bell Top formation (new).

In Las Cruces region of Rio Grande Valley.

Uvas Conglomerate Member (of Tejon Formation)

Eocene: Southern California.

J. G. Marks, 1941, (abs.) Geol. Soc. America Bull., v. 12, pt. 2, p. 1922; 1943, California Div. Mines Bull. 118, pt. 3, p. 535, 536 (fig. 232), 537 (fig. 233). Listed as basal member of Tejon formation in type area of Tejon. Thickness 110 feet. Conformably underlies Liveoak member (new); unconformably overlies basement complex.

Type locality: Grapevine Canyon, Tehachapi Mountains, Kern County.

Uwekahuna Ash (in Puna Volcanic Series)

Pleistocene or Recent: Hawaii Island, Hawaii.

J. B. Stone, 1926, Bernice P. Bishop Mus. Bull. 33, p. 27–28. Ash bed in wall of Kilauea caldera. Thickness 1 inch to 7 feet. At northeast end of exposure, bed is 3 feet thick and consists of gravel and a few lava-coated bombs; beneath Uwekahuna intrusive body is 6½ feet of ash having

basal layer of medium-coarse black ash overlain by a second gravel stratum, and at top about 8 inches of yellow ash; at southwest end of exposure, ash bed lies on surface of unconformity in the lavas.

G. A. Macdonald, 1949, U.S. Geol. Survey Prof. Paper 214–D, p. 65, 67–68. Included in Puna volcanic series. Recent.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 134. Pleistocene or Recent.

Type locality: West wall of Kileau caldera at Uwekahuna Bluff.

Vaca Triste Sandstone Member (of Salado Formation)

Permian (Ochoa): Subsurface in southeastern New Mexico and western Texas.

J. E. Adams, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 11, p. 1600 (fig. 2), 1610. Fine-grained orange-red sand about 10 feet thick. Occurs between 1,555 and 1,565 feet in type well.

Type well: Continental's King well 1, sec. 26, T. 25 S., R. 32 E., Lea County, N. Mex. Name derived from Vaca Triste Draw.

Vacaville Shale

Eocene, lower or middle: Northern California.

C. W. Merriam and F. E. Turner, 1937, California Univ. Pubs., Dept. Geol. Sci. Bull., v. 24, no. 6, p. 95 (fig. 1), 98 (table 1). Named on correlation chart. Occurs below unit termed Domengine(?). Middle Eocene.

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 129 (table), 133. Vacaville shales considered equivalent to Capay formation in age (lower Eocene).

Named for occurrence at Vacaville, Solano County.

Vadito Formation

Precambrian: Central northern New Mexico.

Arthur Montgomery, 1953, New Mexico Bur. Mines Mineral Resources Bull. 30, p. 8 (fig. 2), 21–31, pl. 1. In general it comprises lower conglomerate member—thickness about 2,000 feet, and upper schist member—thickness about 2,500 feet. Lower member consists of quartzite and conglomerate interlayered with flows and sills. Upper schist member consists of quartz schists, phyllites, and granulites interlayered with thick flows and sills of various kinds of amphibolite. Younger than Ortega formation in Picuris area. Intruded by Embudo granite (new).

Named after village of Vadito, located near southeastern corner of Picuris range, and several miles south of excellent outcrops of rocks of this formation. Occurs in southern third of Picuris range, Taos County. Best exposures within 1-mile radius of Harding mine.

Valcour Limestone[1] or Formation

Ordovician (Chazyan): Western Vermont and eastern New York.

Original reference: H. P. Cushing, 1905, New York State Mus. Bull. 95.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 817–853. Formation included in Valcourian stage (new), Shazyan series. Thickness about 250 feet. Includes Hero member below and Beech member above (both new). Overlies Crown Point formation; underlies "Lowville" limestone. Reference section designated.

Reference section: Exposures on hill 0.6 mile southwest of Rutland Railroad Station of South Hero Vt. Forms northern and southeastern shores of Valcour Island.

Valcourian Stage

Ordovician (Chazyan) : North America.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 91, 94 (table 2). Chazy has long been divided into three lithologic and faunal zones (Brainerd and Seely, 1888, Am. Geologist, v. 2) which were given "substage" names Day Point, Crown Point, and Valcour (Cushing, 1905, New York State Mus. Bull. 95). As stages, these have been called Dayan, Crownian, and Valcourian by Oxley (unpub. ms.).

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 833–838. In Champlain Valley, Chazy series is separable into Dayan, Crownian, and Valcourian stages, distinguished by faunal criteria. Each stage has several lithologic facies. Reefs are prevalent.

Valders Stade

Valderan Substage

Valders Glacial Substage

Pleistocene (Wisconsin) : Northeastern Wisconsin.

F. T. Thwaites, 1943, Geol. Soc. America Bull., v. 54, no. 1, p. 121, 136–141. Wisconsin drift is divisible into deposits of Cary below and Valders substages. Name Valders proposed because of uncertainty of former correlations across brush- and forest-covered region around Lake Superior. Drift of Valders age is distinguished from Cary till by its red color and higher clay content; this lithologic criterion is not easily applicable in the northern part of district.

F. T. Thwaites, 1946, Outline of glacial geology, Ann Arbor, Mich., Edwards Bros., Inc., p. 75. Valders and Cary glaciations separated by Two Creeks interstadial.

M. M. Leighton, 1957, Jour. Geology, v. 65, no. 1, p. 108–109. Valders considered a substage of the Wisconsin succeeding the Mankato substage.

R. J. Mason, 1958, Michigan Univ. Mus. Anthropology, Anthropol. Paper 11, p. 22 (map 4), 23–25. Radiocarbon age determination places Valders maximum around 10,700 B. P. (before present) ; correlated with red drift in Wisconsin and Michigan. Two Creeks interstadial placed between Mankato and Valders substages.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 9. In classification proposed herein, Valderan substage is defined as youngest time-stratigraphic subdivision of Wisconsinan stage in Lake Michigan lobe. Base is defined as base of Valders till (Thwaites, 1946; Thwaites and Bertrand, 1957 Geol. Soc. America Bull., v. 68, no. 7) of eastern Wisconsin that overlies Two Creeks forest bed. Substage terminated with final dissipation of Wisconsinan continental glacier, even though glacial till representative of entire time span does not occur in Lake Michigan basin. Substage includes alluvial deposits made during time of rising sea level that is thought to have reached its present position of equilibrium about 5,000 years ago. Deposits of glacial till or of loess of Valderan age not known to occur in Illinois.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529, 549. Mankato-Valders intraglacial substage is herein named Two Creeks.

Name amended to Valders Stade to comply with Stratigraphic Code adopted 1961.

Name based on exposure in quarry at Valders, Manitowoc County.

Valdez Group[1]

Upper Mesozoic(?) : Central southern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 408–410, 413.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–E, p. 236, 242–247, 275, pl. 8. Workers who have studied sedimentary deposits of Prince William Sound region have accepted rocks around Port Valdez as typical of Valdez group and have agreed in assigning basaltic flows and intrusives, or greenstones as they are commonly called and massive conglomerate beds of Ellamar district to Orca group. Aside from these points held in common, there is no generally accepted definition of what constitutes Valdez and Orca groups, what are their limits, and what are stratigraphic and structural relations of the beds included in them. Valdez dominantly graywacke, argillite, and slate. Measured in thousands of feet. Part of the rocks assigned to Valdez group, in mountains north of Prince William Sound, not older than Late Cretaceous.

Typified by sedimentary rocks exposed about Port Valdez, Prince William. Sound region.

Vale Formation (in Clear Fork Group)[1]

Lower Permian : Central and central northern Texas.

Original reference: J. W. Beede and V .V. Waite, 1918, Texas Univ. Bull. 1816, p. 47.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42. Consists of Bullwagon dolomite at top and about 350 feet of red shale below; grades westward in subsurface as a unit so that thickness of basal red shale becomes less and less as amount of dolomite, gray shale, and anhydrite increases, although formation maintains its thickness of about 390 feet.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Underlies Choza formation; overlies Arroyo formation. Includes Bullwagon dolomite member at top. Leonard series.

Named for old post office on Ballinger-Maverick Road, on east side of Valley Creek, Runnels County.

Valencian series[1]

Precambrian: New Mexico.

Original reference: C. R. Keyes, 1915, Conspectus of geologic formations of New Mexico : Des Moines, Robert Henderson, State Printer, p. 4, 12.

Valentine Formation[1]

Valentine Member (of Curtin Formation)

Middle Ordovician : Central and central southern Pennsylvania.

Original reference: R. M. Field, 1919, Am. Jour. Sci., 4th ser., v. 48, p. 404, 414–417, 422.

G. M. Kay, 1943, Econ. Geology, v. 38, no. 3, p. 194 (table 2), 197. Rank reduced to member status in upper part of Curtin limestone (new). Overlies Valley View member (new). Underlies Nealmont limestone. Thickness at Bell Mine. Bellefonte, about 91 feet. Contains thin yellow clay—

metabentonite "A" at base; about 25 feet of very light-gray white-weathering dense laminated limestone; and about 66 feet of very light white-weathering dense heavy-ledged massive limestone ("Bellefonte Ledge") at top. Restricted to outcrop belts northwest of line from east of Lock Haven and Rebersburg to north of Millheim, Spring Mills, Lemont, and Stormstown, in Clinton and Centre Counties. Regional unconformity at base of overlying Nealmont gradually reduces unit toward line of extinction. Black River group.

Named for small hamlet and forge near Bellefonte, Centre County.

Valentine Formation (in Ogallala Group)

Valentine Member (of Ogallala Formation)

Valentine Beds[1]

Pliocene: Northwestern Nebraska, western Kansas, and southwestern South Dakota.

Original reference: E. H. Barbour and H. J. Cook, 1917, Nebraska Geol. Survey, v. 7, pt. 19, p. 173.

R. A. Stirton and P. O. McGrew, 1935, Am. Jour. Sci., 5th ser., v. 29, no. 170, p. 125–132. Three late Tertiary faunas representing two epochs were found in one formation near Valentine, Nebr., and following faunal names have been applied: Niobrara River, upper Miocene; Burge, lower Pliocene; and Valentine, transitional from lower to middle Pliocene.

F. W. Johnson, 1936, Am. Jour. Sci., 5th ser., v. 31, no. 186, p. 467–475. Paper reestablishes original and proper usage of name Valentine beds as designating lower part of Ogallala formation of Valentine area, northern Nebraska. Vertebrate fauna from these beds is known as Valentine fauna. Fine-grained sands and clays of Valentine beds are overlain by Burge sands, a name proposed for the fine- to coarse-grained sands and gravels in which Burge fauna typically occurs. Overlying the Burge is the cap rock bed that lithogically resembles typical Ogallala of southwestern Nebraska. Valentine beds are 175 to 225 feet thick and unconformably overlie Brule(?) clay of Oligocene(?) age. Lower part of Valentine beds is composed of loose channel sands, and it is in these beds that Valentine fauna occurs at type locality. In most places, the loose sand is overlain by beds of greenish-gray massive sandstones (upper Valentine beds). These massive sands are not very fossiliferous in Valentine area. The beds were called Fort Niobrara formation by Osborn (1918), but Valentine was used by Thorpe (1922, Am. Jour. Sci., 5th ser., v. 3) and other writers. Simpson (1933, Am. Mus. Nat. History Bull., v. 57, art. 3) recognized Valentine as having priority over Fort Niobrara and more firmly established the name in its correct usage. Name Valentine was first used erroneously when it was applied to upper fauna in area by Cook (1933, Nebraska Geol. Survey Paper 5). Stirton (1933, Am. Jour. Sci., ser. 5, v. 26, no. 156) assigned name Valentine to upper fauna in region and substituted term Niobrara River fauna for fauna from lower beds (Valentine beds). Usage of term Valentine when applied to upper fauna of area is incorrect. Term Valentine should be used to designate lower beds of area and their included fauna. Type locality designated.

A. L. Lugn, 1938, Am. Jour. Sci., 5th ser., v. 36, no. 213, p. 220–227. Discussion of Valentine problem and presentation of table of Tertiary stratigraphic divisions acceptable in Nebraska and Kansas. Tertiary is divisible into four lithologic groups (ascending): White River, Arikaree (re-

defined). Hemingford (new), and Ogallala redefined to include (ascending) Valentine, Ash Hollow, Sidney, and Kimball formations. Valentine formation, in Nebraska, includes *Stipidium* fossil seed zone; Burge channel member, and "Burge" fauna at top; the true Valentine fauna occurs well down in the formation. Thickness 175 to 225 feet. Overlies Hemingford group which includes Sheep Creek formation at top. Pliocene.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 134–139. Lower formation in Ogallala group. In type area, formation is composed largely of unconsolidated layers of greenish silty marl sand and sandy silt and very few local lenses of diatomaceous marl and light bluish-gray volcanic ash. Lowermost described occurrence of mammalian fauna is at so-called Railroad quarries on south side of Niobrara River south of Valentine, Nebr. This is Niobrara River fauna of Stirton and McGrew (1935). Channel sands from which this fauna has been collected are herein designated Niobrara River channel. Arboreous floral described by Chaney and Elias (1936, Carnegie Inst. Washington Pub. 476) from lower part of Valentine formation of White Bluff locality occurs in bed of diatomaceous marl herein designated Brown County bed. Highest known fauna in Valentine comes from Burge channel quarries. Seems best not to consider the Burge a channel member of the Valentine, but merely a channel within the undivided Valentine. Underlies Ash Hollow formation.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 20. Uppermost member of Ogallala formation in Kansas. Underlies Ash Hollow member. Maximum thickness 140 feet. Early Pliocene and possibly late Miocene. Major unconformity marks base of Tertiary rocks. They are known to rest on all subdivisions of Comanchean series (Cretaceous) and on Permian redbeds.

S. G. Collins, 1960, Geology of the Patricia quadrangle (1:62,500): South Dakota Geol. Survey. Lower formation in Ogallala group. Consists mostly of light-gray and light-olive-greenish, fine to medium, very poorly consolidated feldspathic or arkosic sand. Estimated thickness at least 175 feet. Grades upward into conformably overlying Ash Hollow formation. Underlies Harrison formation of Arikaree group.

Type locality: On south side of drainage cut between old and new railroad grades in NE¼ sec. 17, T. 33 N., R. 27 W., Cherry County, Nebr. Named for town of Valentine in Cherry County.

Valentine Limestone or **Dolomite Member** (of Sultan Limestone)[1]

Middle and Upper Devonian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 10, 14.

J. C. Hazzard, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881, 884 (fig. 3). Geographically extended into Nopah Range, Inyo County, Calif., where it is 690 feet thick, overlies Ironside(?) member and underlies Crystal Pass limestone member. Suggested that name Stewart Valley limestone be abandoned and that Devonian beds ascribed to it be assigned to Crystal Pass and Valentine members of Sultan.

U.S. Geological Survey currently designates the age of the Sultan Limestone and its members as Middle and Upper Devonian.

Well exposed east of Valentine mine in sec. 23, T. 25 S., R. 58 E., Clark County, Nev.

Valera Shale Member (of Belle Plains Formation)[1]

Valera Shale and Anhydrite (in Belle Plains Group)

Permian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 421, 426.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Rank raised to formation in Belle Plains here given group status.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Member of Belle Plains formation. An unfossiliferous dark-blue clay shale unit, 25 to 50 feet thick, that occurs next above Jagger Bend limestone member. Well expressed topographically along most of its outcrop, but near Colorado River upper boundary of unit is ill. defined. Underlies Bead Mountain limestone member.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 274. Valera shale member is 65 to 180 feet thick in Brazos River valley. Overlies Jagger Bend limestone member; underlies Bead Mountain limestone member.

Named from town of Valera, west-central Coleman County.

Vallecito Basalt

Quaternary: North-central New Mexico.

H. T. U. Smith, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 103. Named as third in series of seven Quaternary formations in area. Younger than Canones andesite; older than Black Mesa basalt.

Occurs in Abiquiu quadrangle, Rio Arriba County.

Vallecito Conglomerate (in Needle Mountains Group)[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

N. E. A. Hinds, 1939, 6th Pacific Sci. Cong. Proc., v. 1, p. 290. Mentioned in discussion of Precambrian formations of western North America. Thickness 2,000 feet; underlies Uncompahgran quartzite.

Named for exposures on both sides of Vallecito Creek for about 1 mile north from south boundary of Needle Mountains quadrangle.

Vallecitos Rhyolites

Precambrian (Proterozoic): Central northern New Mexico.

Evan Just, 1937, New Mexico School Mines Bull. 13, p. 13 (table 1), 44, pl. 3. A number of rhyolite and trachyte flows, contained in Hopewell series and Ortega quartzite. Trachyte subordinate to rhyolite in amount. In some places, flows are somewhat schistose, but characteristically their original textures (aphanitic ground masses with distinct phenocrysts up to a quarter inch in diameter) have been well preserved and flow banding is well developed. Range in color from deep pink to brick red. Flows are as much as three-fourths mile thick. Thicknesses presumably represent aggregates of flows rather than single flows.

Exposed in mountainous area between towns of Petaca and Vallecitos, Rio Arriba County.

Vallejo Formation

Eocene or Oligocene: Central southern Colorado.

J. E. Upson, 1941, Am. Jour. Sci., v. 239, no. 8, p. 577–589. Consists of fine-grained unconsolidated but compact silt and clay with thin lenses of cemented sand and fine gravel, and thick layers of coarse gravel containing rounded cobbles. Whole formation stained dark-red in marked contrast to other beds of region. Thickness from 0 to 500 feet. Rests on Precambrian basement rocks; in some places, it underlies unnamed volcanics believed to be mid-Tertiary in age, in other localities, it unconformably underlies Hinsdale beds.

Named from Vallejo Creek in whose valley characteristics of the beds are well displayed. Apparently restricted to the Culebra Re-entrant along west flank of Culebra Range.

Vallenar Formation[1]

Middle Devonian: Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p. 40–52, map.

Mapped as broad belt on west side of Gravina Island, but was positively identified only at Vallenar Bay, Ketchikan region.

†Valley Limestone[1]

Cambrian and Ordovician: Eastern Pennsylvania to northern Virginia.

Original reference: P. Frazer, Jr., 1883, Pennsylvania 2d Geol. Survey Rept. C_4, p. 99–100, 112–144.

Named for Great Valley of Appalachian region, of which Shenandoah Valley is a part.

†Valley Forge Quartzite[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: F. Bascom, 1904, Am. Jour. Sci., 4th, v. 17, p. 143.

Philadelphia region.

Valley Head Sandstone[1]

Upper Devonian: Eastern West Virginia.

Original reference: D. B. Reger, 1928, Am. Jour. Sci., 5th, v. 15, p. 50–57.

G. A. Cooper, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart above Elkins sandstone and below Hendricks sandstone.

Well exposed at village of Valley Head, Randolph County.

Valley Heads Drift

Valley Heads Substage

Pleistocene (Wisconsin): Southwestern New York.

Paul MacClintock and E. T. Apfel, 1944, Geol. Soc. America Bull., v. 55, no. 10, p. 1145 (fig. 1), 1159–1161, pl. 1. Based primarily on lithologic differences, three Wisconsin drift sheets are recognized (ascending): Olean, Binghamton, and Valley Heads, Valley Heads drift covers inner, or north edge of Binghamton drift in area of this report [southwestern New York].

L. C. Peltier, 1949, Pennsylvania Geol. Survey, 4th ser., Bull. G–23, p. 4 (table 1), 16 (fig. 5). Referred to as Valley Heads substage in discussion of glacial geology of Susquehanna River terraces.

Derivation of name not given. Valley Heads moraine enters New York from west and is continuation of Lake Escarpment morainic system (Leverett, 1902, U.S. Geol. Survey Mon. 41).

Valley Mountain facies (of Flagstaff Formation)

Paleocene, upper: Central Utah.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 26–28, pl. 11. In general, Flagstaff formation in Valley Mountains grades from dominantly yellow and gray with some red dense lacustrine limestone in northern area to dominantly red and pink, partly arenaceous limestone with some sandstone and conglomerate in southern area. Southern type of lithology continues into Pavant Plateau and becomes more clastic. Formation thickens southward from over 1,100 feet in Hayes Canyon to about 1,400 feet in southern Valley Mountains. Divisible into five lithologic units, three of which may be coincident with faunal zones—units A and B tend to thin southward, whereas C and E thicken in the same direction. Unit D is missing in southern Valley Mountains. Overlies North Horn formation; underlies Colton formation.

In Valley Mountains, Gunnison quadrangle, Sevier and Sanpete Counties. All five (A–E) lithologic units clearly exposed in Picket Canyon.

Valley Spring Gneiss[1]

Precambrian (Llano Series): Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey Ann. Rept., p. lvi, 274, pl. 3.

V. E. Barnes, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 56 [1945]. Intruded by Big Branch Gneiss.

Virgil Barnes, Frederick Romberg, and W. A. Anderson, 1954, Internat. Geol. Cong., 19th, Algiers 1952, Comptes rendus, sec. 9, pt. 9, p. 152–153. Oldest Precambrian rocks in Llano uplift are mostly light-colored, highly feldspathic metasediments named Valley Spring gneiss, followed by dark-colored metasediments, including amphibolite, mica schist, graphite schist, and some marble, all of which are included in Packsaddle schist. These rocks are highly folded, and during folding it is believed the igneous rocks were intruded which were metamorphosed into Red Mountain gneiss and dioritic Big Branch gneiss. Date of intrusion of perioditic rocks, now serpentized into Coal Creek serpentine, in relation to Big Branch gneiss not satisfactorily determined. Town Mountain granite invaded the already deformed metasediments and was followed by Oatman Creek granite, Sixmile granite, and Llanite, the latter being the youngest.

Named for Valley Spring, Llano County.

Valley Springs Formation[1]

Miocene, upper(?): Northern California.

Original reference: A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 34 (table), 71–80, pl. 1.

J. H. Eric, A. A. Stromquist, and C. M. Swinney, 1955, California Div. Mines Spec. Rept. 41, p. 16–18, pls. 1, 3. Described in Angels Camp quadrangle as interbedded white to light-gray rhyolite tuff and gravel containing pebbles and cobbles of rocks of pre-Tertiary age. Maximum thickness about 200 feet. Unconformably underlies Mehrten formation; unconformably overlies auriferous river gravel of Eocene(?) age. Miocene(?).

Type section: West slope of Valley Springs Peak, 1½ miles northwest of Valley Springs, near center sec. 11, T. 4 N., R. 10 E., Calaveras County.

Valleytown Formation[1]

Lower Cambrian: Western North Carolina, central northern Georgia, and eastern Tennessee.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 143, p. 4.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 285. Green phyllite, slate, and ottrelite-mica schist overlie Big Butt (Tusquitee) quartzite in Murphy syncline. Keith (1907) separated these rocks into Brasstown schist and Valleytown formation. Only locally is there lithologic criteria for separating these rocks into two formations. The phyllites and schists for the most part are closely folded and have prominently developed schistosity which obscures the bedding so that, on stratigraphic evidence available, they are not readily divisible. In this report, these two formations are treated as Valleytown formation, the more widely used name.

G. W. Crickmay, 1952, Georgia Geol. Survey Bull. 58, p. 27. Included in Talladega series believed to be Precambrian.

V. J. Hurst, 1955, Georgia Geol. Survey Bull. 63, p. 48–51. In Mineral Bluff quadrangle, Ga., Keith's (1907) sequence is not entirely applicable. Rocks mapped by LaForge and Phalen (1913, U.S. Geol. Survey Geol. Atlas, Folio 187) as Valleytown formation belong to four formations: Brasstown, Andrews schist, Nottely quartzite, and Mineral Bluff (new). As originally defined, the Valleytown is without definite lower boundary and is lithologically indistinguishable from underlying beds, therefore name Valleytown is not retained. Rocks between Tusquitee quartzite and Murphy marble all conform to Keith's description of the Brasstown and they are renamed Brasstown formation.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 32; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. Lower Cambrian(?).

Named for exposures in vicinity of Valleytown, Cherokee County, N.C.

Valley View Member (of Curtin Limestone)

Middle Ordovician (Trentonian): Central Pennsylvania.

G. M. Kay, 1943, Econ. Geology, v. 48, no. 3, p. 194, 197–200. Lower member of Curtin limestone (new). An impure cherty fine- to medium-textured heavy ledge, in part, gray limestone with argillaceous partings and interbeds. Contains four metabentonites (B–E); top of member is at base of metabentonite A. Thickness 52 feet in type section. Remarkably constant in character and thickness from Nippenose Valley, south of Jersey Shore, to Pleasant Gap and western end of Bellefonte district. Underlies redefined Valentine member in type section; also underlies Nealmont limestone. Overlies Stover member of Benner limestone. Persists to limit of distribution of Curtin, though bevelled by unconformably overlying Nealmont near limit.

G. M. Kay, 1944, Jour. Geology, v. 52, no. 1, p. 20–21. Beds between metabentonites E and D have been termed "Lemont member of Carlim". Upper part of unit has been classified as "Lowville." It is preferable to use

a local name since precise correlation with Lowville of New York uncertain. Unit has also been included in an expanded "Valentine formation".

Type section: In quarry wall south of headframe of Bell mine of American Lime and Stone Company at Bellefonte, Centre County. Named from hamlet 2 miles southwest of Bell mine.

Valmeyer Series[1]

Mississippian: Mississippi Valley.

Original reference: R. C. Moore, 1933, Historical geology; New York, McGraw-Hill Book Co., p. 261–264.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 132. Series is sequence of dominantly limestone strata, which succeed each other conformably except upon flank of Ozark area where several unconformities have been recognized. Overlies Kinderhook series unconformably in Mississippi Valley and overlaps those beds onto strata as old as Ordovician. Includes Osage and Meramec groups.

L. E. Workman and Tracey [Tracy] Gillette, 1956, Illinois Geol. Survey Rept. Inv. 189, p. 12. Illinois Geological Survey accepts the name Valmeyer series to include Osage and Meramec groups.

Name derived from southern Illinois where rocks of series are well exposed.

Valmont Dolomite

Upper Ordovician: South-central New Mexico.

L. C. Pray, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1897 (fig. 2), 1899 (fig. 4), 1900 (fig. 5). 1902, 1906–1911. Name proposed for strata consisting predominantly of light-gray-weathering thin- to medium-bedded sublithographic dolomite lying between underlying cherty member of Montoya formation and generally massive darker and more coarsely crystalline dolomite termed "upper member of Fusselman limestone" by Darton (1917, U.S. Geol. Survey Prof. Paper 108–C). Thickness 150 to 225 feet. A few feet of argillaceous dolomite from 40 to 70 feet above base divides formation into two members. Fossils from lower member are upper Ordovician, those from upper member are indeterminate as Upper Ordovician or Silurian. Underlies Fusselman(?) formation.

L. C. Pray, 1958, West Texas Geol. Soc. Guidebook Field Trip Nov. 6, 7, 8, p. 35. Valmont dolomite is equivalent to Cutter dolomite of Caballo Mountains, and latter term has priority on basis of date of publication.

Type section: On northeast side of Alamo Canyon in SE¼SW¼SW¼ sec. 6, T. 17 S., R. 11 E., Sacramento Mountains, Otero County. Name derived from station of Valmont on Southern Pacific Railroad in sec. 14, T. 18 S., R. 9 E., about 10 miles south of Alamogordo.

Valmonte Diatomite Member (of Monterey Shale)[1]

Miocene, upper: Southern California.

Original reference: W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 2, p. 143.

W. P. Woodring, M. N. Bramlette, and W. S. W. Kew, 1946, U.S. Geol. Survey Prof. Paper 207, p. 11 (fig. 3), 14 (table), 15 (fig. 4), 33–35, pl. 1. Relatively pure diatomaceous strata. Diatomite occurs as layers of laminae of varying thickness; in some areas, thinly laminated diatomite forms units several feet thick alternating with massive diatomaceous mudstone; in other areas, entire exposed thickness consists of laminated

diatomite and diatomaceous shale containing varying proportions of diatoms. Thickness 300 to 500 feet. Underlies Malaga mudstone member; overlies Altamira shale member.

Type region: Along lower course of Agua Negra Canyon, southeast of Valmonte residential district, where diatomite is quarried and processed. Palos Verdes Hills area, Los Angeles County.

Valmy Formation

Lower, Middle, and Upper Ordovician: North-central Nevada.

R. J. Roberts, 1951, Geology of the Antler Peak quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–10]. Interbedded quartzite, chert, argillite, slate, and a little intercalated greenstone (altered andesitic lava). Quartzites thick-bedded to massive, medium to coarse grained. Chert is gray, green, brown, and black with argillite interbeds and partings. Intercalated greenstones include pillow lavas. Thickness estimated at more than 3,000 feet, may be as much as 5,000 feet. In thrust contact with Comus formation (new). Middle(?) Ordovician.

H. G. Ferguson, R. J. Roberts, and S. W. Muller, 1952, Geology of the Golconda quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–15]. Type locality designated.

R. J. Roberts and others, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2823 (fig. 5), 2832–2833. Lower, Middle, and Upper Ordovician.

Type locality: North Peak, 8 miles south of Valmy, a station on the Southern Pacific Railway, Golconda quadrangle.

Valparaiso Till or Drift

Pleistocene (Wisconsin): Northeastern Illinois.

J. H. Bretz, 1939, Illinois Geol. Survey Bull. 65, pt. 1, p. 52, 53, 55. A till about 10 feet thick; overlies Lemont drift (new).

Leland Horberg and P. E. Potter, 1955, Illinois Geol. Survey Rept. Inv. 185, p. 9 (fig. 2), 10, 12. Differentiated from overlying Tinley drift primarily on basis of morphology and areal relations; in a few places, such as Worth gravel pit [near Chicago], the two tills occur together stratigraphically; here they are differentiated by unconformity with basal gravel and greater abundance of Devonian shale pebbles in Tinley.

Named for town of Valparaiso, Ind., which is situated on Valparaiso moraine.

Valverde flags[1]

Upper Cretaceous (Gulf Series): Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 221, 229, 230.

Named for Val Verde County.

Val Verde Tonalite

Jurassic(?): Southern California.

R. W. Wilson, 1937, Am. Mineralogist, v. 22, no. 2, p. 122–130. Coarse-grained rock, medium dark in color, and varying only slightly in composition throughout district. Constant feature is presence of abundant dark fine-grained rounded inclusions that vary from a few inches to several feet in diameter. In some places inclusions occur in swarms making up 50 percent or more of rock.

E. F. Osborn, 1939, Geol. Soc. America Bull., v. 50, no. 6, p. 921–950. Discussion of structural petrology of Val Verde tonalite. Name credited to F. L. Ransome (1932, unpub. rept.). Footnote states that Val Verde tonalite is same as Perris quartz diorite of Dudley (1935).

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. Plutonic sequence lists Perris and Estelle quartz diorite (Val Verde tonalite) as older than Lakeview quartz monzonite and younger than Virginia quartz norite. Late Mesozoic.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 58. In this report, name Bonsall tonalite replaces name Val Verde tonalite as used by Osborn (1939).

Crops out in Val Verde district, a part of the Perris fault block in Riverside County. Probably named for railroad station of Val Verde.

Vamoosa Formation[1]

Pennsylvanian (Virgil Series) : Central Oklahoma.

Original reference: G. D. Morgan, 1924, Bur. Geol. [Oklahoma] Bull. 2, p. 125–128, pls. 3, 27, map.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119 (fig. 1), 121 (fig. 2), 122. Unconformably overlies Tallant formation (new). Includes Cheshewalla sandstone at base.

W. F. Tanner, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 2046–2050. Unconformably overlies Hilltop formation (new).

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 80–84, pl. 1. In type area, Vamoosa conformably overlies Belle City limestone and is overlapped by overlying Ada so that only lower shale and about 30 feet of clastic part of formation are exposed near town of Byng. In Okfuskee County, the Vamoosa strike-overlaps Tallant and Barnsdall formations and is conformably overlain by "Pawhuska" formation. Discovery of unconformity at base of lowermost conglomerate of Vamoosa necessitates redefinition of formation. Vamoosa (as used by Morgan) is herein redefined and restricted so that its lower boundary is extended upward to unconformity at base of lowermost conglomerate (Boley conglomerate member, new) in formation. Thickness 650 to 690 feet in Okfuskee County. This unconformity makes it possible to establish a natural boundary for base of formation and also establishes natural Missouri-Virgil series boundary.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 89–98, pls. 1, 2. Described in Seminole County where it consists of a sequence of shales, sandstones, and chert conglomerates, thinning southward as result of numerous periods of erosion. Coarsest conglomerates are in middle and lower parts of formation. Three highest members of formation have been mapped across northern and central parts of county as Pawhuska or Lecompton limestone by some geologists. This report does not so consider them; they, like the overlying Pawhuska of Okfuskee County, are truncated by overlying Ada formation at more or less regular intervals. Thickness 125 to 550 feet. Includes Boley conglomerate member at base. Unconformably overlies Hilltop formation.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 39–54, pl. 1. Lower part of Vamoosa formation described in Osage County where it consists of gray-green, blue-green, and maroon shale, sandstone and siltstone, and thin limestones. Thickness 250 to 310 feet. Named and mapped members

include (ascending) Cheshewalla sandstone, Bowring limestone (new), Kiheki sandstone (new), Labadie sandstone, Cochahee sandstone, Bowhan sandstone, Jonesburg sandstone, Wynona sandstone, and Oread limestone. Overlies Tallant formation.

K. E. Masters, 1957, Shale Shaker, v. 7, no. 5, p. 8, 10. Bird Creek limestone considered upper bed of Vamoosa in Prague area, Lincoln and Pottawatomie Counties, Okla.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 43–47, pls. 1, 2. In present usage, base of Vamoosa is at base of lowest conglomerate of Morgan's Vamoosa in Stonewall quadrangle and at base of similarly situated conglomerate and sandstone northward to Kansas-Oklahoma line. Top of formation from Kansas-Oklahoma line to North Canadian River, is at base of Lecompton limestone member of Pawhuska formation. South of North Canadian River, top of formation is at base of Ada formation. Thickness in Creek County 220 to 400 feet. Unconformably overlies Tallant formation; conformably underlies Pawhuska. South of Canadian River, unconformably overlain by Ada formation. Not known that unconformity at base of Ada extends north of North Canadian River but, if it does so, it is in rocks younger than Vamoosa formation, in rocks of Vanoss formation of this report.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25 (table 2), 26 (fig. 6), 27–37, pls. 1, 2, 3. Formation in Pawnee County extends upward from Missouri-Virgil unconformity to base of Lecompton limestone member of Pawhuska. Thickness about 400 feet. Contains no conglomerate or coarse clastic beds. Many thick sandstone members present in southern part of county wedge out northward in width of one township. Others can be traced completely across county and continue into Osage County and southern Kansas with little change in thickness; still others thicken northward from little or no representation in Pawnee County to prominent sandstones in central and northern Osage County. Table 2 lists (ascending) Cheshewalla sandstone, Kiheki sandstone, Cochahee sandstone, Wynona sandstone, Oread limestone, and Kanawaka shale members. Of these only Kanawaka and Wynona can be positively identified. Formation included in Douglas-Shawnee group, Virgil series.

Named for exposures about one-half mile east of village of Vamoosa, Seminole County.

Vamos Vamos Beds[1]

Eocene or Oligocene: Panamá.

Original reference (Vamos Á Vamos): R. T. Hill, 1898, Harvard Coll. Mus. Comp. Zoology Bull., v. 28, no. 5, p. 179–180, 206–207.

W. P. Woodring, 1957, U.S. Geol. Survey Prof. Paper 306–A, p. 22–23; *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 349. Vamos Á Vamos beds are now interpreted as marine deposits in lower part of Bohio formation. Name should be Vamos Vamos.

Vamos Vamos is now submerged locality on French Canal, C.Z. Site is off northeast coast of present Barro Colorado Island.

Vanar Hills Volcanics

Tertiary: Southeastern Arizona.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 69–70, table 1, pl. 1. Flows, vitric tuffs, crystal tuffs, and pitchstone;

pinkish-gray latitic rocks, with phenocrysts of feldspar and biotite in an aphanitic hypocrystalline groundmass. Rock is similar, except for texture, to latite porphyry dikes and sills which intrude most of the rocks in the area. Probably middle or late Tertiary. Younger than Steins Mountain quartz latite porphyry (new); believed to be older than Weatherby Canyon ignimbrite (new).

Crop out in Vanar Hills, north of Arizona State Highway 68, in northwest corner of mapped area in central part of Peloncillo Mountains, Cochise County. Extend northward for undetermined distance.

Van Bibber Shale Member (of South Platte Formation)

Lower Cretaceous: North-central Colorado.

K. M. Waagé, 1955, U.S. Geol. Survey Prof. Paper 274–B, p. 31–33, figs. 10, 17, 19. Dark-gray refractory shale and silty shale with interbeds of fine-grained sandstone. Persistent kaolinitic marker at base of main refractory shale bed. Thickness at type section is 50 feet which is thickest of the many sections measured; more commonly member ranges from 35 to 45 feet thick. Unconformably underlies unnamed first sandstone subunit of South Platte formation (new); overlies Kassler sandstone member (new) of South Platte formation.

Type section: Composite of adjacent exposures on scarp of hogback, between 200 and 500 yards north of Van Bibber Creek; southernmost of these exposures, showing the main clay bed, is in airhole of Golden Fire Brick Co. mine. Named for exposures in vicinity of Van Bibber Creek, Golden quadrangle, Jefferson County.

Van Buren Formation[1]

Van Buren Member (of Gasconade Dolomite)

Lower Ordovician: Southeastern Missouri.

Original reference: H. S. McQueen, 1930, Insoluble residues as a guide in stratigraphic studies: Missouri Bur. Geology and Mines, separate.

O. R. Grawe, 1945, Missouri Geol. Survey and Water Resources, 2d ser., v. 30, p. 55–56. Basal zone of Gasconade is the Gunter. It is overlain by 80 to 125 feet of thin- to medium-bedded cherty dolomite which, in some Missouri Survey reports, is referred to as Van Buren formation, and this in turn is overlain by massively bedded, cherty dolomite 140 to 200 feet thick. In reports in which term Van Buren is used, term Gasconade is restricted to the upper cherty dolomite. In this report, Gasconade is used in unrestricted sense to include all strata between Eminence and Roubidoux.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (column 52). Shown on correlation chart as member of Gasconade dolomite.

R. D. Knight, 1954, Kansas Geol. Soc. Guidebook 17th Ann. Field Conf., p. 57. [Reprinted as Missouri Geol. Survey and Water Resources Rept. Inv. 17.] Gunter sandstone is considered member at base of Gasconade. Term Van Buren not used in Missouri.

Name derived from town of Van Buren, Carter County. Well exposed along U.S. Highway 60 west of Van Buren.

Vanceburg Black Shale[1]

Mississippian: Northeastern Kentucky.

Original reference: E. Orton, 1880, Review of strat. geology of eastern Ohio, p. 21, table.

Probably named for Vanceburg, Lewis County.

Vanceburg facies (of New Providence Formation)

Vanceburg sandstone facies[1] (of Cuyahoga Formation)

Vanceburg sandstone facies (of Logan Formation)

Lower Mississippian: Northern Kentucky and southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 657, 758–763.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 134, pl. 6. Vanceburg facies is northeasternmost one of New Providence formation in Kentucky; limited on outcrop to west-central and northern Lewis County. Thickness in vicinity of Vanceburg about 275 feet. Includes (ascending) Henley shale, Buena Vista siltstone, Rarden shale, Vanceburg siltstone, and Churn Creek shale members of formation. Considered Lower Mississippian.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 53, 54 (fig. 3), 62–64. In Ohio, considered facies of Logan formation. Includes Buena Vista sandstone, Rarden shale, Vanceburg siltstone, Churn Creek, and Vinton sandstone members. Lies to west of Scioto Valley shale facies.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 25. Here considered facies of Cuyahoga formation. Editor's note states that Hyde (1921, Ohio Geol. Survey Bull. 23) correlated Buena Vista sandstone with Berne and lower part of Byer in discussing geology of Camp Sherman quadrangle; such a correlation would necessitate placing Rarden, Vanceburg, Churn Creek and most of Portsmouth shale in Logan formation.

Well developed in vicinity of Vanceburg, Ky., and Buena Vista Ohio.

Vanceburg Sandstone Member (of Cuyahoga Formation)[1]

Vanceburg Siltstone Member (of Logan Formation)

Vanceburg Siltstone Member (of New Providence Formation)

Lower Mississippian: Northern Kentucky and southern Ohio.

Original reference: J. E. Hyde, 1915, Jour. Geology, v. 23, p. 656, 657, 665. 758, 763, 768.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 77, 134, pl. 6. Hyde's "Vanceburg member" is retained for the series of even-bedded siltstones constituting bulk of New Providence formation in area of Vanceburg facies. Just how much of the column should be included in this member and where stratigraphic limits should be placed are subject to question. Overlies Rarden shale member; underlies Churn Creek shale member. Considered Lower Mississippian.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 2), 62–63. Vanceburg siltstone member included in Vanceburg facies of Logan formation in Ohio. Thickness 80 to 150 feet. Overlies Rarden shale member; underlies Churn Creek member, no dependable horizon separates the two, the distinction being made on the basis of the larger sandstone content of Vanceburg.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 3 (table 1), 25. Here considered member of Cuyahoga formation in area of Vanceburg facies.

Editor's note states that Hyde (1921, Ohio Geol. Survey Bull. 23) correlated Buena Vista sandstone with Berne and lower part of Byer in discussing geology of Camp Sherman quadrangle; such correlation would necessitate placing Rarden, Vanceburg, Churn Creek, and most of Portsmouth shale in Logan formation.

Well developed in vicinity of Vanceburg, Ky., and Buena Vista, Ohio.

Van Cleve Flow (of Capulin Basalt)

Van Cleve Flow (of Clayton Basalt)

Quaternary: Northeastern New Mexico.

R. F. Collins, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1031. Dark-gray fine-grained vesicular olivine basalt.

Brewster Baldwin and W. R. Muehlberger, 1959, New Mexico Bur. Mines Mineral Resources Bull. 63, p. 133, 137, 144. East of type locality, Clayton basalt consists of many long tongues. The basalt flows have been named, from south to north, Carrizo, Herringa, Clayton Mesa, Apache, Seneca, Gaps, and Van Cleve flows. All basalts rest on sand and gravel of Ogallala-like material in ancient valleys. Vents that give rise to these basalts are unknown.

Nineteen mile flow from northeast flank of Sierra Grande east and northeast to Van Cleve, sec. 7, T. 29 N., R. 32 E, Union County.

†Vancouver Group[1]

Upper Cretaceous: Southwestern British Columbia, Canada, and northwestern Washington.

Original reference: C. A. White, 1889, U.S. Geol. Survey Bull. 51, p. 33.

Probably named for Vancouver Island, B.C.

Vanderburg Sandstone (in Dixon Formation)

Vanderburg Sandstone (in Henshaw Formation)[1]

Pennsylvanian: Western Kentucky.

Original reference: L. C. Glenn, 1912, Kentucky Geol. Survey Rept. Prog. 1910 and 1911, p. 26.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 106. A division of Dixon formation, between Mount Gilead shale above and Bald Hill shale. [Apparently so designated by Glenn, 1922, Kentucky Geol. Survey, 6th ser., p. 5.]

Named for Vanderburg, Webster County.

Vandever Member (of Crab Orchard Mountains Formation)

Vandever Shale (in Lee Group)[1]

Vandever Formation (in Crab Orchard Mountains Group).

Vandever Member (of Lee Formation)

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: Charles Butts, 1916, Tennessee Geol. Survey Resources of Tennessee, v. 6, p. 107–110.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

V. H. Johnson, 1946, Coal deposits of Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map Geographically extended into northern Georgia where it is 150 to 200 feet thick; overlies Bon Air sandstone and underlies Rockcastle sandstone.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4. Originally named Vandever shale, but presence of large amounts of sandstone in unit along eastern edge of Walden Ridge makes term formation more applicable. Over most of Walden Ridge, consists of three units: lower shaly part, prominent middle sandstone or conglomerate, and upper shaly part. Thickness less than 100 to more than 400 feet: near Vandever, where exposed along axis of an anticline, about 250 feet. Includes Lantana coal near base and Morgan Springs coal near top. Included in Crab Orchard Mountains group (new); underlies Rockcastle conglomerate; overlies Newton sandstone.

U.S. Geological Survey currently classifies the Vandever as a member of Crab Orchard Mountains Formation on the basis of a study now in progress.

Named for exposures at Vandever, Cumberland County, Tenn.

Vandusen cyclothem

Pennsylvanian (Pottsville Series): Southeastern Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 29, table 1, geol. map. Includes (ascending) Vandusen shale and (or) sandstone, 10 feet thick, clay, coal, and Lowellville or Poverty Run limestone (absent in Perry County). Occurs above Bear Run cyclothem and below Lower Mercer cyclothem. In area of this report, Pottsville series is described on cyclothemic basis; 10 cyclothems are named; [For sequence see Anthony cyclothem.]

Exposed in southeastern Perry County.

Vandusen Shales

Pennsylvanian (Pottsville Series): Eastern Ohio.

R. E. Lamborn, C. R. Austin, and Downs Schaaf, 1938, Ohio Geol. Survey, 4th ser., Bull. 39, p. 67 (chart), 88–99. Vandusen shale horizon extends from top of Vandusen coal to base of Lower Mercer coal. Sandstones locally present. Average thickness about 24 feet.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 29. Vandusen shale and (or) sandstone included in Vandusen cyclothem.

Type locality and derivation of name not given.

Van Etten[1] zone

Upper Devonian: South-central New York.

Original reference: H. S. Williams, 1907, Jour. Geology, v. 15, p. 97, 108, 109.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Van Etten zone in Enfield formation. Occurs above Juliand zone.

Exposed along railroad cuts at Van Etten, Chemung County.

Vanhem Formation (in Sanborn Group)

Pleistocene and Recent: Southwestern Kansas.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 4, p. 69 (fig. 1), 84–87. Proposed for sediments laid down during cycle of deposition which followed entrenchment of streams into Kingsdown and older formations. Includes following lithologic units (ascending): (1) sand and gravel; (2) silt, (3) silt to clayey silt, and (4) loess. Thickness

at type section 68 feet. Type section of the Vanhem is the section given by Smith (1940) as a typical section of the Kingsdown. Most exposures previously referred to or mapped as Kingsdown silt are of deposits younger than the Kingsdown formation and are part of the Vanhem.

C. W. Hibbard, 1958, Am. Jour. Sci., v. 256, no. 1, p. 55 (fig. 1). Upper formation in Sanborn group in southwestern Kansas.

Type locality: In N½ sec. 13, and S½ sec. 12, T. 30 S., R. 23 W., Pyle Ranch, on north side of Bluff Creek, Clark County; type section is along west bluff of a small tributary of Bluff Creek in secs. 12 and 13, T. 30 S., R. 23 W.

Van Horn Sandstone[1]

Precambrian(?): Western Texas.

Original reference: G. B. Richardson, 1904, Texas Univ. Min. Survey Bull. 9, p. 28.

P. B. King, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 145 (table), 152–153. Van Horn sandstone, as defined by Richardson, included red arkosic sandstones below and white quartzose sandstones above; the two parts were supposed to be conformable. Subsequent work has shown that the two parts of original formation are separated by well-marked unconformity. Proposed here to restrict name Van Horn to lower red arkosic part of original formation. Upper part included in Bliss sandstone. Maximum thickness of restricted Van Horn about 700 feet. Rests on truncated edges of Allamoore (new) and Hazel formations. Cambrian and Precambrian.

P. B. King and P. T. Flawn, 1953, Texas Univ. Bur. Econ. Geology Pub. 5301, p. 21 (table 1), 24, 25, 90–97. Precambrian(?).

Named for Van Horn, El Paso County.

Vanhornsville Sandstone[1]

Silurian (Niagaran): Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Exposed at Vanhornsville, Herkimer County.

Vann Quartzite (in Chilhowee Group)

Lower Cambrian: Northwestern North Carolina.

G. W. Stose and A. J. Stose, 1947, Am. Jour. Sci., v. 245, no. 10, p. 626, 627, 629. Thick-bedded arkosic quartzite, shale, and hard feldspathic light-gray quartzite 1,200 to 1,400 feet thick. Underlies Sandsuck shale; unconformable above Precambrian granite gneiss, Keith [1904, U.S. Geol. Survey Geol. Atlas, Folio 116] used name Snowbird formation in this area.

S. S. Oriel, 1950, North Carolina Div. Mineral Resources Bull. 60, p. 13 (table 3), 26. Vann quartzite is included in Snowbird formation in this report.

G. W. Stose and A. J. Stose, 1949, Geol. Soc. America Bull., v. 60, no. 2, p. 300 (table 4). Table 4 lists Vann quartzite as late Precambrian.

Named from exposure at Vann Cliff on Spring Creek, near Hot Springs, Madison County.

†Van Nest Gap Gneiss[1]

Precambrian: Northern New Jersey.

Original reference: N. E. A. Hinds, 1921, Am. Jour. Sci., 5th, v. 1, p. 355–364.

Occurs at Van Nest Gap, near Oxford Furnace, Warren County.

Van Oser Member (of Jordan Sandstone)

Van Oser Submember (of Jordan Member of Trempealeau Formation)

Upper Cambrian (St. Croixian): Southeastern Minnesota and southwestern Wisconsin.

C. R. Stauffer, G. M. Schwartz, and G. M. Thiel, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, p. 1902; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1238 (table 2), 1240. Coarse massive gray to white sandstone. Overlies Norwalk member. Forms uppermost division of St. Croixian series in Minnesota. Commonly overlain by Oneota dolomite. Has been referred to as *Tellerina-Saukiella* zone in Minnesota classification.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 48–49. Thickness about 40 feet at type locality of Jordan sandstone. Overlies Norwalk member.

G. O. Raasch, 1952, Illinois Acad. Sci. Trans., v. 45, p. 93. In Stoddard quadrangle, Wisconsin, considered submember of Jordan member of Trempealeau formation.

Probably named for exposures on Van Oser Creek, Scott County, Minn.

Vanoss Formation (in Pontotoc Group)[1]

Pennsylvanian (Virgil Series): Central southern Oklahoma.

Original reference: G. D. Morgan, 1924, Bur. Geology [Oklahoma] Bull. 2, p. 133–137, pls. 3, 27, map.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2040–2044. The four principal conglomerates in the Arbuckle Mountains region are divisible into two general groups, older consisting of "Franks" and Deese, and younger consisting of Collings Ranch (new) and Vanoss. Each group is characterized by rocks of which the pebbles and cobbles in the conglomerates are composed. The Vanoss (youngest) contains granite feldspar, and vein quartz from Precambrian rocks that were exposed only after the highest uplift and deepest erosion of the Arbuckles. Formation consists of lower conglomerate member and an upper shale member. Combined maximum thickness about 1,550 feet. Conglomerate member has maximum thickness of 650 feet and is restricted to northern edge of mountains in area between Sulphur and Hennepin. Northward from Sulphur, the conglomerate member disappears by interfingering into shale member whereas, westward and southward around Arbuckle anticline it is overlapped by shale member. In area south of Sulphur, the Vanoss overlies Deese conglomerate. At most places, the rocks have gentle dips and are nonfaulted, although in a few areas they dip as much as 40° and are cut by small faults whose displacement dies out upward in conglomerate sequence. Collings Ranch and Vanoss conglomerates rest with pronounced angular unconformity on older rocks that were steeply folded during culmination of Arbuckle orogeny.

W. F. Tanner, 1956, Oklahoma Geol. Survey Bull. 74, p. 103–108, pl. 1. Described in Seminole County where it overlies Ada formation or completely cuts out the Ada and rests on Arbuckle group. Underlies Permian

Konawa formation, locally unconformable. Consists of shales and sandstones, and in southern part of county, limy arkosic sandstones and conglomerates. Thickness 140 to 550 feet, thickening southward.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 51–52, pl. 1. In this report [Creek County], term "Vanoss" applies to all rocks from top of Lecompton limestone member of Pawhuska formation up to top of Pennsylvanian system, which, in northern Oklahoma and southern Kansas, is top of Brownville limestone. Term as so applied probably includes not only Morgan's (1924) Vanoss but also his Ada formation and lower part of his Konawa formation. Rocks to which term "Vanoss" is here applied crop out in a band 6 to 12 miles wide from North Canadian River, in northeastern Pottawatomie County and southwestern Okfuskee County, northeastward to Kansas-Oklahoma line in north-central Osage County. Maximum thickness in county about 300 feet. Intergrades laterally with Pawhuska formation and contains and interfingers with units named in northern Oklahoma and in Kansas, notably the Bird Creek and Wakrusa limestones.

Named for exposures in Vanoss, T. 3 N., R. 4 E., Pontotoc County.

Vanport flint, limestone, or shale member

See **Vanport Limestone** (in Allegheny Group) and Scrubgrass cyclothem.

Vanport Limestone (in Allegheny Group)

Vanport Limestone Member (in Allegheny Formation)[1]

Vanport Limestone Member (of Clarion Formation)

Pennsylvanian: Western Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: I. C. White, 1878, Pennsylvania 2d Geol. Survey Rept. Q, p. 60–66.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 44–45, table 1. Vanport member of Scrubgrass cyclothem in report on Perry County. Composed of either milky-colored flint or chert, crystalline limestone, sandy limestone, calcareous limestone, or very fossiliferous shale. Flint facies dominates all others whereas limestone facies is more localized than any other. Thickness 4 inches to 2½ feet. Overlies Scrubgrass coal. Underlies Ferriferous member, Allegheny series.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 22 (table 5). Vanport limestone listed with recognizable members of Allegheny formation in Harrison County.

G. C. Williams, 1960, Jour. Paleontology, v. 34, no. 5, p. 910 (fig. 2). Member of Clarion formation. Above Clarion sandstone member and below Lower Kittanning sandstone. Allegheny group.

Named for exposures at Vanport, Beaver County, Pa.

Van Schaick[1] zone

Middle Ordovician: Eastern New York.

Original reference: R. Ruedemann and G. H. Chadwick, 1935, Science, new ser., v. 81, p. 400.

In Mohawk Valley.

Van Vacter Gypsum Member (of Blaine Formation)

Permian: Southwestern Oklahoma.

G. L. Scott, Jr., and W. E. Ham, 1957, Oklahoma Geol. Survey Circ. 42, p. 17 (fig. 3), 26–28, pl. 1. Name applied to gypsum bed at top of Blaine formation (redefined). In type area, Van Vacter consists of lower and upper division of massive white and pink granular gypsum, respectively 14 and 18 feet thick, separated by 4 feet of red shale. Maximum thickness about 50 feet. Overlies Mangum dolomite member; underlies Dog Creek shale.

Type area: Along west branch of Boggy Creek, center E½ sec. 10 and center W½ sec. 11, T. 8 N., R. 22 W., about 2 miles northwest of Van Vacter ranchhouse, Beckham County.

Van Valkenurg Beds

[Recent?]: Central eastern Florida.

E. H. Sellards, 1940, Geol. Soc. America Bull., v. 51, no. 3, p. 381–385. Proposed for deposit of sand and muck that overlies Melbourne bone bed; contact erosional unconformity. Contains vertebrate fossils, human remains, and pottery. Thickness as much as 7 feet.

Irving Rouse, 1950, New York Acad. Sci. Trans., ser. 2, v. 12, no. 7, p. 220–222. Article correlates cultural periods with geologic intervals. The Valkenburg includes Malabar I (in part), Malabar II, St. Augustine, and Seminole. Malabar I may be dated between 750 and 1150 A.D.

Van Vleck Sands

Oligocene: Southern Texas (subsurface)

Alexander Deussen and K. D. Owen, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1617, 1630 (fig. 5), 1631 (fig. 6), 1634. Name suggested for thick body of sands, now commonly called the "Frio" in subsurface, that lie below a marine Oligocene shale wedge and above the Vicksburg. Approximately 2,900 feet thick; occupies interval between 8,100 and 11,000 feet below sea level in type well.

Typically displayed in well No. 21 (Skelly Oil Co., Cobb No. 14–B), at Van Vleck, Matagorda County.

Vaqueros Sandstone[1] or **Formation**

Vaqueros Stage

Oliogcene(?) and Miocene, lower: Southern California.

Original reference: H. Hamlin, 1904, U.S. Geol. Survey Water-Supply Paper 89.

Thomas Clements, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 2, p. 215, 216, (fig. 1). Formation, in Tejon quadrangle, overlies Sespe formation and underlies Temblor formation, marked angular unconformity.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 7–9, fig. 4. Vaqueros formation rests directly on quartz diorites of Santa Lucia Range; apparently attains thickness of about 4,000 feet; neither top nor bottom of formation at type locality has as yet been exactly defined. Underlies Monterey shale. Zemorrian and lower Saucesian.

J. E. Eaton, U. S. Grant, H. B. Allen, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 195–199, 204–205 (fig. 3), 212–213, 216–224, fig. 8. Discussion of Miocene of Caliente Range and environs. Marine Miocene of California is transgressive series, essentially conformable basinward, but revealing strandward two oscillations which respectively

inaugurate and divide its upper third. It comprises three nearly equal natural divisions—Vaqueros, Temblor, and Monterey stages—which approximate lower, middle, and upper Miocene. Each of these has a more or less distinctive epeirogenic history, fauna, and average physical aspect. Vaqueros stage is divisible into a lower and an upper substage by minor but usually perceptible change in fauna that coincided with an acceleration of transgression about the middle of Vaqueros time. At Caliente Mountain, a homoclinal section exposes about 1,100 feet of upper Oligocene(?), 4,500 feet of Vaqueros, 4,700 feet of Temblor, and 4,600 feet of Monterey strata.

R. R. Thorup, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1957–1958; 1943, California Div. Mines Bull. 118, pt. 3, p. 463–466. Type Vaqueros formation restricted and five new formations named in Vaqueros Valley. Formation below restricted Vaqueros are (ascending) Junipero sandstone, Lucia shale, The Rocks sandstone, and Berry conglomerate. Restricted Vaqueros consists of about 2,000 feet of marine sandstone and interbedded siltstone containing "Vaqueros" fossils. Subdivided into six members (A to F); upper member considered to be of lower Saucesian age and lower members Zemorrian. Separated from overlying Monterey by Sandholdt formation (new).

J. E. Allen, 1946, California Div. Mines Bull. 133, p. 18 (fig. 2), 26–30. Vaqueros group, in San Juan Bautista quadrangle, consists of fossiliferous sandstones and red beds as much as 1,800 feet thick (commonly less) which form highest points of rolling hills near town of San Juan Bautista. Conformably overlies Pinecate formation, contact determined only by lowest horizon containing Vaqueros fossils; unconformably underlies lavas and agglomerates.

C. J. Leith, 1949, California Div. Mines Bull. 147, p. 12 (fig. 2), 21, pl. 1. In Hollister quadrangle, which borders Quien Sabe quadrangle on west, Taliaferro (unpub. ms.) reports maximum of 225 feet of sandstone, gravel, and limestone containing upper Vaqueros fossils; these [sediments] rest on Cretaceous and are overlain by Quien Sabe volcanics. These sediments thin eastward and, at boundary of Hollister and Quien Sabe quadrangles, the Vaqueros in this area gives new evidence on extent of lower Miocene sea and provides definite evidence for delineating lower limit of age of overlying volcanics.

T. W. Dibblee, Jr., 1950, California Div. Mines Bull. 150, p. 31–32, pls. 1, 3. Formation, in southwestern Santa Barbara County, is as much as 900 feet thick. Underlies Rincon shale; overlies Sespe formation, and in some areas, Alegria formation (new), a marine facies of continental Sespe.

J. E. Upson, 1951, U.S. Geol. Survey Water-Supply Paper 1108, p. 13–14, table facing p. 12, pls. 1, 2. Exposed low on south flank of Santa Ynez Mountains and crops out in small bodies southwest of Santa Barbara and near coast of Summerland. Average thickness about 350 feet. Overlies Sespe formation; underlies Rincon shale. Lower Miocene.

M. L. Hill, S. A. Carlson, and T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12 p. 2982 (fig. 5), 2983–2988. Discussion of Cuyama Valley-Caliente Range area. Lower Miocene marine sandstone and shale formation lying above Simmler (new) or older formations and conformably underlying Monterey shale or its time equivalent, is mapped

as Vaqueros formation. Along northeast flank of La Panza Range, formation is composed almost entirely of standstone and averages about 500 feet in thickness. In Caliente Range, from Caliente Mountain northward, formation thickens to more than 7,000 feet and is made up of two members, here named Soda Lake shale below and Painted Rock sandstone above. Southeast of Caliente Mountain, consists of (ascending) Soda Lake sandstone, Soda Lake shale, and Painted Rock sandstone members. At southeastern end of the range and in Cuyama Badlands, the Vaqueros is about 700 feet thick and almost all sandstone. Thinning in this direction is in part the result of gradation of upper beds into overlying continental Caliente formation (new). In Salisbury Canyon, a sandstone 1,200 feet thick was mapped as Vaqueros by English (1916, U.S. Geol. Survey Bull. 621–M); it is here included in younger Branch Canyon formation (new).

U.S. Geological Survey currently designates the age of the Vaqueros as Oligocene(?) and lower Miocene on the basis of a study now in progress.

Type area: T. 20, T. 6 E., M. D. M., Junipero Serra quadrangle, Monterey County. Named for exposures on Los Vaqueros Creek.

Vashon Stade

Vashon Drift[1]

Vashon glacial epoch[1] or glaciation

Pleistocene (Wisconsin): Western Washington.

Original reference: B. Willis, 1898, Geol. Soc. America Bull., v. 9, p. 111.

R. C. Newcomb, 1952, U.S. Geol. Survey Water-Supply Paper 1135, p. 18–26, 39–44, pls. 1, 2. Pleistocene deposits, in Snohomish County, consists, above sea level, of about 200 feet of Admiralty clay and as much as 1,000 feet of deposits of Vashon glaciation. The latter include as much as 300 feet of either clay or sand units of advance outwash, as much as 150 feet of till, and variable thicknesses of outwash-terrace and train material. Vashon drift includes Pilchuck clay and Esperance sand members (both new).

J. E. Sceva, 1957, U.S. Geol. Survey Water-Supply Paper 1413, p. 20–26, pls. 1, 3. Vashon drift, in Kitsap County, consists of advance outwash, till, and recessional outwash. Overlies Puyallup sand.

P. D. Snavely, Jr., and others, 1958, U.S. Geol. Survey Bull. 1053, p. 74–77, pl. 1. Vashon drift, consisting of outwash sand, gravel, and marginal terrace deposits, occurs above Logan Hill formation in Centralia-Chehalis district.

D. R. Crandell, D. R. Mullineaux, and H. H. Waldron, 1958, Am. Jour. Sci., v. 256, no. 6, p. 384–397. Pleistocene succession in Puget Sound Lowland is (ascending) Orting glaciation, Alderton nonglacial interval, Stuck glaciation (new), Puyallup nonglacial interval, Salmon Springs glaciation (new), erosion interval, and Vashon glaciation. According to Willis (1898) deposits of Vashon age include Vashon drift, Osceola tills, Oceola clays, and Douty gravels. Osceola till of Willis is now known to be a postglacial volcanic mudflow deposit from Mount Rainier. The Osceola clays and Douty gravels of Willis are glacial drift of Vashon age, and the two names are abandoned.

Named for occurrence on Vashon Island, Puget Sound region.

Vasquez Formation

Vasquez Series[1]

Oligocene and Miocene, lower(?): Southern California.

Original reference: R. P. Sharp, 1935, Pan-Am. Geologist, v. 63, no. 4, p. 314.

R. H. Jahns, 1939, Am. Jour. Sci., v. 237, no. 11, p. 820. In Mint Canyon-Bouquet Canyon area, Vasquez series underlies Tick Canyon formation (new).

L. F. Noble, 1953, Geology of the Pearland quadrangle, California: U.S. Geol. Survey Geol. Quad. Map [GQ–24]. Described as formation consisting of sedimentary and volcanic rocks, mostly well indurated and forming bold outcrops on mountain slopes south of San Andreas fault zone. Sediments lie at base of formation at one place but are absent elsewhere; they are well-bedded red sandstone, shale, and conglomerate composed mostly of granitic material but containing a few rhyolite cobbles. Volcanics constitute most of the formation and include lava flows of pyroxene basalt, andesite, dacite, and rhyolite and some interbedded tuff, ash, and breccia. Thickness more than 500 feet. Unconformably underlies Punchbowl formation (new); unconformably overlies basement rocks. Oligocene and lower Miocene(?).

G. B. Oakeshott, 1958, California Div. Mines Bull. 172, p. 23 (fig. 3), 59–62, pl. 1. Present north of San Gabriel fault. Formation distributed over several square miles of northeastern part of Soledad basin almost completely across northern part of San Fernando quadrangle. Occupies faulted structural basin plunging 25° to 40° toward the southwest from the northeastern corner of quadrangle. In upper Vasquez Canyon-Tick Canyon area, continuity of formation across quadrangle is interruped by exposure of gneissoid biotite-muscovite granite 1¼ miles wide between Mint Canyon fault and pre-Tick Canyon formation fault in Vasquez Canyon. Most complete and continuous section is in Escondido Canyon. Consists of total thickness of about 8,800 feet, comprised of 500 feet of basal conglomerate and sandstone lying on quartz-augite syenite at head of north branch of Escondido Canyon, 3,800 feet of basaltic volcanic rocks, and 4,500 feet of sandstone, shale, and conglomeraate, overlain unconformably by Mint Canyon formation at Agua Dulce Canyon. Also unconformably overlain by Tick Canyon formation, marked angular unconformity. In most places, it is in fault contact with granitic rocks; in several places, in northeastern corner of quadrangle, it lies unconformably on syenite and related hornblende diorite, both of probable Upper Jurassic or Lower Cretaceous age.

Named for outcrops at Vasquez Rock, in upper Agua Dulce Canyon, San Fernando quadrangle, Los Angeles County.

Vassalboro Sandstone[1] or Formation

Silurian(?): Southwestern Maine.

Original reference: E. H. Perkins and E. S. C. Smith, 1925, Am. Jour. Sci., 5th ser., v. 9, p. 204–228.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 124–125, table 1 facing p. 112. Termed a formation. Consists of massive bluish-gray sandstone, calcareous mica phyllite, biotite phyllite, and limestone and calcareous sandstone. Traced into Androscoggin formation near Litchfield. Silurian(?).

A. R. Cariani, 1959, Dissert, Abs., v. 19, no. 10, p. 2577. Correlates with Anson formation (new) on basis of similar lithology.

Well exposed in town of Vassalboro, Kennebec County.

Vatia Trachyte

Pleistocene(?): Samoa Island (Tutuila).

R. A. Daly, 1924, Carnegie Inst. Washington Pub. 340, p. 108–110, 129–130. Trachyte plug. Cuts older basalt flows. Pioarhyolite, Matafao, Papatele, Afono, and Vatia trachytes were erupted contemporaneously or nearly so.

H. T. Stearns, 1944, Geol. Soc. America Bull., v. 55, no. 11, p. 1285–1286 (table 1), 1304–1305. Vatia trachyte plug associated with Pago volcanics (new). Pliocene and early Pleistocene(?).

G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, P. 223. Pleistocene(?).

Crops out on Pola Island at northwest side of Vatia Anchorage. Total length about 3 kilometers; maximum width about 500 meters.

Vaucluse zone[1]

Precambrian: Northwestern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in Catalogue of mineral localities of South Carolina, South Carolina Geol. Survey, ser. 4, Bull. 2: 1907, Summary of mineral resources of South Carolina, p. 6, 9, 12.

Named for exposures at Vaucluse, Aiken County.

Vaughn Member (of Blackleaf Formation)

Lower Cretaceous: Northwestern Montana.

W. A. Cobban and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2790–2791, 2792 (fig. 3); 1959, Billings Geol. Soc. [Guidebook] 10th Ann. Field Conf., p. 89 (fig. 1), 90. Characterized by light-colored highly bentonitic clay and sandstone of nonmarine origin. Mineral heulandite occurs as minute crystals, earthy masses, and short irregular veinlets throughout much of member and gives red color to so-called red speck zone. Basal part chiefly arkosic sandstone containing abundant petrified wood. Black carbonaceous shale forms top of member north of Great Falls. Thickness at type section 97 feet; thins eastward and thickens westward. Underlies Bootlegger member (new); overlies Taft Hill glauconitic member (new).

Type section: About 3½ miles northeast of Vaughn in low south-facing bluffs in NE¼ sec. 6, T. 21 N., R. 2 E., and SE¼ sec. 31, T. 22 N., R. 1 E. Named from village of Vaughn in sec. 24, T. 21 N., R. 1 E., Cascade County.

Vaughn Hills Member (of Worcester Formation)

Carboniferous: Eastern Massachusetts.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 1, 23–25, pl. 1. Proposed for those predominantly quartzitic rocks, previously undifferentiated, that lie at base of mica schist facies of Worcester formation in Harvard and Bolton area. The Vaughn Hills feathers out to north and northeast. Overlies Harvard conglomerate lentil.

Best exposed on southern of the two Vaughn Hills (locality from which it is named) in town of Bolton, Worcester County.

Veazie Formation

Age not stated: South-central Maine.

L. A. Wing, 1957, Maine Geol. Survey GP. and G. Survey 1, sheet 1. Bucksport formation (new) appears to be overlain by interbedded quartzites and slates which are referred to informally as Veazie formation by workers in area. Within this formation is a thin band of iron and manganese slate which closely resembles some of deposits in Aroostook County described by Miller (1947, Maine Geol. Survey Bull. 4). He described the majority of these deposits as of Silurian age and suggested that they may correlate with the Clinton.

Report covers parts of Hancock and Penobscot Counties.

Vecol limestone

[Upper Devonian] (Jeromian): Arizona.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 3, p. 228 (table). Lower part of Jeromian series (new). Thickness 250 feet. Underlies Sycamore sandstone; younger than Espinal limestone (new). Lower part of Jerome formation (of Stoyanow).

In Jerome region.

Vedder Greenstone[1]

Carboniferous: Southwestern British Columbia, Canada, and central northern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey Dept. Mines Mem. 38, maps 16, 17.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 16–17. Associated with rocks of Chilliwack series are greatly altered gabbroid masses which have been termed Vedder formation. Carboniferous.

Mapped on Vedder Mountain, British Columbia.

Veleno Member (of Cook Mountain Formation)

Eocene (Claiborne): Tamaulipas, Mexico, and western Texas.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 262–263. Name proposed for middle member of formation. Consists of alternating beds of shale and sandstone as differentiated from the practically solid sandstone members above and below. Sandstones are calcareous, fossiliferous, concretionary, and in many places glauconitic; shales are mainly carbonaceous, fossiliferous, and weather to characteristic chocolate color. Thickness 700 to 800 feet. Underlies Falcon sandstone member (new); overlies Garceno sandstone member (new).

Named for Arroyo Veleno (misspelled Boleno on topographic map), Zapata quadrangle. Member is exposed on Mexico side of the Rio Grande in vicinity of Zapata.

Velpen Limestone (in Carbondale Group)

Pennsylvanian: Southern Indiana.

J. M. Weller, L. G. Henbest, and C. O. Dunbar *in* C. O. Dunbar and L. G. Henbest, 1942, Illinois Geol. Survey Bull. 67, p. 32 (chart); C. L. Cooper, 1946, Illinois Geol. Survey Bull. 70, p. 16 (fig. 2). Shown on correlation chart at base of Carbondale group; stratigraphically below Houchin Creek [limestone].

Locality not given but may be in vicinity of Velpen, Pike County.

Venado Formation

Upper Cretaceous (Chico Series): Northern California.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 287–289, 291, 293. Predominantly sandstone with minor amounts of siltstone and shale; conglomerate layers particularly at or near base. Thickness 1,890 to 3,440 feet. Underlies Yolo formation (new); overlies Shasta series. Replaces preoccupied name Golden Gate formation (Kirby, 1942).

Type locality: In sec. 9, T. 17 N., R. 4 W., Colusa County. Named from village of Venado.

Venango Formation[1] (in Conewango Group)

Upper Devonian: Northern Pennsylvania and southern New York.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 2, p. 1405–1406, 1438–1440, 1500–1506.

Bradford Willard, 1939. Pennsylvania Geol. Survey, 4th ser., Bull. C–19. p. 14, 243, 253. Formation in Conewango group comprises (ascending) Panama conglomerate, Amity shale, Bimber Run conglomerate, North Warren shale, Pope Hollow conglomerate, Saegerstown shale, Tuna-Kilbuck conglomerate lens, and Woodcock sandstone member. Underlies Riceville formation. Overlies Chadakoin formation of Conneaut group.

I. H. Tesmer, 1954, Dissert. Abs., v. 14, no. 12, p. 2317, 2318. Term Cherry Creek member proposed for succession of gray siltstones and shales which overlie Panama conglomerate member of Venango in Cherry Creek quadrangle, New York.

Name derived from Venango County, Pa.

Venango Group,[1] Stage,[b] monothem[1]

Devonian: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1880, Pennsylvania 2d Geol. Survey Rept. I_3, Atlas, pl. 11.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Prog. Rept. 126, p. 9–11. Devonian comprises Chautauquan and Conewango series. Conewango series includes Venango and Riceville stages. Venango stage includes Sandstone B which will probably be named Youghiogheny sandstone and Shale C which will probably be named Watering Trough shale.

Named for Venango County.

Venice Member (of Columbus Limestone)[1]

Middle Devonian: Northeastern and central Ohio.

Original reference: C. K. Swartz, 1907, Johns Hopkins Univ. Circ. 7, p. 62.

J. W. Wells, 1944, Geol. Soc. America Bull., v. 55, no. 3, p. 276 (fig. 1). Upper member of formation; overlies Marblehead member.

Named for Venice, Erie County.

Ventana sandstones[1]

Upper Triassic: Arizona, Colorado, and Utah.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 338.

Charles Keyes, 1936, Pan-Am. Geologist, v. 65, no. 1, p. 63 (table). Overlies Leroux limestones. Name spelled Vantana.

Named for Ventana Mesa, near Chinle, Apache County, northeastern Arizona.

Venteran Substage

Pennsylvanian (Desmoinesian): Missouri, Iowa, Kansas, Nebraska, and Oklahoma.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1), 2749. Named on northern Midcontinent composite stratigraphic column. Venteran substage together with overlying Cygnian substage (new) make up Desmoinesian stage. Comprises Seville limestone and lower "Cherokee" beds [Krebs group].

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv., 20, p. 10. Type locality and derivation of name.

Type locality: Venter Bluff on U.S. Highway 54, Cedar County, Mo.

Ventioner Beds (in Brad Formation)[1]

Pennsylvanian: North-central Texas.

Original reference: G. Scott and J. M. Armstrong, 1932, Texas Univ. Bull. 3224, p. 35.

Occurs on west side of Trinity River, upstream from mouth of Ventioner Creek, and exposed 1 mile west of Ventioner Creek bridge.

Ventura Formation[1]

Triassic(?): Central northern Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137, map.

J. D. Barksdale, 1948, Northwest Science, v. 22, no. 4, p. 174. Red tuffaceous sandstones and shales named Ventura formation by Russell (1900) are included at base of newly defined Upper Cretaceous Midnight Peak formation.

Named for mining camp in mountains bordering Methow Valley, Okanogan County.

Ventura Sands[1]

Pliocene and Pleistocene: Southern California.

Original reference: C. M. Carson, 1925, Pan-Am. Geologist, v. 43, p. 265–270.

Well exposed in foothills between Ventura and Santa Paula, in Las Posas Hills, near Camarillo, on south and west flanks of South Mountain and in Simi Valley, Ventura County.

Venturian Stage

Pliocene: Southern California.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. One of four stages, based on foraminiferal assemblages, in the Pliocene and Pleistocene of southern California. Includes interval between Wheelerian above and Repettian, below (both new). Venturian is equivalent to lower Pico as used by many geologists.

Venus formation

Precambrian (Chuaran series): Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 112. Dark brown and green shales. Thickness 600 feet. Underlies Marble limestone (new); overlies Oso beds (new).

Named from butte known as Venus Temple, Grand Canyon region.

†Vera Cruz Graphite Schist[1]

Precambrian: Southern Pennsylvania.

Original reference: B. L. Miller, 1911, Pennsylvania Topog. and Geol. Survey Rept. 4, p. 16.

Easton-Reading district.

Veraguas Crystalline Series[1]

Cretaceous(?): Panama.

Original reference: O. H. Hershey, 1901, California Univ. Dept. Geol. Bull., v. 2, p. 247.

W. P. Woodring *in* R. Hoffstetter and others, 1960, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 349. Volcanic and intrusive rocks. Cretaceous(?).

Present in range forming continental divide in Veraguas Province.

Verda Member (of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 100–102. A series of sparingly fossiliferous brackish-water lignitic clays, and interbedded silty sands, with intercalated lenticular marine sandstones, freshwater leaf-bearing silts, and marine clays. Aggregate average thickness 200 feet. Includes, in lower part, Saddle Bayou lentil (new) and in upper part Mossy Ridge and Zenoria lentils (both new) which occupy about same stratigraphic horizon. Grades into underlying Tullos member (new) through transitional phase herein named Union Church; gradationally underlies Danville Landing beds.

J. Huner, Jr., 1939, Louisiana Dept. Conserv. Geol. Bull. 15, p. 149 (fig. 7), 159–163. In Caldwell Parish, includes Myatt lentil (new) and Bayou Calamus lentil (new), both near middle of member.

Well exposed in vicinity of Verda and New Verda, Grant Parish.

Verde Formation[1]

Pliocene(?) or Pleistocene: Central Arizona.

Original reference: L. E. Reber, 1922, Am. Inst. Mining and Metall. Engineers Trans., v. 66, p. 3–26.

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 59–61, fig. 2. Age shown on map as Pliocene(?) or Pleistocene. Unconformably overlies Hickey formation (new) in Jerome area. Derivation of name given.

R. E. Lehner, 1958, U.S. Geol. Survey Bull. 1021–N, p. 557–563, pls. 45, 46, 47. Mutual relationship of Verde with Perkinsville formation (new) not demonstrated in Clarkdale quadrangle but they are tentatively correlated. Thickness as much as 2,000 feet.

Named from occurrence in Verde Valley in region about Clarkdale and Camp Verde, Yavapai County.

Verden Sandstone Member (of Marlow Formation)

Verden Sandstone[1]

Permian: Central southern and southwestern Oklahoma.

Original reference: N. Meland and R. D. Reed, 1924, Jour. Geology, v. 32, no. 2, p. 150–167.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Shown on correlation chart as member of Marlow formation.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 65, fig. 4 (chart). Crossbedded dolomitic sandstone about 10 feet thick. Occurs near middle of formation.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, Marlow formation includes Doe Creek sandstone member in northwestern Oklahoma and Verden sandstone member in southwestern Oklahoma.

Named for exposures on buttes a few miles northwest of village of Verden, Grady County.

Verdi Beds (in St. Louis Limestone)[1]

Verdi Member (of St. Louis Limestone)

Mississippian (Meramec): Southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 319.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 813, 815. The St. Louis is divided into two members, Croton below and Verdi above. Verdi consists of dense gray limestone which grades locally into fine sandstone. Maximum thickness 35 feet. Unconformably overlain by Pella beds.

Named for exposures in old railroad quarry near Verdi Station, Washington County.

Verdigris Limestone Member (of Cabaniss Formation or Senora Formation)

Verdigris Formation (in Cabaniss Group or Cherokee Group)

Verdigris Limestone (in Cherokee Formation)[1]

Pennsylvanian (Des Moines Series): Oklahoma, Kansas, and Missouri.

Original reference: C. D. Smith, 1928, Oklahoma Geol. Survey Bull. 40–U, map.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Verdigris formation in Cabaniss group shown on composite stratigraphic column of Desmoinesian rocks in northern midcontinent. Overlies Croweburg formation; underlies Bevier formation.

W. V. Searight *in* W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. On generalized section of strata exposed in Carroll and Livingston Counties, Mo., Verdigris formation underlies Wheeler formation (new) and overlies Croweburg formation. Cabaniss group.

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ. 31, p. 9, 13, 16 (fig. 2). Member of Senora formation in Oklahoma. Thickness 5 to 11 feet.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 5. Listed as Verdigris coal cycle in Senora formation in Oklahoma. Includes shale, limestone, Verdigris black shale, Verdigris limestone, and Wheeler coal. Occurs above Croweburg coal cycle and below Bevier coal cycle.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 72–78 (measured sections). Formation includes beds above Croweburg coal and extending to top of Wheeler coal. Underlies Bevier formation; overlies Croweburg formation. Takes its name from widespread Verdigris ("Ard-

more") limestone which is its most prominent member. In northern Missouri, formation includes the following members (ascending): thinly laminated light-gray clay shale, black fissile shale, Verdigris limestone, underclay, and Wheeler coal. In western Missouri and in Cherokee and Crawford Counties, Kans., underclay of Bevier coal lies directly on Verdigris limestone, and the Verdigris becomes uppermost member of formation in these areas. In eastern Labette County, Kans., and in northern Oklahoma, a succession of shale and sandstone beds occurs between Verdigris limestone and Bevier coal. Thickness as much as 53 feet. Cabaniss subgroup of Cherokee group.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Verdigris limestone member of Cabaniss formation shown on correlation chart.

Name derived from Verdigris River in southern Rogers County, Okla.

Verdos Alluvium

Pleistocene (Kansan or Yarmouth): Northeastern Colorado.

G. R. Scott, 1960, Geol. Soc. America Bull., v. 71, no. 10, p. 1541–1542. Name applied to alluvial deposit lying 100 feet below older alluvium (Rocky Flats, new), and 100 feet above next younger alluvium (Slocum, new). Where typically exposed, it is a sheet, 16 to 35 feet, of brown well-stratified coarse sand containing some larger stones and volcanic ash bed. Unconformably overlies Mesozoic bedrock. Volcanic ash considered to be correlative with Pearlette ash.

Typically exposed in an outcrop on slope of pediment on Verdos Ranch, in NE¼NW¼SE¼ sec. 22, T. 6 S, R. 69 W., Littleton quadrangle.

Veredas Group

Pennsylvanian (Missouri Series): Central and southern New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull., 17, p. 27 (table 2), 57–60. Term proposed for (ascending) Coane formation, Adobe formation, and Council Spring limestone (all new). Stratigraphic limits of group at type locality are top of Bolander group (new) of Des Moines series below and base of Hansonburg group (new) of upper part of Missouri series. Thickness about 125 feet at type locality.

Type locality: Northwest side of Oscura Mountains on west slope of range in eastern part of SE¼ sec. 36, T. 5 S., R. 5 E., Socorro County. Name derived from Canyon de las Veredas, in central part of Oscura Mountains.

Verendrye Member (of Pierre Shale)

Verendrye Beds or zone (in Sully Member of Pierre Shale)

Upper Cretaceous: Central South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 25–26, 31, pls. 2, 3. Zone, or beds, at top of Sully member (new) of Pierre formation. Consists of clay and shale beds underlying Virgin Creek member (new) and overlying manganiferous Oacoma zone of Sully. Thickness 170 to 180 feet.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1), 2343, 2345. Rank raised to member of Pierre shale. Underlies Virgin Creek member; overlies DeGrey member (new).

Named from exposures under and above Verendrye monument, at Fort Pierre, Stanley County.

Vergennes Sandstone Member (of Spoon Formation)

Vergennes Sandstone Member (of Carbondale Formation)[1]

Middle Pennsylvanian: Southwestern and central western Illinois.

Original reference: E. W. Shaw and T. E. Savage, 1912, U.S. Geol. Survey Geol. Atlas, Folio 185.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 50 (table 1). Reallocated to member status in Spoon formation (new). In lower part of formation below Seahorne limestone member.

Type locality: N¼ sec. 11, T. 7 S., R. 3 W., Jackson County. Named for Vergennes.

†Verkin Shales[1]

Lower Triassic: Southwestern Utah.

Original reference: E. Huntington and J. W. Goldthwait, 1903, Jour. Geology, v. 11, p. 46–63.

Name probably derived from Verkin Creek, Washington County.

Vermejo Formation[1]

Upper Cretaceous: Northeastern New Mexico and southeastern Colorado.

Original reference: W. T. Lee, 1913, Am. Jour. Sci., 4th, v. 35, p. 531.

W. T. Lee, 1917, U.S. Geol. Survey Prof. Paper 101, p. 163–169. In Fremont County, Colo., includes Rockvale sandstone member.

W. T. Lee, 1924, U.S. Geol. Survey Bull. 752. In Raton coal field, New Mexico, includes Rail Canyon sandstone member.

R. L. Griggs, 1948, New Mexico Bur. Mines Mineral Resources Ground-Water Rept. 1, p. 33; G. H. Wood, Jr., S. A. Northrup, and R. L. Griggs, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141. In Colfax County, N. Mex., conformably overlies and interfingers with Trinidad sandstone; unconformably overlies Raton formation. Consists of interbedded coal, shale, siltstone, and sandstone. Maximum thickness about 85 feet.

R. B. Johnson and G. H. Wood, Jr., 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 4, p. 709 (fig. 2), 712. Formation rests conformably on Trinidad sandstone over most of Raton basin region. Tongues of Vermejo strata wedge out in easterly and northeasterly directions, and tongues of Trinidad wedge out west and northwest. Underlies Raton formation. Vermejo rocks consist of buff, gray, and dark-gray siltstone; buff, gray, and gray-green slightly arkosic sandstone; nearly black carbonaceous coaly and silty shale; and numerous coal beds. Thickness as much as 550 feet near East Spanish Peak. Formation absent near Raton, Van Houten, and Ute Park, N. Mex. Montana age.

Type locality: At southeastern extremity of Vermejo Park, N. Mex.

Vermilion facies (of Cleveland Shale)

See **Cleveland Shale.**

Vermilion Granite[1]

Precambrian: Northeastern Minnesota.

Original reference: F. F. Grout, 1923, Econ. Geology, v. 18, p. 253–269.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1036. Presumably contemporaneous with Kekequabic granites. Algoman(?).

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1040. Intrudes Knife Lake series at hundreds of places and is clearly younger, but how much is not clear. Nowhere in contact with Animikie sediments to prove that it is older than Animikie. Magnetite associated with Vermilion granite pegmatites gives tentative age (Hurley, 1943, Geol. Soc. America Bull., v. 54, no. 3) of 750 million years.

Named for exposures on Vermilion Lake and along Vermilion River, northern St. Louis County.

†Vermilion Series,[1] Schists,[1] or Group[1]

Precambrian (Keewatin) : Northeastern Minnesota.

Original reference: N. H. Winchell and A. Winchell, 1887, Minnesota Geol. Nat. History Survey 15th Ann. Rept., p. 4, 192, 355–357.

Occur at northwestern extremity of Vermilion Lake and extend east from Vermilion Lake to Basswood Lake, Vermilion district.

†Vermilion Cliff Group[1]

Upper Triassic: Southwestern to northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 52–54, 151.

Named for Vermilion Cliffs, to south of White Cliffs, near Paria, a little town on Paria River, Kane County, Utah.

†Vermilion Creek Group[1]

Eocene: Northwestern Colorado, northeastern Utah, and southwestern Wyoming.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par., Atlas, maps 1, 2.

†Vermilion Lake Iron-Bearing Series[1]

Precambrian (Huronian) : Minnesota.

Original references: R. D. Irving, 1883, U.S. Geol. Survey 3d Ann. Rept., pl. 3, map; 1888, U.S. Geol. Survey 7th Ann. Rept., p. 440–441.

Vermilion Lake region.

Vermilionville Sandstone Lentil (in Carbondale Formation)[1]

Vermilionville Sandstone (in Carbondale Group)

Vermilionville Sandstone Member (of Carbondale Formation)

Middle Pennsylvanian: Northern and southern Illinois.

Original reference: G. H. Cady, 1919, Illinois Geol. Survey Bull. 37, p. 31, 56–58.

H. B. Willman and J. N. Payne, 1942, Illinois Geol. Survey Bull. 66, p. 123 (fig. 66), 127–128. Described in Marseilles, Ottawa, and Streator quadrangles as a sandstone in Carbondale group. Thickness 15 to 75 feet; variations in thickness result partly from the sandstone filling channels in underlying Canton shale and partly from the channellike depressions in top of sandstone. Included in Brereton cyclothem.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 10. Type locality given.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 34, 35, 48 (table 1). Member of Carbondale formation (redefined).

Name is extended from northern Illinois to equivalent sandstone in southern Illinois for which name Cuba sandstone has been used. Name Cuba preempted.

Type locality: SE part sec. 9, T. 32 N., R. 2 E., La Salle County. Named for outcrops along Vermilion River near Vermilionville.

†Vermont Formation[1] or Quartzite[1]

Lower Cambrian: Southwestern Vermont and western Massachusetts.

Original reference: J. D. Dana, 1873, Am. Jour. Sci., 3d, v. 6, p. 272–278.

Derivation of name not stated, but probably named for development in southern Vermont.

Vermont Quartz Diorite

Pre-Cretaceous(?): Southern California.

G. J. Neuerburg, 1953, California Div. Mines Spec. Rept. 33, p. 3, 7 (table 1), 10–11, pl. 1. A medium-grained quartz diorite in Vermont pluton. Present only in northern half of Mount Hollywood fault block, where it intruded and metamorphosed a complex of basalt, diabase, and gabbro. Suggested sequence of intrusion in area is Vermont quartz diorite, Lar quartz diorite (new) and Feliz granodiorite (new).

Occurs in Griffith Park area, city of Los Angeles. [Name probably derived from fact that it is near Vermont Ave., Los Angeles.]

Vernal[1] (shale)

Upper Jurassic: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Vernal Mesa Quartz Monzonite

Vernal Mesa Granite[1]

Precambrian: Central western Colorado.

Original reference: J. F. Hunter, 1925, U.S. Geol. Survey Bull. 777.

Occurs near northwest end of Vernal Mesa and walls adjacent to part of Black Canyon, in Gunnison River region.

Verne cyclothem (in Saginaw Group)

Pennsylvanian: Southern Michigan.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 159, 166, 177, 183, 190. Cyclical formation in Saginaw group. Contains Verne shaly limestone.

Named for Verne mine, sec. 23, T. 10 N., R. 4 E., Saginaw County.

Verne Shaly Limesone Member (of Saginaw Formation)

Pennsylvanian: Southern Michigan.

W. A. Kelly, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 159, 166, 177, 183, 190. Verne shaly limestone member of Verne cyclothem. Limestone is persistent and makes it possible to divide Saginaw into pre- and post-Verne cyclical formations.

Michigan Geol. Soc., 1954, *in* Geologic cross section of Paleozoic rocks central Mississippi to northern Michigan: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 28. Referred to as limestone member of Saginaw formation. Consists of a few feet of black highly argillaceous limestone that grades upward into a calcareous shale. Limestone is late

Pottsvillian in age and its fauna is more closely related to fauna of the Pottsville in Illinois than to fauna of same age in Ohio.

Type locality (cyclical formation): Verne mine, sec. 23, T. 10 N., R. 4 E., Saginaw County.

†Vernon Gneiss[1]

Upper Carboniferous or post-Carboniferous: Southeastern Vermont and western central Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 17, pl. 34.

Named for occurrence in Vernon Township, Vt.

Vernon Limestone[1]

Devonian: Southeastern Vermont and western central Massachusetts.

Original reference: B. K. Emerson, 1890, Am. Jour. Sci., 3d, v. 40, p. 365.

Occurs in Vernon Township, Vt.

Vernon Shale (in Salina Group)

Vernon Shale Member (of Salina Formation)[1]

Upper Silurian: Western to east-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 18–19, chart.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as shale in Salina group, Cayugan series. Overlies Pittsford shale; underlies Syracuse salt.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 10, fig. 1. Discussion of age of Brayman shale. The Brayman lies first upon Ordovician strata in type area and at Sharon Springs. West of Cherry Valley, it lies upon progressively younger strata of Middle and Upper Silurian. At western border of Richfield Springs quadrangle, the Lockport, Vernon, Camillus, and Bertie have all appeared in the section. Figure 1 shows the Vernon underlying the Camillus and overlying the Herkimer.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7. Salina formation, in central New York, consists of two facies, Vernon red shales near base, and above, Camillus gray calcareous shales and dolomites with salt and gypsum beds.

W. P. Leutze, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 7, p. 1693, 1694 (fig. 1). Underlies Syracuse formation where that formation outcrops in Onondaga and Madison Counties. Thickness about 300 feet. Salina group.

W. L. Kreidler, 1957, New York State Mus. Bull. 361, p. 6. Underlies Syracuse salt member of Camillus.

D. W. Fisher, 1957, New York State Mus. Bull. 364, p. 3–30. Discussion of Vernon shale in type area; reference section designated. The Vernon has been variously treated as a distinct formation or as a member of Salina formation and commonly considered to be 150 feet thick in type area. At least five distinct rock types are represented in strata classed as Vernon, but they are so interrelated that further differentiation into smaller units is not warranted from cartographic standpoint. The Vernon is here regarded as a phase of sedimentation (magnafacies) capable of geologic mapping; hence, it can properly be termed a formation.

Name "Pittsford shale" is suppressed and the discontinuous occurrence of greenish-black shale above Lockport dolomite is included in Vernon formation. Thickness at reference section 270 feet; contact with underlying Lockport not exposed, and section does not extend up to contact with overlying Camillus. Total estimated thickness of Vernon in type area 400 feet. Within New York, the Vernon is considered correlative of High Falls shale of Orange and Ulster Counties. Upper Silurian.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Included in Canastota(n) stage (new), Cayugan series.

Type locality: Vernon Township, Oneida County. Reference section: Downing Brook, which enters Oneida Creek from east 1.3 miles south of part of Sherrill known as Kenwood and 0.6 miles north of southern boundary of Oneida County. This is 2.3 miles south of intersection of New York Highway 5 and Kenwood-Sherrill Road.

Versailles Bed (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana and north-central Kentucky.

Original reference: A. F. Foerste, 1905, Science, new ser., v. 22, p. 150.

Named for Versailles, Ripley County, Ind.

Vershire Schist[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 115.

Probably named for exposures in or near Vershire village or elsewhere in Vershire Township, Stafford quadrangle, in Orange County.

Vestal Limestone[1]

Ordovician (Chazyan): Central Tennessee.

Original reference: C. H. Gordon, 1924, Tennessee Dept. Ed., Div. Geol. Bull. 28, p. 35, 40.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 94. A marble about 150 to 200 feet thick near base of Sevier formation on south side of Knoxville. Has about same position as Meadow marble.

Named for exposures in town of Vestal, Knox County.

Veta Pass Limestone Member[1] (of Sangre de Cristo Conglomerate)

Pennsylvanian: South-central Colorado.

Original reference: F. A. Melton, 1925, Jour. Geology, v. 33, p. 812.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 811 (fig. 1), 829. If, in its type section, top of member were drawn at Whiskey Creek Pass limestone (new), 3,138 feet would be more nearly correct for thickness of member than 2,100 feet as cited by Melton.

D. W. Bolyard, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 1911. Madera formation as used in this report replaces Veta Pass limestone member of Sangre de Cristo conglomerate of Melton (1925).

Type section: Along Placer Creek north of Russell post office, near La Veta Pass, Sangre de Cristo Range.

Vick Formation

Lower(?) Cretaceous: Central Alabama.

L. C. Conant, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 5, p. 711–715. Semi-indurated sandstone and mottled brick-red and gray

sandy clay unlike and apparently older than anything known in Tuscaloosa but younger than near-by Paleozoic rocks. Proposed that strata represented by these outcrops be tentatively designated Vick formation, of either Jurassic or Lower Cretaceous age. Several outcrops have between 20 and 50 feet of beds; composite section shows total thickness of about 100 feet represented. In some areas, unconformably overlain by coarse conglomeratic sandstone believed to be base of Eoline formation.

C. W. Drennan, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 3, p. 536. Coker formation is extended to include all outcropping pre-Gordo sediments of Tuscaloosa group except those designated Vick formation by Conant (1946), which may be Tuscaloosa in age.

Type locality: Series of exposures along old Centerville-Randolph Road in SE¼SW¼ and SW¼SE¼ sec. 27, T. 23 N., R. 10 E., together with exposures in wall of 60-foot sink hole a quarter mile southwest of road exposures, in vicinity of Vick, Bibb County.

Vicksburg Group[1]

Vicksburg Formation

Oligocene: Gulf Coastal Plain.

Original reference: T. A. Conrad, 1848, Acad. Nat. Sci. Philadelphia Proc., v. 3, p. 280–299.

W. D. Chawner, 1936, Louisiana Dept. Conserv. Geol. Bull. 9, p. 94–110. Group exposed in northwestern Catahoula Parish in broad outcrop. Overlies Danville Landing zone of Jackson group. Contact is not distinct lithologic break, and contact line as mapped is based on uppermost appearance of Danville Landing fossils in various sections. Upper part of Vicksburg section unconformably overlain by Cassel Hill member of Catahoula.

A. N. Fisk, 1938, Louisiana Dept. Conserv., Geol. Bull. 10, p. 124–141. Outcrop of Vicksburg follows outcrop of Catahoula formation as narrow band from Rosefield, Catahoula Parish, to region north of Summerfield, Grant Parish. In the field, no definite contact can be drawn separating the Vicksburg from overlying continental siltstone of Catahoula or from underlying marine Jackson beds. Nor can any hard or fast line be drawn between similar beds within the Vicksburg sediments. However, beds can be separated into two interrelated members of sedimentation, a lower gypsiferous member and an upper sandy clay member with microfaunas characteristic of both Byram marl and Mint Spring marl.

F. F. Miller, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 23–24. Rank reduced to formation. Comprises Mint Spring facies, Glendon and Byram members. Overlies Jackson formation with disconformity; underlies Citronelle formation with disconformity.

F. S. MacNeil, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1313–1354. Vicksburg group is restricted to middle part of the Oligocene, namely Marianna limestone (with Mint Spring marl member) and Byram formation (with Bucatunna clay and Glendon limestone members). Excluded from group are the three youngest Oligocene formations—Chickasawhay limestone, Suwannee limestone, and Flint River formation—and basal Oligocene formations—Forest Hill sand, and Red Bluff clay. Thus, the Vicksburg includes only beds for which name was intended, the fossiliferous Oligocene of Warren County, Miss. This restriction is not a new idea. Various geologists have suggested that

the top, or bottom, or both, of the Oligocene be removed from the Vicksburg, some have suggested that the upper part is Miocene, and others that the lower part is Eocene.

C. W. Stuckey, Jr., 1953, Am. Assoc. Petroleum Geologists Guidebook Field Trips Houston Mtg., p. 25–27. Vicksburg group, overlying the Jackson, is accepted as lower part of Oligocene. There is disagreement as to upper boundary of Oligocene. The Vicksburg does not appear on surface in Texas because of overlap by Miocene beds. In subsurface of Texas, consists of about 500 feet of gray calcareous shales containing local sand lenses. Distinctive microfauna. Top is picked on *Textularia warreni*. Section overlying Vicksburg in subsurface is referred to as Frio.

Named from exposures at Vicksburg, Miss.

†Vicksburg (fossiliferous) Loam[1]

Recent(?): Mississippi.

Original reference: T. A. Conrad, 1846, Am. Jour. Sci., 2d, v. 2, p. 212.

Vicksburg Stage, Age

Oligocene: Gulf Coastal Plain.

G. E. Murray, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 700–707. Since Vicksburg, in its present broad application, has no real lithologic unity and is applied in essentially a time-rock (time-stratigraphic) sense, it is proposed to recognize it as a stage, even though its exact isochronous boundaries are unknown and, except at its type locality, may never be precisely determined. Vicksburg stage and its corollary, Vicksburg age, should contain sediments deposited during stand of sea in Gulf and Atlantic coastal region as represented by type section of Vicksburg deposits at and in vicinity of Vicksburg, Miss., and their equivalents. Name Mosley Hill formation proposed for sediments at Sabine River equivalent to type Vicksburg. Harris (1902, Louisiana State Expt. Sta. Geol. Agr. Louisiana, pt. 6, Spec. Rept. 1) applied Vicksburg stage to sediments exposed in and around Rosefield, Catahoula Parish, La., and used term stage in essentially the modern concept.

E. C. Tonti, 1955, Dissert. Abs., v. 15, no. 8, p. 1372. Two sedimentary cycles identified in Vicksburg stage. Distinct disconformity marks upper and lower boundary of each unit. Lowermost cycle extends from disconformity at base of Mint Springs-Marianna formation to similar break at top of Byram formation as defined in this report. Uppermost cycle contains Bucatunna marl and clay facies extending to disconformity at base of overlying Catahoula and Chickasawhay formations. In each case, cycle contains a lower transgressive and an upper regressive unit. Term Vicksburg stage suggested to include at least those deposits mentioned and whatever variable, but equivalent facies might be determined elsewhere.

A. D. Warren, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 221–237. In Louisiana, the subsurface stratigraphic section between Anahuac stage and Vicksburg stage is named Frio stage.

Victor Andesite[1]

Tertiary: Nevada.

Original reference: T. B. Nolan, 1930, Nevada Univ. Bull., v. 24, no. 4, p. 16.

In Tonopah Extension mine, Tonopah district.

Victor Formation[1]

Pleistocene: Central California.

A. M. Piper and others, 1939, U.S. Geol. Survey Water-Supply Paper 780, p. 33 (table), 38–49, pl. 1. Fluviatile sand, silt, and gravel, in small part well sorted and well stratified. Thickness as much as 125 feet. Underlies Recent alluvium; overlies Arroyo Seco gravel (new); locally overlies Mehrten formation (new).

Type section: Pit in SW¼NE¼ sec. 3, T. 3 N., R. 7 E., 190 feet north of Southern Pacific Railroad at east edge of Bruella Road, Mokelumne area.

†Victoria Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Victoria mine, Ontonagon County.

†Victoria Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Victoria mine, Ontonagon County.

Victoria Formation

Victoria Quartzite[1]

Upper Devonian: Central northern Utah.

Original reference: C. F. Loughlin, 1919, U.S. Geol. Survey Prof. Paper 107.

H. T. Morris, 1957, Utah Geol. Soc. Guidebook 12, p. 11 (fig. 3), 12–13. As currently defined by U.S. Geological Survey, formation includes all Victoria quartzite as originally defined, plus 70 to 80 feet of mottled coarse-grained dolomite, now known to be of Devonian age, that was formerly placed in lower part of Loughlin's Gardner dolomite. Thickness 250 to 300 feet. Overlies Bluebell dolomite; underlies Pinyon Peak limestone. Upper boundary of Victoria is placed at top of uppermost dolomite bed that underlies thin-bedded shaly limestones of the Pinyon Peak. This contact marks disconformity that is unimportant in East Tintic Mountains, but corresponds to major pre-late Late Devonian unconformity that is recognized in Stansbury Mountains, Oquirrh, central Wasatch, and eastern Uinta Ranges.

Named for Victoria mine, three-fourths mile south-southeast of Eureka.

†Victoria Formation, Clays,[1] or Shale[1]

Upper Cretaceous: Central Kansas.

Original reference: F. W. Cragin, 1896, Colorado Coll. Studies, v. 6, p. 50.

Named for exposures at Victoria, Ellis County.

Victoria Peak Massive Member (of Bone Spring Limestone)[1]

See **Victorio Peak** correct spelling.

Victorio Peak Limestone

Victorio Peak Gray Member (of Bone Spring Limestone)

Permian (Leonard Series): Western Texas and southeastern New Mexico.

Original reference: P. B. King and R. E. King, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 921, 922, 925.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 569, pl. 2; 1948, U.S. Geol. Survey Prof. Paper 215, p. 16–17, pl. 3. Referred to as Victorio Peak gray member. Consists of gray, calcitic limestone in thick, fairly even beds, 500 to more than 1,000 feet thick. Overlies unnamed black limestones in lower part of formation; underlies Cutoff shaly member (new).

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 21. Formation described in Wylie Mountains and vicinity. Composed dominantly of dolomite. Mapped in four units: basal thin-bedded marly limestone; limestone member; marl member; dolomite member. Thickness 1,600 feet. Overlies Hueco limestone; underlies Seven Rivers limestone. Leonard-Guadalupe.

D. W. Boyd, 1958, New Mexico Bur. Mines Mineral Resources Bull. 49, p. 12–13, 62–63, pl. 1, strat. sections. Victorio Peak gray member mapped and described in Otero County, N. Mex.

Named for exposures on Victorio Peak, promontory of Sierra Diablo scarp, Texas.

Victorville Quartz Monzonite

Upper Jurassic: Southern California.

W. J. Miller, 1944, California Jour. Mines and Geology, v. 40, no. 1, p. 105–106. Typically very light gray, massive, medium grained, and almost totally devoid of dark minerals. Dikes of the quartz monzonite cut Oro Grande metasediments.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 504. Cuts Bell Mountain quartz diorite (new).

Named for exposures north and northeast of Victorville, Barstow quadrangle, San Bernardino County.

Victory Member (of Grand Detour Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., fig. 3. Shown on columnar section as underlying Forreston member (new) and overlying Eldena member (new) of Nachusa formation (new).

Occurs in Dixon-Oregon area.

Victory Junction Shale Member[1] (of Stanton Limestone)

Pennsylvanian (Missouri Series): Central eastern and northeastern Kansas.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans., [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, pt. 1, p. 76–79.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 51. Rock Lake shale was named in Nebraska by Condra (1927) but was named Victory Junction shale by Newell (1935) for occurrences in Kaw Valley area, Kansas. On the basis of subsequent studies, it is agreed that original name is valid.

Named for Victory Junction in western part of Wyandotte County.

Vidae Flows, Lavas

Pleistocene to Recent: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 37. Probably first dacites erupted by Mount Mazama were those forming Grayback Ridge and those making up southern end of Vidae Ridge. They date back to time preceding maximum glaciation of Mount Mazama and are older than lavas of Llao Rock, Cleetwood Cove, Grouse Hill, and Redcloud Cliff. Vidae lavas thickens southward from probable vent to as much as 500 to 600 feet.

Vidae Ridge is on south side of Crater Lake.

Vidrio Limestone Member (of Word Formation)

Vidrio Massive Member (of Capitan Limestone)[1]

Permian (Guadalupe Series): Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 52.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 655–656, pl. 2. Restricted to that part of former Vidrio member which is believed to be middle Guadalupe in age, and classed as member of Word formation. Capitan is restricted to that part of former Vidrio member or reef facies that is upper Guadalupe (post-Word) in age. Overlies and (or) interfingers with unnamed limestones or formation; underlies Capitan limestone in western part of Glass Mountains and Gilliam limestone in eastern part.

Unit is conspicuous part of Glass Mountains. Vidrio is Spanish word for glass and is often used among local Mexican population as a name for the mountains.

Vieja Group

Vieja Series[1]

Tertiary: Southwestern Texas.

Original reference: T. W. Vaughan, 1900, U.S. Geol. Survey Bull. 164, p. 78–81.

R. K. DeFord, 1958, Texas Jour. Sci., v. 10, no. 1, p. 13, 15 (fig. 3). Redefined as Vieja group; stratigraphically extended upward; subdivided. Vieja series of Vaughan is subdivided into five formations (descending): Chambers tuff, Buckshot ignimbrite, Colmena tuff, Gill breccia (all new), and Jeff conglomerate. Expanded upward to include four newly defined formations (ascending) Bracks rhyolite, Capote Mountain tuff, Brite ignimbrite, and Petan basalt. Group unconformably overlies Upper Cretaceous rocks; in many places contact is concordant, but in others Cretaceous rocks were folded or thrust-faulted prior to Vieja deposition.

Named for exposures in Vieja Mountains, Presidio County.

Viejas Gabbro-Diorite[1]

Upper Jurassic or Lower Cretaceous: Southern California.

Original reference: W. J. Miller, 1935, California Jour. Mines and Geology, v. 31, no. 2, p. 115–141, map.

Type occurrence: In Viejas Mountains, southern Peninsular Ranges, San Diego and Imperial Counties.

Vienna Limestone[1]

Vienna Limestone (in Elvira Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, western Kentucky, and southeastern Missouri.

Original references: S. Weller, 1920, Jour. Geol., v. 28, no. 4, p. 281-290; no. 5, p. 395–416.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 836. Assigned to Elvira group (new). In standard Mississippian section, underlies Waltersburg sandstone and overlies Tar Springs sandstone. Youngest Chester formation recognized in Missouri where it is represented by thick residual chert on a few hilltops in southeastern Perry County.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Name Vienna limestone extended into Indiana and applied to shale and limestone interval underlying Waltersburg sandstone and overlying Tar Springs sandstone.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Vienna limestone shown on stratigraphic column of upper Chester rocks in Indiana as dark- to olive-green shale; locally contains dark-gray or brown thin beds of crystalline limestone. Thickness 5 to 15 feet. Term Elvira group not used in Indiana.

Named for exposures at Vienna, Johnson County, Ill., where it is exposed in some streets and in an old quarry just west of town.

Viesca Member (of Weches Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 97, 104–107. Composed of poorly bedded fossiliferous argillaceous and calcareous glauconite rock where fresh and of red and brown clays and clay-ironstones with fossil casts where weathered. Thickness varies from 5½ to a little more than 38 feet, average 26 feet. Underlies Therrill member (new) with boundary transitional; overlies Tyus member (new) with boundary transitional.

Type locality: Lee's Waterfall in Jose Maria Viesca survey, Leon County.

Vigo Limestone Member (of Shelburn Formation)

Upper Pennsylvanian: Southwestern Indiana.

C. E. Wier, 1952, Indiana Geol. Survey Prelim. Coal Map 1. Shown on columnar section as limestone near top of Shelburn formation. Occurs above Vigo coal.

Courtney Waddell, 1954, U.S. Geol. Survey Coal Inv. Map C–17. Limestone bed 1½ to 2½ feet thick near top of formation. Where weathered, limestone is dull gray and appears argillaceous; on fresh surface, appears to be made up of small aggregates of brown crystalline calcite in argillaceous matrix. Underlies a black fissile shale 8 to 10 inches thick. Separated from underlying Maria Creek member by a unit of thin-bedded gray-green nonfossiliferous sandy shale about 110 feet thick that contains a few thin local bands of iron concretions and several thin discontinuous coal beds, less than 1 foot thick. Derivation of name given.

D. J. McGregor, 1958, Indiana Geol. Survey Bull. 15, p. 46 (table 8). Stratigraphically below Murphys Bluff sandstone member.

Name from exposures along Prairie Creek near Vigo, center NW½NW¼ sec. 28, T. 10 N., R. 10 W., Sullivan County.

Vilas Shale (in Lansing Group)[1]

Vilas Shale Member (of Lansing Formation)[1]

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: E. Haworth, 1898, Kansas Univ. Geol. Survey, v. 3, p. 51, 103.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Shale in Lansing group. Overlies Plattsburg formation; underlies Stanton formation. This is classification agreed upon by Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 33. Thickness about 8 feet in Cass and Sarpy Counties, Nebr. Lansing group.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 419. In Madison and Adair Counties, Iowa, formation is 10 to 12 feet thick. Overlies Plattsburg formation; underlies Stanton formation(?).

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 24, fig. 5. Exposed only in Adair and Madison Counties where it is a 12-foot sequence of gray unfossiliferous shale overlying a maroon shale. Underlies Stanton limestone; overlies Plattsburg limestone. Lansing group.

Named for exposures in vicinity of Vilas, Wilson County, Kans.

Village Bend Limestone (in Mineral Wells Formation)[1]

Village Bend Member (of East Mountain Shale)

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer, 1929, Texas Bur. Econ. Geology, geol. map of Palo Pinto County.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in East Mountain shale. Uppermost member of formation; overlies Capps limestone member; underlies Lake Pinto sandstone member of Salesville formation. Strawn-Canyon boundary placed at top of Village Bend limestone. Name Mineral Wells dropped in this report.

J. W. Shelton, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1515–1524. Discussion of Strawn-Canyon boundary. In eastern Palo Pinto County, boundary is placed at base of Lake Pinto sandstone which overlies Village Bend limestone.

L. F. Brown, Jr., 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2866–2871. Discussion of problems of stratigraphic nomenclature and classification, Upper Pennsylvanian, north-central Texas—erecting series from groups, suppression of formations, redefining and raising rank of rock-stratigraphic units, and time-stratigraphic boundaries versus lithologic contacts.

Type locality: Exposure near west end of Village Bend of Brazos River 2¾ miles in direct line southeast of Palo Pinto, Palo Pinto County.

Villa Nueva Sandstone Member (of Fayette Formation)[1]

Eocene, upper: Tamaulipas, Mexico, and southern Texas.

Original reference: W. G. Kane and G. B. Gierhart, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 9, p. 1387.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 270. In Texas, overlies Agua Verde shale member (new). Exposures limited. Thickness probably more than 100 feet in Starr County. Appears to be overlapped by Frio south of Zapata County line.

Derivation of name not stated.

Vinalhaven Rhyolite[1]

Vinalhaven Granite

Upper Silurian: South-central Maine.

Original reference: G. O. Smith, 1896, Geology of the Fox Islands, Maine, p. 12, 46–55.

H. W. Fairbairn and P. M. Hurley, 1957, Am. Geophys. Union Trans., v. 38, no. 1, p. 104 (table 7), 106 (table 9). Referred to as granite.

Occurs in northwestern part of Vinalhaven Island, Knox County.

Vincentown Formation (in Rancocas Group)

Vincentown Sand (in Rancocas Group)[1]

Paleocene: New Jersey.

Original reference: W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897, Geol. Soc. America Bull., v. 8, p. 316–338.

A. R. Loeblich, Jr., and Helen Tappan, 1957, Jour. Paleontology, v. 31, no. 6, p. 1113 (fig. 2), 1128 (fig. 5), 1129–1132. Age of formation given as Paleocene (Landenian). Determination made on basis of foraminiferal studies. Report summarizes opinions of several workers and cites bibliography.

H. G. Richards, J. J. Groot, and R. M. Germeroth, 1957, Geol. Soc. America Guidebook Field Trips Atlantic City Mtg., p. 184 (table 2), 186 (table 3), 199–200, 201 (table 4). Marl (formation) underlies Manasquan marl; overlies Hornerstown marl and occurs in belt immediately to southeast of it. Consists of calcareous phase and quartz phase with varying amounts of glauconite; the two phases are probably not traceable over great distances. Thickness at outcrop 25 to 100 feet; average dip 27 feet per mile. Opinion as to age is now divided between Paleocene (Midway) and Lower Eocene (Wilcox); general opinion now favors Paleocene dating.

S. K. Fox, Jr., and R. K. Olsson, [abs.] 1955, Jour. Paleontology, v. 29, no. 4, p. 736. Comparison of type Vincentown microfauna with Hornerstown and basal Vincentown assemblages reveals that type Vincentown is Eocene in age. It contains no diagnostic Paleocene forms.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184. Rancocas group includes (ascending) Hornerstown sand, Vincentown formation, and Manasquan formation.

Named for Vincentown, Burlington County.

Vindicator Rhyolite[1]

Tertiary: Southwestern Nevada.

Original reference: F. L. Ransome, 1909, U.S. Geol. Survey Prof. Paper 66, p. 28, 37.

Well exposed on flanks of Vindicator Mountain, Goldfield district.

Vine Hill Sandstone

Paleocene: Northwestern California.

C. E. Weaver, 1953, Washington [State] Univ. Pubs. in Geology, v. 7, p. 19 (chart), 21–30, pls. 4B, 4C. Name applied to Paleocene rocks of Martinez area. Consists of massive medium- to coarse grained brown to reddish-brown glauconitic sandstone and minor amounts of interbedded silty shale formerly considered by several writers as Lower Martinez. Thickness at type section approximately 1,225 feet; beds dip from 70° to vertical toward southwest. Base of section [type section] as exposed in cuts along Santa Fe Railway does not represent lowermost part of Vine Hill. Basal beds, which occur farther to southeast in low hills are about 425 feet thick and consist of poorly exposed dark-brown gritty sandstone with interbedded layers of silty shale. Underlies Las Juntas shale (new); contact with underlying Cretaceous Chico not established. Vine Hill sandstone together with Las Juntas shale were mapped and described in San Francisco folio (Lawson, 1914) as Martinez group. At type section, Vine Hill sandstone is equivalent to basal sandstone part of Martinez group as that term was used by early investigators.

B. Y. Smith, 1957, California Univ. Pub. Geol. Sci., v. 32, no. 3, p. 143–144. Since Pacheco syncline is generally accepted as type area for the Martinez, it is particularly difficult to follow Weaver's (1953) omission of that term as an appropriate designation for lower part of sequence, and it seems desirable that Weaver's new units, Vine Hill, Las Juntas, and Muir, be included either as members within Martinez formation or as formations within Martinez group. Foraminifera described.

Type section: In east limb of Pacheco syncline in cuts along Santa Fe Railway immediately east of Pacheco Road, near Martinez, Contra Costa County. Exposed in limbs of northwest trending folds in hills between Southampton and Franklin faults from Franklin Ridge southeast to town of Walnut Creek. On west limb of syncline, concealed beneath surface along Southampton fault.

Vineyard Formation[1]

Vineyard Interglaciation

Vineyard interglacial stage[1]

Pleistocene: Southeastern Massachusetts and southeastern New York.

Original reference: J. B. Woodworth, 1896, U.S. Geol. Survey 17th Ann. Rept., pt. 1, p. 975–988.

C. W. Cooke and others, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Correlation chart shows Vineyard formation younger than Manhassett formation. Wisconsin.

Name amended to Vineyard Interglaciation in compliance with Code of Stratigraphic Nomenclature (1960), article 40.

Named for occurrence on Martha's Vineyard.

Vineyard Series[1]

Upper Cretaceous to Pliocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S. Geol. Survey 7th Ann. Rept., p. 303–363, map.

Well exposed at both extremities of Marthas Vineyard.

Vinini Formation

Lower and Middle Ordovician: Central Nevada.

C. W. Merriam and C. A. Anderson, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1953; 1942, Geol. Soc. America Bull., v. 53,

no. 12, pt. 1, p. 1693–1698. Quartzites, calcareous sandstones, cherty shales, cherts, and andesite flows and tuffs. Present in low-angle thrust plate above Pogonip limestone, Eureka quartzite, and Hanson Creek limestone in Roberts Mountains area. Vinini embraces at least two and possibly three formational divisions; for purposes of this report, divided into lower and upper divisions. Age established on the basis of graptolites.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 34–36. Discussed in stratigraphic section in vicinity of Eureka. Formation has been folded and cut by local minor thrust faults; both folds and thrust faults seem to be transgressed by unconformity at base of overlying Permian sequence.

Named from exposures along Vinini Creek, eastern slope of Roberts Creek Mountain, 25 miles northwest of Eureka, Roberts Mountains quadrangle.

Vinita Beds[1] or Sandstones (in Chesterfield Group)

Upper Triassic: Eastern Virginia.

Original reference: N. S. Shaler and J. B. Woodworth, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 2, p. 435.

C. B. Brown, 1937, Virginia Geol. Survey Bull. 48, p. 16. Incidental mention in discussion of Triassic rocks in Goochland County.

Occur in James River bluff west of Vinita Station on Tomahawk Creek and crop out on east slope of Goat Hill near Vinita, Goochland County.

†Vinita Formation[1]

Pennsylvanian: Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 12.

Named for Vinita, Craig County.

Vinland Shale[1] Member (of Stranger Formation)

Vinland Shale Member (of Plattford Formation)

Pennsylvanian (Virgil Series): Eastern Kansas and northwestern Missouri.

Original references: R. C. Moore, M. K. Elias, and N. D. Newell, 1934, Stratigraphic sections of Pennsylvanian and "Permian" rocks of Kansas River valley: Kansas Geol. Survey, issued Dec.; R. C. Moore, 1935, Rock formations of Kansas *in* Kansas Geol. Soc.: Wichita, Kans., [Am. Assoc. Petroleum Geologists 20th Ann. Mtg., Mar. 21–23]; N. D. Newell, 1935, Kansas Geol. Survey Bull. 21, p. 82.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 72–73. Member of Stranger formation. Gray clayey, calcareous and sandy shale, and locally some sandstone underlying Haskell limestone member; locally in Woodson County, Kans., dark-green layer occurs in middle part; north of Anderson and Coffey Counties, Kans., where Westphalia limestone member is absent, top of Upper Sibley coal is regarded as marking base of Vinland shale. Disconformity beneath sandstone at base of Vinland cuts out the Westphalia limestone locally in Coffey County. Thickness 9 to 50 feet.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 30 In Nebraska, uppermost member of Plattford formation. Thickness 6 to 14 feet in outcrop area in Cass County where it rests unconformably on Stanton formation.

Type locality: About 2 miles northeast of Vinland, Douglas County, Kans.

Vintage Dolomite[1]

Lower Cambrian: Southeastern Pennsylvania and northern Virginia.

Original reference: G. W. Stose and A. I. Jonas, 1922, Washington Acad. Sci. Jour., v. 12, p. 359, 362, 363.

G. W. Stose and A. I. Jonas, 1938, Virginia Geol. Survey Bull. 51–A, p. 19, 20, 21. Proposed to extend names Vintage dolomite, Kinzers formation, and Ledger dolomite to comparable Lower Cambrian formations in area southeast of Austinville, Va. Section near Austinville shows Vintage dolomite overlying Erwin quartzite.

Well exposed in cut of Pennsylvania Railroad at Vintage, 15 miles east of Lancaster, Lancaster County, Pa.

Vinton Member[1] (of Logan Formation)

Lower Mississippian: Central Ohio.

Original reference: J. E. Hyde, 1912, History of Fairfield County and representative citizens, by C. C. Miller, p. 206–212.

F. T. Holden, 1941, Illinois Acad. Sci. Trans., v. 34, no. 2, p. 172–173; 1942, Jour. Geology, v. 50, no. 1, p. 41 (table 1), 59, 62, 64. Included in Pretty Run sandstone facies, Scioto Valley shale facies, and Vanceburg siltstone facies (all new) of Logan formation. In Pretty Run facies, overlies Allensville conglomerate member and underlies Rushville shale member; in Scioto Valley facies, overlies Portsmouth shale member; in Vanceburg facies, overlies Churn Creek siltstone. Lower Mississippian.

Named for Vinton County.

Vinton phase (of Otis Limestone)[1]

Middle Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1921?, Iowa Geol. Survey, v. 27, p. 377.

M. A. Stainbrook, 1944, Illinois Geol. Survey Bull. 68, p. 182, 185. "Vinton phase" is shown by its fossils to belong to Cedar Valley formation.

Exposed in quarries north of Vinton, Benton County, along Cedar River.

Viola Limestone[1]

Viola Limestone (in Patterson Ranch Group)

Middle and Upper Ordovician: Central southern and southwestern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

C. E. Decker, 1942, Oklahoma Acad. Sci. Proc., v. 22, p. 153, 154 (table 1). Basal formation in Patterson Ranch group (new). Overlies Bromide formation; underlies Fernvale.

C. E. Decker, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 1, p. 101–102, 135 (table 5). Discussion of Athens graptolites in Viola limestone. Viola extends east of Arbuckle Mountains to northwest edge of Ouachita Mountains where it has been more complexly folded and more highly metamorphosed, part of the limestones having been silicified. From east edge of Arbuckle Mountains, Viola thickens from 200 to 500 feet and westward to more than 900 feet. Overlies Bromide formation. Of the 59 graptolites identified from the Viola, 48 are found in Athens. *Nemagraptus* present. Trentonian.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 54, 55). As shown on correlation chart overlies Bromide formation (limestone) in Arbuckle and Wichita Mountains. Black River-Trentonian.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2038–2039. Collings Ranch conglomerate (new) rests with marked angular unconformity on steeply dipping rocks of Arbuckle anticline. Viola limestone is listed among units exposed beneath the conglomerate.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped in central southern and southwestern Oklahoma.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 123–125. Information on Viola formation is relevant to the discussion of brachiopods forming subject of this monograph because of Decker's (1952) correlations of Athens shale of Virginia with part of Viola limestone of Oklahoma. Report of *Nemagraptus* in Viola is disturbing because it leads to correlation that is in distinct conflict with that indicated by other groups of animals. On the basis of brachiopods, lower Viola would be placed at the lowest with about middle Trenton. Decker makes same age assignment for the Viola, but this is inconsistent with his reported discovery of *Nemagraptus* fauna in lower part of Viola.

R. W. Harris, 1957, Oklahoma Geol. Survey Bull. 75, p. 100. Disconformably overlies Corbin Ranch formation (new).

Named for former village of Viola, near Bromide, Johnston County, which was located near outcrop of formation.

Violin Breccia (in Ridge Basin Group)

Miocene to Pliocene: Southern California.

J. C. Crowell, 1954, California Div. Mines Bull. 170, map sheet 7. Consists of rubble of gneiss blocks as much as 6 feet in diameter in muddy matrix, accumulated as talus or alluvial debris at base of San Gabriel fault scarp. Thickness 27,000 feet; extends along strike for maximum distance of 4,000 feet. Grades abruptly into finer grained Ridge Basin rocks on east. Underlies Hungry Valley formation; overlies Castaic formation (new).

Named for exposures on divide between Violin and Palomas Canyons, Ridge Basin area, Los Angeles and Ventura Counties.

Vipont Limestone

Carboniferous(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Consists of fine-grained crystalline blue-gray limestone, locally containing numerous small calcite stringers. Thickness 50 to 100 feet. Underlies newly named Wardlaw shale and overlies newly named Sentinell limestone.

In Ashbrook mining district on west side of Goose Creek Range.

Virden Formation

Upper Cretaceous: Northwestern New Mexico.

W. E. Elston, 1960, New Mexico Bur. Mines and Mineral Resources Geol. Map 15. Fanglomerate, fluvial conglomerate, tuffaceous sandstone, and gray shale. Contains plant fossils tentatively dated as late Cretaceous. Maximum thickness 4,000 feet. Stratigraphically above Colorado shale and below Datil formation.

Type locality: Sec. 16, T. 18 S., R. 20 W., Hidalgo County, Virden quadrangle.

Virgelle Sandstone (in Montana Group)[1]

Virgelle Sandstone Member (of Eagle Sandstone)[1]

Upper Cretaceous: Northwestern, central northern, and central southern Montana.

Original reference: E. Stebinger, 1914, U.S. Geol. Survey Prof. Paper 90, p. 62–68.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf., p. 108 (fig. 1), 114, 115. On northwest flank of Sweetgrass arch, Virgelle is considered of formation rank. Here it is a cliff-forming formation with average thickness of about 160 feet. Underlies Two Medicine formation; overlies Telegraph Creek formation. On northeast flank of Sweetgrass arch, considered member of Eagle sandstone. Thickness 95 to 210 feet. Underlies unnamed upper member; overlies Telegraph Creek formation.

Well exposed along Missouri River from town of Virgelle, a few miles below Fort Benton, Chouteau County, eastward.

Virgen [Virgin] series[1]

Tertiary, late: Southeastern California and southwestern Nevada. .

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52, 61.

Occurs in Virgen Valley and in Furnace Canyon, Inyo County, Calif.

Virgil Series[1]

Upper Pennsylvanian: Kansas, Arkansas, Iowa, Missouri, Nebraska, and Oklahoma.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf. correlation chart.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 657–706, chart 6. In upward order, midcontinent time-rock divisions of Pennsylvanian are designated as Morrowan, Lampasan, Desmoinesian, Missourian, and Virgilian.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2020–2022. Uppermost Pennsylvanian rocks, lying between post-Missourian disconformity and similar break occurring above horizon of Brownville limestone, which in northern midcontinent area is recognized to define Pennsylvanian-Permian boundary, are classified as Virgilian series. They are characterized by invertebrate faunas of intermediate nature between those of the Missourian and Lower Permian and are classed as composing upper part of zone of *Triticites*. As recognized by State Geological Surveys of northern midcontinent area, series comprises (ascending) Douglas, Shawnee, and Wabaunsee groups.

R. C. Moore and M. L. Thompson, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 3, p. 297. Approximately upper one-third of Pennsylvanian system belongs to Kawvian series (new). Kawvian rocks are divided into Missourian stage below and Virgilian stage above.

W. H. Bradley, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2284–2285. In midcontinent region (including Arkansas, Iowa, Kansas, Missouri, Nebraska, and Oklahoma), U.S. Geological Survey uses following series subdivision of the Pennsylvanian: Morrow, Atoka, Des Moines, Missouri, and Virgil. Virgil is late Pennsylvanian.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 23. In Iowa it is not possible to locate accurately unconformity separating Pedee group of Missouri series from Douglas group of Virgil series. If break in sedimentation exists, it may be above, within, or below sediments lying between Oread limestone of Shawnee group (Virgil series) and Stanton limestone of Lansing group (Missouri series).

Named for town in eastern part of Greenwood County, Kans.

Virgilian Series or Stage

See **Virgil Series.**

Virgilina Greenstone[1]

Virgilina Group[1] or Volcanic Group[1]

Precambrian: Central northern North Carolina and central southern Virginia.

Original reference: T. L. Watson, 1916, Virginia Geol. Survey geol. map of Virginia.

J. P. Meador, 1949, (abs.) Virginia Acad Sci. Proc. 1948–1949, p. 137. In eastern Lunenburg County, Va., Flat Rock Creek granite (new) lies between Virgilina greenstone and injected gneisses.

Rocks form Virgilina Ridge and are typically developed in and near town of Virgilina, Halifax County, Va.

Virgin Limestone Member (of Moenkopi Formation)[1]

Virgin Formation (in Moenkopi Group)

Lower Triassic: Southwestern Utah and northwestern Arizona.

Original reference: H. Bassler and J. B. Reeside, Jr., 1921, U.S. Geol. Survey Bull. 726–C, p. 90–92.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 226; 1950, U.S. Geol. Survey Prof. Paper 220, p. 48 (fig. 24), 52 (table), 60. Separated from underlying Timpoweap member (new) by unnamed lower red member about 200 feet thick. Thickness 8 to 116 feet.

S. J. Poborski, 1952, (abs.) Geol. Soc. America Bull., v. 63, no. 12, pt. 2, p. 1342; 1953, Plateau, v. 25, no. 4, p. 69–79; 1954, Geol. Soc. America Bull., v. 65, no. 10, p. 971–1006. Rank raised to formation in Moenkopi group herein rank raised. Boundary of formation is placed at base of lowest limestone layer; this limestone rests disconformably on either "lower red member" of Moenkopi or upon alpha member of Kaibab. Thickness as much as 213 feet..

Named for Virgin City [now Virgin], Washington County, Utah.

Virgin Creek Member (of Pierre Shale)

Upper Cretaceous: Central and southeastern South Dakota.

W. V. Searight, 1937, South Dakota Geol. Survey Rept. Inv. 27, p. 35–43, pl. 3. Includes all beds between Sully member (new) below and Mobridge member (new) above. Consists of gumbo-forming shale; zone of limestone concretions near top; many thin bentonites in lower part. Thickness 55 to 224 feet.

D. R. Crandell, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 12, p. 2340 (table 1). Overlies Verendrye member (new); underlies Mobridge member.

H. E. Simpson, 1960, U.S. Geol. Survey Prof. Paper 328, p. 12 (table 1), 38–39. Thickness about 25 feet in Yankton area. Overlies Verendrye member; underlies Mobridge member.

Named from exposure in valley wall of Virgin Creek and in flats and hills above it, 1½ miles south of Promise, northeastern Dewey County.

Virginia Limestone Member (of Moenkopi Formation)[1]

See **Virgin Limestone Member** (of Moenkopi Formation)

Virginia Quartz Hypersthene Norite[1]

Late Mesozoic: Southern California.

Original reference: P. H. Dudley, 1935, California Jour. Mines and Geology, v. 31, no. 4, p. 491, 501.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 481, table 4. In succession of intrusives Virginia quartz norite is older than Perris and Estelle quartz diorite (Val Verde tonalite) and younger than Gavilan Peak gabbro. Late Mesozoic.

Occurs in Perris fault block, Riverside County.

Virginia Slate[1] (in Animikie Group)

Precambrian: Northeastern Minnesota.

Original reference: C. R. Van Hise and C. K. Leith, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 3, p. 353, 360.

G. M. Schwartz, 1951, Geology of the Cuyuna Range: Minnesota Univ. Center for Continuation Study, Mining [Geology] Symposium [No. 2], p. 3. For most part, the Deerwood iron formation and Cuyuna slates have been considered to belong to the Virginia. This correlation has very little evidence to support it.

F. F. Grout and others, 1951, Geol. Soc. America Bull., v. 62, no. 9, p. 1021 (table 3), 1047–1050. Included in Animikie group. Unit is an argillite and graywacke; lacks slaty cleavage and is not dynamically metamorphosed; much of it is thin bedded, but graywacke is thick bedded. Thickness estimated to be 2,000 to 3,000 feet in Cook County, but on western Mesabi may be much greater. Data on unit based largely on drill-core information. Overlies Biwabik iron-formation; contact may or may not be conformable.

F. F. Grout and J. F. Wolff, 1955, Minnesota Geol. Survey Bull. 36, p. 3, 4, 7, 56, pl. 6. In Cuyuna district, includes South Range member (new).

Named Virginia slate because in its typical form it has been found in numerous test pits and drill holes west of town of Virginia, St. Louis County. Recently has been exposed on south side of Embarrass Lake mine near Aurora.

Virginia Blue Ridge Complex

Precambrian: South-central Virginia.

W. R. Brown, 1958, Virginia Div. Mineral Resources Bull. 74, p. 7–9, 48, pl. 1. Complex of schistose, gneissose, granitoid, and migmatitic rocks, which is older than Lynchburg and Swift Run formations. Comprises inner or core portion of Blue Ridge structural province in Virginia referred to variously as "injection complex," "granitized complex," and "basement complex." Principal units included are: Pedlar formation,

Marshall gneiss, Lovingston gneiss and granite, Roseland anorthosite, and Moneta gneiss (with Reusens migmatite facies).

In Catoctin-Blue Ridge anticlinorium of Lynchburg quadrangle.

Virginia Creek Member (of Pierre Shale)

Probably lapsus for **Virgin Creek Member** (of Pierre Shale).

†Virginian[1]

Miocene: Maryland and Virginia.

Original references: A. Heilprin, 1883, Philadelphia Acad. Nat. Sci. Proc. 1882, p. 183–184; 1884, Philadelphia Acad. Nat. Sci. Jour. 2d ser., v. 9, pt. 1, p. 120.

Virginian Ridge Formation

Lower and Middle Cretaceous(?): Northwestern Washington.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 169–171. Black siltstones, graywackes, and silica pebble conglomerates. Bulk of formation composed of spheroidally weathering black to dark-greenish siltstone occasionally interbedded with dark graywacke. Contains at least five beds of well-sorted pebble conglomerate from 10 to 30 feet thick. Complete absence of granitic debris characterizes conglomerates made up of well-rounded gray to black chert and white vein quartz pebbles. Basal conglomerate in some places several hundred feet thick. Approximately 12,000 feet of section above basal conglomerate. Rests unconformably on Newby formation (new) and grades into overlying Winthrop sandstone.

Type locality: In Wolf Creek and along Virginian Ridge between Wolf Creek and the west fork of Methow River in northwestern part of Methow quadrangle. Basal conglomerate best exposed along Twisp River 3½ miles west of Twisp.

Virgin Island Group

Upper Cretaceous: Virgin Islands.

T. W. Donnelly, 1960, Dissert. Abs., v. 20, no. 7, p. 2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Overlies Water Island formation (new), slight angular unconformity. Includes (ascending) Louisenhoj formation, Outer Brass limestone, Tutu formation, and Hans Lollik formation. Considered of Cenomanian age.

Report discusses geology of St. Thomas and St. John Islands.

Virgin Spring phase (of Amargosa chaos)

Post-Miocene(?): Southern California.

L. F. Noble, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 1936. Listed as phase of Amargosa chaos, an assemblage of blocks on overthrust plate of Amargosa thrust.

L. F. Noble, 1941, Geol. Soc. America Bull., v. 52, no. 7, p. 965–968, pl. 3. Mosaic of fault blocks composed mostly of dolomite, limestone, sandstone, quartzite, shale, and slate; prevailingly dark shades of brown and gray; consists essentially of later Precambrian and Cambrian formations but contains a few blocks of Tertiary volcanic rocks. Average thickness about 600 feet; maximum thickness more than 1,000 feet. Lies everywhere directly on the Amargosa thrust. Underlies Calico phase with which it is folded just as if the two units were beds in sedimentary series.

Occurs in Virgin Spring area near Death Valley. Name is derived from Virgin Spring, in Virgin Spring Canyon. Phase covers about 20 square miles in area mapped.

Virgin Valley Beds[1]

Virgin Valley Formation

Miocene: Northwestern Nevada and southeastern Oregon.

Original references: J. C. Merriam, 1907, Science, new ser., v. 26, p. 380–382; 1910, California Univ. Dept. Geology Bull., v. 6, no. 2, p. 33–36.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 35, pl. 1. Virgin Valley formation, late Hemingfordian or early Barstovian.

D. O. Cochran, 1959, Oregon Dept. Geology and Mineral Industries Bull. 50, p. 10 (chart), 14. Correlation chart shows Virgin Valley formation in Steens-Pueblo Mountain area, Oregon. Upper zone white to buff beds; ash and diatomaceous beds. Middle zone gray to yellow and brown shales and clays; carbonaceous shales, lignites, diatomaceous beds. Lower zone white to green, purple, and red clays and ash. Thickness 1,000 to 2,000 feet. Overlies Canyon rhyolite; underlies Danforth(?) formation. Miocene, Barstovian.

Virgin Creek drains valley in which beds occur in Nevada.

Vishnu Schist[1]

Vishnu Series

Precambrian: Northern Arizona.

Original reference: C. D. Walcott, 1889, Geol. Soc. America Bull., v. 1, p. 50.

Ian Campbell and J. H. Maxson, 1938, Carnegie Inst. Washington Year Book 37, p. 361–362. Vishnu series proposed for the 25,000 feet or more of metasediments, a usage which will restrict term "Vishnu schist," originally proposed by Walcott for entire Archean terrane. Type locality indicated.

C. A. Anderson, 1951, Geol. Soc. America Bull., v. 62, no. 11, p. 1333–1334. No name was given by Campbell and Maxson for metavolcanic rocks in Grand Canyon and until they complete their studies, it is desirable to retain Vishnu schist for all metasediments and metavolcanics older than Grand Canyon series.

Type locality: In lower canyon of Vishnu Creek, Grand Canyon region.

Vista Member (of White River Formation)

Oligocene (Whitneyan): Northeastern Colorado.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 15 (fig. 5), 16–18, 25. Beds composed of massive, tan silt with highly calcareous zone (the "white marker") at bottom; erosional disconformity at top. Thickness at type locality about 97 feet. Overlies Cedar Creek member (new); underlies Pawnee Creek formation.

Type locality: NE½ sec. 17, T. 11 N., R. 53 W., Logan County. Name derived from Vista triangulation station, SW¼ sec. 1, T. 11 N., R. 54 W., which is almost at center of Vista member exposures.

Vista Monzonite or Granodiorite Porphyry

Tertiary(?): Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 39, pl. 1. Gray-green granodiorite or monzonite intrusive of unknown age.

In sec. 21, T. 19 S., R. 9 W., in northern Cooks Range, near Vista fluorite mine, Dwyer quadrangle.

Vitrefrax Formation

Paleozoic or older: Southern California.

P. C. Henshaw, 1942, California Jour. Mines and Geology, v. 38, no. 2, p. 153–155, pl. 2. Comprises several indefinitely bounded lithologic units —quartz, kyanite schist, sericite schist.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 489, table 4. Older Precambrian(?).

Occurs in Cargo Muchacho Mountains, Imperial County. Named for its best developed exposure in Bluebird quarry on Vitrefrax Hill.

Vivian Sandstone (in Pocohontas Group)

Vivian Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 232.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 107. Sandstone in Pocahontas group.

Has been quarried east of East Vivian railway station, McDowell County.

Volcano Bay Basalt Flow (in Mount Hague Volcanics)

Quaternary: Southwestern Alaska.

G. C. Kennedy and H. H. Waldron, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 2, p. 15, pl. 2 (geol. map). Believed to be at most only a few hundreds of years old, because of its fresh blocky surface and lack of dissection. May have had its source on southeast flank of Mount Hague. Flow believed to have moved southwestward until it reached heads of two narrow southeastward-trending valleys carved in older Dushkin and Arch Point flows (new). Lava followed these two valleys until it flowed out on low plain at valley mouths where the two lava streams fanned out and coalesced. Much of flow has been capped by younger flow from Cone G.

Covers much of lowlands north of Dushkin and Long John Lagoons in vicinity of Pavlof Volcano, near end of Alaska Peninsula.

Volga shales[1]

Upper Ordovician: Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 55, p. 217–222.

Volta Formation (in Orestimba Group)

Upper Cretaceous: Central California.

R. D. Reed, 1943, California Div. Mines Bull. 118, pt. 2, p. 109 (table 6) [preprint 1941]. Listed on table as uppermost formation of Orestimba group. Name credited to F. M. Anderson.

Occurs in San Joaquin Valley.

Volusia Shale[1]

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 14. Volusia shale (Chadwick, 1923) bearing *Pugnoides duplicatus*, is here included in Dexterville member of Chadakoin formation.

Named for occurrence near Volusia, Chautauqua County.

Voss Shale Member (of Belle Plains Formation)

Permian: West-central Texas.

R. C. Moore, 1948, *in* M. G. Cheney, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets 3, 4. Shown on columnar section. Underlies Jagger Bend limestone member; overlies Elm Creek limestone member.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheets 1, 2. Thickness 10 to 50 feet. No complete outcrop found; partial exposures indicate that member consists mainly of yellowish and blue clay shale.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 273. Thickness 20 to 85 feet in Brazos River area. Overlies Elm Creek limestone member; underlies Jagger Bend limestone member.

Name derived from village of Voss, southwestern Coleman County, 9 miles south and 1 mile west of Valera.

Vowell Mountain Group

Pennsylvanian (Pottsville Series): Eastern Tennessee.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 1, 11, 19, pls. 2, 3, 4, 6, 8. Includes all strata between top of Redoak Mountain group (new) below and base of Cross Mountain group (new) above that is between top of Pewee coal and top of Frozen Head sandstone. Thickness 230 to 390 feet. Includes (ascending) shale interval, Pilot Mountain sandstone, shale interval, and Frozen Head sandstone.

Type locality: Cross Mountain, Lake City quadrangle, Anderson County. Name derived from Vowell Mountain, a spur on east side of Cross Mountain. Group is preserved only on higher mountains and, hence, has more restricted outcrop area than older groups.

Vulcan Iron-Formation[1] (in Menominee Group)

Precambrian (Animikie Series): Northern Michigan.

Original reference: C. R. Van Hise, 1899, U.S. Geol. Survey 19th Ann. Rept., pt. 3, p. 16; Mon. 36, p. xxv, xxvi.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 35. Upper formation in newly defined Menominee group. Includes (ascending) Traders iron-bearing member, Brier slate member, Curry iron-bearing member, and Loretto slate member. Overlies Felch formation; underlies Goodrich quartzite of Baraga group (new).

Named for exposures in vicinity of West Vulcan, Menominee district, [Dickinson County].

Waawaa Volcanics (in Hualalai Volcanic Series)

Waawaa pyroclastic materials

Pleistocene(?): Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 86–87, 145. Pumiceous and dense, trachytic lapilli and ash in Puu Waawaa cone referred to as Waawaa pyroclastic materials.

H. T. Stearns and G. A. Macdonald, 1946, Hawaii Div. Hydrography Bull. 9, p. 138 (table), 143–148; D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6 Océanie,

fasc. 2, p. 134–135. Waawaa volcanics considered member of Hualalai volcanic series (new). Consist of trachyte flow and its source cone. Flow made up of several units 250 to 500 feet thick; exposed thickness 900 feet; base not exposed. Older than at least part of Pahala ash. Pleistocene(?).

Type locality: Puu Waawaa. Covers about 3 square miles on northern slope of Hualalai.

Wabash Formation[1]

Pennsylvanian: Southwestern Indiana.

Original reference: M. L. Fuller and F. G. Clapp, 1904, U.S. Geol. Survey Geol. Atlas, Folio 105.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 25). Shown on correlation chart as comprising (ascending) Parker limestone, Buffkin limestone, Graysville limestone, and Livingston limestone. Occurs above Inglefield sandstone and below Merom sandstone.

Named for exposures in bluff of Wabash River in Patoka quadrangle.

†Wabash Group[1]

Pennsylvanian: Indiana.

Original reference: G. H. Ashley, 1902, U.S. Geol. Survey 22d Ann. Rept., pt. 3, p. 273.

D. W. Franklin, 1944, Illinois Acad. Sci. Trans., v. 37, p. 86 (table 1). Shown on table as a group 250 to 300 feet thick above the Merom group.

Named for Wabash River, which cuts through the various formations.

†Wabash Stage[1] or Beds[1]

Pleistocene: Central Indiana.

Original reference: O. P. Hay, 1912, Smithsonian Misc. Colln., v. 59, no. 20, p. 13.

Type locality: About 4 miles east of Fairmount, Grant County. Named for Wabash River, where it is well developed in valley of river and its tributaries.

Wabaunsee Group[1]

Wabaunsee Formation[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, southeastern Nebraska, and northern Oklahoma.

Original reference: C. S. Prosser, 1895, Jour. Geology, v. 3, p. 688–697.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 165–196. Uppermost major division of Virgilian strata. As adopted by interstate conference of Geological Surveys, includes (ascending) Severy shale, Howard formation, White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Rulo limestone, Silver Lake shale, Reading limestone, Harveyville shale, Elmont limestone, Willard shale, Tarkio limestone, Wamego shale, Maple Hill limestone, Langdon shale, Dover limestone, Dry shale, Grandhaven limestone, Friedrich shale, Jim Creek limestone, French Creek shale, Caneyville limestone, Pony Creek shale, and Brownville limestone. Overlies Shawnee group. Top drawn at prominent disconformity just above Brownville limestone. Comprises Sacfox, Nemaha, and Richardson subgroups. Agreed that nomenclature in the several States may be required to deviate from this standard section by com-

bination or omission of terms where certain named rock units are not recognizable.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. viii, 19–21. As redefined for Missouri, includes beds from top of Topeka formation to top of Pennsylvanian in Missouri, which is top of French Creek shale. Grandhaven limestone has not been identified in Missouri, and shale between Dover limestone and Jim Creek limestone is called Dry-Friedrich shale. Lower limestone of Tarkio has been considered base of Wabaunsee and lower limestone (Elmont) and Willard shale included in Shawnee group.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 12–20. Nebraska follows interstate agreement on classification of Wabaunsee except in use of Pierson Point for Wamego, Morton formation for Grandhaven interval, and Wood Siding formation between French Creek formation and Brownville limestone. Thickness of group in Nebraska about 396 feet.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2271–2278. Redefined. Includes ascending [Severy shale, Howard limestone], Scranton shale, Bern limestone (new), Auburn shale, Emporia limestone, Willard shale, Zeandale limestone (new), Pillsbury shale (new), Stotler limestone (new), Root shale (new), and Wood Siding formation.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 25 (table 2), 44–71. Uppermost group of Virgilian series. Currently group includes beds upward from top of Topeka (Turkey Run limestone) to top of Brownville limestone. In Kansas, Wabaunsee deposits are cyclic and similar to those of underlying Shawnee group. Southward these deposits lose much of their cyclic character, and although alternating marine and nonmarine beds are present in Pawnee County section, the rhythmic pattern of cyclic deposition is obscure. Key beds in group in Pawnee County are traceable northward into Kansas, and names of these beds are generally taken from Kansas section. When it comes to naming shale-sandstone sequences between key limestones of Pawnee County, modification of Kansas nomenclature is necessary. Most of limestones on which subdivision of Kansas section is based pinch out southward; hence, beds between any two key units of Pawnee County may represent several formations in Kansas section. Moore (1936, Kansas Geol. Survey Bull. 22) suggested that this situation be dealt with by applying hyphenated names in areas where missing key units make standard Kansas section inapplicable. Branson (1956, Oklahoma Geology Notes, v. 16, no. 11) proposed alternate solution to problem by giving names to each of shale-sandstone units between most extensive limestones of upper Pennsylvanian in north-central Oklahoma. Stratigraphic sequence to which each name applies becomes progressively greater southward as recognizable Kansas units disappear from section. Branson's revised nomenclature is followed in this report. Key beds of group in north-central Oklahoma are (ascending) Bird Creek, Wakarusa, Reading, Elmont, Grayhorse, and Brownville limestones. Names used in this report are (ascending) Severy shale, Bird Creek limestone, Hallett shale, Wakarusa limestone, Auburn shale, Emporia limestone with Reading limestone, Harveyville shale, and Elmont limestone members, Gano shale, Wood Siding formation with "Grayhorse" limestone, Pony

Creek shale, and Brownville limestone members. Wabaunsee outcrops cover most of central part of Pawnee County, forming belt up to 8 miles wide that strikes north-south across county.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 10–14, fig. 5. Present only in Adams, Montgomery, Taylor, Page, and Fremont Counties. Group is predominantly shale with limestone, siltstone, minor sandstone units, and thin coal seams. The subgroups, Richardson, Nemaha, and Sac-Fox, are not well defined in Iowa and are not identified in this report, nor are major units broken down into members as they are in other groups of the Pennsylvanian. Because of predominance of shale within the group, exposures soon become slumped and overgrown; for this reason, some sections described by early workers have since become obscured. For example, youngest rocks to be described in Iowa was exposure on Mill Creek, south of Riverton (Smith, 1908, Iowa Geol. Survey, v. 19). Here French Creek shale, Jim Creek limestone, and Friedrich-Dry shale were exposed but are no longer visible. Younger rocks may be present beneath the drift between Hamburg and Thurman and east of Hamburg, but they are not exposed and have not been reported in drilling records. There is little to distinguish units as seen, and many correlations are necessarily on basis of sequence and not lithologic or paleontologic distinction. Strata are believed to thin considerably to northwest. Group includes (ascending) Severy shale, Howard limestone, White Cloud shale, Happy Hollow limestone, Cedar Vale shale, Silver Lake shale, Burlingame limestone. Soldier Creek shale. Wakarusa limestone, Auburn shale, Reading limestone, Elmont limestone, Willard shale, Tarkio limestone, Pierson Point shale, Table Creek shale, Dover limestone, Dry shale, Grandhaven limestone, Friedrich shale, Jim Creek limestone, and French Creek shale.

Named for exposures in Wabaunsee County, Kans.

Waccamaw Formation[1]

Pliocene, lower: Southern and eastern South Carolina and southern North Carolina.

Original reference: W. H. Dall, 1892, Wagner Free Inst. Sci. Trans., v. 3, pt. 2, p. 209–213.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in coastal plain of North Carolina Oct. 8–9, p. 11–12. In this report, Waccamaw is considered contemporaneous with Duplin marl and placed in Yorktown formation which is geographically extended into North Carolina. This reclassification made on the basis of the fact that 15 species of Ostracoda known to occur in Duplin marl occur in Waccamaw formation, and, in addition, no ostracod species have been found in the Waccamaw that do not occur in the Duplin. Yorktown is considered upper Miocene.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook for South Carolina Coastal Plain Field Trip No. 16–17, p. 20–22. Although age of the Waccamaw could be either latest Miocene or Pliocene, it is here included in the Pliocene until more conclusive evidence is found to the contrary.

Named for exposures along Waccamaw River, Horry County, S.C.

Wachsmuth Limestone (in Lisburne Group)

Lower Mississippian: Northern Alaska.

A. L. Bowsher and J. T. Dutro, Jr., 1957, U.S. Geol. Survey Prof. Paper 303–A, p. 4, 6, 17–24, figs. 2–4, pl. 2. Comprises four unnamed members at type locality (ascending): shaly limestone, 18 feet thick; crinoidal limestone, 179 feet; dolomite, 564 feet; and banded chert-limestone, 429 feet. Total thickness 1,230 feet. Underlies Alapah limestone (new) and overlies Kayak shale (new) both disconformably.

Type locality: On south slope of Mount Wachsmuth, from which limestone takes its name, Shainin Lake area, central Brooks Range.

†Wachusett Gneiss[1]

Upper Carboniferous or post-Carboniferous: Central northern Massachusetts.

Original reference: L. S. Burbank, 1876, Rept. on geol. map of Massachusetts, by W. O. Crosby, p. 43–52.

Wachusett Range in Worcester County region.

Waco Limestone[1]

Silurian (Niagaran): East-central Kentucky.

Original references: A. F. Foerste, 1905, Kentucky Geol. Survey Bull. 6, p. 145; 1906, Kentucky Geol. Survey Bull. 7, p. 10, 52.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Waco limestone stratigraphically below Dayton limestone and above Lulbegrud conglomerate.

Named for Waco, Madison County.

Waddell Sandstone (in Simpson Group)

Middle Ordovician: Western Texas (subsurface).

Taylor Cole, C. D. Cordry, and H. A. Hemphill, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 280 (fig. 1), 281–282. Proposed for lower sandstone bed in Simpson group. Lies between depths of 6,143 and 6,231 feet in type well. Top occurs 280 feet below top of McKee sand (new) and about 355 feet above top of Ellenburger; these intervals vary somewhat in a widespread area.

Type well: Gulf Oil Corp. W. N. Waddell et al No. 1, sec. 4, Block B–27, PSL Survey, Crane County.

Wading Branch Formation (in Snowbird Group)

Precambrian (Ocoee Series): Western North Carolina.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 954, 955 (table 1), 956 (fig. 3). Consists of medium-bedded dark clastic rocks, including sandy argillaceous rocks, siltstone, and coarse pebbly feldspathic sandstone; coarser rocks are poorly sorted, have a dark micaceous matrix, and are somewhat graded; a basal unit generally less than 100 feet thick, representing residual reworked clay, is present throughout much of the formation. Basal formation of group; underlies Longarm quartzite (new); contact gradational over several tens of feet; unconformably overlies earlier Precambrian granitic and gneissic rocks (Max Patch granite of Keith).

Type section: Along Pigeon River, 4½ miles southeast of Waterville. Named for Wading Branch Ridge west of Pigeon River about 5 miles

southeast of Waterville, Haywood County. Traceable southwestward through several belts of outcrop as far as Cherokee.

†Wadmalaw Shell Marl[1] or phase[1]

Pleistocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 20–21.

Exposed south of Bees Ferry, at the Faber place, and along northerly shore of Stono and Wadmalaw inland waterway, at Cherokee, Bolton, and St. Andrews phosphate mines, and at base of Simmons Bluff, Charleston County.

Wagnon Member (of Pride Mountain Formation)

Upper Mississippian: Northern Alabama.

S. W. Welch, 1958, U.S. Geol. Survey Oil and Gas Inv. Chart OC–58. Series of limestones and shales. Includes lower part of strata referred to by Butts (1926) as Gasper formation. Thickness ranges from 70 feet at south Tuscumbia to 30 feet near Pride and averages about 50 feet. Underlies Southward Spring sandstone member and overlies Tanyard Branch member (new); both contacts sharp and conformable. At type locality of the Pride Mountain, where Southward Spring sandstone member is absent, underlies Sandfall member (new).

Named for exposure along road up Wagnon Mountain about 5 miles south of Pride, in south-central sec. 6, T. 5 S., R. 12 W., Colbert County.

Wagonhound Member[1] (of Uinta Formation)

Eocene: Northeastern Utah and southwestern Wyoming.

Original reference: H. E. Wood 2d, 1934, Am. Mus. Nat. History Bull., v. 67, art. 5, May 26, p. 241–242.

C. H. Dane, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 3, p. 417. Mentioned in discussion of Uinta formation.

Name derived from Wagonhound Canyon which opens into White River, Utah.

Wagontire Formation[1]

Eocene(?): Central southern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Type locality: Wagontire Mountain, northeastern part of Lake County.

Wagontongue Formation

Miocene(?): Central Colorado.

J. H. Johnson, 1937, (abs.) Colorado Univ. Studies, v. 25, no. 1, p. 77; J. T. Stark and others, 1949, Geol. Soc. America Mem. 33, p. 34 (table 7), 68–69, 173, pl. 1. Series of coarse sandstones, sandy clays, and conglomerates made up largely of reworked volcanic materials. Contains beds of volcanic ash. Thickness 110 to 500 feet. Underlies Trump conglomerate (new); overlies Antero formation (new).

Well exposed in two northward-facing cuts in secs. 29 and 30, T. 14 S., R. 75 W. Many good outcrops along Wagontongue Creek, from which unit takes its name, and small tributaries leading into it, especially in NE¼ sec. 6, T. 15 S., R. 75 W., Park County.

Wagonwheel Formation[1]

Oligocene or Oligocene(?): Southern California.

Original reference: H. R. Johnson, 1909, Science, new ser., v. 30, p. 63–64.

H. P. Smith, 1956, California Univ. Pubs. Geol. Sci., v. 32, no. 2, p. 65–108. Consists of three unnamed members, a lower sandstone, a middle argillaceous siltstone, and an upper glauconitic siltstone. Thickness about 470 feet. Unconformably underlies basal shale of Temblor; conformably overlies Welcome member of Kreyenhagen. Oligocene. Entire area of outcrop not more than 2¼ miles long and one-quarter mile wide.

Occurs in Devil's Den district, approximately 25 miles southeast of Avenal and 50 miles northwest of Taft, northwestern Kern County.

Wagon Yard Gypsum[1]

Wagon Yard Gypsum Member (of Dog Creek Formation)

Permian (Guadalupe): Western Texas.

Original reference: L. W. Storm, 1929, Texas Econ. Geol. Survey map of Stonewall County.

T. S. Jones, 1953, Stratigraphy of the Permian Basin of west Texas: West Texas Geol. Soc., p. 30, fig. 9. Shown on chart as top member of Dog Creek formation. Overlies Guthrie dolomite member; underlies Childress formation.

First used in Stonewall County.

Wahkiakum Formation[1]

Miocene, lower: Southwestern Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 15, p. 10–12.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 100. Name abandoned. Unit considered part of Blakeley formation.

Occurs near head of Alockaman River, Wahkiakum County.

Wahluke Formation

Pleistocene: Central Washington.

G. F. Beck, 1936, Mineralogist, v. 4, no. 11, p. 12–14. Name applied to thin layer of sediments lying above a white lime-rock layer that lies within Columbia basalts, Ellensburg sediments, Wenas basalts, or Ringold sediments—whichever of these was exposed or truncated by post-Ringold surface. Wahluke sediments are fossiliferous, poorly cemented, flat lying, and crossbedded; locally contains lenses and horizons of sand. Includes Tiflis member (new) at top.

Named for typical exposure above undoubted Ringold at head of Beverly highway grade, about 1 mile south of Wahluke, Grant County.

Wahs Creek Shale (in Moran Formation)[1]

Permian: Central northern Texas.

Original reference: O. F. Hedrick, E. Owens, and P. A. Meyers, 1929, Texas Bur. Econ. Geology, geol. map of Shackelford County.

In Shackelford County.

Wahwah Limestone (in Pogonip Group)

Lower Ordovician (Canadian): Western Utah and east-central Nevada.

L. F. Hintze, 1951, Utah Geol. and Mineralog. Survey Bull. 39, p. 16–17, 51. Ledge-forming quartz silty calcisiltite. Thickness at type section

227 feet. Overlies Fillmore limestone (new); underlies Juab limestone (new).

R. E. Cohenour, 1959, Utah Geol. and Mineralog. Survey Bull. 63, p. 12 (table 1), 72–73, pl. 1. Described in Sheeprock Mountains where it is 456 to 476 feet thick; conformably overlies Fillmore limestone and conformably underlies Juab limestone. Included in Pogonip group.

Type section: Ibex, Millard County, Utah. Name derived from Wahwah (also spelled Wah Wah) Valley. Unit extends into east-central Nevada.

Wah Wah Springs Tuff Member (of Needles Range Formation)

Eocene(?) or Oligocene, lower(?): Southwestern Utah.

J. H. Mackin, 1960, Am. Jour. Sci., v. 258, no. 2, p. 90 (table 1), 92 (fig. 2), 99. Shows complete gradation upward from black vitrophyre at base to light-gray nonwelded ashy top. Thickness 700 to 800 feet. Basal member of formation; underlies Minersville tuff mmeber (new).

Named for occurrence south of Wah Wah Springs, 15 miles west of abandoned mining town of Frisco, Iron Springs district.

Wahweap Sandstone[1]

Upper Cretaceous: Central southern Utah.

Original reference: H. E. Gregory and R. C. Moore, 1931, U.S. Geol. Survey Prof. Paper 164.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 200, p. 51 (table), 107–109, pls. 2, 4, 5. Described in Zion Park region where it overlies Straight Cliffs sandstone and underlies Kaiparowits formation. Most common beds of Wahweap are sandstones 5 to 10 feet thick, irregularly laminated and lenticularly stratified with highly arenaceous shale; some beds of considerable length are thick, uniformly massive, cross-bedded, and consist of coarse and fine rounded grains of quartz; others combine to make series of thin evenly or roughly stratified beds; many sandstones change along strike from solid beds of uniform composition and texture to beds that include shalelike and iron concretions and into series of platy beds of various dimensions. Absence of continuous guide beds and scarcity of fossils in Wahweap and upper Straight Cliffs make it impracticable to draw definite division line between the two formations. Thickness of the two formations 600 to 1,200 feet.

Upper part of Wahweap Creek, Kane County, is cut in the formation.

Waiaaka Basaltic Andesite (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 230 (table), 243–244, pl. 1. A persistent thin lava flow overlying Makapipi basalts (new); clinker layers interbedded in the lava may indicate two or more flows. Predominantly aa except in extreme southwestern part where it is pahoehoe. Prominent platy jointing parallel to flow planes. Average thickness 30 feet; 120 feet in test hole 47. Where Makapipi basalts have been removed by erosion, Waiaaka rests on gravel above Kula basaltic andesite (new). Locally overlain by Mossman basalt (new). Each member in series is underlain by local erosional unconformity.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 135. Pleistocene(?).

Named for occurrence along Waiaaka Gulch. Best exposed in Hanawi Gulch north of highway.

Waianae Volcanic Series[1]

Pliocene(?): Oahu Island, Hawaii.

Original reference: H. T. Stearns, 1935, Hawaii Div. Hydrography Bull. 1.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 135–136. Divided into lower, middle, and upper members. Lower predominantly olivine basalt, in thin flows of both aa and pahoehoe; middle consists of same rock types but in thick massive flows ponded in the caldera; upper predominantly basaltic andesite, with some flows of basalt and olivine basalt near base. Total thickness above sea level 4,025 feet; series presumably extends down to level of surrounding ocean, about 12,000 feet below sea level. On east side, overlapped with erosional unconformity by lavas of Koolau series. Pliocene(?).

No single type locality designated. Lower member well exposed in cliffs along lower Nanakuli and Lualualai Valleys and in Puu Heleakala; middle member exposed continuously from head of Nanakuli Valley around head of Lualualai and Waianae Valleys and in Keaau-Makaha Ridge overlaps lower member with erosional unconformity; upper member veneers most of eastern slope of Waianae Range. Crops out over area of about 100 square miles comprising most of Waianae Range on western side of island.

Waiau Formation

Pleistocene to Recent: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 36, 57–86. Consists both of central cinder cone phase and yellow tuff phase of pyroclastic materials produced by explosive eruptions from numerous vents in Mauna Kea summit area. Overlies Waimea formation (new).

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 136. Cinder cone and fresh ash phase now largely included in Laupahoehoe volcanic series and partly in Hamakua volcanic series; yellow tuff phase now considered part of Pahala ash. Pleistocene to Recent.

Slopes of Mauna Kea.

Waihu Fanglomerate

Pleistocene: Hawaii Island, Hawaii.

H. T. Stearns, 1945, Geol. Soc. America Bull., v. 56, no. 3, p. 269, 270–273. Described by Wentworth and Powers (1939, 1941) as Waihu drift. It is here interpreted as laid down by floods caused by eruptions melting ice cap of Mauna Kea in early Wisconsin time. Well indurated, distinctly bedded and crossbedded. Forms fans 100 feet thick between altitudes 9,000 and 9,750 feet between Waikahalulu and Pohakuloa Gulches. Thins down slope and below 6,900 feet is only a few feet thick Stratigraphically lower than Makanaka drift and outwash.

Probably named from Waihu Springs, west of Pohakuloa Gulch. Exposed over area of about one-half square mile on south slope of Mauna Kea.

Waihu Stage and Drift

Pleistocene: Hawaii Island, Hawaii.

C. K. Wentworth and W. E. Powers, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1942; 1941, Geol. Soc. America Bull., v. 52, no. 8, p. 1207. Four stages of glaciation, presumably correlative with Ice Age elsewhere, occurred on Mauna Kea. These are (beginning with latest) Makanaka, Waihu, Pohakuloa, and pre-Pohakuloa stages. Drift 25 to 30 feet thick.

H. T. Stearns, 1945, Geol. Soc. America Bull., v. 56, no. 3, p. 269. Of glacial deposits described by Wentworth and Powers, only Makanaka deposits can be accepted as definitely glacial. Waihu drift redefined as fanglomerate.

Drift occurs in vicinity of Waihu Springs, at 9,700 feet altitude west of Pohakula Gulch.

Wailuanui Basalt (in Hana Volcanic Series)

Pleistocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 94, 95 (table). Dark-gray olivine pahoehoe basalt. Older than Ohia lava (new) but time relationship to Pauwalu lava (new), oldest basalt in series in Keanae Valley, not known. Each formation of series underlain by local erosional unconformity.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 137. Pleistocene(?).

A narrow flow that descended west fork of Wailuanui Valley, in Keanae area.

Wailuku Volcanic Series

Pliocene(?): Maui Island, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 65 (table), 159 (table), 160–172, pl. 1. Primitive olivine basalts, at type locality composed of thin-bedded pahoehoe and aa dipping 15° E. Aa is mostly highly vesicular and lies in jointed beds 2 to 10 feet thick, underlain, overlain, and in places mixed with clinker beds 6 inches to 4 feet thick. In cliffs, thin beds weather to dark gray, red, red violet, and brown in contrast to overlying Honolua lavas (new) which weather to light gray and white. In some areas, apparently never covered by Honolua lavas. Separated from Lahaina lavas (new) by erosional unconformity.

G. A. Macdonald *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 314–320. Petrography discussed.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 138. Pliocene(?).

Type locality: The 3,500-foot south wall of Iao Valley behind Wailuku. Exposed at surface on most of West Maui and in all deep canyons.

Waimea Agglomerate or Formation

Pleistocene: Hawaii Island, Hawaii.

C. K. Wentworth, 1938, Hawaiian Volcano Observatory 3d Spec. Rept., p. 38–39. Hummocky accumulations of agglomerate, 15 to 20 feet thick in places, underlying tuff of Waiau formation.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 138. Now known to

be fragmental tops of aa lava flows of Hamakua and Laupahoehoe volcanic series. Pleistocene.

Occurs on slopes of Mauna Kea from several miles southeast of Laupahoehoe to Waimea.

Waimea Conglomerate

Pliocene(?): Kauai Island, Hawaii.

N. E. A. Hinds, 1930, Bernice P. Bishop Mus. Bull. 71, p. 56, 65, 76. Coarse conglomerate 75 to 100 feet thick. Overlies lower Kauai lavas and underlies upper Kauai lavas.

D. A. Davis and G. A. Macdonald *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 138–139. Equivalent to part of Mokuone member of Makaweli formation. Pliocene(?).

Type locality: Bottom of Waimea Canyon between Waialae and Poomau Streams.

Waimea Volcanic Series

Pliocene and older: Kauai Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 83 (fig. 22), 85–86. Forms main mass of Kauai; subdivided into extra-caldera, or lower member, and caldera filling, or upper member. Lower member composed of more than 3,500 feet of thin-bedded primitive-type olivine basalts dipping 5° to 20° away from ancient caldera; upper member composed of 4,000 feet of chiefly horizontal and massive olivine basalts laid down in summit caldera. Members separated by partly exhumed fault scarps more than 3,000 feet high and talus breccia. Waimea and Haupu volcanic series are separated by deep zone of weathering and angular erosional unconformity from Kolea series.

G. A. Macdonald, 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1555, 1557. Preoccupied name Waimea replaced by Waimea Canyon volcanic series.

Exposed in walls of Waimea Canyon.

Waimea Canyon Volcanic Series

Pliocene(?): Kauai Island, Hawaii.

G. A. Macdonald, 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1555, 1557. Proposed to replace preoccupied term Waimea volcanic series. Unconformable below Koloa volcanic series.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1954, Volcano Letter 526, p. 2; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 118. Includes Napali, Olokele, Haupu, and Makaweli formations.

G. A. Macdonald, D. A. Davis, and D. C. Cox, 1960, Hawaii Div. Hydrography Bull. 13, p. 21–52, table facing p. 20, pl. 1. Consists almost entirely of olivine basalt, with less abundant basalt poor in olivine, and picrite-basalt rich in olivine. All formations cut by small dikes. Exposed thickness about 8,650 feet. Comprises Napali, Olokele, Haupu, and Makaweli formations. Underlies Koloa volcanic series with profound erosional unconformity. Age not accurately known; contains no fossils; age determinations on basis of uranium-lead ratios, or similar methods, available. Latest lavas of series believed to be about 4 million years old; this places their extrusion in Pliocene. Stratigraphic table

shows age Pliocene; map legend (p. 18) shows Pliocene(?); map legend (pl. 1) shows later Tertiary.

Type locality: In walls of Waimea Canyon. Exposed over most of island.

Waiokamilo Basalt (in Hana Volcanic Series)

Pleistocene(?): East Maui, Hawaii.

H. T. Stearns *in* H. T. Stearns and G. A. Macdonald, 1942, Hawaii Div. Hydrography Bull. 7, p. 95 (table), 96. Dark-gray olivine basalt, with some phenocrysts of plagioclase in dense fine-grained mass.

G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 139. Pleistocene(?).

Lava followed valley of Waiokamilo Stream, and cascaded down cliff at eastern edge of Keanae Valley, building small lava fan.

Waiokawa Flow

Recent: Maui Island, Hawaii.

Grote Reber, 1959, Geol. Soc. America Bull., v. 70, no. 9, p. 1246 (fig. 1). A very recent flow.

On southwest side of Haleakala.

Wait Member (of Day Point Formation)

Ordovician (Chazyan): Northwestern Vermont and northeastern New York.

Philip Oxley and Marshall Kay, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 4, p. 824 (fig. 3), 825 (fig. 4), 826 (fig. 5), 827, 845, geol. sections. Defined as 5 feet of medium to dark-gray finely laminated dense calcareous fine quartz sandstone to siltstone overlying Scott member (new) in cove at north end of Scott Point, Isle La Motte; underlies Fleury member (new). Member is irregularly divided by disconformity, blocks of lower beds forming pebbles in conglomerate above. The typical gray dense fine quartz sandstone grades eastward to dark quartz-silty shaly argillite with thin quartz sandy lenses. Thickens from type section to 15 feet on east shore of Isle La Motte; westward in New York, it is 5 feet at Wool Point and 3 feet southwest of Chazy; increases southward to about 28 feet on southern Valcour Island and 38 feet on South Hero.

Type locality: In Cove at Scott Point, Isle La Motte, Vt. Name derived from Wait Bay.

Waits River Formation

Waits River Limestone[1]

Waits River Limestone Member (of Memphremagog Formation)

Silurian and Devonian: East-central and northeastern Vermont and northwestern New Hampshire.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 79–115.

L. S. Currier and R. H. Jahns, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1491, 1492, 1506. Formation is largely the Waits River limestone of earlier reports. Includes prominent beds of phyllite and quartzite. Ordovician(?).

C. G. Doll, 1945, Vermont State Geologist 24th Rept., p. 16, pl. 4. Rank reduced to member of Memphremagog formation in northeastern Vermont. Middle Silurian or Lower Devonian.

G. E. Moore, Jr., 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1618–1619, pl. 1. In Keene-Brattleboro area, New Hampshire-Vermont, Waits River formation crops out in north-south band along extreme western edge of area. Thickness 4,000 to 5,000 feet. Orfordville formation crops out in north-south belt between Northey Hill thrust on east and Waits River formation on west.

W. S. White and R. H. Jahns, 1950, Jour. Geology, v. 58, no. 3, p. 187–189, 192, fig. 2. Standing Pond amphibolite member is tentatively included in uppermost part of formation. In southern part of Strafford quadrangle, Standing Pond marks boundary between Gile Mountain and Waits River formations; farther north, occurs beneath calcareous beds in the Waits River.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 22. Name not used in northeastern Vermont because too comprehensive; in its place, three new names used: Ayers Cliff, Barton River, and Westmore formations.

M. P. Billings, 1956, The geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 6–8. Geographically extended to New Hampshire. Middle Ordovician(?); possibly Silurian and (or) Lower Devonian.

J. G. Dennis, 1956, Vermont Geol. Survey Bull. 8, p. 16–19, 25, 26–28. Summary of earlier uses of name. Contains Ayers Cliff member and Barton River member in northeastern Vermont.

W. M. Cady, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–79. Age designated Silurian(?) and Devonian(?).

V. R. Murthy, 1957, Vermont Geol. Survey Bull. 10, p. 20, 23 (table 1), 24, 35–38, pls. Metasedimentary rocks of East Barre quadrangle divided into four mappable units. Previously, the western three units were included in one formation, the Waits River (Currier and Jahns, 1941). On basis of present study it is proposed that term Waits River formation be redefined and stratigraphic sequence modified as follows (ascending): Northfield slate (exposed in Barre quadrangle), Barton River formation (partly exposed in area), Westmore formation (type locality—Memphremagog quadrangle), Waits River formation (as newly restricted—type locality in this area), and Gile Mountain formation (type locality—Strafford quadrangle). If structural interpretation offered in this report is accepted, Westmore formation may be correlated with Gile Mountain and stratigraphic column modified as follows: Northfield slate, Barton River formation, Gile Mountain formation (equivalent to Westmore) and Waits River (as here restricted). Waits River is restricted in this area to essentially calcareous rocks in central and eastern parts of quadrangle. Stratigraphically younger than Westmore and Gile Mountain formations. Thickness 4,750 to 6,500 feet. Age may be Lower Devonian(?).

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 276–287. Rocks between Northfield slate and Gile Mountain formation in east-central Vermont can be divided into three mappable units. Western two units are continuous with Barton River and Westmore formations as defined in Memphremagog quadrangle to north. These units have been included in Waits River formation, a thick sequence of calcareous and noncalcareous rocks in Barre and East Barre quadrangles. Analysis of structural relations in area indicates possibility of correlating Westmore formation and Gile Mountain formation across limbs of major syncline, trough of

which is occupied by calcareous unit in central part of East Barre quadrangle. If correct, this interpretation makes this calcareous unit the youngest in Paleozoic sequence in Vermont and calls for revision of stratigraphic sequence. Proposed that name Waits River formation be restricted to this youngest calcareous unit. Also that total section of rocks included under Waits River formation of Currier and Jahns (1941) be redefined as Barre group composed of Barton River, Westmore, and present Waits River.

L. M. Hall, 1959, Vermont Geol. Survey Bull. 13, p. 15, 19–28, 36–41, pls. 1–4. Formation present in two regions in St. Johnsbury quadrangle where it occupies more surface area than any other formation. Largest area is belt 4 to 9 miles wide that trends northeastward through quadrangle. Small area located in northwest portion. Includes Crow Hill member (new) and Standing Pond amphibolite member. Total thickness not known because lower contact is not exposed. Age not certain. Present information favors Waits River as being older than Gile Mountain formation.

Type locality: Waits River town, Orange County, Vt.

Wakarusa Limestone Member (of Bern Limestone)

Wakarusa Limestone (in Shawnee Group)

Wakarusa Limestone (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Northeastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 30.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 32). Correlation chart shows Wakarusa limestone in Shawnee group in Missouri.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. 20. Assigned to Wabaunsee group when that group was redefined for Missouri.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273 (fig. 1), 2277. Rank reduced to member status in Bern limestone (new). Overlies Soldier Creek shale member; underlies Auburn shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 53–54. As now defined, name Wakarusa is applied to first resistant limestone unit above Burlingame limestone in Kansas section. Fusulinid-bearing phase of Wakarusa extends into Oklahoma, where, in earlier reports, it was referred to as *Cryptozoon* limestone. Thickness in Pawnee County 2 to 9½ feet. Overlies Hallett shale; underlies Auburn shale. Wabaunsee group.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 13, fig. 5. Consists of two blocky bluish-gray fine-grained limestone beds separated by thin gray crinoidal shale. Underlies Auburn shale; overlies Soldier Creek shale. Wabaunsee group.

Named for exposures along Wakarusa Creek immediately south of Auburn, Shawnee County, Kans. Well exposed on Kansas Highway 10, west of Topeka, in sec. 35, T. 11 S., R. 13 E., and along creek north of highway.

Wakefield Marble

Lower Paleozoic(?) (Glenarm Series): Western Maryland and southeastern Pennsylvania.

A. I. Jonas and G. W. Stose, 1938, Washington Acad. Sci. Jour., v. 28, no. 8, p. 346. Name applied to white finely crystalline marble which underlies and is interbedded with volcanic flows in western Piedmont of Maryland and York County, Pa.; in part of area it is beneath and infolded with albite-chlorite schist facies of Wissahickon formation. Occurs on northwestern side of Peach Bottom syncline; the Cockeysville marble underlies the Wissahickon on southeastern side of the syncline but, since equivalency of the two marbles is not established, name Wakefield is proposed. In some areas, grades into Silver Run limestone (new). Precambrian(?).

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 38–39, pl. 1. Described in Hanover-York district, Pennsylvania, where it is apparently oldest formation in region and underlies the albite-chlorite schist facies of Wissahickon. Estimated thickness in southern Pennsylvania and adjacent Maryland 100 feet.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties [Rept. 12], p. 58–62. Described in Carroll and Frederick Counties. Underlies Libertytown metarhyolite (new). No complete section of the Wakefield found; estimated thickness near Union Bridge 150 feet.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 43 (table 7). Late Precambrian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Probably Lower Paleozoic.

Named from Wakefield, Carroll County, Md.

†Wakulla Formation[1]

Miocene, lower: Northern Florida.

Original reference: L. C. Johnson, 1892, Geol. Soc. America Bull., v. 3, p. 128–132.

Exposed in vicinity of Wakulla Springs in Wakulla County.

Walcott Tuff

Pliocene, middle: Southern Idaho.

H. T. Stearns and Andrei Isotoff, 1956, Geol. Soc. America Bull., v. 67, no. 1, p. 23. Name proposed for unit that was formerly called Eagle Rock tuff (Stearns and others, 1938). Eagle Rock was used as locality name at the time but, because a basaltic tuff originated at Eagle Rock vent, confusion can be avoided in present report by renaming the tuff from Walcott Lake. Four phases recognized: dark-red brittle pitchstone, fine-grained pink and gray rock rock honeycombed with lithophysae, hard obsidian containing spherulites, and well-bedded glass shard tuff and loose white and gray ash. Thickness 50 to 70 feet.

Named from Lake Walcott, where an excellent section is exposed in east bank in SE¼ sec 29, T. 8 S., R. 30 E., Power County.

Walden Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southeastern Tennessee, northeastern Alabama, and northwestern Georgia.

Original reference: C. W. Hayes, 1892, Alabama Geol. Survey Bull. 4, p. 49–51.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 8, 9, 10, 45, 152. Includes Whitwell, Herbert, Eastland, Newton, Vandever, and Rockcastle formations of present Tennessee classification.

Named for exposures on Walden Ridge, Chattanooga, Pikeville, and Kingston quadrangles, southeastern Tennessee.

Walden Creek Group

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 953 (fig. 2), 955 (table 1), 961–962. Forms northern sequence of Ocoee series. A varied assemblage of argillaceous and silty rocks and quartz-pebble conglomerate, with locally prominent quartzite, limestone, and dolomite. Best defined sequence is south of English Mountain in eastern part of foothills, where rocks form a broad pattern of northeast-plunging folds that expose a section about 8,000 feet thick. Formations of group defined in this area are (ascending) Licklog (new), Shields (new), Wilhite, and Sandsuck. Overlain by Chilhowee group of Cambrian and Precambrian(?) age; in fault contact with Snowbird group on southeast; not in contact with Great Smoky group; northeast of Great Smoky Mountains, the Walden Creek is reported to overlie Snowbird group as part of a sedimentary sequence from basement rocks upward through Chilhowee group into the overlying Paleozoic. Group corresponds approximately to Wilhite slate, Citico conglomerate, and Pigeon slate as mapped by Keith (1895) and to his more inclusive Hiwasse slate of his later terminology (1904).

Named for Walden Creek, Sevier County, a western tributary of the West Fork of the Little Pigeon River, which drains southeast slope of Chilhowee Mountain and northern foothill belt, an area underlain by rocks of the group. Crops out in a belt a few miles to 8 miles wide in northwesternmost foothills of Great Smoky Mountains and extends along strike for many miles northeast and southwest.

Walden Hollow Glacial Stage

Pleistocene: North-central Colorado.

R. L. Ives, 1942, Geog. Review, v. 32, no. 3, p. 450 (table 1). Name appears only on table giving late Pleistocene chronology of the Monarch Valley. Younger than Hell Inlet glacial stage (new); older than Stillwater glacial stage.

Monarch Valley, Grand County.

†Waldo Formation[1]

Miocene, lower: Northern Florida.

Original reference: L. C. Johnson, 1888, Am. Jour. Sci., 3d, v. 36, p. 230–236.

Occurs near Waldo, Alachua County, at old Fort Harlee.

Waldo Granite

Devonian(?) or Carboniferous(?): South-central Maine.

J. M. Trefethen, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2020. Medium-textured porphyritic biotite granite.

Occurs in central part of Bucksport quadrangle.

†Waldrip division[1]

Pennsylvanian: Central Texas.

Original reference: E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxvii, pl. 3.

Named for Waldrip, McCulloch County.

Waldrip Shale Member (of Pueblo Formation)

Waldrip Bed or Formation (in Cisco Group)[1]

Waldrip Limestone Member (of Harpersville Formation)[1]

Permian (Wolfcamp Series): Central Texas.

Original references: N. F. Drake, 1893, Texas Univ. Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 412; F. B. Plummer, 1919, Am. Assoc. Petroleum Geologists Bull., v. 3, p. 133–145.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Reallocated to member status in Pueblo formation. Age designated as Permian. This reallocation made on basis of change of Pennsylvanian-Permian boundary. Top of Pennsylvanian is drawn in middle part of Cisco group and within sequence of rocks formerly designated as Harpersville formation. Use of Harpersville is suppressed, lower part of Harpersville being added to underlying Thirfty formation, which is classed as Pennsylvanian, and upper part being added to Pueblo, which is classed as Permian. In Colorado River valley, Waldrip consists of prominent red shale, yellowish to gray shale, light-gray to tan sandstone, and thin beds of hard blue-gray limestone. Thickness 40 to 55 feet. Lies 20 to 25 feet below Saddle Creek limestone member.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 58 (table 1), 75–76, pl. 27. Waldrip shale member of Pueblo was described by Drake (1893), who called it Waldrip bed, as consisting of blue clay, sandstone, coal, carbonaceous shale, and limestone. The beds of sandstone are mostly near the base of unit and are quite irregular in thickness. Three limestone beds near top of Waldrip, Drake designated by numbers 1, 2, and 3 beginning with lowest. Plummer and Moore (1921, Texas Univ. Bull. 2132) included in their Harpersville formation the beds later called Waldrip shale by Moore (1949), together with Saddle Creek limestone member. Bullard and Cuyler (1935, Texas Univ. Bull. 3501) restricted term Waldrip to about 115 feet of beds from base of No. 1 limestone to base of Saddle Creek limestone. Lower part of the unit to top of Chaffin limestone member of Thirty formation (their Breckenridge limestone) they found to be about 90 feet in thickness, and they called this part Lower Harpersville beds. Nickell (1938, Texas Univ. Bur. Econ. Geology Pub. 3801) found Waldrip beds of Drake to be 238 feet thick. Cheney (1940) placed upper boundary of Cisco series at unconformity in Harpersville formation above Waldrip-Newcastle coal zone and below *Schwagerina*-bearing Waldrip limestone No. 3. The beds underlying this systemic boundary and overlying his Chaffin formation he termed Obregon formation. Moore (1949) placed Permian-Pennsylvanian boundary 40 to 55 feet below top of Waldrip shale member, between limestones 1 and 2 of Drake. In survey for present report [Brown and Coleman Counties], no traceable horizon was found which could be considered boundary between Pennsylvanian and Permian. For purposes of this report, whole interval that Drake called Waldrip beds is considered Waldrip shale member of Pueblo. Underlies Saddle

Creek limestone member; overlies Chaffin limestone member of Thrifty formation.

Named for Waldrip, McCulloch County.

Waldron Clay Member (of Wayne Formation)[1]

Waldron Shale[1]

Middle Silurian: Southern Indiana, west-central Kentucky, and central Tennessee.

Original reference: M. N. Elrod, 1883, Indiana Dept. Geology and Nat. History 12th Ann. Rept., p. 106–111.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 249–251. Waldron shale included in Wayne group. A gray or greenish-gray calcareous shale with occasional thin beds of limestone or argillaceous shale. Southward along Tennessee River, thins and changes character from place to place; at many localities it is tripartite, consisting of upper foot or so of red or gray shale or red or gray calcareous mudstone, middle thin bed of gray limestone, and lower thin zone of white clay-shale; south of Saltillo, consists of 18 inches of red earthy limestone or red calcareous mudstone; at Cerro Gordo and Swallow Bluff, consists of 1 foot of gray shale. Thickness between 2 and 5 feet; average 3 feet. Overlies Laurel limestone; underlies Lego limestone; where Lego is absent, unconformably underlies Chattanooga shale.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, pl. 1. In Indiana, Waldron formation overlies Laurel formation and underlies Louisville formation. Consists of shale, blue gray, knotty, calcareous, locally fossiliferous. Thickness 0 to 10 feet. In Clinton group.

Named for Waldron, Shelby County, Ind.

†Waldron Sandstone (in Douglas Formation)[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 52.

Named for exposures at Waldron, Platte County.

Wales Group[1]

Pre-Ordovician to Devonian: Southeastern Alaska.

Original reference: A. H. Brooks, 1902, U.S. Geol. Survey Prof. Paper 1, p. 40–52, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Name appears on map legend under undifferentiated Paleozoic metamorphic rocks.

Occupies large area on Prince of Wales Island.

Walgreen Member (of Grand Detour Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., figs. 3, 15A. Shown on columnar section as underlying Stillman member (new) and overlying Dement member (new). Thickness about 6½ feet.

Occurs in Dixon-Oregon area.

Walhalla formation (in Kwaguntan series)

Precambrian: Northern Arizona.

Charles Keyes, 1938, Pan-Am. Geologist, v. 70, no. 2, p. 107 (chart), 114. Black shales having a thickness of about 200 feet. Underlies Nunkoweap sandstone (new); overlies Echo limestone (new).

Shales crop out under Walhalla Plateau from which they take their name; Grand Canyon region.

†Walker Beds[1]

Lower Cretaceous (Comanche Series): Central southern Kansas.

Original reference: F. W. Cragin, 1895, Am. Geologist, v. 16, p. 359.

Named for Walker's Draw, a well-known branch of Medicine Lodge River south of Belvidere, Kiowa County.

Walker Conglomerate and Sandstone[1]

Pennsylvanian: Western Missouri.

Original reference: F. C. Greene and W. F. Pond, 1926, Missouri, Bur. Geology and Mines, v. 19, 2d ser., p. 62–65.

Occurs only on crest of ridge which extends to northwest on Walker Mound, sec. 8, T. 36 N., R. 30 W., Vernon County.

Walker Formation[1]

Oligocene: Southern California (subsurface and surface).

Original reference: V. H. Wilhelm and L. W. Saunders, 1927, California State Mining Bur., v. 12, no. 7, p. 9, pl. 1.

T. W. Dibblee, Jr., and C. W. Chesterman, 1953, California Div. Mines Bull. 168, p. 12 (fig. 2), 33–35, pls. 1, 2, 3. Described in surface section. Consists of granitic sandstone, conglomerate, siltstone, and tuff breccia. Thickness at type section herein designated, 2,000 feet; thickens southwestward along strike to 2,950 feet and grades into Bealville fanglomerate (new) facies; thins northwestward, and in Cottonwood Canyon consists of about 200 feet of sand and gravel. At type section, overlies (Jurassic) quartz diorite conformably underlies Ilmon basalt (new); in Cottonwood Canyon (outside mapped area), conformably underlies Freeman-Jewett shale. Oligocene.

Otto Hackel and K. F. Krammes, 1958, San Joaquin Geol. Soc. [Guidebook] Spring Field Trip May 17, p. 10. Walker formation overlies basement complex in outcrop. To the west, subsurface Eocene rocks rest on basement, and it is apparent that Walker is land-laid equivalent of marine rocks of lower Miocene through upper Eocene.

Type section: Along southeast bank of Walker Basin Creek, 1 to 2 miles northeast of Bena, Breckenridge Mountain quadrangle, Kern County.

Walker Shale[1]

Upper Devonian: Southwestern Virginia.

Original reference: M. R. Campbell, 1894, Geol. Soc. America Bull., v. 5, p. 171, 177, pl. 4.

In Wythe, Montgomery, and Pulaski Counties. Named for Walker Mountain, Giles County.

Walker Mountain Sandstone Member (of Moccasin Formation)

Ordovician: Southwestern Virginia.

Charles Butts and R. S. Edmundson, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1678. Name proposed for upper of two sandstones in formation. Thick-bedded gray quartzose rock 8 to 12 feet thick. Underlies Martinsburg formation.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 95. Butts and Edmundson did not designate type section. Exposure noted herein.

Named for exposures in southwestern end of Walker Mountain, Washington County. Well exposed along Keywood Branch Road about one-half mile north of Seven Springs and along Virginia Highway 91, about 1 mile northwest of McCall Gap, Washington County.

Walker Plain Basalt

Miocene: Northern California.

Anna Hietanen, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 586, 587. Youngest rock in area; hence, younger than Merrimac granodiorite, Bucks granodiorite, and Bald Rock granite (all new).

Occurs on both sides of old Quincy-Oroville Road extending south from Four Trees Junction, Merrimac area, Plumas National Forest.

Walker Ridge Sandstones[1]

Post-Franciscan and pre-upper Miocene: Northern California.

Original reference: W. Stalder, 1915, California State Mining Bur. Bull. 69, p. 447–449.

D. L. Everhart, 1950, California Jour. Mines and Geology, v. 46, no. 3, p. 388. Incidental mention in report on quicksilver mine in Sonoma County.

Named for exposures on Walker Ridge, Humboldt County.

Walker Ridge Shales[1]

Post-Franciscan and pre-upper Miocene: Northern California.

Original reference: W. Stalder, 1915, California State Mining Bur. Bull. 69, p. 447–449.

Named for Walker Ridge, Humboldt County.

Walkup Clay[1]

Eocene: Northern California.

Original reference: V. T. Allen, 1929, California Univ. Pub., Dept. Geol. Sci. Bull., v. 18, no. 14, p. 364, 403.

Occurs at Walkup pit, less than one-half mile east of Gladding McBean pit in Chico quadrangle.

Wall Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 24, figs. 3, 12. Dolomite, argillaceous in upper part, with bentonite 3 feet above base. Thickness about 9 feet. Shown on columnar section as underlying Wyota member (new) and overlying Sherwood member (new).

Occurs in Dixon-Oregon area.

Wallace Formation[1] (in Piegan Group)

Precambrian (Belt Series): Northeastern Idaho and western Montana.

Original reference: F. L. Ransome, 1905, U.S. Geol. Survey Bull. 260, p. 277–285.

F. L. Ransome and F. C. Calkins, 1908, U.S. Geol. Survey Prof. Paper 62, p. 39–44, pl. 11. Thin-bedded bluish and greenish more or less calcareous shales, underlain by rapidly alternating thin beds of argillite, calcareous sandstone, impure limestone; these in turn underlain by

gray-green siliceous argillites. Ripple marks, sun cracks, and so on, throughout. Thickness about 4,000 feet. Overlies St. Regis formation; underlies Striped Peak formation.

Russell Gibson, 1948, U.S. Geol. Survey Bull. 956, p. 13–16, pl. 1. Thickness as much as 17,000 feet in Libby quadrangle, Montana. Overlies Ravalli formation; underlies Striped Peak formation.

C. P. Ross, 1949, (abs.) Washington Acad. Sci. Jour., v. 39, no. 3, p. 112–113. Principal component of Piegan group has been variously called Siyeh, Newland, and Wallace limestone or formation, and these names are retained locally. In and near Coeur d'Alene region, the Wallace is the only representative of the group.

R. E. Wallace and J. W. Hosterman, 1956, U.S. Geol. Survey Bull. 1027–M, p. 584–585, pl. 48. Crops out over large part of Mineral County, Mont. Thickest section, about 6,500 feet, is exposed at head of Savenac Creek near Mount Bushnell on north flank of Savenac syncline; base of section here is fault contact. Commonly overlies St. Regis formation with contact transitional. Predominantly argillite.

A. B. Campbell, 1960, U.S. Geol. Survey Bull. 1082–I, p. 557–560, pl. 28. In St. Regis-Superior area, Montana, conformably underlies Spruce formation (new) of Missoula group; overlies St. Regis formation.

Well exposed at town Wallace, Coeur d'Alene district, Idaho.

Wallace shale

Cretaceous (Mid-Cretacic): Northwestern Kansas.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 76, no. 4, p. 304 (chart). Name applied to upper formation in Buckskinian series. Consists of shales about 300 feet thick. Overlies Gove chalk; underlies unnamed interval below Arickaree formation of Rawlinsian series.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 76, no. 5, p. 374, 376. Proposed for so-called Pierre shales of Kansas. Derivation of name given.

Name derived from Wallace County.

Wallace Creek Formation[1]

Lower Ordovician: Northwestern Vermont, and southeastern Quebec, Canada.

Original reference: H. W. McGerrigle, [1931], Vermont State Geologist 17th Rept., p. 182, 184, 185.

J. A. Dresser and T. C. Denis, 1944, Quebec Dept. Mines Geol. Rept. 20, v. 2, p. 396, 397. Consists of thin-bedded dark-gray to black limestones, with interbedded shale. Thickness about 250 feet. Overlies Strites Pond limestone; overlies Morgan Corners dolomite.

Exposed from northern part of St. Albans quadrangle, Vermont, across the international border for about 20 miles into Quebec.

Wallace Ledge Formation

Lower Cambrian: West-central Vermont.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1089, pl. 1. Gritty purplish slate in lower part and soft green slate with some purple slate above. Thickness about 100 feet. Underlies Zion Hill quartzite; overlies Schodack formation.

Named for exposure on western side of Wallace Ledge, Castleton Township, Rutland County. Occurs in northern end of Taconic Range.

†Wallala Beds[1] or Group[1]

See Gualala Group accepted spelling.

Wall Creek Sandstone Member (of Frontier Formation)[1]

Wall Creek facies (of Carlile Formation)

Wall Creek Member (of Carlile Formation)

Upper Cretaceous: Eastern Wyoming and western South Dakota.

Original reference: C. H. Wegemann, 1911, U.S. Geol. Survey Bull. 452, p. 43, 45.

E. P. Rothrock, 1949, South Dakota Geol. Survey Rept. Inv. 62, p. 17–19, fig. facing p. 4. Wall Creek member lies about 250 feet above base of Carlile in Fall River County. Where typically exposed, appears to consists of beds about one-fourth inch thick of alternating sand and black shale or carbonaceous matter. Thickness about 20 feet.

R. E. Stevenson, 1952, South Dakota Geol. Survey Rept. Inv. 69, p. 13, fig. 1. Facies of Carlile formation in southwestern Butte County. Facies (which is unit 1 of Turner member—Cobban, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 10), lies about 86 to 126 feet above base of Carlile. Thickness 20 to 60 feet, thickens westward.

J. D. Haun, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 85. In Powder River basin, top of Frontier is placed at top of Wall Creek sandstone member.

Named for exposures in escarpment 12 miles west of Salt Creek, which rims Powder River dome, forming lofty escarpment known locally as "The Wall." Also well exposed above Wall Creek stream, eastern Wyoming.

Wallingford Dolomite[1]

Wallingford Member (of Danby Formation)

Lower Cambrian: West-central Vermont.

Original reference: A. D. Hager, 1861, Rept. Geol. Vt., v. 2.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 535–536. Rank reduced to member at top of Danby formation. Upper Cambrian.

Type locality: Wallingford Township, Rutland County.

Wallington Limestone (in Clinton Group)

Middle Silurian (Ontarian): Western New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser., no. 1. Name suggested for limestone formerly regarded as Reynales at Rochester and eastward. Thickness at type section 15 feet. Younger than type Reynales of Niagara and Orleans Counties and separated stratigraphically from it by Furnaceville hematite. Underlies lower Sodus shale.

Type section: Along east branch of Salmon Creek at Wallington, Wayne County.

†Wallkill Limestone[1]

Upper Cambrian and Lower Ordovician: Northern New Jersey.

Original reference: J. E. Wolff and A. H. Brooks, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 443–454.

In vicinity of Franklin Furnace and Hamburg; also in Wallkill Valley, south of Franklin Furnace, Sussex County.

Walloomsac Slate[1]

Middle Ordovician: Southwestern Vermont, northwestern Massachusetts, and eastern New York.

Original reference: L. M. Pringle and E. B. Knopf, 1932, Am. Jour. Sci., 5th, v. 24, p. 268–269 (map), 274–275.

R. V. Cushman, 1950, New York State Water Power and Control Comm. Bull. GW–21, p. 9 (table 2), 11, pl. 2. In Rensselaer County, Walloomsac slate underlies broad areas in Hoosick-Berlin Valley and is everywhere separated from adjacent Lower Cambrian shale and grit by thrust faults. It lies in elongated belt east and southeast of Rensselaer Plateau where it forms most of Kinderhook Creek valley southward from Berlin to Columbia County boundary. Also underlies area that reaches from Eagle Bridge to Hoosick and extends eastward to Vermont boundary. Appears to rest conformably on uppermost blue phase of Stockbridge limestone. Thickness unknown. Stratigraphic position of the Walloomsac and fossils found in it indicate age that is probably equivalent to that of upper Normanskill shale of Hudson Valley.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Vermont shows Walloomsac slate overlies Stockbridge limestone. Middle Ordovician.

R. V. Cushman, 1953, New York State Water Power and Control Comm. GW–33, p. 10 (table 3), 15, pl. 2. In southeastern part of Washington County, there is an extensive massive known as Walloomsac slate. Massif consists of green to black smooth shale, schist, and soft slate. Included fossils indicate age equivalent to upper Normanskill. Thickness unknown. Probably separated from other Taconic rocks by thrust fault. Table 3 lists Walloomsac slate below Snake Hill formation.

J. A. MacFayden, Jr., 1956, Vermont Geol. Survey Bull. 7, p. 27–28, p. 16. In Bennington area, overlies Mount Anthony formation (new). Contact with underlying Canadian limestone appears to be locally conformable but over large area it marks major unconformity. Along eastern flank of Taconic Range lies in apparent normal stratigraphic succession on limestone section; southeastward, just north of Mason Hill, it overlies Upper Cambrian Clarendon Springs; on western flank of The Dome, a small remnant of the phyllite with one of the characteristic limestone lenses lies on Lower Cambrian Dunham dolomite. Middle Ordovician.

Named for extensive distribution in valley of Walloomsac River, west and northwest of Bennington, Vt., in both Bennington County, Vt., and Rensselaer County, N.Y.

Walnut Clay (in Fredericksburg Group)[1]

Walnut Shaly Member (of Goodland Limestone)[1]

Walnut Marl (in Fredericksburg Group)

Lower Cretaceous (Comanche Series): Northeastern Texas and southern Oklahoma.

Original reference: R. T. Hill, 1891, Geol. Soc. America Bull., v. 2, p. 504, 512.

L. W. Stephenson and others, 1942, Geol. Soc. America Bull., v. 53, no. 3, chart 9. Walnut shaly member in lower part of Goodland shown on correlation chart.

W. O. George, 1952, U.S. Geol. Survey Water-Supply Paper 1138, p. 14 (table 7), 21–22. Walnut clay described in Comal County, Tex., where it is lowest formation of Fredericksburg group. Conformably overlies Glen

Rose limestone; conformably underlies Comanche Peak limestone. In most places, represented by bed of sandy marl 3 to 5 feet thick.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Walnut clay in Fredericksburg group, mapped in southeastern Oklahoma.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 21–22. Foraminifera of Walnut clay described. Basal formation of Fredericksburg group. Underlies Goodland limestone. The Walnut is time-transgressing formation, laterally equivalent to Comanche Peak formation and in part to Edwards limestone.

V. E. Barnes, 1958, Texas Univ. Bur. Econ Geology Guidebook 1, p. 34. In Travis and Williamson Counties, includes Cedar Park limestone member.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 11–15, pls. 1, 2. In this report [Fort Worth-Weatherford area], term Walnut marl is used for yellow and gray shell-bed-bearing marls delimited below by Paluxy sand and above by basal blue marl of Goodland formation. Consists of beds of shells of *Gryphaea mucronata* Gabb and *Exogyra texana* Roemer alternating with thin marl units. Thickness about 25 feet. Previous writers have placed upper and lower contacts of Walnut formation at various stratigraphic levels; as a result, reports of thickness of formation have ranged from 27 to 170 feet. Taff (1893 Texas Geol. Survey Ann. Rept. 4, pt. 1) assigned 170 feet to the formation (Texana limestone) and included about 15 feet of arenaceous marl that in this report is considered Paluxy and about 130 feet of limestone and marly limestone that in this report is considered Goodland. Hill (1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7) assigned 130 feet to the formation and included 3 feet of sand herein considered Paluxy and more than 90 feet of marly limestone herein considered Goodland. Winton and Adkins (1920 [1919], Texas Univ. Bull. 1931) placed upper contact of Walnut at top of uppermost massive *Gryphaea mucronata* ledge, as is done in this report, but included in formation 100 feet of marl, sand, and shell ledges considered Paluxy in this report. Scott and Hawley (*in* Adkins, 1933 (Texas Univ. Bull. 3232) and Hawley and Smith (1933, Texas Univ. Bull. 3201) applied name Walnut in area west and northwest of Fort Worth to calcareous sediments including *Gryphaea marcouri* [*G. mucronata*] shell banks. This application was followed by Lozo (1944, Am. Midland Naturalist, v. 31, no. 3). Thompson (1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 10) included in his definition of Walnut, arenaceous marls presently assigned to Goodland formation.

Named for Walnut (also called Walnut Springs), Bosque County, Tex.

†Walnut Shale[1]

Pennsylvanian: Eastern Kansas and northeastern Oklahoma.

Original reference: E. Haworth and J. Bennett, 1908, Kansas Acad. Sci. Trans., v. 21, pt. 1, p. 74.

Named for Walnut, Crawford County, Kans.

Walnut Wells Monzonite

[Tertiary]: Southwestern New Mexico.

A. M. Alper and Arie Poldervaart, 1957, Econ. Geology, v. 52, no. 8, p. 953, 954, 963, 965. Believed to be penecontemporaneous and derived from same magma as quartz monzonite-porphyry of Animas intrusive.

Occurs in vent 6 miles south of Animas stock, Walnut Wells quadrangle, Hidalgo County.

Walston Silt

Pleistocene (Yarmouth): Southeastern Maryland (subsurface and surface).

W. C. Rasmussen and T. H. Slaughter, 1955, Maryland Dept. Geology, Mines and Water Resources Bull. 16, p. 115 (table 17), 116–117. Lenticular unit of sand, silty sand, sandy silt, silt, clayey silt, silty clay, and clay, with organic material. Thickness from a fraction of a foot to as much as 57 feet at reference locality. Underlies unconformably Parsonsburg sand (new) and overlies unconformably Beaverdam sand (new).

Reference locality is a test hole, Wi–Cg 40, 2 miles north of Parsonsburg. Crops out in banks of Walston Branch, from which it takes its name, a tributary to Beaverdam Creek, Wicomico County.

Walter Johnson Sandstone Member (of Nowata Shale)

Pennsylvanian (Des Moines Series): Eastern Kansas, western Missouri, and northeastern Oklahoma.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, pt. 11, p. 292, 335. Name applied to lenticular sandstone in Nowata.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 96. Thin-bedded to massive sandstone in lower and middle part of Nowata. Thickness commonly 4 to 10 feet.

W. B. Howe, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 9, p. 9, 22. Name Walter Johnson applied to sandstone and siltstone, about 6 feet thick, in Nowata shale, in LaFayette County.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 3. Stratigraphic column in northeastern Oklahoma includes Nowata shale with Walter Johnson sandstone member.

Named from Walter Johnson School in sec. 10, T. 35, S., R. 17 E., Montgomery County, Kans.

Waltersburg Sandstone[1] or Formation

Waltersburg Sandstone (in Elvira Group)

Upper Mississippian (Chester Series): Southern Illinois, southern Indiana, and western Kentucky.

Original references: S. Weller, 1920, Jour. Geology, v. 28, no. 4, p. 281–290; no. 5, p. 395–416; 1920, Illinois Geol. Survey Bull. 4.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 136; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 837. Assigned to Elvira group (new). In standard Mississippian section, underlies Menard limestone and overlies Vienna limestone.

C. A. Malott, 1942, Stratigraphy of Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Name Waltersburg sandstone extended into Indiana where it replaces Wickliff sandstone. Local Indiana names of upper Chester are dropped, and formations are given names of standard Chester column.

T. G. Perry and N. M. Smith, 1958, Indiana Geol. Survey Bull. 12, pl. 1. Waltersburg sandstone shown on stratigraphic column of upper Chester rocks in Indiana as gray to brown sandstone and gray to green-gray shale and silty shale. Thickness 30 to 60 feet. Term Elvira group not used in Indiana.

Named for exposures at Waltersburg, Pope County, Ill.

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Waltham Gneiss[1]

Precambrian: Eastern Massachusetts.

Original reference: L. LaForge, 1932, U.S. Geol. Survey Bull. 839.

Occupies much of northern Waltham, southeast Lexington and Burlington, and northwest Woburn, in Middlesex County. Extends northeast into Lawrence and Salem quadrangles and southwest into Framingham and Franklin quadrangles.

Waltham Shale (in Panoche Formation or Group)

Upper Cretaceous: Central western California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 962 (fig. 2), 993. Panoche group (or formation) is subdivided into 10 units. Waltham shale is divided into lower unit and upper unit separated by Juniper Ridge sandstone (new). Upper Waltham may belong to Cachenian stage (new) and lower Waltham may belong to Delevanian stage (new). Name credited to J. Q. Anderson.

Occurs in Alcalde Hills, Coalinga-Ortigalito area, San Joaquin Valley.

Wamego Shale Member (of Zeandale Limestone)

Wamego Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Eastern Kansas and southeastern Nebraska.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 42–43. Name applied to shale between Maple Hill limestone above and Tarkio limestone below. Thickness at type locality 15 to 18 feet. Replaces Pierson Point shale of Condra (1927). [See explanation under Pierson Point.]

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 15. Reference made to Pierson Point shale by Condra and Reed (1943) is in error; name Pierson Point retained and Wamego dropped.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2276. Rank reduced to member status in Zeandale limestone (new).

Type locality: In bluffs north of U.S. Highway 40, about 4 miles west of Wamego, Pottawatomie County, Kans.

Wamsutta Formation[1]

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134, 141–158, pl. 17.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 5b). Age of lowermost part of formation shown as Mississippian; remainder is Pennsylvanian.

A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Pennsylvanian. Appears to interfinger with both Rhode Island formation and Pondville conglomerate in southern part of Pawtucket quadrangle.

A. W. Quinn, 1952, Bedrock geology of the East Greenwich quadrangle, Rhode Island: U.S. Geol. Survey Geol. Quad Map [GQ–17]. Not recog-

nized south of Greenwich Bay, R.I., where unit as mapped by Emerson (1917, U.S. Geol. Survey Bull. 597) is assigned to Rhode Island formation.

Wamsutta was name proposed but not actually adopted for North Attleboro, Mass., where Wamsutta Mills are located.

†Wamsutta Volcanics[1]

Carboniferous: Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 155–156.

Wanakah Formation (in San Rafael Group)

Wanakah Marl Member (of Morrison Formation)

Wanakah Member (of Morrison Formation)[1]

Upper Jurassic: Southwestern Colorado and northwestern New Mexico.

Original reference: W. S. Burbank, 1930, Colorado Sci. Soc. Proc., v. 12, no. 6, p. 172.

M. I. Goldman and A. C. Spencer, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 9, p. 1748 (fig. 2), 1749, 1952 (fig. 3), 1753 (table 1), 1754 (fig. 4), 1756 (fig. 5), 1762 (fig. 7). Restricted and termed marl member of Morrison. Consists of succession, 50 to 150 feet thick, of hard, calcareous, concretionary, sandy, red, argillaceous beds with some thin sandstones. Overlies Bilk Creek sandstone member (new); underlies Junction Creek sandstone member (new). [See La Plata sandstone.]

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1668. Inasmuch as upper limit of beds that may be properly assignable to San Rafael group, rather than Morrison formation, is not yet definitely known in New Mexico, it seems desirable to extend into New Mexico and adjacent parts of northeastern Arizona, for these upper beds of San Rafael group, use of term Wanakah formation, which has been sharply discriminated from overlying Morrison in San Juan Mountain region of southwestern Colorado. Todilto limestone and gypsum, where present, are thus members of Wanakah formation.

E. B. Eckel, 1949, U.S. Geol. Survey Prof. Paper 219, p. 27 (table), 28–29. Term Wanakah formation is here applied to beds between Entrada and Junction Creek sandstones. Formation is equivalent to La Plata limestone and La Plata shale, as these terms are applied by miners, and to middle part of La Plata sandstone as defined in La Plata folio (no. 60) and other early reports on parts of southwestern Colorado. In La Plata district and elsewhere, rocks here placed in the Wanakah were formerly regarded as part of Morrison formation. As redefined, consists of (ascending) Pony Express limestone member, Bilk Creek sandstone member, and unnamed marl member. Thickness 25 to 150 feet. Overlies Entrada sandstone; underlies Junction Creek sandstone.

L. C. Craig and C. N. Holmes, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 94. Redefined to include Junction Creek sandstone member, which has been treated as member of Morrison formation and as separate formation.

G. O. Bachman, 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–137. In Mora County, N. Mex., conformably overlies Ocate sandstone (new); conformably underlies Morrison formation. Average thickness 25 feet.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 39. In this report [Navajo country], unit herein assigned to Summerville formation, together with Todilto limestone, has been assigned to Wanakah formation by other workers.

R. L. Griggs and C. B. Read, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 8, p. 2006. Name Bell Ranch formation applied to sequence of beds in Tucumcari-Sabinoso area believed by Wood, Northrop, and Griggs (1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–141) to be equivalent of Wanakah formation.

Named for exposures in Wanakah mine, Ouray district, Colo.

Wanakah Member (of Ludlowville Shale)

Wanakah Shale[1] or Formation

Middle Devonian: Western and central New York.

Original reference: A. W. Grabau, 1917, Jour. Geology, v. 25, p. 338 (footnote).

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., v. 9, no. 5–6, p. 364–369, pl. 1. In Batavia quadrangle, Wanakah and Ledyard members of Ludlowville were not separated as defined by Cooper (1930, Am. Jour. Sci., 5th ser., v. 19). Ledyard-Wanakah member overlies Centerfield limestone member and underlies Tichenor limestone member.

T. B. Coley, 1954, Jour. Paleontology, v. 28, no. 4, p. 453, 454, 455 (fig. 2). Referred to as formation. Thickness 48 feet at Jacox Run near Geneseo. Overlies Ledyard formation; underlies Tichenor formation. Ostracodes discussed.

R. S. Boardman, 1960, U.S. Geol. Survey Prof. Paper 340, p. 4 (fig. 2), 5–6. Trepostomatous Bryozoa discussed.

Type section: In Wanakah and Lakewood Beach Cliffs along Lake Erie.

†Wando Clays and Sands[1]

Pleistocene: Southern South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies, published in 1908 in South Carolina Geol. Survey, ser. 4, Bull. 2, p. 484; 1907, Summary of mineral resources of South Carolina, p. 12 (table).

Named for exposures along Wando River, between Charleston and Berkeley Counties.

Wanette division

Permian: Oklahoma.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 12, p. 1518–1521. Named as lowermost of three time divisions of Permian of Oklahoma. Followed by the Minco division and Upper Red-Beds division. In central Oklahoma, the Wanette includes sediments from top of Brownville limestone to top of Stratford shale.

J. E. Adams and others, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1677. Recommended that in Oklahoma term Wanette be dropped in favor of Wolfcamp series which in northern Oklahoma, Kansas, and Nebraska includes beds from disconformity immediately above Brownville limestone up to horizon near top of Herington limestone.

Reference locality, town of Wanette, Pottawatomie County.

Wann Formation[1] (in Ochelata Group)

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

Original reference: D. W. Ohern, 1910, Oklahoma State Univ. Research Bull. 4, p. 28.

M. C. Oakes, 1939, Oklahoma Acad. Sci. Proc., v. 20, p. 105, 106 (fig. 2). Restricted and redefined to apply to all strata between top of Iola formation below and base of Torpedo sandstone above or base of Birch Creek limestone in areas where Torpedo sandstone was removed by pre-Birch erosion.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 119–122. Underlies Barnsdall formation (new).

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 83–88. Described in Tulsa County where it is about 225 feet thick along north side of area and thickens southward uniformly to about 265 feet at southside of area. Progressive southward truncation at top, by Pre-Barnsdall erosion, and interfingering of lower part into Avant limestone member of Iola formation are offset by progressive southward increase in thickness of remaining parts of formation. Northward from area of this report, the Wann has been subdivided into four lithologic zones (ascending): basal shale; shale and thin platy limestones; limestone and calcareous, fossiliferous shale; and sandstone and shale. Upper limit of zone 3 is base of Clem Creek sandstone of Emery (1918); zone 2 includes sandstone locally known as Washington Irving.

M. C. Oakes, 1959, Oklahoma Geol. Survey Bull. 81, p. 34–36, pls. 1, 2. Oakes (1951) included Birch Creek limestone in his Barnsdall formation as basal member, in northern Oklahoma. Torpedo sandstone and shale above the Torpedo and beneath Birch Creek limestone crop out only in Washington County and eastern Osage County. This situation led Miser (1954, Geologic map of Oklahoma) to place top of Wann at base of Barnsdall formation throughout and to include Torpedo sandstone and shale above it in Wann formation. This amounts to minor change in definition of Wann, but it is significant for northern Oklahoma only. In this report [Creek County], Miser's definition is followed and term Wann formation is applied to rocks that crop out above Iola formation and below Barnsdall formation. Thickness 40 to 180 feet in Creek County.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 14–18, pls. 1, 2, 3, 4. Only upper part of formation crops out in Pawnee County. Thickness 142 feet at most complete section. Includes both Clem Creek and Washington Irving sandstones.

Named for Wann, Nowata County.

Wanrhodes Volcanics

Oligocene: Northern Utah.

Frank Neighbor, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 179. Series of water-laid tuffs. Light gray, medium to conglomeratic and fairly well bedded. Overlie Unita formation.

Crop out on northwest flank of Diamond Fork anticline, Utah County. Type locality and derivation of name not stated.

Wanship Formation

Upper Cretaceous and Paleocene: Northeastern Utah.

A. J. Eardley, 1952, Utah Geol. Soc Guidebook 8, p. 53–54. Unconformably overlies Frontier formation in Coalville anticline. In Wasatch hinterland may unconformably underlie Almy conglomerate. Name credited to N. C. Williams.

R. H. Peterson, D. J. Gauger, and R. R. Lankford, 1953, Utah Geol. and Mineralog. Survey Bull. 47, p. 13. Term first used in reference to 2,117 feet of strata outcropping in Cherry Canyon, east of Wanship. Composed of medium-bedded to massive ridge-forming sandstone beds separated by soft friable sandstone and siltstone and soft light- to dark-gray shale beds; intercalated lenticular seams of coal. Basal 170 feet consist of three thick beds of coarse conglomerate separated by two horizons of medium- to coarse-grained brown sandstone.

D. J. Jones, M. D. Picard, and J. C. Wyeth, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 10, p. 2221 (table). Wanship formation shown on correlation table of Cenozoic formations of Utah and parts of adjacent states. Underlies Almy formation; overlies Henefer formation in north-central Wasatch Mountains. Upper Cretaceous.

N. C. Williams, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 127–129. Sequence of sandstones and shales, largely marine but partly of brackish water and continental origin. Fossil evidence indicates deposition of Wanship continued without interruption from Montanan time into early Paleocene. Locally truncates Frontier and older formations; underlies Almy conglomerate, in some areas gradational, in others, unconformable.

N. C. Williams and J. H. Marsden, Jr., 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 122–123. In Coalville area, Utah, formation is about 4,950 feet thick. Unconformably overlies Frontier formation; underlies Echo Canyon conglomerate (new). Unit has been considered part of Frontier formation which is herein restricted to exclude unit termed Wanship.

Named for occurrence near Wanship, Summit County.

Wapanucka Limestone[1]

Pennsylvanian: Central southern and southeastern Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 858, 902–908. Harlton (1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 8) proposed to subdivide Wapanucka into basal, middle, and upper units. It is now proposed to apply names Primrose and Limestone Gap (new) formations to unit heretofore designated as basal Wapanucka. Name Wapanucka is restricted and applied to middle unit (or main lower massive limestone as Taff undoubtedly intended the usage); to upper unit, name Barnett Hill formation is applied. Wapanucka formation has been defined in various ways by different authors. Differences of opinion respecting age arose largely from the fact that Taff did not describe or designate a type locality. Hence it has been customary to accept exposures at town of Wapanucka as type. Section at this locality is not complete and units above Wapanucka have been included at other exposures. Original description by Taff appears to have included chiefly or entirely the lower limestone series, and same limits

are observed in this paper. In extreme northwestrn Ouachitas, this formation, together with the Barnett Hill, as well as the Primrose, was erroneously designated by Taff (1902, U.S. Geol. Survey Geol. Atlas, Folio 79) as Chickachoc chert lentils. Recommended that Chickachoc be abandoned. Thickness of Wapanucka at Taff's possible type locality, 1 mile west of Wapanucka, about 220 feet. At Limestone Gap, near center of E½ sec. 31, T. 2 N., R. 13 E., thickness is 198 feet. Here Wapanucka overlies Limestone Gap shale and underlies Barnett Hill formation. Wapanucka is included in Morrow series of Bendian period.

H. D. Miser and others, 1944, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Mapped as Pennsylvanian. Chickachoc chert equals Wapanucka.

R. B. Laudon, 1958, Oklahoma Geol. Survey Circ. 46, p. 10 (fig. 3), 19–20. Chart shows Wapanucka underlies Atoka formation in McAlester Basin and Ouachita Front. Overlies Bloyd formation in McAlester Basin and Caney shale and Union Valley [sandstone] in Ouachita Front. Subsequent workers have not separated Harlton's (1938) Barnett Hill from the Atoka.

Named for Wapanucka, Johnston County.

Wapellan series[1]

Pleistocene (pre-Wisconsin): Iowa.

Original reference: C. R. Keyes, 1931, Pan-Am. Geologist, v. 56, p. 349.

†Wappinger Limestone[1] or Marble

†Wappinger Valley Limestone[1]

Lower Cambrian to Middle Ordovician: Southeastern New York.

Original reference: W. W. Mather, 1838, New York Geol. Survey 2d Rept., p. 168–169.

Robert Balk, 1936, Geol. Soc. America Bull., v. 47, no. 5, pl. 1. Wappinger limestone shown on geologic map of vicinity of Dutchess County; crystalline marble east of Poughquag.

P. H. Bird, 1941, New York Acad. Sci. Trans., 2d ser., v. 3, no. 5, p. 107, 108. Wappinger limestone (formation) of Cambro-Ordovician age conformably overlies Poughquag sandstone and underlies Hudson River formation. Thickness about 1,000 feet.

K. E. Lowe, 1947, Geol. Rev., v. 7, no. 1, p. 10. Wappinger limestone crops out near Tomkins Cove. Both Wappinger limestone and associated Annsville phyllite (new) trend southwest representing continuation of Cambro-Ordovician belt of sediments in Sprouts Brook (Peekskill) across Hudson River to northeast.

F. M. Swartz, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1521–1522. *Olenellus* fauna of Lower Cambrian has been discovered in median to southern parts of Hudson River valley of New York in Poughquag quartzite and Wappinger limestone. Wappinger mass is a complex that is much deformed and poorly exposed. Discovery of *Olenellus* fauna in some layers of the Wappinger in Poughkeepsie quadrangle shows that these particular layers are Lower Cambrian in age, if it may be assumed that the specimens were not carried in by reworking; other parts of the Wappinger according to their faunas represent Potsdam, Beekmantown, and Trenton formations. Total thickness of Wappinger sequence about 1,000 feet.

Sidney Paige, 1956, Geol. Soc. America Bull., v. 67, no. 3, p. 391–394. Stratigraphic sequence, recognized and accepted as Paleozoic (Cambro-Ordovician) by workers in region, consists of three formations: Poughquag quartzite at base (about 200 feet), Wappinger limestone (about 2,000 feet), and Hudson River phyllite and shale (thickness unknown?) at top. These beds have been mapped both east and west of Hudson River (1) in northeast-trending strip about 1 mile north of Peekskill and east of the river, and (2) at Tomkins Cove, west of river. A second (shown on West Point quadrangle) stratigraphic sequence, "Inwood" limestone and "Manhattan" schist, has been mapped east of river, in city of Peekskill and to the southeast and southwest. Concluded that in Peekskill region stratigraphic units mapped as Cambro-Ordovician north of Peekskill and at Tomkins Cove, west of Hudson River, are identical with stratigraphic units in and south of Peekskill, mapped as "Inwood" limestone and "Manhattan" schist of "doubtful" age and referred to by Berkey and Rice (1921, New York State Mus. Bulls. 225–226) as of late Grenville age.

J. W. Clarke, 1958, Connecticut Geol. Nat. History Survey Quad. Rept. 7, p. 18. In this report [Danbury quadrangle], term Inwood marble is used in preference to term Wappinger marble (Balk, 1936) because unit is nearly physically continuous with Inwood of type locality (Inwood district of New York City).

S. Schaffel, 1958, New York Geol. Assoc. Guidebook 30th Ann. Mtg., p. 1–5. Conformably overlies Poughquag quartzite; conformably underlies Annsville phyllite (Hudson River pelite group). True thickness about 1,000 feet. Cambro-Ordovician. Discussion of controversies regarding age of stratigraphic units in area.

Named for Wappinger Creek, Dutchess County.

Wapsipinicon Limestone[1]

Middle Devonian: Eastern Iowa and southwestern Illinois.

Original reference: W. H. Norton, 1895, Iowa Geol. Survey, v. 4, p. 127, 155–166.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1788. Referred to Taghanic stage (new).

M. A. Stainbrook, 1945, Am. Jour. Sci., v. 243, no. 2, p. 66. Formation comprises (ascending) Coggon, Otis, Kenwood, Spring Grove, and Davenport members. Studies indicate that, normally, Independence shale lies immediately below Cedar Valley limestone and above Wapsipinicon formation.

Named for Wapsipinicon River, between Troy Mills, Linn County, and Central City, Linn County, Iowa.

Waramaug Formation

Precambrian(?) or pre-Triassic: Northwestern Connecticut.

R. M. Gates *in* R. M. Gates and W. C. Bradley, 1952, Connecticut Geol. Nat. History Survey Misc. Ser. 5, p. 7, 8–14. Name proposed for those rocks previously termed Berkshire formation in this area. Includes two important rock types: coarse mica-quartz gneiss and gray mica quartzite with streaks of biotite. Weathering of gneiss member causes rough corrugated surface. Foliation locally significant. All rock types are injected and intruded by granites, pegmatites and granitic materials. Precambrian(?).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic.

Typical occurrence around Lake Waramaug, Kent and New Preston quadrangles.

Ward Gypsum[1]

Permian: Central northern Texas.

Original reference: L. W. Storm, 1929, Geologic map of Stonewall County: Texas Bur. Econ. Geology.

Stonewall County.

Ward Limestone[1] Member (of Cannon Limestone)

Middle Ordovician: Central Tennessee.

Original reference: P. M. Jones, 1892, Geology of Nashville and immediate vicinity: Univ. Press, p. 36–38.

C. W. Wilson, Jr., 1948, Tennessee Div. Geology Bull. 53, p. 24, 27–29, geol. map. Averages 25 feet thick in Nashville area; consists of massively bedded very coarse-grained gray to bluish-gray limestone, locally extensively crossbedded or irregularly bedded. Overlain and underlain by units termed upper dove-colored member and lower dove-colored member.

Named for exposures in Mrs. Ward's quarry, near the Hudson place on Addison Ave., and Pearl St., Nashville, Davidson County.

Ward Cove Limestone

Ward Cove Limestone Member (of Cliffield Formation)

Middle Ordovician: Southwestern Virginia.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 827–832, 863, 884 (fig. 3). In Tazewell County, strata embraced by Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Ward Cove limestone member of Cliffield formation is applied to first coarse-grained limestone (zone 6) and overlying *Nidulites* beds (zone 7). Thickness 225 feet. Underlies Lincolnshire member (new); overlies Peery limestone member (new). First coarse-graind limestone is Butts' Holston of some areas; *Nidulites* beds constitute a part of Butts' lower Ottosee.

B. N. Cooper, 1945, Virginia Geol. Survey Bull. 66. p. 46–49. Rank raised to formation.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1152, 1157–1159. Restricted to *Nidulites* beds (zone 7); zone 6 is herein named Thompson Valley limestone. Thickens southwest from about 150 feet, near New Castle, to over 350 feet at Mechanicsburg, and over 550 feet near Sharon Springs.

Well exposed along State Highway 91 south of junction with County Road 604 and opposite Al Gillespie Farm. Takes its name from a breached plunging anticline in Tazewell County.

Wardell Formation

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 838–840, 873–875, 884 (fig. 3), pl. 5. In Tazewell County, strata embraced by Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones.

Name Wardell formation is applied to *Stromatocerium* beds (zone 16), *Receptaculites biconstrictus* beds (zone 17), third coarse-grained limestone (zone 18), and overlying buff shale (zone 19). Thickness more than 200 feet south of Wardell; thins gradually to the northeast and pinches out a short distance east of Tazewell; 35 feet at Marys Chapel, about 60 feet at North Tazewell, and 45 feet in west end of Burkes Garden. In type section and in southeastern end of Thompson Valley, overlies Burkes Garden member of Benbolt formation (both new); toward Tazewell from Russell-Tazewell County line, Gratton limestone (new) appears between the two formations and thickens at expense of the Wardell; in western part of the county, the Wardell is overlain by a sandstone that pinches out northeast of Russell-Tazewell County line; east of Liberty the sandstone that pinches out northeast of Russell-Tazewell County line; east of Liberty, the sandstone is absent and Wardell is overlain by red mudrock tongue of Bowen formation (new); in other words, the Wardell overlaps successively younger beds northeastward and is overlapped in the same direction by successively younger beds. Wardell includes beds which Butts considered characteristic limestone of Ottosee in Russell County.

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1166–1171. Northeast of Clinch Mountain, the Wardell occurs throughout entire Copper Creek belt from Pearisburg, Va., where it is only about 10 feet thick, to Knoxville region, where it is several hundred feet thick.

G. A. Cooper, 1957, Smithsonian Misc. Colln., v. 127, pt. 1, p. 96–97. Where Gratton limestone is not present, as at Rye Cove, it is difficult to separate the Wardell from the Benbolt, and the two combined are known as Dryden formation (new).

Type section: About 150 feet east of County Road 610 about 1 mile north of ford across Little River, Tazewell County, Va. Name derived from settlement near Tazewell-Russell County line.

Wardlaw Shale

Carboniferous(?): Northwestern Utah.

V. E. Peterson, 1942, Econ. Geology, v. 37, no. 6, p. 471 (table 1). Consists of black to gray thin to massive bedded pyritic shale, locally containing lenses of gray dolomitic limestone. Thickness 400 feet. Underlies newly named Phelan limestone and overlies newly named Vipont limestone.

In Ashbrook mining district on west side of Goose Creek Range.

War Eagle Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 216.

H. R. Wanless, 1939, Geol. Soc. America Special Paper 17, p. 93. Massive sandstone in Kanawha group.

Named for association with War Eagle coal [Mingo County].

War Eagle Underclay (in Kanawha Group)

Pennsylvanian (Pottsville): Eastern West Virginia.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 18. Varies from light to dark gray, and from plastic to hard. Average thickness 7.2 feet. Occurs below War Eagle coal, and about 1,400 feet below top of Pottsville series.

Present in Nicholas and Webster Counties.

Ware Schist[1]

Carboniferous: Central Massachusetts.

Original reference: E. Callaghan, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 230.

Occurs along Ware River near village of Coldbrook, Worcester County.

Warley Hill Marl[1]

Warley Hill Formation

†Warley Hill phase[1]

Eocene, middle: Western and central South Carolina.

Original references: E. Sloan, 1905, South Carolina Geol. Survey geognostic map of South Carolina, advance copies; published in 1908, in South Carolina Geol. Survey, ser. 4, Bull. 2; 1907, Summary of mineral resources of South Carolina, p. 12, 16.

C. W. Cooke and F. S. MacNeil, 1952, U.S. Geol. Survey Prof. Paper 243–B, p. 20 (fig. 2), 23. "Warley Hill phase," described by Sloan, was included in the McBean formation by Cooke (1936, U.S. Geol. Survey Bull. 867). Name Warley Hill marl is here revived in restricted sense to include dominantly glauconitic beds that intervene between Congaree formation (rank raised) and *Ostrea sellaeformis* zone, or restricted McBean. As restricted, the Warley Hill includes beds 9 and 10 of section described by Cooke (1936, p. 71); this is considered type locality and thickness here is 16 feet.

G. E. Siple, 1957, Carolina Geol. Soc. Guidebook Nov. 16–17, p. 11, 12. Referred to as Warley Hill formation.

Type locality: On abandoned road west of State Highway 267 and south of Warley Creek 3 miles north-northwest of Lone Star, Elloree quadrangle, Calhoun County. Phase and marl were named for exposures at Warley Hill, in eastern part of Orangeburg County.

Warm[1] (formation)

Lower Cretaceous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46.

Derivation of name not stated.

Warman Quartz Monzonite

Precambrian (late Algoman): Central Minnesota.

M. S. Woyski, 1949, Geol. Soc. America Bull., v. 60, no. 6, p. 1002, 1009, 1011, pl. 1. White to very light gray; may be weathered to pink, red, or yellow; medium granitoid with poikilitic orthoclase phenocrysts 1 to 3 centimeters long; massive except locally where there is slight primary foliation. Cut by basalt dikes; contains inclusions and roof pendants of Thomson formation. One of five major instrusives in late Algoman; these cannot be shown to be members of single magma series; age relations of named intrusives, St. Cloud gray granodiorite, Hillman tonalite, and the Warman are indeterminate as no contacts are exposed.

Exposed along the Snake River in T. 42 N., and T. 43 N., in vicinity of Ann River, and in quarries at Warman, Isle, and Pierz, in Pine, Kanabec, Mille Lacs, and Morrison Counties.

Warm Creek Shale (in Colorado Group)[1]

Upper Cretaceous: Central northern Montana.

Original reference: A. J. Collier and S. H. Cathcart, 1922, U.S. Geol. Survey Bull. 736–F, p. 172.

J. B. Reeside, Jr., 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 10. As shown on correlation chart, Colorado group in central Montana, comprises Mowry shale below and Warm Creek shale, which underlies Telegraph Creek formation.

J. P. Gries, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 4, p. 449. Colorado group, which formerly included all of Graneros formation around Black Hills, has been restricted to Upper Cretaceous (Cobban and Reeside, 1952, Geol. Soc. America Bull., v. 63, no. 10, chart 10–b) and includes Belle Fourche shale, together with overlying Greenhorn, Carlile, and Niobrara formations. Term Bell Fourche shale is now used in Williston basin wherever underlying Mowry can be differentiated, except in Little Rocky Mountains where name lower Warm Creek shale is applied.

Named for exposures along Big Warm and Little Warm Creeks, Little Rocky Mountain region.

Warmington Limestone Member (of Elephant Butte Formation)

Pennsylvanian (Des Moines Series): Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 47, 49. Named proposed for basal 22 feet of Elephant Butte formation (new). Member consists of medium- to light-gray dense and cherty limestone. Overlies Cuchillo Negro formation (new).

Type locality: Western end of Whiskey Canyon, in northern part of Mud Springs Mountains, sec. 1, T. 13 S., R. 5 W., Sierra County.

Warm Spring Formation

Lower (?) Triassic: Southeastern California.

B. K. Johnson, 1957, California Univ. Pub. Geol. Sci., v. 30, no. 5, p. 384, 385–388, figs. 1, 3. Consists of two unnamed members, an upper, 10 to 100 feet thick, that is a limestone breccia or pépérite; and a lower, more than 4,000 feet thick, of andesite flows. Upper limit of formation is marked at some places by bodies of Jurassic(?) quartz monzonite that intruded the andesite and at other places by extrusive Tertiary rocks that conceal the andesites; thus, total thickness of the formation is unknown. Due to eastward overlap of Triassic rocks, the Warm Spring rests on Triassic Butte Valley formation (new) east of Striped Butte and on Permian Anvil Spring formation (new) near eastern edge of quadrangle.

Named for exposures at head of Warm Spring Canyon in eastern part of Manly Peak quadrangle, Inyo County.

Warm Springs Formation (in Colpitts Group)

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229–249. Sandstone, shale, and mudstone gradation in upper part of Colpitts group (new). Thickness 100 to 300 feet. Unconformably underlies Hyde formation (new); overlies Weberg formation (new) with contact not sharply defined.

W. R. Dickinson, 1960, Dissert. Abs., 20, no. 11, p. 4367 Weberg, Warm Springs, and Basey (new) formations are lateral equivalents of Snowshoe formation.

Type area: On east side of Warm Springs Creek valley in secs. 19, 20, 29, and 30, T. 18 S., R. 26 E. Named for Warm Springs Creek, Crook County.

Warner Basalt[1]

Pliocene, upper: Northeastern California.

Original reference: R. J. Russell, 1928, California Univ. Pub., Dept. Geol. Sci. Bull., v. 17, no. 11, p. 416–425, map.

R. S. LaMotte, 1936, Carnegie Inst. Washington Pub. 455, p. 65. Geologic section exposed at Rattlesnake Butte, Modoc County, shows Warner basalt overlying Alturas formation.

T. E. Gay, Jr., and Q. A. Aune, 1958, Geologic map of California (1:250000) Alturas Sheet: California Div. Mines. Mapped with Pliocene volcanic rocks. Warner basalt of Russell (1928) includes lithologically similar basalts ranging in age from post middle Miocene through Pleistocene; subdivided on this map sheet into Pleistocene, Pliocene, and Miocene units.

Cordell Durrell, 1959, California Univ. Pubs., Geol. Sci., v. 34, no. 3, p. 165 (fig. 1), 178–180. In Blairsden quadrangle, overlies Penman formation. Thickness 350 to 1,300 feet. The Warner was last formation to be deposited as sheet over area. Older than Mohawk lake beds. Upper Pliocene.

Named for exposures on sides of Warner Valley and for widespread distribution in Warner Lakes Range and Warner Range.

Warner Sandstone Member (of McAlester Formation)[1]

Warner Formation (in Cherokee Group or Krebs Group)

Warner Sandstone Member (of Krebs Formation)

Pennsylvanian (Des Moines Series): Eastern Oklahoma, southeastern Kansas, and southwestern Missouri.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 37–41. Member of McAlester formation. Generally consists of massive buff calcareous and hard sandstone 5 to 30 feet thick. In Tps. 12, 13, and 14 N., a thin-bedded sandstone as much as 10 feet thick occurs a few feet above scarp forming sandstone of Warner and a thin coal bed occurs in the intervening 5-foot shale. The two sandstones and intervening shale and coal were included by Wilson in the Warner. Term Warner is here restricted to the scarp-forming massive lower sandstone. Overlies McCurtain shale member; underlies unnamed shale below Lequire sandstone member. Reconnaissance mapping northward from Wagoner indicates that Warner sandstone is continuous with Little Cabin sandstone of northeastern Oklahoma. From Wagoner northward, Warner (Little Cabin) sandstone gradually converges with top of Mississippian rocks unitil it rests directly on Mississippian in southeastern Kansas.

M. C. Oakes and M. M. Knechtel, 1948, Oklahoma Geol. Survey Bull. 67, p. 32–35. Member of McAlester. Described in Haskell County. Type locality stated.

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Warner formation in Krebs group. Overlies Riverton formation; underlies Rowe formation (new). Includes beds up to and including Neutral coal. A lower coal above Warner is present in Oklahoma and its horizon is identifiable in Kansas.

W. V. Searight, 1955, Missouri Geol. Survey and Water Resources Rept. Inv. 20, p. 9 (fig. 1), 11 (fig. 3), 18 (fig. 7), 19, 41. Formation, in Jasper County, Mo., is about 25 feet thick and consists of a sequence of shale and

sandstone. Overlies Riverton formation. Thickness 31 feet in Vernon County. Name has priority over Little Cabin sandstone. Krebs group.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 32–35. Warner formation, in Krebs sub-group of Cherokee, includes beds above Riverton coal extending upward to top of Neutral coal bed. Succession includes prominent and wide-spread Warner (Little Cabin) sandstone from which it takes its name. Thickens southward in outcrop area in southeastern Kansas; generally less than 50 feet thick in Vernon and Barton Counties, Mo.; 50 to 100 feet in Cherokee County, Kans.

D. T. Russell, 1960, Oklahoma Geol. Survey Circ. 50, p. 14–17, pl. 1. Member of McAlester. Described in Latimer County where it is 77 feet thick; overlies McCurtain shale member, and underlies unnamed shale below Cameron sandstone member. Lequire sandstone member not recognized in area of this report.

Type locality (Oakes and Knechtel): About one-fourth mile east of NW cor. sec. 21, T. 12 N., R. 19 E., 1 mile north of Warner, Okla.

†Warren Beds (in Richmond Group)[1]

Upper Ordovician: Southwestern Ohio, southeastern Indiana, west-central Kentucky, and west-central Tennessee.

Original reference: J. M. Nickles, 1902, Cincinnati Soc. Nat. History Jour., v. 20, p. 86.

Named for Warren County, Ohio.

Warren Sandstone[1]

Mississippian: Northeastern Ohio.

Original reference: H. P. Cushing, 1888, Am. Assoc. Adv. Sci. Proc., v. 36, p. 214–215.

Named for Warren, Trumbull County.

†Warrendale Formation[1]

Oligocene or Miocene, lower: North-central Oregon.

Original references: W. D. Smith and E. L. Packard, 1919, Oregon Univ. Bull., v. 16, no. 7, p. 97–99; 1919, Jour. Geology, v. 27, p. 97–98.

T. P. Thayer, 1939, Oregon Dept. Geology and Mineral Industries Bull., v. 15, p. 7. Mehama volcanics are comparable in age to Warrendale or Eagle Creek formation in Columbia River Gorge. Oligocene.

E. T. Hodge, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2025. Referred to as lower Miocene pyroclastics.

Named for town of Warrendale, near Eagle Creek, Multnomah County.

Warren Point Sandstone Member (of Gizzard Formation)[1]

Warren Point Sandstone (in Gizzard Group)

Warren Point Sandstone (in Lee Formation)

Lower Pennsylvanian: Eastern Tennessee and Georgia.

Original reference: W. N. Nelson, 1925, Tennessee Div. Geology Bull. 33–a, p. 43, 44, 148–149, 184.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, chart 6 (column 18). Shown on correlation chart for northern Tennessee as sandstone in Lee formation.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p.

1, 4, 19, pls. 3, 4, 12–D. Rank raised to formation in Gizzard group (herein rank raised). Attains its maximum thickness—a little more than 200 feet—in vicinity of Signal and Lookout Mountains near Chattanooga, where it is conglomeratic. The Warren Point of this area may be composite sandstone, with true Warren Point sandstone resting unconformably on one or more sandstones of Raccoon Mountain formation (new); from Chattanooga northeastward to Sale Creek-Soddy mining district, the Warren Point thins gradually and splits into several nonconglomeratic sandstones; this change makes identification difficult; farther northeast, in Roddy quadrangle, it is again a single massive conglomeratic sandstone. Underlies Signal Point shale (new); overlies Raccoon Mountain formation. Pottsville series. Type locality stated.

Type locality: Warren Point, just north of Monteagle, Grundy County, Tenn.

Warren Ranch conglomerate facies (of Deese Group)

Pennsylvanian (Desmoinesian): Southern Oklahoma.

C. W. Tomlinson and William McBee, Jr., 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 33–35. Series of boulder conglomerates, totaling about 100 feet in aggregate thickness and distributed through about 1,000 feet of other sediments, chiefly gray and red shales. Lowest conglomerate lies about 900 feet above Rocky Point member; upper conglomerates lie within West Arm formation (new).

Occurs in an area of 2 or 3 square miles in sec. 14, S½ sec. 11, W½W½ sec. 23, E½E½ secs. 22 and 27, T. 3 S., R. 2 E., west of Ardmore Air Force Base, Carter County. Name taken from ranch which occupies much of outcrop area.

Warrensburg Channel Sandstone[1]

Warrensburg Sandstone (in Labette Shale)

Warrensburg Sandstone Member (of Nowata Formation)

Pennsylvanian: Central western Missouri.

Original reference: A. Winslow, 1892, Missouri Geol. Survey Sheet Rept. 1, (v. 9), p. 22, 45–54.

F. C. Greene and W. V. Searight, 1949, Missouri Geol. Survey and Water Resources Rept. Inv. 11, p. v (fig. 1), 8–9. Shown on stratigraphic section as Warrensburg sandstone member of Nowata formation. Name is retained in Missouri for sandstones occupying the Warrensburg and Moberly channels. Name has also been applied by Missouri geologists to sandstone now known to lie between the Altamont and Sni Mills limestones in Jackson County. Howe (unpub. thesis) restricted position of subsurface Warrensburg when he tentatively correlated a thin limestone overlying it with Norfleet limestone or lower Lenapah. These subsurface sandstones thus lie within the Nowata interval and occupy the approximate position of Walter Johnson sandstone of Kansas Geological Survey. Because of priority in usage, name Warrensburg will continue to be used in Missouri to include post-Altamont, pre-Lenapah sandstones of Marmaton age, and channels sands of the Warrensburg and Moberly channels.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 97. Englevale sandstone member is one of several bodies of sandstone collectively

referred to as Warrensburg sandstone, lying in middle and lower parts of Labette shale.

Named for exposures at Warrensburg, Johnson County.

†Warrensburg Group[1]

Pennsylvanian: Central western Missouri.

Original reference: G. C. Broadhead, 1873, Missouri Geol. Survey Prelim. Rept. on Iron Ores, pt. 2, p. 169, 182.

Named for exposures at Warrensburg, Johnson County.

Warrens Ranch Latite

Tertiary: Southeastern Arizona.

W. H. Brown, 1939, Geol. Soc. America Bull., v. 50, no. 5, p. 742. Quartz-bearing latite porphyry. Constitutes a sill at extreme eastern end of Silver Lily dike system. Rests on narrow belt of Safford tuff (new) on the south and apparently in fault contact with Cat Mountain rhyolite (new) on the north.

Outcrops over an elliptical area 1½ miles by one-half mile in extent; approximately 1 mile north of Twin Hills, Tucson Mountains, Pima County.

Warrenton Agglomerate Member (of Catoctin Series)

Precambrian: Northeastern Virginia.

A. S. Furcron, 1939, Virginia Geol. Survey Bull. 54, p. 20–22, pl. 1. Composed of boulders, cobbles, and pebbles of greenstone imbedded in finer matrix of similar material. Largest boulders several feet in diameter. In some places, agglomerate composed almost entirely of greenstone fragments; in other places, greenstone fragments sparingly scattered through a fine matrix. Fragmental character best criterion for identification of rock in field. Most fragments of epidosite. Thickness variable; at Shiloh School and in Piney Mountain at least 1,500 to 2,000 feet; in southwestern corner of Warrenton quadrangle, it is thin. At or near base of greenstone making up series. Overlies Fauquier formation (new).

Widespread in Warrenton area, Warrenton quadrangle, Culpeper and Fauquier Counties.

Warrior Limestone[1]

Upper Cambrian: Central Pennsylvania.

Original reference: Charles Butts. 1918, Am. Jour. Sci., 4th v. 46, p. 528, 534, 537.

Charles Butts, 1939, Pennsylvania Geol. Survey, 4th ser., Topo. and Geol. Atlas 96, p. 9–10. Described in Tyrone quadrangle. Composed of interbedded limestone and dolomite, with thin layers of siliceous shale or shaly sandstone. Thickness about 1,200 feet. Overlies Pleasant Hill limestone; underlies Gatesburg dolomite.

J. L. Wilson, 1952, Geol. Soc. America Bull., v. 63, no. 3, p. 278–281, pl. 1. Described in Nittany Arch belt. Thickness at Williamsburg 1,340 feet. Overlies Pleasant Hill formation; underlies Stacy member of Gatesburg formation.

Named for exposures on Warrior Run, along river bluff 1 mile west of Williamsburg, Blair County, and on Warrior Creek, east of Warriorsmark in northern part of Huntingdon County.

Warsaw Shale, Limestone, or Formation

Warsaw Formation (in Osage Group)

Warsaw Shale or Limestone (in Meramec Group)[1]

Upper Mississippian (Meramec Series): Illinois, northern Alabama, Indiana, Iowa, Kentucky, northeastern Mississippi, eastern Missouri, and Tennessee.

Original references: J. Hall, 1857, Am. Assoc. Adv. Sci. Proc., v. 10, pt. 2, p. 54–56; 1858, Iowa Geol. Survey Rept., v. 1.

Charles Butts, 1922, Kentucky Geol. Survey, 6th ser. [Geol. Repts.], v. 7, p. 89–120, 121, 122, 123, 124. Formation in Meramec group. Warsaw succeeds rocks or Keokuk age. Lower limit in Jefferson County, Ky., is placed at top of Holtsclaw sandstone, whereas, in southern Kentucky. where Holtsclaw is absent, lower limit is determined by differences in lithology and fossils. In Kentucky, includes (ascending) Wildie sandstone, Somerset shale, and Garrett Mill sandstone members. Limestone of the Warsaw throughout Kentucky and Tennessee is practically identical in lithologic character with "Harrodsburg" limestone, of Warsaw age, at its type locality, Harrodsburg, Ind. Thicknesses; about 240 feet between Colesburg and Tunnel Hill, Hardin County; about 200 feet in Ohio River bluff in Indiana opposite West Point, Ky.; less than 100 feet at Edwardsville, Ind.; 80 to 100 feet in southern counties of central Kentucky and in northern middle Tennessee. In part of Kentucky and Tennessee, underlies St. Louis limestone. In south-central Indiana, particularly in Monroe, Lawrence, and Washington Counties, the limestone between the same upper and lower limits as the Warsaw of Kentucky, as herein interpreted, is divided into two formations, Warsaw ("Harrodsburg") limestone below and Spergen limestone above, the Spergen being called Salem limestone by Indiana geologists.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 14, 15, 16, 17, 35, 41, 44, 49, 54, 57, 216, 222, 229. Discussion of Lower Mississippian of east-central interior. Lower Mississippian as used here includes Kinderhook and Osage divisions of standard Mississippian time scale. Warsaw is uppermost subdivision of the Osage and not the Meramec. Papers by Butts discussed, especially (1922). Some strata regarded by Butts (1922) as Warsaw are not so regarded in present study. Lower Harrodsburg (Keokuk age) is removed from Warsaw and placed at top of Muldraugh formation (new), uppermost formation of Borden group. Upper Harrodsburg (Harrodsburg, restricted) contains distinctive Warsaw fauna and consitutes definite bounding unit at top of lower Mississippian rocks studied in this report. Wildie sandstone member (Butts, 1922) is reallocated to Muldraugh formation; Somerset shale member (Butts, 1922) is interpreted as basal phase of Salem limestone at top of Harrodsburg (restricted). So-called Warsaw of Tennessee not studied for this report, but question arises as to correctness of classification and correlation of "Warsaw" in Tennessee. This involves "Garrett Mill" sandstone member of Warsaw (Butts, 1922).

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 766 (fig. 1), 802–805. Uppermost formation of Osage group, Iowa series. This classification follows Illinois Geological Survey. Name Warsaw was originally given to 18 feet of thin-bedded bluish-gray limestone with interbedded calcareous shale which crops out at Warsaw, Hancock County, Ill. Hall (1858) expanded the Warsaw to include about 50 feet of strata lying between the geode beds and St. Louis limestone.

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Subsequently, 8 feet of crossbedded yellowish-weathering limestone grading locally into calcareous sandstone which occurs immediately below St. Louis limestone was removed from Warsaw at its type locality and assigned to Salem limestone (Weller, 1908, Illinois Geol. Survey Bull. 8), and the geode beds, which had formerly been included in the Keokuk, were transferred to Warsaw formation (Butts, 1915, Kentucky Geol. Survey, ser. 4, v. 3, pt. 2; Tuyl, 1925, Iowa Geol. Survey, v. 30). The Warsaw, as thus defined, was considered exact equivalent of Harrodsburg limestone of Indiana (Butts, 1915; Cumings, 1922, Indiana Dept. Conserv. Pub. 21), and latter name was abandoned because Warsaw had priority. Lower division of Warsaw, which at type locality is about 36 feet thick and has been termed "geode beds," consists of massive fine-grained earthy geode-bearing limestone below, thin bed of locally brownish dolomitic cherty limestone in middle, and bluish-gray slightly calcareuos geode-bearing shale above. Upper part of Warsaw has not been distinguished from overlying Salem everywhere in western Illinois and adjacent parts of Missouri. Upper division of Warsaw, at Warsaw, consists of about 40 feet of bluish-gray shale with thin interbedded layers of argillaceous limestone, a few thin beds of fine-grained bluish-gray sandstone, and several massive bluish-gray dense to finely crystalline limestone strata which locally are irregularly and incompletely dolomitized. It thins northward and disappears from section a little north of Keokuk. South of Warsaw this part of formation becomes increasingly calcareous and has probably been included in Salem or Spergen formation. In Ste. Genevieve County, Mo., and Monroe County, Ill., the upper Warsaw consists of about 60 feet of gray to buff fine-grained more or less earthy and locally dolomitic limestone. Warsaw and Salem limestones have not been separated in southern Illinois and western Kentucky where they attain maximum combined thickness of 200 to 250 feet. In northern Hardin County, Ky., the Warsaw, including the few feet of limestone above Somerset shale that may be equivalent to the Salem, is about 220 feet thick. Because Edwardsville formation of Borden group has commonly been included in Warsaw formation in Jefferson, Hardin, and adjoining counties, Kentucky, its reported thicknesses there may be too great by 50 feet or more. In Indiana, the Warsaw crops out continuously from Montgomery County to Ohio River with thickness of 60 to 90 feet. Divisible into two parts: upper, massive limestone 30 to 50 feet thick, and lower, divided into (ascending) Ramp Creek, Leesville, and Guthrie Creek. Conformably overlies Edwardsville formation in Indiana.

L. R. Laudon, 1948, Jour. Geology, v. 56, no. 3, p. 289–290. Discussion of Warsaw problem and Osage-Meramec contact. Warsaw formation has been classified with beds of Meramec age or with beds of Osage age. Type section of Warsaw restudied. At type section, slightly more than 118 feet of strata occur between last crystalline crinoidal beds of Keokuk formation and contact of St. Louis limestone. No beds of Salem age recognized in area. No evidence found at type section for separating some 10 feet of crossbedded calcareous sandstone, which lies immediately beneath St. Louis limestone in the area, from the Warsaw. This sandstone has been considered to represent Salem formation (Weller, 1908). No evidence of disconformity found between rocks of Keokuk age and Warsaw beds at type section or at several other sections studied in area. No evidence of physical break found within Warsaw. Contact with overlying St. Louis remarkably conformable. All previously published lists of faunas disregarded and new collections made. Thirty

species of abundant Warsaw forms identified and 27 of them were found in Keokuk rocks. Comparison of Warsaw fauna with 20 abundant species from type area of Salem formation shows almost no affinities at all. This observation contrasts strongly with general opinion regarding relationships of Warsaw-Salem faunas (Weller and Sutton, 1940). The Warsaw resembles clastic facies of older Osage formations farther east but does not resemble typical Meramec rocks. In present report, Salem is considered as base of Meramec series in upper Mississippi Valley area. If Salem is calcareous facies development within Warsaw formation, as suggested by Weller and Sutton (1940), this classification will need serious revision.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 99–100, chart 5. Shown on standard Mississippian section as basal formation in Meramecian series. Occurs below Salem limestone and above Keokuk limestone of Osagean series. Disagreement regarding boundary between Meramecian and Osagean series has been widespread and prolonged and has been concerned principally with proper placement of Warsaw formation. Current usage is not consistent.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 45–47. Formation in Osage group, Valmeyer series. Oldest outcropping formation in area of this report [Beardstown, Glasford, Havana, and Vermont quadrangles]. Thickness 50 to 75 feet. Underlies Salem limestone.

J. W. Baxter, 1960, Illinois Geol. Survey Circ. 284, p. 2 (table 1), 4. Underlies Kidd member (new) of Salem limestone.

Typical exposure: Along creek known as Soap Factory Hollow, which joins the Mississippi from the east about one-half mile south of Lower Warsaw, Ill. Named from exposures at Warsaw, Hancock County, Ill.

Wartburg Sandstone[1]

Wartburg Sandstone (in Crooked Fork Group)

Pennsylvanian: Northeastern Tennessee.

Original reference: Arthur Keith, 1896, U.S. Geol. Survey Geol. Atlas, Folio 33.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau, Tennessee: Tennessee Div. Geology [Folio], p. 5 (pl. 4), 6. Reallocated to Crooked Fork group (new). Overlies Glenmary shale (new); underlies Poplar Creek coal at top of group.

Named for Wartburg, Morgan County.

Wartburg Sandstone Member[1] (of Briceville Formation)

Pennsylvanian: Northeastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33B, p. 311.

Occurs in town of Wartburg, Morgan County.

Warwick Limestone[1]

Lower Ordovician: New York.

Original reference: W. W. Mather, 1843, Geology New York, v. 1, p. 367.

Wasatch Formation[1]

Wasatch Group[1]

Paleocene and Eocene: Utah, western Colorado, central southern and southeastern Montana, northwestern New Mexico, southwestern North Dakota, and western Wyoming.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Terr. 3d Ann. Rept., p. 191 of 1873 ed.

Walter Granger, 1914, Am. Mus. Nat. History Bull., v. 33, p. 205–207. Estimated thickness of Wasatch beds in New Mexico is about 1,000 feet. Mammalian fossils occur throughout greater part of vertical range. Lower two-thirds of Wasatch, referred to as Almagre beds (new) and upper horizon, comprising remaining third, the Largo beds (new). Overlies Torrejon formation.

E. M. Spieker and J. B. Reeside, Jr., 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 448–451. Formation, as recognized in Wasatch Plateau, consists of three members— lower member of sandstone, varicolored shale, conglomerate and small amounts of fresh-water limestone; middle member of fresh-water limestone, here called Flagstaff member; and an upper member of varicolored shale and sandstone. East of Wasatch Plateau, in Book Cliffs—Uinta Basin region—the three divisions lose their distinctness through wedging out, in many tongues, of the Flagstaff limestone.

W. T. Nightingale, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 8, p. 1019–1040. Includes Hiawatha member (new).

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 35–36, pl. 1. Term Wasatch is properly a group, though usually called a formation, in southwestern Wyoming, especially Uinta County. Early Eocene and (?) Paleocene. By unjustified extensions, term has come to include a wide variety of continental deposits of variegated colors in western North America, of uncertain age, presumed to be early Tertiary, as well as numerous actually dated deposits of Wasatchian age. In spite of its wide use in literature, it is an unfortunate term because the standard "Wasatch faunas" (those of the Bighorn and San Juan Basins) occur in formations which are merely called "Wasatch" and the Wasatch group proper is almost without fossil vertebrates. In the Wasatch proper, the La Barge local fauna is equivalent to that of the Lost Cabin, and the Knight fauna to that of the Lysite. Thus, the fossiliferous Wasatch is exactly equivalent, faunally, to the fossiliferous Wind River which, according to most text books and standard manuals, is supposed to overlie it. The exceedingly tentative determinations of the Fowkes as late Paleocene, the Almy as mid-Paleocene, and underlying Evanston as early Paleocene, do not rest on satisfactory evidence. When the "Wasatch fauna" is spoken of, it means in practice one of two things: (1) lower Eocene or Wasatchian of this report or (2) Gray Bull. The latter is difficult to justify because no fauna of Gray Bull age has been found in type Wasatch so that it is not certain that beds of that age are present. Term Canyon Largo group is here resurrected to replace term "San Juan Wasatch" (Holmes, 1877, U.S. Geol. and Geog. Survey Terr. 9th Ann. Rept. for 1875).

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 32–34, pls. 1, 8. Formation described in Randolph quadrangle, Utah-Wyoming, where it forms a belt across central part of the area, capping most of Bear River Plateau and extending westward over summit of part of Bear River Range. Composed of varicolored and varitextured continental deposits consisting principally of conglomerate and sandstone with subordinate amounts of sandy and clay shale, limestone, and tuff. Prevailing color red. Approximate thickness 1,000 feet. Not subdivided in this area. Overlies Bear River formation; near northern boundary of quadrangle, overlies tilted Twin Creek limestone. Eocene.

A. J. Eardley, 1944, (abs.) Utah Acad. Sci. Proc., v. 19, p. 19; 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 824 (table 1). Group comprises (ascending) Almy conglomerate (with Pulpit and Saw Mill conglomerates, both new), Fowkes(?), and Knight(?) formations. Overlies Henefer formation (new); underlies Norwood tuff (new). Middle Paleocene(?), upper Paleocene(?), and lower Eocene.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 114. In Uinta Basin, unconformably overlies Williams Fork formation.

H. E. Gregory, 1944, Am. Jour. Sci., v. 242, no. 11, p. 589–591, 601, 602. Formation, in upper Sevier River valley, Utah, underlies Brian Head formation (new). Thickness about 520 feet.

C. H. Dane, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 24. Overlying the Nacimiento formation in southern part of San Juan Basin, and Animas formation in northern part, is series of gray, tan, and copper-colored conglomerates and sandstones and red and gray clays that, in San Juan Basin, for many years has been referred to Wasatch formation. For convenience this usage is continued in present report, with understanding that age limits of beds included in formation are not thereby implied to be same as those included in Wasatch at type locality. Formation occupies all of central part of basin. In part of T. 23 N., R. 1 W., about 1,000 feet stratigraphically above base of formation, is an escarpment capped by a higher horizon of sandstones and conglomerates. Between these higher resistant beds and basal sandstones the lower 1,000 feet of formation consists in large part of soft red and gray clays. Upper part of clays contains the lower faunule division of the Wasatch as recognized by Granger (1914), the Almagre beds. Thickness not less than 2,000 feet. Lower part of formation in northeastern part of basin contains beds of Paleocene age.

E. M. Spieker, 1946, U.S. Geol. Survey Prof. Paper 205–D, p. 121, 122 (fig. 15). Discussion of late Mesozoic and early Cenozoic history in central Utah. Discovery of dinosaur bones in strata of central Utah formerly assigned to Wasatch formation, together with other findings, notably recognition of thick section of conglomerates as Colorado in age, has made possible an outline of late Mesozoic and early Cretaceous history considerably different from scheme hitherto used. Important changes are recognition of orogenic epoch in eastern part of Great Basin early in Upper Cretaceous time and placing of main Laramide folding of central Utah between middle and late Montana time instead of end of Cretaceous. Present report presents data bearing on these conclusions, together with many other stratigraphic and structural determinations that bear on history and paleogeography of region, and discusses certain problems involved. Main points of revision of stratigraphic nomencalture involved are as follows: (1) abandonment of classification as Wasatch of the three units, Lower member, Flagstaff limestone member, and Upper member, formerly designated as members of that formation; (2) recognition of basal conglomerate of former lower member as equivalent to original Price River formation, and distinction of overlying part of lower member as North Horn formation; (3) establishment of Flagstaff limestone as independent formation; (4) adoption of name Colton for upper member of Wasatch formation as originally defined; (5) naming of unit beneath the Price River in western districts the Indianola group, subdivided where feasible and undifferentiated where not; and (6) assignment to Cretaceous of all beds up to and including highest dinosaur

zone, and assignment to Paleocene of overlying part of North Horn formation. Wasatch problem discussed and history of usage of term reviewed. Believed name should not be abandoned without more thorough study of type area than has yet been done.

G. G. Simpson, 1948, Am. Jour. Sci., v. 246, no. 5, p. 257–282; no. 6, p. 363–385. Term San Jose formation proposed for "Wasatch" of authors in San Juan basin.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1130 (table), 1144–1147, pl. 1. Group, in Logan quadrangle, Utah, includes Cowley Canyon member (new) at base. Thickness 0 to 530 feet. Stratigraphically below Salt Lake group. Paleocene or lower Eocene.

M. D. Williams, 1950, Utah Geol. Soc. Guidebook 5, p. 102–106. Stratigraphic interval between Upper Cretaceous Mesaverde group and Green River formation in Uinta basin was originally referred to by early workers as Wasatch group but later came to be termed Wasatch formation. Spieker (1946) discusses Wasatch problem and in central Utah referred strata formerly assigned to Wasatch formation to North Horn, Flagstaff, and Colton formations. In a later publication, Spieker (1949, Utah Geol. Soc. Guidebook 4) does not use term Wasatch and apparently favors abandoning it, but without offering suitable substitute which can be used on regional basis. Top of Mesaverde group and base of Green River formation are usually readily recognizable horizons in regional mapping; intervening interval will here be designated as Wasatch group. Because lithologic boundaries and time limits do not always coincide, no definite age is assigned to the group other than "Cretaceous-Tertiary transition." As herein defined, Wasatch group may comprise North Horn, Flagstaff, and Colton formations; the 3,500 feet of strata containing the bituminous sandstone deposits at Sunnyside; the several thousand feet of strata assigned to the Wasatch in Piceance Creek basin and adjoining areas in western Colorado; the 780 feet of strata between the Mesaverde and Green River at Ravin Ridge; and Current Creek and Tuscher formations.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 51 (table), 111–112, pls. 2, 4, 5. Generalized section of formations, in Zion Park region, shows Wasatch formation, about 400 feet thick unconformable above Kaiparowits formation. In topography, formation makes up the Pink Cliffs.

J. D. Love and J. L. Weitz, 1951, U.S. Geol. Survey Oil and Gas Inv. Map OM–122. Formation, in Powder River basin, includes Kingsbury and Moncrief members. Overlies Fort Union formation; underlies White River formation. Base in some areas arbitrarily placed at top of Rowland coal. Eocene.

J. H. Donavan, 1950, Wyoming Geol. Assoc. Guidebook 5th Ann. Field Conf., p. 62, 64. As exposed in south-central Sublette County, the upper Wasatch is divided into two units, Knight member below and New Fork tongue (new). The Knight is stratigraphically succeeded by Green River formation, basal part of which is herein designated Fontenelle formation.

J. R. Donnell, W. B. Cashion, and J. R. Brown, Jr., 1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–134. Formation crops out in relatively broad belt in west-central part of Cathedral Bluffs area. As defined in this area by Gale (1910, U.S. Geol. Survey Bull. 415), the formation was believed to include, in its lower part, beds equivalent to Fort Union

formation which is of Paleocene age. Paleontological evidence collected by several workers since this early report has demonstrated that lowermost part of formation is of Eocene age. Boundary between Paleocene and Eocene beds is indefinite in Cathedral Bluffs area. Along Cathedral Creek, formation consists mostly of beds of buff sandstone and small amounts of interbedded varicolored shale and clay; to the north, formation consists predominantly of varicolored shale and small amounts of brown sandstone and limestone in lenticular beds. Thickness as much as 371 feet. Contact between Wasatch and overlying Green River (Douglas Creek member) drawn at top of uppermost bed of red shale; near head of Cathedral Creek, boundary drawn directly above uppermost sequence of interbedded thin beds of coal, shale, and redbeds. Overlies Mesaverde formation.

G. N. Pipiringos, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 100–103. Formation, as mapped in this area [central part of Great Divide basin, Sweetwater County, Wyo.], is of early and middle Eocene age. Consists of rocks probably fluviatile and paludal in origin and intertongues throughout most of its vertical extent with rocks of Green River formation. Also intertongues with Battle Spring formation (new). Overlies Fort Union formation. Includes Red Desert and Niland tongues (both new) and Cathedral Bluffs tongue.

W. J. Morris, 1955, Dissert. Abs., v. 15, no. 3, p. 394. Use of term Wasatch for deposits in Washakie basin, Wyoming, is confusing. Name Knight extended from Bridger basin to include dominantly fluviatile Wasatchian deposits in Washakie basin. Knight formation includes Hiawatha member and Cathedral Bluffs tongue.

J. I. Tracey, Jr., and S. S. Oriel, 1959, Intermountain Assoc. Petroleum Geologists Guidebook 10th Ann. Field Conf., p. 128 (table 1), 129, 130. Formation, in Fossil Basin, Wyoming, overlies Evanston formation and underlies Green River formation. Confusion in original definition of Almy, Fowkes, and Knight formations as subdivisions of Wasatch group, and their areal distribution as mapped in much of Fossil Basin, had led to doubt as to validity of these names, especially Almy and Knight. These terms are not included in the Wasatch which is herein termed a formation.

W. J. Mapel, 1959, U.S. Geol. Survey Bull. 1078, p. 62–73. Formation described in Buffalo-Lake De Smet area, where it unconformably overlies Fort Union formation. Near Bighorn Mountains, comprises Kingsbury conglomerate and Moncrief members, which are separated by angular unconformity. Eastward, both members grade laterally into a conformable, nonconglomeratic sequence of sandstone, shale, and coal that makes up formation east of Buffalo and Lake De Smet. Eocene.

Type locality: Extends from Carter, Wyo., to the "Narrows on Weber," 7 miles below Echo City, Utah, and 10 to 15 miles east of crest of Wasatch Mountains. Name derived from Wasatch [Wahsatch] Station on Union Pacific Roalroad, Summit County, Utah.

†Wasatch Limestone[1]

Upper Ordovician, Silurian, Devonian, and Mississippian: Northeastern Utah.

Original reference: C. King, 1876, Am. Jour. Sci., 3d, v. 11, p. 477–479.

Northern Wasatch Mountains.

Wasatchian Age

Eocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc America Bull., v. 52, no. 1, p. 9, 10, pl. 1. Provincial time term, based on at least upper part of Wasatch group of southwestern Wyoming (modified to Wasatchian series by C. R. Keyes). Covers the time during which the faunas of the Sand Coulee, Gray Bull, Lysite, and Lost Cabin were deposited. As a functional term, the typical areas and faunas are those of the Bighorn and Wind River basins of Wyoming. Includes the interval between the Clarkforkian (Paleocene) and Bridgerian (Eocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan].

†Washakie Formation[1]

Eocene: Southwestern Wyoming.

Original reference: F. V. Hayden, 1869, U.S. Geol. Survey Terr. 3d Ann. Rept., p. 190 of 1873 ed; (1869 ed. not available).

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 36, pl. 1. Late Bridgerian and early Uintan.

W. J. Morris, 1955, Dissert. Abs., v. 15, no. 3, p. 394. Reinstated and applied to Bridgerian and Uintan strata lying above the Green River formation in Washakie Basin.

Named for exposures at Washaki Station between Creston and Bitter Creek on Union Pacific Railroad in Sweetwater Canyon, Wyo. (Washakie approved spelling).

Washburn Beds[1] (in Chequamegon Sandstone)

Precambrian (Keweenawan): Northeastern Wisconsin.

Original reference: F. T. Thwaites, 1912, Wisconsin Geol. Nat. History Survey Bull. 25, p. 34.

G. O. Raash, 1950, Illinois Acad. Sci. Trans., v. 43, p. 147. Discussion of Cambrian-Keweenawan boundary. Believed that Thwaites[1] Chequamegon brownstone formation is same as Port Wing brownstone member of Orienta formation repeated by faulting. Thwaites (1912) detailed description of the "Quarry" or "Brownstone beds" of the Chequamegon is essentially identical with that of the "Port Wing Brownstone" of the Orienta, whereas the upper or "Washburn beds" [upper part of Thwaites' Chequamegon] are described in much the same terms as his "upper member" of Orienta formation.

Named for exposures in shore cliffs south of Washburn, Bayfield County.

Washburn Sandstone[1]

Pennsylvanian: Western Arkansas and eastern Oklahoma.

Original reference: A. Winslow, 1896, New York Acad. Sci. Trans., v. 15, p. 51.

Probably named for Washburn, Sebastian County, Ark.

Wash Creek Slate[1]

Precambrian or Paleozoic: Central Alabama.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226. Overlies Brewer phyllite; underlies Weisner formation. Thickness about 5,000 feet.

Named for exposures on Wash Creek, south of Sawyer Cove, Chilton County, in Columbiana quadrangle.

Washington cyclothem

Permian (Washington Series): Southeastern Ohio and western West Virginia.

A. T. Cross and M. P. Schemel, 1956, West Virginia Geol. Survey [Repts.], v. 22, pt. 1, p. 72 (fig. 1–61). Shown on geologic section below Winklers Mill cyclothem (new). Includes Washington coal at base and Washington "Rider B" No. 1 coal horizon at top.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 213–215. Embraces interval from base of Washington sandstone to top of roof shale of Washington coal. Occurs above Little Washington cyclothem (new). Thickness about 53 feet. Includes (ascending) Washington shale and sandstone, redbed, Bristol limestone, Washington fire clay shale, Washington (No. 12) coal, and Washington roof shale members. Where Little Washington coal is missing, lower boundary of cyclothem is placed at base of Mannington sandstone, hence, thickness of cyclothem is variable due to boundary differences in that absence or presence of Little Washington coal is controlling factor. In area of this report, Washington series is discussed on a cyclothemic basis; four cyclothems are named. [For sequence see Elm Grove cyclothem.]

Present in Parkersburg quadrangle, West Virginia, and in Athens County, Ohio.

Washington Fire Clay (in Washington Formation)[1]

Washington fire clay shale member

Permian: Northern West Virginia and eastern Ohio.

Original reference: C. E. Krebs, 1911, West Virginia Geol. Survey Rept. Jackson, Mason, and Putnam Counties, p. 117.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 215. Fire clay shale member of Washington cyclothem in report on Athens County. A yellowish-green, gray, or mottled maroon clay shale. Maximum thickness about 1 foot. Associated with Washington coal or at its horizon.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Washington fire-clay shale in Washington listed in summary of stratigraphic sections of Dunkard group in Harrison County.

Named for association with Washington coal.

Washington Formation (in Dunkard Group)[1]

Washington Group

Washington Series

Lower Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876, Pennsylvania 2d Geol. Survey Rept. K, p. 44–46.

W. A. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135–152. Washington group lies between Monongahela and Greene groups and, together with the latter, forms Dunkard series which was formerly called Upper Barren Coal Measures. Group consists of shale, sandstone, and limestone with several impure beds of coal. Base is taken at top of Waynesburg coal and at top of Upper Washington limestone. Named units listed.

R. E. Lamborn, 1951, Ohio Geol. Survey, 4th ser., Bull. 49, p. 39. Rank raised to series. In Ohio, comprises lower part of Permian extending from top of Waynesburg coal to top of Upper Washington limestone. Four coal beds and five limestone horizons are present; remainder of series consists of sandstone and shale. Limestones, which are freshwater type, are (ascending) Elm Grove, Mount Morris, Lower Washington, Middle Washington, and Upper Washington. Average thickness about 220 feet.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 89, geol. map. In Morgan County, series includes only lower part of strata, that is, from Cassville shale to within lower Marietta sandstone.

H. L. Berryhill *in* C. O. Dunbar and others, 1960, Geol. Soc. America Bull., v. 71, no. 12, pt. 1, p. 1789–1790, chart 7 (column 80). Washington formation designated Pennsylvanian-Permian and Greene formation as Early Permian. There are neither lithologic nor faunal-floral bases for differentiating Washington and Greene formations anywhere in Dunkard Basin. Subdivision made by Stevenson (1876) has been handed down mainly through tradition. His Washington "group" is actually only a facies. Away from northern edge of basin, the Washington "group" has few of the lithologic characteristics of "type" area.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Formation mapped as Pennsylvanian and Permian. Consists of cyclic sequences of sandstone, shale, limestone, and coal; base at top of Waynesburg coal.

Named for exposures in highlands of Washington County, Pa.

Washington Gneiss[1]

Precambrian: Western Massachusetts and northern Connecticut.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, p. 18, 20, 31–32, pl. 24.

Named for occurrence at Washington and Washington Center, Berkshire County, Mass.

†Washington Greensand[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept., 1888, v. 2, p. 72–75, 188.

Named for exposures in Town Creek Valley at Washington, Hempstead County.

†Washington Limestone[1]

Ordovician: Northeastern Vermont.

Original reference: C. H. Richardson, 1898, Am. Assoc. Adv. Sci. Proc., v. 47, p. 295–296.

In Orange, Washington, Windsor, Orleans, Essex, and Caledonia Counties.

†Washington reds (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. J. Stevenson, 1906. Geol. Soc. America Bull., v. 17, p. 65–216.

Washington roof shale member

See Washington cyclothem.

Washington Sandstone Member (of Washington Formation)[1]

Washington shale and sandstone member

Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1876. Pennsylvania 2d Geol. Survey Rept. K.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 213. Shale and sandstone member of Washington cyclothem in report on Athens County. Can probably be more correctly identified stratigraphically with Mannington sandstone. In areas where Little Washington coal is absent and Waynesburg "A"—Washington coal interval is occupied by massive sandstone, this sandstone would then be equivalent to Mannington sandstone, but timewise the upper part of this sandstone may be equivalent to Washington sandstone. In areas where Waynesburg, Mannington, and Washington sandstones are separate entities, they could merely be channel deposits in tributaries of main "Hockingport" trunk channel which were migrating upward through time. Therefore, upper part of "Hockingport" sandstone could be equivalent to Washington sandstone.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 18 (table 2). Washington sandstone member of Washington formation listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness about 10 feet.

Named for Washington County, Pa.

†Washington Shale and Sandstone[1]

Pennsylvanian: Northwestern Arkansas and eastern Oklahoma.

Original reference: F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. 26, 75–82.

Named for Washington Mountain, Washington County, Ark.

Washington Hill Rhyolite

Pliocene: Western Nevada.

G. A. Thompson, 1956, U.S. Geol. Survey Bull. 1042–C, p. 56–57, pl. 3. Light-gray highly flow-banded devitrified rhyolitic glass and perlite making up extrusive dome. Contains sparse phenocrysts of sodic plagioclase and biotite. Cuts through Kate Peak rocks and earlier beds of Truckee formation. Later beds of Truckee formation contains blocks of devitrified rhyolitic glass from the dome.

Name given to dome in and immediately southwest of Washington Hill, Virginia City quadrangle.

Washington Irving Sandstone (in Wann Formation)

Washington Irving Sandstone Member (of Wann Formation)

Pennsylvanian (Missouri Series): Northeastern Oklahoma.

M. C. Oakes, 1952, Oklahoma Geol. Survey Bull. 69, p. 86. Name applied locally to sandstone in lower part of Wann formation, Tulsa County. In some area, it is a massive sandstone formed by coalescence of several thin sandstones, and in some areas consists of two sandstones with intervening shale.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 14 (table 1), 15 (fig. 3), 16–17. Washington Irving and Clem Creek sandstones both

occur in Pawnee County where Washington Irving is lowest recognizable member of Wann. In SE¼ sec. 25, T. 20 N., R. 9 E., it is overlain by 38 feet of silty maroon shale capped by eroded remnant of Clem Creek sandstone. To the northwest, shale pinches out and Washington Irving-Clem Creek section is represented by 90 feet of massive to crossbedded sandstone.

Named because outcrop rims Washington Irving glen in NW cor. sec. 29, T. 20, N., R. 10 E., Tulsa County.

Washingtonville Member (of Allegheny Formation)[1]

Washingtonville shale member

Pennsylvanian (Allegheny Series): Eastern Ohio, western Pennsylvania, and northern West Virginia.

Original reference: W. Stout and R. E. Lamborn, 1924, Ohio Geol. Survey, 4th ser., Bull. 28, p. 175–181.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 49, table 1. Included in Middle Kittanning cyclothem, Allegheny series, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 76. Shale member of Middle Kittanning cyclothem not recognized in area of this report [Athens County]. Nearest known exposure is near Lexington in Perry County. Member varies from 1 to 6 feet in thickness and normally rests directly upon or is separated from Middle Kittanning coal by several feet of unfossiliferous shale.

Named for exposures at Washingtonville, Green Township, Mahoning County, Ohio.

Washita Group[1]

Lower and Upper Cretaceous (Comanche Series): Southern Oklahoma, southwestern Arkansas, northwestern Louisiana, and Texas.

Original reference: R. T. Hill, 1887, Am. Jour. Sci., 3d, v. 33, p. 298.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Washita group, Lower and Upper Cretaceous (upper Albian-lower Cenomanian). In north-central Texas includes (ascending) Duck Creek limestone, Fort Worth limestone, Denton clay, Weno limestone, Pawpaw formation, Main Street limestone, Grayson shale, and Buda limestone; other Texas areas include (ascending) Georgetown limestone, Grayson shale, and Buda limestone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes (ascending) Duck Creek formation, Fort Worth limestone, Denton clay, Weno clay, Pawpaw formation, Main Street limestone, and Grayson shale.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 23–31. In this report [Cretaceous Foraminifera of Texas], group includes (ascending) Duck Creek, Fort Worth, Denton, Weno, Pawpaw, Main Street, and Grayson formations, Buda limestone, and Maness shale (subsurface only). Overlies Kiamichi formation of Fredericksburg group; underlies Cretaceous Woodbine group.

N. M. Curtis, Jr., 1959, Oklahoma Geology Notes, v. 19, no. 12, p. 257–264. In Bryan County, group includes (ascending) Kiamichi clay, Caddo limestone, Bokchito formation, Bennington limestone, and Grayson marl.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 16 (table 2), 35–39, pl. 1. In McCurtain County, group is undifferentiated. Overlies Fredericksburg group; underlies Woodbine formation. As mapped, includes Kiamichi formation of Fredericksburg group.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 21–42, pls. 1, 2. Described in Fort Worth area where it comprises (ascending) Kiamichi formation, Duck Creek formation, Fort Worth limestone, Denison formation, and Buda limestone. Overlies Fredericksburg group; underlies Woodbine sandstone.

Named for old Fort Washita, T. 5 S., R. 7 E., about sec. 23, Bryan County, Okla.

†Washita Limestone[1]

Lower Cretaceous (Comanche Series): Southern Oklahoma and Texas.

Original reference: B. F. Shumard, 1860, St. Louis Acad. Sci. Trans., v. 1, p. 583, 586.

Named for old Fort Washita, T. 5 S., R. 7 E., about sec. 23, Bryan County, Okla .

Wasson Formation (in Little Butte Volcanic Series)

Oligocene, upper(?): Southwestern Oregon.

F. G. Wells, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–89. Name applied to sequence of tuff beds and flow breccias that form upper part of Little Butte volcanic series (new). Most conspicuous layer of sequence is chalky white tuff about 200 feet thick; below this tuff and separated from it by about 300 feet of platy andesite flows is a 300-foot bed of dirty-yellow tuff consisting of angular fragments in basaltic tuff matrix. Overlies Roxy formation (new); capped by Heppsie andesites (new).

Well exposed in Wasson Canyon and in amphitheater north of Brest Mountain, T. 38 S., R. 2 E., Jackson County.

Wassonville Limestone (in Osage Group)[1]

Wassonville Limestone Member (of Hampton Formation)

Mississippian (Kinderhook Series): Southeastern Iowa.

Original reference: H. F. Bain, 1895, Am. Geologist, v. 15, p. 322.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 69). Shown on correlation chart as upper member of Hampton formation; overlies North Hill beds member. Included in Kinderhook series.

Named for outcrops at old Wassonville Mill, Washington County.

Wassuk Group

Miocene, upper, to Pliocene, middle: Western Nevada.

D. I. Axelrod, 1956, California Univ. Pubs. Geol. Sci., v. 33, p. 23, 61, 67–68, fig. 4. Made up of (ascending): Aldrich Station formation (new), thickness 4,050 feet; Coal Valley formation (new), thickness 3,325 feet; Morgan Ranch formation (new), thickness 700 feet. Aggregate thickness approximately 8,200 feet. Rests unconformably on biotite-hornblende andesite, or on granodiorite of Jurassic-Cretaceous(?) age. On page 67, age of Morgan Ranch formation is given as middle or upper Pliocene.

Exposed in Coal Valley-Mason Valley, Hawthorne quadrangle. Name derived from Wassuk Range.

Wassum Formation

Middle Ordovician (Mohawkian): Southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 97, chart 1 (facing p. 130). Calcarenites and buff crumbly shales. Composed principally of variegated marble or calcarenite in type locality. Total thickness 150 feet. Underlies Bays formation; overlies Chatham Hill formation (new). Name attributed to B. N. Cooper and G. A. Cooper.

Type locality: Four miles northwest of Marion, Marion quadrangle, Smyth County. Probably named for Wassum, Smyth County.

†Watauga Shale[1]

Lower Cambrian: Eastern Tennessee, northwestern Georgia, western North Carolina, and southwestern Virginia.

Original reference: A. Keith, 1903, U.S. Geol. Survey Geol. Atlas, Folio 90, p. 5.

Named for exposures in drainage area of Watauga River, Carter County, Tenn.

Watchman Flow, Andesite

Pleistocene: Southwestern Oregon.

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 44–46. At least six of the Northern Arc of Vents on former Mount Mazama are visible on caldera walls of Crater Lake. In clockwise direction these are: vents of Watchman andesite, of the andesitic cone forming Hillman Peak, of Llao, Cleetwood, and Redcloud dacite flows, and Sentinel Rock andesite. Watchman flow is about 1¼ miles long with an average width of 2,000 feet. Average thickness between 400 and 500 feet. Watchman flow is one of youngest of pre-caldera andesites and probably coeval with andesite of Sentinel Rock. All but highest crags of Watchman flow have been overridden by ice. Watchman vent was active before the vents of the Llao, Cleetwood, and Redcloud dacite lavas. [Diller and Patton, 1902, U.S. Geol. Survey Prof. Paper 3, described Watchman andesite area.]

The Watchman is peak on western side of Crater Lake.

Watchorn Formation (in Meramec Group)

Upper Mississippian: Kansas (subsurface).

Wallace Lee, 1940, Kansas Geol. Survey Bull. 33, p. 84–89, pl. 2. Term applied in subsurface where subdivision of strata into Spergen, St. Louis, and possibly Ste. Genevieve limestones is impracticable. In Watchorn and Olson No. 1 Morrison, consists of three units: at base, a noncherty or sparsely cherty semigranular gray limestone 120 feet thick; in middle, a buff sucrose dolomite containing dull and semitranslucent gray chert, 25 feet thick; at top, semigranular gray and white limestone 545 feet thick. Overlies Warsaw limestone; unconformable below rocks of Batesville age.

First penetrated in Watchorn Oil and Gas Co. No. 2 Morrison well, in NE¼NW¼ sec. 20, T. 32 S., R. 21 W., Clark County. Thick sections occur in western Kansas; outliers of lower part present in eastern Kansas.

Watchung Basalt[1] or **Lava Flows** (in Newark Group)

Upper Triassic: Northern New Jersey and southeastern New York.

Original reference: N. H. Darton, 1889, Am. Jour. Sci., 3d, v. 38, p. 134–139; 1890, U.S. Geol. Survey Bull. 67.

Helgi Johnson *in* Erling Dorf, ed., 1957, Geol. Soc. America Guidebook Atlantic City Mtg., p. 112–113, 115. Termed basalts. Interbedded with sandstone and shales of upper Newark group. Only slight differences in composition of various sheets. Rocks generally fine granular to aphanitic except for vesicular zones which are glassy and filled with variety of secondary minerals. Visible phenocrysts in dense groundmass rarely found. Occasional beds of red-colored tuffs seen in drill cores. Geographically extended to New York.

E. D. McKee and others, 1959, U.S. Geol. Survey Misc. Geol. Inv. Map I-300. Listed as Watchung lava flows. Includes Hood Mountain flow.

Probably named for occurrence in Watchung Mountains of New Jersey.

Waterboot Basalt[1]

Miocene(?) or Pliocene(?): Southwestern Alaska.

W. M. Cady and others, 1955, U.S. Geol. Survey Prof. Paper 268, p. 21 (table), 55–56, pl. 1. Black porphyritic scoriaceous and vesicular olivine basalt. Groundmass predominantly ophitic, though locally trachitic. Cellular structure is recurrent feature that apparently marks tops of several successive and nearly horizontal lava flows, each a few feet thick. Total thickness probably not much more than 100 feet. Inferred that Waterboot basalt succeeds Holokuk basalt (new) in stratigraphic position. Gemuk group (new) probably forms footing of the basalt on eastern sides of mountain.

Type exposures: The nearly horizontal caprock of Flat Top Mountain, east of upper-middle course of Aniak River. Mountain lies between Atsaksovluk Creek, an easterly tributary of Aniak River, and Waterboot Creek (for which unit is named), which flows west at south foot of mountain, and then north into Atsaksovluk Creek; in central Kuskokwim region.

Waterbury Gneiss[1]

Precambrian(?): Central Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 86, 100, map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Complex of gneiss and schist of variable composition and texture. Schist mainly medium grained. Rusty-weathering gneiss typically strongly banded; quartz-feldspar bands alternate at inch or foot intervals with more micaceous bands that grade into schist. Small granitic and pegmatitic sills and dikes common in more contorted gneiss bodies. Mapped in Waterbury dome only. Pre-Triassic. Derivation of name stated.

Named for town of Waterbury, New Haven County.

Water Canyon Formation

Lower Devonian: Northern Utah and southeastern Idaho.

J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1138–1139, pl. 1. Consists of two unnamed members. Lower member essentially of compact thin-bedded silty and sandy dolomites that weather smoke gray (white) or buff. In upper member detrital content increases, and

brown sandstone intraformational breccias and sandy shales are interbedded with dolomites, the only red beds in Paleozoic sequence in the quadrangle. Thickness of lower member estimated as much as 400 feet. Upper member 150 feet; missing northwest of Dry Lake. Disconformably underlies Hyrum member (new) of Jefferson formation; disconformably overlies Laketown dolomite.

H. W. Coulter, 1956, Idaho Bur. Mines and Geology Pamph. 107, p. 30–32, figs. 2, 3. Geographically extended to Preston quadrangle, Idaho.

Name taken from tributary of Green Canyon, Logan quadrangle, Utah, where, in sec. 4, T. 12 N., R. 3 E., it is well exposed.

Waterford Slate[1]

Ordovician(?): Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept., p. 97.

In Waterford village or township, Caledonia County.

Watering Trough Shale

Upper Devonian (Conewango): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 11. Name will probably be used, following more definitive study of area, for unit here termed Shale C and described as gray thin-bedded shales with interbedded gray limy brown-weathering sandstones and some clay-gall conglomerates. Sandstones lenticular and very local; may be channel fillings. Thickness 181 feet at type locality; varies from 137 to about 406 feet. Conformably underlies Sandstone D (Jumonville sandstone); overlies Sandstone B (Youghiogheny sandstone) with gradational contact.

Type section: Along National Pike about 2¼ miles east of town of Hopwood, Fayette County. Section best exposed in cuts above and below Watering Trough Inn and Spring.

Water Island Formation

Age not stated: Virgin Islands.

T. W. Donnelly, 1960, Dissert, Abs., v. 20, no. 7, p. 2755–2756; 1960, Caribbean 2d Geol. Conf. Trans., Mayagüez, Puerto Rico, p. 153. Chiefly keratophyre flows and tuffs with minor spilite flows and rare radiolarites. Terrigenous sediments absent. Exposed thickness 15,000 feet. Underlies Virgin Island group (new) with slight angular unconformity. Age not stated. Only fossils are radiolaria, *Stomiosphaera* cf. *moluccana* Wanner, which ranges from Tithonian to Turonian.

Report discusses geology of St. Thomas and St. John Islands.

Waterloo Quartzite[1]

Precambrian (Middle Huronian): Central southern Wisconsin.

Original reference: T. C. Chamberlin, 1877, Geology Wisconsin, v. 2, p. 252–256.

Exposed at foot of ridge on border of marsh in town of Waterloo, Jefferson County.

Waterman Gneiss

Precambrian(?) or Upper Paleozoic(?): Southern California.

O. E. Bowen, Jr., 1954, California Div. Mines Bull. 165, p. 16 (fig. 2), 17–23, pls. 1, 2, 3. Black hornblende-plagioclase-quartz-mica gneiss and

local diorite and pegmatite. At least 4.000 feet thick at type section. Believed to be younger than Oro Grande series and intrusive into it.

T. W. Dibblee, Jr., 1960, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–233. Probably Precambrian, possibly Paleozoic. In vicinity of Hinckley Mound, was mapped by Bowen as Oro Grande series and gneissic hornblende diorite. Maximum exposed thickness about 10,000 feet.

Type section: In deeply eroded northeast-trending broad simple anticline south of Camp Irwin Road opposite Waterman silver mine, Barstow quadrangle, San Bernardino County. Unit covers about 3½ square miles in Barstow quadrangle and extends east into unmapped territory for undetermined distance.

Waterton Dolomite[1]

Waterton Member (of Altyn Formation)

Precambrian (Belt Series): Southern Alberta, Canada.

Original reference: R. A. Daly, 1913, Canada Dept. Int. Rept. Chief Ast. 1910, v. 2, p. 50, 178.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, p. 1882. Member of Altyn formation. Thickness about 280 feet, base not exposed. Grades upward in Hell Roaring member (new).

C. P. Ross, 1959, U.S. Geol. Survey Survey Prof. Paper 296, p. 19. Not known to crop out in United States.

Exposed in Waterton Lakes Park.

Watertown Limestone (in Black River Group)[1]

Watertown Member (of Chaumont Formation)

Middle Ordovician: Central New York.

Original reference: R. Ruedemann, 1910, New York State Mus. Bull. 138, p. 72.

G. M. Kay, 1929, Jour. Geology, v. 37, no. 7, p. 664. Chaumont formation (new) comprises (ascending) Leray, Glenburnie (new), and Watertown members.

G. M. Kay, 1937, Geol. Soc. America Bull., v. 48, no. 2, p. 252, 253. Near Dexter, Jefferson County, Watertown member of Chaumont underlies Selby member (new) of Rockland formation. In earlier description of this section (Kay, 1931, Jour. Geology, v. 39, no. 4), the thin metabentonite that is 3 feet from base of Shelby member was mistakenly believed to separate Leray and Watertown members of Chaumont and to be same as persistent clay at that horizon in Glenburnie shale of Ontario. Type Hounsfield metabentonite is thus of Selby age. Hence, in revised section at Dexter, the Watertown underlies the Selby. Thickness at this section 5¾ feet.

G. M. Kay, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 599. Chaumont is separable into two members, Leray and Watertown limestones, only in limited area near Watertown.

Named for exposures at Watertown, Jefferson County.

Waterville Shale[1] or Slate

Silurian: South-central Maine.

Original reference: C. H. Hitchcock, 1861, Maine Bd. Agric. 6th Ann. Rept., p. 232.

Jacob Freedman, 1950, Geol. Soc. America Bull., v. 61, no. 5, p. 488. Middle Silurian.

Named for fine exposures at Waterville, Kennebec County.

Watson Limestone[1]

Lower Silurian: Northwestern Missouri.

Original reference: R. R. Rowley, 1916, Am. Jour. Sci., 4th, v. 41, p. 317–320.

Charles Schuchert, 1943, Stratigraphy of the eastern and central United States: New York, John Wiley and Sons, Inc., p. 671. Abandoned.

First described near Watson Station, Pike County.

†Watson Sandstone Member[1] (of Cattaraugus Formation)

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 203.

Watson Ledge Quartz Syenite

Carboniferous(?): East-central New Hampshire.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 377, 388, 400. Grayish quartz syenite. Porphyritic along contact with syenite which it intrudes. Porphyritic phase contains inclusions of syenite and fine-grained basic rock. Contains many small coarse streaks of amphibole and large grains of quartz clustered together. Belongs to White Mountain magma series.

Forms prominent bluffs known as Watson Ledge on Red Hill, Carroll County.

Watson Ranch Tongue (of Swan Peak Quartzite)

Middle Ordovician: Western Utah and eastern Nevada.

G. W. Webb, 1956, Utah Geol. and Mineralog. Survey Bull. 58, p. 12, 13 (fig. 3), 35, 42–43 (fig. 11), 44; 1956, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2338. Thickness 243 feet at Smooth Canyon, near Ibex, Utah. Divided by numerous strongly developed bedding planes. In general, quartz arenite beds weather to an iron oxide-stained, reddish-brown-colored surface, although lower beds are light gray or yellow weathering. Underlies Crystal Peak dolomite (new).

Named for Jack Watson Ranch, Ibex, Millard County, Utah.

Watts Creek Shale Member (of Moran Formation)[1]

Permian: North-central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 387, 419.

R. C. Moore, 1948, *in* M. G. Cheney, Abilene Geol. Soc. [Guidebook] Spring Field Trip, June 11–12, sheets 3, 4; R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Underlies Gouldbusk limestone member (new); overlies Camp Colorado limestone member of Pueblo formation.

Named for Watts Creek, Coleman County.

Waubakee Dolomite[1]

Upper Silurian: Southeastern Wisconsin.

Original reference: W. C. Alden, 1906, U.S. Geol. Survey Geol. Atlas Folio 140.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Correlation chart shows Waubakee limestone stratigraphically above Guelph dolomite.

First described near village of Waubakee, Ozaukee County.

Waucoba Lake Beds

Quaternary: Eastern California.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 418. Name applied to lake beds in vicinity of Waucoba Canyon. Younger than Coso formation. Correlated with Sherwin glacial stage.

Vicinity of Waucoba Mountain, Inyo Range, Inyo County. [Walcott (1897, Jour. Geology, v. 5, no. 4) described these beds and referred to them informally as the lake beds of the Waucobi embayment.]

Waucoban Series[1]

Waucoban Epoch[1]

Lower Cambrian: North America.

Original reference: C. D. Walcott, 1912, Smithsonian Misc. Colln., v. 57, no. 10, p. 305–306.

A. B. Shaw, 1954, Geol. Soc. America Bull., v. 65, no. 11, p. 1046. Suggested that term Waucoban series be abandoned and term Georgian series be reinstated.

Name derived from Waucoba Springs, northeastern side of Saline Valley, Inyo County, Calif. Lower Cambrian strata are well exposed in this area and east into Nevada.

Waucoma Limestone[1] (Alexandrian Group)

Silurian (Albion Series): Northwestern Illinois and northeastern Iowa.

Original reference: T. E. Savage, 1914, Am. Jour. Sci., 4th, v. 38, p. 35–36.

E. H. Scobey, 1938, Jour. Geology, v. 46, no. 2, p. 213–214. Beds found at type section of Waucoma are placed in the Edgewood formation on the basis of paleontology, lithology, and normal stratigraphic sequence; beds contain no chert and, where observed in Iowa, the Kankakee normally carries some chert bands.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart as overlying Winston limestone; placed in Albion series.

Named for Waucoma, Fayette County, Iowa.

Waukesha Limestone[1] or Formation (in Coe Group)

Middle Silurian: Eastern Wisconsin, northeastern and northwestern Illinois, and northeastern Iowa.

Original reference: I. A. Lapman, 1851, Rept. of J. W. Foster and J. D. Whitney on geology of Lake Superior district, pt. 2, S. Ex. Doc. 4, U.S. 32d Cong., spec. sess., p. 168–171.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, p. 536, 547, chart 3. Waukesha limestone has been defined as underlying Racine dolomite, but its lower limit has been placed at various horizons from the base of Cordell to base of Byron. The term hence lacks precision and in Wisconsin has been replaced by names used here, Cordell dolomite and Schoolcraft dolomite. Savage proposed name Bellwood dolomite for beds formerly called Waukesha dolomite in northeastern

Illinois, and also proposes name Cordova dolomite for beds formerly called Waukesha in northwestern Illinois and Iowa.

H. B. Williams, 1943, Illinois Geol. Survey Rept. Inv. 90, p. 29. Term Bellwood as used by Savage (1942) includes strata herein considered Waukesha and Racine.

H. A. Lowenstam, 1949, Illinois Geol. Survey Rept. Inv. 145, p. 18. Included in Coe group. (new).

First described in Waukesha County, Wis.

Waukon sandstone[1]

Upper Cambrian: Northeastern Iowa.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 320–321, 326.

Named for exposures in vicinity of Waukon, Allamakee County.

Waupecan Sandstone[1]

Pennsylvanian: Northeastern Illinois.

Original reference: H. E. Culver, 1922, Illinois Geol. Survey, Extract from Bull. 43, 1923, p. 53–56.

Named for exposures along Waupecan Creek, Grundy County.

Wausau Granite[1]

Precambrian: Wisconsin.

Original reference: C. C. Wang, 1932, Geol. Soc. China Bull., v. 11, no. 4, p. 427.

Wausau Graywacke[1]

Precambrian (middle Huronian): Central northern Wisconsin.

Original reference: S. Weidman, 1907, Wisconsin Geol. Nat. History Survey Bull. 16, p. 55.

Occurs in isolated masses within a few miles northeast and northwest of Wausau, Marathon County.

Wauseca Pyritic Member (of Dunn Creek Slate)

Precambrian (Animikie Series): Northern Michigan.

H. L. James, 1958, U.S. Geol. Survey Prof. Paper 314–C, p. 30 (table 1), 38. Name applied to very fine-grained pyritic graphitic slate, typically containing 35 to 40 percent pyrite, that occurs in uppermost part of formation. Member is subdivided into two or three parts in detailed geologic mapping; one subunit is chaotic breccia that ranges from a foot or so to about 50 feet in thickness and is composed of small fragments of pyritic slate in matrix of same composition. True thickness probably 30 feet or less but commonly much greater or less due to squeezing and shearing.

Only exposure is roadcut south of Alpha, Iron County. Named for Wauseca mine at Iron River, in which unit is exposed in thousands of feet of mine workings.

Waushara Granite[1]

Precambrian (pre-Huronian?): Central southern Wisconsin.

Original reference: S. Weidman, 1898, Wisconsin Geol. Nat. History Survey Bull. 3, Sci. ser. 2, p. 47–64.

Crops out at several places in Marion and Warren Townships, Fox River district, southeastern part of Waushara County.

Wauswaugoning Quartzite[1]

Precambrian (Huronian): Northeastern Minnesota.

Original reference: N. H. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept.

At head of Wauswaugoning Bay.

†Wautubbee Marl (in Claiborne Group)[1]

Wautubbee Member (of Lisbon Formation)

Eocene, middle: Mississippi.

Original reference: E. N. Lowe, 1919, Mississippi Geol. Survey Bull. 14. p. 78.

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook] Field Trip, Feb. 10, 11, columnar section. Uppermost member of Lisbon. Overlies Kosciusko sand member. Thickness 60 feet.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 47–68, pls. Term Wautubbee used in this report essentially as applied by Lowe. Includes all of marine section above Kosciusko and below Cockfield in eastern and central Mississippi and its nonmarine equivalent, Shipps Creek shale, in western Mississippi. In eastern part of State, includes (ascending) Archusa marl, Potterchitto, and Gordon Creek shale members (all new). This subdivision impractical in central Newton County, and formation is mapped as undifferentiated as far northwest as Yockahockany River in northwestern Leake County. In western Holmes and Carroll Counties, tongue of carbonaceous shale lying at stratigraphic horizon of marine Wautubbee is here named Shipps Creek member. Thickness 45 to 75 feet.

Named for exposures near Wautubbee, Clarke County, on Northeastern Railroad, in cut beneath highway bridge on Highway 11, sec. 10, T. 3 N., R. 14 E.

Wauwatosa Formation

Silurian: Southeastern Wisconsin.

F. B. Phleger, Jr., 1937, Harvard Coll. Mus. Comp. Zoology Bull., v. 80, no. 11, p. 420. Incidental mention only.

Wauwatosa, Milwaukee County.

†Waverly Conglomerate[1]

Mississippian: Ohio.

Original reference: E. B. Andrews, 1871, Ohio Geol. Survey Rept. Prog. 1870.

Named for occurrence within Waverly group.

†Waverly Group[1] or Series

Mississippian (Kinderhookian-Osagean): South-central Ohio and northern Kentucky.

Original references: W. W. Mather, 1838, Am. Jour. Sci., 1st, v. 34, p. 363; C. Briggs, Jr., 1838, Ohio Geol. Survey 1st Ann. Rept., pl. 1, p. 79.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 56. In Kentucky, includes (ascending) Bedford formation, Berea sandstone, and Sunbury shale.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 84). Age given on correlation chart as Kinderhookian and Osagean.

J. E. Hyde, 1953, Ohio Geol. Survey Bull. 51, p. 1–213. Name is applied to sandy and argillaceous series of rocks, 700 to 1,000 feet thick, which occupies interval between Ohio shale and the Coal Measures (excepting local Maxville limestone which intervenes between it and the Coal Measures). So delimited, series includes (ascending) Bedford shale, Berea grit, Sunbury shale, Cuyahoga shale, Black Hand formation, and Logan formation. Devonian-Mississippian contact and post-Waverlian disconformity in Ohio discussed.

Named for Waverly, Pike County, Ohio.

Waverlyan System[1]

Mississippian: North America.

Original references: E. O. Ulrich, 1905, U.S. Geol. Survey Prof. Paper 36, p. 24 (table); 1911, Geol. Soc. America Bull., v. 22, no. 3, p. 581–582.

R. C. Moore, 1948, Jour. Geology, v. 56, no. 4, p. 373. Lower Mississippian rocks of North America, comprising Kinderhookian and Osagean beds, which have been called "Waverlyan series," correspond to Tournaisian strata of Europe.

Waxahatchee Slate[1]

Precambrian or Paleozoic: Central Alabama.

Charles Butts, 1940, U.S. Geol. Survey Geol. Atlas, Folio 226, p. 3. Basal slate formation exposed in Montevalo-Columbiana quadrangles. Includes all slate below Brewer phyllite. Includes Sawyer limestone member near top. Thickness about 5,000 feet.

Named for exposures on Waxahatchee Creek, Shelby County, in Columbiana quadrangle.

Wayan Formation[1]

Lower(?) and Upper Cretaceous: Southeastern Idaho.

Original reference: G. R. Mansfield and P. V. Roundy, 1916, U.S. Geol. Survey Prof. Paper 98–G, p. 83.

W. L. Stokes, 1953, Intermountain Assoc. Petroleum Geologists 4th Ann. Field Conf., p. 17–18. Continental sandstone, limestone, shale, and conglomerate, all showing rapid lateral facies changes. Passes eastward into Bear River and Aspen formations with complex facies relationships. Of Upper Cretaceous age.

J. D. Vine, 1959, U.S. Geol. Survey Bull. 1055–I, p. 259, 263–264, pl. 51. Mapped in Fall Creek area, Bonneville County, where it comprises about 3,000 to 4,000 feet of red and purple shale, and gray medium- to coarse-grained crossbedded friable sandstone. Overlies Bear River formation.

Named for settlement of Wayan, Bannock County, in northwestern part of Wayan quadrangle.

Wayland Shale Member (of Graham Formation)[1]

Wayland Shale (in Graham Group)

Upper Pennsylvanian: Central and central northern Texas.

Original references: F. B. Plummer and R. C. Moore, 1921, Texas Univ. Bull. 2132, p. 127–158; 1922, Jour. Geology, v. 30, p. 24, 31.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 698, chart 6 (column 38). Shown on correlation chart as formation in Graham group, Cisco series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 70. In Brown and Coleman Counties, Colorado River valley, Wayland shale member overlies Gunsight limestone member and underlies Ivan limestone member. Thickness about 100 feet along Colorado River. Plummer and Moore (1921) correlated their Wayland shale in Stephens County with Drake's (1893) Trickham bed in Coleman County. Most authors have followed Plummer and Moore in bringing term Wayland into Colorado River valley. Although term Trickham has priority, retention of name Wayland shale is recommended in Colorado River valley. Nickell (1938, Texas Univ. Bur. Econ. Geology Pub. 3801) extended term Avis sandstone into Colorado River valley and applied it to lenticular beds of sandstone at one or more positions below Ivan limestone member. Inasmuch as sandstone is present only locally and the sandstone lenses occupy several stratigraphic positions in the Wayland, name Avis member probably should not be brought into Colorado River valley.

Named for exposures at and near Wayland, Stephens County, Brazos River region.

Wayne Formation[1]

Wayne Group

Middle Silurian: Western Tennessee and northeastern Mississippi.

Original reference: N. F. Drake, 1914, Tennessee Geol. Survey Resources of Tennessee, v. 4, no. 3, p. 103.

C. W. Wilson, Jr., 1949, Tennessee Div. Geology Bull. 56, p. 244. Wayne group includes the following formations (ascending): Osgood limestone, Laurel limestone, Waldron clay, Lego limestone, and Dixon limestone.

Named for Wayne County, Tenn., where all units are well developed.

Waynesboro Formation[1]

Lower Cambrian: Central and southern Pennsylvania, western Maryland, northern Virginia, and northern West Virginia.

Original reference: G. W. Stose, 1906, Jour. Geology, v. 14, p. 209.

C. E. Resser, 1938, Geol. Soc. America Spec. Paper 15, p. 4, 7. Name considered invalid. Rome was called Waynesboro by Stose (1906).

H. P. Woodward, 1949, West Virginia Geol. Survey, v. 20, p. 142–155. Described in West Virginia where it consists of a miscellaneous assortment of red, purple, and green shale, thin slabby limestone, impure sandstone, and dolomite. Estimated thickness about 1,000 feet. Main outcrop is in Jefferson County. Underlies Elbrook limestone; occurs above Tomstown dolomite which is present only in Jefferson County.

Philip King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 7 (table), 30–32, pl. 1. Described in Elkton area, Virginia, where it is about 1,700 feet thick, overlies Tomstown dolomite and underlies Elbrook dolomite. Consists of red and brown shale, calcareous shale and siltstone, and some limestone. Closely resembles Rome formation in character and stratigraphic position. Name Waynesboro is now used in Virginia as far south as Roanoke, beyond which name Rome is used for same unit.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 41–43. Overlies Tomstown dolomite; underlies Elbrook limestone. Many outcrops in Washington County, but complete sections are not known. Most complete section is east of Chewsville, where formation is about 875 feet thick.

Named for exposures in ridge just north of Waynesboro, Franklin County, Pa.

Waynesburg Clay[1] (in Monongahela Formation)

Waynesburg underclay member

Pennsylvanian (Monongahela Series): Southwestern Pennsylvania, eastern Ohio, and northern West Virginia.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 189. Underclay member of Waynesburg cyclothem in report on Athens County. Less than 1 foot thick. What is frequently termed Waynesburg "horizon" is an underclay with carbonaceous matter rather than coal or coaly shale. Monongahela series.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 10. Waynesburg underclay immediately underlies Waynesburg coal. Clay is light gray with iron-stained fractures. Average thickness of clay about 3½ feet.

Waynesburg cyclothem

Pennsylvanian (Monongahela Series) and Permian: Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 186–189. Youngest cyclothem in Pennsylvanian system in Appalachian region. Occurs above Little Waynesburg cyclothem (new). Includes (ascending) Gilboy sandstone, Waynesburg redbed, fresh water limestone, Waynesburg underclay, Waynesburg (No. 11) coal, and Cassville shale members. By drawing Pennsylvanian-Permian boundary at top of Waynesburg coal, Cassville shale becomes basal member of Permian system; hence, Waynesburg cyclothem transcends systemic boundary. Average thickness 20 feet; this interval is filled by Gilboy sandstone and the redbed member. Lateral continuity of the Waynesburg is broken wherever the Gilboy and Waynesburg sandstones are coalesced; also Little Waynesburg Rider cyclothem lies between the Little Waynesburg and Waynesburg coal beds. Although this cyclothem and identification of Waynesburg coal are critical to stratigrapher, they are not disctinctive in field, and a long measured section is necessary to determine intervals from other key horizons. In area of this report, Monongahela series is discussed on cyclothemic basis; 12 cyclothems are named. [For sequence see Pittsburg cyclothem.]

Confined to eastern third of Athens County, an area that includes eastern edge of Lodi Township; extensive parts of Bern, Carthage, and Rome Townships; and along Hocking River and its tributaries in Troy Township.

Waynesburg "A" cyclothem

Permian (Washington Series): Southeastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 204–210. Embraces interval between Elm Grove cyclothem (new) below and Little Washington cyclothem (new). Includes all strata from top of Cassville shale to base of Mannington sandstone. Thickness about 36½ feet. Includes (ascending) Waynesburg shale and sandstone, redbed, Mount Morris limestone, underclay, Waynesburg "A" (No. 11a) coal, and roof shale members. Variations in thickness and boundaries of cyclothem are due to lack of lateral persistence of Elm Grove and Lower Waynesburg "A" coal horizons or result of erosional

downcutting and (or) coalescence of Waynesburg sandstone with the overlying and underlying sandstones. In area of this report, Washington series is discussed on cyclothemic basis; four cyclothems are named. [For sequence see Elm Grove cyclothem.]

Cyclothem, or parts of it, are present in Bern, Carthage, Lodi, Rome, and Troy Townships, Athens County.

Waynesburg Group[1]

Pennsylvanian: Pennsylvania.

Original reference: H. D. Rogers, 1858, Geology of Pennsylvania, v. 2, pt. 1, p. 474–477.

Waynesburg Limestone Member (of Monogahela Formation)[1]

Waynesburg Limestone (in Monongahela Group)

Waynesburg limestone and shale member

Upper Pennsylvanian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1877, Pennsylvania 2d Geol. Survey Rept. K_2.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 100, 124 (fig. 29), 125–126. Termed Waynesburg limestone in Monongahela group.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 84–85. In Ohio, Waynesburg limestone and shale member (Monongahela series) occurs between Uniontown sandstone and shale member and Little Waynesburg (No. 10–A) coal above. Average thickness about 10 feet. Poorly developed.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 186. Waynesburg limestone member of Little Waynesburg cyclothem in report on Athens County. Member was named by Stevenson (1876, Geology Pennsylvania, Rept. K, p. 62) for its association with Waynesburg coal bed which it underlies in its type area by 20 to 40 feet. Later another coal bed directly overlying the Waynesburg limestone was reported and named by Stevenson the Little Waynesburg coal. Although this member is not directly related to the coal bed from which its name was derived, name Waynesburg has been retained and is firmly entrenched in geologic literature. Thickness of member 2⅓ feet.

Named for Waynesburg, Greene County, Pa.

Waynesburg Member (of Monongahela Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: M. E. Johnson, 1929, Pennsylvania Geol. Survey Topog. and Geol. Atlas 27, p. 31.

Waynesburg redbed member

Pennsylvanian (Monongahela Series): Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 158 (table 13), 188. Member of Waynesburg cyclothem in report on Athens County. This member, together with underlying Gilboy sandstone member, accounts for virtually entire interval between Little Waynesburg and Waynesburg coal beds. Average thickness of member 9½ feet but, because of lateral gradation to sandstone, the range is from 3 to 20 feet. Monongahela series.

Waynesburg Sandstone Member (of Washington Formation)[1]

Waynesburg Sandstone (in Washington Group)

Waynesburg sandstone and shale member

Permian: Southwestern Pennsylvania, western Maryland, southeastern Ohio, and northern West Virginia.

Original reference: J. J. Stevenson, 1873, Am. Philos. Soc. Trans., v. 15, new ser., p. 16.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 135, 146. In Fayette County, Waynesburg sandstone occurs 16 to 25 feet above base of Washington group. Lies between Mount Morris limestone above and Cassville shale below locally separated from latter by Elm Grove limestone. Thickness 10 to 45 feet.

W. D. Martin, 1955, Dissert. Abs., v. 15, no. 8, p. 1371. True Waynesburg sandstone is geographically restricted to southwestern Pennsylvania and northern West Virginia. Relatively local sandstone, which occurs in Washington, Athens, and Meigs Counties, Ohio, and adjacent part of West Virginia, and has previously been considered a part of the Waynesburg sandstone, is here named Hockingport sandstone.

D. L. Norling, 1958, Ohio Geol. Survey Bull. 56, p. 10 (fig. 3), 91–92, geol. map. Waynesburg sandstone and shale member (Washington series) includes interval between Elm Grove limestone below and Waynesburg "A" (No. 11–A) coal. In Morgan County, general absence of these latter units makes basal and upper boundaries of member indefinite. In thicker bodies, sandstone is gray to tan, fine to medium grained with zones of coarser material, and thin to platy bedded; commonly contains beds of sandy shale, and in many areas is an alternation of sandstones and shales. Thickness 28 to 37 feet. Locally coalesces with Gilboy sandstone, which occurs below Waynesburg (No. 11) coal, thus transgressing systemic boundary; in some areas, merges with stratigraphically higher Mannington sandstone.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 203 (table 14), 204–208. Waynesburg sandstone and shale member of Waynesburg "A" cyclothem in report on Athens County. Waynesburg sandstone is first major sandstone occurring in Washington series. Both top and bottom of this member have been used in the past as Pennsylvanian-Permian contact. Thickness 24½ feet.

Named for development on Tenmile Creek, east of Waynesburg, Greene County, Pa.

Waynesville Shale[1] **or Limestone** (in Richmond Group)

Waynesville Formation (in Richmond Group)

Upper Ordovician: Southwestern Ohio, southern Indiana, and north-central Kentucky.

Original reference: J. M. Nickles, 1903, Am. Geologist, v. 32, p. 205.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110, chart facing p. 108. Shown on generalized section of Ohio as Waynesville formation. Thickness 95 feet. Includes (ascending) Fort Ancient, Clarksville, and Blanchester members. Underlies Liberty formation; overlies Arnheim formation.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2 (columns 44, 45). Correlation chart shows Waynesville shale

and limestone underlying Liberty shale and limestone and overlying Arnheim shale and limestone.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define Richmond stage of Cincinnatian series.

Named for Waynesville, Warren County, Ohio.

Wayside Sandstone Member (of Caseyville Formation)

Wayside Sandstone and Shale Member (of Pottsville formation)[1]

Pennsylvanian: Southwestern Illinois.

Original reference: J. E. Lamar, 1925, Illinois Geol. Survey Bull. 48, p. 23, 84–85, map.

J. M. Weller, 1939, Illinois Geol. Survey Rept. Inv. 60, p. 11. Reallocated to member status in Caseyville formation. Basal member of formation; underlies Lick Creek sandstone member.

J. M. Weller, 1940, Illinois Geol. Survey Rept. Inv. 71, p. 36. Strata formerly termed Wayside now included in Lusk formation (new).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 29, 30, 44 (table 1), pl. 1. Member of Caseyville formation (redefined). Occurs below Battery Rock sandstone member. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: N½ sec. 30, T. 11 S., R. 2 E., Jackson County. Named for village of Wayside, a few miles northwest of type exposures.

Wea Shale[1] Member (of Cherryvale Shale or Formation)

Wea Shale Member (of Sarpy Formation)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 85, 91, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4); 1949, Kansas Geol. Survey Bull. 83, p. 68 (fig. 14), 95. Wea shale member of Cherryvale formation; underlies Westerville limestone member; overlies Block limestone member. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 38. In Nebraska, reallocated to member status in Sarpy formation (new). Thickness in eastern Kansas 10 to 30 feet; northwestern Missouri, 15 to 25 feet; Sarpy County, Nebr., 3½ feet; south-central Iowa, 5 feet.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Consists of two dark-gray shale units that are separated by hard black fissile shale. Thickness about 3 feet. Uppermost member of Cherryvale shale; overlies Block limestone member; underlies Westerville limestone.

Type locality: SE cor. sec. 31, T. 16 S., R. 24 E., and at center of east side sec. 12, T. 18 S., R. 22 E., Miami County, Kans. Named for Wea Creek in northeastern part of county.

Wearyman Dolomite Member (of Minturn Formation)

Pennsylvanian: Central Colorado.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 198–199. Prominent and persistent bed of light-gray to buff finely crystalline

slightly siliceous reef dolomite that is pitted with small cavities elongated in plane of the bedding. Weathers to rounded forms but weathered surfaces rough and pitted. Dolomite probably largely of algal origin although at places it contains abundant remains of other fossils. Most organic structures almost obliterated by dolomitization and recrystallization. Thickness 15 to 75 feet. Underlies Hornsilver dolomite member (new).

Named for prominent exposures near Wearyman Creek, which lies in Minturn quadrangle just north of edge of Holy Cross quadrangle. Best exposed and thickest on ridge between Wearyman and Resolution Creeks, at northern edge of Holy Cross quadrangle.

Weatherby Canyon Ignimbrite

Tertiary: Southwestern New Mexico.

Elliot Gillerman, 1958, New Mexico Bur. Mines Mineral Resources Bull. 57, p. 70–75, table 1, pl. 1. Rhyolite and some trachyte ignimbrite and thin interbeds of nonwelded tuff. Most of the ignimbrite is light-gray to red hard compact aphanitic-porphyritic rhyolite with phenocrysts of quartz, sanidine, and orthoclase in devitrified matrix of shards and glass shreds. Thickness at least 3,000 feet on 1117 Peak and ridges to the west. Younger than Vanar Hills volcanic rocks.

Named from exposures in Weatherby Canyon, near southern boundary of the mapped area of central part of Peloncillo Mountains, Hidalgo County. Particularly well exposed on 1117 Peak, south of Weatherby Canyon. Forms surface rock of most of the Peloncillo Mountains between Cowboy Pass and south boundary of area mapped, and extends southward at least additional 5 miles.

Weatherford Member (of Cloud Chief Formation)

Weatherford Dolomite[1]

Permian: Central-western Oklahoma.

Original reference: R. L. Six and others, 1930, Oklahoma Geol. Survey Bull. 40–UU, map.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Basal member of formation.

Present in Custer, Dewey, and Washita Counties. Probably named for Weatherford, Custer County.

Weaver Rhyolite[1] (in Koipato Group)

Permian(?) and Lower Triassic: Northwestern Nevada.

Original reference: A. Knopf, 1924, U.S. Geol. Survey Bull. 762.

R. E. Wallace and others, 1959, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–220. Upper formation in Koipato group. In Buffalo Mountain quadrangle, comprises three units: (1) porphyritic rhyolite with phenocrysts of quartz and feldspar, white or light greenish gray; generally homogeneous with rare, poorly defined bedding; thickness probably more than 1,000 feet in vicinity of Fisher Canyon but appears to pinch out west of Buffalo Mountain; (2) clastics, including pebble conglomerate, sandstone, and thinly laminated dark-gray or brown tuffaceous argillite in variable proportions; well stratified; in places an upper and lower unit; impressions of ammonites of probable Early Triassic age present in argillite; maximum thickness more than 700 feet; and (3) rhyolitic felsite flows; estimated thickness 1,000 feet in Fisher

Canyon. Overlies Rochester trachyte; underlies Prida formation with angular unconformity. Permian(?) and Triassic.

Exposed at head of Weaver Canyon, Rochester district.

Weaver Lake Quartz Monzonite

Jurassic-Cretaceous: Central California.

D. C. Ross, 1958, California Div. Mines Spec. Rept. 53, p. 13, pl. 1. Notably light gray; distinguishing features are fine grain size and low color index; texture is xenomorphic granular and grains average 1 to 2 mm; biotite sprinkled through rock; hornblende rare. Relation to other named plutonic rocks in area not determined.

Named from exposures around Weaver Lake in northeast part of area, Sequoia National Park. Largest mass crops out over about 12 square miles, seven smaller masses, probably satellitic to large mass, are exposed around periphery of main mass.

Weaverville Formation[1]

Oligocene(?): Northern California.

Original reference: N. E. A. Hinds, 1933, California Jour. Mines and Geology, v. 29, nos. 1, 2, p. 79, 115.

W. P. Irwin, 1960, Sacramento Geol. Soc. [Guidebook] Ann. Field Trip, June, 3, 4, 5, p. 22. Mentioned in road log. Oligocene(?).

Named for exposures near Weaverville, Trinity County.

†Webb Bluff[1] (formation)

Eocene: Southern Texas.

Original reference: E. T. Dumble, 1892, Geol. Soc. America Bull., v. 3, p. 224, 228, 230.

Named for Webb Bluff, Webb County, 3 miles below Maverick County line.

Webbers Falls Sandstone Member (of Atoka Formation)[1]

Pennsylvanian (Atoka Series): Eastern Oklahoma.

Original reference: C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 4, p. 503–520.

C. W. Wilson, Jr., and N. D. Newell, 1937, Oklahoma Geol. Survey Bull. 57, p. 24–33. Thickness 10 to 15 feet in Muskogee-Porum district. Separated from underlying Dirty Creek sandstone member and overlying Blackjack School sandstone member by unnamed shales.

Named for exposures in secs. 10 and 15, T. 15 N., R. 20 E., about 2 miles west of Webbers Falls, Muskogee County.

†Webberville Beds[1]

Upper Cretaceous (Gulf Series): Central Texas.

Original reference: R. T. Hill, 1899, Texas Geol. Survey Bull. 4, p. xiii, xxx.

Well exposed at blue bluffs of Colorado River, and at and near Webberville, Travis County.

Weber Conglomerate[1]

Lower Cretaceous: Northeastern Nevada.

Original references: Arnold Hague, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 28; 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253; 1892, U.S. Geol. Survey Mon. 20, p. 30, 91, 92.

Lore David, 1941, Jour. Paleontology, v. 15, no. 3, p. 318–321. On basis of discovery of fish and plant fossils, so-called Weber conglomerate, originally mapped as Upper Carboniferous, is considered to be Lower Cretaceous in age.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 68. Name Newark Canyon proposed for beds of Lower Cretaceous age that include almost all strata mapped as Weber conglomerate by Hague (1883; 1892).

Occurs in Eureka and other districts of Nevada.

†Weber Grits[1]

Pennsylvanian: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1883, U.S. Geol. Survey.

Leadville and neighboring regions.

Weber Quartzite[1] or Sandstone

Weber Formation (in Durst Group)

Pennsylvanian and Permian: Northeastern Utah and western Colorado.

Original reference: C. King, 1876, Am. Jour. Sci., 3d, v. 11, p. 477–479.

K. G. Brill, Jr., 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 8, p. 1384–1385. Names Weber and Maroon abandoned in Gore area, Colorado; term Battle Mountain proposed for sequence of Pennsylvanian clastics. In earlier reports, sequence here assigned to Battle Mountain was divided into six formations (ascending): Weber (divided into Weber shale and Weber grit), Robinson limestone, White Quail limestone, Maroon, Jacque Mountain limestone, and Wyoming. Term Belden shale member of Battle Mountain is here proposed to replace Weber shale.

K. G. Brill, Jr., 1944, Geol. Soc. America Bull., v. 55, no. 5, p. 633–635. Term Weber quartzite restricted in west-central Colorado to white sandstone overlying Maroon formation; in some areas, overlies Morgan formation. Underlies State Bridge formation, Phosphoria, or Dinwoody (Moenkopi) formations. Thicknesses: 880 feet, Disappointment Creek; 70 feet, Miller Creek section; 79 feet, Glenwood Springs section. Term Belden member raised to formation rank and is equivalent to "Weber shale" throughout region.

A. J. Eardley, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 833–834. At type section, herein described for first time, Weber quartzite is about 3,000 feet thick; overlies Morgan sandstone and underlies Park City formation. Lower sandstones, 730 feet thick, are overlain by 355 feet of limestone; remainder of unit is quartzite.

M. L. Thompson, 1945, Kansas Geol. Survey Bull. 60, pt. 2, p. 34, 39. Term Weber restricted in Uinta Mountains to the thick crossbedded to massive buff sandstones above the limestone-bearing part of the section. As thus restricted, overlies Youghall formation (new) and underlies Park City formation. Thickness about 1,000 feet in vicinity of Vernal, Utah; about 850 feet on north side of Uinta Mountains at Sheep Mountain Canyon. No fossils; age not determined.

J. W. Huddle and F. T. McCann, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 75. In Duchesne River area, 1,500 to 1,600 feet thick and consists mainly of very fine grained gray and white sandstone that

weathers buff. Overlies Morgan formation; underlies Park City formation, contact not everywhere distinct.

K. G. Brill, Jr., 1953, Geol. Soc. America Bull., v. 63, no. 8, p. 811 (fig. 1), 823. In vicinity of Glenwood Springs and McCoy, Colo., Weber sandstone includes Schoolhouse tongue at top.

J. W. Vanderwilt, 1953, *in* Rocky Mountain Assoc. Geologists Guidebook Field Conf., May 14–16, p. 15, fig. facing p. 12. Maroon formation, in Glenwood Springs area, contains Glenwood tongue (new) of Weber sandstone. Tongue is 200 feet thick.

Walter Sadlick, 1955, Wyoming Geol. Assoc. Guidebook 10th Ann. Field Conf., p. 58. Because of recent common usage, it is herein proposed that the Weber be henceforth known as Weber sandstone.

D. M. Kinney, 1955, U.S. Geol. Survey Bull. 1007, p. 45–48, pls. Originally defined as quartzite at type locality, the formation throughout Uinta Mountains and most of Wasatch Mountains is more correctly referred to as sandstone. Weber was defined as including strata that were later differentiated by Blackwelder (1910) as Morgan formation. In Uinta Mountains, geologists of Fortieth Parallel Survey mistakenly applied name to great thickness of Precambrian rocks, now known as Uinta Mountain group, instead of the less extensive sandstone of Pennsylvanian age. Powell (1876), in report on Uinta Mountains, named the massive sandstone of Pennsylvanian age the Yampa sandstone. Yampa sandstone was correlated by Schultz (1920, U.S. Geol. Survey Bull. 702) with more widely used Weber sandstone, and since that time Weber sandstone has been used in preference to Yampa. The Weber in Uinta River-Brush Creek area is uniform massive fine- to medium-grained light-gray slightly calcareous quartzose sandstone. Thickness 1,015 to 1,275 feet; thicker sections (in Ashley Creek and on Diamond Mountain) are adjacent and are located in area in which the upper 300 to 400 feet of Weber is particularly crossbedded. Overlies Morgan formation; underlies Phosphoria. No fossils; age open to question.

Walter Sadlick, 1957, Intermountain Assoc. Petroleum Geologists Guidebook 8th Ann. Field Conf., p. 70–71, 75–76. Weber formation included in Durst group (new).

H. J. Bissell and O. E. Childs, 1958, Rocky Mountain Assoc. Geologists Symposium on Pennsylvanian rocks of Colorado and adjacent areas, p. 27–30. Formation, as described in section that extends from type locality eastward to vicinity of Walcott, Colo., consists of western facies of orthoquartzites, shale, and limestone stringers that, in vicinity of Whiterock, Utah, interfingers with eolian and neritic sands. In western Colorado, includes Schoolhouse tongue at top and interfingers with Maroon formation. In vicinity of type locality, overlies Morgan and underlies Park City; eastward, underlies Phosphoria and between Meeker and Walcott, Colo., pinches out beneath State Bridge formation. Interpretation of fossil occurrences shows that Weber transcends Pennsylvanian-Permian time boundary, indicating that upper part of eolian Weber is Permian and that all of Schoolhouse tongue is Permian.

U.S. Geological Survey currently designates the age of the Weber Quartzite or Sandstone as Pennsylvanian and Permian on the basis of a study now in progress.

Type section: Upper Weber Canyon, east of Morgan, Morgan County, Utah.

†Weber Shales[1]

Pennsylvanian: Central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1883, U.S. Geol. Survey Leadville Atlas; 1886, U.S. Geol. Survey Mon. 12.

Leadville and neighboring regions.

Weberg Formation (in Colpitts Group)

Middle Jurassic: East-central Oregon.

R. L. Lupher, 1941, Geol. Soc. America Bull., v. 52, no. 2, p. 227 (table 1), 229, 248. Consists mainly of gray granular limestone with calcareous sandstone, grit, and conglomerate; a thin basal conglomerate is present near Colpitts Ranch; elsewhere in type area, formation begins with limestone or coarse calcareous sandstone. Thickness 100 to 272 feet. Basal formation of group. Underlies Warm Springs formation (new); overlies Nicely shale (new).

W. R. Dickinson, 1960, Dissert. Abs., v. 20, no. 11, p. 4376. Weberg, Warm Springs, and Basey (new) formations are lateral equivalents of Snowshoe formation.

Type area: On east side of Warm Springs Creek valley in secs. 19, 20, 29, and 30, T. 18 S., R. 26 E. Named for Weberg Ranch, on lower Warm Springs Creek, in sec. 18, T. 18 S., R. 26 E., Crook County.

Webster Formation[1]

Ordovician: Oklahoma.

Original references: E. O. Ulrich, 1932, Unpublished chart exhibited at Geological Society of America meeting in December; F. C. Edson, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 8, p. 1122–1130.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. An unpublished name for limestone now called Corbin Ranch.

Webster Group[1]

Devonian: Southwestern Missouri.

Original reference: E. M. Shepard, 1905, Drury Coll. Bradley Geol. Field Sta. Bull. 1, p. 57.

In Greene County. Derivation of name not stated.

Webster Springs Sandstone (in Bluefield Formation[1] or Group)

Mississippian: Southern West Virginia.

Original reference: D. B. Reger, 1920, West Virginia Geol. Survey Rept. Webster County, p. 214, 227–228.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 255, 264. In Greenbrier County, consists of 10 to 50 feet of shaly grayish-brown sandstone. Overlies Glenray limestone; separated from overlying Reynolds limestone by shale which may be equivalent of Bickett shale of Reger (1926). Mauch Chunk series.

Exposed on north side of Elk River at southeast edge of town of Webster Springs, Webster County.

Weches Greensand Member (of Mount Selman Formation)[1]

Weches Formation (in Claiborne Group)

Eocene, middle: Eastern Texas, and northwestern Louisiana.

Original reference: A. C. Ellisor, 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, p. 1339–1346.

H. B. Stenzel, 1939, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 93–114. Rank raised to formation in Claiborne group. Thickness 25 to 45 feet. Subdivided into (ascending) Tyus, Viesca, and Therrill members (all new). Disconformably overlies Queen City sand; disconformably underlies Sparta formation (sand).

C. R. Smith, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2520. In Caddo Parish, La., formation overlies Mytis sand member (new) of Queen City formation; underlies Pleistocene(?) terrace deposits. Thickness about 14 feet.

Well exposed on Crockett Road 1½ miles southwest of Weches, Houston County, Tex.

Wedington Sandstone Member (of Fayetteville Shale)[1]

Upper Mississippian: Northern Arkansas and northeastern Oklahoma.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Prof. Paper 24, p. 27.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (columns 65, 66). Shown on correlation chart about middle of Fayetteville shale.

Named for Wedington Mountain, Washington County, Ark.

Wedowee Formation[1]

Cambrian to Carboniferous: Eastern Alabama.

Original reference: G. I. Adams, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 36, map.

G. W. Crickmay, 1936, Geol. Soc. America Bull., v. 47, no. 9, p. 1379. Here regarded as part of Carolina series, age of which is given as Precambrian.

Named for exposures at and around Wedowee, Randolph County.

Weed Patch Member[1] (of Edwardsville Formation)

Lower Mississippian: Southern Indiana.

Original reference: P. B. Stockdale, 1931, Indiana Dept. Conserv., Div. Geology Pub. 98, p. 76, 119, 189, 202, 280, 281.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 74; J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, pl. 1. Included in Allens Creek facies of formation.

Name derived from Weed Patch Hill, 3 miles southeast of Nashville, Brown County.

Weeks Limestone[1]

Middle and Upper Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 10.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1126, 1141 (fig. 5), 1147, 1166. Weeks formation, originally assigned to Middle Cambrian, contains *Cedaria?* and numerous *Tricrepicephalus* throughout thickness of more than 1,000 feet of strata and is Upper Cambrian (Dresbach) in age. Total thickness 1,940 feet (Walcott gave 1,390); hence, Upper-Middle Cambrian boundary is moved down from horizon given by Walcott. Overlies Marjum limestone (emended).

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 41, 42. Deiss (1938) placed Marjum-Weeks contact at estimated position of Middle-Upper Cambrian boundary. Therefore, as presently defined, these units are regarded invalid. Their present definition is comparable to the Cadiz formation of California and Comet shale in Nevada. Possible that part of lower Weeks may belong to Albertan series.

H. E. Wheeler and Grant Steele, 1951, Utah Geol. Soc. Guidebook 6, p. 30 (table 1), 32 (fig. 5), 34 (fig. 7), 36–37. Middle and Upper Cambrian. In this report, Weeks and Orr formations are described together because their similarity and intergradational character does not appear to justify distinction as separate formation. Total thickness 3,500 feet.

D. K. Powell, 1959, Brigham Young Univ. Research Studies, Geology Ser., v. 6, no. 1, p. 5 (chart), 12–15, geol. map. Weeks formation described and mapped in southern House Range (area of type locality for Weeks). Formation is 1,388-foot thick medium- to dark-gray fine-grained, thin- to thick-bedded argillaceous and arenaceous limestone; becomes more argillaceous toward top; color ranges from reddish brown to dark yellowish orange. Conformably overlies Marjum limestone; conformably underlies Orr formation. Complete section does not crop out in mapped area; much of unit has been intruded by Notch Peak intrusive and a large sill, or is metamorphosed. Albertan-Croxian.

U.S. Geological Survey currently designates the age of the Weeks as Middle and Upper Cambrian.

Type locality: North side Weeks Canyon, north of Orr Ridge, House Range, Millard County. Crops out on western slopes of Notch Peak, in Hansen Canyon, where it is terminated by fault, trends north to Notch Peak Canyon and continues to igneous intrusive.

Weeping Water Limestone Member (of Oread Limestone)[1]

Pennsylvanian (Virgil Series): Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

Original reference: C. S. Prosser, 1897, Jour. Geology, v. 5, p. 154–172.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 26. Thickness 6 to 10 feet in Nebraska; thins to about 3 feet northwest of Leavenworth, Kans.; may be equivalent to part of Toronto limestone of southern Kansas. Nebraska Geological Survey uses name Weeping Water limestone, and Kansas Geological Survey uses name Toronto.

Type locality: West side North Branch Weeping Water Valley, about 1 mile northwest of Nehawka, Cass County, Nebr.

Weir Formation (in Cabaniss Group)

Weir Formation or cyclothem (in Cherokee Group)

Pennsylvanian (Des Moines Series): Southeastern Kansas, southwestern Missouri, and northwestern Oklahoma.

G. E. Abernathy, 1937, Kansas Geol. Soc. Guidebook 11th Ann. Field Conf., p. 18, 20, 22; 1938, Kansas Acad. Sci. Trans., v. 41, p. 193, 195. Cherokee group is divided into 15 cyclic formational units. The Weir, sixth in sequence (ascending), occurs below the Pilot and above the Knifeton. Thickness about 36 feet. Includes a 3-foot coal bed known as Weir-Pittsburg. [For complete sequence see Cherokee group.]

W. V. Searight and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 12, p. 2748 (fig. 1). Shown on northern midcontinent composite stratigraphic section as Weir formation in Cabaniss group. Underlies Tebo formation; overlies Seville formation of Krebs group.

C. C. Branson, 1954, Oklahoma Geol. Survey Guide Book 2, p. 6. Listed as coal cycle in Boggy formation, in Oklahoma.

W. B. Howe, 1956, Kansas Geol. Survey Bull. 123, p. 22 (fig. 5), 46–48. Formation in Cabaniss subgroup of Cherokee group. In Kansas, includes only Weir-Pittsburg coal and its underclay. Thickness averages about 12 feet in Cherokee and Crawford Counties.

Name derived from Weir-Pittsburg coal which is named for towns of Weir, Cherokee County, and Pittsburg, Crawford County, Kans.

Weisburg Member (of Whitewater Formation)

Ordovician (Richmond): Southwestern Ohio.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110, 114, chart facing p. 108. Listed on page 110 as member of Whitewater; sequence (ascending) is Weisburg, Saluda, and Oxford. Stratigraphic chart and page 114 shows Whitewater sequence (ascending) as Lower Whitewater, Saluda, and Upper Whitewater.

Type locality and derivation of name not given.

Weisner Quartzite[1] or Formation[1]

Lower Cambrian: Northern central and northeastern Alabama and northwestern Georgia.

Original reference: E. A. Smith, 1890, Alabama Geol. Survey Rept. Cahaba coal field, p. 149.

T. L. Kesler, U.S. Geol. Survey Prof. Paper 224, p. 8–10, 30–33, pl. 1. Described in Cartersville district in Georgia where it consists principally of finely micaceous quartzite and, less commonly, beds of metaconglomerate, metasiltstone, and crystalline carbonate rocks; beds do not occur in any uniform stratigraphic order and are exposed in a belt of parallel ridges that trend northward through middle of district. Base of section not exposed, but thickness is more than 1,000 feet, probably more than 2,000 feet. As mapped, includes Pinelog conglomerate. Conformably underlies Shady formation.

Named for fact it forms Weisner Mountain, Cherokee County, Ala.

Weissport Member (of Tully Formation)

Upper Devonian: East-central Pennsylvania.

R. E. Stevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 30, 31, 32. Basal member of formation in Lehighton area. Consists of thin-bedded sandy shale. Thickness about 40 feet. Underlies Brodhead Creek member (new); overlies Moscow formation.

Type section: Roadcut 1.1 miles north of Weissport, Carbon County.

Weitchpec Schists[1]

Paleozoic or older: Northwestern California.

Original reference: O. H. Hershey, 1904, Am. Geologist, v. 33, p. 357.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, pt. 4, p. 686. Age given as Paleozoic or older.

Probably named for exposures near Weitchpec, Humboldt County.

Welch Formation (in Pottsville Group)[1]

Lower Pennsylvanian: Southern West Virginia and southwestern Virginia.

Original reference: M. R. Campbell, 1897, U.S. Geol. Survey Geol. Atlas, Folio 44.

Named for exposures at Welch, McDowell County, W. Va.

Welch Sandstone (in New River Group)

Welch Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and R. M. Gawthrop, 1915, West Virginia Geol. Survey Rept. Wyoming and McDowell Counties, p. 198.

P. H. Price and E. T. Heck, 1939, West Virginia Geol. Survey Greenbrier County, p. 216, 234. Commonly grayish white, medium to coarse grained, and lenticular. Thickness 20 to 45 feet. Occurs below unnamed shale; overlies unnamed shale above Welch coal. Apparently coalesces with Upper Raleigh sandstone. Included in New River group, Pottsville series.

Exposed at Welch, McDowell County.

Welcome Formation

Welcome Member (of Kreyenhagen Formation)

Eocene, upper: Central California.

Martin Van Couvering and H. B. Allen, 1943, California Div. Mines Bull. 118, pt. 3, p. 496–500. Siltstone and claystone 1,200 feet thick. Underlies Wagonwheel formation; overlies Point of Rocks formation.

H. P. Smith, 1956, California Univ. Pub. Geol. Sci., v. 32, no. 2, p. 67, 68 (fig. 2), geol. map. Rank reduced to member of Kreyenhagen formation. Map shows age as Eocene; stratigraphic column shows Eocene or Oligocene.

Occurs in Devils Den oil field district in northwestern Kern County, adjacent to Kings County line, about 40 miles from Paso Robles and about 60 miles northwest of Bakersfield.

Welden Limestone[1]

Mississippian: Central southern Oklahoma.

Original reference: C. L. Cooper, 1931, Oklahoma Geol. Survey Bull. 55, map.

C. L. Cooper, 1939, Jour. Paleontology, v. 13, no. 4, p. 381–382. Buff to blue-gray massive argillaceous limestone. Maximum thickness (type locality) 2 feet. Underlies Caney shale; overlies Bushberg-Hannibal strata. Lower Mississippian. Type locality designated.

M. K. Elias, 1956, *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma—a symposium, v. 1: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 70 (table 2). In northern Arbuckles underlies Ahlosa member (new) of Caney shale.

Type locality: In railroad cut in sec. 27 , T. 3 N., R. 6 E., a few miles east of Ada, Pontotoc County. Name derived from Welden Creek which crosses outcrop in same section. Outcrops are some 20 miles in length.

Weldonian Stage

Late Cretaceous: California.

P. P. Goudkoff, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 7, p. 960 (table 1), 989–991, 1006. One of six stages, based on foraminiferal assemblages, in Upper Cretaceous column between top of Moreno and base of Panoche, as defined by Anderson and Pack (1915). Surface equivalents are Joaquin Ridge sandstone in Alcalde Hills section. the Forbes, Guinda, and upper part of Funks formation in Putah Creek section, as classified by Kirby (1942). Includes interval between Tracian stage (new), above, and Cachenian stage (new).

Occurs in Great Valley in both surface and subsurface. Exposed along west side of San Joaquin Valley. Well represented in outcrops along Weldon Canyon.

Welge Sandstone Member (of Wilberns Formation)

Upper Cambrian: Central Texas.

Frederick Romberg and V. E. Barnes, 1944, Geophysics, v. 9, no. 1, p. 88, fig. 7 (geol. map). Brown sandstone that grades upward into Morgan Creek limestone member; overlies Lion Mountain sandstone member of Cap Mountain formation. Contact sharp. Name credited to Josiah Bridge and V. E. Barnes.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 114, pls. 1, 2, 4 (fig. 5). Brown mostly nonglauconitic sandstone. Average thickness 18 feet; at type locality 27 feet; thicker sections are along northern and western sides of Llano uplift. Overlies Lion Mountain sandstone here considered member of Riley formation; contact abrupt.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 155, 187, 225, 253, 310, [1946]. Local stratigraphy described.

Type section: Along Squaw Creek one-half mile north of Gillespie County line. Named from Welge land surveys between Threadgill and Squaw Creeks. Extends throughout Llano uplift.

Wellborn Sandstone[1] (in Jackson Group)

Eocene, upper: South-central Texas.

Original reference: W. Kennedy, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 39, 45.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2627–2628. In south-central Texas, Wellborn sandstone is considered a formation undivided, and is persistent unit chiefly of sandstone. Overlies Caddell formation; underlies McElroy formation (redefined). Ellisor (1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11) applied name Wellborn sands to a member of McElroy formation, overlain by Manning beds and overlying, in east Texas, Wooleys Bluff clays, which she considered basal member of McElroy formation. West of Angelina County, she considered that the Wellborn overlaps Wooleys Bluff and lies directly on the Caddell. Renick (1936, Texas Univ. Bull. 3619) divided Wellborn into three members: Carlos sandstone at top; middle Wellborn, consisting of clay and soft lignitic sandstone; and Bedias sandstone at base. Exposures of Renick's members can be seen in vicinity of Wellborn. These exposures may be considered type locality.

Type locality (Eargle): In vicinity of Wellborn, about 7 miles south-southeast of College Station, Brazos County. On cuesta, one-fourth

mile southeast of crossroads at Wellborn, contact of lower 4 feet of Carlos sandstone with brown clay of Renick's middle Wellborn is exposed in roadcuts in front of cemetery; 1¼ miles north of crossroad, cuts on road to College Station expose 5 feet of gray tuffaceous clayey siltstone of middle member grading down into 6 feet of gray silty very fine grained thin-bedded sandstone of Renick's Bedias sandstone; about 250 yards farther north basal 5 feet of Bedias sandstone, containing prints of pelecypods in lower 2 feet, lies on clay of Caddell formation.

Weller Sandstone[1] or horizon[1]

Miocene(?): Northwestern Colorado.

Original reference: O. A. Peterson, 1928, Carnegie Mus. Mem., v. 11, no. 2, p. 90–94.

Exposed at northern flanks of Douglas Mountain, on Weller Ranch, near Gray Stone post office, Moffat County.

Wellersburg Clay (in Conemaugh Formation)[1]

Pennsylvanian: Pennsylvania.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 65, 114, pl. 6.

Named for association with Wellersburg coal, which was named for occurrence at Wellersburg, Somerset County.

Wellersburg Limestone (in Conemaugh Formation[1] or Group)

Pennsylvanian: Southern Pennsylvania and western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, p. 65, 114, pl. 6.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4). Wellersburg limestone shown on generalized columnar section for Pennsylvanian of western Pennsylvania. Occurs above Barton (Elk Lick) coal and below Wellersburg coal. Conemaugh group.

Named for association with Wellersburg coal which was named for occurrence at Wellersburg, Somerset County, Pa.

Wellesley Formation[1]

Mississippian: Eastern Alaska.

Original reference: A. H. Brooks, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 470–472, 479, 483.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Composes Wellesley Mountain between Tanana and White Rivers.

Wellington Formation (in Sumner Group)[1]

Permian: Central and southern Kansas and northern Oklahoma.

Original reference: F. W. Cragin, 1885, Washburn Coll. Lab. Nat. History Bull., v. 1, no. 3, p. 85–86; Kansas City Review, 8, p. 678–682.

W. A. Ver Wiebe, 1937, Wichita Municipal Univ. Bull., v. 12, no. 5, p. 3–17. Subdivided to include (ascending) Pearl shale, Hollenberg limestone, Geuda Springs shale (new), Annelly gypsum (new), Chisholm Creek shale (new), Carlton limestone, Highland shale (new), Slate Creek limestone (new), and Afton limestone (new) members.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1755–1758, 1762–1763 (fig. 2), 1764–1765 (fig. 3). Includes Milan lime-

stone member (new) at top. Underlies Ninnescah shale (new); Big Blue series.

G. O. Raasch, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 2, pt. 2, p. 1928. Wellington in Oklahoma is limited to north-central section of State; southward it passes into Stillwater redbed complex. Thickness 820 feet. Subdivided into basal sequence, 18 feet; anhydrite sequence, 190 feet; Otoe redbed member (new), 115 feet; Midco (lacustrine) member (new), 255 feet; Billings member (new), 52 feet; Antelope Flats member (new), 195 feet. Upper 372 feet is continuously exposed and includes many key beds. Overlies Herington limestone; underlies Garber redbed complex.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 40–41. Basal formation of Sumner group. Thickness about 700 feet. Includes Milan limestone member at top; Hutchinson salt member in middle part but not exposed; Carlton limestone member below Hutchinson; Hollenburg limestone member near base. Underlies Ninnescah shale; overlies Herington limestone member of Nolans limestone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, includes Fallis sandstone member in upper part.

Named for exposures at Wellington, Sumner County, Kans.

†Wells Chert[1]

Lower Ordovician (Beekmantown): North-central Tennessee.

Original reference: E. O. Ulrich, 1911, Geol. Soc. America Bull., v. 22, no. 3, p. 671, pl. 27.

E. O. Ulrich and G. A. Cooper, 1938, Geol. Soc. America Spec. Paper 13, p. 26. Upper Canadian (approximately Cotter).

In Wells Creek basin, Stewart and Houston Counties.

Wells Formation[1]

Pennsylvanian and Permian: Eastern Idaho, Montana, northeastern Utah, and southwestern Wyoming.

Original reference: R. W. Richards and G. R. Mansfield, 1912, Jour. Geology, v. 20, p. 683, 684, 689–693.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 24–25, pl. 6. Described in Randolph quadrangle, Utah-Wyoming, where it is about 1,000 feet thick; overlies Brazer limestone and underlies Phosphoria formation. Pennsylvanian.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12, p. 2842. In southeastern Idaho and western Wyoming, upper siliceous limestone of Wells formation as used by Mansfield (1927, U.S. Geol. Survey Prof. Paper 153) is designated as lower tongue of Park City formation; the name Wells is thus restricted to underlying sandstones, redbeds, and carbonate rocks of Pennsylvanian age.

E. R. Cressman, 1957, U.S. Geol. Survey Mineral Inv. Field Studies Map MF–118. Mapped in Snowdrift Mountain quadrangle, Caribou County, Idaho, where it overlies Brazer limestone and underlies Phosphoria formation. Consists of upper member, 1,000 to 1,300 feet thick, that contains 100-foot-thick cherty limestone tongue of Park City formation and lower member approximately 500 feet thick.

V. E. McKelvey and others, 1959, U.S. Geol. Survey Prof. Paper 313–A, p. 15, 36 (footnote). Name Wells formation is retained for rocks in

western Wyoming, eastern Idaho, and northern Utah, but is restricted to carbonate rock sandstone, sandstone, and red beds that lie below upper carbonate rock beds that are reassigned to newly named Grandeur member of Park City formation. Pennsylvanian and Permian.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Suggested that Oquirrh formation be raised to group status and carried into Wells formation area and that the Wells be dropped or retained as formation within group.

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (chart). In Sublett Mountains, comprises (ascending) Calder Creek, Heglar Canyon, Sublett, and Indian Fork members (all new). Occurs above Milligen formation and below Grandeur member of Park City. Pennsylvanian-Permian (Springeran-Leonardian).

Name derived from Wells Canyon, in T. 10 S., R. 45 E., Bannock County, Idaho.

†Wells Limestone[1]

Middle Ordovician (Lowville) : North-central Tennessee.

Original reference: A. F. Foerste, 1903, Jour. Geology, v. 11, p. 557, 705.

Named for Wells Creek Basin, Stewart and Houston Counties.

Wellsburg Sandstone Member (of Chemung Formation)[1]

Wellsburg Formation (in Chemung Group)

Upper Devonian: Central and west-central New York and northeastern Pennsylvania.

Original references: H. S. Williams, 1906, Science, new ser., v. 24, p. 365–372; 1907, Am. Assoc. Adv. Sci. Proc., v. 56, p. 265–267.

Bradford Willard, 1939, *in* Bradford Willard, F. M. Swartz, and A. B. Cleaves, Pennsylvania Geol. Survey, 4th ser., Bull. G–19, p. 15 (table 4), 247. Chemung group in south-central New York and adjacent Pennsylvania consists of Cayuta formation and Wellsburg formation. Wellsburg consists of thin-bedded sandstone and shale to flaggy sandstone and coquinite lenses. Fall Creek conglomerate locally at top.

Named for outcrop at Wellsburg, Chemung County, N.Y.

Wells Creek Dolomite

Wells Creek Limestone[1]

Lower Ordovician: Central Tennessee and southwestern Kentucky.

Original reference: R. G. Lusk, 1927, Am. Assoc. Petroleum Geologists Bull., v. 11, no. 9, p. 908.

Ray Bentall and J. B. Collins, 1945, Tennessee Div. Geology Oil and Gas Inv. Prelim. Chart 4, sheet 1. Wells Creek dolomite is here applied to 432 feet of tan to gray-green silty to sandy argillaceous fine-grained dolomite interbedded with dark-brown to tan dense limestone occurring below Murfreesboro limestone and above rocks of Beekmantown age in Ada Belle Oil Co., Hillman No. 2–A (21–E–18E), Trigg County, Ky. Dolomite thins toward the south and east, is erratic in occurrence in easternmost part of area, and in places is absent. Where 30 to 70 feet thick it is very argillaceous silty and sandy fine-grained dolomite interbedded with thin green shales. These rocks are here considered to be Chazy(?), in age. Name was originally used by Lusk to designate about 350 feet of rocks in this stratigraphic position and said by him

to be exposed only in Wells Creek basin in southeastern Stewart County, Tenn.

First mentioned in Stewart and Houston Counties, Tenn.

Wellsville Formation (in Chadakoin Group)

Wellsville Formation (in Conneaut Group)

Wellsville Member (of Chadakoin Formation)

Upper Devonian: Southwestern New York.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 31–33. Consists of thin sandstones or siltstone, ½ to 3 inches thick, interbedded with shales, for the greater part argillaceous but sometimes arenaceous; commonly olive green and gray. Thickness about 200 feet. Basal formation of Conneaut group; underlies Hinsdale formation; overlies Cuba formation.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 18. Rank reduced to member status in Chadakoin formation. Underlies Hinsdale member; overlies Cuba member of Canadaway formation.

L. V. Rickard, 1957, New York State Geol. Assoc. [Guidebook] 29th Ann. Mtg., p. 17 (table 2), 19. A formation in Chadakoin group. Inasmuch as Upper Devonian strata are still not thoroughly understood a more or less permanent classification satisfactory to a majority of workers may not be obtained for some time.

Well exposed near town of Wellsville but also present in nearly every locality of Wellsville quadrangle, Allegany County. [Tesmer and Rickard state that type locality is near Wellsville.]

Wemir Agglomerate

Miocene: Panamá Canal Zone.

[T. F. Thompson], 1943, Panama Canal Spec. Eng. Div., 3d Locks Proj., pt. 2, chap. 5, p. 37, figs. 5–54. Agglomerate is finer in texture than typical basaltic agglomerates in Pacific area; well bedded, with strata ranging from a few inches to several feet in thickness; commonly contains beds of soft shale of soapy fine-grained texture; contains water-sorted fragments and is believed to be phase of more massive land-laid deposits commonly present elsewhere. Age not stated.

W. P. Woodring, 1960, *in* R. Hoffstetter and others, Lexique Strat. Internat., v. 5, Amérique Latine, fasc. 2a, p. 349. Now included in Pedro Miguel agglomerate member of Panamá formation. Miocene.

Occurs in West Miraflores Hill area.

Wenas Basalt[1] Member (of Yakima Basalt)

Pliocene, lower: Central Washington.

Original reference: G. O. Smith, 1903, U.S. Geol. Survey Prof. Paper 19; 1903, U.S. Geol. Survey Geol. Atlas, Folio 86.

R. C. Treasher, 1937, Geol. Soc. Oregon Country News Letter, v. 3, no. 20, p. 218–220. Underlies Snipes conglomerates (new).

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 671, 673, pl. 1. Described in Yakima East quadrangle as basalt flow interstratified in Ellensburg formation. Basalt is about 100 feet thick where it enters quadrangle, but thins rapidly to the east and ends about halfway across

the quadrangle. Where lower sediments of Ellensburg are cut out, the Wenas basalt rests directly on Yakima flows; stratigraphically below Selah Butte flow (new). Map shows basalt flows in the Ellensburg as Miocene and Pliocene.

Type locality: Valley of Wenas Creek, Ellensburg region.

Wendell Grade Basalt[1]

Recent: Southern Idaho.

Original references: H. T. Stearns, 1932, Correlation chart of Idaho, compiled by M. G. Wilmarth, dated Sept. 1, 1932; 1936, Jour. Geology, v. 44, no. 4, p. 434.

H. T. Stearns, Lynn Crandall, and W. G. Steward, 1938, U.S. Geol. Survey Water-Supply Paper 774, p. 29 (table), 84, pl. 4. Overlies Malad basalt and Hagerman lake beds. Thickness about 25 feet.

U.S. Geological Survey currently designates the age of the Wendell Grade Basalt as Recent on the basis of a study now in progress.

Type locality: Wendell grade in road in Gooding County, from which it takes its name. Northwest of town of Wendell.

Wendover Group

Pennsylvanian: Eastern Wyoming, northeastern Colorado, and southwestern South Dakota.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 2 (fig. 2), 3, 5, 22 (fig. 7), 23–24, 28 (fig. 10), 30, 45. Consists of limestones interbedded with sandstones, mudstones, and shales. At the base is a sandstone which probably marks an unconformity. Comprises upper part of Division II of Hartville "formation" (Condra and Reed, 1935, Nebraska Geol. Survey Paper 9). Thickness 104 feet. Underlies Broom Creek beds (new); overlies Meek group (new).

Type locality: Platte River valley in vicinity of Wendover, Platte County, Wyo.

Weno Clay or **Limestone** (in Washita Group)

Weno Clay Member (of Denison Formation)[1]

Weno Limestone Member (of Georgetown Limestone)

Weno Marly Limestone Member (of Denison Formation)

Lower Cretaceous (Comanche Series): Northeastern and central Texas and central southern Oklahoma.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 121, 247, 269–280.

R. W. Imlay, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 3. Chart shows Weno limestone in Washita group. Occurs below Pawpaw formation and above Denton clay. [Denison formation abandoned.] Lower Cretaceous.

D. L. Frizzell, 1954, Texas Univ. Bur. Econ. Geology Rept. Inv. 22, p. 27–28, table 4. Foraminifera of Weno formation described.

W. J. Fox and O. N. Hopkins, Jr., 1960, Baylor Geol. Soc. Guidebook 5th Field Trip, p. 88, 92. In central Texas, considered member of Georgetown limestone. Overlies Denton shale member; underlies Pawpaw shale member. Thickness 40 feet in McLennan County.

B. F. Perkins, 1960, Geol. Soc. America Mem. 83, p. 9 (fig. 3), 12 (fig. 4), 31 (fig. 12), 32, 33 (fig. 13). Referred to as Weno marly limestone

member of Denison formation. In Fort Worth area, consists largely of gray marl with several thick limestone beds in its uppermost and lowermost parts. Thickness about 50 feet. Overlies Denton marl member; underlies Pawpaw shale member.

Named for Weno, Grayson County, Tex.

†Weno Subgroup[1] (of Denison Beds)

Lower Cretaceous (Comanche Series): Northeastern Texas.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 121, 247, 269–280.

Named for Weno, Grayson County.

Wenonah Formation (in Matawan Group)

Wenonah Member (of Matawan Formation)

Wenonah Sand (in Matawan Group)[1]

Upper Cretaceous: New Jersey and Delaware.

Original reference: G. N. Knapp, as reported by R. D. Salisbury, 1899, New Jersey Geol. Survey Ann. Rept. State Geologist, 1898, p. 35, 36.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 32–36. Member of Matawan which is here reduced to formational rank. Conformably overlies Marshalltown member and underlies Mount Laurel member, both contacts conformable. Marine in origin and consists of fine micaceous sparingly glauconitic sand locally laminated with thin layers of clay. Thickness about 40 feet in Monmouth County, but thins to the south where it cannot be differentiated from overlying Mount Laurel. Can be followed in outcrop from Atlantic Highlands into Delaware where it is exposed in cuts of Chesapeake and Delaware Canal.

J. J. Groot, 1954, Delaware Geol. Survey Bull. 3, p. 25–26. Considered of formational rank in Matawan group. Where exposed in Chesapeake and Delaware Canal conformably overlies Merchantville and is gradational into it.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184, B185. Formation in Matawan group. Overlies Marshalltown formation; underlies Mount Laurel sand of Monmouth group. Average dip SE. 35 feet per mile.

Named for occurrence at Wenonah, Gloucester County, N.J.

Wepo Formation (in Mesaverde Group)

Upper Cretaceous: Northeastern Arizona.

G. A. Kiersch, 1955, Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2: Tuscon, Ariz., Univ. Arizona Press, p. 4 (fig. 1). Includes widespread coal beds. Subdivided into lower, middle, and upper members. Overlies Toreva formation (new); underlies Yale Point sandstone (new). Name credited to Repenning and Page.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 271, 277–279. Comprises thick series of intercalated siltstone, mudstone, sandstone, and coal. Siltstone and mudstone units vary from dark olive gray through light olive brown to medium light gray. Carbonaceous in many places, and contains sandy zones and sandstone lenses throughout area. Commonly thin and flat bedded. Above Wepo Wash at type section are 142 feet of cliff-forming

Toreva formation and 656 feet of slope- and ledge-forming Wepo formation, including upper tongue of Toreva, which occupies interval from 67 to 134 feet above base of Wepo. Thins northeast across Black Mesa as result of tonguing in that direction into underlying Toreva formation and into overlying Yale Point sandstone. Thickness of entire formation observable only in northern half of area, where formation ranges in thickness from 743 feet east of Cow Springs to 318 feet near Rough Rock. Type section, therefore, represents nearly maximum thickness of formation, if thickness of upper tongue of Toreva formation is included.

Type section: Seven miles northeast of town of Pinon on west side of Wepo Wash where entire Mesaverde group of Black Mesa is exposed. Wepo Wash is an ephemeral stream that runs in southwesterly direction across central part of Black Mesa and joins Polacca Wash between First and Second Mesas in Hopi villages area.

Werner Formation

Jurassic(?): Subsurface in southern Arkansas, northern Louisiana, and eastern Texas.

R. T. Hazzard, W. C. Spooner, and B. W. Blanpied, [1947], Shreveport Geol. Soc. 1945 Ref. Rept., v. 2, p. 483, 484, 486–487. In type well, consists of an anhydrite member 57 feet thick overlying a red bed and conglomerate member 55 feet thick. Total thickness of red bed member is as much as 110 feet. In type well, the conglomerate is in contact with folded Paleozoic rocks. In some wells, the Werner is in contact with Morehouse formation; in other wells it is inferred that the Werner is in contact with the Eagle Mills. Appears to be conformable with overlying Louann salt. Term "Louann tongue," as formerly used, is synonymous with Werner formation of this report. Permian.

F. M. Swain, 1949, Am. Assoc. Petroleum Geologists Bull., v. 33, no. 7, p. 1207. Eagle Mills of this report includes (ascending) Werner formation, Louann salt, and Norphlet formation of Hazzard, Spooner, and Blanpied, who believe that type Eagle Mills is older than their Werner. Eagle Mills, including the salt, is assigned to Upper Jurassic; if the salt is Permian, an explanation of how it escaped extensive solution throughout Triassic time should be provided.

E. D. McKee and others, 1956, U.S. Geol. Survey Misc. Geol. Inv. Map I–175. Age shown as Jurassic. Position of lower boundary of Jurassic system is believed by some geologists to be above Louann and Werner formations, but by others to be beneath them, at top of Eagle Mills (restricted). Because Louann and Werner formations consist of unfossiliferous deposits of salt, anhydrite, and red beds, and because these formations have not been penetrated very far downdip, problem remains controversial. Base of Jurassic system is herein assumed to be at contact of Werner and Eagle Mills (restricted) formations.

Type well: Gulf Refining Co.'s No. 49 L Werner Saw Mill Co. well located in Louann district, Union County, Ark.

Weskan Shale Member (of Pierre Shale)[1]

Upper Cretaceous: Northwestern Kansas.

Original reference: M. K. Elias, 1931, Kansas Univ. Bull., v. 32, no. 7.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 23. Consists of gray clayey shale; bentonite beds in lower part. Thickness 170

feet. Overlies Sharon Springs shale member; underlies Lake Creek shale member.

Type locality: Five miles north of town of Weskan, Wallace County.

Weskeag Quartzite Member (of Rockland Formation)[1]

Cambrian or Ordovician: South-central Maine.

Original reference: E. S. Bastin, 1908, U.S. Geol. Survey Geol. Atlas, Folio 158, p. 3–4.

H. W. Allen, 1951, Maine State Geologist Rept., 1949–1950, p. 79–80. Sequence of metamorphosed sedimentary rocks in Rockland quadrangle, Knox County, is (ascending) Isleboro formation, containing Coombs limestone member at top; Battie quartzite; Penobscot formation; and Rockland formation consisting of Weskeag quartzite member at base, siliceous limestone member above the quartzite, and Rockport limestone member at top.

Named for exposures on Weskeag River, Knox County.

Wesley Formation (in Jackfork Group)

Upper Mississippian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 857, 886–889. Proposed for uppermost formation in group. Consists of massive siliceous shale 100 to 500 feet thick. Underlies Union Valley sandstone; overlies Markham Mill formation (new); along Choctaw fault zone, shale of Wesley age is in normal contact with Caney shale of Chester age. Wesley shale is a correlative of most of the shale heretofore called "Pennsylvanian Caney," which in Arbuckle Mountains occurs between Union Valley sandstone and Chester Caney shale, and in Ardmore basin occurs between Rod Club sandstone and Chester Caney shale. Since this shale attains great thickness in Ardmore basin and is important lithologic and paleontologic unit of widespread distribution in Midcontinent, the name Wesley shale is proposed for it. Pushmataha series.

B. H. Harlton, 1959, *in* The geology of the Ouachita Mountains, a symposium: Dallas, Tex., Dallas Geol. Soc. and Ardmore Geol. Soc., p. 131 (fig. 1), 135. Underlies Game Refuge formation (new); overlies Markham Mill formation.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 43 (table 3), 55–57, pls. Described in Ouachita Mountains. Late Mississippian.

Type locality: Southwest of village of Wesley in E½SE¼NW¼ sec. 20, T. 1 N., R. 13 E., Atoka County.

Wesson Tongue (of Dorcheat Member of Schuler Formation)

Upper Jurassic: Subsurface in southern Arkansas, northern Louisiana, and eastern Texas.

F. M. Swain, 1944, Am. Assoc. Petroleum Geologists Bull., v. 28, no. 5, p. 608–609. Dark-gray glauconitic fossiliferous shale near top of nearshore facies of Dorcheat member. Occurs between depths of 5,710 feet and 5,872 feet in type well.

Type well: Standard Oil Co. of Louisiana's D. A. Zimmerman No. 1, SE¼ SE¼ sec. 29, T. 18 S., R. 16 W., Union County, Ark.; Wildcat, Wesson area.

West Arm Formation (in Deese Group)

Pennsylvanian (Des Moines Series): Central southern Oklahoma.

C. W. Tomlinson and William McBee, Jr.. 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 33. West Arm formation comprises upper part of Deese group. Includes Williams member at base and Natsy member near middle. Also includes upper members of Warren Ranch conglomerate facies (new). Name credited to B. H. Harlton (in preparation).

B. H. Harlton, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 2, p. 213 (fig. 3), 220–221. Thickness approximately 900 feet. Includes Natsy member about 450 feet below top and Williams member at base. Underlies Confederate limestone of Hoxbar group. Type locality stated. Subsurface relationships discussed.

Type locality: West Arm of Lake Murray along west branch of Anadarche Creek, southeast of Ardmore, secs. 9, 16, 17, and 21, T. 5 S., R. 2 E., Carter County.

West Baden[1] Group

Mississippian, Chester Series): Indiana, Illinois, and Kentucky.

Original reference: E. R. Cumings, 1922, Indiana Dept. Conserv., Pub. 21, pt. 4, p. 514 (footnote).

H. H. Gray, R. D. Jenkins, and R. M. Weidman, 1960, Indiana Geol. Survey Bull. 20, p. 36 (table 5), 44–48, pl. 1. Cumings (1922) suggested West Baden as group name to include (ascending) formations now known as Paoli limestone, Bethel formation, Beaver Bend limestone, Sample formation, Reelsville limestone, Elwren formation, and Beech Creek limestone. Name had little usage. Proposed here to revive Cuming's name West Baden and redefine it as comprising (ascending) Bethel formation, Beaver Bend limestone, Sample formation, Reelsville limestone, and Elwren formation. Thickness 105 to 135 feet. Overlies Blue River group (new); underlies Stephensport group (redefined).

Named for town of West Baden, Orange County, Ind.

West Bath Slate[1]

Pre-Silurian: Northwest New Hampshire.

Original reference: M. Billings, 1933, Am. Jour. Sci., 5th, v. 25, no. 146, p. 149.

In Littleton and Moosilauke quadrangles, Ammonoosuc River region. Village of West Bath is in Woodsville quadrangle.

Westboro Quartzite[1] (in Blackstone Series)

Precambrian(?): Eastern Massachusetts and northern Rhode Island.

Original reference: B. K. Emerson and J. H. Perry, 1903, Geology of Worcester, map.

Alonzo Quinn, R. G. Ray, and W. L. Seymour, 1948, *in* Alonzo Quinn and others, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 3, p. 10–11, geol. map; A. W. Quinn, R. G. Ray, and W. L. Seymour, 1949, Bedrock geology of the Pawtucket quadrangle, Rhode Island-Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–1]. Described in Pawtucket quadrangle, Rhode Island-Massachusetts, as light-buff to white massive quartzite, locally with thin beds of quartz-mica schist. Also includes Albion schist member. Thickness 1,000 to 3,000 feet. Underlies Sneech Pond schist (new) with gradational contact; overlies Mussey

Brook schist (new). Assigned to Blackstone series of Precambrian(?) age.

Named for town of Westboro, Worcester County, Mass.

West Branch Shale Member (of Janesville Shale)

West Branch Shale[1] (in Admire Shale or Group)

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 74, 82, 89, 111, 113.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273, 2274 (fig. 1). Reallocated to member status in Janesville shale (new). Underlies Five Point limestone member; overlies Falls City limestone. Wolfcamp series.

M. R. Mudge and H. R. Burton, 1959, U.S. Geol. Survey Bull. 1068, p. 14 (table 2), 48–49. Thickness about 27 feet in Wabaunsee County, Kans. Underlies Five Point limestone member; overlies Falls City limestone.

Named for exposures in West Branch Township, Pawnee County, Nebr.

Westbrook Granite[1]

Pre-Carboniferous(?): Southwestern Maine.

Original reference: F. J. Katz, 1917, U.S. Geol. Survey Prof. Paper, 108, p. 175.

Named for exposures in Westbrook Township, Cumberland County.

West Brook Member[1] (of Tully Formation)

Middle Devonian: Central New York.

Original reference: G. A. Cooper and J. S. Williams, 1935, Geol. Soc. America Bull., v. 46, p. 790–813.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53. no. 12, pt. 1, p. 1787–1788, chart 4. Seems best to regard Tully as Middle Devonian, and to make a stage, the Taghanic, to include it and its correlates and overlying Geneseo.

R. E. Etevenson and W. S. Skinner, 1949, Pennsylvania Acad. Sci. Proc., v. 23, p. 29–33. Type Tully section consists of following members: Tinkers Falls, Apulia, and West Brook.

Type locality: On West Brook, 3 miles south of Sherburne, Chenango County.

West Canyon Limestone Member (of Oquirrh Formation)

Pennsylvanian: Northern Utah.

P. W. Nygreen, 1958, Utah Geol. and Mineralog. Survey Bull. 61, p. 13–14. Proposed for basal limestone part of formation. Chiefly bioclastic limestones with some interbedded sandstone or siltstone and lesser amounts of chert. Limestones are calcarenites and calcilutites, medium blue gray, thin to thick bedded, and blocky to slabby weathering. Many limestone units cherty or silicified. Some units reflect conditions of probably cyclic sedimentation. Sandstones are quartzose, very fine grained, silty, calcareous cement, and olive brown. Thickness 1,456 feet in type section; 510 feet in Sardine Canyon section, near Logan. Conformably(?) underlies "sandy" part of formation and conformably(?) overlies Manning Canyon formation.

Type section: On divide between Threemile Canyon and Fourmile Canyon, tributaries to drainage of West Canyon. in E½ sec. 23, W½ sec. 24, T. 5 S., R. 3 W., Utah County. Named for excellent exposures along northeast side of West Canyon 6 to 9 miles north of Cedar Fort, Utah, and northwest of town along base of ridge.

West Castleton Formation or Group.

Lower Cambrian: Eastern New York and west-central Vermont.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 2. Consists largely of gray siltstone and black fissile slate, with rare beds of quartzite, pebble conglomerate, and rusty-weathering dolostone; near base of unit is black limestone, Beebe limestone, which is massive but discontinuous. Overlies Castleton member (new) of Bull formation; major unconformity probably separates West Castleton from Poultney River group (new). This conclusion is based on overlap relations as well as gaps in the stratigraphy. Thickness not determined; entire sequence has undergone intense deformation. Formation was called Hooker by Keith (1932), Schodack by Ruedemann (1914), Kaiser (1945) and Fowler (1950).

George Theokritoff, 1959, New England Intercollegiate Geol. Soc. Guidebook 51st Ann. Mtg., p. 53, 55. Described in Washington County, N.Y., where it overlies Mettawee slate member of Bull formation and locally Bomoseen grit member, and underlies Hatch Hill formation (new).

J. G. Elam, 1960, Dissert. Abs., v. 21, no. 6, p. 1523–1524. Discussion of Troy South and East Greenbush quadrangles, New York. Stratigraphic section subdivided into four groups and previously described dominant formational names have been elevated to group status. Groups are Bull (Lower Cambrian), West Castleton (upper Lower Cambrian-Upper Cambrian), Poultney (Lower Ordovician), and Normanskill (Middle Ordovician).

Westchester Gneisses and Granites[1]

Precambrian: Southeastern New York and northern New Jersey.

Original reference: F. J. H. Merrill, 1901, Geologic map of New York.

Probably named for Westchester County, N.Y.

West Cove Member (of Little Sitkin Dacite)

Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 182–183, pl. 23. Consists of two aa flows (crater flow and cove flow). Rocks of both flows are black glassy dacite containing abundant small plagioclase phenocrysts and shown by analyses to be low in silica for dacite. Flows nearly contemporaneous and were extruded about 50 years ago. Cove flow overlies Williwaw Cove formation (new); crater flow overlies low-silica dacite of Little Sitkin dacite.

Type locality: Along coast on north side of West Cove, Little Sitkin Island, in Rat Island group of Aleutian Islands. Crater flow on south slope of Little Sitkin volcano; cove flow at West cove.

West Dummerston Granite[1]

Devonian: Southeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table opposite p. 288.

Quarried at village of West Dummerston, Dummerston Township, Brattleboro quadrangle, Windham County.

West Elk Breccia[1]

Miocene(?): Western central Colorado.

Original reference: W. Cross, 1894, U.S. Geol. Survey Geol. Atlas, Folio 9.

Forms West Elk Mountains and extends south to Gunnison River, in Anthracite-Crested Butte region.

West End Rhyolite[1]

Tertiary: Central Nevada.

Original references: J. E. Spurr, 1911, Min. and Sci. Press, v. 102, p. 560–561; 1911, Report on geology of property of Montana-Tonopah Mining Co., Tonopah, Nev., published privately; 1915, Econ. Geology, v. 10, p. 713–769.

Well exposed in Tonopah Extension and West End mines, Tonopah district.

Westerly Granite[1]

Pennsylvanian or younger: Southwestern Rhode Island and southeastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 136, 152, 154.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic.

G. E. Moore, Jr., 1959, U.S. Geol. Survey Geol. Quad. Map GQ–117. Described and mapped in Carolina and Quonochontaug quadrangles. Intrudes Blackstone series, Hope Valley alaskite gneiss, and Narragansett Pier granite. Lead-alpha age determinations of zircon and monazite from Westerly are 243 and 220 million years. Map bracket shows Pennsylvanian or younger.

Quarried at Westerly, R.I.

Western Cascade series

Eocene to Miocene: California and Oregon.

Eugene Callaghan, 1933, Am. Geophysical Union Trans., p. 243–249. Discussion of volcanic sequence in Cascade Range in Oregon. Cascade Range south of Mount Hood is divided into two parts, Western Cascades and High Cascades on basis of pronounced unconformity in stratigraphic sequence of lavas. Older series [Western Cascades] is divided into two groups on basis of dominant rock-type and associated structural features. One of these is characterized by black lavas with associated red agglomerates, tuffs, and rhyolites; the other of irregular flows of dominantly andesitic lavas with rhyolite and abundant andesitic and rhyolitic pyroclastic rocks in most places. The black lavas occur in two separate areas along western margin of range—one in southern Oregon in Rogue River valley area and the other along Willamette Valley. In southern Oregon, they rest upon an arkosic formation of Eocene age. Along Willamette Valley, they rest upon Oligocene. Gray andesitic series occupies remainder of Western Cascades from Rogue River north toward the Columbia. In vicinity of Rogue River, they appear to interfinger with the black lavas and farther north they are stratigraphically higher.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 20–32, pls. 1, 2. Most of Macdoel quadrangle is occupied by volcanic materials. These belong to two series, first Western Cascade series, ranging in age from Eocene to Miocene, and second, High Cascade series of Pliocene, Pleistocene, and Recent age. Older series covers most of western half of quadrangle and consists mainly of andesitic lavas, with subordinate flows of basalt and dacite, beds of rhyolite tuff, and a few domical protrusions of rhyolitic lava. At close of the Miocene, this older series was gently tilted to east and northeast and was cut by faults that border long narrow horsts trending slightly west of north. At the same time, ancestral Cascade Range was formed by regional uplift. Subsequently, a north-trending chain of volcanoes was built along crest of range; their products form High Cascade series. Width of the belt of Western Cascade series in Oregon ranges generally from 30 to 40 miles. Southward the belt becomes narrower. Along California-Oregon line, width is about 24 miles; 18 miles in southern part of Macdoel quadrangle; 3 miles south of Weed. Belt comes to end owing to overlap by lavas discharged from Mount Shasta. In Oregon, Western Cascade series corresponds with Clarno, John Day, Columbia River basalt, Mascall, and Payette formations; in northeastern California, part of series is equivalent to Cedarville beds of Warner Range. Because of overlap by flows of High Cascade volcanoes, Western Cascade series is nowhere exposed in full thickness. About 12,000 to 15,000 feet along Oregon-California boundary; about 10,000 feet in latitude of Yreka.

Westerville Limestone Member (of Cherryvale Formation)

Pennsylvanian: Western Maryland, western Pennsylvania, and western West Virginia.

Original reference: I. C. White, 1882, The Virginias, v. 3, p. 141–143.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, 4th ser., Bull. C–26, p. 73, fig. 21. In Fayette County, Westernport sandstone lies between Upper and Lower Kittanning coals; commonly divided into two parts by Johnstown limestone and Middle Kittanning coal; in vicinity of Normalville and Whites Bridge, the parts coalesce and cut out intervening limestone and coal. Thickness 30 to 60 feet. Included in Allegheny group.

Forms cliffs along Potomac west of Westernport, Allegany County, Md.

Westerville Limestone Member (of Cherryvale Formation)

Westerville Limestone (in Kansas City Group)

Westerville Limestone Member (of Kansas City Formation)[1]

Westerville Limestone Member (of Sarpy Formation)

Pennsylvanian (Missouri Series): Southwestern Iowa, northeastern Kansas, northwestern Missouri, and southeastern Nebraska.

Original reference: H. F. Bain, 1898, Am. Jour. Sci., 4th, v. 5. p. 437–439.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 45 (fig. 8), 100–101. Westerville limestone included in Kansas City group. Underlies Quivira shale; overlies Wea shale.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2030, 2031 (fig. 4). Rank reduced to member status in Cherryvale formation. Underlies Quivira shale member; overlies Wea shale member. This is classification agreed upon by State Geological Surveys of

Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947. Clair (1943, Missouri Geol. Survey and Water Resources, 3d ser., v. 27) included the Westerville in Cherryvale shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 37–38. In Nebraska classified as uppermost member of Sarpy formation (new). Overlies Wea shale member.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 421. In section near Winterset, Iowa, Westerville member of Cherryvale is about 62 feet thick; underlies Quivira shale member; overlies Wea-Fontana shale members.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 26, fig. 5. Formation in Kansas City group. Thickness about 2 feet in Madison County; 10 feet in Pottawattamie County. Underlies Quivira shale; overlies Cherryvale shale.

Named for exposures at Westerville, Decatur County, Iowa.

West Fairview Member (of Martinsburg Shale)

Ordovician: South-central Pennsylvania.

Bradford Willard and A. B. Cleaves, 1938, Pennsylvania Geol. Survey, 4th ser., Bull. G–8, p. 5, 6. Name proposed for principal body of massive usually weak sandstone with calcareous cement in Martinsburg shale in Harrisburg area.

Named for village of West Fairview, Cumberland County, near which unit forms prominent hill.

West Falls Formation

Upper Devonian: Western and west-central New York.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Includes all rocks between top of Cashaqua shale and base of Pipe Creek shale member of Hanover shale. Thickness 415 feet in western Erie County and at type exposure; thickens eastward; 925 feet in Letchworth Park along western boundary of Livingston County and 1,170 feet in eastern Steuben County. Comprises (ascending) Rhinestreet shale, Hatch shale, Grimes siltstone, Gardeau shale, West Hill, and Nunda sandstone members; all members not present in every area. In Naples-Hammondsport area, underlies Wiscoy sandstone. Rocks of formation comprise thin wedge of Upper Devonian deltaic deposits of black mud, gray mud, and silt.

Wallace de Witt, Jr., 1956, U.S. Geol. Survey Geol. Quad. Map GQ–97. Described in Eden quadrangle where it is about 415 feet thick and composed of two members: Rhinestreet shale below and Angola shale above. Overlies Cashaqua shale and underlies Pipe Creek member of Hanover shale.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1933, 1935 (fig. 2). Underlies Pipe Creek shale reallocated to member status in Java formation (new).

Type exposure: Along Cazenovia Creek in vicinity of West Falls and East Aurora, central Erie County.

Westfield phase (of Otis Limestone)[1]

Middle Devonian: Central eastern Iowa.

Original reference: W. H. Norton, 1921, Iowa Geol. Survey, v. 27, p. 377.

Occurs at Westfield Bridge at Fayette, Fayette County and southeast of Waverly, Bremer County.

Westfield Serpentine[1]

Ordovician: Western Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 92.

Crops out in western edge of Westfield, Hampden County.

Westfield Shale[1] (in Canadaway Group)

Westfield Shale Member (of Canadaway Formation)

Upper Devonian: Western New York.

Original reference: G. H. Chadwick, 1923, Geol. Soc. America Bull., v. 34, p. 69.

I. H. Tesmer, 1954, Hobbies, v. 35, no. 2, p. 30, 32; 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 18. Member of Canadaway formation. Overlies Laona siltstone member; underlies Shumla siltstone member. Thickness 120 to 150 feet.

Probably named for exposures at or near Westfield, Chautauqua County.

Westford Schist

Precambrian: Northwestern Vermont.

E. C. Jacobs, [1937], Vermont State Geologist 20th Rept., p. 57, 117–118. Gray fine-grained thinly foliated schist. Interbedded with metamorphic rocks of Green Mountain series.

E. C. Jacobs, [1939], Vermont State Geologist 21st Rept., p. 33–35. Age designated. Derivation of name given; exposures described.

Named for occurrence in Westford Township, Chittenden County. Exposures include those in Lamoille River Gorge at Fairfax Falls and small gorge of Browns River in Jericho where eastern border of outcrop area is exposed.

West Fork Formation[1]

Upper Devonian or Mississippian: Northern Alaska.

Original reference: F. C. Schrader, 1900, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 475.

Crosses Chandalar River valley in belt 15 miles wide from below Granite Creek to above West Fork of Chandalar River, in Wiseman-Chandalar region.

West Franklin Limestone[1]

West Franklin Limestone Member (of Modesto Formation)

Upper Pennsylvanian: Southwestern Indiana and southern Illinois.

Original references: Leo Lesquereux, 1862, *in* Rept. of Geol. Reconn. of Indiana, p. 294, 297; J. Collett, 1884, Indiana Dept. Geology and Nat. History 13th Ann. Rept., p. 61–62.

C. A. Malott, 1947, Indiana Acad. Sci. Proc., v. 57, p. 126 (fig. 1), 128. In Dicksburg Hills area, where only upper part of formation is exposed, underlies Ditney formation.

C. E. Wier, 1951, U.S. Geol. Survey Coal Inv. Map C–9. In Greene and Sullivan Counties, underlies Shelburn formation (restricted).

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 49 (table 1). Member of Modesto formation (new) in southeastern

Illinois. Complex member which may include Piasa limestone, DeGraff, Pond Creek, and Lake Creek coal members in part of area. Type locality noted.

Type locality: South-central part sec. 24, T. 7 S.,R. 12 W., Posey County, Ind. Named for exposures at West Franklin.

West Gull jasper facies (of Ogishke Conglomerate)

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1034, 1035. Characterized (at type locality) by closely spaced red jasper pebbles and cobbles. Thickness about 1,700 feet. Underlies Zeta Lake conglomerate or granite porphyry facies; overlies Peebles granite facies.

Type locality: On West Gull Lake, a few miles northeast of Ogishkemuncie Lake, in Vermilion district.

Westheimer Member (of Hoxbar Formation)[1]

Pennsylvanian: Central southern Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 15.

Well exposed on property of Westheimer & Daube, in NW¼SE¼ sec. 7, T. 6 S., R. 2 E, and about 200 yards east of asphalt prospect belonging to that firm, in Carter County.

West Hill Member (of West Falls Formation)

West Hill Formation[1]

Upper Devonian: West-central New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Handb. 19, p. 23.

J. F. Pepper, Wallace de Witt, Jr., and G. W. Colton, 1956, U.S. Geol. Survey Oil and Gas Inv. Map OC–55. Name West Hill flags proposed by Clarke (1903) and applied by Clarke and Luther (1904 New York State Mus. Bull. 63) to sequence of siltstones and shales overlying the Grimes and underlying the Nunda in vicinity of West Hill. Measured sections for present report show that in Naples area rocks for 300 to 400 feet above Grimes member are similar in lithology to upper part of Gardeau member in Genesee Gorge. Therefore, these rocks in Naples area are herein included in Gardeau. West Hill member of West Falls formation (new) as used in this report applies only to those rocks higher in stratigraphic column that show noticeable increase in siltstone content. As used here, West Hill member consists of a series of rocks intermediate in lithology between Gardeau shale member and Nunda sandstone member. Consists mainly of gray siltstone and silty gray shale and at some places includes small amounts of petroliferous dark-gray shale and grayish-black slightly silty shale and a few layers of calcareous nodules; in southeastern part of mapped area, silty gray mudrock makes up much of member. Thickness 35 feet, northwestern Wyoming County; 240 feet northeastern Steuben County. Basal and upper contacts arbitrarily drawn. In western Wyoming County, West Hill intertongues with Gardeau member and uppermost siltstone bed is overlain by thin tongue of Gardeau.

Named for West Hill, Ontario County.

West Index Andesitic Series[1]

Eocene or Miocene: Central Washington.

Original reference: C. E. Weaver, 1912, Washington Geol. Survey Bull. 7, p. 34–50.

Named for Mount West Index, Snohomish County.

West Jefferson Sandstone[1]

Middle Devonian: Central Ohio.

Original reference: E. Orton, 1888, Ohio Geol. Survey, v. 6, p. 4, 21.

Named for West Jefferson, Madison County.

West Ledge Formation[1]

Precambrian: Southwestern South Dakota.

Original reference: J. O. Hosted and L. B. Wright, 1923, Eng. Mining Jour-Press., v. 115, p. 793–799, 836–843, maps.

Occurs in Lead district, Lawrence County. Derivation of name not stated.

West Mead limestone member[1]

Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 132, table facing p. 61.

Named for West Mead Township, Crawford County, where it is well developed.

West Minesota Conglomerate[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: S. H. Broughton, 1863, Remarks on the mining interest and details of the geology of Ontonagon County, 24 p., map, Philadelphia, 1863; p. 21, map.

Named for occurrence on property of West Minesota Mining Co., in Ontonagon County.

West Molokai Volcanic Series

Pliocene(?): Molokai Island, Hawaii.

H. T. Stearns, 1946, Hawaii Div. Hydrography Bull. 8, p. 69 (table), 71; H. T. Stearns and G. A. Macdonald, 1947, Hawaii Div. Hydrography Bull. 11, p. 23–25, table facing p. 16; G. A. Macdonald and D. A. Davis *in* Jacques Avias and others, 1956, Lexique Strat. Internat., v. 6, Océanie, fasc. 2, p. 146. Thin-bedded aa and pahoehoe basalt flows, associated cinder cones; some intercalated vitric tuff. Thickness 1,381 feet; base not exposed. Separated from overlying East Molokai volcanic series (new) by erosional unconformity.

Type locality: West Molokai Mountain (Mouna Loa). Cover an area of 120 square miles, comprising most of mountain.

Westmore Formation (in Barre Group)

Silurian or Lower Devonian: Northeastern Vermont.

C. G. Doll, 1951, Vermont Geol. Survey Bull. 3, p. 15, 33–37. Chiefly light- to medium-gray phyllites interbedded with smaller amounts of light-gray to black schists and limestone and quartzites; all are generally fine to medium grained. Thickness about 4,300 feet. Overlies Barton River formation (new).

V. R. Murthy, 1958, Jour. Geology, v. 66, no. 3, p. 276–287. Formation crops out in southeastern corner of Barre quadrangle and northwestern

corner of East Barre quadrangle in belt 1¾ to 2 miles wide. These rocks have been mapped as Waits River formation (Currier and Jahns, 1941) and as Gile Mountain(?) formation by White and Jahns (1950, Jour. Geology, v. 58, no. 3). Thickness 3,700 to 5,100 feet. Overlies Barton River formation; underlies Waits River (redefined). Included in Barre group (new).

Type locality: Section exposed in whetstone quarry 1¼ miles due north of Lake Willoughby in southeastern Brownington. Other exposures directly north and south of village of Margan; in pasture one-half mile west-southwest of Echo Pond; and in cuts along State highway leading from West Charleston to Island Pond. Named from village of Westmore on Lake Willoughby in southeastern corner of Memphremagog quadrangle.

Westmoreland Member (of Clinton Formation)

Middle Silurian: New York.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 90, 93–94. Name Westmoreland (iron ore) is introduced as designation for oolitic iron ore of Smyth [1892, Am. Jour. Sci., 3d, v. 43] and Newland and Hartnagel (1908, New York State Mus. Bull. 123). Overlies Sauquoit beds; underlies Willowvale shale (new). Thickness about 18 inches at type locality.

Type locality: On tributary of Oriskany Creek about one-half mile east of hamlet of Lairdsville in town of Westmoreland, Oneida County.

Westmoreland Shale (in Chattanooga Shale)

Lower Mississippian: Central Tennessee.

Guy Campbell, 1946, Geol. Soc. America Bull., v. 57, no. 9, p. 885, pl. 1.

Hard fissile black shale, indistinguishable in lithology from the Gassaway (new); contains scattered nodules at Westmoreland. Thickness 6 to 12 inches. Distinguishable as distinct bed in the Chattanooga only by its position above the Eulie shale (new). Underlies New Providence shale. Eulie and Westmoreland shales are complementary in their stratigraphic relations; absence of either would make determination of the status of the other very difficult.

W. H. Hass, 1956, U.S. Geol. Survey Prof. Paper 286, p. 11. Westmoreland shale is grayish-black shale which locally contains phosphatic nodules. Name Westmoreland shale not used in present report [Chattanooga shale and Maury formation]; beds so named by Campbell are placed in Maury formation and not named.

Type section: Two Hundred yards north of Garritt's Creek Church, north of Westmoreland, Sumner County.

Weston Limestone[1]

Pennsylvanian: Northwestern Missouri.

Original reference: J. A. Gallaher, 1898, Missouri Bur. Geology and Mines Bienn. Rept., p. 52.

Named for exposures at Weston, Platte County.

Weston Sandstone (in Monongahela Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 124.

Occurs along Town Run, at southeast edge of village of Weston, Lewis County.

Weston Shale (in Monongahela Formation)[1]

Pennsylvanian: Northern West Virginia.

Original reference: D. B. Reger, 1916, West Virginia Geol. Survey Rept. Lewis and Gilmer Counties, p. 128.

Exposed in vicinity of Weston, Lewis County.

Weston Shale (in Pedee Group)

Weston Shale or Shale Member (in Douglas Formation or Group)[1]

Weston Shale (in Lansing Group)

Pennsylvanian (Missouri Series): Northwestern Missouri, southwestern Iowa, eastern Kansas, and northeastern Oklahoma.

Original reference: C. R. Keyes, 1899, Am. Geologist, v. 23, p. 306.

H. S. McQueen and F. C. Greene, 1938, Missouri Geol. Survey and Water Resources, v. 25, 2d ser., p. 28. Included in Pedee group in Missouri.

L. W. Wood, 1941, Iowa Geol. Survey, v. 37, p. 284 (table), 295. Weston and Iatan formations included in Lansing group. Term Pedee dropped from Iowa nomenclature.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Chart shows Weston shale in Ochelata group in Oklahoma.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 31. Thickness in Missouri and Kansas about 80 feet and 88 feet in northern Oklahoma. Missing in Nebraska due to post-Missourian erosion which extended into top of Lansing group.

Named for Weston, Platte County, Mo.

Westphalia Limestone[1] Member (of Stranger Formation)

Pennsylvanian (Virgil Series): Eastern Kansas.

Original reference: R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 145, 146, 150.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 73. Characterized by abundant fusulines. Thickness ranges from featheredge to about 5 feet. Underlies Vinland shale member; overlies Tonganoxie sandstone member.

Named for village in western part of Anderson County. Typical outcrops are in roadside exposures along northern part of sec. 12, T. 21 S., R. 17 E., and at NE cor. sec. 20, T. 21 S., R. 18 E., not definitely recognized in outcrops north of T. 19 S.

West Point facies (of Muldraugh Formation)

Lower Mississippian: Northern Kentucky and southern Indiana.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 75, 202–210. Northwesternmost facies of formation within Kentucky outcrop belt. It is an impure limestone phase most of which extends but a short distance in Indiana, as far as middle of T. 5 S., southeastern Harrison County, where it includes the two divisions which have been differentiated as Edwardsville and Lower Harrodsburg. Thickness as much as 95 feet. Thickness at type section 95 feet; here facies overlies Floyds Knob formation(?) and underlies Harrodsburg limestone.

Type section: At quarry, one-eighth mile southeast of Louisville and Henderson Railroad station at West Point, Hardin County, Ky.

†West Point Member[1] (of Warsaw Formation)

Mississippian: Western Kentucky.

Original reference: A. H. Sutton, 1931, Kentucky Geol. Survey, ser. 6, v. 37, p. 281.

J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 801. Cherty Edwardsville limestone in Jefferson and adjacent counties, Kentucky, has generally been referred to Warsaw formation and name West Point member has been proposed for it, but it has not been distinguished as a separate unit of the section farther south. Although name West Point has priority, it is abandoned in favor of Edwardsville because of the much clearer stratigraphic relations of the latter in Indiana.

Derivation of name not stated, but there is a village called West Point in Hardin County.

West Prong Lentil (in Grayson Shale)

Lower Cretaceous: Southwestern Texas.

Robert Greenwood, 1956, Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 168 (fig. 2), 169. Yellowish-brown poorly indurated argillaceous limestone with thin clay partings. Estimated thickness 50 feet. Overlies Georgetown limestone, apparent conformity.

Type locality: At intersection of West Prong Fork (a local name not shown on quadrangle map) with West Nueces River, Uvalde County.

West Prospect Basalt[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932, California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, p. 214–376, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 686. Cenozoic.

Occurs in Lassen National Park.

West Range Limestone[1]

Upper Devonian: Eastern Nevada.

Original references: L. G. Westgate and A. Knopf, 1927, Am. Inst. Mining Metall. Engineers Trans., no. 1647, p. 7; 1932, U.S. Geol. Survey Prof. Paper 171, p. 7, 16, map.

R. L. Langenheim, Jr., 1960, Illinois Acad. Sci. Trans., v. 53, nos. 3 and 4, p. 122–131. Discussion of Pilot shale, West Range limestone, and Devonian-Mississippian boundary in eastern Nevada. Thickness of West Range 296 feet at type section where it overlies Silverhorn dolomite and underlies 32 feet of calcareous siltstone or silty limestone assigned to lower Pilot shale.

Composes, together with underlying Silverhorn limestone, the whole of West Range, which lies west of Bristol Range, Pioche district.

West Ridge Group

Age unknown: Southern California.

K. J. Hsu, 1955, California Univ. Dept. Geol. Sci. Bull., v. 30, no. 4, p. 275–278, geol. map. Hypersthene amphibolites and almandine-diopside rocks. Occurs in narrow lenticular zone between Aurela Ridge granulites (new)

and East Ridge mylonites (new); contact probably transitional. Separated from East Ridge rocks by north-dipping Marjo Canyon thrust.

Exposed in Cucamonga quadrangle, San Bernardino County.

West River Shale Member (of Genesee Formation)

West River Shale (in Genesee Group)[1]

Upper Devonian: Western and central New York.

Original reference: J. M. Clarke and D. D. Luther, 1904, New York State Mus. Bull. 63, p. 28.

W. L. Grossman, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 60–66. Formation (or shale) in Genesee group. Consists of interbedded blue-black, dark-gray, and black fissile shale with abundant spherical concretions. Proposed here to include *Styliolina* limestone facies (Genundewa limestone) in the base so that lower boundary of the West River will be lowest *Styliolina* layer. Term Genundewa abandoned. Uppermost boundary is marked by Middlesex shale. The West River continues as a clearly recognizable unit from its type area at Canadaigua Lake to Lake Erie. Interval between Geneseo shale and Middlesex shale in Keuka Lake Valley is thicker than at Canandaigua Lake. Tongue of Sherburne type rock in middle of the West River causes thickening of whole sequence to 250 feet. The West River is divided into the Penn Yan tongue (new) below and the Milo tongue (new) above by penetration of Starkey tongue (new) of Sherburne formation.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2814 (fig. 3), 2815, 2819, 2822. Name West River was proposed by Clarke and Luther (1904) for sequence of dark shaly rocks lying above their Genundewa limestone and below their Standish flags and shales. The West River is herein redefined as West River shale member of Genesee formation. Upper boundary is extended to include all rocks between base of Genundewa limestone member of the Genesee and base of Sonyea formation. Standish flags and shale of Luther and Clarke are included in the West River. At reference section, herein designated, member is about 132 feet thick, and composed largely of dark-gray shale and mudrock that contain several beds of black shale, very dark gray argillaceous limestone nodules, and a few layers of dark-gray or brown siltstone as much as 2 inches thick. In vicinity of Cayuga Lake, member is composed largely of medium-dark-gray shale and mudrock and contains many layers of siltstone ranging from laminae to beds as much as 2 feet thick near Ithaca and to beds 5 feet thick at Sheldrake Creek, 18 miles northwest of Ithaca. Thickness about 150 feet near Ithaca. Highly cross-laminated ripple-marked layer of siltstone 1 to 2 inches thick is present at base of upper third of member in most exposures between Lake Erie and Canandaigua Lake. This key bed, which is present in more than 500 square miles of western and west-central New York was traced eastward to Keuka Lake where it was found to be the 3- to 4-inch Bluff Point flagstone of Torrey (1932, Am. Petroleum Inst. Div. Production Paper 826–4A), the same bed that was named Keuka flagstone by Fox (1932).

Reference section: Exposures in Seneca Point Gully on west side of Canandaigua Lake, 9 miles north on Naples, Ontario County. Named for exposures in West River valley, Yates County.

†West Roxbury Slate[1]

Devonian or Carboniferous: Eastern Massachusetts.

Original reference: W. W. Dodge, 1881–1882, Boston Soc. Nat. History Proc., v. 21, p. 208–210.

Occurs on each side of the tract near West Roxbury Station, Boston region.

West Rutland Marble[1]

Middle Ordovician: West-central Vermont.

Original reference: E. J. Foyles, 1929, Vermont State Geologist 16th Rept., p. 281–288.

Named for economic occurrences around West Rutland, Rutland County.

West Spring Formation (in Salt Lake Group)

Pliocene, lower and middle: Northeastern Utah.

Neal Smith, 1953, Intermountain Assoc. Petroleum Geologists [Guidebook] 4th Ann. Field Conf., p. 73, 75 (fig. 2). Chiefly soft earthy gray tuff and occasional pebble conglomerate; thin compact stromatolitic limestone in basal part. Thickness 1,200 feet. Overlies Collingston conglomerate (new); underlies Cache Valley formation; both contacts unconformable. Name credited to J. S. Williams (unpub. ms.).

R. D. Adamson, C. T. Hardy, and J. S. Williams, 1955, Utah Geol. Soc. Guidebook 10, p. 6. Considered to be part of Cache Valley formation.

Exposed on Hyrum Bench along southwest side of Cache Valley, about 12 miles south of Logan, Cache County.

West Spring Creek Formation[1] (in Arbuckle Group)

Lower Ordovician: Central southern Oklahoma.

Original reference: C. E. Decker, 1930, Am. Assoc. Petroleum Geologists Bull., v. 14, no. 12, p. 1495 (table 4).

C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55, 56. Uppermost formation in Arbuckle group. Overlies Alden limestone (new); underlies Joins formation of Simpson group. Upper Canadian.

C. E. Decker, 1939, Oklahoma Geol. Survey Circ. 22, p. 16 (table 1), 26–28; 1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1320–1321, table 1. Characterized chiefly by many zones of thin shaly limestones separated by thick resistant limestone beds. Thickness 1,611 feet at type section in Arbuckles; 250 feet in Wichitas. Gradationally overlies Kindblade formation (new) which replaces preoccupied name Alden. Lower Ordovician.

W. E. Ham, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2038–2039. Collings Ranch conglomerate (new) rests with marked angular unconformity on steeply dipping rocks of Arbuckle anticline. Exposed rocks beneath conglomerate are West Spring Creek formation of Arbuckle group, Joins, Oil Creek, McLish, Tulip Creek, and Bromide formations of Simpson group, and Viola limestone.

Type section: Along U.S. Highway 77 about 3 miles north of Springer, sec. 19, T. 2 S., R. 1. E., Carter County. Named for West Spring Creek at west end of Arbuckle Mountains (sec. 31, T. 2 S., R. 1 W.), where it flows across formation.

West Sutton Slate[1] or Formation

Precambrian(?) or Lower Cambrian: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1931, Geol. Soc. America Bull., v. 42, pt. 1, p. 225–226.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 143–144. Fine mud rock varying from medium and dark gray to dark blue black. Hematite characteristically present either as discrete masses or disseminated. Contains gritty beds at type locality which is cited. Thickness generally 40 to 250 feet. Underlies Gilman quartzite; overlies White Brook dolomite.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1147, 1148. Extended to Vermont where it is known as West Sutton formation because of lithologic variations.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Precambrian(?).

Type locality: One-half mile northwest of the West Sutton four corners, Sutton quadrangle, Quebec.

West Union Formation[1]

Silurian (Niagaran): Southwestern Ohio.

Original reference: E. Orton, 1871, Ohio Geol. Survey Rept. Prog. 1870, p. 271, 274, 301, fig. 1.

Alwyn Williams, 1953, Geol. Soc. America Mem. 56, p. 62. West Union formation mentioned in list of fossil localities.

Named for exposures at West Union, Adams County.

West Union Gravel

Pleistocene: Central Minnesota.

Kirk Bryan, Henry Retzek, and F. T. McCann, 1938, Texas Archeol. Paleont. Soc. Bull. 10, p. 125. Name applied to gravel in which skeleton of Sauk Valley man was discovered. Gravel is 5 to 6 feet thick and well stratified; coarse and rubbly at base and containing pebbles 2 to 4 inches in diameter; grades to finer material toward top. At south end of gravel pit, gravel rests on yellow clayey till which is more than 5 feet thick; till thins northward to featheredge and rests on slightly deformed gray gravel; the West Union rests unconformably on both of these materials. Underlies black loam about 1 foot thick.

Occurs in gravel pit on land of Daniel W. Fraser, Lot 1 of NE¼ sec. 11, T. 127 N., R. 35 W., West Union Township, Todd County.

Westville Shale[1]

Pennsylvanian: Southeastern Massachusetts.

Original reference: J. B. Woodworth, 1899, U.S. Geol. Survey Mon. 33, p. 134.

Westwater Gneisses and Schists[1]

Precambrian: Western Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 39, 281.

Exposed in bed of Grand River at Utah-Colorado line. Derivation of name not stated.

Westwater Sandstone Member (of Morrison Formation)

See **Westwater Canyon Sandstone Member** (of Morrison Formation).

Westwater Canyon Sandstone Member (of Morrison Formation)[1]

Upper Jurassic: Southeastern Utah, northeastern Arizona, southwestern Colorado, and northwestern New Mexico.

Original reference: H. E. Gregory, 1938, U.S. Geol. Survey Prof. Paper 188, p. 59, pl. 15.

J. W. Harshbarger, C. A. Repenning, and R. L. Jackson, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 98. Geographically extended into Arizona and New Mexico. About 155 feet thick at Kayenta, Ariz.; decreases in thickness to the south and not present in Hopi Buttes area; pinchout due to pre-Dakota erosion.

L. C. Craig and others, 1955, U.S. Geol. Survey Bull. 1009–E, p. 153–155. Westwater Canyon constitutes lower unit of upper part of Morrison in southern part of region of this study [Colorado Plateau]. Unit was formed as large alluvial fan. To the north, Westwater Canyon intertongues with and grades into lower part of Brushy Basin member along a limit of recognition that passes just south of Monticello, Utah. In most of northwestern New Mexico and a small part of northeastern Arizona, upper part of Brushy Basin member overlies Westwater Canyon, but to the southwest, post-Morrison erosion has removed Brushy Basin, and the Westwater Canyon is only part of upper part of Morrison preserved. Arbitrarily divided into two facies: conglomeratic sandstone facies and sandstone facies. Maximum thickness 330 feet, 30 miles northeast of Gallup.

V. L. Freeman and L. S. Hilpert, 1956, U.S. Geol. Survey Bull. 1030–J, p. 309, 314, 315 (fig. 60), 324, 326, 330, 333. In Laguna area, New Mexico, Recapture, Westwater Canyon, and most of Brushy Basin members are present in stratigraphic interval previously considered as Recapture. Sandstone, previously considered as Westwater Canyon, is at top of Brushy Basin and is informally called Jackpile ore-bearing bed. Westwater Canyon in Gallup-Albuquerque area ranges from about 50 to 190 feet in thickness; locally absent near Laguna. In general, thickens from Laguna area westward toward Gallup and northward toward San Ysidro.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 53–55, strat. sections. Gregory suggested that Westwater Canyon member might be correlative with Salt Wash member, but, in view of regional relationships presented by Stokes (1944 Geol. Soc. America Bull., v. 55, no. 8), the Salt Wash appears to be correlative with basal part of Gregory's Recapture. In this report [Navajo country], name Westwater Canyon is applied to cliff-forming sandstone of the Morrison lying below variegated shale of Brushy Basin member and above Recapture member. No positive evidence found to indicate that Westwater Canyon intertongues with Cow Springs sandstone as do underlying Recapture and Salt Wash; however, such a relationship between the Westwater Canyon and Cow Springs appears to exist in exposures between Todilto Park and Lupton. Where Brushy Basin has been removed by pre-Dakota erosion, Westwater Canyon unconformably underlies Dakota sandstone. Thicknesses: 155 feet south of Kayenta; 239 feet at Yale Point; 227 feet at Todilto Park; 127 feet at Thoreau, N. Mex.

R. T. Zitting and others, 1957, The Mines Magazine, v. 47, no. 3, p. 55, 57. In Ambrosia Lake area, McKinley County, N. Mex., includes Poison Canyon sandstone (new) at top.

Named for exposures in canyon of Westwater Creek near Blanding, San Juan County, Utah.

Wetmore conglomerate member[1] (of Knapp formational suite)

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

Original reference: K. E. Caster, 1934, Bulls. Am. Paleontology, v. 21, no. 71, p. 61, 111–112, table facing p. 61.

Occurs only in McKean, northern Forest, northern Elk, and eastern Warren Counties, Pa., and in typical Knapp area, in vicinity of Knapp Creek, N.Y. Named for exposures along face of the hills between Wetmore and Ludlow, McKean County, Pa.

Wetumka Shale[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Central Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 30–32. Described in Okfuskee County where it is 120 to 148 feet thick. Conformably overlies Calvin sandstone; conformably underlies Wewoka formation. Marmaton group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, extends northeastward from Pontotoc County through Hughes, Okfuskee, Okmulgee, and Tulsa Counties to near Arkansas River. Marmaton group.

Named for exposures at or near Wetumka, Hughes County.

Weverton Quartzite or Formation (in Chilhowee Group)

Weverton Sandstone[1]

Lower Cambrian(?): Maryland, southeastern Pennsylvania, Virginia, and West Virginia.

Original reference: A. Keith, 1893, as reported by G. H. Williams and W. B. Clark in Maryland, its resources, industries, and institutions, chap. 3, p. 68.

A. J. Stose and G. W. Stose, 1946, Maryland Dept. Geology, Mines and Water Resources Carroll and Frederick Counties [Rept. 12], p. 34–39. Weverton quartzite described in Carroll and Frederick Counties, where it is about 500 feet thick. Overlies Loudoun formation; underlies Harpers phyllite. Lower Cambrian.

P. B. King, 1950, U.S. Geol. Survey Prof. Paper 230, p. 15 (fig. 5), 17–19, pl. 1. Formation described in Elkton area, Virginia, where it is included in Chilhowee group. Divided into three members: lower, conglomerate and coarse-grained feldspathic quartzite; middle, persistent body of argillaceous shale; upper, contains numerous beds of quartzite, many of which are dark and ferruginous, between are layers of thin-bedded siltstone and fine-grained gray sandstone. Thickness 1,000 to 1,600 feet. In some areas, Loudoun formation pinches out and Weverton lies directly in injection complex. Conformably underlies Harpers formation. Lower Cambrian.

D. M. Scotford, 1951, Geol. Soc. America Bull., v. 62, no. 1, p. 48–49. Discussion of Sugarloaf Mountain area, Maryland. Quartzites on Sugarloaf Mountain were considered Lower Cambrian and therefore Weverton by early workers such as J. P. Lesley, G. H. Williamson, and C. R. Keyes. Jonas and Stose (1938, Geologic map of Frederick County) mapped these rocks as Sugarloaf Mountain quartzites and assigned them to probable Lower Cambrian age. Writer [Scotford] believes these rocks are equivalent to Lower Cambrian Weverton quartzite because Sugarloaf Mountain is an anticline rather than a syncline as reported by Stose and Stose (1946). Stratigraphic sequence is therefore reverse of that previously described and corresponds to known Cambrian sequence in South Mountain uplift. Underlies Harpers phyllite.

A. J. Stose and G. W. Stose, 1951, Geol. Soc. America Bull., v. 62, no. 6, p. 697–699. Discussion of article by Scotford (1951) in which he interpreted Sugarloaf Mountain area as anticlinal. Arguments are presented to uphold interpretation that area is synclinal.

J. C. Whitaker, 1955, Geol. Soc. America Bull., v. 66, no. 4, p. 442–445, pl. 1. Discussion of geology of Catoctin Mountain. Results of study indicate that area is not a syncline as previously interpreted, but a tightly folded eastward-dipping sequence which forms upper and eastern limb of South Mountain anticlinorium. Strata previously mapped as Loudon along eastern border of Catoctin Mountain constitute a zone including upper Weverton quartzite and basal Harpers phyllite. Weverton as herein interpreted forms complex unit of clastic which vary along strike over limited geographic area. Rock types are: banded quartzite, thin-bedded quartzite, laminated micaceous quartzite, interbedded quartzite and phyllite, ferruginous quartzite, crossbedded quartzite, ledge-maker quartzite, and ferruginous quartz conglomerate. Overlies Loudoun formation; underlies Harpers phyllite.

W. B. Brent, 1960, Virginia Div. Mineral Resources Bull. 76, p. 18. Formation, in Rockingham County, crops out on northwest slopes of Blue Ridge. Overlies Loudoun formation; underlies Hampton formation. Term Hampton used in preference to Harpers in this report.

Named for exposures at Weverton, Washington County, Md.

Wewe Slate[1]

Precambrian: Northwestern Michigan.

Original reference: C. R. Van Hise and W. S. Bayley, 1895, U.S. Geol. Survey 15th Ann. Rept., p. 530.

S. A. Tyler and others, 1940, Geol. Soc. America Bull., v. 51, no. 10, p. 1436 (table 1), 1461. Palmer gneiss, previously considered pre-Huronian, consists of metamorphic Mesnard quartzite, Kona dolomite, Wewe slate, and Ajibik quartzite. Table 1 shows lower Huronian sequence in Marquette area (ascending) Mesnard, Kona, and Wewe. Palmer gneiss is not listed on this table.

Typical development on Wewe Hills, west of Goose Lake, Marquette district.

Wewoka Formation[1] (in Marmaton Group)

Pennsylvanian (Des Moines Series): Central Oklahoma.

Original reference: J. A. Taff, 1901, U.S. Geol. Survey Geol. Atlas, Folio 74.

E. R. Ries, 1954, Oklahoma Geol. Survey Bull. 71, p. 32–40. Described in Okfuskee County where it is a succession of thick shales containing interstratified friable sandstones and a few local limestones. Has composite thickness ranging from 780 feet in southern part of county to 730 feet along northern boundary. Conformably overlies Wetumka formation and conformably underlies Holdenville shale. Marmaton group.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. As mapped, extends northeastward from east-central part of Pontotoc County, through Hughes, Okfuskee, Okmulgee, and Tulsa Counties to Arkansas River. Marmaton group.

Named for Wewoka Creek, Seminole and Hughes Counties.

Weybridge Member (of Chipman Formation)

Weybridge Member (of Beldens Formation)

Lower Ordovician: West-central Vermont.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 524, 550–552. Limestone with sandy streaks which weather into raised ridges and are more granular and darker than the intervening blue limestone. Sedimentary channels, some filled with fossil fragments, and crossbedding common. Current ripple marks present. Maximum thickness about 500 feet. Underlies and overlies undifferentiated parts of Beldens formation.

Marshall Kay, 1950, (abs.) Geol. Soc. America Bull., v. 61, no. 12, pt. 2, p. 1476. Quartz-silty facies of Beldens in Middlebury synclinorium. *Goniotelus* and *Syntrophia* support late Canadian age.

W. M. Cady and E-an Zen(1960, Am. Jour. Sci., v. 258, no. 10, p. 728–739. A real distribution and structural and stratigraphic relations of the Beldens, Burchards, and Weybridge indicate that these members are lithofacies in Chipman formation. Sequence varies; in some areas, the Weybridge is at or near the bottom of formation; in other areas, either the Beldens or the Burchards is at the bottom and they are succeeded to west and upward stratigraphically by the Weybridge; in other areas, the Weybridge is succeeded by both the Burchards and the Beldens lithofacies. Lower Ordovician.

Typically exposed at "Weybridge Upper Falls," 1 mile east-northeast of Weybridge village, now locally known as Huntington Falls, Addison County.

Weymouth Formation[1]

Lower Cambrian: Eastern Massachusetts.

Original reference: Laurence LaForge, 1909, Science, new ser., v. 29, p. 945–946.

B. F. Howell and others, 1944, Geol. Soc. America Bull., v. 55, no. 8, chart 1. Shown on correlation chart above Hoppin formation.

Exposed north and east of Mill Cove at Weymouth, Norfolk County, and at Nahant, Essex County.

Weyquosque Formation[1]

Pleistocene: Southeastern Massachusetts and Rhode Island.

Original reference: J. B. Woodworth and Edwards Wigglesworth, 1934, Harvard Coll. Mus. Comp. Zoology Mem., v. 52.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1715, chart 12. Pleistocene (Kansan).

Named for exposures at east end of Nashaquitsa Cliffs on south shore of Marthas Vineyard, Mass., at locality known as Weyquosque.

†Weyquosque Series[1]

Pleistocene: Southeastern Massachusetts.

Original reference: N. S. Shaler, 1888, U.S Geol. Survey 7th Ann. Rept., p. 303–363, maps.

Well exposed in western part of Chilmark or Weyquosque Cliffs, Marthas Vineyard.

Whaleback Basalts

Recent: Northern California.

Howel Williams, 1949, California Div. Mines Bull. 151, p. 42, pl. 3. Name appears on explanation of geologic sections. Text discusses basalt flows that make up cone of Whaleback volcano.

Whaleback volcano is largest of Recent volcanoes in Macdoel quadrangle.

Whalen Group[1]

Precambrian: Southeastern Wyoming.

Original reference: W. S. T. Smith and N. H. Darton, 1903, U.S. Geol. Survey Geol. Atlas, Folio 91.

G. E. Condra, E. C. Reed, and O. J. Scherer, 1940, Nebraska Geol. Survey Bull. 13, p. 32 (fig. 11), 36. In section measured in vicinity of Lake Guernsey, the Precambrian (Whalen group) is exposed in banks and bed of Platte River. Composed of schists, granite, and dolomite. Underlies Deadwood sandstone.

Typical occurrence along walls of Whalen Canyon, Hartville uplift.

Wharncliffe Sandstone (in Pottsville Group)[1]

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 222.

Named for town in Mingo County.

Whately Bed[1]

Pre-Triassic: Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 190, 193.

Crops out beneath the sands of the valley in Whately, Old Hampshire County.

Wheatland Formation

Eocene, upper, or Oligocene, lower: Northern California.

B. L. Clark and C. A. Anderson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 326–327. Fossiliferous conglomerate, sandstone, and silty shales. Thickness about 300 feet. Upper Eocene.

B. L. Clark and C. A. Anderson, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 932–938, 942–945. Overlies greenstone of Sierra Nevada basement complex. Exact measurement of thickness impossible because of disconnected exposures and because dip varies both in amount and direction. Upper Eocene or lower Oligocene. Type section designated.

Type section: Six miles northeast of Wheatland at east margin of Sacramento Valley, Yuba County.

Wheatland Formation

Pleistocene, upper: Eastern New Mexico.

Sheldon Judson, 1950, Geol. Soc. America Bull., v. 61, no. 3, p. 263. Fine sand, gravel, and silt 5 to 15 feet thick. Base 1 to 5 feet above base of arroyos.

Sheldon Judson, 1953, Smithsonian Misc. Colln., v. 121, no. 1, p. 22–23, 24 (fig. 9), 30. Name proposed for terrace sediments at San Jon site. Each terrace remnant consists of fine basal gravel, mostly fragments of concretions from Ogallala sandstone, and of sand. Sand gravel layer is 1 to 3 feet thick and overlies irregular surface cut in older formations. Highest terrace has base 20 to 25 feet above grade of streams at point nearest

head of canyon. Two lower terraces have bases at 8 to 10 feet and 1 to 5 feet above present grades. Each terrace records downcutting of streams through Sand Canyon and older formations with stabilization of grades and later slight alluviation. This episode was repeated three times before present stream grades were established. Highest terrace contains *Bison bison* bones.

Type locality: San Jon site approximately 10 miles south of town of San Jon, Quay County. Name derived from town of Wheatland, about 4½ miles south of site.

Wheeler Formation[1]

Middle Cambrian: Western Utah.

Original reference: C. D. Walcott, 1908, Smithsonian Misc. Colln., v. 53, no. 1804, p. 9, 10.

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1141 (fig. 5), 1146. Wheeler (emended) consists of dull-sooty-black, fine-grained, hard, platy, and rarely, fissile calcareous shale, which weathers pale gray and contains numerous intercalated argillaceous and finely arenaceous limestones which increase slightly in amount upward; about 85 feet below top is 2- to 4-foot zone of black thin-bedded fine-grained limestone which weathers bright orange tan. Fossiliferous. Thickness 350 feet. Overlies Swasey limestone (emended); underlies Marjum limestone (emended).

Type locality: Center of Wheeler Amphitheater, southeast of Antelope Springs, House Range, Millard County. Emended section measured south of Marjum Canyon, 10 miles southwest of Wheeler Amphitheater.

Wheeler Formation (in Cabaniss Group)

Pennsylvanian (Desmoinesian): Southwestern Missouri.

W. V. Searight *in* W. B. Howe and W. V. Searight, 1953, Missouri Geol. Survey and Water Resources Rept. Inv. 14, pl. 1. Name appears on generalized stratigraphic section. Underlies Bevier formation; overlies Verdigris formation. Contains Wheeler coal at top.

Exposed in northeastern Carroll and southeastern Livingston Counties.

Wheeler limestone

See **Pioche Shale.**

Wheeler Sandstone or Sandstone Member (of Juncal Formation)

Eocene, middle: Southern California.

T. L. Bailey, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 11, p. 1920 (fig. 3). Wheeler sandstone shown on structure section as underlying middle Eocene Sisar black shale and overlying lower Eocene beds.

W. R. Merrill, 1952, *in* Am. Assoc. Petroleum Geologists, Soc. Econ. Paleontologists Mineralogists, Soc. Exploration Geophysicists, Joint Ann. Mtg. Guidebook, p. 77. Wheeler sandstone member of Juncal noted on road log from Ojai to Ozena.

Occurs in Ventura County.

Wheelerian Stage

Pliocene: Southern California.

Manley Natland, 1953, Pacific Petroleum Geologist, v. 7, no. 2, p. 2. One of four stages, based on foraminiferal assemblages, in the Pliocene and Pleistocene of southern California. Includes interval between Hallian stage above and Venturian stage. The Wheelerian includes the middle

Pico and part of the upper Pico. Division between Wheelerian and Hallian is within the upper Pico or "Mud Pit shale."

Wheeling Group[1]

Pennsylvanian: Appalachian Basin.

Original reference: J. J. Stevenson, 1907, Geol. Soc. America Bull., v. 18, p. 178.

Named for stream which flows through western parts of Greene and Washington Counties, Pa., and Marshall and Ohio Counties, W. Va.

Wheelock Marl Member (of Cook Mountain Formation)

Wheelock Marl Member (of Crockett Formation)

Eocene, middle: Eastern Texas.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 20 (table), 125–134 [1939]. Basal member of Crockett formation. Commonly light gray-green, bluish-gray, or slate-gray thin-bedded to laminated marl not rich in glauconite and fossils. Calculated thickness 70 feet. Interfingers with and transitional into overlying Landrum shale member; disconformably overlies Stone City beds.

H. B. Stenzel, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 9, p. 1664. Reallocated to Cook Mountain formation. Type locality stated.

Type locality: Wheelock Prairie in Brazos and Robertson Counties.

Whetstone Branch Shale[1]

Upper Devonian and Mississippian (Kinderhook): Northeastern Mississippi.

Original reference: W. C. Morse, 1928, Jour. Geology, v. 36, p. 31–43.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 163, 166, chart 5 (column 89). Whetstone Branch formation is local designation for Chattanooga shale which contains interbedded sandstones in this area. Occurrence of *Tentaculites* seems to prove Devonian age of at least part of this formation, but middle New Albany conodonts have been recognized nearby in Tennessee, so the upper part may be younger. Shown on chart as Kinderhookian.

Type locality: In Tishomingo County in middle part of Whetstone Branch, which enters Tennessee River about 3½ miles above Tennessee State line and mouth of Yellow Creek.

Whetstone Creek Shale Member (of Breathitt Formation)

Middle Pennsylvanian: Southeastern Kentucky.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 64, 65, 76, 153. Proposed for dark-gray shale that contains numerous fairly regular bands of ironstone. Thickness about 71 feet. Occurs in upper part of Breathitt formation below Bacon Creek or lower Blue Gem coal.

Exposed in north bluff of Cumberland River along Kentucky Highway 92 just west of Whetstone Creek, about 9 miles east of Williamsburg, Whitley County.

Whetstone Gulf Formation[1] (in Lorraine Group)

Upper Ordovician: Northern New York, and Southern Ontario, Canada.

Original reference: Rudolf Ruedemann, 1925, New York State Mus. Bull. 258.

W. H. Twenhofel and others, 1954, Geol. Soc. America Bull., v. 65, no. 3, chart 2, column 19. Shale is lower unit in Lorraine group.

Named for exposure in Whetstone Gulf near Martinsburg, Lewis County, N.Y.

Whetstone Hill Member (of Moretown Formation)

Age not stated: Vermont.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 51. Incidental mention of name. Refers to Thompson (unpub. thesis, 1950).

Whetstonian series

Paleozoic (Mid-Cambric): Arizona and New Mexico.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 107 (table), 120. Comprises (ascending) Dragoon and Carrasco terranes.

Whim Hill Breccia

Upper Cretaceous or younger: Southwestern New Mexico.

P. F. Kerr and others, 1950, Geol. Soc. America Bull., v. 61, no. 4, p. 289–291, fig. 3, pl. 1. Compact mass of angular blocks firmly cemented by matrix rich in magnetite. Fragments represent a number of rock types known to occur in the stratigraphic section. Broken pieces of biotite granodiorite porphyry predominate. Angular and rounded fragments of indurated shales and quartzites, which probably came from Beartooth and Colorado formations, included.

Two areas of exposure in northern part of Santa Rita stock; larger, comprises area of over 40,000 square feet and forms elongate mass in central part of North Pit; second body found on northern edge of Central Island between North and South Pits. In Santa Rita copper mine, in southeastern corner of Santa Rita quadrangle, about 12 miles east of Silver City, Grant County.

Whipple Marble

Ordovician: West central Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 13, 32–34, pl. 1. Thin-bedded dark-blue-gray marble containing lenses of black slate and some buff-weathering dark-gray dolomite beds. Thickness from 50 to 250 feet. Underlies Hortonville slate though locally appears to be contemporaneous with it. Lenses of each occur in the other. Overlies Orwell limestone unconformably. Middle Ordovician (Trenton).

E-an Zen, 1956, (abs.) Geol. Soc. America Bull., v. 67, no. 12, pt. 2, p. 1830. Age of at least a part is Canadian [Lower Ordovician].

Best exposed in band about 2½ miles long extending northward along east side of West Rutland Valley from point about 2 miles north of West Rutland. Northern part of West Rutland Valley is labeled "Whipple Hollow" on Proctor 7½ minute topographic map. Other exposures also in and near Castleton quadrangle.

Whirlpool Sandstone (in Albion Group)

Whirlpool Sandstone (in Medina Group)

Whirlpool Sandstone Member (of Albion Sandstone)[1]

Lower Silurian: Western New York, and Ontario, Canada.

Original reference: A. W. Grabau, 1909, Jour. Geology, v. 17, p. 238.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Albion group in New York and Cataract group in Ontario.

D. W. Fisher, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 1981 (fig. 2), 1982 (fig. 3), 1985–1987. Discussion of stratigraphy of Medinan group in Ontario and New York. Whirlpool sandstone is basal formation of group. Extends from Mitchells Mills, Ontario, along, or slightly north of, base of Niagara escarpment to its easternmost exposure at Medina, N.Y., a distance of about 150 miles. Maximum thickness 25 feet. Underlies Manitoulin dolomite in vicinity of Hamilton; underlies Fish Creek shale (new) from DeCew Falls to Lockport. Overlies Queenston shale.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Underlies Rumsey Ridge, herein raised to formational rank, and preoccupied term Fish Creek abandoned.

Named for occurrence at the Whirlpool of Niagara River.

Whirlwind Breccia Member (of Pruett Formation)

Tertiary: Western Texas.

C. G. Moon, 1953, Geol. Soc. America Bull., v. 64, no. 2, p. 179. Persistent light-colored sandstone marker bed that extends from northwest corner of area [Agua Fria quadrangle] southward to about latitude of Burnt House Camp may correspond to upper Whirlwind breccia member of Pruett formation. [Goldich and Elms (1949) refer to breccia-conglomerate at Whirlwind Spring.]

Sandstone bed dips gently west and is continuous along west bank of tributary which flows from north and empties into Crystal Creek.

Whirlwind Formation

Middle Cambrian: Western Utah and eastern Nevada.

R. A. Robison, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 47, 48 (fig. 3), 50 (fig. 4), 51. Name replaces Condor member of Swasey formation (Wheeler, 1948) and Condor formation (Cohenour, 1959). Series of paleolithofacies maps of Great Basin area illustrates gross shifts in lithofacies boundaries caused by alternately transgressive and regressive Lower and Middle Cambrian sea. Major Middle Cambrian regressive movements during *Glossoplura* and *Bathyuriscus-Elrathina* times caused noncalcareous detrital sediments to be swept westward over top of older carbonate sediments. Those two regressive tongues form recognizable stratigraphic marker units in much of eastern Great Basin. Name Chisholm formation is here extended to include all occurrences of older tongue. Rocks of younger tongue have had name Condor member of Swasey applied to them. Type section of Condor member is believed to be noncorrelative with type section of Swasey limestone; hence, younger regressive tongue has no valid name and term Whirlwind is proposed. In House and Wah Wah Ranges, underlies Swasey formation and overlies Dome formation; in Pioche district, overlies Burrows formation and underlies Highland Peak formation.

Type section: Along road in Marjum Canyon, House Range, Utah. Name derived from Whirlwind Valley to east of House Range.

Whiskey Canyon Limestone (in Armendaris Group)

Pennsylvanian (Des Moines Series) : Central New Mexico.

M. L. Thompson, 1942, New Mexico Bur. Mines Mineral Resources Bull. 17, p. 27 (table 2), 43–47, 50. Term proposed for massive bluish-gray to gray cherty limestones between top of Elephant Butte formation (new) below and base of Garcia formation (new) above. Thickness at type section about 163 feet.

J. A. Young, Jr., 1946, (abs.) Geol. Soc. America Bull., v. 57, no. 12, pt. 2, p. 1247. In Sangre de Cristo Mountains, overlies Cortado formation (new).

Type locality: Westernmost box canyon of Whiskey Canyon, in southwest part of sec. 1, T. 13 S., R. 5 W., Sierra County.

Whiskey Creek Pass Limestone Member (of Madera Formation)

Pennsylvanian (Desmoinesian) : South-central Colorado and north-central New Mexico.

K. G. Brill, Jr., 1952, Geol. Soc. America Bull., v. 63, no. 8, p. 818–819, pl. 1. Interbedded sandstone and light-gray sandy oolitic limestone, about 150 feet thick in vicinity of Whiskey Creek Pass. Persistent horizon marker in southern part of Permo-Pennsylvanian zeugogeosyncline of Colorado and New Mexico.

Typically developed at an elevation of about 13,000 feet above sea level on north side of north fork of Whiskey Creek, Las Animas County, Colo.

Whiskey Mountain Granodiorite

Mesozoic: Northeastern Washington.

A. C. Waters and Konrad Krauskopf, 1941, Geol. Soc. America Bull., v. 52, no. 9, p. 1370–1371, pl. 1. Porphyritic biotite granodiorite occurring in Whiskey Mountain stock which is considered roughly contemporaneous with Colville batholith.

Exposed over about 6 square miles on Whiskey Mountain, northern Okanogan County.

Whistle Creek Limestone

Middle Ordovician: Western Virginia.

B. N. Cooper and G. A. Cooper, 1946, Geol. Soc. America Bull., v. 57, no. 1, p. 74–75, 85 (fig. 7), 103. Name introduced for cherty limestones containing *Hesperorthis* fauna, which succeed New Market limestone (new) and underlie either coarse-grained "Holston" limestone of Lexington area or *Dinorthis atavoides* zone; at type section, underlies Lincolnshire limestone. Predominantly dark-bluish to brownish-gray cherty limestone, irregularly bedded. Thickness at type locality 82 feet. In many places, position of the Whistle Creek is indicated by blocks of fossiliferous. punky chert; where Whistle Creek is in direct contact with *Dinorthis atavoides* zone, the two can be distinguished only by fossils.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 80. Neuman named an 800-foot sequence of "Stones River" the Row Park formation. Cooper and Cooper had previously identified this sequence as Whistle Creek on basis of contained fossils. Below the New Market of Cooper and Cooper, Neuman discovered granular limestone containing abundance of *Rostricellula*. It is postulated here that both identifications of New Market are correct but that the Row Park is partial facies of the New Market and also the Whistle Creek.

Type section: Between U.S. Route 60 and Whistle Creek about 2 miles N. 40° W. of Lexington, Rockbridge County, Va.

Whistler Mountain Alaskite

Post-Mississippian: East-central Nevada.

C. W. Merriam, 1940, Geol. Soc. America Special Paper 25, p. 28, 29, 44, fig. 2. Consists of fine-grained alaskite intrusive body cutting certain shales and quartzitic deposits long regarded as entirely Diamond Peak Carboniferous but known to include beds of Ordovician age.

Constitutes central mass of Whistler Mountain, Roberts Mountain quadrangle.

White Porphyry[1]

Upper Cretaceous or early Tertiary: West-central Colorado.

Original references: S. F. Emmons, 1882, U.S. Geol. Survey 2d Ann. Rept., p. 215–230; 1883, U.S. Geol. Survey Leadville Atlas; 1886, U.S. Geol. Survey Mon. 12, p. 76; 1927, U.S. Geol. Survey Prof. Paper 148.

C. H. Behre, Jr., 1953, U.S. Geol. Survey Prof. Paper 235, p. 42–46, pl. 1. Since term White porphyry is well established in local mining parlance and in literature, it is retained here for the older of two white porphyries in area [west slope of Mosquito Range].

Term first used in Leadville district.

White Beach Sandrock[1]

Miocene, lower: Central Florida.

Original reference: W. H. Dall, 1892, U.S. Geol. Survey Bull. 84, p. 114, 337.

Named for exposures at a locality known in 1892 as "White Beach," at northern and western extreme of Little Sarasota Bay, south of Tampa Bay.

White Bluff Formation

White Bluff Marl[1]

Eocene (Jacksonian): Southeastern Arkansas.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 343, table opposite p. 334.

L. J. Wilbert, Jr.. 1953, Arkansas Div. Geology Bull. 19, p. 27–80. Resurrected and emended; includes all marine Jacksonian deposits exposed in southeastern Arkansas. Includes three facies: Pastoria sand member (new) and Caney Point marl member, which are stratigraphically equivalent, and Rison clay member, which in places overlies the other members. Outcrops in northern Jefferson County lie near northern limit of Jacksonian outcrop area in this part of the embayment; formation thins northward and disappears; to the south, it dips beneath Redfield formation (new). Overlies beds of Claiborne group; where Caney Point marl member is present, contact is sharp and exhibits evidence of unconformity; where Pastoria sand member constitutes basal unit, contact is not so well expressed. Type locality designated.

Type locality: White Bluff, a prominent bluff on right bank of Arkansas River, 4 miles east of village of Redfield, in northern Jefferson County.

White Brook Dolomite[1]

Precambrian(?) or Lower Cambrian: Southern Quebec, Canada, and northwestern Vermont.

Original reference: T. H. Clark, 1931, Geol. Soc. America Bull., v. 42, no. 1, p. 225–226.

T. H. Clark, 1936, Royal Canadian Inst. Trans., v. 21, pt. 1, p. 137, 143. Commonly white dolomite mottled with pink or purple patches, though very variable in color. Weathers to buff or brown shades. Contains much vein and nodular quartz. Stratification rare; where present, rock is a dolomitic sandstone. Thickness 20 to 75 feet. Underlies West Sutton slate; overlies Pinnacle graywacke. Type locality cited.

V. H. Booth, 1950, Geol. Soc. America Bull., v. 61, no. 10, p. 1135, 1136, 1145–1147. Extended into Vermont.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, pl. 1. Precambrian(?).

Type locality: Exposures around headwaters of White Brook, one-half mile northeast of four corners at West Sutton, Sutton quadrangle, Quebec.

White Caps Limestone Member (of Gold Hill Formation)[1]

Cambrian: Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

At White Caps mine, Manhattan district.

†White Cliff Limestone[1]

Upper Jurassic: Southwestern to northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 51, 152.

Caps the White Cliffs, Kane County, Utah; also occurs in vicinity of Flaming Gorge, northeast Utah.

†White Cliff Sandstone[1] or Group[1]

Jurassic(?): Southwestern to northeastern Utah and northwestern Colorado.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 51, 52, 151.

Type locality: Escarpment known as White Cliffs, in Paria, Kanab, and Rio Virgen region, Kane County.

†White Cliffs Chalk[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas and northwestern Louisiana.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 72, 87–88, 188.

Named for exposures at White Cliffs of Little River, Little River County, Ark.

†White Cliffs subchalk[1]

Upper Cretaceous (Gulf Series): Southwestern Arkansas.

Original reference: R. T. Hill, 1888, Arkansas Geol. Survey Ann. Rept. 1888, v. 2, p. 7, 88–89, 188.

At White Cliffs of Little River, Little River County, Ark.

White Cloud Shale Member (of Scranton Shale)[1]

White Cloud Shale (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra, 1927, Nebraska Geol. Survey Bull. 1, 2d ser., p. 40, 41, 58.

R. C. Moore, 1936, Kansas Geol. Survey Bull. 22, p. 49 (fig. 11), 210–211. Rank raised to formation in Wabaunsee group. Term Scranton abandoned. Overlies Howard limestone; underlies Happy Hollow limestone. Thickness 30 to 80 feet.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 19. Areal extent given.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2274 (fig. 1), 2277. Rank reduced to member of Scranton shale here reintroduced as formation with stratigraphic span as assigned to it by Haworth and Bennett (1908). Underlies Happy Hollow limestone member; overlies Howard limestone [Utopia member].

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 14, fig. 5. Thickest formation of Wabaunsee group in area. Gray and green shale; upper half commonly contains many limestone nodules; massive sandstone present at base locally. Full thickness not exposed at surface. Measured at 100 feet in coal mines in Adams County. Overlies Howard limestone; underlies Happy Hollow limestone.

Named from exposures west of White Cloud, Doniphan County, Kans.

White Cone Member (of Bidahochi Formation)

White Cone Series[1]

Pliocene: Northeastern Arizona.

Original reference: A. B. Reagan, 1932, Kansas Acad. Sci. Trans., v. 35, p. 253–258.

E. M. Shoemaker, F. S. Hensley, Jr., and R. W. Hallogen, 1957, U.S. Atomic Energy Comm. TEI Rept. 690, p. 392–394. An informal field designation for member of Bidahochi. Consists mainly of trachybasalt tuff and claystone. This member includes major part of section measured at White Cone by Gregory (1917, U.S. Geol. Survey Prof. Paper 83) which was designated White Cone series by Reagan (1932). It includes beds designated as "volcanic member" as well as beds included in lower part of "upper member" of Repenning and Irwin (1954).

Present in Hopi Volcanic Buttes field and along edge of Black Mesa west and northwest Hopi Volcanic Buttes. A typical section is at White Cone.

White Eagle Rhyolite

Tertiary: Southwestern New Mexico.

W. E. Elston, 1957, New Mexico Bur. Mines Mineral Resources Bull. 38, p. 36–37, pl. 1. Porphyritic rhyolite flows, sills and dikes. Rock is aphanitic, cream colored, flow banded, and flow folded. Many dikes in Precambrian granite as much as 1 mile long and 50 feet wide. Sills as thick as 56 feet in Bliss quartzite. Stratigraphic position unknown but possibly equivalent to Mimbres Peak rhyolite.

Named after White Eagle mine, in sec. 34, T. 19 S., R. 9 W. Confined to northern part of Cooks Range, Dwyer quadrangle.

White Earth Clay (in Golden Valley Formation)

Eocene: Western North Dakota.

1958, Great Northern Railway Company Mineral Research and Devel. Dept. Rept. 5, p. 2, 3, 12, 14, 15, map. Light-colored clay in lower part of Golden

Valley formation. Average thickness about 20 feet. South Ross, Lakeside, and East Tioga clays occur in same general area.

Occurs 9 miles north of town of White Earth and 7 miles southeast of Power Lake in secs. 20, 29, and 30, T. 158 N., R. 93 W., Mountrail County.

Whiteface Anorthosite[1]

Precambrian: Northern New York.

Original reference: J. F. Kemp, 1898, New York State Mus. 52d Ann. Rept., v. 1, p. 51–63.

A. F. Buddington, 1939, Geol. Soc. America Mem. 7, p. 19–21, table 3, pl. 5. Discussion of Adirondack igneous rocks and their metamorphism. Main massif of anorthositic rocks occupies about 1,200 square miles. Two facies of anorthositic rocks have been defined, named, and differentiated on geologic maps. One facies, the Whiteface, originally described by Kemp, is almost wholly restricted to borders of anorthosite masses or to bands closely involved with Grenville layers and inclusions, characterized by medium granular texture, more dark silicates than core of massif, a milky-white or nearly white feldspar, and usually a distinct foliation. Predominant rock is gabbroic anorthosite, but rocks mapped as Whiteface facies include true anorthosite, gabbroic anorthosite, and anorthositic gabbro. Miller (1918, Geol. Soc. America Bull., v. 29, no. 3) named rock characteristic of the core of the anorthosite massif the Marcy anorthosite. Thus, terms Whiteface and Marcy have been used in sense of formation names rather than of closely defined rock types, and it is with this significance that they are used in this report. Locally there are belts of anorthositic rocks which do not fit requirements for either Marcy or Whiteface facies, and term "transitional facies" is used to cover them. "Border facies," as shown in figure 3, includes both the Whiteface and "transitional" facies and in addition, as along exposed north border of St. Regis-Marcy anorthosite, a facies which has coarse Marcy texture but is commonly gabbroic anorthosite and contains garnet.

Forms summit and southern part of Mount Whiteface, Essex County.

Whitefield Gneiss (in Oliverian Plutonic Series)

Middle or Upper Devonian(?): Northwestern New Hampshire.

M. P. Billings, 1955, Geologic map of New Hampshire (1:250,000): U.S. Geol. Survey. Dark-gray medium-grained foliated biotite granodiorite gneiss. Included in Oliverian plutonic series.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, Bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 49–50, 52. Cut by pink quartz monzonite dikes of the Oliverian plutonic series. Derivation of name.

Named for town of Whitefield, Coos County, where well exposed. Lies in belt extending from Barrett to Riverton.

Whitefish Bay Limestone

Whitefish Bay member (of Alpena limestone stage)

Middle Devonian: Southern Michigan.

W. A. Kelly, 1940, Michigan Acad. Sci. Arts and Letters Sec. Geology and Mineralogy [Guidebook] 10th Ann. Field Excursion, [p. 13, columnar

section]. Shown on columnar section as limestone underlying Alpena limestone and overlying Genshaw formation.

Charles Schuchert, [1943], Stratigraphy of the eastern and central United States: New York, John Wiley & Sons, p. 606 (chart 480, 613). Basal member of Alpena stage. Shown on chart as underlying Alpena limestone member and overlying Killians limestone member, Long Lake stage.

Present in Alpena area.

Whitehall Formation (in Beekmantown Group)

Lower Ordovician: New York and Vermont.

John Rodgers, 1937, Geol. Soc. America Bull., v. 48, no. 11, p. 1576–1577. Beds of Calciferous Division B (Brainerd and Seely, 1890, Am. Mus. Nat. History Bull., v. 3), together with upper 35 feet of their Division A, form a stratigraphic unit. They are separated from Division C above and from Little Falls formation below by unconformities. These beds are here named Whitehall formation. According to Brainerd and Seely, Division B consists of dove-colored limestone, intermingled with light-gray dolomite in massive beds; in lower beds and just above the middle, dolomite predominates; middle and upper beds are nearly pure limestone; thickness of unit 295 feet. Base of Whitehall is made up of 35 feet of alternating sandstone and dolomite. Underlies unnamed formation (Upper Calciferous).

R. H. Wheeler, 1942, Am. Jour. Sci., v. 240, no. 7, p. 518–524. Base of Whitehall is raised to coincide with contact of Little Falls dolomite and Hoyt limestone, and the latter redefined as lower member of Whitehall. Includes Skene member (new) at top. Underlies Tribes Hill formation. Thickness about 160 feet.

John Rodgers, 1952, Geol. Soc. America Guidebook for Field Trips in New England, Nov. 10–12, p. 35 (table 2), 53 (road log). Table of Upper Cambrian and Lower Ordovician formations shows Whitehall formation (Upper Cambrian) above Dewey Bridge dolomite (new) and below Lower Ordovician Baldwin Corner formation (new). Baldwin Corner formation formerly included in original Whitehall.

C. W. Welby, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 22–23. In central Champlain Valley, formation (dolostone) is basal unit of Beekmantown group. Thickness about 300 feet. Underlies Cutting formation. As originally defined, Whitehall included beds that are now placed in underlying Ticonderoga formation (new).

Type section: On Skene Mountain, which rises out of village of Whitehall, Washington County, N.Y. Base of formation exposed not far below brow of mountain on steep west face; base of Division C is exposed in hillock to east just across first road east of mountain.

Whitehead Granite[1]

Precambrian: Southwestern Colorado.

Original reference: W. Cross and E. Howe, 1905, U.S. Geol. Survey Geol. Atlas, Folio 131.

Named for occurrence about mouth of Whitehead Gulch, Needle Mountain quadrangle.

Whitehorse Sandstone[1] or Group

Whitehorse Formation (in Custer Group)

Permian: Western and southern Oklahoma, central southern Kansas, and Texas.

Original reference: C. N. Gould, 1905, U.S. Geol. Survey Water-Supply Paper 148, p. 55.

N. H. Darton, L. W. Stephenson, and Julia Gardner, 1937, Geologic map of Texas (1:500,000): U.S. Geol. Survey. Whitehorse sandstone mapped in Double Mountain group in northwestern Texas.

Robert Roth, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 422–433. Report reviews history of problem of Whitehorse nomenclature and correlation. Term Whitehorse has been loosely applied to sediments of Custer age in Texas.

D. A. Green, 1937, Am. Assoc. Petroleum Geologists Bull., v. 21, no. 4, p. 1526 (fig. 3), 1528. Used as group term to include Marlow, Rush Springs, and Cloud Chief formations.

R. K. DeFord, 1938, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1706. The Whitehorse-Capitan [Eddy County, N. Mex.] is subdivided from top downward into Carlsbad, Yates, Seven Rivers, and Queen. This involves redefinition of the Carlsbad. Gradation of Whitehorse into Capitan disposes of theory that Whitehorse is Triassic.

G. H. Norton, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 12, p. 1802–1811. In Kansas, Whitehorse sandstone can be divided into four members (ascending): Marlow, Relay Creek dolomite, an even-bedded sandstone member, and an upper shale member, the latter two representing Rush Springs-Cloud Chief members of Oklahoma section. Overlies Dog Creek shale; underlies Day Creek dolomite. Cimarron series.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 44–49. Whitehorse is used as group term in Texas-New Mexico area to include (ascending) Grayburg, Queen, Seven Rivers, Yates, and Tansill formations.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Chart of revised terminology shows Whitehorse group above El Reno (San Andres group).

Robert Roth, N. D. Newell, and B. H. Burma, 1941, Jour. Paleontology, v. 15, no. 3, p. 313. Table shows Custer group comprises (ascending) Whitehorse formation, Day Creek dolomite, and Quartermaster formation.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, pl. 2. Correlation chart shows Whitehorse group in central basin platform and Midland basin comprises (ascending) Grayburg formation, Queen sandstone, Seven Rivers formation, Yates sandstone, and Tansill formation; in eastern shelf area comprises (ascending) Childress dolomite member of Marlow formation, Eskota dolomite, and Claytonville dolomite; north-central Texas, near Red River (ascending) Marlow formation, Rush Springs formation, and Cloud Chief gypsum. Name Double Mountain group abandoned in this report.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 81, p. 36 (fig. 15), 37–38. Whitehorse sandstone, in Quartermaster group, comprises (ascending) Marlow sandstone member, Relay Creek(?) dolomite and

sandstone member, even-bedded sandstone and siltstone member, and upper shale member. Thickness about 270 feet. Underlies Day Creek dolomite; overlies Dog Creek shale of Nippewalla group.

L. V. Davis, 1955, Oklahoma Geol. Survey Bull. 73, p. 57–81. As used in this report, name Whitehorse is group name applied to all Permian strata above El Reno group and below Cloud Chief formation. Divided into two formations (ascending) Marlow and Rush Springs. Limited above and below by unconformities. Summary of literature.

J. M. Jewett, 1959, Graphic column and classification of rocks in Kansas: Kansas Geol. Survey. Formation comprises Marlow sandstone, Relay Creek dolostone, and unnamed member. Underlies Day Creek dolomite; overlies Dog Creek formation of Nippewalla group. Term Quartermaster group not used in this report.

Named for exposures in vicinity of Whitehorse Springs, Woods County, Okla.

†White Iron Granite[1]

Precambrian (Laurentian): Northeastern Minnesota.

Original reference: A. Winchell, 1888, Minnesota Geol. Nat. History Survey 16th Ann. Rept.

Occurs on shores of White Iron Lake, Vermilion district.

†White Mesa Sandstone[1]

Jurassic(?): Northeastern Arizona.

Original reference: H. F. Lunt, 1904, Am. Inst. Mining Engrs. Trans., v. 34, p. 989–990.

Occurs in White Mesa.

White Mountain Plutonic-Volcanic Series

White Mountain Magma Series[1]

Permian: New Hampshire and southeastern Vermont.

Original reference: M. P. Billings, 1934, Science, v. 79, no. 2038, p. 55–56.

David Modell, 1936, Geol. Soc. America Bull., v. 47, no. 12, p. 1894–1914, pl. 1. Chronology in Belknap Mountains, N.H., is (ascending) Moat volcanics, Gilford gabbro, Endicott diorite, Ames monzodiorite, Gilmanton monzodiorite, Belknap syenite, Sawyer quartz syenite, Lake quartz syenite, Albany quartz syenite, Conway granite, and Rowes vent-agglomerate. Also includes Pine Mountain complex; its age relative to other units in series unknown. Numerous leucocratic and melanocratic dikes cut the major intrusives.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 379, 400. Subdivided in Red Hill area of central New Hampshire to include Garland Peak quartz syenite (new), Watson Ledge quartz syenite (new), and other syenites and a granite.

C. R. Williams and M. P. Billings, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1025–1034, 1042. Further description of extrusive and intrusive phases in Franconia quadrangle, New Hampshire. Probably Mississippian.

A. P. Smith and others, 1938, Geologic map and structure sections of the Mount Chocorua quadrangle, New Hampshire (1:62,500): New Hampshire Highway Dept. Red Hill complex and Mount Tripyramid complex assigned to series in Mount Chocorua quadrangle.

C. J. Roy and Jacob Freedman, 1944, Geol. Soc. America Bull., v. 55, no. 7, p. 908. Represented by Pawtuckaway complex in Pawtuckaway Mountains of southeastern New Hampshire.

M. P. Billings, 1945, Am. Jour. Sci., v. 243–A, p. 43–47. Geographically extended to Vermont where unit includes rocks of Mount Ascutney area. Description of ring dikes in series.

M. P. Billings, 1956, Geology of New Hampshire, pt. 2, bedrock geology: Concord, New Hampshire State Plan. Devel. Comm., p. 35–37, 69–88, 105, 106–107, 129–135, 145–146, 182–183, 186. Summary discussion of plutonic-volcanic series. Rocks are massive and rarely show foliation and banding. Hypidiomorphic granular texture typical. Mineralogically characterized by amphiboles, pyroxenes, and olivines even in syenites and granitic rocks; muscovite absent. Pegmatites very rare. Mississippian(?). Derivation of name.

H. W. Jaffe, H. T. Evans, Jr., and R. W. Chapman, 1956, Am. Mineralogist, v. 41, nos. 5–6, p. 474, 485. Includes Devils Slide syenite (new) in Percy quadrangle, New Hampshire.

U.S. Geological Survey currently designates the age of the White Mountain Plutonic-Volcanic Series as Permian on the basis of a study now in progress.

Type area: North Conway quadrangle, New Hampshire. No one type locality can be designated. Named for extensive development in White Mountains of New Hampshire.

White Mountain Series[1]

Precambrian(?) and younger: Northern New Hampshire.

Original reference: C. H. Hitchcock, 1869, New Hampshire 1st Rept. on geology and mining.

White Mountain region.

White Oak Mountain Sandstone[1]

White Oak Mountain Sandstone (in Red Mountain Group)

Silurian (Albion Series): Southeastern Tennessee and northeastern Georgia.

Original reference: N. Sayler, 1866, Geologic map of Tennessee.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on correlation chart in Red Mountain group, Albion series. Underlies Clinton formation.

Named for White Oak Mountain, James and Bradley Counties, Tenn.

†White Pine Shale[1] or Group

Mississippian: Northeastern Nevada and eastern California.

Original reference: A. Hague, 1883, U.S. Geol. Survey 3d Ann. Rept., p. 253, 255–267.

C. W. Merriam, 1940, Geol. Soc. America Spec. Paper 25, p. 8 (table 1), 43–46. Term Diamond Peak series used to apply to post-Devils Gate sedimentary rocks in Roberts Mountains region; term is used in preference to extending Hagues' White Pine shale and Diamond Peak quartzite into area.

C. W. Merriam and C. A. Anderson, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1690–1691. Because stratigraphic relations of true White Pine formation in White Pine district are not well understood, it appears

undesirable to use this term for dark shale in Eureka and Roberts Mountains area. In this report, term Diamond Peak beds is used to include not only original Diamond Peak quartzite of Diamond Peak (Eureka district) but also underlying black shales and sandy interbed referred by Hague (1892, U.S. Geol. Survey Mon. 20) to White Pine shale.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2), 149. In recommended revisions of stratigraphic units in Great Basin, it is proposed that White Pine shale be subdivided to include (ascending) Pilot shale, Joana limestone, and Chainman shale members. Term White Pine shale to be used in Roberts Mountains and Lone Mountain area, Eureka district, Ely district, and Pioche districts, Nevada, and Confusion and House Ranges, and Ibex area, Utah.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 56–57. Problems of nomenclature and correlation of White Pine shale and Diamond Peak quartzite reviewed. Usage of White Pine shale as proposed by Easton and others rejected; their proposal has advantage of retaining White Pine for dominant black-shale sequence but does not provide for satisfactory treatment of the thick gradational zone between the black shales and coarser clastics characteristic of Hague's Diamond Peak. Proposed to use Diamond Peak formation for coarse clastic part of upper Mississippian sequence where it can be separated from underlying black shales and to adopt Spencer's name of Chainman for lower unit, where it can be mapped separately.

R. L. Langenheim, Jr., and Herbert Tischler, 1960, California Univ. Pubs., Geol. Sci., v. 38, no. 2, p. 108 (fig. 5), 110. Discussion of Quartz Spring area, Inyo County, Calif. For purposes of expressing regional stratigraphic relationships, many already proposed stratigraphic names are redundant. Figure 5 presents condensed set of already proposed names, as restricted and applied to units of regional significance. These names, selected on basis of priority, have been utilized for rock bodies that most nearly approach original author's concept of the formation. Names Peers Spring formation and Chainman shale are retained for formational units within White Pine group, although these names have frequently been employed in synonymous sense. Name White Pine has been retained for group because it was first applied to entire detrital sequence (Hague, 1883).

Walter Sadlick, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Field Conf., p. 81–90. Discussion of aspects of Chainman stratigraphy. Chainman is recognized as valid stratigraphic unit. White Pine shale seems to be correlative with Pilot shale, Joana limestone, and Chainman formation; if so, term White Pine should be suppressed.

R. L. Langenheim, Jr., and others, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 149 (fig. 1), 151. White Pine shale, in Ely No. 3 quadrangle, is 950 feet thick and consists of 50 feet of calcareous siltstone assigned to Peers Spring member, succeeded by 900 feet of black fissile shale belonging to Chainman member. Overlies Joana limestone, disconformity; underlies Scotty Wash quartzite with contact gradational. Assigned to Late Mississippian because of goniatite occurrences in surrounding regions.

Named for exposures in White Pine mining district (now known as Hamilton), White Pine County, Nev.

Whiteport Dolomite Member (of Rondout Limestone)

Whiteport Waterlime

Lower Devonian: Southeastern New York.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey, Map and Chart Ser., No. 1. Recent studies by L. V. Rickard (in press) suggest that Manlius, upper Chrysler, and Whiteport (Upper Cement of the Rondout) are Devonian, pending precise placement of the Silurian-Devonian contact in Europe and more refined intercontinental correlations.

U.S. Geological Survey currently classifies the Whiteport as a member of the Rondout Limestone and designates its age as Lower Devonian on the basis of a study now in progress.

Town of Whiteport is in Ulster County.

White Quail Limestone Member (of Minturn Formation)

White Quail Limestone

Pennsylvanian and Permian(?): Northwestern Colorado.

S. F. Emmons, 1898, U..S. Geol. Survey Geol. Atlas, Folio 48, p. 4. Commonly, a single limestone bed about 20 feet thick. Occurs above Robinson limestone and below Jacque Mountain limestone.

Ogden Tweto, 1949, Colorado Sci. Soc. Proc., v. 15, no. 4, p. 152 (table 1), 203–204, 208–211. Limestone which in Pando area lies 150 to 200 feet above Elk Ridge limestone member of Minturn, or about 5,000 feet above Belden shale, has been known as White Quail limestone in Kokomo district. It is here designated White Quail limestone member of Minturn. Consists of massive dark-gray oolitic limestone and small lenses of dolomite; locally black dolomite and fossiliferous dolomitic shale. Thickness 8 to 10 feet. Separated from overlying Jacque Mountain member by 950-foot interval of siltstone, grit, conglomerate, arkose, and shale. Age uncertain; more likely Pennsylvanian than Permian.

Well exposed on northeastern slope of Elk Ridge, near Kokomo, Summit County. Named derived from White Quail mines.

White Ranch Limestone (in Graham Formation)[1]

Pennsylvanian: Central Texas.

Original reference: F. M. Bullard and R. H. Cuyler, 1936, Texas Univ. Bull. 3501, p. 197, 222.

Typically exposed on White Ranch along west side of Bluff Creek, McCulloch County.

White Raven Quartz Monzonite[1]

Eocene: Central northern Colorado.

Original reference: P. G. Worcester, 1921, Colorado Geol. Survey Bull. 21, p. 33–34.

Named for White Raven mine, Boulder County.

White Ridge Limestone Member[1] (of Jefferson Limestone)

Upper Devonian: Northwestern Montana.

Original reference: C. F. Deiss, 1933, Montana Bur. Mines and Geology Mem. 6, p. 42.

Charles Deiss, 1939, Geol. Soc. America Spec. Paper 18, p. 15, 49, 50. Basal Devonian.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4 (facing p. 1788). Age shown as Upper Devonian on correlation chart.

Named for White Ridge. Forms lower part of slope above saddle on south side of peak forming west end of White Ridge, in S½ sec. 16, T. 22 N., R. 11 W.

White Ridge Quartzite or Formation

Precambrian: Central New Mexico.

J. T. Stark and E. C. Dapples, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 1936. Older than Sevilleta rhyolite (new); younger than Blue Springs muscovite schist (new); intruded by Los Pinos granite (new).

J. T. Stark and E. C. Dapples, 1946, Geol. Soc. America Bull., v. 57, no. 12, pt. 1, p. 1133–1134. Near base, formation composed of massive quartzite beds 2 to 7 feet thick which vary from white to light pink, tan, and red. Impure shaly beds occur throughout formation and become prominent near top, where beds vary from light pink to red. Thin beds of gray quartzite 1 to 2 feet thick alternate with schistoze zones of gray and white sericitic schist near top. Thickness ranges from 3,000 to 3,700 feet in central part of belt. Near Sierra Montosa it thins to 900 feet.

Named after White Ridge, a prominent ridge on eastern side of Precambrian section of Los Pinos Mountains. Forms high eastern ridge crests in northern half of Los Pinos Range. Outcrop maintains width of 1 mile for 5 miles south of Highway 60, then narrows to less than one-half mile and continues southward another 5 miles.

White Rim Sandstone Member (of Cutler Formation)[1]

Permian: Southeastern Utah.

Original reference: A. A. Baker and J. B. Reeside, Jr., 1929, Am. Assoc. Petroleum Geologists Bull., v. 13, no. 11, p. 1423, 1425, 1436, 1444, 1445, 1446.

C. B. Hunt, Paul Averitt, and R. L. Miller, 1953, U.S. Geol. Survey Prof. Paper 228, p. 39 (table), 45, pl. 1. White Rim, as mapped in Henry Mountains, is restricted to white crossbedded sandstone at top of Cutler. Thickness as much as 250 feet. Conformably overlies Organ Rock tongue; in most places White Rim and Organ Rock are separated by sharp bedding plane, but at some places where color changes from red to white within a massive sandstone bed, boundary was mapped at next higher bedding plane. Unconformably underlies Moenkopi formation.

Exposed in escarpment between Green and Colorado Rivers, known as the White Rim.

White River Group[1] **or Formation**[1]

Oligocene: South Dakota, northeastern Colorado, eastern Montana, Nebraska, North Dakota, and Wyoming.

Original reference: F. B. Meek and F. V. Hayden, 1858, Philadelphia Acad. Sci. Proc. 1857, v. 9, p. 119, 133.

A. L. Lugn, 1938, Am. Jour. Sci., v. 36, 5th, no. 213, p. 227;1939, Geol. Soc. America Bull., v. 50, no. 8, p. 1250–1251, 1264 (table 1). Group, in

Nebraska, attains or exceeds thickness of 700 feet. Comprises Chadron and Brule formations. Underlies Arikaree group; overlies Cretaceous shale formations, the Pierre, and others.

A. R. Edwards, 1941, Wyoming Geol. Survey Bull. 32, p. 10–13. As used in this report, term White River group includes Chadron, Brule, and Arikaree formations.

F. B. Van Houten, 1950, U.S. Geol. Survey Oil and Gas Inv. Map OM–113. White River formation of Granger (1910, Am. Mus. Nat. History Bull., v. 28) in Fremont County, Wyo., includes (ascending) unnamed channel deposit, Beaver Divide conglomerate member, and unnamed upper part. Upper part is divided into three units. Lower unit is massive, light-gray, tuffaceous siltstone and fine-grained sandstone with very little clay or coarse sand. Next is a thicker unit consisting of massive pale grayish-orange siltstone and fine-grained sandstone. Uppermost unit is massive, grayish-orange, locally cross-bedded arkosic conglomerate 60 to 80 feet thick, resting on erosional unconformity that has several feet of relief. Thickness 225 to 485 feet. Overlies middle and upper Eocene rocks. Underlies Miocene(?) rocks.

P. O. McGrew, 1953, Wyoming Geol. Assoc. Guidebook 8th Ann. Field Conf., p. 61–63. In Wyoming, it is customary to use term White River as formation name recognizing that to east the unit becomes a group divisible into two distinct formations.

E. C. Galbreath, 1953, Kansas Univ. Paleont. Contr. 13, Vertebrata, art. 4, p. 12–18, 27 (fig. 8). Formation in northeastern Colorado comprises (ascending) Horsetail Creek (of Chadron age), Cedar Creek (of Orellan age), and Vista (new) members. Underlies Pawnee Creek formation; overlies Cretaceous sandstones. Late lower Oligocene to early upper Oligocene, inclusive.

F. B. Van Houten, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–140. Formation in Long Creek-Beaver Divide area, Fremont County, Wyo., includes (ascending) Sand Draw sandstone lentil (new), Beaver Divide conglomerate member, and unnamed upper part. Overlies middle and upper Eocene rocks and underlies Miocene(?) rocks.

R. K. Hose, 1955, U.S. Geol. Survey Bull. 1027–B, p. 70–71, pls. 6, 8. Formation restricted to two small outliers on subsummit uplands of Bighorn Mountains and consists mainly of marlstone, conglomerate, and soft brown bentonitic clay. Thickness 200 to 300 feet along North Fork of Crazy Woman Creek. Formation fills pre-Oligocene valleys of high relief. Stratigraphically above Wasatch formation.

John de la Montagne and W. C. Barnes, 1957, Guidebook to the geology of the North and Middle Parks Basin, Colorado: Rocky Mountain Assoc. Geologists, p. 55–60. White River formation of this report is equivalent of Chadron. Thickness about 400 feet. Underlies North Park formation; overlies Coalmont formation.

J. C. Harksen, 1960, Geology of the Sharps Corner quadrangle (1:62,500): South Dakota Geol. Survey. Group comprises (ascending) Brule formation and Sharps formation (new). Underlies Arikaree group.

T. A. Steven, 1960, U.S. Geol. Survey Bull. 1082–F, p. 350–353, pl. 12. Formation described in Northgate district, Colorado, where it consists of grayish to white tuffaceous silt and clay beds that partly fill old valleys cut in Precambrian rocks. Underlies North Park formation.

Named for occurrence near mouth of White River, S. Dak.

†White River Limestone[1]

Lower Ordovician: Southwestern Missouri.

Original reference: A. Winslow, 1894, Missouri Geol. Survey, v. 6, p. 331, 338–340.

Named for White River.

Whiterock Stage

Middle Ordovician (Mohawkian): North America.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 7–8, chart 1 (facing p. 130). Mohawkian series divided into five stages of which the Whiterock is lowermost. Brachiopod fauna taken from rocks deposited during this stage is characterized by numerous orthids, early strophomenids, plectambonitids, and decline of Syntrophiacea. Followed by Marmor stage (new). Discussion of unsuitability of older stage terms, such as Chazyan, Black River, Bolarian, Hatterian, and Hunterian.

Name is taken from Whiterock Canyon in Monitor Range, south center of Roberts Mountains quadrangle, Nevada. Rocks of interval well exposed in parts of Antelope, Monitor, and Toquima Ranges.

Whiterock Bluff Shale Member (of Santa Margarita Formation)[1]

Whiterock Bluff Shale Member (of Monterey Shale)

Miocene, upper: Southern California.

Original reference: W. A. English, 1916, U.S. Geol. Survey Bull. 621, p. 191–215.

M. L. Hill, S. A. Carlson, T. W. Dibblee, Jr., 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2874 (fig. 1), 2978 (fig. 3), 2990–2991. Reallocated to member status in Monterey shale. Conformably overlies Saltos shale member (new); conformably underlies Santa Margarita sand. Grades southeastward into upper part of Branch Canyon sandstone (new). Thickness in type area 1,200 feet.

Type area: Near Whiterock Bluff, sec. 25, T. 11 N., R. 28 W., north side Cuyama Valley, Caliente Mountain quadrangle. Well exposed on both flanks of Caliente Range. Traceable along northeast flank of La Panza Range into restricted Monterey shale as mapped by Bramlette and Daviess (1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. May 24).

White Sage Formation[1]

Eocene(?): Western Utah.

Original reference: T. B. Nolan, 1935, U.S. Geol. Survey Prof. Paper 177.

Occurs only in northwest part of Gold Hill quadrangle. Named for White Sage Flat in Gold Hill district.

Whites Bend Limestone[1]

Silurian (Niagaran): Western Tennessee.

Original reference: A. F. Foerste, 1901, Geol. Soc. America Bull., v. 12, p. 397, 402.

Named for Whites Bend, Davidson County.

Whitesburg Limestone Member (of Blockhouse Shale)

Whitesburg Limestone (in Blount Group)[1]

Middle Ordovician: Northeastern Tennessee and western Virginia.

Original reference: E. O. Ulrich, 1924, Tennessee Dept. Ed., Div. Geology Bull. 28, p. 34; Bull. 31, p. 16.

R. B. Neuman, 1956, U.S. Geol. Survey Prof. Paper 274–F, p. 149. Rank reduced to member status in Blockhouse shale (new). Thickness at type locality of Blockhouse 5 to 20 feet. At base of formation. Overlies Lenoir limestone.

Type locality: Two miles southeast of Whitesburg, Hamblen County, and 1½ miles southwest of Bulls Gap, Tenn.

Whites Creek Beds Member (of Shoal River Formation)

Miocene, middle: Western Florida.

H. R. Smith, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 2, p. 270 (fig. 2), 271 (table 1), 275. Proposed for member of Shoal River formation either older than, or in part equivalent to, typical Shoal River as exposed at Shell Bluff on Shoal River. At type section, about 12 feet thick; consists of blue shell marl, gray shell marl in places indurated to form hard lumps, brown and yellow sand; fossiliferous.

Type locality: In gulch about 200 feet south of road from Knoxhill to Eucheeana on east bank of Whites Creek, Walton County.

Whites Crossing Coquina Member (of Chappel Formation)

Mississippian: Central Texas.

F. B. Plummer, 1950, Texas Univ. Bur. Econ. Geology Pub. 4329, p. 28. Consists of several lenticular layers of massive limestone made up of crinoidal fragments and poorly preserved fossils; occurs in limestone sinks and depressions in the Ellenburger where it has escaped post-Chappel erosion; deposits range in thickness up to 60 feet or more depending upon the depth of the sink hole. Chappel comprises [ascending] King Creek marl (new), Ives conglomerate, Espey Creek limestone (new), and Whites Crossing coquina members.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 810 (footnote). Plummer's Whites Crossing coquina referred by him to Chappel formation is echinodermal limestone facies in lower part of Barnett formation.

Well exposed on east side of Llano River and on north side of road at White's Crossing, Mason County.

Whiteside Granite[1]

Ordovician to Devonian: Western North Carolina and northwestern South Carolina.

Original reference: A. Keith, 1907, U.S. Geol. Survey Geol. Atlas, Folio 147, p. 4.

W. R. Griffitts and W. C. Overstreet, 1952, Am. Jour. Sci., v. 250, no. 11, p. 787. Geographically restricted to area of its type locality where it is in part medium-grained biotite-muscovite-quartz-monzonite, having composition that is common in granitic rocks through much of southeast; also includes coarse-grained pegmatitic rock dissimilar to Toluca and Cherryville quartz monzonites (both new). Both Toluca and Cherryville were included in unit assigned to Whiteside granite by Keith and Sterrett (1931, U.S. Geol. Survey Bull. 660–D, p. 130–132).

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 24; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. As mapped, Whiteside granite is essentially Whiteside granite as originally named and described by Keith. Paleozoic.

Named for exposures in cliffs of Whiteside Mountain, Jackson County, N.C.

White Spot Sandstone[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 165, 166.

At White Spot on mountain behind Reading, Berks County.

Whitesville Formation (in Chadakoin Group or Conneaut Group)

Whitesville Member (of Chadakoin Formation)

Upper Devonian: Southwestern New York.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 17 (fig. 4), 37–47. Whitesville formation is lower 300 feet of what has been called by Chadwick (1924) the Chadakoin formation. Overlies Hinsdale formation; underlies Germania formation (new). Beds are twofold in character: those of marine deposition and those of "Catskill" type of deposition. Nearly horizontal beds with marine fossils occur near Whitesville, but beds deposited at the same time 10 to 15 miles north are thinly laminated crossbedded green sandstone, bearing few or no marine fossils.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1), 18. Rank reduced to member status in Chadakoin formation. Underlies Germania member; overlies Hinsdale member.

L. V. Rickard, 1957, New York State Geol. Assoc. [Guidebook] 29th Ann. Mtg., p. 17 (table 2), 19. Formation in Chadakoin group. Inasmuch as Upper Devonian strata are still not thoroughly understood, a more or less permanent classification satisfactory to majority of workers may not be obtained for some time.

Named for exposures near village of Whitesville, Wellsville quadrangle, Allegany County. [Tesmer and Rickard state type locality is near Whitesville.]

Whitetail Conglomerate[1]

Tertiary(?): Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

P. A. Wood, 1959, Arizona Geol. Soc. Guidebook 2, p. 60. In Globe-Ray area, consists of conglomerate up to about 1,000 feet thick that rests unconformably on eroded surfaces of older rocks and is conformably overlain by dacite flow. Near Ray, dacite is overlain by 125 feet of conglomerate referred to by Ransome (1923, U.S. Geol. Survey Geol. Atlas, Folio 217) as Gila conglomerate. Tentatively considered younger than middle Tertiary.

T. F. Stipp and H. M. Beikman, 1959, U.S. Geol. Survey Oil and Gas Inv. Map OM–201. Shown on stratigraphic section as Tertiary(?).

D. W. Peterson, 1960. U.S. Geol. Survey Geol. Quad. Map GQ–128. Thickness 0 to 200 feet in Haunted Canyon quadrangle. Was deposited in low-lying areas on erosion surface of considerable relief and may overlie any of the older formations. Tertiary(?).

Named for exposures in Whitetail Gulch and Whitetail Spring, Globe quadrangle.

White Tank Monzonite

Jurassic(?): Southern California.

W. J. Miller, 1946, Geol. Soc. America Bull., v. 57, no. 5, p. 493. Megascopically monzonite, light gray to light pinkish gray, medium to moderately coarse-grained, contains several percent of mafic minerals; massive with faint primary foliation. Plainly and sharply cuts other rocks—Gold Park gabbro-diorite (new) and Pinto gneiss (new). Contains roof pendants of Palms granite (new). Late Mesozoic.

J. J. W. Rogers, 1958, Geol. Soc. America Bull., v. 69, no. 4, p. 449–464. Textural and spectrochemical study.

Named because of its typical occurrence in vicinity of White Tank, 10 miles south of Twentynine Palms, Riverside County.

†White Wall Sandstone[1]

Jurassic(?): Southeastern Utah.

Original reference: B. S. Butler, 1920, U.S. Geol. Survey Prof. Paper 111, p. 619.

In Abajo (Blue) Mountains, San Juan County.

Whitewater Formation (in Richmond Group)[1]

Upper Ordovician: Southeastern Indiana, north-central Kentucky, and southwestern Ohio.

Original reference: J. M. Nickles, 1903, Am. Geologist, v. 32, p. 208, 218.

Wilber Stout, Karl Ver Steeg, and G. F. Lamb, 1943, Ohio Geol. Survey, 4th ser., Bull. 44, p. 110. In Ohio, Whitewater formation is shown on page 110 as including (ascending) Weisburg, Saluda, and Oxford members. Stratigraphic chart and page 114 shows Whitewater sequence (ascending) Lower Whitewater, Saluda, and Upper Whitewater members. Calcareous shales with thin-bedded limestones. Thickness 60 to 100 feet. On chart, occurs above Liberty formation and below Silurian Elkhorn formation.

E. B. Branson, M. G. Mehl, and C. C. Branson, 1951, Jour. Paleontology, v. 25, no. 1, p. 2, fig. 1. Formation geographically extended into west-central Kentucky where it includes Saluda member. Overlies Liberty formation.

James Conklin, 1952, Kansas Acad. Sci. Trans., v. 55, p. 130. In Oldham County, Kentucky, Upper Richmond, which is similar to that of Ohio, is divided into Liberty formation, Lower Whitewater, Saluda, and Upper Whitewater members of Whitewater formation.

J. B. Patton, T. G. Perry, and W. J. Wayne, 1953, Indiana Geol. Survey Field Conf. Guidebook 6, p. 13–15, pl. 1. Thickness of formation in Indiana 4 to 35 feet. As described at stop 4 on itinerary, it is 14 feet thick and consists of dark-gray to black finely crystalline limestone in lower part and interbedded black limestone and shale in upper part; underlies Ordovician Brassfield limestone. North of Cross Plains, Brassfield is locally missing and Silurian Osgood formation rests on the Whitewater. Stratigraphic chart shows that Whitewater overlies Saluda formation and underlies Elkhorn where it is present.

W. C. Sweet and others, 1959, Jour. Paleontology, v. 33, no. 6, p. 1030. Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn formations define Richmond stage of the Cincinnatian.

Named for Whitewater River, at Richmond, Wayne County, Ind.

Whitewater Creek Rhyolite[1]

Tertiary: New Mexico.

Original reference: H. G. Ferguson, 1927, U.S. Geol. Survey Bull. 787.

Named for exposures in steep canyons along lower reaches of Whitewater and Mineral Creeks, Mogollon district.

Whitewood Limestone[1] **or Dolomite**

Upper Ordovician: Western South Dakota and northeastern Wyoming.

Original reference: N. H. Darton, 1904, Geol. Soc. America Bull., v. 15, p. 383.

W. M. Furnish, E. J. Barragy, and A. K. Miller, 1936, Am. Assoc. Petroleum Geologists Bull., v. 20, no. 10, p. 1329–1341. In northern Black Hills, Middle(?) Ordovician fossils have been found to occur throughout approximately 70 feet of shale and siltstone beds immediately below typical Whitewood dolomite. Concluded that strata involved should be included tentatively with overlying Whitewood formation (Ordovician) rather than with underlying Deadwood formation (Cambrian) as has been done heretofore.

M. R. McCoy, 1952, Billings Geol. Soc. Guidebook 3d Ann. Field Conf., p. 44, 45, 46. Referred to as Whitewood dolomite. Thickness 50 to 60 feet. Underlies Englewood dolomite with angular unconformity; overlies Roughlock siltstone (new).

M. R. McCoy, 1958, Wyoming Geol. Assoc. Guidebook 13th Ann. Field Conf., p. 25–30. Thickness Whitewood dolomite about 50 feet at type section; underlies Englewood dolomitic shale; overlies Roughlock siltstone with gradational contact. Ordovician (Champlainian-Cincinnatian.)

Type section (McCoy): Sec. 13, T. 5 N., R. 3 E., Lawrence County, S. Dak. Named for exposures at Whitewood Canyon below Deadwood.

Whitingham Schist[1]

Upper Cambrian(?): Southeastern Vermont.

Original reference: G. D. Hubbard, 1924, Vermont State Geologist 14th Rept., p. 276–278, map.

Named for exposures in Whitingham Township, Windham County.

Whitmore Point Member (of Moenave Formation)

[Triassic]: Southwestern Utah.

R. A. Cadigan, 1957, U.S. Geol. Survey Trace Elements Inv. Rept. TEI–700, p. 126 (fig. 26), 127. Limy arkoses about 61 feet thick. Underlies Springdale sandstone member; overlies Dinosaur Canyon member.

Type locality and derivation of name not given. Report discusses area near St. George.

Whitmores Ferry Amphibolite[1]

Pre-Triassic: Massachusetts.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 190, 194.

Crops out at Whitmores Ferry, in North Sunderland, Old Hampshire County.

Whitney Member (of Brule Formation)

Oligocene, upper: Northwestern Nebraska, eastern Colorado, southwestern South Dakota, and eastern Wyoming.

C. B. Schultz and T. M. Stout, 1938, (abs.) Geol. Soc. America Bull., v. 49, no. 12, pt. 2, p. 1921; 1941, Guide for a field conference on the Tertiary and Pleistocene of Nebraska: Nebraska Univ. State Mus. Spec. Pub., p. 4 (table 1), 37, fig. 9. Proposed for massive clays of upper or *Leptauchenia* zone part of Brule formation. Thickness about 290 feet. Disconformably overlies Orella member (new).

A. L. Lugn and B. W. Brown, 1952, (abs.) Geol. Soc. America Bull., v. 63, pt. 2, p. 1384. Geographically extended into Bear Lodge Mountains, Wyo. Erosional unconformity separates Whitney from 11 to 16 feet of overlying Ogallala "mortar beds" of lower Ash Hollow formation.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 42 (fig. 12), 44–46, figs. 3, 10, tables 1, 2. Three divisions of member recognized throughout much of outcrop belt in western Nebraska, eastern Wyoming, and in area southeast of Oelrichs, S. Dak. Recognition of these divisions is largely on the basis of separating beds of volcanic ash. Member consists chiefly of massive pinkish-buff silt and silty clay. Thickness in Crawford area, Nebraska, 278 feet; 460 feet in Scotts Bluff and Torrington areas, western Nebraska and eastern Wyoming. Bayard paleosol complex (new) locally caps member; elsewhere there is disconformity at contact; underlies Gering formation. Late Oligocene.

T. M. Stout, 1960, Nebraska Acad. Sci. Proc. 70th Ann. Mtg., p. 15. Proposed that classification of Oligocene sediments in Nebraska (Schultz and Stout, 1955) be extended into northeastern Colorado and eastern Wyoming. Exposures south and west of Peetz, Logan County, Colo., display the Lower ash and Upper ash beds of Whitney member of Brule. When these beds are traced westward, it is evident that the Upper ash is the "White marker bed" of Galbreath (1953, Kansas Univ. Paleont. Contr., Vertebrata, art. 4); thus basal part of Galbreath's "Vista" is equivalent to Upper Whitney (Whitney C) of Nebraska, and remainder of the "Vista" is probably Miocene (Gering and younger). Remaining Whitney as well as the Orella and Chadron units are like those in Nebraska.

Type locality: East of Toadstool Park along escarpment near Round Top, in secs. 16 and 21, T. 33 N., R. 53 W., about 16 miles west and 3 miles north of Whitney, Dawes County, Nebr.

Whitneyan Age

Oligocene: North America.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 11, pl. 1. Provincial time term, based on Whitney member of Brule formation, type locality, Whitney, northwestern Nebraska. Includes old term, "*Protoceras-Leptauchenia* beds," used in the most extended sense. Covers interval between the Orellan (Oligocene) and Arikareean (Miocene) ages. Report defines 18 provincial time terms, based on mammal-bearing units, for the North American continental Tertiary. [For sequence see under Puercan.]

Whitsett Formation (in Jackson Group)

†Whitsett Beds[1]

Eocene, upper: South-central Texas.

Original reference: E. T. Dumble, 1924, Am. Assoc. Petroleum Geologists Bull., v. 8, p. 424–436.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2624 (fig. 1), 2626 (table 1), 2631–2634. Formation includes (ascending) Stones Switch sandstone, Dubose, Calliham sandstone, and Fashing clay members. Characterized chiefly by preponderance of sandstone near base and of carbonaceous tuffs and bentonitic clays near top. Overlies McElroy formation (redefined); overlain by Olmos sand of Ellisor (1933); this sand is apparently overlapped by the Catahoula. Additional information on type locality.

Type locality: Bluff 90 feet in height, on east bank of Atascosa River, near Whitsett's house in sec. 48, Reiffert and Forbese 109-acre tract of Juan Houligan Survey. Bluff is in Atascosa County, just northwest of Live Oak County line, and extends from 6½ to 7½ miles south of Campbellton, Atascosa County, and 1.7 miles N. 60°–70° W. of Whitsett, Live Oak County.

Whitsett Limestone Lentils (in Myrtle Formation)[1]

Upper Jurassic and Upper Cretaceous: Southwestern Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

R. W. Imlay and others, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2778–2780. Some of Diller's Whitsett limestone lentils are included in Riddle formation (new). Lentils are gray to white or locally pink, range from 15 to 60 feet or more in thickness, are thin- to thick-bedded, and may be dense, coarsely crystalline, locally oolitic, or fossiliferous. Most common megafossils are fragments of pelecypods and echinoids. In one lentil exposed in Roberts Creek in secs. 14 and 15, T. 28 S., R. 5 W., James Storr collected fossils that T. W. Stanton identified as *Opis californica* Stanton and *Hoplites* cf. *H. dilleri* Stanton (Diller, 1898). The ammonite appears to be an immature specimen of Portlandian genus *Durangites*. Its presence indicates that at least one of the limestone lentils is middle Portlandian in age. Probably, some clastic beds associated with the limestone lentils likewise belong in Riddle and Days Creek (new) formations. Age problem of Diller's Whitsett lentils is complicated by fact that some lentils contain microfossils of Cenomanian or Turonian age.

Occur near J. H. Whitsett's secs. 14 and 15, T. 28 S., R. 5 W., Roseburg quadrangle.

Whitt Group

Pennsylvanian (Canyon Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Beds between the Millsap Lake and Graford (restricted) groups are divided into lower Lone Camp group and upper Whitt group with common boundary at disconformity between Strawn and Canyon series. Includes (ascending) Salesville, Keechi Creek, and Palo Pinto formations. Group is nearly equivalent to Brownwood shale.

M. G. Cheney and D. H. Eargle, 1951, Geologic map of Brown County, Texas (1:62,500): Texas Univ. Bur. Econ. Geology. Includes Brownwood shale at base and Adams Branch limestone at top. Overlies Lone Camp group; underlies Graford formation.

R. J. Cordell and others, 1954, *in* Abilene Geol. Soc. Guidebook Nov. 19–20, fig. 2 (strat. chart). Revision suggested since Strawn-Canyon boundary

has been placed at faunal break at top of Salesville shale and base of Turkey Creek sandstone and conglomerate member of Keechi Creek shale.

Named for village of Whitt in northwest Parker County near which included formations appear from beneath Comanche overlap.

Whitwell Shale (in Lee Group)[1]

Whitwell Shale Member (of Crab Orchard Mountains Formation)

Whitwell Member (of Lee Group)

Whitwell Shale (in Crab Orchard Mountains Group)

Lower Pennsylvanian: Eastern Tennessee and northern Georgia.

Original reference: Charles Butts and W. A. Nelson, 1925, Tennessee Div. Geology Bull. 33–D, p. 7, pl. 4.

H. R. Wanless, 1939, (abs.) Geol. Soc. America Bull., v. 50, no. 12, pt. 2, p. 1941. Listed as member of Lee formation.

V. H. Johnson, 1946, Coal deposits on Sand and Lookout Mountains, Dade and Walker Counties, Georgia: U.S. Geol. Survey Prelim. Map. Geographically extended into northern Georgia where it is 6 to 50 feet thick. Underlies Bonair sandstone; overlies Sewanee member of Lookout sandstone.

C. W. Wilson, Jr., J. W. Jewell, and E. T. Luther, 1956, Pennsylvanian geology of the Cumberland Plateau: Tennessee Div. Geology [folio], p. 4, 19, pls. 2, 3, 4. Assigned to Crab Orchard Mountains group (new). Thickness 60 to more than 200 feet; 75 to 100 feet in type area. Includes Richland and Sewanee coal. Underlies Newton sandstone; grades conformably downward into Sewanee conglomerate. In northwestern part of Cumberland Plateau, forms part of Fentress formation. Pottsville series.

U.S. Geological Survey currently classifies the Whitwell Shale as a member of the Crab Orchard Mountains Formation on the basis of a study now in progress.

Named for exposures west of Whitwell, Marion County, Tenn.

†Wichita Conglomerate (in Clear Fork Formation)[1]

Permian: Central northern Texas.

Original reference: E. C. Case, 1907, Am. Mus. Nat. History Bull. 23, p. 662–664.

Named for Big Wichita River, near Seymour-Vernon Road, Baylor County.

Wichita Group[1] or **Formation**[1]

Lower Permian: Northern and central Texas and western Oklahoma.

Original reference: E. T. Dumble and W. F. Cummins, 1890, Texas Geol. Survey 1st Ann. Rept., p. lxix, 188, pl. 3.

R. I. Dickey, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 42. Cheney proposes to abandon term Wichita. He places part of old Wichita group in Wolfcamp series and subdivides remaining part in Leonard series into three groups (ascending): Belle Plains, Clyde, and Lueders. These three groups are not distinguishable in subsurface of west Texas. Proposed here to continue term Wichita group (restricted) for beds of Leonard age between base of Clear Fork group and top of

Wolfcamp series. Wichita group (restricted) in Fisher County is about 800 feet thick from top of Lueders limestone to top of Fisk formation.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 97. Term Wichita group discarded. Terms Pueblo, Moran, Putnam, Admiral, Belle Plains, Clyde, and Lueders raised to rank of group. Pennsylvanian-Permian boundary placed at base of Pueblo group. Wolfcamp-Leonard boundary placed at top of Fisk formation (new) in Admiral group.

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80. Group comprises (ascending) Pueblo, Moran, Putnam, Admiral, Belle Plains, Clyde, and Lueders formations. Overlies Cisco group; underlies Clear Fork group. Permian.

G. W. Chase, 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 9, p. 2028–2035. In Wichita Mountains, Okla., formation includes Post Oak conglomerate member (new). Member is equivalent to Wellington formation and may be as old as upper part of Pontotoc group and as young as lowermost part of Garber sandstone.

P. T. Stafford, 1960, U.S. Geol. Survey Bull. 1081–G, p. 266–276, pl. 11. Group in north-central Texas includes rocks between base of Waldrip shale member of Pueblo formation and top of Lueders limestone. Comprises (ascending) Pueblo, Moran, Putnam, Admiral, Belle Plains, and Clyde formations, and Lueders limestone. Includes all rocks assigned to Wolfcamp series and about half of those assigned to Leonard series. Rocks of Pennsylvanian-Permian transition zone are included in lower part of Waldrip shale member of Pueblo. Overlies Pennsylvanian Cisco group; underlies Clear Fork group. Thickness ranges from about 1,650 feet in northern Callahan and northwestern Eastland Counties to 1,550 feet in central Shackelford and western Stevens Counties, and to 1,800 feet north of Clear Fork of Brazos River in Young and Throckmorton Counties. Channel deposits near base of group locally may increase thickness as much as 200 feet.

Named for Wichita River and Wichita County, Tex.

Wichitan series[1]

Carboniferous: Texas.

Original reference: C. R. Keyes, 1928, Pan-Am. Geologist, v. 49, p. 130, 133.

Wichman Formation

Pliocene, upper: Western Nevada.

D. I. Alexrod and W. S. Ting, 1960, California Univ. Pubs. Geol. Sci., v. 39, no. 1, p. 2–5. Consists of light-colored poorly indurated fluvio-lacustrine sediments and associated rhyolite ash; well-bedded pumiceous claystone, diatomaceous mudstone, sandstone, and conglomerate; rhyolitic tuff; rhyolitic breccia-agglomerate. Thickness not determined precisely; approximately 500 feet. Faults duplicate part of upper section. Lower part of section in fault contact with three formations: Excelsior, Kate Peak, and Coal Valley.

Type area: Four miles north of Wichman post office, Lyon County, and 1 mile northwest of entrance to East Walker Ranch headquarters. Exposed on east side of Pine Grove Mountains from vicinity of Wichman northward for over 15 miles; in southern part of area, crops out discontinuously under alluvial cover.

Wickcliff Sandstone (in Chester Group)[1]

Mississippian: Southern Indiana and western central Kentucky.

Original reference: C. A. Malott, 1925, Indiana Acad. Sci. Proc., v. 34, p. 108–132.

C. A. Malott, 1952, Stratigraphy of the Ste. Genevieve and Chester formations of southern Indiana: Ann Arbor, Mich., The Edwards Letter Shop, p. 7. Replaced by Waltersburg sandstone. Local Indiana names of upper Chester are dropped and formations given names of standard Chester column.

Named for exposures in ravines around Wickcliff, Crawford County, Ind.

†Wicker Formation[1]

Pliocene: Florida.

Original reference: H. F. Osborn, 1907, Am. Mus. Nat. History Bull., v. 23, pl. facing p. 249.

Wicomico Formation (in Columbia Group)[1]

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

Original reference: G. B. Shattuck, 1901, Johns Hopkins Univ. Circ., v. 20, no. 152, p. 73–75.

G. G. Parker and C. W. Cooke, 1944, Florida Geol. Survey Bull. 27, p. 75–77, pls. 2, 3. In southern Florida, the Talbot, Penholoway, and Wicomico formations comprise a conformable sequence of deposits whose differentiation is based mainly on location of their respective shore lines—42, 70, and 100 feet above present sea level. Presumably, the Penholoway everywhere merges downward into deposits of Wicomico age, and the Talbot into Penholoway and Wicomico successively. The sequence unconformably overlies Caloosahatchee marls and is likewise separated by a stratigraphic break from the Pamlico which fringes around it.

C. W. Cooke, 1952, Maryland Dept. Geology, Mines and Mineral Resources Bull. 10, p. 48–50. In Prince Georges County, Md., and District of Columbia, consists of coarse gravel bed at base and finer sand and silt above; color of silt ranges from yellow to drab to dirty white; local basal deposits of carbonaceous clay contain tree stumps and other woody debris. Thickness rarely more than 30 feet. In Potomac Valley, follows meandering course cut in crystalline bedrock and the Potomac group; along Patuxent River, lies on Cretaceous, Eocene, and Miocene beds; is sunk below base of Sunderland formation, and separated from it by a slope exposing older rocks. Deposition is believed to have begun during second (Kansan) glacial stage and completed during second (Yarmouth) interglacial stages.

Named for Wicomico River, St. Marys and Charles Counties, Md.

Wiggins Formation

Oligocene: Northwestern Wyoming.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 79–85, pl. 17. Proposed to replace preoccupied name Ramshorn volcanic series (Love, 1934). Consists of white and light-colored sequence of conglomerates, tuffs, sandstone, and shale. Thickness 1,700 feet on East Fork-South Fork of Owl Creek divide; 3,000 feet in vicinity of Brown Rock Canyon; 989 feet on east face of Steamboat Rock. Unconformably overlies Tepee Trail formation (new). Overlain by younger rocks only on Wiggins Peak.

Oligocene(?). Lithology varies from place to place; no standard section designated.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 37, pl. 1. Oligocene (Chadronian).

Name taken from Wiggins Fork River. Comprises high divides and ridges of southern and highest part of Absaroka Range.

Wigwam Formation[1]

Precambrian: Southern British Columbia, Canada, and northwestern Montana.

Original reference: R. A. Daly, 1912, Canada Geol. Survey, Dept. Mines Mem. 38, maps.

C. L. Fenton and M. A. Fenton, 1937, Geol. Soc. America Bull., v. 48, no. 12, pt. 1, p. 1892. Incidental mention in discussion of Belt series.

Named for Wigwam River, which essentially is in British Columbia.

Wilbarger Creek Bed (in Strawn Formation)[1]

Pennsylvanian: Central Texas.

Original reference: N. F. Drake, 1893, Texas Geol. Survey 4th Ann. Rept., pt. 1, p. 374, 384.

D. A. Zimmerman and G. D. Glover, 1956, Soc. Econ. Paleontologists and Mineralogists, Permian Basin Sec., [Guidebook] Spring Mtg., p. 78. Thickness 75 to 200 feet. Underlies Comanche Creek bed; overlies Buffalo Creek bed. Strawn series.

D. H. Eargle, 1960, U.S. Geol. Survey Prof. Paper 315-D, p. 58, pl. 27. Drake (1893) separated rocks of Strawn group [division] into 20 units of alternating sandstone and shale beds. He gave local names to these units, or "beds" as he termed them, and numbered them from bottom to top, 4 to 23. Only Drake's name for upper unit, the Ricker, is in common use today, and that name has been restricted to the base of Drake's Ricker bed.

Named for Wilbarger Creek, San Saba County.

Wilberns Formation[1]

Upper Cambrian: Central Texas.

Original reference: S. Paige, 1911, U.S. Geol. Survey Bull. 450, p. 23.

Frederick Romberg and V. E. Barnes, Geophysics, v. 9, no. 1, p. 88. Subdivided to include (ascending) Welge sandstone, Morgan Creek limestone, Point Peak shale, San Saba limestone, and Pedernales dolomite members.

P. E. Cloud, Jr., V. E. Barnes, and Josiah Bridge, 1946, Texas Univ. Bur. Econ. Geology Pub. 4301, p. 133, 149–151, 155–156 [1945]. Underlies Tanyard formation of Ellenburger group; overlies Riley formation (new). San Saba limestone and Pedernales dolomite are essentially equivalent facies, with limestone predominating to the west and dolomite to the east. Dolomites here termed Pedernales had formerly been considered part of Ellenburger limestone herein redefined as group and restricted to Lower Ordovician.

Josiah Bridge, V. E. Barnes, and P. E. Cloud, Jr., 1947, Geol. Soc. America Bull., v. 58, no. 1, p. 114–123, pls. 1, 2. Through most of Llano uplift thickness ranges from 540 to 610 feet; in southeastern part of region about 360 feet due to truncation and disconformity at top.

P. E. Cloud, Jr., and V. E. Barnes, 1948, Texas Univ. Bur. Econ. Geology Pub. 4621, p. 136, 155–157, 187–188, 192–194, 225, 253–255, 310–312, pls. [1946]. Local stratigraphy described in detail.

V. E. Barnes and W. C. Bell, 1954, San Angelo Geol. Soc. [Guidebook] March 19–20, p. 35, 36–37. Name Pedernales dropped. Formation includes four members: Welge sandstone, Morgan Creek limestone, Point Peak shale, and San Saba limestone.

Named for Wilberns Glen, Llano County.

†Wilbraham Gneiss[1]

Late Carboniferous or post-Carboniferous: Southern central Massachusetts.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 116.

Wilbur Member (of Rondout Limestone)

Wilbur Limestone Member (of Salina Formation)[1]

Upper Silurian: Eastern New York.

Original reference: J. M. Clarke, 1903, New York State Mus. Bull. 69, p. 855–867.

U.S. Geological Survey currently classifies the Wilbur as a member of the Rondout Limestone on the basis of a study now in progress.

Named for exposures at Wilbur, Ulster County.

Wilbur Tuff Lentils[1]

Eocene: Southwestern Oregon.

Original reference: J. S. Diller, 1898, U.S. Geol. Survey Geol. Atlas, Folio 49.

Has been traced from 2 miles west of Wilbur to Calapooya, Lynn County, a distance of 13 miles.

Wilburton Group[1]

Pennsylvanian: Oklahoma and Kansas.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Abandoned by Oklahoma Geological Survey.

Named for town in Latimer County, Okla.

Wilcox Formation

Precambrian: West-central Vermont.

W. F. Brace, 1953, Vermont Geol. Survey Bull. 6, p. 19–20, 21–22, 29. Predominantly green, white, and black schist enclosing thin dolomite beds near base of schist. Schists are feldspathic and dolomitic, show fine banding, and contain thin buff and blue quartzite beds. Pegmatitic quartzose gneiss occurs near middle of the formation. Above the gneiss, dark schistose grits contrast with strictly argillaceous types below. Thickness about 3,000 feet. Underlies Mendon formation unconformably.

Exposed in western part of Mendon and Shrewsbury Towns, Rutland quadrangle. Best seen on slopes south of Cold River at Wilcox Hill and on northwest slopes of Mendon Peak.

Wilcox Group[1] or **Formation**

Eocene, lower: Gulf Coastal Plain from Georgia to southern Texas, inclusive, also southwestern Illinois, western Kentucky, southeastern Missouri, and western Tennessee.

Original reference: A. F. Crider and L. C. Johnson, 1906, U.S. Geol. Survey Water-Supply Paper 159, p. 5, 9.

Wythe Cooke, 1925, U.S. Geol. Survey Prof. Paper 140–E, p. 133, 134–135. Wilcox group in Alabama comprises (ascending) Nanafalia, Tuscahoma, Bashi, and Hatchetigbee formations. In Mississippi, comprises (ascending) Ackerman, Holly Springs sand, and Grenada formation. Overlies Midway group (Porters Creek clay in Mississippi and Naheola formation in Alabama). Underlies Tallahatta formation of Claiborne group.

H. V. Howe, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 6, p. 617–621. Term Wilcox group should be abandoned in favor of Sabine. Sabine has priority and better type locality.

E. N. Lowe, 1933, Mississippi Geol. Survey Bull. 25, p. 32–119. Group subdivided into (ascending) Ackerman formation, Holly Springs sand, Bashi formation, Hatchetigbee formation, and Grenada formation. Although the same number of subdivisions is recognized in Mississippi as in Alabama, it is not possible to correlate them with corresponding subdivisions of Alabama Wilcox, except the Bashi and overlying Grenada beds which, in part, at least, correspond with Hatchetigbee of Alabama. Naheola is probably traceable in State in extensive sand outcrops immediately west of Porters Creek outcrop. Overlies Midway group; underlies Claiborne group.

F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 571–606. Group, in Texas, subdivided into (ascending) Seguin, Rockdale, and Sabinetown formations. Overlies Wills Point formation of Midway group; underlies Carrizo formation of Claiborne group.

H. V. Howe and J. B. Garrett, Jr., 1934, Louisiana Dept. Conserv., Geol. Bull. 4, p. 3–9. Sabine group divided into Mansfield and Wilcox subgroups. In Sabinetown outcrop, Mansfield subgroup is equivalent of "Rockdale formation" of Plummer in Texas. Wilcox subgroup is represented in Pendleton, Marthaville, and Fort Jessup outcrops and in Sabinetown outcrops. Alabama equivalents of Wilcox subgroup are Tuscahoma and Nanafalia formations and Bashi formation. Although name Wilcox is unfortunate because of its original usage, it has gained such wide acceptance that it is retained as subgroup name when it is distinctly understood that it applies only to upper one-third(?) of Sabine group or to marine beds overlying continental Mansfield subgroup. Such usage is fair because it is giving term "Wilcox" exactly same usage in Louisiana that it has at present in Alabama—its type section—and it is preferable to use of Sabinetown.

J. M. Weller and H. S. McQueen, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 159. Group in southeastern Missouri includes Ackerman formation.

F. F. Mellen, 1939, Mississippi Geol. Survey Bull. 38, p. 29–46. Wilcox series in Winston County comprises (ascending) Fearn Springs (new), Ackerman, Holly Springs, and Hatchetigbee formations. Disconformably overlies Betheden formation (new) of Midway series; disconformably underlies Meridian formation of Claiborne series.

L. D. Toulmin, Jr., 1940, Alabama Geol. Survey Bull. 46, p. 25–36. Under heading of Wilcox group, report discusses (ascending) Ackerman formation, Nanfalia formation, Salt Mountain limestone, Tuscahoma formation, Bashi formation, and Hatchetigbee formation.

R. J. LeBlanc and J. O. Barry, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 4, p. 734–737. Basal Wilcox of Louisiana, as of Alabama, is characterized by beds containing *Ostrea thirsae* (Gabb). In Louisiana, this fossil, which characterizes Nanafalia formation, of Alabama, has been reported in abundance only from beds of Marthaville, Natchitoches Parish. Collections have been made recently from 18 additional *Ostrea thirsae* localities between Red River and Sabine River flood plains. These localities comprise zone traceable from 8 miles east of Marthaville to 5 miles east of Zwolle, Sabine Parish. Establishment of this zone affords firmer basis for correlation proposed by Veatch (1905, Louisiana Geol. Survey Bull. 5) and Howe and Garrett (1934), of beds at Marthaville with Nanafalia. Basal Wilcox of Texas is also equivalent of *Ostrea thirsae* zone of Louisiana. Writers have collected from three localities in this zone specimens of another oyster, *Ostrea multilirata* Conrad (*tasex Gardner*), a species which, according to Plummer, occurs in Caldwell Knob member of Seguin formation, the basal Wilcox formation of Texas. Extension of *Ostrea multilirata* zone into Louisiana as part of *Ostrea thirsae* zone forms connecting link between lower Wilcox of Alabama and of Texas.

J. O. Barry, 1941 (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941. Discovery of 40 new fossil localities permits better definition of the three faunal units of Louisiana Sabine (Wilcox): Sabinetown (youngest), Pendleton, and Marthaville beds (oldest). Study of these fossils substantiates long-standing correlation of Louisiana section with marine Wilcox of Alabama. Presence of *Ostrea multilirata* Conrad, a guide fossil of basal Wilcox Seguin formation of Texas, associated with *Ostrea thirsae* (Gabb) in Marthaville beds is of importance because it establishes connecting link between basal Wilcox faunas of Alabama and Texas.

R. J. Le Blanc, 1941, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 25, no. 5, p. 941. Lower Eocene sediments below basal Sabine (Wilcox) *Ostrea thirsae* zone have surface thickness of about 800 feet in Sabine uplift region of northwestern Louisiana. Upper 300 feet of sediments contain limited fauna. Lower 500 feet carry fauna which is older than Solomon Creek fauna of Texas (basal Wilcox or upper Midway in age) and correlated with upper Midway faunas of Alabama, Naheola formation, and Kerens member of Wills Point formation of Texas. This correlation based on results of study of over 90 species from 15 previously undescribed localities in Sabine, Natchitoches, and De Soto Parishes, La.

D. P. Meagher and L. C. Aycock, 1942, Louisiana Geol. Pamph. 3, p. 12. Group in Louisiana, includes Marthaville, Pendleton, and Sabinetown units.

C. W. Cooke, 1943, U.S. Geol. Survey Bull. 941, p. 48–53. Deposits of Wilcox age in Georgia have not been subdivided and are called Wilcox formation, though equivalents of Nanafalia, Tuscahoma, and Bashi formations are known to be represented. Thickness 150 to 200 feet. Unconformably overlies Clayton formation; unconformably underlies McBean formation or Flint River formation, both of which overlap it.

M. W. Beckwith and F. E. Turner, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 5, p. 608–621. Seguin formation as originally defined straddles boundary between Midway and Wilcox groups. Members of Seguin formation, Solomon Creek clays, and Caldwell Knob sands, are

redefined so that base of Wilcox group is placed at disconformity marking top of Solomon Creek clays and base of Caldwell Knob sands. Solomon Creek member, as defined herein, apparently corresponds to upper part of Hall Summit unit of Barry and LeBlanc, whereas Caldwell Knob member may be correlated with basal sand member of Marthaville unit and beds containing *Ostrea thirsae* in association with *O. multilirata.*

Lyman Toulmin, Jr., Sept. 1944, Alabama Acad. Sci. Jour., v. 16, p. 41–42. Discussion of Midway-Wilcox contact in Alabama. Contact is easily located in exposures on Chattahoochee River at Fort Gaines, Ga., where fossiliferous Wilcox (Nanafalia) beds lie on irregular surface of Midway limestone. Stratigraphic position of Midway-Wilcox contact in central and western Alabama has heretofore been indefinite. Stratigraphic interval consisting of 200 feet or more of beds of uncertain age separates uppermost fossiliferous Midway bed and lowermost fossiliferous Wilcox bed. These beds consist of laminated clay and sand, lignite, greensand, and crossbedded coarse sand. Heretofore, paleontological evidence has been insufficient for determining whether these beds should be assigned to Midway or Wilcox group. A fossiliferous greensand marl within this sequence has been discovered in Wilcox County. Microfossils, including diagnostic Midway species, occur in this bed, and it has been assigned to Midway group. Midway-Wilcox contact has been placed above sequence of greensand beds at erosional unconformity beneath crossbedded coarse sand that underlies fossiliferous Nanafalia beds of Wilcox group. The crossbedded sand is absent in places and fossiliferous Nanafalia beds lie directly on irregular surface of the Midway. Wilcox group comprises (ascending) Nanafalia formation consisting of (ascending) "Basal sand," "Nanafalia Landing (*Ostrea thirsae*) marl," and "Gullette Bluff beds," Tuscahoma formation (including beds below Bashi marl formerly assigned to Bashi formation), Bashi marl (restricted), and Hatchetigbee formation. Disconformity separates "Basal sand" of Nanafalia formation from "Coal Bluff beds" of Naheola formation of Midway group.

F. S. MacNeil, 1944, Southeastern Geol. Soc. [Guidebook] 2d Field Trip, p. 23–28. Wilcox formations were treated together as undifferentiated Wilcox formation in Georgia by Cooke (1943). Wilcox is here treated to show same units recognized in Alabama section—Nanafalia formation, Tuscahoma sand, and Hatchetigbee formation with Bashi marl member. Wilcox formations are progressively overlapped in Georgia by Claiborne and Jackson groups. Not certain that Jackson anywhere rests directly on Wilcox in present exposures. It is probable that at least a thin wedge of Claiborne overlies Wilcox as far as vicinity of Montezuma where both Midway and Wilcox pass under cover of younger beds, Claiborne and Jackson. Basal beds of Claiborne, definitely equivalent to Tallahatta formation, rest directly on upper shales and sands of Hatchetigbee formation near Fort Gaines and down Chattahoochee River to near mouth of Abbie Creek, on Alabama side about 13 miles south of Fort Gaines. Near Andersonville, in northern Sumter County, sands of either Claiborne or Jackson rest directly on Nanafalia.

W. E. Belt and others, 1945, Geologic map of Mississippi (1:500,000): Mississippi Geol. Survey. Formation, as mapped in Mississippi, includes Fearn Springs sand member at base, Bashi marl member, and fossiliferous marl bed which, in Alabama, occurs near middle of Nanafalia formation.

G. E. Murray, Jr., and E. P. Thomas, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 1, p. 45–70. Sabine uplift of northwestern Louisiana and northeastern Texas is reflected as subregional doming by presence of inlier of Midway, Wilcox, and lower Claiborne sediments. Midway and Wilcox beds are largely deltaic and barren of fossils, but lentils bearing marine faunas are found around southern flank of uplift. Wilcox age of upper part of section was established by Harris and Veatch (1899, Louisiana State Expt. Sta., Geol. Rept., pt. 5, section 2), and entire section was considered Wilcox in age by subsequent writers until recent investigations by Louisiana Geological Survey revealed presence of faunas of Midway age in lower part. Three Midway and four Wilcox formations are recognized within section exposed on Sabine uplift, and these are correlated with type formational units of Alabama section. Group, in southern half of Sabine uplift, comprises (ascending) Marthaville, Pendleton (with Bayou Lenann, Slaughter Creek, and High Bluff members), Sabinetown, and Carrizo formations. In northern half of uplift, comprises (ascending) Marthaville(?) shale, undifferentiated Wilcox, and Carrizo formation. Overlies Hall Summit formation of Midway group. Eocene. Carrizo formation considered basal Claiborne by many geologists.

F. S. MacNeil, 1946, U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. 3–195, p. 17–22, correlation chart. Discussion of beds of Wilcox age-Wilcox formation and Wilcox group. Name Wilcox is not based on a type exposure, an objection commonly voiced against employing it at all. Name was derived from either Wilcox County or now abandoned Wilcox post office in Alabama. In Alabama, Wilcox group consists of Nanafalia formation with Fearn Springs sand member at base, Tuscahoma sand, and Hatchetigbee formation with Bashi marl member at base. In Mississippi, the Wilcox is treated as a formation equivalent to whole Wilcox group in Alabama. Two members of formation are recognized: Fearn Springs sand member at base and Bashi marl member in upper part. Formation is more than 800 feet thick in southeastern Neshoba County, Miss.; thins northward along strike, largely as result of overlap by Claiborne group to less than 100 feet at Tennessee line. Recent work has revealed that type Holly Springs formation of northern Mississippi, formerly included in the Wilcox and correlated with Tuscahoma sand of Alabama, is nonmarine equivalent of Tallahatta formation to south; name Holly Springs abandoned in favor of Tallahatta for all Mississippi. Removal of beds designated as Holy Springs from Wilcox group left Ackerman formation as only unit formerly recognized by U.S. Geological Survey in Wilcox of Mississippi. Although usually correlated with Nanafalia formation of Alabama, Ackerman at its type locality in Mississippi was found to be correlated with beds well up in Tuscahoma sand of Alabama. Rather than attempt to redefine the Ackerman, it was decided to adopt Wilcox formation for all beds of Wilcox age in Mississippi.

G. E. Murray, 1948, Louisiana Dept. Conserv., Geol. Bull. 25, p. 135–140. Barry and Le Blanc have presented evidence for drawing base of Wilcox group in Louisiana at base of *Ostrea thirsae-Ostrea multilirata* zone. In present report, base of Wilcox group is drawn at base of lithologic sequence (Marthaville formation) that contains the *Ostrea thirsae-Ostrea multilirata* zone.

H. B. Stenzel, 1950, Texas Univ. Bur. Econ. Geology Pub. 5019, p. 12–18. Wilcox group described in Troup district. Only upper part exposed. Includes Henrys Chapel ball clay (new).

G. E. Murray, 1953, Mississippi Geol. Soc. [Guidebook] 10th Ann. Field Trip, p. 48–60. Controversy concerning term Wilcox, as well as term Midway, stems from usage of both terms in dual sense, as (1) rock terms and as (2) time and time-rock terms. Proposed to use Wilcox strictly as rock-unit term. Such usage permits retention of Midway as time and time-rock term for all time and rocks deposited during fluctuations of Paleocene sea in Coastal Plain province. This usage also permits application of Sabine as a time and time-rock term for all time and rocks deposited during fluctuations of early Eocene sea in Coast Plain province. Wilcox group is considered to be the mass of complexly interbedded continental to deltaic deposits of Midway and Sabine ages. It is a three-dimensional lithologic unit, limits of which are determined by discernible extent of typical Wilcox lithology. Group contains delineatable and mappable litholigic units, some of Midway age and some of Sabine age. Exposures in Wilcox County, Ala., are typical of the group.

G. E. Murray, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 5, p. 671–696. Discussion of history and development of Paleocene-lower Eocene nomenclature of central Gulf Coast region. Midway group, Wilcox group, and Sabine group, the modern geographic class nouns most commonly applied to these deposits, are used dually as major divisions (groups) of rocks and as provincial subdivisions (stages) of the Paleocene and Eocene. Initially established as names of lithologic units, stated or implied modern usage of Midway, Wilcox, and Sabine is predominantly in a time-rock sense. Dual usage of Wilcox as a rock-unit name is increasingly common. Use of (1) Midway and Sabine stages and their companion units, Midway and Sabine ages, as provincial time-rock and time units of early Tertiary of Coastal Plain, based on major fluctuations of strand line; and (2) Wilcox group for mass of lignitic, prominently arenaceous deposits of both Midway and Sabine ages can clarify nomenclatural confusion and permit conformity to standard usage of time and time-rock units elsewhere in world. Exposures of Naheola, Nanafalia, Tuscahoma, and Hatchetigbee formations in Wilcox County, Ala., are typical of Wilcox group. Exposures of Naborton, Hall Summit, Logansport, Marthaville, Pendleton, and Sabinetown formations in De Soto, Red River, Natchitoches, Sabine Parishes, La., and in Panola, Shelby, and Sabine Counties, Tex., are cited as reference sections. Wilcox group is discriminated lithologically on first occurrence of clays or silts, commonly lignitic or carbonaceous, and (or) dirty sands, below marine greensands of Claiborne stage and above dark shales or glauconitic strata of Porters Creek formation.

C. O. Durham, Jr., and C. R. Smith, 1958, Louisiana Dept. Conserv., Geol. Pamph. 5, p. 1–17. Discussion of Louisiana Midway-Wilcox correlation problems and comparison of Alabama and Louisiana sequences. Problem of determining boundary in Louisiana involves same difficulties as in Alabama but with added necessity of correlating cross-country with Alabama section. In both Louisiana and Alabama, lower beds of deltaic (Wilcox) lithology contain fauna of Midway aspect. Sequence in Alabama embraces Naheola as now restricted and in Louisiana the Mansfield subgroup of Howe and Garrett (1934) later subdivided by Murray (1941). Surface evidence in Mississippi-Alabama area indicates that Naheola is missing inland so that these problematical and somewhat transition beds only occur in thicker gulfward sections. By analogy, the

same is true in Louisiana although documentation is incomplete. Evidence does not prove exact contemporaneity for base of Wilcox in Louisiana and Alabama but certainly does not indicate any great variation in time of deposition. In both Alabama and Louisiana, a wedge of gulfward thickening deltaic sediments is present. This wedge, absent inland, contains typical Wilcox lithology but fossils considered by most workers to be Midway in affinity. Various Louisiana workers have dealt differently with nomenclature problem of this wedge. The many interpretations reflect difficulty of using same names in lithologic, faunal, and time sense when geologic facts do not lend themselves to such combined usage. It is doubtful if Murray's (1955) proposal of labeling the same sequence both Midway and Wilcox will be adopted generally. Several recent papers by both paleontologists and stratigraphers have used Midway and Paleocene as well as Wilcox and lower Eocene in synonymous sense (Cushman, 1944, Cushman Lab. Foram. Research Contr., v. 20, pt. 2; Munsey, 1953, Jour. Paleontology, v. 27, no. 1; Loeblich and Tappan, 1957, Jour. Paleontology, v. 31, no. 6; Toulmin and others, 1951, Alabama Geol. Survey Spec. Rept. 21; LaMoreaux and Toulmin, 1953, Mississippi Geol. Soc. Guidebook 10th Field Trip). This usage of Midway and Wilcox is based on faunal rather than lithologic considerations reinforced perhaps in some instances by position of disconformable contact between the Naheola and Nanafalia of Alabama. In stratigraphic summary, Toulmin (1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 2) eliminated all reference to terms Midway and Wilcox using Paleocene and lower Eocene exclusively instead. This frees terms Midway and Wilcox to be used in their other lithologic sense. As first used, Wilcox was called a formation, and that usage persists in Mississippi. Inland where Wilcox is thin, of variable rapid facies changes, and mappable subdivisions cannot be made, this is permissible. Gulfward in thicker Alabama and west-central Louisiana sequences, individual formations as well as members have been delineated and mapped. In this area, Wilcox must be considered a group. In northernmost Louisiana, the Wilcox has the same characteristics that led it to be called formation in Mississippi. But, inasmuch as it is subdivided into formations only a short distance southward, it is preferable to refer to it as "undifferentiated Wilcox group" in that area. In present report, the term "Mansfield subgroup," as used by Howe and Garrett (1934), is used informally for the lower Wilcox although it embraces subdivisions of Murray (1941, 1948) that is, Naborton, Logansport, and Hall Summit formations with their members. "Mansfield" thus comprises the thicker Louisiana counterpart of Naheola formation of Alabama. Use of the several formational names of Murray is avoided because recent work in Sabine, Red River, and Caddo Parishes has indicated need for their revision. In Alabama and Louisiana, the Paleocene character of the fauna persisted during deposition of older part of deltaic sequence, the Naheola of Alabama and Mansfield of Louisiana. Thus, Paleocene-Eocene contact falls within deltaic mass. Inland, a disconformity rests on Midway clay. Lack of fossils prevents positive proof, but this hiatus probably occurred while Naheola and Mansfield were being deposited to the south during late Paleocene. Hence, Midway and Wilcox cannot be used in both lithologic sense and as time-stratigraphic terms equivalent to Paleocene and lower Eocene, but Midway and Wilcox are available for use as lithologic terms. Without this usage, no terms exist to describe the underlying lime and clay sequence of Paleocene age nor overlying deltaic sequence of late Paleocene and early Eocene age.

A lithologic boundary is drawn between Midway and Wilcox groups in Louisiana. Updip in Caddo Parish, this contact is disconformable; to the south, it is transitional. Lower deltaic Wilcox comprises partially fossiliferous sequence containing Paleocene fossils beneath beds containing *Ostrea thirsae*. This sequence is probably completely absent inland, thickens rapidly gulfward, and is divisible into formational units, locally. Upper Wilcox group of lower Eocene age includes *O. thirsae* beds (Marthaville), as well as overlying Pendleton and Sabinetown formations on south flank of Sabine uplift, but is undifferentiated in thinner nonfossiliferous sequence on north flank. This is practical nomenclature for both surface and subsurface Midway-Wilcox sequence wherever studied in Louisiana, as well as entire Gulf Coast area.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and W. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 4), 38–58. Group described in Arkansas bauxite region. Divided into (ascending) Berger formation, Saline formation, and Detonti sand (all new). Thickness as much as 1,209 feet. Unconformably overlies Wills Point formation of Midway group. Overlain by variegated clay and sand and thin liguite beds similar to those assigned to Claiborne group in other parts of Arkansas; whether this represents true contact of Wilcox and Claiborne must be decided by later studies. It is possible that Wilcox in Arkansas bauxite region, on lithologic basis, probably should be restricted to Berger formation, but current Arkansas usage is being followed in this report. Lower Eocene.

H. V. Andersen, 1960, Louisiana Dept. Conserv., Geol. Bull. 34, p. 48–85, maps. Wilcox group (rock group) in Sabine Parish comprises (ascending) Converse (new), Lime Hill, and "Hall Summit" formations (all Paleocene) and Marthaville, Pendleton, Sabinetown (with lower Pierson glauconite member), and Carrizo formations (all Eocene). Naborton, Dolet Hills, and Cow Bayou formations recognized in subsurface.

C. C. Mason, 1960, Texas Board Water Engineers Bull. 6003, p. 15–25. Group, In Dimmit County, contains Indio formation. Overlies Kincaid formation of Midway group; underlies Carrizo sand of Claiborne group. Eocene.

Named for extensive development in Wilcox County, Ala.

†Wild Cat Coquinite[1]

Upper Devonian or Mississippian: Northwestern Pennsylvania.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 203.

Well exposed on Wild Cat Creek at Ludlow, McKean County.

Wildcat Group

Wildcat Series[1]

Miocene, upper, to Pleistocene, lower: Northern California.

Original reference: A. C. Lawson, 1894, California Univ. Pub., Dept. Geol. Bull., v. 1, p. 255–263.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 24–26, 102, pls. 1, 2. Wildcat series (Lawson 1894) has become established in literature as loose term for Tertiary sediments (in Humboldt County) of suspected Pliocene age. Term Wildcat group is used here for sediments ranging from upper Miocene to lower Pleistocene. Composed principally of slightly indurated mudstone, siltstone, claystone, sandstone, and con-

glomerate; minor amounts of limestone, tuff, and lignite. Thickness more than 12,000 feet. In Ferndale Hills, on south side of Cenozoic basin, subdivided into (ascending) Pullen, Eel River, Rio Dell, Scotia Bluffs, and Carlotta formations (all new). Northeast of Foruna, group is undifferentiated. Strong angular unconformity separates group from Yager formation (new) and Franciscan; Hookton formation (new) deposited on eroded surface of Wildcat group.

G. C. Gester, 1951, Am. Assoc. Petroleum Geologists Bull., v. 35, no. 2, p. 205. Generalized stratigraphic section across Tertiary formations of Eel River basin near Scotia shows that Pliocene Wildcat series, 11,000 feet thick, overlies upper Miocene Bear River formation.

Type locality for group: Along Eel River from west of Scotia, Humboldt County, north to Van Duzen River. Region occupied by terrace is commonly known to people of Humboldt County as "Wild-cat Country."

Wildcat Marble

Precambrian: Northern New Jersey.

J. M. Hague and others, 1956, Geol. Soc. America Bull., v. 67, no. 4, p. 440, 468, 469, fig. 18. Throughout most of outcrop length horizon represented by single band of marble, but in area north of Sparta it gradually changes into series of tightly folded bands of impure marble and calcareous hornblende and pyroxene gneisses. Commonly contains blocks and discontinuous bands of gneiss and pegmatite. Thickness at Franklin, 300 feet. Underlies Pochuck Mountain gneiss series (new); overlies Cork Hill gneiss (new).

Named for small creek which flows through its outcrop southwest of Franklin. Also found north, west, and southwest of Sparta.

Wildcat Creek Shale Member (of Admiral Formation)

Permian: North-central Texas.

R. C. Moore, 1947, *in* A. K. Miller and Walter Youngquist, Kansas Univ. Paleont. Contr. 2, Mollusca, art. 1, p. 1 (footnote). Name introduced for shale overlying Hords Creek limestone and underlying Overall limestone (new).

R. C. Moore, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 80, sheet 2. Drake (1893) applied name Indian Creek bed to predominantly shaly strata occurring between Hords Creek limestone below and "Bed No. 5" (here named Overall limestone) above. Drake also used Indian Creek for beds in his Strawn division of Pennsylvanian age; Sellards (1933, Texas Univ. Bull. 3232) restricted application of name to the Strawn without renaming the Permian Indian Creek. This shale member is named Wildcat Creek shale. Thickness near Colorado River about 60 feet. Wildcat Creek shale makes up lower main part of Cheney's Fisk formation.

Named for exposures on Wildcat Creek which joins Home Creek at a point about 0.9 mile north of south line, and 1 mile east of west line of J. H. Barkey Survey No. 700, 6 miles S. 15° W. from courthouse at Coleman, Coleman County.

Wild Cat Mountain Conglomerate[1]

Pennsylvanian: Southeastern Kentucky.

Original reference: C. J. Norwood, 1877, Kentucky Geol. Survey, 2d ser., v. 2, pt. 6, p. 201, 243.

Forms top of Wild Cat Mountain and extends to hills around London, Laurel County, which it covers.

Wildcat Peak Formation

Carboniferous: Central Nevada.

Marshall Kay, 1960, Internat. Geol. Cong., 21st, Copenhagen, pt. 12, p. 98 (fig. 4). Named on structure section in report on Paleozoic continental margin in central Nevada. Overlies Pinecone formation (new).

Toquima Range, Nye County.

Wilder Formation

Late Tertiary(?) or Pleistocene(?): West-central Arizona.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 1, 26–27, pl. 3. Consists of porphyritic olivine basalt flows, intrusive plug of olivine basalt, coarse pyroclastic basaltic deposits formed as cinder cones or interbeds of pyroclastics in flows, and horizontically bedded basaltic tuffaceous sediments. Aggregate thickness generally ranges from 200 to 300 feet, but west of Contreras Wash 400 feet is exposed. In Wilder and upper Boulder Canyons, intercalated throughout the Gila(?) conglomerate; on west bank of Wilder Canyon, intercalated with and underlies Sanders basalt (new).

Exposed along walls of Wilder Canyon, for which it is named. Also crops out to east of Wilder Creek, along north wall of Boulder Canyon; to the south, along west wall of Boulder Canyon, and along eastern margin of Bozarth Mesa, Bagdad area, Yavapai County.

Wilderness Stage

Middle Ordovician (Mohawkian): North America.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 8–9, chart 1 (facing p. 130). Mohawkian series divided into five stages (ascending): Whiterock, Marmor, Ashby, Porterfield, and Wilderness. Wilderness stage includes old Black River stage plus the Rockland and their equivalents. Older than Trenton stage. Name credited to G. A. Cooper and B. N. Cooper.

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 94. Pre-Trentonian part constitutes upper part of type Bolarian series.

Named from Wilderness Trail (U.S. Highway 58) that parallels Cumberland Front in western Virginia. Rocks deposited during this stage well exposed for several miles east of Cumberland Gap and are revealed in their entirety along the railroad at the switch near Hagan, Rose Hill quadrangle, Virginia.

Wildhorse Dolomite Member or Bed (in Barnsdall Formation)

Wildhorse Limestone (in Nelagoney Formation)[1]

Pennsylvanian (Missouri Series): Central northern Oklahoma.

Original reference: F. C. Greene, 1918, Am. Assoc. Petroleum Geologists Bull., v. 2, p. 121–122.

M. C. Oakes, 1951, Tulsa Geol. Soc. Digest, v. 19, p. 120. Rank reduced to bed in unnamed shale member of Barnsdall formation (new).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 19. Wildhorse dolomite member, which occurs near top of Barnsdall in southern Osage County, is not found south of Arkansas River.

First described in Osage County.

Wildhorse Formation[1]

Pleistocene: Southeastern Oregon.

Original reference: W. D. Smith, 1926, Oregon Univ. Commonwealth Rev., v. 8, p. 207–214.

Typically exposed in Kieger and Wildhorse Canyons, Harney County.

Wildhorse Member (of Muldoon Formation)

[Upper Mississippian or Pennsylvanian]: Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert. Abs., v. 20, no. 3, p. 999. Overlies Iron Mine member (new); underlies Wood River formation.

Deposited in Muldoon trough, alined N. 30° W.

Wildhorse Sandstone[1]

Permian: Central southern Oklahoma.

Original reference: E. R. Brockway and H. J. Owens, 1923, Oklahoma Univ. Bull., new ser., no. 271, p. 95–96.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Name preoccupied.

Exposed along Wildhorse Creek, Garvin and Carter Counties.

Wildhorse Canyon Series

Precambrian: Southwestern Utah.

K. C. Condie, 1959, The Compass, v. 36, no. 3, p. 184, 185, 186, 187. Comprised of ptygmatically folded gneisses and schists. Enclosed within Mineral Range pluton. Early Precambrian in age.

Crops out on west side of Mineral Range from Ranch Canyon on the south to contact of the pluton on the north; in Beaver and Millard Counties.

Wildhorse Mountain Formation (in Jackfork Group)

Upper Mississippian: Southeastern Oklahoma.

B. H. Harlton, 1938, Am. Assoc. Petroleum Geologists Bull., v. 22, no. 7, p. 854 (fig. 1), 856–857, 878–880. Proposed for lowermost formation of group. Consists of massive basal sandstone, which is commonly succeeded by thin-bedded sandstones and intercalated shales, and massive sandstone about 60 feet thick at top. Thickness varies from east to west; approximately 3,600 feet at type locality (in Tuskahoma syncline); about 1,000 feet in Round Prairie syncline in Tps. 1 and 2 S., R. 12 E. Underlies Prairie Mountain formation (new); overlies Chickasaw Creek siliceous shale (new) of Stanley group. Pushmataha series.

L. M. Cline, 1956, Tulsa Geol. Soc. Digest, v. 24, p. 101, 102. Restudy of type sections of Jackfork formation reveals that upper part of type Wildhorse Mountain formation duplicates an equivalent interval in lower part of type Prairie Mountain formation. By definition Harlton's type Prairie Mountain includes type locality of Prairie Hollow maroon shale member but it has been found that the Prairie Hollow also occurs in midst of Wildhorse Mountain type section; stratigraphic overlap amounts to about 3,600 feet.

L. M. Cline, 1960, Oklahoma Geol. Survey Bull. 85, p. 47–51. Redefined to include Prairie Hollow shale member.

Type locality: Wildhorse Mountain, north of town of Moyers, in T. 2 S., R. 16 E., Pushmataha County.

Wildie Sandstone Member (of Warsaw Formation)[1]

Upper Mississippian: Southeastern Kentucky.

Original reference: Charles Butts, 1922, Kentucky Geol. Survey, ser. 6, v. 7, p. 89, 102.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 215, 229. Unit termed Wildie sandstone member of Warsaw formation is here included in Wildie siltstone member (new) of Muldraugh formation (new).

Well exposed in vicinity of Wildie, Rockcastle County.

Wildie Siltstone Member (of Muldraugh Formation)

Lower Mississippian: Southeastern Kentucky.

P. B. Stockdale, 1939, Geol. Soc. America Spec. Paper 22, p. 215–216, pls. 6, 15. Name applied to rock unit bounded by two well-marked glauconitic silt horizons, irrespective of number or thickness of individual siltstone beds or relative proportions of interval filled by siltstone or silty shale. Thickness 20 to 30 feet; at type locality about 27 feet. In vicinity of type locality, consists mostly of bedded fairly resistant siltstone, with subordinate amount of shale. Included in Hummel facies (new) at base of formation; underlies unnamed silty yellow limestone; overlies Floyds Knob formation. As defined, includes unit termed Wildie sandstone member of Warsaw formation by Butts (1922).

Type locality: Sec. 36, at quarry of A. G. Carter Stone Works, Hummel post office, east of south end of abandoned tunnel of Louisville and Nashville Railroad, 1¾ miles south-southeast of Wildie, Rockcastle County. This is abandoned quarry of old Kentucky Freestone Co.

Wildrose Formation[1] (in Telescope Group)

Precambrian: Southeastern California.

Original references: F. M. Murphy, 1930, Econ. Geology, v. 25, p. 309–310, map; 1933, California Div. Mines Rept. 28 of State Mineralogist, July-Oct. 1932, p. 329–356.

B. K. Johnson, 1957, California Univ. Dept. Geol. Sci., v. 30, no. 5, p. 355, 365, 378 (fig. 7). This study [Manly Peak quadrangle] has made possible correlation of formations defined by Murphy (1930, 1932 [1933]) in Telescope Peak quadrangle with formations now commonly in use in Death Valley region. South Park member (new) of Kingston Peak formation (Precambrian) is correlative of three formations in Murphy's Telescope group: Middle Park formation, Mountain Girl conglomerate-quartzite, and Wildrose formation. None of these formations was recognized as mappable unit in Manly Peak quadrangle.

Probably named for exposures near Wildrose Canyon, Panamint Mountains, Inyo County.

Wildwood Limestone[1]

Permian: Northern California.

Original reference: J. P. Smith, 1910, Jour. Geology, v. 18, p. 218, chart facing p. 217.

Named for Wildwood (Landis' Ranch), on Hay Fork, Trinity County.

Wiles Limestone Member (of Graford Formation)[1]

Wiles Limestone (in Whitt Group)

Wiles Limestone Member (of Palo Pinto Formation)

Upper Pennsylvanian: Central northern Texas.

Original reference: C. E. Dobbin, 1922, U.S. Geol. Survey Bull. 736–C, p. 60.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Reallocated to member status in Palo Pinto formation (redefined). Overlies Wynn limestone member (new); underlies Adams Branch formation.

C. E. Davis, 1956, *in* North Texas Geol. Soc. Guidebook, May 25–26, p. [6]. Shown on columnar section as uppermost formation in Whitt group. Stratigraphically above Palo Pinto limestone and below Wolf Mountain shales in Graford group.

Named for exposures near Wiles, Stephen County.

Wiley Coal Member (of Spoon Formation)

Pennsylvanian: Western Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33, 46 (table 1), 62, pl. 1. Assigned member status in Spoon formation (new). Occurs below Greenbush coal member and above Seahorne limestone member. Thickness 10 inches in type section of formation. Coal named by Wanless (1931, Illinois Geol. Survey Bull. 60). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SW¼NW¼ sec. 16, T. 7 N., R. 2 E., Fulton County. Near Wiley School.

Wiley cyclothem (in Spoon Formation)

Wiley cyclothem[1] (in Tradewater Group)

Pennsylvanian: Western Illinois and eastern Iowa.

Original reference: H. R. Wanless, 1931, Illinois Geol. Survey Bull. 60, p. 188, 192.

J. M. Weller and others, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 10, p. 1589. Geographically extended into Iowa.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 50 (fig. 22), 63, 79–81. Normally thinnest cyclothem in area—about 4 inches to 4½ feet thick. Underlies Greenbush cyclothem; overlies Seahorne cyclothem. Gives type exposure.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), 56 (table 3), pl. 1. In Spoon formation (new). Above Seahorne cyclothem and below Greenbush cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type exposure south bank of ravine, near westline of SW¼SW¼ sec. 16, T. 7 N., R. 2 E., Avon quadrangle, Fulton County, Ill.

Wiley dolomite[1]

Carboniferous: Texas.

Original reference: C. R. Keyes, 1933, Pan-Am. Geologist, v. 59, no. 2, p. 136.

Wiley Mountains east of Van Horn, Culberson County.

†Wileys Landing Bed[1]

Miocene, lower: Southwestern Georgia and northern Florida.

Original reference: A. F. Foerste, 1894, Am. Jour. Sci., 3d v. 48, p. 50–51.

Named for exposures at Wiley's Landing, on Flint River, in Decatur County, Ga.

Wilgus Clay[1] (in Conemaugh Formation)

Wilgus underclay member

Pennsylvanian (Conemaugh Series) : Southeastern Ohio.

[Original reference:] Wilber Stout and R. E. Lamborn, 1924, Ohio Geol. Survey, 4th ser., Bull. 28, p. 334–335.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 65. Included in Wilgus cyclothem, Conemaugh series. Clay not present in area of this report, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 116. Wilgus underclay member noted in discussion of Wilgus cyclothem in Athens County. Thickness about 1¾ feet.

Named for its association with Wilgus coal which is well developed near Wilgus, Lawrence County. Wilgus coal named by D. D. Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17).

Wilgus cyclothem

Pennsylvanian (Conemaugh Series) : Southeastern Ohio.

N. K. Flint, 1949, Ohio Acad. Sci. [Guidebook] 24th Ann. Field Conf., p. 11. Incidental mention in road log.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 65–66, table 1, geol. map. Includes (ascending) Buffalo shale, 33 feet; Wilgus clay and Wilgus coal (both absent in Perry County); and Cambridge limestone. Occurs below Anderson cyclothem and above Brush Creek cyclothem. In area of this report, Conemaugh series is described on cyclothemic basis; seven cyclothems are named. [For sequence see Mahoning cyclothem.]

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 95 (table 11), 113–118. In Athens County, includes (ascending) Buffalo shale and (or) sandstone, Meyersdale redbed, Wilgus underclay and coal, and Cambridge limestone members. Overlies Upper Brush Creek cyclothem; underlies Anderson cyclothem. Conemaugh series.

Wilgus coal was named by Condit (1912, Ohio Geol. Survey, 4th ser., Bull. 17) for occurrence near Wilgus, Lawrence County.

Wilhite Formation (in Walden Creek Group)

Wilhite Slate[1]

Precambrian (Ocoee Series) : Eastern Tennessee, northwestern Georgia, and western North Carolina.

Original reference: C. D. Walcott, 1894, Geol. Soc. America Bull., v. 5, p. 196–198.

A. S. Furcron, K. H. Teague, and J. L. Calver, 1947, Georgia Geol. Survey Bull. 53, p. 21–22, pl. 1. Wilhite slate mapped in Chatsworth talc district, Murray County. Wilhite of this area does not seem to correspond entirely to description of Wilhite to north; thus its age is open to question. Mapped separately from Ocoee rocks as it does not appear to belong to that series lithologically.

John Rodgers, 1953, Tennessee Div. Geology Bull. 58, pt. 2, p. 29. Wilhite slate, as used by Keith (1895, U.S. Geol. Survey Geol. Atlas, Folio 16) is considered synonym of Sandsuck shale.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 955 (table 1), 962, 963. Redefined as formation in Walden Creek group

(new). Near type locality, divisible into two members (ascending) Dixon Mountain and Yellow Breeches (both new). Combined thickness of members at type locality about 3,500 feet. Overlies Shields formation (new); underlies Sandsuck formation.

Type locality: Wilhite Creek, Sevier County, Tenn.

Wilkes Formation

Miocene, upper: Southwestern Washington.

M. H. Pease, Jr., and Linn Hoover, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–188. Named on correlation chart. Older than Logan Hill formation. Name credited to A. E. Roberts (in press).

A. E. Roberts, 1958, U.S. Geol. Survey Bull. 1062, p. 12 (chart), 34–37, pl. 1. Name designates sequence of fluvial, lacustrine, and brackish-water deposits consisting of more than 760 feet of semiconsolidated claystone, siltstone, sandstone, and conglomerate. Contains fossil wood. Unconformably underlies Logan Hill formation; overlies middle(?) Miocene volcanic sequence and in some areas unconformably overlies Toutle formation.

Type area: Section measured from new roadcuts along State Highway 1–Q in secs. 20 and 29, T. 11 N., R. 1 E., and secs. 3 and 10, T. 10 N., R. 1 E., in Wilkes Hills, Toledo-Castle Rock district.

Wilkeson [coal] series[1]

Eocene: Western central Washington.

Original reference: B. Willis, 1886, U.S. 10th Census, v. 15, pls. 81, 84.

Puget Sound region.

Wilkeson Formation (in Puget Group)[1]

Eocene: Western Washington.

Original reference: Bailey Willis, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 400–436.

C. E. Weaver, 1937, Washington [State] Univ. Pubs. in Geology, v. 4, p. 55, 63, 65. Middle formation of group in Carbon River area. Lies stratigraphically below Burnett formation on South Prairie Creek and is approximately 1,000 feet thick. Overlies Carbonado formation. Formations in Carbon Canyon have been folded into anticlines and synclines with general northwesterly trend.

Typical occurrence upon the eastern dip, either in quarries along South Prairie Creek, east of Burnett or in bluffs a quarter mile east of Wilkeson, Pierce County, on north side of valley.

Wilkins Peak Member (of Green River Formation)

Eocene, lower and middle: Southwestern Wyoming.

W. H. Bradley, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 5, p. 1073–1074. Name applied to beds in Bridger basin formerly thought to be Laney shale member of Schultz (1920). Thickness about 900 feet at type locality. Overlies Tipton shale member along eastern side of Bridger basin; does not crop out on west side of basin. Everywhere underlies Laney shale member.

Type locality: Wilkins Peak, T. 18 N., R. 106 W., Sweetwater County.

Wilkinson Creek Member (of Fleming Formation)

Probably lapsus for Williamson Creek Member (of Fleming Formation).

Willamette Group[1]

Miocene: Northwestern Oregon.

Original reference: T. Condon, 1902, The Two Islands: Portland, Oreg., The J. K. Gill Co.

Named for Willamette region.

Willamette Silt

Pleistocene: Western Oregon.

R. C. Treasher, 1942, Geologic map of Portland area, Oregon (1:96,000): Oregon Dept. Geology and Mineral Resources. Referred to as Willamette terrace deposits occurring along Willamette River at elevations from 100 to 250 feet. Thickness probably as much as 150 feet.

I. S. Allison, 1953, Oregon Dept. Geology and Mineral Industries Bull. 37, p. 12–13. Name Willamette silts proposed for parallel to bedded sheets of silt and associated materials that cover the greater part of Willamette Valley lowland. At type section, silts are 9 to 13 feet thick and overlie deposits of Linn stage [Linn gravels].

E. M. Baldwin and others, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–155. In McMinnville quadrangle, Willamette silt is approximately 75 feet thick and uniform in texture; bedding is not distinct but is shown by faint color changes. Top of silt deposits reaches altitude of 160 feet throughout Willamette Valley and thinner coverings along hill slopes reach altitude of 200 feet or more; above 200 feet silt is difficult to distinguish from weathered Tertiary formations and soil.

Type locality: On right bank of Willamette River at Irish bend in southwestern Linn County.

Willamettian Stage[1] or Glacial Epoch

Pleistocene: Central northern Oregon.

Original reference: E. T. Hodge, 1930, Monthly Weather Rev., v. 58, p. 405–411.

E. T. Hodge, 1938, Geol. Soc. America Bull., v. 49, no. 6, p. 836, 841 (table 1). Third of five glacial epochs in area. Occurs in interval between Bull Run epoch and Jeffersonian.

Willapa Clays

Pleistocene: Southwestern Washington.

S. L. Glover, 1941, Washington Div. Mines and Geology Bull. 24, p. 52–53. Term adopted to designate surficial materials that occur throughout much of southwestern Washington and which are abundant in Willapa Hills region. As used, term includes vast amounts of clays, clayey sand, and decomposed gravel that masks bedrock throughout large part of nonglaciated western Washington. Commonly clays are alluvial; lacustrine and marine beds occur near coast.

Name derived from Willapa, Pacific County.

Willard Shale (in Wabaunsee Group)[1]

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: J. W. Beede, 1898, Kansas Acad. Sci. Trans., v. 15, p. 31.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull. 40, no. 9, 2274 (fig. 1), 2276. Underlies Zeandale formation (new); overlies Emporia limestone.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 12, fig. 5. Shale, gray at top, maroon near center, and black at base. Thin argillaceous limestone present about 3 feet below top. Thickness 9½ feet. Underlies Tarkio limestone; overlies Elmont limestone. Wabaunsee group.

Named for exposures south of Willard, Shawnee County, Kans.

William Henry Bay Marble

Lower Paleozoic: Southeastern Alaska.

E. C. Robertson, 1955, Geol. Soc. America Bull., v. 66, no. 10, p. 1309. White medium-grained rock. Age tentatively set as early Paleozoic.

In small inlet of same name, off Lynn Canal and about 20 miles south of Haines.

Williams Formation

Upper Cretaceous: Southern California.

W. P. Popenoe, 1937, Jour. Paleontology, v. 11, no. 5, p. 380. Named on generalized section of formations in Santa Ana Mountains. Thickness about 520 feet. Comprises two sandstone members (ascending) Schulz and Pleasants. Unconformably underlies Eocene Martinez(?); unconformably overlies Ladd formation (new).

W. P. Popenoe, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 166, 168 (fig. 2), 173. Type locality and derivation of name given.

W. P. Woodring and W. P. Popenoe, 1945, U.S. Geol. Survey Oil and Gas Inv. Prelim. Chart 12. In this report, name Schulz member has been altered to Schulz Ranch sandstone member of Williams formation. Underlies Silverado formation (new).

Type locality: Along Williams Canyon near its mouth. Formation forms summit of Cretaceous section of Santa Ana Mountains, Orange County.

Williams Member (of Deese Formation or Group)

Pennsylvanian (Des Moines Series): Central Oklahoma.

C. W. Tomlinson, 1937, Ardmore Geol. Soc. [Guidebook] Field Trip, Mar. 13, p. 1, geol. map. At type locality, includes 2 feet of impure silty fossiliferous limestone capping some 30 feet of more or less calcareous sandstones. At base of formation; underlies Natsy member (new). Name credited to Guthrey and Milner (unpub. map).

C. W. Tomlinson and William McBee, Jr., 1959, *in* Ardmore Geol. Soc., Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 35. Williams member, about 900 feet from top of Deese group, southeast of Ardmore includes 2 feet of impure silty limestone which caps some 30 feet of more or less calcareous sandstones and underlies 3 or 4 feet of calcareous shale. This is basal member of Harlton's West Arm formation, which extends upward to top of Deese group. Stratigraphically above Camp Ground member. About 300 feet below Natsy member.

Type locality: On former Williams Farm, now part of Lake Murray State Park, 100 yards north of CSL SE¼ sec. 17, T. 5 S., R. 2 E., Carter County.

Williams Brook Shale (in Ithaca Shale)

Williams Brook coquinite member[1] (of Ithaca facies subgroup)

Upper Devonian: South-central New York.

Original reference: K. E. Caster, 1933, Geol. Soc. America Bull., v. 44, no. 1, p. 202.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, p. 1768, chart 4. Termed shale and included in Ithaca shale.

Wallace de Witt, Jr., and G. W. Colton, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 12, p. 2824, 2827. At Williams Brook, about 1½ miles northwest of Ithaca, Williams Brook coquinite (Caster, 1933) is apparently at horizon of Crosby sandstone of Torrey (1932)—the horizon of Genundewa member of Genesee formation.

Occurs in Ithaca region.

Williamsburg Granodiorite[1]

Carboniferous(?): Central Massachusetts and north-central Connecticut.

Original references: B. K. Emerson, 1898, U.S. Geol. Survey Geol. Atlas, Folio 50; 1898, U.S. Geol. Survey Mon. 29, pl. 34.

M. E. Willard, 1951, Bedrock geology of the Mount Toby quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map [GQ–8]. Restricted. Gneissic rocks which occur extensively north of town of Amherst, Mass., and which Emerson (1917, U.S. Geol. Survey Bull. 597) mapped as Williamsburg are here included in Amherst schist and Joshua schist (new).

M. E. Willard, 1956, U.S. Geol. Survey Geol. Quad. Map GQ–85. In Williamsburg quadrangle, only body which fits Emerson's (1917) description is that exposed east and north of Haydenville. Dikes and sills of equigranular medium-grained biotite-muscovite granodiorite are associated with pegmatite and pegmatitic alterations of country rock. All other exposures, including those in village of Williamstown, are of mixed type. Carboniferous(?).

Named for exposures at Williamsburg, Mass.

†Williamsburg Marl[1] or Pseudobuhr[1]

Eocene, lower: Eastern South Carolina.

Original reference: E. Sloan, 1908, South Carolina Geol. Survey, ser. 4, Bull. 2, p. 449, 451, 452.

Named for exposures in Williamsburg County, near Rhems, but more extensively as mantle covering ridge between Black River and Santee River, notably on scarp of swamp southwest of Gourdin Station and on crest of ridge, 3 miles north of Salters.

Williams Canyon Limestone[1]

Mississippian: Eastern Colorado.

Original reference: A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte, 1933, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 4, p. 381–396.

J. C. Maher, 1950, U.S. Geol. Survey Oil and Gas Prelim. Chart 39; 1951, World Oil, v. 133 (Oct.), 89–91. Sequence of dolomite and limestone beds overlying Ordovician rocks and underlying Pennsylvanian rocks along Front Range has been divided in earlier reports into Williams Canyon limestone, considered Devonian in age, and Madison (or Leadville) limestone considered lower Mississippian. In this report, these

beds are considered Mississippian (Meramec?). Commonly, a thin-bedded sequence of lavender- to purple-mottled, gray to buff, finely granular to finely crystalline limestone, dolomitic limestone, dolomite, and sandy dolomite with a few thin layers of pink to lavendar fine- to medium-grained sandstone; thin beds of tan limy to sandy shale and gray platy limy shale present near middle of formation at several places; very thin bed of maroon fine sandy shale containing dolomite pebbles present at base in Priest Canyon; pinkish-white chert nodules present locally. Thickness 16 to 53 feet. Underlies Hardscrabble limestone (new); overlies Fremont limestone; both contacts unconformable.

Typically exposed near Cave of Winds in Williams Canyon at Manitou, El Paso County.

Williams Fork Formation (in Mesaverde Group)[1]

Upper Cretaceous: Northwestern Colorado and northeastern Utah.

Original references: Named by E. T. Hancock, but publication of his report was delayed, so name first appeared in U.S. Geol. Survey Press Memo. 16037, Oct. 1, 1923, on map of Hamilton and Seeping Gulch domes and vicinity, Moffat County, Colo; also used by J. D. Sears but credited to Hancock, in U.S. Geol. Survey Bull. 751, 1924, p. 290.

E. T. Hancock and J. B. Eby, 1929, U.S. Geol. Survey Bull. 812–D, p. 203–208. In Meeker quadrangle, Colorado, includes Fairfield coal group, Goff coal group, Lion Canyon sandstone member, and Lion Canyon coal group. Overlies Iles formation; unconformably underlies Wasatch formation.

P. T. Walton, 1944, Geol. Soc. America Bull., v. 55, no. 1, p. 99 (table 2), 114–117. Geographically extended into Uinta Basin, Utah. Consists of buff, brown, and white sandstone, gray, pink, and brown shale, and coal beds. Includes more than type Williams Fork. Thickness as much as 2,614 feet. Overlies Rim Rock sandstone (new). Beginning at Asphalt Ridge and proceeding eastward, formation is successively overlain unconformably by Duchesne River, Green River, and Wasatch formations.

N. W. Bass, J. B. Eby, and M. R. Campbell, 1955, U.S. Geol. Survey Bull. 1027–D, p. 157–159, pl. 19. Includes all beds between top of Trout Creek limestone member of Iles formation and base of Lewis shale. Thickness 1,100 to about 2,000 feet. Includes lower unit about 1,000 feet thick, consisting chiefly of shale, thin sandstone beds, sandy shale, and several coal beds; Twentymile sandstone member, 100 to 200 feet thick; upper unit of interbedded sandstone, sandy shale, shale, sandstone, and coal beds.

Exposed on Williams Fork Mountain and along Williams Fork near its junction with Yampa River, Moffat County, Colo.

Williamson Sandstone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen and D. B. Reger, 1914, West Virginia Geol. Survey Rept. Logan and Mingo Counties, p. 84, 165.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 108. Massive sandstone in Kanawha group.

Exposed on Williamson Creek at Williamson, Mingo County.

Williamson Shale (in Clinton Group)

Williamson Shale Member (of Clinton Formation)[1]

Middle Silurian: Central and western New York.

Original reference: J. M. Clarke, 1906, New York State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 16 (table 1), 71–79. Formation in Clinton group. Williamson shale described in Clyde and Sodus Bay quadrangles where it is lowest member of Upper Clinton group. Directly overlies Wolcott Furnace iron ore. Lower Sodus and Williamson are in contact at Rochester, but in area of this report the two are separated by upper Sodus shale, Wolcott limestone, and Wolcott Furnace iron ore. Underlies Irondequoit limestone. In Genesee Gorge, Hartnagel used term Williamson to include both the Williamson and Lower Sodus as used in this report.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13 (fig. 2), 15 (table 2), 79–84. Williamson shale enters Clinton section between Oak Orchard Creek in Orleans County and Genesee Gorge. In the gorge, formation is about 6 feet thick and is dark-green to black calcareous to slightly calcareous fissile graptolite-bearing shale. Upper part, which is predominantly dark green, contains a few limestones. The limestones are particularly evident near contact with Irondequoit. Unconformity at base of Williamson is of considerable magnitude; at Lakeport, the Williamson rests on the Sauquoit; overlaps westward progressively older formations, Wolcott Furnace iron ore, Wolcott limestone, and Lower Sodus shale. Williamson is westward equivalent of lower part of Willowvale shale of Oneida and Madison Counties.

Named for exposures at Williamson, Wayne County.

Williamson Creek Member (of Fleming Formation)

Miocene: Central Louisiana.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 118 (fig. 26), 161–164, geol. map. Consists of thick group of non-marine silts and silty clays, with incorporated sand lentils and local brackish-water clay tongues. Total thickness approximately 500 feet. Overlies Dough Hills member (new), and contact arbitrarily is placed in clayey-silt sequence where sand lentils begin to appear in abundance; underlies Castor Creek member (new), and contact is placed where sand lentils are replaced by silty clay sequence grading upward into calcareous clays.

Typically exposed in uplands within drainage area of Williamson Creek headwaters south of Dough Hills, Rapides Parish.

Williamsport Sandstone[1]

Upper Silurian (Cayugan): Northern West Virginia, western Maryland, and western Virginia.

Original reference: D. B. Reger, 1924, West Virginia Geol. Survey Rept. Mineral and Grant Counties, p. 395–398.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 149–153. Term Williamsport sandstone, applied by Reger (1924) to this sandstone when it was considered to be subdivision of Bloomsburg shale, is herein redefined as formational name. As thus interpreted, Williamsport sandstone is basal member of Cayugan group. Its identity in eastern Silurian outcrops is obliterated by, or absorbed in, red nonmarine Bloomsburg facies. Near Cumberland, Md., includes near middle, Cedar Cliff limestone member (reallocated). Abruptly overlies calcareous shales of McKenzie formation; transition unto overlying Wills Creek limestone is normally sharp. At some localities in Virginia, contacts are gradational

and the formation is more a zone of sandstones than a distinct siliceous body. Geographically extended into Maryland and Virginia.

Named for exposure on a short branch of Patterson Creek, 0.6 mile east of Williamsport, Grant County, W. Va., at point where private road turns northeast from main Williamsport-Moorefield Highway.

†Williamsport Sandstone[1]

Mississippian: Central western Indiana.

Original references: A. Winchell, 1870, Am. Philos. Soc. Proc., v. 11, p. 414–415; S. S. Gorby, 1886, Indiana Dept. Geology and Nat. History 15th Ann. Rept., p. 86.

Probably named for Williamsport, Warren County.

Williamstown Granite[1]

Devonian: Northeastern Vermont.

Original reference: E. J. Foyles and C. H. Richardson, 1929, Vermont State Geologist 16th Rept., table facing p. 288.

Probably named for Williamstown Township, or village within the township, northwestern part of Orange County.

Williamsville Dolomite Member (of Bertie Formation)

Williamsville Waterlime (in Bertie Group)

Williamsville Waterlime and Shale[1]

Upper Silurian: Western and central New York.

Original reference: G. H. Chadwick, 1919, *in* M. Y. Williams, Canada Geol. Survey Mem. 111, p. 85, 93.

D. W. Fisher and L. V. Rickard, 1953, New York State Mus. Circ. 36, p. 9, fig. 1. Rank reduced to member status at top of Bertie formation. Overlies unnamed middle member; underlies Cobleskill.

L. V. Rickard, 1955, New York State Geol. Assoc. Guidebook 27th Ann. Mtg., p. 7, 9. In central New York, considered upper member of Bertie formation. Overlies Forge Hollow member (new); underlies Cobleskill formation. Thickness 4 to 10 feet. Believed to be continuous with same unit in western New York. Cayugan series.

D. W. Fisher, 1959, New York State Mus. Sci. Service Geol. Survey Map and Chart Ser. 1. Williamsville waterlime is uppermost formation in Bertie group. Overlies Scajaquada shale or waterlime; underlies Akron dolomite. Fieldwork has not demonstrated lateral continuity of Williamsville and Oxbow dolomite (new) as shown on present chart. Thick glacial deposits conceal units in area where they may merge. For the present, distinct names are retained for western and central New York.

Probably named for exposures at Williamsville, Erie County.

Williana Formation

Williana member

Pleistocene: Central and southwestern Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 78 (fig. 6), 155–157. The series of Pleistocene deposits in Grant and La Salle Parishes is divided into four members, their names corresponding to the four distinct depositional terrace surfaces, Williana (oldest), Bentley, Montgomery, and Prairie. Williana member consists of three transitional phases: coarse phase with lenticular masses of sands and

gravels, predominantly sandy phase with local lenses of gravels, and upper silty clay phase with local sand lenses. Thickness 50 to 95 feet. Unconformably overlies Vicksburg sediments.

H. N. Fisk, 1940, Louisiana Dept. Conserv. Geol. Bull. 18, p. 176–177, pl. 1. Rank raised to formation. Described in Rapides and Avoyelles Parishes where it overlies undifferentiated Fleming formation.

P. H. Jones *in* P. H. Jones, A. N. Turcan, Jr., and H. E. Skibitzke, 1954, Louisiana Dept. Conserv. Geol. Bull. 30, p. 57, 63–65. In southwestern Louisiana, overlies Pliocene Foley formation (new).

Well exposed along U.S. Highway 167 between Mosley Hill, 2 miles north of Williana and Bentley, Grant County.

Willimantic Gneiss[1]

Pre-Pennsylvanian: Eastern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 115, 140, 141, 142.

W. G. Foye, 1949, Connecticut Geol. Nat. History Survey Bull. 74, p. 51. Restricted; igneous part of Willimantic included in Monson gneiss.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440): Connecticut Geol. Nat. History Survey. Pre-Triassic.

U.S. Geological Survey currently designates the age of the Willimantic Gneiss as pre-Pennsylvanian on the basis of a study now in progress.

Crops out in and around Willimantic, Windham County.

Willis Coal Member (of Abbott Formation)

Pennsylvanian: Southern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 31, 44 (table 1), 62, pl. 1. Assigned to member status in Abbott formation (new). Occurs above Grindstaff sandstone member and below Finnie sandstone member. Thickness 2 to 4 inches at type section of Abbott. Coal named by Charles Butts (1925, Illinois Geol. Survey Bull. 47). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois.

Type locality: SE¼SW¼ sec. 30, T. 10 S., R. 9 E., Gallatin County.

Willis Phyllite

Precambrian: Southwestern Virginia.

R. V. Dietrich, 1959, Virginia Polytech. Inst. Bull., Engineering Expt. Sta. Ser. 134, p. 74, 75, pl. 1. A highly crenulated garnet-bearing phyllite. Top of unit grades into Lynchburg formation through many hundred feet of alternating layers of phyllite like the Willis proper and layers of mica schist-gneiss indistinguishable from Lynchburg mica schist. (Lynchburg as used here may not be correlative of type locality Lynchburg). Base of Willis not recognized in Floyd County; phyllite unit may be wholly beneath the Lynchburg and may even represent a facies of Little River gneiss (new), or it may be wholly within the Lynchburg and therefore be a member of that formation. May be of same general age as some of rocks in Blue Ridge complex.

Named for the fact that it underlies Willis Ridge, Floyd County. It also is bedrock of two belts that trend east-northeast with their geographical centers on either side of Route 221 near Kings store.

Willis Sand[1]

Pliocene(?): Southeastern Texas and southern Louisiana.

Original reference: J. Doering, 1935, Am. Assoc. Petroleum Geologists Bull., v. 19, no. 5, p. 644, 656, 660.

A. W. Weeks, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1695 (fig. 1), 1702–1703. Discussed with Quaternary deposits of Texas Coastal Plain. Unconformably overlies sandstone and clay beds of Pliocene and upper Miocene age. Underlies terrace deposit herein named Gay Hill. Age of Willis not determined from fossil evidence but is here considered to be Pleistocene.

J. A. Doering, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1822. Citronelle formation of south Mississippi and Alabama, which was considered to be, in part, a residual formation is now recognized to be equivalent of Willis formation of Texas and Louisiana. Name Citronelle has priority and is here used for combined Citronelle-Willis in newly proposed classification of Gulf Coast. Pleistocene.

Named for town of Willis, 10 miles north of Conroe, Montgomery County, Tex.

Williston Formation (in Ocala Group)

Williston Member (of Moodys Branch Formation)

Eocene: Western Florida.

R. O. Vernon, 1951, Florida Geol. Survey Bull. 33, p. 141–152. Upper member of formation. Overlies Inglis member (new). Two types of marine limestone predominate: cream-colored coquina of camerinids and miliolids loosely held in calcite paste, and cream to tan-colored detrital limestone composed of quantities of small foraminifers with minor percentages of echinoids, large foraminifers, Comatulid brachials, and mollusks loosely held by secondary calcite and calcite paste. Thickness 27 to 32 feet. Underlies Ocala limestone restricted.

H. S. Puri, 1953, (abs.) Jour. Sed. Petrology, v. 23, no. 2, p. 130; 1957, Florida Geol. Survey Bull. 38, p. 29–30. Rank raised to formation in Ocala group. Overlies Inglis formation; underlies Crystal River formation (new).

Type locality: Pit in SE¼NE¼ sec. 27, T. 12 S., R. 18 E., Levy County.

Williston Limestone[1]

Upper Cambrian: Northwestern Vermont.

Original reference: Arthur Keith, 1923, Am. Jour. Sci., 5th ser., v. 5, p. 117+.

Charles Schuchert, 1937, Geol. Soc. America Bull., v. 48, no. 7, p. 1078. Age designated Beekmantown, Upper Canadian series [Lower Ordovician].

Named for exposures in western part of Williston Township about 5 miles southeast of Burlington.

Williwaw Cove Formation

Tertiary or Quaternary: Southwestern Alaska.

G. L. Snyder, 1959, U.S. Geol. Survey Bull. 1028–H, p. 173–175, pl. 23. Thick sequence of andesite and bandaite flows with minor amounts of basalt and dacite flows and major amounts of pyrocalstic material. Dikes of andesite and basalt in some areas. Pyroclastic deposits occur in beds, 1 to 40 feet thick, interbedded with the flows. Vertical sea cliff

exposures, as much as 550 feet high appear to represent a single flow. Forms base upon which all later volcanic deposits accumulated. Contact with younger rocks very irregular; locally has relief of several thousand feet. Probably late Tertiary or early Quaternary. Andesite adjacent to West Cove member (new) of Little Sitkin dacite (new) has been highly altered by fumarolic activity.

Named from exposures in sea cliffs on west side of Williwaw Cove, Little Sitkin Island, in Rat Islands group of Aleutian Islands.

Willoughby Limestone

Upper Silurian: Southeastern Alaska.

J. F. Seitz, 1959, U.S. Geol. Survey Bull. 1058–C, p. 71–72, pl. 6. Discussion of Geikie Inlet area, Glacier Bay. Limestone of Willoughby formation forms one isolated outcrop within area; relationship to other bedded rock in area not determined. In adjacent areas, Willoughby forms large conspicuous outcrops that reveal stratigraphic thickness of more than 5,000 feet.

Type locality and derivation of name not given.

Willow limestone[1]

Lower Ordovician: Eastern Nevada.

Original reference: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 53; 1924, Pan-Am. Geologist, v. 41, p. 78.

Named for exposures on east flank of Egan Range along Willow Creek, Ely region.

†Willow Creek Beds[1]

Upper Cretaceous: Eastern Colorado.

Original reference: G. T. Eldridge, 1888, Colorado Sci. Soc. Proc., v. 3, pt. 1, p. 86–112.

Named for Willow Creek, in southern part of field, 1 to 3 miles southeast of mouth of Platte Canyon, where it is well exposed.

Willow Creek facies (of Flagstaff Formation)

Paleocene, upper: Central Utah.

W. N. Gilliland, 1951, Nebraska Univ. Studies, new ser., no. 8, p. 29–30, pl. 5 (fig. B). Consists of light-gray to white very dense limestone and gray conglomerate with limestone and quartzite pebbles. Minor amounts of red shale and siltstone also included. Thickness nearly 750 feet. Three units generally recognized (ascending): conglomerate, limestone, and conglomerate. Overlies Twist Gulch formation.

In prominent hogback located just south of Willow Creek, northeast of Redmond, Gunniston quadrangle.

Willow Creek Formation[1]

Upper Cretaceous and Paleocene: Southwestern Alberta, Canada, and northwestern Montana.

Original reference: G. M. Dawson, 1883, Canada Geol. Survey Rept. 1880–1882, p. 3B–6B.

R. W. Brown, 1949, Map showing Paleocene deposits of the Rocky Mountains and Plains (1:1,000,000): U.S. Geol. Survey. Paleocene.

W. A. Cobban, 1955, Billings Geol. Soc. Guidebook 6th Ann. Field Conf. p. 108 (fig. 1), 118. Discussion of Cretaceous rocks of northwestern

Montana. Willow Creek formation overlies St. Mary River formation. Present on northwest flank of Sweetgrass arch. Little is known concerning fossil record of formation in Montana. In Alberta, according to Tozer (1953, Alberta Soc. Petroleum Geologists Guidebook 3d Ann. Field Conf.), Cretaceous-Paleocene boundary falls within Willow Creek formation.

Type section: Willow Creek, west of Granum, Alberta, Canada.

Willow Creek Rhyolite (in Alboroto Group)

Willow Creek Rhyolite (in Potosi Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

E. S. Larsen, Jr., and Whitman Cross, 1956, U.S. Geol. Survey Prof. Paper 258, p. 93 (table 18). Alboroto rhyolite described in San Juan district. Lower part consists of tridymite rhyolite which includes Campbell Mountain and Willow Creek rhyolites and probably Outlet Tunnel quartz latite [all included in Alboroto group] of Creede district.

Well exposed above Creede in canyons of Willow Creek.

Willow Lake Basalts[1]

Cenozoic: Northern California.

Original reference: Howel Williams, 1932. California Univ. Pub., Dept. Geol. Sci. Bull., v. 21, no. 8, geol. map.

O. P. Jenkins, 1943, California Div. Mines Bull. 118, p. 686. Cenozoic.

Occur in Lassen National Park.

Willow Lake Norite

Lower Cretaceous(?): Northeastern Oregon.

W. H. Taubeneck, 1957, Geol. Soc. America Bull., v. 68, no. 2, p. 191–193, 235. Medium-grained rock with banding characterized by plagioclase and mafic minerals in alternating layers in which the direction of elongation of individual crystals is essentially at right angles to the banding. Intrudes Elkhorn Ridge argillite.

Well exposed along cirque walls east of Willow Lake, in Elkhorn Mountains [Grant County]. Forms part of Bald Mountain batholith.

Willow Point Limestone (in Palo Pinto Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: J. M. Armstrong, 1929, Texas Bur. Econ. Geology, geol. map.

Named for Willow Point in southwestern part of Wise County.

†Willow River Limestone[1]

Willow River Member (of Prairie du Chien Formation)

Lower Ordovician: Central western Wisconsin.

Original reference: L. C. Wooster, 1882. Geology of Wisconsin, v. 4, p. 106, 123–129.

L. A. Thomas and C. A. Balster, 1949, Iowa Acad. Sci. Proc., v. 56, p. 236 (table 1). In discussion of micropaleontological zones in Iowa, Willow River is shown as uppermost member of Prairie du Chien. Occurs above Root Valley member and below the St. Peter.

Named for exposures on Willow River, St. Croix County.

Willow Spring Granodiorite

Willow Spring Granite[1]

Upper Cretaceous or lower Tertiary: Central Arizona.

Original reference: F. L. Ransome, 1903, U.S. Geol. Survey Prof. Paper 12.

E. D. Wilson, 1952, Arizona Geol. Soc. Guidebook for field trip excursions in southern Arizona, p. 8 (table 3). Name appears on table as Willow Springs granodiorite. Age given as Laramide (Late Cretaceous to early Tertiary).

N. P. Peterson, 1952, Arizona Geol. Soc. Guidebook for field trip excursions in southern Arizona, p. 122 (fig. 43), 124. Age of granite given as Late Cretaceous or early Tertiary.

Exposed in Willow Spring Gulch, Globe quadrangle.

Willow Spring Member (of Cove Mountain Formation)

Tertiary: Southwestern Utah.

E. F. Cook, 1960, Utah Geol. and Mineralog. Survey Bull. 70, p. 18 (fig. 1). Volcanic sediments. Thickness 0 to 50 feet. Basal member of formation. Underlies Racer Canyon tuff member (new).

Occurs in Washington County.

Willow Tank Formation

Upper Cretaceous: Southeastern Nevada.

C. R. Longwell, 1949, Geol. Soc. America Bull., v. 60, no. 5, p. 929 (table 1), 931–932, figs. 2, 3, pl. 5. Coarse conglomerate at base ranging in thickness from few feet to maximum of 30 feet. Conglomerate succeeded rather abruptly by about 300 feet of fine-grained deposits, largely gray and buff clays interspersed with layers of tuffaceous sandstone. Clays distinctly bentonitic at several horizons. Underlies Baseline sandstone (new); overlies Aztec sandstone with slight angular unconformity. Previously part of Overton fanglomerate.

Section described was measured near Willow Tank, in Muddy Mountains, about 5 miles southwest of Overton, Clark County.

Willowvale Shale (in Clinton Group)

Middle Silurian: New York.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 22 (fig. 6). Shown on cross section below Herkimer sandstone and above Sanquoit beds.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 94–96, 99. Name introduced for those rocks which occupy position between Westmoreland (oolitic iron ore) and the Kirkland (red flux iron ore). At type locality, unit is about 22 feet thick and consists of uniform dark-gray to purple thin-bedded shale which is highly fossiliferous. In vicinity of Clinton, underlies Dawes sandstone (new). Between Clinton and Lakeport, the Willowvale merges with Irondequoit and Williamson formations.

Type locality: On small tributary flowing eastward into Sauquoit Creek at village of Willowvale, Oneida County.

Wills Creek Shale (in Cayuga Group)[1]

Wills Creek Limestone or Formation

Upper Silurian: Western Maryland, central Pennsylvania, western Virginia, and West Virginia.

Original reference: P. R. Uhler, 1905, Maryland Acad. Sci. Trans., v. 2, p. 20–25.

H. P. Woodward, 1941, West Virginia Geol. Survey, v. 14, p. 8, 175–207, measured sections. Wills Creek limestone described in West Virginia, where it is 54 to 458 feet thick. Underlies Tonoloway limestone. Overlies Williamsport sandstone—Bloomsburg facies. Cayugan series, Upper Silurian. This is "Rondout limestone" of earlier reports.

H. H. Arndt and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 5, 20, 22. Thickness of formation in central Pennsylvania 400 to 650 feet. Underlies Tonoloway formation; overlies Bloomsburg formation. Silurian.

Named for exposures on Wills Creek at Cumberland, Md.

Wills Point Formation (in Midway Group)[1]

Paleocene: Eastern Texas and southern Arkansas.

Original reference: R. A. F. Penrose, Jr., 1890, Texas Geol. Survey 1st Ann. Rept., p. xliii, 17, 19.

C. W. Cooke and others, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Shown on correlation chart as overlying Kincaid formation. Paleocene.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 11 (fig. 2), 25–38, pls. "Basal or Wills Point clays" was name given by Penrose (1890) to lower Tertiary clay beds exposed in vicinity of Wills Point, Tex. Under this designation, Penrose included all beds above unconformity at top of Upper Cretaceous and below base of partly continental Sabine River strata (Wilcox). Harris (1896, Bulls. Am. Paleontology, v. 1, no. 4) noted that laminated blue and yellow clay beds exposed west of Wills Point are equivalent only to upper part of section that in Alabama was designed Midway series by Smith and Johnson (1887, U.S. Geol. Survey Bull. 43). Name Wills Point was dropped for sometime because it was considered synonymous with earlier name Midway. In 1930's name Wills Point was revived and redefined to apply only to upper part of Midway group that lies above top of Tehuacana member of Kincaid formation or its lateral equivalents in south-central to northeast Texas. In this part of Texas, the Kincaid is subdivided into (ascending) Mexia member and Kerens member containing Wortham aragonite lentil. Geographically extending into bauxite region, Arkansas [this report]. Formation is undifferentiated and consists of dark-bluish-gray to black silty clay with sideritic layers; a dark-gray calcareous mudstone containing marine microfossils at base. Thickness as much as 450 feet. Overlies Kincaid formation; underlies Berger formation (new). Paleocene.

Named for Wills Point, Van Zandt County, Tex.

Willwood Formation

Eocene, lower: Northern Wyoming.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 15, 37. Name to be proposed by Van Houten for the "Bighorn Wasatch".

F. B. Van Houten, 1944, Geol. Soc. America Bull., v. 55, no. 2, p. 178–191. Proposed for variegated shales and hornblende-bearing sandstones conformably overlying Polecat Bench formation near center of Big Horn basin, and truncating folds along western margin of area. Thickness

about 2,500 feet. Oldest Willwood deposits yield mammals of Clark Fork fauna, and the youngest, Lost Cabin mammals. Underlies Tatman formation. Late Paleocene and early Eocene.

R. L. Hay, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1871 (fig. 5), 1875 (fig. 8), 1878 (fig. 9), 1886–1888. Underlies Pitchfork formation (new). Lower Eocene.

Name derived from Willwood division of Shoshone Reclamation project in Park County, located between Shoshone River and northeastern slope of McCulloch Peaks.

†Wilmington Beds[1]

Eocene, upper, and Miocene, lower: Southeastern North Carolina.

Original reference: W. H. Dall, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 2, p. 344, chart facing p. 334.

Probably named for exposures at Wilmington, New Hanover County.

Wilmington Complex

Age not stated: Delaware, Maryland, and Pennsylvania.

R. F. Ward, 1959, Geol. Soc. America Bull., v. 70, no. 11, p. 1425–1458, pl. 1. Consists of banded gneiss comprising mafic bands of calcic plagioclase, hypersthene, augite, and commonly hornblende and thick felsic bands of quartz and andesine with minor pyroxene; in central part, gneiss has been invaded by granite [Arden] consisting of orthoclase, oligoclase-andesine, biotite, and pyroxene; to the southwest, banded gneiss grades into amphibolites. Veins of granite, apparently related to Port Deposit granodiorite, intrude southwestern part of complex; coarse-grained undeformed gabbro stock intrudes gneiss north of Wilmington; similar body of gabbro occurs as group of low hills surrounded by Coastal Plain sediments. Complex is bordered by Wissahickon formation (lower Paleozoic?) and Port Deposit granite; southern edge of complex is covered by Coastal Plain sediments.

Occupies about 100 square miles in Delaware and adjacent Pennsylvania and Maryland.

Wilmington Group[1]

Pleistocene, late: Southern California.

Original reference: R. T. Hill, 1929, Science, new ser., v. 69, p. 379–380.

Derivation of name not stated.

Wilmington Limestone[1]

Upper Ordovician (Richmond): Northeastern Illinois.

Original reference: J. R. C. Evans, 1926, Chicago Univ. Abs. Theses, Sci. ser., v. 2, p. 199–200.

Type locality not stated.

†Wilmore Limestone[1]

Middle Ordovician (Trenton): Central Kentucky.

Original reference: J. M. Nickles, 1905, Kentucky Geol. Survey Bull. 5, p. 15.

Named for exposures at Wilmore, Jessamine County.

Wilmore Sandstone Member (of Conemaugh Formation)[1]

Upper Pennsylvanian: Western Pennsylvania.

Original reference: C. Butts, 1905, U.S. Geol. Survey Geol. Atlas, Folio 133.

Exposed at top of first railroad cut west of Wilmore, on hillside west of Wilmore, about 3 miles southwest of Wilmore, Cambria County, and at other places.

Wilson Diorite or Quartz Diorite

See Mount Wilson Quartz Diorite.

†Wilson Formation[1]

Pennsylvanian: Southeastern Kansas and northeastern Oklahoma.

Original reference: F. C. Schrader and E. Haworth, 1905, U.S. Geol. Survey Bull. 260, p. 447.

U.S. Geological Survey has abandoned the term Wilson formation by the acceptance of its members or their successors as formations. Northward from Wilson County, they are included in Lansing group and upper part of Kansas City group.

Named for Wilson County, Kans.

Wilson Creek Member (of Wood River Formation)

Permian (Wolfcampian): Central and eastern Idaho.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. Youngest member of formation. Overlies Lake Creek member (new).

Deposited in Muldoon trough, aligned N. 30° W.

Wilson Ranch Beds[1]

Pliocene: Western California.

Original reference: V. C. Osmont, 1904, California Univ. Pub., Dept. Geol. Bull., v. 4, p. 74.

Probably named for exposures on a ranch in Sonoma County.

†Wilton Formation[1]

Precambrian(?): Southwestern Connecticut.

Original reference: J. G. Percival, 1842, Connecticut Geol. Survey Repts., p. 51–53, 63, map.

Covers large part of Wilton, Fairfield County.

Wimer Beds[1]

Miocene, upper: Northwestern California.

Original reference: J. S. Diller, 1902, U.S. Geol. Survey Bull. 196, p. 32–35, 47.

F. W. Cater, Jr., and F. G. Wells, 1953, U.S. Geol. Survey Bull. 995–C, p. 104. Described in Gasquet quadrangle as marine beds consisting of friable yellow shale and siltstone that weather red. Exposed at an altitude of 2,000 feet along Big Flat-Bear Basin Road just north of French Flat and at an altitude of 2,200 feet on Lower Coon Mountain.

Well exposed along old Wymer (Wimer) stage road, in sec. 20, about 13 miles northeast of Crescent City, Del Norte County.

Wimer School Limestone Member (of Labette Shale)

Pennsylvanian (Des Moines): Northeastern Oklahoma.

C. M. Cade 3d, 1953, Tulsa Geol. Soc. Digest, v. 21, p. 132 (fig. 2), 138–139. Persistent limestone in upper part of Labette. Compact massive lithographic limestone, very fossiliferous; dark gray to yellow brown, weathering to light yellow. Thickness 2 feet. Overlies greenish-yellow

calcareous shale; separated from overlying Anna shale by shale interval of varying thickness.

Type locality: On north side of Oklahoma Highway 10, one-quarter mile west of SW cor. sec. 19, T. 28 N., R. 18 E., [Craig County]. This locality is three-quarters mile west of Wimer School.

Wimsattville Formation

Tertiary, lower: Southwestern New Mexico.

R. M. Hernon, W. R. Jones, and S. L. Moore, 1953, New Mexico Geol. Soc. Guidebook 4th Field Conf., p. 118 (map), 120. Listed in table of formations. Basin-filling gravel and sand. Thickness about 1,000 feet. Unconformably underlies Rubio Peak formation (new); unconformably overlies unnamed andesite breccia.

Restricted to Wimsattville basin, Santa Rita quadrangle.

Winchell Limestone (in Canyon Group)

Winchell Formation (in Graford Group)

Winchell Member (of Graford Formation)[1]

Upper Pennsylvanian: Central northern Texas.

C. O. Nickell, 1938, Texas Univ. Bur. Econ. Geology Pub. 3801, p. 97, 104–107. Name Winchell member of Graford formation is applied to group of thin limestones separated by thick shale beds and thin sandstones in Winchell area, Brown County, which to the west develop into conspicuous limestone bed, as recorded by well logs in central Coleman County. This group of limestones includes Clear Creek limestone of Drake (1893) and of Plummer and Moore (1921, Texas Univ Bull. 2132), plus some higher beds heretofore included in Placid shale member of Plummer and Moore (1921). Thickness 50 to 72 feet. Overlies Cedarton shale member.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Rank raised to formation in Graford group. Overlies Cedarton shale; underlies Placid shale of Brad group.

D. H. Eargle, 1958, San Angelo Geol. Soc. Guidebook Apr. 17–19, p. 51; 1960, U.S. Geol. Survey Prof. Paper 315–D, p. 65–66. Shown on composite stratigraphic section of Brown and Coleman Counties as Winchell limestone in Canyon group. Underlies Placid shale member of Brad formation; overlies Cedarton shale member of Graford formation. Consists of lower unnamed limestone, light olive gray to dark yellowish brown, containing brachiopods; shale, olive gray to greenish gray to yellowish-brown and grayish-red, that contains beds of fine sand and conglomerate-filled channels which have removed lower limestone locally; upper unnamed limestone, upper part of which is light gray, thick bedded, and contains brachiopods and crinoids, lower part of olive gray, thick bedded, fine grained, and separated from upper part by shale traceable across Brown County. Thickness about 100 feet.

Named for occurrence near Winchell, Brown County.

Winchester Limestone[1]

Middle and Upper Ordovician: Central Kentucky.

Original reference: M. R. Campbell, 1898, U.S. Geol. Survey Geol. Atlas, Folio 46.

Named for Winchester, Clark County.

Windfall Formation

Upper Cambrian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 19–20, pl. 2. Proposed for rocks of Cambrian age at Eureka between Dunderberg shale below and Pogonip group, as restricted above. Formation in Windfall Canyon is close to 650 feet thick, and this figure appears to be approximately correct for whole area of outcrop. At Eureka, divided into two limestone members (ascending) Catlin and Bullwhacker (both new).

J. C. Young, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 161. In Ely district, includes Barton Canyon member (new).

Type locality: Windfall Canyon, just north of old Windfall mine, Eureka mining district, Eureka County.

Windham Sand

Pleistocene (Wisconsin): Northeastern Ohio.

G. W. White, 1960, U.S. Geol. Survey Bull. 1121–A, p. 2 (table 1), 3 (fig. 1), 7–8. Medium-grained outwash sand. Commonly 4 to 6 feet thick; in depression on pre-Windham surface, it is 30 feet or more thick as shown by well records. Unconformably overlies Kent till; underlies Hiram till. Associated with buried Lavery till.

Type section: Sand pit of Miller-Dutter Sand and Gravel Co., 2 miles northeast of village of Windham, 1 mile east of east line of Windham Township and 1½ miles south of north line of township, one-quarter mile south of Erie Railroad and 100 yards south of Garrettsville-Warren Road, Windham Township, Portage County.

Windom Member[1] (of Belvidere Formation)

Lower Cretaceous (Comanche Series): Central Kansas.

Original reference: W. H. Twenhofel, 1924, Kansas Geol. Survey Bull. 9, p. 31–32.

Named for extensive occurrence northeast of village of Windom, McPherson County.

Windom Member (of Moscow Shale)

Windom Shale[1]

Middle Devonian: Western New York and eastern Pennsylvania.

Original reference: A. W. Grabau, 1917, Geol. Soc. America Bull., v. 28, p. 946.

Bradford Willard, 1937, Am. Jour. Sci., 5th, v. 33, no. 196, p. 276. Table of Hamilton correlations in Maryland, Pennsylvania, and New York shows Windom member present in eastern Pennsylvania.

R. G. Sutton, 1951, Rochester Acad. Sci. Proc., nos. 5–6, p. 337–379, pl. 1. In Batavia quadrangle, underlies Leicester marcasite member (new). Overlies Kashong shale member.

Wallace de Witt, Jr., 1956, U.S. Geol. Survey Geol. Quad. Map GQ–96. Member described in Eden quadrangle where it is 11½ to 15½ feet thick. Overlies Tichenor limestone member of Ludlowville shale; underlies Genundewa limestone lentil of Geneseo shale.

Named for exposures near village of Windom, Erie County, N.Y.

Windous Butte Tuff

Tertiary: Eastern Nevada.

E. F. Cook, 1960, Intermountain Assoc. Petroleum Geologists Guidebook 11th Ann. Field Conf., p. 139, 140 (fig. 4). Consists of lower member, 200 to 350 feet thick, of highly welded vitric-crystal ignimbrite, dark purplish gray and red brown with black glass zone near base, and upper member, 165 to 860 feet thick, of moderately welded crystal-vitric ignimbrite, pale purple to mottled pink and gray, prominent angular quartz. Occurs above Currant tuff and below Needles Range formation. Has K–A age of 34 million years.

Present in Grant Range.

Wind River Formation[1]

Eocene, lower: Western Wyoming.

Original reference: F. T. Hayden, 1862, Am. Philos. Soc. Trans., new ser., v. 12, p. 125–127.

J. D. Love, 1939, Geol. Soc. America Spec. Paper 20, p. 63–66, pl. 17. Meek and Hayden (1862, Philadelphia Acad. Nat. Sci. Proc. 1861) were not sure of relationships of Wind River strata to others in region so they provisionally placed formation between Fort Union and White River groups. Granger (1910, Am. Mus. Nat. History Bull., v. 28, art. 21) described rocks of Bridger(?) and Uinta ages, between top of Wind River sequence and base of White River group on Beaver Divide, thus restricting usage of term Wind River to lower Eocene rocks. Wood (1934) gave name Green Cove formation to Bridger(?) beds described by Granger in Beaver Divide section. Sinclair and Granger (1911) divided lower Eocene strata of Wind River basin into Lysite and Lost Cabin "formations" on faunal basis. In present report [southern margin of Absaroka Range], Indian Mountain formation (new) is separated from lower part of original part of Wind River on the basis of both faunal and structural breaks, thus limiting usage of term Wind River to beds of upper lower Eocene age, between Indian Meadows formation and Green Cove or other middle Eocene formations in Wind River basin. As thus defined, the Wind River is a formation including only Lysite and Lost Cabin members or faunal zones. No definite structural break noticeable between two members and they are both lithologically and paleontologically so similar that they are not mappable units.

H. E. Wood 2d and others, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 24, 25, pl. 1. Includes Lysite and Lost Cabin members.

W. R. Keefer, 1956, Wyoming Geol. Assoc. Guidebook 11th Ann. Field Conf., p. 110 (fig. 1), 111–114. Described in northwestern part of Wind River basin where it is most widespread lithologic unit. Five sequences recognized: lower variegated sequence, greenish-gray and drab tuffaceous sequence, middle variegated sequence, conglomerate sequence, and upper variagated sequence. Lower three units are most widespread and are best exposed along east side of Bench Creek where they have composite thickness of 1,618 feet. Two upper units of Wind River as herein defined may be lateral equivalents of some parts of Aycross formation. Underlies Tepee Trail formation; overlies Indian Meadows formation.

H. A. Tourtelot, 1957, Smithsonian Misc. Colln., v. 134, pt. 1, no. 4, p. 4–5. Described in northeastern Wind River basin where it is divided into Lysite and Lost Cabin members, each of which consists of two facies. Underlies Tepee Trail formation.

Named for exposures in Wind River basin.

Windrock Sandstone[1]

Pennsylvanian: Northeastern Tennessee.

Original reference: L. C. Glenn, 1925, Tennessee Geol. Survey Bull. 33B, p. 327–328.

Exposed in cross-country sections from Windrock to American Knob, Morgan County.

Windrow Formation[1]

Cretaceous or Tertiary: Southwestern Wisconsin, northeastern Iowa, and southeastern Minnesota.

Original references: F. T. Thwaites and W. H. Twenhofel, 1920, Geol. Soc. America Bull., v. 31, p. 133; 1921, v. 32, p. 293–311.

C. R. Stauffer and G. A. Thiel, 1931, Minnesota Geol. Survey Bull. 29, p. 103–104. Name Windrow abandoned in southeastern Minnesota and sediments named Ostrander member of Dakota formation.

G. W. Andrews, 1958, Jour. Geology, v. 66, no. 6, p. 597–624. Here defined to include known deposits of upper Mississippi Valley which are in lithologic and mineralogic conformity with type section as described by Thwaites and Twenhofel (1921) and as described in this paper. Comprises Iron Hill member below and East Bluff member (both new). Underlain by rocks as old as Precambrian and as young as Devonian. Overlain by deposits as old as Nebraskan drift and as young as recent soil. Available evidence strongly suggests Cretaceous age.

Named for exposure on top of Window Bluff, near Tomah, Monroe County, Wis. Area of occurrence includes Driftless Area of Wisconsin, north of Wisconsin River and extends northward into older glaciated region of west-central Wisconsin; a part of glaciated region of southeastern Minnesota and northeastern Iowa.

Windy Gap Limestone Member (of Greene Formation)[1]

Permian: Southwestern Pennsylvania and northern West Virginia.

Original reference: I. C. White, 1891, U.S. Geol. Survey Bull. 65, p. 24, 30.

R. L. Nace and P. P. Bieber, 1958, West Virginia Geol. Survey Bull. 14, p. 17 (table 2). Listed in summary of stratigraphic sections of Dunkard group in Harrison County. Thickness 5 feet near top of Greene formation.

Thomas Arkle, Jr., 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 118 (table 2). Listed with members of Greene series. Occurs below Lower Proctor sandstone and above Windy Gap coal.

Named for Windy Gap, a divide separating Laurel Run branch of Fish Creek from waters of Wheeling Creek, in Springfield Township, Greene County, Pa.

Windy Gulch Rhyolite Breccia (in Potosi Volcanic Series)[1]

Miocene: Southwestern Colorado.

Original reference: W. H. Emmons and E. S. Larsen, 1923, U.S. Geol. Survey Bull. 718.

In drainage basin of Windy Gulch and to west in Creede district.

Windy Point Granite[1]

Precambrian: East-central Colorado.

Original reference: G. I. Finlay, 1916, U.S. Geol. Survey Geol. Atlas, Folio 203.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, p. 43. Summit of Pikes Peak marks position of nearly vertical stock of coarsely porphyritic quartz monzonite of mineral belt associated with Laramide revolution. South of peak a linear series of outcrops of this granite, known as Windy Point granite, shows almost horizontal contacts with underlying and earlier Pikes Peak granite.

Forms summit of Pikes Peak, El Paso County.

Wineglass Welded Tuff

Wineglass Dacite Flow

Pleistocene to Recent: Southwestern Oregon.

J. S. Diller and A. B. Patton, 1902, U.S. Geol. Survey Prof. Paper 3, p. 37–38. Wineglass dacite flow lies in gap of Crater Lake rim southeast of Round Top. It is about 1 mile long, about 50 feet wide, and about 20 feet thick. Might be considered tuff were it not for stringers of black glass intermingled with reddish groundmass containing fragments of other material and imparting a decided fluidal structure to the mass. A small sheet of this tuffaceous dacite, 10 feet thick, occurs along western edge of Cloud Cap flow (new) and closely resembles tuffaceous material of Redcloud Cliff. At the Wineglass slide it is immediately associated with pumiceous tuff. Hard rock of the rim is andesite, overlain by 15 feet of pumiceous tuff with 10 feet of red tuffaceous dacite. This is overlain by 30 feet of conglomerate and capped by fine layer of pumice 25 feet thick. Evident from this section that the fragmental dacite does not represent final eruption, for that finds expression in top layer of pumice. Gap west of Round Top contains small sheet of tuffaceous dacite like that on other side, but thicker. It is 50 feet thick in middle and tapers to thin edge on west. On east of Round Top it extends up slope a short distance, and is seen above glacial striae and is undoubtedly a post-Glacial flow. Mapped as tuffaceous dacite. Near Rugged Crest, overlaps Rugged Crest flow (new). [See Sun Creek Dacite Flow.]

Howel Williams, 1942, Carnegie Inst. Washington Pub. 540, p. 60–63, pl. 15 (fig. 1). Diller's Wineglass dacite flow or "tuffaceous dacite" named Wineglass welded tuff. At time Diller wrote, manner of deposition of such material was not known. Wineglass welded tuff is regarded as product of glowing avalanche. As the tuff and underlying lump pumice, in sections northwest of the Wineglass, are traced uphill toward Roundtop, the pumice thins to about 50 feet and the tuff to 10 feet, at the same time losing its welded character and merging into yellow, orange, or brown friable pumiceous lapilli tuff. If the tuff was once continuous over entire top of Roundtop lava (new), it has since been stripped away and is exposed only in the saddle-shaped depression over the center, where it is about 8 feet thick and is overlain by bouldery drift. In descent from Roundtop to shallow depression separating it from Palisades flow (new), the tuffaceous dacite thickens and becomes compact again and within short distance it shows same firmly welded appearance as displayed in brim of the Wineglass. In center of valley, it forms 30-foot cliff underlain by about 50 feet of incoherent white lump pumice. The two layers then continue westward over top of Palisades flow.

Beyond Palisade Point, on rise toward Rugged Crest, both pumice and welded tuff rest on margin of Cleetwood dacite. They are not present over center of Cleetwood lava. They are exposed along Rim Road, and here the tuff rests directly on crest of Cleetwood lava. South from the Wineglass, the dacite tuff extends to top of Skell Head, a distance of 2 miles, where it comes to an end. Deposit varies in thickness between 4 and 6 feet, reaching maximum of 12 feet at head of the "Champagne Glass," just before it comes to an end. Talus obscures relations at north edge of Redcloud lava (new). Presumably, the steep margin or Redcloud flow prevented tuff from spreading farther.

Type section: Forms brim of the Wineglass and the brick-red layer near top of the long slide above Grotto Cove near Crater Lake. Throughout most of its length of 4 miles, tuff makes a conspicuous cliff as much as 50 feet in height.

†Winfield dolomite[1]

Lower Ordovician: Central eastern Missouri and southwestern Illinois.

Original reference: C. R. Keyes, 1898, Iowa Acad. Sci. Proc., v. 5, p. 59, 60.

Named for Winfield County, Mo.

Winfield Limestone (in Chase Group)[1]

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

Original reference: C. S. Prosser, 1897, Kansas Univ. Geol. Survey, v. 2, p. 64–66.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 39, p. 82–88. Although name Winfield was applied because of exposures near Winfield in Cowley County, Prosser's original type exposure near Marion, in Marion County, should still be regarded as typical for formation. When formation was first named and when name was changed to Winfield, the formation included three members (ascending): Stovall limestone, Grant shale, and Cresswell limestone. Kansas Geological Survey now includes a fourth member, the Luta, above the Cresswell, Overlies Doyle shale; underlies Odell shale.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41–44. Winfield comprises (ascending) Stovall limestone, Grant shale, and Cresswell limestone members. "Luta" limestone included in Cresswell. Thickness about 25 feet. Individual members not identified in southern Kansas.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 116–119. Winfield limestone is uppermost Permian unit exposed in Pawnee County. In the western part of county, red sandstones and shales of the Doyle are capped by about 7 feet of thin-bedded sandstone, which contains thin lenticular beds of light-colored nonfossiliferous calcareous sandstone and sandy limestone. This section has been correlated with and mapped as Winfield limestone. Possibility exists that Pawnee correlative of the Winfield is the brown fossiliferous limestone in upper part of Doyle. Southern extent of formation not known. Wolfcamp series.

Named for exposures around Winfield, Cowley County, Kans.

Wing Conglomerate[1]

Lower Ordovician (Beekmanstown): Northwestern Vermont.

Original reference: H. M. Seely, 1906, Vermont State Geologist 5th Rept., p. 174–187.

Champlain Valley.

Wingate Sandstone (in Glen Canyon Group)[1]

Upper Triassic: Western New Mexico, northeastern Arizona, southwestern and western Colorado, and southeastern Utah.

Original reference: C. E. Dutton, 1885, U.S. Geol. Survey 6th Ann. Rept., p. 136, pl. 16.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936, U.S. Geol. Survey Prof. Paper 183, p. 4–5, pls. Summary of results of fieldwork in eastern Utah and adjacent parts of Arizona, New Mexico, and Colorado and revision of interpretations and correlations of Jurassic formations in area. Wingate is basal unit of Glen Canyon group which is classified as Jurassic(?). The Wingate occurs in full development in southeastern Utah, northeastern Arizona, northwestern New Mexico, and apparently across north-central New Mexico. Extends eastward into Colorado but reaches mountains only in attenuated form. Northern boundary not known; probably not represented in Nugget sandstone of Wasatch Mountains. As much as 470 feet thick but in most of extent is about 300 feet. Underlies Kayenta formation; overlies Chinle formation.

R. L. Heaton, 1937, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 8, p. 1153–1177. Results of study show that basal "Jurassic" of northern Colorado is probably part Entrada and partly Upper Triassic; that latter grades into redbeds southward and the former continues into New Mexico where it is identical with so-called Wingate. True Wingate of Zuni Mountains grades marginally into red beds and may be of Upper Triassic age.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 9, p. 1665, 1667–1668. Discussion of revised correlation of Jurassic formations in parts of Utah, Arizona, New Mexico, and Colorado and problems of stratigraphic nomenclature involved. Study indicates that Entrada sandstone extends into northeastern New Mexico, where it is the Jurassic sandstone that was designated by writers of present report and others as Wingate sandstone. Strict application of rules of priority would require that name Wingate sandstone be applied to unit heretofore called Entrada and that new name be applied to Wingate sandstone of Utah and adjacent regions. However, these names are well entrenched in literature and abandonment through principle of priority would be confusing. Therefore, name Entrada is extended to include sandstone at type locality of Wingate sandstone, and name Wingate is retained for sandstone forming lower part of Glen Canyon group, with understanding that original type locality of Wingate has been abandoned.

H. E. Gregory, 1950, U.S. Geol. Survey Prof. Paper 220, p. 49 (fig. 25), 51 (table), 76–79, pl. 2. Described in Zion Park region where it is best exposed in walls of Johnson, Hog, Kanab, Cottonwood, and Sand Canyons and in mesas and towers along southern edge of Wygaret Terrace. Forms band of massive crossbedded sandstone, gray, red, or tan, which lies between bedded red sandstones of Chinle below and Kayenta above. Thickness as much as 400 feet. Jurassic(?).

Paul Averitt and others, 1955, Am. Assoc. Petroleum Geologists Bull., v. 39, no. 12, p. 2521, 2523. Name Lamb Point tongue (new) of Navajo sandstone is applied to rocks in Kanab area formerly classified as Wingate by Gregory (1950). Unit mapped as Wingate sandstone by Wanek and Stephens (1953, U.S. Geol. Survey Oil and Gas Inv. Map OM–145) is here considered Springdale sandstone member of Moenave formation. Hence,

name Wingate sandstone is eliminated in Kanab, Utah, area. Triassic age assigned to Wingate.

J. W. Harshbarger, C. A. Repenning, and J. H. Irwin, 1957, U.S. Geol. Survey Prof. Paper 291, p. 3 (fig. 2), 8–12, pl. 2. Dutton described Wingate from exposures in cliffs north of Fort Wingate, N. Mex. In his description he refers to limestone unit in the Chinle, since referred to as Chinle "B" by Gregory (1917, U.S. Geol. Survey Prof. Paper 93). Units Chinle "B" and Wingate stand out clearly in sketch included in Dutton's report. At point shown in sketch, unit described as Wingate is 658 feet thick. Of this thickness, basal 355 feet is composed of sedimentary rocks now considered to be Wingate sandstone, as recognized throughout northeastern Arizona, southeastern Utah, and Parts of western Colorado. Upper 303 feet of Dutton's type Wingate is now recognized as Entrada sandstone of San Rafael group (Baker, Dane, and Reeside, 1947). Wingate sandstone is here restricted to lower half of Dutton's type section. In Navajo country, Wingate comprises two mappable units herein named (ascending) Lukachukai and Rock Point members. At type locality underlies Entrada sandstone; in Arizona underlies Kayenta formation or Moenave formation. Upper Triassic.

Type locality: Cliffs north of Fort Wingate, N. Mex.

Winifrede Limestone (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: R. V. Hennen, 1941, West Virginia Geol. Survey Rept. Kanawha County, p. xxvi, 641.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 108. Limestone in Kanawha group.

Exposed on South Hollow Branch of Fields Creek, south of Winifrede, Kanawha County.

Winifrede Sandstones (in Kanawha Formation[1] or Group)

Pennsylvanian: Southern West Virginia.

Original reference: I. C. White, 1908, West Virginia Geol. Survey, v. 2A, p. 271, 430.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 93, 106. Lower and Upper Winifrede sandstones included in Kanawha group.

Probably named for occurrence at Winifrede, Kanawha County.

Winifrede Underclay

Pennsylvanian (Pottsville Series): Southwestern West Virginia.

W. A. Tallon and R. G. Hunter, 1959, West Virginia Geol. and Econ. Survey Rept. Inv. 17, p. 17–18. Immediately underlies Winifrede coal. Where sampled in Kanawha County, clay is about 2 feet thick and is silty with small iron nodules.

Type locality and derivation of name not given.

Winkler Ford Limestone Member (of Grape Creek Formation)[1]

Permian: Central Texas.

Original reference: W. Kramer, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 12, p. 1581.

Crops out 0.1 mile south of northwest corner Elizabeth Aurand survey No. 1861, on road 1.2 mile southeast of that crossing on Concho River, Concho County.

Winklers Mill cyclothem

Permian: Western West Virginia.

A. T. Cross and M. P. Schemel, 1956, West Virginia Geol. Survey [Repts.], v. 22, pt. 1, p. 72 (fig. 1–61). Shown on geologic section above Washington cyclothem (new) and below unnamed cyclothem.

Present in Parkersburg quadrangle.

Winnebago Drift

Pleistocene (Wisconsinan): Northern Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 2 (fig. 1), 5. Named applied to rock-stratigraphic unit described by Shaffer (1956, Illinois Geol. Survey Rept. Inv. 198, p. 18–19) and assigned to Farmdale substage. Consists of till and outwash; occurs stratigraphically below loess below Shelbyville till and is younger than Sangamon soil. Assigned to Altonian substage (new).

Named for exposures in Winnebago County.

Winnebago Shale[1]

Winnebago Shale Member (of Burlingame Formation)

Pennsylvanian (Virgil Series): Southeastern Nebraska, southwestern Iowa, and northeastern Kansas.

Original reference: G. E. Condra, 1935, Nebraska Geol. Survey Paper 8, p. 5.

E. H. Wenberg, 1942, Iowa Acad. Sci. Proc., v. 49, p. 343 (fig. 6). Listed as Winnebago shale in insoluble residue correlations of Missouri and Virgil strata in Iowa.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 45–46. In Nebraska, Burlingame limestone includes (ascending) Taylor Branch limestone, Winnebago shale, and South Fork limestone members.

Type locality: In Missouri River bluffs south of mouth of Winnebago Creek, north of Rulo, Richardson County, Nebr.

Winnemucca Formation

Upper Triassic: North-central Nevada.

S. W. Muller, H. G. Ferguson, and R. J. Roberts, 1951, Geology of the Mount Tobin quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–7]; 1951, Geology of the Winnemucca quadrangle, Nevada: U.S. Geol. Survey Geol. Quad. Map [GQ–11]. Consists of shales and sandstones interbedded with dolomites and limestones. In Sonoma Range, lower part is shale or slate with numerous limestones and dolomite beds; sandstone prominent near top. In East Range, slate and quartzite, some limestone in upper part. Basal contact drawn at lowest prominent clastic bed. Thickness at type locality about 2,000 feet. In East Range, about 3,000 feet thick. Overlies Dun Glen formation (new) with local unconformity.

R. R. Compton, 1960, Geol. Soc. America Bull., v. 71, no. 9, p. 1387, pl. 1. In Santa Rosa Range, overlies Grass Valley formation and conformably underlies O'Neill formation (new). Thickness 600 to 1,500 feet. No persistent unit as calcareous as the Dun Glen formation occurs in Santa Rosa Range, but local thick lenses of limestone and dolomite indicate that the Winnemucca formation of Santa Rosa Range may connect laterally with both Winnemucca and Dun Glen formations of Winnemucca quadrangle.

Type locality: Mullen Canyon, west side of Sonoma Range, 8 miles south of Winnemucca, Winnemucca quadrangle.

Winneshiek limestone[1]

Lower Ordovician: Iowa.

Original reference: C. R. Keyes, 1934, Pan-Am. Geologist, v. 61, no. 3, p. 240.

†Winnfield Limestone[1]

Upper Cretaceous(?): Northwestern Louisiana.

Original reference: G. D. Harris and A. C. Veatch, 1899, Louisiana Geol. Survey Rept. 1899, pt. 5, p. 56–59.

Named for Winnfield, Winn County.

Winnipeg Formation

Winnipeg Sandstone[1]

Middle Ordovician: Surface and subsurface in Manitoba, and subsurface in Saskatchewan, Canada; and subsurface in Montana, North Dakota, and South Dakota.

Original references: D. B. Dowling, 1896, Ottawa Field Nat. Club Trans. 1895–1896, v. 11, p. 67–68; 1901, Canada Geol. Survey Ann. Rept. 11, p. 39F–46F.

H. D. Erickson, 1954, South Dakota Geol. Survey Rept. Inv. 74, p. 43–44. Name Winnipeg formation has only recently been introduced into South Dakota by oil geologists to correlate with wells drilled north of South Dakota. Name St. Peter sandstone had been used for the Winnipeg.

Georgia Macauley, 1955, Alberta Soc. Petroleum Geologists Jour., v. 5, no. 4, p. 49–52, 59. Winnipeg formation is herein defined as the shale and sandstone section which underlies the limestone of Red River formation and which rests upon Precambrian basement complex in Manitoba. In Saskatchewan and the Dakotas, formation is underlain by Cambrian sediments. No type outcrop section can be established because nowhere are both upper and lower contacts exposed in any one outcrop. , Section between 5,220 and 5,359 feet in California Standard No. 15–8 well, in Lsd. 15, sec. 18, T. 10, R. 27, West 1st Mer., could be designated as type well section, although Union Aanstad Stratigraphic Test No. 1, in sec. 29, T. 158 N., R. 62 W., North Dakota, was cored through much of the shale and sandstone, and if this core is available, may be a better type well section.

R. J. Ross, Jr., 1957, U.S. Geol. Survey Bull. 1021–M, p. 446 (fig. 68), 448–449, pl. 44. Discussion of Ordovician fossils from wells in Williston basin, eastern Montana. In subsurface, Winnipeg formation overlies Deadwood formation and underlies Red River formation of Bighorn group.

Named for exposures on islands and shores of south part of Lake Winnipeg, Manitoba, Canada.

Winnipegosis Formation (in Elk Point Group)

Winnipegosan Formation[1]

Middle Devonian: Surface and subsurface in Manitoba, Canada, and subsurface in northeastern Montana, western North Dakota, and northwestern South Dakota.

Original reference (Winnipegosan): J. B. Tyrrell, 1893, Canada Geol. Survey, new ser., v. 5, pt. 1, p. 144E–199E.

A. D. Baillie, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 2, p. 444–447; 1953, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 52–5, p. 19, 20–21, 22 (fig. 4), 24. Formation originally called Winnipegosan by Tyrrell (1892) [1893] but, because adjectival suffix has time connotation, term Winnipegosis is used in this paper to conform with usage recommended by Geological Survey of Canada and American Commission on Stratigraphic Nomenclature. In outcrop, overlies Elm Point formation and underlies Dawson Bay formation (new). Redefined in subsurface to include Elm Point limestone. Elk Point group.

C. A. Sandberg and C. R. Hammond, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 10, p. 2299 (fig. 2), 2303 (fig. 4), 2304–2306. Report deals with Devonian system of United States part of Williston basin and adjacent parts of central Montana and northern Wyoming between which deposition was continuous. In area of this report, the Winnipegosis is redefined to include deposits previously assigned to Ashern formation of Baillie (1951, Manitoba Dept. Mines and Nat. Resources Mines Br. Pub. 49–2). In the United States, the Winnipegosis is restricted to Williston basin and northeastern Montana. Ranges in thickness from fraction of a foot to about 300 feet. Lower formation of Elk Point group. Underlies Prairie formation. In Birdbear well, Dunn County, N. Dak., lies between depths of 11,438 and 11,698 feet and rests unconformably on Silurian rocks. Middle Devonian. Subsurface nomenclature of this report is for Williston basin and Montana east of 111° meridian.

Well exposed in outcrop area along shores of Lake Manitoba and Lake Winnipegosis, Manitoba, Canada.

Winnipesaukee Quartz Diorite (in New Hampshire Plutonic Series)

Winnipesaukee Gneiss[1]

Upper Devonian(?): East-central New Hampshire.

Original reference: C. H. Hitchcock, 1874, Geology New Hampshire, pt. 1, p. 508–545.

Alonzo Quinn, 1937, Geol. Soc. America Bull., v. 48, no. 3, p. 377, 378, 400. Name revived and unit redescribed as light- to medium-gray medium-grained quartz diorite. Characterized by faint foliation. Streaky in places and cut by many small pegmatite veins and aplite dikes. Locally porphyritic with plagioclase phenocrysts. Assigned to New Hampshire magma series of probable Upper Devonian age. Subdivision of Chatham granite of Billings (1928).

Alonzo Quinn, David Modell, and Louise Kingsley, 1940, Geologic map and structure sections of the Winnipesaukee quadrangle, New Hampshire (1:62,500): New Hampshire State Highway Dept. Mapped extensively in Lake Winnipesaukee area. Includes granite, granodiorite, and diorite.

Named for Lake Winnipesaukee, Belknap and Carroll Counties.

Winoka Gravel[1]

Pliocene: Southwestern Missouri.

Original reference: E. J. Park, Mabel Hays, and E. M. Shepard, 1904, Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, p. 14, 19, 41.

Named for exposures at Winoka, Greene or Christian County.

Winona Amygdaloid[1] (in Central Mine Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survery Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Winona mine, Houghton County.

Winona Conglomerate[1] (in Bohemia Range Group)

Precambrian (Keweenawan): Northern Michigan.

Original reference: A. C. Lane, 1911, Michigan Geol. and Biol. Survey Pub. 6, geol. ser. 4, p. 547, 563, 566, 576, 982, fig. 42.

Named for occurrence in Winona mine, Houghton County.

Winona Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Winona mine, Houghton County.

Winona Sand or Formation (in Claiborne Group)

Winona Sand Member (of Lisbon Formation)[1]

Eocene, middle: Mississippi.

Original reference: E. N. Lowe, 1919, Mississippi Geol. Survey Bull. 14, p. 73.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 28–33. Most authors have considered Winona greensand to be a member of either the Tallahatta or Lisbon formation. It is herein raised to formational rank. Overlies Neshoba sand member (new) of Tallahatta formation; underlies Zilpha shale. Thickness commonly 25 feet in general vicinity of type locality.

F. S. MacNeil, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim, Chart 29. Correlation chart shows Winona formation in Claiborne group. Underlies Zilpha clay; overlies Tallahatta formation, either Holly Springs sand member, Basic City shale member, or Neshoba sand member.

Named for development at Winona, Montgomery County.

Winooski Marble[1] **or Dolomite**

Lower Cambrian: Northwestern Vermont.

Original reference: Edward Hitchcock, 1861, Rept. Geol. Vermont, v. 1, p. 329.

W. M. Cady, 1945, Geol. Soc. America Bull., v. 56, no. 5, p. 525, 532, 534. Winooski dolomite restricted to dolomitic beds in Winooski Falls or Winooski village in Colchester Township. Localities near Malletts Bay, in vicinity of Ethan Allen Park in Burlington, and along lower Winooski River are in a distinctly lower stratigraphic zone. Thickness difficult to determine because faunal zone that must exist between top of formation and beds of Upper Cambrian age is not accompanied by recognized lithologic break. Top of Winooski has never been identified. For mapping purposes, top of formation is placed beneath lowest beds of typical Upper Cambrian Danby quartzite. Lower limit of formation also indistinct. Lower contact (with Monkton quartzite) is mapped through points where, passing down section, quartzite beds over 1 foot thick and separated by less than 25 feet begin to appear. Thickness: 100 to 150 feet on east slope Snake Mountain; about 600 feet at Brandon; at least

800 feet at Pittsford; about 350 feet on north slope of Snake Mountain on Buck Mountain.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 536. Discussion of St. Albans area, northwestern Vermont. Name Winooski abandoned in area. Rocks that are here assigned to Dunham dolomite have been known in this area as Winooski marble. Cady (1945) has shown that name Winooski has been applied to two distinct units and has restricted name to the younger of the two, which is above Monkton quartzite, a formation in west-central Vermont. The Winooski, as thus restricted, is not present in St. Albans area but is represented by its equivalent, Rugg Brook dolomite.

Named for exposures along Winooski River in Burlington, Chittenden County, where the marble was first quarried.

†Winslow Formation[1]

Pennsylvanian: Northwestern Arkansas and northeastern Oklahoma.

Original reference: G. I. Adams, 1904, U.S. Geol. Survey Prof. Paper 24, p. 29.

C. W. Wilson, Jr., 1935, Am. Assoc. Petroleum Geologists Bull., v. 78, no. 4, p. 511. Rocks mapped in Muskogee County, Okla., as Winslow formation on State geological map have been subdivided into units herein designated as Atoka, Hartshorne, McAlester, and Savannah formations, and lower part of true Boggy shale.

Named for exposures in and around Winslow, Ark.

Winslow Member (of Moenkopi Formation)

Lower Triassic: Northeastern Arizona.

E. D. McKee, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 86, 87 (fig. 1). Composed largely of light-colored (gray) siltstones and mudstones with considerable bedded gypsum. Contrasts strongly with red-colored overlying Holbrook member and underlying Wupatki member (new) and in slope-forming tendencies. Thickness over 50 feet.

In Winslow-Holbrook area.

Winslow shale[1]

Lower Triassic: Northern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 250, 339.

Exposed in Rio Chiquito Colorado Valley, at mouth of Rio Puerco, Navajo and Coconino Counties. Derivation of name not stated.

Winsor Formation

Winsor Formation (in San Rafael Group)

Upper Jurassic: Central Southern Utah.

H. E. Gregory, 1948, Geol. Soc. America Bull., v. 59, no. 3, p. 235; 1950, U.S. Geol. Survey Prof. Paper 220, p. 49 (fig. 25), 51 (table), 96–98, pl. 5. Consists of sandstone and very subordinate conglomerate. Bulk is unbroken series of horizontal white or yellow-white beds characterized by regularity of stratification and consistency of texture and composition. Few beds are more than 2 feet thick—most of them measured in inches—except in uppermost 50 feet where continuity is broken by inclusion of lenses of extraneous material. Thickness 180 to 300 feet in Zion Park region; 450 to 800 feet in Paria Valley. Unconformably underlies

Dakota(?) sandstone; unconformably overlies Curtis formation of San Rafael group. No fossils found. Provisionally classed as Jurassic.

C. T. Snyder, 1952, Utah Geol. Soc. Guidebook 7, p. 12. Included in San Rafael group.

R. R. Kennedy, 1960, Brigham Young Univ. Research Studies, Geology Ser., v. 7, no. 4, p. 24, 25, 26, geol. map. Unconformably underlies Tushar conglomerate (new) in Tushar Range, Piute County.

Name derived from Winsor, the original settlement at Mount Carmel, Kane County. Present in upper Virgin Valley, Orderville Gulch, Muddy Creek, Flume Canyon, and eastward along Gray Cliffs to Paria Valley at Cannonville.

Winston Dolomite[1]

Silurian (Albion Series): Northwestern Illinois and northeastern Iowa.

Original reference: T. E. Savage, 1914, Am. Jour. Sci., 4th, v. 38, p. 34–37.

C. K. Swartz and others, 1942, Geol. Soc. America Bull., v. 53, no. 4, chart 3. Shown on chart as underlying Waucoma limestone; placed in Albion series.

Named for Winston, Jo Daviess County, Ill.

Winterport (type) Granite

Age not stated: South-central Maine.

J. M. Trefethen, 1941, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2020. Described as foliated granites. Biotite streaking on foliation planes occurs locally. Older than Waldo granite.

Crops out in small masses in Bucksport quadrangle.

Winters Clay (in Allegheny Formation)[1]

Winters underclay member

Pennsylvanian (Allegheny Series): Southeastern Ohio.

[Original reference:] Wilber Stout, 1927, Ohio Geol. Survey, 4th ser., Bull. 31, p. 186–187.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 42. Considered part of Winters cyclothem (Allegheny series). Not present in area of this report, Perry County.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 11), 56. Winters underclay member of Winters cyclothm in report on Athens County. Thickness about 1½ feet.

First described in Vinton County.

Winters cyclothem

Pennsylvanian (Allegheny Series): Ohio.

N. K. Flint, 1951, Ohio Geol. Survey, 4th ser., Bull. 48, p. 40, 42. Winters clay and coal are only representatives of Winters cyclothem in area studied. Occurs above Ogan cyclothem and below Clarion cyclothem.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 56. Incomplete in Athens County [this report]. Includes Winters shale (or) sandstone members and Winters coal and underclay members. Occurs above Ogan cyclothem and below Clarion cyclothem. Allegheny series.

Named for Winters coal. Orton (1884, Ohio Geol. Survey, v. 5, Econ. geology) first used name Winters for coal in vicinity of McArthur, Vinton County.

Winters shale and (or) sandstone member

Pennsylvanian: Eastern Ohio.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 11), 56. Member of Winters cyclothem in report on Athens County. Thickness less than 2 feet. Allegheny series.

Winterset Limestone Member (of Dennis Limestone)

Winterset Limestone (in Kansas City Group)[1]

Winterset Limestone Member (of Hogshooter Limestone)

Winterset Limestone Member (of Kansas City Formation)

Upper Pennsylvanian (Missouri Series): Western Iowa, eastern Kansas, northern Missouri, southeastern Nebraska, and northeastern Oklahoma.

Original reference: J. L. Tilton, 1897, Iowa Acad. Sci. Proc., v. 4, p. 48–54.

M. C. Oakes, 1940, Oklahoma Geol. Survey Bull. 62, p. 44–47; 1952, Oklahoma Geol. Survey Bull. 69, p. 59–64. Uppermost member of Hogshooter formation in Oklahoma. Normally overlies Stark shale member but locally overlies Lost City member. Except where Canville, Stark, or Lost City members are present, Winterset lies on Coffeyville strata; underlies Nellie Bly formation.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Uppermost member of Dennis formation. Overlies Stark shale member; underlies Fontana shale member of Cherryvale formation. In Oklahoma, member of Hogshooter limestone. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 27, fig. 5. Winterset, at type section, is composed of massive upper unit commonly containing brown chert nodules changing to thin-bedded basal section. Shalley zone 4 feet from top has abundance of fusulinid *Triticites irregularis*. Thickness about 12 feet. Overlies Stark shale member; underlies Fontana shale member of Cherryvale formation.

Named for exposures at Winterset, Madison County, Iowa.

Winthrop Phyllite

Silurian: Southwestern Maine.

L. W. Fisher, 1941, Geol. Soc. America Bull., v. 52, no. 1, p. 130, pl. 1, table 1 (facing p. 112). Described as quartz-biotite phyllite. Chloritoid and garnet-staurolite facies are recognized. In middle-grade metamorphic zone. Overlies Androscoggin formation.

Type locality: A quarter mile northwest of village of Winthrop, Kennebec County. Other outcrops located along railroad on west side of Lake Marancook half mile north of village.

Winthrop Sandstone[1]

Upper Cretaceous: Central northern Washington.

Original reference: I. C. Russell, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 2, p. 100–137.

J. D. Barksdale, 1948, Northwest Sci., v. 22, no. 4, p. 165, 167–169. Described in Methow quadrangle. Conformably overlies Virginian Ridge formation (new); conformably underlies Midnight Peak formation (new). Upper Cretaceous.

Well exposed on north border of Methow Valley about 5 miles northwest of Winthrop, Okanogan County.

Winzeler Shale[1] Member (of Howard Limestone)

Pennsylvanian (Virgil Series): Southwestern Iowa, eastern Kansas, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. Guidebook 6th Ann. Field Conf., p. 20, 94, 96.

R. C. Moore, 1949, Kansas Geol. Survey Bull. 83, p. 170 (fig. 34), 174. Bluish-gray or yellowish and clayey to calcareous shale. About 3 to 8 feet thick. Underlies Utopia limestone member; overlies Church limestone member. Recognizable from Nebraska and Iowa southward to Oklahoma, but locally, where Utopia limestone disappears, the Winzeler cannot be differentiated from White Cloud shale.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 19. Occurrence, southeastern Nebraska, southwestern Iowa, and northwestern Missouri, and southward into Kansas.

Type locality: Winzeler Farm, sec. 4, T. 26 S., R. 11 E., Greenwood County, Kans.

Wiota Gravels

Pleistocene: Northwestern Montana.

R. B. Colton, 1955, U.S. Geol. Survey Geol. Quad. Map GQ–67. Name applied by Jensen (1951, U.S. Geol. Survey Open-File Rept.) to preglacial gravels deposited later than Flaxville gravel. Consist of well-rounded fragments of very fine- to medium-grained quartzite. Large part of unit is sand; lenses of silt and clay are present locally. Vary laterally from deposits that consist entirely of sand to those that contain coarse gravel. Commonly reddish brown. Thickness 1 to 30 feet; commonly 10 to 15 feet; at Wolf Point 26 feet. Overlie rocks ranging in age from Upper Cretaceous to Miocene or Pliocene. In vicinity of Wolf Point, overlie Bearpaw shale, Fox Hills, Hell Creek, and Fort Union formations, and Flaxville gravel. Capped by till as much as 20 feet thick.

Area of this report is Wolf Point quadrangle. Jensen used name in area 25 miles to west. Town of Wiota is in Valley County.

Wisconsin Glaciation, Drift, Till

Wisconsinan Stage

Wisconsin stage of glaciation[1]

Pleistocene: North America.

Original reference: T. C. Chamberlain, 1894, *in* James Geikie, The Great Ice Age, 3d ed.: London, Edward Stanford, p. 754–775.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 123–140. Five substages (subages) of Wisconsinan recognized in Kansas: Iowan, Tazewellian, Bradyan, Caryan, and Mankatoan. Four of these substages are characterized by glacial advance and retreat and are based on type localities in Mississippi Valley region. The Bradyan is interglacial interval. Wisconsinan follows Sangamonian stage and is followed by Recent stage.

J. C. Frye and A. B. Leonard, 1955, Am. Jour. Sci., v. 253, no. 6, p. 358–364. Bradyan interglacial interval is most significant break in sedimentation in Midcontinent region during post-Sangamonian time. Correlation of deposits in this interval with those of Upper Mississippi Valley Wisconsin is still tenuous and debatable. Provincial classification of post-Sangamonian time into Scandian, Bradyan, and Almenan sub-ages is proposed for use in Midcontinent region.

T. N. V. Karlstrom, 1956, U.S. Geol. Survey Bull. 1021–J, p. 304–330. Proposed that the Cochrane be considered a Wisconsin event of substage rank.

H. R. Wanless, 1957, Illinois Geol. Survey Bull. 82, p. 174–177. Wisconsin glaciation consisted of five successive glacial advances: Farmdale (oldest), Iowan, Tazewell, Cary, and Mankato. None of the glaciers reached area of this report although the Tazewell came within less than 2 miles of Glasford quadrangle. First and second glaciations are recorded by widespread loesses and the next three by glacio-fluvial, alluvial, or lacustrine deposits in Illinois Valley and its tributaries. Pleistocene epoch.

M. M. Leighton, 1957, Jour. Geology, v. 65, no. 1, p. 108–109. Discussion of Cary-Mankato-Valders problem. Wisconsin stage classified as follows (ascending): Farmdale, Iowan, Tazewell, Cary, Mankato, and Valders substages. Cochran[e] excluded from classification because it is considered that it represents a minor incident in final climactic adjustment to present interglacial stage, the Recent.

V. C. Shepps and others, 1959, Pennsylvania Geol. Survey, 4th ser., Bull. G–32, p. 22–46. Ice advanced into northwestern Pennsylvania five times during Wisconsin age. Advances occurred at least once during Tazewell substage and four times during Cary substage.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1–16. Revised time-stratigraphic classification of Wisconsinan stage of Lake Michigan lobe as used by Illinois Geological Survey consists of following substages (descending): Valderan, Twocreekan, Woodfordian (new), Farmdalian, and Altonian (new). Extrapolation from presently available radiocarbon dates suggests that Wisconsinan time started 50,000 to 70,000 radiocarbon years ago and terminated about 5,000 radiocarbon years ago. More than half this time falls within Altonian substage. New rock-stratigraphic names introduced are Roxana silt, Morton loess, and Richland loess. In terms of stratigraphic sequence, stage includes all deposits above Sangamon soil and below Recent alluvium. Although this expands definition of stage to include deposits now known to be older than type Farmdale loess, these deposits had previously been included in the Wisconsinan. Former classification of stage as used by Illinois Geological Survey was (descending) Mankato, Cary, Tazewell, Iowan, and Farmdale.

M. M. Leighton, 1960, Jour. Geology, v. 68, no. 5, p. 529–552. Wisconsin stage is classified on basis of stratigraphy into six glacial substages (ascending): Farmdale, Iowan, Tazewell, Cary, Mankato, and Valders. In this paper, names are proposed for the interglacial substages not previously designated, completing sequence as follows (ascending): Farmdale (glacial), Farm Creek (new), Iowan (glacial), Gardena (new), Tazewell (glacial), St. Charles (new), Cary (glacial), Bowmanville (new), Mankato (glacial), Two Creeks, and Valders (glacial). Paper also gives consideration to other classifications, including one

proposed by Frye and Willman (1960). Author [Leighton] does not agree with Frye and Willman.

†Wisconsin Valley Slates[1]

Precambrian (Huronian): Central northern Wisconsin.

Original references: C. R. Van Hise, 1892, U.S. Geol. Survey Bull. 86, pl. 3, map; 1892, U.S. Geol. Survey Mon. 19, pl. 1, map.

Upper part of Wisconsin River.

Wiscoy Sandstone Member (of Java Formation)

Wiscoy Member (of Chemung Formation)

Wiscoy Shale or Sandstone[1]

Upper Devonian: Western and west-central New York.

Original references: J. M. Clarke, 1897, Ann. Rept. State Engineer and Surveyor, p. 737; 1899, New York State Mus. 16th Ann. Rept., p. 31–41.

J. F. Pepper and Wallace de Witt, Jr., 1950, U.S. Geol. Survey Oil and Gas Prelim. Inv. Chart 37. Referred to as Wiscoy sandstone. At type locality, composed largely of massive greenish-gray silty mudstones and some argillaceous limestones. East of type locality, in vicinity of Arkport, Wiscoy is mainly greenish-gray siltstones and some medium-bedded sandstones. Intertongues with Hanover shale.

J. F. Pepper and Wallace de Witt, Jr., 1951, U.S. Geol. Survey Oil and Gas Inv. Chart OC–45. From Franklin Gulf eastward, an expanding wedge of Wiscoy sediments underlies Perrysburg formation (new).

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 10 (fig. 1). Considered member of Chemung formation.

Wallace de Witt, Jr., 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 12, p. 1935–1936. Wiscoy sandstone redefined as member of Java formation (new). In type section of the Java, the Wiscoy is represented by several beds of medium-gray to medium-greenish-gray argillaceous siltstone and silty mudrock in upper 15 feet of Hanover shale member. Wiscoy thickens to east as gray shale and mudrock of Hanover shale member intertongue at successively older stratigraphic horizons with medium-gray and medium-greenish-gray silty mudrock, siltstone, and very fine grained sandstone. East of central Wyoming County, upper contact of Wiscoy is clearly marked at most places by black or brownish-black shale of Dunkirk member of Perrysburg formation.

Typically exposed in valley of Wiscoy Creek at Wiscoy, Hume Township, Allegany County.

Wise Formation

Wise Formation (in Pottsville Group)[1]

Middle Pennsylvanian: Southwestern Virginia and southeastern Kentucky.

Original reference: M. R. Campbell, 1893, U.S. Geol. Survey Bull. 111, p. 28, 34.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 72–75. In Wise County, formation includes coals from High Splint (above) at top to Dorchester; underlies Harlan sandstone; overlies Gladeville sandstone. Addington sandstone occupies interval between Clinton and Addington coals.

Named for Wise County, Va.

Wise Lake Formation (in Galena Group)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 6, figs. 3, 15B. Massively bedded dolomite, pure in upper part, slightly argillaceous in lower part. Thickness about 90 feet. Comprises (ascending) Stewartville and Sinsinawa members. Shown on columnar section as underlying Dubuque formation and overlying Dunleith formation (new).

Occurs in Dixon-Oregon area.

Wisenor Formation

Lower Cretaceous: West-central California.

L. I. Briggs, Jr., 1953, California Div. Mines Bull. 167, p. 12 (fig. 2), 20–22, pls. 1, 2, 3, 4. Dark shale and thin hard carbonaceous sandstone. Thickness about 1,800 feet. Lies between Franciscan rocks of Ortigalita thrust and basal conglomerate of Panoche formation. Angular discordance exists between the Wisenor where strikes of the two formations differ, but everywhere the angle of dip of the formations is steep and approximately the same. Beds were originally included in Panoche formation by Anderson and Pack (1915). Taliaferro (1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 2) placed them in Shasta group on basis of lithology and stratigraphic position.

Named for exposures in Wisenor Hills. Area of report is Ortigalita Peak quadrangle, which is in the Coast Ranges bordering the San Joaquin Valley, about 5 miles south of Los Banos.

Wise Ridge Coal Member (of Spoon Formation)

Pennsylvanian: Southeastern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 33. 46 (table 1), 64, pl. 1. Proposed for coal formerly called Stonefort in order to restrict that name to Stonefort limestone. Thickness about 1 foot. Stratigraphically above Mount Rorah coal member (new) and below Stonefort limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼SE¼ sec. 25, T. 10 S., R. 4 E., Williamson County. Named for Wise Ridge, about 3 miles west of town of Stonefort.

Wishbone Formation

Eocene: South-central Alaska.

T. G. Payne, 1955, U.S. Geol. Survey Misc. Geol. Inv. Map I–84. Name appears only on correlation chart. Paleocene(?). Nonmarine formation in Matanuska Valley.

F. F. Barnes and T. G. Payne, 1956, U.S. Geol. Survey Bull. 1016, p. 13, 18–19, pls. 1, 2. Predominantly conglomerate composed of pebbles, cobbles, and a few boulders in sandy matrix. Includes numerous lenticular beds of sandstone, generally crossbedded and ranging in thickness from a few inches to 40 feet, and a few small lenses of silty claystone. Maximum thickness at least 1,850 feet. Overlies Chickaloon formation with gradational contact; unconformably underlies Tsadaka formation (new). Represents lower conglomeratic beds in Wishbone Hill district, mapped as Eska conglomerate by Martin and Katz (1912). Probably Paleocene, or possibly early Eocene in age.

U.S. Geological Survey currently designates the age of the Wishbone as Eocene on the basis of a study now in progress.

Named for exposures on Wishbone Hill, Wishbone Hill district, Matanuska coal field.

Wiskanian series

Cretaceous (Cretacic): Northwestern Kansas and eastern Colorado.

C. R. Keyes, 1941, Pan-Am. Geologist, v. 75, no. 5, p. 369–371. Term proposed for great section of dark shales usually called vaguely and erroneously the Pierre formation. Thickness about 1,000 feet. Covers large but indefinite part of median portion of Assiniboine centrum shales, which itself is not really a stratigraphic unit of any rank, but a term applied to great central filling of Cordillera geosyncline.

Name derived from a way-station in Wallace County, Kans.

Wissahickon Schist[1] or Formation[1]

Wissahickon Gneiss

Lower Paleozoic(?) (Glenarm Series): Southeastern Pennsylvania, Delaware, northern Maryland, and Virginia.

Original reference: F. Bascom, 1902, Maryland Geol. Survey Cecil County Rept., p. 104–108.

R. O. Bloomer, 1939, Virginia Geol. Survey Bull. 51–F, p. 141–145. In Hanover County, Wissahickon granitized gneiss is intruded by Petersburg granite. Wissahickon underlies Triassic sediments.

A. W. Postel, 1940, (abs.) Geol. Soc. America Bull., v. 52, no. 12, pt. 2, p. 2004–2005. Igneous rocks in Wissahickon schist in Philadelphia region owe their origin to two types of magmatic activity: definite magmatic intrusions into Wissahickon schist, and hydrothermal replacement of Wissahickon by potash and soda-rich intrusions. The metagabbro, the Springfield aplitic granodiorite (new), and Ridley Park granodiorite (new) are products of magmatic intrusion. Age of Wissahickon is in doubt.

A. J. Stose and G. W. Stose, 1944, U.S. Geol. Survey Prof. Paper 204, p. 39–42, 52, 54, pl. 1. Formation described in Martic overthrust block in Hanover-York district, Pennsylvania, where it is an oligoclase-biotite-muscovite schist. This schist lies on southeast side of Peters Creek quartzite. On northwest side of this quartzite, there is belt of albite-chlorite-muscovite schist regarded as different metamorphic facies of Wissahickon formation. This albite-chlorite schist occupies most of southeastern part of district. The Wissahickon lies southeast of Marburg schist and contains infolds of metabasalt. Precambrian(?) Glenarm series. Precambrian age of Glenarm series not proved.

Judith Weiss, 1949, Geol. Soc. America Bull., v. 60, no. 10, p. 1689–1726. Report deals with structure, petrology, and metamorphism of Wissahickon schist in and near Philadelphia. Area under consideration is 35 miles long and 8 miles wide, and extends from Morrisville, Pa., on Delaware River, west to Darby Creek in Delaware County. Paleozoic rocks and Baltimore gneiss form northern boundary and Delaware River southern boundary. Formation is called Wissahickon schist in order to avoid cumbersome phrase "schist and gneiss," and because prevalent structure is schistose. Name applies to those recrystallized dominantly pelitic rocks that are south of Cream Valley-Huntingdon Valley fault and Rosemont fault and that extend southwest into Delaware and Chester Counties. Deposits of unconsolidated clays, sand, and gravels of Cretaceous, Tertiary, and Quaternary age overlap Wissahickon schist to the southeast of area studied. Overlap extends

west of Delaware River. Schist is exposed along major streams and at altitudes above 100 feet; small isolated patches of gravel cover schist up to altitudes as high as 400 feet. On the north and northwest, Cream Valley-Huntingdon Valley and Rosemont faults separate schist from Precambrian Baltimore gneiss and Paleozoic sediments. These sediments are Cambro-Ordovician limestone that underlies Huntingdon Valley, Wissahickon, and Cambrian Chickies quartzite that crops out between Somerton and Edge Hill. Baltimore gneiss is older than Wissahickon schist. However, since in this region a high-angle thrust fault separates schist from northern bordering rocks, stratigraphic relation between schist and Paleozoic sediments is not clear. Age not certain.

R. O. Bloomer, 1950, Am. Jour. Sci., v. 248, no. 11, p. 753–783. In places, there appears to be complete section between Catoctin in the Blue Ridge and Wissahickon in the Piedmont of central Virginia. No continuous faults, including Martic overthrust, have been identified. Catoctin is not everywhere separated from Wissahickon or Lynchburg from Wissahickon by faults. Wissahickon is herein interpreted as Paleozoic in age and at least partly equivalent to Lower Cambrian Chilhowee group of Appalachian geosyncline.

J. W. Frondel, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1550. Recent work suggests that Wissahickon schist at Philadelphia is higher grade metamorphic equivalent of phyllitic rocks lying to northwest. The phyllite, in normal stratigraphic sequence with other Paleozoic rocks, is Cambro-Ordovician or possibly Cambrian. Assignment of Wissahickon schist to Paleozoic does not seem valid.

W. C. Rasmussen and others, 1957, Delaware Geol. Survey Bull. 6, v. 1, p. 102–104, pl. 3. Mapped in northern Delaware. Glenarm series. Precambrian(?).

A. W. Postel and H. W. Jaffe, 1957, Pennsylvania Acad. Sci. Proc., v. 31, p. 120–123. Study indicates that lead-alpha ages of zircon of Wissahickon schist are older than those of Swarthmore granodiorite (new) and related rocks, and that all ages are younger than Precambrian. Swarthmore replaces preoccupied name Springfield granodiorite.

P. W. Choquette, 1960, Geol. Soc. America Bull., v. 71, no. 7, p. 1029 (table 1). In Cockeysville area, Maryland, Wissahickon formation overlies Cockeysville formation with contact gradational. Glenarm series. Pre-Silurian.

Carlyle Gray and others, 1960, Geologic map of Pennsylvania (1:250,000): Pennsylvania Geol. Survey, 4th ser. Wissahickon formation mapped as probably Lower Paleozoic.

Named from Wissahickon Creek, in Philadelphia, Pa.

Witnet Formation[1]

Miocene, pre-middle: Southern California.

Original reference: J. P. Buwalda, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 310.

J. P. Buwalda and G. E. Lewis, 1955, U.S. Geol. Survey Prof. Paper 264–G, p. 147. Consists mainly of alternate beds of coarse gray arkose, locally bouldery, and dark sandy shale; probably of continental origin. Thickness not more than 4,000 feet. Strata steeply tilted and partly overturned. Neither top nor base exposed; at lower contact, granitic basement rocks are thrust over formation, and youngest beds are covered by

gently dipping Miocene strata that overlies upper part of Witnet with strong angular unconformity. Type section designated; derivation of name given.

Type section: Lower Oil Canyon about 1 mile above its junction with Cache Creek; NW¼ sec. 13, T. 32 S., R. 34 E., Mojave quadrangle; Tehachapi quadrangle, Kern County. Named from Witnet Ridge north of lower Oil Canyon.

Witt Coal Member (of Bond Formation)

Pennsylvanian: Central and southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 39, 50 (table 1), 71, pl. 1. Name applied to coal member stratigraphically above Flat Creek coal member (new) and below Coffeen limestone member (new). Mainly gray limestone with some gray shale. Thickness about 1 foot. Name credited to H. J. Gluskoter. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NW¼SE¼ sec. 7, T. 8 N., R. 2 W., Montgomery County. Exposed about 6½ miles due south of town of Witt.

Witt cyclothem (in Bond Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 43, 53 (table 2), 70, pl. 1. Uppermost cyclothem in formation in area. Occurs above Flat Creek cyclothem. Name credited to H. J. Gluskoter (unpub. ms.). Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: East bank of East Fork, Shoal Creek, NE¼NW¼SE¼ sec. 7, T. 8 N., R. 2 W., Montgomery County. Named from village of Witt, 6 miles north of type outcrop.

Witten Limestone

Middle Ordovician: Southwestern Virginia and northeastern Tennessee.

B. N. Cooper and C. E. Prouty, 1943, Geol. Soc. America Bull., v. 54, no. 6, p. 841–843, 877–879, 884 (fig. 3), pl. 5. In Tazewell County, strata embraced by Chazyan and Black River groups of Butts (1940, Virginia Geol. Survey Bull. 52, pt. 1) are subdivided into (ascending) 29 zones. Name Witten limestone is proposed for zones 22 through 25, or upper laminated limestone, fourth calcilutite, *Cryptophragmus* beds, and *Camarocladia* beds. Average thickness 100 feet. Intertongues with underlying Bowen formation (new); northeast of Five Oaks, Marys Chapel, and Thompson, lies disconformably on Wardell or Gratton limestone (both new). Underlies Moccasin formation. Corresponds to part, and locally to all, of Lowville limestone or Lowville limestone facies of Lowville-Moccasin formation as defined by Butts (1941, Virginia Geol. Survey Bull. 52, pt. 2).

C. E. Prouty, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 7, p. 1172–1176. Geographically extended into northeastern Tennessee. Locally, in Cumberland Plateau, calcilutite zone attains thickness of more than 500 feet.

Type section: Along State Highway 16 about one-fourth mile north of County Road 604, Tazewell County, Va. Name derived from Witten Valley Church.

Wittenberg Conglomerate[1]

Wittenberg Conglomerate Member (of Katsberg Redbeds)

Upper Devonian: Southeastern New York.

Original reference: G. H. Chadwick, 1935, Am. Jour. Sci. 5th ser., v. 29, no. 170, p. 140.

G. H. Chadwick, 1944, New York State Mus. Bull. 336, p. 135. Termed member of Katsberg redbeds. Described as white-looking and pebbly beds consisting of gray to "white" sandstones or flagstones with small amounts of red shale and red or reddish sandstones. Quartz pebbles common especially in "white" layers. Thickness about 1,250 feet on Hunter Mountain. Overlies Stony Clove sandstone member; underlies Slide Mountain conglomerate. Unit occurs about 800 feet stratigraphically below top of Katsberg as exposed on Slide Mountain. Beds are in Pocono facies and have been called "Pocono", but are older than Pocono beds of Pocono Mountains in northeastern Pennsylvania.

Best exposed on summit of Wittenberg in Catskill Mountains.

Wittenberg shale[1]

Middle Devonian: Southeastern Missouri.

Original reference: C. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 253.

Probably named for Wittenberg, Perry County.

Wizard Wells Limestone (in Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: J. M. Armstrong and G. Scott, 1930, Texas Bur. Econ. Geology map of Wise County.

In Wise County.

Woburn Formation[1]

Precambrian: Eastern Massachusetts.

Original reference: L. LaForge, 1932, U.S. Geol. Survey Bull. 839.

Named for good exposures in southwestern part of Woburn, Middlesex County.

Wolcott Limestone (in Clinton Group)

Wolcott Limestone Member (of Clinton Formation)[1]

Middle Silurian: Central and western New York, and Ontario, Canada.

Original reference: J. M. Clarke, 1906, New York State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12.

Tracy Gillette, 1940, New York State Mus. Bull. 320, p. 63–68. Formation in Clinton group. In Clyde and Sodus Bay quadrangles, overlies Sodus shale; underlies Wolcott Furnace iron ore. Consists of limestones and interbedded shales. Thickness about 20 feet. Base taken as lowest *Pentamerus*-bearing beds.

R. E. Griswold, 1950, New York State Water Power and Control Comm. Bull. GW–29, p. 13. Referred to as member of Clinton formation. In

Wayne County 15 feet thick; overlies Sodus shale member and underlies Williamson shale member.

Named for Wolcott, Wayne County, N.Y.

Wolcott Furnace iron ore[1] (in Clinton Group)

Middle Silurian: Central New York.

Original reference: G. H. Chadwick, 1918, Geol. Soc. America Bull., v. 29, p. 327–368.

Tracy Gillette, 1947, New York State Mus. Bull. 341, p. 13, 70–72, 93. Name used for all dominantly hematitic formations at top of lower Clinton group to avoid multiplicity of names. Includes Verona iron ore of Chadwick (1918). Dominantly fossiliferous at type locality. Has high calcareous content which varies noticeably between layers. At top is a thin dark-gray sandy layer with abundant phosphatic nodules. Total thickness about 1 foot. Traced westward from type locality to Second Creek where consists of 18 inches of hematitic limestone and shale. At center is a highly calcareous layer with relatively high concentration of iron; remainder of unit contains only scattered oolites of hematite. Upper limit sharp and well defined. In Wayne County, thin conglomeratic sandstone separates unit from Williamson shale above; contact with underlying Wolcott limestone everywhere gradational. Type locality described.

Type locality: In bed of Wolcott Creek at old Wolcott Furnace, 1 mile north of Wolcott village, Wayne County.

Wolf formation[1]

Precambrian: Southern British Columbia, Canada, and northeastern Washington.

Original reference: R. A. Daly, 1912, Canada Geol. Survey, Dept. Mines Mem. 38, map.

Exposed from Mount Ripple north to headwaters of Wolf Creek, in Selkirk Mountains, British Columbia.

Wolf Porphyry[1]

Post-Cretaceous: Central northern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55.

F. C. Armstrong, 1957, Econ. Geology, v. 52, no. 3, p. 221. In Little Belt Mountains, both Neihart and Flathead quartzites unconformably overlie Archean rocks, and locally the Flathead has been intruded by post-Cretaceous Wolf and Barker porphyries.

Forms intrusive mass of Wolf Butte, the peak south of it, and Mixes Baldy, east of Barker, Fort Benton quadrangle.

Wolfcamp Formation[1] **or Series**

Lower Permian: Western Texas and New Mexico.

Original reference: J. A. Udden, 1917, Texas Univ. Bull. 1753, p. 41, pl. 3.

P. B. King, 1937, U.S. Geol. Survey Prof. Paper 187, p. 94–97. Wolfcamp is oldest formation of Glass Mountains section and crops out in scattered exposures in southern foothills of the mountains. In western part of mountains, it rests with strong unconformity on older Paleozoic rocks of Marathon basin. To the east, this unconformity is no longer evident, and formation rests with no marked difference in dip or strike upon higher

members of the Pennsylvanian. Top of formation is everywhere well-marked plane of unconformity, by which it is separated from succeeding Leonard formation. Udden (1917) separated the Wolfcamp from uppermost Pennsylvanian (Gaptank) formation on the basis of fossils of Permian aspect collected at type locality. Section at Wolf Camp, as shown by Udden, includes at base shales and limestones of Pennsylvanian age, succeeded by 100 feet of shale containing ammonoids described by Böse as *Uddenites* fauna. These in turn are succeeded by a thick-bedded limestone which is here considered to be basal bed of Wolfcamp formation. Above this are several hundred feet of shales and thin limestones, which extend up to basal conglomerate of overlying Leonard formation. Since original work in the area, the Wolfcamp formation and its fossils have been studied by many geologists. Upper part of formation has been generally considered to be of Permian age, but shale containing *Uddenites* fauna has been interpreted by some paleontologists as uppermost Pennsylvanian and by others as lowermost Permian. It is here included in Gaptank formation and considered to be Pennsylvanian. Wolfcamp formation north of Wolf Camp is 583 feet thick and consists of lower gray limestone member, 49 feet thick, and upper shale member, 534 feet thick. Fossils listed at type section.

J. E. Adams and others, 1939. Am. Assoc. Petroleum Geologists Bull., v. 23, no. 11, p. 1674–1675, 1677. Permian system divided into four divisions of series rank. Wolfcamp is first and lowest of these divisions. Comprises beds that have been referred to as Wolfcamp formation (restricted), which is thus raised to series rank. In Glass Mountain, series consists of about 600 feet of limestone, limestone conglomerates, and shales. In West Texas, Wolfcamp rests with angular unconformity on rocks ranging in age from Precambrian to upper Pennsylvanian and is unconformably overlain by Leonard series. Characterized by fusulind genera *Schwagerina* s. s., *Pseudoschwagerina*, and *Paraschwagerina*. Wolfcamp equivalents include Hueco formation (restricted) of Diablo Plateau and Abo formation of New Mexico. Series in northern Oklahoma, Kansas, and Nebraska includes beds from disconformity above Brownville limestone up to horizon near top of Herington limestone. Recommended that in Oklahoma term Wanette be dropped in favor of Wolfcamp series.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 556–566, 646–650. Series is not exposed in Guadalupe Mountains but comes to surface in Sierra Diablo; here it is represented by Hueco limestone. Local representative of series is Wolfcamp formation, which is about 600 feet thick and consists of alternating thick beds of shale and thin beds of limestone. Base of formation is defined as bottom of gray limestone member about 45 feet thick, which lies directly on *Uddenites*-bearing shale member at top of Gaptank formation. At type locality and elsewhere in Glass Mountains, Wolfcamp formation is unconformably overlain by Leonard formation of Leonard series.

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 41. Wolfcampian series, formerly called Big Blue series, contains older Permian rocks of Kansas. Outcrop thickness in Kansas about 785 feet.

C. A. Ross, 1959, Washington Acad. Sci. Jour., v. 49, no. 9, p. 299–311. Wolfcamp series in Glass Mountains, Tex., is represented by sequence of diverse lithologies and includes regional unconformity. Detailed study reveals that two formations can be recognized in field and

that both units are within "zone of *Pseudoschwagerina*." Each formation has characteristic fusulinid fauna. Nealranch formation (new) embraces upper part of beds originally called Wolfcamp by Udden (1917) in Wolf Camp Hills and is renamed to retain this widely used name for time-stratigraphic unit, Wolfcamp series. Lenoxhills formation (new) unconformably overlies Nealranch formation and is upper formation of Wolfcamp series in Glass Mountains. It was in part included in Wolfcamp formation of King (1931, Texas Univ. Bull. 3080) where it crops out in western Glass Mountains and is now known to be present across southern escarpment of eastern Glass Mountains, and is lower 200 to 300 feet of Hess formation of Udden (1917). Exact placement of top of Pennsylvanian system in Glass Mountains has long been major controversy. Fusulinid faunas of Cisco (Virgil) age are known from strata as high as "grey limestone" of King (1931 and 1937). In Wolf Camp Hills, the Nealranch (300 to 470 feet thick unconformably) overlies the "grey limestone" and contains oldest *Schwagerina* and *Pseudoschwagerina* faunas thus far discovered in Glass Mountains. Boundary between Permian and Pennsylvanian systems is taken at this unconformity. The "grey limestone" of King (1931) contains youngest Pennsylvanian fauna in Wolf Camp Hills and includes *Triticites comptus* n. sp., *T. ventricosis* (Moller), *T. pinguis* Dunbar and Skinner, and *T. koschmanni* Skinner.

G. V. Cohee, 1960, Am. Assoc. Petroleum Geologist Bull., v. 44, no. 9, p. 1578-1579. U.S. Geological Survey recognizes two-fold subdivision of Permian system and period. The divisions (Lower and Upper series and Early and Late Epochs) coincide as nearly as possible with those recognized in type Permian and are drawn according to existing concepts of biotic correlation with type sequence. Reference sequence of United States is Permian outcrops of northwestern Trans-Pecos Texas (Delaware Mountains, Guadalupe Mountains, and Sierra Diablo Mountains) where approximate faunal boundary is taken as that between Cherry Canyon and Bell Canyon formations which are encompassed by Guadalupe provincial series. Boundary falls between Word and Capitan formations as recognized in Glass Mountains area. West Texas provincial series, Wolfcamp, Leonard, Guadalupe, and Ochoa, are retained according to current usage.

C. C. Branson, 1960, Oklahoma Geology Notes, v. 20, no. 9, p. 229–235. Name Lyon series (Lyonian epoch) proposed for American standard early Permian(?) rocks. Kansas section of rocks of Sakmarian age is complete and well exposed over wide and accessible area, including parts of Oklahoma and Nebraska. Name Wolfcamp and time term Wolfcampian should not be used in Kansas, Oklahoma, and Nebraska.

Named for Wolfcamp, site of an old dwelling place, just south of the two buttes, located 6½ miles east and 2 miles north of east of Leonard Mountain. Wolf Camp Hills are at base of south face of Glass Mountains, 12 to 14 miles northeast of Marathon, Brewster County, Tex.

Wolfcampian Series or Stage

See **Wolfcamp Formation or Series.**

Wolf Creek Conglomerate Lentil (in Cattaraugus Formation)[1]

Wolf Creek Conglomerate (in Conewango Group)

Devonian: Southwestern New York.

Original reference: C. S. Prosser, 1892, Rochester Acad. Sci. Proc., v. 2, p. 54–57, 64, 93–95.

J. G. Woodruff, 1942, New York State Mus. Bull. 326, p. 54–63. In Wellsville quadrangle, conglomerate which is lowest bed carrying Conewangan fauna is tentatively called Wolf Creek conglomerate member of Cattaraugus. Underlies Salamanca conglomerate member; overlies Germania formation.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Upper Devonian.

I. H. Tesmer, 1955, New York State Mus. Sci. Service Circ. 42, p. 19. Panama and Wolf Creek conglomerates and sandstones are contiguous. Panama has priority; name Wolf Creek is abandoned.

L. V. Rickard, 1957, New York Geol. Assoc. Guidebook 29th Ann. Mtg., p. 17 (table 2), 19. Referred to as Wolf Creek conglomerate in Conewango group. In Genesee Valley, overlies Germania formation and underlies Cattaraugus shales. Average thickness about 30 feet. Upper Devonian; Chautauquan series.

Named for occurrence on Wolf Creek, west of West Clarksville, Allegany County.

Wolf Creek Dolomite[1] (in Arbuckle Group)

Ordovician: Southern Oklahoma.

Original reference: C. E. Decker, 1933, Tulsa Geol. Soc. Digest, p. 55–57.

C. E. Decker, 1939, Geol. Soc. America Bull., v. 50, no. 9, p. 1313. Preoccupied name Wolf Creek dolomite replaced by Strange formation.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 108. Abandoned by Oklahoma Geological Survey. Name preoccupied. Unit named Wolf Creek by Decker is probably Butterly dolomite.

Occurs in Arbuckle and Wichita Mountains.

Wolfe City Sand Member (of Taylor Marl)[1]

Wolfe City Sand or Formation (in Taylor Group)

Upper Cretaceous: Northeastern Texas.

Original reference: L. W. Stephenson, 1918, U.S. Geol. Survey Prof. Paper 102–H, p. 155.

H. B. Stenzel, 1938, Texas Univ. Bur. Econ. Geology Pub. 3818, p. 38, 39 (fig. 4), 41–42 [1939]. Rank raised to formation in Taylor group. Gray fine calcareous argillaceous partly glauconitic sand or sandy marl. Thickness near Wolfe City 75 to 100 feet. Underlies Pecan Gap chalk; overlies unit referred to as lower Taylor marl.

J. T. Rouse, 1944, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 4, p. 524. Wolfe City sand (formation) described along belt of outcrop from Collin County eastward into Red River County. Name sand is confusing because in many localities formation is arenaceous clay, marl, or sandy chalk rather than sand; sandy facies is best developed in vicinity of Wolfe City. Thickness 200 to 300 feet. Underlies Pecan Gap chalk; correlated with Annona chalk.

H. R. Blank, N. L. Stoltenberg, and H. H. Emmerich, 1952, Texas Bur. Econ. Geology Rept. Inv. 12, p. 5, 10 (table 1), 11–12. Member described in Blacklands experimental watershed, near Waco. Consists of basal sandy marl about 100 feet thick and upper silty marl about 40 feet. Un-

conformably underlies Pecan Gap member. Lowest strata outcropping in area.

Named for exposures at Wolfe City, Hunt County.

Wolf Hollow Limestone Member (of Tribes Hill Formation)

Lower Ordovician (Lower Canadian): East-central New York.

D. W. Fisher, 1954, Geol. Soc. America Bull., v. 65, no. 1, p. 76 (fig. 2), 87–88. Name proposed for typically very massive thick-bedded white-weathering blue-black dolomitic calcilutite in upper part of formation. Spatterings of dolomite form buff-weathering raised reticulate markings; these have erroneously been called siliceous matter. A stratum of dolomite a few feet above base contains pockets of white, yellow, and pink calcite. Thickness 28 feet at type section; fairly uniform from one section to another. Underlies Fonda member (new) of formation in Mohawk Valley.

Type section: Abandoned quarry and field exposure 2 miles north of Greens Corners in Amsterdam quadrangle. Named for narrow north-south-trending trenchlike valley 3 miles southeast of type locality.

Wolf Lake Granite[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: R. C. Allen and L. P. Barrett, 1915, Michigan Geol. and Biol. Survey Pub. 18, geol. ser. 15, p. 131–139.

Named for occurrence in vicinity of Wolf Lake, Gogebic County.

Wolf Lake Schist[1]

Precambrian (upper Huronian): Northwestern Michigan.

Original reference: R. C. Allen and L. P. Barrett, 1915, Michigan Geol. and Biol. Survey Pub. 18, geol. ser. 15, p. 131–139.

Occurs in Wolf Lake area, Gogebic County.

Wolf Mountain Granite

[Precambrian]: Central Texas.

R. E. McAdams, 1936, Am. Mineralogist, v. 21, p. 128–135. Name used in discussion of accessory minerals of Wolf Mountain granite mass or intrusive. Apparently same age as Lone Grove granite and probably older than Bear Mountain granite (new).

Wolf Mountain intrusive, approximately 30 square miles in area, is north and west of Llano, Llano County.

Wolf Mountain Shale Member (of Graford Formation)[1]

Pennsylvanian: Central northern Texas.

Original reference: F. B. Plummer and J. Hornberger, Jr., 1936, Texas Univ. Bull. 3534, p. 48–55, map.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1). Correlation chart shows Graford group comprises (ascending) Adams Branch, Cedarton shale, and Ranger limestone. Wolf Mountain shale shown equivalent to Adams Branch and Cedarton.

Typically exposed below capping Merriman limestone in slopes of Wolf Mountain, 4 miles west-northwest of Palo Pinto, Palo Pinto County.

Wolfpen Tonalite[1]

Devonian(?): Eastern Massachusetts.

Original reference: B. K. Emerson, 1917, U.S. Geol. Survey Bull. 597, p. 170, 171, map.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 12. In type locality of Marlboro formation, oldest unit in contact with Marlboro is Wolfpen tonalite of Devonian(?) age.

Well exposed in Wolfpen Hill in Southboro, Worcester County.

Wolf Ridge Sandstone Member (of Pottsville Formation)[1]

Pennsylvanian: North-central Alabama.

Original reference: C. Butts, 1927, U.S. Geol. Survey Geol. Atlas, Folio 221.

Named for fact that it forms Wolf Ridge.

Wolf River Limestone[1] Member (of Topeka Formation)

Pennsylvanian (Virgil Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: G. E. Condra and E. C. Reed, 1937, Nebraska Geol. Survey Bull. 11, 2d ser., p. 7, 12, 16, 20, 24, 26, 30, 33, 51–52, figs. 1, 2.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 21. Condra and Reed (1937) were uncertain regarding relation of the Hartford of southern Kansas to lower member of the Topeka in northeastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa so proposed name Wolf River for basal member of the Topeka in this area. Nebraska Survey will drop name Wolf River if it proves to be correlative with the Hartford, which was loosely defined by Kirk (1896) and may have priority if it does not include beds of Du Bois, Iowa Point, and Wolf River age.

Type locality: Missouri River bluffs just east of mouth of Wolf River north of Sparks, Doniphan County, Kans.

Wolfskill Formation

Pliocene: Northwestern California.

C. E. Weaver, 1949, Geol. Soc. America Mem. 35, p. 16 (table 3), 94–97, pls. 7, 8, 12. Consists of conglomerates, sandstones, and interbedded deposits of andesitic tuffs, all continental; poorly consolidated. Approximately 500 feet thick. Unconformably overlies San Pablo group, Lawlor tuff, and Neroly sandstone; east of Putah Creek overlaps on the Markley sandstone. Unconformably underlies Montezuma formation (new).

N. L. Taliaferro, 1951, California Div. Mines Bull. 154, p. 147. Suggests that name Wolfskill be abandoned in favor of Tehama since Wolfskill, as mapped and defined, is continuous with the Tehama and name Tehama has priority.

Named from Wolfskill Station between Vacaville and Winters in northwest Vacaville quadrangle. Formation mapped on western slope of Vacaville Hills, Potrero Hills, western border of Montezuma Hills, and north slope of Los Medanos Hills. Type section not designated, but unit typically exposed in extreme northeast corner of Mount Vaca quadrangle and northwest corner of Vacaville quadrangle along highway which follows south side of Putah Creek.

Wolsey Shale[1] or Formation

Wolsey Shale (in Gros Ventre Group)

Wolsey Shale Member (of Gros Ventre Formation)

Middle Cambrian: Western Montana and northwestern Wyoming.

Original references: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55; 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 285–286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1276, 1328–1330, strat. sections. Weed's original definition emended; new type section designated as exposure referred to by Weed, near dam on Sheep Creek, is now covered. Conformably overlies Flathead sandstone (emended) wherever these formations are exposed in Montana and Yellowstone National Park; underlies Meagher limestone (emended). Deposit clearly transitional between subjacent and superjacent formations. Lower part of Wolsey is dominantly dull-green to greenish-gray shale, interbedded with thin lenses of sandstone; worm trails, *Cruziana*, and borings common. Middle part of formation is nearly pure micaceous paper-thin shale and occasional thin platy intercalated beds of rusty-weathering sandstone, which in upper part is often slightly calcareous and usually contains worm borings; several zones of chocolate-brown fissile shales interbedded with the characteristically green shales; intercalated limestone lenses. Upper third consists of fissile shales, dominantly chocolate- to maroon-brown in upper part; intercalated thin beds of gray crystalline limestone, which contain iron and glauconite; fossils present in the limestone lenses and in fissile maroon and green shales, and are largely concentrated into two zones. In type section, upper of these two zones occurs 10 to 24 feet below top of Wolsey, and lower occurs 25 to 50 feet below upper zone. Thickness at type section 174 feet; maximum thickness 363 feet, Beaver Creek. Type section of emended Wolsey is on south end of South Hill in Belt Park; best exposure is on Crowfoot Ridge, Yellowstone National Park. [See Flathead Quartzite.]

Charles Deiss, 1938, Geol. Soc. America Bull., v. 49, no. 7, p. 1089. Deiss (1933, Montana Bur. Mines and Geology Mem. 6) divided Cambrian rocks of northwestern Montana into 11 formations. Second in sequence was Wolsey shale. This sequence is herein revised, and Walcott's name Gordon is used instead of Wolsey for shale which lies upon Flathead sandstone and underlies Damnation limestone (redefined).

A. B. Shaw and P. O. McGrew, 1954, Wyoming Geol. Assoc. Guidebook 9th Ann. Field Conf., Chart 2. Gros Ventre group in western Wyoming includes three mappable formations (ascending): Wolsey shale, Death Canyon limestone, and Park shale.

H. R. Wanless, R. L. Belknap, and Helen Foster, 1955, Geol. Soc. America Mem. 63, p. 12–13. In this report, the Wolsey is considered basal member of Gros Ventre formation. Underlies Meagher limestone member; overlies Flathead sandstone. Thicknesses: 86 feet, Gros Ventre Range; 134 feet, Teton Range; 607 feet, Snake River Range.

M. R. Klepper, R. A. Weeks, and E. T. Ruppel, 1957, U.S. Geol. Survey Prof. Paper 292, p. 8, pls. 1, 2, 3. Five lowest natural Cambrian map units in southern Elkhorn Mountains are lithologically similar to Flathead sandstone, Wolsey shale, Meagher limestone, Park shale, and Pilgrim dolomite of nearby areas, as redefined by Deiss (1936), and these formational names have been adopted. Wolsey shale is 368 feet thick; underlies Meagher limestone, and overlies Flathead quartzite. Upper half of unit is interbedded gray argillaceous limestone and greenish- and yellowish-gray calcareous mudstone and shale; lower half is greenish-gray and drab shale with some interbeds of sandstone and limestone; many beds micaceous, some glauconitic.

Type section (emended): South end of South Hill Belt Park. Little Belt Mountains. Keegan Butte is in central part of sec. 15, T. 14 N., R. 7 E.,

and isolated hill immediately to south, called South Hill (Deiss, 1936), is in central part of sec. 15, in same township and range. Keegan Butte is near southern edge of Fort Benton quadrangle. and south Hill is near northern edge of Little Belt Mountains quadrangle. Both are from 4 to 6 miles west of Belt Creek section. Field evidence indicates Weed meant South Hill to be type locality of Wolsey, but that he took name Wolsey from post office of that name at a ranch on Sheep Creek. Post office no longer in existence. Named for exposures at dam on Sheep Creek near Wolsey, Meagher County, Mont.

Wolverine Sandstone[1] (in Portage Lake Lava Series)

Precambrian (Keweenawan): Northern Michigan.

Original reference: L. L. Hubbard, 1898, Michigan Geol. Survey, v. 6, pt. 2, p. 77, 81, 93.

W. S. White, H. R. Cornwall, and R. W. Swanson, 1953, U.S. Geol. Survey Geol. Quad. Map GQ-27. Included in Portage Lake lava series.

Named for outcrops near Wolverine mine, Houghton County.

Wolverine Canyon Limestone Member (of Preuss Sandstone)

Upper Jurassic: Southeastern Idaho.

R. W. Imlay, 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 9, p. 1741–1743. Consists mainly of yellowish gray sandy thin- to medium-bedded limestone but including some yellowish thin-bedded sandstone and containing, a little above the middle, one prominent unit of cliff-forming oolite 14 feet or more in thickness. Upper part of oolite crumbly and less massive then lower part and bears corals and algal-like markings or, locally, numerous gastropods and pelecypods. Member is 193 feet thick at type section, where it is bounded above and below by sandstones of the Preuss.

Type section: North slope of Wolverine Canyon is west-central part of sec. 27, T. 1 S., R. 39 E., Bingham County. Main area of outcrop is in Ammon quadrangle from Wolverine Canyon northward 5 miles to headwaters of Henry Creek. Excellent exposures occur along ridges at head of Dry Fork of Henry Creek.

Womac Coal Member (of Modesto Formation)

Pennsylvanian: Southwestern Illinois.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 37, 38, 49 (table 1), 68, pl. 1. Proposed for coal formerly called Macoupin coal. Name Macoupin restricted to Macoupin limestone. Thickness 8 inches. Stratigraphically above Burroughs limestone member and below Macoupin limestone member. Presentation of new rock-stratigraphic classification of Pennsylvanian of Illinois. Cyclical classification retained but is entirely independent of rock-stratigraphic classification.

Type locality: NE¼NW¼ sec. 2, T. 9 N., R. 7 W., Macoupin County. Named for village of Womac approximately 3 miles northeast of type exposure.

Womack Gneiss[1]

Precambrian: Eastern Colorado.

Original reference: L. C. Graton, 1906, U.S. Geol. Survey Prof. Paper 54.

Named for Womack Hill, at east edge of town of Cripple Creek, Teller County.

Womble Shale,[1] Schistose Sandstone,[1] or Formation

Lower and Middle Ordovician: Southwestern Arkansas and southern Oklahoma.

Original reference: H. D. Miser, 1917, U.S. Geol. Survey Bull. 600, p. 67.

August Goldstein, Jr., and T. A. Hendricks, 1953, Geol. Soc. America Bull., v. 64, no. 4, p. 424 (fig. 2). Formation consists of shale, black to green, with thin layers of limestone and argillaceous sandstone in Arkansas. Predominantly schistose, micaceous, chloritic sandstone in McCurtain County, Okla. Thickness 250 to 1,000 feet. Underlies Bigfork formation; overlies Blakely formation.

W. D. Pitt, 1955, Oklahoma Geol. Survey Circ. 34, p. 23, 24–25. Womble shale, as defined in this report (core of Ouachita Mountains), includes stratigraphic interval between Mazarn shale below and Bigfork chert above. As originally defined, Blakely sandstone lies stratigraphically above Mazarn shale and below Womble shale. A series of beds distinct lithologically from Mazarn shale below and Womble siltstone above was noted at some localities. This [unit] could be designated as separate formation, but if it were designated in this way, it is recommended that it not be called Blakely because of findings of current field work in Blakely sandstone type area in Arkansas.

Type section: Crystal Mountain, Ark. Named for town of Womble (now called Norman).

Wompats limestone[1] (in Aubreyan series)

Carbonic: Northern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, p. 251, 339.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (chart), 223, Underlies Kanab limestones (new). Of Carbonic age. Spelled Wombats on page 223.

Named for Wompats Spring, northeast of great Shinumo Amphitheater, Grand Canyon.

Wonder Rhyolite[1]

Tertiary: Central western Nevada.

Original reference: J. A. Burgess, 1917, Econ. Geology, v. 12, no. 7, p. 589–593.

Quarried in Nevada Wonder mine, Wonder district, Churchill County.

Wonder Lake Glaciation

Pleistocene: South-central Alaska.

A. T. Fernald, 1960, U.S. Geol. Survey Bull. 1071–G, p. 232 (chart). Named on correlation chart. Correlated with Farewell, Riley Creek, and Donnelly glaciations. Younger than Slow Fork glaciation (new). Name credited to J. C. Reed, Jr.

In Mount McKinley area.

Wood Shale Tongue (of Ankareh Formation)

Wood Shale[1]

Upper Triassic: Southeastern Idaho, central northern Utah, and central western Wyoming.

Original references: G. R. Mansfield, 1915, Washington Acad. Sci. Jour., v. 5, p. 492; 1916, Washington Acad. Sci. Jour., v. 6, p. 41.

J. S. Williams, 1945, Am. Jour. Sci., v. 243, no. 9, p. 473, 476–477. Use of term Wood shale extended to Park City area, Utah, to replace upper part of Ankareh shale, latter being stratigraphically restricted. Upper Triassic.

G. R. Mansfield, 1952, U.S. Geol. Survey Prof. Paper 238, p. 17, 35, pl. 1. Type locality designated. Mapped in Ammon and Paradise Valley quadrangles where rock is primarily bright-red sandy shale or shaly sandstone. Locally contains purplish and green shale in addition to red beds.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 180, 181, fig. 18. Unit considered to be westward extending tongue of Ankareh formation in western Wyoming and southeastern Idaho. Thickness approximately 250 feet at Spring Canyon, 40 feet at Cokesville, and 400 feet at Hot Springs. Upper Triassic.

Type locality: On Wood Creek, from which unit takes its name, in T. 3 S., R. 38 E., less than 2 miles west of Paradise Valley quadrangle, Idaho.

Woodbine Sand,[1] Clay,[1] or Formation

Woodbine Group

Upper Cretaceous (Gulf Series): Texas, southwestern Arkansas, western Louisiana, and central southern and southeastern Oklahoma.

Original reference: R. T. Hill, 1901, U.S. Geol. Survey 21st Ann. Rept., pt. 7, p. 293.

R. T. Hazzard, B. W. Blanpied, and W. C. Spooner, [1947], Shreveport Geol. Soc. 1945 Reference Rept., v. 2, p. 475, 476, 477, 480. Woodbine group comprises (ascending) Euless formation (new) with basal Dexter sand member, Lewisville formation with basal Pine Bluff tuffaceous gravelly member, and Eagle Ford formation with Tarrant member. Unconformably overlies South Tyler formation (new); unconformably underlies Austin chalk.

H. R. Bergquist, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 98. Formation crops out in belt a few miles wide to form Eastern Cross Timbers area between Black and Grand Prairies of northeastern Texas. Belt extends northward from Hill County nearly to the Red River, but from northeastern Cooke County, it trends southeast across Grayson County into northwestern part of Fannin County. Along this belt, formation consists of varied and interlensing sequence of nonmarine, brackish water, and marine beds of sand, shale, clay, and sandstone about 350 feet thick. Seemingly lies unconformably on Washita group and older beds of Comanche series. At some places, Grayson marl appears to grade upward into Woodbine and it is difficult to determine where unconformity occurs. At these places, Woodbine appears to be conformable with fossiliferous clay and shale younger than Grayson marl. Top of Woodbine of Red River area is about 40 or 50 feet below base of *Metoicoceras whitei* zone of lower Eagle Ford shale. Sequence exposed in Cooke, Grayson, and Fannin Counties is divided into (ascending) Dexter, Red Branch (new), Lewisville, and Templeton (new) members.

W. S. Adkins and F. E. Lozo *in* F. E. Lozo, 1951, Fondren Sci. Series, no. 4, p. 105–161, pls. Report is symposium on Woodbine group and adjacent strata. Relationships of Woodbine with Eagle Ford and Comanchean beds discussed in detail. Pepper shale is believed to be southward

continuation of part of Woodbine group (Lewisville formation) in north-central Texas. In Dallas, McLennan, and Travis Counties, the Woodbine underlies Lake Waco formation (new).

L. W. Stephenson, 1952, U.S. Geol. Survey Prof. Paper 242, p. 1–226, pls. Woodbine formation, as originally defined, is made up of deposits laid down in fresh, brackish, and very shallow marine waters. Formation intervens between deeper marine facies of Comanche series below and Eagle Ford and younger formations above. Basal unit of Woodbine is Dexter member which consists chiefly of nonmarine sands interbedded with clays, but includes also important marine fossil-bearing zones in Tarrant and Denton Counties. Dexter is overlain in different areas by nearly contemporaneous nonmarine carbonaceous shales and tuffaceous sandstones of Red Branch member and marine shaly beds of Euless member. These in turn are overlain by marine sandy shales and sandstones of Lewisville member, and these by marine shales and minor sands of Templeton member. Hazzard, Blanpied, and Spooner's classification discussed and reasons cited for not accepting it. As used in present report, name Euless member is restricted to an upper shale unit between Dexter member and Lewisville member. So-called Pine Bluff member is part of Lewisville member and "Tarrant" unit is also considered part of Lewisville. Systematic description of larger invertebrate fossils.

L. W. Stephenson, 1953, U.S. Geol. Survey Prof. Paper 243–E, p. 57–66, pls. Includes Pepper shale member. Evidence afforded by assemblage of mulluscan fossils from Pepper shale confirms conclusion that the Pepper is southward extension of the Woodbine, and is probably extension of Lewisville member.

L. V. Davis, 1960, Oklahoma Geol. Survey Bull. 86, p. 39–42. Formation described in McCurtain County, where it is as much as 355 feet thick. Lower member is principally crossbedded dark tuffaceous sand, red clay, and gravel lentils. Upper member mostly gray to brown crossbedded quartz sand and sandy gravel. Unconformably underlies Tokio formation; unconformably overlies Washita group.

Named for exposures at Woodbine, Cooke County, Tex.

Woodbridge fire clay[1] (in Raritan Formation)

Cretaceous: Northeastern New Jersey.

Original reference: G. H. Cook and J. C. Smock, 1877, Map of clay district of Middlesex County. New Jersey Geol. Survey; G. H. Cook, 1878, New Jersey Geol. Survey Rept. on clays, p. 34.

H. C. Barksdale and others, 1943, The ground-water supplies of Middlesex County, New Jersey: New Jersey State Water Policy Comm. [Spec. Rept. 8], p. 66, 103–104. Overlies Farrington sand member (new); underlies Sayreville sand member (new). Thickness 50 to 90 feet.

Named for occurrence at Woodbridge, Middlesex County.

Woodburn Limestone Member (of Cynthiana Formation)

Woodburn Limestone

Woodburn Phosphatic Member (of Brannon Limestone)

Woodburn Phosphatic Member (of Flanagan Limestone)[1]

Middle Ordovician: North-central Kentucky.

Original reference: A. M. Miller, 1913, Kentucky Geol. Survey, 4th ser., v. 1, pt. 1, p. 326.

D. K. Hamilton, 1948, Econ. Geology, v. 43, no. 1, p. 41 (fig. 2), 42. Woodburn limestone in Lexington area is about 40 feet thick and consists of coarsely crystalline phosphatic limestone. Overlies Brannon limestone; underlies Perryville limestone.

A. C. McFarlan, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 8, p. 1636–1637. Referred to as phosphatic member of Brannon limestone.

D. K. Hamilton, 1950, Kentucky Geol. Survey, ser. 9, Bull. 5, p. 17, 18. Rank reduced to member status in Cynthiana formation.

Named for celebrated Alexander Estate in Woodford County.

Woodbury Clay (in Matawan Group)[1]

Woodbury Member (of Matawan Formation)

Upper Cretaceous: New Jersey.

Original reference: G. N. Knapp, as reported by R. D. Salisbury, 1899, New Jersey Geol. Survey Ann. Rept. State Geologist 1898, p. 35.

W. B. Spangler and J. J. Peterson, 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 1, p. 8 (fig. 4), 24, 26–28. Member of Matawan which is here reduced to formational rank. Underlies Marshalltown member; overlies and apparently grades into Merchantville member. Thickness about 50 feet.

J. P. Minard and J. P. Owens, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B184. Formation in Matawan group. Overlies Merchantville formation; underlies Englishtown formation. Average dip SE. 40 feet per mile. Thickness 50 feet.

Named for exposures in railway cut at Woodbury, Gloucester County.

Woodbury cyclothem (in McLeansboro Group)

Woodbury cyclothem (in Mattoon Formation)

Pennsylvanian: Southeastern Illinois.

W. A. Newton and J. M. Weller, 1937, Illinois Geol. Survey Rept. Inv. 45, p. 9, 28–30; J. M. Weller, 1942, Illinois Acad. Sci. Trans., v. 35, no. 2, p. 145 (table 1). Uppermost cyclothem exposed in area. Occurs above Greenup cyclothem (new) in Cumberland County and above the Gila cyclothem in Jasper County.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 53 (table 2), pl. 1. In Mattoon formation (new). Above Gila cyclothem and below Newton cyclothem. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification is independent of rock-stratigraphic classification.

Type locality: Along Webster Creek just north of Jasper County line about 2 miles southwest of Woodbury, Cumberland County.

†Woodbury Formation[1]

Upper Cretaceous: Northwestern Iowa.

Original reference: C. A. White, 1870, Iowa Geol. Survey, v. 1, p. 26. 291–293.

Named for Woodbury County.

Woodbury Granite[1]

Devonian: Northeastern Vermont.

Original reference: C. H. Richardson, 1906, Vermont State Geologist 5th Rept.

Quarried in Woodbury Township, Washington County.

†Woodbury Granite

Devonian or post-Devonian: West-central Connecticut.

R. M. Gates, 1951, Connecticut Geol. Nat. History Survey Misc. Ser. 3, p. 3, 5, 11–12. Described as intrusive into Hartland formation. Texture varies from aplitic to pegmatitic.

R. M. Gates *in* R. M. Gates and W. C. Bradley, 1952, Connecticut Geol. Nat. History Survey Misc. Ser. 5, p. 12, 14. Both granite and associated granite gneisses were formerly termed Thomaston granite. Name Woodbury restricted to intrusive granite. Age tentatively designated Devonian or younger. Type occurrence given.

R. M. Gates, 1954, Connecticut Geol. Nat. History Survey Quad. Rept. 3, p. 3 (footnote). Name abandoned to avoid confusion with Woodbury granite in Vermont. Replaced by Nonewaug granite.

Type occurrence: Northern half of Woodbury quadrangle west of Watertown.

Woodbury Limestone Member (of Mattoon Formation)

Woodbury Limestone (in McLeansboro Group)

Pennsylvanian: Southeastern Illinois.

H. R. Wanless, 1939, Geol. Soc. America Spec. Paper 17, p. 108. Thin marine limestone in upper part of McLeansboro, between Shumway above and Gila coals.

H. R. Wanless and Raymond Siever, 1956, Illinois Geol. Survey Circ. 217, p. 12, pl. 1. Correlation chart shows Woodbury limestone below Bogota cyclothem and above Gila limestone. Gives type locality same as Woodbury cyclothem.

R. M. Kosanke and others, 1960, Illinois Geol. Survey Rept. Inv. 214, p. 40, 41, 51 (table 1), 78, pl. 1. Assigned member status in Mattoon formation (new). Above Gila limestone member and below Reisner limestone member (new). Thickness about 7 inches at type outcrop. Presentation of new rock-stratigraphic classification of Pennsylvanian strata in Illinois; cyclical classification independent of rock-stratigraphic classification.

Type locality: SE½SE¼ sec. 32, T. 9 N., R. 8 E., Cumberland County.

Woodbury Creek Member (of Esopus Formation)

Lower Devonian: Southeastern New York.

A. J. Boucot, 1959, Jour. Paleontology, v. 33, no. 5, p. 728, 731 (fig. 2), 734. Consists of interbedded brown-weathering medium- to fine-grained sandstone, blue gray where fresh. Fossiliferous. Thickness about 50 feet. Gradationally overlies unnamed middle member of formation; contact with overlying Kanouse sandstone not exposed, but strata on either side of contact are conformable.

Type section: Thruway cut at Highland Mills, Orange County. Unit known only from this area. Name derived from Woodbury Creek which is adjacent to exposures of member in railroad cut at Highland Mills. Section is located on eastern side of Green Pond-Schunemunk Mountain outlier.

Wood Canyon Formation[1]

Precambrian and Lower Cambrian: Southeastern Nevada and eastern California.

Original reference: T. B. Nolan, 1928, Am. Jour. Sci., 5th, v. 17, p. 461–472.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 278 (fig. 3d), 307–312. Geographically extended into Nopah-Resting Springs area, Inyo County, Calif., where it is about 3,033 feet thick and includes Zabriskie quartzite member (new) in upper half. Overlies Stirling quartzite; underlies Cadiz formation.

R. H. Hopper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 404 (fig. 1), 406–407. Formation, in Panamint Range, is about 2,600 feet thick and consists largely of quartzite, but with some limestone and shale in upper part. Includes Zabriskie quartzite member. Overlies Stirling(?) quartzite; underlies unnamed Cambrian and Lower Ordovician dolomite and limestone. Lower Cambrian.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 24 (fig. 3), 25–26, fig. 5. As defined in this report, includes strata above Prospect Mountain quartzite and below Zabriskie quartzite, here given formational rank. This restricts Hazzard's 1938 [1937] section both above and below. On basis of establishment of base of zone of *Olenellus* as base of Cambrian, basal 343 feet of Wood Canyon formation in Nopah Range appears to belong to latest Precambrian and upper 363 feet to Lower Cambrian. On the basis of lithology and fauna, formation is correlated with Lower Cambrian Wood Canyon formation of northwestern part of Spring Mountain, Nev. (Nolan, 1929 [1928]) although it includes more beds than were placed in formation by Nolan at type locality.

B. K. Johnston, 1957, California Univ. Pubs. Geol. Sci., v. 30, no. 5, p. 377–380, 381 (fig. 8), figs. 1 (geol. map), 2 (columnar section). Described in Manly Peak quadrangle, southern Panamint Range, Calif., where it is mostly quartzite and quartz-rich sandstone, with large amounts of siltstone and shale and some limestone and dolomite. Comprises two sections that are not in depositional contact and do not overlap. Lower section about 1,600 feet thick; upper section, about 700 feet thick, includes Zabriskie quartzite member. In fault contact with Archean gneiss; conformably underlies Lotus formation (new). Considered both Cambrian and Precambrian in age.

U.S. Geological Survey currently designates the age of the Wood Canyon as Precambrian and Lower Cambrian on the basis of a study now in progress.

Named for exposures in Wood Canyon, about 4 miles south of Crystal Springs, on west side of Spring Mountains, Clark County, Nev.

Woodchopper Volcanics[1]

Middle Devonian: Northeastern Alaska.

Original reference: J. B. Mertie, Jr., 1930, U.S. Geol. Survey Bull. 816, p. 75–80, map.

J. T. Dutro, Jr., and T. G. Payne, 1957, Geologic map of Alaska (1:2,500,000): U.S. Geol. Survey. Appears on map legend.

Exposed on Woodchopper Creek at and below Woodchopper, Eagle-Circle district.

Woodcock Member (of Venango Formation)

Woodcock Sandstone[1]

Upper Devonian: Northwestern Pennsylvania.

Original reference: G. H. Chadwick, 1925, Geol. Soc. America Bull., v. 36, no. 3, p. 457–464.

Bradford Willard, 1937, Pennsylvania Acad. Sci. Proc., v. 11, p. 32. Shown on generalized succession of marine Upper Devonian as member of Venango formation above Saegerstown member and below Roystone member of Riceville formation.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Woodcock sandstone shown on correlation chart above Saegerstown [formation] and below Oswayo formation. Upper Devonian.

Named for exposures along Woodcock Creek, Woodcock Township, Crawford County.

Wood Creek Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 90–95, 137, 141, 149, 154.

Well exposed along Wood Creek, between Lee's Center and Stokes, 7 miles northwest of Rome, Oneida County, and in Lorraine Gulf.

Woodford Chert[1] or Shale

Devonian and Mississippian: Central southern and southeastern Oklahoma.

Original reference: J. A. Taff, 1902, U.S. Geol. Survey Geol. Atlas, Folio 79.

G. A. Cooper and others, 1942, Geol. Soc. America Bull., v. 53, no. 12, pt. 1, chart 4. Shown on correlation chart as Upper Devonian.

S. P. Ellison, Jr., 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 1, p. 93–110. Discussion of conodonts as Paleozoic guide fossils and problem of correlation among beds containing upper Devonian conodonts and fossil wood. Woodford formation and Arkansas novaculite are part of this correlation problem. However, assignment of Devonian age to Woodford is not acceptable to many stratigraphers.

T. A. Hendricks, L. S. Gardner, and M. M. Knechtel, 1947, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 66. In western part of Ouachita Mountains in block southeast of Pine Mountain fault, Woodford chert unconformably overlies Pinetop chert. Basal 7 feet consist of white chert breccia or conglomerate containing some lenses of very fine grained crystalline limestone. Upper part consists of alternating beds of black papery shale that weather light gray, and black chert in beds 1 to 4 inches thick. Contains abundant round and discoidal phosphate nodules and conodonts. Thickness about 67 feet. Table shows Woodford chert separated from upper part of Arkansas novaculite. Upper Devonian(?). Correlated with Chattanooga shale, Woodford chert of Arbuckle Mountains, and upper part of Arkansas novaculite.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, p. 145, chart 5 (columns 55, 56). Woodford chert shown on correlation chart as Kinderhookian. Locally contains considerable black shale of Chattanooga type, and the two formations are known to be continuous in subsurface although beds of later Kinderhookian age have not been identified and are probably not represented in Chattanooga as it is developed in Ozark region. Woodford overlies older formations with conspicuous unconformity and in subsurface locally overlaps onto Arbuckle limestone.

H. D. Miser and others, 1954, Geologic map of Oklahoma (1:500,000): U.S. Geol. Survey. Woodford shale and Woodford chert mapped as Devonian and Mississippian.

T. W. Amsden, 1957, Oklahoma Geol. Survey Circ. 44, p. 6 (fig. 2), 48–49, fig. 3. Throughout Arbuckle region Hunton group is unconformably overlain by Woodford shale. Erosional interval separating Woodford from Hunton is considerable, so this shale may be in contact with any of Hunton formations or members, and in places Woodford rests directly on Sylvan shale.

J. D. Prestridge, 1959, *in* Petroleum geology in southern Oklahoma, v. 2: Tulsa, Am. Assoc. Petroleum Geologists, p. 158 (fig. 2), 161. Underlies Cornell Ranch member (new) of Sycamore formation. Uppermost Wooford is Kinderhookian.

Named for exposures about one-fourth mile north of Woodford, Carter County.

†Woodford Gneiss[1]

Precambrian: Southwestern Vermont.

Original reference: F. A. Burt, 1929, Vermont State Geologist 16th Rept., p. 68–69.

Probably named for Woodford village or Woodford Township, Bennington County.

Woodfordian Substage

Pleistocene (Wisconsinan): Illinois.

J. C. Frye and H. B. Willman, 1960, Illinois Geol. Survey Circ. 285, p. 1, 2 (fig. 1), 6–8. Wisconsinan stage of Lake Michigan lobe is subdivided into (ascending) Altonian, Farmdalian, Woodfordian, Twocreekan, and Valderan substages. Woodfordian is based on pre-Shelbyville Morton loess (new) that overlies Farmdale silt, and succession of progressively younger moraines extending from the Shelbyville to, but not including, the Valders. Stratigraphically terminated upward by Two Creeks forest bed of Wisconsin. From former classification Woodfordian includes Iowan substage of Illinois usage (but not of the type), the type Tazewell and Cary substages, it includes that part of the Cary that has recently been assigned to Mankato (Leighton, 1957). On the basis of numerous dates, the total time span of Woodfordian is less than 10,000 radiocarbon years. Includes Peoria loess and Richland loess (new). Also contains about 30 recognized end moraines.

Name derived from Woodford County which is just north of Shelbyville moraine and is crossed by Bloomington, Metamora, Normal, and Cropsey moraines.

Woodglen Limestone (in Washington Group)

Permian (Dunkard): Southeastern Pennsylvania.

W. O. Hickok 4th and F. T. Moyer, 1940, Pennsylvania Geol. Survey, ser. 4, Bull. C–26, p. 147–148. Name given to gray to dark fine-grained homogeneous nonfossiliferous limestone which breaks with conchoidal fracture. Maximum thickness 10 feet, average about 7 feet. Underlies Lower Mannington sandstone; commonly overlies clay shale or sandy shale below which is Colvin Run limestone. Included in lower part of Washington group.

Well exposed in Hugh Murphy quarry just northeast of Woodglen, Fayette County.

Woodhams Formation

Miocene (Relizian?): Northern California.

R. M. Touring, 1959, Dissert. Abs., v. 20, no. 4, p. 1325. Name given to about 500 feet of siliceous mudstone and foraminiferal shales which conformably overlie Mindego formation (new) near east edge of La Honda quadrangle.

Area of report is in Santa Cruz Mountains, 30 to 40 miles south of San Francisco.

Woodhill Member (of Franconia Formation)

Upper Cambrian: Central Wisconsin and southeastern Minnesota.

R. R. Berg, 1951, Minnesota Geologist, v. 8, no. 4, p. 1. Proposed for basal member of Franconia. At type locality, consists of lower coarse-grained, poorly sorted sandstone 13 feet thick overlain by a medium-grained well-sorted sandstone 17 feet thick; in all outcrops, base of member is characterized by coarse-grained sandstone that overlies uniformly medium-grained Galesville sandstone member of Dresbach formation. Maximum thickness 44 feet in Houston County, Minn. Underlies Birkmose member (new).

R. R. Berg, 1953, Jour. Paleontology, v. 27, no. 4, p. 553, 554, 555; 1954, Geol. Soc. America Bull., v. 65, no. 9, p. 858 (fig. 1), 861–862, 871. Term Ironton member had previously been applied to basal unit of Franconia; although defined as lithic unit (Ulrich, 1924, Wisconsin Acad. Sci. Trans., Arts, and Letters, v. 21), "Ironton member" came to mean all beds containing *Elvinia* fauna, and new name that did not carry faunal connotation became advisable.

Type locality: Roadcuts on State Highway 80 at Wood Hill, SE¼ sec. 3, T. 15 N., R. 2 E., Juneau County, Wis.

Woodhouse Clay (in Ogallala Formation)[1]

Woodhouse Formation

Miocene or Pliocene: Western Kansas.

Original reference: M. K. Elias, 1931, Kansas Geol. Survey Bull. 18, p. 155.

M. K. Elias, 1937, Kansas Geol. Survey Mineral Resources Circ. 7, p. 8. Woodhouse formation in Rawlins and Decatur Counties described as local clayey formation that is wedged in between sandy Ogallala beds above and Pierre shale below. Consists of silts and fine silty sands, with coarses sand to conglomerate at base, and chocolate to maroon plastic clays in upper part. Thickness as much as 60 feet.

Type locality: One mile west of Woodhouse Ranch, Wallace County.

Woodhurst Limestone Member (of Lodgepole Limestone)

Woodhurst Limestone Member (of Madison Limestone)[1]

Lower Mississippian: Central northern, central southern, and southwestern Montana.

Original reference: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 56.

L. L. Sloss and R. H. Hamblin, 1942, Am. Assoc. Petroleum Geologists Bull, v. 26, no. 3, p. 315, 317, 319, 320, 321–322, 324. Reallocated to member status in Lodgepole limestone; overlies Paine member; underlies Mission Canyon limestone. Thickness 240 to 570 feet.

First described in vicinity of Woodhurst Mountain, northeastern part Little Belt Mountains quadrangle.

Woodland Gneiss

Precambrian: Central western Georgia.

D. F. Hewett and G. W. Crickmay, 1937, U.S. Geol. Survey Water-Supply Paper 819, p. 29–30, pl. 1. Largely coarse-grained biotite augen gneiss. Persistently underlies basal bed of Hollis quartzite; 100 feet or more of gneiss immediately underneath quartzite is thinly laminated, locally schistose; progressively lower or deeper in the mass, the lamination is more widely spaced, and rock assumes common gneissic texture; because gneiss is most completely metamorphosed of the igneous rocks of the region, it is assumed to be the oldest. Intruded by Cunningham granite (new).

J. W. Clarke, 1952, Georgia Geol. Survey Bull. 59, p. 6 (table), 7–11. Precambrian(?).

Named for Woodland, Talbot County. Confined to belt that lies between Pine and Oak Mountains, south of Towaliga fault; also present in Thomaston quadrangle.

Woodland Trachyte[1]

Age(?): Northeastern Maine.

Original reference: H. E. Gregory, 1900, U.S. Geol. Survey Bull. 165, p. 109, 110, 164.

Forms low hills along branch of Caribou Stream, in Woodland Township, Aroostook County.

Woodman Formation[1]

Upper Mississippian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 30). Shown on correlation chart above Madison limestone and below Ochre Mountain limestone.

Named for the fact that it underlies Woodman Peak on south end of Dutch Mountain, Gold Hill region.

Woodmansie phase (of Bridgeton Formation)[1]

Pleistocene: New Jersey.

Original reference: R. D. Salisbury and G. N. Knapp, 1917, New Jersey Geol. Survey, v. S, p. 11, 62.

Probably named for occurrence at or near Woodmansie, Burlington County.

Woodmont Shale

Woodmont Shale Member (of Jennings Formation)[1]

Upper Devonian: Western Maryland, southern Pennsylvania, and northern West Virginia.

Original reference: C. K. Swartz and others, 1913, Maryland Geol. Survey Lower Devonian volume, p. 26; 1913, Middle and Upper Devonian volume, p. 411, 412.

Ernst Cloos, 1951, Maryland Dept. Geology, Mines and Water Resources Washington County [Rept. 14], p. 90–91. In Washington County, Md., varies in thickness between 1,600 feet in eastern and 1,200 to 1,300 feet

in western sections. Conformably overlies Genesee member or, where latter is lacking, rests on Romney shale; underlies Parkhead sandstone member.

Named from Woodmont Station, Washington County, Md., one-half mile east of which it is well exposed in cut of Western Maryland Railroad.

Woodpecker limestone[1]

Devonian: East-central Nevada.

Original references: C. R. Keyes, 1923, Pan-Am. Geologist, v. 40, p. 52; 1924, Pan-Am. Geologist, v. 41, p. 79.

Name derived from Woodpecker Peak, Eureka district.

Woodpecker Limestone Member (of Nevada Formation)

Middle Devonian: Central Nevada.

T. B. Nolan, C. W. Merriam, and J. S. Williams, 1956, U.S. Geol. Survey Prof. Paper 276, p. 41, 44–45, pl. 2. Made up of thin- to medium-bedded limestone not uncommonly sandy or argillaceous. Limestones fine grained to aphanitic or porcellaneous and light olive gray to dark gray. Weathering of shaly partings produces pinkish or yellowish colors. Thickness ranges from 220 through 450 feet. Lower boundary notably gradational with underlying Sentinel Mountain dolomite member (new) whereas contact with overlying Bay State dolomite member (new) is quite sharp being marked by varying thickness of light-gray dolomite sand at base of Bay State dolomite member. Calcareous nature of unit between the two dolomite members serves to distinguish it.

Type locality: In gulch draining south slope of Woodpeckers Peak, which is situated on north boundary of Oxyoke Canyon, in vicinity of Eureka.

Wood River Formation[1]

Pennsylvanian and Permian: Southern central Idaho.

Original reference: W. Lindgren, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 89–90, 193–195, pl. 8.

D. A. Bostwick, 1955, Jour. Paleontology, v. 29, no. 6, p. 941–951. Formation, with exception of several hundred feet of conglomerates and limestones near base, is succession of calcareous sandstones and arenaceous limestones of 12,000 feet maximal thickness. Near Bellevue, contains fusulinids that compare closely with those of Desmoinesian, Virgilian, and Wolfcampian ages in rocks of Midcontinent and Southwest regions.

M. R. Thomasson, 1959, Dissert, Abs., v. 20, no. 3, p. 999. Subdivided into (ascending) Hailey, Slate Creek (Desmoinesian-Missourian), Lake Creek (Virgilian), and Wilson Creek (Wolfcampian) members. Overlies Muldoon formation (new). Wood River and Muldoon are time equivalents of Lemhi formation (new).

H. J. Bissell, 1960, Am. Assoc. Petroleum Geologists Bull., v. 44, no. 8, p. 1427 (fig. 3). Correlation chart shows that Wood River formation in Bellevue area comprises (ascending) Hailey member, unnamed lower sandy limestones, and upper calcareous sandstones and sandy limestones. Uncomformable above Milligen formation and below Phosphoria. Morrowan-Leonardian.

C. P. Ross, 1960, U.S. Geol. Survey Prof. Paper 400–B, p. B232. Discussion of interfingering Carboniferous strata in Mackay quadrangle, Idaho. Wood River where exposed west of Mackay quadrangle is lithologically diverse, but is characterized by abundant sandy beds, and, especially near base, by abundant conglomerate, part of it coarse and in thick

layers. Formation has been regarded as of Pennsylvanian age, but microfossils (Bostwick, 1955), discovered since formation was defined, have shown that large thicknesses of beds assigned to it by Bostwick are of Permian age. These beds have nowhere been mapped separately. Formation west of Mackay quadrangle is probably at least 8,000 feet thick, and may be much thicker if beds containing Permian fossils are included in it. Beds definitely assignable to Wood River are now known to occur east of western part of Mackay quadrangle, but name has been used tentatively as far east as Montana boundary.

First described in vicinity of Hailey, Blaine County.

†Woods Bluff Group[1] or Series[1]

Eocene, lower: Southern Alabama and southeastern Mississippi.

Original reference: A. Heilprin, 1882, Philadelphia Acad. Nat. Sci. Proc. 1881, p. 158–159.

Named for exposures at Woods Bluff, on Tombigbee River, in northwestern part of Clarke County, Ala.

Woods Bluff Marl (in Bashi Formation)[1]

Eocene, lower: Southwestern Alabama.

Original reference: A. Heilprin, 1882, Philadelphia Acad. Nat. Sci. Proc. 1881, p. 157.

Named for exposures at Woods Bluff, on Tombigbee River, in northwestern part of Clarke County.

Woods Corners Group

Middle Cambrian: Northwestern Vermont.

A. B. Shaw, 1958, Geol. Soc. America Bull., v. 69, no. 5, p. 532 (fig. 5), 533 (fig. 6), 536. Proposed for entire succession between Rugg Brook dolomite below and Gorge formation above. Includes (ascending) St. Albans slate, Mill River conglomerate, Skeels Corners slate, Rockledge conglomerate, and its northern equivalent Saxe Brook dolomite, and Hungerford slate.

Name is taken from alternate local name for Skeels Corners, 5 miles north of St. Albans, St. Albans quadrangle.

Woods Hole Shale

Probably lapsus for **Woods Hollow shale.**

Woods Hollow Shale[1]

Middle Ordovician: Southwestern Texas.

Original reference: P. B. King, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 9, p. 1066, 1071–1072.

W. B. N. Berry, 1960, Texas Univ. Bur. Econ. Geology Pub. 6005, p. 23–27, strat. sections. Graptolite fauna discussed. Underlies Maravillas chert; overlies Fort Pena formation.

Named for exposures in Woods Hollow Mountains between Woods Hollow and Little Woods Hollow, in anticlinal valley on former Louis Granger Ranch, Brewster County.

Woodside Formation, Siltstone, or Redbeds

Woodside Shale[1]

Lower Triassic: Northeastern Utah, southeastern Idaho, southwestern Montana, and southwestern Wyoming.

Original reference: J. M. Boutwell, 1907, Jour. Geology, v. 15, p. 439–458.

J. S. Williams, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 1, p. 91–93. In Uinta Mountains, overlies Phosphoria formation (Rex member); Park City not considered valid term. Concomitantly with thinning of Rex member of Phosphoria, gray and red sandstones and shales appear between the calcareous sandstones and main body of Woodside shale; they are here named Mackentire redbeds tongue of Phosphoria.

H. D. Thomas, 1939, Am. Assoc. Petroleum Geologists Bull., v. 23, no. 8, p. 1249–1250. Discussion of Williams' paper. Proper designation should be Mackentire redbeds tongue of Woodside formation.

H. D. Thomas and M. L. Krueger, 1946, Am. Assoc. Petroleum Geologists Bull., v. 30, no. 8, pt. 1, p. 1268–1270, strat. sections. Along western part of Uinta Mountains, Woodside shale consists of 500 to 800 feet or red to maroon shales, siltstones, and very fine grained sandstones. Type Woodside rests directly above Phosphoria equivalent of Park City. Eastward along Uinta Mountains, it is impossible to separate redbeds of Park City age from true Woodside, and base of Woodside descends in section until at Skull Creek the entire upper Park City is represented by basal Woodside. Underlies Stanaker formation (new) at type section of Stanaker. Underlies Ankareh or Thaynes formations in some areas. Nomenclatural problems discussed.

N. D. Newell, 1948, Geol. Soc. America Bull., v. 59, no. 10, p. 1056 (fig. 2), 1057. Woodside formation in Confusion Range consists of several hundred feet of alternating red shales and sandy limestones. Overlies Phosphoria formation.

Bernhard Kummel, 1954, U.S. Geol. Survey Prof. Paper 254–H, p. 170–171. In type area, consists of approximately 1,000 feet of maroon and red, shaly siltstone; overlies Phosphoria formation and underlies Thaynes formation. Extends over wide area in northern Utah, western Wyoming, and southwestern Montana; tongues out westward in southeastern Idaho and southwestern Montana into Dinwoody formation. Areas of occurrence discussed.

V. E. McKelvey and others, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 12 p. 2837 (fig. 2), 2842–2843. In central and southern Wasatch Mountains and western Uinta Mountains, overlies Franson member (new) of Phosphoria.

W. W. Rubey, 1958, U.S. Geol. Survey Geol. Quad. Map GQ–109. Referred to as Woodside redbeds in Bedford quadrangle, Wyoming.

R. K. Hose and C. A. Repenning, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 9, p. 2185–2189. Term Thaynes extended into Confusion Range where it replaces term Woodside as used by Newell (1948).

Named for Woodside Gulch, Park City district, Utah.

Wood Siding Formation (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Southeastern Nebraska and eastern Kansas.

G. E. Condra and E. C. Reed, 1943, Nebraska Geol. Survey Bull. 14, p. 41, 42, 43. Name applied to include section between base of the Brownville above and base of the Nebraska City below. This was done because (1) the Nebraska City limestone, with Lorton coal below it, is persistent recognizable marker; (2) nonpersistent Gray Horse limestone, named from Oklahoma, is not good boundary marker between so-called Caneyville formation and Pony Creek as restricted by Moore (1936, Kansas Geol. Survey Bull. 22); and (3) restricted Caneyville and Pony Creek

are not good formations in Nebraska. Includes (ascending) Nebraska City limestone, 9 to 10 feet of greenish-gray sandy shale, 6 to 11 feet of gray to brownish limy sandstone, and Pony Creek shale; first three units are the Caneyville formation of Kansas Geological Survey.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 13. Type locality and derivation of name stated.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 9, p. 2273–2275. As originally defined, formation included approximately 20 feet of beds between former Nebraska City limestone and base of former Brownville limestone. As herein redefined, includes (ascending) Nebraska City limestone, Plumb shale (new), Grayhorse limestone, Pony Creek shale, and Brownville limestone members. Thickness 12 to 50 feet. Underlies Permian Onaga shale (new); overlies Root shale (new).

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 62–71. Uppermost formation of Pennsylvanian system in Midcontinent area. As redefined by Moore and Mudge (1956), includes (ascending) Nebraska City limestone, Plumb shale, Grayhorse limestone, Pony Creek shale, and Brownville limestone members. Branson (1956, Oklahoma Geology Notes, v. 16) extended name into Oklahoma and modified Kansas definition to suit transitional sediments of Oklahoma section. As redefined, formation extends downward from top of Brownville limestone to base of lowest recognizable member unit. As result of southward pinchout of Nebraska City limestone member in Osage County, Okla., base of formation is defined by base of "Grayhorse" limestone. South of Pawnee County where "Grayhorse" limestone cannot be recognized, Brownville limestone member constitutes entire formation. In Pawnee County, formation comprises (ascending) "Grayhorse" limestone, Pony Creek shale, and Brownville limestone members. Average thickness in Pawnee County 75 feet. Overlies Gano shale; underlies Admire group.

Type locality: Missouri River bluffs south of Wood Siding Station, Nemaha County, Nebr.

Woodson Mountain Granodiorite

Cretaceous: South California.

F. S. Miller, 1937, Geol. Soc. America Bull., v. 48, no. 10, p. 1399. Incidental mention. Named credited to E. S. Larsen, Jr.

E. S. Larsen, Jr., 1948, Geol. Soc. America Mem. 29, p. 76–82, pl. 1. Light-colored rather coarse-grained granodiorite that contains biotite and a little hornblende. Intrudes Green Valley, Bonsall, and La Sierra tonalites, and Temescal Wash porphyry. Older than Roblar leucogranite (new) and Mount Hole granodiorite. Includes Steele Valley granodiorite and Cajalco quartz monzonite of Dudley (1935).

Named from its characteristic outcrops on Woodson Mountain, which is a few miles northeast of southeastern corner of San Luis Rey quadrangle and a few miles southwest of Ramona, San Diego County. Underlies area of about 220 square miles; among rocks of batholith, is exceeded in area only by Bonsall tonalite.

Woods Run Limestone (in Conemaugh Formation)[1]

Woods Run Limestone (in Conemaugh Group)

Pennsylvanian: Western Pennsylvania and western Maryland.

Original reference: P. E. Raymond, 1910, Carnegie Mus. Annals, v. 7, p. 147.

M. N. Shaffer, 1952, Pennsylvania Geol. Survey, 4th ser., Prog. Rept. 141, geol. map. This report considers Conemaugh a group.

J. J. Burke, 1958, Science, v. 128, no. 3319, p. 302. Original name Woods Run retained, without modification, for limestone described by Raymond (1910). Separated from overlying Carnahan Run shale (new) by 21½ feet of reddish-brown shale that carries plant fossils. Johnson (1929, Pennsylvania Geol. Survey Topog and Geol. Atlas 27) described a limestone which, in Pittsburgh region, occurs approximately 8 to 17 feet below the Woods Run; subsequent workers have referred to the two strata as Woods Run limestones or as Upper and Lower Woods Run limestones. Name Nadine limestone is here applied to this limestone described by Johnson.

Named for Woods Run within city of Allegheny, Pa. Allegheny is now incorporated in city of Pittsburgh.

Woods Run Shale (in Conemaugh Formation)[1]

Pennsylvanian: Western Pennsylvania and western Maryland.

Original reference: C. K. Swartz, 1922, Maryland Geol. Survey, v. 11, pl. 6.

R. R. Dutcher and others, 1959, Geol. Soc. America Guidebook Pittsburgh Mtg., p. 69 (fig. 4). Woods Run (Friendsville) shale shown on generalized columnar section for western Pennsylvania above Lower Bakerstown coal and below Ewing limestone.

Named derived from Woods Run, Pa.

Woodstock Granite[1] or **Granodiorite**

Carboniferous(?): Northern Maryland.

Original reference: G. H. Williams and N. H. Darton, 1892, U.S. Geol. Survey map of Baltimore and vicinity to accompany "Guide to Baltimore," prepared for Baltimore meeting Am. Inst. Min. Engrs., Feb. 1892.

H. E. Vokes, 1957, Maryland Dept. Geology, Mines and Water Resources Bull. 19, p. 63. At least three periods of granite formation are recognized in Maryland. Granitic rocks of third period are represented by the Woodstock, Ellicott City, and at least part of the Sykesville.

Occurs in small elliptical area of less than 2 miles in diameter near Granite, close to junction of North and South Branches of Patapsco River. Woodstock is in Howard County, across river from Granite.

Woodstock Greensand Marl Member (of Nanjemoy Formation)[1]

Eocene, middle: Eastern Virginia and eastern Maryland.

Original reference: W. B. Clark, 1895, Johns Hopkins Univ. Circ., v. 15, no. 121, p. 3.

C. W. Cooke, Julia Gardner, and W. P. Woodring, 1943, Geol. Soc. America Bull., v. 54, no. 11, chart 12. Uppermost member of formation. Overlies Potapaco clay member. Middle Eocene (Claiborne).

Named for Woodstock, an old estate a short distance above Mathias Point on Virginia bank of the Potomac in King George County, Va.

Woodstock Quartz Schist[1]

Woodstock quartz schist phase (of Hebron Gneiss)

Pre-Triassic: Northwestern Connecticut.

Original reference: H. E. Gregory, 1906, Connecticut Geol. Nat. History Survey Bull. 6, p. 114, 128, and map.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1 :253,440) : Connecticut Geol. Nat. History Survey. Refers to Woodstock (Paxton) quartz schist phase of Hebron gneiss. Occurs chiefly in northeastern part of Hebron outcrop area. Further described as including fine-grained quartz-mica schist, quartzite, and quartzose gneiss. Also contains thin layers of greenish lime-silicate rock and impure limestone. Pre-Triassic.

Crops out in eastern part of Woodstock Township, Windham County.

Woodstock Schist[1]

Ordovician: Southeastern Vermont.

Original reference: C. H. Richardson, 1927, Vermont State Geologist 15th Rept., p. 127–158.

Crops out in Woodstock, Windsor County.

Woodville Marble

Pre-Triassic: Western Connecticut.

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,440) : Connecticut Geol. Nat. History Survey. Described as grayish-white coarsely granular marble, generally calcitic but locally dolomitic.

Named for Woodville in town of Washington, Litchfield County.

Woodville Sandstone Member (of Saginaw Formation)

Woodville Sandstone[1]

Woodville Sandstone (in Grand River Group)

Pennsylvanian: Southern Michigan.

Original reference: A. Winchell, 1861, Michigan Geol. Survey 1st Ann. Rept. Prog., p. 126, 138, 153, 158.

W. A. Kelley, 1936, Michigan Dept. Conserv., Geol. Div. Pub. 40, Geol. Ser. 34, p. 206–207, 211. Included in Grand River group (new). Stratigraphic relation to Eaton sandstone (new) not determined. Not known certainly whether Woodville at type locality represents lentil of limited distribution which should be grouped with sandstones of Saginaw group or whether it is formation younger than any member of Saginaw group.

G. V. Cohee, Carol Mach, and Margery Holk, 1951, U.S. Geol. Survey Oil and Gas Inv. Chart 41, sheet 5. Recommended that name Woodville be restricted to sandstone member in lower part of Saginaw formation.

Type locality: Exposure in cut of side track from (Woodville) mine to Central Railroad. Name has no reference to village of Woodville, in Newaygo County, but to old Woodville mine in Jackson County.

†Woodward Group[1]

Permian: Southwestern Oklahoma and Texas.

Original reference: C. N. Gould, 1902, Oklahoma Geol. Survey 2d Bien. Rept., p. 42, 49.

C. C. Branson, 1957, Oklahoma Geology Notes, v. 17, no. 11, p. 103. Poorly understood sequence including Dog Creek, Whitehorse, and Day Creek. Abandoned by Oklahoma Geological Survey.

Named for Woodward County, Okla.

Woodway Limestone

Middle Ordovician: Southwestern Virginia.

R. L. Miller and W. P. Brosgé, 1950, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 104, (two sheets). Cryptocrystalline tan and gray limestone with interbeds and zones of medium-crystalline limestone; prominent zone of *Stromatocerium rugosum* at base. Thickness 256 to 288 feet. Overlies Hurricane Bridge limestone (new); underlies Ben Hur limestone (new). Same as platy member of Lowville limestone on U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 76.

R. L. Miller and W. P. Brosgé, 1954, U.S. Geol. Survey Bull. 990, p. 32 (table 1), 33–34, 51–56, pl. 1. Further described and type section given. Discussion of problems of correlation and summary of nomenclature of Middle Ordovician formations in Lee and Tazewell Counties.

Type section: On north slopes of Elk Knob, 1¾ miles east of Woodway, Lee County.

Wooleys Bluff Clays[1] (in McElroy Formation)

Eocene (Jackson): Western Louisiana and eastern Texas.

Original reference: A. C. Ellisor, 1936, Am. Assoc. Petroleum Geologists Bull., v. 17, no. 11, p. 1303.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2627–2628, 2629. Incidental mention in discussion of Wellborn sandstone and McElroy formation.

Named for locality in sec. 4, T. 3 N., R. 12 W., Sabine Parish, La.

Woolsey Member (of Bloyd Shale)

Pennsylvanian (Morrow Series): Northwestern Arkansas.

L. G. Henbest, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 8, p. 1943–1944, 1948 (fig. 2). Consists of a succession of terrestrial sediments up to 45 feet thick that intervene between Brentwood limestone member and unnamed upper division of Bloyd shale which includes Kessler limestone lentil. Member includes Baldwin or Zion Chapel coal. Disconformably overlies and (or) truncates uppermost beds of Brentwood member.

Named for its most complete and characteristic development in vicinity of Woolsey Station, Washington County.

Woonasquatucket Formation

Precambrian(?): North-central Rhode Island.

G. M. Richmond *in* G. M. Richmond and W. B. Allen, 1951, Rhode Island Port and Indus. Devel. Comm. Geol. Bull. 4, p. 10, 12, pl. 1. Comprises four distinct rock types: light-gray medium-grained feldspathic quartz-muscovite schist which is very weakly foliated, gray medium-grained quartz biotite schist with strong foliation, gray medium-grained feldspathic quartz biotite gneiss which is strongly foliated and thinly and irregularly layered, and conglomerate of granite and quartzite pebbles and cobbles in a quartz-muscovite schist matrix. Thickness 575 to 1,300 feet. Underlies Blackstone series; overlies Absalona formation (new); both contacts gradational.

Named from exposures on slopes northeast of Woonasquatucket Reservoir, Georgiaville quadrangle, Providence County.

†Woonsocket Conglomerate[1]

Carboniferous: Northeastern Rhode Island.

Original reference: G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zoology Bull., v. 49, geol, ser., v. 8, p. 100.

Occurs in rather limited area around Woonsocket, Providence County.

†Woonsocket Basin Series[1]

Carboniferous: Northeastern Rhode Island.

Original reference: A. C. Hawkins, 1918, Am. Jour. Sci., 4th, v. 46, p. 437–472, map.

Occurs in Woonsocket Basin, Providence County.

Wooster Shale Member (of Cuyahoga Formation)

Lower Mississippian (Osagian): Northern Ohio.

E. J. Szmuc, 1957, Dissert. Abs., v. 18, no. 6, p. 2109. Used in place of name Black Hand shale since latter term is restricted to the pebbly sandstone. Intertongues with partly younger Black Hand sandstone, and in parts of Wayne, Medina, and Ashland Counties the sandstone is completely replaced by shale. Overlies Armstrong member.

Area investigated extends from vicinity of Meadville, Pa., to southern Ashland County, Ohio.

Worcester Formation

Worcester Phyllite[1]

Carboniferous: Eastern Massachusetts, northern Connecticut, and southern New Hampshire.

Original reference: B. K. Emerson, 1889, Geol. Soc. America Bull., v. 1, p. 560.

W. R. Hansen, 1956, U.S. Geol. Survey Bull. 1038, p. 20–31, pl. 1. Name Worcester formation proposed to include rocks of Carboniferous age formerly mapped in this area as Worcester phyllite and Brimfield schist and also a previously unmapped quartzite unit here named Vaughn Hills member. Worcester phyllite and Brimfield schist of previous reports dealing with this area are regarded as stratigraphically equivalent metamorphic facies, and terms "phyllite facies" and "mica schist facies" are suggested for use in this area. Also proposed that term "Brimfield schist" be restricted to those areas where the schist is not known to be equivalent to Worcester formation. Problematical whether or not Worcester formation of Hudson quadrangle and adjoining areas is to be correlated with Brimfield schist of Emerson's (1917) type locality; the two areas are separate and the schist is not exposed continuously between them; on the other hand, field evidence supports correlation of mica schist facies of this area with phyllite facies of Worcester formation. Includes Harvard conglomerate lentil. Mica schist facies grades upward into Nashoba formation (new).

John Rodgers and others, 1956, Preliminary geological map of Connecticut (1:253,400): Connecticut Geol. Nat. History Survey. Refers to Pomfret (Worcester) phyllite phase of Hebron gneiss; pre-Triassic.

Named for exposures in Worcester County, Mass.

†Worcester Quartzite[1]

Carboniferous: Eastern central Massachusetts, northern Connecticut, and central southern New Hampshire.

Original reference: B. K. Emerson, 1898, U.S. Geol. Survey Mon. 29, p. 17.

Exposed at Worcester, Mass., and over large area in northern part of Worcester County.

†Worcester County Gneiss[1]

Age(?): Massachusetts.

Original reference: E. Hitchcock, 1833, Rept. on geology, mineralogy, botany, and zoology of Massachusetts, p. 387–388.

Occurs along western margin of Worcester County gneiss range, in Northfield, Mass., and Winchester, N.H.

Word Formation[1]

Permian: Western Texas.

Original reference: J. A. Udden, C. L. Baker, and E. Böse, 1916, Texas Univ. Bur. Econ. Geology and Tech. Bull. 44, p. 52.

P. B. King, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 4, p. 654–662, pl. 2. In this report, the Vidrio is restricted to that part of former member which is believed to be middle Guadalupe in age and classed as member of Word formation. Includes four unnamed limestone members. Plate shows uppermost limestone member grades laterally into Vidrio limestone member. Overlies Leonard formation; underlies Altuda formation, Capitan limestone, and Gilliam limestone.

R. L. Clifton, 1945, Am. Assoc. Petroleum Geologists Bull., v. 29, no. 12, p. 1766–1768. Fauna and stratigraphic correlatives discussed. Word strata considered correlative with strata of Cherry Canyon and Brushy Canyon of Delaware Mountain group, San Andres group, and Blaine and Dog Creek formations.

E. R. Lloyd, 1947, West Texas, Geol. Soc [Guidebook] Spring Field Trip May 30–31, p. 5–6. Name Word should be restricted to local formation in Glass Mountains.

Named for Word's Ranch, Glass Mountains, Hess Canyon quadrangle, Brewster County.

Workman Hill Conglomerate

Miocene and Pliocene: Southern California.

G. J. Bellemin, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 4, p. 652 (fig. 1), 653–655. Named as one of five conglomerates interbedded in Miocene and Pliocene shales of Puente Hills, Los Angeles County.

Named for occurrence adjacent to Workman Hill.

Worland Limestone[1]

Worland Limestone (in Altamont Limestone Member of Oologah Formation)

Worland Limestone Member (of Altamont Limestone)

Pennsylvanian (Des Moines Series): Western Missouri, southern Iowa, southeastern Kansas, and northeastern Oklahoma.

Original reference: F. C. Greene, 1933, Missouri Bur. Geology and Mines 57th Bien. Rept., p. 14, 18, 37, App. 2, pl. 2.

L. M. Cline, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 29. Lower and upper Worland limestone of Greene (1933) have been traced across southwestern Missouri into southeastern Kansas and are equivalent to lower and upper Altamont limestones, respectively. Lower limestone of Altamont is herein named Tina, and name Worland retained for upper member of Altamont. Traced into Appanoose County, Iowa.

J. M. Jewett, 1941, Kansas Geol. Survey Bull. 38, p. 332–334. At type exposure, herein designated, consists of about 4½ feet of gray-brown-weathering massive limestone containing large fusulinids. Overlies Lake Neosho shale member (new).

R. D. Alexander, 1954, Oklahoma Geol. Survey Circ., 31, p. 14–15, 16 (fig. 5). In this report, Oologah is used for sequence of beds between base of cap rock of Lexington coal and top of Altamont limestone in Nowata County and for equivalent sequence of limestone not yet subdivided in vicinity of Tulsa. In Nowata County, upper member of Oologah is Altamont limestone which is subdivided into Amoret limestone below and Worland limestone above, with shale interval between. The Worland is gray massive cherty limestone about 30 feet thick. Occurs below Nowata shale.

H. G. Hershey and others, 1960, Iowa Highway Research Board Bull. 15, p. 30–31, fig. 5. Uppermost member of Altamont limestone in southwestern Iowa. Consists of thin wavy beds separated by green-gray fossiliferous shale seams and occasional pockets of green shale. Thickness 2½ feet in Madison County; 6 feet in Appanoose County. Overlies Lake Neosho shale member; underlies Nowata shale.

Type exposure: Along Kansas City Southern Railway just north of grade crossing northeast of Worland, Bates County, Mo.

Worldbeater Granite Porphyry

World Beater Porphyry[1]

Precambrian(?): Southeastern California.

Original reference: F. M. Murphy, 1933, California State Div. Mines Rept. 28 of State Min., July-Oct. 1932, p. 339, map.

J. H. Maxson, 1950, Geol. Soc. America Bull., v. 61, no. 2, p. 111. Incidental mention of Worldbeater granite porphyry in discussion of physiographic features of Panamint Range.

Occurs in southern part of Panamint Range, Inyo County, between Pleasant Canyon and Happy Canyon. Probably named for Worldbeater mine.

Worm Creek Quartzite member (of St. Charles Limestone)[1]

Upper Cambrian: Southeastern Idaho and northeastern Utah.

Original reference: G. B. Richardson, 1913, Am. Jour. Sci., 4th, v. 36, p. 407, 408.

J. S. Williams and G. B. Maxey, 1941, Am. Jour. Sci., v. 239, no. 4, p. 282, 283 (fig. 2); J. S. Williams, 1948, Geol. Soc. America Bull., v. 59, no. 11, p. 1135, pl. 1. Described in Logan quadrangle, Utah. Drab fine- to medium-grained medium-bedded quartzite; at base of formation. Thickness on High Creek 75 feet; at Calls Fort, west of quadrangle, 6 feet. Overlies Nounan formation. Deiss (1938, Geol. Soc. America Bull., v. 49, no. 7) erred in redefinition of St. Charles in Blacksmith Fork section, because he failed to locate Worm Creek quartzite, which is distinctly present there. Upper Cambrian.

G. B. Richardson, 1941, U.S. Geol. Survey Bull. 923, p. 13. In Randolph quadrangle, Utah, is massive gray quartzite about 300 feet thick.

W. H. Coulter, 1956, Idaho Bur. Mines and Geology Pamph. 107, p. 18. Thickness, east of Willow Flat, Idaho, 170 feet.

R. H. Olson, 1956, Utah Geol. Soc. Guidebook 11, p. 48–49. Area of report is Promontory Range. A 3,800-foot sequence of dolomites, limestones, and

minor interbedded shales lying between Dunderberg shale (herein geographically extended into Utah) and Ordovician Garden City formation is referred to as Upper Cambrian (undifferentiated). A 60-foot quartzite member is present 1,160 feet below base of Garden City formation. This quartzite unit may be correlative of Worm Creek quartzite member of St. Charles formation.

C. B. Bentley, 1958, Bringham Young Univ. Research Studies Geology Ser., v. 5, no. 6, p. 22. Haynie (1957, unpub. thesis) affirmed Olsou's (1956) Worm Creek designation in Promontory Range. Since Worm Creek is same age as Dunderberg shale of Eureka, Nev., Olson's Dunderberg shale is misnomer.

Named for exposures on Worm Creek, Bear Lake County, Idaho.

†Wortham Aragonite Lentil (in Wills Point Formation)[1]

Paleocene: Northeastern Texas.

Original reference: F. B. Plummer, 1933, Texas Univ. Bull. 3232, p. 530, 535, 537, 538, 559.

Mackenzie Gordon, Jr., J. I. Tracey, Jr., and M. W. Ellis, 1958, U.S. Geol. Survey Prof. Paper 299, p. 25. Lentil in Kerens member of Wills Point formation.

Named for occurrence in stream valley, 1 mile east of Wortham, Freestone County.

Worthey Member (of Sycamore Formation)

Mississippian: Central southern Oklahoma.

J. D. Prestridge, 1959, *in* Petroleum geology of southern Oklahoma, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 158 (fig. 2), 161–162, 163. Comprises approximately 310 feet of compact tough blocky blue slate, silty to sandy limestone which is massive at base becoming thick bedded near middle and thin bedded near top; also member becomes more shaly toward top. Eastward from type locality upper part gives way to lower Caney shale which becomes calcareous near base; contact gradational. Overlies Cornell Ranch member (new).

Type section: SE¼SE¼NE¼ sec. 33, T. 2 S., R. 1 E., Carter County. Named for Ed Worthey Farm. Massive part of member forms prominent Sycamore hogback.

Worthington Sandstone Member (of Allegheny Formation)[1]

Middle Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1880, Pennsylvania 2d Geol. Survey Rept. H_5, p. xxi, 319.

Worthington is in Armstrong County.

Worthville Beds[1]

Upper Ordovician: Northern New York.

Original reference: R. Ruedemann, 1925, New York State Mus. Bull. 258, p. 137, 141, 149, 154.

Exposed along Sandy Creek about Worthville, Jefferson County.

Wrangell Lava[1]

Tertiary to Recent: Southeastern Alaska.

Original reference: W. C. Mendenhall, 1905, U.S. Geol. Survey Prof. Paper 41, p. 54, map.

F. H. Moffit, 1954, U.S. Geol. Survey Bull. 989–D, p. 165–167, pls. 6, 7. Proportion of fragmental beds, tuffs, and agglomerates much greater in western part of area (eastern part of Alaska Range and adjacent area), near the volcanic centers. The lava flows, particularly younger flows, are quite fresh and commonly black or dark gray in color; less commonly show colors of brick red, brown, and tan. Most lava is porphyritic and much is highly vesicular. Columnar structure well developed in many flows. Glassy phases of lava more numerous in upper part of section. Thickness varies with distance from vents; may be 12,000 feet or more in neighborhood of Mount Sanford, but because base of deposits is uneven surface, definite measurement applies to only one locality. Extrusion of Wrangell lava probably began in Eocene time and continued intermittently to Recent time. Mapped as Tertiary to Recent.

Forms entire western part of Wrangell group of mountains. Occupies an irregular elongated area extending from lower western slopes of Mount Drum to international boundary, a distance of about 130 miles.

Wray Channel Beds (in Ash Hollow Formation)

Pliocene: Northeastern Colorado.

M. K. Elias, 1942, Geol. Soc. America Spec. Paper 41, p. 143. Name applied to thin channel sandstone near base of Ash Hollow.

Occurs near Beecher Island Post Office about 15 miles south of Wray, Yuma County.

Wreford Limestone (in Chase Group)[1]

Permian: Eastern Kansas, central Oklahoma, and southeastern Nebraska.

Original reference: R. Hay, 1893, Kansas State Bd. Agr. 8th Bien. Rept., p. 104.

R. C. Moore, J. C. Frye, and J. M. Jewett, 1944, Kansas Geol. Survey Bull. 52, pt. 4, p. 165. Includes (ascending) Threemile limestone, Havensville shale, and Schroyer limestone members. Average thickness 35 feet. Underlies Matfield shale; overlies Speiser shale. Wolfcamp series.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 105–109. Described in Pawnee County where it overlies Garrison shale in Council Grove group, and underlies Matfield shale. This is essentially usage of Prosser (1902). In Kansas, Wreford is divided into three members but these divisions have not been recognized in Oklahoma. Thickness 12 to 31 feet.

Named from exposures near Wreford, Geary County, Kans.

Wrightsville Conglomerate[1]

Devonian or Carboniferous: Northwestern Pennsylvania.

Original reference: J. F. Carll, 1883, Pennsylvania 2d Geol. Survey Rept. L_4, p. 180, 203–208, 230.

Forms several escarpments near Wrightsville, Warren County.

Wupatki Member (of Moenkopi Formation)

Lower Triassic: Northeastern Arizona.

E. D. McKee, 1951, New Mexico Geol. Soc. Guidebook 2d Field Conf., p. 86, 87 (fig. 1). Red beds—shaly siltstones and structureless mudstones—alternating with resistant thick-bedded sandstones. Thickness over 50 feet. Underlies Winslow member (new); overlies Kaibab limestone.

E. D. McKee, 1954, Geol. Soc. America Mem. 61, p. 18, 19. Thickness ranges from 70 to 119 feet. Underlies Moqui member (new) in Poverty Tank-Concho area. Units here called Wupatki and Moqui were referred to as Salt Creek by Hager (1922, Mining and Oil Bull., v. 8, no. 2, p. 73).

Named in Winslow-Holbrook area.

Wurtemburg Limestone (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. J., p. 93–100.

Well exposed just east of Wurtemburg along Slippery Rock Creek, in Lawrence County.

Wurtemburg Sandstone (in Pottsville Formation)[1]

Pennsylvanian: Western Pennsylvania.

Original reference: J. P. Lesley, 1875, Pennsylvania 2d Geol. Survey Rept. J, p. 93–94.

Wurtemburg, Lawrence County.

Wyandot Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Wyandot mine, Houghton County.

Wyandot Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Wyandot mine, Houghton County.

Wyandot No. 8 Amygdaloid[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Occurs in interval between conglomerate No. 6 above and Superior West amygdaloid below and is eight amygdaloids back from Wyandot shaft, Houghton County.

Wyandot No. 8 Flow[1]

Precambrian (Keweenawan): Northern Michigan.

Original reference: B. S. Butler and W. S. Burbank, 1929, U.S. Geol. Survey Prof. Paper 144 (chart compiled by M. G. Wilmarth).

Named for occurrence in Wyandot mine, Houghton County.

Wyandotte Group[1]

Pennsylvanian: Eastern Kansas.

Original reference: R. C. Moore, 1931, Kansas Geol. Soc. Guidebook 5th Ann. Field Conf., correlation chart.

Wyandotte Limestone[1] (in Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, northwestern Missouri, and southeastern Nebraska.

Original reference: R. C. Moore, 1932, Kansas Geol. Soc. 6th Ann. Field Conf., Guidebook, p. 85, 91, 92, 97.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4). Formation includes (ascending) Frisbie limestone, Quindaro shale, Argentine limestone, Island Creek shale, and Farley limestone members. Underlies Bonner Springs shale; overlies Lane shale. This is classification agreed upon by State Geological Surveys of Iowa, Kansas, Missouri, Nebraska, and Oklahoma, May 1947.

G. E. Condra, 1949, Nebraska Geol. Survey Bull. 16, p. 34. Thickness of formation about 32 feet in Cass County, Nebr.

T. L. Welp, L. A. Thomas, and H. R. Dixon, 1957, Iowa Acad. Sci. Proc., v. 64, p. 418 (fig. 1), 420. Thickness of formation about 22 feet in Madison County, Iowa. Five members present.

Named from Wyandotte County, Kans.

†Wyckoff Limestone[1]

Pennsylvanian: Eastern Kansas.

Original reference: E. Haworth and M. Z. Kirk, 1894, Kansas Univ. Quart., v. 2, p. 111.

Named for Wyckoff, Lyon County.

Wykoff Beds[1]

Wykoff Member (of Maquoketa Formation)[1]

Upper Ordovician (Cincinnatian): Southeastern Minnesota and northeastern Iowa.

Original reference: C. W. Hall and F. W. Sardeson, 1892, Geol. Soc. America Bull., v. 3, p. 349, 359, 366.

C. R. Stauffer and G. A. Thiel, 1941, Minnesota Geol. Survey Bull. 29, p. 9, 92–93. Wykoff member of Maquoketa consists of about 30 to 45 feet of argillaceous gray limestone and weathered shale; fossiliferous. Occurs above Dubuque member and below Devonian Cedar Valley limestone. Name is satisfactory and should be retained in Minnesota classification.

Named for exposures at Wykoff, Fillmore County, Minn. Also well exposed 1 mile east of Spring Valley, along U.S. Highway 16.

Wyman Formation[1]

Precambrian(?): Southern California.

Original reference: J. H. Maxson, 1934, Pan-Am. Geologist, v. 61, no. 4, p. 311.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 280 (fig. 4). Shown on columnar section above Roberts formation and below Reed dolomite. Thickness 3,700 feet.

U.S. Geological Survey currently designates the age of the Wyman as Precambrian(?) on the basis of a study now in progress.

In Wyman Canyon, Inyo Range.

Wyman[1] (formation)

Lower Cretaceous: Montana.

Original reference: C. R. Keyes, 1926, Pan-Am. Geologist, v. 46, p. 195–232.

†Wyman Sandstone[1]

Mississippian: Northern Arkansas and eastern Oklahoma.

Original reference: F. W. Simonds, 1891, Arkansas Geol. Survey Ann. Rept. 1888, v. 4, p. 26, 38–41.

Named for Wyman, Washington County, Ark.

Wymanian series

Precambrian (Protozoic): Eastern California.

C. R. Keyes, 1942, Pan-Am. Geologist, v. 77, no. 4, p. 307 (chart). Listed as lowermost series in section. Consists of 3,700 feet of schists. Unconformable below Reedian series.

Occurs in Death Valley region.

Wymer Beds[1]

See Wimer Beds.

Wymore Shale Member (of Matfield Shale)

Wymore Shale (in Chase Group)[1]

Permian: Southeastern Nebraska and eastern Kansas.

Original reference: G. E. Condra and J. E. Upp, 1931, Nebraska Geol. Survey Bull. 6, 2d ser., p. 37.

D. E. Hattin, 1957, Kansas Geol. Survey Bull. 124, p. 49–50, 122. Generally exhibits fourfold depositional sequence (ascending): (1) silty green shale; (2) silty red shale and red mudstone, (3) silty green shale, and (4) very silty shale, very calcareous mudstone, or hard very silty limestone. Thickness 9 to 26 feet. Underlies Kinney limestone member; overlies Schroyer limestone member of Wreford limestone. Wolfcamp series.

Type locality: Ravines on west side of creek 2½ miles east of south side of Wymore, Gage County, Nebr., in E½ sec. 27, T. 2 N., R. 4 E., about one-quarter mile north of where highway crosses Burlington and Union Pacific Railroads.

Wynn Limestone Member (of Palo Pinto Formation)

Pennsylvanian (Canyon Series): North-central Texas.

M. G. Cheney, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 66 (fig. 1), 88. Name applied to lower limestone member of formation. Underlies Posideon shale member (here reallocated to redefined Palo Pinto).

Named from Wynn Mountain, 2½ miles east of Palo Pinto, Palo Pinto County.

Wynona Sandstone Group[1] or Series[1]

Pennsylvanian: Central northern Oklahoma.

Original reference: H. T. Beckwith, 1928, Oklahoma Geol. Survey Bull. 40T, p. 22–24.

Occurs in vicinity of Wynona, Osage County.

Wynona Sandstone Member (of Vamoosa Formation)

Wynona Sandstone Member (of Nelagoney Formation)[1]

Pennsylvanian (Virgil Series): Northeastern Oklahoma.

Original reference: C. F. Bowen, 1918, U.S. Geol. Survey Bull. 686–D, p. 17, 18.

W. F. Tanner, 1956, Oklahoma Geol. Survey Circ. 40, p. 12 (fig. 1), 50–52, fig. 14, pl. 1. Reallocated to Vamoosa formation. Described as sequence of beds about 70 feet thick; consists of at least two sandstones, each about 25 feet thick, separated by about 20 feet of shale and sandy shale. Beds are buff, very fine to coarse grained, thin bedded to massive; sandstones become thinner northward and split into many tongues. Lies stratigraphically above Cochahee sandstone member and below Oread limestone member.

P. B. Greig, 1959, Oklahoma Geol. Survey Bull. 83, p. 30. Lowest member of Vamoosa identified in Pawnee County. Thickness 15 feet. Occurs at top of complex 100-foot shale-sandstone sequence which comprises lower part of Vamoosa; underlies thick sequence of dark fossiliferous shales; occurs below Kanwaka shale member.

Named from exposures near Wynona, T. 24 N., R. 9 E., Osage County.

Wyo division[1]

Upper Cambrian or Lower Ordovician: Central Texas.

Original reference: T. B. Comstock and E. T. Dumble, 1890, Texas Geol. Survey 1st Ann. Rept., p. 295–306, pl. 3.

Named for "well-known cattle brand (YO) used in Blue Mountain region along course of James River in adjoining parts of Mason and Kimble Counties."

†Wyoming Conglomerate[1]

Miocene(?): Northwestern Colorado, northeastern Utah, and southern Wyoming.

Original reference: C. King, 1876, U.S. Geol. Expl. 40th Par. Atlas, maps 1, 2; separate sheets were issued in 1875, but atlas bears 1876 imprint.

Occurs in region of Big Thompson, eastern Colorado, and east of Laramie Hills, Wyo.

†Wyoming Formation[1] or Group[1]

Pennsylvanian, Permian, and Triassic(?): Eastern Colorado.

Original reference: G. H. Eldridge, 1896, U.S. Geol. Survey Mon. 27.

T. S. Lovering and E. N. Goddard, 1950, U.S. Geol. Survey Prof. Paper 223, pl. 6; R. L. Langenheim, Jr., 1952, Am. Assoc. Petroleum Geologists Bull., v. 36, no. 4, p. 550 (fig. 2). Name appears on correlation charts citing history of nomenclature applied to Pennsylvanian and Permian rocks in Colorado.

Named for widespread development in Wyoming, but application of name in literature has been restricted to eastern Colorado.

Wyoming Valley Limestone Beds[1]

Pennsylvanian: Pennsylvania.

Original reference: C. A. Ashburner, 1886, Pennsylvania 2d Geol. Survey Rept. 1885, p. 437–450, map.

Occurs in Wyoming Valley, Luzerne County.

Wyopo Formation (in Chugwater Group)

Triassic: Northwestern Wyoming.

E. B. Branson and C. C. Branson, 1941, Am. Assoc. Petroleum Geologists Bull., v. 25, no. 1, p. 124 (table 1), 136. Cliff-forming series of white buff light-gray, and pink siltstone which is crossbedded in large part. In

southern part of range, lower part of formation changes in short distances from light gray to light red. Thickness about 200 feet in Lander region and less than 100 feet near Dubois. Underlies Gypsum Spring formation; overlies Popo Agie formation.

Type locality: Wyopo, a loading spur on Northwestern Railway, 2 miles northeast of Lander, Fremont County.

Wyota Member (of Dunleith Formation)

Middle Ordovician: Northern Illinois.

J. S. Templeton and H. B. Willman, 1952, Tri-State Geol. Soc. Guidebook 16th Ann. Field Conf., p. 24, figs. 3, 12. Dolomite, argillaceous and dense at top; pure, coarsely crystalline and porous below; medium- to thick-bedded. Thickness about 19 feet. Shown on columnar section as underlying Sinsinawa member (new) of Wise Lake formation and overlying Wall member (new) of Dunleith formation.

Occurs in Dixon-Oregon area.

XI Member (of Rexroad Formation)

Pliocene, upper: Southwestern Kansas.

C. W. Hibbard, 1949, Michigan Univ. Mus. Paleontology Contr., v. 7, no. 5, p. 93–94, 96–97. Consists of about 25 feet of sand, caliche, and clay beds in basal part of formation. Overlies Laverne formation with angular unconformity. Contains vertebrate fauna.

C. W. Hibbard, 1953, Michigan Acad. Sci., Arts, and Letters, Papers, v. 38, p. 389, 408. Contains Saw Rock Canyon fauna considered to be lower upper Pliocene in age.

Type locality: Near center of west line of sec. 36, T. 34 S., R. 31 W., Seward County. Name derived from XI ranch on which exposures occur.

Yaak Quartzite[1]

Precambrian: Northwestern Montana, and British Columbia, Canada.

Original reference: R. A. Daly, 1905, Canada Geol. Survey Summ. Rept. 1904, p. 96–100.

Probably named for Yaak River, Montana-British Columbia.

Yabucoa Granite[1]

Age(?): Puerto Rico.

Original reference: C. R. Fettke, 1924, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 2, p. 159.

Yaeger Greenstone (in Yavapai Group)

Precambrian: Central Arizona.

E. D. Wilson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 112; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1118 (table 1), 1120, pl. 10. Largely of intermediate to mafic flows and small intrusives, tuff, and agglomerate, together with some sedimentary material. Rocks show extensive alteration to greenish-black and grayish-green aggregates and fine-grained chlorite, sericite, and quartz, with local rude schistosity. Thickness appears to exceed 2,000 feet; base not exposed. Probably oldest member of Yavapai group. In fault contact with Red Rock rhyolite (new) above. Yaeger greenstone is equivalent to "greenstone complex" of earlier authors, especially Lausen (1930, Jour. Geology, v. 38, no. 2, p. 174).

Gordon Gastil, 1958, Geol. Soc. America Bull., v. 69, no. 12, pt. 1, p. 1496. In Gila County, basic volcanic rocks belong not to a single unit, the Yaeger greenstone, placed at base of stratigraphic sequence, but to at least three stratigraphically separate units—Flying W, Board Cabin, and Haigler formations (new).

Named for typical occurrence east of Yaeger mine, in southwestern part of Black Hills. Also crops out in Mazatzal Mountains and eastern Tonto Basin areas.

Yager Formation

Upper Jurassic to Lower Cretaceous: Northwestern California.

B. A. Ogle, 1953, California Div. Mines Bull. 164, p. 13 (fig. 3), 16–22, pls. 1, 2. Series of dark-gray indurated mudstone, shale, graywacke, and conglomerate. Thickness about 10,000 feet. In fault contact with Franciscan in northeastern part of Fortuna quadrangle and with rocks of False Cape shear zone along Russ fault in southern part of quadrangle; in southern area, unconformably underlies Pullen formation (new) and farther north undifferentiated Wildcat group; along Yager fault is faulted against Rio Dell formation (new) and Eel River formation (new). It is possible that rocks included in formation range from Upper Jurassic to Upper Cretaceous; most evidence points to Cretaceous age. Columnar section shows Upper Jurassic to Lower Cretaceous.

Exposed in Yager Creek in Fortuna quadrangle, Eel River valley area, Humboldt County.

Yakataga Formation[1]

Miocene and Pliocene(?): Southeastern Alaska.

Original reference: N. L. Taliaferro, 1932, Geol. Soc. America Bull., v. 43, no. 3, p. 756.

D. J. Miller, 1951, Preliminary report on the geology and oil possibilities of the Yakataga district, Alaska: U.S. Geol. Survey, p. 35, fig. 1. Horizon of Yakataga-Poul Creek contact in area between Twomile Creek and White River found to lie several hundred feet stratigraphically above sandstone cited by Taliaferro as marking base of Yakataga formation. Formation includes entire sequence of Tertiary strata overlying Poul Creek formation in Yakataga district. Upper Oligocene(?), Miocene and Pliocene(?).

D. J. Miller, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–187, sheets 1 and 2. In southeastern part of Robinson Mountains, formation comprises minimum of 10,000 feet, possibly 15,000 feet or more, of sedimentary rocks, chiefly siltstone, sandstone, and unsorted coarse ice-transported debris, called conglomeratic sandy mudstone. Lower part of Yakataga Reef section reassigned to Poul Creek formation. Considerable diversity of opinion as to age of formation. Mapped as Miocene and Pliocene(?).

Well exposed at Yakataga Reef and on both flanks of "Yakataga" anticline (Sullivan anticline in report of Miller, 1957), Yakataga district, Controller Bay region.

Yakima Basalt[1]

Miocene, upper, and Pliocene, lower: Eastern Washington.

Original reference: G. O. Smith, 1901, U.S. Geol. Survey Water-Supply Paper 55.

W. C. Warren, 1940, (abs.) Geol. Soc. America Bull., v. 51, no. 12, pt. 2, p. 2034–2035; 1941, Jour. Geology, v. 49, no. 8, p. 795–814. Yakima basalt is typical plateau basalt which is associated toward west in Cascade Mountains with different type of volcanic formation, the Keechelus andesitic series. Latter has commonly been regarded as younger. In Mount Aix quadrangle, upper part of Keechelus andesitic series, which has long been known to be unconformable on lower part, has been split off as separate unit and is here named Fifes Peak andesite. Marginal flows of Yakima overlap Fifes Peak andesite. In some areas, overlies Taneum andesite. Yakima commonly regarded as middle Miocene but may be upper Miocene.

J. H. Mackin, 1947, Northwest Sci., v. 21, no. 1, p. 33. In Yakima-Ellensburg area, Yakima basalt with Squaw Creek diatomite member (new) one flow below top, is overlain in ascending order by Selah tuff (new), Wenas basalt, and main body of Ellensburg formation.

A. C. Waters, 1955, Geol. Soc. America Bull., v. 66, no. 6, p. 669–672, pl. 1. Described and mapped in Yakima East quadrangle where it is exposed in four southeast-trending strips that coincide with crestal portions of four anticlinal axes. Interfingers with overlying Ellensburg formation. Thickness as much as 1,500 feet; base not exposed. Lenses of micaceous silt, sandstone, and clay, with occasional conglomerate beds, occur between flows at many localities in upper part of section. Layer of fresh-water diatomite, 6 to 10 feet thick, together with 150-foot basalt on which it rests, forms good horizon marker. Top of flow that overlies the diatomite was apparently selected by Smith as top of Yakima basalt and base of Ellensburg where he mapped Ellensburg quadrangle. Present mapping indicates that contact between any one basalt flow and an overlying sedimentary bed cannot serve as workable horizon for defining top of Yakima basalt and base of Ellensburg; in general, sedimentary parts of the section thin and pinch out between successively younger flows when traced eastward; in some areas, exact position of contact is a matter of arbitrary choice; at one locality, Ellensburg pinches out and Wenas basalt rests directly on Yakima. In a broad sense, entire lower part of Ellensburg can be considered marginal sedimentary facies of Yakima basalt flows.

Named for occurrence in Yakima area.

Yakima Group[1]

Pliocene: Central northern Oregon.

Original reference: T. Condon, 1902, The two Islands: Portland, Oreg., The J. K. Gill Co.

Yakinikak Limestone[1]

Upper Mississippian: Northwestern Montana.

Original reference: Bailey Willis, 1902, Geol. Soc. America Bull., v. 13, p. 316, 324.

L. L. Sloss, 1945, Jour. Paleontology, v. 19, no. 3, p. 309. Represents remnant of an imbricate thrust sheet that has been thrust over subjacent Pennsylvanian(?) quartzite.

Type locality: On Yakinikak Creek, 4 miles west of North Fork of Flathead River, Glacier National Park.

Yakutat Group[1]

Upper(?) Cretaceous: Southeastern Alaska.

Original reference: I. C. Russell, 1891, Nat. Geog. Mag., v. 3, p. 167–175.

George Plafker and D. J. Miller, 1957, U.S. Geol. Survey Oil and Gas Inv. Map OM–189. Sedimentary sequence in Malaspina district assigned to Yakutat group probably thousands of feet thick. Paleontological evidence indicates Upper (?) Cretaceous age. Underlies Tertiary(?) siltstone sequence and overlies Cretaceous or older crystalline complex with unconformable contacts.

Exposed about Yakutat Bay and westward along foot of St. Elias Mountain to Icy Bay. Also forms major part of coastal mountains between Disenchantment Bay and Dry Bay.

Yale Member (of Ironwood Iron-Formation)[1]

Precambrian (Animikie Series): Northwestern Michigan and northwestern Wisconsin.

Original reference: W. O. Hotchkiss, 1919, Eng. Mining Jour., v. 108, p. 501, 503.

N. K. Huber, 1959, Econ. Geology, v. 54, no. 1, p. 104 (table 10), 106 (table 11), 107 (fig. 6). Underlies Norrie member; overlies Plymouth member. Thicknesses (taken from drill holes) 48½ and 67½ feet.

Named for Yale mine, near Bessemer, Gogebic County, Mich.

Yale Point Sandstone (in Mesaverde Group)

Upper Cretaceous: Northeastern Arizona.

G. A. Kiersch, 1955 Mineral Resources Navajo-Hopi Indian Reservations, Arizona-Utah, v. 2: Tucson, Ariz., Univ. Arizona Press, p. 4 (fig. 1), 7. Prominent cliff-forming sandstone capping group along eastern margin of Black Mesa. Overlies Wepo formation (new). Name credited to Repenning and Page.

C. A. Repenning and H. G. Page, 1956, Am. Assoc. Petroleum Geologists Bull., v. 40, no. 2, p. 271, 279–281. Yellowish-gray massive sandstone, weathering grayish orange, and composed of coarse- to medium-grained subrounded to subangular clear quartz. Bedding is lenticular, individual units crossbedded. Thin silty units present at widely spaced intervals. Minor amounts of coal present. Thickness at Yale Point 204 feet, maximum of 300 feet at north end of Marsh Pass. Caps Black Mesa; no younger sediments overlie formation; and its upper limit is surface of recent erosion. Intertongues with underlying Wepo formation to south. Type section designated.

Type locality: Three-fourths mile west of Yale Point of Black Mesa, from which it is named, Apache County.

Yamhill Formation

Eocene, upper: Western Oregon.

E. M. Baldwin and others, 1955, U.S. Geol. Survey Oil and Gas Inv. Map OM–155. Name proposed for thick sequence of marine sedimentary rocks that overlie Siletz River volcanic series. These sedimentary rocks have been known locally as Mill Creek beds. At Mill Creek, sedimentary rocks that compose lower 500 feet of formation are predominantly dark-gray shale and siltstone with occasional beds of lime-cemented sandstone. The siltstone and shale sequence along Mill Creek is overlain by sequence of massive sandstone beds. The sandstone is medium to greenish gray, thick bedded, and fossilferous. This sandstone is about 500 feet thick and grades upward into more argillaceous rock. Greenish-gray sand beds of

the Yamhill are in turn overlain along Mill Creek by approximately 4,000 feet of finely micaceous siltstone and mudstone. Unconformably overlain by Nestucca formation. Yamhill and Burpee formations occupy same general stratigraphic position and are probably equivalent in age. Eocene.

E. M. Baldwin, 1959, Geology of Oregon: Ann Arbor, Mich., Edwards Bros., Inc., p. 13–14. Formation is exposed along south slope of Yamhill Valley and southward through the Dallas area to Luckiamute River where it appears to interfinger with beds of Tyee formation. Near Dallas, limestone at base of formation is referred to as Dallas limestone member.

Type section: Exposures along Mill Creek from a point 0.6 mile south of Sheridan quadrangle to point 0.1 mile southeast of Mill Creek School. Formation best preserved within Yamhill Valley downwarp, which occupies broad area along South Yamhill River in Sheridan quadrangle.

Yampa Limestone Lentil (of Bingham Quartzite)[1]

Pennsylvanian: Central northern Utah.

Original reference: A. Keith, 1905, U.S. Geol. Survey Prof. Paper 38, p. 43, map, sections.

Named for Yampa mine, Bingham district.

†Yampa Sandstone[1]

Pennsylvanian: Northeastern Utah.

Original reference: J. W. Powell, 1876, Geology of eastern portion of Uinta Mountains, p. 41, 55.

Occurs along Yampa River and on Yampa Plateau.

Yampai sandstone[1]

Yampai shales (in Tusayan series)

Permian: Northwestern Arizona.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 38, no. 3, p. 251, 339.

Charles Keyes, 1936, Pan-Am. Geologist, v. 66, no. 3, p. 215 (table). Underlies Shiwits sandstones; overlies Seligman limestones. In Tusayan series (new) of Carbonic age.

In Grand Canyon region.

Yankee Fork Rhyolite Member (of Challis Volcanics)[1]

Oligocene, upper, or Miocene, lower: Southern central Idaho.

Original reference: C. P. Ross, 1932, Idaho correlation chart compiled by M. G. Wilmarth.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 13. In Bayhorse region, Challis volcanics have been divided into five members: latite-andesite, Germer tuffaceous, basalt and related flows, Yankee Fork rhyolite, and travertine. Rhyolitic member has three subdivisions that have been distinguished in mapping on the basis of differences in lithology.

Type locality: Head of Yankee Fork Creek, southeast corner of Casto quadrangle.

Yankeetown Chert[1]

Yankeetown Chert (in New Design Group)

Upper Mississippian (Chester Series): Southwestern Illinois and eastern Missouri.

Original reference: S. Weller, 1913, Illinois Acad. Sci. Trans., v. 6, p. 120, 124.

J. M. Weller, 1939, Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 131, 135; J. M. Weller and A. H. Sutton, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 5, p. 826. Assigned to New Design group (new).

Named for Yankeetown School, southeastern corner Monroe County, Ill.

Yanktonian series

Cretaceous: Iowa.

C. R. Keyes, 1936, Pan-Am. Geologist, v. 66, no. 2, p. 154–156. Term used for so-called Benton shales of Iowa. Comprises (ascending) Woodbury shales, Dixon chalk, Hawarden shales, and Niobrara chalk.

Yap Beds or Formation

Pre-Tertiary(?): Caroline Islands (Yap).

Risaburo Tayama, 1935, Topography, geology, and coral reefs of the Yap Islands: Tohoku Univ., Inst. Geology and Paleontology Contr. in Japanese Language, no. 19, p. 36–38 [English translation in library of U.S. Geol. Survey, p. 32–33]; 1952, Coral reefs in the South Seas: Japan Hydrog. Office Bull., v. 11, p. 60–61, table 4 [English translation in library of U.S. Geol. Survey, p. 71–72]. Group of green rocks composed chiefly of massive amphibolite, granular amphibolite, platy amphibolite, and green schist. Dips at high angles. Unconformably underlies Map beds. Pre-Tertiary(?).

C. G. Johnson, R. J. Alvis, and R. L. Hetzler, 1960, Military geology of Yap Islands, Caroline Islands: U.S. Army Far East Command, p. 63–65. Pre-Miocene, possibly Mesozoic.

Occurs in Yap proper, Yap Island group.

Yapoah Flows, Basalt

Recent: Southwestern Oregon.

Howel Williams, 1944, California Univ. Pub., Dept. Geol. Sci. Bull. 27, no. 3, p. 55, 62, pl. 9. Discussion of volcanoes of Three Sisters region. Name is applied to flows from Yapoah Cone.

Yapoah Cone is north of North Sister Mountain.

Yaquian series

Cambrian (Mid-Cambric): Northern Arizona.

Charles Keyes, 1940, Pan-Am. Geologist, v. 74, no. 2, p. 154–156. Name proposed for beds of Mid-Cambric age in the Grand Canyon which were previously called Tonto group and correlated with the type Tonto series section (of Protozoic age) near Fort Apache.

In the Grand Canyon region.

Yaquina Formation[1] or Sandstone

Oligocene, upper: Northwestern Oregon.

Original reference: Harrison and Eaton [consulting firm], 1920, Report on investigation of oil and gas possibilities of western Oregon: Oregon Bur. Mines and Geology, Mineral Resources Oregon, v. 3, no. 1, p. 3–40.

H. E. Vokes, Hans Norbisrath, and P. D. Snavely, Jr., 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 88. Described in Newport-Waldport area as approximately 2,700 feet of shallow-water deposits, predominantly light-gray to brown tuffaceous and usually carbonaceous poorly consolidated sandstones, sandy tuffs, and interbedded or alternating tuffs and

sandstones. Disconformably overlies Toledo formation; disconformably underlies Nye mudstone.

P. D. Snavely, Jr., and H. E. Vokes, 1949, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 97. Described in coastal area near Cape Foulweather as 2,500 to 3,000 feet of arenaceous sedimentary rocks, unconformably overlying Nestucca formation. Outcrop belt narrows northward as dip steepens and the Yaquina is progressively overlapped by Astoria formation.

Type locality not designated in original description. Schenck (1928) interpreted type locality to be near village of Yaquina, near Newport, Lincoln County.

Yarmouth Interglaciation

Yarmouth (Yarmouthian) Stage, Age

Yarmouth stage of deglaciation[1]

Pleistocene: Mississippi Valley.

Original reference: F. Leverett, 1898, Jour. Geology, v. 6, p. 176, 238–243.

J. C. Frye and A. B. Leonard, 1952, Kansas Geol. Survey Bull. 99, p. 24, 31, 35, 38, 52, 55, 104, 118, 156. Discussion of Yarmouth soil, Yarmouthian age, and stage. The Yarmouthian follows the Kansan and precedes the Illinoian.

Name amended to Yarmouth Interglaciation to comply with Stratigraphic Code adopted 1961.

Name derived from Yarmouth, Des Moines County, Iowa.

Yates Formation (in Artesia Group)

Yates Sandstone (in Whitehorse Group)

Permian: Subsurface in Texas and subsurface and surface in New Mexico.

G. C. Gester and H. J. Hawley, 1929, Structure of typical American oil fields: Tulsa, Okla., Am. Assoc. Petroleum Geologists, v. 2, p. 487, 488. In Yates field, upper division of Permian is known as "Anhydrite series" and ranges in thickness from 650 to 750 feet. Yates is 50-foot sandstone that occurs 100 to 150 feet below top of Anhydrite series and from 500 to 550 feet above top of "brown lime," topmost member of "Big lime" in this field.

R. K. DeFord, G. D. Riggs, and N. H. Wills, 1938, (abs.) Am. Assoc. Petroleum Geologists Bull., v. 22, no. 12, p. 1706. Yates sand has been traced from subsurface to surface outcrop and top of Yates mapped from Carlsbad to McKittrick Canyon. Subdivision of Whitehorse-Capitan is simplified. From top downward, it is subdivided into Carlsbad, Yates, Seven Rivers, and Queen. This involves redefinition of the Carlsbad.

P. T. Hayes, 1957, U.S. Geol. Survey Geol. Quad. Map GQ–98. Formation included in Carlsbad group. Overlies Seven Rivers formation; underlies Tansill formation.

Term Artesia Group (D. B. Tait and others, 1962, Am. Assoc. Petroleum Geologists Bull., v. 46, no. 4) used in preference to Whitehorse Group in New Mexico.

Named from subsurface sections in Yates field in Pecos County, Tex.

Yauco Mudstone (in Mayagüez Group)

Upper Cretaceous: Southwestern Puerto Rico.

P. H. Mattson, 1958, Dissert. Abs., v. 18, no. 1, p. 197. Group comprises seven units. The Yauco is fourth in sequence [ascending]; overlies Melones limestone and underlies Maricao basalt (both new). Group ranges in age from Santonian or Campanian to early Maestrichtian.

P. H. Mattson, 1960, Geol. Soc. America Bull., v. 71, no. 3, p. 330 (fig. 3), 331–333, pl. 1. Mudstone, minor tuff, and rare conglomerate are herein named Yauco mudstone. These are rocks called strongly bedded shale by Mitchell (1922) who named them Río Yauco shale. Hubbard (1923, New York Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, v. 2, pt. 1) named them Río Yauco series. Río has been dropped to avoid confusion with other Puerto Rican formational names. Consists of foraminiferal tuffaceous mudstone with minor amount of tuff, wacke, conglomerate, and bedded chert. Bedded tuff forms 20 to 60 percent of Yauco mudstone; the larger tuff and flow units have been separated as Maricao basalt (new). Mudstone forms narrow belts on limbs of Hormigueros syncline; it averages 250 meters in north limb and ranges from 0 to 30 meters in south limb. Bedding in Yauco mudstone generally parallels contact with Rio Loco lava, but locally exposures show bedding truncated at contact. Relationships with Río Blanco formation not definitely known. Gradational contact with Sabana Grande andesite.

Report discusses Mayagüez area, about 250 square miles, in southwest Puerto Rico. Area contains large alluvium-filled valleys and part of the Cordillera Central in its southern foothills.

Yavapai Series

Yavapai Group

Yavapai Schist[1]

Precambrian: Central Arizona.

Original reference: T. A. Jaggar, Jr., and C. Palache, 1905, U.S. Geol. Survey Geol. Atlas, Folio 126.

E. D. Wilson, 1937, (abs.) Geol. Soc. America Proc. 1936, p. 112; 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1119–1120, table 1. Precambrian schists in central Arizona, which show recrystallization only in vicinity of intrusive bodies, collectively termed Yavapai group and subdivided into (ascending) Yaeger greenstone (new), Red Rock rhyolite (new), and Adler [Alder] sedimentary series (new). Term Yavapai group preferred because Yavapai formation is only locally schistose.

C. A. Anderson, E. A. Scholz, and J. D. Strobell, Jr., 1955, U.S. Geol. Survey Prof. Paper 278, p. 7, pl. 3. Series composed of many formations in Jerome area and divided into two groups. In Bagdad area, series comprises three formations (ascending): Bridle formation (new), Butte Falls tuff (new), and Hillside mica schist (new).

C. A. Anderson and S. C. Creasey, 1958, U.S. Geol. Survey Prof. Paper 308, p. 8–9, pl. 1. Series includes all older Precambrian volcanic and sedimentary rocks in Prescott-Jerome area. Separated into two major subdivisions: eastern Ash Creek group (new) of seven formations and western Alder group of six formations. The two groups separated by the Shylock fault. Wilson (1939) suggested that Yavapai schist be modified to Yavapai group. Yavapai series is used in this report to replace Yavapai schist.

Named for extensive development in Yavapai County.

Yazoo Clay (in Jackson Group)

Yazoo Clay Member (of Jackson Formation)[1]

Yazoo Group

Eocene, upper: Mississippi, southwestern Alabama, and central northern Louisiana.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 79.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 98–105. Yazoo clay, as used in this report [Grant and La Salle Parishes], includes all materials between Danville Landing beds above and Moodys Branch marl below. Includes Tullus clay member (new) below and Verda member (new). Thickness 275 to 375 feet. Jackson group.

F. F. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 18–22. Member of Jackson formation. Conformably overlies Moodys Branch marl member; conformably underlies Forest Hill sand member. Thickness about 500 feet.

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook 1] Field Trip Feb. 10, 11, 2d day's field trip, p. 2, columnar section. Yazoo clay in Jackson group. Massively bedded yellow to green calcareous clay. Interbedded lignitic clay in western Mississippi. Bentonitic zone near base. Thickness 90 to 600 feet. Underlies Forest Hill sand; overlies Moodys marl. Contains Cocoa sand member.

H. A. Tourtelot, 1944, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 6. Yazoo clay, in Quitman fault zone area, is divided into two tongues by Cocoa sand member. Estimated thickness 125 feet in southeastern part of area; thickens northwest to 250 feet in Jasper County, Miss. Overlies Moodys marl; underlies Red Bluff clay.

G. E. Murray, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 10, p. 1838 (fig. 6), 1839. Yazoo clay, in Mississippi and Alabama, divided into (ascending) North Creek clay (new), Cocoa sand, Pachuta clay (new), and Shubuta clay (new) members.

Alan Cheetham, 1957, Gulf Coast Assoc. Geol. Soc. Trans., v. 7, p. 97 (fig. 5). Chart shows Yazoo group, consisting of North Creek clay, Cocoa sand, Pachuta marl, and Shubuta clay, as Eocene–Oligocene.

H. V. Andersen, 1960, Louisiana Geol. Survey Geol. Bull. 34, p. 96–99. Most continuous section of Yazoo formation in Sabine Parish extends from bottom of Caney Creek (SW¼SE¼ sec. 34, T. 4 N., R. 12 W.) approximately 100 yards south of bridge and thence eastward in ditches along Clare-Toro ward road. At this locality, about 65 feet of Yazoo clay is exposed. Included in this section is a 5.8-foot bed of highly fossiliferous, glauconitic, sandy marl, which is equivalent to basal sediment of Wooleys Bluff clays (member?) of Wellborn formation of Texas, and a 7-foot fossiliferous sand, which is probably equivalent to some part of sands reported overlying Wooleys Bluff clays at Sabine River in Texas. Overlies Moodys Branch marl with contact transitional; underlies Danville Landing beds. Jackson group.

Named for exposures in bluff of Yazoo River at Yazoo City, Yazoo County, Miss.

†Yeager Clay[1]

Oligocene(?): Southern Texas.

Original reference: Julia Gardner and A. C. Trowbridge, 1931, Am. Assoc. Petroleum Geologists Bull., v. 15, no. 4, p. 470.

Named from Yeager Ranch, on Cotulla-Sandiego Road, in northeast Webb County.

Yeager Greenstone

See Yaeger Greenstone.

Yearwood Formation

Cretaceous (Comanche Series): Southwestern Texas.

J. P. Brand and R. K. DeFord, 1958, Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 373–376. Name proposed for lowermost Cretaceous formation in Kent quadrangle. Formation consists of up to 160 feet of limestone and a sporadically distributed basal conglomerate. Basal clastic part is restricted to vicinity of type locality where maximum section of about 55 feet is recorded; elsewhere, basal conglomerate is absent or exemplified by scattered quartz pebbles in basal few feet of the limestone. Upper member consists of up to 110 feet of light-gray to grayish-orange-pink thin bedded to massive micrograined limestone with thin light-gray calcareous shale interbeds. Yearwood rests unconformably on Permian formations; at type locality, on Permian red beds; in escarpment northeast of Kent and between Kent and Boracho Station, on Tansill (Guadalupian) limestone; underlies Cox sandstone with contact disconformable.

P. C. Twiss, 1959, Texas Univ. Bur. Econ. Geology Quad. Map 23. Crops out in four isolated localities in northern third of Van Horn Mountains area. Average thickness about 225 feet. At all exposures, overlies Permian limestone unconformably and slightly discordantly. Regional stratigraphy indicates the Yearwood is correlative with Bluff formation.

Type locality: West slope of prominent hill in NW¼ sec. 7, Blk. 59, Texas and Pacific Railroad Co., Kent quadrangle. Name derived from Yearwood (Drake) Ranch about 5 miles north-northeast of Kent, Culberson County.

Yegua Formation (in Claiborne Group)[1]

Yegua Group

Yegua Member (of Lisbon Formation)

Eocene, middle: Eastern and southern Texas, northwestern Louisiana, and western and southern Mississippi.

Original reference: E. T. Dumble, 1892, Brown coal and lignite of Texas, p. 124, 148–154.

H. B. Stenzel, 1940, Texas Univ. Bur. Econ. Geology Pub. 3945, p. 847–904. Comprehensive report on Yegua problem. Terms Lufkin, Yegua, and Cockfield have been used for beds in question in the past. All three terms have their advocates. Writer [Stenzel] would have preferred Lufkin but consensus was decidedly against it and for retention of name Yegua; hence, term Yegua is retained in this report. Type localities of Yegua as given by Dumble and other authors following him are declared invalid and are abandoned. However, new type locality is not designated. Formation is divided into an upper, partly marine member Creola (new), and lower, nonmarine member, Lufkin. Lower boundary of Yegua lies at top of Mount Tabor member of Crockett formation and

at base of Bryan sand, which is local sand lentil in Yegua; upper boundary is defined by disconformity with which sediments of Jackson group begin.

F. F. Mellen, 1940, Mississippi Geol. Survey Bull. 39, p. 12 (table), 13–16. Referred to as member of Lisbon formation. In Yazoo County, consists of about 100 feet of silty lignitic clays, argillaceous lignitic silts, and fine-grained argillaceous sands of nonmarine or estuarine origin. Disconformably underlies Moodys Branch member of Jackson formation; base not exposed.

J. M. Patterson, 1942, Am. Assoc. Petroleum Geologists Bull., v. 26, no. 2, p. 259 (fig. 2), 263–266. Formation described in south Texas. In Starr and Zapata Counties, consists of two marine sandstones and three marginal shale members. Northward, in southern Webb County, these sand members wedge out and entire Yegua section becomes a series of red and green bentonitic shales with interbedded tuff and ash beds. Includes (ascending) La Perla shale member (new), Mier sandstone tongue, Jose shale member (new), Loma Blanca tongue, and Los Arrieros shale member (new). Thickness about 800 feet. Overlies Falcon sandstone member (new) of Cook Mountain formation; underlies Fayette formation.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 1–4. Rank raised to group. Includes (ascending) Smetana sandstone (new), Bryan sandstone, Easterwood shales (new), and Cockfield formation. Estimated thickness about 1,700 feet. Unconformably underlies Rock Prairie sandstone (new) of Jackson group. Unconformably overlies Mount Tabor shales.

U.S. Geological Survey has restricted the term Yegua to Texas and restored the term Cockfield Formation for use in Mississippi, Louisiana, and Arkansas.

Type locality: Near mouth of Elm Creek, on [West] Yegua River [Creek], Lee County, Tex.

Yegua River Conglomerate (in Yegua Formation)[1]

Eocene: Eastern Texas.

Original reference: L. C. Reed and O. M. Longnecker, Jr., 1929, Texas Univ. Bull. 2901, p. 163–174.

A. A. L. Mathews, 1950, Texas Eng. Expt. Sta. Research Rept. 14, p. 2. Reed and Longnecker described Yegua River conglomerate with thickness of 40 feet and stated that it gouges both the Turkey and upper Turkey Creeks beds. Since its position in Yegua group is not clear or determinable, nor location of Turkey Creek definite, and since only conglomerate of Yegua age observed in Brazos County is at base of Smetana sandstone (new), name Yegua River conglomerate cannot be used.

Derivation of name not stated.

Yellian series[1]

Pennsylvanian: Western Arkansas.

Original reference: C. R. Keyes, 1928, Pan-Am. Geologist, v. 49, p. 287; 1932, Pan-Am. Geologist, v. 57, p. 344.

Named for Yell County.

Yellow Branch Member (of Poteet Formation)

Middle Ordovician (Mohawkian): Southwestern Virginia.

G. A. Cooper, 1956, Smithsonian Misc. Colln., v. 127, pt. 1, p. 99, pl. 1 (facing p. 130). Gray thick-bedded calcarenite. Thickness about 8 or 9 feet. Chart shows unit in lower part of Poteet formation. Corresponds to "9-foot limestone bed" in much discussed Yellow Branch section. Name attributed to B. N. Cooper and G. A. Cooper.

Occurs in section along Yellow Branch (so called locally, but Yellow Creek on Rose Hill quad. map), 5¼ miles south of Hagan and 2 miles north of Tennessee line, Rose Hill quadrangle, Lee County.

Yellow Breeches Member (of Wilhite Formation)

Precambrian (Ocoee Series): Southeastern Tennessee.

P. B. King and others, 1958, Geol. Soc. America Bull., v. 69, no. 8, p. 55 (table 1), 962. Characterized by limestone and dolomite which in places form units more than 100 feet thick, many of which are sandy and conglomeratic; these are interbedded with various argillaceous, silty, and sandy rocks. Thickness about 2,000 feet. Upper member of formation; overlies Dixon Mountain member (new).

Named for Yellow Breeches Creek east of Jones Cove, Sevier County.

†Yellow Creek Beds[1]

Devonian and Lower Mississippian: Northeastern Mississippi.

Original reference: E. N. Lowe, 1915, Mississippi Geol. Survey Bull. 12, p. 51.

Named for exposures on Yellow Creek, a branch of Tennessee River in Tishomingo County.

Yellow Creek Sandstone Member (of Hance Formation)[1]

Middle Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

Original reference: G. H. Ashley and L. C. Glenn, 1906, U.S. Geol. Survey Prof. Paper 49, p. 31, 33, 38, 119.

H. R. Wanless, 1946, Geol. Soc. America Mem. 13, p. 65, 66, 67, 154. In Hance formation about 100 feet above Naese sandstone, the top member of Lee formation.

Named for Yellow Creek, Bell County, Ky.

Yellow Hill Limestone[1]

Yellow Hill Limestone (in Pogonip Group)

Lower Ordovician: Eastern Nevada.

Original reference: L. G. Westgate and A. Knopf, 1932, U.S. Geol. Survey Prof. Paper 171.

L. F. Hintze, 1952, Utah Geol. and Mineralog. Survey Bull. 48, p. 48–50, 51–52. In Ely Springs Range, Pogonip group includes Yellow Hill limestone and Tank Hill limestone (top of Ordovician sequence). Inasmuch as both upper and lower limits of Yellow Hill are fault bounded as is lower limit of Tank Hill, it is not considered advisable to carry these formations as stratigraphic units into other areas.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Shown on correlation chart of Pioche district above Mendha limestone and below Tank Hill limestone. Pioche district as used in this report extends to Dutch John Mountain, approximately 40 miles north of Pioche.

Well exposed on Yellow Hill, near center of Ely Springs Range, Pioche region.

Yellowjacket Formation[1]

Precambrian (Belt Series) : Southern central Idaho.

Original reference: C. P. Ross, 1934, U.S. Geol. Survey Bull. 854.

C. P. Ross and J. D. Forrester, 1958, Idaho Bur. Mines and Geology Bull. 15, p. 7. Belt series, in vicinity of middle Fork of Salmon River includes Yellowjacket formation, at least 9,000 feet thick, overlain by Hoodoo quartzite over 3,560 feet thick.

Named for exposures at town of Yellowjacket, Casto quadrangle.

Yellow Leaf Quartz Schist[1]

Devonian (possibly post-Lower Devonian) : Eastern Alabama.

Original reference: C. Butts, 1926, Alabama Geol. Survey Spec. Rept. 14, p. 57, 147–148, map.

Named for exposures on headwaters of Yellow Leaf Creek, 1½ miles east of Jemison, Chilton County.

Yellowpine Limestone Member (of Monte Cristo Limestone)

Upper Mississippian: Southeastern Nevada and southeastern California.

Original reference: D. F. Hewett, 1931, U.S. Geol. Survey Prof. Paper 162, p. 9, 18.

J. M. Weller and others, 1948, Geol. Soc. America Bull., v. 59, no. 2, chart 5 (column 23). Age shown on correlation chart as Mississippian (Meramecian).

J. C. Hazzard, 1951, (abs.) Geol. Soc. America Bull., v. 62, no. 12, pt. 2, p. 1503; 1954, Am. Assoc. Petroleum Geologists Bull., v. 38, no. 5, p. 881, 883 (fig. 2), Geographically extended into Nopah Range, Inyo County, Calif., where it is 100 feet thick, and overlies Bullion limestone member (Arrowhead limestone member not recognized in area). Underlies Bird Springs formation.

D. F. Hewett, 1956, U.S. Geol. Survey Prof. Paper 275, p. 42. Described in Ivanpah quadrangle (California-Nevada). About 120 feet thick in Goodsprings quadrangle, generally thinner westward and southward. Overlies Arrowhead limestone member; underlies Bird Spring formation.

Contains productive ore bodies of Yellow Pine, Potosi, Ingomar, and other mines, Good Springs region, Nevada.

†Yellowstone Formation[1]

Jurassic(?) and Lower and Upper Cretaceous: Central southern Montana.

Original reference: G. D. Harris, 1845, Philadelphia Acad. Nat. Sci. Proc., v. 2, p. 235–237.

Occurs on east flank of Little Belt Mountains, in southwestern part of Little Belt quadrangle, Little Belt Mountains region.

†Yellowstone Lake Group[1]

Pliocene: Northwestern Wyoming.

Original reference: T. B. Comstock, 1874, Rept. of reconn. of northwestern Wyoming made in 1873 by Wm. A. Jones, table facing p. 103.

†Yellville Limestone[1]

Lower Ordovician: Northern Arkansas and southern Missouri.

Original reference: G. I. Adams and E. O. Ulrich, 1904, U.S. Geol. Survey Prof. Paper 24, p. 18, 32 (fig. 1), 90, 93.

Named for exposures at Yellville, Marion County, Ark.

†Yentna Beds[1]

Tertiary: Southern Alaska.

Original reference: J. E. Spurr, 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 7, p. 172, 183.

Crops out opposite Sushitna trading post, on Sushitna River, below mouth of the Yentna.

Yeoman Beds

Ordovician: Subsurface in north-central North Dakota, and southern Saskatchewan, Canada.

Saskatchewan Geological Society, 1958, Report of the Lower Palaeozoic names and correlations committee: Saskatchewan Geol. Soc., p. 4, 5, charts A and B [p. 18, 19]. Largely composed of mottled fossiliferous-fragmental brown dolomitic limestone; dense brown dolomites abundant in outlying areas of the Williston Basin. Thin but very widespread argillaceous section marks top of unit. Reach maximum known thickness of 600 feet in north-central North Dakota. Underlies Herald beds (new) and overlies Winnipeg formation with conformable contacts.

Type locality: Shell Yeoman No. 6–32 (Lsd. 6, sec. 32, T. 8, R. 16, W. 2nd Mer., Saskatchewan) between 8,008 and 8,281 feet; Williston Basin.

Yeso Formation

Yeso Member (of Chupadero Formation)[1]

Permian: Northern, central, and southern New Mexico.

Original reference: W. T. Lee, 1909, U.S. Geol. Survey Bull. 389.

C. E. Needham and R. L. Bates, 1943, Geol. Soc. America Bull., v. 54, no. 11, p. 1655 (fig. 1), 1657–1661. Lee (1909) named the Yeso as middle formation of Manzano group. Name is derived from Mesa del Yeso, a small tableland 12 miles northeast of Socorro. Lee stated that Yeso beds were typically exposed on this mesa. However section he described in text, columnar section, and faunal list lies 2 miles southeast of this Mesa del Yeso. Section given in present report was measured in immediate vicinity of Lee's section and some parts are no doubt identical with his. Lee's description of Yeso is unsatisfactory because: (1) type locality is not completely designated; (2) section is measured in such general terms that it is not suitable for present stratigraphic needs; (3) at top of Lee's section, and included by him in Yeso, is a 75-foot limestone, top of which is an exposed erosion surface. This limestone is now known to be basal San Andres; (4) below this bed, Lee also included in Yeso 200 feet of sandstone, part of which is now separated as Glorieta sandstone; and (5) a limestone layer at base of Yeso is described as highly fossiliferous and 50 feet thick. Such a layer is not believed to occur at or near base of formation. In present report, base of Yeso is placed at base of a limestone bed, this bed is only 7 to 10 feet thick and is barren of fossils. Prominent exposure of San Andres limestone is present three-eighths mile west of base of Yeso type section as herein described, the position of which is result of faulting. Because this stratum is about 50 feet thick and contains many fossils, it is thought that Lee may have mistakenly included it in basal Yeso. As redescribed herein, Yeso consists of at least four units. Lowest is general zone of clastic material, characterized by pink and orange sandstone; middle evaporites; Canas member (new); Joyita member (new) Thickness 592.7 feet at type section; thickens toward both northwest

and southeast from type section. Overlies Abo formation; underlies Glorieta sandstone. Darton (1922, U.S. Geol. Survey Bull. 726) reduced Yeso to member status in Chupadero formation, a term he introduced to include beds of Yeso and San Andres age. Term Chupadero has been abandoned by U.S. Geological Survey, and Yeso is now considered formation in Manzano group.

G. H. Wood and S. A. Northrop, 1946, U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 57. In Sandoval and Rio Arriba Counties, subdivided into Meseta Blanca member at base and San Ysidro member above (both new). Overlies Abo formation; underlies Glorieta sandstone member of San Andres.

V. C. Kelley and G. H. Wood, 1946, U. S. Geol. Survey Oil and Gas Inv. Prelim. Map 47. Formation, in Lucero uplift, Valencia, Socorro, and Bernalillo Counties, subdivided into (ascending) Meseta Blanca member, 0 to 20 feet, and Los Vallos member (new), 820 to 1,020 feet. Overlies Abo formation; underlies San Andres formation.

R. H. Wilpolt and others, 1946, U.S. Geol. Survey Oil and Gas Prelim. Map 61. In La Joya area, Los Pinos Mountains, and northern Chupadera Mesa, subdivided into (ascending) Meseta Blanca, Torres (new), Canas gypsum, and Joyita sandstone members. Thickness as much as 1,015 feet.

G. O. Bachman and P. T. Hayes, 1958, Geol. Soc. America Bull., v. 69, no. 6, p. 696 (fig. 4), 697. In Otero County, includes Otero Mesa member (new). Overlies Lee Ranch tongue (new) of Abo sandstone; west of Otero Mesa overlies Hueco limestone.

Type section (Needham and Bates): Base of section is 11.2 miles N. 46° E. of Socorro at point on Socorro quadrangle where its eastern edge is intersected by the 34° 10′ parallel. Section measured northeast from this point, in canyons and cuesta escarpments in secs. 4 and 5, T. 2 S., R. 2 E., and in sec. 33, T. 1 S., R. 2 E., Socorro County. Top of section is 2¼ miles southeast of Mesa del Yeso on high isolated butte. Named for exposures on Mesa del Yeso, small tableland, 12 miles northeast of Socorro.

Ynezian Stage

Paleocene: California.

V. S. Mallory, 1953, (abs.) Jour. Paleontology, v. 27, no. 6, p. 903. Named as lowermost of six stages, based on foraminiferal assemblages, in lower Tertiary of California. Occurs below Bulitan [Bulitian] stage.

V. S. Mallory, 1959, Lower Tertiary biostratigraphy of the California Coast Ranges: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 22–27, 74, 91, fig. 7, tables. Lowest of Tertiary stages. Divisible into two zones, *Silicosigmoilina californica* below and *Bulimina excavata* above. Stage is generally correlative with Laiming's (1939, 6th Pacific Cong. Proc., v. 2) "E-Zone." Base of chronologic-biostratigraphic classification presented is taken as being horizon at which "Martinez" megafossils or associated Foraminifera first occur as distinguished from those horizons generally understood to be Upper Cretaceous. Base of Paleocene, as established here, would be at horizons immediately superjacent to European Danian stage; base of Ynezian may not represent lowest Tertiary

in California region. Type section of stage in lower Anita formation rests conformably on strata referred to Jalama formation by Dibblee (1950).

Type area: Canada el Bulito, Santa Barbara County.

Yoakum Dolomite Member (of Queen Formation)

Permian: Subsurface in Texas and New Mexico.

W. C. Fritz and James Fitzgerald, Jr., 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 1, p. 24–25. Name applied to brown dolomite in Queen formation. Occurs between depths of 4,180 feet and 4,215 feet in type well.

Type well: Well No. 30, formerly Davidson, now Honolulu-Cascade, Bennett No. 1, center NE¼ sec. 678, Block D, John H. Gibson Survey, Yoakum County, Tex.

Yoder Formation[1]

Oligocene, lower: Southwestern Wyoming.

Original reference: E. M. Schlaikjer, 1935, Harvard Coll. Mus. Comp. Zool., v. 76, no. 3, p. 71–75.

C. B. Schultz and T. M. Stout, 1955, Nebraska Univ. State Mus. Bull., v. 4, no. 2, p. 31, 34, table 1. Lower Chadron, or Chadron A of this report, is essentially the Yoder of Schlaikjer (1935) and the Ahearn of Clark (1954), which may prove to be a synonym of the former.

Type locality: SE¼ sec. 29, T. 23 N., R. 62 W., Goshen County. Named for town of Yoder, 1½ miles southeast of type locality.

Yogo Limestone[1]

Upper Cambrian: Central northern and central southern Montana.

Original references: W. H. Weed, 1899, U.S. Geol. Survey Geol. Atlas, Folio 55; 1899, Folio 56; 1900, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 285–286.

Charles Deiss, 1936, Geol. Soc. America Bull., v. 47, no. 8, p. 1272, 1282, 1285, 1336, 1337. Original description of Yogo limestone has no meaning because Cambrian rocks could not be found in any section in Montana or Yellowstone Park between Dry Creek shale and overlying Devonian limestone or dolomites. Name Yogo has no basis in observable fact and must be discarded.

L. L. Sloss and W. M. Laird, 1947, Am. Assoc. Petroleum Geologists Bull., v. 31, no. 8, p. 1413–1415. In work on Little Belt Mountains, Weed (1900) described thin-bedded limestones interbedded with gray or greenish shale and grading into rather pure thick-bedded limestone. To these beds, he gave name Yogo limestone and assigned them to Cambrian. It is evident that Weed considered Yogo limestone equivalent to Peale's (1893, U.S. Geol. Survey Bull. 110) pebbly limestones of Three Forks area. It now seems clear that Weed's Yogo limestone is equivalent to basal Devonian of this paper, plus a variable part of the base of limestone member of Jefferson formation. If the basal Devonian unit is proved to be a cartographic unit, Yogo, suitably revised, would have priority as formational name. Deiss (1936) found no Cambrian fossils above Dry Creek shale in Belt Creek section; hence, no Yogo in the

section. He believed that name Yogo should be discarded. Present authors agree that there may be no Cambrian above Dry Creek shale in central Montana, but this fact does not invalidate term Yogo. If formation is a lithologic unit, its identity is not destroyed because it was first assigned to wrong geologic age.

Christina Lochman,. 1950, Am. Assoc. Petroleum Geologists Bull., v. 34, no. 11, p. 2212. Yogo limestone, if used as originally defined by Weed does not exist. Even if used in restricted sense as indicated by Sloss and Laird, Yogo can only be lithologic and stratigraphic equivalent of beds in upper part of their basal Devonian unit—beds which because of their transitional character are more difficult to separate from overlying Jefferson than the prominent red and yellow dolomites and mudstones of lower part of basal Devonian unit.

Derivation of name not stated. Unit was mapped by Weed in vicinity of village of Yogo and along Yogo Creek, Little Belt Mountains quadrangle.

Yokohl Amphibolite (in Kaweah Series)

Triassic(?): Southern California.

Cordell Durrell, 1940, California Univ. Dept. Geol. Sci. Bull., v. 25, no. 1, p. 13–14, 116, fig. 29, geol. map. Oldest in sequence (ascending) of four units in series. Most important original lithologic types are basic volcanic rocks, both flows and tuffs; bedded cherts of radiolarian type; acid volcanic rocks; argillaceous sediments; and limestone. Approximate thickness in Woodlake Mountain 8,000 feet, base not exposed; older than Lemon Cove schist (new).

Occurs in the southern Sierra Nevada in north-central Tulare County.

Yokut Sandstone

Eocene: East-central California.

R. T. White, 1940, Am. Assoc. Petroleum Geologists Bull., v. 24, no. 10, p. 1726–1727 (fig. 1), 1744 (fig. 5), 1745–1747. Massive sandstone, fine-grained, white, brown, and gray. Thickness varies from 0 to 305 feet; at type locality 45 feet. Underlies Domengine formation (as restricted by Clark, 1926, California Univ. Pub. Bull., Geology Dept., v. 16, no. 5); overlapped by Domengine at axis of Coalinga anticline on south, and approximately 1 mile northwest of Tumey Gulch on north; overlies Arroyo Hondo member of Lodo formation with contact gradational. This unit was lower part of "Tejon" of Anderson and Pack (1915, U.S. Geol. Survey Bull. 603); referred to "Meganos" group by some authors. Incorrectly included in Domengine by White (1938, Geol. Soc. America Proc. 1937) and erroneously included in Arroyo Hondo by Vokes (1939).

I. F. Wilson, 1943, California Jour. Mines and Geology, v. 39, no. 2, p. 208–209. Described in San Benito quadrangle where it is exposed along southwest flank of Butts Ranch syncline. Thickness varied between 800 to 1,200 feet. Overlies Lodo formation; unconformably overlain by Domengine sandstone.

M. B. Payne, 1951, California Div. Mines Spec. Rept. 9, p. 15. North of Cantua Creek in Panoche Hills [Fresno County], Yokut sand underlies basal Kreyenhagen glauconitic sand, Domengine formation missing.

Type locality: Near west boundary of SE¼ sec. 29, T. 18 S., R. 15 E., in Domengine Creek. No geographic names were available. Yokut was named after Yokut Indians who inhabited San Joaquin Valley.

Yolo Formation

Upper Cretaceous (Chico Series) : Northern California.

J. M. Kirby, 1943, Am. Assoc. Petroleum Geologists Bull., v. 27, no. 3, p. 282, 285–287, 291, 293. Consists of well-bedded greenish-gray or light drab siltstones with numerous thin layers of fine flaggy sandstone. Thickness 500 to 1,100 feet. Underlies Sites formation; overlies Venado formation (new). Replaces preoccupied name Mills formation (Kirby, 1942).

Named because of widespread distribution along west side of Sacramento Valley in Yolo County. Well exposed at Cache Creek, immediately downstream from concrete bridge on Rumsey-Lake County highway.

Yonkers Granite[1]

Precambrian: Southeastern New York.

Original reference: F. J. H. Merrill, 1890, Am. Jour. Sci., 3d ser., v. 39, p. 388.

T. W. Fluhr, 1948, Rocks and Minerals Mag., v. 23, no. 8, p. 699. Age shown in map legend as probable Upper Ordovician.

Occurs in hills in Yonkers, Westchester County.

Yonna Formation

Pliocene: Southwestern Oregon.

R. C. Newcomb, 1958, Northwest Sci., v. 32, no. 2, p. 41–48. In type area, consists of (1) a lower sedimentary (lacustrine) section consisting of ashy diatomite, stratified sandstone, laminated siltstone, waterlaid volcanic ash, pumice, and semiconsolidated gravel, and (2) a rather thick upper unit of basaltic lapilli tuff, part of which was deposited in water. Outside type area, there is much diatomite, waterlaid volcanic ash, and other sedimentary material in upper part of formation, and relation of a sedimentary lower unit and a tuffaceous upper unit is not clearly established. As much as 2,000 feet thick. Formation is cut by dikes and sills of generally basaltic composition and is broken by an intricate system of block faulting; breakage and displacement are greatest in the Klamath and Langell grabens, here strata of the Yonna have dips as high as 30° or 40°. Overlies unnamed lava rocks; underlies with minor erosional unconformity, lava rocks (Pliocene?), Quaternary lava or alluvium.

Type locality: Along west side of Yonna Valley in T. 38 S., R. 11½ E., Willamette meridian and baseline, Klamath County. Crops out in large areas in Yonna, Swan Lake, Sprague River, Williamson River, Poe and Klamath Valleys, and adjacent Lost River basin.

Yorba Member (of Puente Formation)

Miocene, upper: Southern California.

J. E. Schoellhamer and others, 1954, U.S. Geol. Survey Oil and Gas Inv. Map OM–154. Thin-bedded gray siltstone with lesser amounts of thin-bedded fine-grained sandstone. Maximum exposed thickness about 2,500 feet. Underlies Sycamore Canyon member, contact gradational; overlies Soquel member (new), contact gradational.

Named for Yorba Bridge across Santa Ana River, 2½ miles east of Atwood, Orange County. Exposed in Puente Hills north of Yorba Bridge and in northwestern Santa Ana Mountains to south of bridge.

†York Limestone[1]

Cambrian and Ordovician: Southeastern Pennsylvania.

Original reference: P. Frazer, Jr., 1876, Pennsylvania 2d Geol. Survey Rept. C, p. 130.

In York County.

†York Schist[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: P. Frazer, Jr., 1876, Pennsylvania 2d Geol. Survey Rept. C, p. 130–143.

Composes greater part of Chikis Ridge and Chestnut Hill in York County.

†York Shale[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: C. D. Walcott, 1896, U.S. Geol. Survey Bull. 134, p. 14–15, 26, 36–37.

Well exposed in York County.

†York County Hydromica Slates[1]

Lower Cambrian: Southeastern Pennsylvania.

Original reference: J. P. Lesley, 1892, Pennsylvania 2d Geol. Survey Summ. Final Rept., v. 1, p. 203.

Composes greater part of Chikis Ridge and Chestnut Hill in York County.

York Harbor Biotite Granite[1]

Devonian(?): Southwestern Maine.

Original reference: A. Wandke, 1922, Am. Jour. Sci., 5th, v. 4, p. 148, 149.

Exposed along south side of York Harbor, York County.

Yorkian[1] or Yorkic period[1]

Silurian and Devonian: New York.

Original reference: C. R. Keyes, 1922, Pan-Am. Geologist, v. 37, p. 234, 243–244.

York-Petro Limestone[1]

Pennsylvanian: Utah.

Original reference: R. N. Hunt and O. P. Peterson, 1924, Am. Inst. Mining Metall. Engineers Trans., v. 70, p. 859–883, 908–926.

Occurs in Bingham district.

†Yorktown Epoch[1]

Miocene: Atlantic coast.

Original reference: J. D. Dana, 1863, Manuel geology, p. 506, 510, 521, 522.

Occurs at Gay Head on Martha's Vineyard; in New Jersey; in Maryland, on both sides of the Chesapeake Bay for a great distance; and in Virginia, at Yorktown, Suffolk, Smithfield, and through larger part of Tertiary region.

Yorktown Formation (in Chesapeake Group)[1]

Miocene, upper: Eastern Virginia, eastern Maryland, and North Carolina.

Original reference: W. B. Clark and B. L. Miller, 1906, Virginia Geol. Survey Bull. 2, pt. 1, p. 19.

L. W. Stephenson and F. S. MacNeil, 1954, Geol. Soc. America Bull., v. 65, no. 8, p. 733–738. Geographically extended into eastern Maryland

where it reaches Chesapeake Bay in the Calvert Cliffs. Overlies St. Marys formation.

H. E. LeGrand and P. M. Brown, 1955, Carolina Geol. Soc. Guidebook of Excursion in Coastal Plain of North Carolina, Oct. 8–9, p. 11–12. Formation, as extended into North Carolina, may include elements of St. Marys formation as mapped elsewhere. In this report, Duplin marl is considered to be a shallow-water facies of the Yorktown; Waccamaw formation, considered as contemporaneous with Duplin, is also included in Yorktown.

J. L. Stuckey and S. G. Conrad, 1958, North Carolina Div. Mineral Resources Bull. 71, p. 45; J. L. Stuckey, 1958, Geologic map of North Carolina (1:500,000): North Carolina Div. Mineral Resources. As mapped, includes Duplin marl.

First described at Yorktown on James River, Va.

Yorktownian Substage

Miocene, upper: Maryland, New Jersey, and Virginia.

D. S. Malkin, 1953, Jour. Paleontology, v. 27, no. 6, p. 767, 768. A substage based on microfaunal assemblages; includes all sediments deposited in central Atlantic Coastal Plain province during time of accumulation of Yorktown formation, type exposure of which is considered exemplary of the substage. In sequence, the Yorktownian succeeds St. Marysan substage.

Yorkville Quartz Monzonite

Yorkville Granite[1]

Permian: Northwestern South Carolina and southern North Carolina.

Original reference: A. Keith, 1931, U.S. Geol. Survey Geol. Atlas, Folio 222.

L. L. Smith and Roy Newcome, Jr., 1951, Econ. Geology, v. 46, no. 7, p. 759–760. Granite exposed over large area south and southeast of Henry Knob, which is 3 miles west of Clover, S. C.

Named for exposures at Yorkville (also called York), York County, S.C.

Yosemite Glacial Epoch[1]

Pleistocene: California.

Original reference: E. Blackwelder, 1930, Geol. Soc. America Bull., v. 41, p. 91–92.

Youghall Formation

Youghall Member (of Morgan Formation)

Pennsylvanian: Northwestern Colorado and northeastern Utah.

M. L. Thompson, 1945, Kansas Geol. Survey Bull. 60, pt. 2, p. 29, 30, 34–39, geol. sections. Proposed for the fossiliferous limestones, thin shales, and thick interbedded highly crossbedded sandstones stratigraphically between Hells Canyon formation (new) and Weber sandstone (redefined). Type section, approximately 625 feet thick, composed of crossbedded to massive buff to reddish-brown sandstone and interbedded highly fossiliferous limestone. Thickness at Juniper Mountain 650 feet, contact with overlying Weber not observed; 500 feet at Split Mountain; 600 feet at White Rock Canyon; 530 feet at Sheep Mountain Canyon. Overlies Hells Canyon formation on south and southeast margins of Uinta Mountains; on southwest margin, overlies Morgan formation (as defined by Williams); on north margin, overlies Belden formation.

D. O. Peterson, 1960, Dissert. Abs., v. 20, no. 7, p. 2757. Redefined as upper member of Morgan formation and restricted to upper tan and buff sandstones and interbedded limestones; balance of formation which is red sandstone and interbedded limestone is designated "Red Morgan" member.

Type locality: Exposures on west side of Hells Canyon in sec. 31, T. 6 N., R. 102 W., and along east side of head of Hells Canyon in W½ sec. 7, T. 5 N., R. 102 W., Moffat County, Colo. Name derived from old stage station of Youghall, east of Hells Canyon.

Youghiogheny Sandstone

Upper Devonian (Conewango): Southwestern Pennsylvania.

W. M. Laird, 1941, Pennsylvania Topog. and Geol. Survey Progress Rept. 126, p. 9–11. Name will probably be used, following more definitive study of area, for unit here termed Sandstone B and described as alternating red sandstone and brick-red shales interbedded with some massive green sandstones and green shales. Red beds show rapid lateral change to green. A tongue like expression of Catskill magnifacies into a marine magnafacies represented by Shale C above (Watering Trough shale) and Sandstone A below (Maple Summit sandstone). Thickness 422 feet in Youghiogheny Gorge through Laurel Hill. Conformable contacts with overlying and underlying units.

Type exposure along tracks of Western Maryland Railroad on south bank of Youghiogheny River opposite settlement of Victoria, Fayette County.

Youngman Formation (in Maquam Group)

Middle Ordovician (Chazyan): Northwestern Vermont, and southeastern Quebec, Canada.

Marshall Kay, 1945, (abs.) Geol. Soc. America Bull., v. 56, no. 12, pt. 2, p. 1172. Typically argillaceous limestone grading up into dark slate having limestone interbeds. Thickness 300 feet at type locality. Underlies Isle la Motte limestone disconformably; overlies Carman quartzite.

Marshall Kay and W. M. Cady, 1947, Science, v. 105, no. 2736, p. 601. Upper formation of Maquam group (new).

Marshall Kay, 1958, Am. Jour. Sci., v. 256, no. 2, p. 81–82, 83–85. Type Youngman contains some fossils known in the Chazy limestones to west along Lake Champlain, but others that are unknown there and have been thought diagnostic of later age. Stratigraphic relations of Carman and Youngman seem to preclude their being other than Chazyan. It is concluded that the Carman-Youngman is Chazyan of facies different from typical Chazyan group and from St. Dominique [in Quebec] and that presence of *Christiania, Sowerbycella*, and *Platymena* and other forms in formation must be accepted as showing that ranges of these genera are somewhat greater than had been recognized, and that their sensitivity in correlation is reduced.

Type locality: Mississquoi Park, Highgate Springs, Franklin County, Vt.

Young Peak Dolomite[1]

Middle Cambrian: Western Utah.

Original reference: T. B. Nolan, 1930, Washington Acad. Sci. Jour., v. 20, no. 17, p. 421–432.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 147 (fig. 2). Listed on correlation chart of recommended

revision of stratigraphic units in Great Basin. Above Abercrombie formation and below Trippe limestone.

Well exposed on Young Peak, on south side of Dry Canyon, Gold Hill district.

Youngs Bluff Bed[1]

Eocene (Jackson): Northwestern Louisiana.

Original reference: T. L. Casey, 1902, Science, new ser., v. 15, p. 716.

Named for outcrops on estate of John Young, south of Montgomery, Grant County.

Ysidro shale[1]

Precambrian: Central northern New Mexico.

Original references: C. R. Keyes, 1915, Iowa Acad. Sci. Proc., v. 22, p. 257–259; 1915, Conspectus of geologic formations of New Mexico: Des Moines, Robert Henderson, State Printer, p. 4, 12.

Well exposed in sharp truncated arch in Tijeras Canyon between Sandia and Manzano Ranges. Derivation of name not given.

Yucca Formation

Yucca Bed[1]

Lower Cretaceous: Western Texas.

Original reference: J. A. Taff, 1891, Texas Geol. Survey 2d Ann. Rept., p. 725, 736.

R. M. Huffington, 1943, Geol. Soc. America Bull., v. 54, no. 7, p. 992 (fig. 2), 997–1000. Formation, in northern Quitman Mountains, is predominantly gray, buff, and red limestone, arenaceous limestone, maroon shale, sandstone, and limestone-, chert-, and quartz-pebble conglomerate. Thickness 1,117 to 5,518 feet. Overlies Torcer formation (emended) with contact not exposed; underlies Bluff formation with contact arbitrarily chosen. Beds correlative with parts or all of Yucca formation have previously been mapped or designated by other names in parts of Quitman area. Baker (1927, Texas Univ. Bull. 2745) erroneously mapped Yucca as Cox. Las Vigas(?) in Malone Mountains is evidently same as the Yucca. Recommended that earlier and diverse terminology for all, or parts, of the same formation be abandoned in favor of name Yucca.

Elliot Gillerman, 1953, U.S. Geol. Survey Bull. 987, p. 12 (table 1), 15–16, pl. 1. In Eagle Mountains, formation consists chiefly of red shales and limestones; brown limestones, red and brown sandstones, and limestone pebble conglomerate. Thickness as much as 330 feet. Overlies Wolfcamp(?); underlies Bluff Mesa formation (name replaces preoccupied Bluff formation).

D. L. Amsbury, 1958, Texas Univ. Bur. Econ. Geology Geol. Quad. Map 22. In Presidio County, overlies Pinto Canyon formation (new); underlies Bluff formation.

R. K. DeFord and L. W. Bridges, 1959, Texas Jour. Sci., v. 11, no. 3, p. 291. In northern Rim Rock country, locally underlies Tarantula gravel (new).

Named for Yucca Mesa, El Paso County.

†Yucca Flat Formation

Middle to Upper Cambrian: Southern Nevada.

M. S. Johnson and D. E. Hibbard, 1957, U.S. Geol. Survey Bull. 1021–K, p. 340–342, pls. 32, 33. Consists of two parts: lower part of generally light- to medium-gray massive calcitic limestone which weathers a mottled buff to gray, thickness 395 feet; upper part contains four recognizable units, (ascending) A through D, and consists of dark- and light-colored, well-bedded, and generally thin-bedded limestone and dolomite; thickness more than 2,420 feet. Underlies Dunderberg shale and overlies Jangle limestone (new) with contacts conformable.

Named for exposures on east side of Yucca Flat in the Atomic Energy Commission Nevada proving grounds area, Nye County. Occupies hills and valleys of great relief. Banded Mountain obtains its name from alternating bands of dark- and light-colored limestone and dolomite characteristic of parts of formation. Mose complete section exposed from Jangle Ridge to Banded Mountain but section incomplete due to faulting.

Yukon Group[1]

Precambrian: Northeastern Alaska, and northwestern Yukon, Canada.

Original references: D. D. Cairnes, 1914, Geol. Soc. America Bull., v. 25, p. 184; 1914, Canada Geol. Survey Summ. Rept. 1912, p. 11; 1914, Canada Geol. Survey Mem. 67, p. 40.

Yukon Silts[1]

Pleistocene: Northeastern Alaska.

Original reference: J. E. Spurr, 1898, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 200–220.

A. J. Eardley, 1938, Geol. Soc. America Bull., v. 49, no. 2, p. 317–336. Divided into six groups of unconsolidated deposits.

Form lower terraces of Yukon River.

†Yule Limestone[1]

Ordovician: Western and central Colorado.

Original reference: G. H. Eldridge, 1894. U.S. Geol. Survey Geol. Atlas, Folio 9.

J. H. Johnson, 1955, Geol. Soc. America Bull., v. 55, no. 3, p. 315, 320, 322. Mentioned in report on Paleozoic stratigraphy of Sawatch Range. Yule limestone of various authors is now included in Manitou dolomite, Harding sandstone, and Fremont limestone of this report.

Named for development at head of Yule Creek, Anthracite-Crested Butte area.

†Yulean series[1]

Cambrian to Upper Devonian: Western Colorado.

Original reference: C. R. Keyes, 1924, Pan-Am. Geologist, v. 41, p. 281, 289.

Yuma Sandstone Member[1] (of Manning Formation)

Eocene, upper: Southeastern Texas.

Original reference: B. C. Renick, 1936, Texas Univ. Bull. 3619, p. 36–39, table opp. p. 17.

D. H. Eargle, 1959, Am. Assoc. Petroleum Geologists Bull., v. 43, no. 11, p. 2630. Tentatively considered equivalent to Stones Switch sandstone member of Whitsett formation.

Exposed in vicinity of Yuma.

Zabriskie Quartzite

Zabriskie Formation

Zabriskie Quartzite Member (of Wood Canyon Formation)

Lower Cambrian: Southeastern California and western Nevada.

J. C. Hazzard, 1937, California Jour. Mines and Geology, v. 33, no. 4, p. 278 (fig. 3d), 309–310. Discussion of Paleozoic section in Nopah and Resting Springs Mountains, Inyo County. Zabriskie quartzite member is 160-foot unit, upper 100 feet of which consists of massive indistinctly crossbedded fine- to medium-grained fairly well-sorted pinkish to light-gray quartzite in beds 1 to 6 feet thick; weathered surface is characteristically salmon pink to rusty brown; below 100-foot massive part unit grades into reddish-brown sandy shale and medium- to coarse-grained shaly quartzite and sandstone, locally conglomeratic. Basal 10 feet is light-gray to nearly white reddish-brown weathering massive quartzite. Basal part contains vertical tubelike structures assumed to be sand-filled burrows of forms like *Scolithus;* these are characteristics of base of Zabriskie both in the Nopah and Resting Springs Ranges; in Emigrant Pass, upper beds of Zabriskie show horizontal worm(?) castings and ripple marks. Top of Zabriskie is 630 feet below top of Wood Canyon formation; overlies unnamed micaceous shale interval of Wood Canyon; upper 630 feet of Wood Canyon unnamed.

R. H. Hooper, 1947, Geol. Soc. America Bull., v. 58, no. 5, p. 404 (fig. 1), 406. Member, in Panamint Range, is about 70 feet thick and consists of light-pink cross-laminated saccharoidal quartzite.

H. E. Wheeler, 1948, Nevada Univ. Bull., Geology and Mining Ser., no. 47, p. 24 (fig. 3), 26–27, fig. 5 facing p. 32. Rank raised to formation. Underlies Tecopa formation (new); overlies Wood Canyon formation. Thins to about 20 feet at Spring Mountain and apparently grades out completely toward the east. By inference, the Zabriskie is a tongue extending northwestward from the time-transgressing top surface of Prospect Mountain quartzite and thus should become part of the Prospect Mountain as the Wood Canyon thins out on border of geosyncline. Geographically extended into southwestern Nevada.

Name derived from Zabriskie Station on Tonopah and Tidewater Railroad in Amargosa Valley west of Resting Springs Range, Inyo County, Calif.

Zadoc Member (of McNairy Formation)

Cretaceous (Gulf Series): Southeastern Missouri.

H. S. McQueen and others, 1939, *in* Kansas Geol. Soc. Guidebook 13th Ann. Field Conf., p. 70 (fig. 25), 71. Light-gray to dark-brown sandy, ferruginous clay about 29 feet thick. Occurs about 10 feet above base of formation and 22 feet below top.

Present in Ardeola Hill section, center NW¼ sec. 10, T. 27 N., R. 11 E., Ardeola, Stoddard County. This is stop 33 on road log.

Zaleski Flint (in Allegheny Formation)[1]

Zaleski marine member

Pennsylvanian (Allegheny Series): Southeastern Ohio.

Original reference: Wilber Stout, 1927, Ohio Geol. Survey, 4th ser., Bull. 31, p. 181.

M. T. Sturgeon and others, 1958, Ohio Geol. Survey Bull. 57, p. 49 (table 7), 55–56. Member of Ogan cyclothem in report on Athens County. In its type area, this bed is normally a flint but locally in type area is also represented by calcareous flint, siliceous limestone, calcareous shale, and iron ore. Nodular fossiliferous marine limestone and shale has been observed in Sandy Township, Tuscarawas County, at horizon of Zaleski member. Thickness about 8 inches. Overlies Ogan coal and underclay members; underlies members of Winters(?) cyclothem. Allegheny series.

Exposed near Zaleski, Vinton County.

Zanzibar Limestone[1]

Ordovician(?): Central Nevada.

Original reference: H. G. Ferguson, 1924, U.S. Geol. Survey Bull. 723.

W. H. Easton and others, 1953, Am. Assoc. Petroleum Geologists Bull., v. 37, no. 1, p. 148. Listed with names not included on chart of recommended revision of stratigraphic units in Great Basin. Reasons for omission usually are that names are incapable of being interpreted or are rejected synonyms. [Toquima formation and Mayflower schist, noted by Ferguson, 1924, as overlying and underlying Zanzibar are also omitted from chart.]

Prominently developed on Zanzibar claim, about 1½ miles east of Manhattan, Nye County.

Zarah Subgroup (of Kansas City Group)

Pennsylvanian (Missouri Series): Eastern Kansas, southwestern Iowa, western Missouri, and southeastern Nebraska.

R. C. Moore, 1948, Am. Assoc. Petroleum Geologists Bull., v. 32, no. 11, p. 2031 (fig. 4), 2033. Name applied to upper part of Kansas City group. Includes beds between top of Iola formation and base of Plattsburg formation of Lansing group. As thus defined, subgroup comprises (ascending) Lane shale, Wyandotte formation, and Bonner Springs shale. Thickness of subdivisions varies from place to place. Occurs above Linn subgroup (new).

R. C. Moore and others, 1951, Kansas Geol. Survey Bull. 89, p. 81. Thickness in Kansas about 100 feet.

Named for village of Zarah on Kansas Highway 10 at Santa Fe Railway crossing in western Johnson County, Kans.

Zeandale Limestone (in Wabaunsee Group)

Pennsylvanian (Virgil Series): Northeastern Kansas.

R. C. Moore and M. R. Mudge, 1956, Am. Assoc. Petroleum Geologists Bull., 40, no. 9, p. 2274 (fig. 1), 2276. Defined to include strata between Pillsbury shale (new) above and Willard shale below. Thickness ranges from 19 to 53 feet and averages about 25 feet. Comprises (ascending) Tarkio limestone, Wamego shale, and Maple Hill limestone members.

Type section: In SE¼NE¼NE¼ sec. 28, T. 10 S., R. 9 E., along north-south farm access road south of Deep Creek, about 1 mile east and

one-quarter mile south of Zeandale, Riley County. Name derived from town of Zeandale on south side of Kansas River.

Zell Limestone Member (of Macy Formation)

Middle Ordovician: Southeastern Missouri.

E. R. Larson, 1951, Am. Assoc. Petroleum Geologists, v. 35, no. 9, p. 2061–2064. Name applied to upper member of formation. Consists of fine-textured well-bedded calcitite with green shale partings and thin layers of intraformational conglomerate and shell beds; contains thin bed of metabentonite near top. Thickness at type locality 32 feet; thickens southward to 69 feet in southeastern Perry County. Overlies Hook member (new); underlies Decorah formation.

Type exposure: At type exposure of Macy formation, along Missouri Highway 25 in SE¼ NW¼ sec. 27, T. 38 N., R. 8 E., 1 mile north of Zell, Ste. Genevieve County.

Zemorrian Stage[1]

Miocene, lower: California.

Original reference: R. M. Kleinpell, 1934, Am. Assoc. Petroleum Geologists Bull., v. 18, no. 3, p. 376–378.

R. M. Kleinpell, 1938, Miocene stratigraphy of California: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 103–113, figs. 4, 14 (correlation chart). Superjacent to Refugian stage; subjacent to Saucesion stage. Includes two zones: *Uvigerina gallowayi* and *Uvigerinella sparsicostata*. Systematic catalogue.

Type locality: Zemorra Creek, head of which is in SW¼ sec. 17, T. 29 S., R. 20 E., western Kern County. Creek runs northeast cutting the northwestern tip of sec. 16 and thence across SW¼ sec. 9, turns east-northeast and joins Chico Martinez Creek near center NW¼ sec. 10.

Zenoria Lentil (in Verda Member of Yazoo Clay)

Eocene (Jackson): Central Louisiana.

H. N. Fisk, 1938, Louisiana Dept. Conserv. Geol. Bull. 10, p. 101 (fig. 9), 104–105. Consists of series of fossiliferous blue-gray clays and sands; clays are fine, very plastic, contain considerable glauconite and lack lignitic particles of the typical Verda. Occurs in upper part of member at about the same stratigraphic position as the Mossy Ridge lentil (new). Thickness in wells about 50 feet.

Named from exposure along a creek bank 1 mile northeast of Zenoria, La Salle Parish.

†Zesch Formation

Upper(?) Devonian: Central Texas.

V. E. Barnes, P. E. Cloud, Jr., and L. E. Warren, 1947, Geol. Soc. America Bull., v. 58, no. 2, p. 128 (fig. 2), 137 (fig. 7), 138–139. Thin highly siliceous limestone and leached silica rock containing a few species of brachiopods; brownish to yellowish and contains angular fragments of chert. About 18 to 24 inches thick; thins to feather edge. Rests on older Devonian strata (Bear Spring formation) and is collapsed into middle Ellenburger strata (Gorman formation); appears to grade upward into chert breccia here assigned to Ives breccia.

P. E. Cloud, Jr., V. E. Barnes, and W. H. Hass, 1957, Geol. Soc. America Bull., v. 68, no. 7, p. 811. Term abandoned. Partial synonym for Ives breccia member of Houy formation (new).

Type locality: On Ray Zesch Ranch, Mason County.

Zeta Lake granite porphyry facies (of Ogishke Conglomerate)

Precambrian (Knife Lake Series): Northeastern Minnesota.

J. T. Stark and V. G. Sleight, 1939, Geol. Soc. America Bull., v. 50, no. 7, p. 1032 (table 2), 1034, 1035. Black granite porphyry pebble conglomerate at top of Ogishke conglomerate. Thickness 1,000 feet. Conformably underlies and interbeds with Knife Lake slates; overlies West Gull jasper facies of Ogishke conglomerate.

Occurs in vicinity of Zeta Lake in Vermilion district.

Zeto Point Basalt Porphyry

Tertiary: Southwestern Alaska.

R. R. Coats, 1947, U.S. Geol. Survey Alaskan Volcano Inv. Rept. 2, pt. 5, p. 77, pl. 6. Constitues five domical masses of basalt porphyry. Largest of the masses, about 230 feet thick, lies north of entrance to Sweeper Cove. All rocks have abundant calcic plagioclase phenocrysts, as much as 1 centimeter long, in medium- to light-gray groundmass. Basalt porphyry is younger than Finger Bay volcanics (new) which it intrudes; older than Andrew Bay volcanics (new).

Five domical masses which crop out on and near shore line of Kuluk Bay from Zeto Point northward (two of the domes mapped along Kuluk Bay south of Zeto Point), northern Adak Island, in central part of Aleutian Islands.

Zia Marl[1]

Eocene(?): Central northern New Mexico.

Original reference: A. B. Reagan, 1903, Am. Geologist, v. 31, p. 67–111.

Probably named for village of Zia, near Jemez, Sandoval County.

Zilhlejini Formation[1]

Upper Cretaceous: Northeastern Arizona.

Original reference: A. B. Reagan, 1925, Pan-Am. Geologist, v. 44, p. 287, 291.

Probably named for exposures on Ziltahjina Peak [as spelled on 1924 geologic map of Arizona], in Black Mesa.

Zilpha Clay (in Claiborne Group)

Zilpha Clay Member (of Lisbon Formation)

Eocene, middle: Western Mississippi.

U. B. Hughes and others, 1940, Mississippi Geol. Soc. [Guidebook 2] Field Trip, Mar. 9–10, p. 3, 11–12, column section. Gray-white to chocolate-brown clay; sandy at top and glauconitic at base. Thickness about 60 feet in Lisbon formation; underlies Kosciusko sand member; overlies Winona sand member. Name credited to Raymond Moore.

E. P. Thomas, 1942, Mississippi Geol. Survey Bull. 48, p. 33–40, fig. 1, pls. 1, 2, profiles A, B, C. Rank raised to formation in Claiborne group. Thickness at designated type locality 54 feet; upper contact not exposed. Overlies Winona greensand and underlies Kosciusko formation.

Type locality: Along county road at Bucksnort Hill 1½ miles north of Zilpha Creek and near center sec. 8, T. 16 N., R. 6 E., northwestern Attala County.

Zion Hill Member (of Bull Formation)

Zion Hill Quartzite[1]

Zion Hill Quartzite Member (of Schodack Formation)

Lower Cambrian: Southwestern Vermont and eastern New York.

Original reference: R. Ruedemann, 1914, New York State Mus. Bull. 169, p. 69–70.

D. M. Larrabee, 1939, Eng. Mining Jour., v. 140, no. 12, p. 47–48, 49 (fig. 3), 51. In area studied [near Rutland, Vt.], Cambrian grits, quartzites, slates, limestone, and shales are separated from overlying Ordovician quartzites, graywackes, slates, and cherts by angular unconformity, exposed in road cut at Hampton, N.Y., where at a near contact, Cambrian Schodack shales dip 78° E., and Ordovician Zion Hill quartzite dips 48° E. Thickness about 70 feet. Underlies Normanskill.

Rudolf Ruedemann, J. H. Cook, and D. H. Newland, 1942, New York State Mus. Bull. 331, p. 65–67. Member of Schodack formation. Exposed as deep iron-red quartzitic sandstone in many localities in Catskill quadrangle. At top of formation.

E. P. Kaiser, 1945, Geol. Soc. America Bull., v. 56, no. 12, pt. 1, p. 1084 (table 1), 1089, 1090, 1091, pl. 1. Discussion of Taconic thrust sheet in Vermont. Zion Hill formation is chiefly massive gray medium- or coarse-grained quartzite. Thickness at Zion Hill and Wallace Ledge about 80 feet. Formation varies in details of lithology and thickness. In Zion Hill district, composed of two massive beds of quartzite separated by thin layer of sandy shale. In slate belt, overlies Schodack slate; in Zion Hill district, overlies Wallace Ledge formation (new); underlies Normanskill formation. Keith's (1932, Washington Acad. Sci. Jour., v. 22; 1933, 16th Internat. Geol. Cong. Guidebook 1 [eastern New York and western New England]) sequence and the sequence used in this report are incompatible. Keith's Barker quartzite (which must be that exposed on Barker Hill) is Zion Hill quartzite. Bird Mountain grit is thick facies of Zion Hill formation.

Phillip Fowler, 1950, Vermont Geol. Survey Bull. 2, p. 53–54. Zion Hill quartzite described in Castleton area. Lower Cambrian, not Ordovician as believed by Larrabee (1939). Cambro-Ordovician boundary is placed between Zion Hill quartzite and overlying banded slate which is arbitrarily mapped as Normanskill. Kaiser (1945) suggested that Bird Mountain grit was phase of Zion Hill. This is not unlikely as long as Berkshire schist surrounding Bird Mountain was considered to be metamorphosed Mettawee and Schodack. Inasmuch as bulk of Berkshire is here assigned to Nassau formation, Bird Mountain grit cannot be facies of Zion Hill quartzite. Overlies Schodack formation.

P. H. Osberg, 1952, Vermont Geol. Survey Bull. 5, p. 116 (fig. 16). Correlation chart for Taconic sequence, Vermont, shows Zion Hill quartzite above Wallace Ledge slate and below Schaghticoke shale.

E-an Zen, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 1. Member of Bull formation. Massive greywacke or subgreywacke, ranging in thickness from 0 to 100 feet. Rapid variation in thickness suggests that it may be a shoestring sand and it occurs as discontinuous beds in general in middle part of formation. Base of rock

may be pebble conglomerate, with load-casting features, whereas top may be mudstone. Overlies Bomoseen graywacke member; underlies Mudd Pond member (new).

George Theokritoff, 1959, New England Intercollegiate Geol. Conf. Guidebook 51st Ann. Mtg., p. 54. In Washington County, N.Y., a fine greenish to brownish quartzite weathering whitish to light gray occurs in Bull formation. It is correlated with Zion Hill quartzite in Vermont on basis of lithological similarity and stratigraphical position. Dale (1899, U.S. Geol. Survey Ann. Rept. 19, pt. 3) correlated quartzite of Zion Hill with quartzites "between Cambrian black shales (Horizon D) and the Ordovician black shales (Horizon G)." He named this unit "Ferruginous quartzite" and included in it the quartzite at Zion Hill as well as quartzites developed at higher horizons. Ruedemann (1914) named Dale's Ferruginous quartzite "Zion Hill quartzite," but quartzites included in this unit which occur at higher horizons are here referred to higher unit assigned to Upper Cambrian and named Hatch Hill formation.

Named for Zion Hill, Hubbardtown, Castleton quadrangle, Vt.

Zoar Limestone (in Pottsville Formation)[1]

Pennsylvanian: Eastern Ohio.

Original reference: J. S. Newberry, 1874, Ohio Geol. Survey, v. 2, p. 133, 134, pl. facing p. 31.

Named for Zoar, Tuscarawas County.

Zopilote Breccia (in Garren Group)

Tertiary: Western Texas:

Hugh Hay-Roe, 1957, Texas Univ. Bur. Econ. Geology, Geol. Quad. Map 21. Named proposed for alkali-feldspar trachyte flow-breccia that forms larger part of Zopilote Hills. Type section, measured from base, includes 148 feet of hard grayish-red massive lithic breccia. Unit is evidently the basal flow breccia of thick sequence, which crops out in hills south of area and is overlain by vesicular andesite correlative with Bell Valley andesite; thus the Zopilote is homotaxially equivalent to Means trachyte. Overlies Moon trachyte.

Type section: Zopilote Hills, Wylie Mountain area, Jeff Davis County.

Zoroaster Granite

Precambrian (Archean): Northern Arizona.

Ian Campbell and J. H. Maxson, 1936, Carnegie Inst. Washington Year Book 35, p. 330, 331. Granite cuts across, at steep angle, the nearly vertical schistosity of the country rocks. Contact best exposed on south side of Colorado gorge.

Well exposed by narrow canyon of Zoroaster Creek, Grand Canyon region.

Zuckerman Limestone Member (of Hoxbar Formation)[1]

Zuckerman (Zuckermann) Sandstone or Beds (in Hoxbar Group)

Pennsylvanian (Virgil Series): South-central Oklahoma.

Original reference: C. W. Tomlinson, 1928, Oklahoma Geol. Survey Bull. 40Z, p. 16.

R. C. Moore and others, 1944, Geol. Soc. America Bull., v. 55, no. 6, p. 697. Upper Hoxbar deposits, including Zuckerman sandstone, may be Virgilian in age.

C. W. Tomlinson and William McBee, Jr., 1959 *in* Ardmore Geol. Soc. Petroleum geology of southern Oklahoma—a symposium, v. 2: Tulsa, Okla., Am. Assoc. Petroleum Geologists, p. 6 (fig. 2), 43–44. Zuckermann beds or member (of Hoxbar group) lies about 500 feet above Daube limestone member. Includes 30 feet or more of strata, chiefly white to buff coarsely crystalline calcareous sandstone, with finer grained layer at top and local development (intraformational?) conglomerate of gray limestone pebbles calcareous matrix. Crops out only in northern part of Lake Murray State Park and around north end of Criner Hills. Elsewhere (if present) it is hidden beneath unconformably overlying sediments.

Named for occurrence at abandoned coal mine of Daube, Westheimer, Munzeheimer, and Zuckerman, SE¼ sec. 8, T. 5 S., R. 2 E., Carter County.

Zuni pebble zone

Tertiary [Oligocene or Miocene]: Northeastern Arizona and northwestern New Mexico.

P. W. Howell, 1959, Dissert. Abs., v. 20, no. 2, p. 641. Younger than Zuni erosion surface, which may extend back to Oligocene time; older than late Miocene-early Pliocene Chetoh formation (new).

In Cheton country, a section of Colorado Plateau north of Little Colorado River, extending from Zuni Uplift west to Painted Desert.

Zuni Sandstone[1]

Upper Jurassic: Northwestern New Mexico and northeastern Arizona.

Original reference: C. E. Dutton, 1885, U.S. Geol. Survey 6th Ann. Rept., p. 137, pl. 16.

U.S. Geological Survey has restored the term Zuni Sandstone for use in Gallup-Zuni and Ackomas Basins.

Named for occurrence in Zuni Plateau, N. Mex.

†Zuni shale[1]

Upper Jurassic: Western New Mexico.

Original reference: C. R. Keyes, 1905, Am. Jour. Sci., 4th, v. 20, p. 424.

Derivation of name not stated.

†Zunian series[1]

Triassic(?) and Jurassic: Northeastern Arizona and northwestern New Mexico.

Original references: C. R. Keyes, 1906, Science, new ser., v. 23, p. 921; 1906, Am. Jour, Sci., 4th, v. 21, p. 298–300.

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